UNIVERSITY OF LONDON

GOLDSMITHS COLLEGE

Department of Computing

B. Sc. Examination 2015

IS50001C
Foundations of programming

Duration: 2 hours 15 minutes

Date and time:

There are five questions in this paper. You should answer no more than THREE questions. Full marks will be awarded for complete answers to a total of THREE questions. Each question carries 25 marks. The marks for each part of a question are indicated at the end of the part in [.] brackets.

There are 75 marks available on this paper.

THIS PAPER MUST NOT BE REMOVED
FROM THE EXAMINATION ROOM

Question 1

(a) i. Write three assignment statements whose effect is to swap the contents of two integer variables `a` and `b`.

ii. What is wrong with the following code fragment?

```
int x = 2;
 String y =  x ;
```

iii. What is the output of the following program?

```
int x=7; int y=1;
x=y; y=x;
print(y);
```

[9]

(b) Given the following code fragment:

```
void setup() {
  size(200,200);
}

void draw() {
  background(255);
  stroke(0);
  line(100,0,100,200);
  line(0,100,200,100);

  noStroke();
  fill(0);

  if (mouseX < 100 && mouseY < 100) {
    rect(0,0,100,100);
  } else if (mouseX > 100 && mouseY < 100) {
    rect(100,0,100,100);
  } else if (mouseX < 100 && mouseY > 100) {
    rect(0,100,100,100);
  } else if (mouseX > 100 && mouseY > 100) {
    rect(100,100,100,100);
  }
}
```

Explain what this program does. Your explanation should include a drawing showing the behaviour of the program. [8]

(c)   i. Write a program that draws a ball (ellipse) at the center of the window. The ball moves horizontally and bounces in the opposite direction whenever it reaches the window borders.

ii. Change the code in (i) such that the ball is created on a mouse click with the point (mouseX, mouseY) at its centre.

[8]

Question 2

(a) i. Give a boolean expression which evaluates to `true` if the variable `y` has the value 0 or the value 1 and which evaluates to `false` otherwise.

ii. Give a boolean expression which evaluates to `true` if the variable `a` has the value 0 and the variable `b` has the value 1 and which evaluates to `false` otherwise.

iii. Give a boolean expression which evaluates to `true` if the variables `x`, `y` and `z` all have different values and which evaluates to `false` otherwise.

[9]

(b) i. What is the output of the following program

```
int i=0;
int j = 3
while(i<=5 || j>0) {print(j); i++;  j--;}
```

ii. Rewrite this code using a for loop instead.

[8]

(c) Write a program that divides the window into squares, each with random color and sides of length 20. [8]

Question 3

(a) i. What is the output of the following program?

```
int [ ] ar = new int [6];
for(int i=0; i< 6; i++) ar[i] = i+1;
for(int i= 5; i>=0; i--) print(ar[i]);
```

ii. What is wrong with the following code fragment?

```
int [ ] ar = new int [5];
for(int i=-1; i< 5; i++) ar[i+1] = i;
```

iii. What is the output of the following program?

```
for(int i=1; i<=6; i++)
{
  for(int j=1; j<=i; j++)  print(j);
  println();
}
```

[9]

(b) i. Write a method whose heading is `"sortArray"` which sorts an array of integers into ascending order.

ii. What is the maximum number of comparisons needed to sort an array of 7 element using the `"bubble sort"` algorithm?

[8]

(c) i. Use the `"binary search"` algorithm to write a method which takes a sorted in ascending order array of integers "arr" and an integer "n" as arguments. "The method returns true if "n"is contained in "arr" and false otherwise".

ii. What is the maximum number of comparisons needed to search an array of 2000 elements using the `"binary search"` algorithm?

[8]

Question 4

(a)   i. Given the following method

```
void f(int n)
{
   if (n==1) return 1;
   return n*f(n-1);
}
```

What is the value of f(4)?

ii. What is the output of the following program?

```
int x;
void setup(){
  x=1;
  g();
  print(x);
}
void g() {
  int x =2;
}
```

iii. What is the output of the following program?

```
int x, int y;
void setup(){
  x=2;
  y=5;
  h();
  println(x);  print(y);
}
void h(){
  int y =0;
  x =10;
}
```

[9]

(b) Given the following method

```
int g(int x, int y) {
  if (y==0) return 0;
  else if(y>0)  return x+g(x,y-1);
       else return - x+g(x,y+1);
}
```

    i. What are the values of g(2, 3) and g(2,-1)?

    ii. What does the method "g" do?

[8]

(c)   i. Write a method with a heading "reverse" which takes a string st as a parameter and returns this string, st, in reverse order.

    ii. Write a method with heading "isPalindrome" which takes a string st as a parameter and returns true is the string st is a palindrome and false otherwise. The function "isPalindrome" has to contain a call to the function "reverse" defined in (i).

[8]

Question 5

(a) i. Explain the difference between an instance variable and a class variable? Give an example of each.

 ii. Explain the difference between following access modiffiers: private and public.

 iii. What is method overloading?

[9]

(b) Consider the following unfinished code:

```
Ball b1;
void setup() {
   size(200,200);
   b1= ------------// Finish this line of code
  }

void draw() {
   background(255);
   b1.move();
   b1.bounce();
   b1.display();
}

class Ball{
  float xpos , ypos, speed ,   radius;


  void move() {
          // --------------add  your code here
   }


  void bounce() {
      // -------------add  your code here
   }

  void display() {
    fill(175);
    ellipse(xpos, ypos,radius,radius);
   }
  }
```

   i. Add a constructor for the class Ball which takes the following arguments:

```
float x which is the  x position of the ball
float y which is  the y position of the ball
float s which is the speed of the ball
float r which is the diameter(radius) of the ball
```

  ii. Use the new constructor defined in (i) and complete the code in line four to create an object $b1$ of type ''Ball".

 iii. Complete the method `move()` which moves the ball horizontally.. Assume the `speed`variables stores the horizontal speed of the ball in pixels per frame.

 iv. Complete the method `bounce()` such that the ball will bounce back whenever it reaches the window limit.

[8]

(c) Rewrite the method `move()` such that the ball stops whenever the mouse is pointed over the ball and moves in the opposite direction whenever a key `"r"` or `"R"` is pressed.

[8]