DM534 — Øvelser Uge 44

Introduktion til Datalogi, Efterår 2021

Jonas Vistrup og Rolf Fagerberg

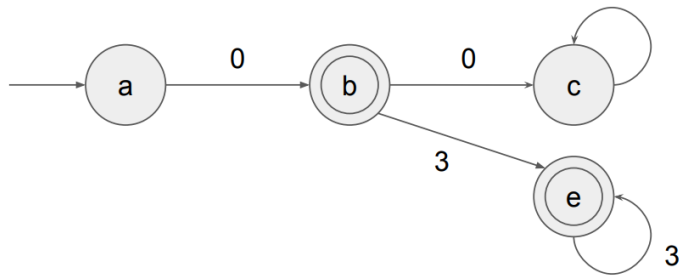---

1 I

Start med at repetere følgende definitioner fra slides:

- En Deterministic Finite Automaton (DFA).
- At en DFA accepterer en streng.
- Sproget bestemt af en DFA.
- En Context-Free Grammar (CFG).
- At en CFG udleder (derives) en streng.
- Sproget bestemt af en CFG.

1.1

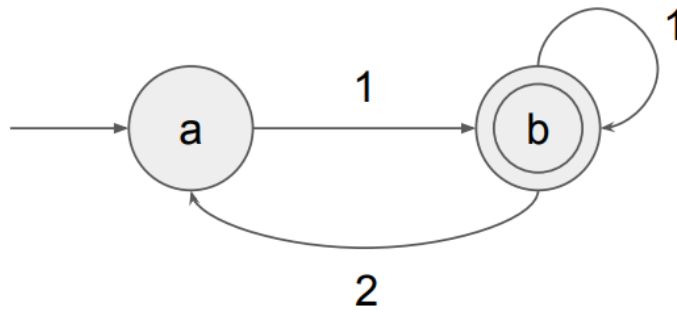What is the language of the following DFA?

SVAR: 0 og så nul eller flere 3'er.
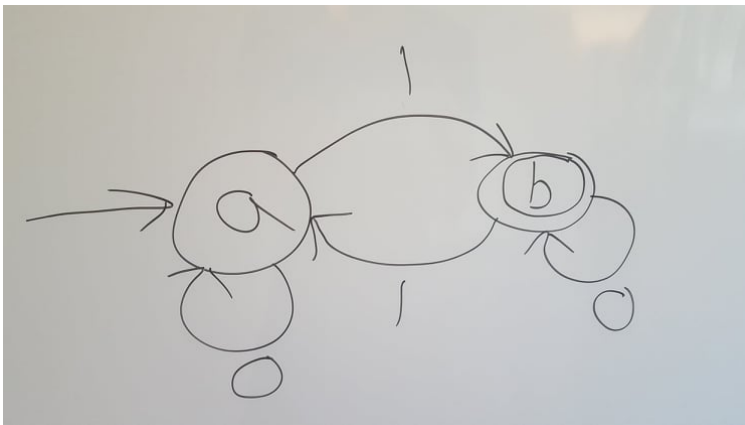
1.2

What is the language of the following DFA?

SVAR: 1 mindst en gang, hvis der er et 2, så skal det efterfølges af mindst et 1.

1.3

Define a DFA that recognises the following language: All strings of 0s and 1s that contain an odd number of 1s and any number of 0s.
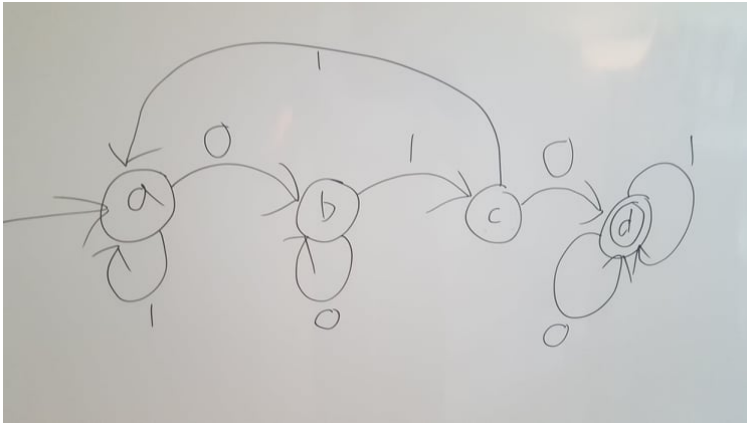
SVAR:

1.4

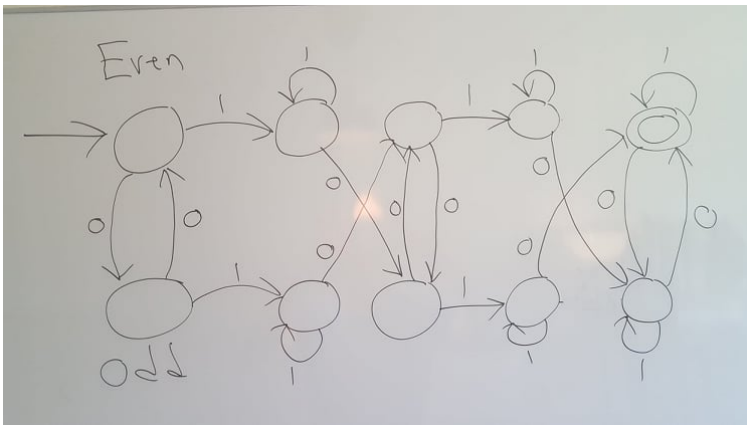Define a DFA that recognises the following language: All strings of 0s and 1s that contain the string 010.

SVAR:

1.5

Define a DFA that recognises the following language: All strings of 0s and 1s that contain at least two occurrences of 10 and an even number of 0s.

SVAR:

1.6

What is the language of the following CFG?

$$S \rightarrow ab$$
$$S \rightarrow SS$$

SVAR: $(ab)^+$. At least one repeat of the string ab.

1.7

Write two different derivations for the string 0001111 with the following CFG. (Same end result, but some different intermediate steps.)

$$S \to 0M1$$
$$M \to M1$$
$$M \to 0M$$
$$M \to 0$$
$$M \to 1$$

SVAR:
$$S \to 0M1 \to 00M1 \to 000M1 \to 000M11 \to 000M111 \to 0001111$$
$$S \to 0M1 \to 0M11 \to 0M111 \to 0M1111 \to 00M1111 \to 0001111$$

1.8

What is the language of the following CFG?

$$S \to 0MM1$$
$$M \to 0M$$
$$M \to 1M$$
$$M \to 0$$
$$M \to 1$$

SVAR: Any 0-1 string that starts with 0 and ends with 1 of at least length 4.

2 II

2.1

Define a CFG that recognizes the following language: All strings of 0s and 1s consisting of n 0s followed by n 1s. Examples: 0011 is OK, 1100 is not OK, 011 is not OK.

SVAR:
$$S \to 0S1$$
$$S \to 01$$

2.2

Define a DFA that recognises the same language of this CFG:

$$S \rightarrow 0M$$
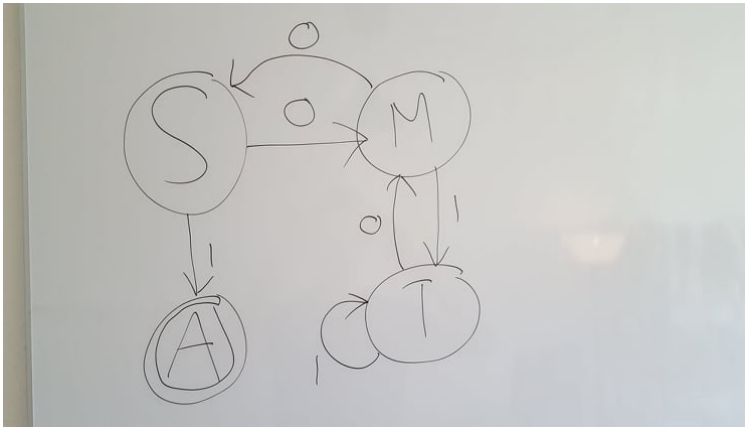
$$S \rightarrow 1$$
$$M \rightarrow 0S$$
$$M \rightarrow 1T$$
$$T \rightarrow 0M$$
$$T \rightarrow 1T$$

SVAR:

2.3

Define a CFG that recognises the following language: All strings of arithmetic additions that contain numbers, the + sign, and (balanced) parentheses. Examples: (0+1) is OK, (2+(3))+4 is OK, 2+3(2) is not OK.

SVAR:

$$S \rightarrow E$$
$$E \rightarrow (E)$$
$$E \rightarrow E + E$$
$$E \rightarrow N$$
$$N \rightarrow NN$$
$$N \rightarrow 0|1|2|3|4|5|6|7|8|9$$