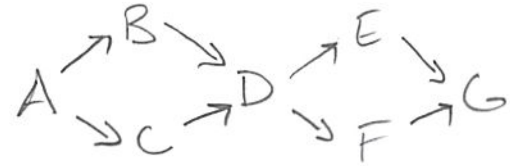
CMPS 3560 2/20/18
Review notes

Expert Systems

$A \Rightarrow C$
$A \Rightarrow B$
$B \cup C \Rightarrow D$
$D \Rightarrow E$
$D \Rightarrow F$
$E \cup F \Rightarrow G$



Inference chain

① Given A, carry out foreward chaining.

Pass 1: $A \Rightarrow \underline{C}$
$A \Rightarrow \underline{B}$
no other rules can be fired.
2: $B \cup C \Rightarrow \underline{D}$
3: $D \Rightarrow E$
$D \Rightarrow F$
4: $E \cup F \Rightarrow G$

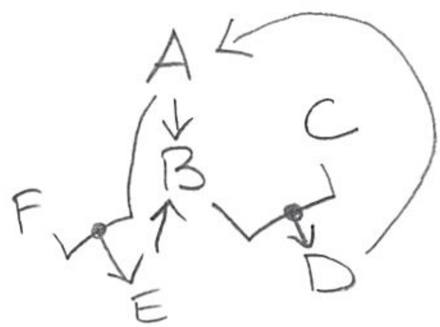
$\Rightarrow$ A, B, C, D, E, F, G known

② Given B, w/ E as the goal, carry out backword chaining.

goal E: $D \Rightarrow E$, D new subgoal
D: $C \cup B \Rightarrow D$, assume C comes first just for example
C new subgoal
C: $A \Rightarrow C$, A new subgoal
A: fails
B: Fact

③ Following ②, is F known during inference?
Backword: No
Foreward: Yes

$A \Rightarrow B$
$B \cap C \Rightarrow D$
$D \Rightarrow A$
$A \cap F \Rightarrow E$
$E \Rightarrow B$



① B & C are fact. Carry out Forward Chaining.

Pass 1: $B \cap C \Rightarrow \underline{D}$
2: $D \Rightarrow \underline{A}$
3: $A \Rightarrow B$, already known

$\Rightarrow$ Fact: A, B, C, D

② B & C are fact Carry out Backward chaining.
What is E?

E: $A \cap F \Rightarrow E$, A new subgoal
A: $D \Rightarrow A$, D new subgoal
D: $B \cap C \Rightarrow D$, B new subgoal
B: Fact
C: Fact, Thus, <u>A true</u>
F: <u>fail</u>

<u>Bayes Rule</u>

	C		¬C	
	B	¬B	B	¬B
A	.05	.2	.15	.05
¬A	.1	.05	.3	.1

Hypothesis: C $\Rightarrow$ rank: $p(C|E)$ vs. $p(\neg C|E)$
Let E be: $\neg A, \neg B$

$$p(C|\neg A, \neg B) = p(\neg A, \neg B|C)\, p(C) / \text{data} \rightsquigarrow \text{ignore}$$

$$= \underbrace{p(\neg A|C)\, p(\neg B|C)}_{\text{assump. of ind.}}\, p(C)$$

$$P(C) = \sum_{(A,B)} P(A,B,C) = P(A,B,C) + P(A,\neg B,C) + P(\neg A,B,C) + P(\neg A,\neg B,C)$$
$$= 0.05 + 0.2 + 0.1 + 0.05$$
$$= 0.4$$

$$P(\neg A | C) = P(\neg A \cap C) / P(C)$$
$$= \left(\sum_{B} P(\neg A, B, C)\right) / P(C)$$
$$= \left(P(\neg A,B,C) + P(\neg A,\neg B,C)\right) / P(C)$$
$$= (0.1 + 0.05) / 0.4$$
$$= 0.375$$

$$P(\neg B | C) = P(\neg B \cap C) / P(C)$$
$$= \left(\sum_{A} P(A,\neg B,C)\right) / P(C)$$
$$= \left(P(A,\neg B,C) + P(\neg A,\neg B,C)\right) / P(C)$$
$$= (0.2 + 0.05)/0.4$$
$$= 0.25/0.4$$
$$= 0.625$$

$$P(C|\neg A,\neg B) = (0.375)(0.625)(0.4)/\text{data}$$
$$= 0.09375/\text{data}$$

Now repeat for $P(\neg C | \neg A, \neg B)$

$$P(\neg C|\neg A,\neg B) = P(\neg A,\neg B|\neg C)\, P(\neg C)/\text{data}$$
$$= P(\neg A|\neg C)\, P(\neg B|\neg C)\, P(\neg C)/\text{data}$$

$$P(\neg C) = 0.15 + 0.05 + 0.3 + 0.1 = 0.6$$

$$P(\neg A|\neg C) = P(\neg A, \neg C) / P(\neg C)$$
$$= \left(P(\neg A, B, \neg C) + P(\neg A,\neg B,\neg C)\right) / P(\neg C)$$
$$= (0.3 + 0.1)/0.6$$
$$= 0.667$$

$$P(\neg B|\neg C) = P(\neg B, \neg C) / P(\neg C)$$
$$= \left(P(A,\neg B,\neg C) + P(\neg A,\neg B,\neg C)\right) / P(\neg C)$$
$$= (0.05 + 0.1)/0.6 = 0.25$$

$P(\neg C \mid \neg A, \neg B) = (0.667)(0.25)(0.6)$ /data
$= 0.10005$ /data

$\dfrac{P(\neg C \mid \neg A, \neg B)}{\text{data}} > \dfrac{P(C \mid \neg A, \neg B)}{\text{data}}$

same term. Save time,
dont bother calc. for
a comparison

$\underline{0.10005} > 0.09375$?

$\underline{\neg C}$