Supplementary Table 9. The results of driver genes embedded in subgraph module and non-subgraph module. A pseudo-count was added if the number of embedded is zero, because the odds ratio is not well-defined. Odds ratio and total number of genes are listed in the last column. An odds ratio greater than one implies that driver genes are enriched in subgraph module.

module.				
Cancer Networks		Genes embedded	Genes not embedded	Odds
		in subgraph	in subgraph	ratio/total
Acute myeloid	Driver gene	18	0+1 (pseudo-count)	0.720
leukemia	Non-driver gene	25	0+1 (pseudo-count)	
[hsa05221]	Total	43	2	45
Basal cell	Driver gene	8	1	0.615
carcinoma	Non-driver gene	13	1	
[hsa05217]	Total	21	2	23
Breast cancer	Driver gene	23	4	1.643
[hsa05224]	Non-driver gene	28	8	
	Total	51	12	63
Choline metabolism	Driver gene	10	2	2.353
in cancer	Non-driver gene	17	8	
[hsa05231]	Total	27	10	37
Chronic myeloid	Driver gene	16	5	0.762
leukemia	Non-driver gene	21	5	
[hsa05220]	Total	37	10	47
Colorectal cancer	Driver gene	16	5	0.914
[hsa05210]	Non-driver gene	21	6	
	Total	37	11	48
Endometrial cancer	Driver gene	14	5	0.560
[hsa05213]	Non-driver gene	15	3	
	Total	29	8	37
Gastric cancer	Driver gene	21	7	1.355
[hsa05226]	Non-driver gene	31	14	
	Total	52	21	73
Glioma [hsa05214]	Driver gene	13	4	0.181
	Non-driver gene	18	1	
	Total	31	5	36
Hepatocellular	Driver gene	21	11	1.074
carcinoma	Non-driver gene	32	18	
[hsa05225]	Total	53	29	82
Melanoma	Driver gene	15	3	0.500
[hsa05218]	Non-driver gene	10	0+1 (pseudo-count)	
[Total	25	4	29
Non-small cell lung	Driver gene	18	2	2.500
cancer [hsa05223]	Non-driver gene	18	5	
	Total	36	7	43
Pancreatic cancer	Driver gene	19	2	0.704
[hsa05212]	Non-driver gene	27	2	27,01
[115405212]	Total	46	4	50
Pathways in cancer	Driver gene	52	2	2.187
[hsa05200]	Non-driver gene	107	9	2.107
[113403200]	11011-diliver gene	107	,	

	Total	159	11	170
Prostate cancer	Driver gene	16	7	1.143
[hsa05215]	Non-driver gene	20	10	
	Total	36	17	53
Renal cell	Driver gene	11	6	0.509
carcinoma	Non-driver gene	18	5	
[hsa05211]	Total	29	11	40
Small cell lung	Driver gene	8	6	0.286
cancer [hsa05222]	Non-driver gene	28	6	
	Total	36	12	48

GET I		Genes embedded	Genes not embedded	Odds
STN		in subgraph	in subgraph	ratio/total
Adipocytokine	Driver gene	4	0+1 (pseudo-count)	0.414
signaling pathway	Non-driver gene	29	3	
[hsa04920]	Total	33	4	37
AMPK signaling	Driver gene	4	4	0.262
pathway [hsa04152]	Non-driver gene	42	11	
	Total	46	15	61
Apelin signaling	Driver gene	8	1	1.436
pathway [hsa04371]		39	7	
	Total	47	8	55
B cell receptor	Driver gene	13	3	1.857
signaling pathway	Non-driver gene	21	9	
[hsa04662]	Total	34	12	46
Calcium signaling	Driver gene	5	0+1 (pseudo-count)	5.263
pathway [hsa04020]	Non-driver gene	19	20	
	Total	24	21	45
cAMP signaling	Driver gene	12	1	1.309
pathway [hsa04024]	Non-driver gene	55	6	
	Total	67	7	74
cGMP-PKG	Driver gene	5	0+1 (pseudo-count)	1.136
signaling pathway	Non-driver gene	44	10	
[hsa04022]	Total	49	11	60
Chemokine	Driver gene	12	0+1 (pseudo-count)	1.000
signaling pathway	Non-driver gene	36	3	
[hsa04062]	Total	48	4	52
C-type lectin	Driver gene	18	0+1 (pseudo-count)	1.000
receptor signaling	Non-driver gene	54	3	
pathway [hsa04625]	Total	72	4	76
ErbB signaling	Driver gene	16	1	0.444
pathway [hsa04012]	Non-driver gene	36	0+1 (pseudo-count)	
	Total	52	2	54
Estrogen signaling	Driver gene	11	1	1.737
pathway [hsa04915]	Non-driver gene	19	3	
	Total	30	4	34
	Driver gene	10	0+1 (pseudo-count)	5.000

Total Signaling pathway FoxO signaling pathway Driver gene 15 2 0.708	Fc epsilon RI	Non-driver gene	20	10	
Insa04664		_			4.1
Pathway Insa04068 Non-driver gene 53 5 Total 68 7 74 Total 68 7 74 Total 68 7 74 Total 1 1.926 Pathway Insa04922 Non-driver gene 27 13 Total 31 14 45 Total 31 14 45 Total 36 5 41 Total 23 2 25 Total 25 Total 25 Total 4 6 Total 52 Total 54 Total 55 Total 56 Total 56		Total	30	11	41
Pathway Insa04068 Non-driver gene 53 5 Total 68 7 74 Total 68 7 74 Total 68 7 74 Total 1 1.926 Pathway Insa04922 Non-driver gene 27 13 Total 31 14 45 Total 31 14 45 Total 36 5 41 Total 23 2 25 Total 25 Total 25 Total 4 6 Total 52 Total 54 Total 55 Total 56 Total 56	FoxO signaling	Driver gene	15	2	0.708
Total 68 7 74	pathway [hsa04068]		53	5	
Pathway [hsa04922]			68	7	74
Pathway [hsa04922]	Glucagon signaling	Driver gene	4	1	1.926
Total			27	13	
Pathway [hsa04912] Non-driver gene 25 4	•		31	14	45
Pathway [hsa04912] Non-driver gene 25 4	GnRH signaling	Driver gene	11	0+1 (pseudo-count)	1.760
Total			25		
Dathway [hsa04340] Non-driver gene 17			36	5	41
Dathway [hsa04340] Non-driver gene 17	Hedgehog signaling	Driver gene	6	0+1 (pseudo-count)	0.353
Total 23 2 25	pathway [hsa04340]		17		
Pathway [hsa04066] Non-driver gene Total 52 10 62	•		23		25
Pathway [hsa04066] Non-driver gene Total 52 10 62	HIF-1 signaling			4	
Total 52 10 62 Hippo signaling pathway [hsa04390] Driver gene 8 5 0.4 Non-driver gene 52 13 Total 60 18 78 Insulin signaling pathway [hsa04910] Driver gene 9 2 0.587 Non-driver gene 9 2 0.587 Non-driver gene 46 6 Total 55 8 63 Jak-STAT signaling pathway [hsa04630] Driver gene 11 0+1 (pseudo-count) 0.500 Non-driver gene 22 1 Total 33 2 35 MAPK signaling pathway [hsa04010] Driver gene 21 0+1 (pseudo-count) 0.457 Non-driver gene 92 2 Total 113 3 116 mTOR signaling pathway [hsa04150] Non-driver gene 10 3 0.580 Non-driver gene 21 1 0.840 Non-driver gene 21 1 0.840 Non-driver gene 21 1 0.840 Non-driver gene 50 2 NF-kappa B signaling pathway [hsa04722] Total 71 3 74 NOD-like receptor signaling pathway [hsa0464] Total 70 31 101 NOD-like receptor signaling pathway [hsa04621] Total 70 31 101 Notch signaling pathway [hsa04621] Total 96 19 115 Notch signaling pathway [hsa04330] Driver gene 1 2 0.250 Non-driver gene 16 8 Total 17 10 27 Oxytocin signaling pathway [hsa04921] Non-driver gene 11 1 1.571 Non-driver gene Driver gene 10 27 Oxytocin signaling pathway [hsa04921] Non-driver gene 11 1 1.571 Non-driver gene 10 27 Oxytocin signaling pathway [hsa04921] Non-driver gene 11 1 1.571 Non-driver gene 12 1 1.571 Non-driver gene 13 5 5 Oxytocin signaling pathway [hsa04921] Non-driver gene 35 5	pathway [hsa04066]		44	6	
Dathway Dath		Total	52	10	62
Dathway Dath	Hippo signaling	Driver gene	8	5	0.4
Insulin signaling pathway [hsa04910]		Non-driver gene	52	13	
Data		Total	60	18	78
Total 55 8 63 Jak-STAT signaling pathway [hsa04630] MAPK signaling pathway [hsa04010] Mon-driver gene pathway [hsa04010] Mon-driver gene pathway [hsa04010] Mon-driver gene pathway [hsa04150] Non-driver gene pathway [hsa04722] Non-driver gene pathway [hsa04722] Non-driver gene pathway [hsa04064] Non-driver gene pathway [hsa04064] Non-driver gene pathway [hsa04064] Non-driver gene pathway [hsa04330] Non-driver gene pathway [hsa04330] Non-driver gene pathway [hsa04330] Non-driver gene pathway [hsa04921] Notch signaling pathway [hsa04921] Non-driver gene pathway [hsa0	Insulin signaling	Driver gene	9	2	0.587
Total 55 8 63 Jak-STAT signaling pathway [hsa04630] Driver gene pathway [hsa04630] Driver gene pathway [hsa04010] Driver gene pathway [hsa04010] Driver gene pathway [hsa04010] Driver gene pathway [hsa04150] Driver gene pathway [hsa04150] Non-driver gene pathway [hsa04722] Driver gene pathway [hsa04064] Non-driver gene pathway [hsa04064] Non-driver gene pathway [hsa04064] Non-driver gene pathway [hsa04621] Non-driver gene pathway [hsa04330] Driver gene pathway [hsa04330] Driver gene pathway [hsa04921] Driver gene pathway [hsa04921]	pathway [hsa04910]	Non-driver gene	46	6	
Description			55	8	63
Total 33 2 35 MAPK signaling pathway [hsa04010] Non-driver gene 92 2 Total 113 3 116 mTOR signaling pathway [hsa04150] Non-driver gene 10 3 0.580 Poiver gene 46 8 Total 56 11 67 Neurotrophin signaling pathway [hsa04722] Total 71 3 74 NF-kappa B signaling pathway [hsa04064] Total 70 31 101 NOD-like receptor signaling pathway [hsa04621] Total 96 19 115 Notch signaling pathway [hsa04330] Non-driver gene 10 3 0.580 Non-driver gene 21 1 0.840 Solution	Jak-STAT signaling	Driver gene	11	0+1 (pseudo-count)	0.500
MAPK signaling pathway [hsa04010] Driver gene 21 0+1 (pseudo-count) 0.457 mTOR signaling pathway [hsa04150] Total 113 3 116 mTOR signaling pathway [hsa04150] Driver gene 10 3 0.580 Neurotrophin signaling pathway [hsa04722] Total 56 11 67 NF-kappa B signaling pathway [hsa04064] Driver gene 8 6 0.538 Non-driver gene 8 6 0.538 NOD-like receptor signaling pathway [hsa04621] Total 70 31 101 NOD-like receptor signaling pathway [hsa04330] Non-driver gene 87 18 15 Notch signaling pathway [hsa04330] Total 96 19 115 Notch signaling pathway [hsa04921] Non-driver gene 16 8 Total 17 10 27 Oxytocin signaling pathway [hsa04921] Driver gene 11 1 1.571 Non-driver gene 35 5	pathway [hsa04630]	Non-driver gene	22	1	
Non-driver gene 92 2 2		Total	33	2	35
Non-driver gene 92 2 2	MAPK signaling	Driver gene	21	0+1 (pseudo-count)	0.457
mTOR signaling pathway [hsa04150] Driver gene 10 3 0.580 Neurotrophin signaling pathway [hsa04722] Driver gene 21 1 0.840 NF-kappa B signaling pathway [hsa0464] Driver gene 8 6 0.538 Non-driver gene 8 6 0.538 Non-driver gene 8 6 0.538 Non-driver gene 62 25 Insa04064] Total 70 31 101 NOD-like receptor signaling pathway [hsa04621] Driver gene 9 0+1 (pseudo-count) 1.862 Non-driver gene 87 18 Non-driver gene 1 2 0.250 Pathway [hsa04330] Non-driver gene 16 8 Total 17 10 27 Oxytocin signaling pathway [hsa04921] Driver gene 11 1 1.571 Non-driver gene 35 5 5	pathway [hsa04010]		92	2	
Non-driver gene 46 8 Total 56 11 67		Total	113	3	116
Non-driver gene 46 8 Total 56 11 67	mTOR signaling	Driver gene	10	3	0.580
Neurotrophin signaling pathway [hsa04722] Driver gene 21 1 0.840 Non-driver gene [hsa04722] Total 71 3 74 NF-kappa B signaling pathway [hsa04064] Driver gene 8 6 0.538 Non-driver gene [hsa04064] Total 70 31 101 NOD-like receptor signaling pathway [hsa04621] Driver gene 9 0+1 (pseudo-count) 1.862 Notch signaling pathway [hsa04330] Total 96 19 115 Notch signaling pathway [hsa04330] Driver gene 1 2 0.250 Non-driver gene pathway [hsa04330] Total 17 10 27 Oxytocin signaling pathway [hsa04921] Driver gene 11 1 1.571 Non-driver gene pathway [hsa04921] Non-driver gene 35 5			46	8	
Non-driver gene So 2		Total	56	11	67
[hsa04722] Total 71 3 74 NF-kappa B signaling pathway [hsa04064] Driver gene 8 6 0.538 Non-driver gene [hsa04064] Total 70 31 101 NOD-like receptor signaling pathway [hsa04621] Driver gene 9 0+1 (pseudo-count) 1.862 Non-driver gene signaling pathway [hsa04621] Total 96 19 115 Notch signaling pathway [hsa04330] Driver gene 1 2 0.250 Non-driver gene pathway [hsa04330] Non-driver gene 16 8 8 Oxytocin signaling pathway [hsa04921] Driver gene 11 1 1.571 Oxytocin signaling pathway [hsa04921] Non-driver gene 35 5 5	Neurotrophin	Driver gene	21	1	0.840
NF-kappa B signaling pathway [hsa04064] Driver gene 8 6 0.538 Non-driver gene [hsa04064] Total 70 31 101 NOD-like receptor signaling pathway [hsa04621] Driver gene 9 0+1 (pseudo-count) 1.862 Non-driver gene [hsa04621] Total 96 19 115 Notch signaling pathway [hsa04330] Driver gene [hsa04330] 1 2 0.250 Pathway [hsa04330] Non-driver gene [hsa04921] 1 1 1.571 Oxytocin signaling pathway [hsa04921] Driver gene [hsa04921] 1 1 1.571	signaling pathway	Non-driver gene	50	2	
signaling pathway [hsa04064] Non-driver gene 62 25 NOD-like receptor signaling pathway [hsa04621] Driver gene 9 0+1 (pseudo-count) 1.862 Notch signaling pathway [hsa04330] Total 96 19 115 Notch signaling pathway [hsa04330] Driver gene 1 2 0.250 pathway [hsa04330] Non-driver gene 16 8	[hsa04722]	Total	71	3	74
[hsa04064] Total 70 31 101 NOD-like receptor signaling pathway [hsa04621] Driver gene 9 0+1 (pseudo-count) 1.862 Non-driver gene signaling pathway [hsa04621] Total 96 19 115 Notch signaling pathway [hsa04330] Driver gene 1 2 0.250 pathway [hsa04330] Non-driver gene 16 8 27 Oxytocin signaling pathway [hsa04921] Driver gene 11 1 1.571 Non-driver gene pathway [hsa04921] Non-driver gene 35 5	NF-kappa B	Driver gene	8	6	0.538
NOD-like receptor signaling pathway [hsa04621] Driver gene 9 0+1 (pseudo-count) 1.862 Non-driver gene [hsa04621] Total 96 19 115 Notch signaling pathway [hsa04330] Driver gene 1 2 0.250 pathway [hsa04330] Non-driver gene 16 8	signaling pathway	Non-driver gene	62	25	
signaling pathway Non-driver gene 87 18 [hsa04621] Total 96 19 115 Notch signaling pathway [hsa04330] Driver gene 1 2 0.250 pathway [hsa04330] Non-driver gene 16 8 Total 17 10 27 Oxytocin signaling pathway [hsa04921] Driver gene 11 1 1.571 pathway [hsa04921] Non-driver gene 35 5	[hsa04064]	Total	70	31	101
[hsa04621] Total 96 19 115 Notch signaling pathway [hsa04330] Driver gene 1 2 0.250 pathway [hsa04330] Non-driver gene 16 8 Total 17 10 27 Oxytocin signaling pathway [hsa04921] Driver gene 11 1 1.571 pathway [hsa04921] Non-driver gene 35 5	NOD-like receptor	Driver gene	9	0+1 (pseudo-count)	1.862
Notch signaling pathway [hsa04330] Driver gene 1 2 0.250 Pathway [hsa04330] Non-driver gene 16 8 Total 17 10 27 Oxytocin signaling pathway [hsa04921] Driver gene 11 1 1.571 Pathway [hsa04921] Non-driver gene 35 5		Non-driver gene	87	18	
pathway [hsa04330] Non-driver gene 16 8 Total 17 10 27 Oxytocin signaling pathway [hsa04921] Driver gene 11 1 1.571 pathway [hsa04921] Non-driver gene 35 5	[hsa04621]	Total	96	19	115
Total 17 10 27 Oxytocin signaling Driver gene 11 1 1.571 pathway [hsa04921] Non-driver gene 35 5	Notch signaling	Driver gene	1	2	0.250
Oxytocin signaling Driver gene 11 1 1.571 pathway [hsa04921] Non-driver gene 35 5	pathway [hsa04330]	Non-driver gene	16	8	
pathway [hsa04921] Non-driver gene 35 5		Total	17	10	27
pathway [hsa04921] Non-driver gene 35 5	Oxytocin signaling	Driver gene	11	1	1.571
Total 46 6 52		Non-driver gene	35	5	
		Total	46	6	52

p53 signaling	Driver gene	14	3	0.491
pathway [hsa04115]		38	4	
•	Total	52	7	59
Phosphatidylinosito	Driver gene	2	0+1 (pseudo-count)	0.240
l signaling system	Non-driver gene	25	3	
[hsa04070]	Total	27	4	31
Phospholipase D	Driver gene	12	1	2.710
signaling pathway	Non-driver gene	31	7	
[hsa04072]	Total	43	8	51
PI3K-Akt signaling	Driver gene	20	6	1.020
pathway [hsa04151]		49	15	1.020
F	Total	69	21	90
PPAR signaling	Driver gene	1	0+1 (pseudo-count)	0.075
pathway [hsa03320]		53	4	0.075
	Total	54	5	58
Prolactin signaling	Driver gene	11	0+1 (pseudo-count)	0.407
pathway [hsa04917]		27	0+1 (pseudo-count)	0.407
paniway [iisao+717]	Total	38	2	40
Rap1 signaling		13	1	3.434
pathway [hsa04015]	Driver gene	53	14	3.434
paurway [118a04013]			15	81
Doggionalina	Total	66		
Ras signaling	Driver gene	15	0+1 (pseudo-count)	0.900
pathway [hsa04014]	Non-driver gene	50	3	60
D 1 ' ' 1'	Total	65	4	69
Relaxin signaling	Driver gene	11	1	1.447
pathway [hsa04926]		38	5	
DIG 1 111	Total	49	6	55
RIG-I-like receptor	Driver gene	3	2	1.050
signaling pathway	Non-driver gene	30	21	
[hsa04622]	Total	33	23	56
Sphingolipid	Driver gene	12	0+1 (pseudo-count)	3.636
signaling pathway	Non-driver gene	33	10	
[hsa04071]	Total	45	11	56
T cell receptor	Driver gene	14	3	1.640
signaling pathway	Non-driver gene	37	13	
[hsa04660]	Total	51	16	67
TGF-beta signaling	Driver gene	8	2	1.517
pathway [hsa04350]	Non-driver gene	29	11	
	Total	37	13	50
Thyroid hormone	Driver gene	18	3	2.516
signaling pathway	Non-driver gene	31	13	
[hsa04919]	Total	49	16	65
TNF signaling	Driver gene	6	3	1.778
pathway [hsa04668]		36	32	
	Total	42	35	77
	Driver gene	7	0+1 (pseudo-count)	0.831
	Non-driver gene	59	7	

Toll-like receptor signaling pathway	Total			74
[hsa04620]		66	8	
VEGF signaling	Driver gene	10	0+1 (pseudo-count)	0.556
pathway [hsa04370]	Non-driver gene	18	0+1 (pseudo-count)	
	Total	28	2	30
Wnt signaling	Driver gene	13	1	0.491
pathway [hsa04310]	Non-driver gene	53	2	
	Total	66	3	69

Cellular Processes		Genes embedded		Odds
Central Frocesses		in subgraph	in subgraph	ratio/total
Adherens junction	Driver gene	13	3	0.699
[hsa04520]	Non-driver gene	31	5	
	Total	44	8	52
Apoptosis	Driver gene	17	1	2.194
[hsa04210]	Non-driver gene	62	8	
	Total	79	9	88
Cell cycle	Driver gene	12	5	1.670
[hsa04110]	Non-driver gene	46	32	
	Total	58	37	95
Cellular senescence	Driver gene	19	5	1.086
[hsa04218]	Non-driver gene	49	14	
	Total	68	19	87
Focal adhesion	Driver gene	15	0+1 (pseudo-count)	0.333
[hsa04510]	Non-driver gene	45	1	
	Total	60	2	62
Gap junction	Driver gene	9	0+1 (pseudo-count)	0.360
[hsa04540]	Non-driver gene	25	0+1 (pseudo-count)	
	Total	34	2	36
Necroptosis	Driver gene	8	0+1 (pseudo-count)	1.098
[hsa04217]	Non-driver gene	51	7	
	Total	59	8	67
Regulation of actin	Driver gene	11	0+1 (pseudo-count)	2.933
cytoskeleton	Non-driver gene	45	12	
[hsa04810]	Total	56	13	69
Signaling pathways	Driver gene	19	4	5.700
regulating	Non-driver gene	20	24	
pluripotency of				
stem cells	Total			67
[hsa04550]		39	28	