

Name: _____

CMSC330 Summer 2009

Midterm 2: Ocaml to Objects

Instructions:

Show your work for all problems. If you need extra space, ask for a sheet of paper and label your work (i.e. which problem your work corresponds to). If I cannot read your handwriting I will have trouble giving you points. For two points extra credit, write an interesting fact in the space below.

1. Trace through the following piece of code and show the printed results using (12 pts):

a. Call by value evaluation (where assignments with = are done using object copy):

20123

b. Call by reference evaluation (where assignments with = are done using reference copy):

40143

c. Call by name evaluation (where assignments with = are done using object copy):

30125

Note that the code below is **not** meant to be any specific language (i.e. Java, C, etc) - assume it is a generic language and evaluate the code using the three options described.

```
void foo(int a, int b) {
    int z = a;
    z++;
    a++;
    b = b + 2;
}
```

```
//main code
int x = 2;
int[] y = [0,1,2,3];
foo(x,y[x]);
```

```
print(toS(x)+toS(y[0])+ toS(y[1])+toS(y[2])+ toS(y[3]));
//toS() is a function that converts the integer to a string
//the plus (+) above is string concatenation
```

2. Consider the following context free grammar:

$$\begin{array}{l} S \rightarrow SM \mid T \\ T \rightarrow M + T \mid \epsilon \mid a \\ M \rightarrow a \mid b \end{array} \qquad \begin{array}{l} S \rightarrow TS' \\ S' \rightarrow MS' \mid \epsilon \end{array}$$

- Is the context free grammar compatible with the top-down recursive-descent parsers we have seen in class? Circle YES or **NO**, and if no, fix the grammar so that it is (you may write/overwrite your answer above). (3 pts)
- Is the context free grammar ambiguous? Circle **YES** or NO and explain why. (3 pts)

$$\begin{array}{l} S \rightarrow SM \rightarrow TM \rightarrow M + T \rightarrow a + T \rightarrow a + a \\ S \rightarrow T \rightarrow M + T \rightarrow a + T \rightarrow a + a \end{array}$$

3. Consider the following context free grammar

$$\begin{array}{l} S \rightarrow aAB \mid aB \\ A \rightarrow aA \mid \epsilon \\ B \rightarrow bB \mid b \end{array} \qquad \begin{array}{l} S \rightarrow aABb \\ A \rightarrow aA \mid \epsilon \\ B \rightarrow bB \mid \epsilon \end{array}$$

(or
$$\begin{array}{l} S \rightarrow aLb \\ L \rightarrow AB \\ A \rightarrow aA \mid \epsilon \\ B \rightarrow bB \mid \epsilon \end{array})$$

- What language does the grammar recognize? Your description should be as complete as possible. (2 pts)

1 or more a-s followed by one or more b-s