

Homework #6: Chapters 13, 14 and 16

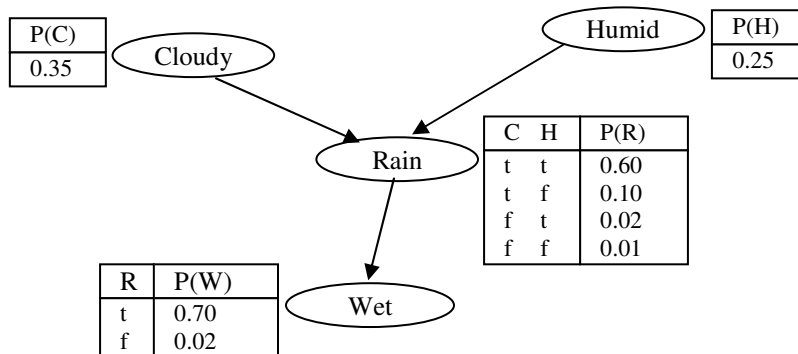
The following exercises are due at the beginning of class on Wednesday, April 19. Note, this homework is continued on the reverse side of the paper.

1. [25 points] A full joint distribution for the Boolean random variables A , B , and C is specified below. Assume that the true value of a random variable is the corresponding lower case letter (e.g., $P(b)$ means $P(B=true)$)

	b		$\neg b$	
	c	$\neg c$	c	$\neg c$
a	0.10	0.01	0.05	0.20
$\neg a$	0.20	0.04	0.15	0.25

Use the distribution to compute the following probabilities and probability distribution. Show your work.

- $P(\neg a)$
 - $P(C)$
 - $P(a \wedge \neg b)$
 - $P(c \vee \neg a)$
 - $P(a \mid \neg b \wedge c)$
2. [30 points] Use the Bayesian network and conditional probability tables shown below to compute the following probabilities and probability distributions. All random variables are Boolean. You must give computed numeric answers and show all of your work.



- [5 pts] $P(w \wedge \neg r \wedge \neg c \wedge h)$
 - [10 pts] $P(W \mid r \wedge c \wedge \neg h)$
 - [15 pts] $P(C \mid w)$
3. [20 pts.] Do exercise 14.3 (a-d) from the book (p. 534).
4. [25 pts.] Consider the following variation of the Wumpus World agent. The agent has a choice of eight actions: move in one of the four directions (north, south, east, or west) or shoot its only arrow in one of those directions. If the agent moves into a square with the Wumpus or a pit in it, the agent dies; it can move into any other square safely. The arrow will only travel one square, but if the Wumpus is in the square the arrow will kill it. The agent's utility is calculated as shown on the next page:

- 1000 for an action that results in death
- 100 for wasting the arrow by shooting at a square that doesn't contain the Wumpus
- 100 for moving into a safe square
- 200 for killing the Wumpus with an arrow

For each of the four adjacent squares (North, South, East, and West), the agent has determined the probability that they contain the Wumpus and the probability that they contain a pit. Assume that the Wumpus is smart enough to avoid pits, so a squares with a Wumpus will not contain a pit and vice versa. These probabilities are given in the following table:

Square	P(Wumpus)	P(Pit)
North	0.8	0.1
South	0.0	0.0
East	0.2	0.5
West	0.0	0.5

What is the expected utility of each action? To maximize the chance for partial credit, be sure to show your work. If the agent follows the principle of maximum expected utility and only considers single actions (as opposed to action sequences), which action will it choose?