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# **GCE EXAMINERS' REPORTS**

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**GCE (NEW)  
COMPUTER SCIENCE  
AS/Advanced**

**SUMMER 2018**

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<b>Unit</b>	<b>Page</b>
Unit 1	1
Unit 2	3
Unit 3	5
Unit 4	8
Unit 5	11

# COMPUTER SCIENCE

## General Certificate of Education (New)

Summer 2018

### Advanced Subsidiary/Advanced

#### UNIT 1: FUNDAMENTALS OF COMPUTER SCIENCE

The majority of candidates demonstrated that they understood and could answer questions on most of the examined topics. The mean mark would suggest that candidates found the paper slightly more accessible than 2016 and 2017. It was particularly pleasing to see many candidates answer the truth table question well and also the question which required them to write an algorithm for an unseen problem.

It was disappointing to see many candidates having difficulty in answering the question on operating systems and how they manage computer resources and provide users with a range of utility software. Poor responses were also seen from many candidates for the feasibility study and weather forecasting system extended prose question.

#### Individual Questions

- Q1. Many candidates were able to complete the given truth table confidently.
- Q2. Around half of candidates were able to state the use of the given network protocols confidently. Candidates were more confident in stating the use of the SMTP and HTTP protocols than they were in stating the use of the DHCP protocol.
- Q3. Many candidates showed an awareness of the dangers that can arise from the use of computers to store personal data and were also able to list the processes that protect the security and integrity of data. The question however required a description of each and a lack of depth in knowledge was evident in a significant number of responses seen with many candidates giving a list for each.
- Q4. Around half of candidates were able to simplify the given expression using Boolean identities and rules well. It is essential that candidates show each step as required by the question to attain higher marks. A common mistake seen this series was to simplify incorrectly as follows  $\overline{B}.B = 1$ .
- Q5. Many candidates were able to convert the given hexadecimal numbers into binary form and add them together using binary addition. A few candidates incorrectly added the numbers together and made an error with their carry bits.

A minority of candidates were able to convert  $16.125_{10}$  into the given floating point form.

A very few candidates were able to calculate the largest positive denary number that the given computer could store. Many candidates calculated that the largest exponent stored could be  $7_{10}$ , which was inaccurate given that two's complementation was used for this example.

- Q6. Only a minority of candidates were able to answer this question well. A majority of candidates lacked technical terminology in this topic. There was also some confusion surrounding the difference between a data structure and data type. A common incorrect answer for the first part of the question was 'a table'.
- Q7. Over half of candidates were able to explain parallel processing and caching in a CPU well. These candidates showed a sound understanding of the parallel processing and were able to explain how calculations are carried out simultaneously and that large problems can often be divided into smaller ones, which are then solved concurrently.

Responses for caching in a CPU were weaker. There was some confusion seen around Internet caching.

- Q8. It was pleasing to see that the algorithm question was the second best answered question of the paper. An improvement was seen nationally in the standard of answers given for this type of question this series. Candidates should take better care, however, with the formatting of outputs from their algorithm.
- Q9. Around half of candidates were able to explain how a linear search and a binary search operates. Only a minority of candidates were able to describe appropriate circumstances for the use of each search algorithm.
- Q10. Only a minority of candidates were able to suggest appropriate test data to dry-run the bubble sort algorithm in order to identify possible errors.

Around half of candidates were able to describe how a bubble sort algorithm should operate. There was a lack of technical terminology used by a significant number of candidates in describing a bubble sort. In particular, candidates were unclear about comparisons being made with two consecutive numbers and that a number of passes are made until the data is in order – this doesn't happen in one pass.

A very few candidates were able to explain why the given bubble sort algorithm will fail and fewer still were able to suggest a suitable change that could be made to the algorithm to overcome this problem.

Around half of candidates were able to name and describe a different sort algorithm. The most popular choice being an insertion sort.

- Q11. This was the most poorly answered question of the paper with only a few candidates being able to explain the use of a range of utility software in computer systems. Many candidates failed to take note that this question required an explanation and instead gave a list of utility software types. This is insufficient for a qualification at this level.

Similarly, only a few candidates were able to explain how an operating system manages computer resources, superficial answers similar to the first part of the question were seen.

- Q12. A minority of candidates gave a sound comparison of bespoke and off-the-shelf software. Only a very few candidates however gained full marks in the question as the depth of knowledge for this topic was insufficient.

Q13. The extended prose question was the second most poorly answered question of the paper. Some very good responses were seen, however, there was a clear lack of understanding by many candidates of the difference between the feasibility study and analysis stage of the systems analysis cycle. Answers such as, interviewing customers, providing them with questionnaires and observing the current system in practice were not awarded credit.

Many candidates showed a lack of technical understanding of the role of the computer system in weather forecasting. Very few answers beyond the requirement for the processing of a huge amounts of data were seen.

# COMPUTER SCIENCE

## General Certificate of Education (New)

Summer 2018

### Advanced Subsidiary/Advanced

## UNIT 2: PRACTICAL PROGRAMMING TO SOLVE PROBLEMS

### Introduction

Unit 2 is a practical examination with candidates required to demonstrate the application of knowledge and understanding at all times.

### General Remarks

Most of the candidates demonstrated a good understanding of the specification. Questions not attempted data is unavailable this series. Many candidates were well prepared and many excellent answers were evident. There was also evidence that some candidates had been well prepared for the majority of the practical programming elements found in section B, however, performance when using file handling code was again disappointing.

### Comments on Individual Questions:

#### Section A:

- Q1. This was well answered by most candidates, however, some candidates could not identify foreign keys.
- Q2. Many good answers were seen although some candidates did not select appropriate validation methods for different fields.
- Q3. This question was generally not well answered. A majority of candidates used incorrect flowchart shapes and the logic was often difficult to follow.
- Q4. Candidates did not perform well in this question. They invariably failed to apply their knowledge to the scenario.
- Q5. Many candidates correctly attempted this question, however only a few candidates used sufficient technical terminology at all times.
- Q6. As is usually the case with algorithm questions, some candidates scored full marks but a large number seemed to have no clear idea about algorithm design. It was very difficult to follow the logic used at times as candidates would begin loops or selection (if) statements but not end them in any meaningful way.

## **Section B:**

- Q1. This question was deemed to be slightly less accessible when set, with the candidates required to fix broken code, this was done well by most candidates.
- Q2. Generally, this was not well answered. Many candidates were unable to implement validation checks nor deal with file handling, however, more attempts were seen at this question, suggesting a slightly stronger attempt by candidates in the lower mark ranges.
- Q3. This question was generally well answered. Many candidates showed detailed annotation of the code.

# COMPUTER SCIENCE

## General Certificate of Education (New)

Summer 2018

### Advanced Subsidiary/Advanced

#### UNIT 3: PROGRAMMING AND SYSTEM DEVELOPMENT

Most candidates were well prepared and demonstrated a high standard of knowledge and application required for A2. There was a broad range of answers with many candidates achieving higher marks in logical and mathematical based questions such as Boolean algebra and truth tables.

Candidates should be encouraged to expand on their explanations and descriptions when answering knowledge focused questions such as the question on the standardisation of computer languages.

#### Individual questions

##### Question 1

Candidates demonstrated a good understand of constructing binary trees and applying pre-order, in-order and post-order traversals. However, fewer candidates were able to identify practical uses for these traversals with many candidates only identifying an in-order traversal being used to search a binary tree alphabetically.

##### Question 2

The question on evaluating a computer-based solution in terms of functionality and system performance was well answered by candidates. With many identifying that performance can be evaluated through measuring results produced in a given timeframe.

Part (b) was less well answered by candidates. Although many candidates identified characteristics of natural and immersive human computer interfaces few were able to provide more than one example beyond speech recognition systems, touch screen interfaces and virtual reality headsets. Candidates could have included additional examples including gesture recognition systems, binaural headphones and force feedback controls.

##### Question 3

The question on proving De Morgan's Law was well answered by many candidates.

##### Question 4

The questions on simplifying Boolean algebra question was well answered, many candidates simplified the expressions to their simplest form using a variety of methods.

##### Question 5

The question on the features of an IDE's code editor was well answered by candidates with many responses identifying features such as auto code completion, colour coding and formatting and highlighting syntactical errors.



Part (b) again was very well answered with candidates understanding the purpose of a code translator.

#### Question 6

The question on dry running a denary to binary conversion algorithm. This question was less well answered by candidates than others, many candidates successful applied MOD2 to the denary number although fewer candidates managed to output the correct string (answer) using the bin character.

Part (a) was answered less well although many candidates could correctly dry run the algorithm fewer identified its purpose of converting a denary number into binary.

Part (c) again was less well answered with few candidates correctly explaining the purpose of the data types for 'bin' and 'answer' and not fully understanding the string 'answer' was being used with the bit pattern of the denary number being expressed in binary form.

#### Question 7

The question on code of conduct appeared less familiar to candidates. In part (a) most candidates had knowledge that a code of conduct outlines the professional standards as a condition of membership. Fewer candidates were aware that code of conduct includes standards for both professional competence and professional integrity.

In part (b) most candidates were able to identify at least one standard that is included in relation to professional competence such as not undertaking work that is out of a person's competence.

In part (c) again most candidates were able to identify at least one standard in relation to professional integrity with most only describing the need to respect privacy and confidentiality.

#### Question 8

This question was explaining the operations of a hash table and producing the correct BNF definition for a postal address. Part (a) was answered well by some candidates with many only identifying that a hash table provides direct access to an item through an index and less explaining that the index is calculated using an item's key value.

The BNF definition in part (b) was well answered by most candidates.

#### Question 9

The question required candidates to describe the terms recursion and iteration and describe the advantages of using an iterative function over a recursive one. In parts (a) and (b) most candidates were able to correctly describe both the terms iteration and recursion and provide suitable examples.

Part (c) was less well answered with fewer candidates being able to describe advantages. Candidates could have referred to the demands required on the stack space where memory is limited.

## Question 10

In part (a) candidates were required to describe the purpose of validation. Most candidates were able to apply their knowledge and describe validation as a means of data being inputted as sensible, reasonable, complete and within acceptable boundaries. Some candidates went on to explain that validation only proves the data input follows the rules of the validation check and not that the data is what the user intended.

In part (b) the algorithm question required candidates to validate a date in dd/mm/yyyy format. Many candidates were able to correctly declare the data types and required variables. Few candidates correctly provided suitable pseudocode for string handling of day, month and year which then led to a poor response in being able to correctly provide validation and month comparisons for 31, 30, 29 and 28 days.

## Question 11

This question was focused on Object-Oriented Programming and its features. Part (a) was somewhat well answered with candidates describing the use of objects, methods and properties. Few candidates went on to describe the use of encapsulation, polymorphism and inheritance.

Part (b) was less well answered by candidates. Candidates were required to explain the relationship between classes and instances. Most candidates were able to identify that a class is a template of an object and an instance is a variable holding the memory address and copy of an object.

Part (c) required candidates to explain the term method. Although candidates demonstrated an understanding of the term method it was usually described in a non-technical way. Some candidates described a method as a programming routine and provided descriptions of public and private methods.

## Question 12

This question required candidates to explain the advantages arising from the use of algorithms and programming languages that have been standardised. There was a poor response to this question overall, with many candidates only identifying the portability of programs and programmers, and the future maintenance of programs. Fewer candidates referred to the development benefits and the advantages of standardising modules, libraries and algorithms.

# COMPUTER SCIENCE

## General Certificate of Education (New)

Summer 2018

### Advanced Subsidiary/Advanced

#### UNIT 4: COMPUTER ARCHITECTURE, DATA, COMMUNICATION AND APPLICATIONS

Many candidates were well prepared and demonstrated a wide knowledge of the topics in the specification. Good answers were seen for questions requiring precise answers to programming or mathematical problems, and for questions requiring descriptive answers.

In descriptive questions, candidates are encouraged to go beyond a theoretical description of the computing techniques by referring to practical examples from commerce or industry, and to include diagrams where appropriate. Candidates can often gain marks by making use of a good, appropriate example.

#### Individual questions

Q1. Candidates were generally familiar with the bus system of computers. In some cases, however, candidates described the buses only as connecting the registers within the CPU rather than connecting the CPU to the main memory and input/output ports of the computer.

Part (b) was generally poorly answered. A number of candidates described the 'fetch' phase of the cycle, rather than the 'execute' phase as requested. Relatively few answers discussed the different types of command which might be received by the CPU and the different actions which might be required to execute these. Candidates could have referred to: loading or saving of data by means of the bus system, making use of the memory address register and memory data register; carrying out a calculation using the arithmetic-logic unit; or carrying out a jump operation in a program by resetting the program counter.

The assembly language programming question in part (c) was well answered by a number of candidates. Teachers are to be commended on an improvement in the ability of candidates to handle jump operations. Where marks were lost, this was often through failing to initialise the 'total' and 'count' registers to zero before input of data.

Q2. Many candidates were familiar with the operation of random access files using an overflow area.

In part(a)(ii), few candidates appreciated that data retrieval is generally faster for a progressive overflow system than when using a separate overflow area. In progressive overflow, records are likely to be stored at, or close to, their calculated location, so relatively few data access operations will be needed in comparison to searching a large serial overflow file. Efficient operation of any random access system depends on allowing a sufficient excess of storage locations, so that collisions are relatively infrequent.

Part (b) was generally well answered, with candidates correctly calculating the storage location for the specified record, and realising that most of the storage locations in the file would therefore be inaccessible. A variety of acceptable hashing methods were suggested, often involving multiplication of day, month or year values before applying a MOD function.

Q3. Link costs were calculated and correct transmission routes found by the majority of candidates.

Q4. In part (a)(i), many candidates appreciated that problems could occur due to multiple entries for 'John Smith' with different addresses, and that more than one hotel room was shown for one of the records. Fewer candidates realised that searching by surname would be difficult when separate 'first name' and 'surname' fields were not included.

Acceptable solutions to part (a)(ii) were: a single table including a 'bookingID' key field, in which records were duplicated where necessary to ensure only one room was present in each record; or a pair of tables 'Booking' and 'Customer' linked by CustomerID, which ensured only one room was present in each booking record, but avoided duplication of customer name and address data.

In part (b)(i), entity-relationship diagrams were generally well drawn using the correct 'bird's foot' symbols for **one-to-many** and **many-to-many** links. Acceptable answers showed either: four entities, with 'trip' and 'resident' as a **many-to-many** link; or the insertion of a fifth entity 'booking' between trip and resident, to create two **one-to-many** links.

In part (b)(ii), designs were presented in a variety of formats. It is recommended that each table design is given as: the table name, followed by a written list of field names. Candidates are reminded that the identification of primary and foreign key fields is an essential part of the design process. Key fields should be clearly marked by underlining/overlining or other symbols, with an explanatory key provided.

Q5. Questions on SQL were well answered by a number of candidates. Where marks were lost, this was often through not following correct SQL syntax in relation to key words or word order.

In part (d), it was acceptable to use two nested SELECT commands, or to link the 'problem' and 'engineer' tables by means of a JOIN command and use a single SELECT structure.

Where a new table is being created, as in part (e), candidates are reminded of the need to declare a primary key field.

Q6. Many good answers were seen in which binary subtraction was demonstrated by the addition of a two's complement negative integer to a positive integer.

In part (b), many candidates appreciated that a two's complement integer should be doubled for each left-bit shift, but shift operations could lead to incorrect results. However, few answers included actual examples. Problems which might have been illustrated are:

**Change of sign**, where a positive number becomes negative, or a negative number becomes positive, e.g.

0100 0101      left shift by 1 bit gives      1000 1010

**Overflow** without change of sign, e.g.

0100 0101      left shift by 2 bits gives      0001 0100

**Underflow**, where bits are lost to produce a zero result, e.g.

0100 0101      left shift by 8 bits gives      0000 0000

- Q7. Good answers were given. In part (b), candidates who realised that the value would be halved were able to easily state the result without a full recalculation from the floating point form.
- Q8. In part (a)(i), the essential problem is that the key must be transferred from the sender to the receiver, and could be intercepted during transfer.
- In part (a)(ii), candidates generally gave correct explanations of the use of double-key encryption in the transmission of data over the internet.
- Good responses were given for the vulnerability of the Caesar cypher, with candidates aware that this could be easily broken by checking only 25 alternative shift positions, or by analysing the frequency of commonly occurring letters.
- The cypher question in part (b) was well answered. Shift positions were often correctly calculated, but a common error was to not apply MOD 26 to the final result, giving a shift[5] of 56 letter positions rather than 4.
- Q9. Candidates were generally familiar with the concepts of parallel processing and distributed processing. However, in many cases part (b) was not well answered. Reference could have been made to: the extent to which parallel processing is possible in the task; the availability of a local area or wide area network for distributed processing; the amount of work for programmers and IT staff in setting up the system, including the handling of input data and combining of final results for the task; and the impact on the organisation of allocating a mainframe computer or multiple desk top computers for the required amount of processing time.
- Q10. The question on biometric data systems was generally well answered. Where marks were lost, this was often through lack of detail in answers. It is recommended that candidates make case studies of the ways in which biometric data is recorded and stored, for example: voice recognition using patterns of sound frequencies and amplitudes; face recognition using key reference points in an image of the face.
- In part (d), many candidates indicated that collection and storage of biometric data could be an infringement of privacy, but few went on to explain how this might have a detrimental effect on individuals. For example, face recognition data collected by official organisations might be used in conjunction with CCTV to monitor and record lawful activities such as attendance at political protests. Other objections to biometric systems include health issues such as: risk of eye damage through retina or iris scanning, or infection through touching a dirty finger print scanner.
- Q11. The question on database management systems was misunderstood and poorly answered by a majority of candidates. Candidates typically gave detailed but irrelevant descriptions of the design of relational databases.
- The question required a discussion of the role of a database management system in allowing appropriate data access for different groups of users. Few candidates provided an example, such as a hospital database where different levels of access might be provided to: doctors, administrative staff, nurses, and managers.
- A wide variety of tasks carried out by the IT staff could have been mentioned, including: back-up of data, security through virus checking and firewalls, monitoring access logs to identify unauthorised activity, updating of hardware and software, help-desk and training facilities for users.

# COMPUTER SCIENCE

## General Certificate of Education (New)

Summer 2018

### Advanced Subsidiary/Advanced

#### UNIT 5: PROGRAMMED SOLUTION TO A PROBLEM

##### General Comments

Many projects of a good standard were submitted for moderation this summer. Moderators saw some work of an excellent standard. Many centres had assessed the work accurately and had clearly explained their assessment decisions which aided the moderation process.

This specification requires work to be submitted electronically. In addition, candidates' functional solutions should also be included in the coursework submission. Centres should ensure that candidates' solutions are presented in a format that allows moderators to run the candidates' programs with ease. In too many instances, moderators found that solutions included absolute rather than relative pathways to files that prevented the solutions from functioning correctly.

It would aid the moderation process if centres would ensure that candidates' work and documentation are saved with filenames that clearly identify the centre number, candidate number and candidate name.

It is an essential requirement that all candidate work is authenticated. The Joint Council for Qualifications (JCQ) document "Instructions for conducting non-examination assessments" states that:

*"All candidates **must** sign a declaration to confirm that the work they submit for final assessment is their own unaided work.*

*Teachers **must** sign a declaration of authentication after the work has been completed confirming that:*

- *the work is solely that of the candidate concerned;*
- *the work was completed under the required conditions;*
- *signed candidate declarations are kept on file."*

When uploading candidates' work for moderation, centres must ensure that the completed mark sheets and authentication sheets are provided for each candidate. In the recent series much time was spent by moderators and WJEC officers contacting centres to request the missing paperwork.

It should also be noted that any additional candidates' work and/or paperwork requested by moderators must be provided in a timely manner.

The following information is provided to help centres guide candidates through the NEA in future. There was evidence of some confusion regarding the following sections of the project work.

In general, many centres had not recognised the importance of the discussion section to the identification of suitably substantive problem situations. This is a good opportunity for teachers to steer candidates away from unsuitable ideas that will lack the scope required to produce work to a standard and level appropriate for this qualification.

During design work candidates should identify the objectives for their problem solutions. These objectives should inform all sections of the candidates' work from this point onwards.

For each objective, candidates should:

- design input and output facilities and appropriate data structures
- produce algorithms for processing
- develop a prototype if relevant and redesign if necessary
- fully develop the solution
- develop testing which covers each objective
- evaluate the solution for each objective

The prototype section of work is intended to allow candidates to trial part of their design and to reflect on the method of solution chosen. In many cases, candidates included feedback from others in this section of work. This was not appropriate as this section of the work relies on self-reflection.

The refinement of design section of the work considers third party feedback in addition to self-reflection to move the project forward.

It is essential that feedback in the discussion work and in the refinement of the design work is provided by informed third parties who are able to move the project forward rather than end users.

In some cases, candidates produced final solutions that were over reliant on application packages such as relational databases and spreadsheets in particular MS Access. This qualification does not allow the use of applications other than as a vehicle for storage of files. Candidates **should not** make use of any of the facilities built into the application and all validation of data and sorts/searches of sets of data must be implemented through the use of original code.

It is strongly recommended that the use of such application packages is always avoided with candidates developing their own file handling routines and facilities.

## **Unit 5 – Non Examination Assessment**

Most candidates had chosen suitable problem situations as a basis for their project work. These problem situations provided them with sufficient scope to produce a fully working system at an appropriate level for this qualification although this was not always fully exploited.

However, a minority of candidates had chosen problem situations that did not provide the opportunities for data handling that are required to access marks for design, implementation and testing at a level appropriate for this qualification.

The specification has been designed to provide two opportunities for feedback from teachers and peers that should have encouraged these candidates to refine or change their choice of problem.

Candidates should consider whether their choice of problem situation provides them with sufficient:

- opportunities to carry out an investigation in appropriate depth to provide evidence to allow them to complete the analysis, problem definition and objectives sections of the work to an appropriate level of complexity for an A2 qualification.
- complexity to provide the opportunities needed to access the full range of marks
- data handling processes to allow thorough testing procedures to take place

## **Discussion**

It is important that centres recognise the importance of the discussion section. This section provides opportunities for the candidates to present their problem situations to their teacher, peers and/or other competent third parties. Candidates should receive informed feedback regarding the scope of their chosen problem and should reflect, in depth, on the discussions and feedback to allow them to firm up their ideas and ensure that unsuitable topics are revised or discarded.

The preparation of the materials for the presentation/discussion allows candidates to reflect on their ideas and the problem situation. If necessary, the candidates are able to reframe their problem situation or even identify a different, more appropriate problem situation.

## **Investigation**

Where candidates had chosen suitable real-life problems they have the opportunity to carry out an investigation of the current system. Candidates should identify the data collected, processed and output by the current system. In many cases candidates did not carry out this investigation and analysis but provided narrative accounts of problem situations that did not allow them to identify suitable objectives for their solutions nor form the basis for a comprehensive design.

Candidates are required to carry out desk-based research into similar commercial solutions created to solve similar problems. In many instances candidates are paying only lip service to this requirement.

This research is an important part of the project as it should inform the design process. In addition, it is essential to note that the final section of the NEA requires candidates to evaluate their final solutions against the commercial systems. This is intended to provide them with informed ideas for further development of their systems.

Where candidates are not able to identify a real-life problem they should carry out extended research into similar commercial systems, identifying common characteristics and should base the conclusions of their investigations on the information that they have been able to gather.

It is important that candidates produce a comprehensive working specification and that measurable objectives are set that will inform the design, prototyping and testing processes.

## **Prototype**

Candidates should identify the areas to be prototyped. These areas should cover the essential sections of the solution.



Candidates should not include facilities such as logon facilities and validation that will complicate the prototype development and testing process. It is not necessary to include all fields for data files. Centres should note that the extent of the prototype will reflect the nature of the chosen problem.

The prototype work is intended to allow self-reflection on the chosen method of solution and the design work. It is not appropriate to include feedback from third parties.

### **Post-prototype refinement of design**

This part of the work is intended to allow candidates to consider third party feedback and to decide what changes, if any, should be made to the original design. It is important that candidates realise that this section of work requires refinement of design not redesign.

Candidates should justify their acceptance or rejection of feedback.

### **Testing**

It is important that the testing work should focus on the functionality of the solution in terms of:

- input facilities, including measures to ensure reasonable data entry
- processing facilities, to ensure correct and accurate output
- appropriate output, including screen and paper-based outputs

The testing work should cover each objective using data designed to measure the actual outcomes of the system against the desired outcome. The quality of the commentaries accompanying the testing evidence have a major role in identifying the marks to be awarded for this section of the work.

### **Evaluation**

The evaluation section should cover the effectiveness of the programming language and a justification of the tools and techniques used.

Candidates should then compare and contrast their completed solutions with the commercial systems considered during the investigation section of the work. This comparison should allow candidates to identify and discuss the good features and shortcomings of their work. It is important that candidates describe significant potential improvements to their systems that would more reflect the facilities of the commercial solutions to the chosen problem.

Candidates should also consider their own strengths and weakness and how they would adapt their approach to improve their performance if faced with a similar task in the future.



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