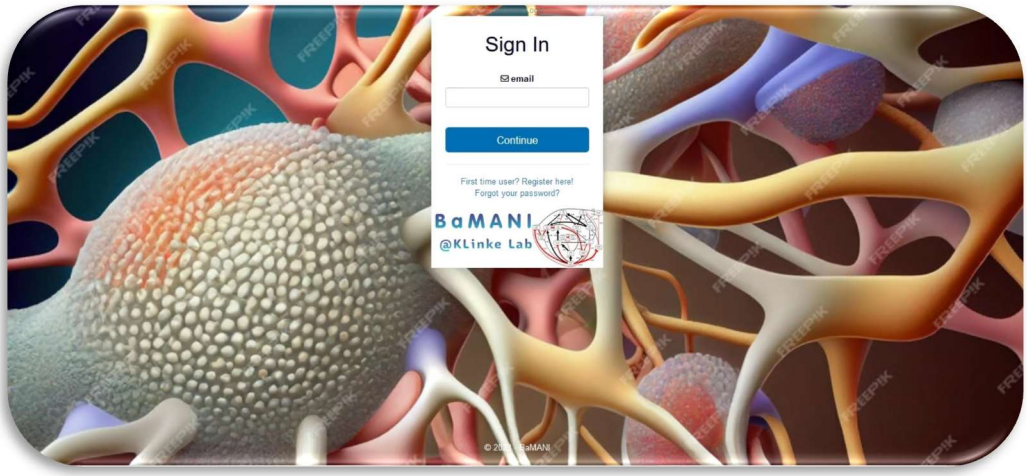
User Guide for BaMANI: Bayesian Multi-Algorithm Network Inference

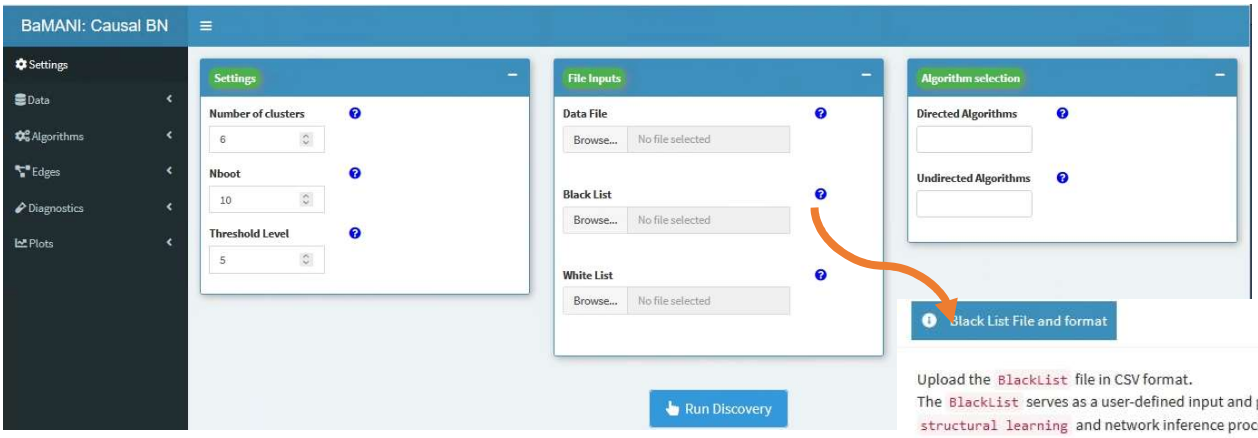
Introduction

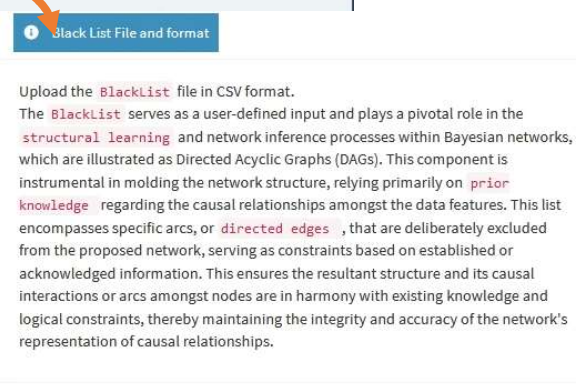
BaMANI is a powerful tool for Bayesian network inference, utilizing a range of algorithms to deduce structure and causality in networks. The following guide walks you through the process of using BaMANI, from creating blacklists based on domain knowledge to learning the final network structure.

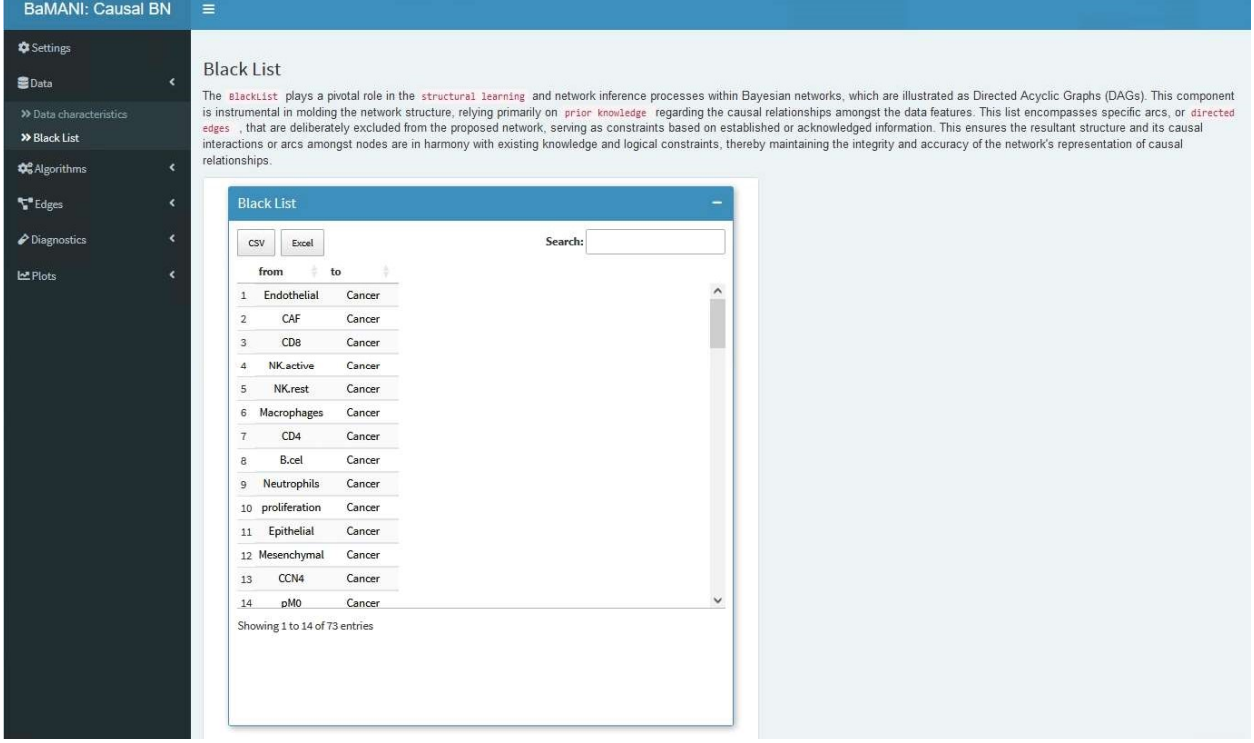


Step 1: Creating and Specifying a Blacklist

- **Objective**: To input a blacklist that outlines prior knowledge and removes implausible arcs. Ensure the blacklist aligns with your domain knowledge and data characteristics
- **Process**:
    - Remove arcs inconsistent with oncogenesis.
    - Specify nodes with majority zero values as leaf nodes.

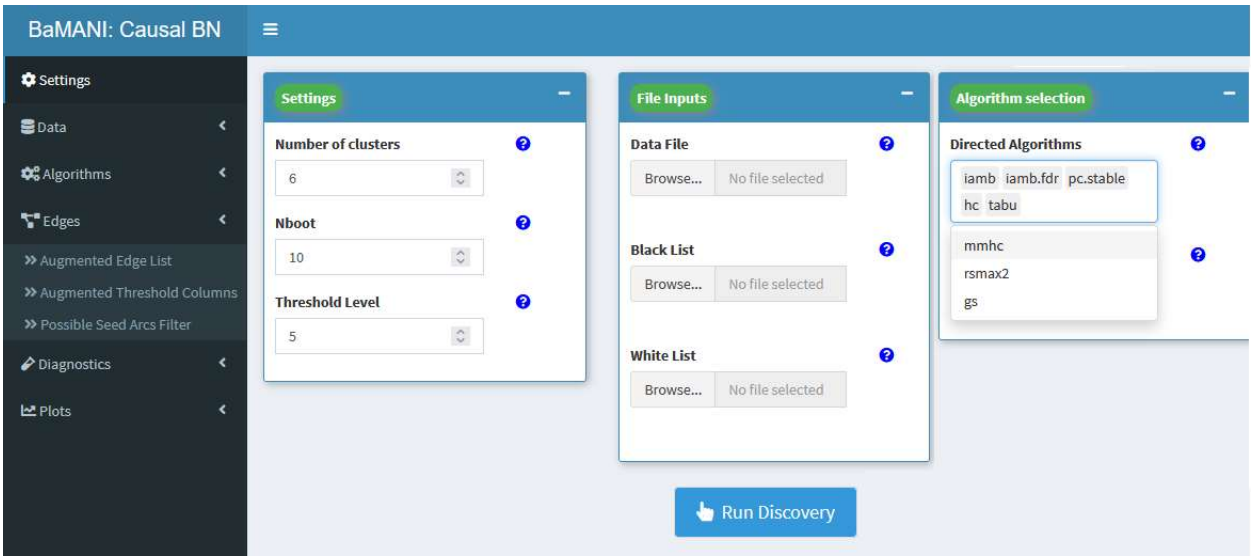




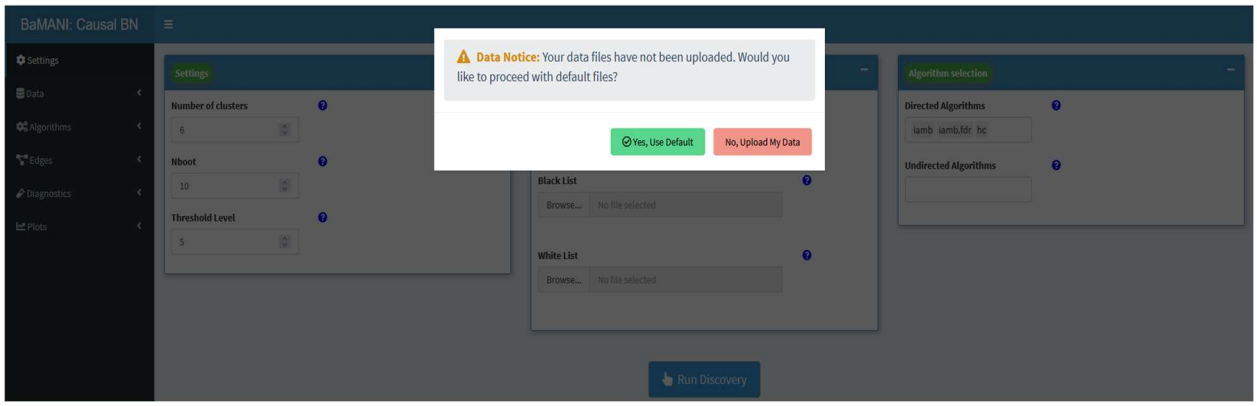


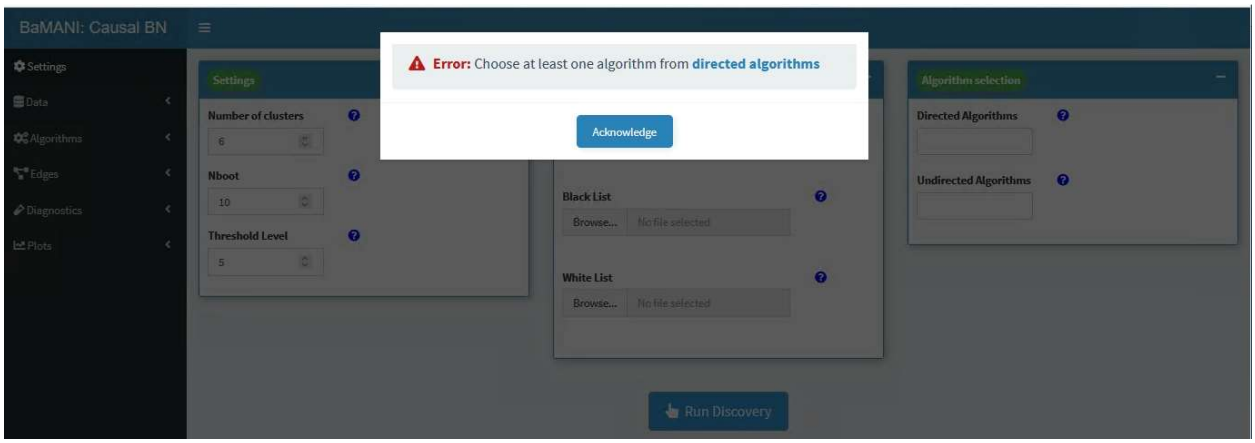
Step 2: Generating an Ensemble of Potential Arcs

- **Objective**: To generate a seed edge list using an ensemble of structural learning algorithms.
- **Process**:



- Use the predefined blacklist to learn the network structure.
- Employ various structur learning algorithms (e.g., IAMB.FDR, PC.STABLE) with bootstrapped arc strength calculations.


BaMANI: Causal BN
Settings
Data
Algorithms
Edges
Diagnostics
Plots
Data Notice: Your data files have not been uploaded. Would you like to proceed with default files?
Yes, Use Default
No, Upload My Data
Settings
Number of clusters
6
Nboot
10
Threshold Level
5
Black List
Browse...
No file selected
White List
Browse...
No file selected
Algorithm selection
Directed Algorithms
iamb iamb.fdr hc
Undirected Algorithms
Run Discovery


BaMANI: Causal BN
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Algorithms
Edges
Diagnostics
Plots
Error: Choose at least one algorithm from directed algorithms
Acknowledge
Settings
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6
Nboot
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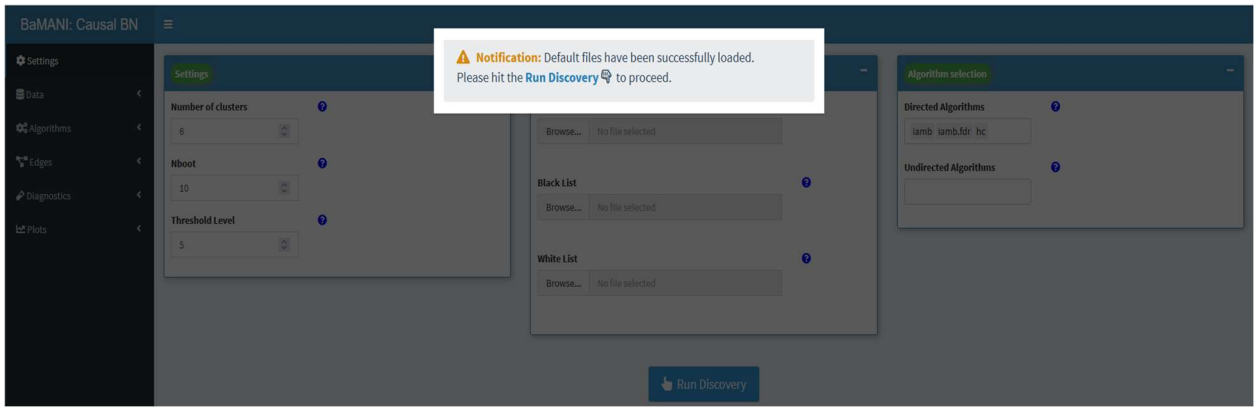
Threshold Level
5
Black List
Browse...
No file selected
White List
Browse...
No file selected
Algorithm selection
Directed Algorithms
Undirected Algorithms
Run Discovery


BaMANI: Causal BN
Settings
Data
Algorithms
Edges
Diagnostics
Plots
Notification: Default files have been successfully loaded.
Please hit the Run Discovery to proceed.
Settings
Number of clusters
6
Nboot
10
Threshold Level
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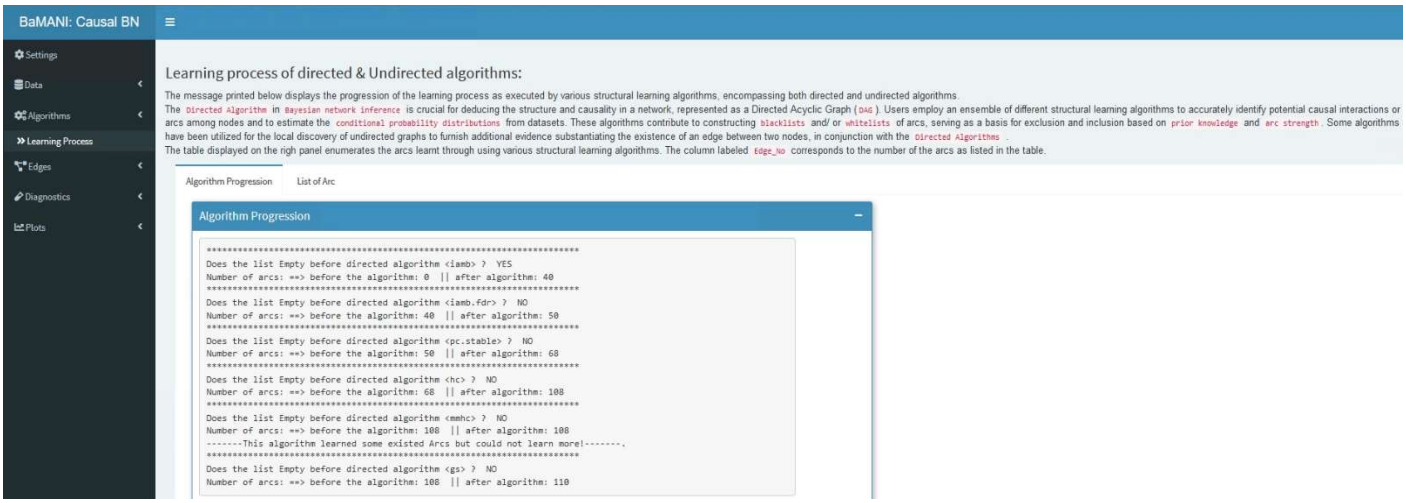
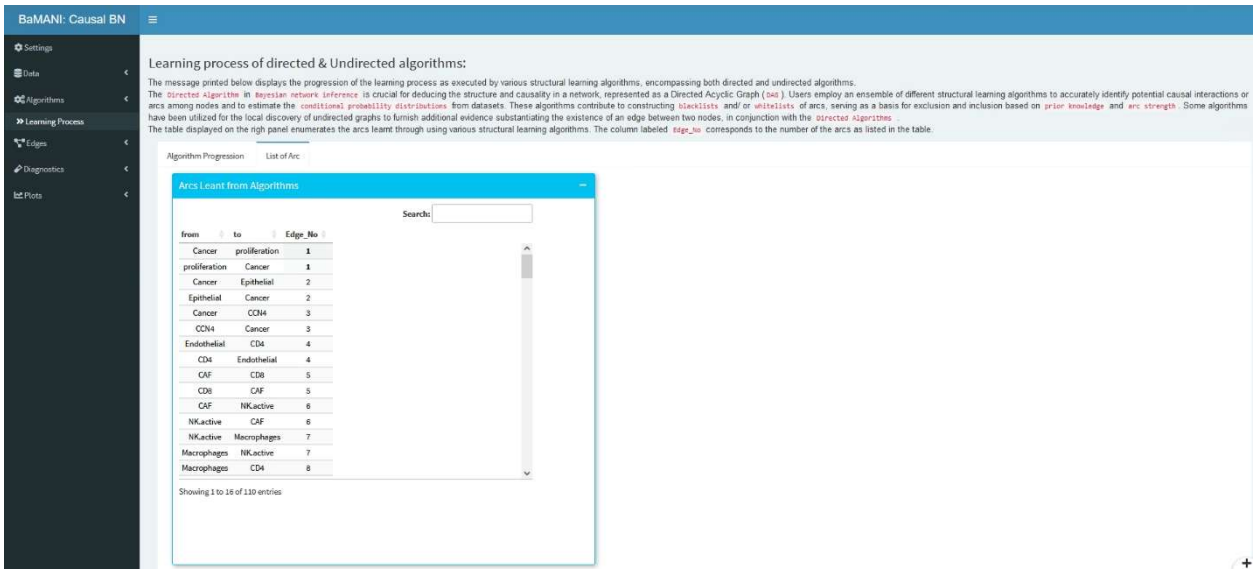
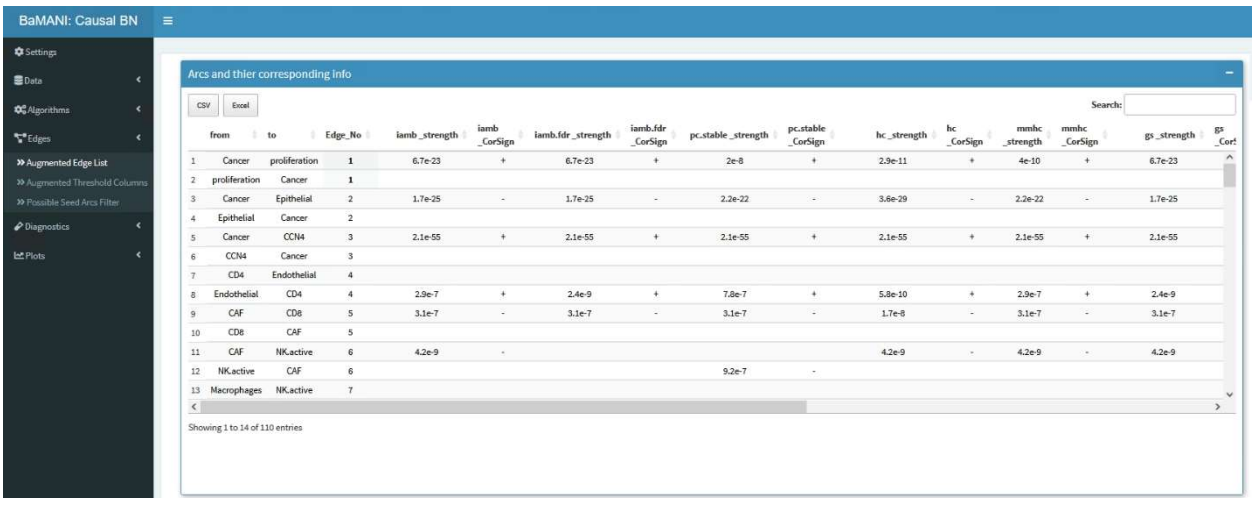
Black List
Browse...
No file selected
White List
Browse...
No file selected
Algorithm selection
Directed Algorithms
iamb iamb.fdr hc
Undirected Algorithms
Run Discovery



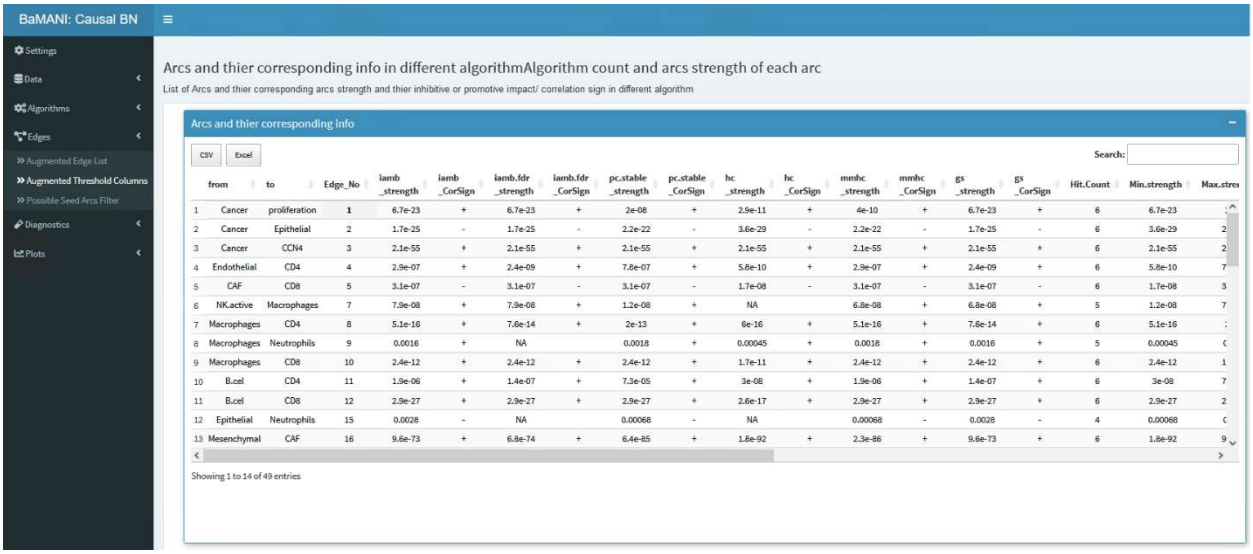


- Calculate the "arc.strength", "CorSign", and unclear_direction" columns for each arc.

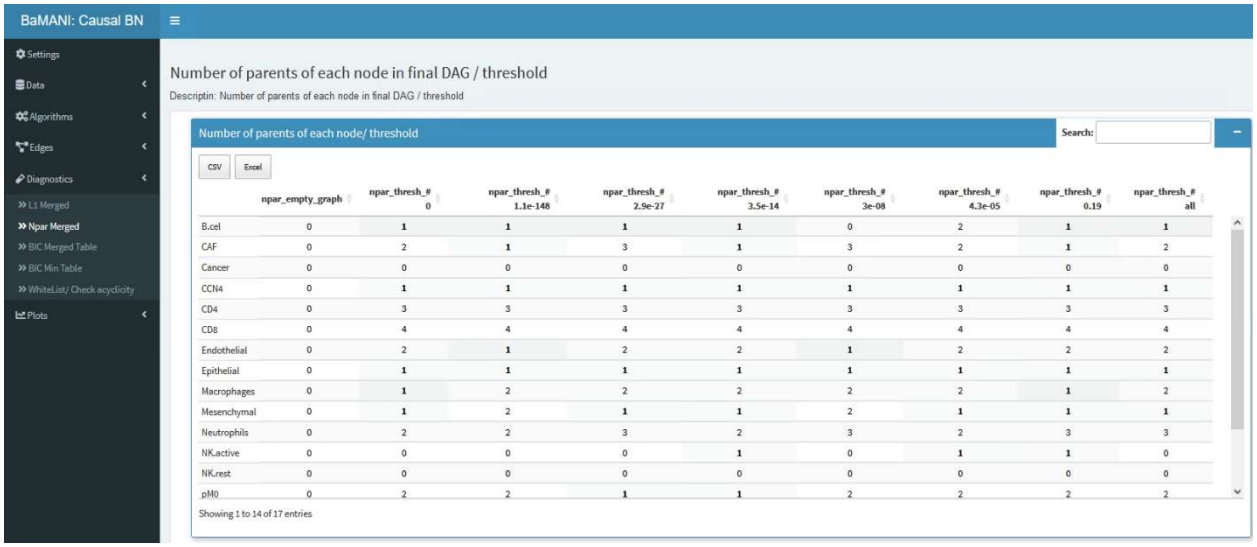


Step 3: Filtering Potential Arcs

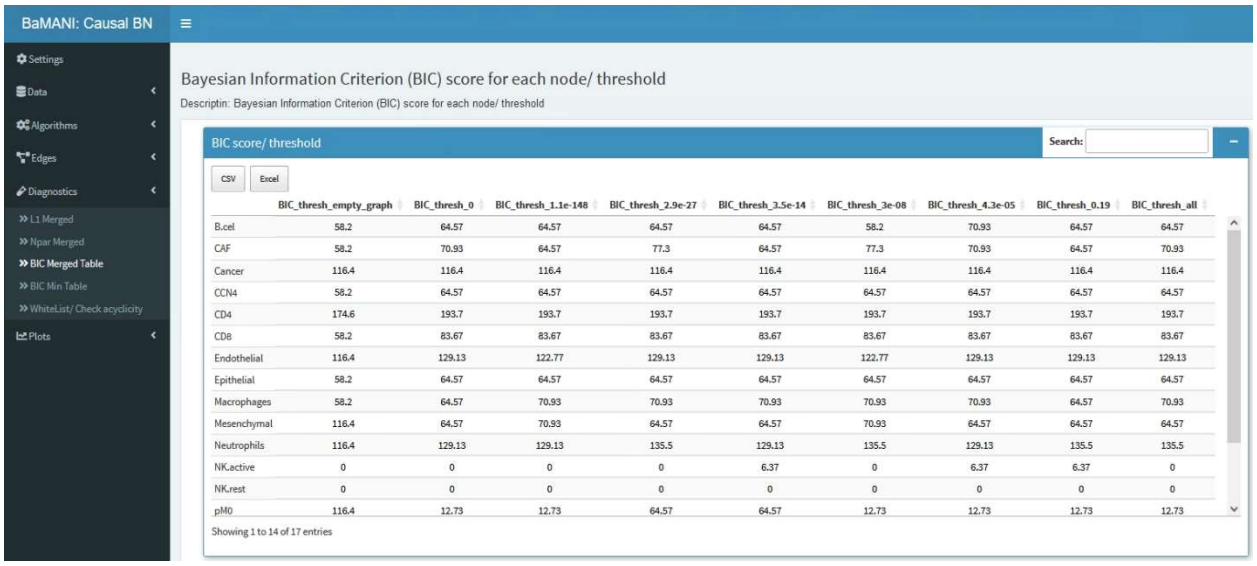
- **Objective**: To create a whitelist based on Bayesian Information Criterion (BIC) and network complexity.
- **Process**:
    - Set arc strength thresholds.
    - Create temporary whitelists and learn BN structures for each threshold.



- Calculate and compare BIC for different thresholds.

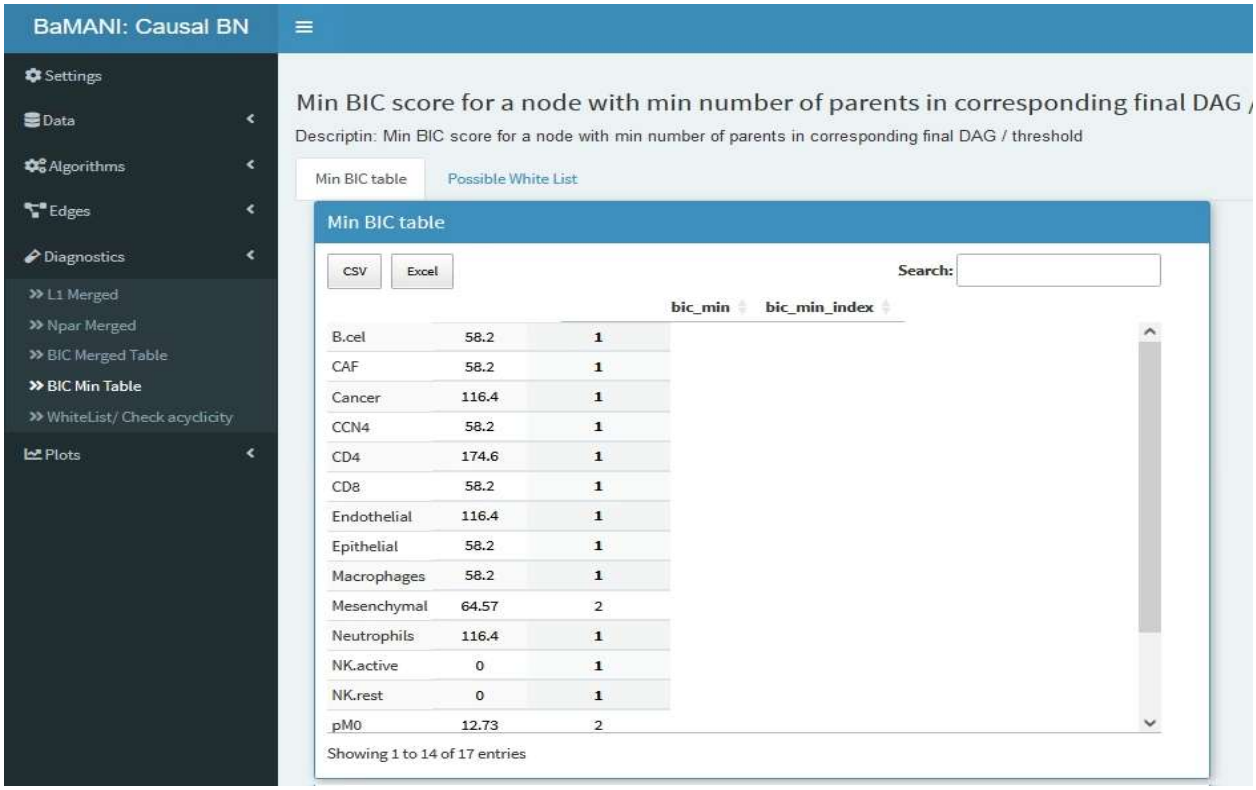


	npar_empty_graph	npar_thresh_# 0	npar_thresh_# 1.1e-148	npar_thresh_# 2.9e-27	npar_thresh_# 3.5e-14	npar_thresh_# 3e-08	npar_thresh_# 4.3e-05	npar_thresh_# 0.19	npar_thresh_# all
B.cel	0	1	1	1	1	0	2	1	1
CAF	0	2	1	3	1	3	2	1	2
Cancer	0	0	0	0	0	0	0	0	0
CCN4	0	1	1	1	1	1	1	1	1
CD4	0	3	3	3	3	3	3	3	3
CD8	0	4	4	4	4	4	4	4	4
Endothelial	0	2	1	2	2	1	2	2	2
Epithelial	0	1	1	1	1	1	1	1	1
Macrophages	0	1	2	2	2	2	2	1	2
Mesenchymal	0	1	2	1	1	2	1	1	1
Neutrophils	0	2	2	3	2	3	2	3	3
NK.active	0	0	0	0	1	0	1	1	0
NK.rest	0	0	0	0	0	0	0	0	0
pM0	0	2	2	1	1	2	2	2	2



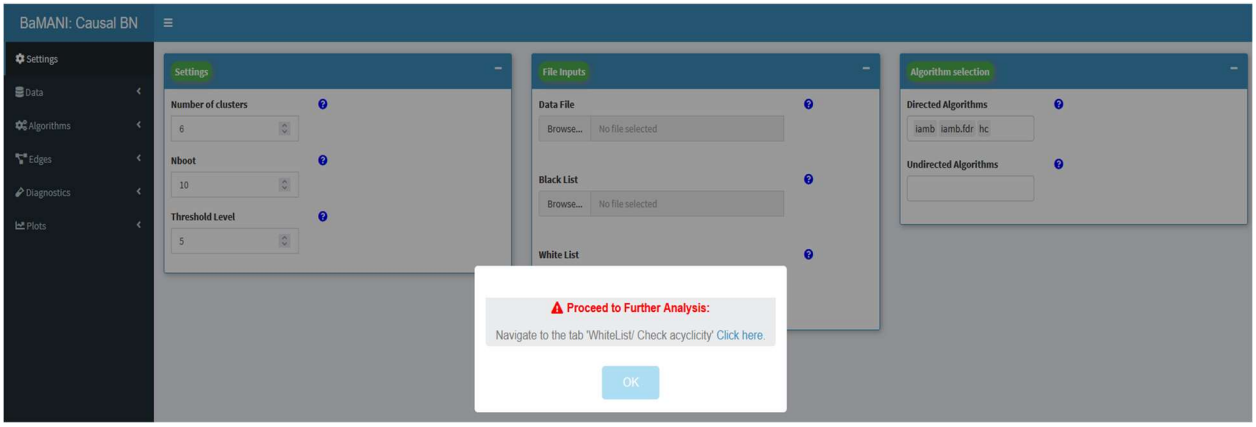
	BIC_thresh_empty_graph	BIC_thresh_0	BIC_thresh_1.1e-148	BIC_thresh_2.9e-27	BIC_thresh_3.5e-14	BIC_thresh_3e-08	BIC_thresh_4.3e-05	BIC_thresh_0.19	BIC_thresh_all
B.cel	58.2	64.57	64.57	64.57	64.57	58.2	70.93	64.57	64.57
CAF	58.2	70.93	64.57	77.3	64.57	77.3	70.93	64.57	70.93
Cancer	116.4	116.4	116.4	116.4	116.4	116.4	116.4	116.4	116.4
CCN4	58.2	64.57	64.57	64.57	64.57	64.57	64.57	64.57	64.57
CD4	174.6	193.7	193.7	193.7	193.7	193.7	193.7	193.7	193.7
CD8	58.2	83.67	83.67	83.67	83.67	83.67	83.67	83.67	83.67
Endothelial	116.4	129.13	122.77	129.13	129.13	122.77	129.13	129.13	129.13
Epithelial	58.2	64.57	64.57	64.57	64.57	64.57	64.57	64.57	64.57
Macrophages	58.2	64.57	70.93	70.93	70.93	70.93	70.93	64.57	70.93
Mesenchymal	116.4	64.57	70.93	64.57	64.57	70.93	64.57	64.57	64.57
Neutrophils	116.4	129.13	129.13	135.5	129.13	135.5	129.13	135.5	135.5
NK.active	0	0	0	0	6.37	0	6.37	6.37	0
NK.rest	0	0	0	0	0	0	0	0	0
pM0	116.4	12.73	12.73	64.57	64.57	12.73	12.73	12.73	12.73

- Look for the minimum BIC value while avoiding the creation of cycles. Remove arcs that create cycles.



Step 4: Learning the Network Structure

- **Objective**: To learn the final network structure using the blacklist and whitelist.
- **Process**:
  - Utilize the final whitelist and blacklist to learn the structure of the Bayesian Network (BN).



    - Observe how the network structure and parameters are determined based on these lists.

- **Note**: Review the final network structure for consistency with your domain knowledge.