

CSE216 – Programming Abstractions

Midterm Examination: 18 April 2019 (50 points)

Name: _____ ID No: _____

| Question # | Points Available | Points Earned |
|-----------------|------------------|---------------|
| 1 | 10 | |
| 2 | 10 | |
| 3 | 10 | |
| 4 | 10 | |
| 5 | 10 | |
| 6 | 10 | |
| Total: (best 5) | 50 | |

Instructions: Solve any 5 questions. If you solve more than 5, best 5 answers will be considered for grading.

Q. 1: Java and Python

A. Provide at least 4 points comparison between Java and Python.

(4 pts)

| Java | Python |
|-----------------------------------|---|
| Statically typed | Dynamically typed |
| Verbose | Terse (aka concise) |
| Not compact | Compact |
| Own file for each top level class | Multiple classes in a single file |
| Uses checked exceptions | Need not catch/throw exceptions in every method |
| Weak support for string handling | Good support for string handling |
| Heavy use of parenthesis | Minimal use of parenthesis |

- B. A binary gap within a positive integer N is any maximal sequence of consecutive zeros that is surrounded by ones at both ends in the binary representation of N. For example, number 9 has binary representation 1001 and contains a binary gap of length 2. The number 529 has binary representation 1000010001 and contains two binary gaps: one of length 4 and one of length 3. The number 20 has binary representation 10100 and contains one binary gap of length 1. The number 15 has binary representation 1111 and has no binary gaps. The number 32 has binary representation 100000 and has no binary gaps.

Write a function `binaryGap(N)` that, given a positive integer N, returns the length of its longest binary gap. The function should return 0 if N doesn't contain a binary gap. For example, given N = 1041 the function should return 5, because N has binary representation 10000010001 and so its longest binary gap is of length 5. Given N = 32 the function should return 0, because N has binary representation '100000' and thus no binary gaps.

You may write your solution in Java or Python depending on your choice.

(6 pts)

```
def solution(N):
    cnt = 0
    result = 0
    found_one = False

    i = N

    while i:
        if i & 1 == 1:
            if (found_one == False):
                found_one = True
            else:
                result = max(result, cnt)
                cnt = 0
        else:
            cnt += 1
        i >>= 1

    return result
```

Q. 2: Java program output

A. What is the output of the following Java program?

(2 pts)

```
class DisplayOverloading3
{
    public void disp(char c, int num)
    {
        System.out.println("I'm the first definition of method disp");
    }
    public void disp(int num, char c)
    {
        System.out.println("I'm the second definition of method disp");
    }
}
class Sample3
{
    public static void main(String args[])
    {
        DisplayOverloading3 obj = new DisplayOverloading3();
        obj.disp('x', 51 );
        obj.disp(52, 'y');
    }
}
```

Output:

I'm the first definition of method disp

I'm the second definition of method disp

```
#include "stdio.h"

int main()
{

    char a[] = { 'A', 'B', 'C', 'D' };

    char* ppp = &a[0];

    printf("%c ", *ppp);

    *++ppp;

    printf("%c ", *ppp);

    printf("%c ", *++ppp);

    printf("%c ", --*ppp);

}
```

Output:

A B C B

B. What is the output of the following Java program?

(2 pts)

```
class Demo
{
    public double myMethod(int num1, int num2)
    {
        System.out.println("First myMethod of class Demo");
        return num1+num2;
    }
    public int myMethod(int var1, int var2)
    {
        System.out.println("Second myMethod of class Demo");
        return var1-var2;
    }
}
class Sample4
{
    public static void main(String args[])
    {
        Demo obj1= new Demo();
        obj1.myMethod(10,10);
        obj1.myMethod(20,12);
    }
}
```

Output:
Compilation error

C. What is the output of the following Java program?

(2 pts)

```
public static void callEat(Animal animal) {
    System.out.println("Animal is eating");
}

public static void callEat(Dog dog) {
    System.out.println("Dog is eating");
}

public static void main(String args[])
{
    Animal a = new Dog();
    callEat(a);
}
```

Output:
Animal is eating

D. What is the output of the following Java program?

(2 pts)

```
import java.util.*;
public class genericstack <E>
{
    Stack <E> stk = new Stack <E>();
    public void push(E obj)
    {
        stk.push(obj);
    }
}
```

```

    }
    public E pop()
    {
        E obj = stk.pop();
        return obj;
    }
}
class Output
{
    public static void main(String args[])
    {
        genericstack <String> gs = new genericstack<String>();
        gs.push("Hello");
        System.out.println(gs.pop());
        genericstack <Integer> gs = new genericstack<Integer>();
        gs.push(36);
        System.out.println(gs.pop());
    }
}

```

Output:

Hello

36

Q. 3. Names, scopes and bindings

- A. Specify the binding time for the following languages and corresponding features. (Any 4). You can choose among the following: language design, language implementation, link, compile, run time. (4 pts)

| Language | Feature | Binding time |
|----------|--|-----------------|
| C | Syntax: e.g. if (a > 0) b := a; | Language design |
| C | Calls to static library routines: e.g. printf | Link |
| C | Specific type of a variable | Compile |
| Java | Reserved keywords: e.g. class | Language design |
| Any | Internal representation of literals (e.g. 3.14 or "foo") | Implementation |
| Any | Non-static allocation of space for variables | Run time |

- Q. 3. Given the following code, show the status of subroutine stack separately for each individual step in the method call, method execution and method finish/return. (10 pts)

```
public static void main(String[]
args) {
    int i = 20;
    int j = 15;
    int k = gcd(i, j);

    System.out.println("GCD " + k);
}
```

```
public static int gcd(int num1, int
num2) {
    while (num1 != num2) {
        if(num1 > num2) num1 = num1 - num2;
        else num2 = num2 - num1;
    }
    return num2;
}
```

See lecture slides for answer

Q. 4. Python Object Oriented Programming: Implement a Python class clock. The class Clock simulates the tick-tack of a clock. An instance of this class contains the time, which is stored in the attributes self.hours, self.minutes and self.seconds. Complete the following methods of class clock:

```
def __init__(self, hours, minutes, seconds): (4 pts)
    """
    The parameters hours, minutes and seconds have to be integers and must satisfy the
    following equations:  $0 \leq h < 24$ ,  $0 \leq m < 60$ ,  $0 \leq s < 60$ . An exception is thrown
    if the values are outside range.
    """
    if type(hours) == int and 0 <= hours and hours < 24:
        self._hours = hours
    else:
        raise TypeError("Hours have to be integers between 0 and 23!")
    if type(minutes) == int and 0 <= minutes and minutes < 60:
        self.__minutes = minutes
    else:
        raise TypeError("Minutes have to be integers between 0 and 59!")
    if type(seconds) == int and 0 <= seconds and seconds < 60:
        self.__seconds = seconds
    else:
        raise TypeError("Seconds have to be integers between 0 and 59!")

def tick(self): (4 pts)
    """
    This method lets the clock "tick", this means that the internal time will be
    advanced by one second.
    """
    if self.__seconds == 59:
        self.__seconds = 0
    if self.__minutes == 59:
        self.__minutes = 0
        if self._hours == 23:
            self._hours = 0
        else:
            self._hours += 1
    else:
```

```

        self.__minutes += 1
    else:
        self.__seconds += 1
def __str__(self):
    """
    Prints the time in the format HH:MM:SS.
    """
    return "{0:02d}:{1:02d}:{2:02d}".format(self._hours,
                                            self.__minutes,
                                            self.__seconds)

```

(2 pts)

Examples:

```

>>> x = Clock(12,59,59)
>>> print(x)
12:59:59
>>> x.tick()
>>> print(x)
13:00:00
>>> x.tick()
>>> print(x)
13:00:01
"""

```


Q. 5. Python programming

- A. Write a Python program for binary search for an ordered list. The program will return index of the number if it exists in the list otherwise will return -1 if the number does not exist. (5 pts)

```
Ordered_binary_Search([0, 1, 3, 8, 14, 18, 19, 34, 52], 3) -> 2
Ordered_binary_Search([0, 1, 3, 8, 14, 18, 19, 34, 52], 17) -> -1
```

```
def binarySearch(lst, key):
    low = 0
    high = len(lst) - 1
    while high >= low:
        mid = (low + high) // 2
        if key < lst[mid]:
            high = mid - 1
        elif key == lst[mid]:
            return mid
        else:
            low = mid + 1
    # Now high < low, key not found
    return - 1
```

- B. Write a Python function to create a dictionary from a string. Note: Track the count of the letters from the string. (5 pts)

Sample string: 'w3resource'

Expected output: {'3': 1, 's': 1, 'r': 2, 'u': 1, 'w': 1, 'c': 1, 'e': 2, 'o': 1}

```
str1 = 'w3resource'
my_dict = {}
for letter in str1:
    my_dict[letter] = my_dict.get(letter, 0) + 1
print(my_dict)
```

Q. 6. Python program output

- A. What is the output of the following Python code? (2 pts)

```
dictionary = {'GFG': 'geeksforgeeks.org',
              'google': 'google.com',
              'facebook': 'facebook.com'
              }
del dictionary['google'];
for key, values in dictionary.items():
    print(key)
dictionary.clear();
for key, values in dictionary.items():
    print(key)
```

Output:
GFG
Facebook

B. What is the output of the following Python code?

(2 pts)

```
T = (1, 2, 3, 4, 5, 6, 7, 8)
print(T[T.index(5)], end = " ")
print(T[T[T[6]-3]-6])
```

Output:

5 8

C. What is the output of the following Python code?

(2 pts)

```
from math import sqrt
L1 = [x**2 for x in range(10)][9]
L1 += 19
print(sqrt(L1), end = " ")
L1 = [x**2 for x in reversed(range(10))][0]
L1 += 16
print(int(sqrt(L1)))
```

Output:

10.0 4

D. What is the output of the following Python code?

(2 pts)

```
L1 = [1, 1.33, 'GFG', 0, 'NO', None, 'G', True]
val1, val2 = 0, ''
for x in L1:
    if(type(x) == int or type(x) == float):
        val1 += x
    elif(type(x) == str):
        val2 += x
    else:
        break
print(val1, val2)
```

Output:

2.33 GFGNO

E. What is the output of the following Python code?

(2 pts)

```
class A(object):
    val = 1

class B(A):
    pass

class C(A):
    pass

print (A.val, B.val, C.val)
B.val = 2
print (A.val, B.val, C.val)
A.val = 3
print (A.val, B.val, C.val)
```

Output:

1 1 1

1 2 1

3 2 3