Name: _____

CSCI 561 Final, Spring 2011

This test is open book and notes, but you must work alone with no help from any other people (any than questions asked of the instructor or TA) or resources. Use of all electronic equipment is forbidden.

1. [5] **Yes** or (**No**): Euclidean distance dominates Manhattan distance as a heuristic for the Eight Puzzle (where both are computed as sums of distances for pieces out of place). Circle the answer that applies.

2. [10] To exhibit via resolution behavior that is similar to forward chaining in a rule system, repetitions of resolving which kind of choice from List A with which kind of choice from List B comes closest? Circle one choice in each list:

List A	*List B*
horn clause	**unit clause**
definite clause	**positive unit clause**
	negative unit clause

3. [10] Compared with *minimax* search, *iterative deepening alpha-beta* yields what advantages? Circle all that apply:

reduced effective branching factor	**reduced search depth**
improved node ordering	**improved coping with deadlines**

4. [10] Which of these relationships can individually (i.e., all by itself) guarantee that *P*(a|b)=P(b|a) ? Circle all that apply:

***P*(*a*)=*P*(*b*)**	***a* and *b* are independent**
***a* and *b* are mutually exclusive**	**a and b constitute an exhaustive decomposition**

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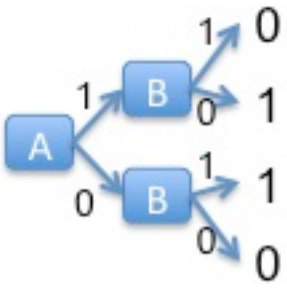
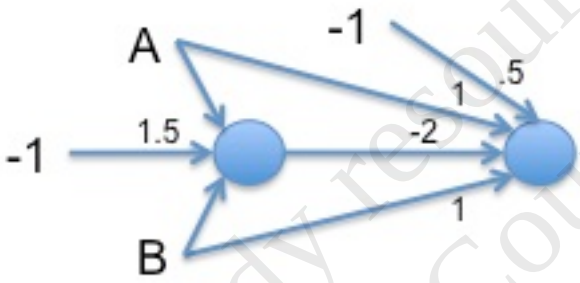
5. [25] You have seen that single-layer Perceptrons can't encode an XOR function, A⊕B, while such a support vector machine can be built. For each of the following formalisms, provide an instance that encodes XOR.

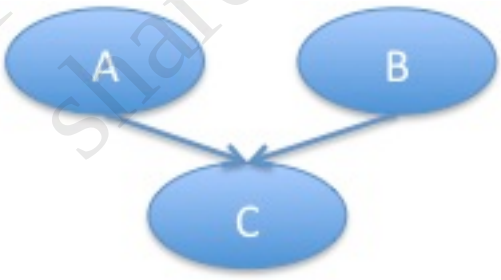
   a. [5] Decision Trees



   b. [10] Two-layer Perceptrons



   c. [10] Bayesian networks



A	B	P(C | A,B)
0	0	0
0	1	1
1	0	1
1	1	0

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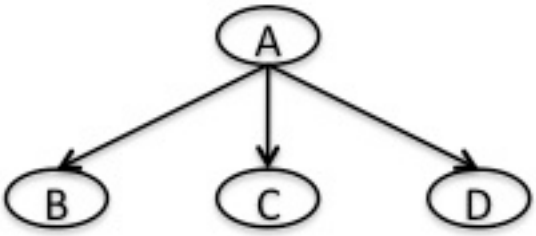
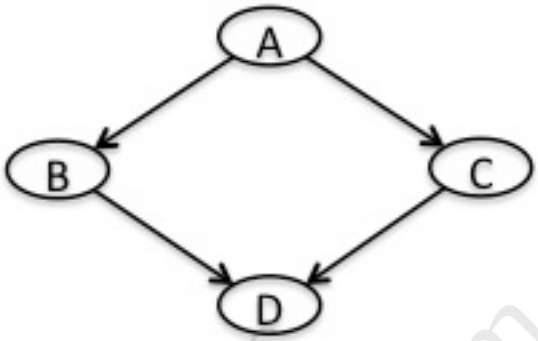
6. [30] Consider the following two Bayesian networks, with CPTs omitted.



NBN: Naive Bayes Network



DN: Diamond Network

a. [10] Write the factored expression each network defines for the joint probability distribution **P**(*A*,*B*,*C*,*D*).

NBN: P(A)P(B | A)P(C | A)P(D | A)

DN: P(A)P(B | A)P(C | A)P(D | B, C)

b. [10] What is the Markov blanket for node *C* in each network?

NBN: A

DN: A, B, D

c. [5] Which of these networks are polytrees?

NBN

d. [5] If training examples include values for all nodes that are either parentless or childless, which of these networks require unsupervised learning in support of Bayesian learning?

DN

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7. [10] Consider the problem of preparing a birthday dinner for a friend who is currently sleeping in the apartment. The goal is to have the meal ready (`dinner`), the gift wrapped (`present`), and the trash gone (`¬garb`). In the initial state, the meal isn't ready, the gift isn't wrapped, your hands are clean (`cleanH`), there is trash, and the apartment is quiet (`quiet`). There are four actions that can be performed:

Action	Preconditions	Effects
`cook` *(cook dinner)*	`cleanH`	`dinner`
`wrap` *(wrap present)*	`quiet`	`present`
`carry` *(carry out garbage)*		`¬garb, ¬cleanH`
`dolly` *(roll out garbage)*		`¬garb, ¬quiet`

Consider an `Extract-Solution` algorithm (within `Graphplan`) that is based on backwards search. Assume that as the search proceeds backwards, a maximal set of compatible actions is included at each level. In the following planning graph, circle the actions (including persistence actions) for the plan (to achieve the goal mentioned above) that would be derived by such an algorithm.