

Lecture 2: Directed Acyclic Graphical Models

Statistical and Computational Methods for Learning through
Graphical Models (aka Probabilistic Graphical Models)

BIOSTAT 830

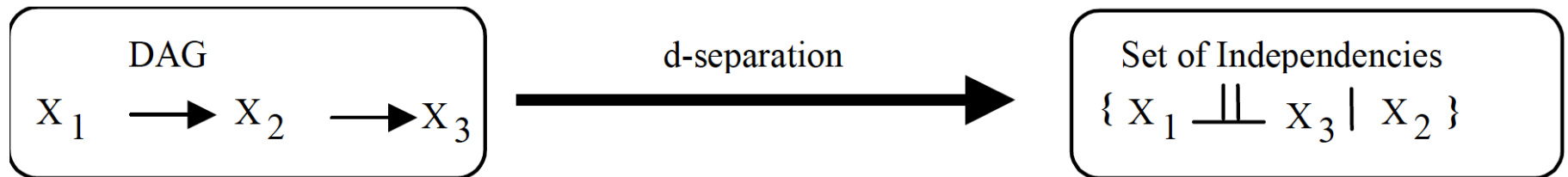
September 8th, 2016

Zhenke Wu

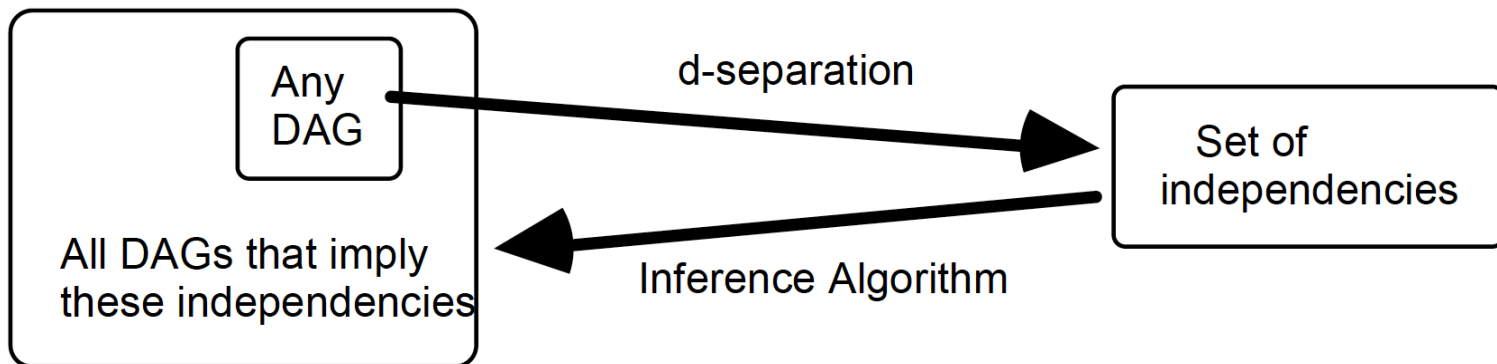
Learning Goals

- Understand and describe how can a directed graph represent probability distributions
- Understand and describe the (semi-)graphoid axioms that govern conditional independence
- Understand and identify d-separation
- Understand and describe Markov condition and faithfulness assumption; Understand why they are relevant

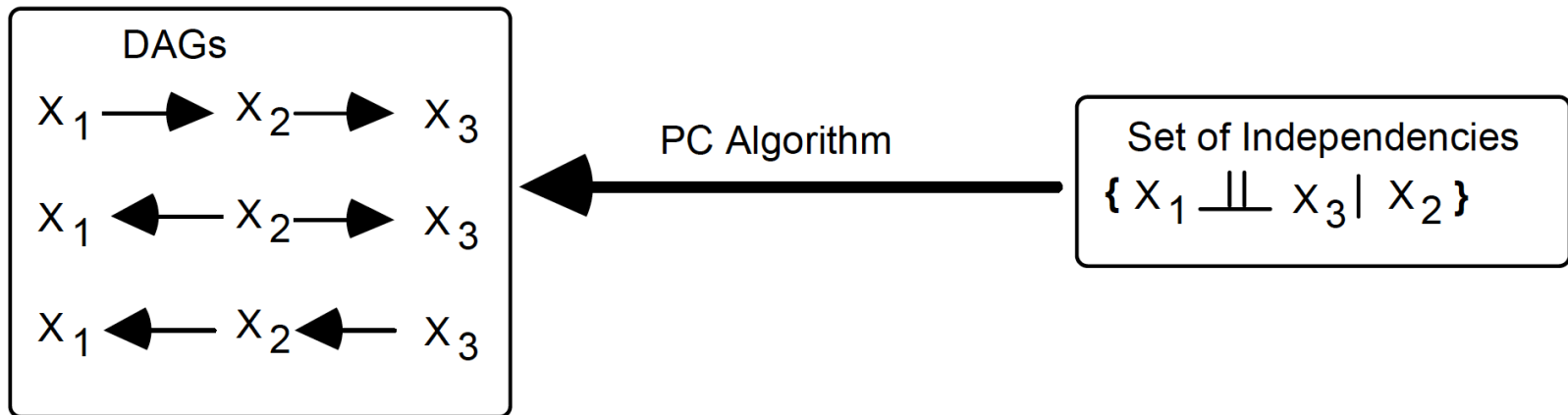
Representation by d-separation



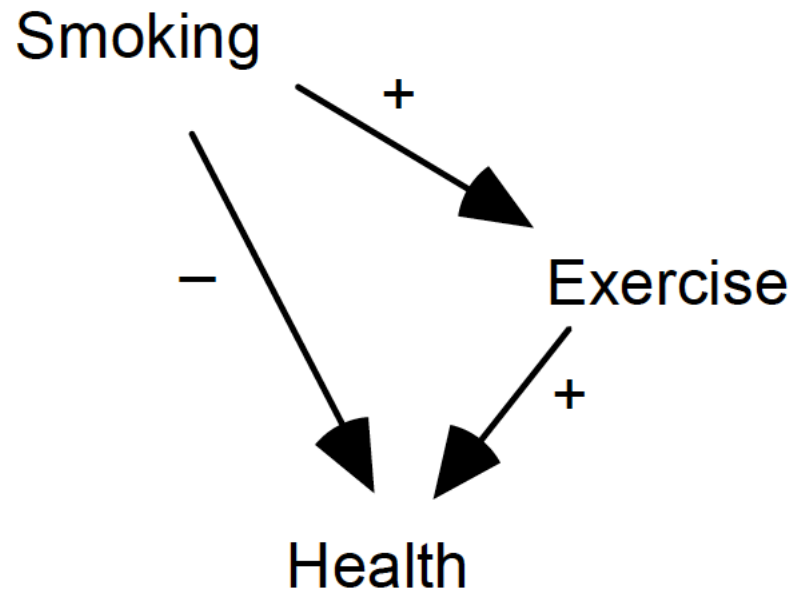
Representation and Inference



Structure Learning



Faithfulness Assumption (about the Population)



Self-Evaluation Problem I

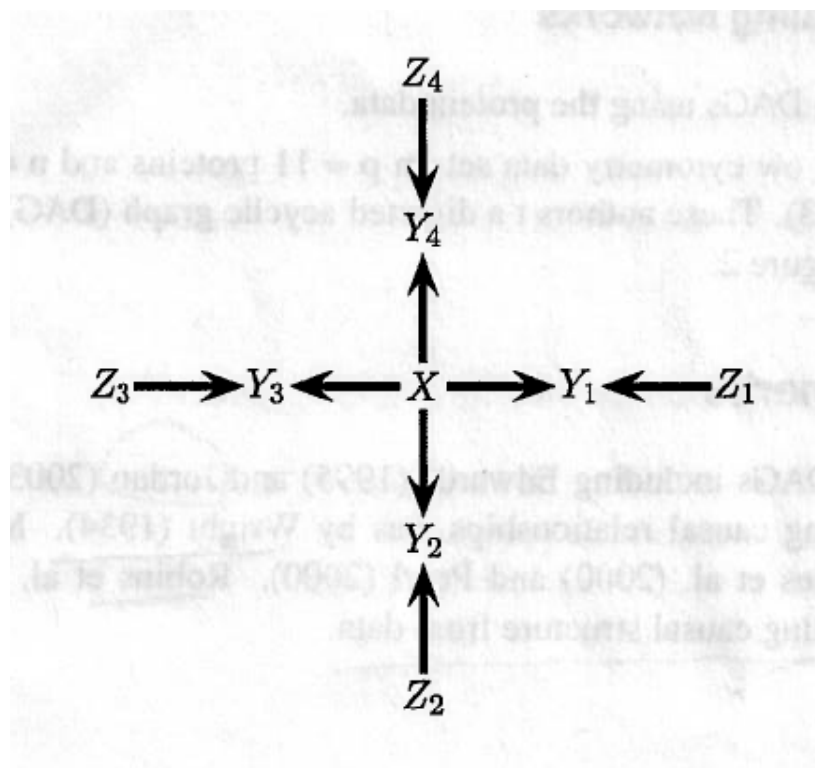
Let X , Y and Z have the following joint distribution:

	$Y = 0$	$Y = 1$		$Y = 0$	$Y = 1$
$X = 0$	.405	.045	$X = 0$	.125	.125
$X = 1$	.045	.005	$X = 1$	.125	.125
	$Z = 0$			$Z = 1$	

- Find the conditional distribution of X and Y given $Z = 0$ and the conditional distribution of X and Y given $Z = 1$.
- Show that $X \perp\!\!\!\perp Y|Z$.
- Find the marginal distribution of X and Y .
- Show that X and Y are not marginally independent.

Self-Evaluation Problem II

1. Write down the factorization of the probability distributions this DAG can represent.
2. Prove X and Z_j are independent



Reading

- Chapter 1.2, Pearl's causality book