

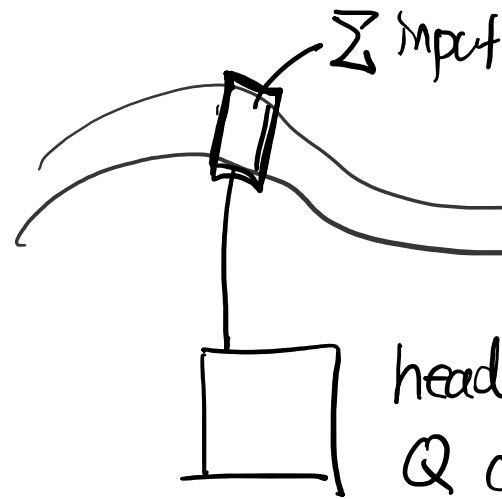
Assignment Project Exam Help

Lecture 6

<https://tutorcs.com>

WeChat: cstutorcs

Recap : Turing Machine



Assignment Project Exam Help

① Write on the tape

<https://tutorcs.com>

② Move Left and right / or stay still

WeChat: cstutorcs

$$\hookrightarrow Q \times \{L, R, S\} \times \Sigma$$

next state output

Turing recognizable vs. decidable

M, w	$\xrightarrow{\text{Accept}}$	Accept	Decidable $w \in L$	Recognizable $w \in L$
	$\xrightarrow{\text{Reject}}$	Reject	$w \notin L$	$w \notin L$
	\rightarrow	Infinite Loop No Halt .	Never ever	$w \notin L$.

Assignment Project Exam Help

<https://tutorcs.com>

WeChat: cstutorcs

“Equivalent” Variants of T.M.

- According to CT thesis everything must be equivalent (or weaker)

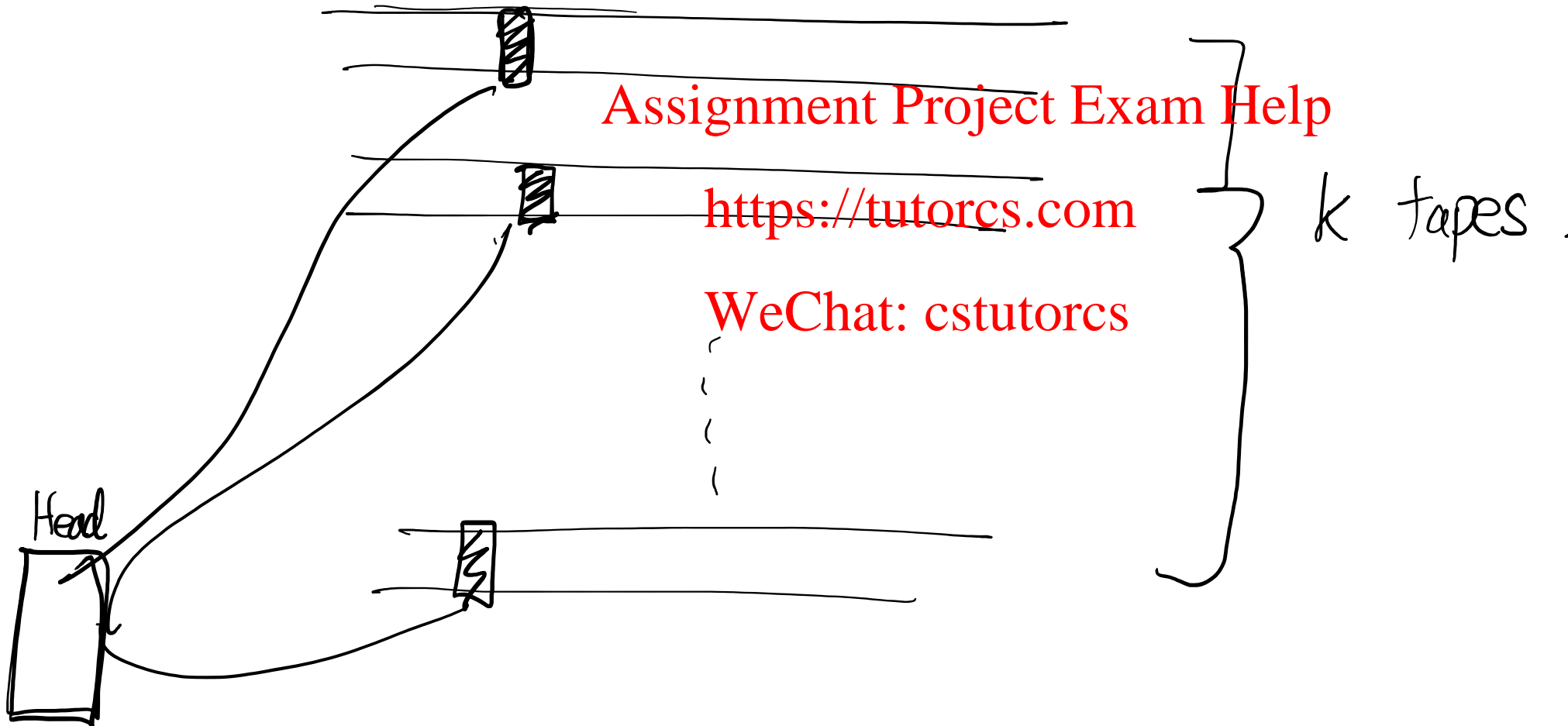
Assignment Project Exam Help

<https://tutorcs.com>

WeChat: cstutorcs

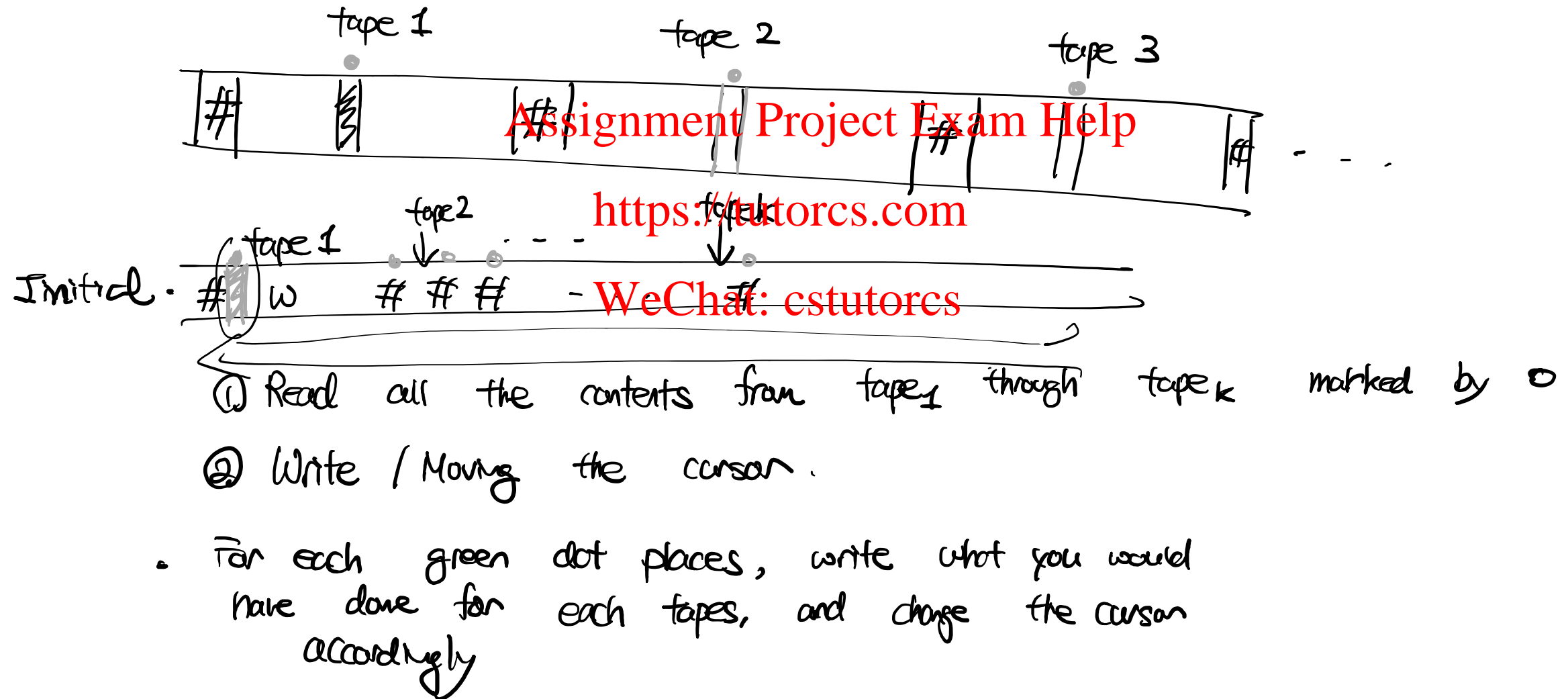
Multi-tape Turing Machine

$\delta: \Sigma^k \times Q \rightarrow \Sigma^k \times Q$
 $\uparrow \quad \uparrow$
 output next
 state
 $\times \{L, R, S\}^k$



Why Equivalent?

Multi tape can be simulated
by single tape.



Nondeterministic T.M.

$$\delta: Q \times \Sigma \longrightarrow P(Q \times \Sigma \times \{L, R, S\})$$

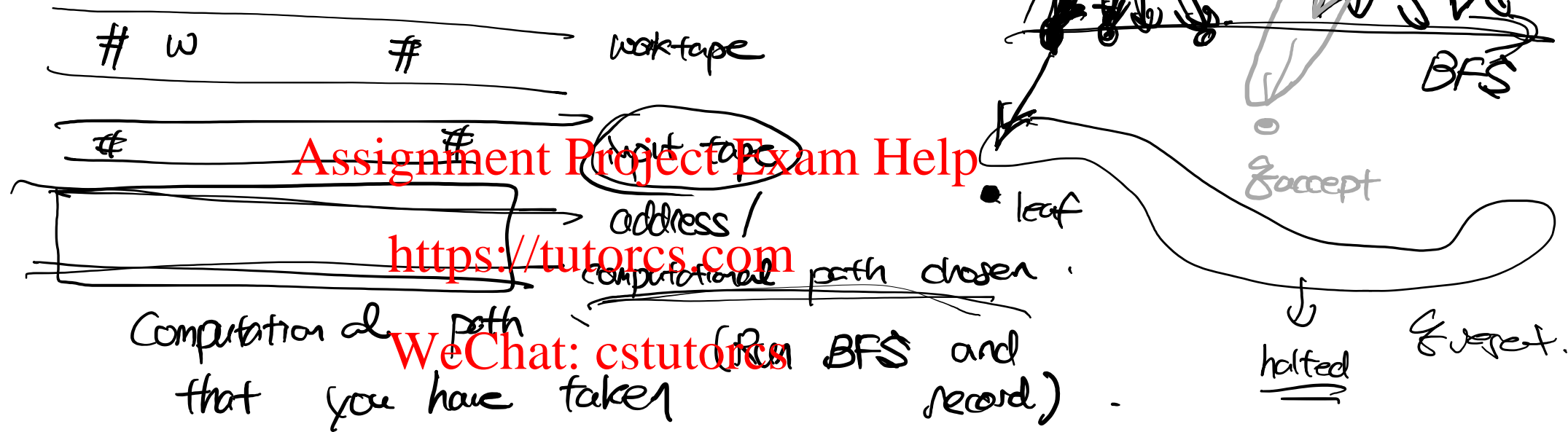


Branch of options

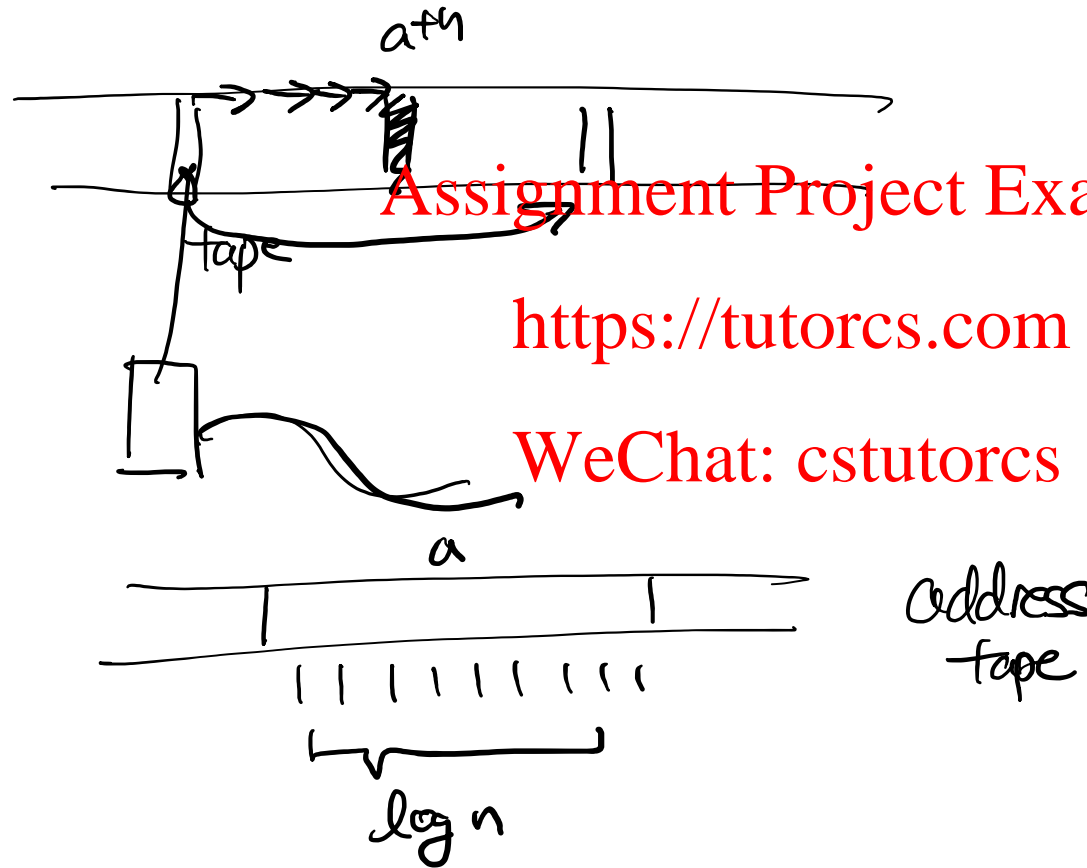
M accepts w if \exists sequence of computation which accepts w

WeChat: cstutorcs

Why Equivalent ?



Random Access T.M. (Why equivalent?)



Assignment Project Exam Help

<https://tutorcs.com>

WeChat: cstutorcs

Comparison with our computer and T.M.

- T.M. computes a single function only (i.e. tailored) as we have defined so far ...

Assignment Project Exam Help

<https://tutorcs.com>

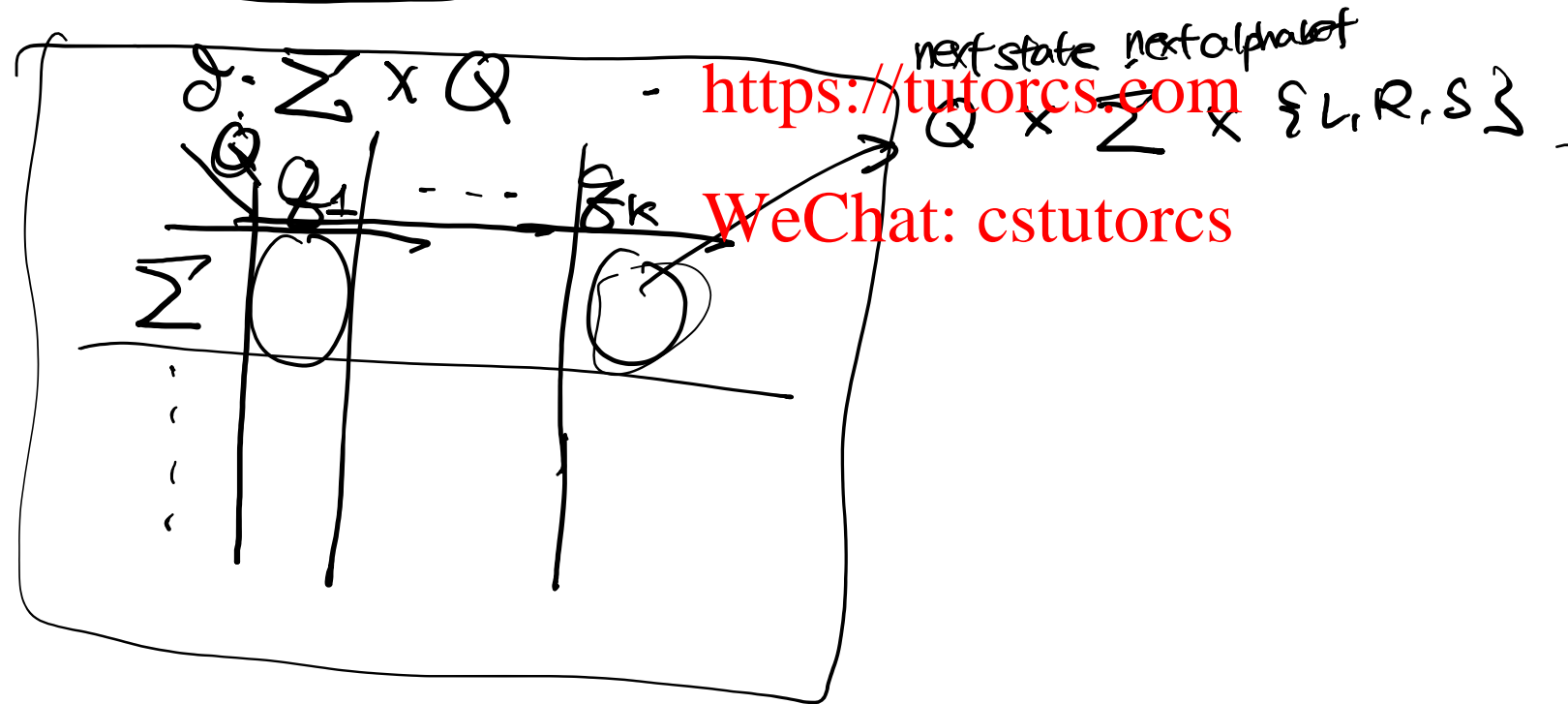
WeChat: cstutorcs

Describing a Turing Machine ?

Q states (finite # of them)
 \uparrow
 q_0
 q_{accept}, q_{reject}

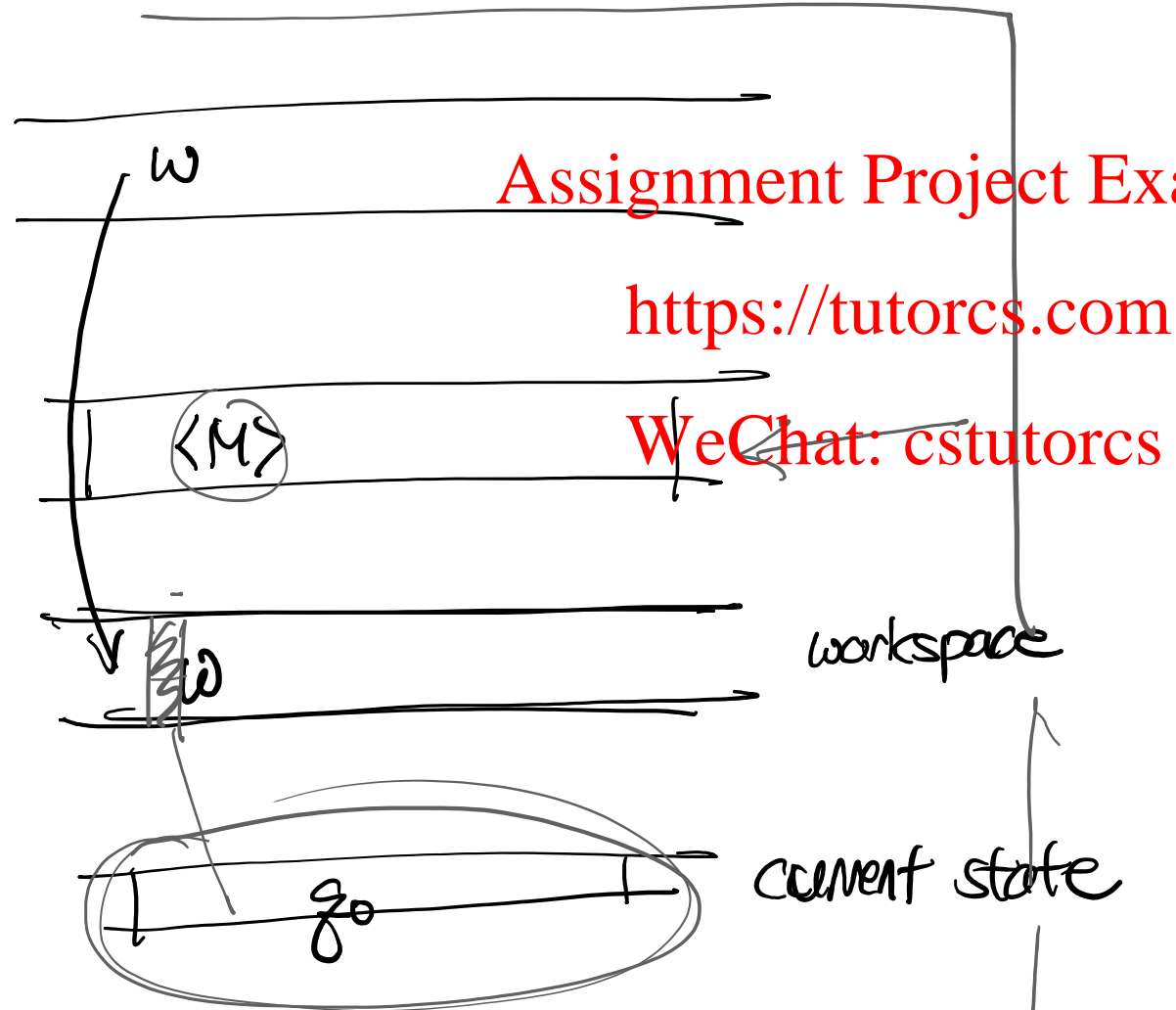
$| \langle M \rangle |$ is finite.

Assignment Project Exam Help



Universal T.M. \rightarrow $\langle M \rangle$ of T.M. and w input to M .

U



Decidable Languages (regarding FAs)

- "Booting Up" DFAs and NFAs and simulate

~~FA~~

Assignment Project Exam Help

The description of Finite Automata is given as part of the input.

<https://tutorcs.com>

$L_{\text{DFA}} := \{ \langle M \rangle, w \mid \langle M \rangle \text{ is a DFA, } w \text{ is the input, } M \text{ accepts } w \}.$

WeChat: cstutorcs

$\langle M \rangle$ accepts w or not at end.

Continued

Claim) L_{DFA} is decidable.

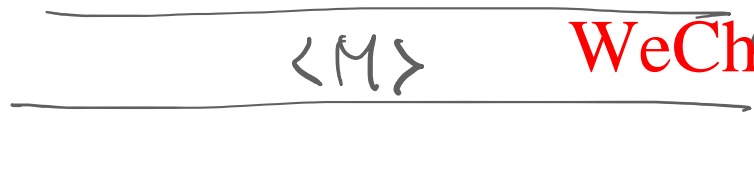
depending on $\langle M \rangle$ and input
cursor, read from the table M



Assignment Project Exam Help

<https://tutorcs.com>

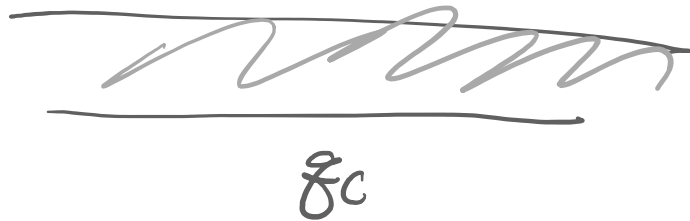
WeChat: cstutorcs



description
of
DFA

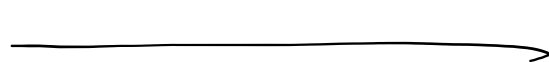
$\langle M \rangle$, change current state
accordingly and move the input
cursor to the right.

$(\langle M \rangle, w) \in L$, this T_{DFA}
will accept



state
tape

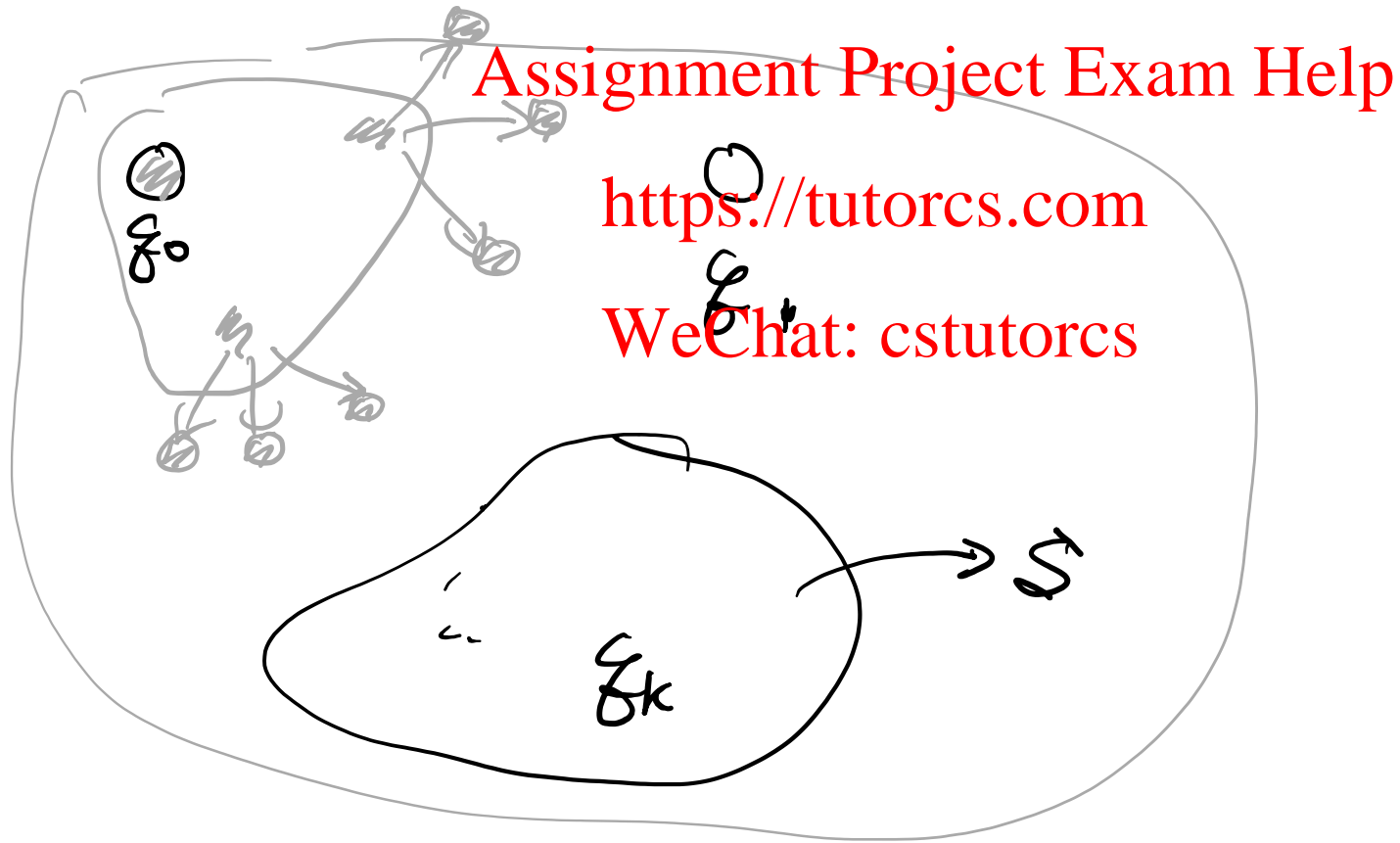
o/w
reject.



computation step
tape

$E_{\{DFA\}}$ or $E_{\{NFA\}}$

$E_{DFA} := \{ \langle M \rangle \mid M \text{ is a DFA, } L(M) = \emptyset \}.$



EQ_{DFA}

- Create a DFA that accepts only symmetric difference of $L(A)$ and $L(B)$

Assignment Project Exam Help

<https://tutorcs.com>

WeChat: cstutorcs

Universal T.M. -- Boots up any T.M.

Assignment Project Exam Help

<https://tutorcs.com>

WeChat: cstutorcs

Does M accept w ?

- Is this Turing recognizable ?

Assignment Project Exam Help

<https://tutorcs.com>

WeChat: cstutorcs

Detour : Real #'s are not countable

Assignment Project Exam Help

<https://tutorcs.com>

WeChat: cstutorcs

Proof By Diagonalization

Assignment Project Exam Help

<https://tutorcs.com>

WeChat: cstutorcs

There are non-recognizable Languages

- Proof via counting -- how many recognizable languages are there?

Assignment Project Exam Help

<https://tutorcs.com>

WeChat: cstutorcs

Table of Acceptance

Assignment Project Exam Help

<https://tutorcs.com>

WeChat: cstutorcs

T.M. D that flips the answer on diagonal

Assignment Project Exam Help

<https://tutorcs.com>

WeChat: cstutorcs

Proof by Diagonalization

Assignment Project Exam Help

<https://tutorcs.com>

WeChat: cstutorcs

Contradiction !

Assignment Project Exam Help

<https://tutorcs.com>

WeChat: cstutorcs

Corollary : Complement of A_{TM}

Assignment Project Exam Help

<https://tutorcs.com>

WeChat: cstutorcs

Now the diagram is complete !

Assignment Project Exam Help

<https://tutorcs.com>

WeChat: cstutorcs