Examiners' commentaries 2015–16

CO1112 Creative computing I: image, sound and motion – Zone A

General remarks

Overall performance on this paper was reasonable, with the average mark being a medium second class. This year, all candidates answered exactly four questions, which meant they did not lose marks unnecessarily for leaving out questions or lose time in answering too many. The examiners were pleased to see this.

What follows is a brief discussion of the individual questions, with hints and explanations of the answers expected by the examiners.

Comments on specific questions

Question 1 General — multiple choice, true and false, and completion of information

Although this was not a compulsory question – unlike in previous years – it was answered by more than two-thirds of candidates. Performance on this question was the highest overall, with the average mark being a low upper-second. One candidate obtained an impressive 24 marks out of a possible 25; and a number obtained 20 or more; with more than 80 per cent of candidates passing it.

Part (a) contained simple multiple choice; each question having only one correct answer. Most of these questions were about cellular automata and Conway's game of life, with one question about matrix multiplication. In general, these were answered correctly.

For part (b), candidates were required to state whether each conjecture was true or false. In some cases, this was carried out poorly, although some candidates answered all questions correctly. The false statements were II, IV and V; the other two were true.

Question 2 Creative thinking and computation

This was one of the least popular questions, answered by under two-thirds of candidates. The average performance was barely a pass, with particularly weak responses for parts (a) and (c) (ii). Although a number of candidates only obtained 5 marks or less, one candidate achieved a very satisfactory 21 marks out of the possible 25.

The main weakness in the responses for part (a) was the incomplete nature of the descriptions. It is essential to address all aspects asked for; and in this case, this included description of software and peripherals, as well as a clear identification of the way creativity is aided, and also any limitations.

Ways of enhancing creativity might include any of the following: being able to do things (such as very fine work) that are physically difficult; being able to do colour work, sometimes more accurately (and here an example of a limitation is that screen colour is different from print colour); patterns and recursive artefacts; mosaic portraits and other such new

visual techniques.

Part (b) required thought and insight rather than specific technical knowledge. Some examples might include: computerised choreographers' notation; animation packages to try out dance moves; use of technology as part of performance; autocue for stage plays; use of internet-driven theatre plots; etc. Other possibilities include musical performance (such as improvisation); and other improvisation forms. Computerised technology for lighting is also within the performance art arena. One candidate's answers were insightful but not focused on the performing arts at all, which meant they were awarded low marks for this question.

For part (c), an algorithm is a step-by-step description of a solution to a (usually numerical) problem. It is a description of how to do something; a recipe might be seen as an algorithm.

Regarding the role of algorithms in creative thinking – some might argue that they have no place, and that if there is an algorithm then there is no creativity; others might argue that it is the algorithm that is the creative entity. Marks were awarded for other reasoned and sensible answers.

Finally, the Magritte piece detailed in part (d) is referred to in the subject guide, and so candidates should have been at least aware of it, had they prepared properly. The painting is a picture of a pipe with the legend (that is, text) 'Ceci n'est pas une pipe' underneath it. Magritte was commenting on advertising, and saying that this was not in fact a pipe, only a picture of one. This was at a time when advertising was gaining more of a foothold.

Question 3 Data, shape and structure

This was the most popular question, answered by almost all candidates. Overall performance was reasonable, with a couple of candidates achieving marks higher than 20 out of a possible 25.

Part (a) was generally answered well. Examiners were looking for any two of the Gestalt laws that relate to perception, and these include: reification (forms appear through suggestion); similarity (we tend to group similar items); closure (we put lines in if they close a figure); continuity (viewers tend to extend shapes beyond their ending points); proximity (we tend to associate group items if they are close to each other).

Part (b) was also answered generally well. For part (i), recursion necessarily requires a 'calling of itself' for a method or procedure; repetition does not have this.

Part (ii) could have been explained through either a brief description or a visual explanation. The sketch is drawing concentric circles; they are progressively darker as they get to the centre, due to the recalculation of the fill colour. The radius is halved each time, so the size decreases by half (the drawing itself will not show an even reduction, but a reduction by half of the previous reduction). Many candidates incorrectly thought that the sketch was drawing two concentric circles.

In response to part (iii), there is only one recursive call, to drawCircle(), in line 18. This is the recursive part, and candidates answering that the recursive part was the function itself (void drawCircle()) only obtained half marks. Finally, it is in theory possible to do anything that has been done recursively without the use of recursion. Some candidates also rewrote the code fragment in a no-recursive way, which was also acceptable.

Part (c) was answered well: data compression is recoding data to use fewer bits. For part (d), examiners expected candidates to understand

the relevance of the size of data and information; and some candidates appropriately mentioned a link to the implications for video.

Part (e) was answered reasonably well, although many candidates discussed only the differences between sampling and compression, without explaining where and how data loss can occur. Good answers showed overall understanding of what happens to data in the digital domain. Sampling is about converting an analogue audio signal to digital; compression is about storing the digital signal in a smaller number of bits. In sampling, data is lost if the sample rate is too infrequent, or if the sample is stored using a low bit-depth; in compression it is lost if the algorithm that is used is a lossy one, in which case relevant information about the signal is lost. Some candidates also gained marks for mentioning bit-depth in terms of the trade-offs.

Question 4 Motion and interaction

Another popular question, also answered by most candidates with generally strong answers.

Almost all candidates correctly answered part (a); the code should be frameRate(60).

For part (b), line 14 sets the R, G and B values of the background colour to 50, 50 and 200 respectively (mid-light blue) and repaints the background every frame. Some candidates noted that this is only the case in RGB colour mode, but this was not essential to obtain full marks.

In response to part (c), candidates needed to explain that the code checks whether the lower edge of the block is touching the bottom edge of the screen, and only allows downwards movement of the block if this is not the case. Not all candidates also explained that 500 is used, as the screen height is 600 and the block height is 100, hence 500 is the y position of the block's top-left corner when the bottom edge is touching the edge of the screen.

Part (d) was answered well by most, although not all candidates knew that the keyPressed() method is a function that can be used. Note that keyReleased() or keyTyped() were also acceptable answers, but the fact that it is a function rather than a variable was what examiners were looking for.

For part (e) you were expected to provide a simple explanation including the following: there is a blue background; a white ball starts at the top-left of the screen and moves diagonally downwards and rightwards; a yellow rectangle elongated in y direction can be moved up and down using the a and z keys.

Part (f) was answered reasonably well. Examiners were looking for correct tests for top, bottom, left and right edges of the sketch window, taking into account the size of the ball, and with a comment for each test. Not all candidates included comments, thereby losing marks.

Finally, for part (g), additional tests for top, bottom, left and right edges of the block itself – taking into account the size of the ball and the current position of the block – were required; again with a comment for each test.

Question 5 Generative systems

This was one of the less popular questions, answered by about half of the candidates. The responses tended to be either strong or weak, with few in the middle. You are reminded to reflect on what you do or do not know, and to choose questions accordingly; it is essential to read through the whole question before making your decision.

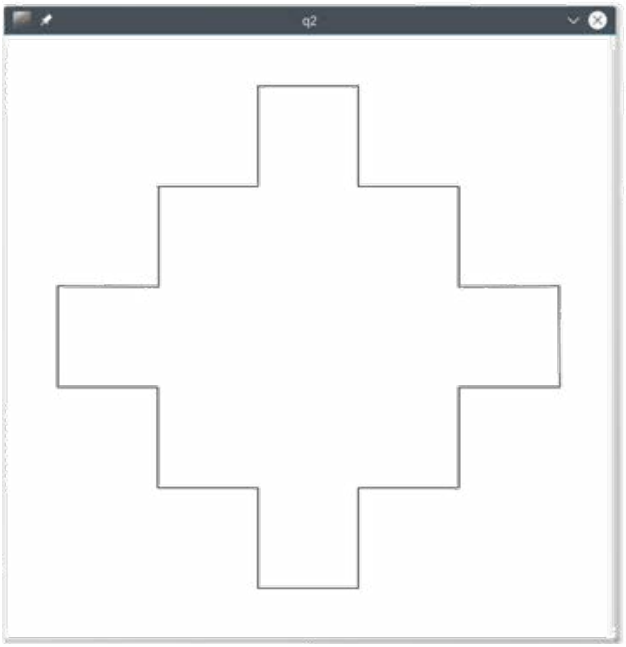
Most candidates were able to correctly state, for part (a), that the initiator is "F-F-F-F" and the generator is "F→F+F-F-F+F". Fewer correctly explained, for part (b), that the turtle interpretation is to draw a line from the current origin

to point (d, 0), and move the origin/drawing head to the end of the line. In this sketch, d = 100 by the time the turtle method gets called, so the move is to point (100, 0).

In general, part (c) was correctly answered; the state will contain the string: F+F-F-F+F-F+F-F-F+F-F+F-F-F+F-F+F-F-F+F.

For part (d), the line gets called after each call to substitute. The length of the generator (in x direction) is 3 times the length of the section being substituted, so dividing the length of each section by 3 means that the end point of the new string is the same as that of the original string. Partial marks were given if candidates only mentioned making the line length smaller without explaining why it is divided by 3 specifically.

Part (e) required a diagram similar to the one below, with the end points of the left-most line at (50, 250) and (50, 350).



Part (f) was either understood well, or very weak answers were given. Stronger answers for part (f) (i) mentioned a population of candidate solutions, with variety in the population and selection of candidates according to their fitness. Candidates – used to form a new generation – are selected, with variety introduced by mutation.

For part (f) (ii), the main requirement was a factual description of a user performing the selection at each generation in user-guided genetic algorithms, versus a function that automatically assigns scores and performs the selection in those that use a fitness function.

Finally, for part (f) (iii), advantages of a user-guided genetic algorithm include that it is useful in cases where it is hard to codify what is required, such as in aesthetic selection, etc, while disadvantages are that it cannot be run offline, or is slower.

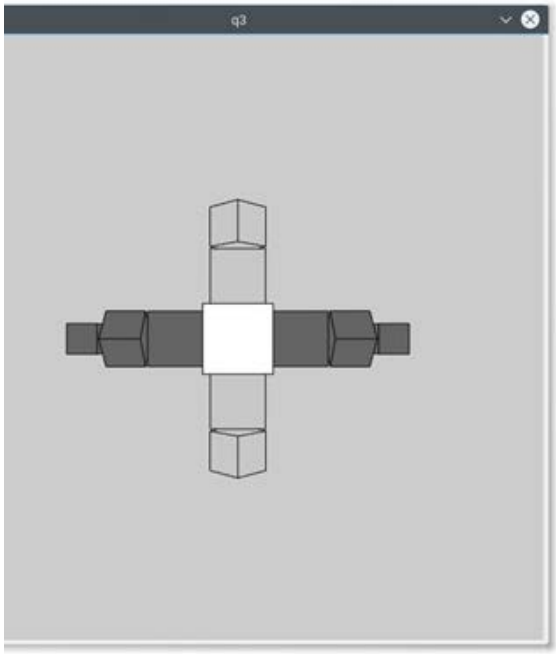
Question 6 3D graphics and effects

Question 6 was the least popular question, and also one that was poorly answered by many of those who chose it. The average mark was 11 out of a possible 25 marks, although one candidate did obtain close to full marks.

Part (a) required a straightforward response that the fill colour is white (255), the box edge length is 100 and the position of the centre of the box is 0, 0, 0. Most candidates managed this.

For part (b), candidates needed to demonstrate that they understood that pushMatrix() saves the current coordinate frame (position and orientation) onto the stack, and popMatrix() retrieves the most recently stored frame from the stack. Many were able to do this, but then did not go on to describe the effect of these statements. In the context of the sketch, it means that the translations and rotations performed in the drawShape() method do not affect the coordinate frame of the main draw method.

Part (c) (i) required understanding that, in general, the order of statements involving a rotate(), does matter. For full marks, candidates should also have explained the relation to transformation matrices. For part (c) (ii), many candidates knew that in this case again there is no translation, but not many explained that this is because the rotation and translation are both along the Y axis only.



Very few candidates were able to provide a reasonable sketch of the output of the program, asked for in part (d). The following diagram was expected:

Many candidates could correctly identify, for part (e), that changing the last three parameters passed into the camera() method on line 3 from (0, 1, 0) to (1, 0, 0) would result in the 'up' axis of the camera being changed from the Y axis to the X axis, so the sketch would appear to be rotated by 90 degrees.

Part (f) was reasonably answered, and most candidates correctly identified some of the following:

A = -100	B = beginShape();	C = bricks
D = 50	E = -50	F = 100
G = 0	H = 50	I = 50
J = 100	K = 100	L = 100

Examiners' commentaries 2015–16

CO1112 Creative computing I: image, sound and motion – Zone B

General remarks

Overall performance on this paper was reasonable, with the average mark being a medium second class. This year, all candidates answered exactly four questions, which meant they did not lose marks unnecessarily for leaving out questions or lose time in answering too many. The examiners were pleased to see this.

What follows is a brief discussion of the individual questions, with hints and explanations of the answers expected by the examiners.

Comments on specific questions

Question 1 General – multiple choice, true and false, and completion of information

Although this was not a compulsory question, unlike in previous years, it was answered by nearly all candidates. Performance on this question was good, although not quite the highest overall, with the average mark around the medium second class. A handful of candidates obtained 20 or more marks out of a possible 25, with only a few candidates not achieving a pass mark.

Part (a) contained simple multiple choice, each question having only one correct answer. Most of these questions were about cellular automata and Conway's game of life, with one question about matrix multiplication. In general, these were answered correctly.

For part (b), candidates were required to state whether each conjecture was true or false. In some cases, this was carried out poorly, although some candidates answered all questions correctly. The true statements were III, IV and V; with the other two being false.

Question 2 Creative thinking and computation

This question was chosen by hardly any candidates, and very weak marks were obtained by those who attempted it, with very few candidates achieving a pass mark.

Good responses for part (a), if they had been forthcoming, might include any of the following: being able to do things (such as very fine work) that are physically difficult; being able to do colour work, sometimes more accurately (and here an example of a limitation is that screen colour is different from print colour); patterns and recursive artefacts; mosaic portraits and other such new visual techniques.

Part (b) required examples, such as using computers to design clothes; direct drive of knitting machines, etc.

For part (c), the three fundamental elements for creating an instance of an interactive design are discussed in the subject guide. They are mathematical (technological), design (including usability) and aesthetics (art).

Finally, for part (d), candidates were expected to know that Cage and Cunningham worked in the areas of musical composition and choreography. They shared an interest in the use of algorithms for the creation of music works and dance pieces, and also produced some collaborative work in this field.

Question 3 Data, perception and structure

This was the most popular question, answered by around two thirds of candidates. Overall performance was weak, with only a couple of candidates obtaining more than 15 out of a possible 25 marks.

Most candidates were able to explain, for part (a), that a fractal is a form that has self-similarity; some candidates omitted the required illustration (which could have been a drawing of a fractal form, or a descriptive example).

Part (b) was answered well by most candidates. Reification is the construction of a form that is not explicitly there (through the presence and arrangement of other forms in the image). Multi-stability refers to being able to see two different images in one, where what is perceived alternates between the two options. A well-known example is between a vase, and two profiles looking at each other. Emergence is the emerging perception of an image from the presence of parts of the image, seen all at once; and closure is the completing of an image; for example, perceiving a square when only three sides are there. All of these descriptions required illustration, which not all candidates gave.

Part (c) was answered less well. Recursion necessarily requires a 'calling of itself' for a method or procedure, while repetition does not have this. Any coherent descriptions were accepted. Examples of artists could include Warhol, Escher, or others, but a discussion of the recursion or repetition they used was essential. For example, Warhol employed mainly repetition – using the same image but changing aspects of the colour in it – within one artwork.

For part (d), candidates were required to demonstrate some overall understanding of what happens to data in the digital domain. Sampling is about converting an analogue audio signal to digital; compression is about storing the digital signal in a smaller number of bits. In sampling, data is lost if the sample rate is too infrequent, or if the sample is stored using a low bit-depth; in compression, data is lost if the algorithm used is lossy, where relevant information about the signal is lost.

Question 4 Motion and interaction

This was an extremely popular question, chosen by all candidates, and had the best performance across all questions. An average mark of a high second was obtained, with a few candidates achieving nearly all of the 25 marks available.

Almost all candidates correctly answered part (a); the code should be frameRate(30).

For part (b), line 14 sets the R, G and B values of the background colour to 50, 200 and 50 respectively (mid-light green) and repaints the background in every frame. Some candidates noted that this is only the case in RGB colour mode, but this was not essential to obtain full marks.

The test in part (c) checks whether the lower edge of the block is touching the bottom edge of the screen, and only allows downwards movement of the block if this is not the case. 650 is used as the screen height is 800 and

the block height is 150, hence 650 is the y position of the block's top-left corner when the bottom edge is touching the edge of the screen.

For part (d), not all candidates knew that the keyPressed() method is another way to detect key presses. Other possibilities are also keyReleased() or keyTyped(). In order to obtain full marks, candidates needed to explain how the method is used.

Part (e) required a simple explanation including the following: there is a green background; a black ball starts at the top-left of the screen and moves diagonally downwards and rightwards; a cyan rectangle is also drawn, elongated in the y direction, that can be moved up and down using the a and z keys.

Part (f) was answered reasonably well. Examiners were looking for correct tests for top, bottom, left and right edges of the sketch window, taking into account the size of the ball, and with a comment for each test. Not all candidates included comments, thereby losing marks.

Finally, for part (g), additional tests for top, bottom, left and right edges of the block itself, taking into account the size of the ball and the current position of the block were required, again with a comment for each test.

Question 5 Generative systems

This question was fairly popular, with reasonable answers given.

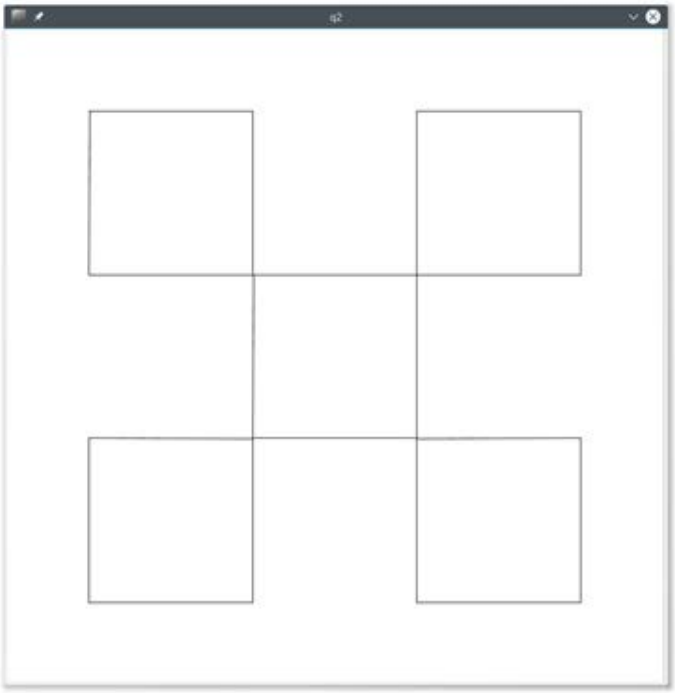
Most candidates were able to correctly state, for part (a), that the initiator is "F-F-F-F" and the generator is "F F-F+F+F-F". Fewer correctly explained, for part (b), that the turtle interpretation is to draw a line from the current origin to point (d, 0), and move the origin/drawing head to the end of the line. In this sketch, d = 200 by the time the turtle method gets called, so the move is to point (200, 0).

In general, part (c) was correctly answered; the state will contain the string:

F-F+F+F-F-F-F+F+F-F-F-F+F+F-F-F-F+F+F-F.

For part (d), the line gets called after each call to substitute. The length of the generator (in x direction) is 3 times the length of the section being substituted, so dividing the length of each section by 3 means that the end point of the new string is the same as that of the original string. Partial marks were given if candidates only mentioned making the line length smaller without explaining why it is divided by 3 specifically.

Part (e) required a diagram similar to the one below, with the top-left corner at (100, 100) and bottom-right corner at (700, 700).



Part (f) was mostly understood well, with only a few weak answers given. Stronger answers for part (f) (i) mentioned a population of candidate solutions, with variety in the population and selection of candidates according to their fitness. Candidates used to form a new generation are selected, with variety introduced by mutation.

For part (f) (ii), the main requirement was a factual description of a user performing the selection at each generation in user-guided genetic algorithms, versus a function that automatically assigns scores and performs the selection in those that use a fitness function.

Finally, for part (f) (iii), advantages of the fitness function include that it can be run offline, is automated and is faster than user-guided approaches. Disadvantages include that it is difficult to use in cases where there should be codification of what is required, such as in aesthetic selection.

Question 6 3D graphics and effects

This was also a popular question, chosen by about two thirds of candidates. However, it was not answered particularly well by many of the candidates who chose it, with an average mark of 11 out of a possible 25 marks, many fails, and only one mark of 20 or above.

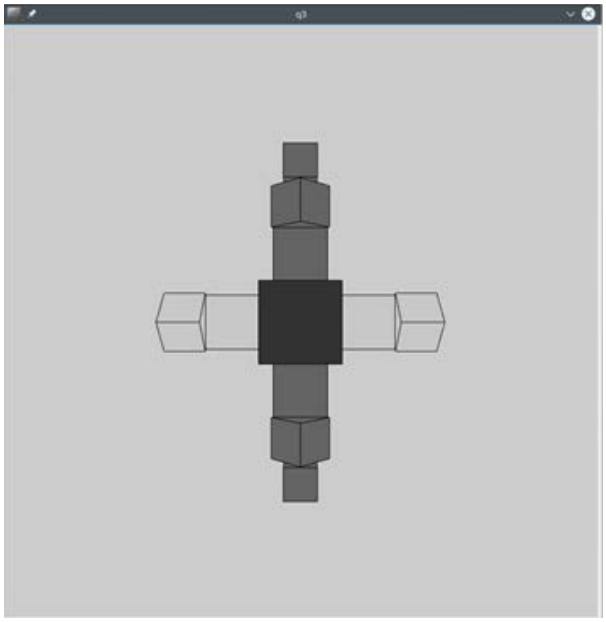
Part (a) required a straightforward response that the fill colour is dark grey (5), the box edge length is 150 and the position of the centre of the box is 0, 0, 0. Most candidates managed this.

For part (b), candidates needed to demonstrate that they understood that pushMatrix() saves the current coordinate frame (position and orientation) onto the stack, and popMatrix() retrieves the most recently stored frame from the stack. Many were able to do this, but then did not go on to describe the effect of these statements. In the context of the sketch, it means that the translations and rotations performed in the drawShape() method do not affect the coordinate frame of the main draw method.

Part (c) (i) required understanding that, in general, the order of statements involving a rotate(), does matter. For full marks, candidates should also have explained the relation to transformation matrices. For

part (c) (ii), many candidates knew that in this case again there is no translation, but not many explained that this is because the rotation and translation are both along the Y axis only.

Very few candidates were able to provide a reasonable sketch of the output of the program asked for in part (d). A diagram similar to the following was expected:



Many candidates could correctly identify, for part (e), that changing the last three parameters passed into the camera() method on line 3 from (0, 1, 0) to (1, 0, 0) would result in the 'up' axis of the camera being changed from the Y axis to the X axis, so the sketch would appear to be rotated by 90 degrees.

Part (f) was reasonably answered, and most candidates correctly identified some of the following:

A = -150	B = beginShape();	C = wood
D = 75	E = -75	F = 150
G = 0	H = 75	I = 75
J = 150	K = 150	L = 75