CS 188
Spring 2011

Introduction to
Artificial Intelligence

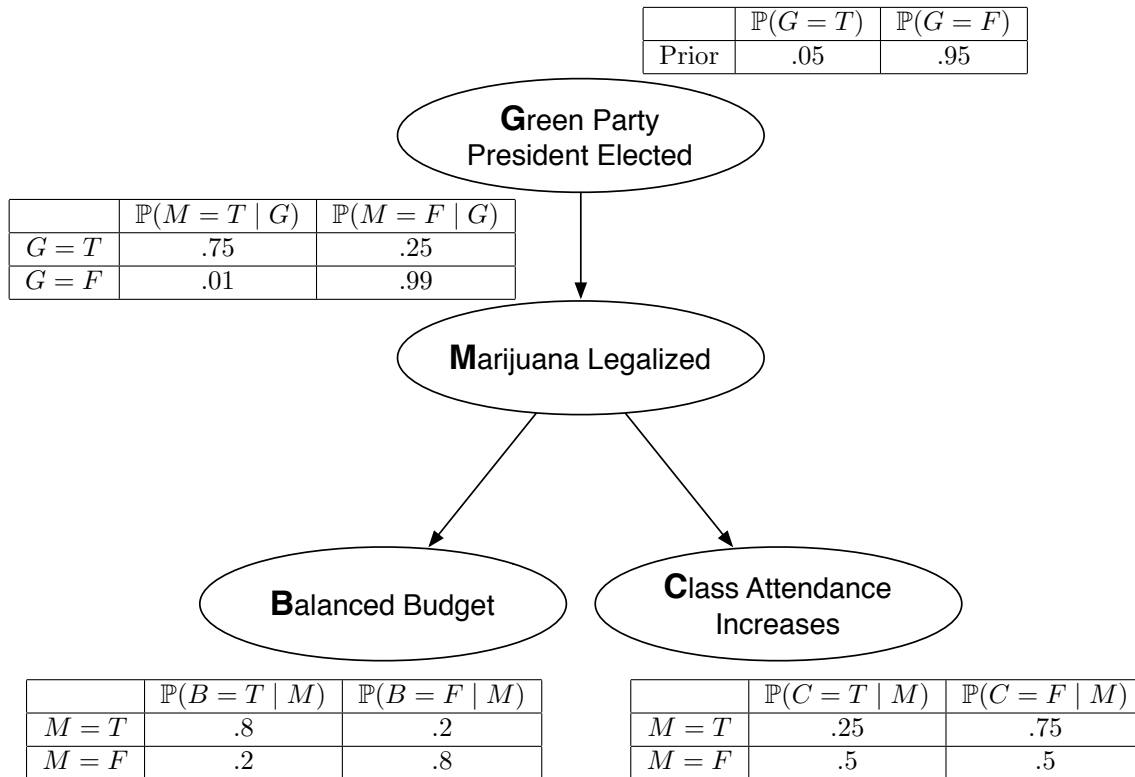Section 7
Probability and Bayes Nets

Q1. Green Party President

The following Bayes Net describes a hypothetical scenario in which a Green Party presidential candidate may be elected President. In the probability tables below, the values T and F denote true and false.

	$\mathbb{P}(G = T)$	$\mathbb{P}(G = F)$
Prior	.05	.95

Green Party President Elected

	$\mathbb{P}(M = T \mid G)$	$\mathbb{P}(M = F \mid G)$
$G = T$	.75	.25
$G = F$	.01	.99

Marijuana Legalized

Balanced Budget

Class Attendance Increases

	$\mathbb{P}(B = T \mid M)$	$\mathbb{P}(B = F \mid M)$
$M = T$	.8	.2
$M = F$	.2	.8

	$\mathbb{P}(C = T \mid M)$	$\mathbb{P}(C = F \mid M)$
$M = T$	.25	.75
$M = F$	.5	.5

(a) Factor the joint distribution of the variables G, M, B, and C using the chain rule.

(b) Now, factor the joint distribution using the simplifying assumptions of this model.

(c) Fill in the full joint probability table below.

G	M	B	C	$\mathbb{P}(G, M, B, C)$	G	M	B	C	$\mathbb{P}(G, M, B, C)$
true	true	true	true		false	true	true	true	
true	true	true	false		false	true	true	false	
true	true	false	true		false	true	false	false	
true	true	false	false		false	true	false	true	
true	false	true	true		false	false	true	true	
true	false	true	false		false	false	true	false	
true	false	false	true		false	false	false	true	
true	false	false	false		false	false	false	false	

(d) While you do not know the outcome of the election, you observe that class attendance decreases. What is the probability that the green party was elected president? Does your answer make sense?

(e) Compute the below quantities from the joint distribution or using the original Bayes net above. You do not need to write in the actual numerical values of your answers, but each term in your expression should either be present in the Bayes net in a CPT or the joint distribution.

    (i) $\mathbb{P}(M = \text{true})$

    (ii) $\mathbb{P}(B = \text{true} \mid G = \text{true}, M = \text{true})$

    (iii) $\mathbb{P}(B = \text{false} \mid M = \text{false})$

    (iv) $\mathbb{P}(C = \text{true} \mid B = \text{true})$

    (v) $\mathbb{P}(B = \text{true})$

(f) Add a node S to the network that reflects the possibility that a new scientific study could influence legalization of marijuana. Which CPT needs to be modified?

(g) Consider your augmented model. Just based on the structure, which of the following are guaranteed to be true, which are guaranteed to be false, and which cannot be determined?

    (i) $B \perp\!\!\!\perp G$

    (ii) $C \perp\!\!\!\perp G \mid M$

    (iii) $G \perp\!\!\!\perp S$

    (iv) $G \perp\!\!\!\perp S \mid M$

    (v) $G \perp\!\!\!\perp S \mid B$

    (vi) $B \perp\!\!\!\perp C$

    (vii) $B \perp\!\!\!\perp C \mid G$