Recit-12

December 28, 2020

Q1

Deterministic TM

Construct a TM, M in tabular or graphical notation to implement the computation $(s, e\underline{\#}w) \rightarrow^* (h, e\underline{\#}w')$; where h is the halt state with $w \in \{0, 1\}^*$ and w' is the string with the 0's and 1's in w interchanged .

TM	condition	next TM
A:R	$\sigma = 0$	1.A
	$\sigma = 1$	0.A
	$\sigma = \#$	$L_\#$ h

$\underline{\#}\,aaa\,\underline{b}$

$L_\#$

$\#$

Describe either in graphical or tabular notation a TM M that semi-decides the language $L = \{w \in \{0,1\}^* | w = 1^n.0^{2n}, n \geq 0\}$

1, 00

$> A : R$	$\sigma = \#$	h
	$\sigma = 0$	D
	$\sigma = 1$	$\# R_\# . L . B$
B	$\sigma = 0$	$\# . L . C$
	$\sigma \neq 0$	D
C	$\sigma = 0$	$\# . L_\# . A$
	$\sigma \neq 0$	D

D	$-$	$\# D$

Q3

Deterministic TM

Construct a deterministic TM M in either a graphical or a tabular form that semi-decides the language $L = \{w \in \{a, b\}^* | \text{no. of a's} \geq \text{no. of b's}\}$.

$> A: R_{\{\#, a\}}$	$\sigma = \#$ $\sigma = a$	C $x L_{\#} . B$
$B: R_{\{\#, b\}}$	$\sigma = b$ $\sigma = \#$	$x . L_{\#} . A$ h
$C:$	$\sigma = a$ $\sigma = b$ $\sigma = \#$	$\# C$

w

L

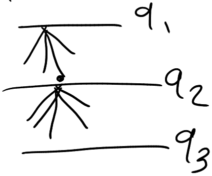
\#
\#
\#
\#

Q4

TM

State the total number of Turing Machines (where for each TM the set H of halt states have 2 elements) in terms of their transition functions that have N states and M alphabet symbols, in terms of N and M.

$$\delta : \underbrace{(Q - H)}_{\text{state}} \times \underbrace{\Sigma}_{\text{input}} \longrightarrow Q \times \{ \rightarrow, \leftarrow, \Sigma(\text{write}) \}$$



$$((N-2)M) \qquad (N)(M+2)$$

$$((N)(M+2)) \cdot (N(M+2)) \cdot (\; . \; . \; . \; . \;) \; . \; . \; . \; . \; .$$

$$\rightarrow (N(M+2))^{(N-2)M}$$

n

11

Suppose $L = \{w \in \{0,1\}^* \mid \text{either } 11 \text{ or } 00 \text{ is a sub-string of w}\}$. Compute a NDTM, M that decides L using a graphical or a tabular notation for M.

TM	Condition	Next TM
A:R	$\sigma = 1$	A
	$\sigma = 1$	B
	$\sigma = 0$	A
	$\sigma = 0$	C
B:R	$\sigma = 1$	h_{YES}
	$\sigma = 0$	h_{NO}
C:R	$\sigma = 0$	h_{YES}
	$\sigma = 1$	h_{NO}

$w_1 \; w_2 \; w_3 \; w_4$

\# 1 0 1 0 0 \#

A

B = halt NO

C = halt NO

B = halt NO

C

A

C = halt yes

Describe a 2-tape non-deterministic TM (NDTM) M with an initial configuration $(s, e\underline{\#}u, \; e\underline{\#}w)$ where $u, v \in 0, 1^*$ either in graphical or tabular notation that halts at h_{YES} iff w is a sub-string of u.

$w \not\subset u$

$\subset$

$u_1 u_2 u_3 u_4 \dots u_k$

$w_1 w_2 \dots w_n$

u_i

$A: R^1$	$\sigma \neq \#$	A
	$\sigma \neq \#$	$L\,B$
	$\sigma = \#$	ha H_{NO}
$B: R^1 R^2$	$\sigma^1 = \sigma^2 \neq \#$	B
	$\sigma^2 = \#$	hoH YES
	$\sigma^2 \neq \sigma^1 \quad \sigma^2 \neq \#$	hoH NO

Q7

Compute using graphical or tabular notation a 2 tape NDTM M that decides the language $L = \{w \in \Sigma^* | w = u.v.u \; ; \; u, v \in \Sigma^*\}$.