

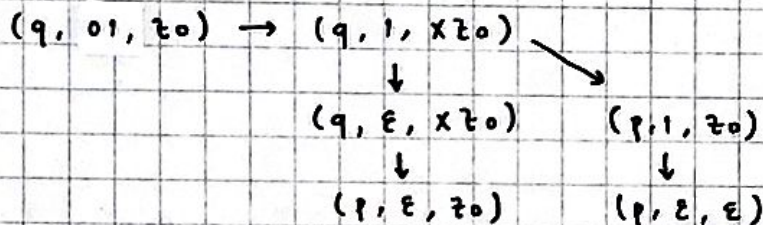
Exercise 6.1.1

Suppose the PDA $P = (\{q, p\}, \{0, 1\}, \{z_0, x\}, \delta, q, z_0, \{p\})$ has the following transition function:

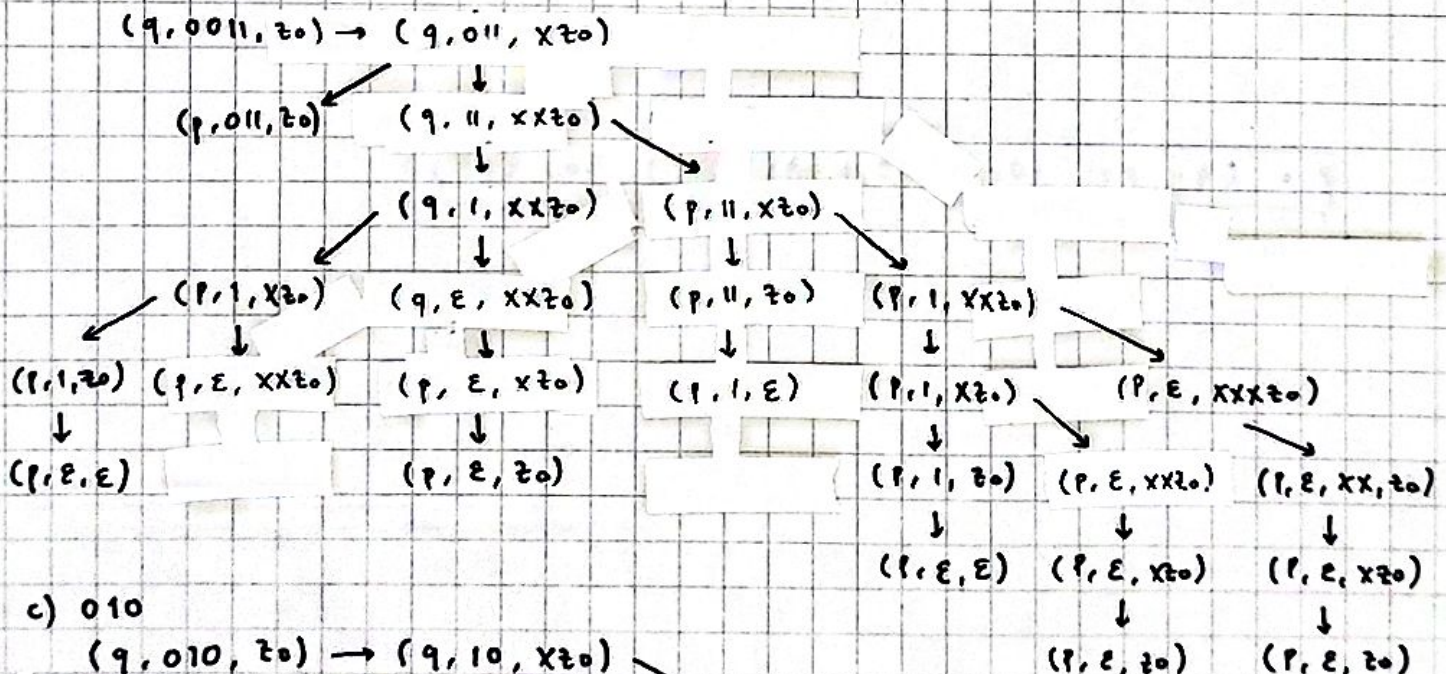
1. $\delta(q, 0, z_0) = \{(q, xz_0)\}$
2. $\delta(q, 0, x) = \{(q, xx)\}$
3. $\delta(q, 1, x) = \{(q, x)\}$
4. $\delta(q, \epsilon, x) = \{(p, \epsilon)\}$
5. $\delta(p, \epsilon, x) = \{(p, \epsilon)\}$
6. $\delta(p, 1, x) = \{(p, xx)\}$
7. $\delta(p, 1, z_0) = \{(p, \epsilon)\}$

Starting from the initial ID (q, w, z_0) , show all the reachable ID's when the input w is:

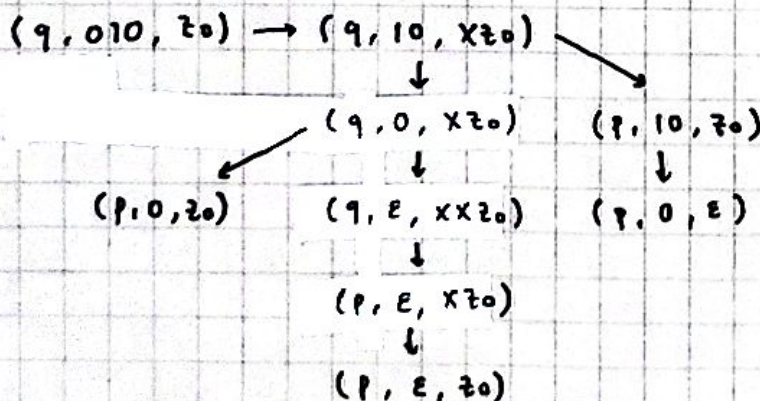
a) 01



b) 0011



c) 010



Exercise 6.2.1

Design a PDA to accept each of the following languages. You may accept either by final state or by empty stack, whichever is more convenient.

a) $\{0^n 1^n \mid n \geq 1\}$

1. $\delta(q, 0, z_0) = \{(q, x)\}$

2. $\delta(q, 0, x) = \{(q, xx)\}$

3. $\delta(q, 1, x) = \{(p, \epsilon)\}$

4. $\delta(p, 1, x) = \{(p, \epsilon)\}$

$P = (\{q, p\}, \{0, 1\}, \{z_0, x\}, \delta, q, z_0, \{p\})$

b) The set of all strings of 0's & 1's such that no prefix has more 1's than 0's.

1. $\delta(q, 0, z_0) = \{(q, xz_0)\}$

2. $\delta(q, 0, x) = \{(q, xx)\}$

3. $\delta(q, 0, x) = \{(p, x)\}$

4. $\delta(q, 1, x) = \{(q, \epsilon)\}$

5. $\delta(q, \epsilon, z_0) = \{(p, z_0)\}$

6. $\delta(q, \epsilon, x) = \{(p, x)\}$

$P = (\{q, p\}, \{0, 1\}, \{z_0, x\}, \delta, q, z_0, \{p\})$

c) The set of all strings of 0's and 1's with an equal number of 0's & 1's.

1. $\delta(q, 0, z_0) = \{(q, 0z_0)\}$

2. $\delta(q, 1, z_0) = \{(q, 1z_0)\}$

3. $\delta(q, 0, 0) = \{(q, 00)\}$

4. $\delta(q, 0, 1) = \{(q, \epsilon)\}$

5. $\delta(q, 1, 1) = \{(q, 11)\}$

6. $\delta(q, 1, 0) = \{(q, \epsilon)\}$

7. $\delta(q, \epsilon, z_0) = \{(p, \epsilon)\}$

$P = (\{q, p\}, \{0, 1\}, \{z_0, x\}, \delta, q, z_0, \{p\})$

Exercise 6.2.5

PDA $P = (\{q_0, q_1, q_2, q_3, f\}, \{a, b\}, \{z_0, A, B\}, \delta, q_0, z_0, \{f\})$

has the following rules defining δ :

$$\delta(q_0, a, z_0) = (q_1, AAz_0)$$

$$\delta(q_1, a, A) = (q_1, AAA)$$

$$\delta(q_2, a, B) = (q_3, \epsilon)$$

$$\delta(q_3, \epsilon, B) = (q_2, \epsilon)$$

$$\delta(q_0, b, z_0) = (q_2, Bz_0)$$

$$\delta(q_1, b, A) = (q_1, \epsilon)$$

$$\delta(q_2, b, B) = (q_2, BB)$$

$$\delta(q_3, \epsilon, z_0) = (q_1, Az_0)$$

$$\delta(q_0, \epsilon, z_0) = (f, \epsilon)$$

$$\delta(q_1, \epsilon, z_0) = (q_0, z_0)$$

$$\delta(q_2, \epsilon, z_0) = (q_0, z_0)$$

Note that, since each of the sets above has only one choice of move, we have omitted the set brackets from each of the rules.

a) Give an execution trace (sequence of ID's) showing that string bab is in $L(P)$

$$(q_0, bab, z_0) \vdash (q_2, ab, Bz_0) \vdash (q_3, b, z_0) \vdash (q_1, b, AAz_0) \vdash (q_1, \epsilon, z_0) \vdash (q_0, \epsilon, z_0) \vdash (f, \epsilon, \epsilon)$$

b) Give an execution trace showing that abb is in $L(P)$

$$(q_0, abb, z_0) \vdash (q_1, bb, AAz_0) \vdash (q_1, b, AAz_0) \vdash (q_1, \epsilon, z_0) \vdash (q_0, \epsilon, z_0) \vdash (f, \epsilon, \epsilon)$$

c) Give the contents of the stack after P has read b^7a^4 from its input.

$$(q_0, b^7a^4, z_0) \vdash (q_2, b^6a^4, Bz_0) \vdash \dots \vdash (q_2, a^4, B^7z_0) \vdash (q_3, a^3, B^6z_0) \vdash (q_3, a^2, B^5z_0) \vdash (q_3, a^2, B^4z_0) \vdash \dots \vdash (q_3, \epsilon, z_0) \vdash (q_1, \epsilon, AAz_0)$$

the stack = Az_0

d) Informally describe $L(P)$

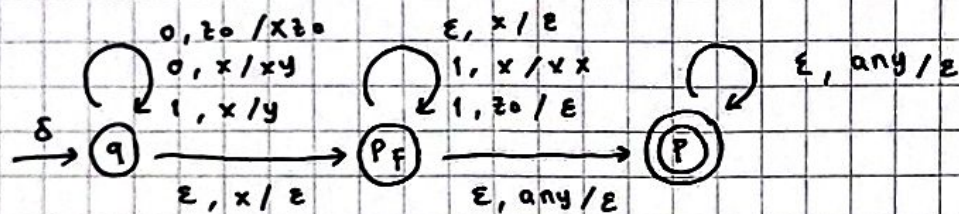
$L(P)$ adalah PDA yg menerima string dgn jml b 2 kali dr a .

Exercise 6.3.6

consider the PDA P from exercise 6.1.1

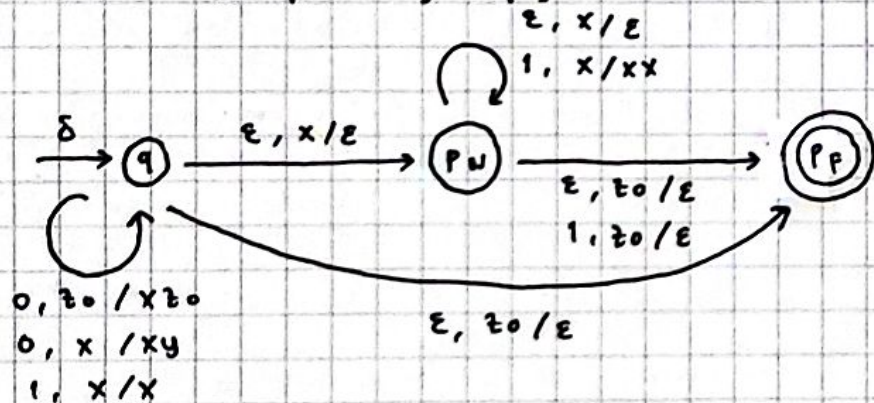
- a) Convert P to another PDA P_1 that accepts by empty stack the same language that P accepts by final state; i.e., $N(P_1) = L(P)$

$$P = (\{q, r\}, \{0, 1\}, \{z_0, x\}, \delta, q, z_0, \{r\})$$



$$P_N = (\{P_0, q, P_F, P_N\}, \{0, 1\}, \{X_0, z_0, x\}, \delta, P_0, X_0)$$

- b) Find a PDA P_2 such that $L(P_2) = N(P)$; i.e. P_2 accepts by final state what P accepts by empty stack.



$$P_L = (\{P_0, q, P_N, P_F\}, \{0, 1\}, \{z_0, x\}, \delta, P_0, X_0, \{P_F\})$$