COMP3308 Assignment 2
Bayesian Networks

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1 Aim

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2 Methods

2.1 Bayesian Networks

Bayesian networks are simple, probabilistic graphical models that represent sets of random variables and their conditional dependencies.

2.2 Variable Elimination

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2.3 Likelihood Weighting

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3 Results and Discussion

3.1 Question 1

Metastatic cancer is a possible cause of a brain tumour and is also an explanation for increased total serum calcium. In turn, either of these could explain a patient falling into a coma. Severe headache is also possibly associated with a brain tumour.

- The prior probability of metastatic cancer $P(m)$ is 0.2.
- The conditional probability of increased total serum calcium $P(I|M)$ is: $P(i|m) = 0.8$ and $P(i|\neg m) = 0.2$
- The conditional probability of brain tumor $P(B|M)$ is: $P(b|m) = 0.2$ and $P(b|\neg m) = 0.05$
- The conditional probability of coma $P(C|I, B)$ is: $P(c|i, b) = 0.8$, $P(c|\neg i, b) = 0.8$, $P(c|i, \neg b) = 0.8$ and $P(c|\neg i, \neg b) = 0.05$.
- The conditional probability of severe headache $P(S|B)$ is $P(s|b) = 0.8$ and $P(s|b) = 0.6$.

a) Construct and show the equivalent graphical model.

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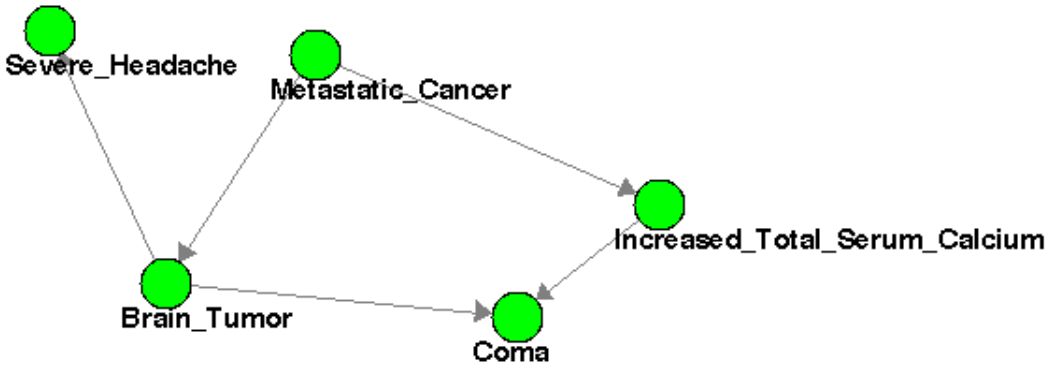

Figure 1: Equivalent graphical model created using JavaBayes

b) What is the prior probability of coma $P(C)$?

```
Posterior distribution:
        probability (  "Coma" ) { //1 variable(s) and 2 values
                table
                        0.32    // p(true | evidence )
                        0.68;   // p(false | evidence );
        }
```

Figure 2: Probability of coma query output using JavaBayes

Using the `Query` function in JavaBayes, $P(C) = 0.32$.

c) What is the probability of metastatic cancer given the patient has severe headaches and has not fallen into coma?

```
Posterior distribution:
        probability (  "Metastatic_Cancer" ) { //1 variable(s) and 2 values
                table
                        0.12087912087912088     // p(true | evidence )
                        0.8791208791208791;     // p(false | evidence );
        }
```

Figure 3: $P(M|S, \neg C)$ query output using JavaBayes

Using the `Query` function in JavaBayes, $P(M|S, \neg C) = 0.12087912087912088$.

d) What is the Markov blanket of coma?

In a Bayesian network, the Markov blanket of node A includes its parents, children and the other parents of all of its children.

Therefore the Markov blanket of coma are brain tumor and increased total serum calcium.

e) Are increased total serum calcium and brain tumor independent given coma? Explain.

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No, because of explaining away otherwise known as Berkson's Paradox.

Normally, total serum calcium and brain tumor are independent, but if we are given coma they become dependent since they share the same child.

f) What is the probability of fallen into coma given the patient has metastatic cancer?

```
Posterior distribution:
        probability (  "Coma" ) { //1 variable(s) and 2 values
                table
                        0.68    // p(true | evidence )
                        0.32;   // p(false | evidence );
        }
```

Figure 4: $P(C|M)$ query output using JavaBayes

Using the `Query` function in JavaBayes, $P(C|M) = 0.68$.

3.2 Question 2

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3.3 Question 3

3.4 Question 4

4 Conclusions

5 Reflection

6 Instructions

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