

1. Language theory studies syntax definitions, semantic definitions, and pragmatics to deal with how computations are expressed. Automata theory studies how computations are carried out by building and studying formal models of computational devices. Computability theory studies the limits of computation and answers questions concerning what can and cannot be computed.

Complexity theory studies the required resources for problems like time and memory.

2a. $\{0, 011, 10, 1\}$

2b. $\{10\}$

2c. $\{010, 01, 01110, 0111, 1010, 101\}$

2d. $\{\text{empty string}, 0, 011, 10, 1, 01, 010, 0111, 01110, 1010, \dots\}$

3a. No grammar.

3b. $s \rightarrow x \text{ "2"* } \mid \text{ "0"* } y$

$x \rightarrow \varepsilon \mid \text{ "0" } x \text{ "1" }$

$y \rightarrow \varepsilon \mid \text{ "1" } y \text{ "2" }$

3c. $s \rightarrow (x \text{ "1"})^* x$

$x \rightarrow \text{ "00" } \mid \text{ "0" } \mid \varepsilon$

3d. $s \rightarrow x^*$

$x \rightarrow \text{ "b" } x \text{ "a" } x \text{ "a" } \mid \text{ "a" } x \text{ "b" } x \text{ "a" } \mid \text{ "a" } x \text{ "a" } x \text{ "b" }$

3e. $s \rightarrow (\text{ "a" }^1 \text{ "b" }^2 \text{ "a" }^3 \text{ "b" })^?$

$\text{ "a" }^1 \rightarrow \text{ "aa" }^1 x$

$$x \text{ “b”} \rightarrow \text{“b” } x$$

$$x^2 \rightarrow \text{“b” }^2 x$$

$$x \text{ “a”} \rightarrow \text{“a” } x$$

$$x^3 \rightarrow \text{“a” }^3 \text{ “b”}$$

$$1 \rightarrow \varepsilon$$

$$2 \rightarrow \varepsilon$$

$$3 \rightarrow \varepsilon$$

$$4. (\{n, x, f, y, d\},$$

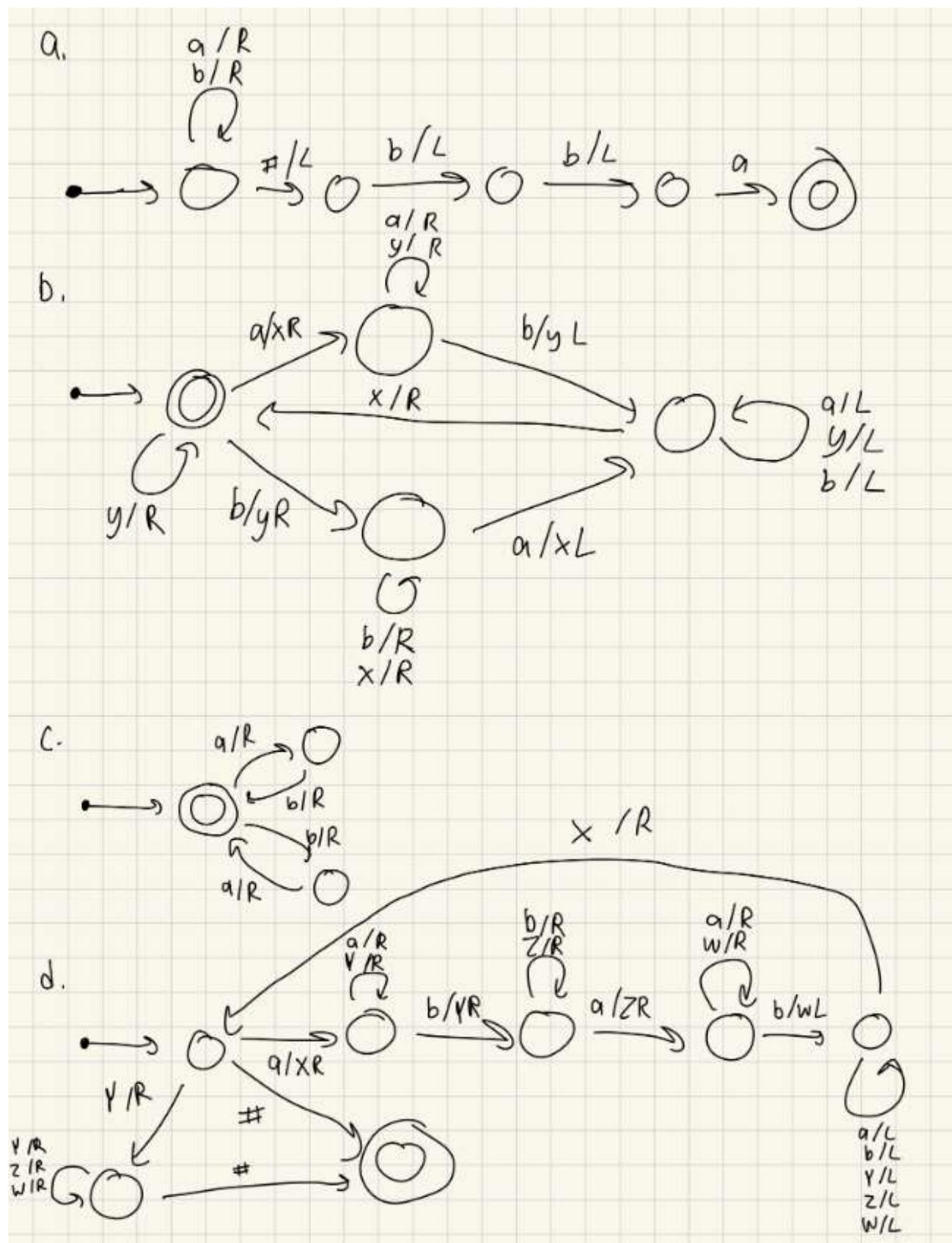
$$\{0,1,2,3,4,5,6,7,8,9,..,e,E,+,-\},$$

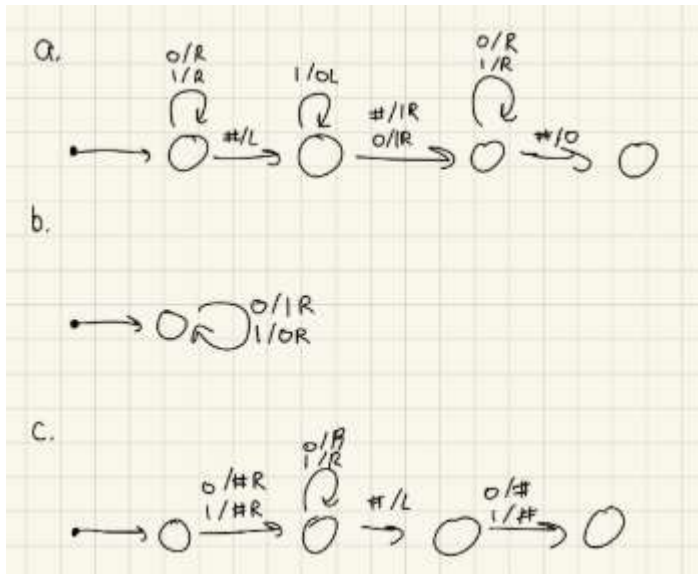
$$\{(n, xfy), (x, d), (x, dx), (f, \varepsilon), (f, .x), (y, \varepsilon), (y, ex), (y, e+x), (y, e-x), (y, Ex), (y, E+x), (y, E-x),$$

$$(d, 0), (d, 1), (d, 2), (d, 3), (d, 4), (d, 5), (d, 6), (d, 7), (d, 8), (d, 9)\},$$

$$n)$$

5.





6.

7a. MUL 5, 3, r1

POW 1, 3, r2

SUB r1, r2, r0

7b. PUSH 5

PUSH 3

MUL

PUSH 1

PUSH 3

POW

SUB

8a. c

8b. b

8c. d

8d. d

8e. a

8f. e

8g. a

8h. c