

UNIVERSITY OF LONDON

GOLDSMITHS COLLEGE

B. Sc. Examination 2012

Department of Computing

IS51008B INTRODUCTION TO PROGRAMMING

Duration: 3 hours

This paper is in two parts: part A and part B. There are a total of three questions in each part. You should answer TWO questions from part A and TWO questions from part B. Your answers to part A and part B should be written in separate answer books.

Full marks will be awarded for complete answers to a total of FOUR questions, TWO from part A and TWO from part B. 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 100 marks available on this paper.

No calculators should be used.

**THIS PAPER MUST NOT BE REMOVED
FROM THE EXAMINATION ROOM**

PART A

Question 1 Wall Breaker

In the game of Wall Breaker, the user is provided with a horizontal paddle and they must use it to bounce a ball against a wall of bricks. When the ball hits a brick, the brick disappears. When all of the bricks have gone, the user moves to the next level. In this question, you are to program some of the functionality for the game.

- (a) The bricks in the game are represented using Brick objects. Write a set of variable declarations which you think are sufficient to represent the state of a Brick and explain what each is for. [3]
- (b) Write a constructor for the Brick class which allows its position to be set using parameters and which sets the other variables you declared to appropriate default values. [3]
- (c) State what is an appropriate data structure to store several Brick objects and why. Write a declaration for a variable with the type of this data structure and write some code to populate the data structure with a set of Brick objects placed in a horizontal line across the screen. [5]
- (d) Write a function which takes the following arguments:
- A float which is the x position of the ball.
 - A float which is the y position of the ball.
 - A float which is the diameter of the ball.
 - Your variable which contains the Brick objects.
- The function should test if the Ball has hit any of the Bricks and update the states of the bricks as appropriate. [5]
- (e) Write a function which returns true if all of the bricks have been hit. [3]
- (f) Write a function which draws the Brick as a green rectangle with a red border. [2]
- (g) Write a complete sub class of Brick called RedBrick which is the same except it draws a red brick. [4]

Question 2 Football

In the game of football, two teams of up to 11 players kick a ball around a rectangular pitch. The aim is to kick the ball into the other team's goal, a special area found at either end of the pitch. The goal is guarded by a goalie. You are set the task of developing a simple football game. In this question, you will be required to write certain key parts of the code for the game.

- (a) In the football game, the user can choose how hard to kick the ball by holding down the mouse. Noting that the `mousePressed` function is called automatically by the Processing system when the user clicks the mouse, and `mouseReleased` is called when the user releases the mouse, write some code which computes how long the user has held the mouse for. Explain how the code works. [5]
- (b) Define a complete `Player` class, which represents a footballer on the pitch.
- i. Declare appropriate variables to store the way the player is facing, their position and if they are moving. [2]
 - ii. Define a constructor which faces the player away from their goal and initialises other variables as appropriate. Explain why you have written it this way. [2]
 - iii. Define movement functions which change the position and direction of the player. Integrate the code into the top level sketch by writing additional code which calls these functions in response to key presses. [3]
 - iv. Define a kick function, which takes a `Ball` object as an argument. The ball has a `dX` and a `dY` field which define its current direction. If the ball is close enough to the player, the kick function should modify the direction of the ball to be the same as the direction the player is facing. It should use the results of the timing function from earlier to decide how fast the ball should move. [5]
- (c) Define a `Goalie` class which is a subclass of the `Player` class from part (b). It represents a goal keeper in the game of football. You need to decide how to override the behaviour of the parent class so the `Goalie` has the following features:
- i. The `Goalie` should only be allowed to move left and right. [3]
 - ii. The `Goalie` should always face away from their goal. [3]
 - iii. The `Goalie` always kicks the ball directly away from the goal. [2]

Question 3 Icon Painter

You are set the task of developing a paint program named 'Icon Painter'. The user selects from a palette of icons, which are images loaded from a disk. They can then draw using the icon they have selected. In this question, you will be required to write certain key parts of the code for 'Icon Painter'.

(a) Define a complete PaintBrush class. Its purpose is to draw the currently selected icon onto the screen. It will need the following features:

i. A variable to store the icon. [1]

ii. A constructor which takes an icon as an argument and stores it to the above variable [2]

iii. A function with the signature `void paint(float x, float y, float size)`, which draws the icon onto the screen using the x and y parameters for the position and the size parameter for the size. [2]

(b) Define a Palette class with the following features:

i. A variable to store several images loaded from disk. [2]

ii. A function to load the images from disk into the variable you created in the previous part. [5]

iii. A function to draw the palette of available images on the screen as a two dimensional grid. [8]

iv. A function which returns the image the user clicked on the grid which takes the mouseX and mouseY variables as arguments. [5]

PART B

Question 4 OOP, Module Coupling and Module Cohesion

- (a) Describe the main features of Object Oriented Programming. [10]
- (b) Define *module coupling* and *module cohesion*. How do the main features described in part (a) help the programmer comply with the best practices for module coupling and module cohesion? [10]
- (c) Discuss how the various features of Processing relate to the concepts of module coupling and module cohesion. [5]

Question 5 Recursion

- (a) Write a function which prints out the first 10 prime numbers using loops. [10]
- (b) Write a function which prints out the first 10 prime numbers using recursion. [10]
- (c) “Recursive programming is often regarded as a more elegant programming technique than iteration”. Discuss, using your previous two answers as examples. [5]

Question 6 Software Development

- (a) Describe 2 advantages and 2 disadvantages of an online discussion of program source code with a peer group. [5]
- (b) Based on your experience of developing complex software projects, what advice would you give to someone who was about to start such a project? [5]
- (c) Explain why it is important to have clearly defined requirements and an evaluation scheme at the start of a software project. [5]
- (d) Compare software development for mobile operating systems such as Android to development for non-mobile operating systems such as Windows 7 or Mac OSX. [10]