# CS 6041 Theory of Computation

# Homework 3

**Make sure you follow the instruction before submission:**

**1, Any late submission due to whatever reason will not be graded.**

**2, The answer should be written in BLUE and the figure can be any color. The wrong format submission might not be considered.**

**3, The submission file must be in PDF. Any other format (i.e., docx, pages) will not be graded. We don’t accept the hand-written submission.**

Lecture: TM

1. For the following Turing machine M = (Q, Σ, Γ, δ, q1, qaccept, qreject) with

Q = {q1, . . . , q8, qaccept, qreject},

Σ = {0, 1, #},

Γ = {0, 1, #, x, ␣},

and transitions below. (20 points)

A picture containing chart

Description automatically generated

The reject state and the transition to qreject is not highlighted in the above figure. If there is no outgoing transition for a given state, it goes to qreject and the head does not change the tape and just moves right.

Please show the sequence of configurations when the Turing machine input tape is string 1#1.

Answer:

Lecture: Decidability

1. Let AεCFG = {⟨G⟩| G is a CFG that generates ε}. Show that AεCFG is decidable. (20 points)

(Hints: Create a Turing machine M, For each x∈L, M either accepts or rejects x)

Answer:

Lecture: Decidability

1. In the chapter of regular language, we know that the DFA is equivalent with NFA and regular expression (RE). For the problem to determine whether a given DFA and RE are the same, C = {<D, R> | D is a DFA and R is a RE that L(D) = L (R)}, please prove that C is decidable. (20 points)

(Hints: Create a Turing machine M, For each x∈L, M either accepts or rejects x)

Answer:

Lecture: Reducibility

1. Show that EQ CFG is undecidable. (20 points)

Hint: You can directly use the result of Theorem 5.13. That is, instead of considering a reduction from ATM, you can directly consider a reduction from ALLCFG.

Lecture: Complexity

1. Answer each part TRUE or FALSE. (20 points)
2. 2n = O(n).
3. n2 = O(n).
4. 3n = 2O(n).
5. 22n = O(22n ).

Please also justify each of your true/false answers using the Definition 7.2.

In more details: what is f(n), what is g(n), whether c and n0 exist so that when n≥n0 that inequation is always true.