CS215 ASSIGNMENT 1

Due Wednesday, January 24, 11:59PM

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Note that students are NOT allowed to copy sentences without showing their references.

Problem 1: Design a Turing Machine for the language L_1 given below.

$$L_1 = \{a^i b^j c^{ij} : i, j \geq 0\}.$$

Use the Turing Machine model with 2-way infinite tape. Your solution should consist of

(a) a high-level description in plain English of the underlying algorithm (at most 100 words),

(b) the state diagram (picture) of your Turing Machine, and

(c) the transition function, in the syntax consistent with the Turing Machine simulator at https:// turingmachinesimulator.com/. (Include the transition function in your assignment using the verbatim environment of LaTeX.)

The correctness of your TM will be determined by running it on a collection of test inputs, using the simulator at https://turingmachinesimulator.com/. So make sure that your TM works correctly on all legal inputs(all strings consisting of a's, b's and c's).

Solution:

Problem 2: Consider a modified Turing Machine model called a *List Turing Machine (LTM)*. A List Turing Machine, in addition to rewriting symbols, can also *delete* the current symbol, or *insert* a new symbol right before the current symbol. (Except for these new features, use the same TM convention as in Sipser's book.)

(a) Give a precise, formal definition of a List Turing Machine. Don't forget to give the definition of the language $L(M)$ accepted by a LTM M.

(a) Prove that List Turing Machines recognize only Turing recognizable languages. (In other words, you need to prove that if M is a List Turing Machine then there is a (standard) Turing Machine M' with $L(M') = L(M)$.)

Solution:

Problem 3: Consider a modification of the Turing Machine model where, in addition to left and right moves, we also allow stationary moves S, in which the machine does not change its location on the tape. (Except for these new features, use the same TM convention as in Sipser's book.)

(a) Give a precise, formal definition of a Turing Machine with stationary moves.

(b) Prove that Turing Machines with stationary moves accept only Turing recognizable languages. You must give a complete and formal proof.

Solution:

Academic integrity / collaboration statement