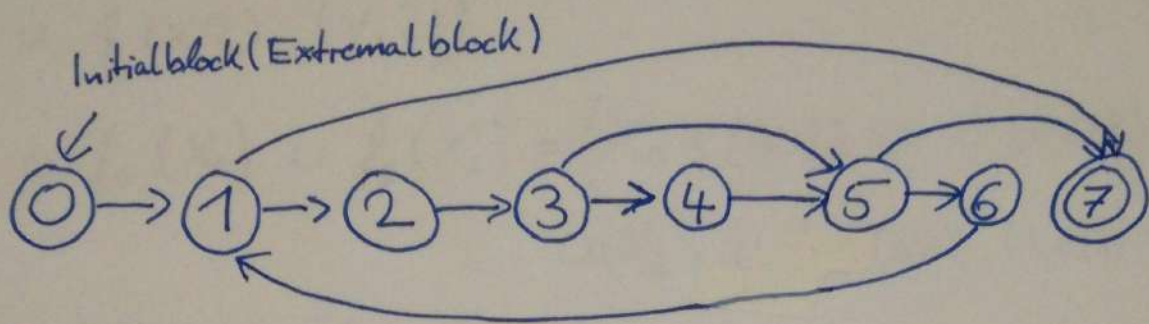


# Aufgabe 1

a)



b) 
$$\text{Kill}(b) = \begin{cases} \{(x, ?) \cup \{(x, b') \mid b' \in \text{Blocks}\}\} & \text{falls } b = [x := a] \\ \emptyset & \text{sonst} \end{cases}$$

$$\text{gen}(b) = \begin{cases} \{(x, b)\} & \text{falls } b = [x := a] \\ \emptyset & \text{sonst} \end{cases}$$

$$f_b(x) = (X \setminus \text{Kill}(b)) \cup \text{gen}(b)$$

$$f_0(x) = (X \setminus \{(x, ?), (x, 0), (x, 6)\}) \cup \{(x, 0)\}$$

$$f_1(x) = X$$

$$f_2(x) = (X \setminus \{(y, ?), (y, 2), (y, 4), (y, 7)\}) \cup \{(y, 2)\}$$

$$f_3(x) = X$$

$$f_4(x) = (X \setminus \{(y, ?), (y, 2), (y, 4), (y, 7)\}) \cup \{(y, 4)\}$$

$$f_5(x) = X$$

$$f_6(x) = (X \setminus \{(x, ?), (x, 0), (x, 6)\}) \cup \{(x, 6)\}$$

$$f_7(x) = (X \setminus \{(y, ?), (y, 2), (y, 4), (y, 7)\}) \cup \{(y, 7)\}$$

(c)

$$f(X_0) = \{(x, 2), (y, 2)\}$$

$$f(X_1) = f_0(X_0) \cup f_6(X_6) = (X_0 \setminus \{(x, 2), (x, 0), (x, 6)\}) \cup \{(x, 0)\} \\ \cup (X_6 \setminus \{(x, 2), (x, 0), (x, 6)\}) \cup \{(x, 6)\}$$

$$f(X_2) = f_1(X_1) = X_1$$

$$f(X_3) = f_2(X_2) = (X_2 \setminus \{(y, 2), (y, 2), (y, 4), (y, 7)\}) \cup \{(y, 2)\}$$

$$f(X_4) = f_3(X_3) = X_3$$

$$f(X_5) = f_3(X_3) \cup f_4(X_4) = X_3 \cup (X_4 \setminus \{(y, 2), (y, 2), (y, 4), (y, 7)\}) \cup \{(y, 4)\}$$

$$f(X_6) = f_5(X_5) = X_5$$

$$f(X_7) = f_1(X_1) \cup f_5(X_5) = X_1 \cup X_5$$

1(c) Forts. $X_0$	$X_1$	$X_2$	$X_3$	$X_4$	$X_5$	$X_6$	$X_7$	
$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$	$\perp$
$\{(x,2), (y,2)\}$	$\{(x,6), (x,0)\}$	$\emptyset$	$\{(y,2)\}$	$\emptyset$	$\{(y,4)\}$	$\emptyset$	$\emptyset$	$f^1(\perp)$
//	$\{(x,0), (x,6), (y,2)\}$	$\{(x,0), (x,6)\}$	$\{(y,2)\}$	$\{(y,2)\}$	$\{(y,2), (y,4)\}$	$\{(y,4)\}$	$\{(x,6), (x,0), (y,4)\}$	$f^2(\perp)$
//	$\{(x,0), (x,6), (y,2), (y,4)\}$	$\{(x,0), (x,6), (y,2)\}$	$\{(x,0), (x,6), (y,2)\}$	$\{(y,2)\}$	//	$\{(y,2), (y,4)\}$	$\{(x,0), (x,6), (y,2), (y,2), (y,4)\}$	$f^3(\perp)$
//	$\{(x,0), (x,6), (y,2), (y,2), (y,4)\}$	$\{(x,0), (x,6), (y,2), (y,4)\}$	//	$\{(y,2), (x,0), (x,6)\}$	$\{(x,0), (x,6), (y,2), (y,4)\}$	//	//	$f^4(\perp)$
//	//	$\{(x,0), (x,6), (y,2), (y,2), (y,4)\}$	//	//	//	$\{(x,0), (x,6), (y,2), (y,4)\}$	//	$f^5(\perp)$
//	//	//	//	//	//	//	//	$f^6(\perp)$

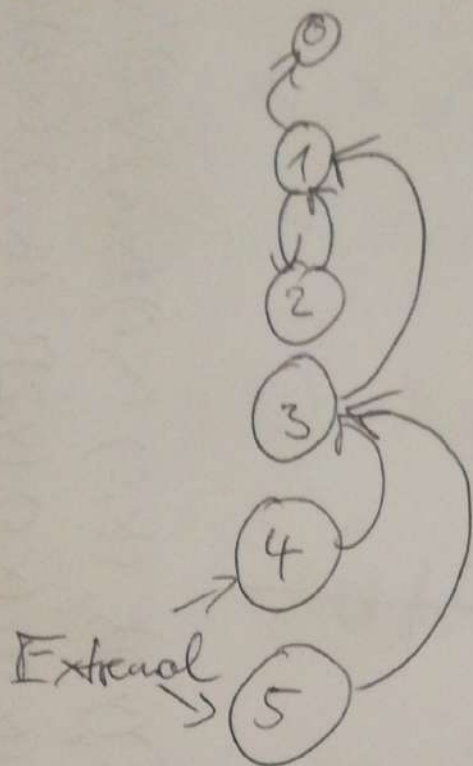
$$f^{n+1}(\perp) = f(f^n(\perp))$$

$$f^6(\perp) = f^5(\perp) = \underbrace{\{(x,2), (y,2)\}}_{X_0}, \underbrace{\{(x,0), (x,6), (y,2), (y,2), (y,4)\}}_{X_1}, \underbrace{\{(x,0), (x,6), (y,2), (y,2), (y,4)\}}_{X_2}, \underbrace{\{(x,0), (x,6), (y,2)\}}_{X_3}$$

$$\underbrace{\{(x,0), (x,6), (y,2)\}}_{X_4}, \underbrace{\{(x,0), (x,6), (y,2), (y,4)\}}_{X_5}, \underbrace{\{(x,0), (x,6), (x,2), (x,4)\}}_{X_6}, \underbrace{\{(x,0), (x,0), (y,2), (y,2), (y,4)\}}_{X_7}$$

# Aufgabe 2

a)



b)

$$kill_b(b) = \begin{cases} \{x\} & | [x := a]^b \\ \emptyset & \text{sonst} \end{cases}$$

$$gen_b(b) = \begin{cases} \text{Nodes } a) \\ \{x\} & | [cond]^b \\ \emptyset & \text{sonst} \end{cases}$$

$$f_0(X) = X \setminus \{x\}$$

$$f_1(X) = X \cup \{x, y\}$$

$$f_2(X) = (X \setminus \{x\}) \cup \{x\} = X \cup \{x\}$$

$$f_3(X) = X \cup \{x, y\}$$

$$f_4(X) = X \setminus \{x\}$$

$$f_5(X) = X \setminus \{x\}$$

## Aufgabe 2

$$(1) f(x_1, x_2, x_3, x_4, x_5) \\ = f_0(y_1, y_2, y_3, y_4, y_5)$$

$$Y_0 = f_1(x_1) = x_1 \cup \{x, y\}$$

$$Y_1 = f_2(x_2) \cup f_3(x_3) = (x_2 \cup \{x\}) \cup (x_3 \cup \{x, y\})$$

$$Y_2 = f_1(x_1) = x_1 \cup \{x, y\}$$

$$Y_3 = f_4(x_4) \cup f_5(x_5) = (x_4 \setminus \{x\}) \cup (x_5 \setminus \{x\})$$

$$Y_4 = \emptyset \cup \{x, y\} = i$$

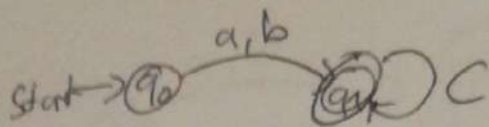
$$Y_5 = \emptyset \cup \{x, y\} = i$$

A 2C) Forts.

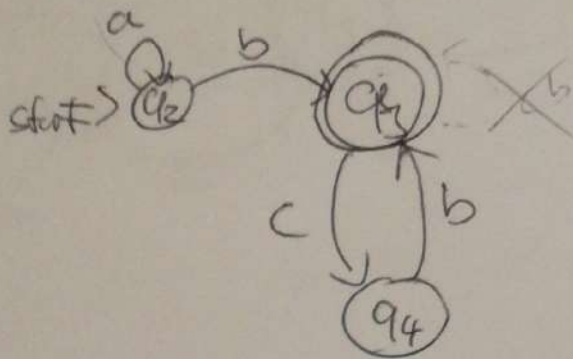
$X_0$	$X_1$	$X_2$	$X_3$	$X_4$	$X_5$	
$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$	$\perp$
$\{X, Y\}$	$\{X, Y\}$	$\{X, Y\}$	$\emptyset$	$\{X, Y\}$	$\{X, Y\}$	$f^1(\perp)$
$\{X, Y\}$	$\{X, Y\}$	$\{X, Y\}$	$\{Y\}$	$\{X, Y\}$	$\{X, Y\}$	$f^2(\perp)$
$\{X, Y\}$	$\{X, Y\}$	$\{X, Y\}$	$\{Y\}$	$\{X, Y\}$	$\{X, Y\}$	$f^3(\perp)$

Aufgabe 2

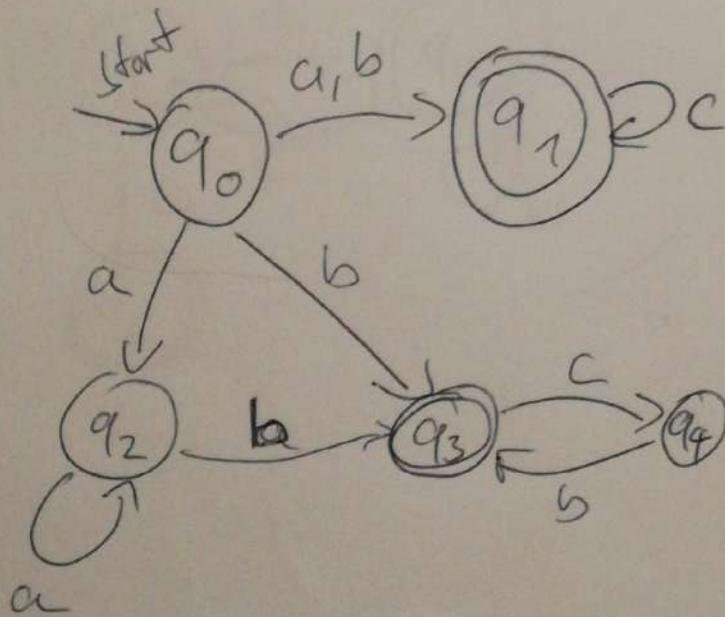
a)  $(a \cup b)c^*$



b)  $a^*b(cb)^*$

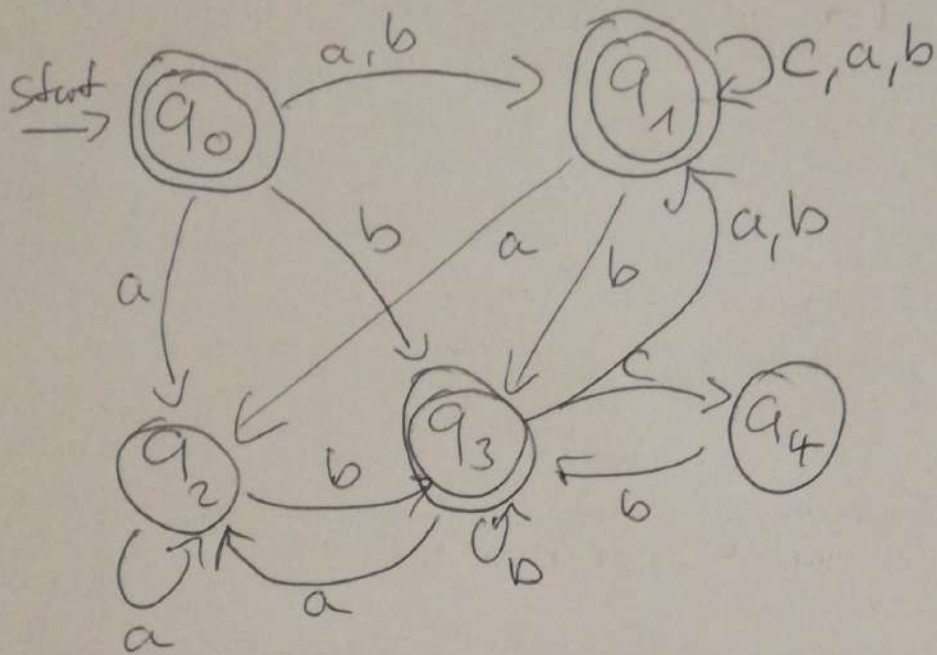


c)  $L(A) \cup L(B)$

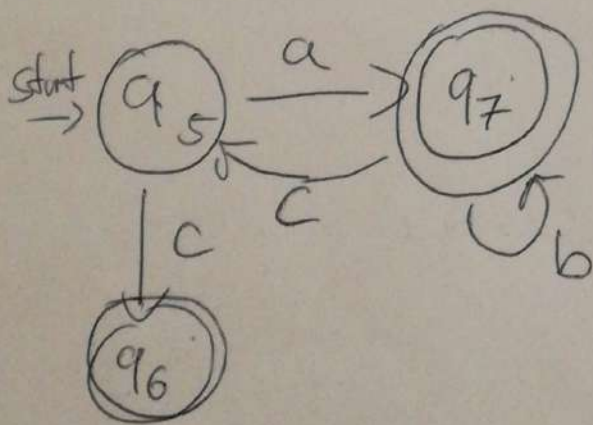


Aufgabe 3

d)  $L(c)^*$



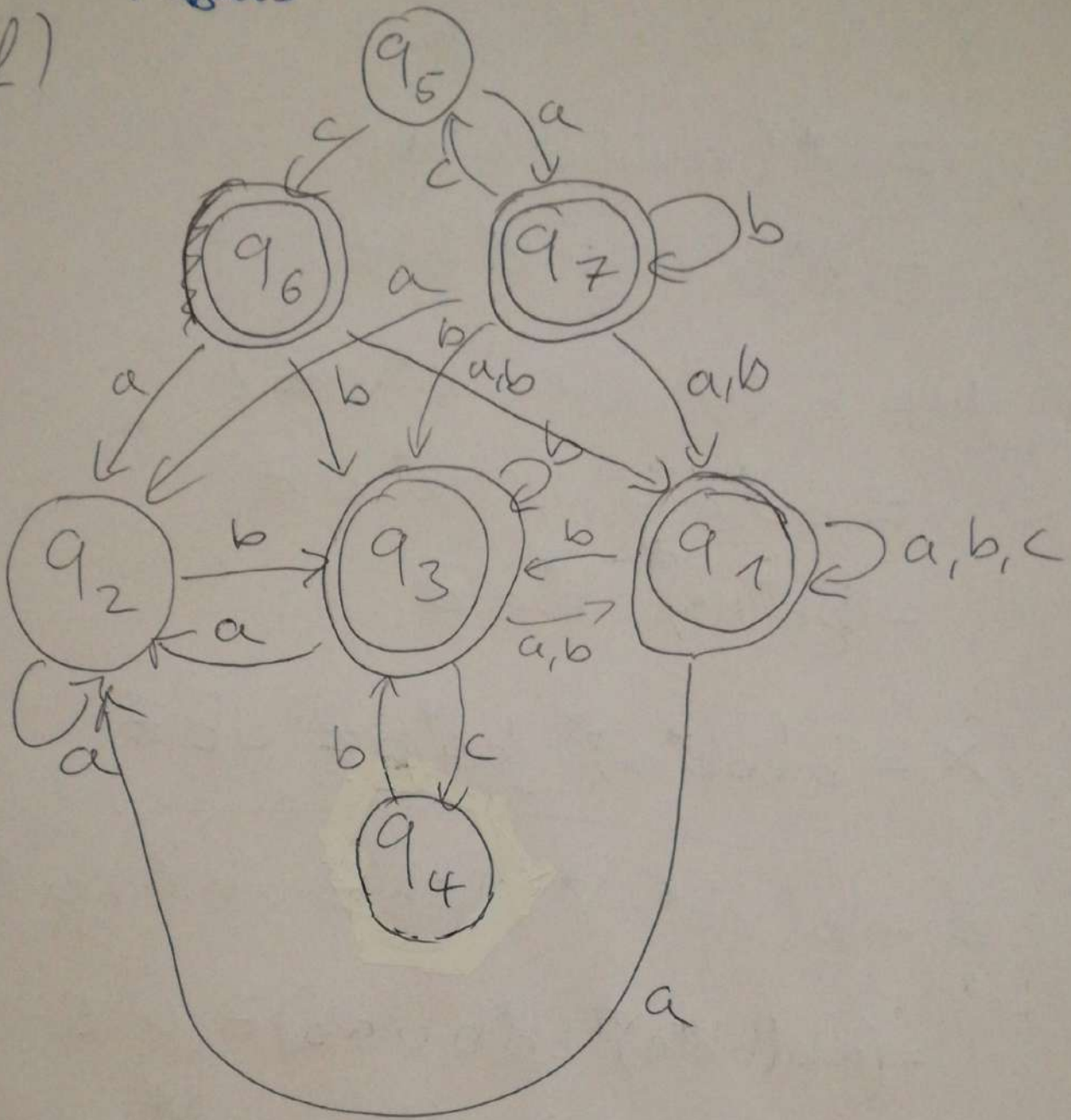
e)  $c \cup a(b \cup c a)^*$  (EULL)





# Aufgabe 3

f)



Aufgabe 4 a)

$$W = b \cdot Y$$

$$X = b \cdot W \cup b \cdot Z$$

$$Y = b \cdot Y \cup a \cdot W \cup b \cdot Z$$

$$Z = a \cdot X \cup \varepsilon$$

b)  $Z = a \cdot X \cup \varepsilon$

$$= a \cdot (b \cdot W \cup b \cdot Z) \cup \varepsilon$$

$$= abW \cup abZ \cup \varepsilon$$

Arbeits  
Lemma  $(ab)^*(abW \cup \varepsilon)$

$$= (ab)^* abW \cup ab^*$$

$$Y = b \cdot Y \cup aW \cup bZ$$

$$= b^*(aW \cup bZ)$$

$$= b^*(aW \cup b((ab)^* abW \cup (ab)^*))$$

$$= b^* aW \cup b b^* (ab)^* abW \cup b^* b (ab)^*$$

$$W = b b^* aW \cup b b b^* (ab)^* abW \cup b b b^* (ab)^*$$

$$= (b b^* a \cup b b b^* (ab)^* ab) W \cup b b b^* (ab)^*$$

$$= (b b^* a \cup b b b^* (ab)^* ab)^* b b b^* (ab)^*$$

Aufgabe 4

$$C) Y = b.Y \cup a.W \cup b.Z$$

$$= b^*(a.W \cup b.Z)$$

$$= b^*a.W \cup b^*b.Z$$

$$W = b.(b^*a.W \cup b^*b.Z)$$

$$= bb^*a.W \cup bb^*b.Z$$

$$= (bb^*a)^*bb^*b.Z$$

$$X = b \underbrace{(bb^*a)^*bb^*b.Z \cup b.Z}_x$$

$$Z = a \underbrace{(bb^*a)^*bb^*b.Z \cup b.Z} \cup \epsilon$$

$$= (ab(bb^*a)^*bb^*b \cup ab)Z \cup \epsilon$$

$$= (ab(bb^*a)^*bb^*b \cup ab)^* \epsilon$$

