

University of Puerto Rico at Rio Piedras  
Department of Mathematics  
Qualifying Exam  
MATE 6681: Higher Level Programming Languages  
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Name	Student ID

**Instructions:** Solve **exactly three** of the following five exercises. Please write clearly and show all your work to get credit. Good luck!

**Exercise 1 (100 points)**

Consider the following C program:

```
int fun(int *x)
{
    *i += 5;
    return 4;
}
void main()
{
    int x = 3;
    x = x + fun( &x);
}
```

What is the value of x after the assignment statement in main, assuming

- (a) operands are evaluated left to right.
- (b) operands are evaluated right to left.

**Exercise 2 (100 points)**

For this problem, assume that the alphabet is  $\Sigma = \{0, 1\}$ . Design a context-free grammar that generates the following language:

$$L = \{w \in \Sigma^* \mid \text{the length of } w \text{ is even and the sum of the 1's in } w \text{ is odd}\}.$$

For instance, 10, 0100, 0111 are in  $L$ , but 1, 11, 1100 are not. Recall that  $\Sigma^*$  is the language of all words of 0's and 1's, including the empty word.

**Exercise 3 (100 points)**

Write Scheme functions for the following two problems:

- a) A function that takes two integer parameters, X and Y, and returns X raised to the Y power.
- b) A function that takes a simple list of numbers as a parameter and returns a list with the largest and smallest numbers in the input list.

**Exercise 4 (100 points)**

Rewrite the following pseudocode segment using a loop structure in (a) Python and in (b) C or C++ languages.

```
k = (j + 13) / 27
loop:
    if k > 10 then goto out
    k = k + 1
    i = 3 * k - 1
    goto loop
out: ...
```

Assume all variables are integer type. Discuss which language, for this code, has the best writability and the best readability.

### Exercise 5 (100 points)

What do each of the following code fragments print?

File test.py

```
a = 3

if a < 5:
    if a > 3:
        print "medium"
    else:
        print "small"
```

File test.cc

```
#include <iostream>

using namespace std;

int main() {
    int a = 3;

    if (a < 5) {
        if (a > 3) {
            cout << "medium" << endl;
        }
        else
            cout << "small" << endl;
    }
}
```

How do C++ and python decide which `if` to pair with the `else`? Is there a better way to decide?