

Homework 3

Date Out: Tuesday, November 14

Due Date: Tuesday, November 28 (start of class)

1 Type Checking

1. The following RAM program has some errors. List them, including the line number and the type of error (lexical, syntactical, semantic). For full credit, find at least five errors with at least one error in each category of (lexical, syntactical, semantic).

```
1 public static void main (String[] args)
2 {
3     new 415_565_HW3().f(5);
4 }
5 public class 416_565_HW3
6 {
7     boolean b;
8     public static void f(int a)
9     {
10         int b;
11         int c = 4;
12
13         if (a < c)
14             return 3;
15         else
16             b = 2;
17         return a / b;
18     }
19 }
```

2. Can the compiler easily recover from the errors above? Discuss.

2 Symbol Tables

1. Ignore the errors in this RAM program, which is copied verbatim from the previous page. Complete an appropriate symbol table for this program. Feel free to include commentary on any design decisions that you incorporated.

```
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```

3 Trees

1. Given the following grammar:

$$\begin{aligned} S &\rightarrow \text{if } E \text{ then } S Q \mid a \mid b \mid c \\ E &\rightarrow x \mid y \\ Q &\rightarrow \text{else } S \mid \epsilon \end{aligned}$$

construct the parse trees and abstract syntax trees for the following expressions:

- (a) `if x then a else b`
- (b) `if x then if y then a else b`

4 Activation Records

1. How many activation records are there in total for the following RAM program?

```
public static void main(String[] args)
{
    println(new Fac().fact(4));
}
```

```
public static integer fact (integer n)
{
    if (n < 1)
        return 1;
    else
        return n * fact(n - 1);
}
```

2. What will be the size in bytes of the activation record for the following method, assuming temporaries are stored in the activation record? Explain how you did this calculation by drawing the activation record. Presume that the original call was: `foo(3,4,5,6)`.

```
public static integer foo(integer x, integer y, integer z, integer w)
{
    if (x eq (y + z))
        return 5;
    else
        return x * (y + (z - x));
}
```

5 Code Generation

1. Write assembly code for the following expression. Place the result into `$v0`. You may not use any other registers except the stack pointer `$sp` and `$v1`.

`5 + 3 * 2 + 4`

2. Write assembly code for the following code segment. You may use the appropriate MIPS registers to hold temporaries.

```
x = 25;
if (x - 1 > 0)
    y = x * 3;
else
    y = 44;
x = 1;
```