GCE A LEVEL EXAMINERS' REPORTS

COMPUTER SCIENCE
A LEVEL

SUMMER 2017

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COMPONENT 1 – PROGRAMMING AND SYSTEM DEVELOPMENT

Many candidates demonstrated that they understood and could answer questions on most of the specification. Candidates were well prepared for the exam and many good answers were evident, particularly for the questions requiring the application of knowledge and understanding of principles and concepts (Assessment Objective 2).

Individual Questions

1. Hashing algorithms (AO 2).

    (a) Many candidates failed to identify the redundancy of using a 7-digit identifier for a data set of limited size, although several candidates did demonstrate understanding of the hashing process.
    (b) Many candidates described a method for dealing with duplicated addresses, with several referring to overflow.

2. Object oriented programming.

    (a) Some candidates produced precise explanations of inheritance, although many would have benefited from use of correct terminology, superclass, subclass, relationships etc.
    (b) Most candidates could name at least one additional fundamental concept.

3. Program translation.

    (a) Well answered. Most candidates described the difference in the scope of translation, as carried out by a complier compared with an interpreter.
    (b) Poorly answered. Few candidates explained the difficulties of debugging compiled code, as required.
    (c) Most candidates identified and provided an example of a syntax error, but many could not identify a second translation error, with ‘logical error’ being a frequent response.
    (d) Well answered (AO 2). Most candidates produced two correct tables, with many gaining full marks. The omission of data type from the identifier table was the most common error.

4. Boolean algebra (AO 2).

   (a) Very well answered, with many candidates gaining full marks for this question.
   (b) As item (a). Very well answered.

5. System maintenance.

   (a) Most candidates identified perfective and adaptive maintenance and several gained full marks, by describing the differing use of each type.
   (b) Many candidates were evidently not aware of this part of the specification, although some identified variable lists and data dictionaries.

6. Variables, parameters and functions.

   (a) Most candidates correctly identified a variable and many identified the parameter, although several candidates lost a mark by naming the function used.
   (b) Most candidates were able to differentiate between passing a parameter by value and by reference.
   (c) Most candidates correctly described truncation and rounding, but many lost marks by not referring to the given example when explaining the effect of each on accuracy.

7. Truth table and masking (AO 2).

   (a) Very well answered, most candidates produced a correct truth table, although several candidates failed to produce a table containing all 8 possible values of A, B and C.
   (b) Very well answered, most candidates designed a suitable mask and applied it correctly using AND. Several candidates suggested the use of XOR to extract the required bits.

8. Syntax diagram and BNF (AO 2).

   (a) Syntax diagrams were well done by most candidates, although the null, or skip arrow was often omitted and many responses would have benefited from greater care in the drawing of the diagrams.
   (b) BNF definitions were not as well done, with most candidates limiting their responses to simple definitions of letter or digit, without developing a string, with a null option, for use in the final definition of the address.

9. Quicksort algorithm.

   Most candidates produced an algorithm in pseudo-code, as required. Many candidates designed an inner loop with a midpoint pivot and a swap, although few included a ‘temp’ variable. Several candidates included an outer loop based on high and low pointers and a terminating condition. Very few candidates initialised the high and low pointers or included any recursive call.

10. Efficiency of an algorithm.

    (a) Some very thorough responses were seen, but these were the exception. Many candidates gained a mark by stating $O(N^2)$, but few explained the growth rate for the time performance with reference to the given algorithm.
    (b) Poorly answered. Few candidates correctly determined the growth rate of memory space used by the algorithm.

11. Binary tree (AO 2).

    (a) Very well answered. Most candidates produced a correct binary tree.
    (b) As above, very well answered.
    (c) Less well answered. Several candidates could not list the correct output from a pre-order traversal.

12. Ambiguity/natural language interface.

    (a) Most candidates gained one mark by describing ambiguity, but many of the explanations on why high-level programming languages must be unambiguous were vague and lacked technical content.
    (b) Several candidates described difficulties faced by programmers in creating a natural language interface for voice input, although many candidates limited their responses to hardware difficulties, such as processing power required.

13. Procedural and non-procedural programming.

    Most candidates described the features of procedural programming and many candidates included correct examples of uses of non-procedural programs, but few related their responses to their own programming experience or included content from other areas of the specification. A summative question which refers to more than one section of the specification is a requirement for the assessment of this unit

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COMPONENT 2 – COMPUTER ARCHITECTURE, DATA, COMMUNICATION AND APPLICATIONS

Many candidates were well prepared and demonstrated a wide knowledge of the topics in the specification. Good descriptive answers were seen, and questions about binary number representation were particularly well answered. However, a few topics presented significant difficulties.

A majority of candidates found the questions on assembly language programming and encryption challenging. These topics have recently been introduced in the specification, and it is hoped that teaching will develop further in these areas.

Another question causing difficulty related to the use of computers in weather forecasting. Many candidates had insufficient technical knowledge of this field. It may benefit candidates to undertake a wider range of case studies of computer applications in commerce and industry during their courses in computer science.

Individual questions

1. Most answers demonstrated a correct use of SQL keywords and command structures. In part b(ii), many candidates produced a query across two tables by use of nested SELECT commands. A minority used a JOIN construction, which was equally acceptable.

2. This question was generally not well answered, with only a minority of candidates managing to produce a program which output the required pattern of star characters. Some apparently successful programs used individual assembly language commands for each character output, rather than the more efficient loop structures which would have gained greater credit. Candidates should be aware that the use of jump commands is expected in appropriate situations. A common error was an attempt to construct a string of star characters in a register before output, whilst the system only allows each register to hold a single character value.

3. (a) Good system diagrams were seen, but in some cases the diagrams lacked detail. Few candidates adequately illustrated and labelled the data bus, address bus and control bus linking the CPU to the main memory, input and output devices.

   (b) Many candidates demonstrated technical knowledge of levels of cache memory. However, relatively few gave a clear explanation of the use of RAM cache to provide rapid access to data and program instructions in current use, for example: where loops in a program require sections of code to be repeated. Some confusion existed between RAM cache and disc cache, with a minority of candidates suggesting that RAM cache holds recently accessed web pages or other large documents.

4. This question was well answered, with many candidates demonstrating practical knowledge of the use of voice input systems, the advantages and limitations.

5. (a) Most candidates were aware of the roles of TCP/IT and FTP in facilitating data transfer across networks. A minority of answers went on to describe in detail the creation of packets and their routing to specified addresses by TCP/IP protocols, or the error checking functions provided in FTP.

   (b) Candidates were generally familiar with the purpose of handshaking, but relatively few gave a full description of the TCP three-way handshaking sequence.

6. The question on binary representation and arithmetic was well answered, with many candidates giving clear and accurate answers.

7. (a) Good answers were seen, with detailed descriptions of the objectives and strategy for database normalisation. In some cases, however, candidates simply quoted very concise technical definitions of first-, second-, and third-normal forms without demonstrating any clear understanding of the terms used or processes involved. Candidates are recommended to illustrate their answers with examples.

   (b) Many candidates produced correct entity-relationship diagrams. A common error was to show a 1:N relational link between ***pupil*** and ***subject***, implying that each subject was studied by only a single pupil. An N:N link was required. A number of candidates appreciated the difficulty of creating a relational database with a many-to-many link. An intermediate table, such as ***registration***, was introduced to link individual students to individual subjects. This approach was equally acceptable.

8. (a) Most candidates were able to describe fragmentation of files and the objective of defragmentation. Fewer answers explained how fragmentation can occur through the repeated addition and deletion of files on a hard disc, or how defragmentation is carried out via a clear area of the disc.

   (b) This question was answered well overall, although only a minority of candidates produced an adequate definition of a master file. Some good examples of master file and sequential file systems were well illustrated with diagrams of the sequential update process. The use of appropriate diagrams in examination answers is to be commended.

9. (a) Many candidates demonstrated a general understanding of indexed sequential file systems, but answers often lacked detail.

   (b) The question on random file access was answered well. Good descriptions of hashing, collisions and overflow were given. However, relatively few candidates appreciated that reorganisation can involve the creation of a new main file with a larger number of storage locations, and the reallocation of all existing records using a revised hash function.

10. The question on cryptography was poorly answered. Many candidates appeared unfamiliar with the terms symmetric and asymmetric cryptography, not realising that these refer to single key and double key encryption systems. Where relevant answers were given, these were often limited to general definitions. Few candidates compared the advantages and drawbacks of single key and double key encryption.

11. This question was generally well answered, with many candidates calculating the original, rounded and truncated values, then going on to determine the absolute errors. Fewer candidates correctly calculated the relative errors.

12. This question was poorly answered, with few candidates showing a detailed knowledge of weather forecasting systems.

    A common error was a failure to focus on weather forecasting, but instead to discuss irrelevant computing applications such as climate change modelling, or even earthquake and tsunami prediction. A number of candidates gave accounts of data security, data warehousing and data mining which were not relevant to weather forecasting applications. Confusion commonly existed between scientific computer modelling and the use of fact-and-rule based expert systems.

    Candidates showed little knowledge of the types of data which must be input to a weather forecasting system, or how this data is obtained at the ground and at different heights through the atmosphere. Few referred to the meteorological processes which have to be modelled, such as frontal and convective rainfall.

    A number of candidates appreciated the value of parallel processing in obtaining rapid weather forecasts. However, few went on to suggest how parallel processing might be implemented, for example: by each processor handing the calculations for a different geographical area during each time step of the model.

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COMPONENT 3 – 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.

This specification requires work to be submitted electronically. In addition, the 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 received CDs that could not be read. Centres should check the media before it is sent to the moderator. Centres should also ensure that candidates' solutions are functioning correctly once transferred from the centre's network.

Coursework samples should be despatched to the named moderator in good time to meet the awarding body's deadline. Centres should ensure that they submit the correct sample for moderation. When centres fail to submit the correct sample the moderation process is delayed. Should moderators' request additional samples of work centres must ensure that the work is provided as quickly as possible. This allows the moderation process to be carried out in accordance with the awarding body's timescales and ensures that results will be available for candidates in August.

The following information is provided to help centres guide candidates through the NEA in future. During the moderation process, it appeared to become clear which centres had attended CPD prior to the submission of the work.

In general, many centres had not recognised the importance of the discussion section to the identification of suitable substantive problem situation. This is a good opportunity to steer candidates away from unsuitable ideas.

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 database and spreadsheets. 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.

Component 3 – Non Examination Assessment

Most candidates had chosen suitable problem situations as a basis for their project work. These problem situations would provide them with sufficient scope to produce a fully working system at an appropriate level for this qualification.

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 this level. 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 process to allow thorough testing processes 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 situation to their teacher and peers and for them to receive informed feedback. Reflection on the discussions and feedback should allow them to firm up their ideas and ensure that unsuitable topics are revised or discarded.

This is an opportunity to ensure that the chosen problem is suitably substantial. In preparing the materials for the presentation/discussion allows students 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.

This specification requires all candidates to carry out desk-based research into similar commercial solutions created to solve similar problems. This is an important part of the project as it should inform the design process. Where candidates paid lip service to this requirement they were unable to analyse the characteristics and requirements for real-life commercial systems. In addition, candidates will be required to evaluate their final solutions against the commercial systems.

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.

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
- Testing should cover each objective
- Evaluation of the solution for each objective

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 testing process. This stage of the work is intended to allow candidates to experiment with ideas and concepts that they would like to include in their final solutions. 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 with data designed to measure the 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 demonstrate their understanding of the language they have used to create the final solution.

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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