Take-Home Mid-Semester Exam

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Pages: 3

Questions: 4

Total Marks: 10

Exam Conditions:

This is a Take-Home Examination – Submit your typed answers to the questions provided via Turn-it-in submission on Blackboard. Pay close attention to the word or size limits to the answers.

Instructions To Students:

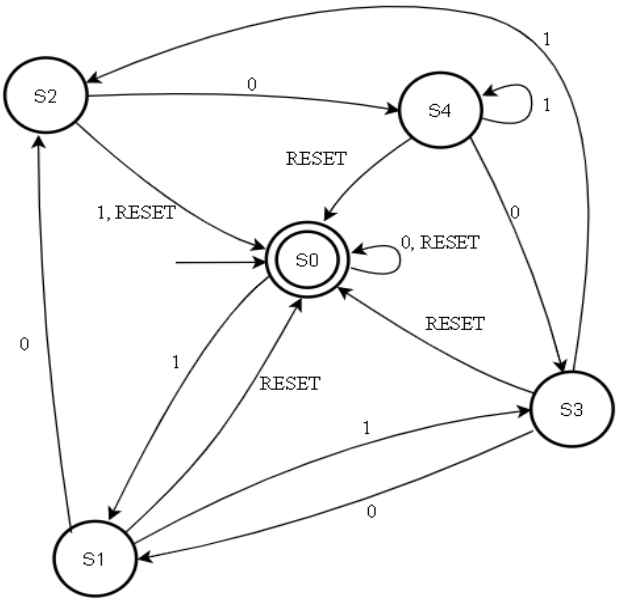
You should attempt all questions. You MUST show the steps used to arrive at your final solution. Best marks will be awarded to (numerically) correct solutions showing complete working. Partial credit will be given to partially complete solutions or to incorrect solutions where errors have been carried through calculations. Assumptions, if any, should be explicitly stated and justified/verified as appropriate.

Problem 1 (2 Marks)

Cantor showed by using a diagonalization proof that the set of all natural numbers is countably infinite and smaller than its power set, i.e. the set of all subsets of the natural numbers. Use the same argument to show that for a given alphabet A, the number of possible finite state machines is countably infinite, while the set of all possible languages is uncountably infinite.

Requirements: Present your answer in less than ½ page A4 size, 12 pt with Normal (2.54 cm) margins (excluding figures or tables). Use tables via the word-processor if any are required.

Problem 2 (3 Marks)



The five-state finite state machine (FSM) above has a three symbol alphabet $A = \{\text{RESET}, 0, 1\}$, where we treat RESET as a single symbol. Describe what the above FSM does and what string it accepts via an example and its transition table. Construct another FSM with the same functionality, but having less than five states.

Requirements: Present your answer in less than 1 page A4 size, 12 pt with Normal (2.54 cm) margins (excluding figures or tables). Use tables via the word-processor if any are required.

Problem 3 (2 Marks)

In a couple of short paragraphs, summarise the differences between finite state machines, Turing machines and modern-day computers. Include in your description what makes Turing machines more powerful than finite state machines and give an example that would demonstrate it.

Present your answer in less than ½ page A4 size, 12 pt with Normal (2.54 cm) margins.

Problem 4 (3 Marks)

Design a simple non-playable character (NPC) or an animal's artificial intelligence (AI) system based on FSMs (without any code) for a computer game. The desired FSM AI system is to (at least) be able to handle the NPC's/animal's interaction after seeing a player and/or approaching it, as well as when the player is not detected or around. Ensure to include the transition diagram, assumptions and other important elements necessary for your AI system. What capabilities are lacking in your AI? How could the AI you've designed be enhanced using a Turning machine?

Requirements: Present your answer in less than 1 page A4 size, 12 pt with Normal (2.54 cm) margins. Although this question has an open answer, the best marks will be awarded to the ones most relevant to the course and its content.

END OF EXAMINATION