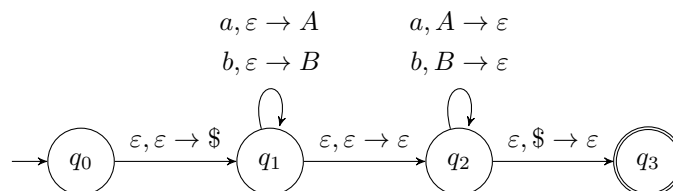**TUDelft**

TI2316 Lab Course
Solutions 4

deadline: May 23, 2017, 13:45

EXTRA, DRAFT

1. Suppose we have the context-free grammar $G = (\{S\}, \{a, b\}, R, S)$ with R containing the following rules:

$$S \rightarrow abSba \mid baSab \mid \varepsilon$$

(a) Consider the following PDA M':

$$a, \varepsilon \rightarrow A \qquad a, A \rightarrow \varepsilon$$
$$b, \varepsilon \rightarrow B \qquad b, B \rightarrow \varepsilon$$

M' is *not* a PDA for G. Give a set of rules R' such that $L(G') = L(M')$ where $G' = (\{S\}, \{a, b\}, R', S)$, and briefly explain why M' generates G'.

> **Solution:** In q_1, whenever M' reads a letter, it pushes information on the stack such that in q_2, it can match those with letters read there. Since a stack is LIFO, M' accepts iff the first half of the word is the reverse of the second half. Hence R' is:
>
> $$S \rightarrow aSa \mid bSb \mid \varepsilon$$

(b) Construct a PDA M such that $L(M) = L(G)$. Use no more than 8 states.

> **Solution:**
>
>
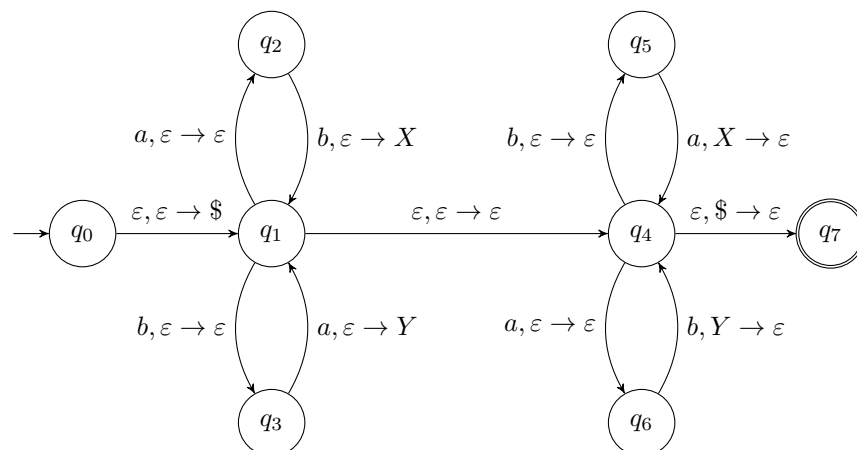
(c) Briefly explain (in no more than 5 lines) what you needed to change to the incorrect PDA M' to fix it.

> **Solution:** The PDA cannot read as and bs independently, but needs to remember (in the left half of the PDA) that an a is part of ab, and that a b is part of ba. We need something similar in the right half. This is the purpose of the extra states.

2. Consider a CFG $G = (\{S, V\}, \{\texttt{if}, \texttt{else}, \texttt{print}, (,), \texttt{x}, \texttt{y}, \texttt{z}\}, R, S)$ with R containing the following rules:

$$S \rightarrow \texttt{if(}\ V\ \texttt{)}\ S \ \mid \ \texttt{if(}\ V\ \texttt{)}\ S\ \texttt{else}\ S \ \mid \ \texttt{print(}\ V\ \texttt{)}$$
$$V \rightarrow \texttt{x} \mid \texttt{y} \mid \texttt{z}$$

Show that G is ambiguous by giving an appropriate word w. What are the different meanings of w when interpreted in a language like Java?

> **Solution:** The word $w = \texttt{if(x) if(y) print(y) else print(z)}$ (ignoring spaces) has two different leftmost derivations. The difference between its two interpretations lies in the question to what $\texttt{if}$ the $\texttt{else}$ belongs: if $\texttt{x}$ is false, is $\texttt{z}$ or nothing printed?
>
> This issue is called the *dangling else problem*.