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ICT40515 Certificate IV in Programming

[Let’s](https://opencolleges.my.salesforce.com/a0QE0000009b11Z) get programming with C#

**SP5/Module 8 Assessment**

ICTPRG406 Apply introductory object-oriented language skills

ICTPRG415 Apply skills in object-oriented design

ICTPRG413 Use a library or pre-existing components

Assessment: 33129/01

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**Assessment task 33129/01**

## Introduction

This assessment will test your skills and knowledge gained through completing the learning and activities in **Module 8: Let’s get programming with C#.**

This is a two-part assessment.

In the first part of the assessment, you will answer a number of questions which will test your knowledge on C#, Object Oriented Design and Reusability.

In the second part of the assessment, you will analyse a requirements brief and develop an application in Visual Studio and C#.

**Note – you must successfully complete ALL assessments (33129/01 and 33129/02) and have been assessed as competent in the previous assessments (33128/01 and 33128/02) from Module 6, Analyse Software Requirements and Module 7, Technical documents to achieve competency in:**

***ICTPRG406 Apply introductory object-oriented language skills***

***ICTPRG415 Apply skills in object-oriented design***

***ICTPRG413 Use a library or pre-existing components***

**Short answer questionnaire**

Answer each of the ten (10) questions. Do not write any more than 100 words for each question.

Rename this document to: StudentNumber\_C#\_33129-01 C.docx. For example, 665437\_C#\_33129-01.docx.

Provide answers in the space under each question.

1. Describe the processes and techniques related to object-oriented programming, including the concepts and language used.

Answer:

OOP (Object-Oriented Programming) is system whereby Data (variables) and code (Methods) to interact with that data, are combined within a Class definition (Encapsulation). This structure is utilised through a process of Instancing which creates an Object within the code based upon the Class definition. Actions on an Object are undertaken via the methods defined within the Class. A Class can be built upon through Inheritance whereby the original Class has additional Data and / or Methods added to the original structure. (<https://en.wikipedia.org/wiki/Object-oriented_programming>)

1. Describe the process of developing small-size applications.

Answer:

One process for developing small programs would be via the Waterfall model (<https://en.wikipedia.org/wiki/Waterfall_model>). This is a linear approach from start to finish the steps being “Conception, Initiation, Analysis, Design, Construction, Testing, Deployment and Maintenance”. Each stage is completed prior to moving onto the next stage. Due to the structured approach, one benefit is it allows for early stages to highlight potential issues later. Alternatively, this approach does not allow for changes within the development cycle (as such well suited to small programs).

1. Identify and outline the key features of a graphical user interface (GUI) for interaction with a user.

Answer:

GUI’s utilise a computers graphical capability to interact with a user through various components. These include the Desktop (the work area which generally contains multiple items), Pointer (utilised to select an object within the Desktop), Pointed Device (generally a mouse although other external items can be used in this case – VR, Trackballs, Tablets), Windows (sub screens which are objects within the Desktop area used to separate individual processes), Menus (commands selected via the Pointer or through various keypress combinations). GUI’s allows users to interact with the environment without knowing specific commands. (<https://www.webopedia.com/TERM/G/Graphical_User_Interface_GUI.html>)

1. List how you would select, evaluate and document re-use components intended for a project. Detail the issues associated with implementing a re-use component. Ensure you explain how the functionality of the reuse component fits with what is required by the parent project, the cost considerations and how you would document your process of evaluation and decision. (this answer can be up to 200 words).

Answer:

I have taken some information from the NATO STANDARD FOR SOFTWARE REUSE PROCEDURES (NATO) and also referenced The Evaluation of Framework Reusability article by Guido Cardino† , Francesco Baruchelli† , Andrea Valerio published in ACM SIGAPP Applied Computing Review - Special issue on frameworks and patterns in software reuse Homepage archive Volume 5 Issue 2, Sept. 1997 Pages 21-27 (Cardino) along with course material.

The first step is within the design stage where a suitably competent person would evaluate the requirements document. This would highlight individual parts of the overall problem and allow initial selection of applicable components already within the programming environment. Using C#, you would use the Object Browser to initially scan those embedded modules which are incorporated within the system.

If this does not provide solutions to the problem, the investigation would extend to: -

* off the shelf products,
* extensions,
* existing project classes developed internally (the NATO document provides an approach relating to the examination of already existing code libraries)
* or search NuGet packages libraries. These options are external to the development software.

There are several factors which may cause issues for the selection of reusability components (NATO): -

* Identifying opportunities for reuse (developers might overlook situations these could be implemented),
* “Not invented here” syndrome (developers might by unwilling to utilise external software),
* Contractual, Legal and Ownership issues (these factors might result in a reuse component not being authorised for reuse or create additional obligations)

In addition, technically, external components might cause issues with integration into the project such as “particular system calls, access to databases or object-oriented repositories, loading and use of external libraries”. (Cardino).

Once an initial analysis has been conducted, evaluation of use within the parent project would be based upon the four main factors of a framework being “portability, adaptability, understandability, and confidence” (Cardino). This is summarised in the below diagram from the same document.

![A close up of a map

Description automatically generated](data:image/jpeg;base64,/9j/4AAQSkZJRgABAQEAYABgAAD/4RD0RXhpZgAATU0AKgAAAAgABAE7AAIAAAAOAAAISodpAAQAAAABAAAIWJydAAEAAAAcAAAQ0OocAAcAAAgMAAAAPgAAAAAc6gAAAAgAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAExhbmNlIEZsYXRtYW4AAAWQAwACAAAAFAAAEKaQBAACAAAAFAAAELqSkQACAAAAAzUyAACSkgACAAAAAzUyAADqHAAHAAAIDAAACJoAAAAAHOoAAAAIAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA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Documentation of the software will need to incorporate information relating to reuse components. Ideally the external documentation should be incorporated into the project documents, naming the component, along with system test documentation (NATO).

The NATO document provides several cases of implementation of reusability components along with cost benefits achieved. These are based upon previously developed internal libraries but highlight the potential benefits in their implementation. These are: -

* Universal Defence Systems (UDS), in Perth, Australia, develops Ada command and control applications. The company began its work in this business with a reuse focus, and has developed a company-owned library of 396 Ada modules comprising 400-500 thousand LOC. With this base, UDS developed the Australian Maritime Intelligent Support Terminal with approximately 60% reuse, delivering a 700 thousand LOC system in 18 months. A recently begun new project anticipates 50-70% reuse based on the company’s asset library.
* GTE Data Services has established a corporate-wide reuse program. Its activities include identification of reusable assets and development of new assets, cataloguing of these assets in an automated library, asset maintenance, reuser support, and a management support group. GTE reports first year reuse of 14% and savings of $1.5 million, and projected figures of 50% reuse and $10 million savings, in telephony management software development.
* NEC Software Engineering Laboratory analyzed its business applications and identified 32 logic templates and 130 common algorithms. A reuse library was established to catalogue these templates and components. The library was automated and integrated into NEC’s software development environment, which enforces reuse in all stages of development. NEC reports a 6.7:1 productivity improvement and 2.8:1 quality improvement.

1. Describe a repository tool and the ways in which it can be used for a project.

Answer:

GitHub is an example of a repository tool. It is a central place where software is stored and accessed by numerous people within a project team (closed) or alternatively accessible as a general place for open source projects and tools which can be added into a project or used standalone through via the programming language it was written in.

1. Describe generalisation, specialisation, inheritance, aggregation and composition in object-oriented programming.

Answer:

Generalisation is the process of looking at “two or more subclasses and combining their duplicate characteristics into a generalised base class (super class)”.

Specialisation is the process of “creating subclasses from existing base classes”.

Inheritance is the process of extending a class (parent) into one or more classes. These derived classes are known as child classes.

(<https://www.infoworld.com/article/3032175/application-development/exploring-generalization-specialization-and-dependency-in-oop.html>)

Association relates to a “‘using’ relationship between two or more objects in which the objects have their own lifetime and there is no owner”. The example provided was a Doctor / Patient. Each can have multiple of the other type but are not dependant on either existing.

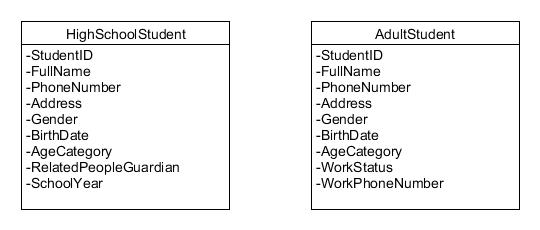
Aggregation this is a parent / child relationship whereby each object is associated but also exists independently. E.g. Department / Employee – here an employee would still exist even if a department object was destroyed.

Composition is also a parent / child relationship where “if the parent object is destroyed, then the child object also ceases”. E.g. a House / Rooms – in this case the room object could not exist without the house parent.

(<https://www.infoworld.com/article/3029325/microsoft-net/exploring-association-aggregation-and-composition-in-oop.html?upd=1543646487858>)

1. Below are two classes that describe a Student. Students can be ‘High School Students’ or ‘Adult Students’. Study their attributes and suggest a superclass named *Student* that is derived from the two suggested subclasses below. Apply generalisation techniques to identify the attributes of the superclass. The attribute *Related People (Guardian)* refers to the person that is responsible for the student up to age 18 and *Work Status* refers to adult students who can possess the following values: Unemployed, Full time, Part time and Casual. Create the *Student* class and the *High School Student* and *Adult Student* subclasses.

Answer:

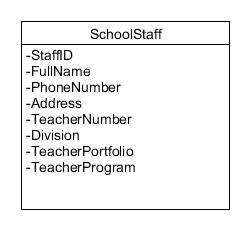


Answer:

A screenshot of a cell phone

Description automatically generated

1. Below is a class that describe a School’s staff. School’s staff can be administration staff or teachers. Identify the subclass for *Teachers* by applying the technique of specialisation.



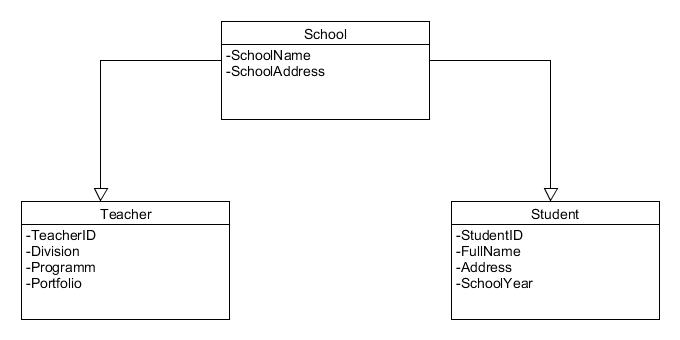
Answer:

The Teachers Class would contain: -

* TeacherNumber
* TeacherPortfolio
* TeacherProgram

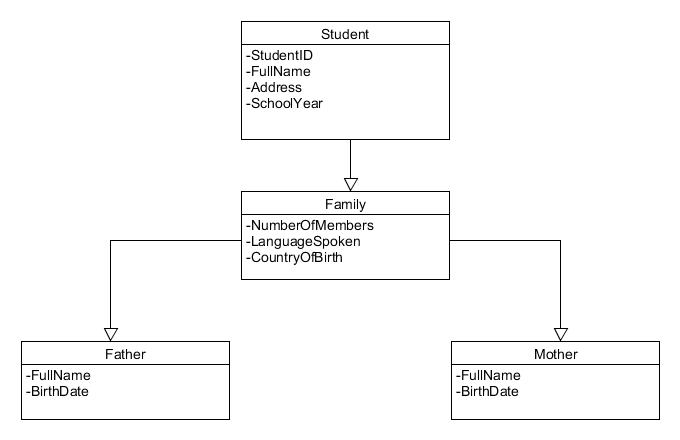
The other items are relevant to all SchoolStaff e.g. StaffID, FullName, PhoneNumber, Address and Division. If the Division for a record was set to “Teacher”, then the Teachers subclass would be created for the information.

1. Examine the class diagram below. Is it an aggregation or a composition? Explain why.



The above Class structure would be considered a Composition association. The Teacher and Student Classes would not be able to exist if the School Class was removed. You could not associate these individual classes. The School is the binding object like a building with separate rooms within. (<https://www.infoworld.com/article/3029325/application-development/exploring-association-aggregation-and-composition-in-oop.html>)

1. Examine the below class diagram. Is it an aggregation or a composition? Explain why.



This could be considered an aggregation and a composition but at separate levels. The link between Student and Family is a weak link. If broken, the Family Class could still survive independently as Family isn’t directly tied to the Student information. This would be considered an Aggregation.

If the Family class was removed, then the Father and Mother Classes would cease to have relevance as they are linked strongly through the Family Class. This would be considered a Composition. (Reference as per link in Q9).

**Next steps for you:**

You have now reached the end of this assessment.

Ensure that you have answered all of the above questions.

Upload this document to OpenSpace. Label your file your StudentNumber\_C#\_33129-01.docx. E.g. 665437\_C#\_33129-01.docx.

Your trainer will provide you with feedback for this assessment.