

# CS375 WK7

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August 22, 2011

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graph TD
    START([START]) --> RD1{READ}
    RD1 -- c --> RD2{READ}
    RD1 -- d --> RD3{READ}
    RD2 -- Δ --> ACCEPT([ACCEPT])
    RD2 -- d --> RD3
    RD3 -- c --> RD1
    RD3 -- d --> RD4{READ}
    RD4 -- Δ --> REJECT1([REJECT])
    RD4 -- c --> RD1
    RD5{READ} -- c --> RD6{READ}
    RD5 -- d --> RD7{READ}
    RD6 -- Δ --> REJECT2([REJECT])
    RD6 -- d --> RD7
    RD7 -- c --> RD5
    RD7 -- d --> RD8{READ}
    RD8 -- Δ --> REJECT2
    RD8 -- c --> RD6
  
```

Figure 3: Q02: FA

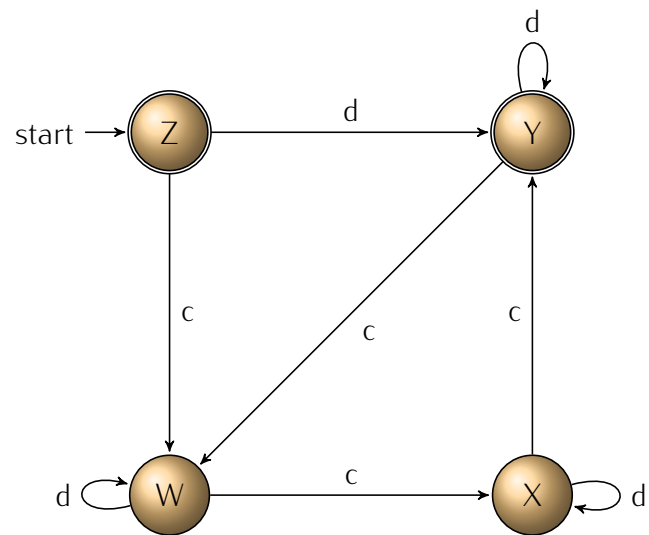


Figure 4: Q02: PDA

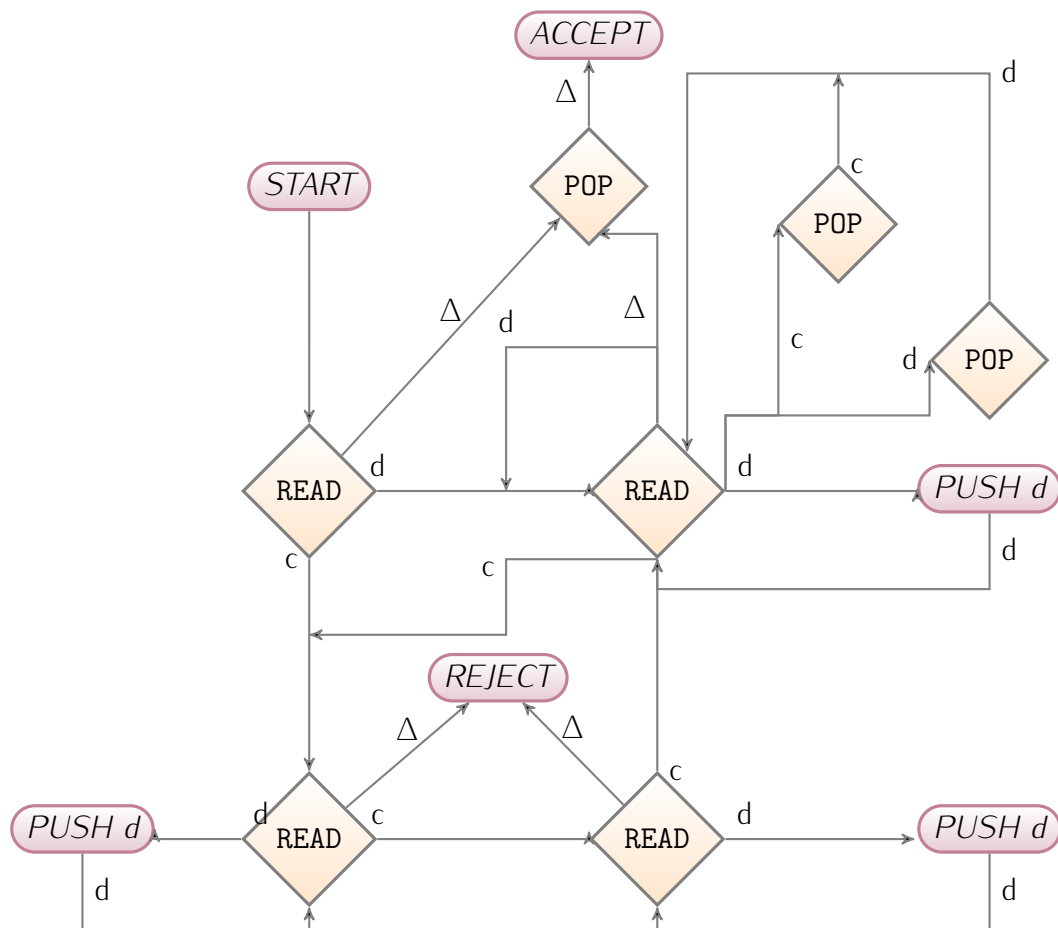
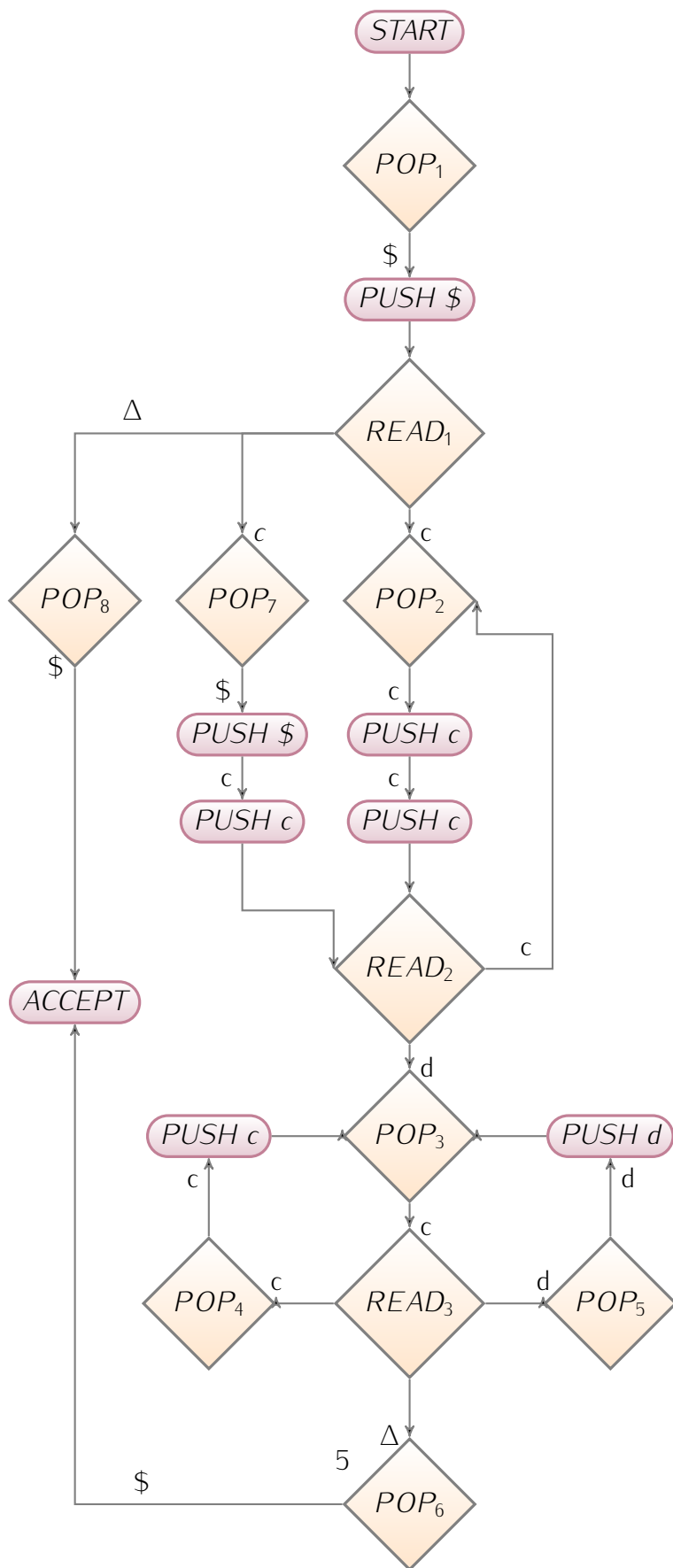


Figure 5: Q03a: Conversion Form



**Figure 6:** Q03.a Summary Table

FROM Where	To Where	READ What	POP What	PUSH What	ROW Number
START	$READ_1$	$\Lambda$	\$	\$	1
$READ_1$	ACCEPT	$\Lambda$	\$	-	2
$READ_1$	$READ_2$	c	\$	c\$	3
$READ_1$	$READ_2$	c	c	cc	4
$READ_2$	$READ_2$	c	c	cc	5
$READ_2$	$READ_3$	d	c	-	6
$READ_3$	$READ_3$	c	cc	c	7
$READ_3$	$READ_3$	d	dc	d	7
$READ_3$	ACCEPT	$\Lambda$	\$	-	8

**Figure 7:** Q03.a Productions

Rule 1:  $S \rightarrow Net(START, ACCEPT, \$)$

Rule 2:

$Net(READ_1, ACCEPT, \$) \rightarrow Row_2$

$Net(READ_2, READ_3, \$) \rightarrow Row_6$

$Net(READ_3, ACCEPT, \$) \rightarrow Row_8$

Rule 3:

$Row_1 \rightarrow \Lambda$

$Row_2 \rightarrow \Lambda$

$Row_3 \rightarrow c$

$Row_4 \rightarrow c$

$Row_5 \rightarrow c$

$Row_6 \rightarrow d$

$Row_7 \rightarrow c$

$Row_8 \rightarrow c$

Figure 8: Q03.b

STATE	STACK	TAPE
Start	$\Delta$	<span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">d</span>
$Read_1$	$\Delta$	<span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">d</span>
Push	$c\Delta$	<span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">d</span>
$Read_2$	$c\Delta$	<span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">d</span>
Push	$cc\Delta$	<span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">d</span>
$Read_2$	$cc\Delta$	<span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">d</span>
Push	$ccc\Delta$	<span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">d</span>
$Read_2$	$ccc\Delta$	<span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">d</span>
Pop	$cc\Delta$	<span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">d</span>
$Read_3$	$cc\Delta$	<span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">d</span>
Pop	$c\Delta$	<span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">d</span>
$Read_3$	$c\Delta$	<span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">d</span>
Pop	$\Delta$	<span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">d</span>
$Read_3$	$\Delta$	<span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">d</span>
Pop	$\Delta$	<span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">d</span>
Accept	$\Delta$	<span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">d</span>

Figure 9: Q03.c

STATE	STACK	TAPE
Start	$\Delta$	<span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">d</span>
$Read_1$	$\Delta$	<span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">d</span>
Push	$c\Delta$	<span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">d</span>
$Read_2$	$c\Delta$	<span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">d</span>
Push	$cc\Delta$	<span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">d</span>
$Read_2$	$cc\Delta$	<span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">d</span>
Push	$ccc\Delta$	<span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">d</span>
$Read_2$	$ccc\Delta$	<span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">d</span>
Pop	$cc\Delta$	<span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">d</span>
$Read_3$	$cc\Delta$	<span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">d</span>
Pop	$c\Delta$	<span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">d</span>
$Read_3$	$c\Delta$	<span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">d</span>
Pop	$\Delta$	<span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">d</span>
$Read_3$	$\Delta$	<span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">d</span>
Pop	$\Delta$	<span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">d</span>
Accept	$\Delta$	<span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">d</span> <span style="border: 1px solid black; padding: 0 2px;">c</span> <span style="border: 1px solid black; padding: 0 2px;">d</span>

Figure 10: Q03.d

STATE	STACK	TAPE
Start	$\Delta$	<span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span>
$Read_1$	$\Delta$	<span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span>
Push	$c\Delta$	<span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span>
$Read_2$	$c\Delta$	<span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span>
Push	$cc\Delta$	<span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span>
$Read_2$	$cc\Delta$	<span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span>
Push	$ccc\Delta$	<span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span>
$Read_2$	$ccc\Delta$	<span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span>
Pop	$cc\Delta$	<span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span>
$Read_3$	$cc\Delta$	<span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span>
Pop	$c\Delta$	<span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span>
$Read_3$	$c\Delta$	<span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span>
Pop	$\Delta$	<span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span>
$Read_3$	$\Delta$	<span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span>
Pop	$\Delta$	<span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span>
Accept	$\Delta$	<span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span>

Figure 11: Q03.e

STATE	STACK	TAPE
Start	$\Delta$	<span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span>
$Read_1$	$\Delta$	<span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span>
Push	$c\Delta$	<span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span>
$Read_2$	$c\Delta$	<span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span>
Push	$cc\Delta$	<span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span>
$Read_2$	$cc\Delta$	<span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span>
Push	$ccc\Delta$	<span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span>
$Read_2$	$ccc\Delta$	<span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span>
Push	$cccc\Delta$	<span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span>
$Read_2$	$cccc\Delta$	<span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span>
Pop	$ccc\Delta$	<span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span>
$Read_2$	$ccc\Delta$	<span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span>
Pop	$cc\Delta$	<span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span>
$Read_3$	$cc\Delta$	<span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span>
Pop	$c\Delta$	<span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span>
Reject	$c\Delta$	<span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">c</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span>



Figure 12: Q05-07: Conversion Form

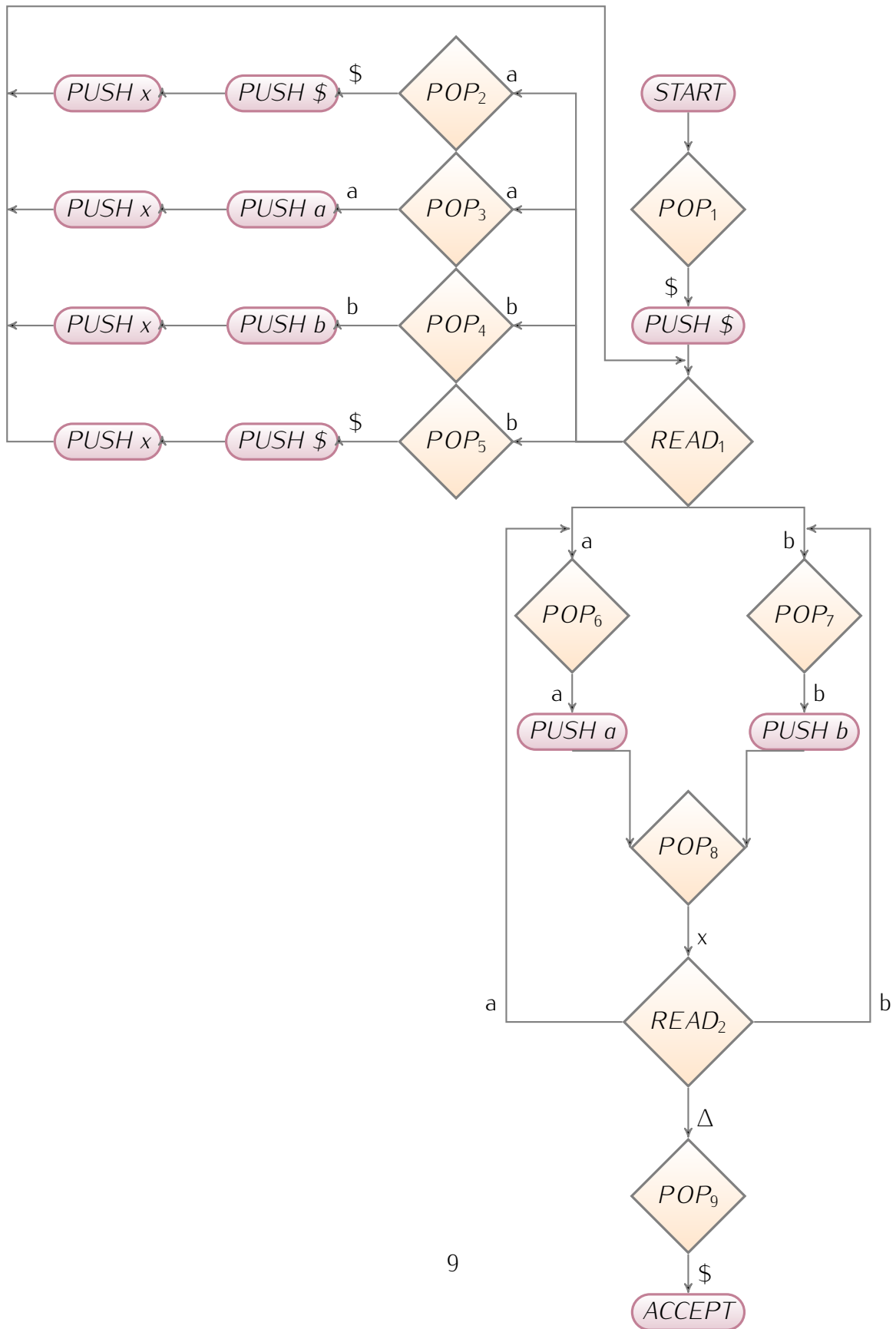


Figure 13: Q05-07: Summary Table

FROM Where	To Where	READ What	POP What	PUSH What	ROW Number
START	$READ_1$	$\Lambda$	\$	\$	1
$READ_1$	$READ_1$	a	\$	x\$	2
$READ_1$	$READ_1$	a	a	xa	3
$READ_1$	$READ_1$	b	b	xb	4
$READ_1$	$READ_1$	b	\$	x\$	5
$READ_1$	$READ_2$	a	ax	a	6
$READ_1$	$READ_2$	b	bx	b	7
$READ_2$	$READ_2$	a	ax	a	8
$READ_2$	$READ_2$	b	bx	b	9
$READ_2$	ACCEPT	$\Delta$	\$	-	10

Figure 14: Q05

$Net(READ_1, READ_1, a)Row2$   
 $Net(READ_1, READ_2, b)Row7$   
 $Net(READ_2, ACCEPT, \Delta)Row10$

Example with Tape

STATE	STACK	TAPE
Start	$\Delta$	a b
$Read_1$	$\Delta$	a b
$Push_x$	x $\Delta$	a b
$Read_1$	x $\Delta$	a b
$Pop$	$\Delta$	a b
$Read_2$	$\Delta$	a b
$Pop$	$\Delta$	a b
Accept	$\Delta$	a b

Figure 15: Q06

$Net(READ_1, READ_1, b)Row5$   
 $Net(READ_1, READ_1, b)Row5$   
 $Net(READ_1, READ_1, b)Row5$   
 $Net(READ_1, READ_2, a)Row6$   
 $Net(READ_2, ACCEPT, \Delta)Row10$

Example with Tape

STATE	STACK	TAPE
Start	$\Delta$	<span style="border: 1px solid blue; padding: 0 2px;">b</span> <span style="border: 1px solid blue; padding: 0 2px;">b</span> <span style="border: 1px solid blue; padding: 0 2px;">b</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span>
$Read_1$	$\Delta$	<span style="border: 1px solid blue; padding: 0 2px;">b</span> <span style="border: 1px solid blue; padding: 0 2px;">b</span> <span style="border: 1px solid blue; padding: 0 2px;">b</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span>
$Push_x$	$x\Delta$	<span style="border: 1px solid blue; padding: 0 2px;">b</span> <span style="border: 1px solid blue; padding: 0 2px;">b</span> <span style="border: 1px solid blue; padding: 0 2px;">b</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span>
$Read_1$	$x\Delta$	<span style="border: 1px solid blue; padding: 0 2px;">b</span> <span style="border: 1px solid blue; padding: 0 2px;">b</span> <span style="border: 1px solid blue; padding: 0 2px;">b</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span>
$Push_x$	$xx\Delta$	<span style="border: 1px solid blue; padding: 0 2px;">b</span> <span style="border: 1px solid blue; padding: 0 2px;">b</span> <span style="border: 1px solid blue; padding: 0 2px;">b</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span>
$Read_1$	$xx\Delta$	<span style="border: 1px solid blue; padding: 0 2px;">b</span> <span style="border: 1px solid blue; padding: 0 2px;">b</span> <span style="border: 1px solid blue; padding: 0 2px;">b</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span>
$Pop$	$x\Delta$	<span style="border: 1px solid blue; padding: 0 2px;">b</span> <span style="border: 1px solid blue; padding: 0 2px;">b</span> <span style="border: 1px solid blue; padding: 0 2px;">b</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span>
$Read_2$	$x\Delta$	<span style="border: 1px solid blue; padding: 0 2px;">b</span> <span style="border: 1px solid blue; padding: 0 2px;">b</span> <span style="border: 1px solid blue; padding: 0 2px;">b</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span>
$Pop$	$\Delta$	<span style="border: 1px solid blue; padding: 0 2px;">b</span> <span style="border: 1px solid blue; padding: 0 2px;">b</span> <span style="border: 1px solid blue; padding: 0 2px;">b</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span>
$Read_2$	$\Delta$	<span style="border: 1px solid blue; padding: 0 2px;">b</span> <span style="border: 1px solid blue; padding: 0 2px;">b</span> <span style="border: 1px solid blue; padding: 0 2px;">b</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span>
$Pop$	$\Delta$	<span style="border: 1px solid blue; padding: 0 2px;">b</span> <span style="border: 1px solid blue; padding: 0 2px;">b</span> <span style="border: 1px solid blue; padding: 0 2px;">b</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span>
Accept	$\Delta$	<span style="border: 1px solid blue; padding: 0 2px;">b</span> <span style="border: 1px solid blue; padding: 0 2px;">b</span> <span style="border: 1px solid blue; padding: 0 2px;">b</span> <span style="border: 1px solid blue; padding: 0 2px;">a</span>

Figure 16: Q08-11: Conversion Form

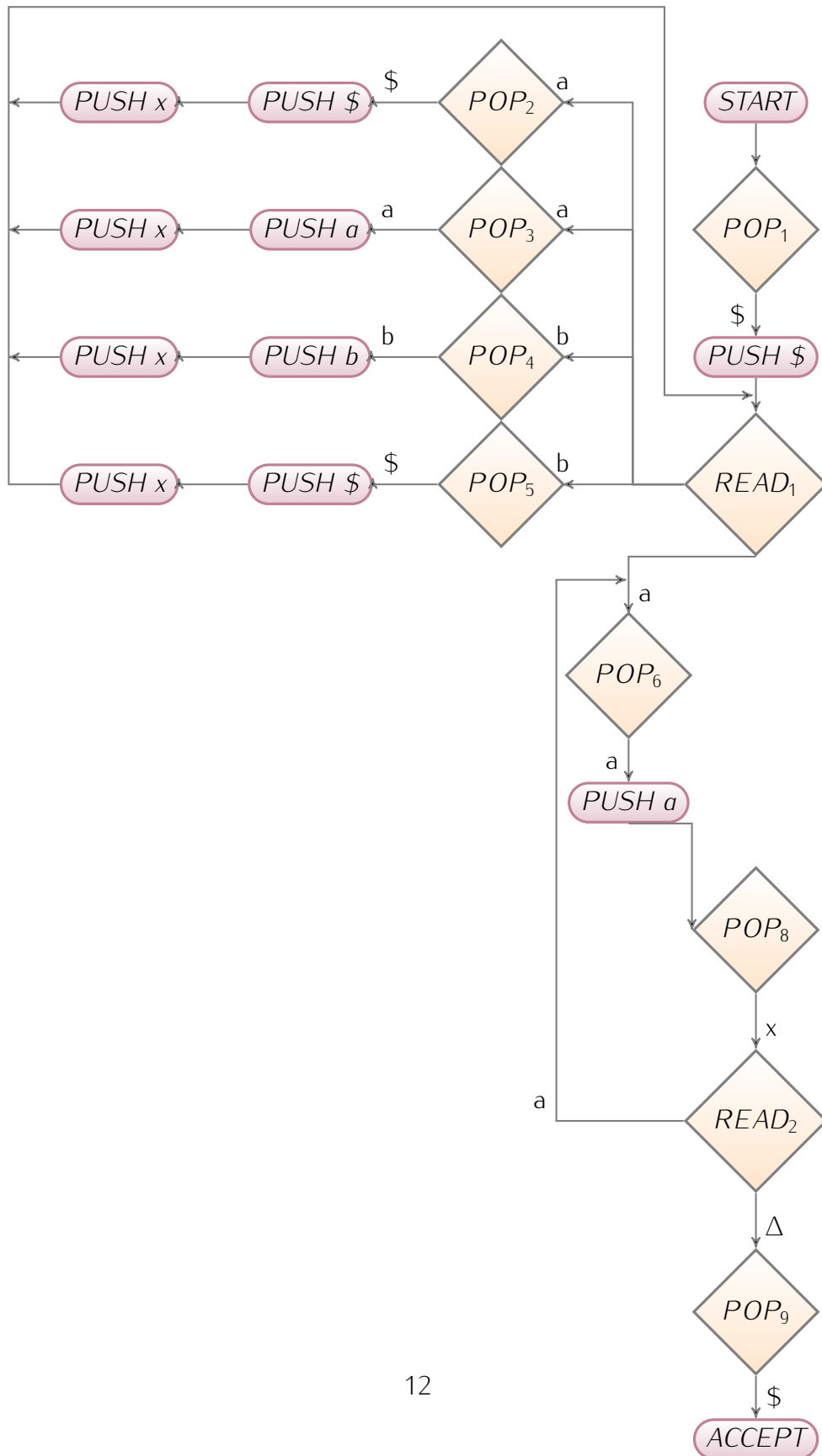


Figure 17: Q08-11: Summary Table

FROM Where	To Where	READ What	POP What	PUSH What	ROW Number
START	$READ_1$	$\Lambda$	\$	\$	1
$READ_1$	$READ_1$	a	\$	x\$	2
$READ_1$	$READ_1$	a	a	xa	3
$READ_1$	$READ_1$	b	b	xb	4
$READ_1$	$READ_1$	b	\$	x\$	5
$READ_1$	$READ_2$	a	ax	a	6
$READ_2$	$READ_2$	a	ax	a	8
$READ_2$	ACCEPT	$\Delta$	\$	-	10

Figure 18: Q08

$Net(READ_1, READ_1, a)Row2$   
 $Net(READ_1, READ_2, a)Row6$   
 $Net(READ_2, ACCEPT, \Delta)Row10$

Example with Tape

STATE	STACK	TAPE
Start	$\Delta$	a b
$Read_1$	$\Delta$	a b
$Push$	x $\Delta$	a b
$Read_1$	x $\Delta$	a b
$Pop$	$\Delta$	a b
$Read_2$	$\Delta$	a b
$Pop$	$\Delta$	a b
Accept	$\Delta$	a b

Figure 19: Q09

$Net(READ_1, READ_1, b)Row5$   
 $Net(READ_1, READ_1, a)Row2$   
 $Net(READ_1, READ_1, b)Row5$   
 $Net(READ_1, READ_2, a)Row6$   
 $Net(READ_2, READ_2, a)Row8$   
 $Net(READ_2, READ_2, a)Row8$   
 $Net(READ_2, ACCEPT, \Delta)Row10$

Example with Tape

STATE	STACK	TAPE
Start	$\Delta$	<b>b</b> a <b>b</b> a <b>a</b> a
$Read_1$	$\Delta$	a <b>a</b> b <b>a</b> a <b>a</b>
$Push$	$x\Delta$	a <b>a</b> b <b>a</b> a <b>a</b>
$Read_1$	$x\Delta$	a <b>a</b> b <b>a</b> a <b>a</b>
$Push$	$xx\Delta$	a <b>a</b> b <b>a</b> a <b>a</b>
$Read_1$	$xx\Delta$	a <b>a</b> a <b>a</b> a <b>a</b>
$Push$	$xxx\Delta$	a <b>a</b> a <b>a</b> a <b>a</b>
$Read_1$	$xxx\Delta$	a <b>a</b> a <b>a</b> a <b>a</b>
$Pop$	$xx\Delta$	a <b>a</b> a <b>a</b> a <b>a</b>
$Read_2$	$xx\Delta$	a <b>a</b> a <b>a</b> a <b>a</b>
$Pop$	$x\Delta$	a <b>a</b> a <b>a</b> a <b>a</b>
$Read_2$	$x\Delta$	a <b>a</b> a <b>a</b> a <b>a</b> b
$Pop$	$\Delta$	a <b>a</b> a <b>a</b> a <b>a</b> b
$Read_2$	$\Delta$	a <b>a</b> a <b>a</b> a <b>a</b> b
$Pop$	$\Delta$	a <b>a</b> a <b>a</b> a <b>a</b> b
Accept	$\Delta$	a <b>a</b> a <b>a</b> a <b>a</b> b

Figure 20: Q10

The PDA for 8-11 is an EVENPALINDROME therefore it is impossible to balance the amount of readable tape with the stack if not even as shown below. If instead of the below example we were to remain in READ 1 an additional cycle then we would have too many x's on the Stack and the tape would complete too soon. In this case the tape completes too late.

$Net(READ_1, READ_1, b)$  Row 5  
 $Net(READ_1, READ_1, a)$  Row 2  
 $Net(READ_1, READ_1, b)$  Row 5  
 $Net(READ_1, READ_2, a)$  Row 6  
 $Net(READ_2, READ_2, a)$  Row 8  
 $Net(READ_2, READ_2, b)$  Row 8  
 CRASH

Example with Tape

STATE	STACK	TAPE
Start	$\Delta$	<span style="border: 1px solid black; padding: 0 2px;">b</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">b</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">b</span>
$Read_1$	$\Delta$	<span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">b</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">b</span>
$Push$	$x\Delta$	<span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">b</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">b</span>
$Read_1$	$x\Delta$	<span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">b</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">b</span>
$Push$	$xx\Delta$	<span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">b</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">b</span>
$Read_1$	$xx\Delta$	<span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">b</span>
$Push$	$xxx\Delta$	<span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">b</span>
$Read_1$	$xxx\Delta$	<span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">b</span>
$Pop$	$xx\Delta$	<span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">b</span>
$Read_2$	$xx\Delta$	<span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">b</span>
$Pop$	$x\Delta$	<span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">b</span>
$Read_2$	$x\Delta$	<span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">b</span>
$Pop$	$\Delta$	<span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">b</span>
$Read_2$	$\Delta$	<span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">b</span>
$Pop$	$\Delta$	<span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">a</span> <span style="border: 1px solid black; padding: 0 2px;">b</span>

Figure 21: Q11

Once again the PDA for 8-11 is an EVENPALINDROME therefore it is impossible to balance the amount of readable tape with the stack if not even as shown below. If instead of the below example we were to remain in READ 1 an additional cycle then we would have too many x's on the Stack and the tape would complete too soon. In this case the tape completes too late. This example is identical to the failure shown above with the exception of the extra character on the string being a 'a'

$Net(READ_1, READ_1, b)Row5$   
 $Net(READ_1, READ_1, a)Row2$   
 $Net(READ_1, READ_1, b)Row5$   
 $Net(READ_1, READ_2, a)Row6$   
 $Net(READ_2, READ_2, a)Row8$   
 $Net(READ_2, READ_2, a)Row8$   
 CRASH

Example with Tape

STATE	STACK	TAPE
Start	$\Delta$	b a b a a a a
$Read_1$	$\Delta$	a b a a a a a
Push	x $\Delta$	a a b a a a a
$Read_1$	x $\Delta$	a a b a a a a
Push	xx $\Delta$	a a b a a a a
$Read_1$	xx $\Delta$	a a a a a a a
Push	xxx $\Delta$	a a a a a a a
$Read_1$	xxx $\Delta$	a a a a a a a
Pop	xx $\Delta$	a a a a a a a
$Read_2$	xx $\Delta$	a a a a a a a
Pop	x $\Delta$	a a a a a a a
$Read_2$	x $\Delta$	a a a a a a a
Pop	$\Delta$	a a a a a a a
$Read_2$	$\Delta$	a a a a a a b
Pop	$\Delta$	a a a a a a b