Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination 2021

Computer Science

Coursework Project Brief

Higher and Ordinary Levels

Time: 12 weeks

90 marks

Information for candidates

The project is worth 90 marks, which is 30% of the overall marks for Leaving Certificate Computer Science. The remaining 210 marks (70%) are for the final examination. You will carry out the project over a period of twelve school weeks, beginning on **Monday December 14th 2020**. The coursework must be completed by **Friday March 26th 2021**. You will present the report in the form of a website comprising of one or more webpages.

Carrying out the project involves responding to a brief by producing a computational artefact and an accompanying report. You will submit the project in digital form. If your artefact has physical elements, such as might arise with an embedded system, you will not be sending these physical items to the State Examinations Commission (SEC). You will capture video footage and/or images of the artefact in operation and embed this into your report.

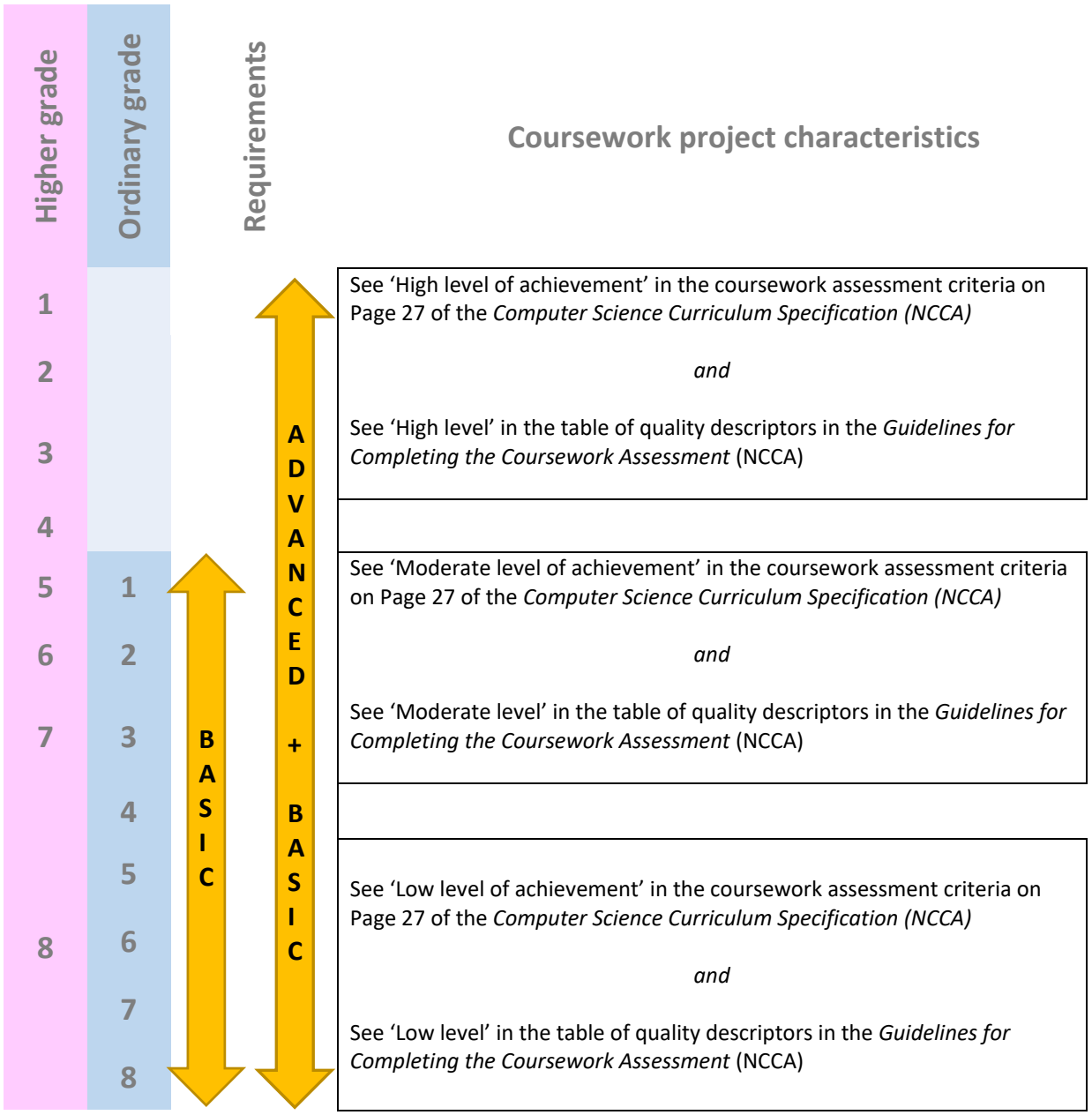
Although you are used to carrying out projects for the *Applied Learning Tasks* in groups, this is an *individual* project. You must carry it out independently of other candidates, and the work you submit must be your own unaided work.

Apart from your initial investigation and research, you must carry out the project in school under the supervision of your teacher. This allows your teacher to authenticate your work to the SEC. Because you are carrying out the work under teacher supervision, the teacher is able to guarantee to us that it is your own work, and that nobody gave you any inappropriate help. If you include work that was not supervised by your teacher, then they cannot authenticate it, even if they believe that you really did do it yourself. We cannot accept work for assessment if your teacher cannot authenticate it, so you will forfeit the marks for the project work. Note also that we cannot give partial marks for 'partially authenticated' work. That is, unless *all* of your work can be authenticated by your teacher, we cannot accept *any* of it for marking.

The same project brief applies to Higher and Ordinary level candidates. However, you do not need to make a final decision about which level you are taking when you submit your project. We will grade your project in line with the standards that apply to the level at which you take the final examination.

The project brief sets out some *basic requirements* and *advanced requirements* of the artefact. The way that the standards at the two levels are aligned with each other is illustrated on the left-hand side of the graphic on the next page. This means that, for example, a project that would get a grade 2 at Ordinary level will automatically get a grade 6 at Higher level. You can also see that any project that would get a grade 4 or better at Higher level exceeds the highest standard of work expected at Ordinary level. Because of this, a project of this quality would automatically get full marks at Ordinary level.

It should be evident from the graphic that it is possible to achieve full marks at Ordinary level by attempting the *basic requirements* only. Similarly, it is not possible to achieve grade 4 or higher at Higher level without attempting the *advanced requirements*.


Higher grade
Ordinary grade
Requirements
Coursework project characteristics
1
2
3
4
5
6
7
8
1
2
3
4
5
6
7
8
BASIC
ADVANCED + BASIC
See 'High level of achievement' in the coursework assessment criteria on Page 27 of the Computer Science Curriculum Specification (NCCA)
and
See 'High level' in the table of quality descriptors in the Guidelines for Completing the Coursework Assessment (NCCA)
See 'Moderate level of achievement' in the coursework assessment criteria on Page 27 of the Computer Science Curriculum Specification (NCCA)
and
See 'Moderate level' in the table of quality descriptors in the Guidelines for Completing the Coursework Assessment (NCCA)
See 'Low level of achievement' in the coursework assessment criteria on Page 27 of the Computer Science Curriculum Specification (NCCA)
and
See 'Low level' in the table of quality descriptors in the Guidelines for Completing the Coursework Assessment (NCCA)

The project brief

Context of the Brief

2020 will be forever remembered as the year of the coronavirus disease (COVID-19). The outbreak of COVID-19 was declared a pandemic by the World Health Organisation (WHO) in March 2020 and schools and businesses all over Ireland were closed.

Research has shown that the virus can spread from person to person by respiratory droplets released when someone with the virus coughs, sneezes or talks. These droplets can be inhaled or land in the mouth, nose or eyes of a person in close contact. Some of the symptoms of COVID-19 are a cough, fever, shortness of breath and a change in ability to taste or smell.

In the absence of a vaccination against the virus and because of the alarming levels of spread and severity, many countries including Ireland responded by introducing measures to flatten-the curve and curb the spread of the virus.

Source: www.gov.ie/en/collection/ee0781-covid-19-posters-for-public-use/

Although many countries differed in the details of how they implemented their responses, most of the approaches taken centred on controlling behaviours relating to two areas – sanitation and social interaction. The list below identifies some example control measures introduced in Ireland at various stages throughout 2020 in an effort to prevent the spread of the virus and get the economy back up and running after sustained periods of restrictions:

- wash your hands regularly and properly (20 seconds)
- exercise proper cough/sneeze etiquette. Also, avoid shaking hands with other people and avoid touching your own eyes, nose or mouth
- keep a distance of least 2 metres from others (social/physical distancing)
- avoid other people/crowds as much as possible (but if you do meet people keep a record for contact tracing purposes)
- know the symptoms (e.g. temperature, cough, breathing difficulties, sudden loss of smell or taste).

In addition, many organisations put their own control measures in place to limit the number of people present at any one time. These included *queue management systems* (i.e. systems to stagger entry of customers and clients into the workplace) and *systems to monitor occupancy levels inside buildings* (e.g. shops, offices, restaurants, pubs, cinemas, theatres, etc.)

Below are some URLs that provide more detailed background and context of the brief. The list is neither exclusive nor exhaustive and is supplied to assist you with your own ideas and research. Some may provide inspiration for the task set out in the next section of this document.

General information on the coronavirus (COVID-19)
www.who.int/health-topics/coronavirus#tab=tab_1
www.citizensinformation.ie/en/covid19/covid19_overview.html
www2.hse.ie/coronavirus/

Issues and measures to prevent the spread of the coronavirus (COVID-19)
https://www.nsai.ie/images/uploads/general/NSAI-COVID19-Guidelines-Shopping-20201023.pdf
www.hopkinsmedicine.org/health/conditions-and-diseases/coronavirus/coronavirus-social-distancing-and-self-quarantine

The use of technology to help reduce the spread of the virus
www.rte.ie/brainstorm/2020/0527/1142864-coronavirus-risk-infection-spreading-online-technology/
www.rte.ie/news/business/2020/0325/1126217-irish-tech-tackles-coronavirus/
www.nearform.com/services/contact-tracing-app-development/
www.irisys.net/people-counting/how-it-works
www.irisys.net/queue-management
www.irisys.net/products/safecount-occupancy-monitoring-solution
www.retailtimes.co.uk/qudini-how-to-ensure-customers-stay-safe-as-stores-reopen/
www.manxtechgroup.com/people-counting-using-wifi-and-bluetooth/
www.manxtechgroup.com/automate-one-in-one-out-with-sensors-and-people-analytics-covid-19/

The Task

Create an innovative computational artefact which you feel could be used to address any or some of the issues raised in the context of this brief and report on the work and process involved.

The basic and advanced requirements of the task are set out as follows:

Basic requirements

The basic requirement is to create an embedded system. The input(s) to the system should consist of any combination of data entered by the end-user, sensor data or data generated by the logic of the system itself. In response to this input, the system will generate output data. This output (or feedback) may be conveyed in the form of textual data displayed on a monitor or LED display, sound or some other sensory indication and should inform a solution to the problem that the system is designed to address.

Specifically, the basic requirements are to incorporate the following into a standalone embedded system:

1. The system should accept analogue data/input(s).
2. An interactive user interface that can be used to configure the system and control its operation in a variety of ways. The system should be automated in so far as possible i.e. once started the system should operate with minimum manual intervention.
3. An analysis component that can be used to highlight certain information and inform future decisions.

Advanced requirements

The advanced requirements extend the functionality of the basic requirements in two main ways. Firstly, it involves a communication sub-system and secondly, it includes a separate standalone Python/JavaScript application that performs the data analysis. In addition to the basic requirements the advanced requirements are:

4. The use of one or more client(s) communicating with a single central remote data collection point. For example, this could be a client-server model in which:
   - each client sends a variety of input data to a server
   - the server processes the data and responds to the client.
5. The system should include a facility for storing data on a digital device for further analysis.
6. An interactive Python/JavaScript application that performs an analysis on the data which has been collected/generated by the embedded system. The result of this analysis should inform some decision in relation to some stated hypothesis or the objective of the system and can be shown using any combination of text and graphics.

Coursework report – content and structure

The report should be presented as a website in HTML and be structured according to the headings below. The report should contain no more than 2500 words. You should ensure that the file structure of your artefact is clear, so that you can clearly reference files or programs in your report. The presentation of content and the demonstration of good user interface design principles in the creation of the webpage are important elements of the assignment.

Further information about the content and structure of the report can be found in the *Guidelines for Completing the Coursework Assessment* on www.curriculumonline.ie.

1. A Rationale for the Approach to the Brief

1.1 Research (approximately 150 - 200 words)

In this section of the report you should show evidence of your own research on the thematic brief, including research on existing solutions, systems or ideas that are aligned to the brief. As a starting point you may consider using the URLs provided in the 'context of the brief' earlier in this document but please note that this list is neither exclusive nor exhaustive. All references should be included in the reference section of your report.

Summary: Research the topic of coronavirus (COVID-19) and computational systems used to address the issues raised in the 'context of the brief' section of this document. Document your research findings.

Key questions:

- Can you identify and describe existing systems that address a selection of the issues raised in the thematic brief?
- Do any of these systems trigger questions that you need to research further?
- Is there any area you are curious to find out more about?
- Are there issues not addressed which you feel an urge to explore further?

1.2 Response to the brief (approximately 150 - 200 words)

Here you should outline a number of possible responses to the brief and provide a statement of the problem you wish to address. Reasons for choosing this problem should be described, along with justification for the target end-user(s) of your system. Evidence should be provided for any engagement with the end-users and the initial system requirements should be specified.

Summary: State the problem you wish to address and the scope of the envisaged solution.

Key questions:

- What are the possible projects?
- What problems could you pursue and aim to solve (either fully or partially)?
- Of all the ideas you have for a system which one resonates with you the most? Explain why?
- What will your system do/not do? What are the aims of the system?
- Who do you envisage as the potential end-user(s) of your system?

2. The Artefact in Operation (video only)

You must embed a video showing the artefact in operation. The video must not be more than 5 minutes in duration and be no more than 1GB in size.

In deciding the content of your video, you should refer back to the description of the task. The video should show all the features of the artefact that you want the examiner to be aware of, as this is the main piece of evidence on which the examiner will judge the quality of the artefact. The video should demonstrate the quality of the user interface and the full functionality of the artefact. The video should only demonstrate the functionality of the artefact, with all other information relating to the design and development being contained in the report. The video should comply with your school's Acceptable Usage Policy (AUP), data protection protocols and GDPR.

Summary: Create a video (max. 5 mins. duration and be no more than 1GB in size) that demonstrates the main features of your system in operation. Embed this video in your report.

Key question:

- What are the main features of the system?

3. Design and Development of the Artefact

This section presents an opportunity to highlight the design and development of the system and the manner in which you addressed the following key areas:

- Design and Development
- Computational thinking
- Computer programming
- Problem solving
- Appropriate use of computing technologies
- Awareness of potential social impacts

3.1 The Iterative Design Process (approximately 700 - 800 words)

The main focus of this section is to describe your engagement with an iterative design process such as that shown in **figure 1**. You should state the name of the design process (methodology) you decided to use, provide justification for this choice and outline briefly the key stages involved. Provide a concise description of the types of activities you carried out as the artefact evolved through these stages.

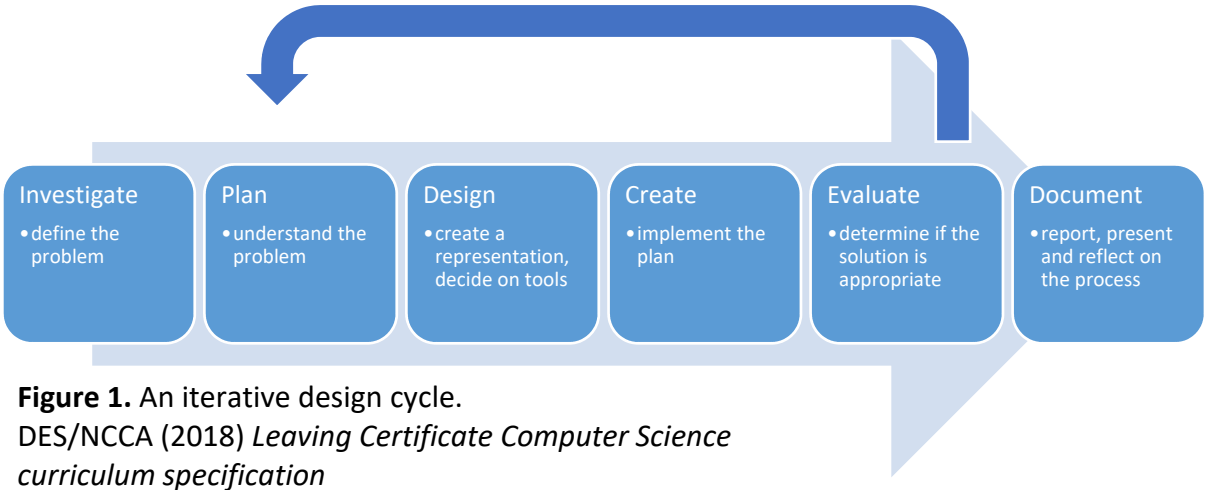


Figure 1. An iterative design cycle.
DES/NCCA (2018) *Leaving Certificate Computer Science curriculum specification*

You should show the timeline of your design and justify the key decisions. In particular, you should explain the rationale behind any adaptations to your design approach.

It is highly recommended that you maintain a record of your work as you engage with the iterative design process. This work log should be updated frequently as and when you work on anything relating the system. In addition, it is recommended that you maintain a record of thinking which you should regularly update with reflections on how your own personal journey of learning is progressing.

Summary: Record your activities, thinking and adaptations as you progress through each iteration of each stage of the design cycle and use these recordings to describe the design process leading to your solution.

Key questions:

- What design approach did you take?
- What are the stages involved and what activities did you carry out during each stage?
- Did you iterate? If so, why and how often?
- What problems occurred during the design and how did you overcome them?
- Did you change your mind about any aspect of the design or did you decide to add any new features to the design at any stage? If so, why, and what was the impact?

3.2 Development of the Artefact (approximately 900 - 1000 words)

There should be a clear description of how the artefact meets the brief and works in an overall design sense. This section should be closely aligned to, and consistent with the video presentation of the final artefact in operation.

There should be an abstracted version of the overall system and design, highlighting the various components of the system and how they relate to one another. You could also select certain aspect(s) of the system and give an overview of the computational thinking process you went through in producing it/them. For example, you could describe your use of pattern recognition,

data structures, abstraction or decomposing problems into smaller problems. You could also provide a detailed explanation of certain selected sections of code you have produced.

The development and function of the artefact should be tested as comprehensively as possible. All programs should be debugged and operational. You should describe the extent of testing you carried out, and major problems you encountered during the testing and development cycle.

Finally, this section of the report presents an opportunity to highlight an awareness of the potential social impacts of the system and also to make links to core concepts such as computer systems and data.

Summary: Explain the system architecture and detail the design, development, testing and deployment/implementation phases of the development.

Key Questions:

- What is the overall design (system architecture)?
- If the system is composed of multiple sub-systems how do these relate to one another?
- What are the main features of the system and how are these realised (i.e. explain the design)?
- How was the system developed?
- What technologies were used?
- Were there any social or ethical considerations?
- How has data been gathered, validated and stored?
- What use cases were employed for testing?
- What problems occurred during the implementation and how did you overcome them?

4. Evaluation of the artefact

4.1 Reflection on meeting the brief (approximately 150 - 200 words)

You should evaluate the final product in relation to the brief. In particular, you should reflect on:

- How well you achieved your design ambitions.
- The degree to which you met the requirements of the brief – you should examine each of the artefact features listed in the brief, and explain how your artefact meets, or does not meet, these features.
- How well the needs of the envisaged end user were met. Include reference to any unexpected results encountered in the application of your artefact.

4.2 Future development of the artefact (approximately 150 - 200 words)

Suggest, with justification, how your artefact could be improved in future iterations of the design cycle.

If you can, identify other possible applications of your artefact, whether as it currently is or as it might be with future improvement or expansion.

5. References

You must reference any information used in your report or in the creation of your artefact, such as: publications including books, professional journals and government reports; online sources and other types of media; source code. To include such material without properly referencing the source will be considered plagiarism. The word count in this section does not count towards your overall word count.

6. Summary word count

You must include a summary of the word count of your report. This could be presented in the form of a table, as shown below, and should show the word count for each section as well as the overall word count.

Section	Word Count
1.1 Research	
1.2 Response to the brief	
3.1 The iterative design process	
3.2 Development of the artefact	
4.1 Reflection on meeting the brief	
4.2 Future development of the artefact	
Total:	

Outline marking scheme

Coursework (90 marks in total)		
Description		***Marks***
Presentation of report	Quality of report structure and layout; evidence of student's adherence to the principles of good user interface design when creating the website.	**5**
A rationale for the approach to the brief		
Research	Shows evidence of research and investigation of the context and the task.	**10**
Response to the brief	Clearly explains choices made; offers clear rationale behind the overall design approach.	
The artefact (design, development and operation)		
Meeting the brief	The artefact is consistent with the context and theme of the brief. The requirements of the brief are met; identified end-user needs are met.	**10**
Iterative design process	Presents a design timeline with justification of key decisions; explains the iterative design approach adopted.	**15**
Computational thinking and problem solving	The construction of the artefact shows skills such as abstraction, decomposition, algorithmic thinking, evaluation and testing. The ability to systematically address and solve problems thrown up in the implementation of the design are clearly demonstrated.	**15**
Programming skills	Fundamental skills are demonstrated, such as using a modular approach, using high level data structures, testing and debugging, minimal duplication of code, readability, effective use of commenting.	**15**
Use of computing technologies and awareness of social impacts	Shows an awareness of adaptive technology; creative and appropriate use of technology; an awareness of core computer science concepts. Demonstrates an awareness of the end-user(s) and potential social impacts.	**10**
Evaluation		
Reflection	Explains the extent to which the artefact meets the design ambition; how well the needs of the envisaged end user are met.	**10**
Future development	Describes with justification how the artefact could be modified and improved.	
References		
References	You must also include references and/or a bibliography.	**0**
Summary word count		
Summary word count	Include a summary of the word count of the report, including the total word count.	**0**

Instructions on completing and submitting the coursework

1. Your coursework project that is submitted for assessment must comprise of the following two components:
   - The digital components of the computational artefact, including all relevant programs.
   - A coursework report of no more than 2500 words, including a video presentation of no longer than 5 minutes. The video should be no more than 1GB in size. This readily can be achieved by using standard definition (720 x 480) at 25 frames per second and a suitable commonly used format. Individuals should not be identifiable in the video but you may include a voiceover in order to explain the features of your artefact. Penalties may apply where the overall word count or video length or size is exceeded.

   You may wish to include some images in the report, such as, for example, a diagram of a database structure, initial sketches of the design approach, a flowchart, a snippet of code, etc. The report should not include more than 15 images in total.

2. Some of the research and investigation that you carry out for the project and describe in section 1 of your report, ('A Rationale for the Approach to the Brief), can be completed outside of class time. However, the actual writing of the report and all of the work on the artefact itself must be done in class under the supervision of your teacher so that they can authenticate your work.

3. Your coursework project must be saved in a single zipped file (.zip). Instructions on how to submit your work to the State Examinations Commission will follow in advance of the submission date.

4. The name of the file submitted should contain your candidate examination number and be in the following format "YearCSCAExamNumber". For example, if your examination number is 123456, the file will be called "2021CSCA123456.zip".

5. The .zip file, when extracted, should be a folder that contains exactly two subfolders. One of these sub-folders should be called "Report" and should contain all of the files relating to the report. It should be possible to access the complete report by opening a file named "index.html" at the top level within the "Report" folder. That is, all of the content of the report should either be in this file itself or accessed via links from within this file. Any subsidiary files, such as additional html files, css stylesheets, image files, and so on, must also be in the "Report" folder, either at the same level as index.html or within a further suitable folder structure. As part of the report you must embed a video of not more than 5 minutes, so this video file should also be within this folder. All content of the report (images, video or other) must comply with the school's Acceptable Usage Policy and with General Data Protection Regulation (GDPR).

6. The other sub-folder should be called "Artefact" and should contain the essential digital components of your artefact. Accordingly, if the artefact is purely digital, without any physical elements such as might arise with an embedded system, then this folder contains the complete artefact. The file structure of your artefact should be made clear. For example,

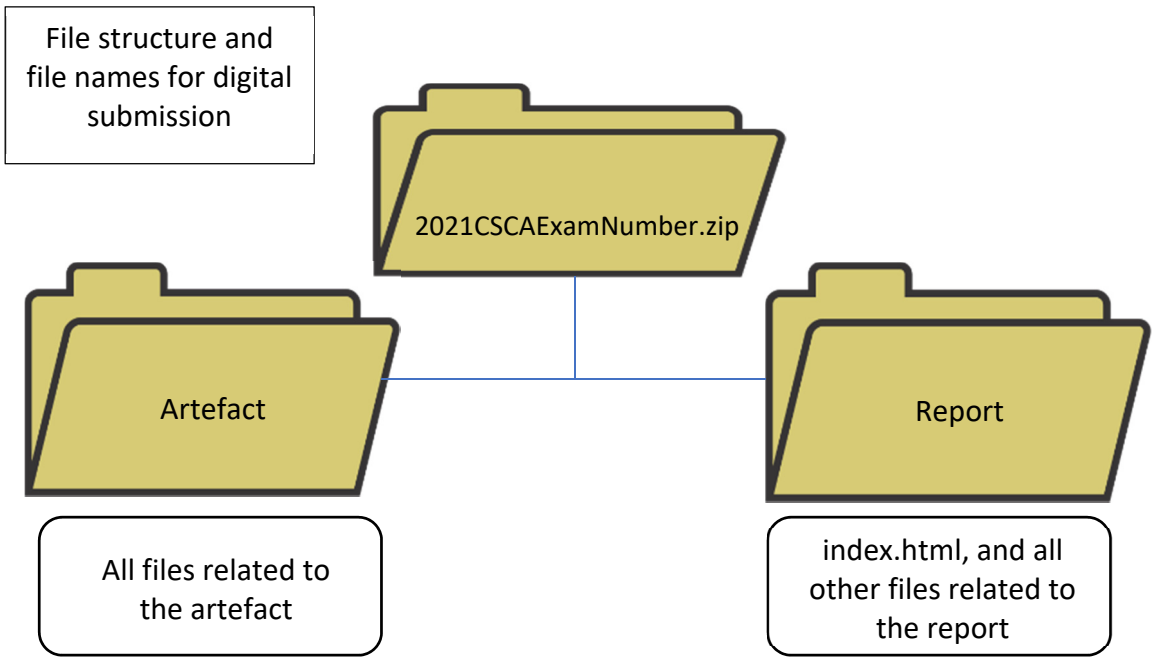
if there is a main, supervising program, from which other programs are imported or called, this program should be clearly named in the sub-folder and referenced in the coursework report.

7. It is **your** responsibility to ensure that all electronic materials submitted are free from viruses, so that examiners can open all required files for assessment, and all code supplied can be evaluated.

8. All programs predominantly written in Python and/or JavaScript should be clearly identifiable. If there is a hierarchy of programs, this should be described in the report. In the case of JavaScript code that is embedded in a HTML file, then the entire HTML file should be included. It is your responsibility to ensure key programs can be readily executed (for example, that any supplied HTML file can be executed in a range of commonly used browsers) or that Python or other code is presented in a way that facilitates an examiner in copying and pasting the relevant code into an integrated development environment (IDE) to verify its functionality. You are encouraged to include comments in your code to explain or describe how particular elements of the code work.

9. In instances where data is stored in a password protected cloud service or a local web server it is not expected that access is to be given to the examiner. This should be clearly flagged in the report and any features that access such data need to be clearly demonstrated in the video that you submit as part of the report.

10. **Other relevant components**: Any dataset used by your artefact, or data gathered from users of the artefact, should be stored, clearly labelled and readily accessible in the "Artefact" sub-folder. All data should be anonymised and comply with GDPR. If an artefact uses programming languages other than Python and JavaScript, these files can also be included in this sub-folder. In such cases, you cannot assume that the examiner will be familiar with the programming language concerned, so the responsibility for demonstrating its accuracy rests with you. Any online applications or IDEs used in the creation of the artefact should also be clearly specified in the report.



11. It is your responsibility to ensure that all of the required files are contained in the zipped file prior to submission of the work. Marks may be lost for not conforming to the filing structure outlined above, and for not using a clearly labelled file structure for the artefact. A **backup copy** of the submitted files must be retained in your school until the assessment process is complete.

Leaving Certificate – Higher and Ordinary Levels

Computer Science, Coursework

Leaving Certificate Examination 2021
Twelve weeks