



Final Examination

College	Engineering, Science & Technology
School	Electrical & Electronics Engineering
Programme	Bachelor of Engineering (BE Year 2)
Semester	I
Year	2017
Unit Code	EEE662
Unit Title	Engineering Software
Date of Examination	June 05
Time	9.00 am to 12.10 pm
Venue	TBA
Duration	3 Hours (<i>extra 10 mins allowed to read the paper</i>)
Maximum Marks	100

Instructions

1. There are five (5) questions worth 20 marks each. Attempt all questions in the answer booklet.
2. Write your answers legibly in the answer booklet.
3. Write your student identification number on each page used.

Question 1 (20 Marks)

- (a) What is inheritance? (1)
- (b) What is the purpose of declaring certain objects with keyword `const`? (1)
- (c) What is meant by redefining a base-class member? (1)
- (d) On what part of memory are variables declared using `new` stored? (1)
- (e) What is an abstract class? (1)
- (f) Explain what the terminology *programming by difference* means in terms of derived classes? (1)
- (g) How are constructors and functions similar? How are they different? (2)
- (h) Explain when to use the dot operator (`.`) and when to use the arrow operator (`->`). (2)
- (i) What is the difference between single and multiple inheritance? (2)
- (j) The following code snippet has a bug. Identify it and indicate how to correct it. (2)

```

1 ...
2 int size;
3 cin >> size;
4 int *nums = new int[size];
5 for(int i = 0; i < size; ++i)
6 {
7     cin >> nums[i];
8 }
9 ... // Calculations with nums omitted
10 delete nums;
11 ...

```

- (k) The following code snippet will cause a memory leak. Indicate how to correct the memory leak. (2)

```

1 ...
2 int *getPtrToFive() {
3     int *x = new int;
4     *x = 5;
5     return x;
6 }
7
8 int main() {
9     int *p;
10    for (int i = 0; i < 3; ++i) {
11        p = getPtrToFive();
12        cout << *p << endl;
13    }
14 }

```

- (l) The following code snippet will cause a “dangling pointer” problem. Explain how the problem can be fixed and fix it by modifying the code. (4)

```
1 ...
2 class IntegerArray {
3 public:
4     int *data;
5     int size;
6
7     IntegerArray(int size)
8     {
9         data = new int[size];
10        this->size = size;
11    }
12
13    ~IntegerArray()
14    {
15        delete[] data;
16    }
17 };
18
19 int main() {
20     IntegerArray a(2);
21     a.data[0] = 4; a.data[1] = 2;
22     if (true) {
23         IntegerArray b = a;
24     }
25     cout << a.data[0] << endl;
26 }
```

Question 2 (20 Marks)

Some students created a class in C++ with the name `Vehicle`. The class contains the following members declared under the respective access specifiers.

1. The license number of the vehicle
protected: `string license`
2. The year of manufacture of the vehicle
protected: `int year`
3. Member function to display the license number and the year of the vehicle
public: `void displayDesc() const`
4. Member function to return the license number of vehicle
public: `const string &getLicense() const`
5. Member function to return the year of the vehicle
public: `const int getYear() const`

The class contains a two parameter constructor that initializes the two data members `Vehicle(const string &myLicense, const int myYear)`. For the following questions, assume that the class is in `main.cpp`, therefore there is no need to separate the header and implementation. Also assume that the appropriate libraries are included.

- (a) Write the C++ code for the class mentioned above.

(10)

- (b) Create a class `Car` that inherits from class `Vehicle` and has the following additional members. (7)
1. The style of the car e.g., sedan, hatchback etc.
`private: string style`
 2. A member function `public: void displayDesc() const`, that overrides the base class member function of the same name. This function displays the description of the car.
 3. A member function `const string &getStyle() const`, that returns the style of the car.
- The `Car` class will also have a constructor to initialize the base class constructor and its own data member.
- (c) Write the C++ code to make the `void displayDesc()` member function *pure virtual*, thus making class `Vehicle` an abstract base class. (1)
- (d) Write the C++ code to create a function by the name `printDescription` that can print or display the description of any type of vehicle. The function should have one input argument that should accept objects of any vehicle types. (2)

Question 3 (20 Marks)

The CNC drilling machine designed at SEEE works such that it reads a text file which contains coordinates (x, y) , which represent the position of holes on the workpiece. Write a complete C++ program that uses the `fstream` class to open a text file which contains an unknown number of hole positions, one on each line, where the x and the y coordinates are separated by comma (,). This is shown in figure 1. Your program should read and store those values in an array. Assume that the array has a fixed size. Your program should also print the coordinates on the console screen. Your program should also cater for the case if the text file is not opened successfully. Note: It is not compulsory to create a class in this question.

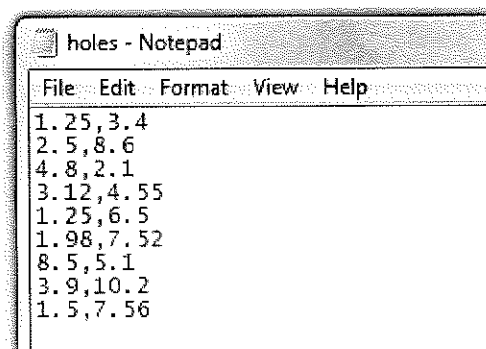


Figure 1: Sample text file

Question 4 (20 Marks)

- (a) What is OpenGL? (2)
- (b) State and explain the three libraries required to build an OpenGL program? (6)
- (c) What are the four steps in OpenGL coding framework? (8)
- (d) Write a function with the name `void display()` that will be GLUT Display Callback for displaying a filled blue polygon with vertex $\{(0.5, 0.5), (0.5, 0.9), (0.9, 0.9), (0.1, 0.1)\}$ on the glut render window. Assume you are using a single buffer. (4)

Question 5 (20 Marks)

- (a) Name the two types of fuzzy inference systems? (2)
- (b) State and explain the fuzzy inference steps in a mamdani type fuzzy inference system? (8)
- (c) Some students built a fuzzy logic based system to control fan speed based on temperature read by a temperature sensor. This is a one input, one output system realized using a microcontroller. The linguistic variable for the input is *Temperature* and contains the linguistic values *cool*, *warm*, *hot*. Triangle membership functions are used and the parameters of the membership functions are $\{25, 62.5, 100\}$

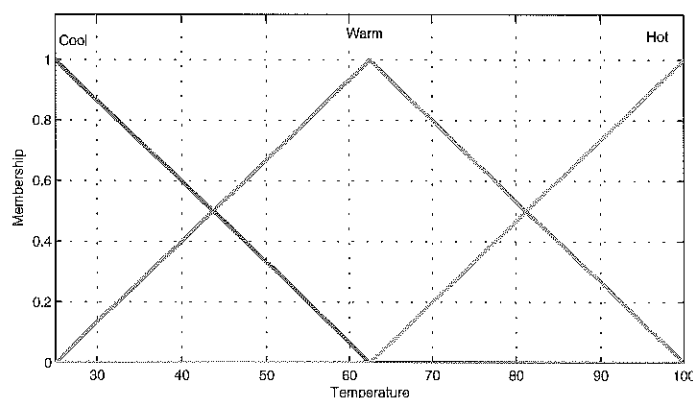


Figure 2: Membership function plot for *Temperature*

The linguistic variable for the output is *Speed* and contains the linguistic values *low*, *medium* and *high*. Singletons are used as membership functions. The parameters for the three singletons are $\{1000, 2250, 3500\}$

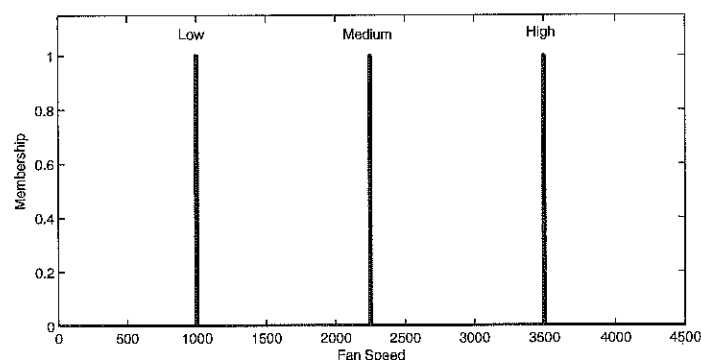


Figure 3: Membership function plot for *Speed*

The system works using three fuzzy rules which are:

IF temperature is cool THEN speed is low

IF temperature is warm THEN speed is medium

IF temperature is hot THEN speed is high

Answer the following questions with respect to the information given

- i. Compute the membership values $\mu_{cool}(t)$, $\mu_{warm}(t)$ and $\mu_{hot}(t)$ if a temperature value $t = 37.0$ is detected by the sensor. (6)
- ii. Determine the activation degrees or the truth values ϕ_1 , ϕ_2 and ϕ_3 of each of the three rules. (1)
- iii. Compute the fan speed output of the fuzzy system based on the input temperature in the part (i) using the weighted average method. (3)

The End

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