Examiners' commentary 2018–2019

CO2227 Creative computing II: interactive multimedia – Zone A

General remarks

Overall, performance on this paper was reasonable, with candidates achieving an average of a high Third Class mark. A small number of candidates achieved a First Class mark, but none of these were above 80 per cent. At the other end of the scale, only a couple of candidates failed the exam, which means that most candidates achieved a mark in the average range.

In any examination, it is very important to read and address the question that is being asked. Little or no credit is given to correct but irrelevant material in an answer, because that irrelevant material does not demonstrate understanding, and actually gives an indication that the candidate may not fully understand some of the concepts.

It is also very important to answer all parts of a question as there are marks assigned to each part. For example, a question that asks you to describe some concept and give examples requires that you do both: describe and give examples. An answer that omits the examples will not score as well.

What follows is a brief discussion of the individual questions on this paper, with some explanations of the answers expected by the examiners.

Comments on specific questions

Question 1: Colour and light

This was a popular question, answered by almost all candidates and with mostly straightforward content. Many of those who chose this gave good responses. There were also a couple of excellent answers.

a. Part (a) was concerned with hue, saturation and brightness.

   i. Most candidates were able to correctly identify that hue is the colour reflected from or transmitted through an object and is typically referred to as the name of the colour (red, blue, yellow, and so on). *Saturation* is the strength or purity of the colour and represents the amount of grey in proportion to the hue. A 'saturated' colour is pure, and an 'unsaturated' colour has a large percentage of grey. Finally, *brightness* is the relative lightness or darkness of a particular colour, from black (no brightness) to white (full brightness).

   ii. Here, the examiners wanted to see the calculations, to obtain that:

   $H = 4{:}61$, $S = 1{:}0$ and $B = 0{:}5$

   For H, answers expressed as degrees or radians were also accepted if the working was clear.

b. Part (b) asked for both an example of a user interface design, and an explanation of why the example provided is appropriate. For example, where users input their username and passwords, the label and box should be close together or connected in some way. Gestalt laws such as proximity would be appropriate to support this.

c. For part (c), a straightforward description of subtractive mixing and the printing of the specific colours was required. CMYK works by applying pigments to a white page. Pigments are cyan, magenta, yellow, and a key colour, which is usually black. Lighter colours can be created using half-toning. Red is a subtractive mixture of magenta and yellow. Most but not all candidates mentioned that because black is usually the key colour, the K ink is applied to the page. Some were also able to say that mixing in this case would instead produce a muddy colour, making K preferable.

d. Finally, candidates were asked to define *deuteranomaly*. Deuteranomaly is the most common kind of colour blindness, affecting perception of red and green hues. Systems should not rely just on colour, but could use: brightness, saturation, shape, location, and so on, to communicate information.

Question 2: Animation

This was also a popular question, though the quality of the responses was of a lower standard than those of Question 1. There were, however, some excellent answers from a couple of candidates.

a. The responses for part (a) did not always show the calculations required to obtain the answers. If the final answer was incorrect, no marks could be awarded.

  i. After 0.8 seconds, the position would be (270, 360)

  ii. After 1.5 seconds, it would be (211.25, 211.25).

b. Here, candidates did not always show strong understanding of the essential aspects. Frame rate is the rate at which different images are displayed. For smooth motion to be perceived, this rate needs to be around 16Hz or faster. Flicker rate is the rate at which projection lights are interrupted. It must be as high as the frame rate, or higher (and is usually double or triple the frame rate). When the frame rate is high enough, we experience Beta motion. Both this and persistence of vision should have been explained to obtain full marks.

c. Part (c) asked candidates to describe different animation techniques.

  i. To obtain full marks, an answer that explained that flat animation is a sequence of hand drawn images, and is how the first animated cartoons were made, would be appropriate. This process is time consuming, so keyframing and layering were developed to speed up the process or distribute it over many animators. Characters were more simple than backgrounds and animations were broken down into sequences that could be repeated.

  ii. For the second part, candidates were asked to describe how they would choose between stop-motion and flat animation for a particular project. Here, you could discuss whether clay or hand drawing is an appropriate aesthetic, whether flat backgrounds are appropriate, and ways in which workload could be distributed. Both are manually intensive processes though, so that would not be relevant to the choice of one or the other, and nor is cost.

c. Part (d) again required candidates to show their working, which was not always done. Two keyframe sketches, with the car in the correct place, were needed. This was (300; 130) in keyframe 1, and at location (650; 480) in keyframe 2. The *x* and *y* coordinates in frame 60 would be (410; 250).

Question 3: Audio and music perception

This was a moderately popular question, but generally resulted in weak answers.

a. For part (a), candidates should have noted that the curves are equal loudness curves and indicate that our perception of sound loudness varies depending on frequency. For instance, for the same decibel (or amplitude or energy level), when the frequency is 1kHz, we will perceive it to be louder than a lower frequency sound. This is useful to know, for instance, when we want to maintain the same perceived loudness of sound with different frequencies.

b. Most candidates were correctly able to identify that the labels were for:
   i. the pinna
   ii. the tympanic membrane (eardrum)
   iii. the semi-circular canals.

c. Part (c) was a very straightforward question, and could be well answered simply by using knowledge obtained from the subject guide. The basilar membrane is responsible for frequency analysis of sounds. The mapping is tonotopic, meaning that different regions are stimulated depending on the frequency components of the sound. Examiners also expected the mention of hair cells.

d. In explaining auditory masking, candidates should have demonstrated understanding that a loud tone can obscure a quieter tone that is close in frequency. The quieter tone must be within the critical bandwidth and be approximately 1=10 the amplitude of the masking tone (-20dB).

e. Weak answers were generally given for part (e). A melody is a usually continuous time sequence of tones that is perceived as a single musical entity.

f. For part (f), candidates were generally able to compare the FFTs given correctly.

g. The final part, was also straightforward. Candidates were able to list three frequencies, but the explanations of why these particular frequencies had been chosen were often lacking.

Question 4: Digital media signals and their representations

About three quarters of the candidates answered this question, with average performance

on it overall. It comprises many sub-parts, each worth a few marks each, so it was possible to achieve a reasonable mark just by making sure to respond to each sub-part.

a. For part (a), the Nyquist frequency is 24kHz, which is the highest frequency that can be reliably reproduced. To calculate the storage space, candidates had to convert to bits and include both channels, to obtain an answer of around 76.9 MB. Showing your working is an important aspect of exam strategy, as it is possible to obtain some marks through demonstrating understanding, even if the final answer is not actually correct.

b. Part (b) was bookwork and could be answered through knowing the basic information provided in the subject guide on FLAC. Not all candidates were familiar with this, and some showed misunderstanding of the material.

c. Part (c) concerned *compression*.
   i. The first sub-part asked for a distinction between *lossy* and *lossless* compression. A simple answer could have been that a lossless compression algorithm allows the original digital signal to be perfectly reconstructed, while a lossy compression algorithm removes information from the signal and does not allow perfect reconstruction. Other explanations that were appropriate were also accepted.
   ii. Here, an actual example was required, rather than just a generic statement that lossy is preferred when you want a smaller representation. Examples could be that lossy algorithms may be preferable for contexts such as streaming over the internet or listening on personal music players, where having a smaller file size is more important than being able to perfectly reconstruct the original signal.

d. Again, for part (d), the material from the subject guide is sufficient to provide a good answer. However, candidates needed to show understanding, rather than just providing a few key words such as masking, and psychoacoustic model, which not all managed to do.

e. Part (e) concerned *quantisation*.

   i. Quantisation is the process of representing each audio sample with a finite number of bits. Here, a clear explanation, as well as a diagram that was correct and relevant was required for full marks to be awarded.

   ii. Similarly, a specific scenario was required here rather than something generic.

Question 5: Signals and systems

This question was only answered by a small number of candidates, but the marks obtained were the highest of all the questions available, showing that those candidates who did attempt it really did understand the concepts.

a. Part (a) required candidates to fill in the blanks. The correct answers were:

   i. multiplying

   ii. time invariance

   iii. linearity

   iv. LTI (linear time invariant)

   v. the impulse response of the system

   vi. the same signal.

b. For part (b), this was an edge detection kernel. Sharp edges or transitions will come out bright while the rest of the image will be dark.

c. For part (c), other possible image effects that can be achieved through an image kernel could include: echo, edge detection, motion blur, low-pass filter, high-pass filter and Gaussian blur.

d. Part (d) required candidates to demonstrate insight about the process of designing and applying filters.

   i. You could use either a high-pass filter or a band-stop (or band-reject) filter.

   ii. For full credit, examiners expected the steps required to include both figuring out what frequency the alarm is (for example by using an FFT or STFT or spectrogram), as well as listening to the result to check that the hum has been removed and undesired artefacts have not been introduced.

   iii. An appropriate sketch was required.

Question 6: Information retrieval

This question was answered by about 50 per cent of candidates, but with the worst performance overall on it, and an average mark that did not even achieve the 10 marks required for a pass on the question itself.

a. Part (a) concerned audio file storage on a disk.

   i. An appropriate data structure could probably have the filenames of the files and their RMS amplitudes stored as a pair in a vector (or an array). To retrieve the sound file closest to a query amplitude, the algorithm would iterate over all of the entries in the vector, computing the absolute difference between the logarithm of the query amplitude and the logarithm of the precomputed amplitude, finally returning the filename whose absolute difference from the query amplitude was a minimum.

    ii. Part (ii) asked candidates to comment on the efficiency of their solution to part (i). The efficiency of this algorithm is linear, and wouldn't scale very well to large collections of music. Indexing is also difficult.

    iii. The log differences between the query and the data set are:

    [0:172; 0:064; 0:047; 0:079; 0:115], so file03.wav should be returned.

    Other approaches to the data structure and algorithm were accepted if they were appropriate.

b. For part (b), it was essential to relate the answers to the particular scenario as well as defining the terms themselves.

    i. It was not sufficient to simply say what *precision* is, you would also have to relate this to the quality of the recommendations of the books.

    ii. A system with high recall would return a larger percentage of books from the database that might appeal to the user.

    iii. A good answer for the importance of recall vs precision should discuss the trade-offs between them, and again relate it to the context. Since reading a book takes substantial time, precision is probably more important in this case. However, very low recall would mean that few or no books would be recommended, which is also undesirable.

c. The final part required knowledge of the features listed, as well as the kinds of uses that could be made of them. Many candidates did not answer this fully, though most candidates did know what the different features were. *Chromagram* was one feature that some candidates thought, incorrectly, related to colour.