DM534 — Øvelser Uge 44

Introduktion til Datalogi, Efterår 2021

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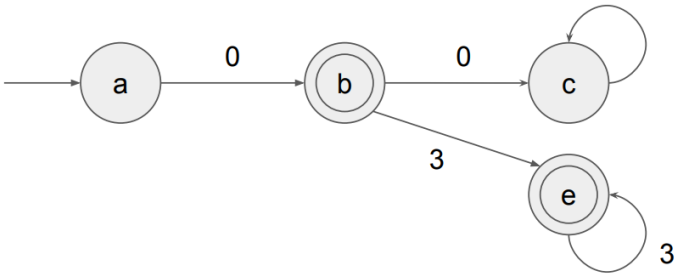
1 I

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

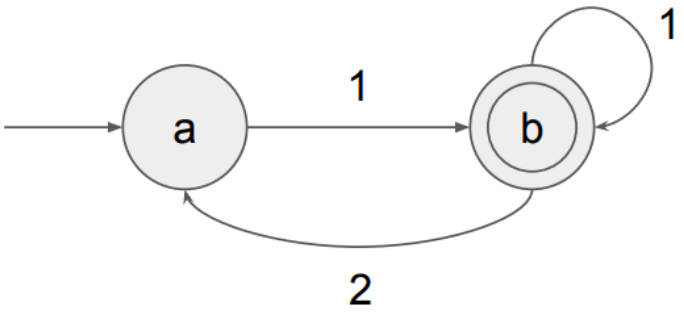
What is the language of the following DFA?



SVAR: 0 og så nul eller flere 3'er.

1.2

What is the language of the following DFA?

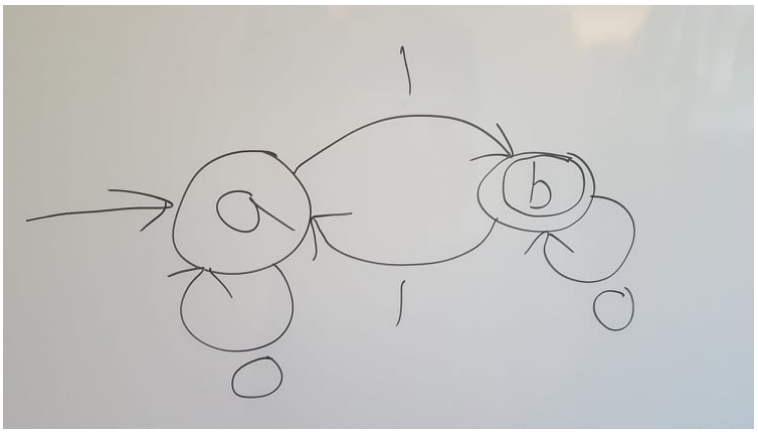


SVAR: 1 mindst en gang, hvis der er et 2, så skal det efterfølges af mindst et 1.

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.

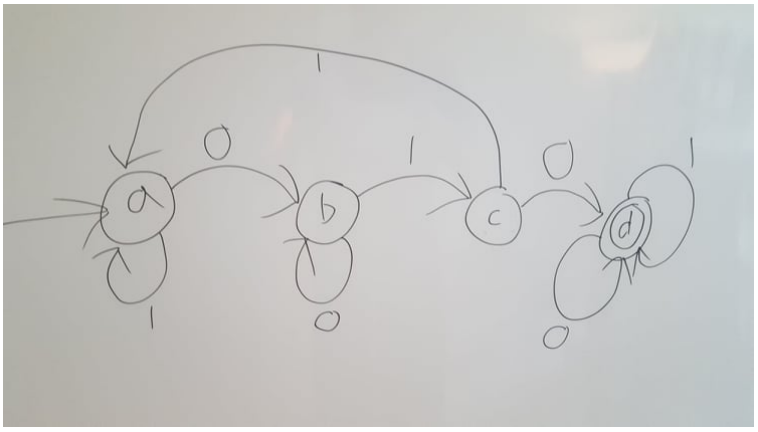
SVAR:



1.4

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

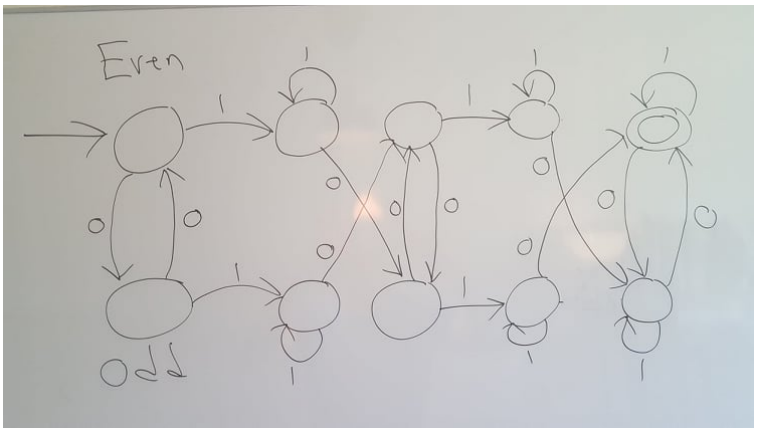
SVAR:



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?

$$S \to ab$$
$$S \to SS$$

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:

$$S \to 0M$$

$$S \to 1$$

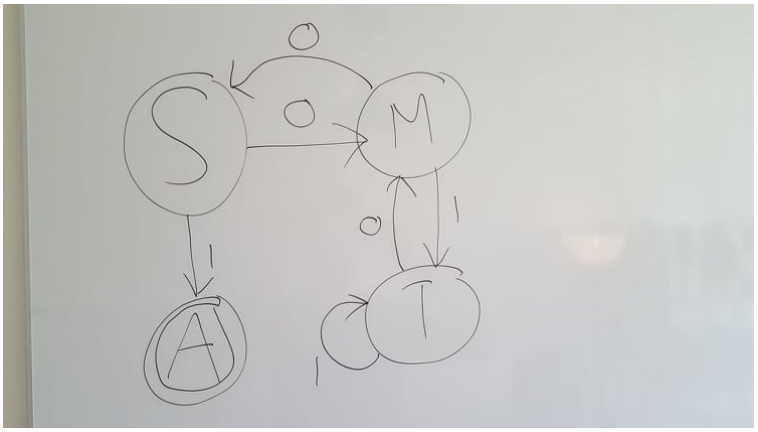
$$M \to 0S$$

$$M \to 1T$$

$$T \to 0M$$

$$T \to 1T$$

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:

$$S \to E$$

$$E \to (E)$$

$$E \to E + E$$

$$E \to N$$

$$N \to NN$$

$$N \to 0|1|2|3|4|5|6|7|8|9$$

(Sidste linje er en forkortet skrivemåde for de ti regler $N \to 0$, $N \to 1$, $N \to 2$,....)