Examiners' commentary 2015–16 – Zone A

CO2227 Creative computing II: interactive multimedia

General remarks

Overall performance on this paper was reasonable, with a couple of candidates showing a very good understanding of the subject, with some First class marks in the high 80s and mid-90s. While there were very few failures, the average mark overall was in the second range, and a number of candidates achieved low passes.

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 examples will not score as highly.

Candidates were asked to choose four out of six questions to answer; all candidates answered at most four questions, which the examiners were pleased to see.

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, and many of those who chose this in general gave good responses. There were also a few excellent answers given.

Part (a) required an understanding that the CMY are subtractive primaries, and that these are printed on top of each other. This makes them act as filters, thereby removing certain colours.

Printing using cyan and yellow will subtract red and blue, leaving green. Finally,

many candidates knew that the K refers to the Key, which is used to print black. Some explained that using all three of CMY results in a rather muddy brownish black, which is why K is preferred; however partial credit was given if candidates did say that CMY is a way to print black.

Part (b) was less well answered. Candidates were asked for the **purpose** of the CIE 1931 colour space, and some just gave a description of how it is used or implemented.

The main point is that it is an attempt to specify all possible colours unambiguously; candidates who described aspects of how it works without including this were given partial credit.

Generally good answers were received for part (c). The fovea is located at the back of the eye, or on the retina. It has the highest density of cones and allows us to have sharp central vision. Credit was also given for explaining that it gives us the ability to perceive fine detail.

For part (d), a good explanation would say that when the disk is spun, people perceive colours. In addition, the colours change if disk direction changes, and colours may vary among people (though these are usually reds and blues). Other relevant points were also given credit, though a few candidates did not mention the connection with visual perception at all.

Finally, for part (e), candidates were expected to know most of the following: different cones are sensitive to different wavelengths (in particular 570, 540, 430nm); these sensitivities are due to different pigments; and they fire in different proportions according to frequency of light. Some candidates described the opponent theory or mentioned visual anomalies that relate to the cone cells, which were credited with marks.

Question 2: Animation

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

Part (a) was a straightforward question requiring a description of the process of interpolation, and how it is used in animation. A figure or diagram was also required, which not all candidates provided. Examiners expected candidates to know that interpolation is used to find the position (or other property) of some object if the position (or other property) is known at times before and after the

desired time. Discussion of keyframes and tweening, and explanations of the difference between linear versus Bezier interpolation were also given marks.

Part (b) required simple calculations and the showing of the calculation work. Candidates who did not show their calculations, giving only the positions of the object, obtained only half the available marks.

The two positions would be (140, 50) and (180, 55), which most candidates were able to calculate. The most appropriate relevant equation would take the form $x_2 = x_1 + (t_2 - t_1)/(t_3 - t_1) \times (x_3 - x_1)$.

The concept of flip-book animation required for part (c) is a simple one, but many candidates were not able to describe it appropriately. It is a method of animation that works by drawing a sequence of still images on consecutive pages of a book, with small changes from one page to the next, and when the book is flipped through at an appropriate speed, we perceive movement. The speed needs to be at least 16 frames per second.

The final part required a mention of the concept of persistence of vision, when an image changes at a high enough rate; not all candidates explained this. Points were also given for mentioning that illusion requires relatively small changes between frames, or correctly discussing the gestalt principles, beta motion, and the phi phenomenon.

Question 3: Audio and music perception

A very popular question, answered by almost all candidates.

Part (a) expected candidates to mention that a melody has a time component in that it is a sequence of tones, and that it is perceived as a single musical entity.

Answers to part (b) usually correctly identified the pinna, the auditory canal and the eardrum (or tympanic membrane). For part (c), not all candidates knew that the pinna (or outer ear) helps with sound localisation, due to the ridges causing interference patterns on the incoming sound.

Many candidates were able to discuss the role the basilar membrane plays in hearing, for part (d), mentioning the perception of different frequencies of sounds at different locations on the membrane. Some candidates also mentioned dissonance, and some knew that the membrane contains hair cells and how these contribute to hearing.

Part (e) was not always well answered. Most candidates could understand that

the pitch would change, from low to high; that sound would not be heard below around 20Hz or above 20kHz. Some candidates knew that volume would change as the frequency changed, becoming louder at around 3–4 kHz and then softer again, while some candidates thought that the volume would only be perceived as increasing, rather than actually increasing. Not all candidates mentioned timbre, which would not change appreciably, even though this was explicitly asked for.

For part (f), candidates either got this completely correct, or completely incorrect in general. The string is vibrating at 400 Hz, there are harmonics (although it is not possible to know exactly how many harmonics there will be).

Question 4: Digital media signals and their representations

Very few candidates answered this question, though those who did gave reasonable or good answers.

Part (a) required simply reading off the frequency (2Hz), amplitude (0.75) and phase ($\pi/2$). These values should then have been used in forming the equation for $y(t)$.

Some candidates confused sampling with quantisation for part (b). While there are similarities, quantisation is the process of representing an audio sample (which would have been obtained via sampling) in a specific number of bits. More bits will give higher quality, while fewer bits take less storage; explicit examples were expected which not all candidates gave.

Part (c) was actually quite an easy question, though some candidates answered it weakly. $n-2, n-1$ and n are points in time, rather than actual values; most candidates who answered this question did not understand this. $e_2(n)$ is the residual, or the error. It is the difference between the predicted value and the actual value, at time n.

The process is linear prediction, and it's useful for compression because the residuals are typically smaller in magnitude than the original signal, so fewer bits are required to represent the values with the same degree of precision.

Part (d)(i) required a calculation to determine that the file size would be 2583 KB; most candidates could do this. The second sub-part would arrange the size as MP3, FLAC, ZIP, WAV. Many candidates were able to do this too.

Part (e) was answered very well; correct examples of lossy formats include MP3 and JPEG, and lossy format is preferred if small storage space is required on disc,

or if the file is to be transmitted over a network (and in both cases, if quality is not a strong requirement).

Question 5: Signals and systems

Again, a question that most candidates did not choose to answer, but that was reasonably well done by those who did.

Part (a) required the drawing of a signal that has values of 0.5, 0.5 and 0.25 at times 1, 2 and 3 respectively.

Part (b) required straightforward knowledge of the material in the subject guide, in order to complete the blanks. Most candidates knew that convolving is equivalent to multiplying in the context given, and that convolving with the impulse response gives the output. For part (iii), not all candidates understood that convolving with the unit impulse produces the same signal. Time invariance is the property that means that a system responds in the same manner in the context described in part (iv). Linearity was expected for (v), and a system that exhibits both linearity and time invariance is called an LTI system.

Part (c) was a reasonably straightforward question, though some candidates seemed to find it confusing. Examiners were looking for a spectrum (rather than a signal), with peaks at 1000, 2000 and 4000. The relative heights of the peaks (examiners were not looking for exact heights) should be medium, shorter and then longer, in that order.

For part (d), the kernel produces a horizontal echo or blur, with the total image brightness remaining unchanged. Answers that said that the image will be shifted to the right and left and then superimposed on each other were also acceptable.

For part (e), most candidates were able to name effects such as echo, edge detection, motion blur, low-pass filter, high-pass filter, etc.

Question 6: Information retrieval

This was a very popular question, answered by almost all candidates.

Part (a) required a simple calculation to establish that there are 20 true positives and 2 false negatives for the query.

For part (b), though there were some good answers, a significant number of candidates did not relate their answers to the particular context given, and pro-

vided very general comments about what high precision and high recall mean. The question specifically asked candidates what these meant for this particular system. A good example answer for part (iii) might be that in this system, it is probably more important to have high precision. Watching a movie takes a lot of time, and the cost of a false positive is very high.

Most candidates correctly explained for part (c) that the Levenshtein distance is a measure of the similarity of two text strings; and some mentioned that there are particular ways to assign cost to insertion, deletion or editing. IR applications that are about text-based search usually find Levenshtein an appropriate measure, and most candidates gave good examples of these.

Part (d) was generally answered very well. Candidates had to calculate the Euclidian distance for the co-ordinates (respectively 98.6, 42.4, 88.3 and 67.0) and then identify that the file `second.png` has the smallest distance, and should therefore be the one chosen.

The final part was a more open question, and candidates who demonstrated thought and understanding, even if they did not choose standard features, obtained full marks, if they included an explanation of why the feature they chose is relevant to musical similarity.