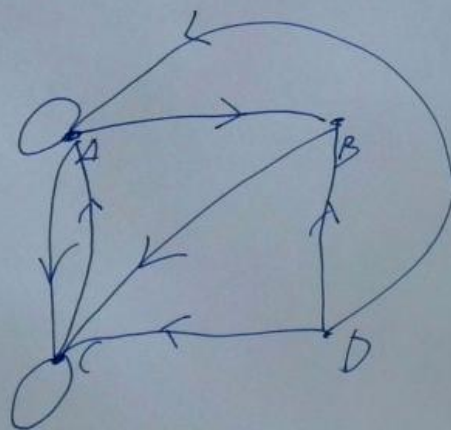


a : b, d.
b : a, d, e
c :
d :
e :

	A	B	C
A	0	1	0
B	1	0	1
C	0	1	0

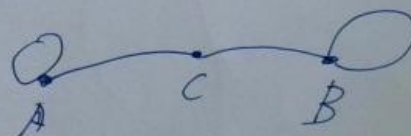
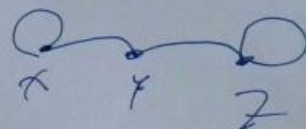
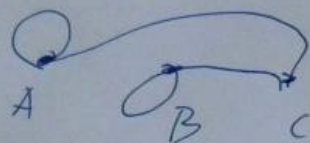


	A	B	C	D
A	1	1	1	0
B	0	0	1	0
C	1	0	1	0
D	1	1	1	0



	A	B	C
A	1	0	1
B	0	1	1
C	1	1	0

	X	Y	Z
X	1	1	0
Y	1	0	1
Z	0	1	1

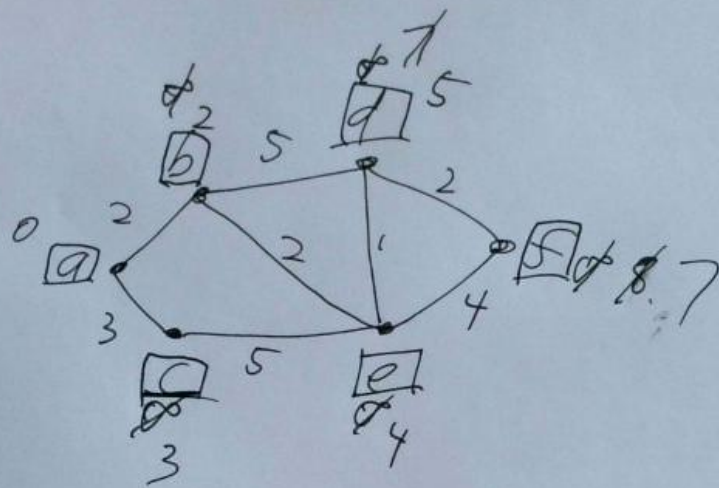


$X \rightarrow A$
 $Y \rightarrow C$
 $Z \rightarrow B$

or

$X \rightarrow B$
 $Y \rightarrow C$
 $Z \rightarrow A$

$\{X, Y, Z\} \rightarrow \{A, C, B\}$



ADDRESS ::= NUMBER D STREETNAME STREETTYPE

NUMBER ::= DIGIT NUMBER / ~~NUMBER~~ DIGIT

D STREETNAME ::= DIRECT STREETNAME

STREETNAME ::= LETTER STREETNAME / LETTER

STREETTYPE ::= 'AVE' / 'ST' / 'BLVD'

DIRECT ::= 'N' / 'S' / 'W' / 'E' / λ

ADDRESS ::= NUMBER D STREETNAME STREETTYPE

NUMBER ::= DIGIT NUMBER / ~~NUMBER~~ DIGIT

D STREETNAME ::= DIRECT STREETNAME

STREETNAME ::= LETTER STREETNAME / LETTER

STREETTYPE ::= 'AVE' / 'ST' / 'BLVD'

DIRECT ::= 'N' / 'S' / 'W' / 'E' / λ

LETTER ::= 'A' / 'B' / ... / 'Z'

ADDRESS ::= NUMBER D STREETNAME STREETTYPE

NUMBER ::= DIGIT NUMBER / ~~NUMBER~~ DIGIT

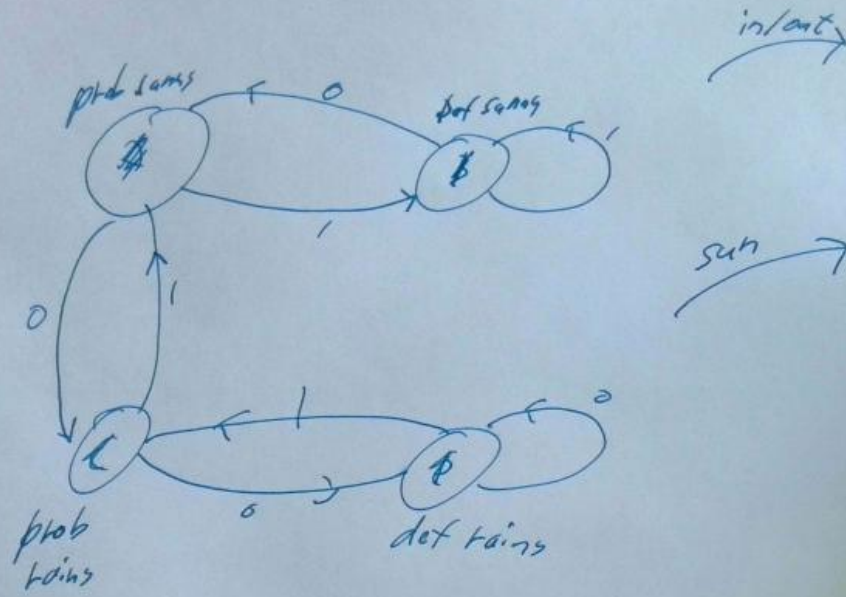
D STREETNAME ::= DIRECT STREETNAME

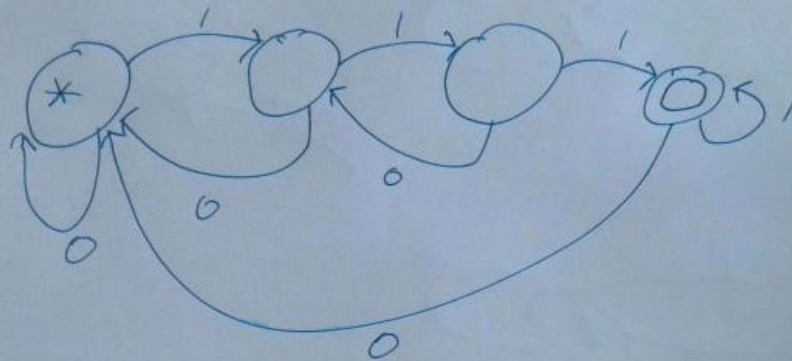
STREETNAME ::= LETTER STREETNAME / LETTER

STREETTYPE ::= 'AVE' / 'ST' / 'BLVD'

DIRECT ::= 'N' / 'S' / 'W' / 'E' / λ

LETTER ::= 'A' / 'B' / ... / 'Z'

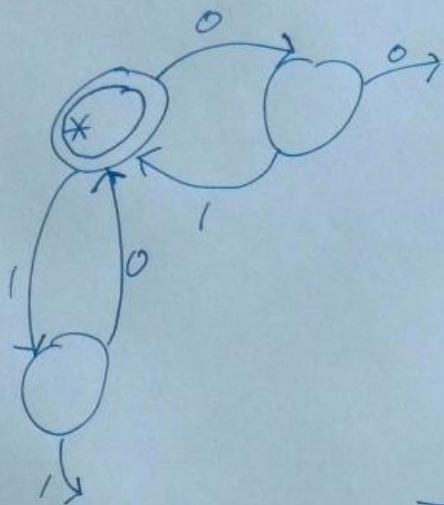




*: initial state

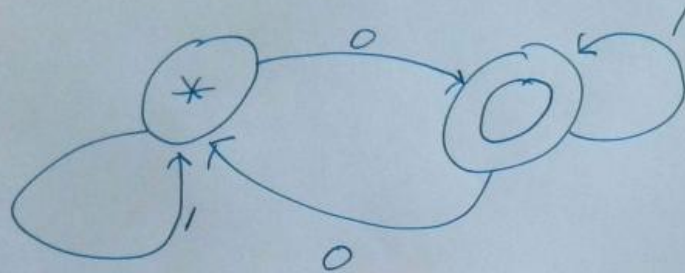
⊙: "recognized state"

111110



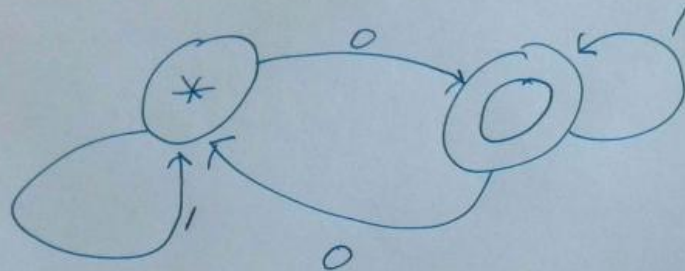
λ
 01
 10
 0101100110

011 $\lambda 0$
 111 $\lambda 0$



0
01111...1

0



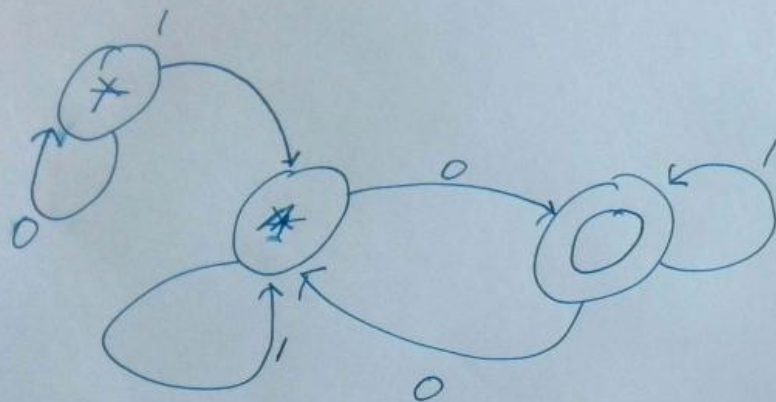
000

0

0111...1

011...100

011...10011...1



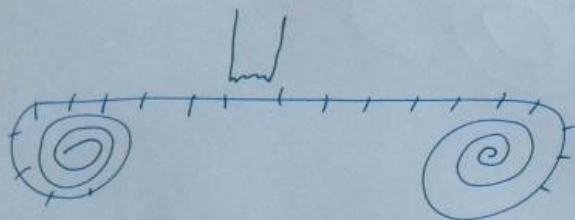
000

0

0111...

011...100

011...10011...



(State, current, new state, new
Symbol, Symbol, L
or
R)

Ex: $(S_0, 0, S_1, 1, R)$

$(S_0, 1, S_1, 0, R)$

$(S_0, B, S_1, 0, R)$

$(S_1, 0, S_2, 1, L)$

$(S_1, 1, S_1, 0, R)$

$(S_1, B, S_2, 0, L)$

$B = \text{blank}$

Start in S_0

$\downarrow$
 $\downarrow \downarrow$
 $B B \dots B \emptyset \emptyset 11 B B \dots B$
 11

STATE = ~~S_0~~ $S_1 S_2$

$\downarrow \downarrow$
 $B B 101 B B$
 01

STATE = ~~S_0~~ $S_1 S_2$

$\dots B B 10101 B \dots$
 $\uparrow \uparrow \uparrow$
 $\uparrow$

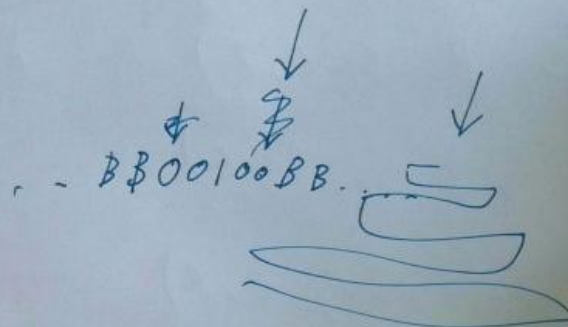
State = ~~S_0~~ $S_1 S_2$

$(S_1, 0, S_1, 0, L)$

$(S_1, 1, S_2, 1, L)$

$(S_2, 0, S_2, 1, L)$

$(S_2, 1, S_2, 0, L)$



Stack = 50

$(S_0, 0, S_0, 0, R)$

$(S_0, 1, S_0, 1, R)$

(S_0, B, S_1, B, L)

11100

$$O(h^2)$$

$$O(h^5)$$

$$O(h^{100})$$

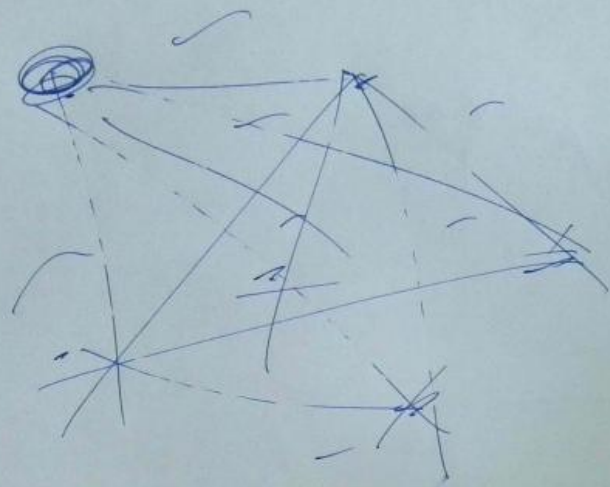
} polys. time.
↑

$$O(h!)$$

←

$$O(h^n)$$

←



$$\sim O(h^h)$$

NDTM



non-deterministic

Types of Problems

P : poly time on TM

NP : poly time on NDTM

NP complete

if $\in P$, then $P = NP$