CSE4107

Class Test 4 Spring-2019

Marks: 10 Time: 25 min.

1. What role does utility theory play in acting under uncertainty? (2)
2. Write a short note on Types of nodes in Decision networks. (3)
3. Consider the 'Escape the monster' environment given below.

OK 1,2 S	OK 2,2 S	
OK 1,1	OK 2,1	OK 3,1 S

Assume that OK indicates absence of a monster(M) at the cell, the status of the cells of the 4 x 4 grid other than those shown are unknown, and that the agent can smell(S) a monster at a cell vertically or horizontally adjacent to it.
Find $P(M_{2,3})$ taking 0.1 as the independent probability of a monster at any of the unknown cells. (5)

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1. What role does probability theory play in acting under uncertainty? (2)
2. Derive the Bayes' rule from the definition of conditional probabilities, and explain its importance. (3)
3. Say, we have a Bayesian network containing 4 random variables A, B, C and D with two distinct values each. The conditional probability tables assigned to the random variables are given below. Draw the network and compute $P(D \mid a \wedge \neg b \wedge c)$ using the network. (5)

A	B	P(c)
a	b	0.7
a	¬b	0.5
¬a	b	0.2
¬a	¬b	0.02

A	C	P(d)
a	c	0.8
a	¬c	0.4
¬a	c	0.3
¬a	¬c	0.01

B	P(a)
b	0.6
¬b	0.05

P(b)
0.09

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1. What are the major components of a Bayesian Network? (2)
2. Explain the basic principle of decision theory. (3)
3. Joint-probability distribution of two random variables, having three different values each is shown in the table below.

		X_2		
		v_{21}	v_{22}	v_{23}
X_1	v_{11}	0.06	0.07	0.13
	v_{12}	0.21	0.14	0.12
	v_{13}	0.08	0.15	0.04

Explain the major features of such a distribution regarding inference about the domain. (5)

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1. What are the major components of a Decision Network? (2)
2. Explain the purpose of Bayesian Networks. (3)
3. Joint-probability distribution of three Boolean random variables is shown in the table below.

	a		¬a	
	c	¬c	c	¬c
b	0.104	0.016	0.082	0.008
¬b	0.016	0.066	0.144	0.564

Compute the posterior probabilities, $P(\neg c \vee b \mid \neg a)$ and $P(a \mid \neg b \vee c)$ using the distribution. (5)

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1. What are the major tools for acting under uncertainty? (2)
2. Explain how utility of an alternative is computed using a decision network. (3)
3. Joint-probability distribution of two random variables, having three different values each is shown in the table below.

		X_2		
		v_{21}	v_{22}	v_{23}
X_1	v_{11}	0.06	0.07	0.13
	v_{12}	0.21	0.14	0.12
	v_{13}	0.08	0.15	0.04

Compute the probabilities of the compound propositions, $v_{11} \vee v_{22}$, $v_{12} | v_{23}$ and $v_{21} | v_{13}$ using the distribution. (5)

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1. What do you know about Decision nodes? (2)
2. Explain the Bayes' rule using an illustrative example. (3)
3. Say, we have a Bayesian network containing 4 random variables A, B, C and D with two distinct values each. The conditional probability tables assigned to the random variables are given below. Draw the network and compute $P(C \mid \neg a \wedge b \wedge d)$ using the network. (5)

A	B	P(d)
a	b	0.7
a	¬b	0.5
¬a	b	0.2
¬a	¬b	0.02

A	D	P(c)
a	d	0.8
a	¬d	0.4
¬a	d	0.3
¬a	¬d	0.01

B	P(a)
b	0.6
¬b	0.05

P(b)
0.09

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1. What do you know about conditional probability tables? (2)
2. Write a brief essay on 'judgmental domains'. (3)
3. Consider the 'Escape the monster' environment given below.

OK 1,2	OK 2,2 S	
OK 1,1	OK 2,1	OK 3,1 S

Assume that OK indicates absence of a monster(M) at the cell, the status of the cells of the 4 x 4 grid other than those shown are unknown, and that the agent can smell(S) a monster at a cell vertically or horizontally adjacent to it.
Find $P(M_{3,2})$ taking 0.2 as the independent probability of a monster at any of the unknown cells. (5)

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1. How probability is related to uncertainty management? (2)
2. Explain the advantages and disadvantages of inference using full joint-probability distribution. (3)
3. Say, we have a Bayesian network containing 4 random variables A, B, C and D with two distinct values each. The conditional probability tables assigned to the random variables are given below. Draw the network and compute $P(C \mid \neg a \wedge b \wedge \neg d)$ using the network. (5)

A	B	P(d)
a	b	0.9
a	¬b	0.5
¬a	b	0.2
¬a	¬b	0.02

A	D	P(c)
a	d	0.8
a	¬d	0.4
¬a	d	0.3
¬a	¬d	0.01

B	P(a)
b	0.6
¬b	0.05

P(b)
0.07

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1. What are the positive sides of Bayesian networks? (2)
2. Illustrate the use of utility theory in Decision Networks. (3)
3. Joint-probability distribution of two random variables, having three different values each is shown in the table below.

		X_2		
		v_{21}	v_{22}	v_{23}
X_1	v_{11}	0.05	0.07	0.09
	v_{12}	0.22	0.14	0.13
	v_{13}	0.11	0.15	0.04

Compute $P(v_{12} \vee v_{22})$, $P(v_{11} \mid v_{23})$ and $P(v_{21} \mid v_{11})$ using the distribution. (5)

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1. Write a short note on Utility node. (2)
2. Describe the components of a Bayesian network. (3)
3. Joint-probability distribution of three Boolean random variables is shown in the table below.

	a		¬a	
	c	¬c	c	¬c
b	0.104	0.012	0.084	0.006
¬b	0.014	0.068	0.146	0.566

Compute the posterior probabilities, $P(\neg c \vee \neg b \mid \neg a)$ and $P(c \mid b \vee \neg a)$ using the distribution. (5)

1. How do you define a Bayesian network? (2)
2. Explain the nodes representing future state in a Decision network. (3)
3. Joint-probability distribution of two random variables, having three different values each is shown in the table below.

		X_2		
		v_{21}	v_{22}	v_{23}
X_1	v_{11}	0.05	0.07	0.09
	v_{12}	0.22	0.14	0.13
	v_{13}	0.11	0.15	0.04

Illustrate the features of inference using full joint-probability distribution in light of the given distribution. (5)

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1. How is the probability theory related to uncertainty management? (2)
2. Explain how utility of an alternative is computed using a Decision network. (3)
3. Say, we have a Bayesian network containing 4 random variables A, B, C and D with two distinct values each. The conditional probability tables assigned to the random variables are given below. Draw the network and compute $P(D \mid \neg a \wedge \neg b \wedge c)$ using the network. (5)

A	B	P(c)
a	b	0.7
a	¬b	0.5
¬a	b	0.2
¬a	¬b	0.02

A	C	P(d)
a	c	0.8
a	¬c	0.4
¬a	c	0.3
¬a	¬c	0.01

B	P(a)
b	0.6
¬b	0.05

P(b)
0.09

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1. How the truth of a proposition is computed involving full joint-probability distribution? (2)
2. What are the functions of Chance nodes and Decision nodes? (3)
3. Consider the 'Escape the monster' environment given below.

OK 1,2 S		
OK 1,2	OK 2,2 S	
OK 1,1	OK 2,1	OK 3,1 S

Assume that OK indicates absence of a monster(M) at the cell, the status of the cells of the 4 x 4 grid other than those shown are unknown, and that the agent can smell(S) a monster at a cell vertically or horizontally adjacent to it.
Find $P(M_{2,3})$ taking 0.3 as the independent probability of a monster at any of the unknown cells. (5)

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1. Why a full joint-probability distribution can be called a complete knowledgebase of the domain. (2)
2. How utility functions are computed in Decision Networks? (3)
3. Say, we have a Bayesian network containing 4 random variables A, B, C and D with two distinct values each. The conditional probability tables assigned to the random variables are given below. Draw the network and compute $P(C \mid a \wedge \neg d)$ using the network. (5)

A	B	P(d)
a	b	0.8
a	¬b	0.5
¬a	b	0.2
¬a	¬b	0.02

A	D	P(c)
a	d	0.9
a	¬d	0.4
¬a	d	0.3
¬a	¬d	0.01

B	P(a)
b	0.7
¬b	0.05

P(b)
0.6

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1. Write a short note on 'A degree of usefulness'. (2)
2. How do you explain the importance of Bayesian Networks? (3)
3. Joint-probability distribution of two random variables, having three different values each is shown in the table below.

		X_2		
		v_{21}	v_{22}	v_{23}
X_1	v_{11}	0.06	0.07	0.09
	v_{12}	0.22	0.14	0.15
	v_{13}	0.11	0.12	0.04

Compute $P(v_{21} \vee v_{12})$, $P(v_{22} \mid v_{12} \vee v_{13})$ and $P(v_{11} \mid v_{22} \vee v_{23})$ using the distribution. (5)

1. Write a short note on 'Future state in Decision Networks'. (2)
2. How consistent models of the environment can be used for making inference in uncertain domains? (3)
3. Joint-probability distribution of three Boolean random variables is shown in the table below.

	a		¬a	
	c	¬c	c	¬c
b	0.103	0.015	0.082	0.007
¬b	0.016	0.068	0.144	0.565

Compute the posterior probabilities, P(a|c), P(¬a∨b|¬c) and P(a|¬b∨c) using the distribution. (5)

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1. How utility of an alternative is computed using a decision network? (2)
2. Explain the main problems and relevant tools for acting under uncertainty. (3)
3. Joint-probability distribution of two random variables, having three different values each is shown in the table below.

		X_2		
		v_{21}	v_{22}	v_{23}
X_1	v_{11}	0.06	0.09	0.13
	v_{12}	0.19	0.14	0.12
	v_{13}	0.08	0.15	0.04

Compute the probabilities of the compound propositions, $v_{12} \vee v_{21}$, $v_{13}|v_{23}$ and $v_{22}|v_{12}$ using the distribution. (5)

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1. What do you know about Utility functions? (2)
2. Point out the positive and negative sides of inference using full joint-probability distribution. (3)
3. Say, we have a Bayesian network containing 4 random variables A, B, C and D with two distinct values each. The conditional probability tables assigned to the random variables are given below. Draw the network and compute P(D|¬b∧c) using the network. (5)

A	B	P(c)
a	b	0.9
a	¬b	0.7
¬a	b	0.2
¬a	¬b	0.02

A	C	P(d)
a	c	0.8
a	¬c	0.4
¬a	c	0.3
¬a	¬c	0.01

B	P(a)
b	0.6
¬b	0.05

P(b)
0.5