

# CS3243 Revision

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# Announcements

1. Assignment 8 scores are still being marked; will be on Gradebook 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 teaching AI.

## Vote tally for agenda today

We will go through the 2 past year questions and have time for Q&A today.



**Figure 1:** Two Options

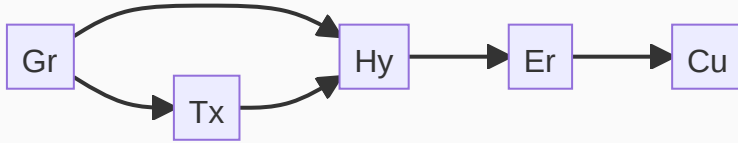
## Previously from T09, Q4

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 2:** PROSPECTOR network.

### **Answer T09.Q4a**

Bayesian network:

1. Vertices 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.

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

## 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).

### Recap

- What are the ingredients needed for KB?



## Question 1

Ancient Lore in the World of Adventure tells us that:

- Every dragon  $[D]$  sleeps in some lair.
- Every wyvern  $[W]$  is a dragon  $[D]$ , and every wyvern  $[W]$  is poisonous  $[P]$ .
- Every lair in which a poisonous  $[P]$  dragon  $[D]$  sleeps is toxic  $[T]$ .
- Anything that sleeps in anything that is toxic  $[T]$  has slime minions  $[S]$ .

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

## 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  $\alpha$ :  $W \implies S$ , every wyvern  $[W]$  has slime minions  $[S]$ .

From  $\neg\alpha$ :

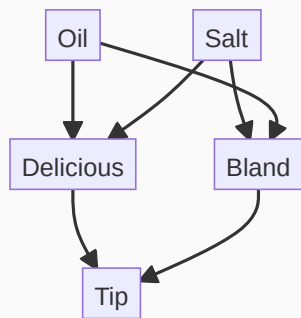
- $R_5 : W$
- $R_6 : \neg S$

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 3:** Tip network.

An ambitious restaurant waiter wants to maximise the number of tips he earns.

- What is the minimum table entries needed to specify?
- Express  $Pr[O, S, B, D, T]$  using the Bayesian Network.
- Which of the following statements is true for the given Bayesian Network?
- Compute the following probabilities...

### Recap

- How to read a Bayes Network?
- What is Marginalisation?

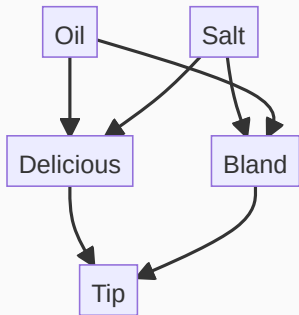
### **Answer 2a**

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

### **Answer 2b**

Just use the network:

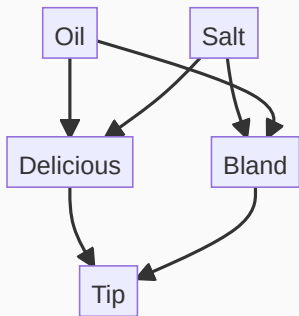
$$Pr[O, S, D, B, T] = Pr[T|D, B] \times Pr[D|O, S] \times Pr[B|O, S] \times Pr[O] \times Pr[S]$$



**Figure 4:** Tip network.

### Answer 2c

- i. Delicious and Bland are conditionally independent causes for the effect, Tip.
- ii. Oil and Salt are independent events.
- iii. Given the values of Oil and Salt, Delicious is conditionally independent of every other value.
- iv. Given the values of Delicious and Bland, Tip is conditionally independent of every other value.



**Figure 5:** Tip network.

### Answer 2c

- i. **[True]** Delicious and Bland are conditionally independent causes for the effect, Tip.
- ii. **[True]** Oil and Salt are independent events.
- iii. **[False]** Given the values of Oil and Salt, Delicious is conditionally independent of every other value.
  - Our knowledge of whether the food was Delicious is affected by whether a Tip was given.
- iv. **[True]** Given the values of Delicious and Bland, Tip is conditionally independent of every other value.

## Answer 2d

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.
  - $Pr[D] = \sum_{o,s} (Pr[D|o,s] \times Pr[o] \times Pr[s]) = 0.288$
- 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:

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



## End of Lesson

### Some tidbits of the (latest) news

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...