

ArsDigitaUniversity
Month8:TheoryofComputation
ProfessorShaiSimonson

Exam2(50points)

1._____ (10points)

2._____ (18points)

3._____ (7points)

4._____ (15points)

Total_____ (50p oints)

1. Decision Algorithms (10 points)

- a. Given a TMM and a specific input string x , explain how to determine if M ever enters the same state twice on x ?
- b. Given a CFL, explain how to determine if the language contains all strings containing at least 7 zeros in them.

2. Name that Set (18 points)

Decide which of the sets below is Deterministic Context Free, Context Free or not Context Free. Prove your answers.

a. The complement of $0^{2n}1^{3n} \cap 0^n1^{2n}$.

b. $\{0^i1^j0^{j+k}1^{i+j+k} \mid i, j \geq 0\}$.

c. The set of all strings $0^i1^j2^k$ where either $i=j+k$ or $k=i+j$.

3. Parsing (7 points)

a. Decide whether or not the grammar below generates 001100.

$S \rightarrow SAB|e$
 $A \rightarrow 0S1|CD|e$
 $B \rightarrow 1S0|e$
 $C \rightarrow BC|AC|0$
 $D \rightarrow CD$

b. Write a grammar that generates all binary strings that have more 0's than 1's.

4. Turing Machines and Complexity Theory (15 points)

- a. Write a high level detailed English description of a single-tape-TM program that accepts the set of binary strings that are prefix free, and analyze its time and space complexity.
- b. For each of the sets state whether it is recursive, recursively enumerable or not recursively enumerable.
- i. The set of TM's whose languages are recursively enumerable.
 - ii. The set of all TM's that accept themselves using at most 30 steps.
 - iii. The set of all CFL's whose languages are not empty.
 - iv. The set of all CFL's that contain a regular set.
 - v. The set of all TM's that are not equal to Σ^* .
 - vi. The set of all Regular Sets that are a subset of $0^n 1^n 0^n$.
 - vii. The set of all TM's that accept an infinite number of strings.
 - viii. The set of all TM's that accept themselves.
 - ix. The set of CFG's that are unambiguous.
 - x. The set of pairs of alternating FSM's that generate the same language.