



UTM
UNIVERSITI TEKNOLOGI MALAYSIA

FACULTY OF ENGINEERING

SCHOOL OF COMPUTING

SESSION 2020/2021 SEMESTER 2

SCSJ3203 THEORY OF COMPUTER SCIENCE
SECTION 04

TUTORIAL 8
PUSH-DOWN AUTOMATA

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TCS Tutorial 8: Pushdown Automata.

$$\begin{array}{ll}
 1. a) & Q = \{q_0, q_1\} & \delta(q_0, a, \lambda) = \{(q_0, \lambda)\} \\
 & \Sigma = \{a, b\} & \delta(q_0, b, \lambda) = \{(q_0, B)\} \\
 & \Gamma = \{A, B\} & \delta(q_0, \lambda, \lambda) = \{(q_1, \lambda)\} \\
 & F = \{q_1\} & \delta(q_1, a, \lambda) = \{(q_1, \lambda)\} \\
 & & \delta(q_1, b, \lambda) = \{(q_1, \lambda)\}
 \end{array}$$

State	a	b	λ
q_0	$q_0, \lambda/A$	$q_0, \lambda/B$	$q_1, \lambda/\lambda$
q_1	$q_1, A/\lambda$	$q_1, B/\lambda$	

1. b) String ab

$$\begin{array}{ll}
 (q_0, ab, \lambda) & \vdash (q_0, b, A) \\
 & \vdash (q_0, \lambda, BA) \\
 & \vdash (q_1, \lambda, BA)
 \end{array}$$

String ab is not accepted in M as there is no empty stack.

String bb

$$\begin{array}{ll}
 (q_0, bb, \lambda) & \vdash (q_0, b, B) \\
 & \vdash (q_1, b, B) \\
 & \vdash (q_1, \lambda, \lambda)
 \end{array}$$

String bb is accepted in M as there is a final state and empty stack.

String baab

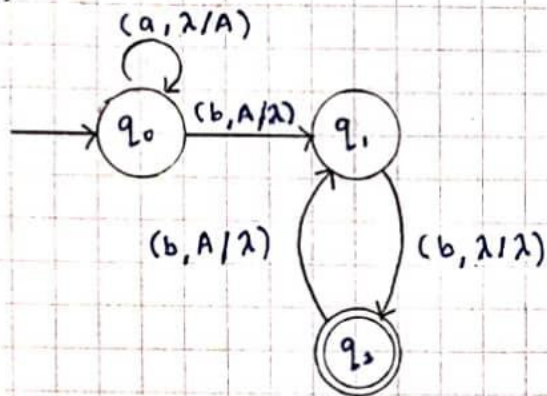
$$\begin{array}{ll}
 (q_0, baab, \lambda) & \vdash (q_0, aab, B) \\
 & \vdash (q_0, ab, AB) \\
 & \vdash (q_1, ab, AB) \\
 & \vdash (q_1, b, B) \\
 & \vdash (q_1, \lambda, \lambda)
 \end{array}$$

String baab is accepted in M as there is a final state and an empty stack.

1. c) Set-theoretic definition

$$\{ww^* \mid w \in \{a, b\}^*\}$$

2. a)



2. b) $(q_0, aabbbb, \lambda) \vdash (q_0, abbbb, A)$
 $\vdash (q_0, bbbb, AA)$
 $\vdash (q_1, bbb, A)$
 $\vdash (q_2, bb, A)$
 $\vdash (q_1, b, \lambda)$
 $\vdash (q_2, \lambda, \lambda)$

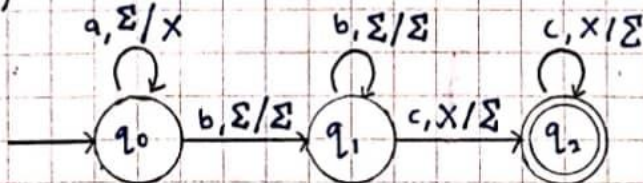
String aabbbb
is accepted in
M

2. c) $L = \{a^n b^{2n} \mid n > 0\}$

2. d) $S \rightarrow aSbb \mid aAbb$
 $A \rightarrow \lambda$

2. e) $S \rightarrow aSbb \rightarrow aaSbbbb \rightarrow aaAbbbs \rightarrow aa\lambda bbs$

3. a)



3.b) String ac

$(q_1, ac, \lambda) \vdash (q_1, c, A) = \text{Rejected}$

String abc

$(q_1, abc, \lambda) \vdash (q_1, bc, A)$
 $\vdash (q_2, c, A)$
 $\vdash (q_3, \lambda, \lambda) = \text{Accepted}$

String aabcc

$(q_1, aabcc, \lambda) \vdash (q_1, abcc, A)$
 (q_1, bcc, AA)
 (q_2, cc, AA)
 (q_3, c, A)
 $(q_3, \lambda, \lambda) = \text{Accepted}$

3.c) $L(M) = \{a^n b^n c^n \mid n, m > 0\}$

3.d) $G: S \rightarrow aSc \mid aBc$
 $B \rightarrow bB \mid b$

3.e) $IN = abc$
 $NOT\ IN = \lambda$