

CS 3100 – SOLUTIONS to mock Final Exam – TOTAL 100 points

The multiple choice problems given here can earn you positive points (correct answer) or and negative points (incorrect). We show it as [+m/-n]. You must write a compact two-sentence (approx.) explanation in support of your answer, without which you won't gain any points. **You must put a check mark (\checkmark) in one of the squares associated with each question.**

PART-1 is similar to that of Midterm-2; just giving more practice below

1. [+5/-1] **Choose from various answers below.**

- A. A DFA reads its input fully before accepting a string Yes; this is by definition so.
- B. A multi-tape TM is equivalent to a single tape TM Yes; read how single tape can be simulated.
- C. A DTM may accept a string without reading its input Yes; a TM is a generalized computational device. It may be designed to read part of its input, skip over the rest and go into a loop. As a matter of fact, we can't force it to be always reading all of the input.
- D. The number of configurations of an LBA is fixed by its number of states Q . No; it also depends on the input length and the tape alphabet size.

- All these assertions are true.
- Assertions A, B, and C are true. **This one.**
- Assertion A and C alone are true.
- Assertions A and D are true.

Explanation: See above.

2. [+5/-1] **Choose from various answers below.** The Schröder-Bernstein Theorem

- A. helps establish a bijection between two sets A and B by finding two one-to-one onto functions $f : A \rightarrow B$ and $g : B \rightarrow A$. No; see below.
- B. ... by finding two one-to-one into functions $f : A \rightarrow B$ and $g : B \rightarrow A$. **This one;** the advantage is to require only 1-1 into maps.
- C. was used in class to show that the number of C programs is countably large. **Yes indeed.**
- D. is another way to present the Diagonalization proof. No.

- None of these assertions are true.
- Assertion A alone is true.
- All assertions except A are true.
- Assertions B and C alone are true. **This one.**

Explanation: See above.

3. [+5/-1] Consider these assertions.

- A. CFLs are closed under intersection. **No**; consider $a^m b^n c^n$ and $a^m b^m c^n$.
- B. RE languages are closed under intersection. **Yes**; one can run TMs one after the other to get a TM for the intersection.
- C. RE languages are closed under complementation. **No**; Else every language will be recursive.
- D. Either a language L is RE or its complement \bar{L} is RE. **No**; there are non-RE languages whose complements are also non-RE.

- All of these assertions are true.
- Assertion B alone is true. **This one.**
- All assertions except A are true.
- Assertions B and D alone are true.

Explanation: See above.

4. [+5/-1] Consider the Pumping Lemma proofs discussed in this course; call them RPL and CPL for the regular and context-free Pumping lemmas. Recall that the main parts of these PLs are as follows: (i) in RPL, a string $uvw \in L \Rightarrow \forall i : uv^i w \in L$. (ii) in CPL, a string $vwxy \in L \Rightarrow \forall i : uv^i wx^i y \in L$. Now consider the assertions.

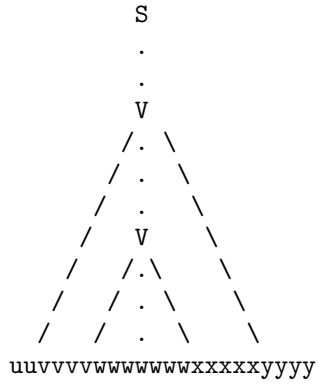
- A. In RPL, $v \neq \varepsilon$ because the language L is not empty. **No**.
- B. In CPL, $vx \neq \varepsilon$ because the grammar of L is assumed to be unambiguous. **No**.
- C. In RPL, $v \neq \varepsilon$ because the loop in the DFA has a length of at least 1. **Yes**.
- D. In CPL, $vx \neq \varepsilon$ because the grammar of L is assumed to be in the Chomsky Normal form. **Yes**.

- Assertions A, B, and C are true
- Assertions C and D are true **This one.**
- Assertion C alone is true
- Assertions A, C, and D are true

Explanation: If $vx = \varepsilon$, we will have some non-terminal V lying along one path from the root to the leaves that supports two distinct parse trees spanning string uvw with the upper occurrence of V (see a diagram depicting the CFL Pumping Lemma, such as the one below) having some ε derivations. But in a Chomsky normal form grammar, a V that is not the same as S cannot have a ε derivation.

Now you might say that the V itself is S . But then, we have two facts: (i) only S can have the ε production, and (ii) the other non-terminals cannot involve S in their right-hand sides (the grammar is turned into a form where S is allowed to refer to other non-terminals, but not vice versa).

With these constraints, we cannot have both v and x turn into ε .



PART-2 will be similar to that of Midterm-2