CECS 329, Learning Outcome Assessment 7, March 16th, Spring 2023, Dr. Ebert

NO NOTES, BOOKS, ELECTRONIC DEVICES, OR INTERPERSONAL COMMUNICATION ALLOWED. Submit solutions to at most 2 LO problems on separate sheets of paper.

Problems

LO3. Provide a regular expression that represents the set of binary words that have at least one 0 and at least one 1.

LO4. Do the following.

(a) Provide a context free grammar $G = (V, \Sigma, R, S)$ for which $L(G)$ is the set of binary words that have an odd number of 0's and exactly one 1.

(b) Use G to provide a leftmost derivation of $w = 000100$.

LO5. Let $\text{Trunc}(x, i)$ denote the number x with its first i digits cut off. For example, $\text{Trunc}(958, 0) = 958$, $\text{Trunc}(958, 1) = 95$, $\text{Trunc}(958, 2) = 9$, and $\text{Trunc}(958, i) = 0$ for every $i \geq 3$. Provide a *recursive* definition of $\text{Trunc}(x, i)$. You may use any PR functions from the General Models of Computation lecture examples and exercises.

LO6. Do the following.

(a) Compute the Gödel number for program $P = Z(3), J(2, 1, 2), T(3, 1), S(4)$. Write your answer as a sum of powers of two minus 1 (see part b).

(b) Provide the URM program P whose Gödel number equals

$$2^9 + 2^{36} + 2^{56} + 2^{77} - 1.$$

LO7. Do the following.

(a) Which of the following is *not* needed by a universal program P_U on inputs x and y?

i. the maximum index of any register used by P_x
ii. the number of instructions of P_x
iii. the maximum number of configurations used in the computation of P_x on input y
iv. All of the above are needed to simulate the computation of P_x on input y.

(b) Consider the computation of $P_U(x, 2)$, where $x = 2^5 + 2^{11} + 2^{27} + 2^{34} - 1$. If the current configuration of $P_x(2)$ has encoding $\sigma = 2^2 + 2^5 + 2^6 + 2^{10} - 1$, then provide the next configuration of the computation *and* its encoding.