**Part 1**

* 1. Outline and describe the steps involved in the process of building an application from writing to execution:

1. Define the problem:

It is the most important and difficult step in the process of building an application and it involves diagnosing the situation itself. It is even more important than defining the solution. Understanding the problem that you are trying to solve by asking yourself [how can we…] will help you to think properly and decide on the steps that you need to solve this problem

1. Algorithm:

There are two ways to solve a problem which are flowchart or pseudocode or both of them.

1. Write a code:

In this step you need to change the flowchart into a programming language such as C++, java, python …etc. In order to make sure that the code works, you need to apply the syntax of the language and code standards precisely. It is a good idea to use good applications such as an IDE because it contains all the necessary tools which you need to write the code.

4- Test and debug :

After writing the code, you need to test the program because no matter how much careful you are in writing the code, it is possible to encounter some problems. To solve these problems, first proofread your code. Then, use a translator to examine the syntax of your software. After that, debug your code whice is the process of discovering and fixing bugs or faults to prevent them.

5- Documentation:

In this step, you need to write explanations of the programming cycle and some details about the program. The most important element of documentation is the comments which describe and explain the steps of the code. Documentation is very important because you need to go back to the code after a period of time and it helps other programmers to understand the code.

**1.2)** Define what an algorithm is and outline the characteristics of a good algorithm: [1]

Algorithm: is a set of instructions or rules which are designed to solve a problem. The order of these rules is very important ( step-by-step process). It can be written by flowchart and pseudocode. An algorithm can be very simple such as multiplying two numbers, or it can be very complex such as playing a video game. Each problem has many algorithm to solve it but programmers always look for the unique and efficient algorithm to solve it.

What are the Characteristics of an Algorithm?[2]

Diagram

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1. Input: An algorithm needs a well defined input.
2. Output: An algorithm must describe and define the output that will be produced clearly.
3. Unambiguity: The instruction of the good algorithm should be clear and straightforward. Each phase should be distinct and lead to single conclusion.
4. Finiteness: An algorithm should be finite and should not end with infinite loops or something similar.
5. Effectiveness: An algorithm should be adequate because each instruction affect the overall process.
6. Language Independent: It must contain simple instructions that can be implemented in any language and give the same results.

**1.3)**Write an algorithm that converts a binary number into decimal and converts the decimal into digital format, explain your chosen algorithm, and describe the algorithm steps in pseudo code:

**I choose this algorithm because I see that get the number digit by digit simpler than any algorithm needs hard mathematic calculations**

1. **Start**
2. Receive the binary number
3. Create variables to store the decimal number and power
4. Initialize the variables
5. Get the first digit of the binary number from right
6. Add the digit multiply with 2 to power to the decimal number
7. Remove the digit from the binary number
8. Increase the power by 1
9. Get the second digit from the binary number then the third until remain just zero
10. **Print the decimal number**
11. Create variable for the digital representation and initialize it with new line
12. Create 3 arrays array for each row of the digital number and initialize them with the correct representation for the number in the index
13. Get the first digit of the decimal number from the left
14. Add the row 1 value at this digit location to the digital representation variable
15. Get the second digit and add the row 1 value at it to the digital representation variable
16. Repeat until the last digit
17. Add new line to the digital variable
18. Then repeat (13-17) for row number 2 then row number 3
19. **Print the digital representation**
20. **End**

* **1.4) Write a Java program code**

**1.5)** Evaluate the above implementation of the algorithm and the relationship between the written algorithm and the implemented code:

**1-Start**

2-Receive the binary number

A picture containing company name

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3-Create variables to store the decimal number and power

4-Initialize the variable

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1. Get the first digit of the binary number from right 
2. Add the digit multiply with 2 to power to the decimal number 
3. Remove the digit from the binary number 
4. Increase the power by 1



1. Get the second digit from the binary number then the third until remain just zero



1. **Print the decimal number**



1. Create variable for the digital representation and initialize it with new line



1. Create 3 arrays array for each row of the digital number and initialize them with the correct representation for the number in the index

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1. Get the first digit of the decimal number from the left

Note: To get first digit from the left you should convert integer to string through



Then : I use function char At() to get value of first digit from left as character then convert it to string after that to integer.





1. Add the row 1 value at this digit location to the digital representation variable



1. Get the second digit and add the row 1 value at it to the digital representation variable



1. Repeat until the last digit

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1. Add new line to the digital variable



1. Then repeat (13-17) for row number 2 then row number 3

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1. **Print the digital representation**



1. **End**

**Part 2**

**2.1**) Define what is meant by a Programming Paradigm. Explain the main characteristics of Procedural, Object oriented and Event-driven paradigms and the relationships among them. [4][5]

**Programming Paradigm:[4]** It is a method to solve a problem or do a task using some programming languages, tools and techniques following some a available approach to us, in other words it is the type of style of the code and how it is written.

There are many types of Programming Paradigm such as:

1. Procedural
2. Object oriented programming
3. Event-driven

**Procedural :** It is the simplest type of programing paradigms. It is the first type which is good for beginner programmers because it is very simple and follows a liner top-down approach which divides a program into procedures (functions) and defines the steps that a programmer must follow.

Characteristics of procedural programming:

1. It reduces code duplication because it breaks down a program into functions.
2. It improve modularity and organization
3. It improve readability and maintainability
4. It expected as liner top down
5. Function are isolated completely, so if you want to share data you should declare it in the upper scope

**Object oriented programming: [5]** It is a type of Programming Paradigm which focuses on software design of data, object, class, inheritance, encapsulation and polymorphism. An object means a data field that has unique attributes and behaviors. It is good for programs which are large and complex and programs for manufacturing and mobile application . It is also useful for collaborative development in which project divided into groups.

object oriented programming characteristics:

1. Inheritance: It allows programmer to reuse the code when it has common feature of other class . It is something like a son inherits his qualities from his father.
2. Encapsulation: It allows programmer to hide details and can be done by keeping the members of the class or methods private so they can only be accessed by setter and the getter methods.
3. Polymorphism: It describe the concept that different types of objects can be accessed through the same interface. It can be done in two different ways such as overloading and overriding.
4. It reduces complexity and increases efficiency and security because it divides the program into classes and objects.
5. Code reusability
6. It is best for group work

**Event-driven:**

It is a programing model in which a program is executed by the occurrence of an event by user such as mouse or keyboard . It is designed to detect events as they occur and deal with them using suitable handling procedures. It can be written in any programming language. It is common in graphic user interfaces (GIU) that are about executing certain actions based on user’s input.

The characteristics of event driven:

1. It is easy to develop and has simplicity of programing.
2. Trigger functions: it determines which code to run when the user clicks the button to start an action, a signal is sent to the program, and it runs
3. Time functions: it is a code designed to be executed over a specific time (once an hour, once a month, once a year and once every two days.
4. Event handlers: it is an action that occurs because if the occurrence of a specific event. In other words when the event occurs action are executed. For example, in my code when I press the button the rules will be executed.
5. Event listener: it is a program code which listens for instruction or event. When one of these action is performed, it then does something based on the event
6. It is common in graphic user interfaces (GIU)

**The relationship between procedural, oop and event driven paradigms:**

In common usage the three paradigms are nested within one another that is the procedural is the basis of three paradigms which means that the oop is based on the procedural and can not work without the procedural. The class is collection of a processors which are connected together to achieve a certain goal. Also, the event driven is based on both the procedural and the oop. We can say that the procedural is used in all cases then we use the oop and the event driven to add new different features. In other words there is no program without procedural paradigm and it should be in the basis of the **hierarchy.** Another point is that the event driven is based on class which means that there is a class for every possible event and there is object for this event.

 keyEvent is a class and e is an object.

**2.3)** Compare and contrast the procedural, object orientated and event driven paradigms used in the above source code .

**Procedural:** I used three methods, each one does different tasks. I didn’t use classes and objects to divide the code, which makes the code more difficult. As a result, I used five arrays to enter information of students which made the code longer and more difficult.

In this type the code is written and executed in a linear style. Override and inheritance are not possible.

Also, it divide the code into small part which are code functions. The code will be less secure because it does not have any way to hide data.

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**OOP:**

In the oop I used one array to enter information of student which makes the code simpler and easier to write and understand.

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Procedural is used when the code is simple but when the code is complicated, we use the oop because the oop divides the code into classes which make it simpler and easier to understand.

In this type the code is written as classes and designed to do specific tasks. Override and inheritance is possible. Also, it divide the code into classes and object. The code will be more secure because it provide good way to hide data.

**Event driven:** it is a type of programming which is different the other two types above because it uses GIU and depends on an event by user and every thing executed depends on the occurrence of an event or not. An event could be click on the button, type on the text and move mouse on the frame.

In this type the code depends on occurrence an event such as mouse clicking and moving or typing on text. Override and inheritance are not possible. The code will be less secure because it does not have any way to hide data.

**2.4)** Critically evaluate the code samples that you have above in relation to their structure and the unique characteristics.

Procedural:

1. The first type of functions

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This function does not take parameter and does not have return type and it is the simplest type because when I call it (print\_decoration() ) I don’t send an argument. It will execute what inside it (/n###################) and it will not return any value.

1. The second type of functions

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This function takes parameter but does not have return type

In this function I send the argument and then it will execute what inside it without returning any value.

1. The third type of functions

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This function takes parameter and it has return type

When I call this function and send the argument, it will execute what inside it and give return value.

1. The fourth type of functions

This functions does not take parameter but have return type

**OOP:**

first we should have classes and object

class is a blueprint that contains attributes, method and constructors and we can take Instances from it by objects.



Object is an instance of class and I can make unlimited number of objects.



Std1 is object that is an instance of class

 by this step I booked a place of attributes in the memory.

**Constructor:**

The main purpose of constructor is to give initial values of attributes

The first type of constructor is called default constructor because it gives default values to attributes.

And if I want to give values to attributer by object (std1. Attributes) these values will be only for this object and this will not affect its value in the class.

In the process of giving values to attributes and the constructor was in type one I will do the process shown in the picture. this way is long so we can use another type of constructor which is called Multi constructor .



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this type of constructor is embedded in class but if we use another type with it we should write it in class

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The second type is multi constructor and it follows overloading (the same name of constructor with different parameter and in each case it does different role)

This way is easy because we enter values of attributes when we call the constructor

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And in this case we should write constructor in the class

Text

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I used (this) to connect attributes value in class with variable in constructor

Note : we should not forget rules of constructor 1) the same name of class and follow naming convention (pascal case) because if I don’t follow it I will think the constructor is function without return type 2) constructor is not function because it does not have return type it is just to initialize value of attributes

3) we can call it just when we use object 4) its number limited in class

**Modifier:**

1)Access modifier we put it before variables, method, classes and constructor such as

public : at the level of project

Graphical user interface, text

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Private : at the level of class



Default: at the level of package such as ( int name;) I don’t write anything before variables, method, classes and constructor

Protected: what could reach this function by adding a value in it is the class which inherits from the class which has the setGpa function

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In my code just two classes can reach this function because they inherited from class which has the setGpa function





2) non access modifier we put it before variables, method, classes and constructor such as

Static: if we put static before variables and method, I can not make object in the class of the variables and method because it becomes owned by the class. If I want to make call of functions I should write in main class (name of class. Name of function(); )



**Encapsulation:**

to do this I need 1) to make the attributes private so that to prevent unwanted access to the values of attributes 2) make getter and setter of these attributes to be able to access the attributes. Also, use access modifier of getter and setter.



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**Library:**

Library : set of packages and classes

There are two types of library

1. Predefine: it originally exists and I just use it
2. user define: I create it then I use it

the purpose of the library is to use functions which I put in the library when I need them instead of writing them every time. Using library saves time and effort and makes errors less.

Examples of predefined library are :

1. Jave.lang.System , Java.lang.String
2. Java.util.Scanner , Java.util.AttayList

Note: when we use new class in any library or packages I must write import in main class

Such as if I use class scanner I should write in main class (import Java.util.Scanner; )

**Inheritance:**

There are super(parent) class and sup(child) classes.

Super class: sup class:

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In this case student is the super and SecondarySchoolStudent inherited from student

And there may be another super and sup classes in the same code

Graphical user interface

Description automatically generated with medium confidence

SecondarySchoolStudentis the super and ScientificStudentinherited from SecondarySchoolStudent

SecondarySchoolStudent is the super and LiteraryStudent inherited from SecondarySchoolStudent

**G** this step helps me not to repeat the code because the sup class inherits the common features from super class by writing (extend). I only write the sup own features which the super does not have.

**override:**

In ScientificStudent class

Text

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In LiteraryStudent class

A picture containing graphical user interface

Description automatically generatedThese are examples of override which is the same name of functions and the same parameters but the implementation is different. These two functions could access

A picture containing text

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**overload:**

In LiteraryStudent class

Graphical user interface, text

Description automatically generated with medium confidence

In ScientificStudent class

Text

Description automatically generated

These are examples of overload which is the same name of function but not the same of parameters.

When the parameter changes, the performance of the function will change.

Event driven:

**Classes**

1. **JFrame**

Text, letter

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**2)JTextField**

Text

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**3)JButton**

Text

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**4)JLabel**

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**Listener**

**Listener:** it depends on the occurrence of a certain event if the event occurs, the listener will check the event. If it is what we want, the listener will execute the task.

1)



a)



It will be executed when I type on the text

KeyEvent is class / e is object that have information of the button on the keyboard

b)



It will be executed when I type on the text then I release my finger from keyboard

c)



It will be executed when I press on the text

2)



addActionListener is a function that has parameter (ActionListener is called interfaces which includes different functions and it is a type of class)

a)



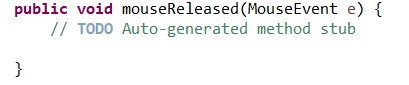
It will be executed when I press on the button

3)



This listener is related to buttons of the mouse and it is used with frame and button.

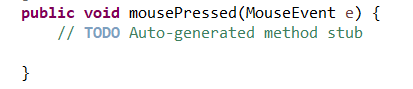
a)



It will be executed when I released my finger from the button using the mouse

e is object that have information of the button on the mouse

b)



It will be executed when I press and pull my finger using mouse

c)

Text

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It will be executed (background of button will change into green and the font of button will change into gray) when I enter the curser on the button using the mouse

d)

Text

Description automatically generated

It will be executed (background of button will change into gray and the font of button will change into green) when I get the curser out on the button using the mouse

e)

Text

Description automatically generated

It will be executed when I click on the using mouse without pull

4)



This listener is related to movement of the mouse and it is used with frame and button.

a)

A picture containing graphical user interface

Description automatically generated

MouseMoved will be executed (the title of frame will change into Binary to decimal converter (You are moving ...) ) when I move my finger on the mouse on the frame

b)

A picture containing graphical user interface

Description automatically generated

 MouseDragged will be executed (the title of frame will change into Binary to decimal converter (You are dragging ...))when I press and move my finger on the mouse on the frame

Joptionpane:

Text

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**it will be executed as the picture below when I enter any letter**

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**Part 3**

* **3.1)** **Use the IDE to manage the development process of the above code implementations.**

**3.2)** Evaluate the use of an IDE for development of applications contrasted with not using an IDE: [3]

An Integrated development environment (IDE) is basically an environment or combination of tools such as compiler, debugger, text editor… which are prepared for the programmer to write a code. It helps to combine usual activities of writing a code into an application such as dubbing, editing source code, building executables. IDE is very important because it support many languages of writing a code. The tools and facilities IDE provides make writing a code easier and faster.

* Using an IDE has many important features:

1- every IDE have a text editor to write and manipulate a code by using drag and drop technique and simple language syntax

2- it has debugger which helps developers to identify and locate and solve mistakes immediately before we run the code, and this is one of the most important tools to spread a successful program.

3- It has a compiler which translates and analyze the programming language into a language that the machine or the computer understands

4- It has a Code insight and completion feature which help developers by guessing and suggesting to complete what you write. As a result, it saves time writing code and reduce errors.

5- it supports many programming languages, you only need to decide which language and it automatically run the suitable tools.

6- It has good integration tools which increase efficiency and make performance faster with less effort.

7-the program can **change text color** to represent different classes, functions, and variable.

8-It helps collaboration of many programmers who can easily work together within IDE.

9-It helps code management.

* Not using an IDE has many disadvantages:

If you are not using an IDE, you will miss many good points:

1. You will not be able to debug and locate mistake immediately while you are coding, which takes more time and effort than using IDE.
2. You can not manage your project as efficient as a programmer who uses an IDE.
3. You will be less efficient than a programmer with an IDE because using IDE save time and effort.
4. Collaboration with other programmers is very difficult when not using an IDE.
5. You will miss using a lot of tools and facilities such as Code insight, text color change, drag and drop technique and many others.

* Negative points and difficulties of using an IDE:

1. It is too complex for beginning programmers.
2. It needs a lot of time to learn how to use it properly.
3. It needs knowledge to code efficiently

To be honest, if an IDE is used by programmers properly and efficiently, its advantages can outweigh any disadvantage of using it.

**3.3)** Explain the debugging process you followed in writing your programs, and explain the debugging facilities available in the IDE: [8]

Debugging is the process of finding problems in the software code and fixing them which may cause abnormal behavior or crash. Debugging is more difficult when the code has many modules which are connected to each other because any change in one module may cause more bugs in other modules. Debugging takes most of the time of the successful developer because finding and solving errors is more important than avoiding them. They start with identifying the problem, isolating the source code and then fixing it.

There are many steps in my debugging process: after I finished writing my code, I checked if there was any syntax error, there were no syntax errors and the code runs well. Just when another user used the code and tried to enter a number which is not binary, the code didn’t give a correct result, thus there was a logical error. I thought of a solution for this error and I found that I should check the number before it is converted into decimal by the code as shown in the picture:

Text

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At the same time, there was another problem which was: after the user gets out of for loop, the code should not execute anything if he entered a number which is not binary so I should check if the number is binary, execute after the for loop as shown in the picture:

Graphical user interface, text, application

Description automatically generatedGraphical user interface, text, application

Description automatically generated

Another problem faced me was that if I entered a letter, the code would stop and show that there was error. I don’t want the code to stop if another user used it and entered any letter, so I used exceptions (try and catch). In this case. After using this solution, the error will be as a message and the code won’t stop as shown in the picture:

Text

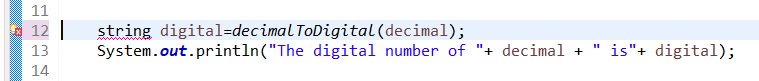
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**The debugging facilities available in the IDE**:

There are many types of errors which could be detected in the debugging process. These could be syntax errors, logical errors and run time errors.

When a syntax error occurs in the software code, the IDE will provide different facilities.

First the error will be marked with cross next to the line number. Then, the whole line will be highlighted. When we press on the cross, many suggestions and solutions will appear which you can choose the most appropriate solution.



There are two ways to detect the logical error. The first one is manual by which we divide the code by writing comment statement and print statement and then we can conquer the errors. The other way is provided by the IDE which is breakpoints. In this way, we set a breakpoint which enables you stop a program at specific points to check the values and variables. We can insert the breakpoint into the code by clicking the line number on the left which we want to trace. They are marked as red circles over the line number. The code will work until it reaches a breakpoint.

Graphical user interface

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Other facilities by IDE are steppers which allow you to keep running the code line by line by pressing these keys on the keyboard: step into, step over, step return and resume. 

They allow you to check the value of variables at each step of the code and they are similar to trace table for a variable.

Graphical user interface, application, table

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**3.4)** Evaluate how the debugging process can be used to help develop more secure, robust applications:[9]

Debugging is the process of finding bugs (errors) in the software code and fixing them. These bugs can be found either by testing or by user. This process makes your program stronger and more powerful because it helps you to write your program professionally so that it will be completely free from errors. It is true that debugging revels the mistakes you may have committed in your code and makes the code stronger and more secure, but at the same time you should not relay on debugging for safety issues because it is a reactive process and it is not strong enough to depend on for safety matters. In other words, through debugging you can find errors but this will not make your program as safer or more secure.

**3.5)** Outline the coding standard you have used in your code: [10]

Coding standards are set of rules and techniques to create and develop a less complex and more efficient code. If you follow these standards the code will be easy to understand and any one can modify at any time.

**Coding standards**

1. **length of function should not be very large**

As I did in my first code I write tiny function because it is easy to understand and perform little tasks. Also, if I have a longer function, I will divide it into smaller ones.

Graphical user interface, text

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1. **Use appropriate naming conventions**

For classes I used Pascal Case (the first letter of each word is capital).

Class: 

For variables and methods I used camelCase ( if the method or variable name is single it is written in lowercase but if the method or variable name is compound the first word is written in lowercase and the next words begin with capital letters).

Function:

Variable: 

1. **Not using long lines**

It is easier to read short lines horizontally. If the line is long it will be difficult to read it because you need to move horizontally.

1. **Code should be documented**

In my code I added comments to the statements so that it is well connected and easy to understand.

Calendar

Description automatically generated with medium confidence

1. **Getter and setter**

I used method of writing the getters and setters. The getter starts with get and does not take an argument and has a return type. The setter starts with set and takes an argument and does not have a return type.

Graphical user interface, text, application, chat or text message

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**and critically evaluate why it was necessary in your work specifically and in team works generally:[11] [12]**

**Why is coding standard necessary in my work?**

It is more important for programmers to have coding standards depending on what is suitable for their company and the type of software they develop. For my the coding standards helped me to reuse the code and to detect errors easily which helped me in terms of cost. Also, the code will be less complex so you can understand it easily and maintain consistency. Coding standard increase chances of success of my code because problems that may occur are less. Finally they improves readability and efficiency of my code.

**Why is coding standard necessary in a team?**

Coding standards ensure that all developers who are writing a code follow the same set of rules and methods in any given language so it is easy for them to understand the code, maintain consistency and complete it without questioning. Another point is the uniform appearance of the code written by different developers. If any programmer looks at, he or she will be able to write and install it easily. In other words, the finished code will look like as if it was written by one developer because it is understandable, easy, high quality and professional.

**References:**

1. <https://www.geeksforgeeks.org/introduction-to-algorithms/?ref=lbp>
2. <https://www.simplilearn.com/tutorials/data-structure-tutorial/what-is-an-algorithm>
3. <https://www.geeksforgeeks.org/ide-full-form/>
4. <https://www.geeksforgeeks.org/introduction-of-programming-paradigms>
5. <https://www.techtarget.com/searchapparchitecture/definition/object-oriented-programming-OOP>
6. <https://www.chegg.com/homework-help/describe-differences-event-driven-procedural-object-oriented-chapter-12-problem-4loc-solution-9781133908456-exc>
7. <https://www.geeksforgeeks.org/differences-between-procedural-and-object-oriented-programming/>
8. <https://economictimes.indiatimes.com/definition/debugging>
9. <https://docs.microsoft.com/en-us/visualstudio/debugger/debugger-security?view=vs-2022>
10. <https://www.browserstack.com/guide/coding-standards-best-practices>
11. <https://www.multidots.com/importance-of-code-quality-and-coding-standard-in-software-development/>
12. <https://www.geeksforgeeks.org/coding-standards-and-guidelines/>