

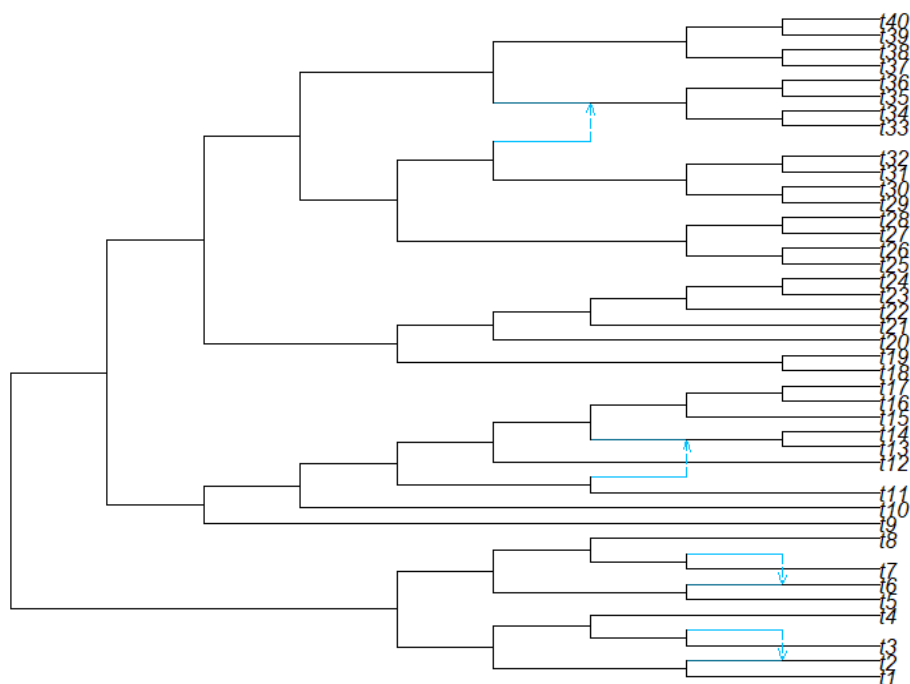
# Robustness Testing

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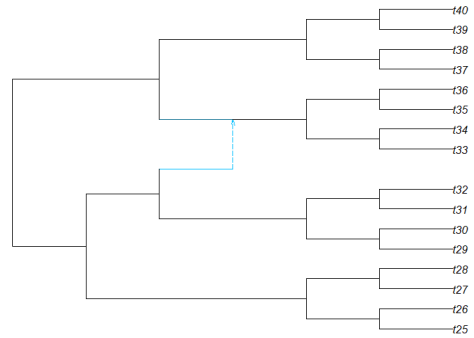
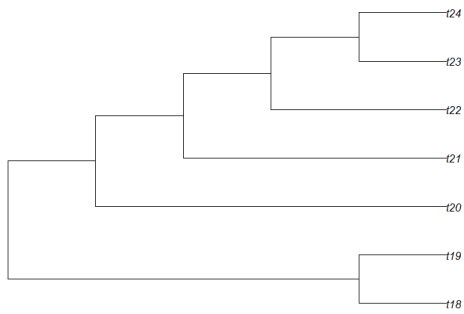
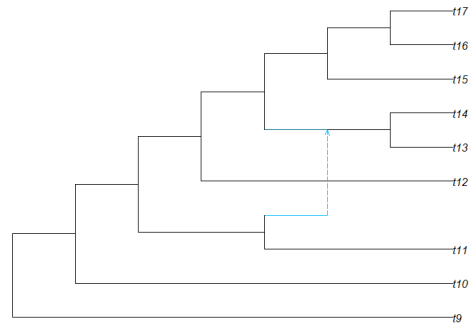
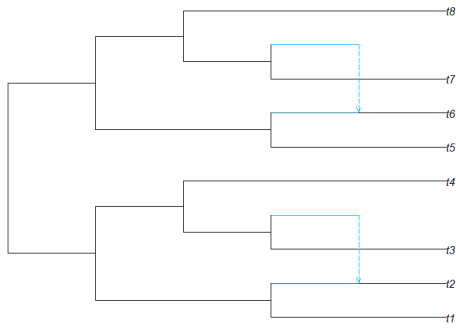
- Our ground truths
    - True network
    - Constraint networks
  - NNI moves on constraints
    - One NNI move on each constraint
    - Two NNI moves on each constraint
    - Three NNI moves on each constraint
    - Random NNI moves on each constraint
  - Distance matrix random noise
    - Gaussian(0, 1) noise
    - Gaussian(2, 2) noise
    - Gaussian(4, 4) noise
    - Completely random distance matrix
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## Our ground truths

True network



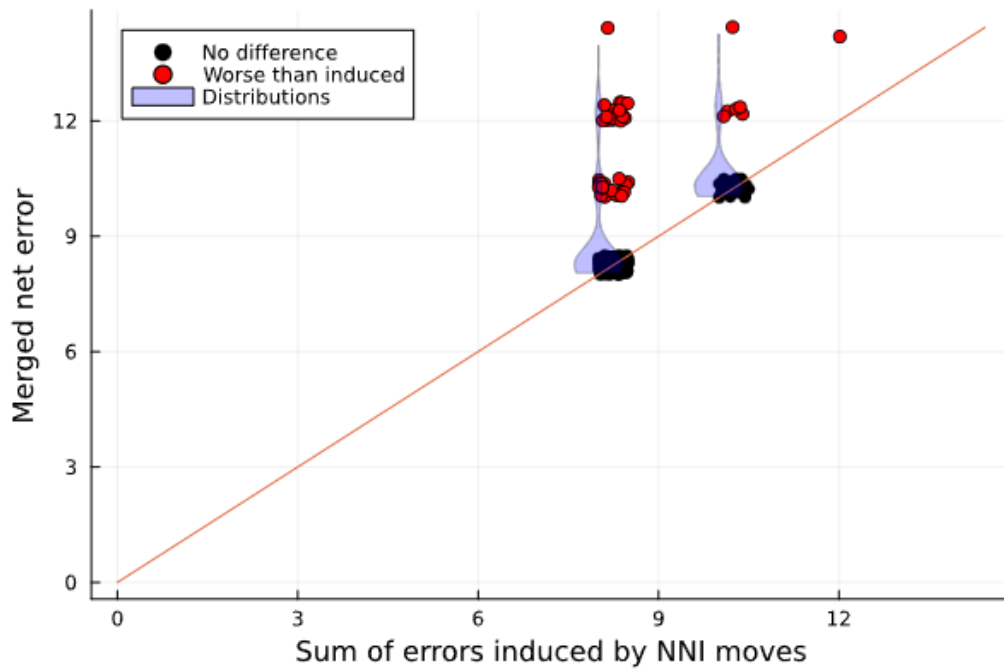
Constraint networks



## NNI moves on constraints

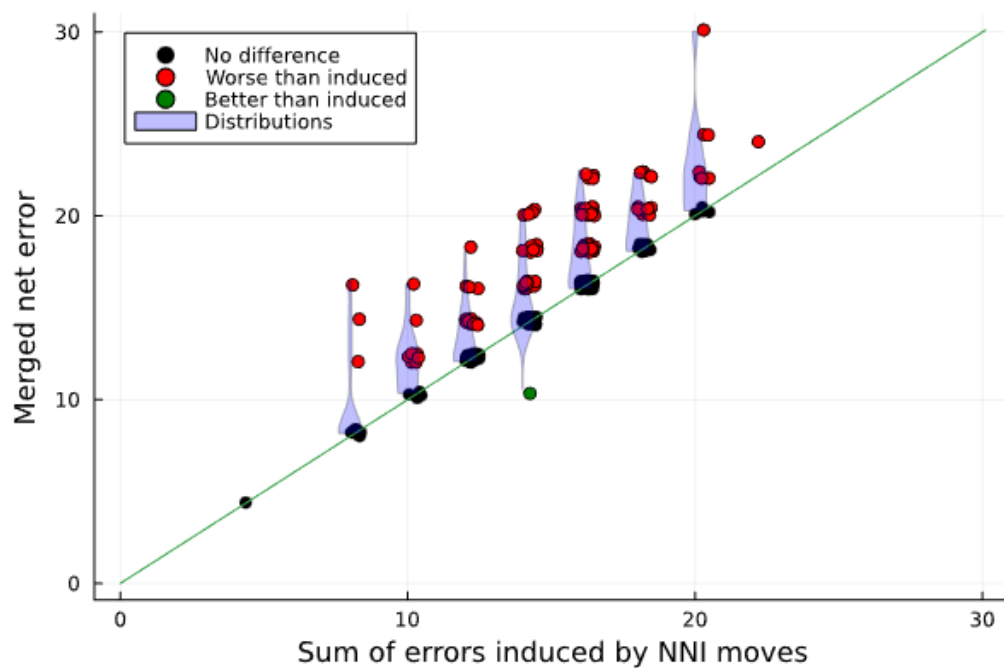
### One NNI move on each constraint

There is error in the merged network, as is expected, but that error is rarely more than the sum of errors that we induced with NNI moves. **196/250 merged networks had error exactly equal to the sum of induced errors.**



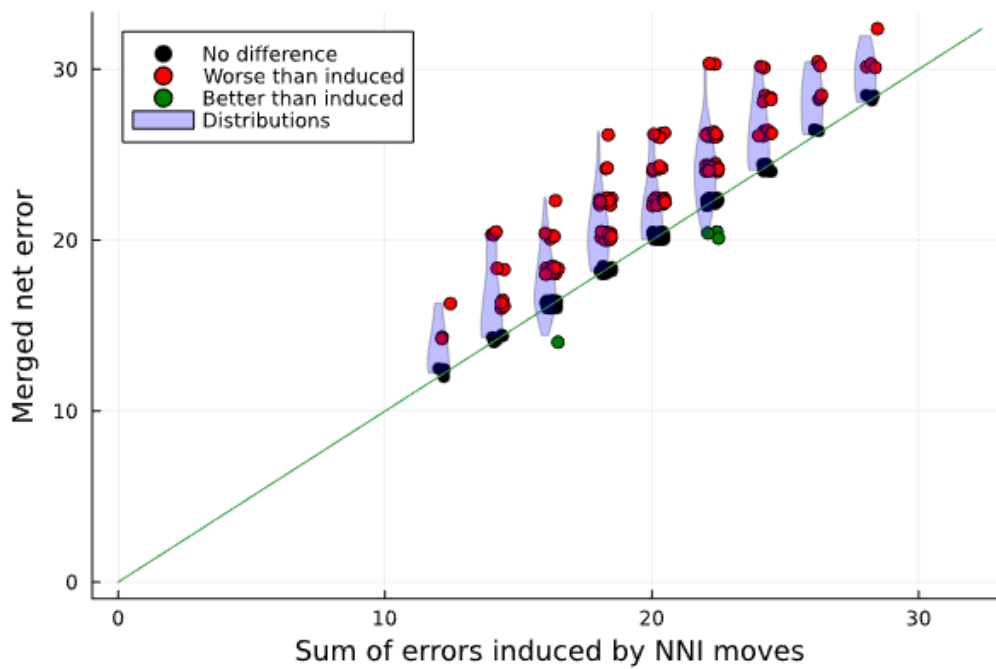
### Two NNI moves on each constraint

With more and more induced error, the merged networks begin to tend to have more error than the sum of induced errors. **118/250 merged networks had error exactly equal to the sum of induced errors, 1 actually improved on the sum of induced errors.**



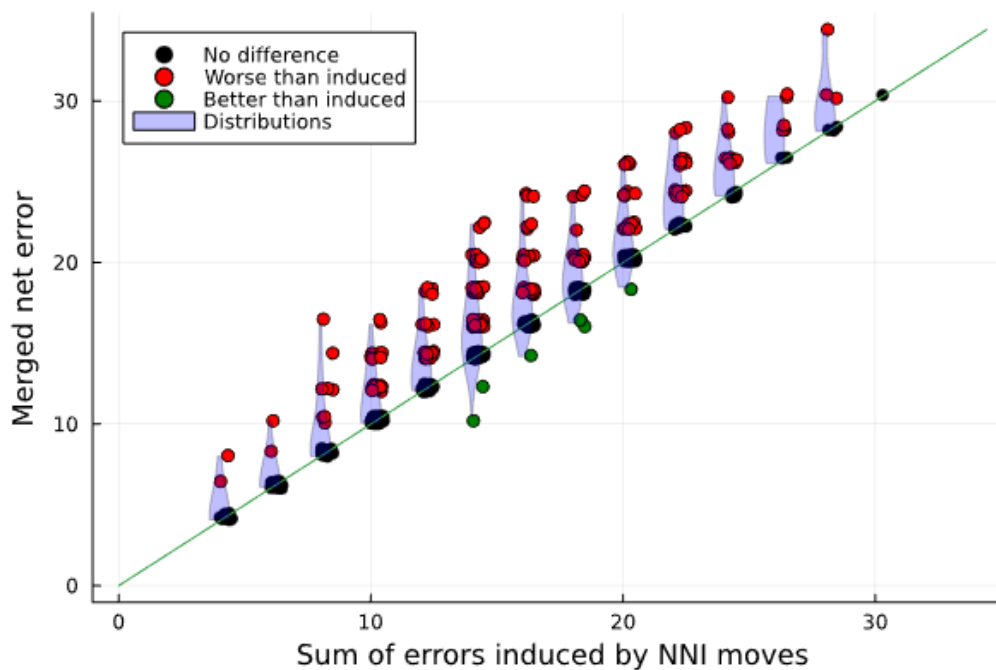
### Three NNI moves on each constraint

The same trend continues. **100/250 merged networks had error exactly equal to the sum of induced errors, 4 actually improved on the sum of induced errors.**



Random NNI moves on each constraint

The number of NNI moves on each constraint is randomly drawn. **272/500 merged networks had error exactly equal to the sum of induced errors, 7 actually improved on the sum of induced errors.**

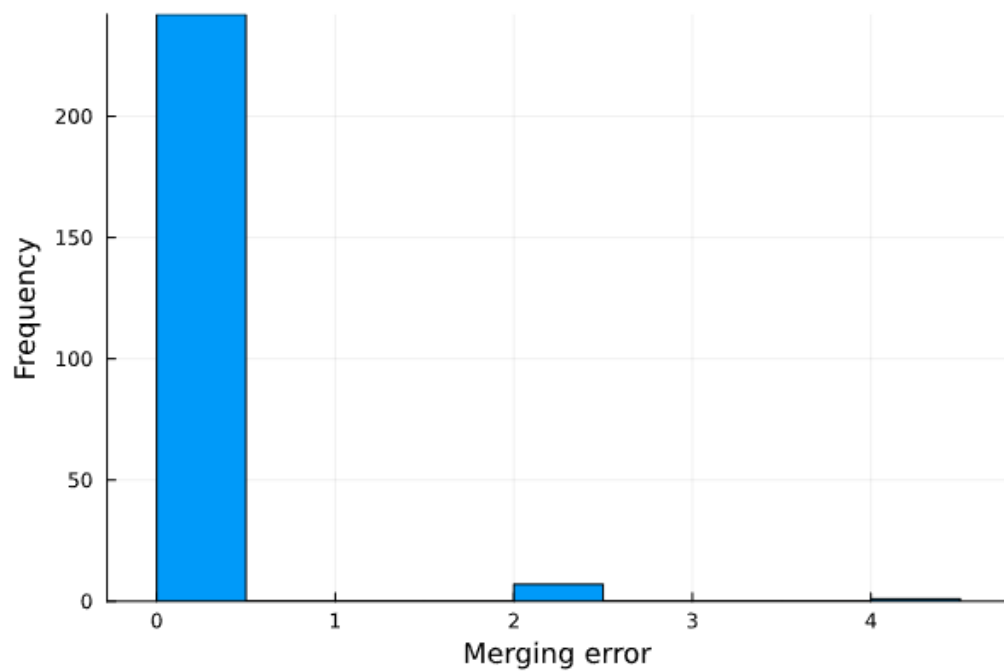


Distance matrix random noise

The true distance matrix has mean=8, std dev=3

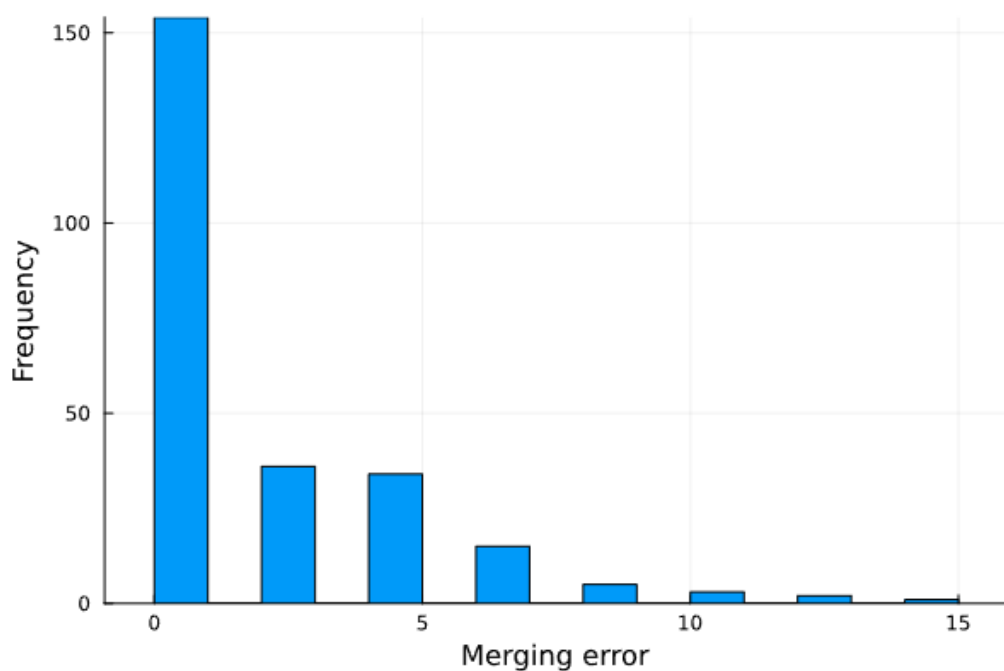
Gaussian(0, 1) noise

**242/250 merged networks had 0 error.**



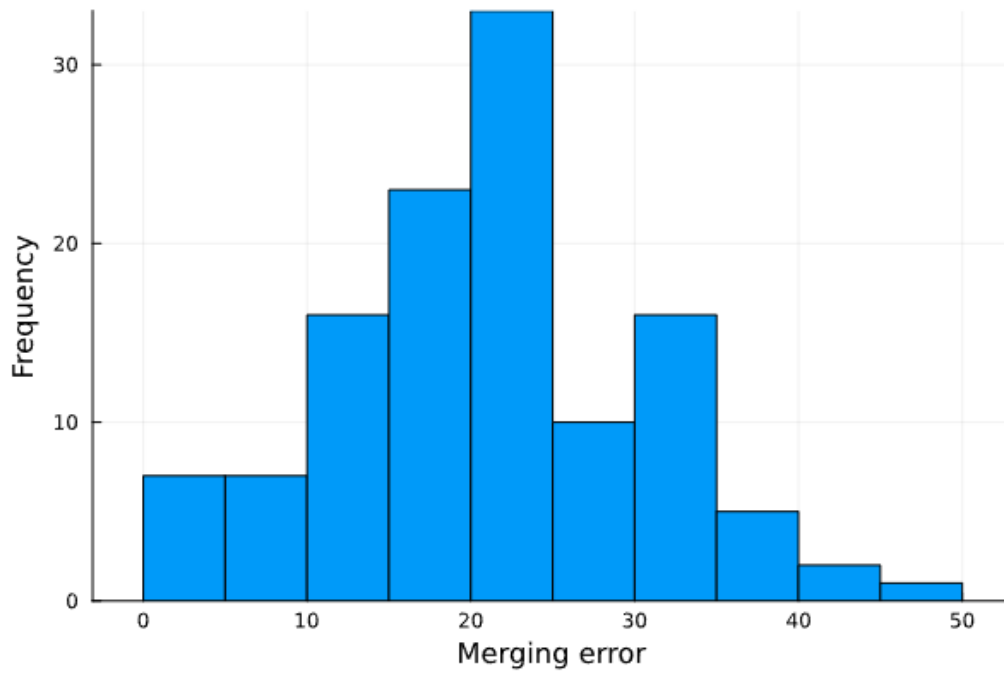
Gaussian(2, 2) noise

True matrix has std dev 3, so noise is very close to signal. **154/250 merged networks had 0 error.**



Gaussian(4, 4) noise

Noise is now more prominent than signal. **0 merged networks had 0 error, 4/250 networks had  $RF(merged, truenet)=2$ .**



### Completely random distance matrix

Over >1000 simulations, **0 completed, because the constraint networks reached a point where there were 0 valid options. This is intended behavior.**

How is that possible? E.g. if the only constraints we have left are  $((A, B), (C, D))$  and  $((A, C), (B, D))$  then none of the pairs  $AB, AC, AD, BC, BD, CD$  are valid options.