CS3243 Revision/Consultation

Eric Han

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Annoucements

1. Assignment 8/9 will be on Luminus soon.
2. Highly recommended to send in your teaching feedback - I appreciate it greatly!
3. LAST LESSON! You made it!

Student Feedback on Teaching (SFT)

Feedback is *optional* but *highly encouraged*, access here: **https://es.nus.edu.sg/blue/**

- **[Tutorial Feedback]** Your feedback is important to me, and will be used to improve my teaching.
  - If I have helped your learning in any way, your positive feedback will be an encouragement to me.
  - If you find your learning can be enhanced by some action on my part, that feedback will be used to improve my teaching.
- **[Module Feedback]** Your feedback will be used to improve the module.
- Feedback is confidential to the university and anonymous to us.
- Avoid mixing the feedback; ie. project feedback to tutorial feedback.

Past student feedback had been used to improve teaching; ie. Telegram access to provide faster feedback. I would greatly appreciate your feedback, especially this is my first time teacing AI.

Previously from T09, Q4

An expert system called PROSPECTOR for use in geological exploration makes use of an inference mechanism similar to a Bayesian Network.

a. Construct a Bayesian network based on the above rules.
b. Determine the probability that this region is favourable for copper deposits and has a favourable level of erosion, given that the region:
   - has large grain size igneous rocks,
   - has non-porphyritic texture rocks, and
   - is a hypabyssal environment.

Recap

- How to write a Bayes Network?
- What is Conditional Probability?

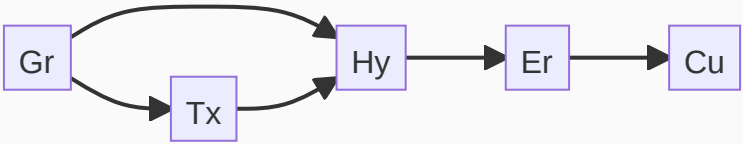

Figure 1: PROSPECTOR network.

Answer T09.Q4a

Bayesian network:

1. Verticies and Edges
2. Probability Tables
3. Variables if not given

Answer T09.Q4b

Determine the probability that this region is favourable for copper deposits $[Cu]$ and has a favourable level of erosion $[Er]$, given that the region:

- has large grain size igneous rocks, $[Gr]$
- has non-porphyritic texture rocks, and $[\neg Tx]$
- is a hypabyssal environment. $[Hy]$

Ingredients:

1) Conditional Prob. - $Pr[A \wedge B|C] = \frac{Pr[A \wedge B \wedge C]}{Pr[B \wedge C]} \times \frac{Pr[B \wedge C]}{Pr[C]} = Pr[A|B \wedge C] \times Pr[B|C]$
2) If A>B>C and B happens, we only need B.

$$
\begin{aligned}
Pr[Cu \wedge Er|\neg Gr \wedge \neg Tx \wedge Hy] &= Pr[Cu|Er \wedge \neg Gr \wedge \neg Tx \wedge Hy] \times Pr[Er|\neg Gr \wedge \neg Tx \wedge Hy] \\
&= Pr[Cu|Er] \times Pr[Er|Hy] \\
&= 0.92 \times 0.75 = 0.69
\end{aligned}
$$

Some tips for finals

- Focus on the second half of the syllabus, but make sure you study for everything:
  - [15%] **Uninformed Search + Informed Search + Local Search**
    - Any misconceptions, must revisit and resolve them.
    - Revisit your midterms and understand everything.
  - [85%] CSPs + **Adversarial Search** + Logical Agents + **Bayesian Networks**

Like mentioned before, suggest solving in order of difficulty:

1. [100%] Compute (bold): First half qns, Adversarial Search, Bayes Net, etc...
   - Don't just practice 'forward'
2. [75%] Formulation Qns: First half qns, CSPs, KB, etc...
3. [25%] Proving Qns: etc...

Percentage indicates the goal...

Question 1

Ancient Lore in the World of Adventure tells us that:

- Every dragon sleeps in some lair.
- Every wyvern is a dragon, and every wyvern is poisonous.
- Every lair in which a poisonous dragon sleeps is toxic.
- Anything that sleeps in anything that is toxic has slime minions.

The above are to be taken as facts in the World of Adventure. A wizard now claims that every wyvern has slime minions. Using resolution, prove the wizard's claim. Note that you should NOT use first-order logic (FOL).

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Recap

- What are the ingredients needed for KB?

Variables

- W: Wyvern
- D: Dragon
- P: Poisonous
- T: Toxic lair
- S: Slime minions

Constraints

- $R_1 : W \implies D$, Every wyvern $[W]$ is a dragon $[D]$
- $R_2 : W \implies P$, Every wyvern $[W]$ is poisonous $[P]$
- $R_3 : P \implies T$,
  - Every lair in which a poisonous $[P]$ dragon $[D]$ sleeps is toxic $[T]$
  - Every dragon $[D]$ sleeps in some lair.
- $R_4 : T \implies S$, Anything sleeps in anything that is toxic $[T]$ has slime minions $[S]$

Query α: $W \implies S$, every wyvern $[W]$ has slime minions $[S]$.

From $\neg\alpha$:

- $R_5 : W$
- $R_6 : \neg S$

Resolution algorithm

- $R_7 : R_2 \oplus R_5 \equiv P$
- $R_8 : R_3 \oplus R_7 \equiv T$
- $R_9 : R_4 \oplus R_8 \equiv S$
- $R_{10} : R_6 \oplus R_9 \equiv \square$

Hence, $W \implies S$.

Question 2

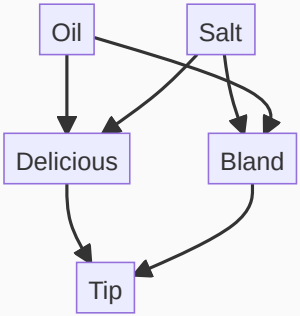

Figure 2: Tip network.

An ambitious waiter wants to maximise his tips earned.

a. Whats the min entries needed to fully specify the (full) joint probability distribution table?

b. Express $Pr[O, S, B, D, T]$ using the Bayesian Network.

c. Compute the following probabilities:

   i. Probability that a Tip was offered, given that someone said the food is Bland.

   ii. Probability that someone said the food was Delicious.

   iii. Probability that the chef added Oil, given that someone said the food was Delicious.

Suppose that we are given that $Pr[O] = 0.4$, $Pr[S] = 0.2$, and the following.

O	S	$Pr[D\|O,S]$
F	F	0.2
F	T	0.4
T	F	0.3
T	T	0.6

O	S	$Pr[B\|O,S]$
F	F	0.7
F	T	0.4
T	F	0.4
T	T	0.1

D	B	$Pr[T\|D,B]$
F	F	0.2
F	T	0.1
T	F	0.6
T	T	0.3

Answer 2a

You dont need the last entry: $2^5 - 1 = 31$

Answer 2b

Just use the network:

$Pr[O, S, D, B, T] = Pr[T|D, B] \times Pr[D|O, S] \times Pr[B|O, S] \times Pr[O] \times Pr[S]$

Answer 2c

Compute the following probabilities:

i. Probability that a Tip was offered, given that someone said the food is Bland.
   - $Pr[T|B] = Pr[T|D,B] \times Pr[D|B] + Pr[T|\neg D,B] \times Pr[\neg D|B] = 0.14984615384615385$

ii. Probability that someone said the food was Delicious.
   - $Pr[D] = \sum_{o,s} \Big(Pr[D|o,s] \times Pr[o] \times Pr[s] \Big) = 0.288$

iii. Probability that the chef added Oil, given that someone said the food was Delicious.
   - $Pr[O|D] = \frac{Pr[O,D]}{Pr[D]} = \frac{\sum_s Pr[D|O,s] \times Pr[O] \times Pr[s]}{Pr[D]} = 0.5$

Other probabilities needed:

- $Pr[D|B] = \frac{Pr[B,D]}{Pr[B]} = \frac{\sum_{o,s} \Big(Pr[B,D|o,s] Pr[o] Pr[s] \Big)}{Pr[B]} = \frac{\sum_{o,s} \Big(Pr[B|o,s] Pr[D|o,s] Pr[o] Pr[s] \Big)}{Pr[B]} = 0.24923076923076926$
- $Pr[B] = \sum_{o,s} \Big(Pr[B|o,s] \times Pr[o] \times Pr[s] \Big) = 0.52$

End of Lesson

Some tidbits from eariler this year

NUS GES 2021, Bachelor of Computing (Computer Science), gross salary:

1. Mean: SGD 6,002
2. Median: SGD 6,000

Our starting salary now exceeds that of lawyers, doctors... For the first time? One of the highest employment rates across the board.

Parting advice

Thank you for being good students, trying your best to complete and attending the tutorials. Some parting advice:

1. Remember you are representing NUS SoC when you go out there.
2. Salary is one *important* aspect, consider other factors.
3. Let your interest and passion guide you.

Ask Me Anything (AMA)

I have enjoyed teaching all of you this semester! It has really become full circle for me.

Feel free to stay and chat with me:

1. Course
2. Computing
3. Research
4. Grad School
5. Art. Intel.
6. Mach. Learning
7. Career
8. Anything...