```
(* © Orly Alter 2004 *)
```



```
<< LinearAlgebra`MatrixManipulation`;
<< NumericalMath`TrigFit`;
<< Graphics`Graphics`;
<< Graphics`Arrow`;
Off[General::"spell"];
Off[General::"spell1"];
```

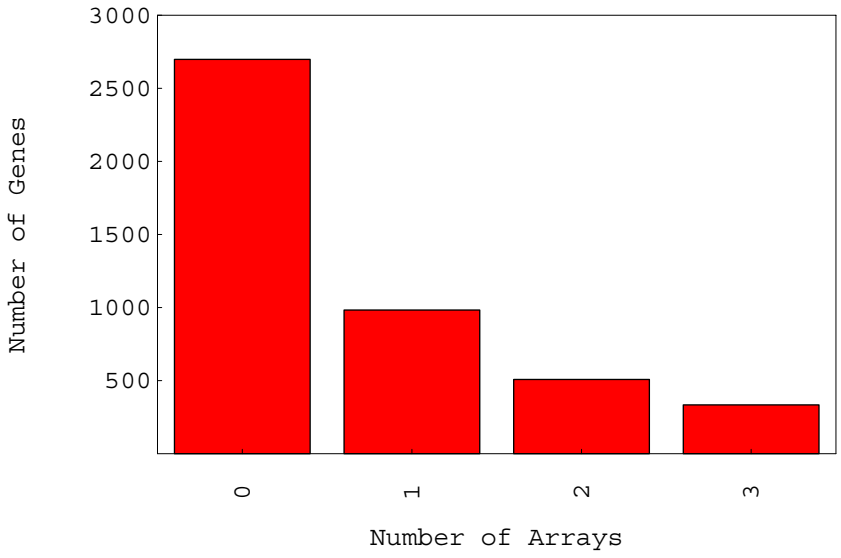
```
(* Calculate GSVD Yeast and Human Common Cell Cycle Subspace *)
```

```
(* Read Yeast Data *)

stream = "Desktop/Networks/Data/Y_GSVD.txt.nb";
matrix = ReadList[stream, Word, RecordLists -> True, NullWords -> True];
{genes, arrays} = Dimensions[matrix] - {2, 6}
Clear[stream];
```

```
{4523, 18}
```

```
genenames = TakeRows[
   TakeColumns[matrix, {1, 6}],
   {3, genes + 2}];
arraynames = TakeColumns[
   TakeRows[matrix, {1, 2}],
   {7, arrays + 6}];
matrix = TakeColumns[
   TakeRows[matrix, {3, genes + 2}],
   {7, arrays + 6}];
matrix = ToExpression[matrix];

sizes = Flatten[
   Table[
    Dimensions[
     Characters[
      ToString[arraynames[[2, a]]
      ]]],
    {a, 1, arrays}]];
size = Sort[sizes, OrderedQ[{#2, #1}] &][[1]];
Do[
  Do[arraynames[[2, a]] = StringJoin[ToString[arraynames[[2, a]]], " "],
   {b, 1, size - sizes[[a]]}],
  {a, 1, arrays}];

(* Estimate Missing Yeast Data Using SVD *)

(* Count Null Data *)

counter = Table[Dimensions[Position[matrix[[a]], Null]][[1]], {a, 1, genes}];
```

```
(* Locate Gene Position of Null Data *)

Clear[positions];
positions = Table[0, {a, 1, arrays + 1}];
Do[
  positions[[a]] = Flatten[
    Position[Flatten[counter], a - 1]],
  {a, 1, arrays + 1}];
numbers = Flatten[
   Table[
    Dimensions[positions[[a]]],
    {a, 1, Round[arrays * 0.2]}]];

(* Create Display Of Gene Position Of Null Data *)

framex = Table[{a, a - 1}, {a, 1, Round[arrays * 0.2]}];
framey = {500, 1000, 1500, 2000, 2500, 3000};
labelx = ColumnForm[{"Number of Arrays"}, Center];
labely = ColumnForm[{"Number of Genes"}, Center];
g = BarChart[numbers,
   Frame -> True,
   Axes -> False,
   FrameLabel -> {labelx, labely, None, None},
   FrameTicks -> {framex, framey, None, None},
   GridLines -> {None, None},
   PlotRange -> {{0.5, Round[arrays * 0.2] + 0.5}, {0, 3000}},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 0.75, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., 1.}] →
    Text[labelx, {b, c - 400}, {0, 1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., 1.}] →
    Text[a, {b, c - 200}, {0, 0}, {0, 1}];

(* Display Gene Position Of Null Data *)

Show[g, PlotRange -> All];
```



```
(* Select Genes by Number of Missing Data Points *)

matrix = AppendRows[Table[{counter[[a]]}, {a, 1, genes}], genenames, matrix];
matrix = Sort[matrix, OrderedQ[{#1, #2}] &];
fullgenenames = TakeColumns[
   TakeRows[matrix, {1, numbers[[1]]}],
   {2, 7}];
fullmatrix = TakeColumns[
   TakeRows[matrix, {1, numbers[[1]]}],
   {8, arrays + 7}];
missinggenenames1 = TakeColumns[
   TakeRows[matrix, {numbers[[1]] + 1, numbers[[1]] + numbers[[2]]}],
   {2, 7}];
missingmatrix1 = TakeColumns[
   TakeRows[matrix, {numbers[[1]] + 1, numbers[[1]] + numbers[[2]]}],
   {8, arrays + 7}];
missinggenenames2 = TakeColumns[
   TakeRows[matrix,
    {numbers[[1]] + numbers[[2]] + 1,
     numbers[[1]] + numbers[[2]] + numbers[[3]]}],
   {2, 7}];
missingmatrix2 = TakeColumns[
   TakeRows[matrix,
    {numbers[[1]] + numbers[[2]] + 1,
     numbers[[1]] + numbers[[2]] + numbers[[3]]}],
   {8, arrays + 7}];
missinggenenames3 = TakeColumns[
   TakeRows[matrix,
    {numbers[[1]] + numbers[[2]] + numbers[[3]] + 1,
     numbers[[1]] + numbers[[2]] + numbers[[3]] + numbers[[4]]}],
   {2, 7}];
missingmatrix3 = TakeColumns[
   TakeRows[matrix,
    {numbers[[1]] + numbers[[2]] + numbers[[3]] + 1,
     numbers[[1]] + numbers[[2]] + numbers[[3]] + numbers[[4]]}],
   {8, arrays + 7}];

(* Locate Array Position of Null Data *)

locator1 = Table[0, {numbers[[2]]}];
Do[
  locator1[[a]] = locator1[[a]] + Flatten[Position[missingmatrix1[[a]], Null]],
  {a, 1, numbers[[2]]}];
locator2 = Table[0, {numbers[[3]]}];
Do[
  locator2[[a]] = locator2[[a]] + Flatten[Position[missingmatrix2[[a]], Null]],
  {a, 1, numbers[[3]]}];
locator3 = Table[0, {numbers[[4]]}];
Do[
  locator3[[a]] = locator3[[a]] + Flatten[Position[missingmatrix3[[a]], Null]],
  {a, 1, numbers[[4]]}];
```

```
(* Sort Raw Data According to the Position of Missing Data Points for Each Gene *)

missingmatrix1 = AppendRows[locator1, missinggenenames1, missingmatrix1];
missingmatrix1 = Sort[missingmatrix1, OrderedQ[{#1, #2}] &];
locator1 = TakeColumns[missingmatrix1, {1, 1}];
missinggenenames1 = TakeColumns[missingmatrix1, {2, 7}];
missingmatrix1 = TakeColumns[missingmatrix1, {8, arrays + 7}];
missingmatrix2 = AppendRows[locator2, missinggenenames2, missingmatrix2];
missingmatrix2 = Sort[missingmatrix2, OrderedQ[{#1, #2}] &];
locator2 = TakeColumns[missingmatrix2, {1, 2}];
missinggenenames2 = TakeColumns[missingmatrix2, {3, 8}];
missingmatrix2 = TakeColumns[missingmatrix2, {9, arrays + 8}];
missingmatrix3 = AppendRows[locator3, missinggenenames3, missingmatrix3];
missingmatrix3 = Sort[missingmatrix3, OrderedQ[{#1, #2}] &];
locator3 = TakeColumns[missingmatrix3, {1, 3}];
missinggenenames3 = TakeColumns[missingmatrix3, {4, 9}];
missingmatrix3 = TakeColumns[missingmatrix3, {10, arrays + 9}];

(* Examine Subset of Genes with Full Data *)

(* Calculate SVD *)

{eigenarrays, eigenexpressions, eigengenes} = SingularValues[fullmatrix];
eigengenes[[5]] = -eigengenes[[5]];
eigenarrays[[5]] = -eigenarrays[[5]];
eigenarrays = Transpose[eigenarrays];
fractions = eigenexpressions^2 / Sum[eigenexpressions[[a]]^2, {a, 1, arrays}];
entropy = -N[Sum[fractions[[a]] * Log[fractions[[a]]], {a, 1, arrays}] / Log[arrays]];
entropy = N[Round[100 * entropy] / 100]

0.17

(* Create Fractions Bar Charts Displays *)

fractions[[3]]

0.00817395

limit = 0.01;

Clear[gridx, framex, framey, sizes];
gridx = Table[a, {a, 0, limit, N[limit / 5]}];
framex = gridx;
sizes = Flatten[
   Table[
    Dimensions[
     Characters[
      ToString[framex[[a]]
      ]]], {a, 1, 6}]];
Do[
  Do[framex[[a]] = StringJoin[ToString[framex[[a]]], " "],
   {b, 1, 5 - sizes[[a]]}],
  {a, 1, 6}];
framex = Table[{gridx[[a]], framex[[a]]}, {a, 1, 6}];
gridx = Table[{gridx[[a]], RGBColor[0, 0, 0]}, {a, 1, 6}];
framey = Table[{a + 1, arrays - a - 6}, {a, 0, 12 - 3}];
table = Table[fractions[[arrays - a]], {a, 6, arrays - 3}];
```

```
g = BarChart[table,
   BarOrientation -> Horizontal,
   PlotRange -> {{0, limit * 1.0001}, {0.5, 12 - 2 + 0.5}},
   AspectRatio -> 1,
   Axes -> False,
   Frame -> True,
   FrameTicks -> {None, framey, framex, None},
   FrameLabel -> {None, None, None, None},
   GridLines -> {gridx, None},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 1.75}, {0, 0}, {0, 1}];
g1 = Show[g,
   AspectRatio -> 1.25,
   PlotRange -> All,
   DisplayFunction -> Identity];

gridx = Table[a, {a, 0, 1, 0.2}];
framex = gridx;
sizes = Flatten[
   Table[
    Dimensions[
     Characters[
      ToString[framex[[a]]
      ]]], {a, 1, 6}]];
Do[
  Do[framex[[a]] = StringJoin[ToString[framex[[a]]], " "],
   {b, 1, size - sizes[[a]]}],
  {a, 1, 6}];
framex = Table[{gridx[[a]], framex[[a]]}, {a, 1, 6}];
gridx = Table[{gridx[[a]], RGBColor[0, 0, 0]}, {a, 1, 6}];
framey = Table[{a + 1, arrays - a}, {a, 0, arrays - 1}];
labelx = ColumnForm[
   {"(b) Eigenexpression Fraction", StringJoin["d1' = ", ToString[entropy]], " "},
   Center];
g = BarChart[
   Table[fractions[[arrays - a]], {a, 0, arrays - 1}],
   BarOrientation -> Horizontal,
   PlotRange -> {{0, 1.0001}, {0.5, arrays + 0.5}},
   AspectRatio -> 1,
   Axes -> False,
   Frame -> True,
   FrameTicks -> {None, framey, framex, None},
   FrameLabel -> {None, None, labelx, None},
   GridLines -> {gridx, None},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 3}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 2.7}, {0, 0}, {0, 1}];
g2 = Show[{g,
    Graphics[{RGBColor[1, 1, 0.8], Rectangle[{0.1, 0.6}, {0.98, 16.6}]}],
    Graphics[{Rectangle[{0.1, 0.6}, {0.98, 16.6}, g1]}]},
   AspectRatio -> 1.35,
   PlotRange -> All,
   DisplayFunction -> Identity];
```

```
(* Create Eigengenes 2 D Red & Green Raster Display *)

contrast = 3.5;
displaying = Table[
   If[contrast * eigengenes[[i, j]] > 0,
    If[contrast * eigengenes[[i, j]] < 1, {contrast * eigengenes[[i, j]], 0}, {1, 0}],
    If[contrast * eigengenes[[i, j]] > -1, {0, -contrast * eigengenes[[i, j]]}, {0, 1}]],
   {i, 1, arrays}, {j, 1, arrays}];
framex = Table[{a - 0.5, arraynames[[2, a]]}, {a, 1, arrays}];
framey = Table[{a + 1 - 0.5, arrays - a}, {a, 0, arrays - 1}];
labely = "Eigengenes";
labelx = ColumnForm[{"(a) Arrays", " ", " "}, Center];

g = Show[
   Graphics[
    RasterArray[
     Table[
      RGBColor[displaying[[i, j, 1]], displaying[[i, j, 2]], 0],
      {i, arrays, 1, -1}, {j, 1, arrays}]]],
   AspectRatio -> 1,
   Frame -> True,
   FrameTicks -> {None, framey, framex, None},
   FrameLabel -> {None, labely, labelx, None},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 3, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 3}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 2.7}, {0, 0}, {0, 1}];
g1 = Show[g,
   AspectRatio -> 1.05,
   PlotRange -> All,
   DisplayFunction -> Identity];

(* Create Selected Eigengenes Graph Display *)

eigengenes3 = Chop[TrigFit[Drop[eigengenes[[3]], {1}], 2, {x - 1, arrays - 1}], 0.15]
eigengenes4 = Chop[TrigFit[Drop[eigengenes[[4]], {1}], 2, {x - 1, arrays - 1}], 0.15]
eigengenes5 = Chop[TrigFit[Drop[eigengenes[[5]], {1}], 2, {x - 1, arrays - 1}], 0.15]
```

$$-0.152794 \cos\left[\frac{2}{17}\pi(-1+x)\right] - 0.154139 \sin\left[\frac{2}{17}\pi(-1+x)\right] - 0.197288 \sin\left[\frac{4}{17}\pi(-1+x)\right]$$

$$0.263474 \cos\left[\frac{4}{17}\pi(-1+x)\right]$$

$$0.157833 \cos\left[\frac{4}{17}\pi(-1+x)\right] - 0.204812 \sin\left[\frac{4}{17}\pi(-1+x)\right]$$

```
eigengenes3 = -Sqrt[2 / 3 / 17.] * Sin[4 * Pi * (x - 1) / 17] - Sqrt[2 / 3 / 17.] * Sin[2 * Pi * (x - 1) / 17 + Pi / 4];
eigengenes4 = Sqrt[2 / 17.] * Cos[4 * Pi * (x - 1) / 17];
eigengenes5 = Sqrt[2 / 17.] * Cos[4 * Pi * (x - 1) / 17 + Pi / 4];
```

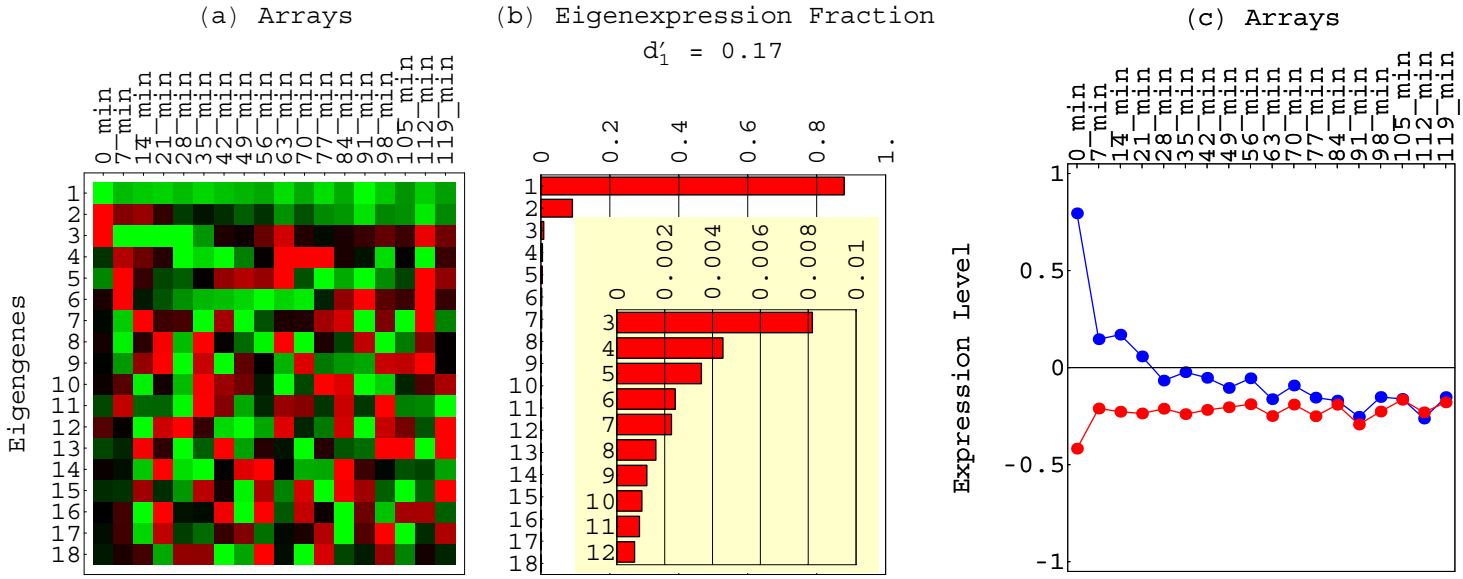
```
labelx = ColumnForm[{"(c) Arrays"}, Center];
labely = ColumnForm[{" ", "Expression Level"}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[1, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[1, 0, 0], PointSize[0.022], points}],
    Graphics[{RGBColor[1, 0, 0], line}]},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {None, {{0, RGBColor[0, 0, 0]}}},
   FrameTicks -> {None, framey, framex, None},
   PlotRange -> {-1.05, 1.05},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 0.25}, {0, 0}, {0, 1}];
p1 = Show[g,
   AspectRatio -> 1.05,
   PlotRange -> All,
   DisplayFunction → Identity];

labelx = ColumnForm[{"(c) Arrays"}, Center];
labely = ColumnForm[{" ", "Expression Level"}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[2, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[0, 0, 1], PointSize[0.022], points}],
    Graphics[{RGBColor[0, 0, 1], line}]},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {None, {{0, RGBColor[0, 0, 0]}}},
   FrameTicks -> {None, framey, framex, None},
   PlotRange -> {-1.05, 1.05},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 0.25}, {0, 0}, {0, 1}];
p2 = Show[g,
   AspectRatio -> 1.05,
   PlotRange -> All,
   DisplayFunction → Identity];
```

```
graph = Plot[eigengenes3,
   {x, 1, arrays - 1},
   PlotStyle -> {RGBColor[1, 0, 0], Dashing[{0.03, 0.02}]},
   DisplayFunction -> Identity];
labelx = ColumnForm[{"(d) Arrays"}, Center];
labely = ColumnForm[{" ", "Expression Level"}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[3, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[1, 0, 0], PointSize[0.022], points}],
    Graphics[{RGBColor[1, 0, 0], line}],
    graph,
    Graphics[{RGBColor[1, 0, 0], Text["-Sqrt[2/(3 T)] [sin(2 π t/T + π/4) +", {6.5, 0.75}]}],
    Graphics[{RGBColor[1, 0, 0], Text["sin(4 π t/T)]", {13.5, 0.5}]}]},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {None, {{0, RGBColor[0, 0, 0]}}},
   FrameTicks -> {None, framey, framex, None},
   PlotRange -> {-1.05, 1.05},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 0.25}, {0, 0}, {0, 1}];
p3 = Show[g,
   AspectRatio -> 1.05,
   PlotRange -> All,
   DisplayFunction → Identity];
```

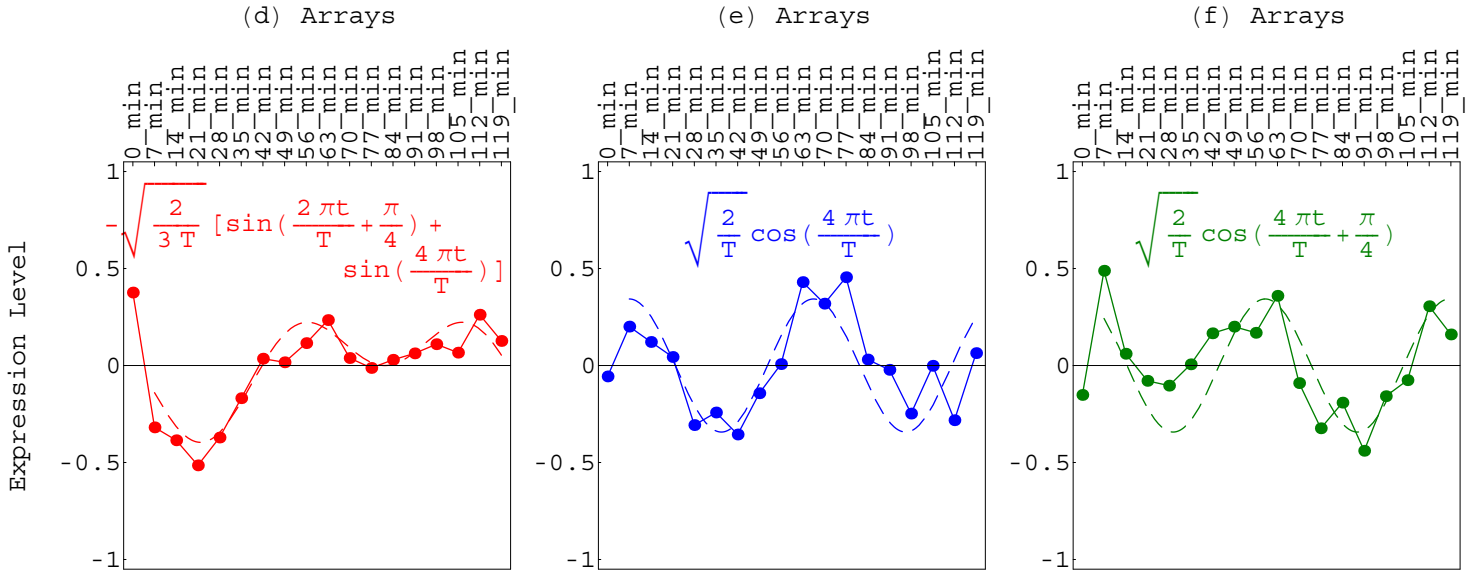
```
graph = Plot[eigengenes4,
   {x, 1, arrays - 1},
   PlotStyle -> {RGBColor[0, 0, 1], Dashing[{0.03, 0.02}]},
   DisplayFunction -> Identity];
labelx = ColumnForm[{"(e) Arrays"}, Center];
labely = ColumnForm[{" ", " "}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[4, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[0, 0, 1], PointSize[0.022], points}],
    Graphics[{RGBColor[0, 0, 1], line}],
    graph,
    Graphics[{RGBColor[0, 0, 1], Text["√(2/T) cos(4πt/T)", {8.5, 0.7}]}]},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {None, {{0, RGBColor[0, 0, 0]}}},
   FrameTicks -> {None, framey, framex, None},
   PlotRange -> {-1.05, 1.05},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 0.25}, {0, 0}, {0, 1}];
p4 = Show[g,
   AspectRatio -> 1.05,
   PlotRange -> All,
   DisplayFunction → Identity];
```

```
graph = Plot[eigengenes5,
   {x, 1, arrays - 1},
   PlotStyle -> {RGBColor[0, 0.5, 0], Dashing[{0.03, 0.02}]},
   DisplayFunction -> Identity];
labelx = ColumnForm[{"(f) Arrays"}, Center];
labely = ColumnForm[{" ", " "}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[5, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[0, 0.5, 0], PointSize[0.022], points}],
    Graphics[{RGBColor[0, 0.5, 0], line}],
    graph,
    Graphics[{RGBColor[0, 0.5, 0], Text["Sqrt[2/T] cos(4 π t/T + π/4)", {8.5, 0.7}]}]},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {None, {{0, RGBColor[0, 0, 0]}}},
   FrameTicks -> {None, framey, framex, None},
   PlotRange -> {-1.05, 1.05},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 0.25}, {0, 0}, {0, 1}];
p5 = Show[g,
   AspectRatio -> 1.05,
   PlotRange -> All,
   DisplayFunction → Identity];
```

```
(* Display Selected Eigengenes *)

g3 = Show[{p2, p1},
    DisplayFunction -> Identity];

(* Display Eigengenes, Fractions and Selected Eigengenes *)

Show[GraphicsArray[{g1, g2, g3}],
  GraphicsSpacing -> -0.15];
```




```
Show[GraphicsArray[{p3, p4, p5}],
  GraphicsSpacing -> -0.15];
```



```
(* Choose Subset of Eigengenes for Estimation *)

eigengenes = TakeRows[eigengenes, {1, 5}];

(* Estimate Missing Data *)

Do[
 missingmatrix1[[a, locator1[[a, 1]]]] =
  N[Round[Flatten[Dot[Dot[
          Transpose[Drop[
            Transpose[{missingmatrix1[[a]]}],
            {locator1[[a, 1]]}]],
          PseudoInverse[Transpose[Drop[
             Transpose[eigengenes],
             {locator1[[a, 1]]}]]]],
         eigengenes]][[locator1[[a, 1]]]] * 100] / 100],
 {a, 1, numbers[[2]]}]

Do[Do[
  missingmatrix2[[a, locator2[[a, b]]]] =
   N[Round[Flatten[Dot[Dot[
           Transpose[Drop[Drop[
              Transpose[{missingmatrix2[[a]]}],
              {locator2[[a, 2]]}], {locator2[[a, 1]]}]],
           PseudoInverse[Transpose[Drop[Drop[
               Transpose[eigengenes],
               {locator2[[a, 2]]}], {locator2[[a, 1]]}]]]],
          eigengenes]][[locator2[[a, b]]]] * 100] / 100],
  {b, 1, 2}],
 {a, 1, numbers[[3]]}]

Do[Do[
  missingmatrix3[[a, locator3[[a, b]]]] =
   N[Round[Flatten[Dot[Dot[
           Transpose[Drop[Drop[Drop[
               Transpose[{missingmatrix3[[a]]}],
               {locator3[[a, 3]]}], {locator3[[a, 2]]}], {locator3[[a, 1]]}]],
           PseudoInverse[Transpose[Drop[Drop[Drop[
                Transpose[eigengenes],
                {locator3[[a, 3]]}], {locator3[[a, 2]]}], {locator3[[a, 1]]}]]]],
          eigengenes]][[locator3[[a, b]]]] * 100] / 100],
  {b, 1, 3}],
 {a, 1, numbers[[4]]}]

genenames = AppendColumns[
   fullgenenames,
   missinggenenames1,
   missinggenenames2,
   missinggenenames3];
matrix = AppendColumns[
   fullmatrix,
   missingmatrix1,
   missingmatrix2,
   missingmatrix3];
{genes, arrays} = Dimensions[matrix];
matrix1 = matrix;
genenames1 = genenames;
arraynames1 = arraynames;
{genes1, arrays1} = Dimensions[matrix1]
```

```
{4523, 18}
```

```
(* Examine Yeast Data After Missing Data Estimation *)

(* Calculate SVD *)

{eigenarrays, eigenexpressions, eigengenes} = SingularValues[matrix];
eigenarrays = Transpose[eigenarrays];
fractions = eigenexpressions^2 / Sum[eigenexpressions[[a]]^2, {a, 1, arrays}];
entropy = -N[Sum[fractions[[a]] * Log[fractions[[a]]], {a, 1, arrays}] / Log[arrays]];
entropy = N[Round[100 * entropy] / 100]
```

```
0.17
```

```
(* Create Fractions Bar Charts Displays *)

fractions[[3]]
```

```
0.0089566
```

```
limit = 0.01;

Clear[gridx, framex, framey, sizes];
gridx = Table[a, {a, 0, limit, N[limit / 5]}];
framex = gridx;
sizes = Flatten[
   Table[
    Dimensions[
     Characters[
      ToString[framex[[a]]
      ]]], {a, 1, 6}]];
Do[
  Do[framex[[a]] = StringJoin[ToString[framex[[a]]], " "],
   {b, 1, 5 - sizes[[a]]}],
  {a, 1, 6}];
framex = Table[{gridx[[a]], framex[[a]]}, {a, 1, 6}];
gridx = Table[{gridx[[a]], RGBColor[0, 0, 0]}, {a, 1, 6}];
framey = Table[{a + 1, arrays - a - 6}, {a, 0, 12 - 3}];
table = Table[fractions[[arrays - a]], {a, 6, arrays - 3}];
g = BarChart[table,
   BarOrientation -> Horizontal,
   PlotRange -> {{0, limit * 1.0001}, {0.5, 12 - 2 + 0.5}},
   AspectRatio -> 1,
   Axes -> False,
   Frame -> True,
   FrameTicks -> {None, framey, framex, None},
   FrameLabel -> {None, None, None, None},
   GridLines -> {gridx, None},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 1.75}, {0, 0}, {0, 1}];
g1 = Show[g,
   AspectRatio -> 1.25,
   PlotRange -> All,
   DisplayFunction -> Identity];
```

```
gridx = Table[a, {a, 0, 1, 0.2}];
framex = gridx;
sizes = Flatten[
   Table[
    Dimensions[
     Characters[
      ToString[framex[[a]]
      ]]], {a, 1, 6}]];
Do[
  Do[framex[[a]] = StringJoin[ToString[framex[[a]]], " "],
   {b, 1, size - sizes[[a]]}],
  {a, 1, 6}];
framex = Table[{gridx[[a]], framex[[a]]}, {a, 1, 6}];
gridx = Table[{gridx[[a]], RGBColor[0, 0, 0]}, {a, 1, 6}];
framey = Table[{a + 1, arrays - a}, {a, 0, arrays - 1}];
labelx = ColumnForm[
   {"(b) Eigenexpression Fraction", StringJoin["d₁ = ", ToString[entropy]], " "},
   Center];
g = BarChart[
   Table[fractions[[arrays - a]], {a, 0, arrays - 1}],
   BarOrientation -> Horizontal,
   PlotRange -> {{0, 1.0001}, {0.5, arrays + 0.5}},
   AspectRatio -> 1,
   Axes -> False,
   Frame -> True,
   FrameTicks -> {None, framey, framex, None},
   FrameLabel -> {None, None, labelx, None},
   GridLines -> {gridx, None},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 3}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 2.7}, {0, 0}, {0, 1}];
g2 = Show[{g,
    Graphics[{RGBColor[1, 1, 0.8], Rectangle[{0.1, 0.6}, {0.98, 16.6}]}],
    Graphics[{Rectangle[{0.1, 0.6}, {0.98, 16.6}, g1]}]},
   AspectRatio -> 1.35,
   PlotRange -> All,
   DisplayFunction -> Identity];

(* Create Eigengenes 2 D Red & Green Raster Display *)

contrast = 3.5;
displaying = Table[
   If[contrast * eigengenes[[i, j]] > 0,
    If[contrast * eigengenes[[i, j]] < 1, {contrast * eigengenes[[i, j]], 0}, {1, 0}],
    If[contrast * eigengenes[[i, j]] > -1, {0, -contrast * eigengenes[[i, j]]}, {0, 1}]],
   {i, 1, arrays}, {j, 1, arrays}];
framex = Table[{a - 0.5, arraynames[[2, a]]}, {a, 1, arrays}];
framey = Table[{a + 1 - 0.5, arrays - a}, {a, 0, arrays - 1}];
labely = "Eigengenes";
labelx = ColumnForm[{"(a) Arrays", " ", " "}, Center];
```

```
g = Show[
   Graphics[
    RasterArray[
     Table[
      RGBColor[displaying[[i, j, 1]], displaying[[i, j, 2]], 0],
      {i, arrays, 1, -1}, {j, 1, arrays}]]],
   AspectRatio -> 1,
   Frame -> True,
   FrameTicks -> {None, framey, framex, None},
   FrameLabel -> {None, labely, labelx, None},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 3, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 3}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 2.7}, {0, 0}, {0, 1}];
g1 = Show[g,
   AspectRatio -> 1.05,
   PlotRange -> All,
   DisplayFunction -> Identity];

(* Create Selected Eigengenes Graph Display *)

eigengenes3 = Chop[TrigFit[Drop[eigengenes[[3]], {1}], 2, {x - 1, arrays - 1}], 0.125]
eigengenes4 = Chop[TrigFit[Drop[eigengenes[[4]], {1}], 2, {x - 1, arrays - 1}], 0.15]
eigengenes5 = Chop[TrigFit[Drop[eigengenes[[5]], {1}], 2, {x - 1, arrays - 1}], 0.15]
```

$$-0.135652 \cos\left[\frac{2}{17}\pi(-1+x)\right] - 0.144566 \sin\left[\frac{2}{17}\pi(-1+x)\right] - 0.221702 \sin\left[\frac{4}{17}\pi(-1+x)\right]$$

$$0.262143 \cos\left[\frac{4}{17}\pi(-1+x)\right]$$

$$0.158409 \cos\left[\frac{4}{17}\pi(-1+x)\right] - 0.194379 \sin\left[\frac{4}{17}\pi(-1+x)\right]$$

```
eigengenes3 = -Sqrt[2 / 3 / 17.] * Sin[4 * Pi * (x - 1) / 17] - Sqrt[2 / 3 / 17.] * Sin[2 * Pi * (x - 1) / 17 + Pi / 4];
eigengenes4 = Sqrt[2 / 17.] * Cos[4 * Pi * (x - 1) / 17];
eigengenes5 = Sqrt[2 / 17.] * Cos[4 * Pi * (x - 1) / 17 + Pi / 4];
```

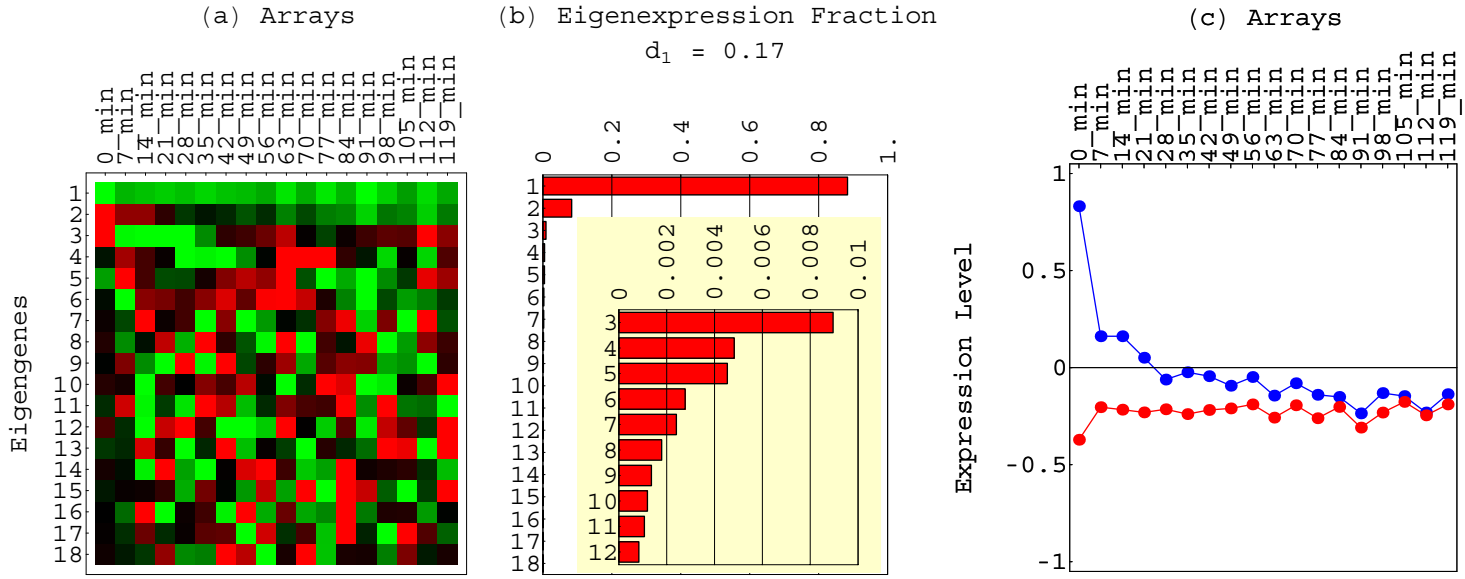
```
labelx = ColumnForm[{"(c) Arrays"}, Center];
labely = ColumnForm[{" ", "Expression Level"}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[1, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[1, 0, 0], PointSize[0.022], points}],
    Graphics[{RGBColor[1, 0, 0], line}]},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {None, {{0, RGBColor[0, 0, 0]}}},
   FrameTicks -> {None, framey, framex, None},
   PlotRange -> {-1.05, 1.05},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 0.25}, {0, 0}, {0, 1}];
p1 = Show[g,
   AspectRatio -> 1.05,
   PlotRange -> All,
   DisplayFunction → Identity];

labelx = ColumnForm[{"(c) Arrays"}, Center];
labely = ColumnForm[{" ", "Expression Level"}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[2, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[0, 0, 1], PointSize[0.022], points}],
    Graphics[{RGBColor[0, 0, 1], line}]},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {None, {{0, RGBColor[0, 0, 0]}}},
   FrameTicks -> {None, framey, framex, None},
   PlotRange -> {-1.05, 1.05},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 0.25}, {0, 0}, {0, 1}];
p2 = Show[g,
   AspectRatio -> 1.05,
   PlotRange -> All,
   DisplayFunction → Identity];
```

```
graph = Plot[eigengenes3,
   {x, 1, arrays - 1},
   PlotStyle -> {RGBColor[1, 0, 0], Dashing[{0.03, 0.02}]},
   DisplayFunction -> Identity];
labelx = ColumnForm[{"(d) Arrays"}, Center];
labely = ColumnForm[{" ", "Expression Level"}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[3, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[1, 0, 0], PointSize[0.022], points}],
    Graphics[{RGBColor[1, 0, 0], line}],
    graph,
    Graphics[{RGBColor[1, 0, 0], Text["-Sqrt[2/(3 T)] [sin(2 π t/T + π/4) +", {6.5, 0.75}]}],
    Graphics[{RGBColor[1, 0, 0], Text["sin(4 π t/T)]", {13.5, 0.5}]}]},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {None, {{0, RGBColor[0, 0, 0]}}},
   FrameTicks -> {None, framey, framex, None},
   PlotRange -> {-1.05, 1.05},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 0.25}, {0, 0}, {0, 1}];
p3 = Show[g,
   AspectRatio -> 1.05,
   PlotRange -> All,
   DisplayFunction → Identity,
   DisplayFunction → Identity];
```

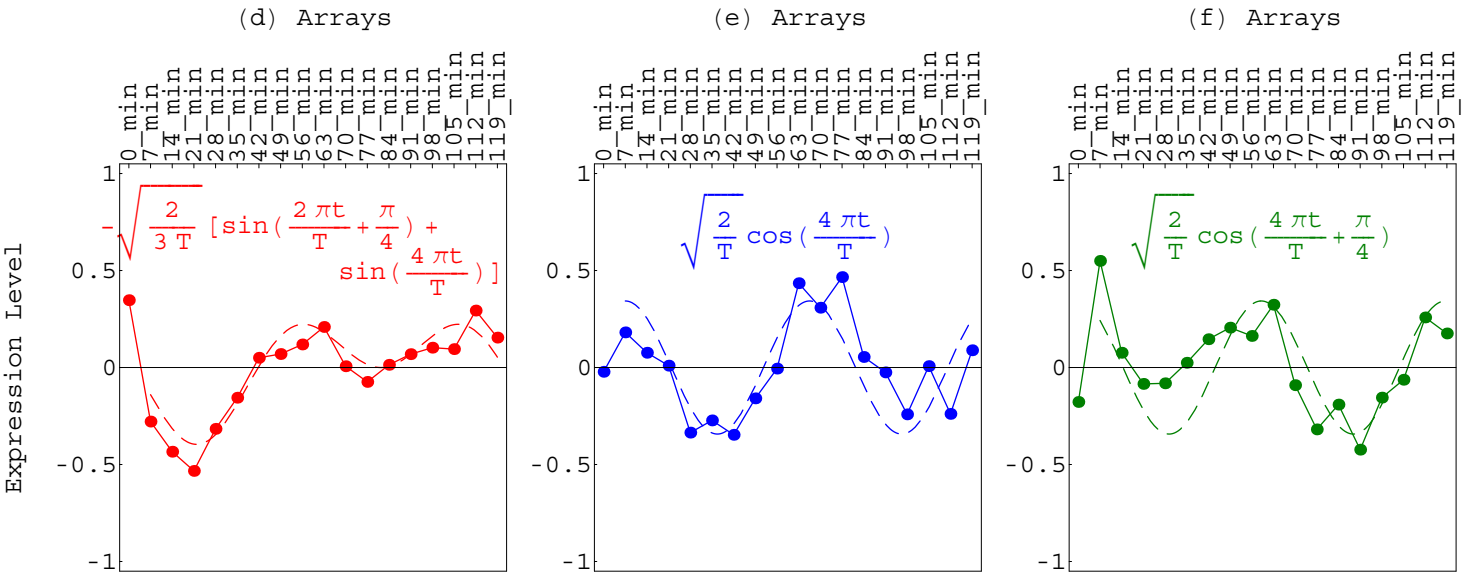
```
graph = Plot[eigengenes4,
   {x, 1, arrays - 1},
   PlotStyle -> {RGBColor[0, 0, 1], Dashing[{0.03, 0.02}]},
   DisplayFunction -> Identity];
labelx = ColumnForm[{"(e) Arrays"}, Center];
labely = ColumnForm[{" ", " "}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[4, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[0, 0, 1], PointSize[0.022], points}],
    Graphics[{RGBColor[0, 0, 1], line}],
    graph,
    Graphics[{RGBColor[0, 0, 1], Text["√(2/T) cos(4πt/T)", {8.5, 0.7}]}]},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {None, {{0, RGBColor[0, 0, 0]}}},
   FrameTicks -> {None, framey, framex, None},
   PlotRange -> {-1.05, 1.05},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 0.25}, {0, 0}, {0, 1}];
p4 = Show[g,
   AspectRatio -> 1.05,
   PlotRange -> All,
   DisplayFunction → Identity];
```

```
graph = Plot[eigengenes5,
   {x, 1, arrays - 1},
   PlotStyle -> {RGBColor[0, 0.5, 0], Dashing[{0.03, 0.02}]},
   DisplayFunction -> Identity];
labelx = ColumnForm[{"(f) Arrays"}, Center];
labely = ColumnForm[{" ", " "}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[5, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[0, 0.5, 0], PointSize[0.022], points}],
    Graphics[{RGBColor[0, 0.5, 0], line}],
    graph,
    Graphics[{RGBColor[0, 0.5, 0], Text["Sqrt[2/T] cos(4 π t/T + π/4)", {8.5, 0.7}]}]},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {None, {{0, RGBColor[0, 0, 0]}}},
   FrameTicks -> {None, framey, framex, None},
   PlotRange -> {-1.05, 1.05},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 0.25}, {0, 0}, {0, 1}];
p5 = Show[g,
   AspectRatio -> 1.05,
   PlotRange -> All,
   DisplayFunction → Identity];
```

```
(* Display Selected Eigengenes *)

g3 = Show[{p2, p1},
    DisplayFunction -> Identity];

(* Display Eigengenes, Fractions and Selected Eigengenes *)

Show[GraphicsArray[{g1, g2, g3}],
  GraphicsSpacing -> -0.15];
```




```
Show[GraphicsArray[{p3, p4, p5}],
  GraphicsSpacing -> -0.15];
```

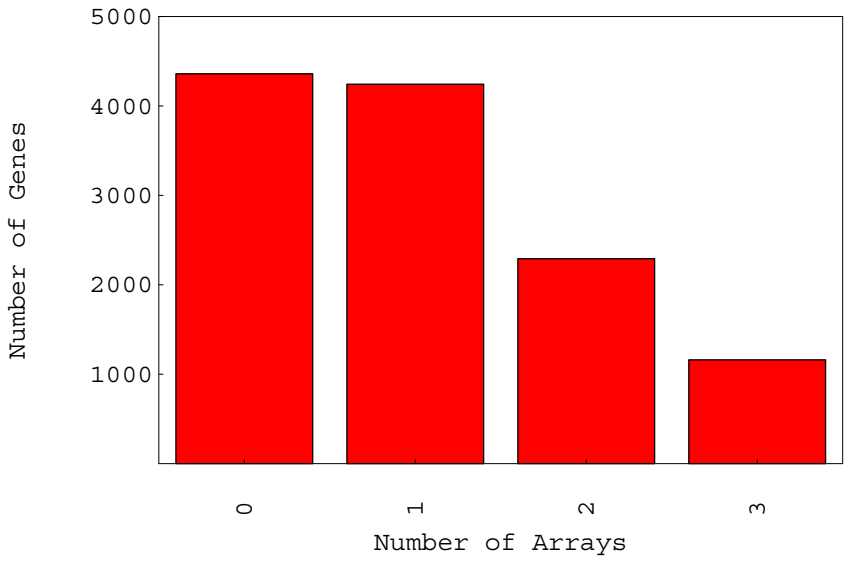


```
(* Read Human Data *)

stream = "Desktop/Networks/Data/H_GSVD.txt.nb";
matrix = ReadList[stream, Word, RecordLists -> True, NullWords -> True];
{genes, arrays} = Dimensions[matrix] - {2, 5}
Clear[stream];
```

```
{12056, 18}
```

```
genenames = TakeRows[
   TakeColumns[matrix, {1, 5}],
   {3, genes + 2}];
arraynames = TakeColumns[
   TakeRows[matrix, {1, 2}],
   {6, arrays + 5}];
matrix = TakeColumns[
   TakeRows[matrix, {3, genes + 2}],
   {6, arrays + 5}];
matrix = ToExpression[matrix];

sizes = Flatten[
   Table[
    Dimensions[
     Characters[
      ToString[arraynames[[2, a]]
      ]]], {a, 1, arrays}]];
size = Sort[sizes, OrderedQ[{#2, #1}] &][[1]];
Do[
  Do[arraynames[[2, a]] = StringJoin[ToString[arraynames[[2, a]]], " "],
   {b, 1, size - sizes[[a]]}],
  {a, 1, arrays}];

(* Estimate Missing Human Data Using SVD *)

(* Count Null Data *)

counter = Table[Dimensions[Position[matrix[[a]], Null]][[1]], {a, 1, genes}];

(* Locate Gene Position of Null Data *)

Clear[positions];
positions = Table[0, {a, 1, arrays + 1}];
Do[
  positions[[a]] = Flatten[
    Position[Flatten[counter], a - 1]],
  {a, 1, arrays + 1}];
numbers = Flatten[
   Table[
    Dimensions[positions[[a]]],
    {a, 1, Round[arrays * 0.2]}]];
```

```
(* Create Display Of Gene Position Of Null Data *)

framex = Table[{a, a - 1}, {a, 1, Round[arrays * 0.2]}];
framey = {1000, 2000, 3000, 4000, 5000};
labelx = ColumnForm[{"Number of Arrays"}, Center];
labely = ColumnForm[{"Number of Genes"}, Center];
g = BarChart[numbers,
    Frame -> True,
    Axes -> False,
    FrameLabel -> {labelx, labely, None, None},
    FrameTicks -> {framex, framey, None, None},
    GridLines -> {None, None},
    PlotRange -> {{0.5, Round[arrays * 0.2] + 0.5}, {0, 5000}},
    DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
        Text[labely, {b_, c_}, {1., 0.}] ->
            Text[labely, {b - 0.75, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
        Text[labelx, {b_, c_}, {0., 1.}] ->
            Text[labelx, {b, c - 600}, {0, 1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
        Text[a_, {b_, c_}, {0., 1.}] ->
            Text[a, {b, c - 400}, {0, 0}, {0, 1}];

(* Display Gene Position Of Null Data *)

Show[g, PlotRange -> All];
```



```
(* Select Genes by Number of Missing Data Points *)

matrix = AppendRows[Table[{counter[[a]]}, {a, 1, genes}], genenames, matrix];
matrix = Sort[matrix, OrderedQ[{#1, #2}] &];
fullgenenames = TakeColumns[
   TakeRows[matrix, {1, numbers[[1]]}],
   {2, 6}];
fullmatrix = TakeColumns[
   TakeRows[matrix, {1, numbers[[1]]}],
   {7, arrays + 6}];
missinggenenames1 = TakeColumns[
   TakeRows[matrix, {numbers[[1]] + 1, numbers[[1]] + numbers[[2]]}],
   {2, 6}];
missingmatrix1 = TakeColumns[
   TakeRows[matrix, {numbers[[1]] + 1, numbers[[1]] + numbers[[2]]}],
   {7, arrays + 6}];
missinggenenames2 = TakeColumns[
   TakeRows[matrix,
    {numbers[[1]] + numbers[[2]] + 1,
     numbers[[1]] + numbers[[2]] + numbers[[3]]}],
   {2, 6}];
missingmatrix2 = TakeColumns[
   TakeRows[matrix,
    {numbers[[1]] + numbers[[2]] + 1,
     numbers[[1]] + numbers[[2]] + numbers[[3]]}],
   {7, arrays + 6}];
missinggenenames3 = TakeColumns[
   TakeRows[matrix,
    {numbers[[1]] + numbers[[2]] + numbers[[3]] + 1,
     numbers[[1]] + numbers[[2]] + numbers[[3]] + numbers[[4]]}],
   {2, 6}];
missingmatrix3 = TakeColumns[
   TakeRows[matrix,
    {numbers[[1]] + numbers[[2]] + numbers[[3]] + 1,
     numbers[[1]] + numbers[[2]] + numbers[[3]] + numbers[[4]]}],
   {7, arrays + 6}];

(* Locate Array Position of Null Data *)

locator1 = Table[0, {numbers[[2]]}];
Do[
  locator1[[a]] = locator1[[a]] + Flatten[Position[missingmatrix1[[a]], Null]],
  {a, 1, numbers[[2]]}];
locator2 = Table[0, {numbers[[3]]}];
Do[
  locator2[[a]] = locator2[[a]] + Flatten[Position[missingmatrix2[[a]], Null]],
  {a, 1, numbers[[3]]}];
locator3 = Table[0, {numbers[[4]]}];
Do[
  locator3[[a]] = locator3[[a]] + Flatten[Position[missingmatrix3[[a]], Null]],
  {a, 1, numbers[[4]]}];
```

```
(* Sort Raw Data According to the Position of Missing Data Points for Each Gene *)

missingmatrix1 = AppendRows[locator1, missinggenenames1, missingmatrix1];
missingmatrix1 = Sort[missingmatrix1, OrderedQ[{#1, #2}] &];
locator1 = TakeColumns[missingmatrix1, {1, 1}];
missinggenenames1 = TakeColumns[missingmatrix1, {2, 6}];
missingmatrix1 = TakeColumns[missingmatrix1, {7, arrays + 6}];
missingmatrix2 = AppendRows[locator2, missinggenenames2, missingmatrix2];
missingmatrix2 = Sort[missingmatrix2, OrderedQ[{#1, #2}] &];
locator2 = TakeColumns[missingmatrix2, {1, 2}];
missinggenenames2 = TakeColumns[missingmatrix2, {3, 7}];
missingmatrix2 = TakeColumns[missingmatrix2, {8, arrays + 7}];
missingmatrix3 = AppendRows[locator3, missinggenenames3, missingmatrix3];
missingmatrix3 = Sort[missingmatrix3, OrderedQ[{#1, #2}] &];
locator3 = TakeColumns[missingmatrix3, {1, 3}];
missinggenenames3 = TakeColumns[missingmatrix3, {4, 8}];
missingmatrix3 = TakeColumns[missingmatrix3, {9, arrays + 8}];

(* Examine Subset of Genes with Full Data *)

(* Calculate SVD *)

{eigenarrays, eigenexpressions, eigengenes} = SingularValues[fullmatrix];
eigengenes[[2]] = -eigengenes[[2]];
eigengenes[[3]] = -eigengenes[[3]];
eigengenes[[4]] = -eigengenes[[4]];
eigenarrays = Transpose[eigenarrays];
fractions = eigenexpressions^2 / Sum[eigenexpressions[[a]]^2, {a, 1, arrays}];
entropy = -N[Sum[fractions[[a]] * Log[fractions[[a]]], {a, 1, arrays}] / Log[arrays]];
entropy = N[Round[100 * entropy] / 100]

0.04

(* Create Fractions Bar Charts Displays *)

fractions[[2]]

0.00573569

limit = 0.008;

Clear[gridx, framex, framey, sizes];
gridx = Table[a, {a, 0, limit, N[limit / 4]}];
framex = gridx;
sizes = Flatten[
   Table[
    Dimensions[
     Characters[
      ToString[framex[[a]]
      ]]], {a, 1, 5}]];
Do[
  Do[framex[[a]] = StringJoin[ToString[framex[[a]]], " "],
   {b, 1, 5 - sizes[[a]]}],
  {a, 1, 5}];
framex = Table[{gridx[[a]], framex[[a]]}, {a, 1, 5}];
gridx = Table[{gridx[[a]], RGBColor[0, 0, 0]}, {a, 1, 5}];
framey = Table[{a + 1, arrays - a - 8}, {a, 0, 10 - 2}];
table = Table[fractions[[arrays - a]], {a, 8, arrays - 2}];
```

```
g = BarChart[table,
   BarOrientation -> Horizontal,
   PlotRange -> {{0, limit * 1.0001}, {0.5, 10 - 1 + 0.5}},
   AspectRatio -> 1,
   Axes -> False,
   Frame -> True,
   FrameTicks -> {None, framey, framex, None},
   FrameLabel -> {None, None, None, None},
   GridLines -> {gridx, None},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 1.75}, {0, 0}, {0, 1}];
g1 = Show[g,
   AspectRatio -> 1.25,
   PlotRange -> All,
   DisplayFunction -> Identity];

gridx = Table[a, {a, 0, 1, 0.2}];
framex = gridx;
sizes = Flatten[
   Table[
    Dimensions[
     Characters[
      ToString[framex[[a]]
      ]]], {a, 1, 6}]];
Do[
  Do[framex[[a]] = StringJoin[ToString[framex[[a]]], " "],
   {b, 1, size - sizes[[a]]}],
  {a, 1, 6}];
framex = Table[{gridx[[a]], framex[[a]]}, {a, 1, 6}];
gridx = Table[{gridx[[a]], RGBColor[0, 0, 0]}, {a, 1, 6}];
framey = Table[{a + 1, arrays - a}, {a, 0, arrays - 1}];
labelx = ColumnForm[
   {"(b) Eigenexpression Fraction", StringJoin["d2' = ", ToString[entropy]], " "},
   Center];
g = BarChart[
   Table[fractions[[arrays - a]], {a, 0, arrays - 1}],
   BarOrientation -> Horizontal,
   PlotRange -> {{0, 1.0001}, {0.5, arrays + 0.5}},
   AspectRatio -> 1,
   Axes -> False,
   Frame -> True,
   FrameTicks -> {None, framey, framex, None},
   FrameLabel -> {None, None, labelx, None},
   GridLines -> {gridx, None},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 3}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 2.7}, {0, 0}, {0, 1}];
g2 = Show[{g,
    Graphics[{RGBColor[1, 1, 0.8], Rectangle[{0.1, 0.6}, {0.98, 16.6}]}],
    Graphics[{Rectangle[{0.1, 0.6}, {0.98, 16.6}, g1]}]},
   AspectRatio -> 1.35,
   PlotRange -> All,
   DisplayFunction -> Identity];
```

```
(* Create Eigengenes 2 D Red & Green Raster Display *)

contrast = 3.5;
displaying = Table[
   If[contrast * eigengenes[[i, j]] > 0,
    If[contrast * eigengenes[[i, j]] < 1, {contrast * eigengenes[[i, j]], 0}, {1, 0}],
    If[contrast * eigengenes[[i, j]] > -1, {0, -contrast * eigengenes[[i, j]]}, {0, 1}]],
   {i, 1, arrays}, {j, 1, arrays}];
framex = Table[{a - 0.5, arraynames[[2, a]]}, {a, 1, arrays}];
framey = Table[{a + 1 - 0.5, arrays - a}, {a, 0, arrays - 1}];
labely = "Eigengenes";
labelx = ColumnForm[{"(a) Arrays", " ", " "}, Center];
g = Show[
   Graphics[
    RasterArray[
     Table[
      RGBColor[displaying[[i, j, 1]], displaying[[i, j, 2]], 0],
      {i, arrays, 1, -1}, {j, 1, arrays}]]],
   AspectRatio -> 1,
   Frame -> True,
   FrameTicks -> {None, framey, framex, None},
   FrameLabel -> {None, labely, labelx, None},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 3, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 3}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 2.7}, {0, 0}, {0, 1}];
g1 = Show[g,
   AspectRatio -> 1.05,
   PlotRange -> All,
   DisplayFunction -> Identity];

(* Create Selected Eigengenes Graph Display *)

eigengenes4 = Chop[TrigFit[eigengenes[[4]], 2, {5 / 4 * (x - 1), arrays - 1}], 0.1]
eigengenes5 = Chop[TrigFit[eigengenes[[5]], 2, {5 / 4 * (x - 1), arrays - 1}], 0.175]
```

$$0.146569 \sin\left[\frac{5}{17} \pi (-1 + x)\right]$$

$$-0.228962 \cos\left[\frac{5}{17} \pi (-1 + x)\right]$$

```
eigengenes4 = Sqrt[2 / 17.] * Sin[5 * Pi * (x - 1) / 17];
eigengenes5 = -Sqrt[2 / 17.] * Cos[5 * Pi * (x - 1) / 17];
```

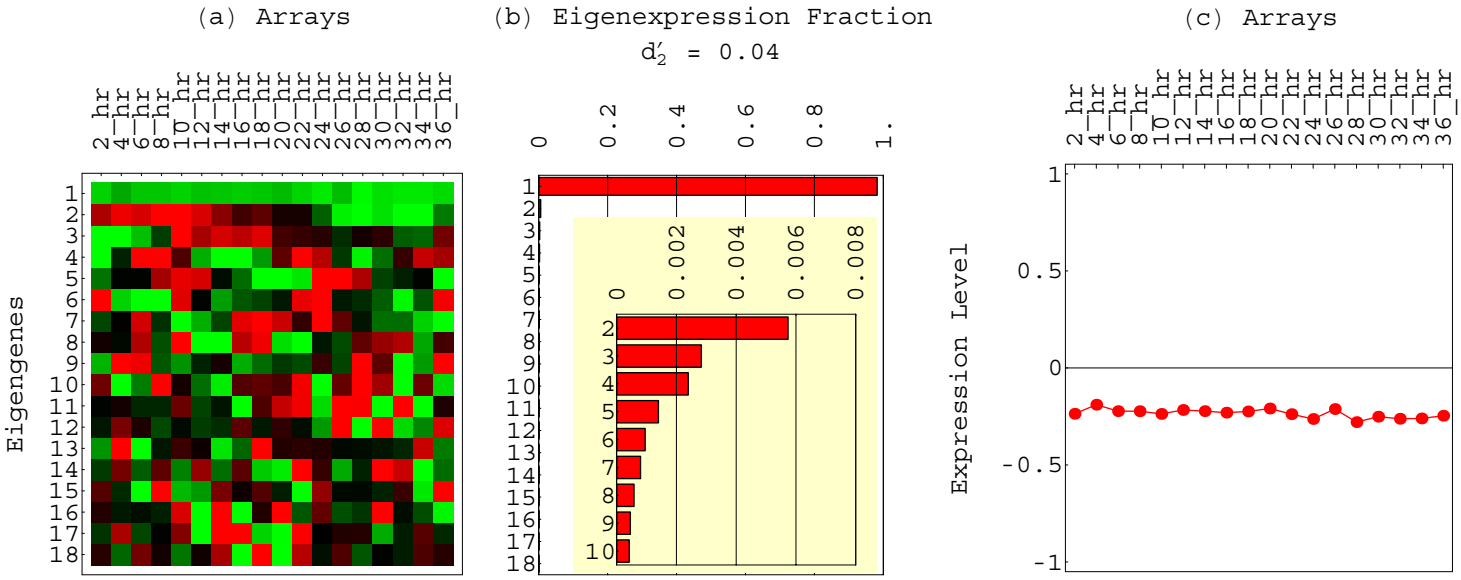
```
labelx = ColumnForm[{"(c) Arrays"}, Center];
labely = ColumnForm[{" ", "Expression Level"}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[1, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[1, 0, 0], PointSize[0.022], points}],
    Graphics[{RGBColor[1, 0, 0], line}]},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {None, {{0, RGBColor[0, 0, 0]}}},
   FrameTicks -> {None, framey, framex, None},
   PlotRange -> {-1.05, 1.05},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 0.25}, {0, 0}, {0, 1}];
p1 = Show[g,
   AspectRatio -> 1.05,
   PlotRange -> All,
   DisplayFunction → Identity];

labelx = ColumnForm[{"(d) Arrays"}, Center];
labely = ColumnForm[{" ", "Expression Level"}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[2, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[1, 0, 0], PointSize[0.022], points}],
    Graphics[{RGBColor[1, 0, 0], line}]},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {None, {{0, RGBColor[0, 0, 0]}}},
   FrameTicks -> {None, framey, framex, None},
   PlotRange -> {-1.05, 1.05},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 0.25}, {0, 0}, {0, 1}];
p2 = Show[g,
   AspectRatio -> 1.05,
   PlotRange -> All,
   DisplayFunction → Identity];
```

```
labelx = ColumnForm[{"(d) Arrays"}, Center];
labely = ColumnForm[{" ", "Expression Level"}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[3, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[0, 0, 1], PointSize[0.022], points}],
    Graphics[{RGBColor[0, 0, 1], line}]},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {None, {{0, RGBColor[0, 0, 0]}}},
   FrameTicks -> {None, framey, framex, None},
   PlotRange -> {-1.05, 1.05},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 0.25}, {0, 0}, {0, 1}];
p3 = Show[g,
   AspectRatio -> 1.05,
   PlotRange -> All,
   DisplayFunction → Identity];
```

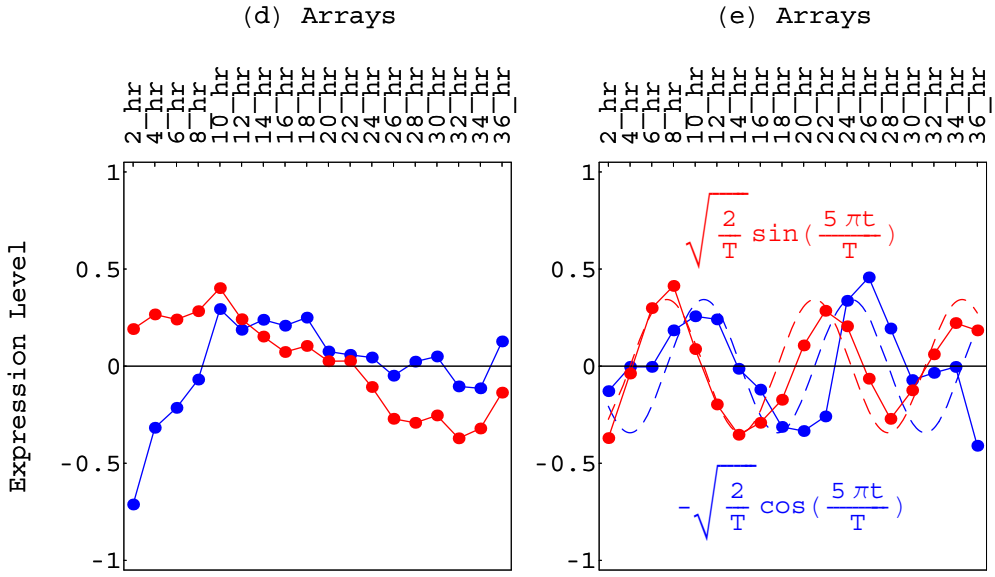
```
graph = Plot[eigengenes4,
   {x, 0, arrays - 1},
   PlotStyle -> {RGBColor[1, 0, 0], Dashing[{0.03, 0.02}]},
   DisplayFunction -> Identity];
labelx = ColumnForm[{"(e) Arrays"}, Center];
labely = ColumnForm[{" ", " "}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[4, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[1, 0, 0], PointSize[0.022], points}],
    Graphics[{RGBColor[1, 0, 0], line}],
    graph,
    Graphics[{RGBColor[1, 0, 0], Text["√(2/T) sin(5πt/T)", {8.5, 0.7}]}]},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {None, {{0, RGBColor[0, 0, 0]}}},
   FrameTicks -> {None, framey, framex, None},
   PlotRange -> {-1.05, 1.05},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 0.25}, {0, 0}, {0, 1}];
p4 = Show[g,
   AspectRatio -> 1.05,
   PlotRange -> All,
   DisplayFunction → Identity];
```

```
graph = Plot[eigengenes5,
   {x, 0, arrays - 1},
   PlotStyle -> {RGBColor[0, 0, 1], Dashing[{0.03, 0.02}]},
   DisplayFunction -> Identity];
labelx = ColumnForm[{"(e) Arrays"}, Center];
labely = ColumnForm[{" ", " "}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[5, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[0, 0, 1], PointSize[0.022], points}],
    Graphics[{RGBColor[0, 0, 1], line}],
    graph,
    Graphics[{RGBColor[0, 0, 1], Text["-Sqrt[2/T] cos(5 π t/T)", {8.5, -0.7}]}]},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {None, {{0, RGBColor[0, 0, 0]}}},
   FrameTicks -> {None, framey, framex, None},
   PlotRange -> {-1.05, 1.05},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 0.25}, {0, 0}, {0, 1}];
p5 = Show[g,
   AspectRatio -> 1.05,
   PlotRange -> All,
   DisplayFunction → Identity];
```

```
(* Display Selected Eigengenes *)

g3 = Show[{p3, p2},
   DisplayFunction -> Identity];
g4 = Show[{p5, p4},
   DisplayFunction -> Identity];

(* Display Eigengenes, Fractions and Selected Eigengenes *)

Show[GraphicsArray[{g1, g2, p1}],
  GraphicsSpacing -> -0.15];
```




```
Show[GraphicsArray[{g3, g4}],
  GraphicsSpacing -> -0.15];
```



```
(* Choose Subset of Eigengenes for Estimation *)

eigengenes = TakeRows[eigengenes, {1, 5}];

(* Estimate Missing Data *)

Do[
 missingmatrix1[[a, locator1[[a, 1]]]] =
  N[Round[Flatten[Dot[Dot[
          Transpose[Drop[
            Transpose[{missingmatrix1[[a]]}],
            {locator1[[a, 1]]}]],
          PseudoInverse[Transpose[Drop[
             Transpose[eigengenes],
             {locator1[[a, 1]]}]]]],
         eigengenes]][[locator1[[a, 1]]]] * 100] / 100],
 {a, 1, numbers[[2]]}]

Do[Do[
  missingmatrix2[[a, locator2[[a, b]]]] =
   N[Round[Flatten[Dot[Dot[
           Transpose[Drop[Drop[
              Transpose[{missingmatrix2[[a]]}],
              {locator2[[a, 2]]}], {locator2[[a, 1]]}]],
           PseudoInverse[Transpose[Drop[Drop[
               Transpose[eigengenes],
               {locator2[[a, 2]]}], {locator2[[a, 1]]}]]]],
          eigengenes]][[locator2[[a, b]]]] * 100] / 100],
  {b, 1, 2}],
 {a, 1, numbers[[3]]}]

Do[Do[
  missingmatrix3[[a, locator3[[a, b]]]] =
   N[Round[Flatten[Dot[Dot[
           Transpose[Drop[Drop[Drop[
               Transpose[{missingmatrix3[[a]]}],
               {locator3[[a, 3]]}], {locator3[[a, 2]]}], {locator3[[a, 1]]}]],
           PseudoInverse[Transpose[Drop[Drop[Drop[
                Transpose[eigengenes],
                {locator3[[a, 3]]}], {locator3[[a, 2]]}], {locator3[[a, 1]]}]]]],
          eigengenes]][[locator3[[a, b]]]] * 100] / 100],
  {b, 1, 3}],
 {a, 1, numbers[[4]]}]

genenames = AppendColumns[
   fullgenenames,
   missinggenenames1,
   missinggenenames2,
   missinggenenames3];
matrix = AppendColumns[
   fullmatrix,
   missingmatrix1,
   missingmatrix2,
   missingmatrix3];
{genes, arrays} = Dimensions[matrix];
matrix2 = matrix;
genenames2 = genenames;
arraynames2 = arraynames;
{genes2, arrays2} = Dimensions[matrix2]
```

```
{12056, 18}
```

```
(* Examine Human Data After Missing Data Estimation *)

(* Calculate SVD *)

{eigenarrays, eigenexpressions, eigengenes} = SingularValues[matrix];
eigengenes[[2]] = -eigengenes[[2]];
eigengenes[[3]] = -eigengenes[[3]];
eigengenes[[4]] = -eigengenes[[4]];
eigenarrays = Transpose[eigenarrays];
fractions = eigenexpressions^2 / Sum[eigenexpressions[[a]]^2, {a, 1, arrays}];
entropy = -N[Sum[fractions[[a]] * Log[fractions[[a]]], {a, 1, arrays}] / Log[arrays]];
entropy = N[Round[100 * entropy] / 100]
```

```
0.04
```

```
(* Create Fractions Bar Charts Displays *)

fractions[[2]]
```

```
0.00536708
```

```
limit = 0.008;

Clear[gridx, framex, framey, sizes];
gridx = Table[a, {a, 0, limit, N[limit / 4]}];
framex = gridx;
sizes = Flatten[
   Table[
    Dimensions[
     Characters[
      ToString[framex[[a]]
      ]]], {a, 1, 5}]];
Do[
  Do[framex[[a]] = StringJoin[ToString[framex[[a]]], " "],
   {b, 1, 5 - sizes[[a]]}],
  {a, 1, 5}];
framex = Table[{gridx[[a]], framex[[a]]}, {a, 1, 5}];
gridx = Table[{gridx[[a]], RGBColor[0, 0, 0]}, {a, 1, 5}];
framey = Table[{a + 1, arrays - a - 8}, {a, 0, 10 - 2}];
table = Table[fractions[[arrays - a]], {a, 8, arrays - 2}];
g = BarChart[table,
   BarOrientation -> Horizontal,
   PlotRange -> {{0, limit * 1.0001}, {0.5, 10 - 1 + 0.5}},
   AspectRatio -> 1,
   Axes -> False,
   Frame -> True,
   FrameTicks -> {None, framey, framex, None},
   FrameLabel -> {None, None, None, None},
   GridLines -> {gridx, None},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 1.75}, {0, 0}, {0, 1}];
g1 = Show[g,
   AspectRatio -> 1.25,
   PlotRange -> All,
   DisplayFunction -> Identity];
```

```
gridx = Table[a, {a, 0, 1, 0.2}];
framex = gridx;
sizes = Flatten[
   Table[
    Dimensions[
     Characters[
      ToString[framex[[a]]
      ]]], {a, 1, 6}]];
Do[
  Do[framex[[a]] = StringJoin[ToString[framex[[a]]], " "],
   {b, 1, size - sizes[[a]]}],
  {a, 1, 6}];
framex = Table[{gridx[[a]], framex[[a]]}, {a, 1, 6}];
gridx = Table[{gridx[[a]], RGBColor[0, 0, 0]}, {a, 1, 6}];
framey = Table[{a + 1, arrays - a}, {a, 0, arrays - 1}];
labelx = ColumnForm[
   {"(b) Eigenexpression Fraction", StringJoin["d₂ = ", ToString[entropy]], " "},
   Center];
g = BarChart[
   Table[fractions[[arrays - a]], {a, 0, arrays - 1}],
   BarOrientation -> Horizontal,
   PlotRange -> {{0, 1.0001}, {0.5, arrays + 0.5}},
   AspectRatio -> 1,
   Axes -> False,
   Frame -> True,
   FrameTicks -> {None, framey, framex, None},
   FrameLabel -> {None, None, labelx, None},
   GridLines -> {gridx, None},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 3}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 2.7}, {0, 0}, {0, 1}];
g2 = Show[{g,
    Graphics[{RGBColor[1, 1, 0.8], Rectangle[{0.1, 0.6}, {0.98, 16.6}]}],
    Graphics[{Rectangle[{0.1, 0.6}, {0.98, 16.6}, g1]}]},
   AspectRatio -> 1.35,
   PlotRange -> All,
   DisplayFunction -> Identity];
```

```
(* Create Eigengenes 2 D Red & Green Raster Display *)

contrast = 3.5;
displaying = Table[
   If[contrast * eigengenes[[i, j]] > 0,
    If[contrast * eigengenes[[i, j]] < 1, {contrast * eigengenes[[i, j]], 0}, {1, 0}],
    If[contrast * eigengenes[[i, j]] > -1, {0, -contrast * eigengenes[[i, j]]}, {0, 1}]],
   {i, 1, arrays}, {j, 1, arrays}];
framex = Table[{a - 0.5, arraynames[[2, a]]}, {a, 1, arrays}];
framey = Table[{a + 1 - 0.5, arrays - a}, {a, 0, arrays - 1}];
labely = "Eigengenes";
labelx = ColumnForm[{"(a) Arrays", " ", " "}, Center];
g = Show[
   Graphics[
    RasterArray[
     Table[
      RGBColor[displaying[[i, j, 1]], displaying[[i, j, 2]], 0],
      {i, arrays, 1, -1}, {j, 1, arrays}]]],
   AspectRatio -> 1,
   Frame -> True,
   FrameTicks -> {None, framey, framex, None},
   FrameLabel -> {None, labely, labelx, None},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 3, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 3}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 2.7}, {0, 0}, {0, 1}];
g1 = Show[g,
   AspectRatio -> 1.05,
   PlotRange -> All,
   DisplayFunction -> Identity];

(* Create Selected Eigengenes Graph Display *)

eigengenes4 = Chop[TrigFit[eigengenes[[4]], 2, {5 / 4 * (x - 1), arrays - 1}], 0.1]
eigengenes5 = Chop[TrigFit[eigengenes[[5]], 2, {5 / 4 * (x - 1), arrays - 1}], 0.175]
```

$$0.182993 \, \text{Sin}\left[\frac{5}{17} \pi \, (-1 + x)\right]$$

$$-0.224054 \, \text{Cos}\left[\frac{5}{17} \pi \, (-1 + x)\right]$$

```
eigengenes4 = Sqrt[2 / 17.] * Sin[5 * Pi * (x - 1) / 17];
eigengenes5 = -Sqrt[2 / 17.] * Cos[5 * Pi * (x - 1) / 17];
```

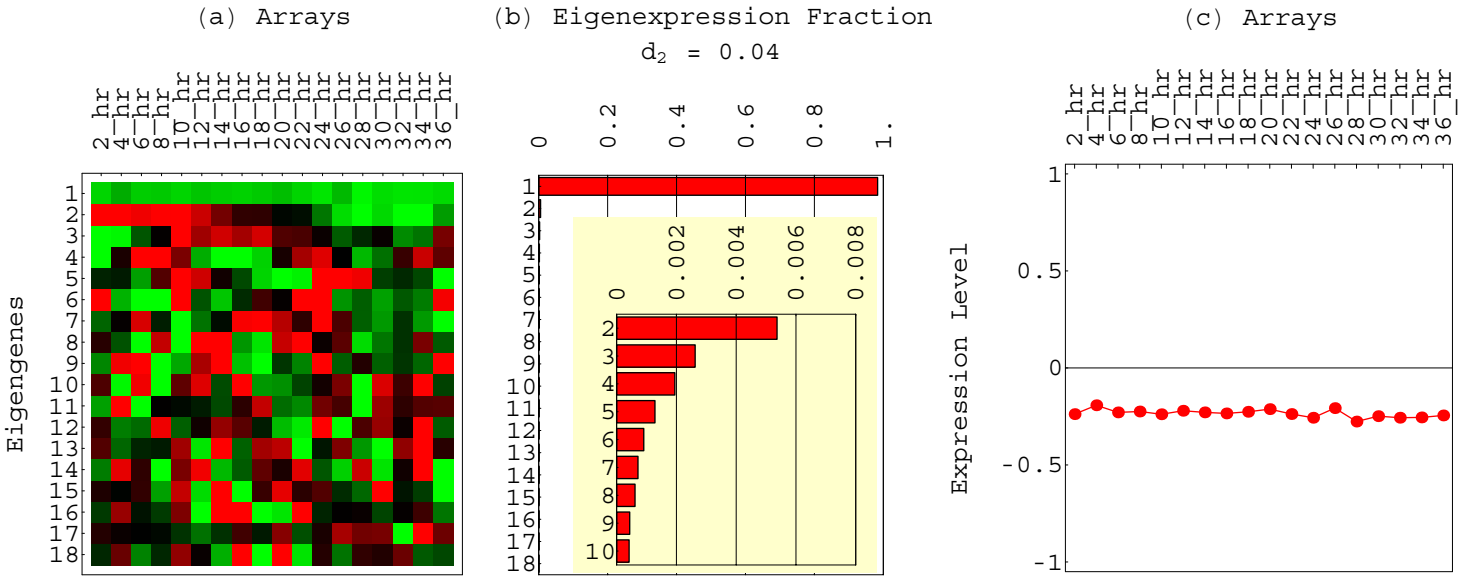
```
labelx = ColumnForm[{"(c) Arrays"}, Center];
labely = ColumnForm[{" ", "Expression Level"}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[1, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[1, 0, 0], PointSize[0.022], points}],
    Graphics[{RGBColor[1, 0, 0], line}]},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {None, {{0, RGBColor[0, 0, 0]}}},
   FrameTicks -> {None, framey, framex, None},
   PlotRange -> {-1.05, 1.05},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 0.25}, {0, 0}, {0, 1}];
p1 = Show[g,
   AspectRatio -> 1.05,
   PlotRange -> All,
   DisplayFunction → Identity];

labelx = ColumnForm[{"(d) Arrays"}, Center];
labely = ColumnForm[{" ", "Expression Level"}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[2, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[1, 0, 0], PointSize[0.022], points}],
    Graphics[{RGBColor[1, 0, 0], line}]},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {None, {{0, RGBColor[0, 0, 0]}}},
   FrameTicks -> {None, framey, framex, None},
   PlotRange -> {-1.05, 1.05},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 0.25}, {0, 0}, {0, 1}];
p2 = Show[g,
   AspectRatio -> 1.05,
   PlotRange -> All,
   DisplayFunction → Identity];
```

```
labelx = ColumnForm[{"(d) Arrays"}, Center];
labely = ColumnForm[{" ", "Expression Level"}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[3, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[0, 0, 1], PointSize[0.022], points}],
    Graphics[{RGBColor[0, 0, 1], line}]},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {None, {{0, RGBColor[0, 0, 0]}}},
   FrameTicks -> {None, framey, framex, None},
   PlotRange -> {-1.05, 1.05},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 0.25}, {0, 0}, {0, 1}];
p3 = Show[g,
   AspectRatio -> 1.05,
   PlotRange -> All,
   DisplayFunction → Identity];
```

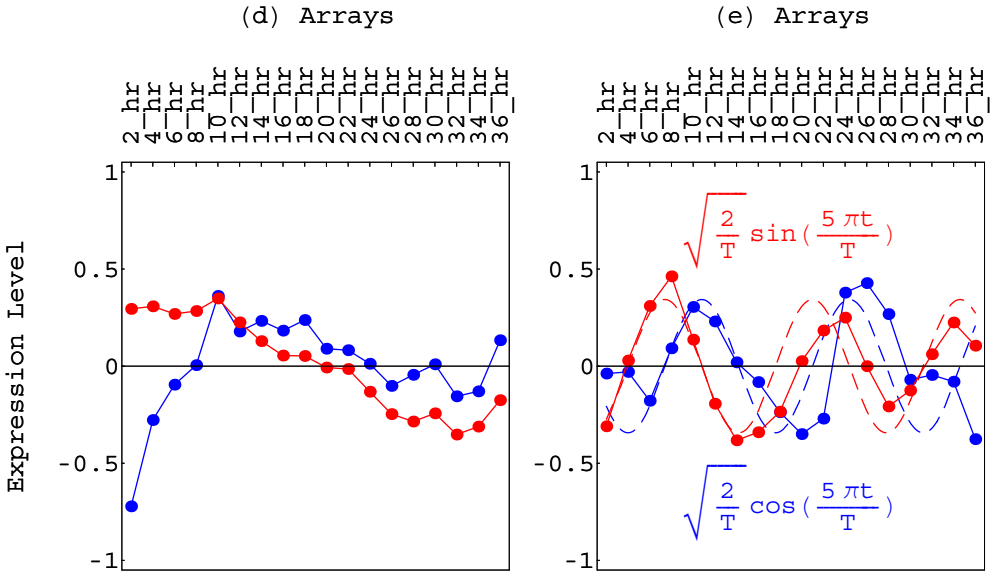
```
graph = Plot[eigengenes4,
   {x, 0, arrays - 1},
   PlotStyle -> {RGBColor[1, 0, 0], Dashing[{0.03, 0.02}]},
   DisplayFunction -> Identity];
labelx = ColumnForm[{"(e) Arrays"}, Center];
labely = ColumnForm[{" ", " "}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[4, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[1, 0, 0], PointSize[0.022], points}],
    Graphics[{RGBColor[1, 0, 0], line}],
    graph,
    Graphics[{RGBColor[1, 0, 0], Text["√(2/T) sin(5πt/T)", {8.5, 0.7}]}]},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {None, {{0, RGBColor[0, 0, 0]}}},
   FrameTicks -> {None, framey, framex, None},
   PlotRange -> {-1.05, 1.05},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 0.25}, {0, 0}, {0, 1}];
p4 = Show[g,
   AspectRatio -> 1.05,
   PlotRange -> All,
   DisplayFunction → Identity];
```

```
graph = Plot[eigengenes5,
   {x, 0, arrays - 1},
   PlotStyle -> {RGBColor[0, 0, 1], Dashing[{0.03, 0.02}]},
   DisplayFunction -> Identity];
labelx = ColumnForm[{"(e) Arrays"}, Center];
labely = ColumnForm[{" ", " "}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[5, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[0, 0, 1], PointSize[0.022], points}],
    Graphics[{RGBColor[0, 0, 1], line}],
    graph,
    Graphics[{RGBColor[0, 0, 1], Text["√(2/T) cos(5πt/T)", {8.5, -0.7}]}]},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {None, {{0, RGBColor[0, 0, 0]}}},
   FrameTicks -> {None, framey, framex, None},
   PlotRange -> {-1.05, 1.05},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 0.25}, {0, 0}, {0, 1}];
p5 = Show[g,
   AspectRatio -> 1.05,
   PlotRange -> All,
   DisplayFunction → Identity];
```

```
(* Display Selected Eigengenes *)

g3 = Show[{p3, p2},
   DisplayFunction -> Identity];
g4 = Show[{p5, p4},
   DisplayFunction -> Identity];

(* Display Eigengenes, Fractions and Selected Eigengenes *)

Show[GraphicsArray[{g1, g2, p1}],
  GraphicsSpacing -> -0.15];
```




```
Show[GraphicsArray[{g3, g4}],
  GraphicsSpacing -> -0.15];
```



```
(* Calculate GSVD of Yeast and Human Data *)

matrix = AppendColumns[matrix1, matrix2];
{q, r} = QRDecomposition[matrix];
q = Conjugate[Transpose[q]];
q1 = TakeRows[q, {1, genes1}];
{u1, w1, v1} = SingularValues[q1];
genelets = Dot[v1, r];
Do[genelets[[a]] = genelets[[a]] / Sqrt[Dot[genelets[[a]], genelets[[a]]]],
 {a, 1, arrays}]

genelets[[1]] = -genelets[[1]];
genelets[[2]] = -genelets[[2]];
genelets[[3]] = -genelets[[3]];
genelets[[4]] = -genelets[[4]];
genelets[[5]] = -genelets[[5]];
genelets[[6]] = -genelets[[6]];
genelets[[14]] = -genelets[[14]];
genelets[[16]] = -genelets[[16]];
genelets[[18]] = -genelets[[18]];

arraylets1 = Dot[matrix1, Inverse[genelets]];
arraylets2 = Dot[matrix2, Inverse[genelets]];
arraylets1 = Transpose[arraylets1];
Do[arraylets1[[a]] = arraylets1[[a]] / Sqrt[Dot[arraylets1[[a]], arraylets1[[a]]]], {a, 1, arrays}];
arraylets1 = Transpose[arraylets1];
arraylets2 = Transpose[arraylets2];
Do[arraylets2[[a]] = arraylets2[[a]] / Sqrt[Dot[arraylets2[[a]], arraylets2[[a]]]], {a, 1, arrays}];
arraylets2 = Transpose[arraylets2];
d1 = Chop[Dot[PseudoInverse[arraylets1], matrix1, Inverse[genelets]]];
d2 = Chop[Dot[PseudoInverse[arraylets2], matrix2, Inverse[genelets]]];

(* Create Angular Distances Bar Charts Displays *)

arraynames = Transpose[Table[{a, a}, {a, 1, arrays}]];
sizes = Flatten[
   Table[
    Dimensions[
     Characters[
      ToString[arraynames[[2, a]]
      ]]], {a, 1, arrays}]];
size = 5;
Do[
  Do[arraynames[[2, a]] = StringJoin[ToString[arraynames[[2, a]]], " "],
   {b, 1, size - sizes[[a]]}],
  {a, 1, arrays}];
distances =
  Table[N[ArcTan[d1[[a, a]] / d2[[a, a]]] / Pi], {a, 1, arrays}] -
   Table[0.25, {a, 1, arrays}];

Clear[gridx, framex, framey, sizes];
gridx = {-0.25, -0.125, 0, 0.125, 0.25};
framex = {"-π/4", "-π/8", "0    ", "π/8 ", "π/4 "};
framex = Table[{gridx[[a]], framex[[a]]}, {a, 1, 5}];
gridx = Table[{gridx[[a]], RGBColor[0, 0, 0]}, {a, 1, 5}];
framey = Table[{a + 1, arrays - a}, {a, 0, arrays - 1}];
labelx = ColumnForm[{"(b) Angular Distance", " ", " "}, Center];
```

```
g = BarChart[
   Table[distances[[arrays - a]], {a, 0, arrays - 1}],
   BarOrientation -> Horizontal,
   BarStyle → RGBColor[1, 0, 0],
   PlotRange -> {{-0.25 * 1.0001, 0.25 * 1.0001}, {0.5, arrays + 0.5}},
   AspectRatio -> 1,
   Axes -> False,
   Frame -> True,
   FrameTicks -> {None, framey, framex, None},
   FrameLabel -> {None, None, labelx, None},
   GridLines -> {gridx, None},
   DisplayFunction → Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 1.6}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 2}, {0, 0}, {0, 1}];
g2 = Show[g,
   AspectRatio -> 1.35,
   PlotRange -> All,
   DisplayFunction → Identity];

(* Create Genelets 2 D Red & Green Raster Display *)

average = Table[1, {a, 1, arrays}];
average = N[average / Sqrt[Dot[average, average]]];
centergenelets = genelets - N[Outer[Times, Dot[genelets, average], average]];

contrast = 4;
displaying = Table[
   If[contrast * centergenelets[[i, j]] > 0,
    If[contrast * centergenelets[[i, j]] < 1, {contrast * centergenelets[[i, j]], 0}, {1, 0}],
    If[contrast * centergenelets[[i, j]] > -1, {0, -contrast * centergenelets[[i, j]]}, {0, 1}]],
   {i, 1, arrays}, {j, 1, arrays}];
framex = Table[{a - 0.5, arraynames[[2, a]]}, {a, 1, arrays}];
framey = Table[{a + 1 - 0.5, arrays - a}, {a, 0, arrays - 1}];
labely = "Genelets";
labelx = ColumnForm[{"(a) Arrays", " ", " "}, Center];
g = Show[
   Graphics[
    RasterArray[
     Table[
      RGBColor[displaying[[i, j, 1]], displaying[[i, j, 2]], 0],
      {i, arrays, 1, -1}, {j, 1, arrays}]]],
   AspectRatio -> 1,
   Frame -> True,
   FrameTicks -> {None, framey, framex, None},
   FrameLabel -> {None, labely, labelx, None},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 3, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 1.6}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 2}, {0, 0}, {0, 1}];
g1 = Show[g,
   AspectRatio -> 1.05,
   PlotRange -> All,
   DisplayFunction → Identity];
```

```
(* Create Selected Genelets Graph Display *)

labelx = ColumnForm[{"(c) Arrays"}, Center];
labely = ColumnForm[{" ", " "}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, genelets[[1, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[1, 0, 0], PointSize[0.022], points}],
    Graphics[{RGBColor[1, 0, 0], line}]},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {None, {{0, RGBColor[0, 0, 0]}}},
   FrameTicks -> {None, framey, framex, None},
   PlotRange -> {-1.05, 1.05},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 0.3}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 0.22}, {0, 0}, {0, 1}];
p1 = Show[g,
   AspectRatio → 0.95,
   PlotRange -> All,
   DisplayFunction → Identity];

labelx = ColumnForm[{"(c) Arrays"}, Center];
labely = ColumnForm[{" ", " "}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, genelets[[2, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[0, 0, 1], PointSize[0.022], points}],
    Graphics[{RGBColor[0, 0, 1], line}]},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {None, {{0, RGBColor[0, 0, 0]}}},
   FrameTicks -> {None, framey, framex, None},
   PlotRange -> {-1.05, 1.05},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 0.3}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 0.22}, {0, 0}, {0, 1}];
p2 = Show[g,
   AspectRatio → 0.95,
   PlotRange -> All,
   DisplayFunction → Identity];
```

```
genelets3 = Sqrt[2 / 3 / 17.] - Sqrt[2 / 3 / 17.] * Cos[4 * Pi * x / 17. + Pi / 3];
graph = Plot[genelets3,
   {x, 0, arrays - 1},
   PlotStyle -> {RGBColor[1, 0, 0], Dashing[{0.03, 0.02}]},
   DisplayFunction -> Identity];
labelx = ColumnForm[{"(a) Arrays"}, Center];
labely = ColumnForm[{" ", "Expression Level"}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, genelets[[3, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[1, 0, 0], PointSize[0.022], points}],
    Graphics[{RGBColor[1, 0, 0], line}],
    graph,
    Graphics[{RGBColor[1, 0, 0], Text["\[Sqrt]2/(3 T) [1 - cos(4 \[Pi] t/T + \[Pi]/3)]", {9, 1}]}]},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {None, {{0, RGBColor[0, 0, 0]}}},
   FrameTicks -> {None, framey, framex, None},
   PlotRange -> {-0.85, 1.25},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 0.3}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 0.22}, {0, 0}, {0, 1}];
p3 = Show[g,
   AspectRatio → 0.95,
   PlotRange -> All,
   DisplayFunction → Identity];
```

```
genelets4 = -Sqrt[2 / 3 / 17.] + Sqrt[2 / 3 / 17.] * Cos[4 * Pi * x / 17.];
graph = Plot[genelets4,
   {x, 0, arrays - 1},
   PlotStyle -> {RGBColor[0, 0, 1], Dashing[{0.03, 0.02}]},
   DisplayFunction -> Identity];
labelx = ColumnForm[{"(a) Arrays"}, Center];
labely = ColumnForm[{" ", " "}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, genelets[[4, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[0, 0, 1], PointSize[0.022], points}],
    Graphics[{RGBColor[0, 0, 1], line}],
    graph,
    Graphics[{RGBColor[0, 0, 1], Text["-Sqrt[2/(3 T)] [1 - cos(4 πt/T)]", {9, 0.65}]}]},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {None, {{0, RGBColor[0, 0, 0]}}},
   FrameTicks -> {None, framey, framex, None},
   PlotRange -> {-0.85, 1.25},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 0.3}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 0.22}, {0, 0}, {0, 1}];
p4 = Show[g,
   AspectRatio → 0.95,
   PlotRange -> All,
   DisplayFunction → Identity];
```

```
genelets5 = Sqrt[2 / 17.] * Cos[4 * Pi * x / 17. - Pi / 3];
graph = Plot[genelets5,
   {x, 0, arrays - 1},
   PlotStyle -> {RGBColor[0, 0.5, 0], Dashing[{0.03, 0.02}]},
   DisplayFunction -> Identity];
labelx = ColumnForm[{"(a) Arrays"}, Center];
labely = ColumnForm[{" ", " "}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, genelets[[5, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[0, 0.5, 0], PointSize[0.022], points}],
    Graphics[{RGBColor[0, 0.5, 0], line}],
    graph,
    Graphics[{RGBColor[0, 0.5, 0], Text["√(2/T) cos(4πt/T - π/3)", {11.5, -0.65}]}]},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {None, {{0, RGBColor[0, 0, 0]}}},
   FrameTicks -> {None, framey, framex, None},
   PlotRange -> {-0.85, 1.25},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 0.3}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 0.22}, {0, 0}, {0, 1}];
p5 = Show[g,
   AspectRatio → 0.95,
   PlotRange -> All,
   DisplayFunction → Identity];
```

```
labelx = ColumnForm[{"(c) Arrays"}, Center];
labely = ColumnForm[{" ", " "}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, genelets[[6, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[0.75, 0, 1], PointSize[0.022], points}],
    Graphics[{RGBColor[0.75, 0, 1], line}]},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {None, {{0, RGBColor[0, 0, 0]}}},
   FrameTicks -> {None, framey, framex, None},
   PlotRange -> {-1.05, 1.05},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 0.3}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 0.22}, {0, 0}, {0, 1}];
p6 = Show[g,
   AspectRatio → 0.95,
   PlotRange -> All,
   DisplayFunction → Identity];
```

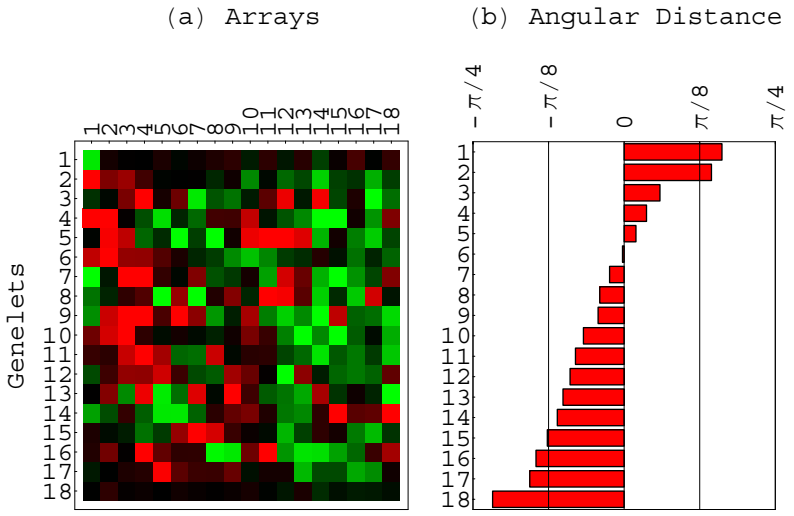
```
genelets14 = -Sqrt[2 / 3 / 17.] + Sqrt[2 / 3 / 17.] * Cos[5 * Pi * x / 17. - Pi / 3];
graph = Plot[genelets14,
   {x, 0, arrays - 1},
   PlotStyle -> {RGBColor[1, 0, 0], Dashing[{0.03, 0.02}]},
   DisplayFunction -> Identity];
labelx = ColumnForm[{"(b) Arrays"}, Center];
labely = ColumnForm[{" ", " "}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, genelets[[14, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[1, 0, 0], PointSize[0.022], points}],
    Graphics[{RGBColor[1, 0, 0], line}],
    graph,
    Graphics[{RGBColor[1, 0, 0], Text["-Sqrt[2/(3 T)] [1 - cos(5 πt/T - π/3)]", {9, 1}]}]},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {None, {{0, RGBColor[0, 0, 0]}}},
   FrameTicks -> {None, framey, framex, None},
   PlotRange -> {-0.85, 1.25},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 0.3}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 0.22}, {0, 0}, {0, 1}];
p14 = Show[g,
   AspectRatio → 0.95,
   PlotRange -> All,
   DisplayFunction → Identity];
```

```
genelets15 = Sqrt[2 / 3 / 17.] + Sqrt[2 / 3 / 17.] * Cos[5 * Pi * x / 17. + Pi / 3];
graph = Plot[genelets15,
   {x, 0, arrays - 1},
   PlotStyle -> {RGBColor[0, 0, 1], Dashing[{0.03, 0.02}]},
   DisplayFunction -> Identity];
labelx = ColumnForm[{"(b) Arrays"}, Center];
labely = ColumnForm[{" ", " "}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, genelets[[15, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[0, 0, 1], PointSize[0.022], points}],
    Graphics[{RGBColor[0, 0, 1], line}],
    graph,
    Graphics[{RGBColor[0, 0, 1], Text[" sqrt(2/(3 T)) [1 + cos(5 π t / T + π/3)]", {9, 0.65}]}]},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {None, {{0, RGBColor[0, 0, 0]}}},
   FrameTicks -> {None, framey, framex, None},
   PlotRange -> {-0.85, 1.25},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 0.3}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 0.22}, {0, 0}, {0, 1}];
p15 = Show[g,
   AspectRatio → 0.95,
   PlotRange -> All,
   DisplayFunction → Identity];
```

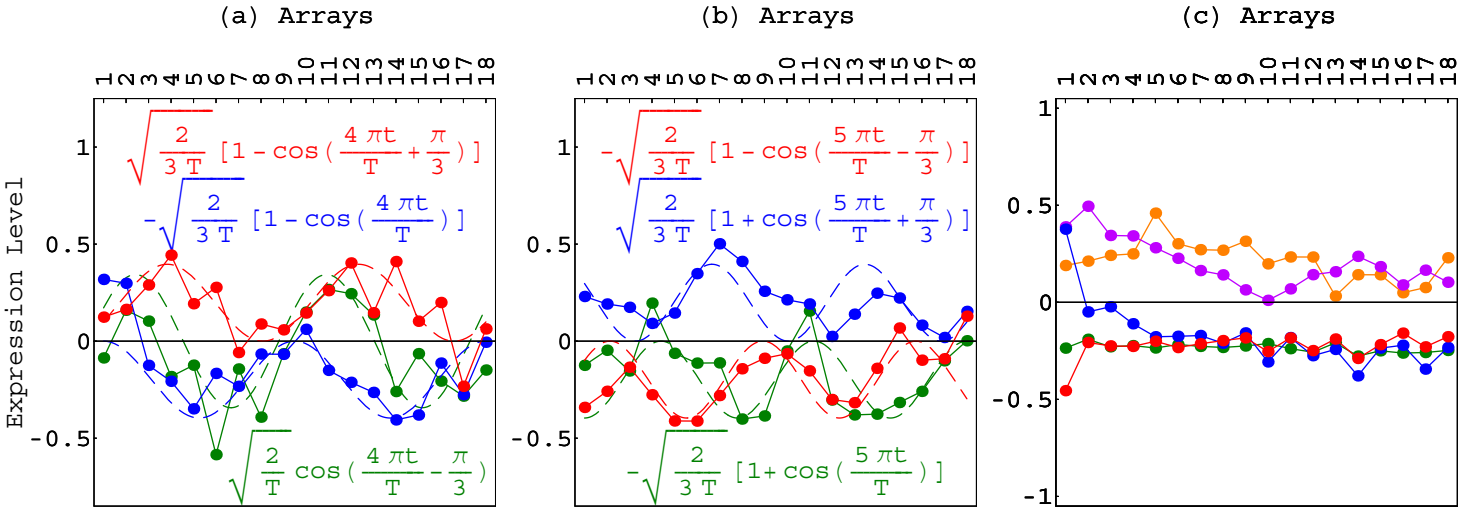
```
genelets16 = -Sqrt[2 / 3 / 17.] - Sqrt[2 / 3 / 17.] * Cos[5 * Pi * x / 17.];
graph = Plot[genelets16,
   {x, 0, arrays - 1},
   PlotStyle -> {RGBColor[0, 0.5, 0], Dashing[{0.03, 0.02}]},
   DisplayFunction -> Identity];
labelx = ColumnForm[{"(b) Arrays"}, Center];
labely = ColumnForm[{" ", " "}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, genelets[[16, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[0, 0.5, 0], PointSize[0.022], points}],
    Graphics[{RGBColor[0, 0.5, 0], line}],
    graph,
    Graphics[{RGBColor[0, 0.5, 0], Text["-Sqrt[2/(3 T)] [1+cos(5 π t/T)]", {9, -0.65}]}]},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {None, {{0, RGBColor[0, 0, 0]}}},
   FrameTicks -> {None, framey, framex, None},
   PlotRange -> {-0.85, 1.25},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 0.3}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 0.22}, {0, 0}, {0, 1}];
p16 = Show[g,
   AspectRatio → 0.95,
   PlotRange -> All,
   DisplayFunction → Identity];
```

```
labelx = ColumnForm[{"(c) Arrays"}, Center];
labely = ColumnForm[{" ", " "}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, genelets[[17, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[1, 0.5, 0], PointSize[0.022], points}],
    Graphics[{RGBColor[1, 0.5, 0], line}]},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {None, {{0, RGBColor[0, 0, 0]}}},
   FrameTicks -> {None, framey, framex, None},
   PlotRange -> {-1.05, 1.05},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 0.3}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 0.22}, {0, 0}, {0, 1}];
p17 = Show[g,
   AspectRatio → 0.95,
   PlotRange -> All,
   DisplayFunction → Identity];

labelx = ColumnForm[{"(c) Arrays"}, Center];
labely = ColumnForm[{" ", " "}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, genelets[[18, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[0, 0.5, 0], PointSize[0.022], points}],
    Graphics[{RGBColor[0, 0.5, 0], line}]},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {None, {{0, RGBColor[0, 0, 0]}}},
   FrameTicks -> {None, framey, framex, None},
   PlotRange -> {-1.05, 1.05},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 0.3}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 0.22}, {0, 0}, {0, 1}];
p18 = Show[g,
   AspectRatio → 0.95,
   PlotRange -> All,
   DisplayFunction → Identity];
```

```
(* Display Selected Genelets *)

g3 = Show[{p5, p4, p3},
   DisplayFunction -> Identity];
g4 = Show[{p16, p15, p14},
   DisplayFunction -> Identity];
g5 = Show[{p18, p17, p6, p2, p1},
   DisplayFunction -> Identity];

(* Display Genelets, Angular Distances and Selected Genelets *)

Show[GraphicsArray[{g1, g2}],
    GraphicsSpacing -> -0.18];
```




```
Show[GraphicsArray[{g3, g4, g5}],
    GraphicsSpacing -> -0.12];
```



```
(* Create Yeast Generalized Fractions Bar Chart Display *)

d = Table[d1[[a, a]], {a, 1, arrays}];
fractions = d^2 / Sum[d[[a]]^2, {a, 1, arrays}];
coordinates = Sort[Table[{fractions[[a]], a}, {a, 1, arrays}], OrderedQ[{{#2}, {#1}}] &];
fractions = Flatten[TakeColumns[coordinates, {1, 1}]];
entropy = -N[Sum[fractions[[a]] * Log[fractions[[a]]], {a, 1, arrays}] / Log[arrays]];
entropy = N[Round[100 * entropy] / 100]
```

```
0.36
```

```
fractions[[3]]
```

```
0.0516352
```

```
limit = 0.052;

Clear[gridx, framex, framey, sizes];
gridx = Table[a, {a, 0, limit, N[limit / 4]}];
framex = gridx;
sizes = Flatten[
   Table[
    Dimensions[
     Characters[
      ToString[framex[[a]]
      ]]], {a, 1, 5}]];
size = Sort[sizes, OrderedQ[{#2, #1}] &][[1]];
Do[
  Do[framex[[a]] = StringJoin[ToString[framex[[a]]], " "],
   {b, 1, 7 - sizes[[a]]}],
  {a, 1, 5}];
framex = Table[{gridx[[a]], framex[[a]]}, {a, 1, 5}];
gridx = Table[{gridx[[a]], RGBColor[0, 0, 0]}, {a, 1, 5}];
framey = Flatten[TakeColumns[coordinates, {2, 2}]];
framey = Table[{arrays - a, framey[[a + 1]]}, {a, 2, arrays - 1}];
table = Table[fractions[[arrays - a]], {a, 0, arrays - 3}];
g = BarChart[table,
   BarOrientation -> Horizontal,
   PlotRange -> {{0, limit * 1.0001}, {0.5, arrays - 2 + 0.5}},
   AspectRatio -> 1,
   Axes -> False,
   Frame -> True,
   FrameTicks -> {None, framey, framex, None},
   FrameLabel -> {None, None, None, None},
   GridLines -> {gridx, None},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 3}, {0, 0}, {0, 1}];
g1 = Show[g,
   AspectRatio -> 1.25,
   PlotRange -> All,
   DisplayFunction → Identity];
```

```
fractions[[1]]
```

```
0.738543
```

```
limit = 0.8;

Clear[gridx, framex, framey, sizes];
gridx = Table[a, {a, 0, limit, N[limit / 5]}];
framex = gridx;
sizes = Flatten[
   Table[
    Dimensions[
     Characters[
      ToString[framex[[a]]
      ]]], {a, 1, 6}]];
size = Sort[sizes, OrderedQ[{#2, #1}] &][[1]] + 1;
Do[
  Do[framex[[a]] = StringJoin[ToString[framex[[a]]], " "],
   {b, 1, size - sizes[[a]]}],
  {a, 1, 6}];
framex = Table[{gridx[[a]], framex[[a]]}, {a, 1, 6}];
framey = Flatten[TakeColumns[coordinates, {2, 2}]];
framey = Table[{arrays - a, framey[[a + 1]]}, {a, 0, arrays - 1}];
labely = "Genelets";
labelx = ColumnForm[
   {"(a) Generalized Fraction", "   of Eigenexpression", StringJoin["D₁ = ", ToString[entropy]], " "},
   Center];
g = BarChart[
   Table[fractions[[arrays - a]], {a, 0, arrays - 1}],
   BarOrientation -> Horizontal,
   PlotRange -> {{0, limit * 1.0001}, {0.5, arrays + 0.5}},
   AspectRatio -> 1,
   Axes -> False,
   Frame -> True,
   FrameTicks -> {None, framey, framex, None},
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {gridx, None},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 0.16, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 2}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 1.75}, {0, 0}, {0, 1}];
g5 = Show[{g,
    Graphics[{RGBColor[1, 1, 0.8], Rectangle[{0.1, 0.6}, {0.78, 16.5}]}],
    Graphics[{Rectangle[{0.1, 0.6}, {0.78, 17}, g1]}]},
   AspectRatio → 1.15,
   PlotRange -> All,
   DisplayFunction → Identity];
```

```
(* Create Human Generalized Fractions Bar Chart Display *)

d = Table[d2[[a, a]], {a, 1, arrays}];
fractions = d^2 / Sum[d[[a]]^2, {a, 1, arrays}];
coordinates = Sort[Table[{fractions[[a]], a}, {a, 1, arrays}], OrderedQ[{{#2}, {#1}}] &];
fractions = Flatten[TakeColumns[coordinates, {1, 1}]];
entropy = -N[Sum[fractions[[a]] * Log[fractions[[a]]], {a, 1, arrays}] / Log[arrays]];
entropy = N[Round[100 * entropy] / 100]
```

```
0.12
```

```
fractions[[2]]
```

```
0.0148912
```

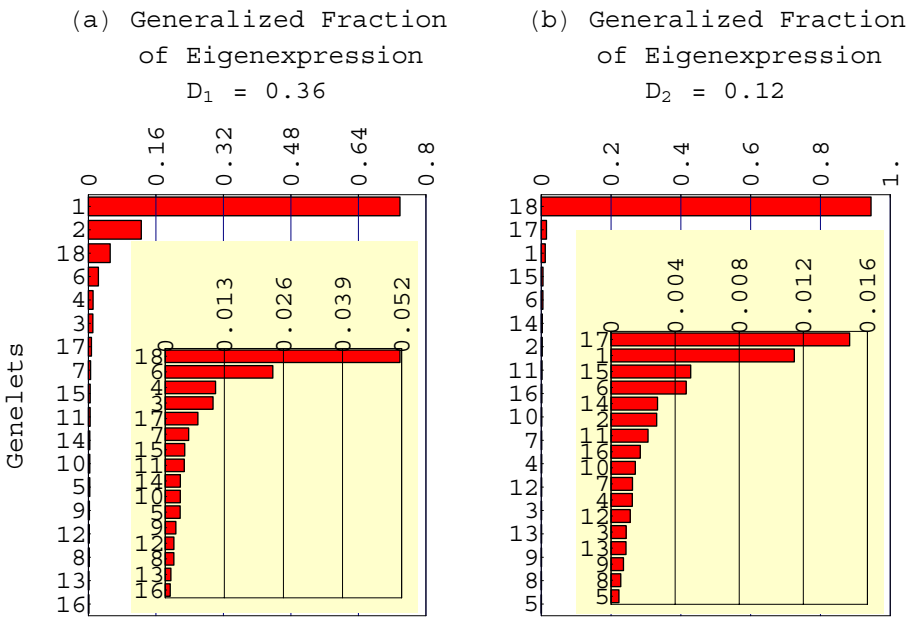
```
limit = 0.016;

Clear[gridx, framex, framey, sizes];
gridx = Table[a, {a, 0, limit, N[limit / 4]}];
framex = gridx;
sizes = Flatten[
   Table[
    Dimensions[
     Characters[
      ToString[framex[[a]]
      ]]], {a, 1, 5}]];
size = Sort[sizes, OrderedQ[{#2, #1}] &][[1]];
Do[
  Do[framex[[a]] = StringJoin[ToString[framex[[a]]], " "],
   {b, 1, 7 - sizes[[a]]}],
  {a, 1, 5}];
framex = Table[{gridx[[a]], framex[[a]]}, {a, 1, 5}];
gridx = Table[{gridx[[a]], RGBColor[0, 0, 0]}, {a, 1, 5}];
framey = Flatten[TakeColumns[coordinates, {2, 2}]];
framey = Table[{arrays - a, framey[[a + 1]]}, {a, 1, arrays - 1}];
table = Table[fractions[[arrays - a]], {a, 0, arrays - 2}];
g = BarChart[table,
   BarOrientation -> Horizontal,
   PlotRange -> {{0, limit * 1.0001}, {0.5, arrays - 1 + 0.5}},
   AspectRatio -> 1,
   Axes -> False,
   Frame -> True,
   FrameTicks -> {None, framey, framex, None},
   FrameLabel -> {None, None, None, None},
   GridLines -> {gridx, None},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 3}, {0, 0}, {0, 1}];
g1 = Show[g,
   AspectRatio -> 1.25,
   PlotRange -> All,
   DisplayFunction → Identity];
```

```
fractions[[1]]
```

```
0.945012
```

```
limit = 1;

Clear[gridx, framex, framey, sizes];
gridx = Table[a, {a, 0, limit, N[limit / 5]}];
framex = gridx;
sizes = Flatten[
   Table[
    Dimensions[
     Characters[
      ToString[framex[[a]]
      ]]], {a, 1, 6}]];
size = Sort[sizes, OrderedQ[{#2, #1}] &][[1]] + 2;
Do[
  Do[framex[[a]] = StringJoin[ToString[framex[[a]]], " "],
   {b, 1, size - sizes[[a]]}],
  {a, 1, 6}];
framex = Table[{gridx[[a]], framex[[a]]}, {a, 1, 6}];
framey = Flatten[TakeColumns[coordinates, {2, 2}]];
framey = Table[{arrays - a, framey[[a + 1]]}, {a, 0, arrays - 1}];
labely = " ";
labelx = ColumnForm[
   {"(b) Generalized Fraction", "   of Eigenexpression", StringJoin["D₂ = ", ToString[entropy]], " "},
   Center];
g = BarChart[
   Table[fractions[[arrays - a]], {a, 0, arrays - 1}],
   BarOrientation -> Horizontal,
   PlotRange -> {{0, limit * 1.0001}, {0.5, arrays + 0.5}},
   AspectRatio -> 1,
   Axes -> False,
   Frame -> True,
   FrameTicks -> {None, framey, framex, None},
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {gridx, None},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 0.16, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 2}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 1.75}, {0, 0}, {0, 1}];
g6 = Show[{g,
    Graphics[{RGBColor[1, 1, 0.8], Rectangle[{0.1, 0.6}, {0.98, 17}]}],
    Graphics[{Rectangle[{0.1, 0.6}, {0.98, 17.5}, g1]}]},
   AspectRatio → 1.15,
   PlotRange -> All,
   DisplayFunction → Identity];
```

```
(* Display Yeast and Human Generalized Fractions *)

Show[GraphicsArray[{g5, g6}],
  GraphicsSpacing → -0.15];
```




```
(* GSVD Sort Yeast Data *)

matrix = matrix1;
genes = genes1;
arraynames = arraynames1;
genenames = genenames1;

(* GSVD Sort Yeast Arrays *)

(* Center Genelets and Calculate Contributions of Arraylets to Arrays *)

arraycontributions3 = (genelets[[3]] - Sqrt[2 / 3 / 17.]) * d1[[3, 3]];
arraycontributions4 = (genelets[[4]] + Sqrt[2 / 3 / 17.]) * d1[[4, 4]];
arraycontributions5 = genelets[[5]] * d1[[5, 5]];
arraycontributions14 = (genelets[[14]] + Sqrt[2 / 3 / 17.]) * d1[[14, 14]];
arraycontributions15 = (genelets[[15]] - Sqrt[2 / 3 / 17.]) * d1[[15, 15]];
arraycontributions16 = (genelets[[16]] + Sqrt[2 / 3 / 17.]) * d1[[16, 16]];
```

```
(* Project Arrays from 6 D Arraylets Subspace Onto 2 D Subspace  *)

coordinates = Table[{
    (-Sqrt[3] * (arraycontributions3[[a]] - arraycontributions15[[a]]) +
        2 * Sqrt[3] * (arraycontributions4[[a]] - arraycontributions16[[a]]) +
        (3 * arraycontributions5[[a]] + Sqrt[3] * arraycontributions14[[a]])) / 6 /
     Sqrt[(arraycontributions3[[a]] - arraycontributions15[[a]]) ^ 2 / 3 +
       (arraycontributions4[[a]] - arraycontributions16[[a]]) ^ 2 / 3 +
       (arraycontributions5[[a]] + arraycontributions14[[a]] / Sqrt[3]) ^ 2 +
       Abs[(arraycontributions3[[a]] - arraycontributions15[[a]]) / Sqrt[3] *
          (arraycontributions4[[a]] - arraycontributions16[[a]])] / Sqrt[3] +
       Abs[(arraycontributions3[[a]] - arraycontributions15[[a]]) / Sqrt[3] *
         (arraycontributions5[[a]] + arraycontributions14[[a]] / Sqrt[3])] +
       Abs[(arraycontributions4[[a]] - arraycontributions16[[a]]) / Sqrt[3] *
         (arraycontributions5[[a]] + arraycontributions14[[a]] / Sqrt[3])]],
    (3 * (arraycontributions3[[a]] - arraycontributions15[[a]]) +
        Sqrt[3] * (3 * arraycontributions5[[a]] + Sqrt[3] * arraycontributions14[[a]])) / 6 /
     Sqrt[(arraycontributions3[[a]] - arraycontributions15[[a]]) ^ 2 / 3 +
       (arraycontributions4[[a]] - arraycontributions16[[a]]) ^ 2 / 3 +
       (arraycontributions5[[a]] + arraycontributions14[[a]] / Sqrt[3]) ^ 2 +
       Abs[(arraycontributions3[[a]] - arraycontributions15[[a]]) / Sqrt[3] *
          (arraycontributions4[[a]] - arraycontributions16[[a]])] / Sqrt[3] +
       Abs[(arraycontributions3[[a]] - arraycontributions15[[a]]) / Sqrt[3] *
         (arraycontributions5[[a]] + arraycontributions14[[a]] / Sqrt[3])] +
       Abs[(arraycontributions4[[a]] - arraycontributions16[[a]]) / Sqrt[3] *
         (arraycontributions5[[a]] + arraycontributions14[[a]] / Sqrt[3])]]},
   {a, 1, arrays}];

(* Create Parameter Plot of Yeast Arrays Projected Onto 2 D Subspace *)

points1 = {Point[coordinates[[2]]], Point[coordinates[[11]]]};
points2 = {Point[coordinates[[3]]], Point[coordinates[[4]]],
   Point[coordinates[[5]]], Point[coordinates[[12]]],
   Point[coordinates[[13]]], Point[coordinates[[14]]]};
points3 = {Point[coordinates[[6]]], Point[coordinates[[15]]]};
points4 = {Point[coordinates[[7]]]};
points5 = {Point[coordinates[[1]]], Point[coordinates[[8]]],
   Point[coordinates[[9]]], Point[coordinates[[10]]],
   Point[coordinates[[16]]], Point[coordinates[[17]]],
   Point[coordinates[[18]]]};
textcoordinates = coordinates;
Do[
  textcoordinates[[a, 1]] = If[
    textcoordinates[[a, 1]] > 0,
    textcoordinates[[a, 1]] - 0.085,
    textcoordinates[[a, 1]] + 0.095],
  {a, 1, 9}];
Do[
  textcoordinates[[a, 1]] =
   If[textcoordinates[[a, 1]] > 0,
    textcoordinates[[a, 1]] - 0.11,
    textcoordinates[[a, 1]] + 0.12],
  {a, 10, arrays}];
textcoordinates[[1]] = textcoordinates[[1]] + {0.04, -0.095};
textcoordinates[[3]] = textcoordinates[[3]] + {0.18, 0};
textcoordinates[[7]] = textcoordinates[[7]] + {0.18, 0};
textcoordinates[[8]] = textcoordinates[[8]] + {0.18, 0};
textcoordinates[[11]] = textcoordinates[[11]] + {0.12, -0.11};
textcoordinates[[12]] = textcoordinates[[12]] - {0.23, 0.06};
textcoordinates[[13]] = textcoordinates[[13]] + {0.23, 0};
textcoordinates[[15]] = textcoordinates[[15]] - {0.23, 0};
textcoordinates[[16]] = textcoordinates[[16]] - {0.02, 0.095};
textcoordinates[[17]] = textcoordinates[[17]] - {0.23, 0};
textcoordinates[[18]] = textcoordinates[[18]] + {0.11, 0.11};
```

```
texts = Table[Text[a, textcoordinates[[a]]], {a, 1, arrays}];
radius = Sqrt[coordinates[[2, 1]]^2 + coordinates[[2, 2]]^2];
p = Show[
   {Graphics[{RGBColor[1, 1, 0], PointSize[0.035], points1}],
    Graphics[{RGBColor[0, 0.5, 0], PointSize[0.035], points2}],
    Graphics[{RGBColor[0, 0, 1], PointSize[0.035], points3}],
    Graphics[{RGBColor[1, 0, 0], PointSize[0.035], points4}],
    Graphics[{RGBColor[1, 0.5, 0], PointSize[0.035], points5}],
    Graphics[{RGBColor[1, 0.5, 0], Text["G2/M", {1.075, -0.52}]}],
    Graphics[{RGBColor[0, 0, 0], Text["M/G1", {0.9, 0.75}]}],
    Graphics[{RGBColor[1, 0, 0], Text["S/G2", {0.1, -1.12}]}],
    Graphics[{RGBColor[0, 0, 1], Text["S", {-0.95, -0.6}]}],
    Graphics[{RGBColor[0, 0.5, 0], Text["G1", {-0.8, 0.8}]}],
    Graphics[{RGBColor[0, 0, 0], Text["(d)", {-1.1, 1.15}]}],
    Graphics[{RGBColor[0, 0, 0], Text["ϕ=π/3 ", {0.925, 1.15}]}],
    Graphics[{RGBColor[0, 0, 0], Text["ϕ=0", {1.12, 0.12}]}],
    Graphics[{RGBColor[0, 0, 0], Text["ϕ=-π/3", {0.925, -1.15}]}],
    Graphics[texts],
    Graphics[{RGBColor[0, 0, 0], Dashing[{0.03, 0.02}], Circle[{0, 0}, 0.5]}],
    Graphics[{RGBColor[0, 0, 0], Dashing[{0.03, 0.02}], Circle[{0, 0}, 1]}],
    Graphics[{RGBColor[0, 0, 0], Arrow[{-1.25 / Tan[Pi / 3.], 1.25}, {1.25 / Tan[Pi / 3.], -1.25},
       HeadCenter -> 0.5, HeadLength -> 0.035, HeadWidth -> 0.75]}],
    Graphics[{RGBColor[0, 0, 0], Arrow[{-1.25, 0}, {1.25, 0},
       HeadCenter -> 0.5, HeadLength -> 0.035, HeadWidth -> 0.75]}],
    Graphics[{RGBColor[0, 0, 0], Arrow[{-1.25 / Tan[Pi / 3.], -1.25}, {1.25 / Tan[Pi / 3.], 1.25},
       HeadCenter -> 0.5, HeadLength -> 0.035, HeadWidth -> 0.75]}],
    Graphics[{RGBColor[0, 0, 0], Circle[{0, 0}, 0.6,
       {ArcTan[coordinates[[1, 2]] / coordinates[[1, 1]]], 0}]}],
    Graphics[{RGBColor[0, 0, 0], Arrow[{0.6 * Cos[-0.05], 0.6 * Sin[-0.05]}, {0.6 * Cos[0], 0.6 * Sin[0]},
       HeadCenter -> 0.5, HeadLength -> 0.035, HeadWidth -> 0.75]}],
    Graphics[{RGBColor[0, 0, 0], Arrow[{0, 0}, coordinates[[1]],
       HeadCenter -> 0.5, HeadLength -> 0.035, HeadWidth -> 0.75]}],
    Graphics[{RGBColor[0, 0, 0], Text["r", {0.5, -0.35}]}],
    Graphics[{RGBColor[0, 0, 0], Text["ϕ", {0.65, -0.15}]}]},
   AspectRatio -> 1,
   PlotRange -> {{-1.25, 1.25}, {-1.25, 1.25}},
   Frame -> True,
   FrameTicks -> False,
   FrameLabel -> {None, None, None, None},
   GridLines -> {None, {{0, RGBColor[0, 0, 0]}}},
   DisplayFunction -> Identity];
p = FullGraphics[p];
p[[1, 2]] = p[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {-1.18, 0}, {0, 0}, {0, 1}];
s4 = Show[p,
   AspectRatio → 1.0,
   PlotRange -> All,
   DisplayFunction → Identity];

(* GSVD Sort Yeast Genes *)

(* Center Arraylets and Calculate Contributions of Genelets to Genes *)

centerarraylets = Transpose[arraylets1];
average = Table[1, {a, 1, genes}];
average = N[average / Sqrt[Dot[average, average]]];
centerarraylets = centerarraylets - N[Outer[Times, Dot[centerarraylets, average], average]];
centerarraylets = Transpose[centerarraylets];
genecontributions = Transpose[Dot[centerarraylets, d1]];
```

```
(* Project Genes from 6 D Genelets Subspace Onto 2 D Subspace  *)

coordinates = Table[{
    (-Sqrt[3] * (genecontributions[[3, a]] - genecontributions[[15, a]]) +
        2 * Sqrt[3] * (genecontributions[[4, a]] - genecontributions[[16, a]]) +
        (3 * genecontributions[[5, a]] + Sqrt[3] * genecontributions[[14, a]])) / 6 /
     Sqrt[(genecontributions[[3, a]] - genecontributions[[15, a]]) ^ 2 / 3 +
       (genecontributions[[4, a]] - genecontributions[[16, a]]) ^ 2 / 3 +
       (genecontributions[[5, a]] + genecontributions[[14, a]] / Sqrt[3]) ^ 2 +
       Abs[(genecontributions[[3, a]] - genecontributions[[15, a]]) / Sqrt[3] *
          (genecontributions[[4, a]] - genecontributions[[16, a]])] / Sqrt[3] +
       Abs[(genecontributions[[3, a]] - genecontributions[[15, a]]) / Sqrt[3] *
         (genecontributions[[5, a]] + genecontributions[[14, a]] / Sqrt[3])] +
       Abs[(genecontributions[[4, a]] - genecontributions[[16, a]]) / Sqrt[3] *
         (genecontributions[[5, a]] + genecontributions[[14, a]] / Sqrt[3])]],
    (3 * (genecontributions[[3, a]] - genecontributions[[15, a]]) +
        Sqrt[3] * (3 * genecontributions[[5, a]] + Sqrt[3] * genecontributions[[14, a]])) / 6 /
     Sqrt[(genecontributions[[3, a]] - genecontributions[[15, a]]) ^ 2 / 3 +
       (genecontributions[[4, a]] - genecontributions[[16, a]]) ^ 2 / 3 +
       (genecontributions[[5, a]] + genecontributions[[14, a]] / Sqrt[3]) ^ 2 +
       Abs[(genecontributions[[3, a]] - genecontributions[[15, a]]) / Sqrt[3] *
          (genecontributions[[4, a]] - genecontributions[[16, a]])] / Sqrt[3] +
       Abs[(genecontributions[[3, a]] - genecontributions[[15, a]]) / Sqrt[3] *
         (genecontributions[[5, a]] + genecontributions[[14, a]] / Sqrt[3])] +
       Abs[(genecontributions[[4, a]] - genecontributions[[16, a]]) / Sqrt[3] *
         (genecontributions[[5, a]] + genecontributions[[14, a]] / Sqrt[3])]]},
   {a, 1, genes}];

(* Create Parameter Plot of Cell Cycle Genes Projected Onto 2 D Subspace *)

stream = "Desktop/Networks/Data/Y_Classify.txt.nb";
list = ReadList[stream, Word, RecordLists -> True, NullWords -> True];
list = Drop[list, 1];
Clear[stream];
stages = {"M/G1", "G1", "S", "S/G2", "G2/M"};
points = {points1, points2, points3, points4, points5};
radii = {radii1, radii2, radii3, radii4, radii5};
Do[{
  position = Position[list, stages[[b]]],
  table = Table[list[[position[[a, 1]], 1]], {a, 1, Dimensions[position][[1]]}],
  position = Table[Position[genenames, table[[a]]], {a, 1, Dimensions[table][[1]]}],
  table = Flatten[Position[position, {}]],
  Do[
   position = Drop[position, {table[[a]], table[[a]]}],
   {a, Dimensions[table][[1]], 1, -1}],
  points[[b]] = Table[Point[coordinates[[position[[a, 1, 1]]]]], {a, 1, Dimensions[position][[1]]}],
  radii[[b]] = Table[
    Sqrt[coordinates[[position[[a, 1, 1]], 1]] ^ 2 + coordinates[[position[[a, 1, 1]], 2]] ^ 2],
    {a, 1, Dimensions[position][[1]]}]},
 {b, 1, Dimensions[stages][[1]]}]
```

```
Dimensions[points[[1]]][[1]]
Dimensions[points[[2]]][[1]]
Dimensions[points[[3]]][[1]]
Dimensions[points[[4]]][[1]]
Dimensions[points[[5]]][[1]]
```

```
81
```

```
238
```

```
54
```

```
95
```

```
144
```

```
radii = Sort[Flatten[radii], OrderedQ[{{#1}, {#2}}] &];
N[Round[radii[[60]] * 100] / 100]
N[Round[radii[[61]] * 100] / 100]
```

```
0.49
```

```
0.5
```

```
(* 612 cell cycle genes, 81 in M/G1, 238 in G1, 54 in S, 95 in S/G2, 144 in G2/M. *)
```

```
(* For 552 genes, 50 % or more of the contributions of the 6 genelets add up. *)
```

```
p = Show[
   {Graphics[{RGBColor[1, 0.5, 0], PointSize[0.02], points[[5]]}],
    Graphics[{RGBColor[1, 1, 0], PointSize[0.02], points[[1]]}],
    Graphics[{RGBColor[1, 0, 0], PointSize[0.02], points[[4]]}],
    Graphics[{RGBColor[0, 0.5, 0], PointSize[0.02], points[[2]]}],
    Graphics[{RGBColor[0, 0, 1], PointSize[0.02], points[[3]]}],
    Graphics[{RGBColor[1, 0.5, 0], Text["G2/M", {1.075, -0.52}]}],
    Graphics[{RGBColor[0, 0, 0], Text["M/G1", {0.9, 0.75}]}],
    Graphics[{RGBColor[1, 0, 0], Text["S/G2", {0.1, -1.12}]}],
    Graphics[{RGBColor[0, 0, 1], Text["S", {-0.95, -0.6}]}],
    Graphics[{RGBColor[0, 0.5, 0], Text["G1", {-0.8, 0.8}]}],
    Graphics[{RGBColor[0, 0, 0], Text["(e)", {-1.1, 1.15}]}],
    Graphics[{RGBColor[0, 0, 0], Text["ϕ=π/3 ", {0.925, 1.15}]}],
    Graphics[{RGBColor[0, 0, 0], Text["ϕ=0", {1.12, 0.12}]}],
    Graphics[{RGBColor[0, 0, 0], Text["ϕ=-π/3", {0.925, -1.15}]}],
    Graphics[{RGBColor[0, 0, 0], Dashing[{0.03, 0.02}], Circle[{0, 0}, 0.5]}],
    Graphics[{RGBColor[0, 0, 0], Dashing[{0.03, 0.02}], Circle[{0, 0}, 1]}],
    Graphics[{RGBColor[0, 0, 0], Arrow[{-1.25 / Tan[Pi / 3.], 1.25}, {1.25 / Tan[Pi / 3.], -1.25},
       HeadCenter -> 0.5, HeadLength -> 0.035, HeadWidth -> 0.75]}],
    Graphics[{RGBColor[0, 0, 0], Arrow[{-1.25, 0}, {1.25, 0},
       HeadCenter -> 0.5, HeadLength -> 0.035, HeadWidth -> 0.75]}],
    Graphics[{RGBColor[0, 0, 0], Arrow[{-1.25 / Tan[Pi / 3.], -1.25}, {1.25 / Tan[Pi / 3.], 1.25},
       HeadCenter -> 0.5, HeadLength -> 0.035, HeadWidth -> 0.75]}]},
   AspectRatio -> 1,
   PlotRange -> {{-1.25, 1.25}, {-1.25, 1.25}},
   Frame -> True,
   FrameTicks -> False,
   FrameLabel -> {None, None, None, None},
   GridLines -> {None, None},
   DisplayFunction -> Identity];
p = FullGraphics[p];
p[[1, 2]] = p[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {-1.18, 0}, {0, 0}, {0, 1}];
s5 = Show[p,
   AspectRatio → 1.0,
   PlotRange -> All,
   DisplayFunction → Identity];
```

```
(* Create Plot of GSVD Cell Cycle 2 D Subspace *)

R[theta_] = {{Cos[theta], Sin[theta]}, {-Sin[theta], Cos[theta]}};
x = Transpose[{{0.4, 0}, {1.1, 0}, {0.75, 0.25}}];
polypoints[theta_] = Transpose[Dot[R[theta], x]];
p = Show[
   {Graphics[{RGBColor[1, 0.5, 0], Text["G2/M", {1.075, -0.52}]}],
    Graphics[{RGBColor[0, 0, 0], Text["M/G1", {0.9, 0.75}]}],
    Graphics[{RGBColor[1, 0, 0], Text["S/G2", {0.1, -1.12}]}],
    Graphics[{RGBColor[0, 0, 1], Text["S", {-0.95, -0.6}]}],
    Graphics[{RGBColor[0, 0.5, 0], Text["G1", {-0.8, 0.8}]}],
    Graphics[{RGBColor[0, 0, 0], Text["(f)", {-1.1, 1.15}]}],
    Graphics[{RGBColor[0, 0, 0], Text["ϕ=π/3 ", {0.925, 1.15}]}],
    Graphics[{RGBColor[0, 0, 0], Text["ϕ=0", {1.12, 0.12}]}],
    Graphics[{RGBColor[0, 0, 0], Text["ϕ=-π/3", {0.925, -1.15}]}],
    Graphics[{RGBColor[1, 0.5, 0], Disk[{0, 0}, 1, {-Pi / 3, 0}]}],
    Graphics[{RGBColor[1, 1, 0], Disk[{0, 0}, 1, {0, Pi / 2}]}],
    Graphics[{RGBColor[0, 0.5, 0], Disk[{0, 0}, 1, {Pi / 2, Pi}]}],
    Graphics[{RGBColor[0, 0, 1], Disk[{0, 0}, 1, {Pi, 4 * Pi / 3}]}],
    Graphics[{RGBColor[1, 0, 0], Disk[{0, 0}, 1, {4 * Pi / 3, 5 * Pi / 3}]}],
    Graphics[{RGBColor[1, 1, 1], Disk[{0, 0}, 0.5]}],
    Graphics[{RGBColor[1, 0.5, 0], Polygon[polypoints[0]]}],
    Graphics[{RGBColor[0, 0.5, 0], Polygon[polypoints[Pi]]}],
    Graphics[{RGBColor[0, 0, 1], Polygon[polypoints[2 * Pi / 3]]}],
    Graphics[{RGBColor[1, 0, 0], Polygon[polypoints[Pi / 3]]}],
    Graphics[{RGBColor[0, 0, 0], Arrow[{-1.25 / Tan[Pi / 3.], 1.25}, {1.25 / Tan[Pi / 3.], -1.25},
       HeadCenter -> 0.5, HeadLength -> 0.035, HeadWidth -> 0.75]}],
    Graphics[{RGBColor[0, 0, 0], Arrow[{-1.25, 0}, {1.25, 0},
       HeadCenter -> 0.5, HeadLength -> 0.035, HeadWidth -> 0.75]}],
    Graphics[{RGBColor[0, 0, 0], Arrow[{-1.25 / Tan[Pi / 3.], -1.25}, {1.25 / Tan[Pi / 3.], 1.25},
       HeadCenter -> 0.5, HeadLength -> 0.035, HeadWidth -> 0.75]}]},
   AspectRatio -> 1,
   PlotRange -> {{-1.25, 1.25}, {-1.25, 1.25}},
   Frame -> True,
   FrameTicks -> False,
   FrameLabel -> {None, None, None, None},
   GridLines -> {None, {{0, RGBColor[0, 0, 0]}}},
   DisplayFunction -> Identity];
p = FullGraphics[p];
p[[1, 2]] = p[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {-1.18, 0}, {0, 0}, {0, 1}];
s6 = Show[p,
   AspectRatio → 1.0,
   PlotRange -> All,
   DisplayFunction → Identity];
Clear[x];

(* Define the Initial Phase *)

zerophase = Pi / 2;
```

```
(* Sort Yeast Genes by GSVD Phase *)

gsvdphase = Table[{
    coordinates[[a, 1]] / Sqrt[coordinates[[a, 1]]^2 + coordinates[[a, 2]]^2],
    coordinates[[a, 2]] / Sqrt[coordinates[[a, 1]]^2 + coordinates[[a, 2]]^2]},
   {a, 1, genes}];
gsvdphase = Table[{
    -gsvdphase[[a, 1]] * Cos[zerophase] - gsvdphase[[a, 2]] * Sin[zerophase],
    -gsvdphase[[a, 2]] * Cos[zerophase] + gsvdphase[[a, 1]] * Sin[zerophase]},
   {a, 1, genes}];
gsvdphase = Table[{
    gsvdphase[[a, 1]],
    gsvdphase[[a, 2]],
    N[ArcTan[gsvdphase[[a, 1]] / gsvdphase[[a, 2]]] / Pi]},
   {a, 1, genes}];
sortmatrix = AppendRows[gsvdphase, genenames, matrix, arraylets1];
sortmatrix = Sort[sortmatrix, OrderedQ[{{#1}, {#2}}] &];
negative1 = 2112;
positive1 = 2113;
sortmatrix[[negative1, 1]]
sortmatrix[[positive1, 1]]
```

```
-0.0007522
```

```
0.000147134
```

```
sortmatrix = Transpose[Drop[Transpose[sortmatrix], {1}]];
sortmatrix = AppendColumns[
  Sort[
   TakeRows[sortmatrix, {1, negative1}],
   OrderedQ[{{#2}, {#1}}] &],
  Sort[
   TakeRows[sortmatrix, {positive1, genes}],
   OrderedQ[{{#1}, {#2}}] &]];
phases = TakeColumns[sortmatrix, {2, 2}];
gsvdphases = phases;
sortmatrix = Transpose[Drop[Transpose[sortmatrix], {1, 2}]];

(* Reconstruct Yeast Data With Sorted Genes *)

genenames1 = TakeColumns[sortmatrix, {1, 6}];
matrix1 = TakeColumns[sortmatrix, {7, arrays + 6}];
arraylets1 = TakeColumns[sortmatrix, {arrays + 7, 2 * arrays + 6}];
```

```
(* Classify Yeast Gene Phases into Yeast Cell Cycle Phases *)

ph1 = 0;
ph2 = -1 / 2.;
ph3 = -1.;
ph4 = -4 / 3.;
ph5 = -5 / 3.;

endph5 = genes;
beginph1 = 1;
phases[[endph5]] - ph1
phases[[beginph1]] - ph1
```

```
{0.0000468343}
```

```
{-0.000239433}
```

```
endph1 = 1107;
beginph2 = 1108;
phases[[endph1]] - ph2
phases[[beginph2]] - ph2
```

```
{0.00152245}
```

```
{0.999794}
```

```
endph2 = 2112;
beginph3 = 2113;
phases[[endph2]] - ph3
phases[[beginph3]] - ph3
```

```
{1.0003}
```

```
{0.999906}
```

```
endph3 = 2816;
beginph4 = 2817;
phases[[endph3]] - ph4
phases[[beginph4]] - ph4
```

```
{1.0009}
```

```
{0.99987}
```

```
endph4 = 3827;
beginph5 = 3828;
phases[[endph4]] - ph5
phases[[beginph5]] - ph5
```

```
{2.00019}
```

```
{1.99935}
```

```
(* 4523 yeast genes, 1107 in M/G1, 1005 in G1, 704 in S, 1011 in S/G2, 696 in G2/M. *)
```

```
(* Display GSVD Sorted and Reconstructed Yeast Data *)

genes = genes1;
genenames = genenames1;
arraynames = arraynames1;

(* Reconstruct Sorted Yeast Data *)

Do[d1[[a, a]] = 0, {a, 1, 2}];
Do[d1[[a, a]] = 0, {a, 6, 13}];
Do[d1[[a, a]] = 0, {a, 17, 18}];
matrix = Dot[arraylets1, d1, genelets];

(* Center Reconstructed Sorted Yeast Data *)

average = Table[1, {a, 1, arrays}];
average = N[average / Sqrt[Dot[average, average]]];
matrix = matrix - N[Outer[Times, Dot[matrix, average], average]];
matrix = Transpose[matrix];
average = Table[1, {a, 1, genes}];
average = N[average / Sqrt[Dot[average, average]]];
matrix = matrix - N[Outer[Times, Dot[matrix, average], average]];
matrix = Transpose[matrix];

(* Create Recosntructed Sorted Yeast Data 2 D Red & Green Raster Display *)

contrast = 10 * 1.5;
displaying = Table[
   If[contrast * matrix[[i, j]] > 0,
    If[contrast * matrix[[i, j]] < 1, {contrast * matrix[[i, j]], 0}, {1, 0}],
    If[contrast * matrix[[i, j]] > -1, {0, -contrast * matrix[[i, j]]}, {0, 1}]],
   {i, 1, genes}, {j, 1, arrays}];
framex = Table[{a - 0.5, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {
   {genes - endph1 / 2, "M/G1"},
   {genes - (endph1 + endph2) / 2, "G1"},
   {genes - (endph2 + endph3) / 2, "S"},
   {genes - (endph3 + endph4) / 2, "S/G2"},
   {(genes - endph4) / 2, "G2/M"}};
gridy = {
   {genes - endph1 + 0.5, {RGBColor[0, 0, 0]}},
   {genes - endph2 + 0.5, {RGBColor[0, 0, 0]}},
   {genes - endph3 + 0.5, {RGBColor[0, 0, 0]}},
   {genes - endph4 + 0.5, {RGBColor[0, 0, 0]}}};
labelx = "(a) Arrays";
labely = ColumnForm[{" ", "Genes", " ", " ", " ", " ", " ", " "}, Center];
g = Show[
   Graphics[
    RasterArray[
     Table[
      RGBColor[displaying[[i, j, 1]], displaying[[i, j, 2]], 0],
      {i, genes, 1, -1}, {j, 1, arrays}]]],
   AspectRatio -> 1,
   Frame -> True,
   FrameTicks -> {None, framey, framex, None},
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {None, gridy},
   DisplayFunction -> Identity];
```

```
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {1., 0.}] →
    Text[a, {b - 1.5, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 1100}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 550}, {0, 0}, {0, 1}];
g1 = Show[g,
   AspectRatio -> GoldenRatio * 1.2,
   PlotRange -> All,
   DisplayFunction → Identity];

(* Center Sorted Yeast Arraylets *)

arraylets = Transpose[arraylets1];
average = Table[1, {a, 1, genes}];
average = N[average / Sqrt[Dot[average, average]]];
arraylets = arraylets - N[Outer[Times, Dot[arraylets, average], average]];
arraylets = Transpose[arraylets];

(* Create Sorted Yeast Arraylets 2 D Red & Green Raster Display *)

contrast = 75 * 1.5;
displaying = Table[
   If[contrast * arraylets[[i, j]] > 0,
    If[contrast * arraylets[[i, j]] < 1, {contrast * arraylets[[i, j]], 0}, {1, 0}],
    If[contrast * arraylets[[i, j]] > -1, {0, -contrast * arraylets[[i, j]]}, {0, 1}]],
   {i, 1, genes}, {j, 1, arrays}];
labelx = "(b) Arraylets";
labely = ColumnForm[{" ", " ", " ", " ", " ", " ", " ", " ", " "}, Center];
framey = {
   {genes - endph5 / 2, "     ", 0},
   {genes - (endph5 + endph1) / 2, "   ", 0},
   {genes - (endph1 + endph2) / 2, " ", 0},
   {genes - (endph2 + endph3) / 2, "     ", 0},
   {genes - (endph3 + endph4) / 2, "     ", 0},
   {(genes - endph4) / 2, "     ", 0}};
gridy = {
   {genes - endph1 + 0.5, {RGBColor[0, 0, 0]}},
   {genes - endph2 + 0.5, {RGBColor[0, 0, 0]}},
   {genes - endph3 + 0.5, {RGBColor[0, 0, 0]}},
   {genes - endph4 + 0.5, {RGBColor[0, 0, 0]}},
   {genes - endph5 + 0.5, {RGBColor[0, 0, 0]}}};
framex = Table[{a - 0.5, ToString[a]}, {a, 1, arrays}];
size = 7;
sizes = Flatten[
   Table[
    Dimensions[
     Characters[
      framex[[a, 2]]
     ]], {a, 1, arrays}]];
Do[
  Do[framex[[a, 2]] = StringJoin[framex[[a, 2]], " "],
   {b, 1, size - sizes[[a]]}],
  {a, 1, arrays}];
```

```
g = Show[
   Graphics[
    RasterArray[
     Table[
      RGBColor[displaying[[i, j, 1]], displaying[[i, j, 2]], 0],
      {i, genes, 1, -1}, {j, 1, arrays}
     ]]],
   AspectRatio -> 1,
   Frame -> True,
   FrameTicks -> {None, framey, framex, None},
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {None, gridy},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {1., 0.}] →
    Text[a, {b - 1.5, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 1100}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 550}, {0, 0}, {0, 1}];
g2 = Show[g,
   AspectRatio -> GoldenRatio * 1.2,
   PlotRange -> All,
   DisplayFunction → Identity];

(* Create Selected Sorted Yeast Arraylets Graph Display *)

arraylets = Transpose[arraylets1];

arraylets3 = Chop[TrigFit[arraylets[[3]], 1, {x, genes - 1}], 0.001]
arraylets4 = Chop[TrigFit[arraylets[[4]], 1, {x, genes - 1}], 0.001]
arraylets5 = Chop[TrigFit[arraylets[[5]], 1, {x, genes - 1}], 0.001]
arraylets14 = Chop[TrigFit[arraylets[[14]], 1, {x, genes - 1}], 0.001]
arraylets15 = Chop[TrigFit[arraylets[[15]], 1, {x, genes - 1}], 0.001]
arraylets16 = Chop[TrigFit[arraylets[[16]], 1, {x, genes - 1}], 0.001]
```

$$-0.00350482 \cos\left[\frac{\pi x}{2261}\right] + 0.0105327 \sin\left[\frac{\pi x}{2261}\right]$$

$$-0.00146993 + 0.011125 \cos\left[\frac{\pi x}{2261}\right]$$

$$0.00621296 \cos\left[\frac{\pi x}{2261}\right] + 0.00846298 \sin\left[\frac{\pi x}{2261}\right]$$

$$-0.0012217 + 0.00423362 \cos\left[\frac{\pi x}{2261}\right] + 0.00682806 \sin\left[\frac{\pi x}{2261}\right]$$

$$0.00425716 \cos\left[\frac{\pi x}{2261}\right] - 0.00622375 \sin\left[\frac{\pi x}{2261}\right]$$

$$-0.00500703 \cos\left[\frac{\pi x}{2261}\right]$$

```
graph = ParametricPlot[{arraylets3, -x},
   {x, 0, genes - 1},
   PlotStyle -> {RGBColor[0, 0, 0], Thickness[0.016]},
   DisplayFunction -> Identity];
labelx = "(c) Expression Level";
labely = ColumnForm[{" ", " ", " ", " ", " ", " ", " ", " ", " "}, Center];
framex = {{0, "0      "}, {0.06, "0.06   "}, {0.12, "0.12   "}};
coordinates = Table[
   If[arraylets[[3, a]] < -0.025 * 1.2, -0.025 * 1.2,
    If[arraylets[[3, a]] > 0.125 * 1.2, 0.125 * 1.2, arraylets[[3, a]]]],
   {a, 1, genes}];
coordinates = Table[{coordinates[[a]], -a + 1}, {a, 1, genes}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[1, 0, 0], line}],
    graph},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   FrameTicks -> {None, None, framex, None},
   GridLines -> {{{0, RGBColor[0, 0, 0]}}, None},
   AspectRatio -> GoldenRatio * 1.15,
   PlotRange -> {{-0.025 * 1.2, 0.125 * 1.2}, {135, -genes + 1 - 135}},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {1., 0.}] →
    Text[a, {b - 0.01, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 1125}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 575}, {0, 0}, {0, 1}];
p3 = Show[g,
   AspectRatio -> GoldenRatio * 1.2765,
   PlotRange -> All,
   DisplayFunction → Identity];
```

```
graph = ParametricPlot[{arraylets4 + 0.05 * 1.2, -x},
   {x, 0, genes - 1},
   PlotStyle -> {RGBColor[0, 0, 0], Thickness[0.016]},
   DisplayFunction -> Identity];
labelx = "(c) Expression Level";
labely = ColumnForm[{" ", " ", " ", " ", " ", " ", " ", " ", " "}, Center];
framex = {{0, "0      "}, {0.06, "0.06   "}, {0.12, "0.12   "}};
coordinates = Table[
   If[arraylets[[4, a]] + 0.05 * 1.2 > 0.125 * 1.2, 0.125 * 1.2,
    If[arraylets[[4, a]] + 0.05 * 1.2 < -0.025 * 1.2, -0.025 * 1.2, arraylets[[4, a]] + 0.05 * 1.2]],
   {a, 1, genes}];
coordinates = Table[{coordinates[[a]], -a + 1}, {a, 1, genes}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[0, 0, 1], line}],
    graph},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   FrameTicks -> {None, None, framex, None},
   GridLines -> {{{0.05 * 1.2, RGBColor[0, 0, 0]}}, None},
   AspectRatio -> GoldenRatio * 1.15,
   PlotRange -> {{-0.025 * 1.2, 0.125 * 1.2}, {135, -genes + 1 - 135}},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {1., 0.}] →
    Text[a, {b - 0.01, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 1125}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 575}, {0, 0}, {0, 1}];
p4 = Show[g,
   AspectRatio -> GoldenRatio * 1.2765,
   PlotRange -> All,
   DisplayFunction → Identity];
```

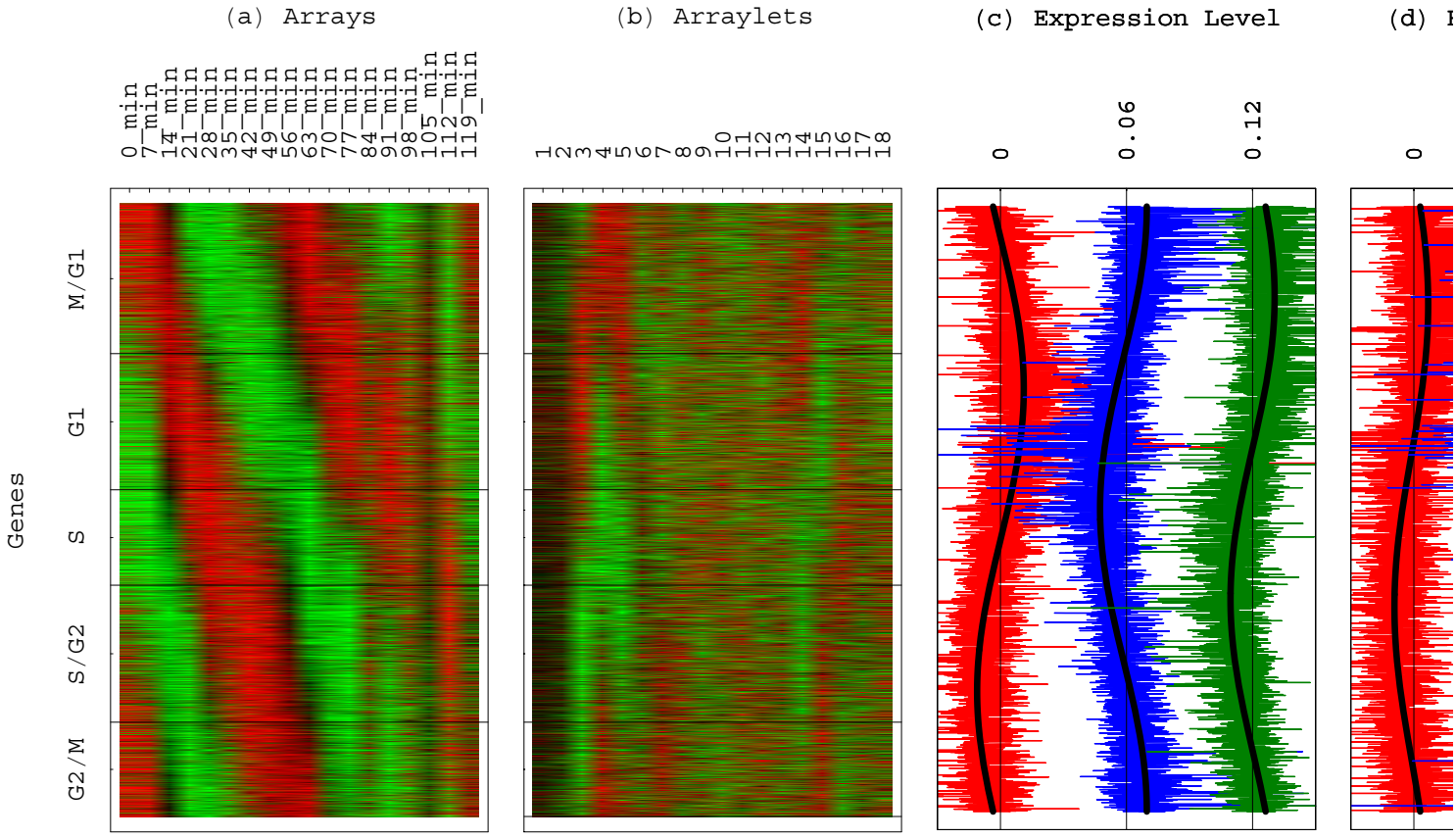
```
graph = ParametricPlot[{arraylets5 + 0.1 * 1.2, -x},
   {x, 0, genes - 1},
   PlotStyle -> {RGBColor[0, 0, 0], Thickness[0.016]},
   DisplayFunction -> Identity];
labelx = "(c) Expression Level";
labely = ColumnForm[{" ", " ", " ", " ", " ", " ", " ", " ", " "}, Center];
framex = {{0, "0      "}, {0.06, "0.06   "}, {0.12, "0.12   "}};
coordinates = Table[
   If[arraylets[[5, a]] + 0.1 * 1.2 < -0.025 * 1.2, -0.025 * 1.2,
    If[arraylets[[5, a]] + 0.1 * 1.2 > 0.125 * 1.2, 0.125 * 1.2, arraylets[[5, a]] + 0.1 * 1.2]],
   {a, 1, genes}];
coordinates = Table[{coordinates[[a]], -a + 1}, {a, 1, genes}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[0, 0.5, 0], line}],
    graph},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   FrameTicks -> {None, None, framex, None},
   GridLines -> {{{0.1 * 1.2, RGBColor[0, 0, 0]}}, None},
   AspectRatio -> GoldenRatio * 1.15,
   PlotRange -> {{-0.025 * 1.2, 0.125 * 1.2}, {135, -genes + 1 - 135}},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {1., 0.}] →
    Text[a, {b - 0.01, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 1125}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 575}, {0, 0}, {0, 1}];
p5 = Show[g,
   AspectRatio -> GoldenRatio * 1.2765,
   PlotRange -> All,
   DisplayFunction → Identity];
```

```
graph = ParametricPlot[{arraylets14, -x},
   {x, 0, genes - 1},
   PlotStyle -> {RGBColor[0, 0, 0], Thickness[0.016]},
   DisplayFunction -> Identity];
labelx = "(d) Expression Level";
labely = ColumnForm[{" ", " ", " ", " ", " ", " ", " ", " ", " "}, Center];
framex = {{0, "0      "}, {0.06, "0.06   "}, {0.12, "0.12   "}};
coordinates = Table[
   If[arraylets[[14, a]] < -0.025 * 1.2, -0.025 * 1.2,
    If[arraylets[[14, a]] > 0.125 * 1.2, 0.125 * 1.2, arraylets[[14, a]]]],
   {a, 1, genes}];
coordinates = Table[{coordinates[[a]], -a + 1}, {a, 1, genes}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[1, 0, 0], line}],
    graph},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   FrameTicks -> {None, None, framex, None},
   GridLines -> {{{0, RGBColor[0, 0, 0]}}, None},
   AspectRatio -> GoldenRatio * 1.15,
   PlotRange -> {{-0.025 * 1.2, 0.125 * 1.2}, {135, -genes + 1 - 135}},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {1., 0.}] →
    Text[a, {b - 0.01, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 1125}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 575}, {0, 0}, {0, 1}];
p14 = Show[g,
   AspectRatio -> GoldenRatio * 1.2765,
   PlotRange -> All,
   DisplayFunction → Identity];
```

```
graph = ParametricPlot[{arraylets15 + 0.05 * 1.2, -x},
   {x, 0, genes - 1},
   PlotStyle -> {RGBColor[0, 0, 0], Thickness[0.016]},
   DisplayFunction -> Identity];
labelx = "(d) Expression Level";
labely = ColumnForm[{" ", " ", " ", " ", " ", " ", " ", " ", " "}, Center];
framex = {{0, "0      "}, {0.06, "0.06   "}, {0.12, "0.12   "}};
coordinates = Table[
   If[arraylets[[15, a]] + 0.05 * 1.2 > 0.125 * 1.2, 0.125 * 1.2,
    If[arraylets[[15, a]] + 0.05 * 1.2 < -0.025 * 1.2, -0.025 * 1.2, arraylets[[15, a]] + 0.05 * 1.2]],
   {a, 1, genes}];
coordinates = Table[{coordinates[[a]], -a + 1}, {a, 1, genes}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[0, 0, 1], line}],
    graph},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   FrameTicks -> {None, None, framex, None},
   GridLines -> {{{0.05 * 1.2, RGBColor[0, 0, 0]}}, None},
   AspectRatio -> GoldenRatio * 1.15,
   PlotRange -> {{-0.025 * 1.2, 0.125 * 1.2}, {135, -genes + 1 - 135}},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {1., 0.}] →
    Text[a, {b - 0.01, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 1125}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 575}, {0, 0}, {0, 1}];
p15 = Show[g,
   AspectRatio -> GoldenRatio * 1.2765,
   PlotRange -> All,
   DisplayFunction → Identity];
```

```
graph = ParametricPlot[{arraylets16 + 0.1 * 1.2, -x},
   {x, 0, genes - 1},
   PlotStyle -> {RGBColor[0, 0, 0], Thickness[0.016]},
   DisplayFunction -> Identity];
labelx = "(d) Expression Level";
labely = ColumnForm[{" ", " ", " ", " ", " ", " ", " ", " ", " "}, Center];
framex = {{0, "0      "}, {0.06, "0.06   "}, {0.12, "0.12   "}};
coordinates = Table[
   If[arraylets[[16, a]] + 0.1 * 1.2 > 0.125 * 1.2, 0.125 * 1.2, arraylets[[16, a]] + 0.1 * 1.2],
   {a, 1, genes}];
coordinates = Table[{coordinates[[a]], -a + 1}, {a, 1, genes}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[0, 0.5, 0], line}],
    graph},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   FrameTicks -> {None, None, framex, None},
   GridLines -> {{{0.1 * 1.2, RGBColor[0, 0, 0]}}, None},
   AspectRatio -> GoldenRatio * 1.15,
   PlotRange -> {{-0.025 * 1.2, 0.125 * 1.2}, {135, -genes + 1 - 135}},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {1., 0.}] →
    Text[a, {b - 0.01, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 1125}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 575}, {0, 0}, {0, 1}];
p16 = Show[g,
   AspectRatio -> GoldenRatio * 1.2765,
   PlotRange -> All,
   DisplayFunction → Identity];

(* Display Selected Sorted Yeast Arraylets *)

g3 = Show[{p3, p4, p5},
   DisplayFunction -> Identity];
g4 = Show[{p16, p14, p15},
   DisplayFunction -> Identity];
```

```
(* Display Recosntructed Sorted Yeast Data, Arraylets and Selected Arraylets *)

Show[GraphicsArray[{g1, g2, g3, g4}],
  GraphicsSpacing -> -0.225];
```



```
(* Calculate SVD Yeast Cell Cycle Subspace *)
```

```
(* Read Yeast Data *)

stream = "Desktop/Networks/Data/Y_SVD.txt.nb";
matrix = ReadList[stream, Word, RecordLists -> True, NullWords -> True];
{genes, arrays} = Dimensions[matrix] - {2, 6}
Clear[stream];
```

```
{4579, 22}
```

```
genenames = TakeRows[
   TakeColumns[matrix, {1, 6}],
   {3, genes + 2}];
arraynames = TakeColumns[
   TakeRows[matrix, {1, 2}],
   {7, arrays + 6}];
matrix = TakeColumns[
   TakeRows[matrix, {3, genes + 2}],
   {7, arrays + 6}];
matrix = ToExpression[matrix];

sizes = Flatten[
   Table[
    Dimensions[
     Characters[
      ToString[arraynames[[2, a]]
      ]]],
    {a, 1, arrays}]];
size = Sort[sizes, OrderedQ[{#2, #1}] &][[1]];
Do[
  Do[arraynames[[2, a]] = StringJoin[ToString[arraynames[[2, a]]], " "],
   {b, 1, size - sizes[[a]]}],
  {a, 1, arrays}];

genes2 = genes;
genenames2 = genenames;
arrays2 = arrays;
arraynames2 = arraynames;
```

```
(* Examine Raw Data *)

(* Calculate Singular Value Decomposition *)

correlation = Dot[Transpose[matrix], matrix] / (arrays - 1);
{eigenexpressions, eigengenes} = Eigensystem[correlation];
eigenexpressions = Sqrt[(arrays - 1) * eigenexpressions];
Clear[correlation];
eigengenes[[2]] = -eigengenes[[2]];
eigengenes[[4]] = -eigengenes[[4]];
eigengenes[[5]] = -eigengenes[[5]];
eigengenes[[6]] = -eigengenes[[6]];
eigengenes[[7]] = -eigengenes[[7]];
eigengenes[[8]] = -eigengenes[[8]];
eigengenes[[9]] = -eigengenes[[9]];
eigenarrays = Dot[eigengenes, Transpose[matrix]];
Do[
  eigenarrays[[a]] = eigenarrays[[a]] / eigenexpressions[[a]],
  {a, 1, arrays}];
eigenarrays = Transpose[eigenarrays];
fractions = eigenexpressions^2 / Sum[eigenexpressions[[a]]^2, {a, 1, arrays}];
entropy = -N[Sum[fractions[[a]] * Log[fractions[[a]]], {a, 1, arrays}] / Log[arrays]];
entropy = N[Round[100 * entropy] / 100]

0.25

(* Create Fractions Bar Charts Displays *)

fractions[[2]]

0.0946134

limit = 0.1;
```

```
Clear[gridx, framex, framey, sizes];
gridx = Table[a, {a, 0, limit, N[limit / 4]}];
framex = gridx;
sizes = Flatten[
   Table[
    Dimensions[
     Characters[
      ToString[framex[[a]]]
     ]], {a, 1, 5}]];
Do[
  Do[framex[[a]] = StringJoin[ToString[framex[[a]]], " "],
   {b, 1, 5 - sizes[[a]]}],
  {a, 1, 5}];
framex = Table[{gridx[[a]], framex[[a]]}, {a, 1, 5}];
gridx = Table[{gridx[[a]], RGBColor[0, 0, 0]}, {a, 1, 5}];
framey = Table[{a + 1, arrays - a - 7}, {a, 0, 15 - 2}];
table = Table[fractions[[arrays - a]], {a, 7, arrays - 2}];
g = BarChart[
   table,
   BarOrientation -> Horizontal,
   PlotRange -> {{0, limit * 1.0001}, {0.5, 15 - 1 + 0.5}},
   AspectRatio -> 1,
   Axes -> False,
   Frame -> True,
   FrameTicks -> {None, framey, framex, None},
   FrameLabel -> {None, None, None, None},
   GridLines -> {gridx, None},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 1.75}, {0, 0}, {0, 1}];
g1 = Show[g,
   AspectRatio -> 1.25,
   PlotRange -> All,
   DisplayFunction -> Identity];
```

```
gridx = Table[a, {a, 0, 1, 0.2}];
framex = gridx;
sizes = Flatten[
   Table[
    Dimensions[
     Characters[
      ToString[framex[[a]]]
     ]], {a, 1, 6}]];
Do[
  Do[framex[[a]] = StringJoin[ToString[framex[[a]]], " "],
   {b, 1, size - sizes[[a]]}],
  {a, 1, 6}];
framex = Table[{gridx[[a]], framex[[a]]}, {a, 1, 6}];
gridx = Table[{gridx[[a]], RGBColor[0, 0, 0]}, {a, 1, 6}];
framey = Table[{a + 1, arrays - a}, {a, 0, arrays - 1}];
labelx = ColumnForm[
   {"(b) Eigenexpression Fraction", StringJoin["d = ", ToString[entropy]], " "}, Center];
g = BarChart[
   Table[fractions[[arrays - a]], {a, 0, arrays - 1}],
   BarOrientation -> Horizontal,
   PlotRange -> {{0, 1.0001}, {0.5, arrays + 0.5}},
   AspectRatio -> 1,
   Axes -> False,
   Frame -> True,
   FrameTicks -> {None, framey, framex, None},
   FrameLabel -> {None, None, labelx, None},
   GridLines -> {gridx, None},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 3}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 3.78}, {0, 0}, {0, 1}];
g2 = Show[{g,
    Graphics[{RGBColor[1, 1, 0.8], Rectangle[{0.1, 0.6}, {0.98, 20.6}]}],
    Graphics[{Rectangle[{0.1, 0.6}, {0.98, 20.6}, g1]}]},
    AspectRatio -> 1.35,
    PlotRange -> All,
    DisplayFunction -> Identity];

(* Create Eigengenes 2 D Red & Green Raster Display *)

contrast = 3.5;
displaying = Table[
   If[contrast * eigengenes[[i, j]] > 0,
    If[contrast * eigengenes[[i, j]] < 1, {contrast * eigengenes[[i, j]], 0}, {1, 0}],
    If[contrast * eigengenes[[i, j]] > -1, {0, -contrast * eigengenes[[i, j]]}, {0, 1}]],
   {i, 1, arrays}, {j, 1, arrays}];
```

```
framex = Table[{a - 0.5, arraynames[[2, a]]}, {a, 1, arrays}];
framey = Table[{a + 1 - 0.5, arrays - a}, {a, 0, arrays - 1}];
labely = "Eigengenes";
labelx = ColumnForm[{"(a) Arrays", " ", " "}, Center];
g = Show[
   Graphics[
    RasterArray[
     Table[
      RGBColor[
       displaying[[i, j, 1]], displaying[[i, j, 2]], 0
      ], {i, arrays, 1, -1}, {j, 1, arrays}]]],
   AspectRatio -> 1,
   Frame -> True,
   FrameTicks -> {None, framey, framex, None},
   FrameLabel -> {None, labely, labelx, None},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 3, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 3}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 3.78}, {0, 0}, {0, 1}];
g1 = Show[g,
   AspectRatio -> 1.05,
   PlotRange -> All,
   DisplayFunction -> Identity];

(* Create Selected Eigengenes Graph Display *)

eigengenes1 = Chop[TrigFit[eigengenes[[1]], 2, {x, arrays - 1}], 0.05]
eigengenes4 = Chop[TrigFit[Drop[Drop[eigengenes[[4]], {19, 22}], {1}], 2, {x - 1, arrays - 5}], 0.05]
eigengenes5 = Chop[TrigFit[Drop[Drop[eigengenes[[5]], {19, 22}], {1}], 2, {x - 1, arrays - 5}], 0.05]
eigengenes6 = Chop[TrigFit[Drop[Drop[eigengenes[[6]], {19, 22}], {1}], 2, {x - 1, arrays - 5}], 0.1]
eigengenes7 = Chop[TrigFit[Drop[Drop[eigengenes[[7]], {19, 22}], {1}], 2, {x - 1, arrays - 5}], 0.05]
eigengenes9 = Chop[TrigFit[Drop[Drop[eigengenes[[9]], {19, 22}], {1}], 2, {x - 1, arrays - 5}], 0.15]
eigengenes11 = Chop[TrigFit[Drop[Drop[eigengenes[[11]], {19, 22}], {1}], 2, {x - 1, arrays - 5}], 0.15]
```

$$-0.211007$$

$$0.0904703 \sin\left[\frac{4}{17} \pi (-1 + x)\right]$$

$$0.13624 \sin\left[\frac{2}{17} \pi (-1 + x)\right] + 0.151972 \sin\left[\frac{4}{17} \pi (-1 + x)\right]$$

$$0.134031 \cos\left[\frac{2}{17} \pi (-1 + x)\right] + 0.121332 \cos\left[\frac{4}{17} \pi (-1 + x)\right]$$

$$0.0788436 \cos\left[\frac{2}{17} \pi (-1 + x)\right] + 0.0901957 \sin\left[\frac{4}{17} \pi (-1 + x)\right]$$

$$0.195534 \cos\left[\frac{4}{17} \pi (-1 + x)\right] - 0.15699 \sin\left[\frac{2}{17} \pi (-1 + x)\right]$$

$$-0.172737 \sin\left[\frac{2}{17} \pi (-1 + x)\right] + 0.179714 \sin\left[\frac{4}{17} \pi (-1 + x)\right]$$

```
labelx = ColumnForm[{"(c) Arrays"}, Center];
labely = ColumnForm[{" ", "Expression Level"}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[1, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[1, 0, 0], PointSize[0.022], points}],
    Graphics[{RGBColor[1, 0, 0], line}]},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {{{17.5, RGBColor[0, 0, 0]}, {19.5, RGBColor[0, 0, 0]}}, {{0, RGBColor[0, 0, 0]}}},
   FrameTicks -> {None, framey, framex, None},
   PlotRange -> {-1.05, 1.05},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 0.35}, {0, 0}, {0, 1}];
p1 = Show[g,
   AspectRatio -> 1.05,
   PlotRange -> All,
   DisplayFunction → Identity];

labelx = ColumnForm[{"(c) Arrays"}, Center];
labely = ColumnForm[{" ", "Expression Level"}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[2, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[0, 0, 1], PointSize[0.022], points}],
    Graphics[{RGBColor[0, 0, 1], line}]},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {{{17.5, RGBColor[0, 0, 0]}, {19.5, RGBColor[0, 0, 0]}}, {{0, RGBColor[0, 0, 0]}}},
   FrameTicks -> {None, framey, framex, None},
   PlotRange -> {-1.05, 1.05},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 0.35}, {0, 0}, {0, 1}];
p2 = Show[g,
   AspectRatio -> 1.05,
   PlotRange -> All,
   DisplayFunction → Identity];
```

```
labelx = ColumnForm[{"(c) Arrays"}, Center];
labely = ColumnForm[{" ", "Expression Level"}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[3, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[0, 0.5, 0], PointSize[0.022], points}],
    Graphics[{RGBColor[0, 0.5, 0], line}]},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {{{17.5, RGBColor[0, 0, 0]}, {19.5, RGBColor[0, 0, 0]}}, {{0, RGBColor[0, 0, 0]}}},
   FrameTicks -> {None, framey, framex, None},
   PlotRange -> {-1.05, 1.05},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 0.35}, {0, 0}, {0, 1}];
p3 = Show[g,
   AspectRatio -> 1.05,
   PlotRange -> All,
   DisplayFunction → Identity];
```

```
graph = Plot[
   eigengenes4,
   {x, 1, arrays - 5},
   PlotStyle -> {RGBColor[1, 0, 0], Dashing[{0.03, 0.02}]},
   DisplayFunction -> Identity];
labelx = ColumnForm[{"(d) Arrays"}, Center];
labely = ColumnForm[{" ", "Expression Level"}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[4, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[1, 0, 0], PointSize[0.022], points}],
    Graphics[{RGBColor[1, 0, 0], line}],
    graph},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {{{17.5, RGBColor[0, 0, 0]}, {19.5, RGBColor[0, 0, 0]}}, {{0, RGBColor[0, 0, 0]}}},
   FrameTicks -> {None, framey, framex, None},
   PlotRange -> {-1.05, 1.05},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 0.35}, {0, 0}, {0, 1}];
p4 = Show[g,
   AspectRatio -> 1.05,
   PlotRange -> All,
   DisplayFunction → Identity];
```

```
graph = Plot[
   eigengenes7,
   {x, 1, arrays - 5},
   PlotStyle -> {RGBColor[0, 0, 1], Dashing[{0.03, 0.02}]},
   DisplayFunction -> Identity];
labelx = ColumnForm[{"(d) Arrays"}, Center];
labely = ColumnForm[{" ", "Expression Level"}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[7, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[0, 0, 1], PointSize[0.022], points}],
    Graphics[{RGBColor[0, 0, 1], line}],
    graph},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {{{17.5, RGBColor[0, 0, 0]}, {19.5, RGBColor[0, 0, 0]}}, {{0, RGBColor[0, 0, 0]}}},
   FrameTicks -> {None, framey, framex, None},
   PlotRange -> {-1.05, 1.05},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 0.35}, {0, 0}, {0, 1}];
p7 = Show[g,
   AspectRatio -> 1.05,
   PlotRange -> All,
   DisplayFunction → Identity];
```

```
graph = Plot[
   eigengenes5,
   {x, 1, arrays - 5},
   PlotStyle -> {RGBColor[1, 0, 0], Dashing[{0.03, 0.02}]},
   DisplayFunction -> Identity];
labelx = ColumnForm[{"(e) Arrays"}, Center];
labely = ColumnForm[{" ", " "}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[5, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[1, 0, 0], PointSize[0.022], points}],
    Graphics[{RGBColor[1, 0, 0], line}],
    graph},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {{{17.5, RGBColor[0, 0, 0]}, {19.5, RGBColor[0, 0, 0]}}, {{0, RGBColor[0, 0, 0]}}},
   FrameTicks -> {None, framey, framex, None},
   PlotRange -> {-1.05, 1.05},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 0.35}, {0, 0}, {0, 1}];
p5 = Show[g,
   AspectRatio -> 1.05,
   PlotRange -> All,
   DisplayFunction → Identity];
```

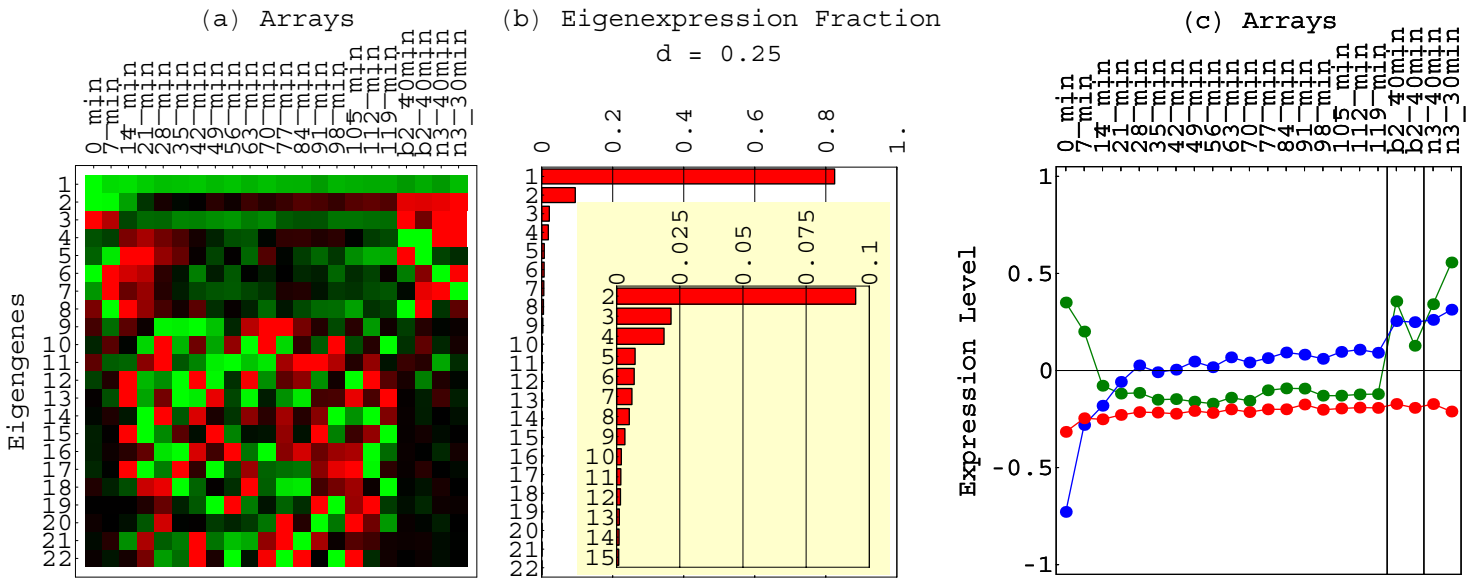
```
labelx = ColumnForm[{"(e) Arrays"}, Center];
labely = ColumnForm[{" ", " "}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[8, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[0, 0, 1], PointSize[0.022], points}],
    Graphics[{RGBColor[0, 0, 1], line}]},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {{{17.5, RGBColor[0, 0, 0]}, {19.5, RGBColor[0, 0, 0]}}, {{0, RGBColor[0, 0, 0]}}},
   FrameTicks -> {None, framey, framex, None},
   PlotRange -> {-1.05, 1.05},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 0.35}, {0, 0}, {0, 1}];
p8 = Show[g,
   AspectRatio -> 1.05,
   PlotRange -> All,
   DisplayFunction → Identity];
```

```
graph = Plot[
   eigengenes11,
   {x, 1, arrays - 5},
   PlotStyle -> {RGBColor[0, 0.5, 0], Dashing[{0.03, 0.02}]},
   DisplayFunction -> Identity];
labelx = ColumnForm[{"(e) Arrays"}, Center];
labely = ColumnForm[{" ", " "}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[11, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[0, 0.5, 0], PointSize[0.022], points}],
    Graphics[{RGBColor[0, 0.5, 0], line}],
    graph},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {{{17.5, RGBColor[0, 0, 0]}, {19.5, RGBColor[0, 0, 0]}}, {{0, RGBColor[0, 0, 0]}}},
   FrameTicks -> {None, framey, framex, None},
   PlotRange -> {-1.05, 1.05},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 0.35}, {0, 0}, {0, 1}];
p11 = Show[g,
   AspectRatio -> 1.05,
   PlotRange -> All,
   DisplayFunction → Identity];
```

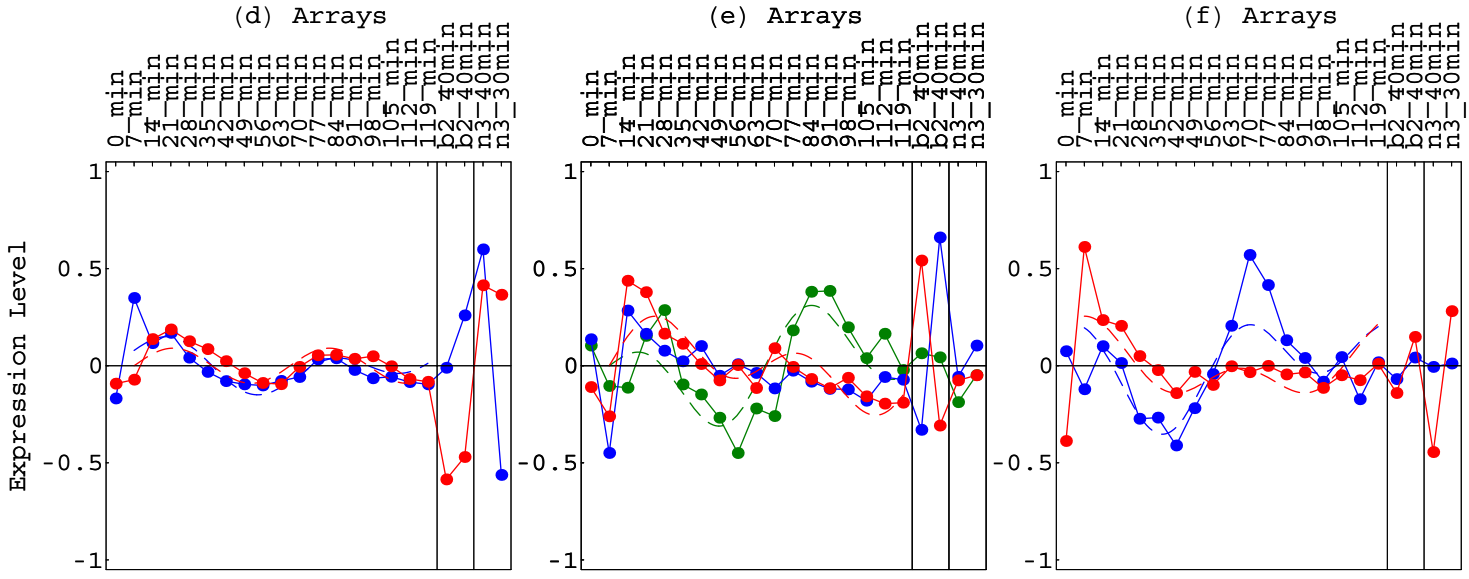
```
graph = Plot[
   eigengenes6,
   {x, 1, arrays - 5},
   PlotStyle -> {RGBColor[1, 0, 0], Dashing[{0.03, 0.02}]},
   DisplayFunction -> Identity];
labelx = ColumnForm[{"(f) Arrays"}, Center];
labely = ColumnForm[{" ", " "}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[6, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[1, 0, 0], PointSize[0.022], points}],
    Graphics[{RGBColor[1, 0, 0], line}],
    graph},
Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {{{17.5, RGBColor[0, 0, 0]}, {19.5, RGBColor[0, 0, 0]}}, {{0, RGBColor[0, 0, 0]}}},
   FrameTicks -> {None, framey, framex, None},
   PlotRange -> {-1.05, 1.05},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 0.35}, {0, 0}, {0, 1}];
p6 = Show[g,
   AspectRatio -> 1.05,
   PlotRange -> All,
   DisplayFunction → Identity];
```

```
graph = Plot[
   eigengenes9,
   {x, 1, arrays - 5},
   PlotStyle -> {RGBColor[0, 0, 1], Dashing[{0.03, 0.02}]},
   DisplayFunction -> Identity];
labelx = ColumnForm[{"(f) Arrays"}, Center];
labely = ColumnForm[{" ", " "}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[9, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[0, 0, 1], PointSize[0.022], points}],
    Graphics[{RGBColor[0, 0, 1], line}],
    graph},
Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {{{17.5, RGBColor[0, 0, 0]}, {19.5, RGBColor[0, 0, 0]}}, {{0, RGBColor[0, 0, 0]}}},
   FrameTicks -> {None, framey, framex, None},
   PlotRange -> {-1.05, 1.05},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 0.35}, {0, 0}, {0, 1}];
p9 = Show[g,
   AspectRatio -> 1.05,
   PlotRange -> All,
   DisplayFunction → Identity];

(* Display Selected Eigengenes *)

g3 = Show[{p3, p2, p1},
   DisplayFunction -> Identity];
g4 = Show[{p7, p4},
   DisplayFunction -> Identity];
g5 = Show[{p11, p8, p5},
   DisplayFunction -> Identity];
g6 = Show[{p9, p6},
   DisplayFunction -> Identity];
```

```
(* Display Eigengenes, Fractions and Selected Eigengenes *)

Show[GraphicsArray[{g1, g2, g3}],
  GraphicsSpacing -> -0.15];
```




```
Show[GraphicsArray[{g4, g5, g6}],
  GraphicsSpacing -> -0.15];
```




```
(* Reconstruct Data Without Additive Artifacts *)

eigenexpressions[[1]] = 0;
eigenexpressions[[2]] = 0;
eigenexpressions[[3]] = 0;
eigenexpressions[[10]] = 0;
Do[eigenexpressions[[a]] = 0,
  {a, 12, arrays}];
matrix = Dot[eigenarrays, DiagonalMatrix[eigenexpressions], eigengenes];
```

```
(* Examine Data in Multiplicative Variance Space *)

(* Calculate Singular Value Decomposition *)

normalization = Log[matrix^2];
correlation = Dot[Transpose[normalization], normalization] / (arrays - 1);
{eigenexpressions, eigengenes} = Eigensystem[correlation];
eigenexpressions = Sqrt[(arrays - 1) * eigenexpressions];
Clear[correlation];
eigengenes[[1]] = -eigengenes[[1]];
eigenarrays = Dot[eigengenes, Transpose[normalization]];
Do[
  eigenarrays[[a]] = eigenarrays[[a]] / eigenexpressions[[a]],
  {a, 1, arrays}];
eigenarrays = Transpose[eigenarrays];
fractions = eigenexpressions^2 / Sum[eigenexpressions[[a]]^2, {a, 1, arrays}];
entropy = -N[Sum[fractions[[a]] * Log[fractions[[a]]], {a, 1, arrays}] / Log[arrays]];
entropy = N[Round[100 * entropy] / 100]
```

```
0.22
```

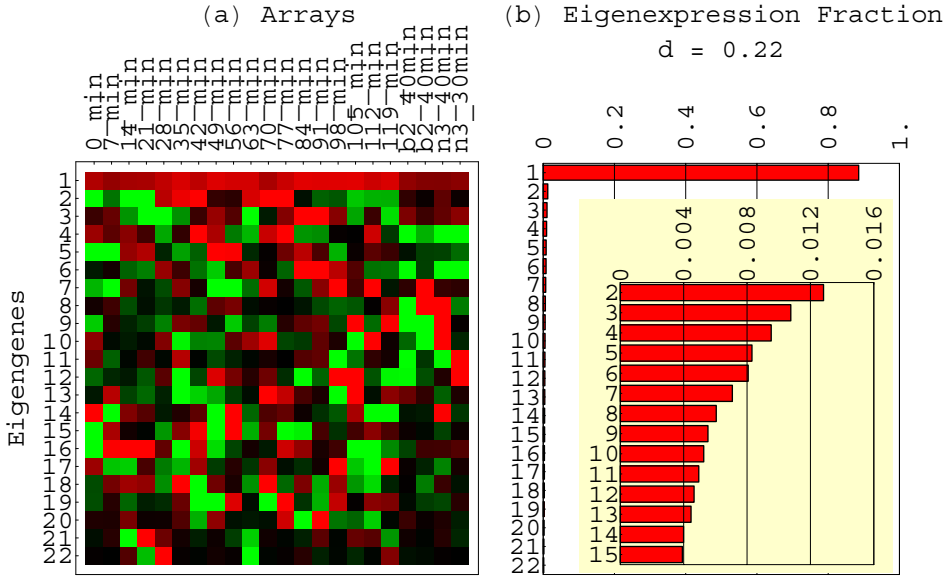
```
(* Create Fractions Bar Charts Displays *)

fractions[[2]]
```

```
0.0128277
```

```
limit = 0.016;

Clear[gridx, framex, framey, sizes];
gridx = Table[a, {a, 0, limit, N[limit / 4]}];
framex = gridx;
sizes = Flatten[
   Table[
    Dimensions[
     Characters[
      ToString[framex[[a]]]
     ]], {a, 1, 5}]];
Do[
  Do[framex[[a]] = StringJoin[ToString[framex[[a]]], " "],
   {b, 1, 5 - sizes[[a]]}],
  {a, 1, 5}];
framex = Table[{gridx[[a]], framex[[a]]}, {a, 1, 5}];
gridx = Table[{gridx[[a]], RGBColor[0, 0, 0]}, {a, 1, 5}];
framey = Table[{a + 1, arrays - a - 7}, {a, 0, 15 - 2}];
table = Table[fractions[[arrays - a]], {a, 7, arrays - 2}];
g = BarChart[
   table,
   BarOrientation -> Horizontal,
   PlotRange -> {{0, limit * 1.0001}, {0.5, 15 - 1 + 0.5}},
   AspectRatio -> 1,
   Axes -> False,
   Frame -> True,
   FrameTicks -> {None, framey, framex, None},
   FrameLabel -> {None, None, None, None},
   GridLines -> {gridx, None},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 1.75}, {0, 0}, {0, 1}];
g1 = Show[g,
   AspectRatio -> 1.25,
   PlotRange -> All,
   DisplayFunction -> Identity];
```

```
gridx = Table[a, {a, 0, 1, 0.2}];
framex = gridx;
sizes = Flatten[
   Table[
    Dimensions[
     Characters[
      ToString[framex[[a]]]
     ]], {a, 1, 6}]];
Do[
  Do[framex[[a]] = StringJoin[ToString[framex[[a]]], " "],
   {b, 1, size - sizes[[a]]}],
  {a, 1, 6}];
framex = Table[{gridx[[a]], framex[[a]]}, {a, 1, 6}];
gridx = Table[{gridx[[a]], RGBColor[0, 0, 0]}, {a, 1, 6}];
framey = Table[{a + 1, arrays - a}, {a, 0, arrays - 1}];
labelx = ColumnForm[
   {"(b) Eigenexpression Fraction", StringJoin["d = ", ToString[entropy]], " "}, Center];
g = BarChart[
   Table[fractions[[arrays - a]], {a, 0, arrays - 1}],
   BarOrientation -> Horizontal,
   PlotRange -> {{0, 1.0001}, {0.5, arrays + 0.5}},
   AspectRatio -> 1,
   Axes -> False,
   Frame -> True,
   FrameTicks -> {None, framey, framex, None},
   FrameLabel -> {None, None, labelx, None},
   GridLines -> {gridx, None},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 3}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 3.78}, {0, 0}, {0, 1}];
g2 = Show[{g,
    Graphics[{RGBColor[1, 1, 0.8], Rectangle[{0.1, 0.6}, {0.98, 20.6}]}],
    Graphics[{Rectangle[{0.1, 0.6}, {0.98, 20.6}, g1]}]},
   AspectRatio -> 1.35,
   PlotRange -> All,
   DisplayFunction -> Identity];
```

```
(* Create Eigengenes 2 D Red & Green Raster Display *)

contrast = 3.5;
displaying = Table[
   If[contrast * eigengenes[[i, j]] > 0,
    If[contrast * eigengenes[[i, j]] < 1, {contrast * eigengenes[[i, j]], 0}, {1, 0}],
    If[contrast * eigengenes[[i, j]] > -1, {0, -contrast * eigengenes[[i, j]]}, {0, 1}]],
   {i, 1, arrays}, {j, 1, arrays}];
framex = Table[{a - 0.5, arraynames[[2, a]]}, {a, 1, arrays}];
framey = Table[{a + 1 - 0.5, arrays - a}, {a, 0, arrays - 1}];
labely = "Eigengenes";
labelx = ColumnForm[{"(a) Arrays", " ", " "}, Center];
g = Show[
   Graphics[
    RasterArray[
     Table[
      RGBColor[
       displaying[[i, j, 1]], displaying[[i, j, 2]], 0
      ], {i, arrays, 1, -1}, {j, 1, arrays}]]],
   AspectRatio -> 1,
   Frame -> True,
   FrameTicks -> {None, framey, framex, None},
   FrameLabel -> {None, labely, labelx, None},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 3, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 3}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 3.78}, {0, 0}, {0, 1}];
g1 = Show[g,
   AspectRatio -> 1.05,
   PlotRange -> All,
   DisplayFunction -> Identity];

(* Display Both Eigengenes & Fractions *)

Show[GraphicsArray[{g1, g2}],
  GraphicsSpacing -> -0.15];
```



```
(* Reconstruct the Data Without Multiplicative Constant *)

eigenexpressions[[1]] = 0;
normalization = Dot[eigenarrays, DiagonalMatrix[eigenexpressions], eigengenes];
normalization = Sqrt[Exp[normalization]];
matrix = Sign[matrix];
matrix = N[matrix * normalization];
Clear[normalization];

(* Examine Normalized Data *)

(* Calculate Singular Value Decomposition *)

correlation = Dot[Transpose[matrix], matrix] / (arrays - 1);
{eigenexpressions, eigengenes} = Eigensystem[correlation];
eigenexpressions = Sqrt[(arrays - 1) * eigenexpressions];
Clear[correlation];
eigengenes[[2]] = -eigengenes[[2]];
eigengenes[[3]] = -eigengenes[[3]];
eigenarrays = Dot[eigengenes, Transpose[matrix]];
Do[
  eigenarrays[[a]] = eigenarrays[[a]] / eigenexpressions[[a]],
  {a, 1, arrays}];
eigenarrays = Transpose[eigenarrays];
arraycorrelations = Dot[DiagonalMatrix[eigenexpressions], eigengenes];
genecorrelations = Dot[eigenarrays, DiagonalMatrix[eigenexpressions]];
genecorrelations = Transpose[genecorrelations];
fractions = eigenexpressions^2 / Sum[eigenexpressions[[a]]^2, {a, 1, arrays}];
entropy = -N[Sum[fractions[[a]] * Log[fractions[[a]]], {a, 1, arrays}] / Log[arrays]];
entropy = N[Round[100 * entropy] / 100]

0.62

(* Create Fractions Bar Charts Displays *)

fractions[[1]]

0.225307

limit = 0.25;
```

```
Clear[gridx, framex, framey, sizes];
gridx = Table[a, {a, 0, limit, N[limit / 5]}];
framex = gridx;
sizes = Flatten[
   Table[
    Dimensions[
     Characters[
      ToString[framex[[a]]]
     ]], {a, 1, 6}]];
Do[
  Do[framex[[a]] = StringJoin[ToString[framex[[a]]], " "],
   {b, 1, size - sizes[[a]]}],
  {a, 1, 6}];
framex = Table[{gridx[[a]], framex[[a]]}, {a, 1, 6}];
framey = Table[{a + 1, arrays - a}, {a, 0, arrays - 1}];
labelx = ColumnForm[
   {"(b) Eigenexpression Fraction", StringJoin["d = ", ToString[entropy]], " "}, Center];
g = BarChart[
   Table[fractions[[arrays - a]], {a, 0, arrays - 1}],
   BarOrientation -> Horizontal,
   PlotRange -> {{0, limit * 1.0001}, {0.5, arrays + 0.5}},
   AspectRatio -> 1,
   Axes -> False,
   Frame -> True,
   FrameTicks -> {None, framey, framex, None},
   FrameLabel -> {None, None, labelx, None},
   GridLines -> {gridx, None},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 3}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 3.78}, {0, 0}, {0, 1}];
g2 = Show[g,
   AspectRatio -> 1.35,
   PlotRange -> All,
   DisplayFunction -> Identity];
```

```
(* Create Eigengenes 2 D Red & Green Raster Display *)

contrast = 3.5;
displaying = Table[
   If[contrast * eigengenes[[i, j]] > 0,
    If[contrast * eigengenes[[i, j]] < 1, {contrast * eigengenes[[i, j]], 0}, {1, 0}],
    If[contrast * eigengenes[[i, j]] > -1, {0, -contrast * eigengenes[[i, j]]}, {0, 1}]],
   {i, 1, arrays}, {j, 1, arrays}];
framex = Table[{a - 0.5, arraynames[[2, a]]}, {a, 1, arrays}];
framey = Table[{a + 1 - 0.5, arrays - a}, {a, 0, arrays - 1}];
labely = "Eigengenes";
labelx = ColumnForm[{"(a) Arrays", " ", " "}, Center];
g = Show[
   Graphics[
    RasterArray[
     Table[
      RGBColor[
       displaying[[i, j, 1]], displaying[[i, j, 2]], 0
      ], {i, arrays, 1, -1}, {j, 1, arrays}]]],
   AspectRatio -> 1,
   Frame -> True,
   FrameTicks -> {None, framey, framex, None},
   FrameLabel -> {None, labely, labelx, None},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 3, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 3}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 3.78}, {0, 0}, {0, 1}];
g1 = Show[g,
   AspectRatio -> 1.05,
   PlotRange -> All,
   DisplayFunction -> Identity];

(* Create Selected Eigengenes Graph Display *)

eigengenes1 = Chop[TrigFit[Drop[Drop[eigengenes[[1]], {19, 22}], {1}], 2, {x - 1, arrays - 5}], 0.1]
eigengenes2 = Chop[TrigFit[Drop[Drop[eigengenes[[2]], {19, 22}], {1}], 2, {x - 1, arrays - 5}], 0.1]
eigengenes3 = Chop[TrigFit[Drop[Drop[eigengenes[[3]], {19, 22}], {1}], 2, {x - 1, arrays - 5}], 0.1]
```

$$0.156573 \sin\left[\frac{2}{17}\pi(-1+x)\right] + 0.245919 \sin\left[\frac{4}{17}\pi(-1+x)\right]$$

$$0.268897 \cos\left[\frac{4}{17}\pi(-1+x)\right] - 0.101226 \sin\left[\frac{2}{17}\pi(-1+x)\right]$$

$$-0.112311 \cos\left[\frac{4}{17}\pi(-1+x)\right] - 0.237957 \sin\left[\frac{2}{17}\pi(-1+x)\right] + 0.164016 \sin\left[\frac{4}{17}\pi(-1+x)\right]$$

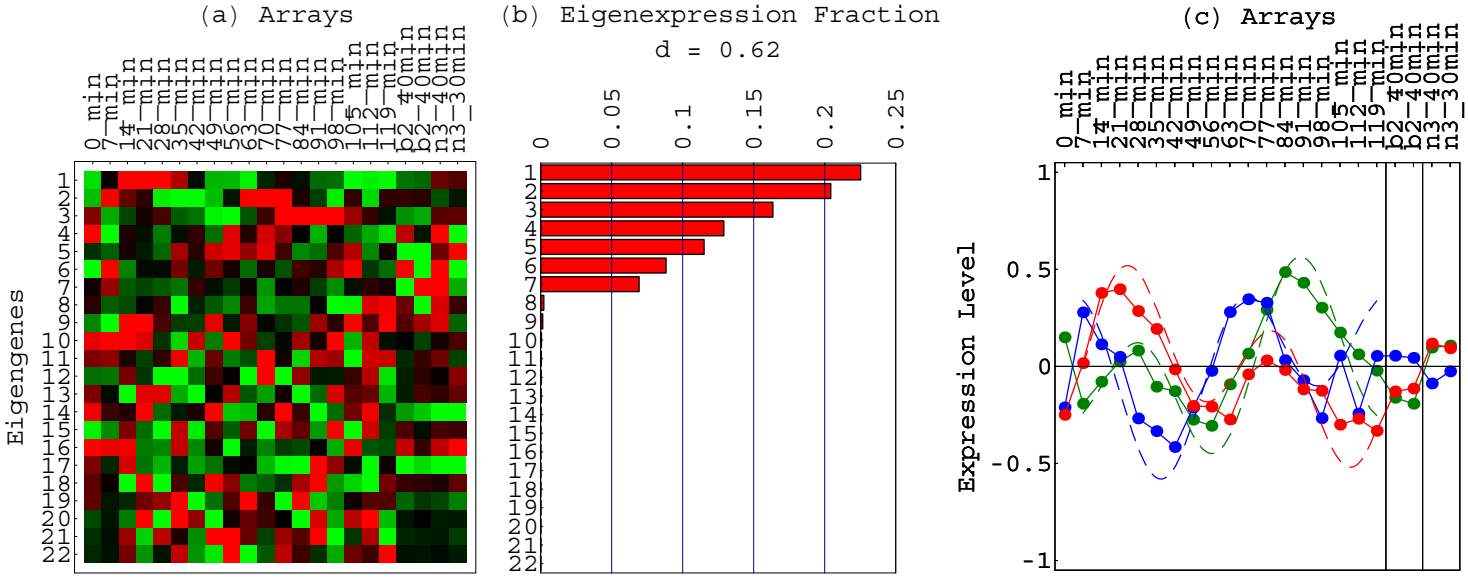
```
eigengenes1 = 0.34 * Sin[4 * Pi * (x - 1) / 17] + 0.24 * Sin[2 * Pi * (x - 1) / 17];
eigengenes2 = 0.34 * Cos[4 * Pi * (x - 1) / 17] - 0.24 * Sin[2 * Pi * (x - 1) / 17];
eigengenes3 = 0.34 * Sin[4 * Pi * (x - 1) / 17 - Pi / 4] - 0.24 * Sin[2 * Pi * (x - 1) / 17];
```

```
graph = Plot[
   eigengenes1,
   {x, 1, arrays - 5},
   PlotStyle -> {RGBColor[1, 0, 0], Dashing[{0.03, 0.02}]},
   DisplayFunction -> Identity];
labelx = ColumnForm[{"(c) Arrays"}, Center];
labely = ColumnForm[{" ", "Expression Level"}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[1, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[1, 0, 0], PointSize[0.022], points}],
    Graphics[{RGBColor[1, 0, 0], line}],
    graph},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {{{17.5, RGBColor[0, 0, 0]}, {19.5, RGBColor[0, 0, 0]}}, {{0, RGBColor[0, 0, 0]}}},
   FrameTicks -> {None, framey, framex, None},
   PlotRange -> {-1.05, 1.05},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 0.35}, {0, 0}, {0, 1}];
p1 = Show[g,
   AspectRatio -> 1.05,
   PlotRange -> All,
   DisplayFunction → Identity];
```

```
graph = Plot[
   eigengenes2,
   {x, 1, arrays - 5},
   PlotStyle -> {RGBColor[0, 0, 1], Dashing[{0.03, 0.02}]},
   DisplayFunction -> Identity];
labelx = ColumnForm[{"(c) Arrays"}, Center];
labely = ColumnForm[{" ", "Expression Level"}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[2, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[0, 0, 1], PointSize[0.022], points}],
    Graphics[{RGBColor[0, 0, 1], line}],
    graph},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {{{17.5, RGBColor[0, 0, 0]}, {19.5, RGBColor[0, 0, 0]}}, {{0, RGBColor[0, 0, 0]}}},
   FrameTicks -> {None, framey, framex, None},
   PlotRange -> {-1.05, 1.05},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 0.35}, {0, 0}, {0, 1}];
p2 = Show[g,
   AspectRatio -> 1.05,
   PlotRange -> All,
   DisplayFunction → Identity];
```

```
graph = Plot[
   eigengenes3,
   {x, 1, arrays - 5},
   PlotStyle -> {RGBColor[0, 0.5, 0], Dashing[{0.03, 0.02}]},
   DisplayFunction -> Identity];
labelx = ColumnForm[{"(c) Arrays"}, Center];
labely = ColumnForm[{" ", "Expression Level"}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[3, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[0, 0.5, 0], PointSize[0.022], points}],
    Graphics[{RGBColor[0, 0.5, 0], line}],
    graph},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {{{17.5, RGBColor[0, 0, 0]}, {19.5, RGBColor[0, 0, 0]}}, {{0, RGBColor[0, 0, 0]}}},
   FrameTicks -> {None, framey, framex, None},
   PlotRange -> {-1.05, 1.05},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 0.35}, {0, 0}, {0, 1}];
p3 = Show[g,
   AspectRatio -> 1.05,
   PlotRange -> All,
   DisplayFunction → Identity];

(* Display Selected Eigengenes *)

g3 = Show[{p3, p2, p1},
   DisplayFunction -> Identity];
```

```
(* Display Eigengenes, Fractions, Selected Eigengenes and Formulas *)

Show[GraphicsArray[{g1, g2, g3}],
  GraphicsSpacing -> -0.15];
```




```
Show[
 {Graphics[{RGBColor[1, 0, 0], Text["√(2/T) sin(4πt/T) + √(1/T) sin(2πt/T)", {605, 1}]}],
  Graphics[{RGBColor[0, 0, 1], Text["√(2/T) cos(4πt/T) - √(1/T) sin(2πt/T)", {605, 0}]}],
  Graphics[{RGBColor[0, 0.5, 0], Text["√(2/T) sin(4πt/T - π/4) - √(1/T) sin(2πt/T)", {605, -1}]}]},
 AspectRatio -> 120 / 750,
 PlotRange -> {{0, 750}, {-1.55, 1.55}}];
```

$$\sqrt{\frac{2}{T}}\sin\left(\frac{4\pi t}{T}\right)+\sqrt{\frac{1}{T}}\sin\left(\frac{2\pi t}{T}\right)$$

$$\sqrt{\frac{2}{T}}\cos\left(\frac{4\pi t}{T}\right)-\sqrt{\frac{1}{T}}\sin\left(\frac{2\pi t}{T}\right)$$

$$\sqrt{\frac{2}{T}}\sin\left(\frac{4\pi t}{T}-\frac{\pi}{4}\right)-\sqrt{\frac{1}{T}}\sin\left(\frac{2\pi t}{T}\right)$$

```
(* Rotate Eigengenes & Eigenarrays in Degenerate Subspace *)

(* Degenerate Subspace Assumption *)

eigenexpression = Sqrt[eigenexpressions[[1]]^2 + eigenexpressions[[2]]^2 + eigenexpressions[[3]]^2] /
   Sqrt[3];
eigenexpressions[[1]] = eigenexpression;
eigenexpressions[[2]] = eigenexpression;
eigenexpressions[[3]] = eigenexpression;
Clear[eigenexpression];

fractions = eigenexpressions^2 / Sum[eigenexpressions[[a]]^2, {a, 1, arrays}];

(* First Rotation *)

eigenarrays = Transpose[eigenarrays];

Clear[x];
x = x /. NSolve[
    (x * eigengenes[[2, 20]] + Sqrt[1 - x^2] * eigengenes[[1, 20]]) -
      (x * eigengenes[[2, 21]] + Sqrt[1 - x^2] * eigengenes[[1, 21]]) == 0, x][[1]]
```

```
0.869386
```

```
eigengenes1 = Table[eigengenes[[1, a]], {a, 1, arrays}];
eigengenes2 = Table[eigengenes[[2, a]], {a, 1, arrays}];
eigengenes[[2]] = x * eigengenes2 + Sqrt[1 - x^2] * eigengenes1;
eigengenes[[1]] = -Sqrt[1 - x^2] * eigengenes2 + x * eigengenes1;
Clear[eigengenes1, eigengenes2];
eigenarrays1 = Table[eigenarrays[[1, a]], {a, 1, genes}];
eigenarrays2 = Table[eigenarrays[[2, a]], {a, 1, genes}];
eigenarrays[[2]] = x * eigenarrays2 + Sqrt[1 - x^2] * eigenarrays1;
eigenarrays[[1]] = -Sqrt[1 - x^2] * eigenarrays2 + x * eigenarrays1;
Clear[x, eigenarrays1, eigenarrays2];

(* Second Rotation *)

Clear[x];
x = x /. NSolve[
    (x * eigengenes[[1, 20]] + Sqrt[1 - x^2] * eigengenes[[3, 20]]) -
      (x * eigengenes[[1, 21]] + Sqrt[1 - x^2] * eigengenes[[3, 21]]) == 0, x][[1]]
```

```
-0.735103
```

```
eigengenes1 = Table[eigengenes[[1, a]], {a, 1, arrays}];
eigengenes3 = Table[eigengenes[[3, a]], {a, 1, arrays}];
eigengenes[[1]] = -Sqrt[1 - x^2] * eigengenes1 + x * eigengenes3;
eigengenes[[3]] = -x * eigengenes1 - Sqrt[1 - x^2] * eigengenes3;
Clear[eigengenes1, eigengenes3];
eigenarrays1 = Table[eigenarrays[[1, a]], {a, 1, genes}];
eigenarrays3 = Table[eigenarrays[[3, a]], {a, 1, genes}];
eigenarrays[[1]] = -Sqrt[1 - x^2] * eigenarrays1 + x * eigenarrays3;
eigenarrays[[3]] = -x * eigenarrays1 - Sqrt[1 - x^2] * eigenarrays3;
Clear[x, eigenarrays1, eigenarrays3];

eigenarrays = Transpose[eigenarrays];
```

```
(* Create Fractions Bar Charts Displays *)

fractions[[1]]
```

```
0.197696
```

```
limit = 0.25;

Clear[gridx, framex, framey, sizes];
gridx = Table[a, {a, 0, limit, N[limit / 5]}];
framex = gridx;
sizes = Flatten[
   Table[
    Dimensions[
     Characters[
      ToString[framex[[a]]]
     ]], {a, 1, 6}]];
Do[
  Do[framex[[a]] = StringJoin[ToString[framex[[a]]], " "],
   {b, 1, size - sizes[[a]]}],
  {a, 1, 6}];
framex = Table[{gridx[[a]], framex[[a]]}, {a, 1, 6}];
framey = Table[{a + 1, arrays - a}, {a, 0, arrays - 1}];
labelx = ColumnForm[
   {"(b) Eigenexpression Fraction", StringJoin["d = ", ToString[entropy]], " "}, Center];
g = BarChart[
   Table[fractions[[arrays - a]], {a, 0, arrays - 1}],
   BarOrientation -> Horizontal,
   PlotRange -> {{0, limit * 1.0001}, {0.5, arrays + 0.5}},
   AspectRatio -> 1,
   Axes -> False,
   Frame -> True,
   FrameTicks -> {None, framey, framex, None},
   FrameLabel -> {None, None, labelx, None},
   GridLines -> {gridx, None},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 3}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 3.78}, {0, 0}, {0, 1}];
g2 = Show[g,
   AspectRatio -> 1.35,
   PlotRange -> All,
   DisplayFunction -> Identity];
```

```
(* Create Eigengenes 2 D Red & Green Raster Display *)

contrast = 3.5;
displaying = Table[
   If[contrast * eigengenes[[i, j]] > 0,
    If[contrast * eigengenes[[i, j]] < 1, {contrast * eigengenes[[i, j]], 0}, {1, 0}],
    If[contrast * eigengenes[[i, j]] > -1, {0, -contrast * eigengenes[[i, j]]}, {0, 1}]],
   {i, 1, arrays}, {j, 1, arrays}];
framex = Table[{a - 0.5, arraynames[[2, a]]}, {a, 1, arrays}];
framey = Table[{a + 1 - 0.5, arrays - a}, {a, 0, arrays - 1}];
labely = "Eigengenes";
labelx = ColumnForm[{"(a) Arrays", " ", " "}, Center];
g = Show[
   Graphics[
    RasterArray[
     Table[
      RGBColor[
       displaying[[i, j, 1]], displaying[[i, j, 2]], 0
      ], {i, arrays, 1, -1}, {j, 1, arrays}]]],
   AspectRatio -> 1,
   Frame -> True,
   FrameTicks -> {None, framey, framex, None},
   FrameLabel -> {None, labely, labelx, None},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 3, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 3}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 3.78}, {0, 0}, {0, 1}];
g1 = Show[g,
   AspectRatio -> 1.05,
   PlotRange -> All,
   DisplayFunction -> Identity];

(* Create Selected Eigengenes Graph Display *)

eigengenes1 = Chop[TrigFit[Drop[Drop[eigengenes[[1]], {19, 22}], {1}], 2, {x - 1, arrays - 5}], 0.1]
eigengenes2 = Chop[TrigFit[Drop[Drop[eigengenes[[2]], {19, 22}], {1}], 2, {x - 1, arrays - 5}], 0.1]
eigengenes3 = Chop[TrigFit[Drop[Drop[eigengenes[[3]], {19, 22}], {1}], 2, {x - 1, arrays - 5}], 0.1]
```

$$0.18596 \cos\left[\frac{4}{17} \pi (-1 + x)\right] - 0.233424 \sin\left[\frac{4}{17} \pi (-1 + x)\right]$$

$$0.22261 \cos\left[\frac{4}{17} \pi (-1 + x)\right] + 0.204797 \sin\left[\frac{4}{17} \pi (-1 + x)\right]$$

$$0.100832 \cos\left[\frac{2}{17} \pi (-1 + x)\right] + 0.298157 \sin\left[\frac{2}{17} \pi (-1 + x)\right]$$

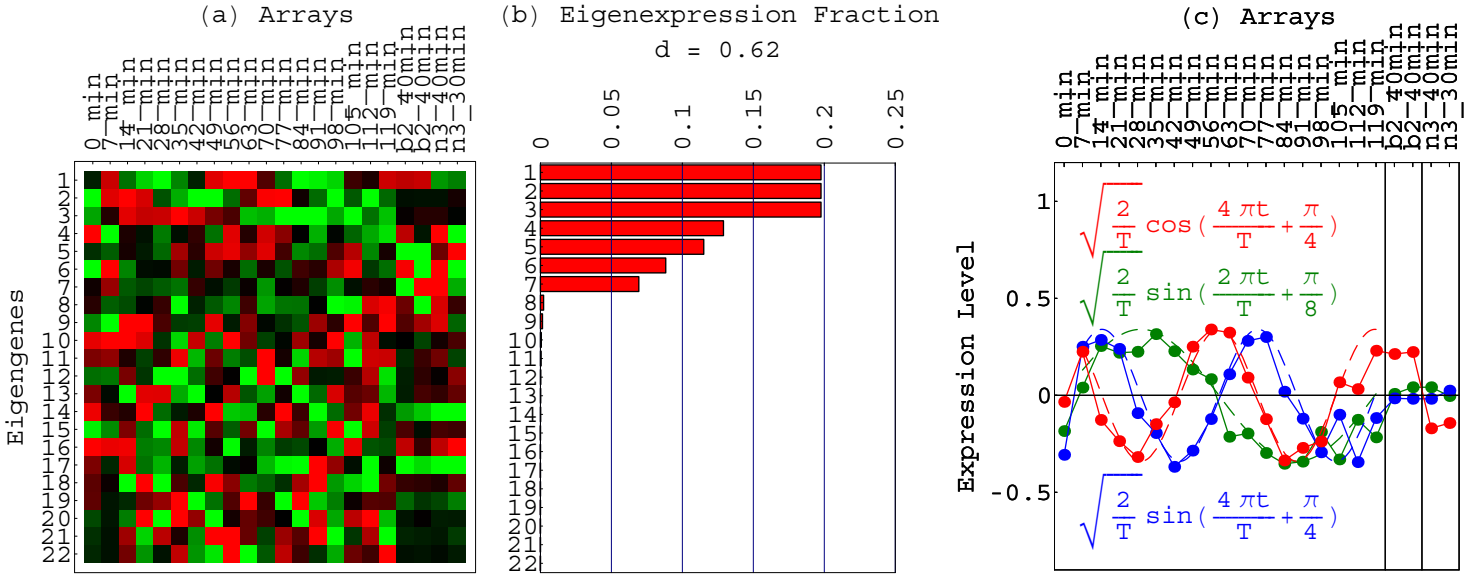
```
eigengenes1 = 0.34 * Cos[4 * Pi * (x - 1) / 17 + Pi / 4];
eigengenes2 = 0.34 * Sin[4 * Pi * (x - 1) / 17 + Pi / 4];
eigengenes3 = 0.34 * Sin[2 * Pi * (x - 1) / 17 + Pi / 8];
```

```
graph = Plot[
   eigengenes1,
   {x, 1, arrays - 5},
   PlotStyle -> {RGBColor[1, 0, 0], Dashing[{0.03, 0.02}]},
   DisplayFunction -> Identity];
labelx = ColumnForm[{"(c) Arrays"}, Center];
labely = ColumnForm[{" ", "Expression Level"}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[1, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[1, 0, 0], PointSize[0.022], points}],
    Graphics[{RGBColor[1, 0, 0], line}],
    graph,
    Graphics[{RGBColor[1, 0, 0], Text["√(2/T) cos(4πt/T + π/4)", {8, 0.9}]}]},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {{{17.5, RGBColor[0, 0, 0]}, {19.5, RGBColor[0, 0, 0]}}, {{0, RGBColor[0, 0, 0]}}},
   FrameTicks -> {None, framey, framex, None},
   PlotRange -> {-0.9, 1.2},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 0.35}, {0, 0}, {0, 1}];
p1 = Show[g,
   AspectRatio -> 1.05,
   PlotRange -> All,
   DisplayFunction → Identity];
```

```
graph = Plot[
   eigengenes2,
   {x, 1, arrays - 5},
   PlotStyle -> {RGBColor[0, 0, 1], Dashing[{0.03, 0.02}]},
   DisplayFunction -> Identity];
labelx = ColumnForm[{"(c) Arrays"}, Center];
labely = ColumnForm[{" ", "Expression Level"}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[2, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[0, 0, 1], PointSize[0.022], points}],
    Graphics[{RGBColor[0, 0, 1], line}],
    graph,
    Graphics[{RGBColor[0, 0, 1], Text["√(2/T) sin(4πt/T + π/4)", {8, -0.6}]}]},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {{{17.5, RGBColor[0, 0, 0]}, {19.5, RGBColor[0, 0, 0]}}, {{0, RGBColor[0, 0, 0]}}},
   FrameTicks -> {None, framey, framex, None},
   PlotRange -> {-0.9, 1.2},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 0.35}, {0, 0}, {0, 1}];
p2 = Show[g,
   AspectRatio -> 1.05,
   PlotRange -> All,
   DisplayFunction → Identity];
```

```
graph = Plot[
   eigengenes3,
   {x, 1, arrays - 5},
   PlotStyle -> {RGBColor[0, 0.5, 0], Dashing[{0.03, 0.02}]},
   DisplayFunction -> Identity];
labelx = ColumnForm[{"(c) Arrays"}, Center];
labely = ColumnForm[{" ", "Expression Level"}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[3, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
   {Graphics[{RGBColor[0, 0.5, 0], PointSize[0.022], points}],
    Graphics[{RGBColor[0, 0.5, 0], line}],
    graph,
    Graphics[{RGBColor[0, 0.5, 0], Text["√(2/T) sin(2πt/T + π/8)", {8, 0.55}]}]},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {{{17.5, RGBColor[0, 0, 0]}, {19.5, RGBColor[0, 0, 0]}}, {{0, RGBColor[0, 0, 0]}}},
   FrameTicks -> {None, framey, framex, None},
   PlotRange -> {-0.9, 1.2},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 0.35}, {0, 0}, {0, 1}];
p3 = Show[g,
   AspectRatio -> 1.05,
   PlotRange -> All,
   DisplayFunction → Identity];

(* Display Selected Eigengenes *)

g3 = Show[{p3, p2, p1},
   DisplayFunction -> Identity];
```

```
(* Display Eigengenes, Fractions and Selected Eigengenes *)

Show[GraphicsArray[{g1, g2, g3}],
  GraphicsSpacing -> -0.15];
```




```
(* Reconstruct Data With Rotated Eigengenes and Eigenarrays *)

matrix = Dot[eigenarrays, DiagonalMatrix[eigenexpressions], eigengenes];
arraycorrelations = Dot[DiagonalMatrix[eigenexpressions], eigengenes];
genecorrelations = Dot[eigenarrays, DiagonalMatrix[eigenexpressions]];

(* SVD Sort Yeast Arrays *)

(* Create Parameter Plot of Arrays According to Projections on Eigenarrays *)

matrix = Transpose[matrix];
coordinates = Table[
    {arraycorrelations[[1, a]] / Sqrt[Dot[matrix[[a]], matrix[[a]]]],
     arraycorrelations[[2, a]] / Sqrt[Dot[matrix[[a]], matrix[[a]]]]},
    {a, 1, arrays}];
matrix = Transpose[matrix];
points1 = {Point[coordinates[[2]]], Point[coordinates[[11]]]};
points2 = {Point[coordinates[[3]]], Point[coordinates[[4]]], Point[coordinates[[5]]],
    Point[coordinates[[12]]], Point[coordinates[[13]]], Point[coordinates[[14]]],
    Point[coordinates[[21]]], Point[coordinates[[22]]]};
points3 = {Point[coordinates[[6]]], Point[coordinates[[15]]]};
points4 = {Point[coordinates[[7]]]};
points5 = {Point[coordinates[[1]]], Point[coordinates[[8]]], Point[coordinates[[9]]],
    Point[coordinates[[10]]], Point[coordinates[[16]]], Point[coordinates[[17]]],
    Point[coordinates[[18]]], Point[coordinates[[19]]], Point[coordinates[[20]]]};
textcoordinates = coordinates;
Do[textcoordinates[[a, 1]] = If[textcoordinates[[a, 1]] > 0,
     textcoordinates[[a, 1]] + 0.095, textcoordinates[[a, 1]] - 0.095],
  {a, 1, 9}];
Do[textcoordinates[[a, 1]] = If[textcoordinates[[a, 1]] > 0,
     textcoordinates[[a, 1]] + 0.12, textcoordinates[[a, 1]] - 0.12],
  {a, 10, arrays}];
```

```
textcoordinates[[9]] = textcoordinates[[9]] - {0.06, 0.12};
textcoordinates[[12]] = textcoordinates[[12]] + {0.12, -0.12};
textcoordinates[[13]] = textcoordinates[[13]] + {0, 0.04};
textcoordinates[[14]] = textcoordinates[[14]] - {-0.06, 0.12};
textcoordinates[[16]] = textcoordinates[[16]] - {0.12, 0.12};
textcoordinates[[18]] = textcoordinates[[18]] - {0.06, 0.12};
textcoordinates[[19]] = textcoordinates[[19]] - {0.12, -0.12};
textcoordinates[[20]] = textcoordinates[[20]] - {0.16, 0.12};
textcoordinates[[21]] = textcoordinates[[21]] - {-0.08, 0.12};
textcoordinates[[22]] = textcoordinates[[22]] + {0.14, 0.12};

texts = Table[Text[a, textcoordinates[[a]]], {a, 1, arrays}];
p = Show[{
    Graphics[{RGBColor[1, 1, 0], PointSize[0.035], points1}],
    Graphics[{RGBColor[0, 0.5, 0], PointSize[0.035], points2}],
    Graphics[{RGBColor[0, 0, 1], PointSize[0.035], points3}],
    Graphics[{RGBColor[1, 0, 0], PointSize[0.035], points4}],
    Graphics[{RGBColor[1, 0.5, 0], PointSize[0.035], points5}],
    Graphics[{RGBColor[1, 0.5, 0], Text["G2/M", {1.075, -0.52}]}],
    Graphics[{RGBColor[0, 0, 0], Text["M/G1", {0.9, 0.75}]}],
    Graphics[{RGBColor[1, 0, 0], Text["S/G2", {0.2, -1.12}]}],
    Graphics[{RGBColor[0, 0, 1], Text["S", {-0.95, -0.6}]}],
    Graphics[{RGBColor[0, 0.5, 0], Text["G1", {-0.8, 0.8}]}],
    Graphics[{RGBColor[0, 0, 0], Text["(a)", {-1.1, 1.15}]}],
    Graphics[{RGBColor[0, 0, 0], Text["ϕ=π/2", {0.2, 1.12}]}],
    Graphics[{RGBColor[0, 0, 0], Text["ϕ=0", {1.12, 0.12}]}],
    Graphics[texts],
    Graphics[{RGBColor[0, 0, 0], Arrow[{1.1, -0.26}, {0.4, -0.04},
       HeadCenter -> 0.5, HeadLength -> 0.035, HeadWidth -> 0.75]}],
    Graphics[{RGBColor[0, 0, 0], Text["CLB2", {1.1, -0.34}]}],
    Graphics[{RGBColor[0, 0, 0], Arrow[{-1.1, 0.37}, {-0.3, 0},
       HeadCenter -> 0.5, HeadLength -> 0.035, HeadWidth -> 0.75]}],
    Graphics[{RGBColor[0, 0, 0], Text["CLN3", {-1.1, 0.44}]}],
    Graphics[{RGBColor[0, 0, 0], Dashing[{0.03, 0.02}], Circle[{0, 0}, 0.5, {0. * Pi, 2 * Pi}]}],
    Graphics[{RGBColor[0, 0, 0], Dashing[{0.03, 0.02}], Circle[{0, 0}, 1]}],
    Graphics[{RGBColor[0, 0, 0], Arrow[{-1.25, 0}, {1.25, 0},
       HeadCenter -> 0.5, HeadLength -> 0.035, HeadWidth -> 0.75]}],
    Graphics[{RGBColor[0, 0, 0], Arrow[{0, -1.25}, {0, 1.25},
       HeadCenter -> 0.5, HeadLength -> 0.035, HeadWidth -> 0.75]}],
    Graphics[{RGBColor[0, 0, 0], Arrow[
        {0.2 * Cos[-0.05], 0.2 * Sin[-0.05]}, {0.2 * Cos[0], 0.2 * Sin[0]},
        HeadCenter -> 0.5, HeadLength -> 0.035, HeadWidth -> 0.75]}],
    Graphics[{RGBColor[0, 0, 0], Circle[{0, 0}, 0.2,
       {ArcTan[coordinates[[1, 2]] / coordinates[[1, 1]]] - Pi, 0}]}],
    Graphics[{RGBColor[0, 0, 0], Arrow[{0, 0}, coordinates[[1]],
       HeadCenter -> 0.5, HeadLength -> 0.035, HeadWidth -> 0.75]}],
    Graphics[{RGBColor[0, 0, 0], Text["r", {-0.1, -0.3}]}],
    Graphics[{RGBColor[0, 0, 0], Text["ϕ", {0.075, -0.1}]}]},
   AspectRatio -> 1,
   PlotRange -> {{-1.25, 1.25}, {-1.25, 1.25}},
   Frame -> True,
   FrameTicks -> False,
   FrameLabel -> {None, None, None, None},
   GridLines -> {{{0, RGBColor[0, 0, 0]}}, {{0, RGBColor[0, 0, 0]}}},
   DisplayFunction -> Identity];
p = FullGraphics[p];
p[[1, 2]] = p[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {-1.18, 0}, {0, 0}, {0, 1}];
s1 = Show[p,
   AspectRatio -> 1.0,
   PlotRange -> All,
   DisplayFunction → Identity];
```

```
(* SVD Sort Yeast Genes *)

(* Create Parameter Plot of Genes According to Projections on Eigengenes *)

coordinates = Table[
   {genecorrelations[[a, 1]] / Sqrt[Dot[matrix[[a]], matrix[[a]]]],
    genecorrelations[[a, 2]] / Sqrt[Dot[matrix[[a]], matrix[[a]]]]},
   {a, 1, genes}];

stream = "Desktop/Networks/Data/Y_Classify.txt.nb";
list = ReadList[stream, Word, RecordLists -> True, NullWords -> True];
list = Drop[list, 1];
Clear[stream];
stages = {"M/G1", "G1", "S", "S/G2", "G2/M"};
points = {points1, points2, points3, points4, points5};
radii = {radii1, radii2, radii3, radii4, radii5};
Do[{
  position = Position[list, stages[[b]]],
  table = Table[list[[position[[a, 1]], 1]], {a, 1, Dimensions[position][[1]]}],
  position = Table[Position[genenames, table[[a]]], {a, 1, Dimensions[table][[1]]}],
  table = Flatten[Position[position, {}]],
  Do[
   position = Drop[position, {table[[a]], table[[a]]}],
   {a, Dimensions[table][[1]], 1, -1}],
  points[[b]] = Table[Point[coordinates[[position[[a, 1, 1]]]]], {a, 1, Dimensions[position][[1]]}],
  radii[[b]] = Table[
    Sqrt[coordinates[[position[[a, 1, 1]], 1]]^2 + coordinates[[position[[a, 1, 1]], 2]]^2],
    {a, 1, Dimensions[position][[1]]}]},
 {b, 1, Dimensions[stages][[1]]}]

Dimensions[points[[1]]][[1]]
Dimensions[points[[2]]][[1]]
Dimensions[points[[3]]][[1]]
Dimensions[points[[4]]][[1]]
Dimensions[points[[5]]][[1]]
```

```
92
```

```
242
```

```
52
```

```
99
```

```
161
```

```
radii = Sort[Flatten[radii], OrderedQ[{{#1}, {#2}}] &];
N[Round[radii[[95]] * 100] / 100]
N[Round[radii[[96]] * 100] / 100]
```

```
0.49
```

```
0.5
```

```
(* 646 cell cycle genes, 92 in M/G1, 242 in G1, 52 in S, 99 in S/G2, 161 in G2/M. *)

(* 551 with more than 25 % of normalized expression in the cell cycle subspace. *)
```

```
clb2 = coordinates[[Position[genenames, "YPR119W"][[1, 1]]]];
cln3 = coordinates[[Position[genenames, "YAL040C"][[1, 1]]]];
p = Show[
   {Graphics[{RGBColor[1, 0.5, 0], PointSize[0.02], points[[5]]}],
    Graphics[{RGBColor[1, 1, 0], PointSize[0.02], points[[1]]}],
    Graphics[{RGBColor[1, 0, 0], PointSize[0.02], points[[4]]}],
    Graphics[{RGBColor[0, 0.5, 0], PointSize[0.02], points[[2]]}],
    Graphics[{RGBColor[0, 0, 1], PointSize[0.02], points[[3]]}],
    Graphics[{RGBColor[1, 0.5, 0], Text["G2/M", {1.075, -0.52}]}],
    Graphics[{RGBColor[0, 0, 0], Text["M/G1", {0.9, 0.75}]}],
    Graphics[{RGBColor[1, 0, 0], Text["S/G2", {0.2, -1.12}]}],
    Graphics[{RGBColor[0, 0, 1], Text["S", {-0.95, -0.6}]}],
    Graphics[{RGBColor[0, 0.5, 0], Text["G1", {-0.8, 0.8}]}],
    Graphics[{RGBColor[0, 0, 0], Text["(b)", {-1.1, 1.15}]}],
    Graphics[{RGBColor[0, 0, 0], Text["ϕ=π/2", {0.2, 1.12}]}],
    Graphics[{RGBColor[0, 0, 0], Text["ϕ=0", {1.12, 0.12}]}],
    Graphics[{RGBColor[1, 0.5, 0], PointSize[0.02], Point[clb2]}],
    Graphics[{RGBColor[0, 0, 0], Arrow[{1.1, -0.26}, clb2,
       HeadCenter -> 0.5, HeadLength -> 0.035, HeadWidth -> 0.75]}],
    Graphics[{RGBColor[0, 0, 0], Text["CLB2", {1.1, -0.34}]}],
    Graphics[{RGBColor[1, 1, 0], PointSize[0.02], Point[cln3]}],
    Graphics[{RGBColor[0, 0, 0], Arrow[{-1.1, 0.37}, cln3,
       HeadCenter -> 0.5, HeadLength -> 0.035, HeadWidth -> 0.75]}],
    Graphics[{RGBColor[0, 0, 0], Text["CLN3", {-1.1, 0.44}]}],
    Graphics[{RGBColor[0, 0, 0], Dashing[{0.03, 0.02}], Circle[{0, 0}, 0.5]}],
    Graphics[{RGBColor[0, 0, 0], Dashing[{0.03, 0.02}], Circle[{0, 0}, 1]}],
    Graphics[{RGBColor[0, 0, 0], Arrow[{-1.25, 0}, {1.25, 0},
       HeadCenter -> 0.5, HeadLength -> 0.035, HeadWidth -> 0.75]}],
    Graphics[{RGBColor[0, 0, 0], Arrow[{0, -1.25}, {0, 1.25},
       HeadCenter -> 0.5, HeadLength -> 0.035, HeadWidth -> 0.75]}]},
   AspectRatio -> 1,
   PlotRange -> {{-1.25, 1.25}, {-1.25, 1.25}},
   Frame -> True,
   FrameTicks -> False,
   FrameLabel -> {None, None, None, None},
   GridLines -> {None, None},
   DisplayFunction -> Identity];
p = FullGraphics[p];
p[[1, 2]] = p[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {-1.18, 0}, {0, 0}, {0, 1}];
s2 = Show[p,
   AspectRatio → 1.0,
   PlotRange -> All,
   DisplayFunction → Identity];
```

```
(* Create Plot of SVD Cell Cycle 2 D Subspace *)

R[theta_] = {{Cos[theta], Sin[theta]}, {-Sin[theta], Cos[theta]}};
x = Transpose[{{0.4, 0}, {1.1, 0}, {0.75, 0.25}}];
polypoints[theta_] = Transpose[Dot[R[theta], x]];
p = Show[
   {Graphics[{RGBColor[1, 0.5, 0], Text["G2/M", {1.075, -0.52}]}],
    Graphics[{RGBColor[0, 0, 0], Text["M/G1", {0.9, 0.75}]}],
    Graphics[{RGBColor[1, 0, 0], Text["S/G2", {0.2, -1.12}]}],
    Graphics[{RGBColor[0, 0, 1], Text["S", {-0.95, -0.6}]}],
    Graphics[{RGBColor[0, 0.5, 0], Text["G1", {-0.8, 0.8}]}],
    Graphics[{RGBColor[0, 0, 0], Text["(c)", {-1.1, 1.15}]}],
    Graphics[{RGBColor[0, 0, 0], Text["ϕ=π/2", {0.2, 1.12}]}],
    Graphics[{RGBColor[0, 0, 0], Text["ϕ=0", {1.12, 0.12}]}],
    Graphics[{RGBColor[1, 0.5, 0], Disk[{0, 0}, 1, {-Pi / 3, 0}]}],
    Graphics[{RGBColor[1, 1, 0], Disk[{0, 0}, 1, {0, Pi / 2}]}],
    Graphics[{RGBColor[0, 0.5, 0], Disk[{0, 0}, 1, {Pi / 2, Pi}]}],
    Graphics[{RGBColor[0, 0, 1], Disk[{0, 0}, 1, {Pi, 4 * Pi / 3}]}],
    Graphics[{RGBColor[1, 0, 0], Disk[{0, 0}, 1, {4 * Pi / 3, 5 * Pi / 3}]}],
    Graphics[{RGBColor[1, 1, 1], Disk[{0, 0}, 0.5]}],
    Graphics[{RGBColor[1, 0.5, 0], Polygon[polypoints[0]]}],
    Graphics[{RGBColor[1, 1, 0], Polygon[polypoints[3 * Pi / 2]]}],
    Graphics[{RGBColor[0, 0.5, 0], Polygon[polypoints[Pi]]}],
    Graphics[{RGBColor[0, 0, 0], Arrow[{-1.25, 0}, {1.25, 0},
       HeadCenter -> 0.5, HeadLength -> 0.035, HeadWidth -> 0.75]}],
    Graphics[{RGBColor[0, 0, 0], Arrow[{0, -1.25}, {0, 1.25},
       HeadCenter -> 0.5, HeadLength -> 0.035, HeadWidth -> 0.75]}]},
   AspectRatio -> 1,
   PlotRange -> {{-1.25, 1.25}, {-1.25, 1.25}},
   Frame -> True,
   FrameTicks -> False,
   FrameLabel -> {None, None, None, None},
   GridLines -> {{{0, RGBColor[0, 0, 0]}}, {{0, RGBColor[0, 0, 0]}}},
   DisplayFunction -> Identity];
p = FullGraphics[p];
p[[1, 2]] = p[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {-1.18, 0}, {0, 0}, {0, 1}];
s3 = Show[p,
   AspectRatio -> 1.,
   PlotRange -> All,
   DisplayFunction → Identity];
Clear[x];

(* Define the Initial Phase *)

zerophase = Pi / 2;
```

```
(* Sort Genes by SVD Phase *)

svdphase = Table[{
    genecorrelations[[a, 1]] / Sqrt[genecorrelations[[a, 1]]^2 + genecorrelations[[a, 2]]^2],
    genecorrelations[[a, 2]] / Sqrt[genecorrelations[[a, 1]]^2 + genecorrelations[[a, 2]]^2]},
   {a, 1, genes}];
svdphase = Table[{
    -svdphase[[a, 1]] * Cos[zerophase] - svdphase[[a, 2]] * Sin[zerophase],
    -svdphase[[a, 2]] * Cos[zerophase] + svdphase[[a, 1]] * Sin[zerophase]},
   {a, 1, genes}];
svdphase = Table[{
    svdphase[[a, 1]],
    svdphase[[a, 2]],
    N[ArcTan[svdphase[[a, 1]] / svdphase[[a, 2]]] / Pi]},
   {a, 1, genes}];
sortmatrix = AppendRows[svdphase, genenames, matrix, eigenarrays, genecorrelations];
sortmatrix = Sort[sortmatrix, OrderedQ[{{#1}, {#2}}] &];
negative1 = 1913;
positive1 = 1914;
sortmatrix[[negative1, 1]]
sortmatrix[[positive1, 1]]
```

```
-0.000990132
```

```
0.000695258
```

```
sortmatrix = Transpose[Drop[Transpose[sortmatrix], {1}]];
sortmatrix = AppendColumns[
  Sort[
   TakeRows[sortmatrix, {1, negative1}],
   OrderedQ[{{#2}, {#1}}] &],
  Sort[
   TakeRows[sortmatrix, {positive1, genes}],
   OrderedQ[{{#1}, {#2}}] &]];
phases = TakeColumns[sortmatrix, {2, 2}];
svdphases = phases;
sortmatrix = Transpose[Drop[Transpose[sortmatrix], {1, 2}]];

(* Reconstruct Data With Sorted Genes *)

genenames2 = TakeColumns[sortmatrix, {1, 6}];
matrix2 = TakeColumns[sortmatrix, {7, arrays + 6}];
eigenarrays = TakeColumns[sortmatrix, {arrays + 7, 2 * arrays + 6}];
genecorrelations = TakeColumns[sortmatrix, {2 * arrays + 7, 3 * arrays + 6}];
```

```
(* Classify SVD Gene Phases into Cell Cycle Phases *)

ph1 = 0;
ph2 = -1 / 2.;
ph3 = -1.;
ph4 = -4 / 3.;
ph5 = -5 / 3.;

endph5 = genes;
beginph1 = 1;
phases[[endph5]] - ph1
phases[[beginph1]] - ph1
```

```
{0.000221307}
```

```
{-0.000315169}
```

```
endph1 = 1020;
beginph2 = 1021;
phases[[endph1]] - ph2
phases[[beginph2]] - ph2
```

```
{0.000187677}
```

```
{0.999788}
```

```
endph2 = 1913;
beginph3 = 1914;
phases[[endph2]] - ph3
phases[[beginph3]] - ph3
```

```
{1.00101}
```

```
{0.999626}
```

```
endph3 = 2588;
beginph4 = 2589;
phases[[endph3]] - ph4
phases[[beginph4]] - ph4
```

```
{1.00001}
```

```
{0.999872}
```

```
endph4 = 3699;
beginph5 = 3700;
phases[[endph4]] - ph5
phases[[beginph5]] - ph5
```

```
{2.00032}
```

```
{1.99995}
```

```
(* 4579 yeast genes, 1020 in M/G1, 893 in G1, 675 in S, 1111 in S/G2, 880 in G2/M. *)
```

```
(* Display SVD Sorted and Reconstructed Yeast Data *)

matrix = matrix2;
genes = genes2;
genenames = genenames2;

(* Create Normalized Sorted Yeast Data 2 D Red & Green Raster Display *)

contrast = 10 * 1.5;
displaying = Table[
   If[contrast * matrix[[i, j]] > 0,
    If[contrast * matrix[[i, j]] < 1, {contrast * matrix[[i, j]], 0}, {1, 0}],
    If[contrast * matrix[[i, j]] > -1, {0, -contrast * matrix[[i, j]]}, {0, 1}]],
   {i, 1, genes}, {j, 1, arrays}];
framex = Table[{a - 0.5, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {
   {genes - endph1 / 2, "M/G1"},
   {genes - (endph1 + endph2) / 2, "G1"},
   {genes - (endph2 + endph3) / 2, "S"},
   {genes - (endph3 + endph4) / 2, "S/G2"},
   {(genes - endph4) / 2, "G2/M"}};
gridy = {
   {genes - endph1 + 0.5, {RGBColor[0, 0, 0]}},
   {genes - endph2 + 0.5, {RGBColor[0, 0, 0]}},
   {genes - endph3 + 0.5, {RGBColor[0, 0, 0]}},
   {genes - endph4 + 0.5, {RGBColor[0, 0, 0]}}};
labelx = "(a) Arrays";
labely = ColumnForm[{" ", "Genes", " ", " ", " ", " ", " ", " "}, Center];
g = Show[
   Graphics[
    RasterArray[
     Table[
      RGBColor[displaying[[i, j, 1]], displaying[[i, j, 2]], 0],
      {i, genes, 1, -1}, {j, 1, arrays}]]],
   AspectRatio -> 1,
   Frame -> True,
   FrameTicks -> {None, framey, framex, None},
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {None, gridy},
   DisplayFunction -> Identity];
```

```
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {1., 0.}] →
    Text[a, {b - 1.5, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 1100}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 550}, {0, 0}, {0, 1}];
g1 = Show[g,
   AspectRatio -> GoldenRatio * 1.2,
   PlotRange -> All,
   DisplayFunction → Identity];

(* Create Sorted Yeast Eigenarrays 2 D Red & Green Raster Display *)

contrast = 75 * 1.5;
displaying = Table[
   If[contrast * eigenarrays[[i, j]] > 0,
    If[contrast * eigenarrays[[i, j]] < 1, {contrast * eigenarrays[[i, j]], 0}, {1, 0}],
    If[contrast * eigenarrays[[i, j]] > -1, {0, -contrast * eigenarrays[[i, j]]}, {0, 1}]],
   {i, 1, genes}, {j, 1, arrays}];
labelx = "(b) Eigenarrays";
labely = ColumnForm[{" ", " ", " ", " ", " ", " ", " ", " ", " "}, Center];
framey = {
   {genes - endph5 / 2, "     ", 0},
   {genes - (endph5 + endph1) / 2, "   ", 0},
   {genes - (endph1 + endph2) / 2, "  ", 0},
   {genes - (endph2 + endph3) / 2, "     ", 0},
   {genes - (endph3 + endph4) / 2, "     ", 0},
   {(genes - endph4) / 2, "     ", 0}};
gridy = {
   {genes - endph1 + 0.5, {RGBColor[0, 0, 0]}},
   {genes - endph2 + 0.5, {RGBColor[0, 0, 0]}},
   {genes - endph3 + 0.5, {RGBColor[0, 0, 0]}},
   {genes - endph4 + 0.5, {RGBColor[0, 0, 0]}},
   {genes - endph5 + 0.5, {RGBColor[0, 0, 0]}}};
framex = Table[{a - 0.5, ToString[a]}, {a, 1, arrays}];
size = 7;
sizes = Flatten[
   Table[
    Dimensions[
     Characters[
      framex[[a, 2]]
     ]], {a, 1, arrays}]];
Do[
  Do[framex[[a, 2]] = StringJoin[framex[[a, 2]], " "],
   {b, 1, size - sizes[[a]]}],
  {a, 1, arrays}];
```

```
g = Show[
   Graphics[
    RasterArray[
     Table[
      RGBColor[displaying[[i, j, 1]], displaying[[i, j, 2]], 0],
      {i, genes, 1, -1}, {j, 1, arrays}
     ]]],
   AspectRatio -> 1,
   Frame -> True,
   FrameTicks -> {None, framey, framex, None},
   FrameLabel -> {None, labely, labelx, None},
   GridLines -> {None, gridy},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {1., 0.}] →
    Text[a, {b - 1.5, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 1100}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 550}, {0, 0}, {0, 1}];
g2 = Show[g,
   AspectRatio -> GoldenRatio * 1.2,
   PlotRange -> All,
   DisplayFunction → Identity];

(* Create Selected Sorted Yeast Eigenarrays Graph Display *)

eigenarrays = Transpose[eigenarrays];

eigenarrays1 = Chop[TrigFit[eigenarrays[[1]], 1, {x, genes - 1}], 0.0025]
eigenarrays2 = Chop[TrigFit[eigenarrays[[2]], 1, {x, genes - 1}], 0.003]
```

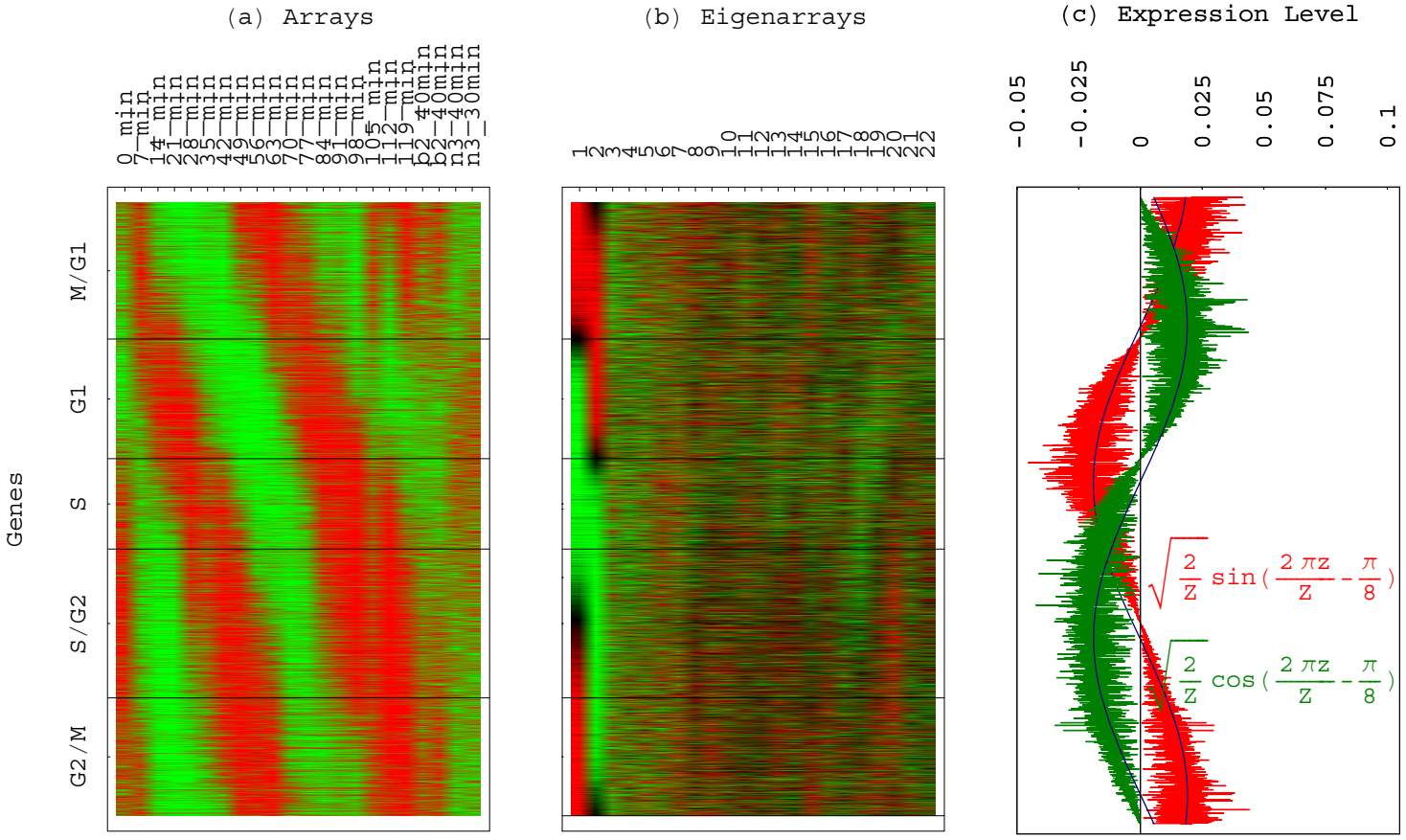
$$0.0183017 \cos\left[\frac{\pi x}{2289}\right] - 0.00523107 \sin\left[\frac{\pi x}{2289}\right]$$

$$0.00544666 \cos\left[\frac{\pi x}{2289}\right] + 0.0181607 \sin\left[\frac{\pi x}{2289}\right]$$

```
graph = ParametricPlot[{eigenarrays1, -x},
   {x, genes - 1, 0},
   PlotStyle -> {RGBColor[0, 0, 0.5]},
   DisplayFunction -> Identity];
labelx = "(c) Expression Level";
labely = ColumnForm[{" ", " ", " ", " ", " ", " ", " ", " ", " "}, Center];
framex = {{-0.05, "-0.05 "}, {-0.025, "-0.025"}, {0, "0     "},
   {0.025, "0.025 "}, {0.05, "0.05  "}, {0.075, "0.075 "}, {0.1, "0.1   "}};
framey = {
   {-genes + endph5 / 2, "    ", 0},
   {-genes + (endph5 + endph1) / 2, "  ", 0},
   {-genes + (endph1 + endph2) / 2, " ", 0},
   {-genes + (endph2 + endph3) / 2, "    ", 0},
   {-genes + (endph3 + endph4) / 2, "    ", 0},
   {-(genes - endph4) / 2, "    ", 0}};
coordinates = Table[{eigenarrays[[1, a]], -a + 1}, {a, 1, genes}];
line = Line[coordinates];
g = Show[{
    Graphics[{RGBColor[1, 0, 0], line}],
    graph,
    Graphics[{RGBColor[1, 0, 0], Text["√(2/z) sin(2πz/z - π/8)", {0.054, -2750}]}]},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   FrameTicks -> {None, None, framex, None},
   GridLines -> {{{0, RGBColor[0, 0, 0]}}, None},
   AspectRatio -> GoldenRatio * 1.15,
   PlotRange -> {{-0.05, 0.105}, {75, -genes + 1 - 75}},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {1., 0.}] →
    Text[a, {b - 0.01, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 1125}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 575}, {0, 0}, {0, 1}];
p1 = Show[g,
   AspectRatio -> GoldenRatio * 1.2765,
   PlotRange -> All,
   DisplayFunction → Identity];
```

```
graph = ParametricPlot[{eigenarrays2, -x},
   {x, genes - 1, 0},
   PlotStyle -> {RGBColor[0, 0, 0.5]},
   DisplayFunction -> Identity];
labelx = "(c) Expression Level";
labely = ColumnForm[{" ", " ", " ", " ", " ", " ", " ", " ", " ", " "}, Center];
framex = {{-0.05, "-0.05 "}, {-0.025, "-0.025"}, {0, "0     "},
   {0.025, "0.025 "}, {0.05, "0.05  "}, {0.075, "0.075 "}, {0.1, "0.1   "}};
framey = {
   {-genes + endph5 / 2, "    ", 0},
   {-genes + (endph5 + endph1) / 2, "  ", 0},
   {-genes + (endph1 + endph2) / 2, " ", 0},
   {-genes + (endph2 + endph3) / 2, "    ", 0},
   {-genes + (endph3 + endph4) / 2, "    ", 0},
   {-(genes - endph4) / 2, "    ", 0}};
coordinates = Table[{eigenarrays[[2, a]], -a + 1}, {a, 1, genes}];
line = Line[coordinates];
g = Show[{
    Graphics[{RGBColor[0, 0.5, 0], line}],
    graph,
    Graphics[{RGBColor[0, 0.5, 0], Text["√(2/z) cos(2πz/z - π/8)", {0.054, -3500}]}]},
   Frame -> True,
   FrameLabel -> {None, labely, labelx, None},
   FrameTicks -> {None, None, framex, None},
   GridLines -> {{{0, RGBColor[0, 0, 0]}}, None},
   AspectRatio -> GoldenRatio * 1.15,
   PlotRange -> {{-0.05, 0.105}, {75, -genes + 1 - 75}},
   DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
   Text[labely, {b_, c_}, {1., 0.}] →
    Text[labely, {b, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {1., 0.}] →
    Text[a, {b - 0.01, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
   Text[labelx, {b_, c_}, {0., -1.}] →
    Text[labelx, {b, c + 1125}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
   Text[a_, {b_, c_}, {0., -1.}] →
    Text[a, {b, c + 575}, {0, 0}, {0, 1}];
p2 = Show[g,
   AspectRatio -> GoldenRatio * 1.2765,
   PlotRange -> All,
   DisplayFunction → Identity];

(* Display Selected Sorted Yeast Arraylets *)

g3 = Show[{p1, p2},
   DisplayFunction -> Identity];
```

```
(* Display Recosntructed Sorted Yeast Data, Arraylets and Selected Arraylets *)

Show[GraphicsArray[{g1, g2, g3}],
  GraphicsSpacing -> -0.15];
```




```
eigenarrays = Transpose[eigenarrays];
```

```
(* Display SVD & GSVD Cell Cycle Subspaces Sorted Yeast Data *)
```

```
Show[GraphicsArray[{{s1, s2, s3}, {s4, s5, s6}}],
    GraphicsSpacing -> 0];
```