THIS PAPER IS NOT TO BE REMOVED FROM THE EXAMINATION HALL

UNIVERSITY OF LONDON

CO1112 ZB

BSc, CertHE and Diploma EXAMINATION

CREATIVE COMPUTING and COMBINED DEGREE SCHEME

Creative Computing 1: Image, sound and motion

Friday 17 May 2019: 14.30 – 17.30

Time allowed: 3 hours

DO NOT TURN OVER UNTIL TOLD TO BEGIN

There are **SIX** questions in this paper. Candidates should answer **FOUR** questions. All questions carry equal marks, and full marks can be obtained for complete answers to a total of **FOUR** questions. The marks for each part of a question are indicated at the end of the part in [.] brackets.

Only your first **FOUR** answers, in the order that they appear in your answer book, will be marked.

There are 100 marks available on this paper.

A handheld calculator may be used when answering questions on this paper but it must not be pre-programmed or able to display graphics text or algebraic equations. The make and type of machine must be stated clearly on the front cover of the answer book.

Question 1 Creativity

(a) Give 3 ways in which a computer, with appropriate software and peripherals, can aid creativity in visual arts. For each of the 3 ways that you list, describe what software and peripherals – if any – might be needed, and for each way, describe very clearly the way in which creativity is aided. Also discuss any limitations in any of these. [10]

(b) Discuss the potential use of computers to aid creativity in the performing arts, such as dance and theatre. [4]

(c) i. What is an algorithm? [2]

ii. Discuss the role of algorithms in creative thinking. [4]

(d) The cultural context in which an artwork is viewed can have a significant impact on how it is seen. Discuss the Damien Hirst work *Mother and Child, Divided* with regard to this. Include in your discussion, if appropriate, how language impacts perception. [5]

Question 2 Data, sound and motion

(a) Explain the difference between sampling and compression in the context of storing sound on a computer. You should begin by explaining what each of these is, and then also discuss the tradeoffs that need to be considered in each of them. [12]

(b) Briefly describe the Theremin device, including stating how pitch and volume are controlled. [5]

(c) What is the `Boolean` data type in *Processing*? [2]

(d) Explain what the *Processing* `frameRate()` function is and discuss its role in the creation of animated output. Include constraints and compromises as part of your discussion. [6]

Question 3 Colour, shape and structure

(a) Many of the Bauhaus artists developed ideas and theories of colour. Describe the theory of colour of a Bauhaus artist of your choice, and discuss how it relates to current ideas about colour. [5]

(b) Describe the two models of colour that *Processing* provides. What is the difference between these two models? When would you choose to work with which? [6]

(c) What is transparency, in the context of colour? Describe the mechanism used in *Processing* for the implementation of this concept. [4]

(d) In the context of 3-D graphics, what is translation and what is rotation? Illustrate your answer with an example of each. [4]

(e) Does translation followed by rotation have the same result as rotation followed by translation? Justify your response. [6]

Question 4 Generative systems

The *Processing* code shown below implements a simple L-System. Study the code and then answer the questions that follow.

```
1  float  d = 50;
2  float  ang = -PI/4;
3  String state = "F";
4  String F_rule = "-FF[+F]";
5  int    n = 2;
6
7  void setup() {
8    size(800,800);
9    background(0);
10   stroke(255);
11   noLoop();
12   for (int i=0; i < n; i++)
13     state = substitute(state, F_rule);
14 }
15
16 void draw() {
17   translate((width*6)/8, (height*3)/8);
18   rotate(-HALF_PI);
19   for (int i=0; i < state.length(); i++) {
20     turtle(state.charAt(i));
21   }
22   println(state);
23 }
24
25 void turtle(char c) {
26   switch(c) {
27   case 'F': line(0, 0, d, 0); translate(d, 0); break;
28   case '-': rotate(ang);  break;
29   case '+': rotate(-ang); break;
30   case '[': pushMatrix(); break;
31   case ']': popMatrix();  break;
32   }
33 }
34
35 String substitute(String s, String F) {
36   String s2 = new String();
37   for (int i=0; i < s.length(); i++) {
38     if(s.charAt(i)=='F')
39       s2 = s2 + F;
40     else
41       s2 = s2 + s.charAt(i);
42   }
43   return s2;
44 }
```

(a) When describing substitution systems such as this L-System, the terms *initiator* and *generator* are often used. What initiator(s) and generator(s) are used in this code? Give both the variable names and values used. [2]

(b) The `noLoop()` function is called on line 11 of the sketch. What effect does this function have, and why is it appropriate to use it in this sketch? [3]

(c) Explain the effect of the '[' and ']' characters in this L-system, and how this is achieved. [4]

(d) Does the code make use of recursion? Justify your answer in detail. [4]

(e) Line 22 calls the `println()` function. Write down the text that this line outputs. [3]

(f) The `turtle()` function takes an individual character from the `state` string and performs certain graphical operations according to what character it is given. What operations are performed when the function is passed an `F` character? [3]

(g) Draw the output of this sketch. Label your drawing with the co-ordinates of the beginning of the first line that is drawn. Also label the drawing with the co-ordinates of the end of the last line that is drawn. [6]

Question 5 Motion and 2D Graphics

Study the *Processing* sketch below, then answer the questions that follow.

```
1  float x = 150, y = 150;
2  float dx = 5, dy = 10;
3  float gravity = 5;
4  float ballSize = 40;
5
6  void setup() {
7   size(600,600);
8   fill(0,0,255);
9   frameRate(20);
10  noStroke();
11 }
12
13 void draw() {
14   background(255);
15   translate(x, y);
16   ellipse(0, 0, ballSize, ballSize);
17   if (x > width-ballSize/2 || x < ballSize/2)
18     dx = -dx;
19   if (y > height-ballSize/2)
20     dy = -dy;
21   else
22     dy += gravity;
23    x += dx;
24    y += dy;
25 }
```

(a) Draw a diagram to show the output of this sketch after the first call to `draw()`. State the size, position and colour of any objects drawn, the dimensions of the window, and the colour of the background. [3]

(b) Explain the purpose of lines 17 and 18 of the sketch, and the effect they have on the sketch's behaviour. [3]

(c) Line 17 includes the condition "`x < ballSize/2`". However, line 19 does not include the condition "`y < ballSize/2`". Explain why this is not required in the context of this sketch. Quantitative calculations are *not* required. [5]

(d) Give a one-sentence definition of velocity, and a one-sentence definition of acceleration. [2]

(e) Does the ball in this sketch experience acceleration in the `y` direction? Explain your answer, with reference to specific lines in the sketch where necessary. [3]

(f) Write code that will produce a visible trail of the ball's path of movement such that the old parts of the trail gradually fade away to the background colour.

You do not need to rewrite the whole sketch in your answer. Just provide any new lines of code you would add, give a line number to indicate where you would insert the code, and provide an explanation of what each new line does. Also state which existing lines you would delete or move (if any). [5]

(g) Write code that causes the ball to lose ten percent of its speed each time it hits the bottom edge of the window.

You do not need to rewrite the whole sketch in your answer. Just provide any new lines of code you would add, or state which existing lines you would delete or modify (if any). Provide an explanation of what each new or modified line does. [4]

Question 6 3D motion and Sound

Study the *Processing* sketch below, then answer the questions that follow.

```
1  float angle = 0.0;
2
3  void setup() {
4    size(800,800,P3D);
5    frameRate(20);
6    sphereDetail(20);
7    noFill();
8  }
9
10 void draw() {
11   background(0);
12   translate(width/2,height/2,0);
13   rotateY(angle);
14   stroke(0,255,0);
15   sphere(80);          // planet
16   translate(250,0);
17   stroke(255,0,0);
18   sphere(15);          // satellite
19   angle += TWO_PI/(8*frameRate);
20 }
```

(a) Draw a diagram to show the output of this sketch after the first call to `draw()`. State the size, position and colour of any objects drawn, the dimensions of the window, and the colour of the background. [5]

(b) Does the sphere labelled "planet" in the sketch (line 15) appear to move as the sketch runs? If so, how many seconds does it take to perform a complete rotation? [3]

(c) Explain the effect of the command "`sphereDetail(20)`" on line 8 of the sketch. Name one advantage, and one disadvantage, of using a lower number as the argument to this function. [3]

(d) Would the behaviour of the sketch change if we swapped lines 12 and 13 around, *i.e.* if `rotateY()` came before `translate()`? Explain your answer. [4]

(e) The movement in this sketch could be implemented in an alternative way by controlling the camera position instead of using the `rotateY()` function. State what *Processing* function you would call to set the camera position, and describe the meaning of each of its parameters. [4]

(f) We would like to extend the sketch so that it plays background music from an audio file while the sketch runs.

i. State the command that is required at the top of the sketch to allow it to make use of the *Processing* sound library. [2]

ii. Assume that the desired audio file is named "`space.wav`" and is located in the sketch's data folder. What code should be added to the sketch to allow it to load and play this file?

You do not need to rewrite the whole sketch in your answer. Just provide any new lines of code you would add, and give a line number to indicate where you would insert each line. [4]

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