



## Final Examination

<b>College</b>	Engineering, Science & Technology
<b>School</b>	Electrical & Electronics Engineering
<b>Programme</b>	Bachelor of Engineering (BE Year 2)
<b>Semester</b>	I
<b>Year</b>	2016
<b>Unit Code</b>	EEE662
<b>Unit Title</b>	Engineering Software
<b>Date of Examination</b>	June 17
<b>Time</b>	9.00 am to 12.10 pm
<b>Venue</b>	NA
<b>Duration</b>	3 Hours ( <i>extra 10 mins allowed to read the paper</i> )
<b>Maximum Marks</b>	100

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### 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) In your own words define an algorithm? (1)
- (b) State and explain the three key features of object oriented programming. (6)
- (c) What is an *abstract base class*? (1)
- (d) Explain what the terminology *programming by difference* means in terms of derived classes? (1)
- (e) Data members declared inside classes can have **public**, **protected** or **private** access specifiers. Explain the visibility of the data members declared under the three access specifiers from
- i. within the same class? (2)
  - ii. within a derived class of the class where it has been declared? (2)
  - iii. outside the class such as in `main()`? (2)
- (f) On what part of memory are variables declared using `new` stored? (1)
- (g) The following code snippets have bugs. Identify them and indicate how to correct them.
- i. \_\_\_\_\_ (2)
- ```

1 ...
2 class Point
3 {
4 private :
5     int x, y;
6
7 public :
8     Point (int u, int v) : x(u),y(v){}
9     int getX () { return x; }
10    int getY () { return y; }
11    void doubleVal ()
12    {
13        x *= 2;
14        y *= 2;
15    }
16 };
17
18 int main ()
19 {
20     const Point myPoint (5, 3)
21     myPoint . doubleVal ();
22     cout << myPoint . getX () << " " << myPoint . getY () << " ";
23     return 0;
24 }

```
- ii. \_\_\_\_\_ (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 ...
```

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**Question 2** (20 Marks)

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

1. The ID number of person associated with FNU  
protected: `int ID`
2. The name of person associated with FNU  
protected: `string Name`
3. The address of person associated with FNU  
protected: `string Address`
4. Member function to display the profile of person associated with FNU  
public: `void displayProfile()`
5. Member function to change the address of person associated with FNU  
public: `void changeAddress(const string& newAddress)`

The class contains a three parameter constructor that initializes the three data members `FNUPerson(int ID, const string& Name, const string& Address)`. 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 `Student` that inherits from class `FNUPerson` and has the following additional members. (4)
  1. The course taken by the student  
private: `string courseTaken`
  2. The year the student is enrolled in  
private: `int Year`
  3. A member function public: `void displayProfile()`, that overrides the base class member function of the same name. This function displays the profile of FNU student.
- (c) Create a class `Staff` that inherits from class `FNUPerson` and has the following additional members. (4)
  1. The course being taught by staff  
private: `string courseTaught`

2. The rank of the staff eg. Assistant, Senior, etc  
`private: string Rank`
  3. A member function `public: void displayProfile()`, that overrides the base class member function of the same name. This function displays the profile of FNU staff.
- (d) Write the C++ code to make the `void displayProfile()` member function *pure virtual*, thus making class `FNUPerson` an abstract base class. (1)
- (e) Write the C++ code to create a function by the name `ShowProfile` that can display the profile of both staff and student. The function should have one input argument that should accept objects of both student and staff types. (1)

### 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 class in C++ called `ReadData` that uses the `fstream` library 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 class should read and store those values in an internal data member of the class. Test your class by creating an instance in `main()` and reading a set of 9 coordinates as shown in figure 1. Your program should also display the coordinates on the console screen. Your program should also cater for the case if the text file is not opened successfully.

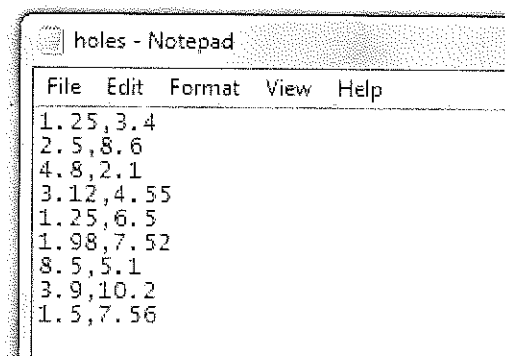


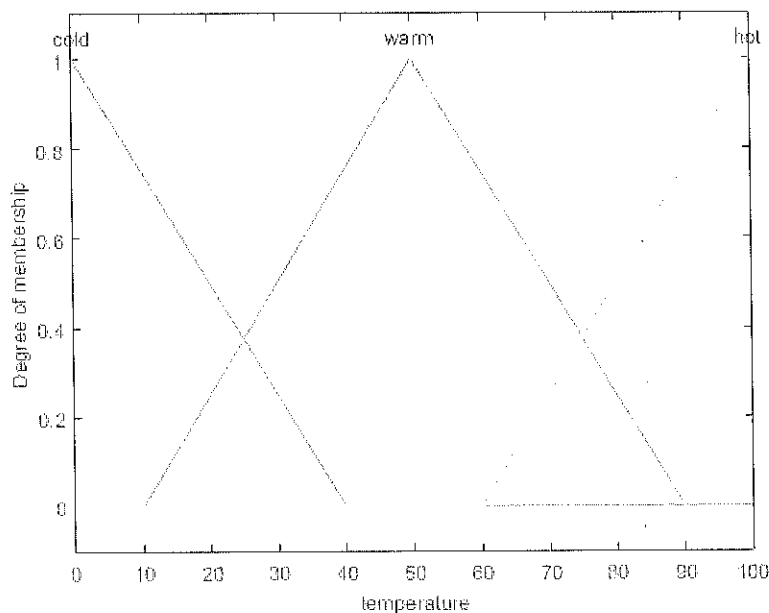
Figure 1: Sample text file

### 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 yellow polygon with vertex  $\{(0.5, 0.5), (0.5, 0.8), (0.8, 0.8), (0.1, 0.1)\}$  on the glut render window. (4)

## Question 5 (20 Marks)

- (a) Name the two types of fuzzy inference systems? (2)
- (b) State and explain the four 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 zero-order Sugeno type fuzzy inference system realized using a microcontroller. The linguistic variable for the input is *Temperature* and contains the linguistic values *cold*, *warm*, *hot*. Triangle membership functions are used as shown in figure 2.

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}

The system works using three fuzzy rules which are:

- IF temperature is cold 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  $\mu_{cold}(t)$ ,  $\mu_{warm}(t)$  and  $\mu_{hot}(t)$  if a temperature value  $t = 70$  degrees is detected by the sensor (6)

- ii. Determine the firing strength  $\phi_1$ ,  $\phi_2$  and  $\phi_3$  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**

Designed using L<sup>A</sup>T<sub>E</sub>X 2<sub>ε</sub>  
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