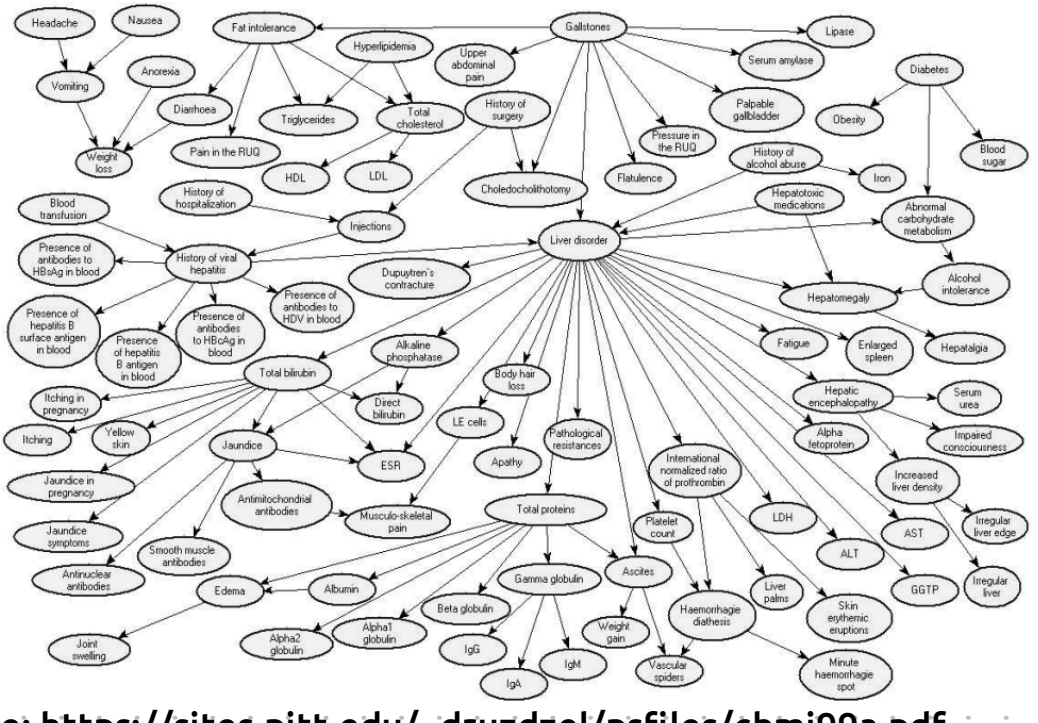
DS 2500 Mar 20

notes part 2 (of 2)

Bayes Nets
- compute conditional probabilities with multiple random variables:
  - P(ABC|XYZ) = P(ABCXYZ) / P(XYZ)
- bayes net motivation, definition
- computing conditional probabilities
  - via spreadsheet ("computer" method)

(enjoy Bayes Nets?
see "Probabilisitic Graphical Models" Daphne Koller & Coursera course)

WHAT ARE BAYES NETS GOOD FOR?



source: https://sites.pitt.edu/~druzdzel/psfiles/cbmi99a.pdf

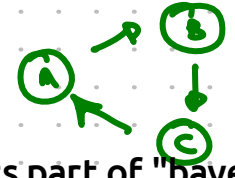
Bayes nets allow us to incorporate multiple pieces of evidence into some conditional prob of interest:

given a person has:
- symptom 4
- symptom 11
- risk factor 7

whats the prob of liver disorder?

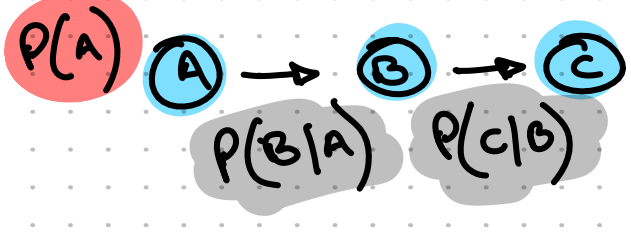
Bayesian Network (Bayes Net)

(formally):
A directed, acyclic graph which represents conditional distributions / independences between a set of random variables.



HAS CYCLE, NOT A BAYES NET

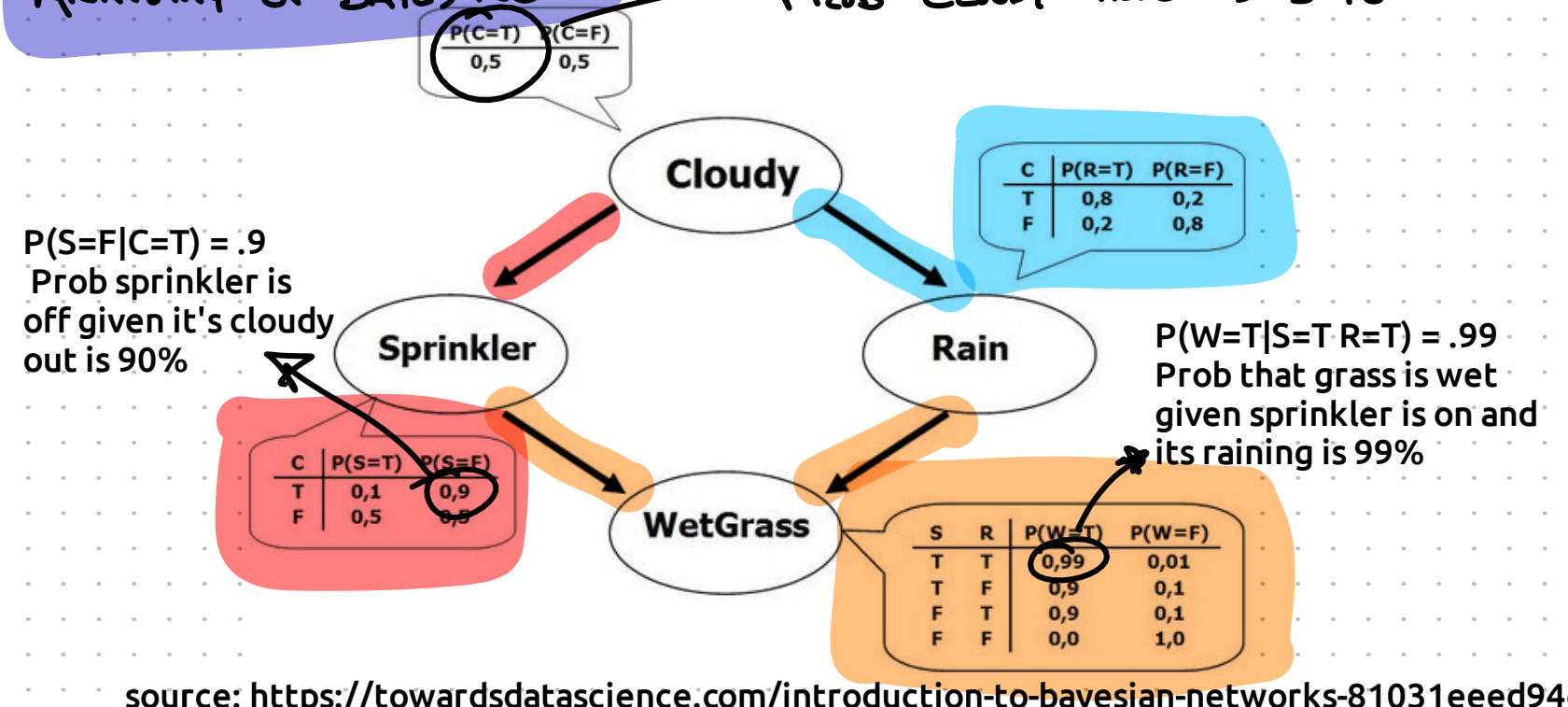
each node represents a random variable
directed edges represent conditional distributions
any node without inward edges has prob specified (its part of "bayes net" too!)



(informally):
a network which describes how random variables influence each other. can be used to compute conditional probabilities of interest

Anatomy of Bayes Net

Prob Cloudy = True is 50%



P(S=F|C=T) = .9
Prob sprinkler is off given it's cloudy out is 90%

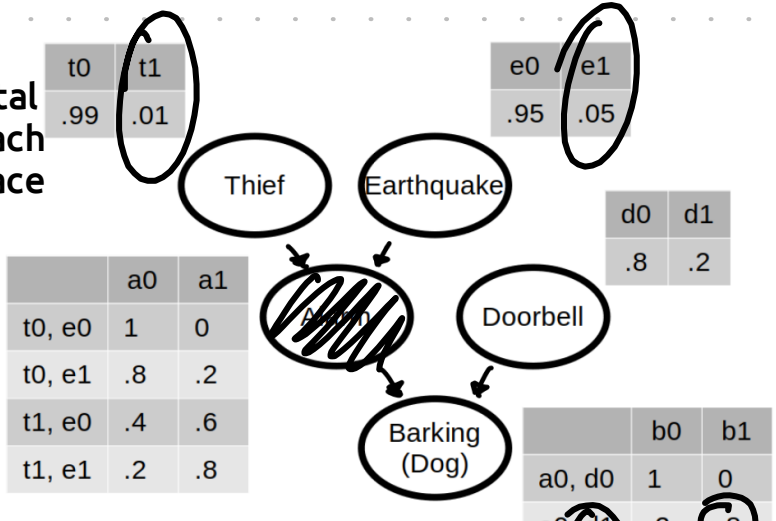
P(W=T|S=T R=T) = .99
Prob that grass is wet given sprinkler is on and its raining is 99%

source: https://towardsdatascience.com/introduction-to-bayesian-networks-81031eeed94e

Bayes Net Notation (our convention)

Each random variable is denoted with a capital letter (T for Thief). Each outcome in sample space has its own lowercase letter :

t0 = no thief
t1 = thief



t0	t1
.99	.01

e0	e1
.95	.05

d0	d1
.8	.2

	a0	a1
t0, e0	1	0
t0, e1	.8	.2
t1, e0	.4	.6
t1, e1	.2	.8

	b0	b1
a0, d0	1	0
a0, d1	.2	.8
a1, d0	.5	.5
a1, d1	.01	.99

(quick) ICA 2:

what's prob of earthquake?

$P(e_1) = .05$

given a thief in house, but no earthquake, what's prob alarm goes off?

$P(a_1 \mid t_1, e_0) = .6$

Interpretation question:
- is alarm better at detecting thieves or earthquakes?

THIEVES

- which sound bothers the dog more, the alarm or doorbell?

DOORBELL

In Class Assignment 3:
Estimate / intuite the four probabilities below. Except for the first, you needn't compute a precise number, but tell if it is greater / lesser / equal to the prob immediately above it.

What is the prob of thief? $P(t_1) = .01$

Given that alarm is going off, what is prob of thief? $P(t_1 | a_1) > P(t_1)$

Given that alarm is going off & dog is barking, what is prob of thief? $P(t_1 | a_1 b_1) = P(t_1 | a_1)$

Given that alarm is going off, dog is barking & earthquake, what is prob of thief?

$$P(t_1 | a_1 b_1 e_1) < P(t_1 | a_1 b_1)$$