

## Exercises for “Computer Science II” — SS 2003

No. 10

Due: July 18, 2003

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### Context Free Grammars

Consider the following grammar:

$$\begin{aligned}G &\rightarrow S\$\$ \\S &\rightarrow AM \\M &\rightarrow S \\M &\rightarrow \epsilon \\A &\rightarrow aE \\A &\rightarrow bAA \\E &\rightarrow aB \\E &\rightarrow bA \\E &\rightarrow \epsilon \\B &\rightarrow bE \\B &\rightarrow aBB\end{aligned}$$

All capital letters are non-terminal symbols. All lower-case letters are terminal symbols (tokens). The symbol  $G$  is the grammar start symbol. The symbol  $\$\$$  is a special terminal symbol which corresponds to the end of an input string.

1. (1 Point) Show a parse tree for the string  $a\ b\ a\ a$ .
2. (1 Point) Is the grammar  $LL(1)$ ?
3. (3 Points) Show PREDICT sets for each production. If the grammar is not  $LL(1)$  show the productions with PREDICT set conflicts.

## Names and Binding

Chapter 3 of *Programming Language Pragmatics* discusses the notion of binding time in computer systems. Possible binding times include

- Language design time
- Language implementation time
- Program writing time
- Compile time
- Link time
- Load time
- Run time

Indicate the binding time for each of the following decision in Java. Explain any answers you think are open to interpretation.

2. (1 Point) The number of built-in functions (abs, cosine, etc.)
3. (1 Point) The variable declaration that corresponds to a particular variable reference (use)
4. (1 Point) The maximum length allowed for a constant (literal) character string
5. (1 Point) The address in memory of a particular library routine
6. (1 Point) The total amount of space occupied by program code and data