May 2013 subject reports

COMPUTER SCIENCE

Overall grade boundaries

Higher level

Grade:	1	2	3	4	5	6	7
Mark range:	0 – 11	12 – 24	25 – 33	34 – 44	45 – 55	56 – 66	67 – 100

Standard level

Grade:	1	2	3	4	5	6	7
Mark range:	0 – 13	14 – 28	29 – 39	40 – 49	50 – 61	62 – 71	72 – 100

Higher level program dossier

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 – 3	4 – 7	8 – 12	13 – 17	18 – 23	24 – 28	29 – 35

The range and suitability of the work submitted

The work submitted was in general well structured with a table of contents and clearly addressed criteria. Candidates submitted a range of hard copy and mostly each was well annotated.

The problems chosen were nearly all appropriate. Database type problems continued to dominate; however, a number of candidates presented games and in general also addressed the mastery factors or included a player database.

It is hoped the range or different classes of problems continues to expand.

Candidate performance against each criterion

A1 Analysis – The data collection process was well shown and many candidates showed an in-depth approach and clearly understood the problem from the user's perspective.

A2 Objectives – This section was reasonable well done with candidates writing a range of objectives – some user, some technical. As with previous years it was not always clear how each related to the Analysis.

A3 Prototype – Well done, candidates mostly included some form of initial design and a good level of user feedback.

B1 Data Structures – The key issue here is to take theoretical structures and justify why these, both memory and disk ones, have been chosen. Often candidates did not provide sample real data in their illustrations showing the structure and operations.

B2 Algorithms – There seemed to be far less copied computer code, and many candidates showed algorithms which had been thought about before coding had begun. A key aspect of computer science is the development of algorithms to solve problems; solutions can often make use of existing techniques but there will be the need to develop problem-specific logic. The best dossiers do this latter aspect clearly.

B3 Modular Design – Mostly well done, but often candidates did not explain the connections between modules.

C1 Program Layout – Generally a well done criteria. However, many candidates include a large amount of code generated listing and so mastery cannot be claimed other than for the use of additional libraries. Code needs to be clearly documented and meaningful variable names need to be used.

C2 Error Handling – There is certainly scope to apply more analysis to what errors need trapping. Many candidates only trapped or detected one class of errors e.g. disk IO or user input but not both. Adequate error handling is a complex and separate program analysis task and is not an afterthought.

C3 Success of Program – Some candidates forgot to include a separate section for this. Using a table of the objectives from A2 and indicating how each objective was achieved worked well for many candidates.

D1 Hardcopy – Generally well done, but it is important to use some form of numbering convention linking the hardcopy to each objective listed in C3.

D2 Report – The best responses were organized using sub-headings. A number of candidates did not comment on algorithm efficiency or on the overall design process.

Recommendations and guidance for the teaching of future candidates

It is recommended that teachers encourage candidates to have a real client and hence solve a specific problem for that client. This makes the project much more meaningful and encourages the candidate to see the development process from the user's perspective, rather than only from a technical one.

Mastery factors cannot be claimed for Java generated code *eg* extending a JFRAME as mastery of inheritance, or for using a two-dimensional array created by a screen writing program. It was often clear the candidate understood what was required but used an inappropriate example to justify their claim.

Mostly simple misunderstanding about RAFiles seemed not to be present this year. However, the restrictions on claiming, inserting or deleting from a sequential file without reading the entire file into memory was poorly understood. Sequential files are re-written instead of appending to the end of the file. This aspect seemed not to be well understood.

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The need to do a thorough analysis of required testing is certainly an area that teachers could focus more attention on.

Standard level program dossier

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0– 4	5 – 9	10 – 14	15 – 19	20 – 24	25 – 29	30 – 35

The range and suitability of the work submitted

The projects were generally appropriate and allowed the candidates access to all criteria. The range was, in many cases limited, with candidates in some schools following a similar pattern.

Candidate performance against each criterion

Section A – Analysis

The better projects implicitly involved an end-user throughout their development. Prototypes were generally detailed.

Section B – Design

Candidates have continually found difficulty in describing and justifying the data structures that they have used in their programs. A fundamental understanding of these structures is essential if they are to successfully carry forward the skills learned during the completion of the project into their examinations.

Section C – Development

The focus on providing an interesting GUI interface should not take preference over the solving of the actual problem, but this was often the case. The better projects made a good use of classes and objects.

Section D – Documentation

The main weakness in the testing continues to be the failure to show the results of any changes in the data. The state of files should be shown both before and after any changes have been made. Files should also be populated within a reasonable number of records.

The awarding of mastery aspects depends upon their functioning being shown in the testing section. This is not always shown by the candidates.

The final evaluation is often an afterthought, but should be considered as important a part in the design cycle as any other.

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Recommendations and guidance for the teaching of future candidates

The Computer Science project will change significantly for May 2014´s examinations, and teachers should prepare accordingly. Many of the comments listed above will apply equally to the new format. Even with the absence of mastery factors, the complexity of the programming (together with the level of skill shown in the design stage) will affect the final mark. This complexity will involve both the candidate's own code and their choice of any previously written modules or libraries.

Higher level paper one

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 – 9	10 – 19	20 – 25	26 – 32	33 – 39	40 – 46	47 – 92

The areas of the programme and examination which appeared difficult for the candidates

Most candidates performed reasonably well.

Many candidates have difficulty responding to questions that required the application of knowledge instead of a straightforward response.

Some candidates faced difficulty in tracing the recursive method. Many answers to questions 18(d) and 18(e) were too vague and off course.

The areas of the programme and examination in which candidates appeared well prepared

There is a wide knowledge base of candidates appearing for this examination. There were only a few candidates who were very poor in their performance. The majority showed a good coverage of the course.

The strengths and weaknesses of the candidates in the treatment of individual questions

Question 1

Most candidates correctly stated two forms of direct data entry.

Question 2

Most candidates answered this question well. Some candidates lost marks because they did not outline an advantage/disadvantage which is relevant to protest groups communicating by social networks.

Question 3

Many candidates did not identify two uses of CASE development tools in the development of a computer-controlled manufacturing process. A few answered the question correctly.

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Question 4

Below average marks were earned in this question. Many candidates outlined the function of the control unit but did not describe correctly how the size of registers is related to the size of primary memory.

Question 5

Many descriptions of the disadvantages of the use of virtual memory were correct. Some candidates confused virtual memory with cloud computing.

Question 6

Well answered question. Almost all candidates outlined the function of virus checker software correctly.

Question 7

Well answered question.

Question 8

Part (a) and (b) were well answered.

Part (c) – A surprising number of candidates did not correctly explain how the use of floating-point representation extends the range of numbers.

Question 9

Tracing the recursive method proved difficult for some candidates.

Question 10

Many candidates defined the term interrupt instead of describing the purpose of the interrupt register.

Question 11

Most candidates correctly compared the use of dynamic and static data structures in storing and accessing data.

Question 12

Well answered question.

Question 13

Well answered question.

Question 14

This question, involving a LAN in a health centre, was answered relatively well by the majority of candidates.

Question 15

Most candidates who attempted this question answered parts (b), (c) and (d) well. Only a few candidates were able to define the term port correctly.

Question 16

Part (a) was well answered.

Part (b) and (c) were discarded. The notation used in the question is off-syllabus.

Question 17

A large number of candidates correctly answered parts (a) and (b). In part (c) most candidates failed to achieve full marks as a result of incomplete and vague answers.

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Question 18

Question 18 parts (a)–(c)

Most candidates who attempted these parts of the question did either very well or very poorly.

In parts (e) and (d) some candidates wrote answers that were too vague and of course. A few candidates showed a very high level of understanding and confidence.

Question 19

Most candidates defined the term analog data. Some candidates wrote answers to parts (b)–(d) in vague and non-specific ways thus received rather few marks.

Recommendations and guidance for the teaching of future candidates

Examination practice – many candidates could have earned more marks by being less subjective and general.

Questions should be analyzed in order to determine what is being asked. All answers should contain computer science and not general observations.

Higher level paper two

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 – 15	16 – 31	32 – 37	38 – 47	48 – 56	57 – 66	67 – 100

The areas of the programme and examination which appeared difficult for the candidates

The examination covered the same topics as in previous years, and the results seem similar to past years. Those candidates (or schools) that have promoted the understanding of data structures (both static and dynamic) through extensive programming activities as well as through the teaching of basic theory, tend to answer not only the algorithm questions well, but also those questions that explore more deeply into what the code is actually doing.

It was those types of question (particularly those that finished each of the four main questions) which required a deeper understanding, and consequently proved quite challenging.

The areas of the programme and examination in which candidates appeared well prepared

Candidates who have followed a sound programming course will always do well in this paper, which leans heavily towards algorithmic thinking. Many scored well on the algorithms in this paper, being well-practised in traversing lists and manipulating objects. Also those who put in a significant amount of research into the Case Study topics scored well on Question 4.

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The strengths and weaknesses of the candidates in the treatment of individual questions

Question 1

The question was based on a standard two-dimensional array problem.

(a) The games question was answered well because of the candidates´ experiences outside of school.

(b)The 'modular approach' benefits were answered well by many.

(c)Most answered this correctly.

(d)Most correctly described the structure as being an array, but not all dealt with the data type.

(e)For candidates with good algorithm experience this was a standard two-dimensional array question. Too many struggled, however, which poses questions about their level of preparation for these examinations.

(f)This required some thinking outside of the box, and was poorly answered. The re-use of modules is an important feature of programming. Even the better candidates had difficulty answering this.

Question 2

The question was based on the linked lists and the use of objects.

(a), (b) and (c) The first three parts focussed on the candidates' understanding of how linked lists work. Many candidates have become well-practised at incorporating lists into algorithms, but it is clear that the fundamental understanding of what is happening and why, is not always there.

(d) Linked lists diagrams should always be complete in that they include a pointer into the list and null pointers, where appropriate, ending the lists.

(e) This algorithm is one that repeatedly comes up in these examinations – a variation on moving through a linked list. Common mistakes are not assigning a temporary pointer to the head and failing to take into account the possibility of an empty list. Although there were many good answers, as would be expected, there were equally many poor ones, which again raised the question about the level of preparation of many candidates.

(f) The final part tested the candidates´ ability to incorporate previously written methods into the solution. Those who answered part (e) well, tended to repeat their success here.

Question 3

This question focussed on hashing. An understanding of hashing on a general level seemed to be present as shown in (a) – advantages of hashing, and (b) – the use of modulo arithmetic. But not many candidates could show a fundamental understanding of what is happening at the Computer Science level as shown in the answers to parts (c), (d) and (e).

(d) The algorithm to locate a record needed to take into account the possibility of collisions, which required moving through the array if necessary (and possibly back to the beginning). Many candidates did not take this into consideration.

(e) The comparison with a full index again showed only a superficial understanding of these access methods for too many candidates.

Question 4

This was the Case Study question.

Over the course of this specification the Case Study has focused increasingly on independent research, and this requirement becomes even more important in the new course. Most of the questions required additional research in order to link the source material in the Case Study to the Computer Science course, and those candidates who carried out this research (who were many)

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scored well. There will normally be a “discuss” question in these examinations. Candidates should, where appropriate, look at both sides of any argument and finish with a justified conclusion.

Recommendations and guidance for the teaching of future candidates

May 2014 sees the first examinations for the new Computer Science course. All teachers are strongly recommended to have taken part in one of the many workshops, both online and face-to-face which are available, as many significant changes have been made.

Those who choose to follow the OOP option (which is closely aligned to this paper), should take into account that there is more focus than before on the use of libraries (*eg* linked list libraries). However, this should not lead schools to ignore the teaching of the fundamentals of data structures, as this knowledge is essential for an overall understanding of the course.

Standard level paper one

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 – 9	10 – 19	20 – 24	25 – 31	32 – 39	40 – 46	47 – 70

The areas of the programme and examination which appeared difficult for the candidates

Candidates struggled with questions related to the hardware architecture of computers. In particular, questions related to the function of the control unit within the CPU, the relationship between the size of memory and the size of the registers, and networking hardware were not well answered.

The areas of the programme and examination in which candidates appeared well prepared

Candidates were generally well-prepared for questions related to aspects of computer usage with which they are likely have direct experience, *eg*. virus-checkers, web-browsing, and application-level design questions.

The strengths and weaknesses of the candidates in the treatment of individual questions

Question 1

Too many candidates specified mouse and keyboard as examples of direct input.

Question 2

Advantages and disadvantages were readily identified but relatively few candidates were able to expand on these in the context of a protest group and instead gave generic answers that would apply to any user.

Question 3

CASE was not recognized by most candidates leading to a large number of creative attempts at this question.

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Question 4

This question was not well answered.

Question 5

A large percentage of candidates responded as though virtual memory were cloud-based rather than local to the computer.

Question 6

This question was generally well answered.

Question 7

Most candidates were able to respond qualitatively; few could provide details.

Question 8

This question was generally well answered.

Question 9

This question was generally well answered.

Question 10

This question was generally well answered.

Question 11

This question was generally well answered.

Question 12

Candidates generally struggled with the first parts of this question, demonstrating only a vague understanding of what the various parts of a network are or how they work together to provide an application. The later portions related to controlling user access to medical files were generally well answered.

Question 13

This question was generally well answered.

Question 14

This question was generally well answered.

Question 15

Candidates frequently failed to recognize the browser as an interpreter. Their responses to the last part tended to focus (incorrectly) on securing the transmission of data between the donors and the database rather than the queried challenge of securing the data after it had reached the organizations servers.

Recommendations and guidance for the teaching of future candidates

Ensure that candidates consider the context in which a question is asked. When discussing network-based, client/server applications for example, a client is NOT the computer professional's client.

Ensure that candidates consider the marks available as part of their answer strategy: 4 marks for a question that is asking for two issues should immediately suggest that they need to expand on each of those issues and not simply identify them.

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Standard level paper two

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 – 11	12 – 22	23 – 29	30 – 34	35 – 40	41 – 45	46 – 70

The areas of the programme and examination which appeared difficult for the candidates

The key issue is the way many candidates approach answering non-algorithm type questions. Q3(e) is a classic example. This question requires candidates to explain three aspects: 2 advantages, 2 disadvantages and provide a justified conclusion. Candidates clearly understood the advantages and disadvantages but often just list one of each and/or explained only one or provided no explanation at all. In a large number of cases candidate then did not provide any conclusion.

Candidates lost marks across a range of these types of questions – as a general rule candidates are required to provide explained answers.

It is expected that candidates that have learnt Java and completed a substantial program for the dossier are able to provide detailed answers to algorithms that show both logical and important detail. For example, correct start and end conditions for loops and correct initialization of variables including initial value.

A number of candidates seemed not to be aware of the importance of the data type in the method signature and the correct use of the return statement. This impacted on the answers to Q2(c) and Q2(e); (e) required an array reference to be returned and hence the signature type needed [ ] and the return required just the name of the array i.e. the reference. A key concept in computer science is the use of functions, in Java called methods, which return a unique value for specific set of parameters, as in the mathematical definition of a function.

Finally, the potential for a relationship between arrays using the corresponding index to link across arrays was not well understood, as shown in Q1(f) & (g).

A minority of candidates did not show relevant understanding of the case study and provided general or vague answers without appropriate reference to the specifics of the case study.

The areas of the programme and examination in which candidates appeared well prepared

Notwithstanding the comments above a number of candidates showed a pleasing facility in the logical construction of algorithms that showed good attention to specific detail.

Many candidates showed a good understanding of data types *eg* boolean and also the implications of incorrect choice or the implications of integer types used in division.

Candidates showed a sound understanding of the use of arrays and where appropriate were able to use dot notation to reference data elements of an object collected into an array.

The use of a flag value to indicate invalid data, as in Q2(a) and (c) was well understood by a large number of candidates.

In general the case study was adequately understood.

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The strengths and weaknesses of the candidates in the treatment of individual questions

Question 1

(a) Many candidates answered this well providing two examples and some supporting explanation. However, some candidate answered in vague terms and it needs to be stressed that computer science level answers require examples and explanations.

(b) In general answered well, but often an example was not provided.

(c) Many candidates answered well, but often marks were lost because the initialization was not done, either at all or not correctly. The loop and test were understood but often the loop start and end conditions were not started correctly.

(d) In general done well, most saw that a two-dimensional structure was needed. A number of candidates failed to provide the data type.

(e) Answered well.

(f) Some candidates saw that a separate data structure was needed and that the index of the corresponding data could be determined.

(g) Often not answered well, but a number of candidates understood the need to pass a parameter to restrict the row that needed to be processed.

Question 2

(a) Clearly understood that –1 was an illegal value, and many candidates showed understanding of how this could be used. A range of candidates were not able to explain the role of –1 adequately in terms of computer science language.

(b) In general done well, but often poorly explained in terms of computer science language;

(c) Done reasonably well by many candidates – commented on above. Data types need to be used more correctly, loop conditions clear, test conditions accurate and blocks of code correctly located. The return was often not included.

(d) Done well by the better candidates; often candidates did not show a thorough knowledge of the use of array sub scripting or dot notation as the array referenced an array of objects. Many candidates showed an understanding of the bubble sort. The assignment of the average ( ) was not well done.

(e) Generally candidates knew that grouping related data together as a unit was advantageous but then could not explain further the ease of coding and referencing elements or the additional benefit of adding methods to the unit.

Question 3

(a) Role of RAM generally understood, but a number of candidates gave answers that often did not address the precise nature of the question.

(b) Well answered.

(c) Well answered – but often candidates did not provide explanation.

(d) Candidates knew 3G/4G allowed access to the Internet, but few identified the increased demands on the networks and the cost of meeting these as critical.

(e) See the comments in the other part of this report.

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(f) Well answered on the whole, required the candidates to give an example, which was often not done.

(g) This was a classic question requiring TWO consequences – general form of the answer should be: 'One consequence is *X* and this is an issue because of *explanation A*'.

(h) Often it was difficult to determine how the candidates answer related to the question, the example given was often vague and then the use discussed was either not related to the sensor outlined, or in fact not provided.

(i) The Kill switch was not understood – many thought it was the power-off button, which is incorrect.

(j) Most candidates were able to show they understood the concept, but often struggled to compose an answer that addressed three points to get 3 marks. Pixel is the smallest element of a screen; by increasing the number of these in a unit area, the sharpness etc. of the display is enhanced.

Recommendations and guidance for the teaching of future candidates

It is recommended that teachers address the way candidates are required to answer questions by addressing the need to answer the question directly and to provide clear points that are explained/justified.

The array data structure is an important component of the SL course and should be emphasized. It is required to be used in the production of the Program dossier and as such teachers should look to enhance candidate understanding by direct reference to what the candidate is doing and promote active learning by the candidate. Candidates should be exposed to a range of examples that are at the heart of similar classification so that finding max and min, for example, is understood as a base abstract algorithm that can be applied in a range of practical solutions.

The case study should be used throughout the year to assist in giving context to the theory that is to be learnt.

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