AI Assignment 3 - Bayesian Networks
The Honours Problem

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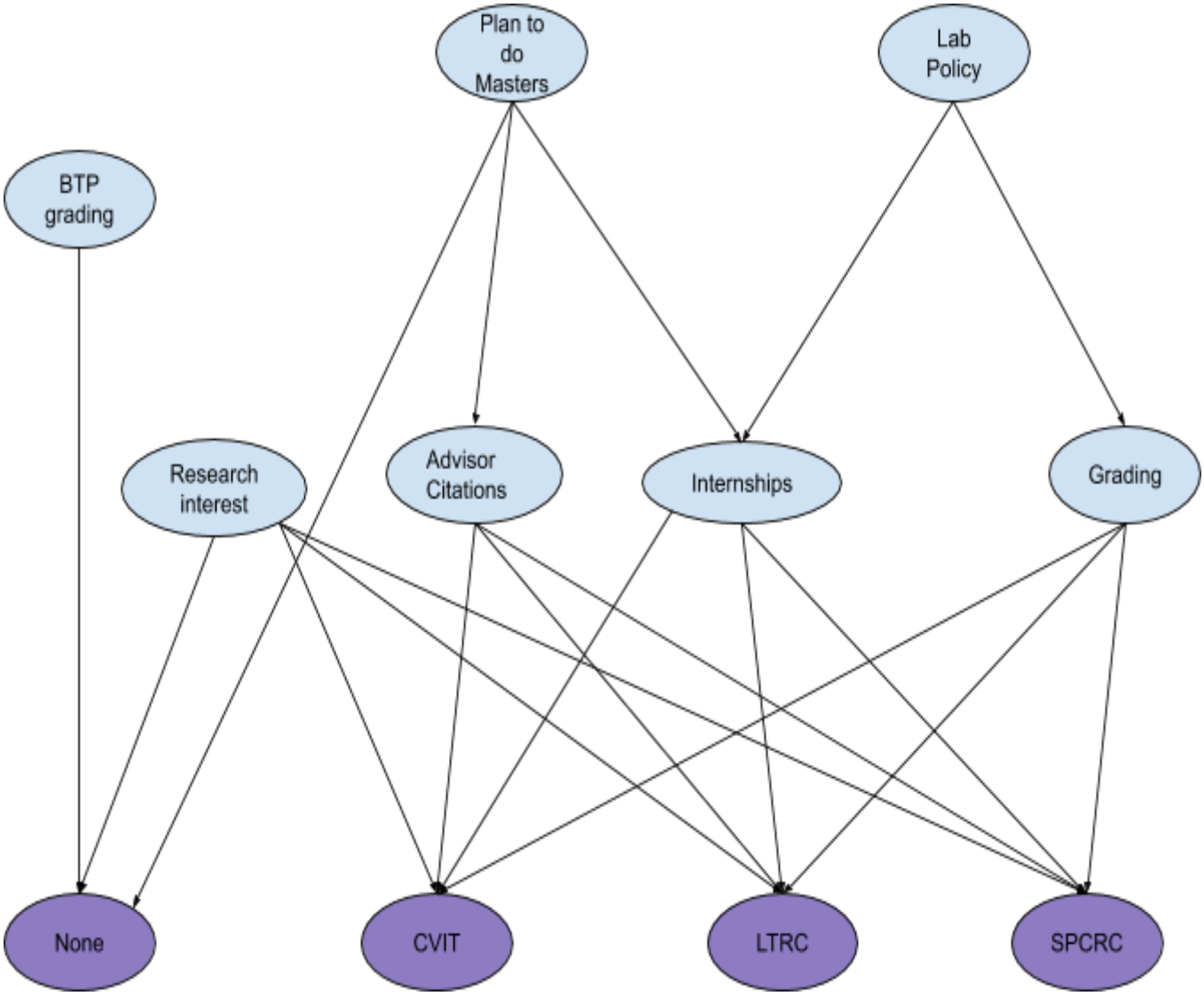
Problem statement: Most of you are currently busy with your honors application. Design a Bayes net modelling the decision process, the net should have an outcome where you don't take honors at all along with outcomes where you take honors in different labs (2 at least).

Diagram:



Key:

Symbol	Full form	Values
RI	Research Interest	Vision, Language, Signals, None
M	Planning to do Masters	Yes, No
A	Lab Advisor Citations	High, Low
BTP	B. Tech Project Grading	Good, Bad
G	Grading by Advisor	Good, Bad
LP	Lab Policy	Flexible, Inflexible
I	Internships allowed	Corporate, Research, None
LTRC	LTRC lab	Yes, No
CVIT	CVIT lab	Yes, No
SPCRC	SPCRC lab	Yes, No
None	Honours not taken	Yes, No

Conditional Probability tables:

1. **Research Interest**

RI	Vision	Language	Signal Processing	None
P(RI)	0.25	0.25	0.25	0.25

2. Planning to do Masters

M	Yes	No
P(M)	0.5	0.5

3. B. Tech Project Grading

BTP	Good	Bad
P(BTP)	0.5	0.5

4. Advisor Citations

Plan to do Masters	A.High	A.Low
Yes	0.85	0.15
No	0.5	0.5

6. Lab Policy

LP	Flexible	Inflexible
P(LP)	0.5	0.5

7. Grading by advisor

Lab Policy	G.Good	G.Bad
Flexible	0.6	0.4
Inflexible	0.5	0.5

8. Internships

Lab Policy	Masters after college	I.Corporate	I.Research	I.None
Flexible	Yes	0.2	0.6	0.2
Flexible	No	0.6	0.35	0.05
Inflexible	Yes	0	0.3	0.7
Inflexible	No	0	0.15	0.85

9. CVIT

Research Interest	Internships	Advisor Citations	Grading	P(CVIT)
Vision	Corporate	High	Good	0.7
Vision	Corporate	High	Bad	0.6
Vision	Corporate	Low	Good	0.6
Vision	Corporate	Low	Bad	0.5
Vision	Research	High	Good	0.8

Vision	Research	High	Bad	0.7
Vision	Research	Low	Good	0.7
Vision	Research	Low	Bad	0.6
Vision	None	High	Good	1
Vision	None	High	Bad	0.9
Vision	None	Low	Good	0.9
Vision	None	Low	Bad	0.8
Language	Corporate	High	Good	0.3
Language	Corporate	High	Bad	0.2
Language	Corporate	Low	Good	0.2
Language	Corporate	Low	Bad	0.1
Language	Research	High	Good	0.4
Language	Research	High	Bad	0.3
Language	Research	Low	Good	0.3
Language	Research	Low	Bad	0.2
Language	None	High	Good	0.45
Language	None	High	Bad	0.35
Language	None	Low	Good	0.35
Language	None	Low	Bad	0.25
Signal Processing	Corporate	High	Good	0.3
Signal Processing	Corporate	High	Bad	0.2
Signal Processing	Corporate	Low	Good	0.2
Signal Processing	Corporate	Low	Bad	0.1
Signal Processing	Research	High	Good	0.4
Signal Processing	Research	High	Bad	0.3
Signal Processing	Research	Low	Good	0.3
Signal Processing	Research	Low	Bad	0.2
Signal Processing	None	High	Good	0.45
Signal Processing	None	High	Bad	0.35

Signal Processing	None	Low	Good	0.35
Signal Processing	None	Low	Bad	0.25
None	(Corporate, Research, None)	(High, Low)	(Good, Bad)	0.03

10. LTRC

Research Interest	Internships	Advisor Citations	Grading	P(LTRC)
Vision	Corporate	High	Good	0.3
Vision	Corporate	High	Bad	0.2
Vision	Corporate	Low	Good	0.2
Vision	Corporate	Low	Bad	0.1
Vision	Research	High	Good	0.4
Vision	Research	High	Bad	0.3
Vision	Research	Low	Good	0.3
Vision	Research	Low	Bad	0.2
Vision	None	High	Good	0.45
Vision	None	High	Bad	0.35
Vision	None	Low	Good	0.35
Vision	None	Low	Bad	0.25
Language	Corporate	High	Good	0.73
Language	Corporate	High	Bad	0.65
Language	Corporate	Low	Good	0.65
Language	Corporate	Low	Bad	0.55
Language	Research	High	Good	0.83
Language	Research	High	Bad	0.75
Language	Research	Low	Good	0.75
Language	Research	Low	Bad	0.65
Language	None	High	Good	1
Language	None	High	Bad	0.9

Language	None	Low	Good	0.9
Language	None	Low	Bad	0.8
Signal Processing	Corporate	High	Good	0.3
Signal Processing	Corporate	High	Bad	0.2
Signal Processing	Corporate	Low	Good	0.2
Signal Processing	Corporate	Low	Bad	0.1
Signal Processing	Research	High	Good	0.4
Signal Processing	Research	High	Bad	0.3
Signal Processing	Research	Low	Good	0.3
Signal Processing	Research	Low	Bad	0.2
Signal Processing	None	High	Good	0.45
Signal Processing	None	High	Bad	0.35
Signal Processing	None	Low	Good	0.35
Signal Processing	None	Low	Bad	0.25
None	(Corporate, Research, None)	(High, Low)	(Good, Bad)	0.03

9. SPCRC

Research Interest	Internships	Advisor Citations	Grading	P(SPCRC)
Vision	Corporate	High	Good	0.4
Vision	Corporate	High	Bad	0.2
Vision	Corporate	Low	Good	0.55
Vision	Corporate	Low	Bad	0.3
Vision	Research	High	Good	0.4
Vision	Research	High	Bad	0.2
Vision	Research	Low	Good	0.55
Vision	Research	Low	Bad	0.3
Vision	None	High	Good	0.4
Vision	None	High	Bad	0.2

Vision	None	Low	Good	0.55
Vision	None	Low	Bad	0.3
Language	Corporate	High	Good	0.4
Language	Corporate	High	Bad	0.2
Language	Corporate	Low	Good	0.55
Language	Corporate	Low	Bad	0.3
Language	Research	High	Good	0.4
Language	Research	High	Bad	0.2
Language	Research	Low	Good	0.55
Language	Research	Low	Bad	0.3
Language	None	High	Good	0.4
Language	None	High	Bad	0.2
Language	None	Low	Good	0.55
Language	None	Low	Bad	0.3
Signal Processing	Corporate	High	Good	0.65
Signal Processing	Corporate	High	Bad	0.6
Signal Processing	Corporate	Low	Good	0.9
Signal Processing	Corporate	Low	Bad	0.7
Signal Processing	Research	High	Good	0.65
Signal Processing	Research	High	Bad	0.6
Signal Processing	Research	Low	Good	0.9
Signal Processing	Research	Low	Bad	0.7
Signal Processing	None	High	Good	0.6
Signal Processing	None	High	Bad	0.5
Signal Processing	None	Low	Good	0.9
Signal Processing	None	Low	Bad	0.7
None	(Corporate, Research, None)	(High, Low)	(Good, Bad)	0.03

10. No Honours

Research Interest	BTP Grading	Plan to do Masters	P(Yes)
Vision	Good	Yes	0.5
Vision	Good	No	0.9
Vision	Bad	Yes	0.3
Vision	Bad	No	0.6
Language	Good	Yes	0.5
Language	Good	No	0.9
Language	Bad	Yes	0.3
Language	Bad	No	0.6
Signal Processing	Good	Yes	0.5
Signal Processing	Good	No	0.9
Signal Processing	Bad	Yes	0.3
Signal Processing	Bad	No	0.6
None	Good	Yes	0.7
None	Good	No	1.0
None	Bad	Yes	0.5
None	Bad	No	0.9

Justifications:

1. We did not consider allowing internships to be a factor decided by the faculty mentor himself/herself, as is sometimes followed in IIIT, but rather a policy of the lab itself, as it is something less subjective and more commonly fol.
2. We have omitted about 18 rows in each of the three labs (LTRC, CVIT, SPCRC), because these rows represented the probabilities of a student applying to each lab while having no interest in any field of research. Even though the possibility of better grading and research internships might entice a student to apply for these labs, our CPT tables were exceeding 70 rows, and the probabilities represented by these rows would have been extremely low anyway. Thus, to enhance readability, we have omitted these rows and replaced it with a single row representing the general probability.
3. We have considered slightly higher probabilities for selecting SPCRC because the lab often advertises itself on the fact that they usually allow students to go for internships, whether research or corporate.
4. We have chosen to not include the allocation policy of the lab (random allocation, certain requirements etc.) because:

A. We have focused more on why a student might gravitate towards a lab based on how the student considers it beneficial for his/her future career aspects, and less on how plausible the student considers getting into the lab is.
B. More importantly, a factor like random allocation would be far outweighed by other factors like interest in the research of the lab, and the internship policy followed by the lab.

5. We were going to consider a non-binary advisor citations - like high, medium, low, or relevant to projects completed, but it involved adding a lot of unnecessary tables, without influencing probabilities too much.
6. For grading by advisors, instead of selecting specific advisors and modelling their grading patterns, we chose to make it a function of the lab policy, wherein a more flexible lab policy would allow a student to perform their research on their conditions, and leading to better research overall, and ultimately leading to better grades.

Sample Query:

P(CVIT = Yes| I = Research, M = Yes)

= Σ(P(CVIT| RI, I = Research, A, G)
= Σ(P(CVIT=Yes) * P(I=Research | I=Research) * P(RI) * P(A) * P(G))

= 0.8 * P(Vision) * 1 * P(High | M=Yes) * P(Good)
= 0.8 * 0.25 * 1 * 0.85 * (0.5 * 0.6 + 0.5 * 0.5)
= 0.8 * 0.25 * 1 * 0.85 * (0.3 + 0.25)
= 0.8 * 0.25 * 1 * 0.85 * 0.55
= 0.0935
+ 0.7 * 0.25 * 1 * 0.85 * 0.45 = 0.0669375
+ 0.7 * 0.25 * 1 * 0.15 * 0.55 = 0.0144375
+ 0.6 * 0.25 * 1 * 0.15 * 0.45 = 0.010125

+ 0.4 * 0.25 * 1 * 0.85 * 0.55 = 0.04675
+ 0.3 * 0.25 * 1 * 0.85 * 0.45 = 0.0286875
+ 0.3 * 0.25 * 1 * 0.15 * 0.55 = 0.0061875
+ 0.2 * 0.25 * 1 * 0.15 * 0.45 = 0.003375

+ 0.4 * 0.25 * 1 * 0.85 * 0.55 = 0.04675
+ 0.3 * 0.25 * 1 * 0.85 * 0.45 = 0.0286875
+ 0.3 * 0.25 * 1 * 0.15 * 0.55 = 0.0061875
+ 0.2 * 0.25 * 1 * 0.15 * 0.45 = 0.003375

+ 0.03 * 0.25 * 1 * 0.85 * 0.55 = 0.00350625
+ 0.03 * 0.25 * 1 * 0.85 * 0.45 = 0.00286875
+ 0.03 * 0.25 * 1 * 0.15 * 0.55 = 0.00061875
+ 0.03 * 0.25 * 1 * 0.15 * 0.45 = 0.00050625

= 0.27 + 0.0925
= **0.3625**