CSE 105 HW 4

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Question 1.

(a) Answer:

(b) Answer:

(c) Answer:

(d) Answer:

Question 2.

(a) Answer: We can define the following context-free grammar for REP($0^n1^n \mid n \geq 0$):

$$S \to \epsilon \mid 2AS2$$
$$A \to 0A1 \mid \epsilon$$

Intuitively, S generates all strings in REP($0^n1^n \mid n \geq 0$) by allowing the production of the empty string or strings that begin and end with 2 and have a sequence of 0s and 1s in between. The A nonterminal generates any valid sequence of 0s and 1s. Examples:

- $w = \epsilon$ is in REP($\{0^n1^n \mid n \geq 0\}$) with the derivation:

$$S \Rightarrow \epsilon$$

- $w = 200112$ is in REP($\{0^n1^n \mid n \geq 0\}$) with the derivation:

$$S \Rightarrow 2AS2 \Rightarrow 20A1S2 \Rightarrow 200A11S2 \Rightarrow 200\epsilon11\epsilon22 \Rightarrow 2001122$$

- $w = 20102$ is not in REP($\{0^n1^n \mid n \geq 0\}$) because for 2v2 to be in SUBSTRING(w), v must be in $\{0^n1^n \mid n \geq 0\}$, which it clearly isn't. Attempting to derive w results in the following:

$$S \Rightarrow 2AS2 \Rightarrow 20A1S2 \Rightarrow 20\epsilon1S2 \Rightarrow 201S2$$

  Note: At no productions of S can we derive a 0, *qed*.

(b) Answer:

Question 3.

(a) Answer:

(b) Answer:

(c) Answer: