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ENPM808Y

HW-10

**Decision Networks**

1. **Prompt**: Deciding whether to purchase a software for AI class

S – Software

L – Learning well

P(L|S) – Probability of learning well given software

|  |  |
| --- | --- |
| S | P (L=Learning Well| S) |
| Obtained | 0.85 |
| Not Obtained | 0.75 |

G – Good grades

|  |  |  |
| --- | --- | --- |
| S | L | P (G=Good grades| S,L) |
| Obtained | Learn Well | 0.95 |
| Obtained | Not Learn Well | 0.45 |
| Not Obtained | Learn Well | 0.80 |
| Not Obtained | Not Learn Well | 0.25 |

(a) Use Netica to implement the decision network for this problem. This network would have two nature nodes (i.e., Learn and GoodGrade), a decision node (Purchase) and a utility node (U).

Graphical user interface, application, table

Description automatically generated

Table

Description automatically generated

Table

Description automatically generated

Diagram

Description automatically generated

(b) Compute the expected utility of purchasing the software as well as the utility of not purchasing it.

As seen in the figure in part (a), the expected utility for:

**Purchasing the software is $325, while for**

**Not Purchasing the software is $297.5**

(c) Would you purchase the software?

Since higher favorability is correlated with higher dollar value, as provided in the problem getting good grades equating to $500, the decision network shows that purchasing the software yields higher return in utility. So, I would purchase the software

**Dynamic Modeling**

2. **Prompt:** Are students are motivated in the AI course

* The prior probability of students being motivated at the start of the semester with no observations is 0.7.
* The probability of student being motivated in week n is 0.75 given that the student was motivated in the previous week, and 0.3 if not.
* The probability of having done the homework is 0.9 if the students were motivated, and 0.4 if not.
* The probability of students’ participation if motivated is 0.8, and 0.3 if not.

(a) Formulate this information as a dynamic Bayesian network so that we can predict student motivation from a sequence of observations. Draw the graph (consider 4 weeks) and provide the conditional probability tables (CPTs).

Student Participation [Yes/No](week 1)

Completed Homework [Yes/No](week 2)

Student Motivation [Yes/No] (week 2)

Student Motivation [Yes/No] (week 4)

Student Participation [Yes/No](week 4)

Student Participation [Yes/No](week 3)

Student Participation [Yes/No](week 2)

Completed Homework [Yes/No](week 2)

Completed Homework [Yes/No](week 3)

Completed Homework [Yes/No](week 2)

Student Motivation [Yes/No] (week 3)

Student Motivation [Yes/No](week 1)

**Assumption:** There was no homework submission on week 1. Homeworks began getting submitted on week 2. Student participation was measured starting from week 1

(b) Implement in Netica, compile, and compute the following:

Diagram

Description automatically generated

b1) what is the chance that a student who is motivated in week 1 is motivated in week 2?  in week 4?

Diagram

Description automatically generated

**Week 2: 75%**

**Week 4: 58.7%**

b2) what is the chance that a student who has done homework and participated in both week 1 and week 2 is motivated in week 3?

Diagram

Description automatically generated

**Week 3: 72.3%**

B3) what is the chance that the student who in week 1 does homework but does not participate is motivated in week 4?

Diagram

Description automatically generated

**Week 4: 57.2%**

B4) what is the chance that the student who does homework and participates in class in week 4 was motivated in week1?

Diagram

Description automatically generated

**Week 1: 72.5%**

**3.** Suppose that an object is moving according to the following transition model:

A picture containing text, clock

Description automatically generated

Here, 0 < p < 1 and 0 < q < 1 are arbitrary probabilities. At time 0, the object is known

to be in state A.

a. What is the probability that the object is in A at time n >= 0?

Text, letter

Description automatically generated

b. What is the probability that the object first reaches B at time n >=1?

Text, letter

Description automatically generated

c. What is the probability that the object is in B at time n >= 1?

A piece of paper with writing on it

Description automatically generated with medium confidence

d. (Bonus) What is the probability that the object first reaches C at time n >=2?

