

CS550: Machine Learning Tierce Examination 3

Name:

Roll Number:

Instructions

- Read all questions carefully before you start to answer them. In case of any doubt, you can write your assumptions before answering the question.
- This is a CLOSED BOOK exam.
- You can use a calculator.
- Use of Phone, INTERNET or Google Searches etc. is NOT ALLOWED.
- Discussion with any other person is NOT ALLOWED. Any unfair means used will result in D or F grade and will be reported to the competent authority.
- You will get 90 minutes to solve all the questions. We won't be giving extra time. Please submit whatever you have done at the end of the allotted time. Anyone found writing after completion time will get -20 marks.
- PLEASE ALWAYS PROVIDE A JUSTIFICATION FOR YOUR ANSWERS. CORRECT SOLUTIONS WITHOUT ANY JUSTIFICATION WILL NOT GET FULL CREDITS. THEY MAY ALSO BE CONSIDERED AS POTENTIAL UNFAIR MEANS.
- Make sure to write your name and roll number on the top of your sheet(s) when submitting.

For Instructor's use only:

Q	Topic	Max. Marks	Marks Obtained				
1	Grading Systems	45					
2	Bus Scheduling	45					
Total		90					

Q1. [45 marks] Comparing grading systems across IITs.

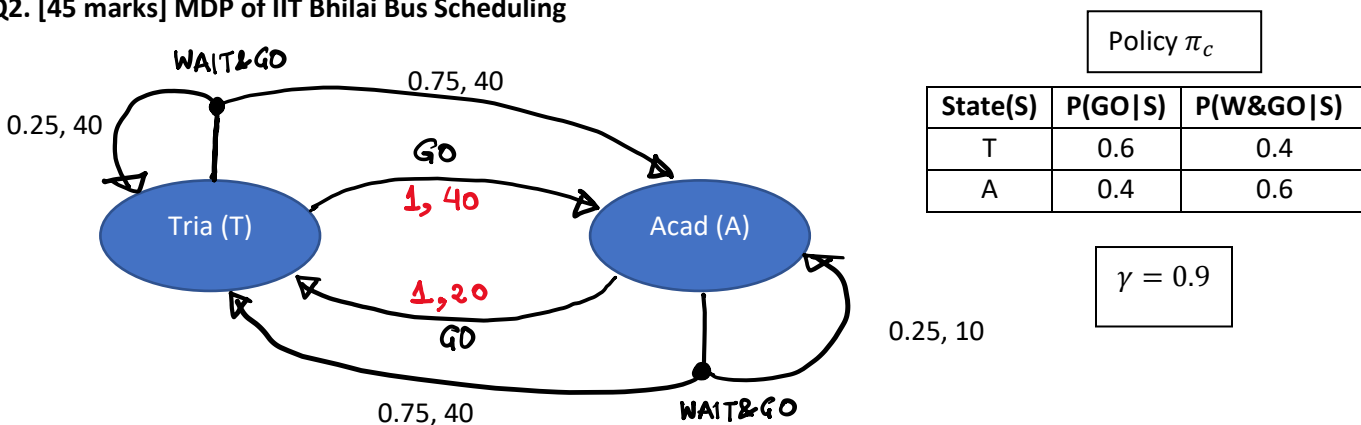
4 students met at the National Physics Olympiad and became friends. Eventually they joined 4 different IITs (B, C, D, K) in CS branch. Now every IIT has its own grading system and they wanted to find a way to normalize GPAs obtained across IITs. They wrote their numerical grades in 5 core subjects (same number of credits) that were common to all: PR, DS, AL, TOC, OS

$$M = \begin{matrix} & \begin{matrix} B & C & D & K \end{matrix} \\ \begin{matrix} PR \\ DS \\ AL \\ TOC \\ OS \end{matrix} & \begin{bmatrix} 10 & 9 & 9 & 10 \\ 9 & 10 & 10 & 10 \\ 9 & 9 & 9 & 9 \\ 10 & 9 & 8 & 10 \\ 9 & 10 & 9 & 9 \end{bmatrix} \end{matrix}$$

Assuming students were very similar in their intellectual abilities, motivation, work and character ethic, please answer the following questions.

- (5) For which course(s), does the grading disagree the most across these IITs?
- (5) For which course(s), does the grading agree the most across these IITs?
- (2.5) Which of these IITs seems to award low GPAs for CS students?
- (2.5) Which course was the toughest to get good grades in?
- (5) The first principal component \mathbf{v} of M is $[-0.49, 0.28, 0, -0.81, 0.16]^T$. Please explain its meaning with reference to the answers in parts a and b.
- (5) Please find out a one-dimensional encoding of each of the 4 students with respect to \mathbf{v} .
- (5) There is another student whose 1-dim encoding is 1. Can you estimate what his numerical grades were in the 5 core subjects.
- (10) Find a linear equation to convert their encodings to their respective GPAs.
- (5) Use above equation to estimate the average GPA of a student whose 1-dim encoding is 1?

Q2. [45 marks] MDP of IIT Bhilai Bus Scheduling



- (10) Please write the Bellman Equations for V under the policy π_c shown in the MDP.
- (10) Solve for V under the policy π_c
- (10) Please write Bellman optimality equations for V
- (10) Using $v_a = 300, v_t = 400$ as the initialization, perform 2 iterations of Value Iteration Algorithm to estimate optimal values of V
- (5) Describe policy thus obtained in part d, and its interpretation.