UNIVERSITY OF LONDON

GOLDSMITHS COLLEGE

Department of Computing

B. Sc. Examination 2014

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 `x` and `y`.

ii. What is wrong with the following code fragment?

```
String x = "3";
int 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);
    rectMode(CENTER);
    if(mouseX <width/2 && mouseY<height/2)  fill(255);
    else fill(0);
    rect(mouseX, mouseY, 50,50);
}
```

i. Explain what this program does.

ii. Change the code such that the rectangle is drawn only if the mouse is on the top half of the window.

[8]

(c) Write a program that draws circle (ellipse) at the centre of window with a radius $\frac{height}{4}$. The colour of the circle depends on the position of the mouse: it should be black if the mouse of over the circle and white otherwise. You can use $dist(x_1, y_1, x_2, y_2)$ to work out the distance between two points $p_1(x_1, y_1)$ and $p_2(x_2, y_2)$. [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;
while(i<=5) {print(i); i++;}
```

ii. Rewrite this code using a for loop instead.

[8]

(c) Consider the following unfinished code.

```
int x=0; int  y=0; float r, b, g;
size(200,200);
background(255);
rectMode(CORNER);
for(x = --------- ;  --------- ;  ---------){
  for (y = --------- ; --------- ; ---------){
      r= ---------;
      b= ---------;
      g= ---------;
      fill(r,g,b);
      rect(---------,---------,20,20);
  }
}
```

Fill in the missing parts of the code marked as "- - - - - - - - -". The program should split the window in squares with sides of length 20 and each square should have a random colour. [8]

Question 3

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

```
int [ ] ar = new int [5];
for(int i=0; i< 5; i++) ar[i] = i+1;
for(int i= 4; i>=0; i--) print(ar[i]);
```

ii. What is wrong with the following code fragment?

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

iii. What is the output of the following program?

```
for(int i=1; i<=5; i++)
{
  for(int j=1; j<=i; j++)  print(j);
  println();
}
```

[9]

(b) i. Use linear search algorithm to write a method which takes an array of integers “arr” and an integer “n” as arguments. “The method returns true in “n”is contained in “arr” and false otherwise”.

ii. What is the maximum number of comparisons needed to search an array of n elements using linear search algorithm?

[8]

(c) Write a method whose heading is `"sortArray"` which sorts an array of integers into ascending order. [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=2;
  g();
  print(x);
}
void g() {
  int x =3;
}
```

iii. What is the output of the following program?

```
int x, int y;
void setup(){
  x=2;
  y=10;
  h();
  println(x);  print(y);
}
void h(){
  int y =0;
  x =3;
}
```

[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 is the values of g(2, 3) and g(2,-1)?

ii. What does this method do?

[8]

(c) Write a recursive method with a heading `"fact"` which takes a positive integer `n` and returns the factorial of `n (n!)`. "if $n < 0$ the function should return -1." `fact(0)` =1 and `fact(n)` = `n` $\times$ `(n - 1)` $\times$ `(n -2)` $\times \cdots \times$ 2$\times$1.

[8]

Question 5

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

ii. What is the role of a constructor?

[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]