

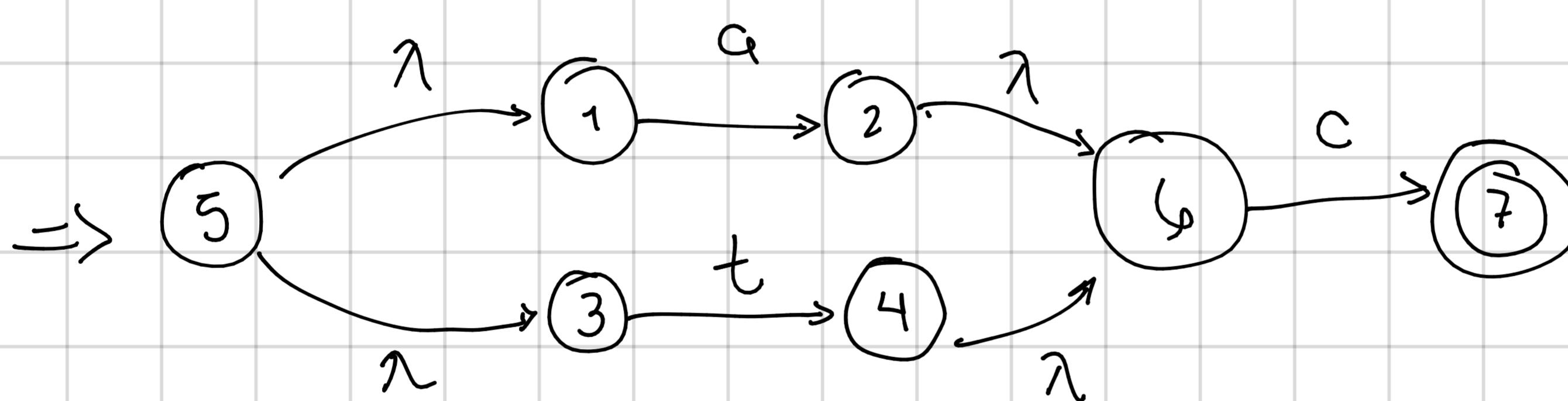
Ejercicio No. 1 (25%) – Convierta las siguientes expresiones regulares en autómatas finitos deterministas (para ello deberá primero convertir las expresiones regulares a AFN y luego convertir a AFD). Muestre todo su procedimiento, i.e., AFN construido con Thompson, tabla de transición, conversión a AFD. Para el inciso g, interprete \ como un escape de carácter, i.e., \\\ significa que su regex reconoce el carácter (.

- a) $(a|t)c$
- b) $(a|b)^*$
- c) $(a^*|b^*)^*$
- d) $((\varepsilon|a)|b^*)^*$
- e) $(a|b)^*abb(a|b)^*$
- f) $0?(1?)?0^*$
- g) $if\\([ae]+\\)\\{[ei]+\\}(\\n(else\\{[jl]+\\}))?$
- h) $[ae03] + @ [ae03] + .(com|net|org).(gt|cr|co)?$

a) $(a|t)c$

AFN

a | t



AFN

$$\Sigma = \{a, t, c\}$$

$$S_0 = \text{\textit{\epsilon-closure}}(\{S_0\}) = \{1, 3, 5\}$$

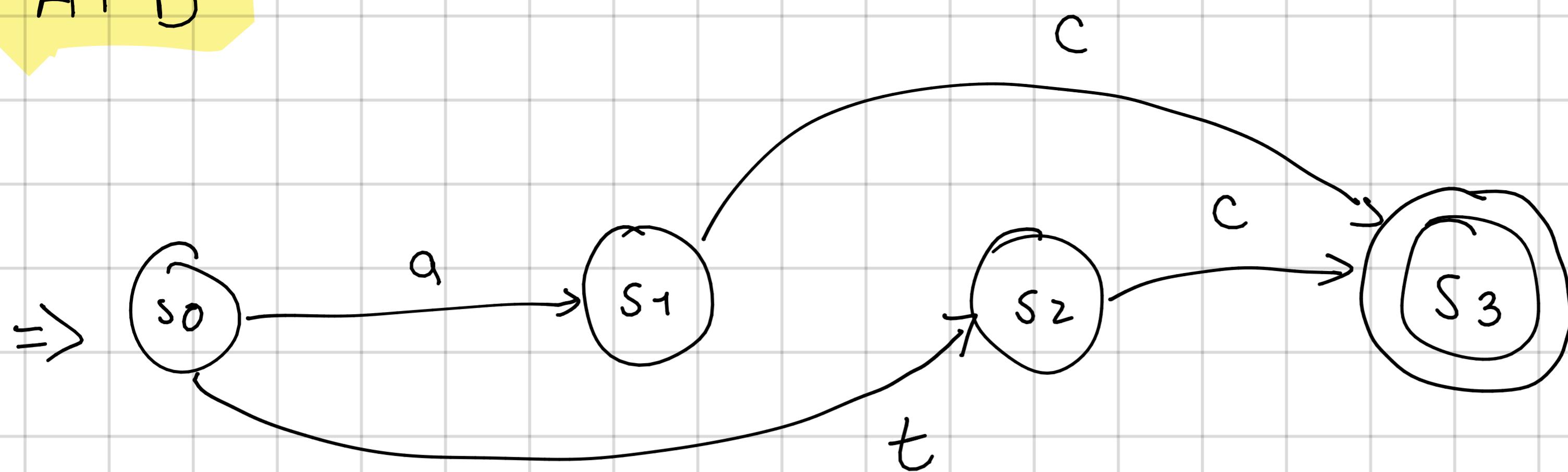
$$S_1 = \text{\textit{\epsilon-closure}}(f(S_0, a)) = \text{\textit{\epsilon-cl}}(\{2\}) = \{2\}$$

$$S_2 = \text{\textit{\epsilon-cl}}(f(S_0, t)) = \text{\textit{\epsilon-cl}}(\{4\}) = \{4\}$$

$$S_3 = \text{\textit{\epsilon-closure}}(f(S_1, c)) = \text{\textit{\epsilon-cl}}(\{7\}) = \{7\}$$

$$\text{\textit{\epsilon-closure}}(f(S_2, c)) = \text{\textit{\epsilon-cl}}(\{7\}) = S_3$$

AFD



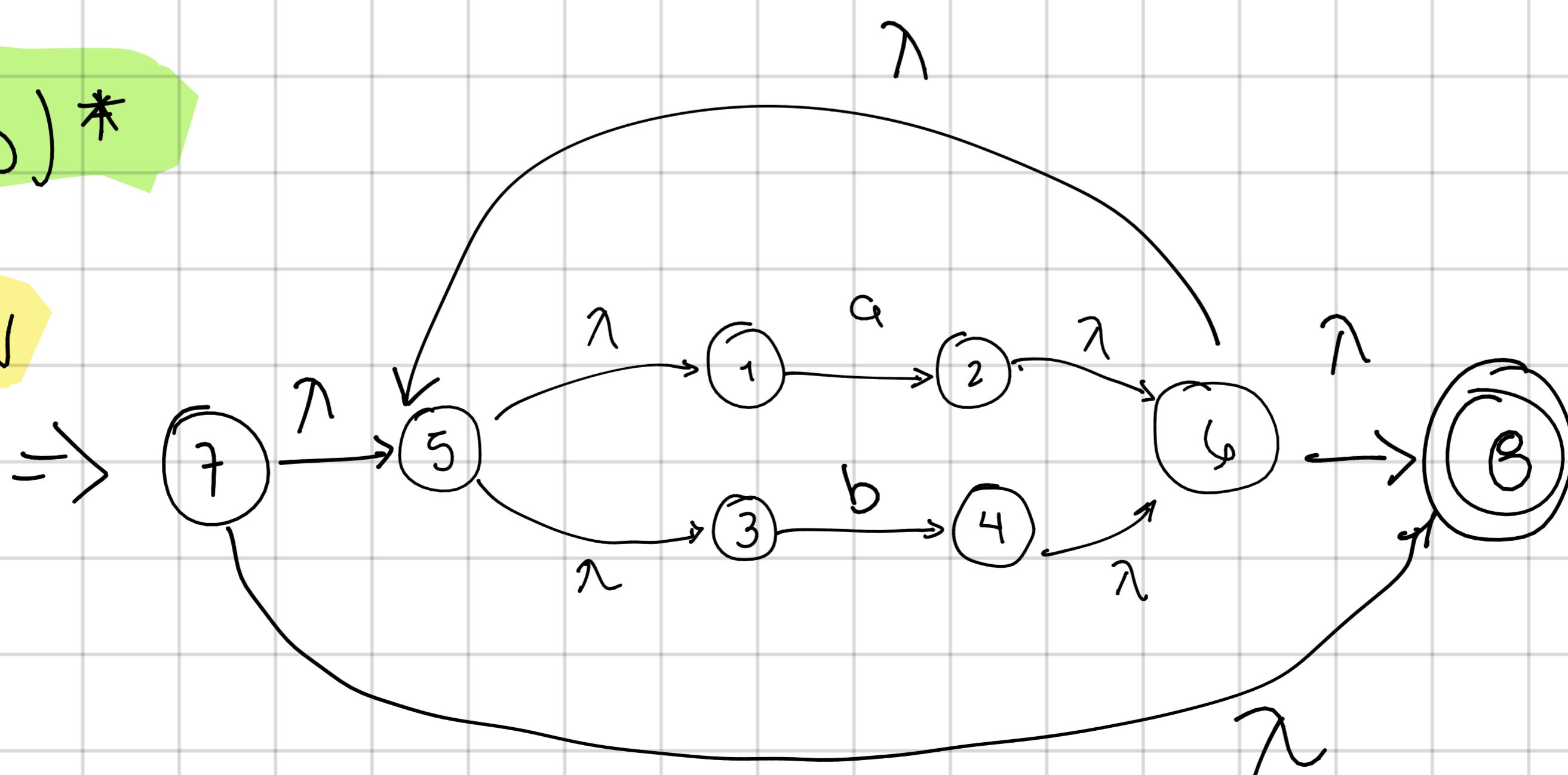
$$\pi_0 = \left\{ \{S_0, S_1, S_2\}, \{S_3\} \right\}$$

Tabla de Transiciones

	a	t	c
S_0	S_1	S_2	
S_1			S_3
S_2			S_3
S_3			

b) $(a|b)^*$

AFN



$$\Sigma = \{a, b\}$$

$$S_0 = \text{E-cl}(\{7\}) = \{7, 5, 1, 3, 8\}$$

$$S_1 = \text{E-cl}(f(S_0, a)) = \text{E-cl}(\{2\}) = \{2, 4, 8, 5, 1, 3\}$$

$$S_2 = \text{E-cl}(f(S_0, b)) = \text{E-cl}(\{4\}) = \{4, 6, 8, 5, 1, 3\}$$

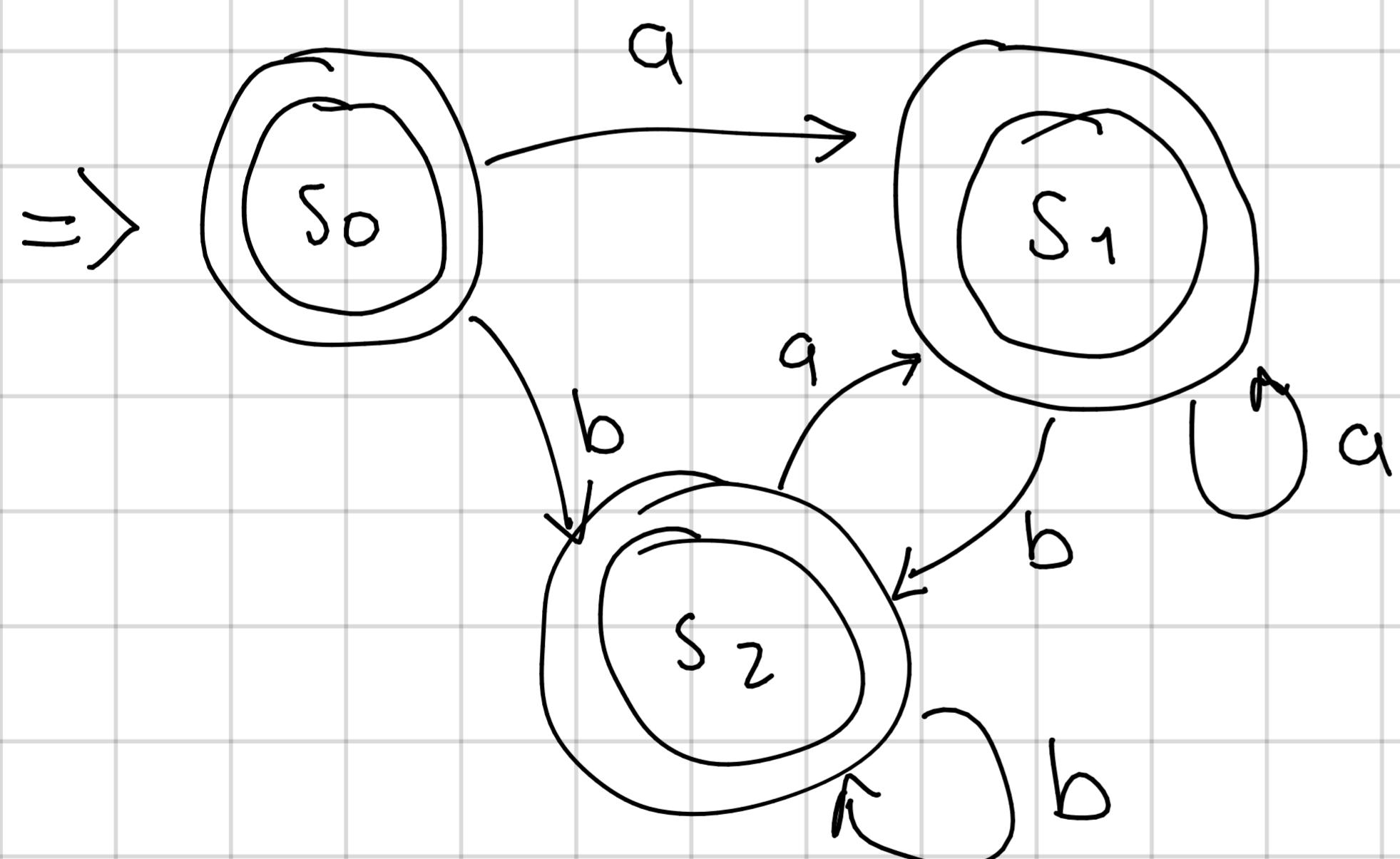
$$= \text{E-cl}(f(S_1, a)) = \text{E-cl}(\{2\}) = S_1$$

$$= \text{E-cl}(f(S_1, b)) = \text{E-cl}(\{4\}) = S_2$$

$$= \text{E-cl}(f(S_2, a)) = \text{E-cl}(\{2\}) = S_1$$

$$\text{E-cl}(f(S_2, b)) = \text{E-cl}(\{4\}) = S_2$$

AFD

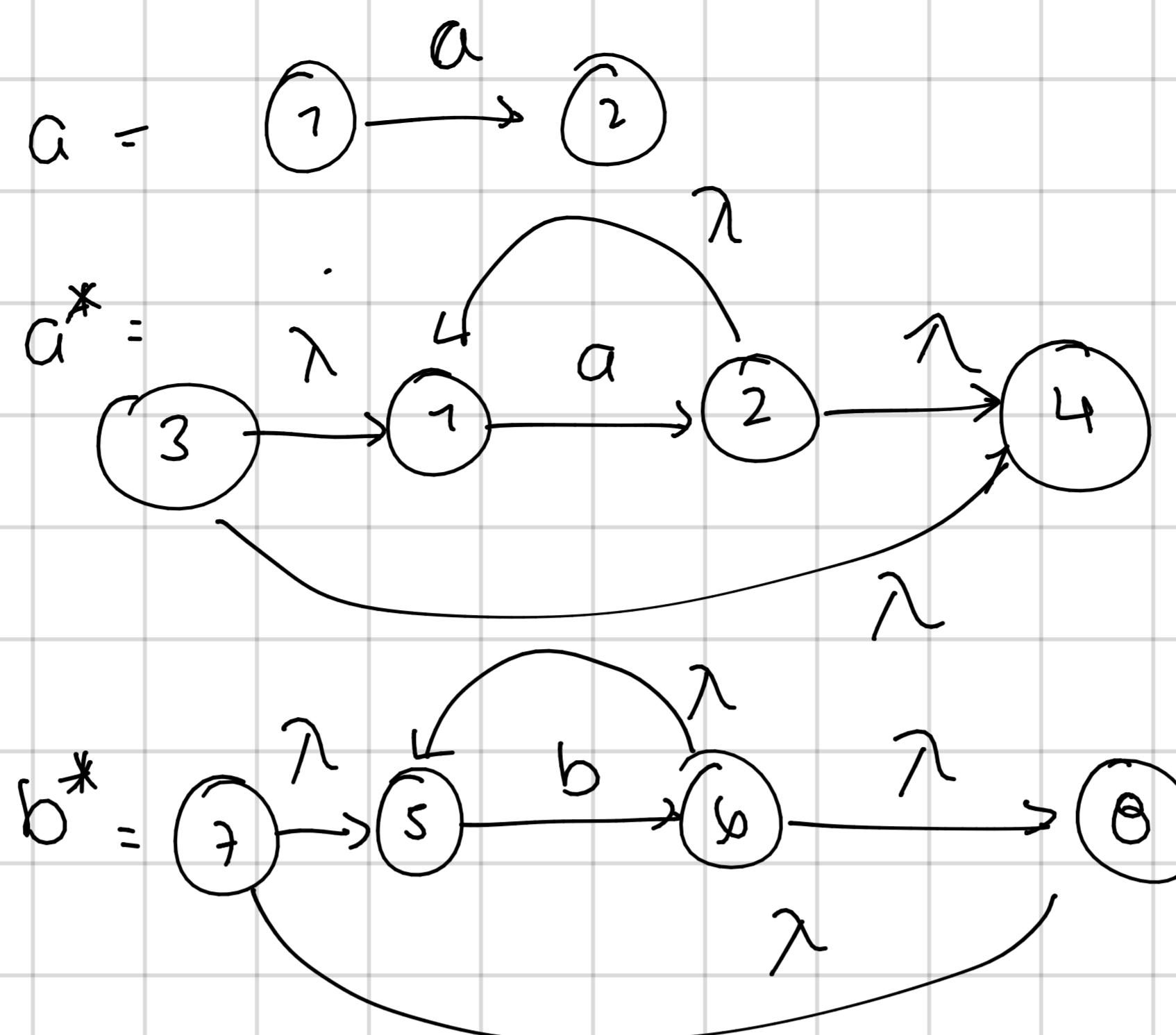


Tabla

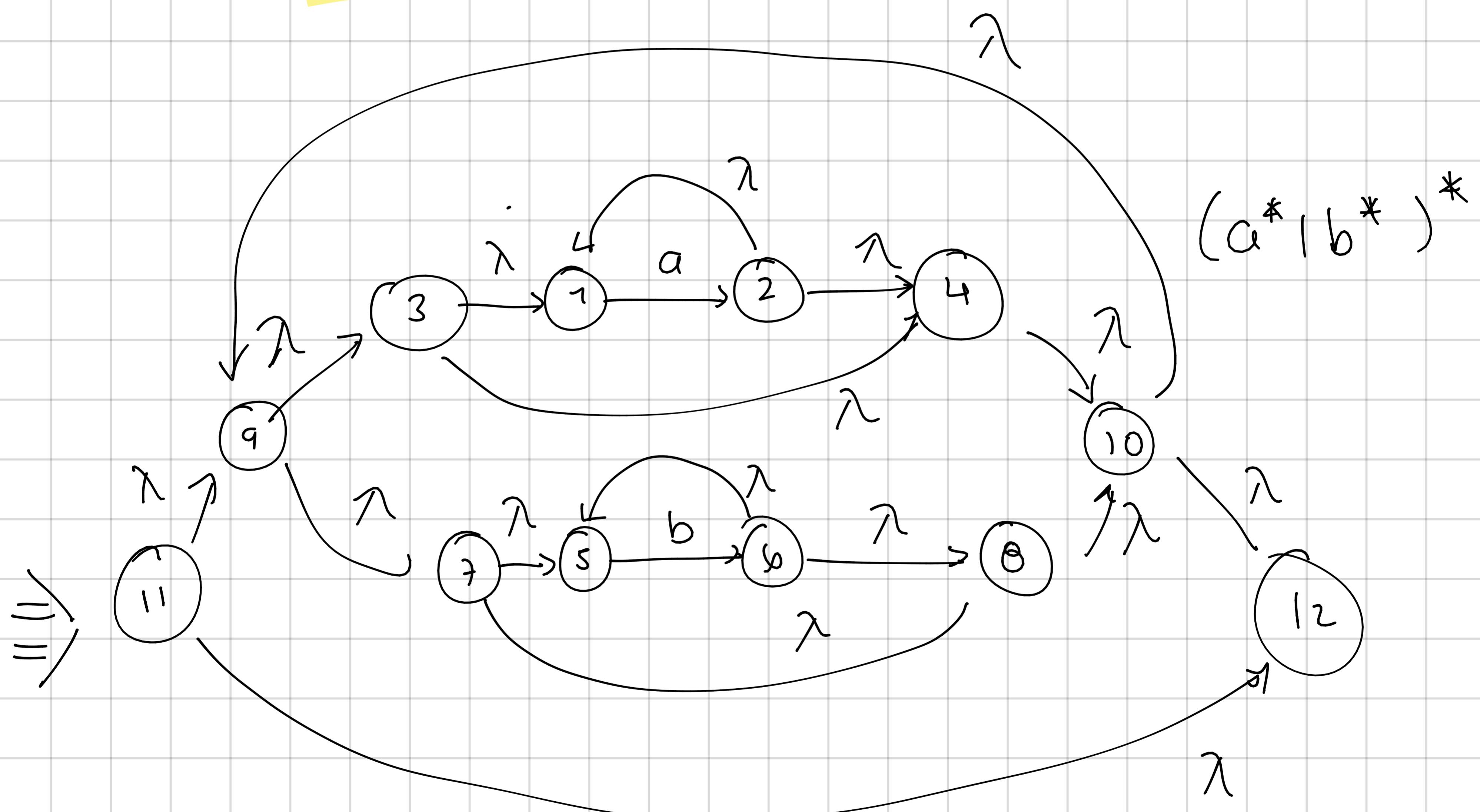
	a	b
S0	S1	S2
S1	S1	S2
S2	S1	S2

$\pi_0 \{ \{S_0, S_1, S_2\} \}$

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



AFN



$$\Sigma = \{a, b\}$$

$$S_0 = \text{E-cl}(\{11\}) = \{11, 9, 3, 1, 4, 10, 7, 0, 12, 5\}$$

$$S_1 = \text{E-cl}(f(S_0, a)) = \text{E-cl}(\{2\}) = \{2, 4, 10, 12, 9, 3, 1, 4, 7, 5, 8, 12\}$$

$$S_2 = \text{E-cl}(f(S_0, b)) = \text{E-cl}(\{4\}) = \{4, 5, 8, 10, 9, 3, 1, 4, 7, 12\}$$

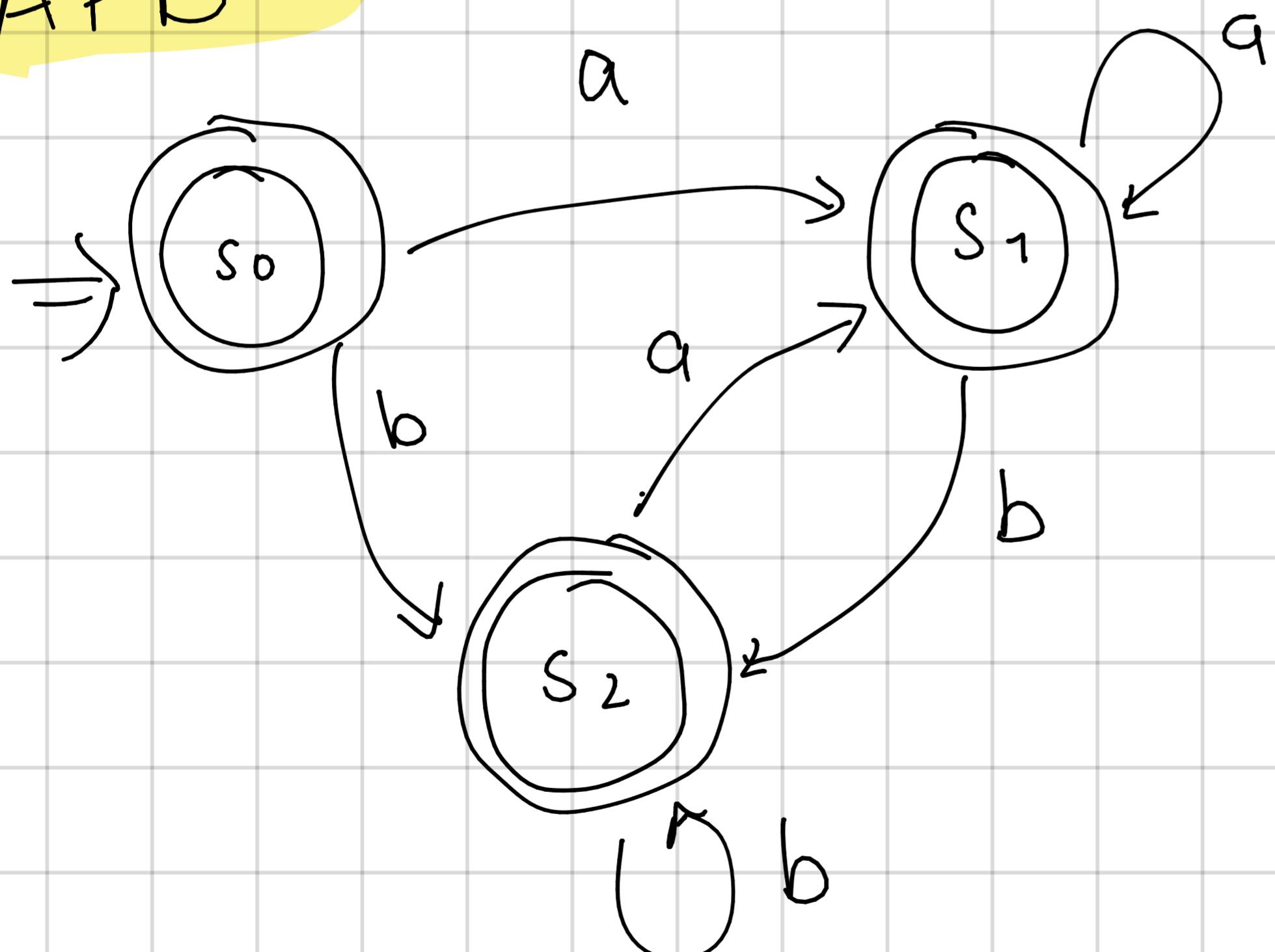
$$= \text{E-cl}(f(S_1, a)) = \text{E-cl}(\{2\}) = S_1$$

$$\text{E-cl}(f(S_1, b)) = \text{E-cl}(\{4\}) = S_2$$

$$\text{E-cl}(f(S_2, a)) = \text{E-cl}(\{2\}) = S_1$$

$$\text{E-cl}(f(S_2, b)) = \text{E-cl}(\{4\}) = S_2$$

AFD



Tabla

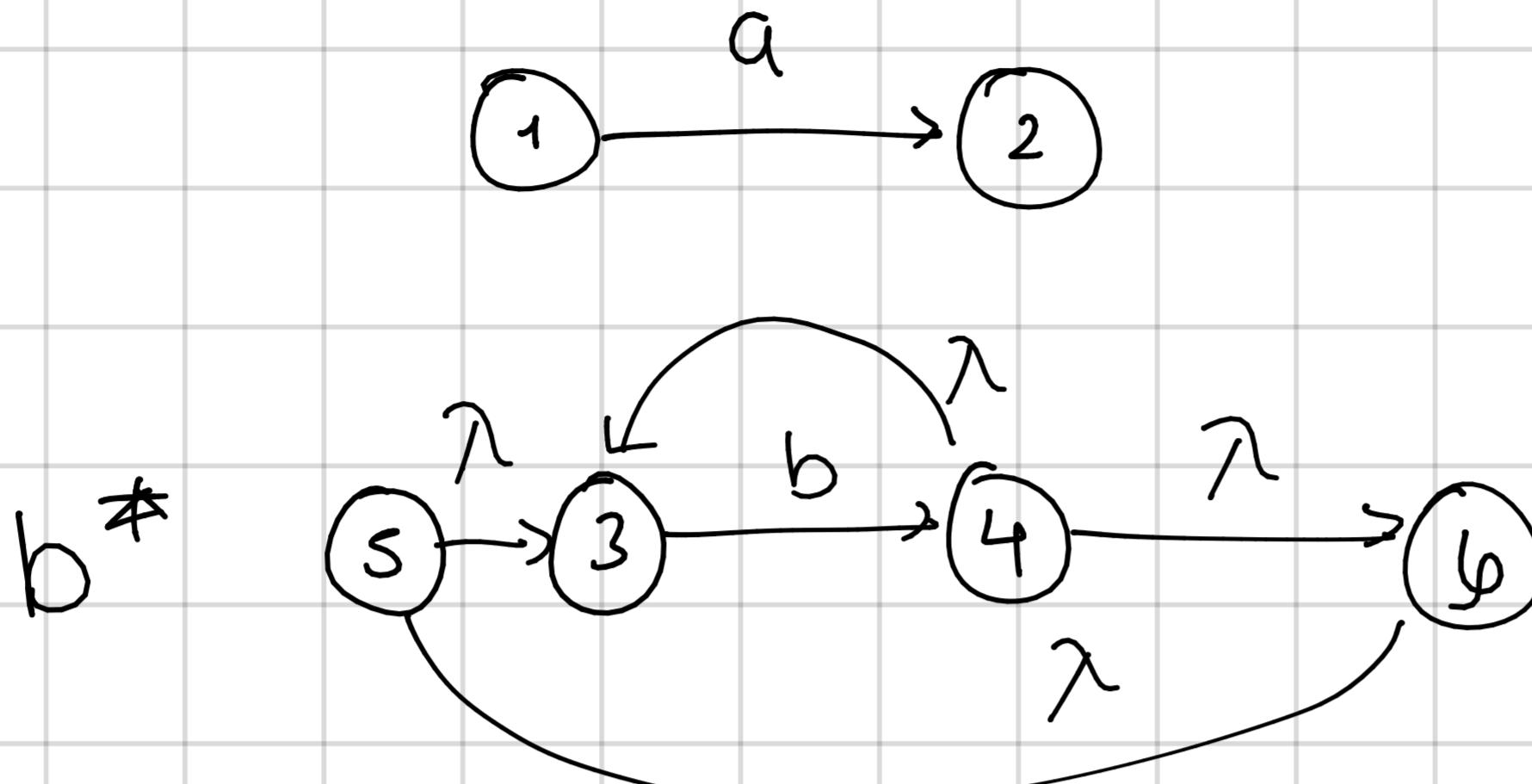
	a	b
S0	S1	S2
S1	S1	S2
S2	S1	S2

$$(a^* | b^*)^*$$

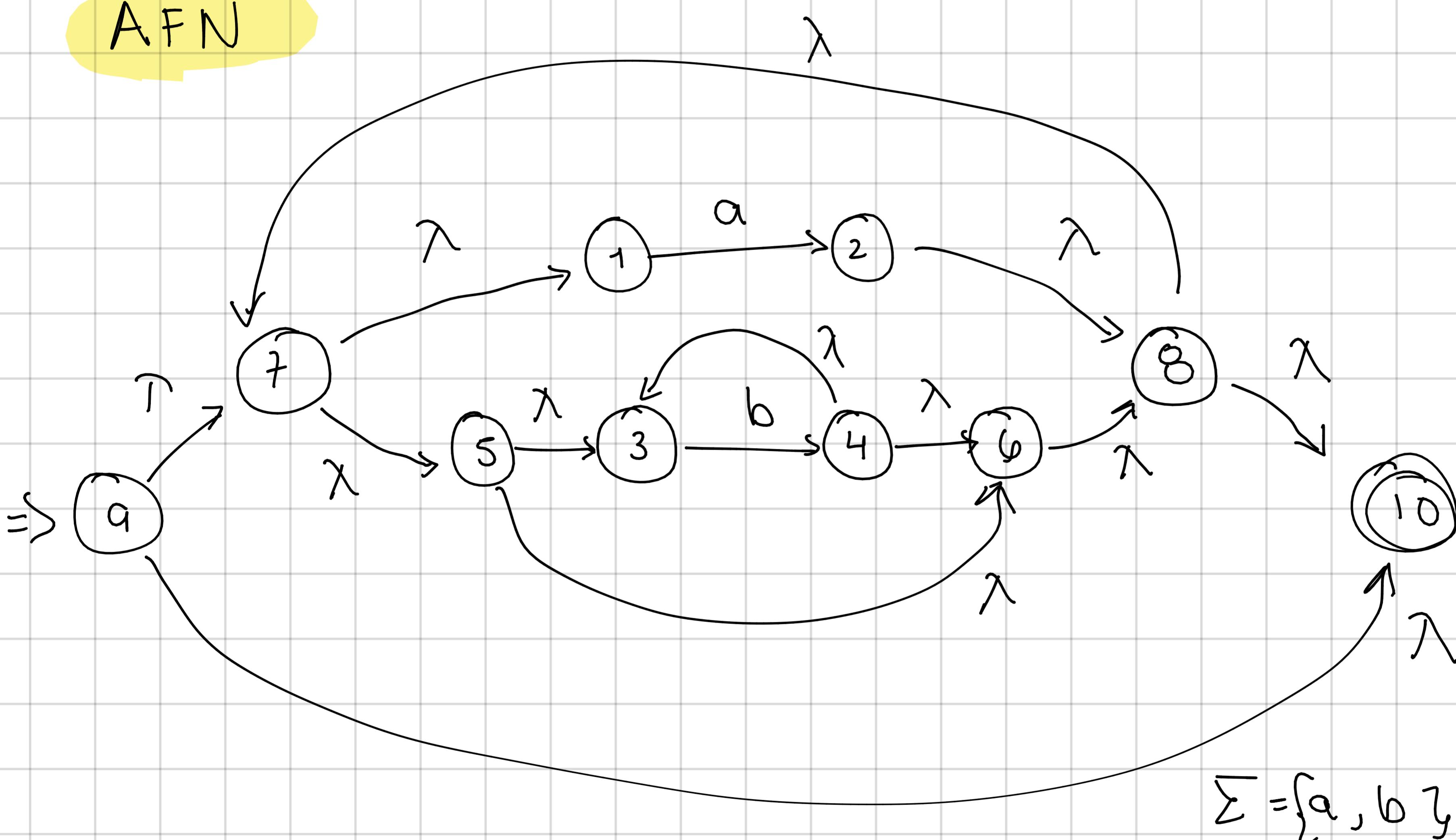
$\pi_0 \{ \{S_0, S_1, S_2\} \}$

d) $((\epsilon \mid a) \mid b^*)^*$

$(a \mid b^*)^*$



AFN



$$S_0 = \text{E-cl}(\{9\}) = \{10, 7, 5, 1, 3, 4, 8, 9\}$$

$$S_1 = \text{E-cl}(f(S_0, a)) = \text{E-cl}(\{2\}) = \{2, 8, 10, 7, 1, 5, 4, 3\}$$

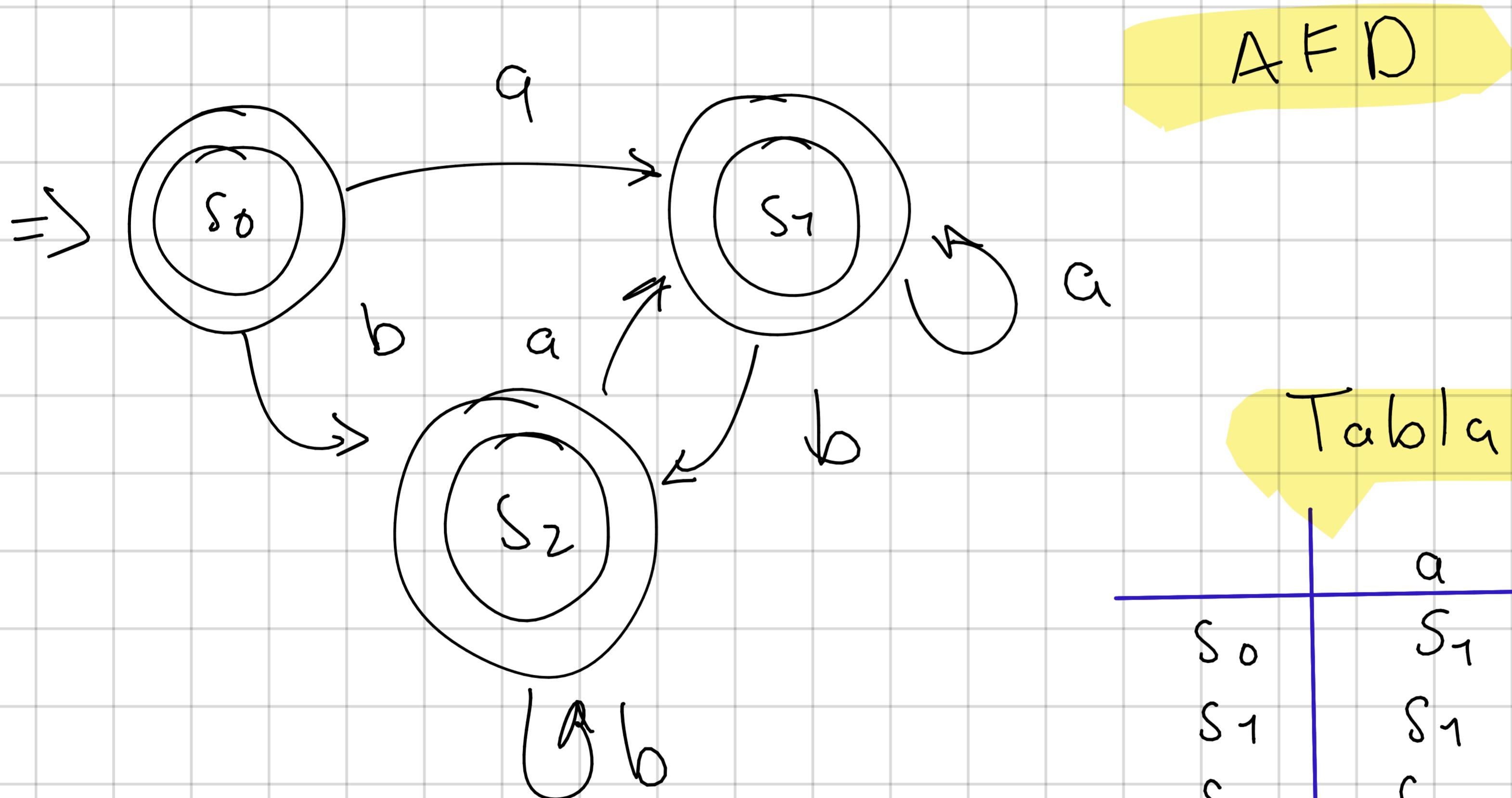
$$S_2 = \text{E-cl}(f(S_0, b)) = \text{E-cl}(\{4\}) = \{4, 8, 10, 7, 1, 5, 3, 4\}$$

$$= \text{E-cl}(f(s_1, a)) = \text{E-cl}(\{2\}) = s_1$$

$$\text{E-cl}(f(s_1, b)) = \text{E-cl}(\{4\}) = s_2$$

$$\text{E-cl}(f(s_2, a)) = \text{E-cl}(\{2\}) = s_1$$

$$\text{E-cl}(f(s_2, b)) = \text{E-cl}(\{4\}) = s_2$$



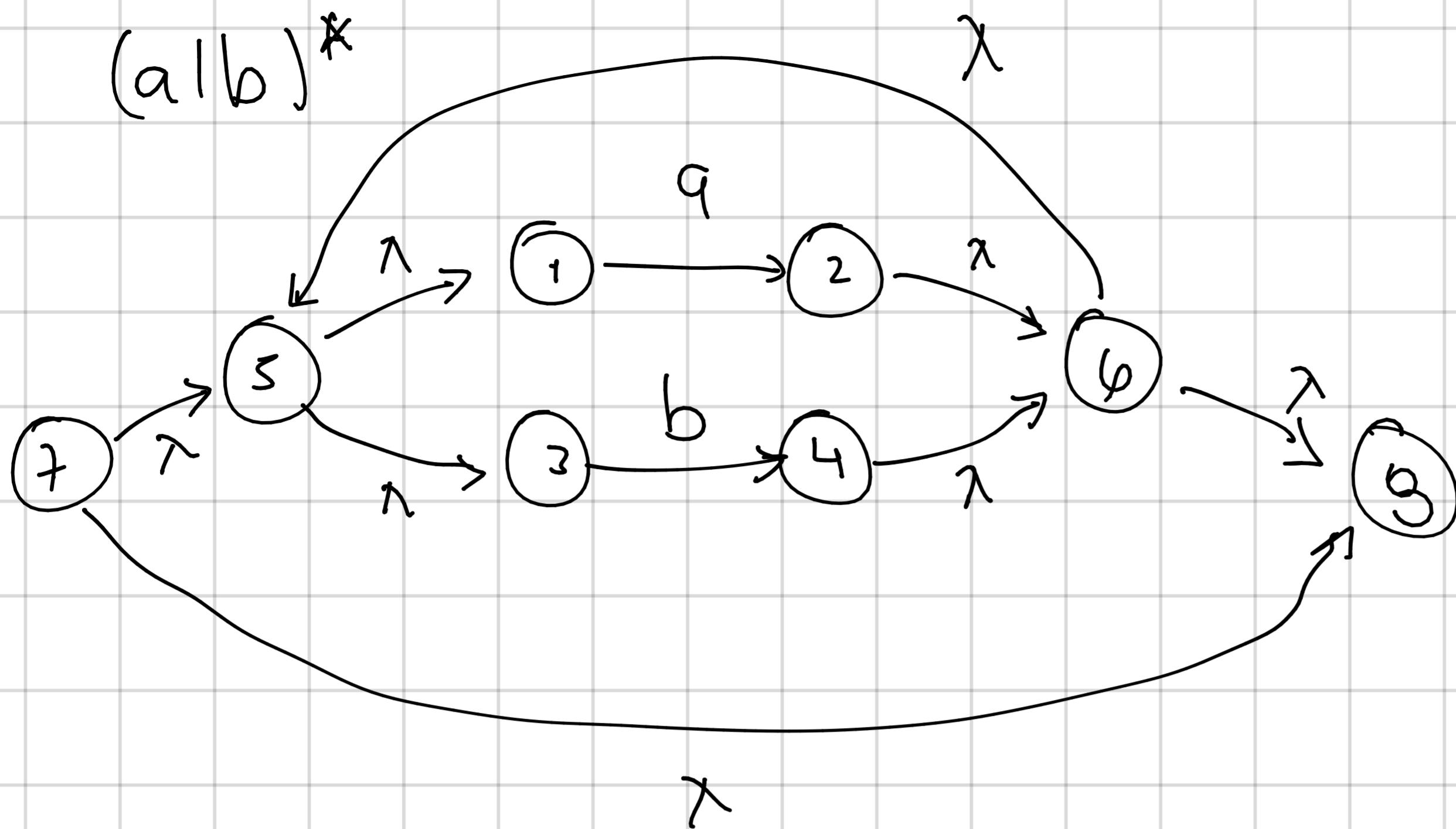
Tabla

	a	b
s0	s1	s2
s1	s1	s2
s2	s1	s2

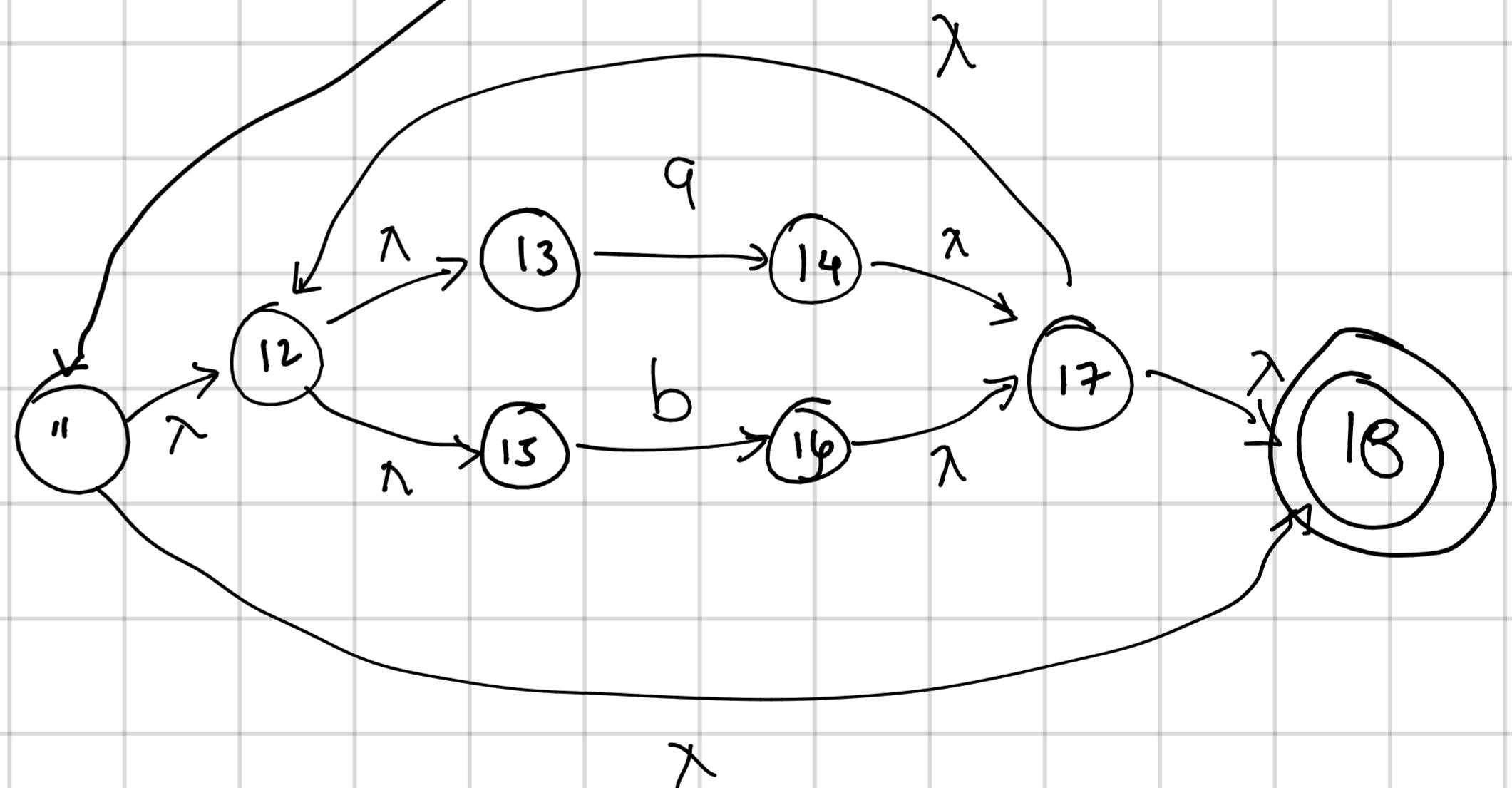
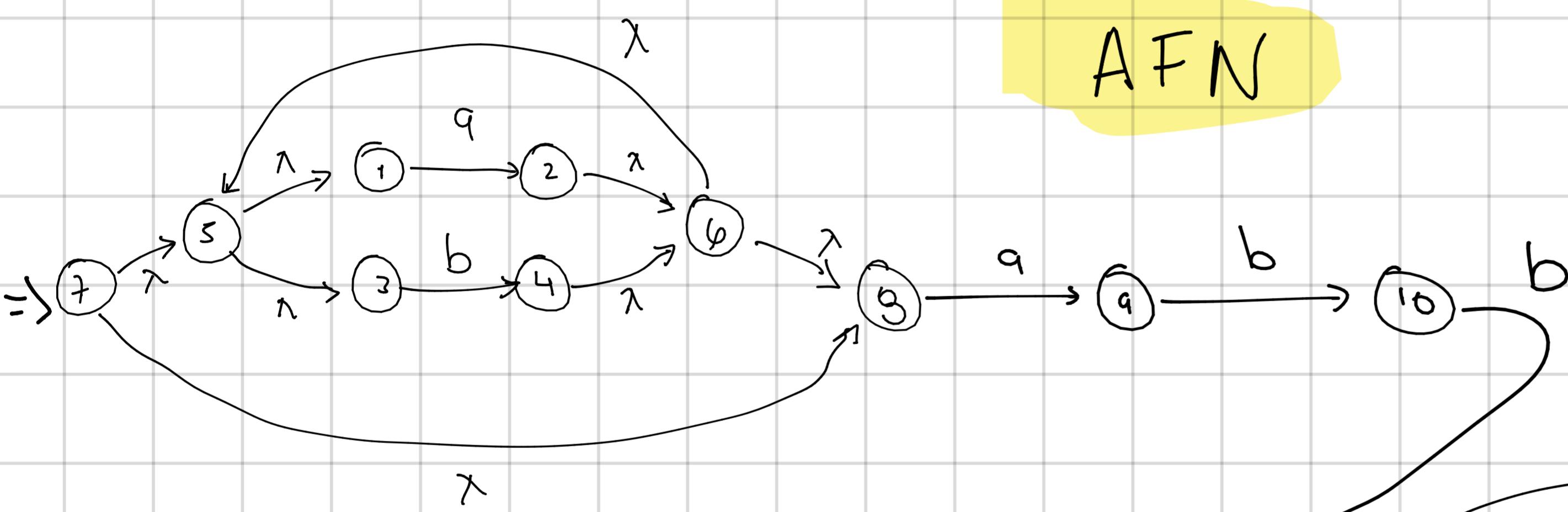
$\pi_0 \{ \{s_0, s_1, s_2\} \}$

$(a \mid b^*)^*$

e) $(a \mid b)^* \text{ abb } (a \mid b)^*$



AFN



$$\Sigma = \{a, b\}$$

$$\Sigma = \{a, b\}$$

$$S_0: \text{E-cl}(\{7\}) = \{7, 8, 5, 1, 3\}$$

$$S_1: \text{E-cl}(f(S_0, a)) = \text{E-cl}(\{2, 9\}) = \{3, 4, 5, 1, 3, 6, 9\}$$

$$S_2 = \text{E-cl}(f(S_0, b)) = \text{E-cl}(\{4\}) = \{4, 6, 5, 1, 3, 8\}$$

$$= \text{E-cl}(f(S_1, a)) = \text{E-cl}(\{2, 9\}) = S_1$$

$$S_3 = \text{E-cl}(f(S_1, b)) = \text{E-cl}(\{4, 10\}) = \{4, 6, 5, 1, 3, 8, 10\}$$

$$= \text{E-cl}(f(S_2, a)) = \text{E-cl}(\{2, 9\}) = S_1$$

$$= \text{E-cl}(f(S_2, b)) = \text{E-cl}(\{4\}) = S_2$$

$$= \text{E-cl}(f(S_3, a)) = \text{E-cl}(\{2, 9\}) = S_1$$

$$S_4: \text{E-cl}(f(S_3, b)) = \text{E-cl}(\{11, 4\}) = \{4, 6, 8, 5, 1, 3, 11, 12, 13, 15, 18\}$$

$$S_5: \text{E-cl}(f(S_4, a)) = \text{E-cl}(\{2, 14, 9\}) = \{4, 6, 8, 5, 1, 3, 14, 17, 18, 12, 13, 15, 9, 2\}$$

$$S_6: \text{E-cl}(f(S_4, b)) = \text{E-cl}(\{4, 16\}) = \{4, 6, 8, 5, 1, 3, 16, 17, 18, 12, 13, 15\}$$

$$= \text{E-cl}(f(S_5, a)) = \text{E-cl}(\{2, 14, 9\}) = S_5$$

$$S_7: \text{E-cl}(f(S_5, b)) = \text{E-cl}(\{4, 10, 14\}) = \{4, 6, 8, 5, 1, 3, 10, 14, 17, 18, 12, 13, 15\}$$

$$= \text{E-cl}(f(S_6, a)) = \text{E-cl}(\{2, 9, 14\}) > S_5$$

$$= \mathcal{E}\text{-d}(f(S_6, b)) = \mathcal{E}\text{-d}(\{4, 14\}) = S_4$$

$$= \mathcal{E}\text{-d}(f(S_7, a)) = \mathcal{E}\text{-d}(\{2, 9, 14\}) = S_5$$

S8

$$= \mathcal{E}\text{-d}(f(S_7, b)) = \mathcal{E}\text{-d}(\{4, 11, 14\}) = \{4, 6, 8, 5, 1, 3, 11, 12, 13, 15, 18, 17, 16\}$$

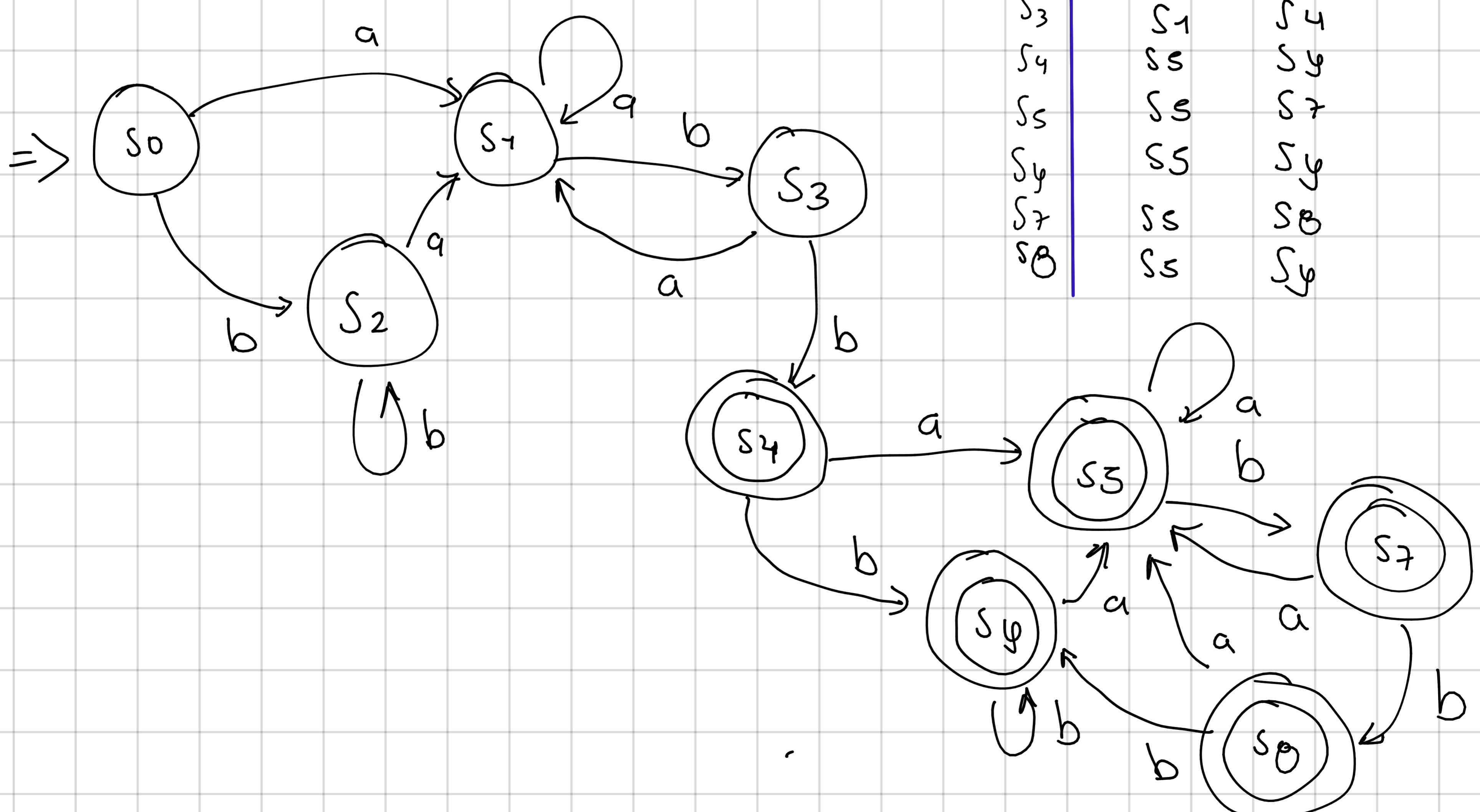
$$\mathcal{E}\text{-d}(f(S_8, a)) = \mathcal{E}\text{-d}(\{2, 9, 14\}) = S_5$$

$$\mathcal{E}\text{-d}(f(S_8, b)) = \mathcal{E}\text{-d}(\{4, 14\}) = S_4$$

Tablas

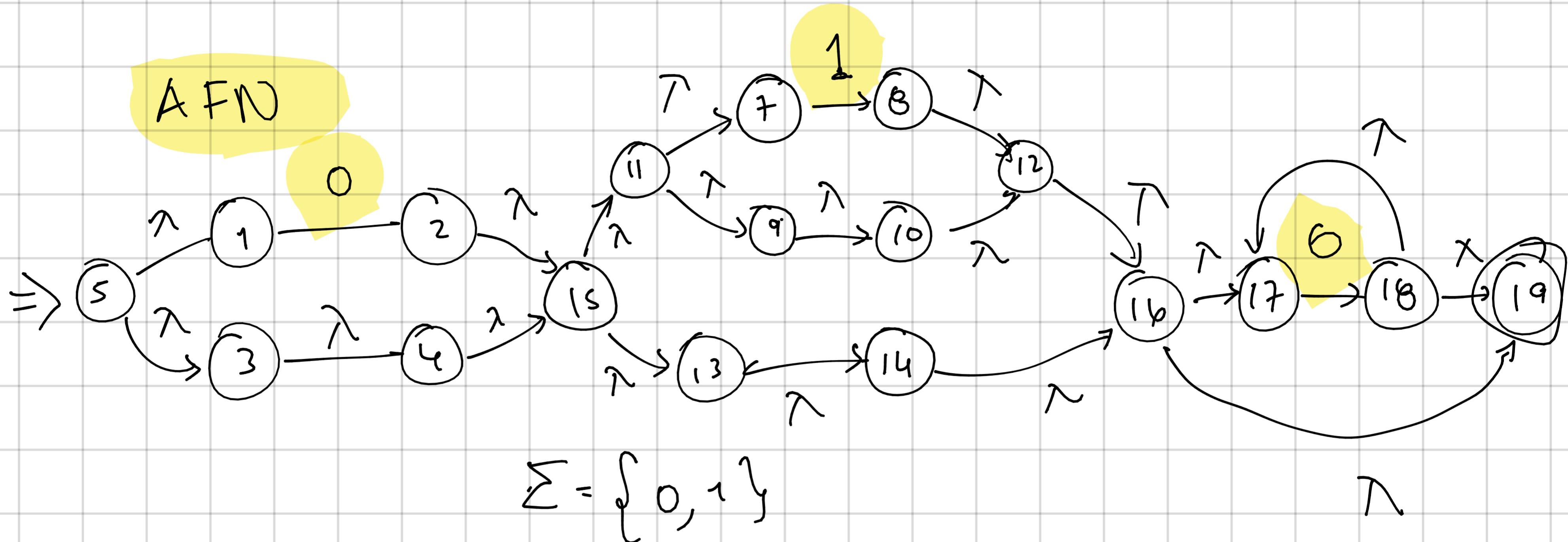
	a	b
S ₀	S ₁	S ₂
S ₁	S ₁	S ₃
S ₂	S ₁	S ₂
S ₃	S ₁	S ₄
S ₄	S ₅	S ₄
S ₅	S ₅	S ₇
S ₆	S ₅	S ₆
S ₇	S ₅	S ₈
S ₈	S ₅	S ₄

AFD



f) $0? (1?)? 0^*$

$(0|ε)((1|ε)|ε) 0^*$



$$S_0 = \text{E-cl}(\{s_0\}) = \{s_0, 1, 3, 4, 15, 11, 13, 14, 16, 17, 19, 7, 9, 10, 12, 19\}$$

$$S_1 = \text{E-cl}(f(S_0, 0)) = \text{E-cl}\{s_1\} = \{2, 15, 13, 14, 16, 17, 19, 11, 7, 9, 10, 12, 18\}$$

$$S_2 = \text{E-cl}(f(S_0, 1)) = \text{E-cl}\{s_2\} = \{8, 12, 14, 17, 19\}$$

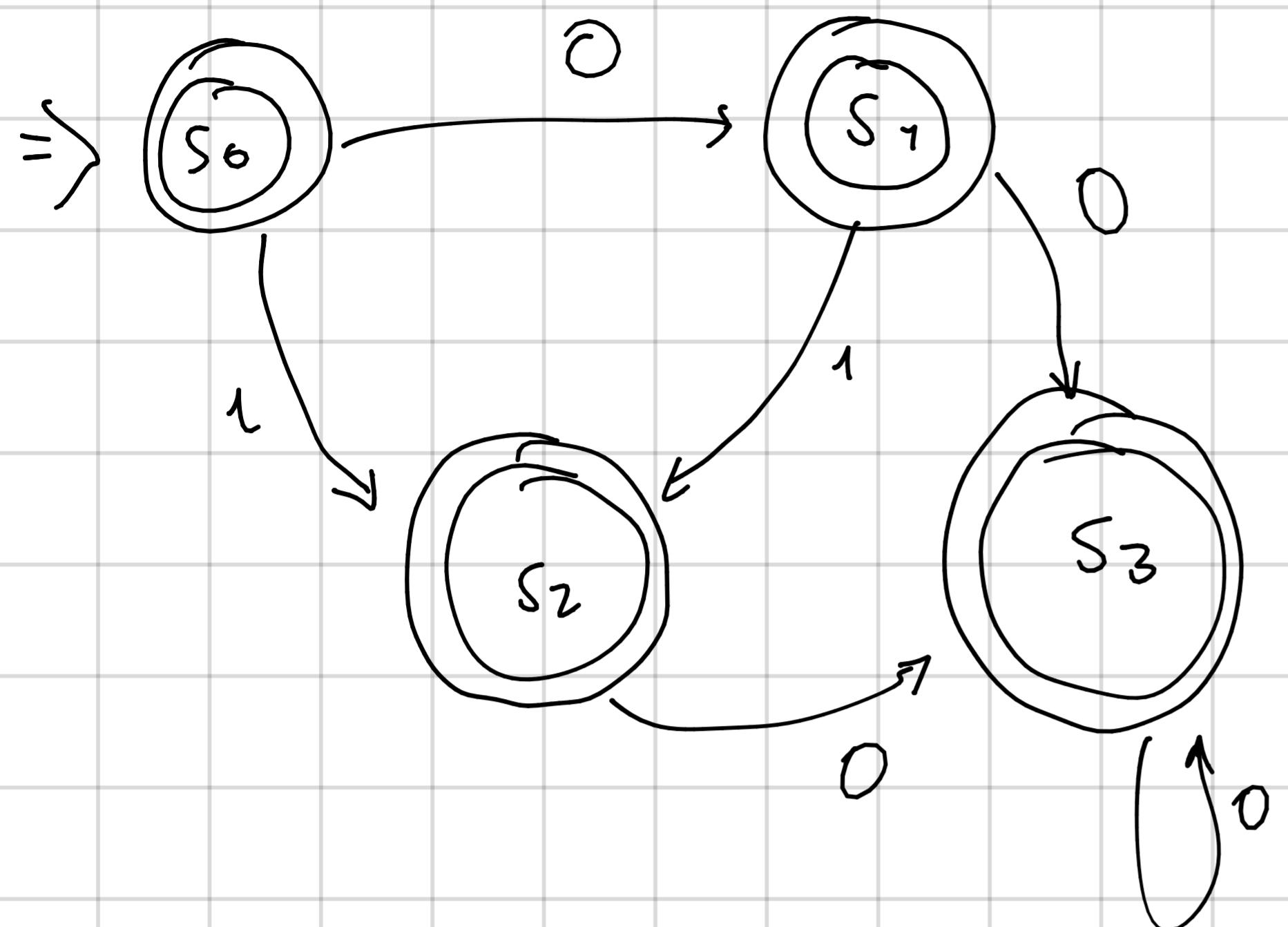
$$S_3 = \text{E-cl}(f(S_1, 0)) = \text{E-cl}\{s_3\} = \{18, 17, 19\}$$

$$= \text{E-cl}(f(S_2, 1)) = \text{E-cl}\{s_4\} = S_2$$

$$= \text{E-cl}(f(S_2, 0)) = \text{E-cl}\{s_5\} = S_3$$

$$= \text{E-cl}(f(S_3, 0)) = \text{E-cl}\{s_6\} = S_3$$

AFD



Tabla

	0	1
S0	S1	S2
S1	S3	S2
S2	S3	
S3	S3	

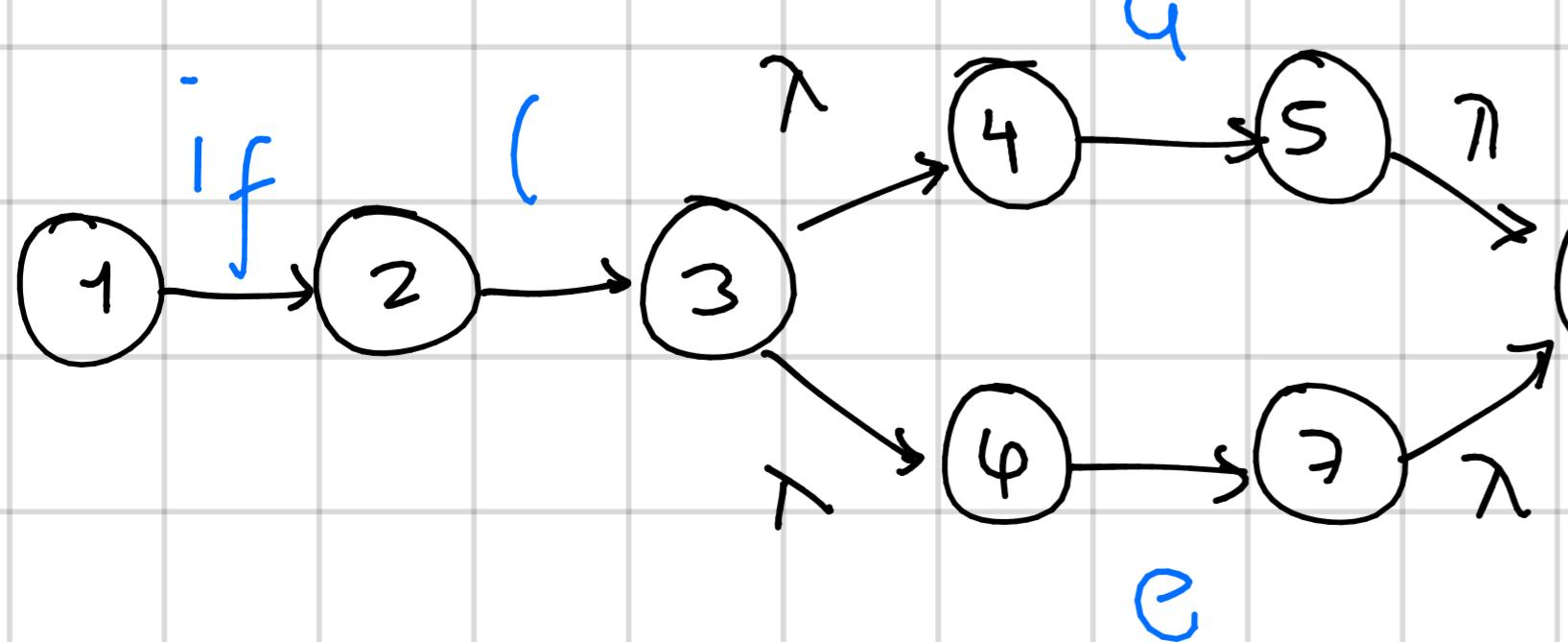
g) if ([ae]+) { [ei]+ } (n(else { [jl]+ })) ?

if ([ae]+) { [ei]+ } (n(else { [jl]+ })) ?

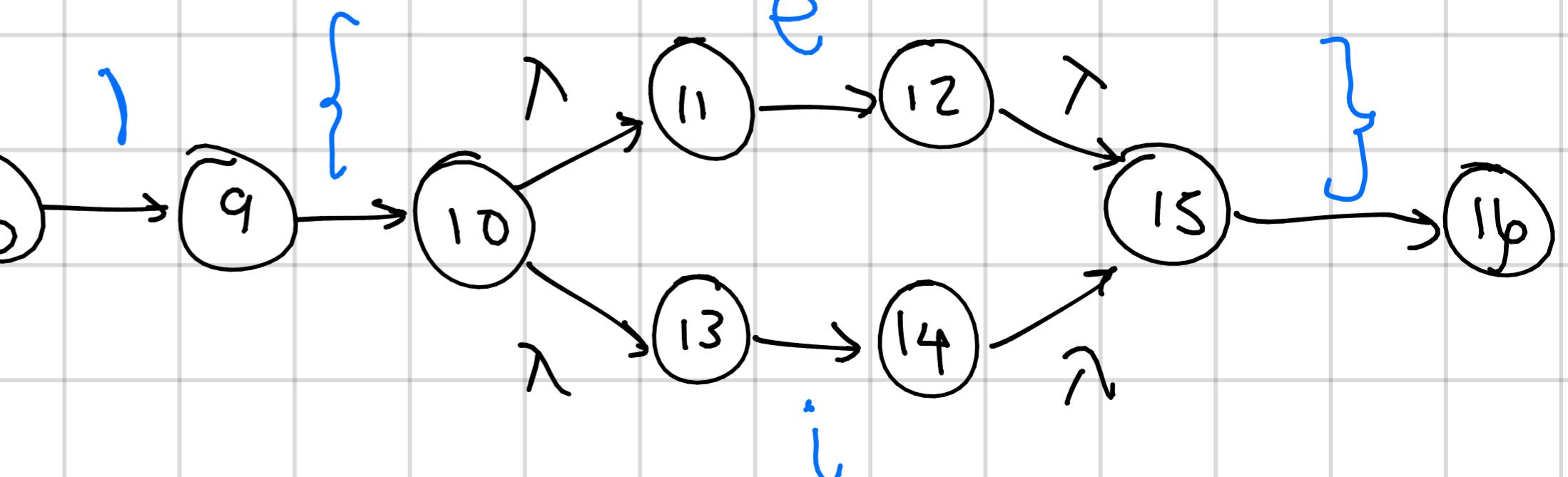
↑ literal ↑ literal

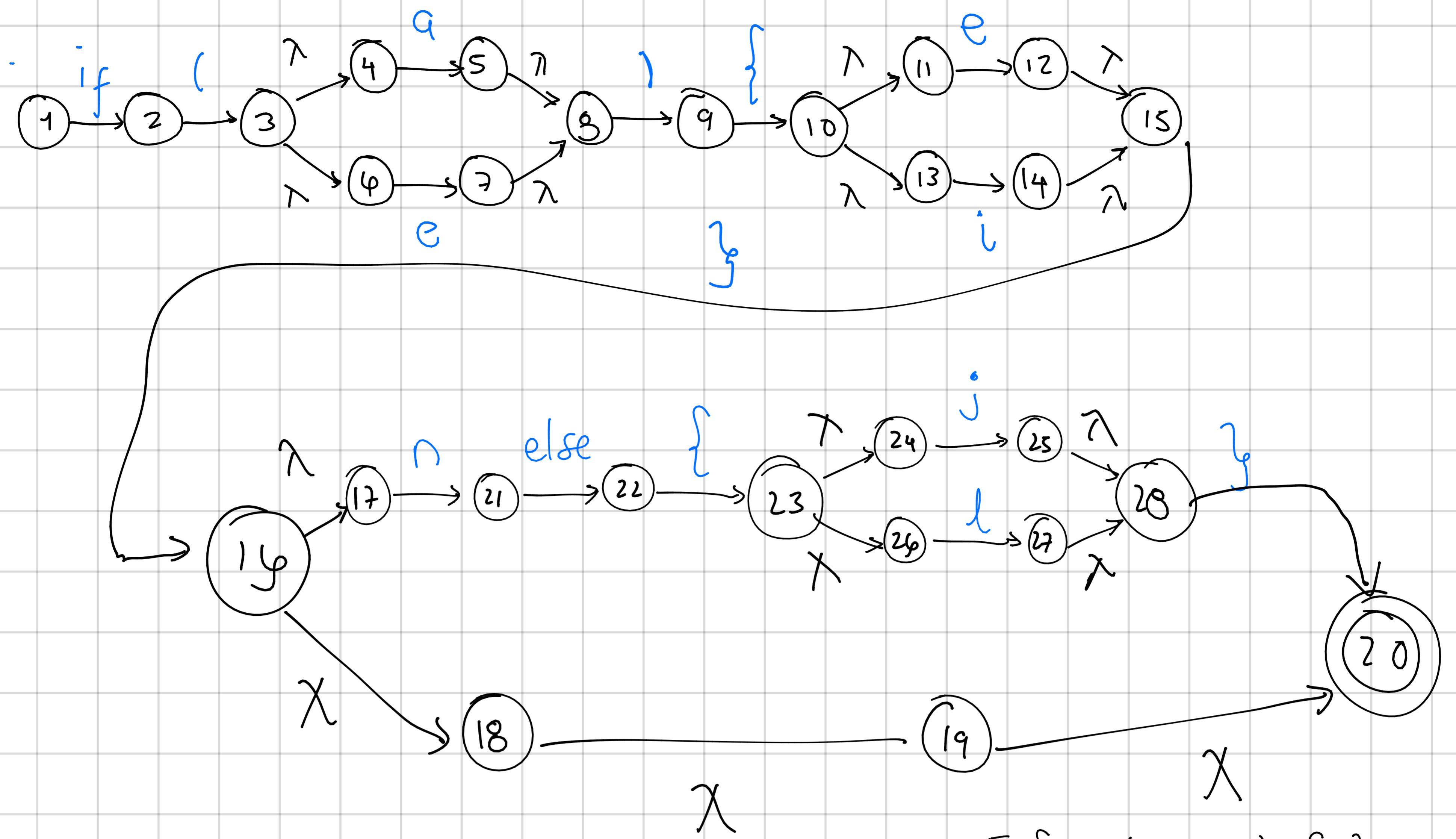
if ((a|e)) { (e|i)} (n(else { (j|l)})) | ε

AFN



if (a|e) { e|i }





$$S_6 \subseteq \mathcal{E} - \{p\} \{1\} = \{1\}$$

$$S_1 = \text{E-cl} \{ f(s_0, i_f) \} = \text{E-cl} \{ 2 \} = \{ 2 \}$$

$$S_2 = E.d \{ f(S_1, \cdot) \} = E.cl \{ 3 \} = \{ 4, 4, 3 \}$$

$$S_3 = \text{E-cl} \{ f(S_2, a) \} = \text{E-cl} \{ 5 \} = \{ 0, 5 \}$$

$$S_4 = \epsilon \cdot cl \{ f(S_2, e) \} = \epsilon \cdot cl \{ f \} = \{ f \}$$

$$S_5 = \mathcal{E}\text{-cl} \left\{ f(S_3, j) \right\} = \mathcal{E}\text{-cl} \left\{ q_j \right\} = \{q\}$$

$$: \quad \text{E-cl} \left\{ f(s_4) \right\}) \} = \text{E-cl} \{ q \} = s_5$$

$$S_y = \text{E-cl} \left\{ f(S_S, \{\}) \right\} = \text{E-cl} \{ \{0\} \} = \{ \{0, 11, 13\} \}$$

$$S_7 = \text{E-cl} \{ f(S_4, e) \} = \text{E-cl} \{ 12 \} = \{ 12, 15 \}$$

$$S_8 = \text{E-cl} \{ f(S_4, i) \} = \text{E-cl} \{ 14 \} = \{ 14, 15 \}$$

$$S_9 = \text{E-cl} \{ f(S_7, y) \} = \text{E-cl} \{ 16 \} = \{ 14, 17, 18, 19, 20 \}$$

$$= \text{E-cl} \{ f(S_8, y) \} = \text{E-cl} \{ 14 \} = S_9$$

$$S_{10} = \text{E-d} \{ f(S_9, n) \} = \text{E-d} \{ 21 \} = \{ 21 \}$$

$$S_{11} = \text{E-cl} \{ f(S_{10}, \text{else}) \} = \text{E-cl} \{ 22 \} = \{ 22 \}$$

$$S_{12} = \text{E-cl} \{ f(S_{11}, \{ \}) \} = \text{E-cl} \{ 23 \} = \{ 23, 24, 24 \}$$

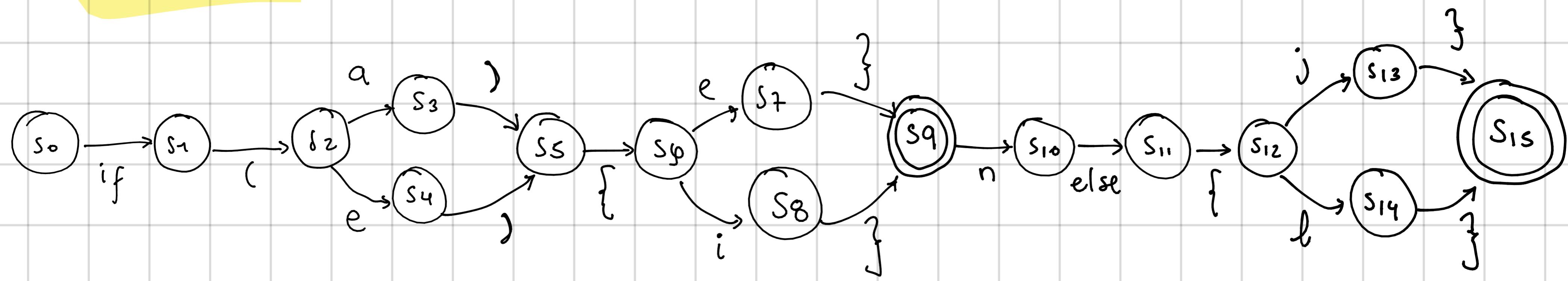
$$S_{13} = \text{E-cl} \{ f(S_{12}, ;) \} = \text{E-cl} \{ 25 \} = \{ 25, 28 \}$$

$$S_{14} = \text{E-d} \{ f(S_{13}, l) \} = \text{E-cl} \{ 27 \} = \{ 27, 28 \}$$

$$S_{15} = \text{E-cl} \{ f(S_{13}, r) \} = \text{E-cl} \{ 20 \} = \{ 20 \}$$

$$\text{E-d} \{ f(S_{14}, y) \} = \text{E-cl} \{ 20 \} = S_{15}$$

AFD



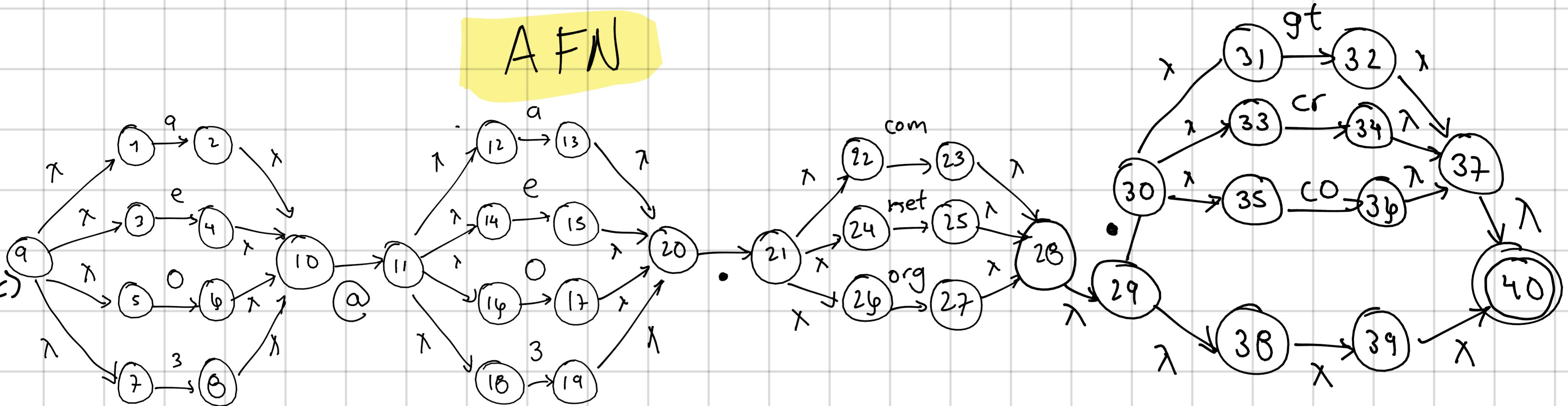
Tablas

if (a e) { i } n else j }

S ₀	S ₁	S ₂	S ₃	S ₄	S ₅	S ₆	S ₇	S ₈	S ₉	S ₁₀	S ₁₁	S ₁₂	S ₁₃	S ₁₄	S ₁₅
----------------	----------------	----------------	----------------	----------------	----------------	----------------	----------------	----------------	----------------	-----------------	-----------------	-----------------	-----------------	-----------------	-----------------

b) [ae03] + @[ae03] + .(com|net|org)(.(gt|cr|co))?

[ae03]+@[ae03].(com|net|org).(gtlcrlco)IE



$$S_0: \text{E-cl}\{q\} \cap \{y = \{1, 3, 5, 7\}\}$$

$$S_1 = E\text{-cl} \{ f(s_0, a) \} = E\text{-cl} \{ 2 \} = \{ 2, 10 \}$$

$$S_2 = E - cl \{ f(s_0, e) \} = E - cl \{ 4 \} = \{ 4, 10 \}$$

$$S_3 = \text{E-cl} \{ f(s_0, 0) \} = \text{E-cl} \{ 4 \} = \{ 4, 10 \}$$

$$S_4 = \varepsilon \cdot cl\{f(S_0, 3)\} = \varepsilon \cdot cl\{B\} = \{B, 10\}$$

$$SS = E - \text{cl}\{f(s_1, @)\} = E - \text{cl}\{1\} = \{11, 12, 14, 15, 18\}$$

$$= E - cl \{ f(s_2, @) \} : E - cl \{ || \} = S_5$$

$$= \epsilon - d \{ f(s_3, @) \} y = \epsilon - d \{ 11 \} y = ss$$

$$= E - d \{ f(s_4, @) \} = E - d \{ 1 + 1 \} = 55$$

$$S_4 = \text{E-d}\{f(S_3, a)\} = \text{E-cl}\{13\} = \{13, 20\}$$

$$S_7 = \text{E-d}\{f(S_5, e)\} = \text{E-d}\{15\} = \{15, 20\}$$

$$S_8 = \text{E-cl}\{f(S_5, o)\} = \text{E-d}\{17\} = \{17, 20\}$$

$$S_9 = \text{E-d}\{f(S_5, 3)\} = \text{E-d}\{19\} = \{19, 20\}$$

$$S_{10} = \text{E-d}\{f(S_4, \circ)\} = \text{E-d}\{21\} = \{21, 22, 24, 26\}$$

$$\text{E-cl}\{f(S_7, \circ)\} = \text{E-d}\{21\} = S_{10}$$

$$\text{E-d}\{f(S_8, \circ)\} = \text{E-d}\{21\} = S_{10}$$

$$\text{E-d}\{f(S_9, \circ)\} = \text{E-d}\{21\} = S_{10}$$

$$S_{11} = \text{E-d}\{f(S_{10}, \text{com})\} = \text{E-d}\{23\} = \{23, 28, 29, 38, 39, 40\}$$

$$S_{12} = \text{E-d}\{f(S_{10}, \text{net})\} = \text{E-d}\{25\} = \{25, 28, 29, 38, 39, 40\}$$

$$S_{13} = \text{E-d}\{f(S_{10}, \text{org})\} = \text{E-d}\{27\} = \{27, 28, 29, 38, 39, 40\}$$

$$S_{14} = \text{E-d}\{f(S_{11}, \circ)\} = \text{E-d}\{30\} = \{30, 31, 33, 35\}$$

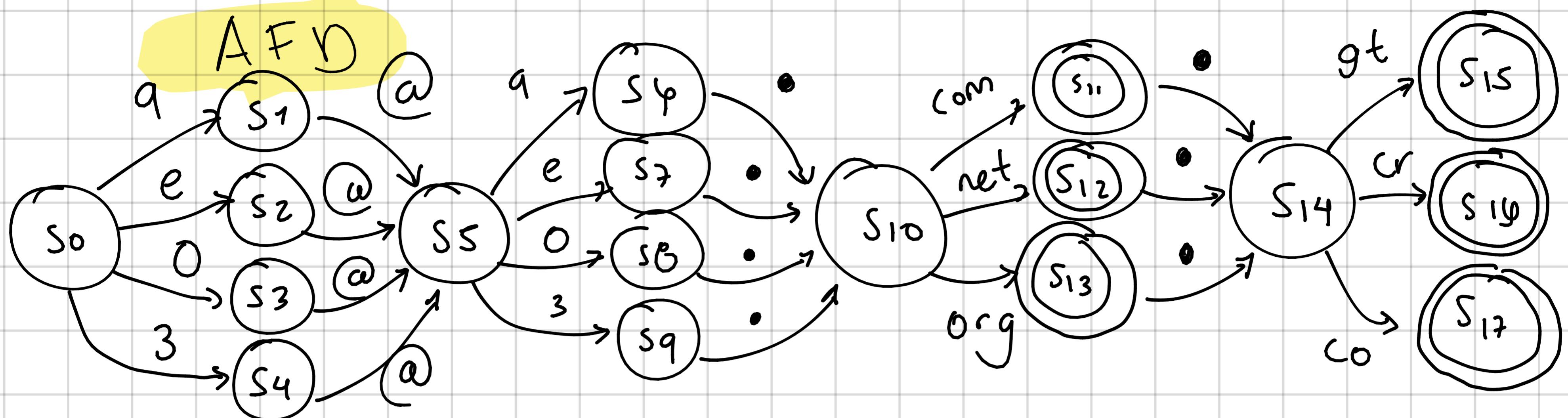
$$= \text{E-d}\{f(S_{12}, \circ)\} = \text{E-d}\{30\} = S_{14}$$

$$= \text{E-d}\{f(S_{13}, \circ)\} = \text{E-d}\{30\} = S_{14}$$

$$S_{15} = \text{E-d}\{f(S_{14}, \text{gt})\} = \text{E-d}\{32\} = \{32, 37, 40\}$$

$$S_{16} = \text{E-d}\{f(S_{14}, \text{cr})\} = \text{E-d}\{34\} = \{34, 37, 40\}$$

$$S_{17} : E - d \{ f(S_{14}, c_0) \} = E - d \{ 34 \} = \{ 34, 37, 40 \}$$



Tablas

	a	e	0	3	@	*	com	net	org	gt	cr	co
S0	S1	S2	S3	S4								
S1					S5							
S2					S5							
S3					S5							
S4					S5							
S5	Sy	S7	S8	S9								
S6						S10						
S7							S10					
S8							S10					
S9							S10					
S10								S11	S12	S13		
S11								S14				
S12								S14				
S13								S14				
S14									S15	S16	S17	