# CS-171, Intro to A.I. — Quiz#4 — Spring Quarter, 2011 — 20 minutes

YOUR NAME AND EMAIL ADDRESS: _____

YOUR ID: _____ ID TO RIGHT:_____ ROW:_____ NO. FROM RIGHT:_____

**1. (20 pts total, 2 pts each) Probability concepts and formulae.**
For each of the following items on the left, write in the letter corresponding to the best answer or the correct definition on the right. The first one is done for you as an example.

| | | | |
|---|---|---|---|
| A . | Probability Theory | A | Assigns each sentence a degree of belief ranging from 0 to 1 |
| H | Conditional independence | B | Degree of belief accorded without any other information |
| G | Independence | C | Degree of belief accorded after some evidence is obtained |
| K | Product rule (chain rule) | D | Gives probability of all combinations of values of all variables |
| C | Conditional probability | E | Takes values from its domain with specified probabilities |
| B | Unconditional probability | F | A possible world is represented by variable/value pairs |
| J | $P(a \vee b)$ | G | $P(a \wedge b) = P(a)\ P(b)$ |
| E | Random variable | H | $P(a \wedge b \mid c) = P(a \mid c)\ P(b \mid c)$ |
| I | Bayes' rule | I | $P(a \mid b) = P(b \mid a)\ P(a) / P(b)$ |
| D | Joint probability distribution | J | $P(a) + P(b) - P(a \wedge b)$ |
| F | Factored representation | K | $P(a \wedge b \wedge c) = P(a \mid b \wedge c)\ P(b \mid c)\ P(c)$ |

**2. (30 pts total, 5 pts each) Unifiers and Unification.**
Write the **most general unifier** (or MGU) of the two terms given, or "None" if no unification is possible. Write your answer in the form of a substitution as given in your book, e.g., {*x / John, y / Mary, z / Bill*}. The first one is done for you as an example.

**2a**. UNIFY( *Knows( John, x ), Knows( John, Jane )* ) { *x / Jane* }

**2b**. UNIFY( *Knows( John, x ), Knows( y, Jane )* ) { *x / Jane, y / John* }

**2c.** UNIFY( *Knows( y, x ), Knows( John, Jane )* ) { *x / Jane, y / John* }

**2d.** UNIFY( *Knows( John, x ), Knows( y, Father (y) )* ) { *y / John, x / Father (John)* }

**2e.** UNIFY( *Knows( John, F(x) ), Knows( y, F(F(z)) )* ) { *y / John, x / F (z)* }

**2f.** UNIFY( *Knows( John, F(x) ), Knows( y, G(z) )* ) None

**2g.** UNIFY( *Knows( John, F(x) ), Knows( y, F(G(y)) )* ) { *y / John, x / G (John)* }

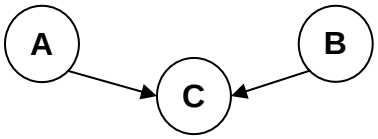
****** TURN PAGE OVER. QUIZ CONTINUES ON THE REVERSE ******

**3. (40 pts total, 10 pts each) Bayesian networks.**
Recall that a Bayesian network represents a joint probability distribution in graphical form, using the approximation

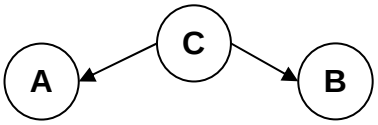
$$p(X_1, X_2, ..., X_N) = \prod p(X_i \mid \text{parents}(X_i))$$

For each Bayesian network shown below, write down in factored form the joint probability distribution that it represents. The first one is done for you as an example.

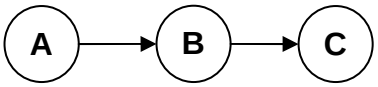
**3a.** P(C | A, B) P(A) P(B)



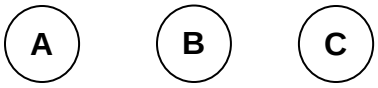

**3b.** P(A | C) P(B | C) P(C)



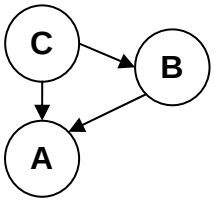

**3c.** P(C | B) P(B | A) P(A)




**3b.** P(A ) P(B) P(C)




**3b.** P(A | B, C) P(B | C) P(C)




**4. (10 pts total) Bayesian networks.**
Draw the Bayesian network that represents P(J | A) P(M | A) P(A | B, E) P(B) P(E).