UCLA Computer Science

Automated Reasoning Group

Conditional Independence in Testing Bayesian Networks

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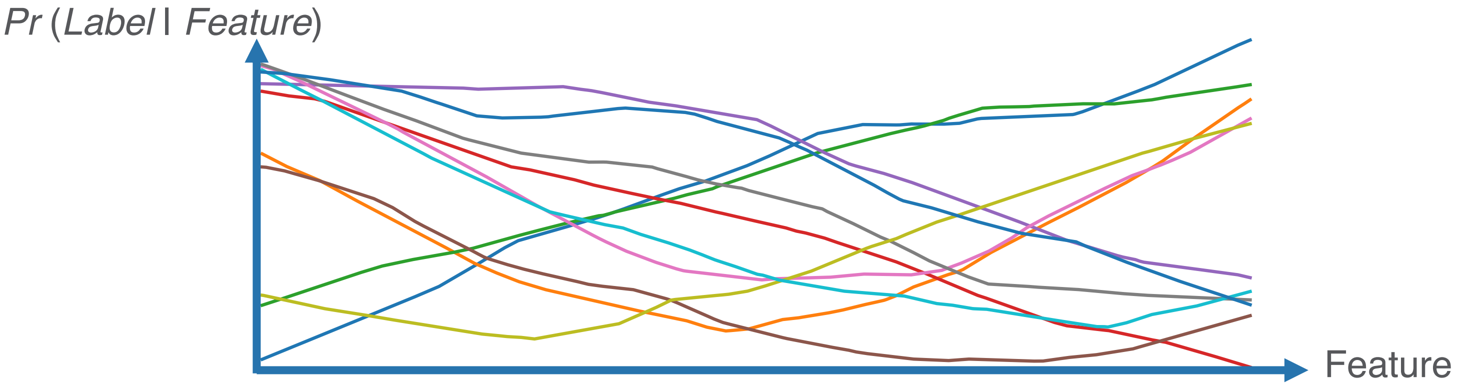
Fuse Knowledge with Expressiveness

DEEP LEARNING

- Neural networks are universal approximators.
- They are data hungry.



Sampled functions that are represented using a simple neural network.

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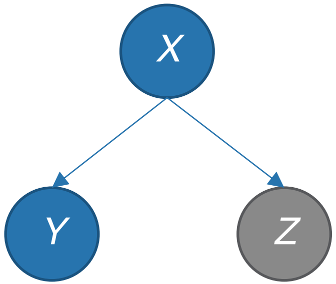
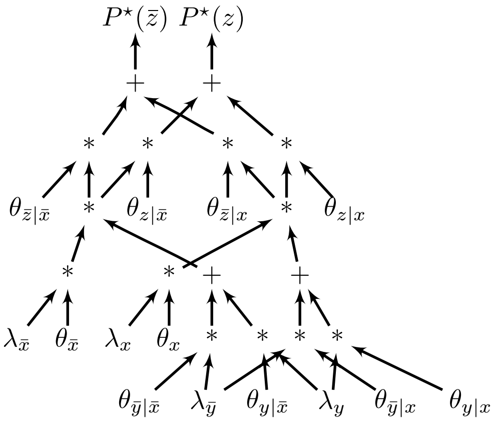
BAYESIAN NETWORKS

- BNs utilize data efficiently using conditional independence assumptions.





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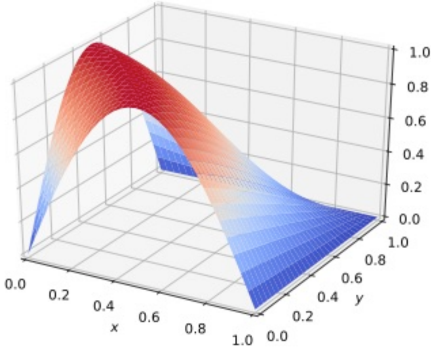
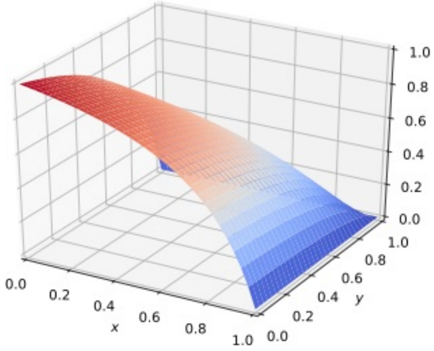
EXPRESSIVENESS IN BAYESIAN NETWORKS

- BNs utilize data efficiently using conditional independence assumptions.
- Marginal queries are not universal approximators.



Ground truth



Best fit for BN

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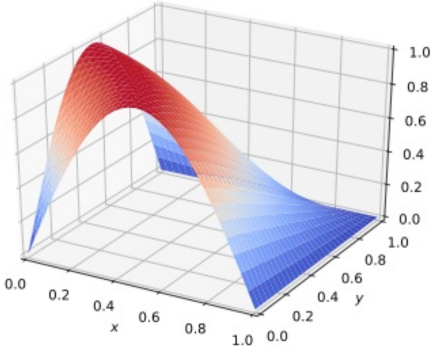
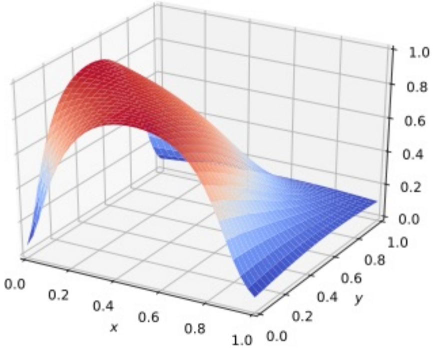
TESTING BAYESIAN NETWORK

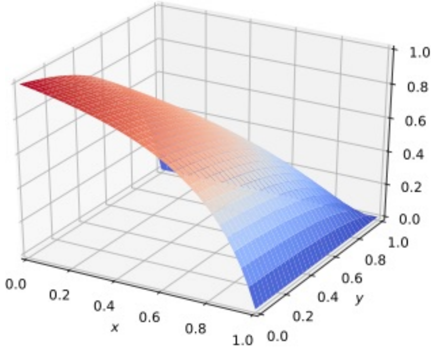
- Testing Bayesian networks are universal approximators [Choi, Darwiche(2018)].



Ground truth



Best fit for TBN
Universal Approximator

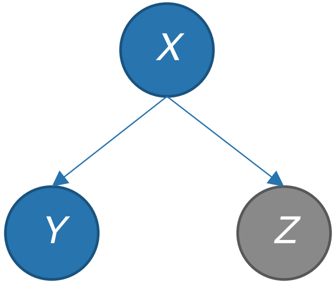


Best fit for BN

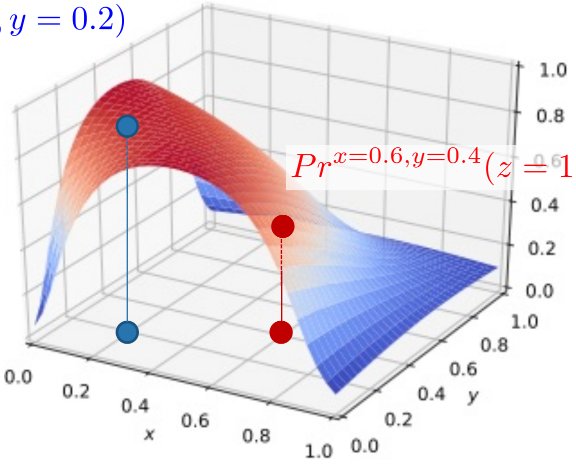
Testing Bayesian Network

A SET OF DISTRIBUTIONS

- TBN represents a set of distributions.
  - Different evidence selects different distribution for inference.



$Pr^{x=0.2,y=0.2}(z = 1 \mid x = 0.2, y = 0.2)$



$Pr^{x=0.6,y=0.4}(z = 1 \mid x = 0.6, y = 0.4)$

Conditional Independence in TBN

Suppose *X* is d-separated from *Y* given *Z*.

In classical Bayesian networks,

$$Pr(x|yz) = Pr(x|z) \; .$$

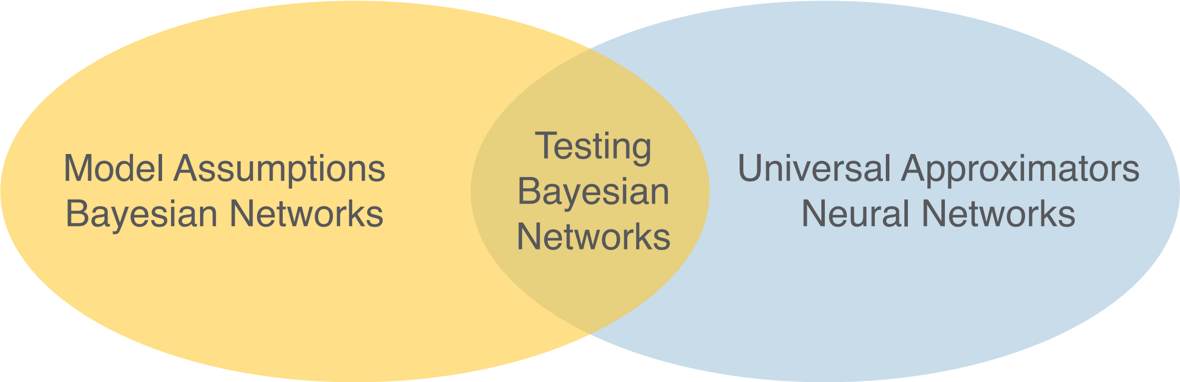
In testing Bayesian networks,

$$Pr^{yz}(x|yz) = Pr^{z}(x|z) \, .$$

Pr^{yz} is the joint distribution selected under evidence *yz*

Pr^{z} is the joint distribution selected under evidence z

Fuse Knowledge with Expressiveness



Thank You

Conditional Independence in Testing Bayesian Networks