CPS 270: Assignment 3

Due Midnight, March 6th
Please submit a PDF of your solutions via Sakai.

Question 1

Show that both of De Morgan's Laws are true, using truth tables. [10]

Question 2

Derive the truth value of A, given the following logical facts in a Knowledge Base:
$B \Rightarrow \neg C$
$A \vee B$
$C \vee D$
$\neg D \wedge E$. [10]

Question 3

You are given the following predicate vocabulary, where x and y are parameters:
```
AuthorOf(x, y)
IsAuthor(x)
IsProgram(x)
Equals(x, y).
```

Write down first-order logic sentences to express the following:

1. All programs have an author.
2. `RichardStallman` wrote the program `emacs`.
3. At least one program has exactly three authors.
4. No programs were written by `George`.

[10]

Question 4

You are given the following joint probability table for binary random variables A, B, and C.

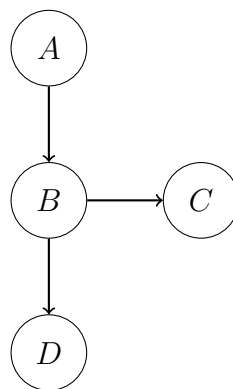| A	B	C	P
True	True	True	0.288
True	True	False	0.192
True	False	True	0.072
True	False	False	0.048
False	True	True	0.060
False	True	False	0.140
False	False	True	0.060
False	False	False	0.140

Answer the following questions (showing all working):

1. Are C and A independent?

2. Is B independent of A given C?

[20]
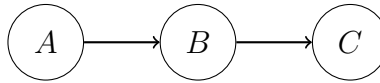
Question 5

You are given the following Bayes Net.

Write down the CPTs you would need to fully describe this Bayes Net, and their sizes. (You do not need to fill in the CPTs, just write down what expression they represent, and the number of entries they have.) [10]

Question 6

You are given the following Bayes Net:

with $P(A = \text{True}) = 0.6$, and the following CPTs:

B	A	P
True	True	0.6
False	True	0.4
True	False	0.1
False	False	0.9
	(a)	

C	B	P
True	True	0.25
False	True	0.75
True	False	0.5
False	False	0.5
	(b)	

Draw 3 samples from the joint distribution. Show your working. [10]