Omnigram Explorer:

A New Interactive Tool for Exploring Bayesian Networks

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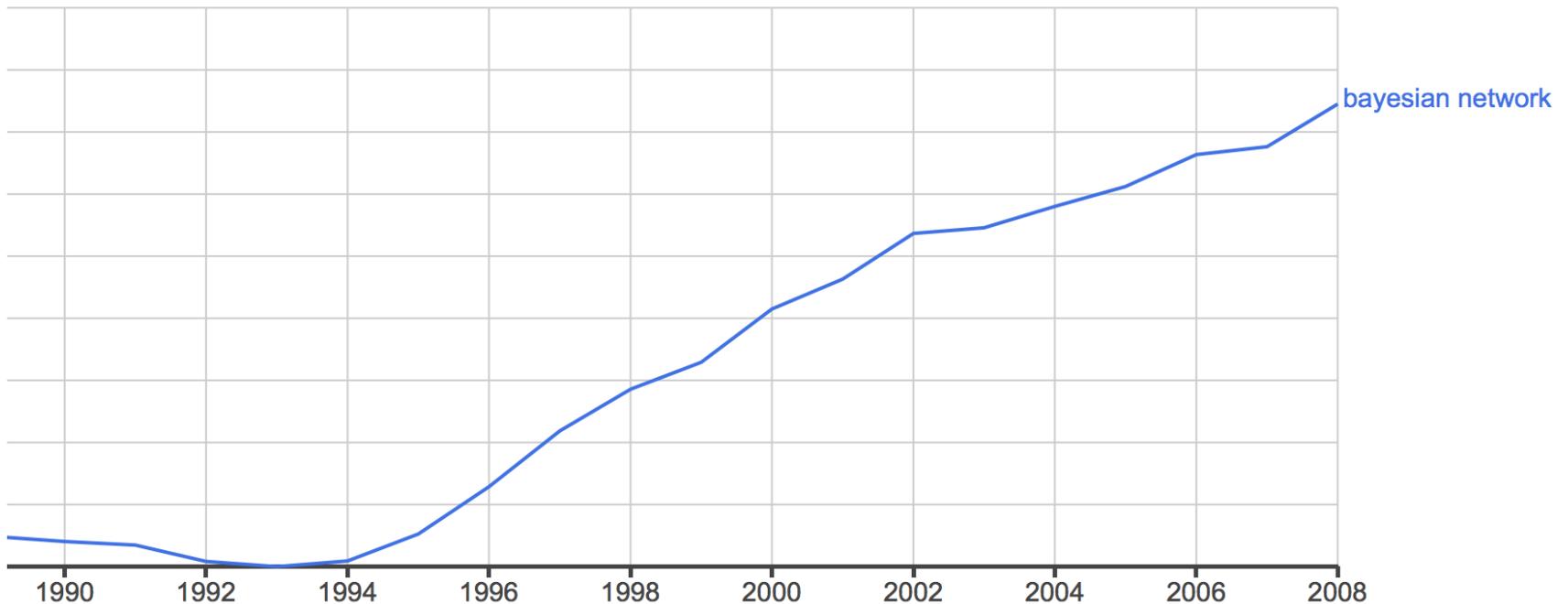
www.tim-taylor.com/omnigram

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Omnigram Explorer

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Motivation

Google's Ngram Viewer reports the relentless growth of Bayesian networks:
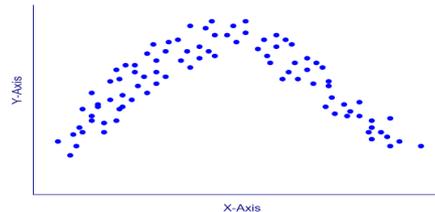

bayesian network

- Parallel increases in complexity & data.
- New ways of interactively visualizing both networks & data are needed.

Omnigram Explorer
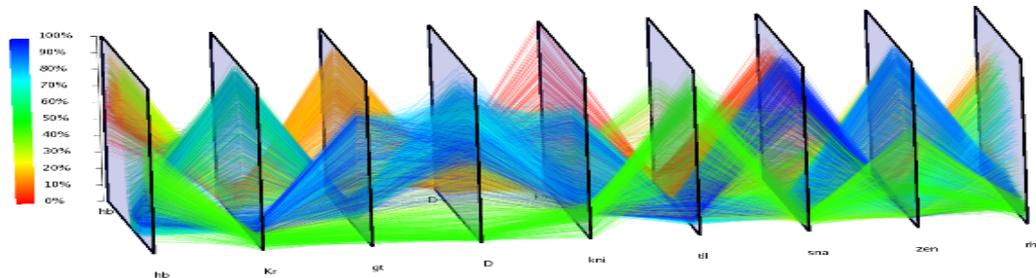
- Developed by Tim Taylor; open source

  - www.tim-taylor.com
  - https://github.com/tim-taylor/omnigram

- Traditional visualization of multiple variables:

  - Scatterplots

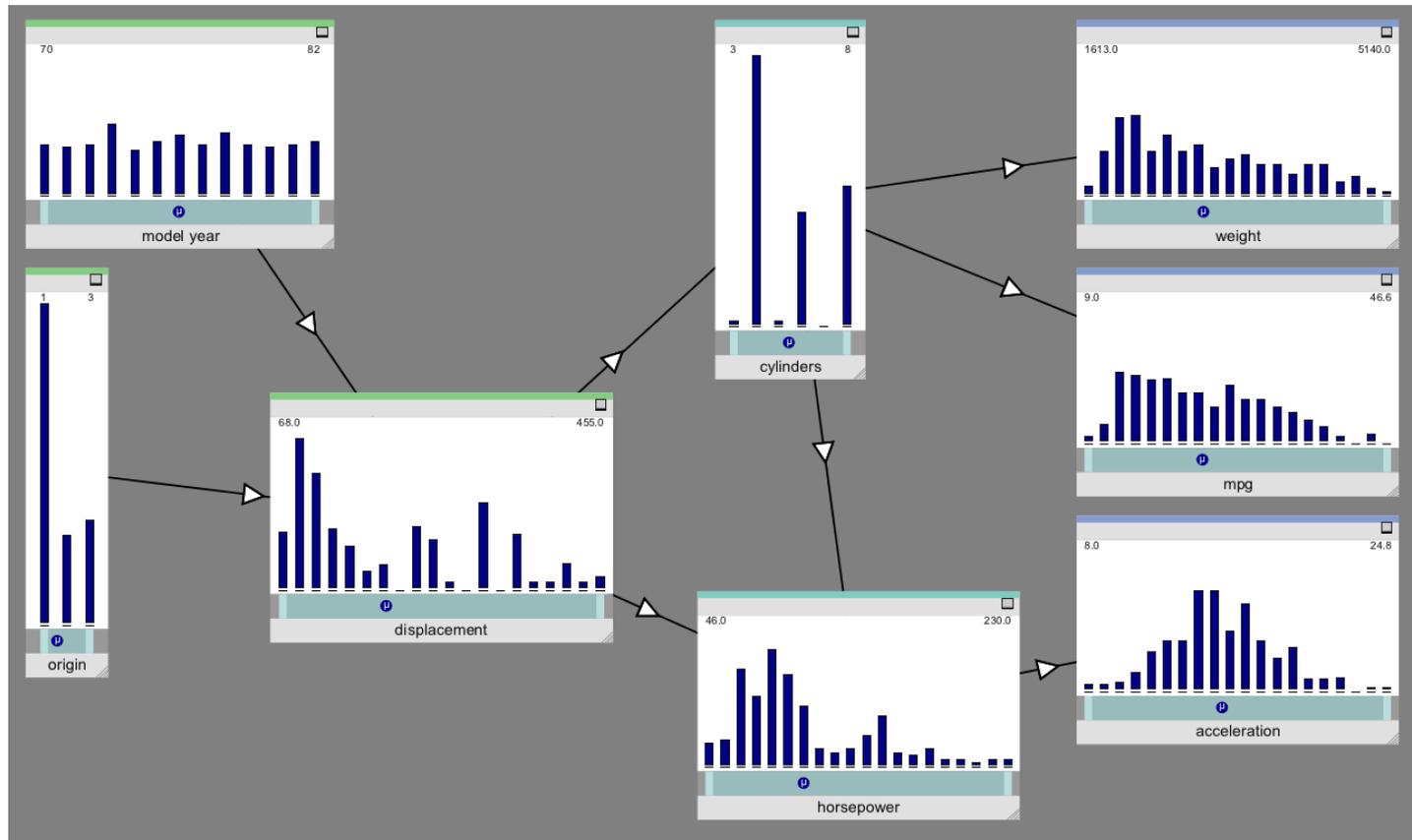 - Parallel Coordinates: allow tracing samples across many dimensions

Omnigram Explorer

Two main innovations:

- Visualization takes advantage of human visual system, especially psychology of pattern and motion perception

- Interactive controls allow user to manipulate patterns, visualizing not just static data but active **dependencies** between variables

In particular, OE enables interactive sensitivity analysis of Bayesian networks with user-chosen sets of observations ("sensitivity to data")
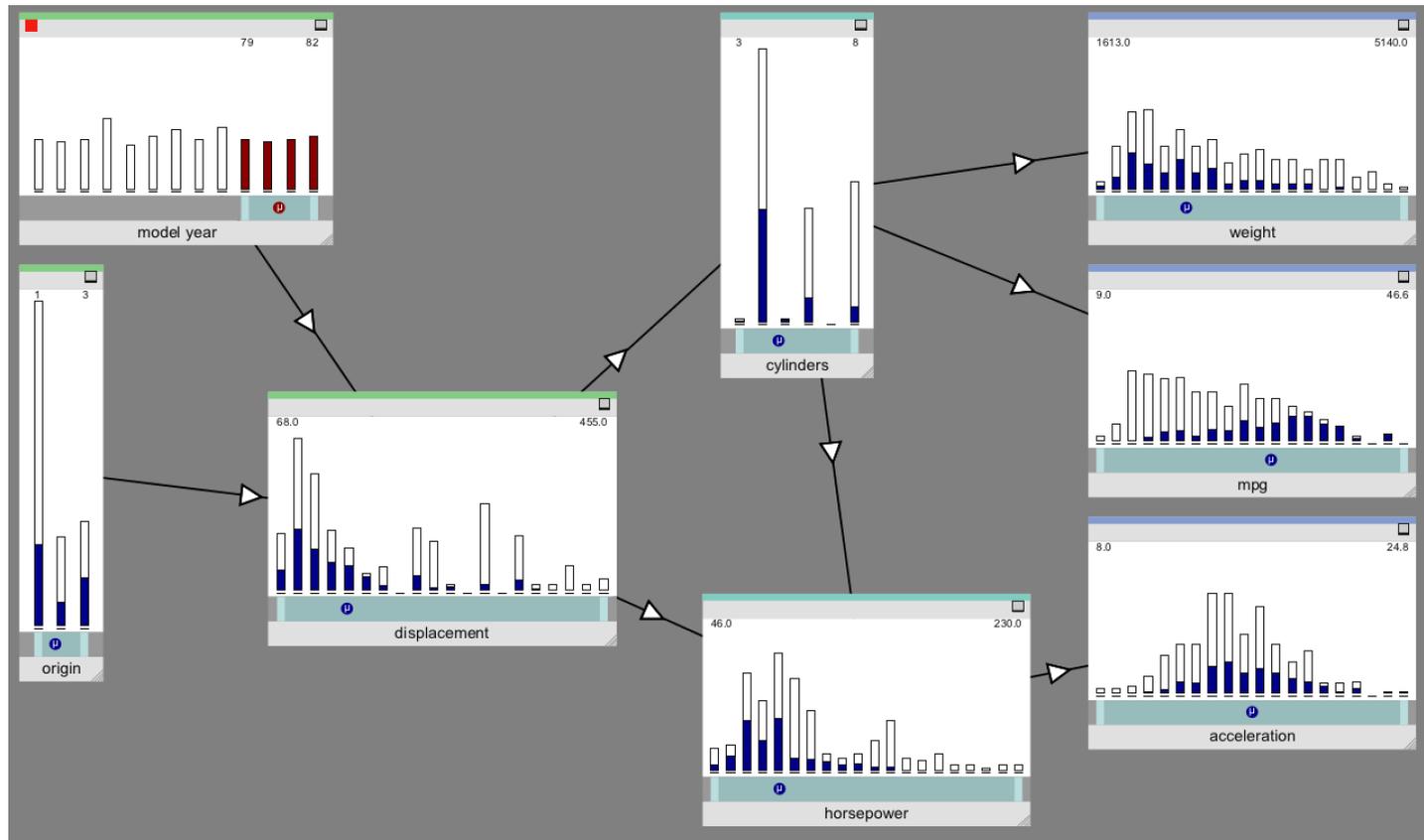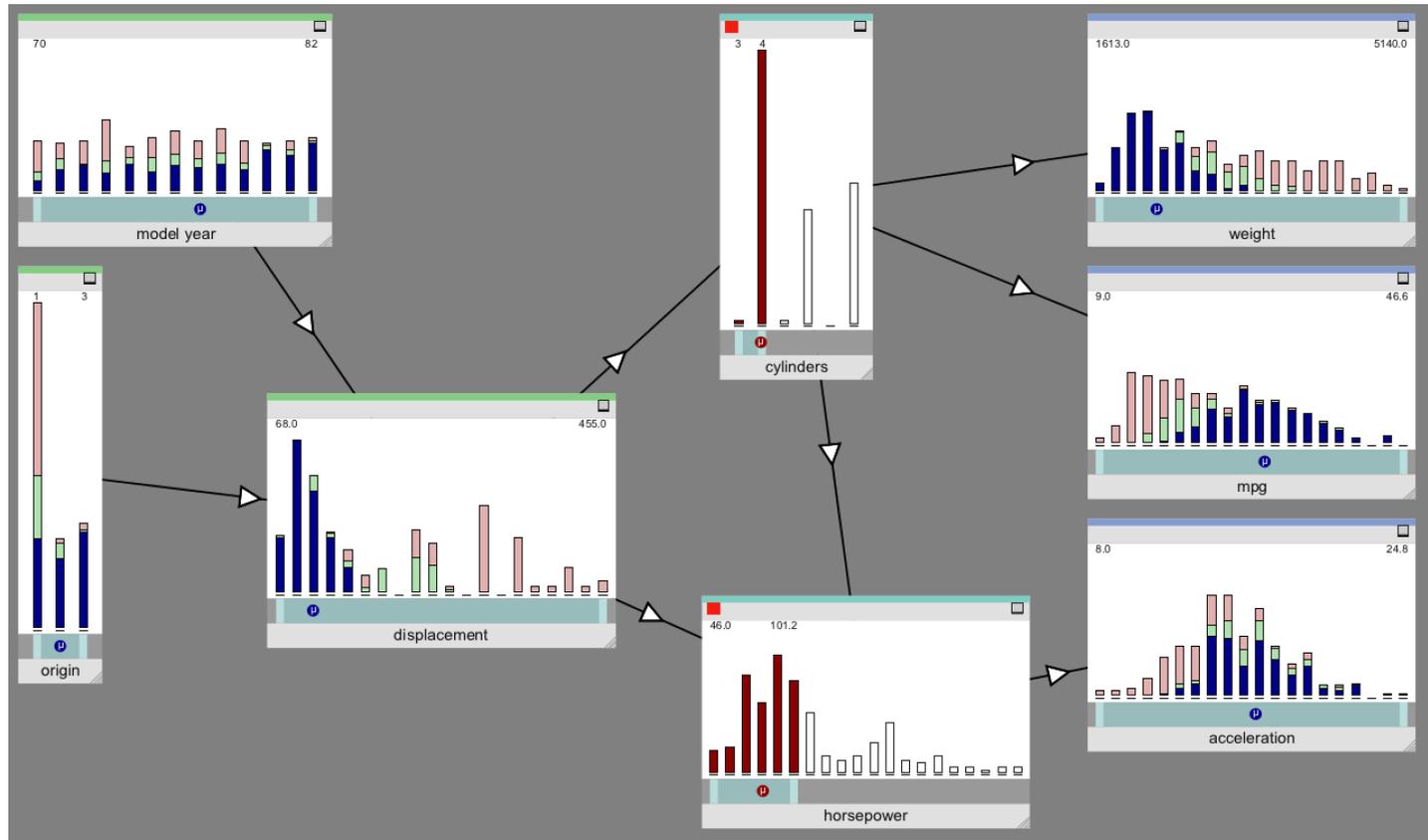
OE

OE Window

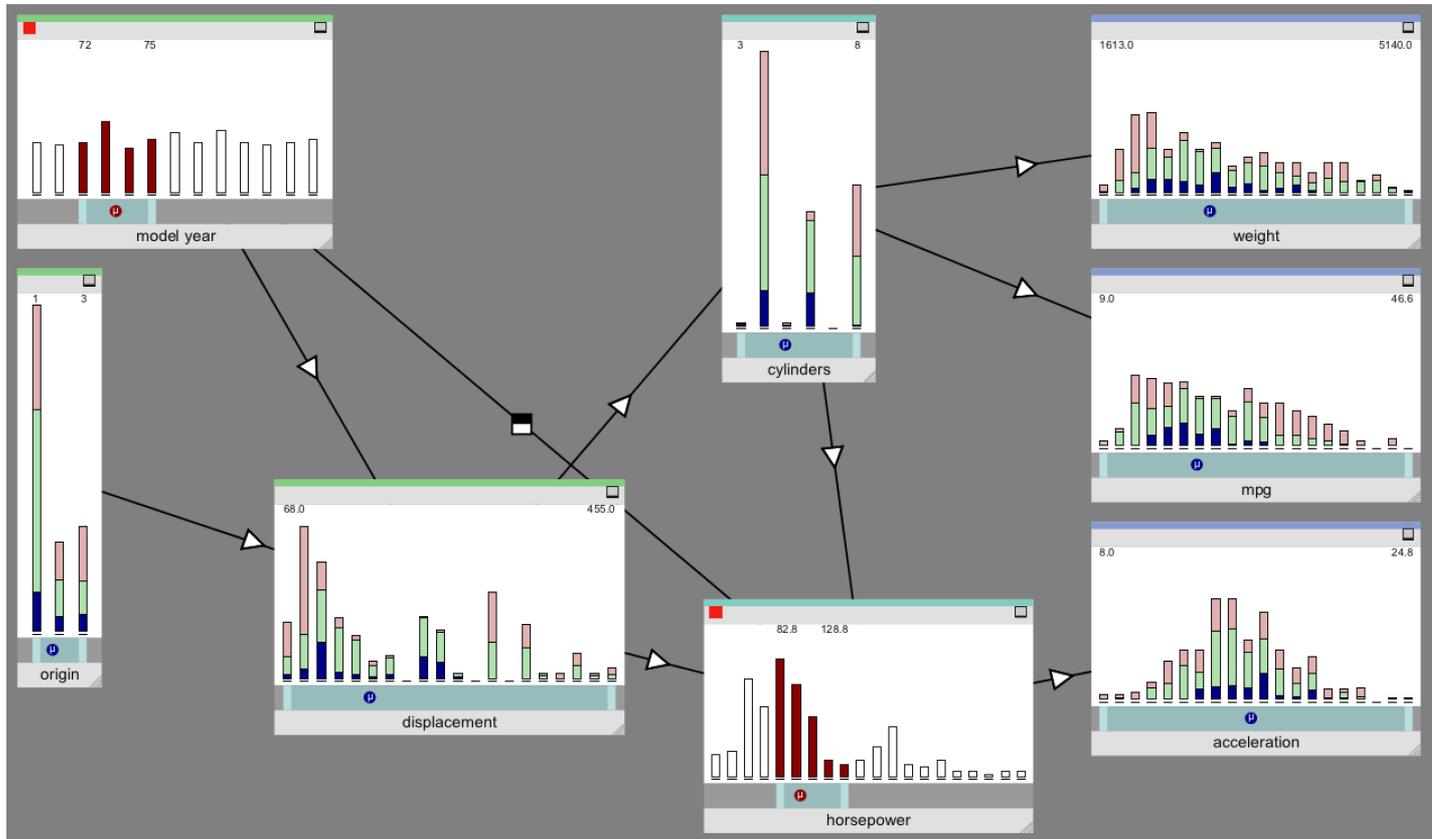BN based on UCI car+mpg data set

OE: Single Node Brushing

- "1" starts single node brushing

- Enter observation as a range in one variable; observe consequences

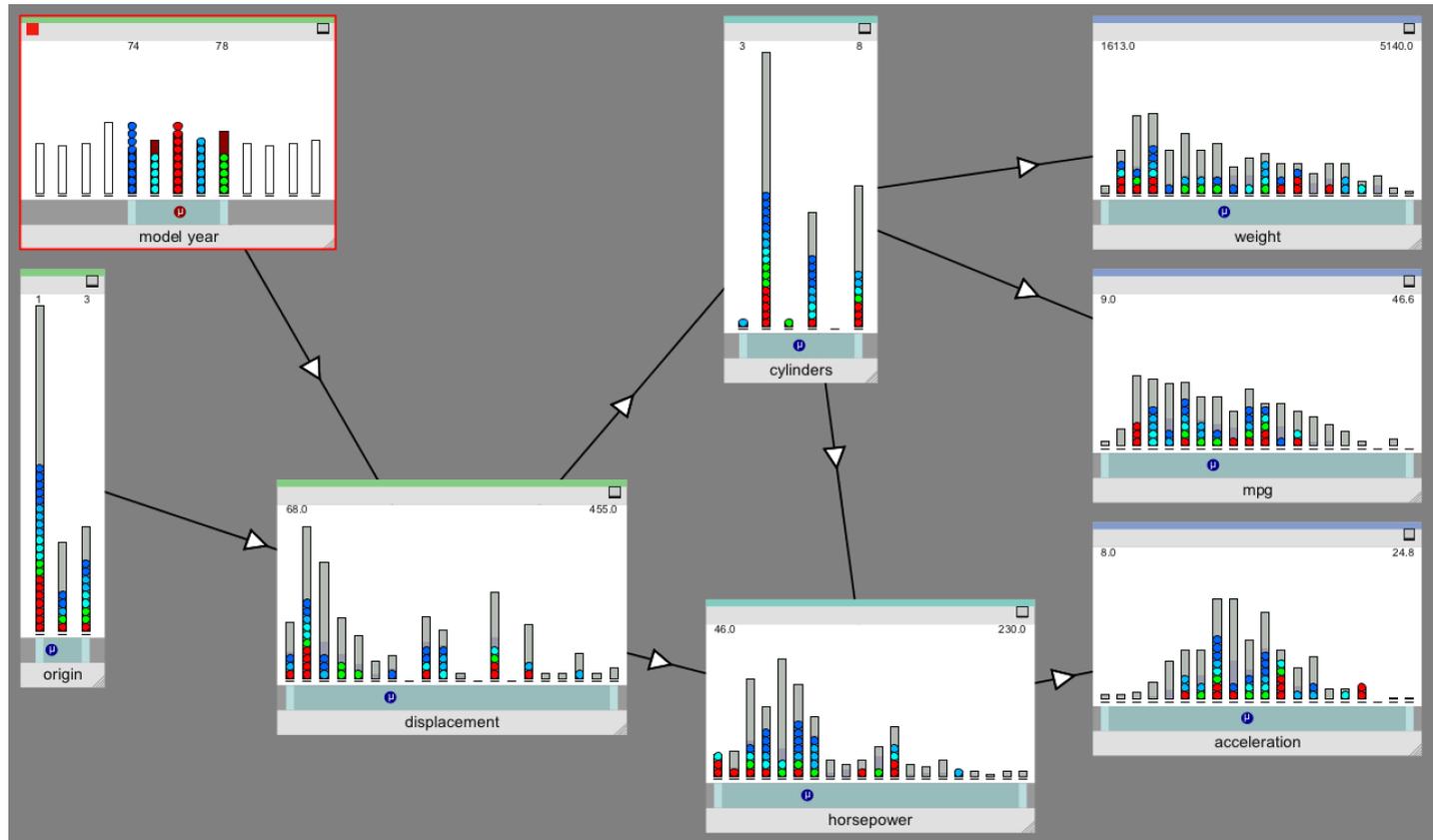- Drag range to observe dependencies

OE: Multi Node Brushing

- "2" starts multi node brushing

- Enter observations as ranges in multiple variables; colors show full & partial matches

- Drag ranges to observe dependencies
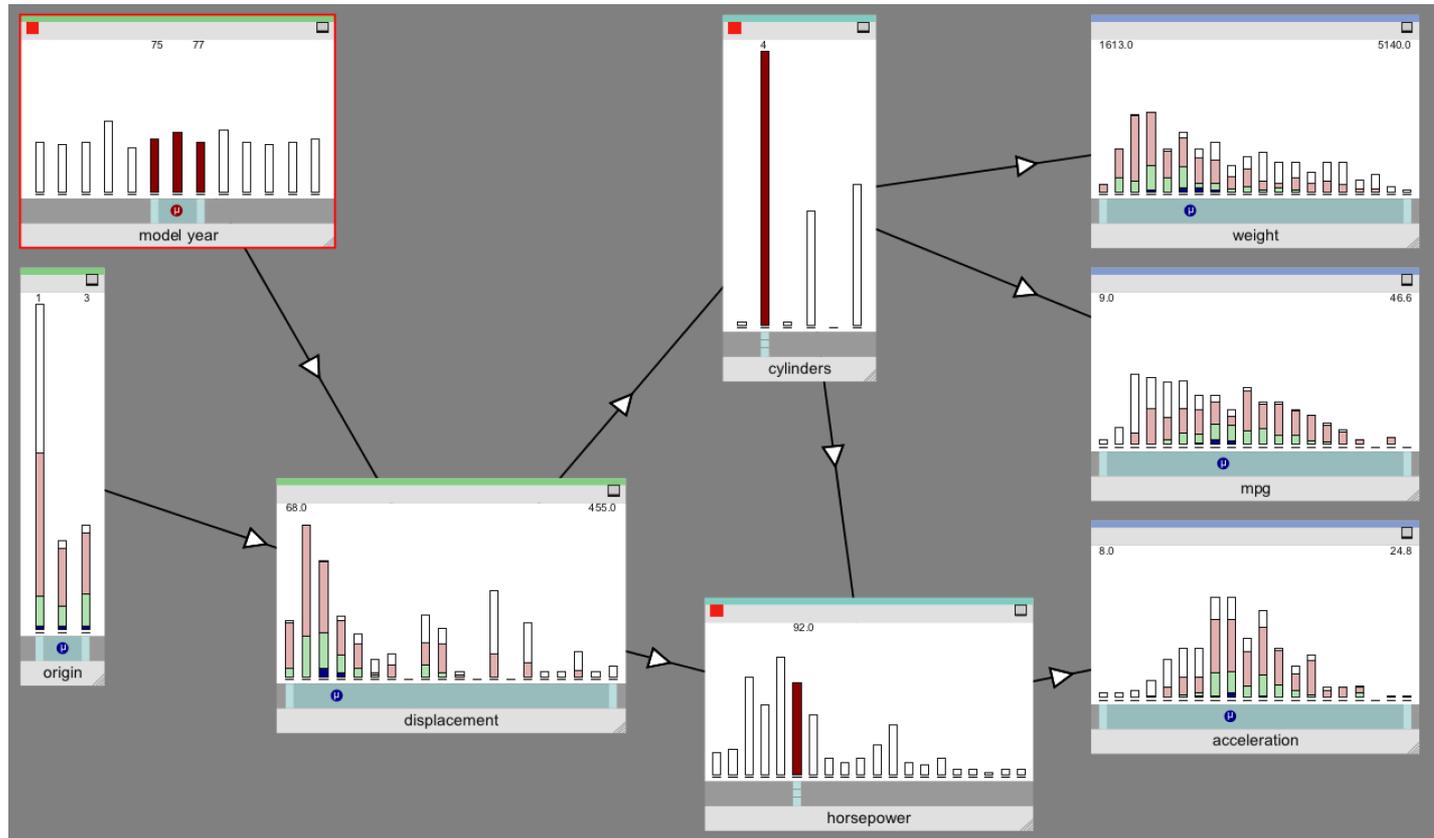
OE: Linked Brushing

- In multi node brushing, hit "L" with cursor over successive nodes

- Drag range in either variable, linked variables follow

- You can reverse link direction (negative dependency); link's box will invert
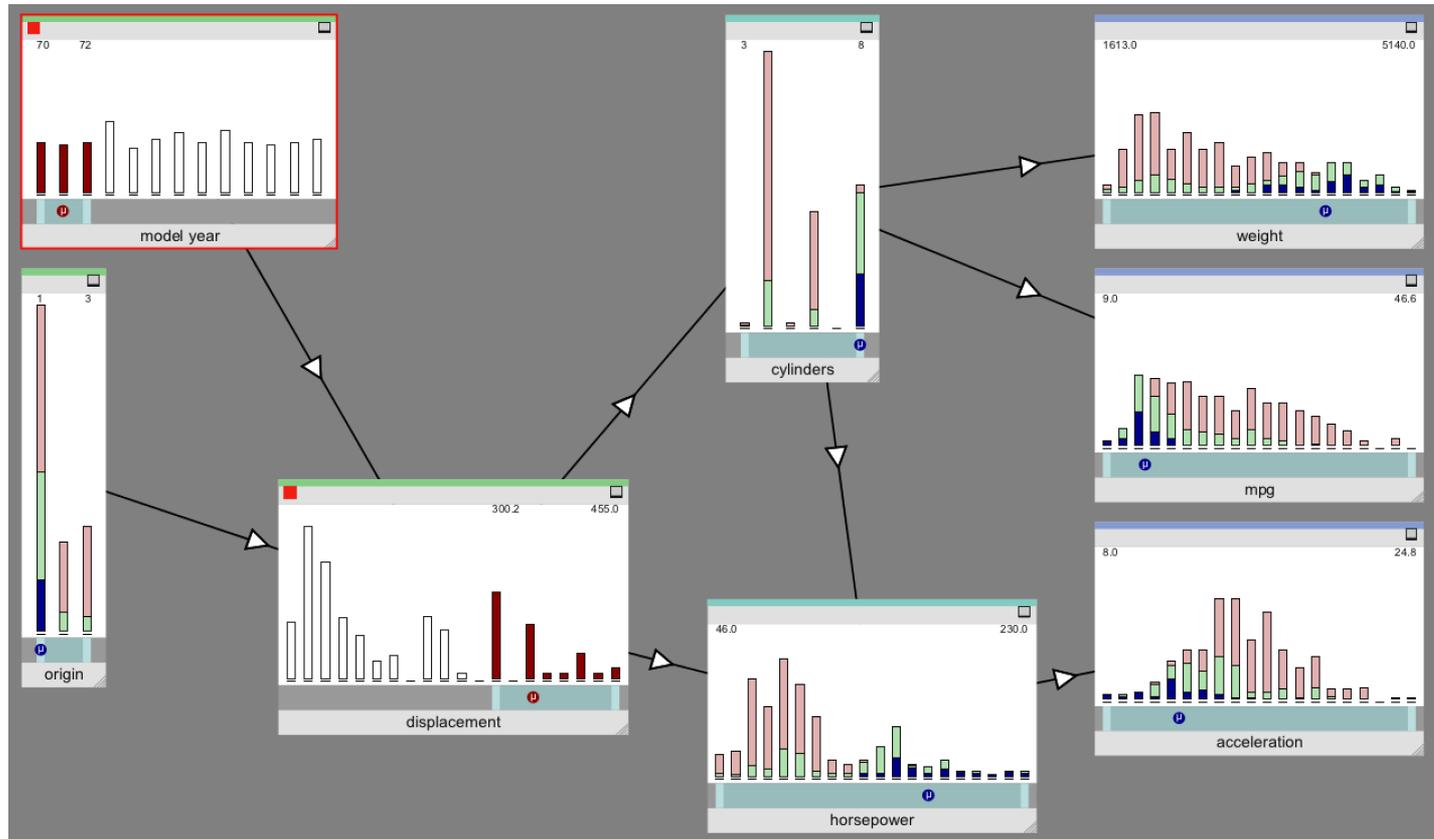
OE: Flash Mode

- "3" starts flash mode

- Cycles through small (or large) samples, replacing oldest with new

- Speed and sample size controllable

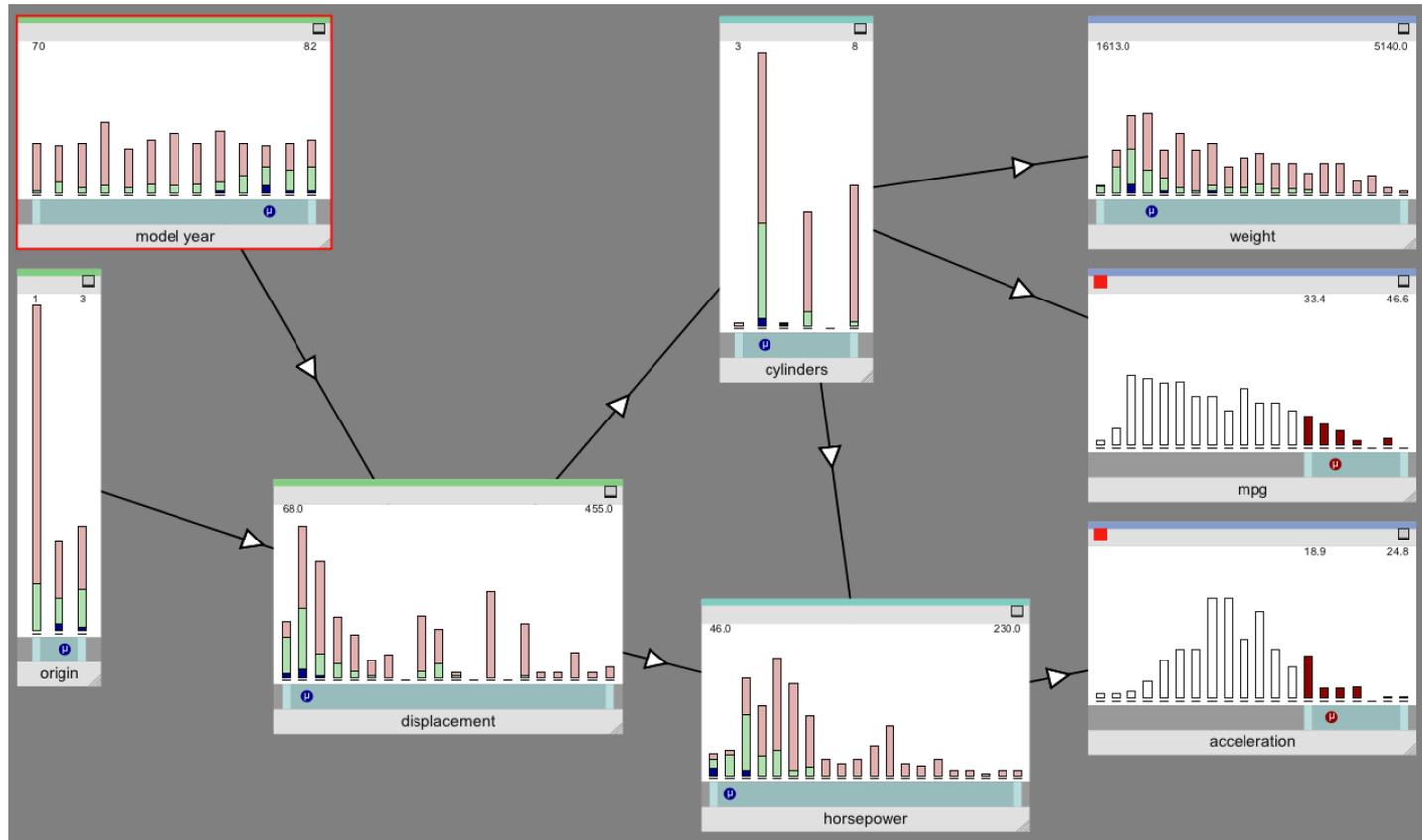# Exploring Dependencies: D-Separation

- In multi node, fix an observation set (here cylinders & horsepower)

- Observe which variables respond when varying another (e.g., model year)

- Partial observations will "leak"; other leakage indicates (some) violation of the Markov property

Exploring Dependencies: Explaining Away

- In multi node, fix a child of more than one parent; explore the induced dependency between parents ("explaining away")

- Here early model year partially explains high displacement, so Origin=1 (US) declines

Exploring Dependencies: Inference to the Best Explanation

- What could explain an unusual event? E.g., high acceleration + good mpg?

- Read off the means for precursor variables: late model, foreign, 4 cylinders, low weight, etc.

Conclusion

OE is a great interactive tool for either:

- Exploring a data set, to get a feel for dependencies and independencies, relations worth exploring

- Exploring a Bayesian network:

  - To get a feel for dependencies and independencies, relations worth exploring
  - Examine d-separation properties
  - Performing sensitivity analysis interactively & visually

NB: OE is not (yet) implemented via a BN API, but can be used via sampling with any BN.

References

- Taylor, T., Dorin, A., & Korb, K. Omnigram Explorer: A Simple Interactive Tool for the Initial Exploration of Complex Systems. *European Conference on Artificial Life, 2015.*

- Ropero, R. F., Nicholson, A. E., & Korb, K. (2015). Using a New Tool to Visualize Environmental Data for Bayesian Network Modelling. In *Advances in Artificial Intelligence* (pp. 175-184). Springer International Publishing.