Examiners' commentary 2017–2018

CO2227 Creative computing II: interactive multimedia – Zone A

General remarks

Overall performance on this paper was reasonable to good, with a couple of candidates showing a very good understanding of the subject, with marks well into the first class range. In contrast there were also some weak papers, including a few failures.

In any examination, it is very important to read and address the question that is asked.

Little or no credit is given to correct but irrelevant material in an answer, because that irrelevant material does not demonstrate understanding of the material, 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, with mostly straightforward content, and many of those who did choose this in general gave good responses. There were also a few excellent answers given.

Most candidates were able to correctly identify, for part (a) that the labels indicated the lens, the pupil and the optic nerve.

Part (b) was not always answered correctly. The fovea is a pit with the highest density of cones on the retina. It is responsible for our sharp central vision, used whenever fine detail is required.

For part (c), most candidates knew that the iris blocks light from travelling into the eye, though more could have been said about its role, such as that it controls the amount of light by expanding or contracting the size of the pupil.

The descriptions of hue, saturation and brightness given for part (d) were usually good.

One mark was given for each of these.

Part (e) was a straightforward calculation, though a number of candidates calculated h incorrectly. The correct equation to choose was the one for max = g, and it is simply a matter of filling in the values of *r*; *g*; *max* and *min*,

and then working out what this comes to. Most candidates were able to correctly calculate *s* and *b* as 1 and 0.5 respectively.

Part (f) was reasonably answered. Rods are important for peripheral vision; they are absent from the centre of the retina; and they are sensitive to motion but have poor spatial discrimination. Cones have a fast response time; are of three types corresponding to different wavelengths of light; and are generally less sensitive to light.

Part (g) was also answered reasonably. Most candidates knew that the dashed line represents a mixture line (or the line of colours that can be made by mixing red and cyan light). Point J represents yellow, while the name for the set of points circumscribed by the triangle is the gamut. The set of points is the set of colours that are expressible by all possible mixtures of these primaries.

Question 2

Animation

This was also a popular question, and there were some excellent answers from some candidates.

The responses for part (a) were reasonable in the sketching of keyframes. Examiners expected two sketches, with the car in the correct location in each. Not all candidates included the location information; and some only included one sketch. The next sub-part is a simple calculation. Candidates were asked to show their work, and in this sub-part and the next, many did not. If an incorrect answer is obtained, the examiners are unable to award partial marks if the working is not shown. Correct answers would be that the *x* coordinate is 80 and the *y* co-ordinate is 35.

Part (b) was a question about splines, answered correctly by most candidates, though many did not explain what cubic Hermite splines actually are. The effect of using a spline rather than linear interpolation is that the car will start and stop smoothly, rather than abruptly, which most candidates understood. Some candidates focused on overall speed, which is not correct. Finally, for the last part, $p(t_{k-1})$, many candidates did not know what this was, but often claimed that it was related to velocity rather than position.

Part (c)(i) required a straightforward response that relates to the relevant aspects of animation, in this case flat animation. Answers that were about layering, or stop motion animation, were not given credit. For part (ii), examiners were expecting well-reasoned answers, which means that justification is required. Issues to consider are aesthetic, pragmatic, and the reality of the physics involved. Some candidates felt that the choice was linked to effort; however both are manually intensive processes, so that isn't relevant to the choice of one or the other.

For the final part, part (d), candidates demonstrated an overall understanding, though sometimes detail was confused or lacking. The work is from the subject guide. Frame rate is the rate at which different images are displayed; for smooth motion to be perceived, this has to be fast enough, specifically around 16Hz. Flicker rate is the rate at which a projector light is interrupted (when changing frames), it must be at least as high as the frame rate though it can be higher. It is usually double, though sometimes even more than that. When frame rate and flicker rate are fast enough, we experience persistence of vision.

Question 3

Audio and Music Perception

This was another very popular question that was answered by many candidates.

For part (a), most candidates know that A is louder than B; however not all were able to say that there is no difference in how the sounds of C and D would be perceived. It is important to understand the impact of a phase shift on the resulting auditory signal. E is lower in pitch than F.

Part (b) was similar in requirement to part (a), but required comparison of FFT signals.

This was more weakly answered; L is quieter than K; H is one octave higher than G, and for I and J, the timbre will be different. Some candidates incorrectly added that L is half as loud as K.

Part (c) was a very straightforward question, and could be answered well simply by using knowledge obtained from the subject guide. It was important though that the parts chosen were actually related to the inner ear; a couple of candidates chose parts that were not.

In the main, part (d) was answered correctly, though not all candidates included the explanation asked for. Frequencies that are integer multiples of 250 Hz would be present, because the air column vibrates with harmonically related frequencies of a fundamental of 250Hz.

For part (e), all reasonable responses were accepted. Examiners expected mention of a sequence of tones, over time, and that these are perceived as a connected or single musical entity.

The final part, part (f), was not always answered well. This question expected explicit answers to three distinct aspects, which were not always given.

Question 4

Digital Media Signals and their representations

Almost every candidate answered this question. It is one with many sub-parts, each worth a few marks, so it is possible to collect a reasonable score just by making sure to respond to each sub-part.

Part (a) was about audio representations. The first two sub-parts required calculations, and with any calculation it is important that you show your working. Not all candidates did this; it was particularly important in the first sub-part, which has a detailed set of calculations to obtain the correct answer of around 28.8 MB. Working out how many seconds in length the song is, and how many bits are required for each second's representation are the initial steps.

The next sub-part of this question required working out what compression ratio is achieved over the PCM representation if an MP3 file of the same song is 6.8 MB. A very simple calculation, working out what percentage of the size of the original file the MP3 one is.

The following sub-part required an explanation of how MP3 achieves the compression ratio and expected mention of MP3 being a lossy format that removes sounds that are masked according to a psycho-acoustic model. The final sub-part concerned the ranking of compression formats in terms of size results. In this case, the correct order would be MP3, FLAC, ZIP, WAV, though ZIP might reasonably be elsewhere in the ordering too.

The questions about compression, in part (b), were generally answered well, though the final sub-part less so. Only one example of either audio or image

lossy compression was asked for, making this part an extremely easy question. Examples of when lossy algorithms may be preferable to lossless ones included 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. Finally, in discussing FLAC, examiners expected candidates to show that they understand that it is likely that audio channels are closely related, and FLAC tries to exploit that by only encoding the differences. The possible modes are: left-right (both channels encoded separately); left-side and right-side (one channel encoded with the difference between the two), and the mid-side (the average and the difference).

Part (c)(i) is a very straightforward calculation, doubling the frequency being digitised gives an answer of 240 kHz, while part (c)(ii) required a description of aliasing, as well as a diagram. There is a very good description of what aliasing is in the subject guide, which many candidates were able to give.

For the final part, part (d), many candidates described quantisation as a thing (for example, as a number of bits per sample) rather than a process, showing less understanding. It is the process of representing each audio sample with a finite number of bits. A diagram was essential in this answer, as was a clear explanation of when more quantisation bits would be appropriate.

Question 5

Signals and Systems

This was an unpopular question, answered by only a small handful of candidates.

Part (a) required the drawing of a unit impulse, showing labels. This is straightforward bookwork and very basic knowledge. The impulse happens at time 0, and has a value of 1, and it was essential to show this. The impulse response is simply the output of a system when the unit impulse is input. It allows us to compute the output of the system for any new input, by convolving the impulse response with the new input. Some candidates confused the unit impulse with the impulse response.

Part (b) required a calculation of the output of a particular signal, showing the calculation for four different times, and also showing the working. The system is a low-pass filter, and marks were awarded for answers that stated this; however it was important to also justify the answer given in order to obtain full marks.

For part (c), examiners were expecting candidates to realise that a high-pass filter or a band-stop/band-reject filter should be used. Following this, it would be necessary to figure out what frequency the hum is, for example using an FFT or spectrogram, and listening to the result to check that the hum has been removed and undesired artefacts have not been introduced. The filter drawn needed to look like a frequency response filter, with a reasonable shape, and be realistic; for example a brick-wall filter would not be a good example.

Hardly any candidates were able to say that the kernel is an edge detection one, which preserves only transitions between neighbouring image values that differ by a large margin, producing an image consisting of only the edges of an original image.

All candidates answered part (e) correctly; acceptable answers included echo, blur, motion blur, low-pass filter, high-pass filter and Gaussian blur.

Question 6

Information Retrieval

This was a popular question, and generally answered well by most candidates that attempted it.

A straightforward calculation was required for part (a)(i) as well as for part (a)(ii). For the final sub-part, some candidates presented an argument along the lines of it being more important to have high recall, since the user really wants to find the right song.

High precision is less important, because the user can ignore bad results. However, if precision is very low this could also be bad. One candidate did point out, in this case, that it is harder to ignore bad results because you have to listen to the results in order to decide, and this takes time with audio, more than with images.

Part (b) was about specific features. Most candidates correctly identified that CIE L*a*b is for image, and term-frequency is for text, but some thought that a chromagram relates to image and in particular colour.

Part (c) was usually answered well. The Euclidean distance is 70:33, and document B is more similar to A because it has a lower distance. Not all candidates explained that the lower distance indicates similarity. Finally, other metrics could include Manhattan distance and p-norm; metrics that require binary features would not be appropriate.

The final part, part (d), required choosing a feature that is relevant to musical similarity; any appropriate feature was awarded marks providing the explanation of how it is relevant to musical similarity was clear.