10.1148/ryai.2020180050

Appendix E1

Patients Used for the Development of Classification Networks and in Radiogenomic Analysis

PatientID	VoxelDimensions (mm)	BitDepth	ScannerManufacturer	Field Strength (T)
TCGA_CS_4941_19960909	0.78124/0.78124/7.5	16	GE	1.5
TCGA_CS_4942_19970222	0.89844/0.89844/7.5	12	Philips	3
TCGA_CS_4943_20000902	0.85938/0.85938/2.5	12	Siemens	1.5
TCGA_CS_4944_20010208	0.85938/0.85938/2.5	12	Siemens	1.5
TCGA_CS_5393_19990606	0.85938/0.85938/2.5	12	Siemens	1.5
TCGA_CS_5395_19981004	0.85938/0.85938/2.5	12	Siemens	1.5
TCGA_CS_5396_20010302	0.6875/0.6875/7.5	12	Philips	3
TCGA_CS_5397_20010315	0.68452/0.68452/7.5	12	Philips	3
TCGA_CS_6186_20000601	0.85938/0.85938/7	12	Philips	1.5
TCGA_CS_6188_20010812	0.6875/0.6875/7.5	12	Philips	3
TCGA_CS_6290_20000917	0.85938/0.85938/2.5	12	Siemens	1.5
TCGA_CS_6665_20010817	0.6875/0.6875/6	12	Philips	3
TCGA_CS_6666_20011109	0.6875/0.6875/6	12	Philips	3
TCGA_CS_6667_20011105	0.4297/0.4297/7.5	16	GE	1.5
TCGA_CS_6668_20011025	0.6875/0.6875/6	12	Philips	3
TCGA_CS_6669_20020102	0.6875/0.6875/7.5	12	Philips	3
TCGA_DU_5849_19950405	0.4688/0.4688/5	16	GE	3
TCGA_DU_5851_19950428	0.9375/0.9375/5	16	GE	1.5
TCGA_DU_5852_19950709	0.4688/0.4688/5	16	GE	3
TCGA_DU_5853_19950823	0.4688/0.4688/5	16	GE	3
TCGA_DU_5854_19951104	0.9375/0.9375/5	16	GE	1.5
TCGA_DU_5855_19951217	0.9375/0.9375/6.0745	12	Philips	1.5
TCGA_DU_5871_19941206	0.4688/0.4688/5	16	GE	3
TCGA_DU_5872_19950223	0.9375/0.9375/2.5	16	GE	1.5
TCGA_DU_5874_19950510	0.4688/0.4688/5	16	GE	3
TCGA_DU_6399_19830416	0.938/0.938/3	16	GE	N/A
TCGA_DU_6400_19830518	0.938/0.938/3	16	GE	N/A
TCGA_DU_6401_19831001	0.938/0.938/3	16	GE	N/A
TCGA_DU_6404_19850629	0.938/0.938/3	16	GE	N/A
TCGA_DU_6405_19851005	0.938/0.938/3	16	GE	N/A
TCGA_DU_6407_19860514	0.9375/0.9375/3	16	GE	1.5
TCGA_DU_6408_19860521	0.938/0.938/3	16	GE	N/A
TCGA_DU_7008_19830723	0.938/0.938/3	16	GE	N/A
TCGA_DU_7010_19860307	0.9375/0.9375/3	16	GE	1.5
TCGA_DU_7013_19860523	0.78125/0.78125/3	16	GE	1.5
TCGA_DU_7014_19860618	0.938/0.938/3	16	GE	N/A
TCGA_DU_7018_19911220	0.4688/0.4688/5	16	GE	3
TCGA_DU_7019_19940908	0.4688/0.4688/5	16	GE	3
TCGA_DU_7294_19890104	0.46875/0.46875/5	16	GE	3
TCGA_DU_7298_19910324	0.9375/0.9375/5	16	GE	1.5
TCGA_DU_7299_19910417	0.46875/0.46875/5	16	GE	3
TCGA_DU_7300_19910814	0.4688/0.4688/5	16	GE	3

TCGA_DU_7301_19911112	0.4688/0.4688/5	16	GE	3
TCGA_DU_7302_19911203	0.4688/0.4688/5	16	GE	3
TCGA_DU_7304_19930325	0.4688/0.4688/5	16	GE	3
TCGA_DU_7306_19930512	0.4688/0.4688/5	16	GE	3
TCGA_DU_7309_19960831	0.4688/0.4688/5	16	GE	3
TCGA_DU_8162_19961029	0.4688/0.4688/5	16	GE	3
TCGA_DU_8163_19961119	0.4688/0.4688/5	16	GE	3
TCGA_DU_8164_19970111	0.4688/0.4688/5	16	GE	3
TCGA_DU_8165_19970205	0.4688/0.4688/5	16	GE	3
TCGA_DU_8166_19970322	0.4688/0.4688/5	16	GE	3
TCGA_DU_8167_19970402	0.4688/0.4688/5	16	GE	3
TCGA_DU_8168_19970503	0.4688/0.4688/5	16	GE	3
TCGA_DU_A5TP_19970614	0.4688/0.4688/5	16	GE	3
TCGA_DU_A5TR_19970726	0.4688/0.4688/5	16	GE	3
TCGA_DU_A5TS_19970726	0.9375/0.9375/5	16	GE	1.5
TCGA_DU_A5TT_19980318	0.46875/0.46875/2.5	12	Philips	3
TCGA_DU_A5TU_19980312	0.39062/0.39062/7	12	Hitachi	1.2
TCGA_DU_A5TW_19980228	0.51339/0.51339/6	12	Philips	1.5
TCGA_DU_A5TY_19970709	0.4688/0.4688/5	16	GE	3
TCGA_EZ_7264A_20010816	0.89844/0.89844/6	12	Siemens	1.5
TCGA_FG_5962_20000626	1.0/1.0/3	12	Siemens	3
TCGA_FG_5964_20010511	0.89844/0.89844/6.5	12	Siemens	1.5
TCGA_FG_6688_20020215	1.0/1.0/4	12	Siemens	1.5
TCGA_FG_6689_20020326	1.0/1.0/4	12	Siemens	1.5
TCGA_FG_6690_20020226	1.0/1.0/3	12	Siemens	3
TCGA_FG_6691_20020405	1.0/1.0/4	12	Siemens	1.5
TCGA_FG_6692_20020606	0.89844/0.89844/5.5	12	Siemens	1.5
TCGA_FG_7634_20000128	0.89844/0.89844/5.2	12	Siemens	3
TCGA_FG_7637_20000922	1.0/1.0/3	12	Siemens	3
TCGA_FG_7643_20021104	1.0/1.0/4	12	Siemens	1.5
TCGA_FG_8189_20030516	1.0/1.0/3.3	12	Siemens	3
TCGA_FG_A4MT_20020212	1.0/1.0/3	12	Siemens	1.5
TCGA_FG_A4MU_20030903	0.89844/0.89844/4.52	12	Siemens	3
TCGA_FG_A60 K_20040224	0.5/0.5/2	12	Siemens	3
TCGA_HT_7473_19970826	0.9375/0.9375/5	12	GE	1.5
TCGA_HT_7475_19970918	0.9375/0.9375/5	12	GE	1.5
TCGA_HT_7602_19951103	0.9375/0.9375/7.5	12	GE	1.5
TCGA_HT_7605_19950916	0.4688/0.4688/5	12	GE	3
TCGA_HT_7608_19940304	0.4688/0.4688/5	12	GE	3
TCGA_HT_7616_19940813	0.9375/0.9375/5	12	GE	1.5
TCGA_HT_7680_19970202	0.9375/0.9375/7.5	12	GE	1.5
TCGA_HT_7684_19950816	0.9375/0.9375/7.5	12	GE	1.5
TCGA_HT_7686_19950629	0.9375/0.9375/7.5	12	GE	1.5
TCGA_HT_7690_19960312	0.9375/0.9375/7.5	12	GE	1.5
TCGA_HT_7692_19960724	0.9375/0.9375/7.5	12	GE	1.5
TCGA_HT_7693_19950520	0.9375/0.9375/7.5	12	GE	1.5
TCGA_HT_7694_19950404	1.0156/1.0156/7.5	12	GE	1.5
TCGA_HT_7855_19951020	0.4688/0.4688/7.5	12	GE	3
TCGA_HT_7856_19950831	0.9375/0.9375/5	12	GE	1.5
TCGA_HT_7860_19960513	0.9375/0.9375/7.5	12	GE	1.5
TCGA_HT_7874_19950902	0.9375/0.9375/7.5	12	GE	1.5

TCGA_HT_7877_19980917	0.4688/0.4688/5	16	GE	3
TCGA_HT_7879_19981009	0.4688/0.4688/5	16	GE	3
TCGA_HT_7881_19981015	1.0156/1.0156/2	16	GE	1.5
TCGA_HT_7882_19970125	0.9375/0.9375/5	12	GE	1.5
TCGA_HT_7884_19980913	0.4688/0.4688/7	16	GE	1.5
TCGA_HT_8018_19970411	0.9375/0.9375/7.5	12	GE	1.5
TCGA_HT_8105_19980826	0.4688/0.4688/7	16	GE	1.5
TCGA_HT_8106_19970727	0.9375/0.9375/7.5	12	GE	1.5
TCGA_HT_8107_19980708	0.4688/0.4688/7.5	16	GE	3
TCGA_HT_8111_19980330	0.4688/0.4688/7	16	GE	1.5
TCGA_HT_8113_19930809	0.93749/0.93749/7.5	12	GE	1.5
TCGA_HT_8114_19981030	0.4688/0.4688/7	16	GE	1.5
TCGA_HT_8563_19981209	0.4688/0.4688/7	16	GE	1.5
TCGA_HT_A5RC_19990831	0.4688/0.4688/5	16	GE	1.5
TCGA_HT_A616_19991226	0.4688/0.4688/5	16	GE	3
TCGA_HT_A61A_20000127	1.0156/1.0156/2	16	GE	3
TCGA_HT_A61B_19991127	1.0156/1.0156/2	16	GE	3

Appendix E2

Table E2.1. Architecture of a Convolutional Neural Network Trained from Scratch on Low-Grade Glioma MRI Data Only. ReLU = Rectified Linear Unit, LRN = Local Response Normalization.

Layer	Data dimensions	Kernel size	Stride
Input	80 × 80x1	—	—
Convolution + ReLU	40 × 40x96	5 × 5	2 × 2
MaxPooling + LRN	20 × 20x96	3 × 3	2 × 2
Convolution + ReLU	20 × 20x256	5 × 5	1 × 1
MaxPooling + LRN	10 × 10x256	2 × 2	1 × 1
Convolution + ReLU	10 × 10x384	3 × 3	1 × 1
MaxPooling + LRN	5 × 5x384	3 × 3	2 × 2
Fully Connected + ReLU	512	—	—
Dropout (50%)	512	—	—
Fully Connected + ReLU	512	—	—
Dropout (50%)	512	—	—
Fully Connected	3	—	—
Softmax	3	—	—

Table E2.2. Hyperparameters Used for Training a Convolutional Neural Network from Scratch on LGG MRI Data Only.

Hyperparameter	Value
Number of backpropagation iterations	4000
Optimizer	Stochastic Gradient Descent (SGD)
Batch size	128
Momentum	0.9
Initial learning rate	0.001
Learning rate decay step size	1000 iterations
Learning rate decay value	0.5

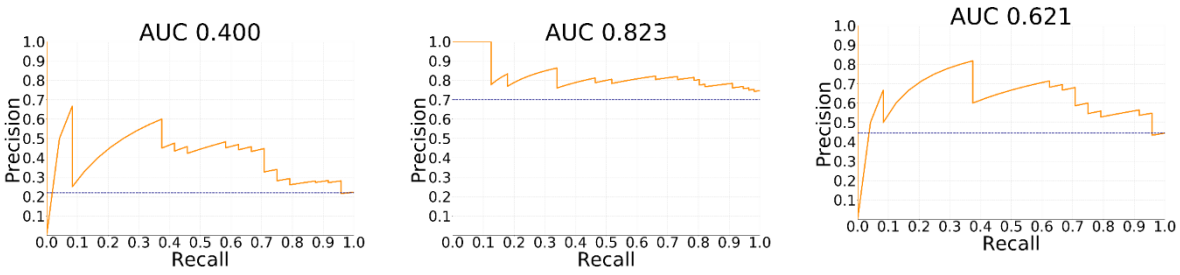
Table E2.3. Architecture of a Convolutional Neural Network Pretrained with Glioblastoma MRI data. ReLU = Rectified Linear Unit,

Layer	Data dimensions	Kernel size	Stride
Input	80 × 80 × 1	—	—
Convolution + ReLU	80 × 80 × 64	3 × 3	1 × 1
Convolution + ReLU	80 × 80 × 64	3 × 3	1 × 1
MaxPooling	40 × 40 × 96	3 × 3	2 × 2
Convolution + ReLU	20 × 20 × 128	3 × 3	1 × 1
Convolution + ReLU	20 × 20 × 128	3 × 3	1 × 1
MaxPooling	10 × 10 × 128	3 × 3	2 × 2
Fully Connected + ReLU	256	—	—
Dropout (50%)	256	—	—
Fully Connected + ReLU	256	—	—
Dropout (50%)	256	—	—
Fully Connected	3	—	—
Softmax	3	—	—

Table E2.4. Hyperparameters Used for Fine-Tuning a CNN Pretrained with GBM MRI Data.

Hyperparameter	Value
Number of backpropagation iterations	4000
Optimizer	Stochastic Gradient Descent (SGD)
Batch size	128
Momentum	0.9
Initial learning rate	0.003
Learning rate decay step size	1000 iterations
Learning rate decay value	0.5

Appendix E3

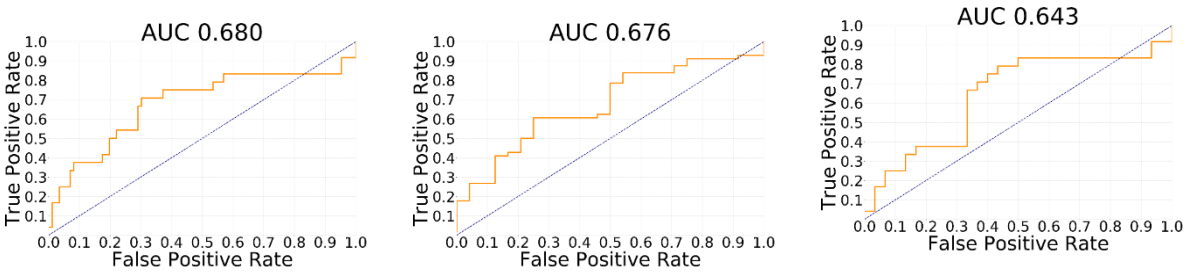


a) CoC2 vs all other clusters b) CoC1 vs CoC2 c) CoC2 vs CoC3

Figure E3.1: Precision/recall curves for transfer learning from GBM MRI experiment related to cluster CoC2.

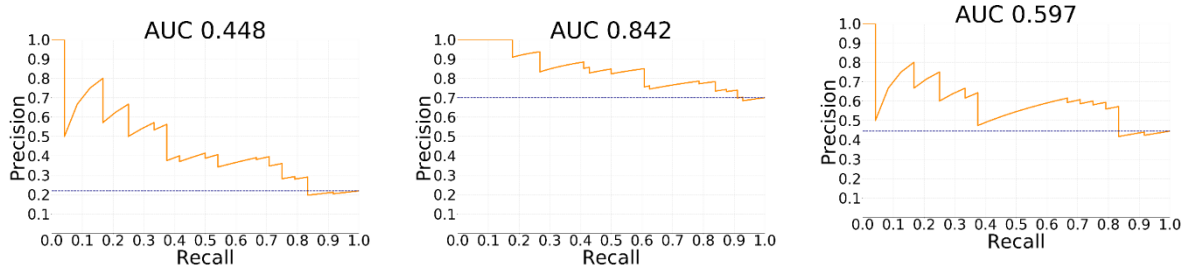
Table E3.1. Results for Classifying CoC with Respect to AUC with 95% Confidence Intervals for the Training from Scratch Experiment.

Output cluster	2	3	One versus all
1	0.676 [0.540, 0.804]	0.558 [0.415, 0.689]	0.610 [0.507, 0.719]
2	—	0.643 [0.481, 0.792]	0.680 [0.538, 0.811]
3	—	—	0.537 [0.405, 0.667]



a) CoC2 vs all other clusters b) CoC1 vs CoC2 c) CoC2 vs CoC3

Figure E3.2: ROC curves for discriminating CoC clusters for training from scratch experiment related to cluster CoC2.

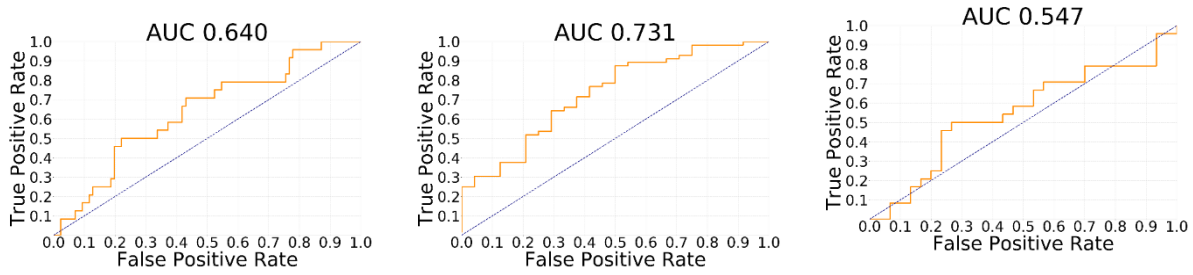


a) CoC2 vs all other clusters b) CoC1 vs CoC2 c) CoC2 vs CoC3

Figure E3.3: Precision/recall curves for discriminating CoC clusters for training from scratch experiment related to cluster CoC2.

Table E3.2: Results for Classifying CoC with Respect to AUC with 95% Confidence Intervals for the Transfer Learning from ImageNet Experiment.

Output cluster	2	3	One versus all
1	0.731 [0.601, 0.844]	0.667 [0.544, 0.782]	0.695 [0.599, 0.790]
2	—	0.547 [0.388, 0.699]	0.640 [0.521, 0.763]
3	—	—	0.507 [0.381, 0.639]

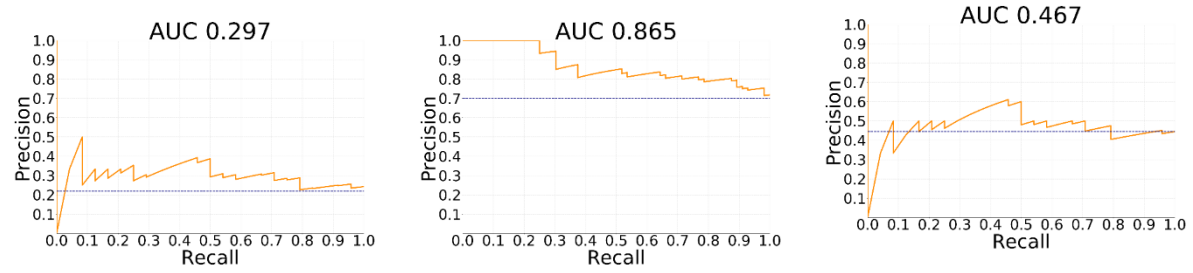


a) CoC2 vs all other clusters

b) CoC1 vs CoC2

c) CoC2 vs CoC3

Figure E3.4: ROC curves for discriminating CoC clusters for transfer learning from ImageNet experiment related to cluster 2.



a) CoC2 vs all other clusters

b) CoC1 vs CoC2

c) CoC2 vs CoC3

Figure E3.5: Precision/recall curves for discriminating CoC clusters for transfer learning from ImageNet experiment related to cluster CoC2.