Diploma Programme
Programme du diplôme
Programa del Diploma

Markscheme

November 2016

Computer science

Higher level

Paper 3

9 pages

General marking instructions

1. Follow the markscheme provided, award only whole marks and mark only in **RED**.

2. Make sure that the question you are about to mark is highlighted in the mark panel on the right-hand side of the screen.

3. Where a mark is awarded, a tick/check (✓) **must** be placed in the text at the **precise point** where it becomes clear that the candidate deserves the mark. **One tick to be shown for each mark awarded.** When marking **Question 4**, use the RM™ Assessor underline tool to underline key parts, and then use the textbox tool to add a comment stating which band the response is in, as well as any supporting explanation.

4. Sometimes, careful consideration is required to decide whether or not to award a mark. In these cases use RM™ Assessor annotations to support your decision. You are encouraged to write comments where it helps clarity, especially for re-marking purposes. Use a text box for these additional comments. It should be remembered that the script may be returned to the candidate.

5. Personal codes/notations are unacceptable.

6. Where an answer to a part question is worth no marks but the candidate has attempted the part question, enter a zero in the mark panel on the right-hand side of the screen. Where an answer to a part question is worth no marks because the candidate has not attempted the part question, enter an "NR" in the mark panel on the right-hand side of the screen.

7. Ensure that you have viewed **every** page including any additional sheets. Please ensure that you stamp "SEEN" on any page that contains no other annotation.

8. A mark should not be awarded where there is contradiction within an answer. Make a comment to this effect using a text box or the "CON" stamp.

Subject details: **Computer science HL paper 3 markscheme**

Mark allocation

Candidates are required to answer **all** questions. Total 30 marks.

General

A markscheme often has more specific points worthy of a mark than the total allows. This is intentional. Do not award more than the maximum marks allowed for that part of a question.

When deciding upon alternative answers by candidates to those given in the markscheme, consider the following points:

- Each statement worth one point has a separate line and the end is signified by means of a semi-colon (;).
- An alternative answer or wording is indicated in the markscheme by a "/"; either wording can be accepted.
- Words in (…) in the markscheme are not necessary to gain the mark.
- If the candidate's answer has the same meaning or can be clearly interpreted as being the same as that in the markscheme then award the mark.
- Mark positively. Give candidates credit for what they have achieved and for what they have got correct, rather than penalizing them for what they have not achieved or what they have got wrong.
- Remember that many candidates are writing in a second language; be forgiving of minor linguistic slips. In this subject effective communication is more important than grammatical accuracy.
- Occasionally, a part of a question may require a calculation whose answer is required for subsequent parts. If an error is made in the first part then it should be penalized. However, if the incorrect answer is used correctly in subsequent parts then **follow through** marks should be awarded. Indicate this with "**FT**".
- Question 4 is marked against markbands. The markbands represent a single holistic criterion applied to the piece of work. Each markband level descriptor corresponds to a number of marks. When assessing with markbands, a "best fit" approach is used, with markers making a judgment about which particular mark to award from the possible range for each level descriptor, according to how well the candidate's work fits that descriptor.

General guidance

Issue	Guidance
Answering more than the quantity of responses prescribed in the questions	• In the case of an "identify" question read all answers and mark positively up to the maximum marks. Disregard incorrect answers. • In the case of a "describe" question, which asks for a certain number of facts *eg* "describe two kinds", mark the first two correct answers. This could include two descriptions, one description and one identification, or two identifications. • In the case of an "explain" question, which asks for a specified number of explanations *eg* "explain two reasons …", mark the first two correct answers. This could include two full explanations, one explanation, one partial explanation *etc*.

1. (a) *Award up to **[2 max]**.*
The original (stored) colour assigned to that point;
The (characteristics of the) light hitting it;
The properties of that point / material of that point **[2]**

(b) These are the basic elements building blocks used;
Such as cubes, cylinders, pyramids, cones, spheres and tori (used to construct the wireframe models);
Note: *At least two of the examples must be seen for the second mark to be awarded.* **[2]**

2. (a) Description of motion capture;
Description of avars;
Mapping between control point on actor and model;
Example of example of movement (can award 2 marks here for good example that implies previous mark point);

[4]

(b) *Award up to **[4 max]***
Inverse kinematics uses algorithms/mathematics;
To determine the angles;
of the various joint angles/positions of the different body parts;
Having been given / in order to achieve the resultant position;
To mimic the movement of a skeleton / to be anatomically correct (<u>not</u> to give realistic movement) **[4]**

3. *Award up to **[2 max]** for a description of the processing required in **each** direction up to **[4 max]**. Award up to **[2 max]**, for the conclusion in terms of processing power.*

From source to eye:
- All possible light rays (within reason) would have to be traced from the source to see if they reached the eye;
- Most of these rays would not reach the eye;

From eye to source:
- Only a small number of rays would have to be traced – one for each pixel on the screen;
- To see if they reached the source;
- As the amount of processing is proportional to the number of rays traced;
- From “eye to source” is a far more efficient method/takes far less processing power; **[6]**

4. *The discussion should consider each of the features identified in the question's bullet points. For each of these, the relevant algorithms should be considered by explaining how they function and the resources demanded by them. Conclusions should be made as to how these features would be achieved by this company taking into account the size of the company, the resources needed and the type of project (an animated commercial).*

The following arguments may feature in this discussion:

The use of three anthropomorphic creatures:
- the use of Mo-cap algorithms can achieve high degrees of photorealism
- many viewpoints must be used
- algorithms combine data from the different cameras/viewpoints
- this is extremely resource-intensive and very expensive
- it is unlikely that this company will use this method
- wireframe models captured at different moments together with tweening to "fill in the gaps"
- many algorithms for each avar for each creature to perform tweening
- time consuming but commercial can be produced in advance so suitable for this company.

Movement through a changing mountainous terrain:
- fractal algorithms can provide realistic landscapes
- different scenes can be easily generated by varying the "error"
- as this is recursive there is an extensive number of calls / levels will consume high memory
- levels can be restricted to a reasonable amount
- this is a viable and cheap process for this company.

A high degree of photorealism:
- apart from the decision on Mo-cap
- a choice between ray-tracing and scanline rendering must be made
- scanline requires less resources and can normally be performed in real-time
- ray-tracing involves the algorithm repeatedly checking all possible rays to see their effect
- each scene would require extensive processing which is time consuming
- however it is more realistic
- and the process can be carried out in advance (as it is a commercial)
- the company should use this form of rendering.

Algorithms to be considered include:

Tweening:
- if wireframe models are used then many avars (control points) for photorealism
- algorithm needs to be applied to each avar
- parallel processing
- different algorithms for different control points
- repeated for each (inbetween) frame.

Mo-cap:
- many avars used
- many cameras at different positions
- data stored for each avar for each creature for each frame (24 fps)
- algorithm combines data from all cameras for each avar for each frame
- algorithm merges final results onto anthropomorphic creatures.

Landscape/Fractals:
- recursive algorithm
- the more depth the more realism the more processor intensive
- repeated if landscape changes.

Ray-tracing:
- recursive process
- each point requires algorithm to analyse how light properties change
- one point affects another
- has to be repeated in parallel for each point on each object for each frame.

Marks	Level descriptor
No marks	• No knowledge or understanding of the relevant issues. • No use of appropriate terminology.
Basic 1–3 marks	• Minimal knowledge and understanding of the relevant issues. • Minimal use of appropriate terminology. • No reference is made to the information in the case study or independent research. • The answer may be little more than a list. • *Algorithms or features may be identified but no knowledge is shown further than repeating sections from the case study.*
Adequate 4–6 marks	• A descriptive response with limited knowledge and/or understanding of the relevant issues. • A limited use of appropriate terminology. • There is limited evidence of analysis. • There is evidence that limited research has been undertaken • The answer shows some understanding but is lacking in one or more of the issues. • *Algorithms are outlined with relation to at least one of the features.* • *Some attempt is made to reach conclusions.*
Competent 7–9 marks	• A response with knowledge and understanding of the related issues. • A response that uses terminology appropriately in places. • There is some evidence of analysis. • There is evidence that research has been undertaken. • The answer shows a reasonable level of understanding of all related issues. • *At least two of the features are considered.* • *Understanding is shown of at least two of the algorithms.* • *Conclusions are reached.*
Proficient 10–12 marks	• A response with a detailed knowledge and clear **understanding**: – *all three features are considered* – *clear understanding of the algorithms are shown* – *conclusions are given regarding the suitability of these algorithms/processes for this project.* • A response that uses terminology appropriately throughout. • There is competent and balanced analysis. • There is clear evidence that extensive research has been undertaken.

[12]

Total: [30]