

Graphic Lasso: $r = 5, \rho = 2000$ algorithm result

Jiixin Hu

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1 Settings

Let $\rho = 2000$ and $r = 5$. The corresponding model is

$$\Omega^k = \Theta_0 + \sum_{l=1}^r u_{kl} \Theta_l,$$

where $\mathbf{U} = \llbracket u_{kl} \rrbracket \in \mathbb{R}^{K \times r}$ has non-overlapped columns. The following are the results after 100 iterations.

2 Convergency Performance

The algorithm did not converge after 100 iterations. The objective function keep decreasing in general, expect the first few iterations. Note that there exist some fluctuations after about 30 iterations. The objective may act like “3.8 - 3.5 - 3.7 - 3.6 - 3.4”. See the objective value trajectory in Figure 1.

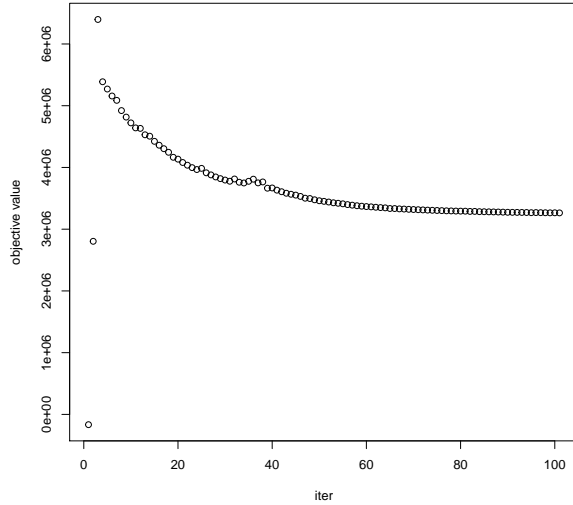


Figure 1: The trajectory of objective values in 100 iterations.

3 Membership Results

Based on \hat{U} , we obtain the membership result for 53 tissues. See Table 1. For comparison, the membership result after 50 iterations is in Table 2.

Note that the membership results after 100 iterations are not much better than 50 iterations. The number of genes may be a factor which has stronger influence to the clustering results.

$A_0 : u_{kl} = 0, l \in [5]$	Minor Salivary Gland ,Brain - Cortex ,Adrenal Gland, Thyroid ,Lung ,Spleen ,Pancreas ,Colon - Sigmoid ,Prostate ,Testis ,Nerve - Tibial, Heart - Left Ventricle ,Pituitary ,Brain - Cerebellum ,Cells - Transformed fibroblasts Artery - Aorta ,Cells - EBV-transformed lymphocytes ,Liver Kidney - Cortex ,Brain - Hippocampus ,Artery - Tibial , Brain - Substantia nigra ,Brain - Anterior cingulate cortex (BA24) Brain - Frontal Cortex (BA9) ,Brain - Cerebellar Hemisphere Brain - Caudate (basal ganglia) ,Brain - Nucleus accumbens (basal ganglia) Brain - Putamen (basal ganglia) ,Brain - Hypothalamus Brain - Spinal cord (cervical c-1) ,Brain - Amygdala Artery - Coronary ,Fallopian Tube ,Bladder ,Cervix - Ectocervix Cervix - Endocervix ,Heart - Atrial Appendage Adipose - Visceral (Omentum) ,Ovary ,Uterus
$A_1 : u_{k1} \neq 0$	Whole Blood Breast - Mammary Tissue Muscle - Skeletal
$A_2 : u_{k2} \neq 0$	Adipose - Subcutaneous
$A_3 : u_{k3} \neq 0$	Stomach, Small Intestine - Terminal Ileum, Colon - Transverse
$A_4 : u_{k4} \neq 0$	Esophagus - Muscularis, Esophagus - Gastroesophageal Junction
$A_5 : u_{k5} \neq 0$	Vagina, Skin - Not Sun Exposed (Suprapubic) Esophagus - Mucosa, Skin - Sun Exposed (Lower leg)

Table 1: Membership result for 53 tissues.

The membership results after 100 iterations is not promising as the results after 50 iterations. Most of the tissues share the global network. On the other hand, some useful patterns are kept. For example, the group A_1 and A_2 are driven by tissues with fat, A_4 is about Esophagus, and skins are clustered in A_5 .

4 Joint Glasso vs Separate Glasso

Here we compare the joint Glasso result (with 50 iterations) and the separate Glasso result for the group A_3 (skin). Figure 2 shows the separate Glasso estimation of Θ in skin tissue. Figure 3 shows the joint Glasso estimation of skin tissue, which is equal to $\Theta_0 + u_{k3}\Theta_3$. Since we only consider top 30 correlations, the joint estimation is dominated by the global correlation network Θ_0 .

The correlations occur in both estimations are circled with the same color in the two networks. Then, to check which estimation is more biological meaningful, we check the other correlations.

In my opinion, the estimation with joint glasso is better, because most of the non-overlapped correlation happen between two genes from one family. For example, “KRT5-KRT14”, and “CKMT1A -

$A_0 : u_{kl} = 0, l \in [5]$	Minor Salivary Gland, Brain - Cortex Adrenal Gland, Thyroid, Spleen, Pancreas, Colon - Sigmoid, Small Intestine - Terminal Ileum, Prostate, Testis, Nerve - Tibial Heart - Left Ventricle, Pituitary, Brain - Cerebellum, Cells - Transformed fibroblasts, Artery - Aorta, Cells - EBV-transformed lymphocytes, Liver, Kidney - Cortex, Brain - Anterior cingulate cortex (BA24), Brain - Frontal Cortex (BA9) Brain - Cerebellar Hemisphere, Brain - Hypothalamus, Brain - Amygdala, Artery - Coronary, Fallopian Tube, Bladder, Cervix - Ectocervix Cervix - Endocervix, Heart - Atrial Appendage, Ovary, Uterus
$A_1 : u_{k1} \neq 0$	Whole Blood, Breast - Mammary Tissue Adipose - Subcutaneous, Muscle - Skeletal
$A_2 : u_{k2} \neq 0$	Lung, Stomach, Artery - Tibial, Adipose - Visceral (Omentum)
$A_3 : u_{k3} \neq 0$	Skin - Not Sun Exposed (Suprapubic) Skin - Sun Exposed (Lower leg)
$A_4 : u_{k4} \neq 0$	Vagina, Esophagus - Mucosa, Colon - Transverse, Brain - Hippocampus Brain - Substantia nigra, Brain - Caudate (basal ganglia), Brain - Nucleus accumbens (basal ganglia), Brain - Putamen (basal ganglia), Brain - Spinal cord
$A_5 : u_{k5} \neq 0$	Esophagus - Muscularis, Esophagus - Gastroesophageal Junction

Table 2: Membership result for 53 tissues.

CKMT1B". However, in separate glasso, the correlations are not very significant from the biological meaning.

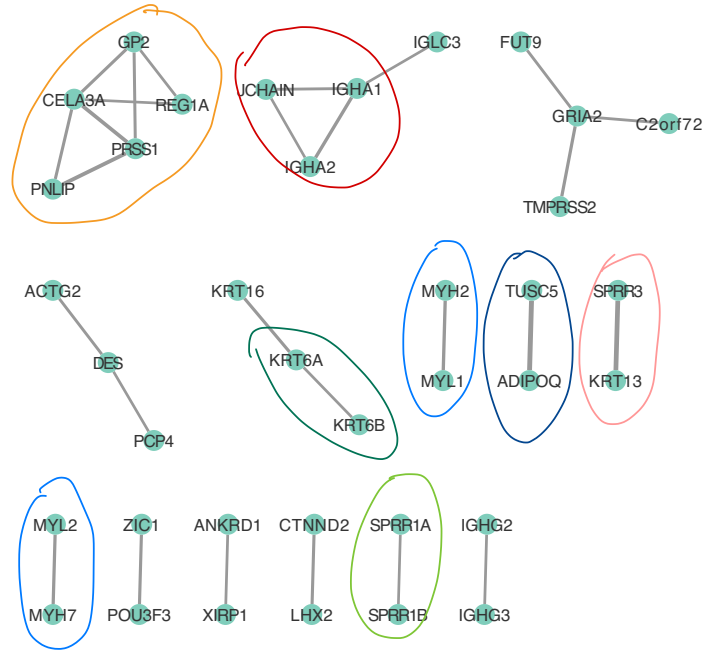


Figure 2: Separate Glasso for the skin tissues Θ . Here include top 30 correlations.

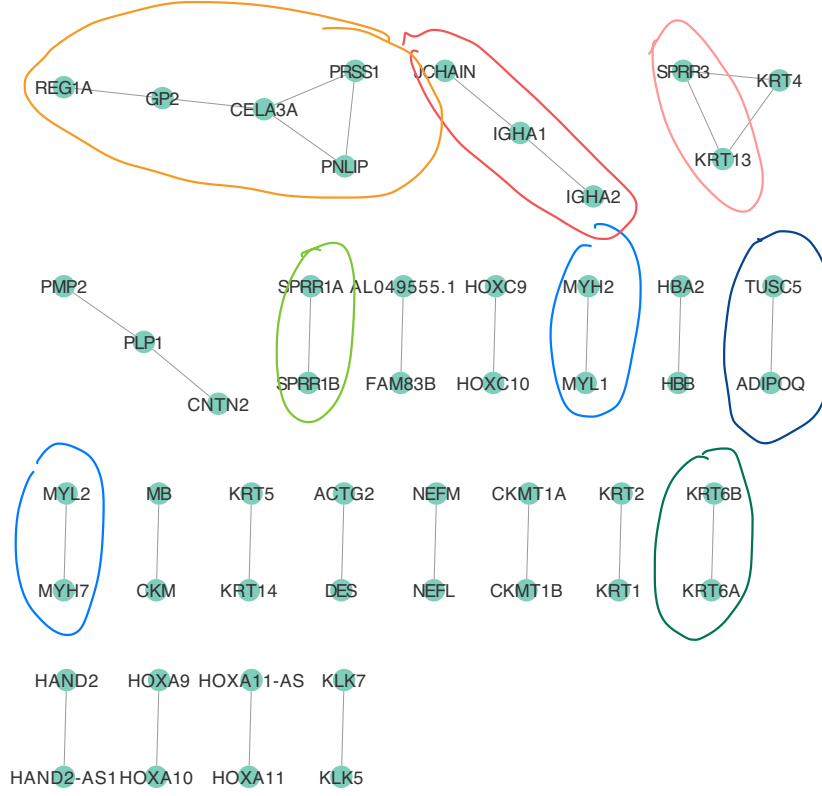


Figure 3: Joint Glasso for the skin tissues $\Theta_0 + u_{k3}\Theta_3$. Here include top 30 correlations.