THIS PAPER IS NOT TO BE REMOVED FROM THE EXAMINATION HALLS

UNIVERSITY OF LONDON **CO3346 ZB**

BSc Examination

CREATIVE COMPUTING

Sound and Music

Tuesday 8 May 2018: 14.30 – 16.45

Time allowed: 2 hours and 15 minutes

There are **FOUR** questions on this paper. Candidates should answer **THREE** questions. All questions carry equal marks, and full marks can be obtained for complete answers to a total of **THREE** questions. The marks for each part of a question are indicated at the end of the part in [.] brackets.

Only your first **THREE** answers, in the order that they appear in your answer book, will be marked.

There are 75 marks available on this paper.

A handheld calculator may be used when answering questions on this paper but it must not be pre-programmed or able to display graphics, text or algebraic equations. The make and type of machine must be stated clearly on the front cover of the answer book.

Question 1 Computational models of music cognition

(a) Give an example of a process humans carry out when they are trying to make sense of a piece of music they are listening to. Do you think it would be possible to model this process with a computer program? Justify your answer.

[4]

(b) Proximity and Similarity are Gestalt principles. For each, describe how it can be used to develop a model of musical cognition. [4]

(c) Describe Schellenberg's Two Factor model – what are the two factors and what kind of data would be used to represent them in a software implementation of the model? [4]

(d) i. What does it mean to experimentally validate a cognitive model? How is this different from the process of creating the model? [2]

ii. Name and describe a type of experiment that could be used to validate a cognitive model of musical expectation. [3]

iii. Describe the key features of a piece of software that could be used to experimentally validate a cognitive model. [5]

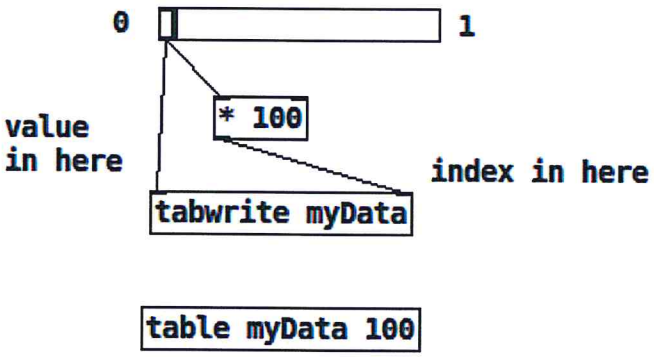
iv. Describe a possible application area for a cognitive model of musical expectation, explaining how the model would be used. [3]

Question 2 Interactive Sound using Pure Data

(a) Name and describe the purpose of four different objects in Pure Data. [4]

(b) Describe the concepts behind sample playback and sound synthesis. Which is more efficient to implement on a computer? Justify your answer. [5]

(c) Consider the diagram below:



i. Describe what happens to the values stored in myData when the user slides the slider from left to right. [2]

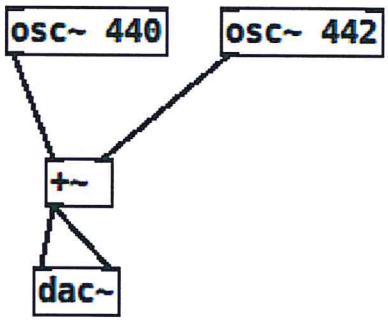
ii. How would you change the patch if you wanted to make myData a bigger array? [2]

iii. If myData contained 44100 values, how long would it take to play them all, with a sample rate of 44100Hz? Justify your answer. [2]

(d) If a musician who is used to playing the guitar wanted to learn about computer music techniques, make one argument for them using Pure Data and one against it, considering other languages they might use. [4]

(e) What is the difference between frequency modulation (FM) and additive synthesis? [2]

(f) Consider the diagram below:



i. Why would you hear a beating sound if you listened to the output of the patch shown above? [2]

ii. What would you change about the patch in order to play the first two components of the harmonic series, starting at 200 Hz? [2]

Question 3 Algorithmic composition and musical interaction

(a) What is the difference between writing an algorithmic music composition system and writing music directly? [3]

(b) Music for video games is a commercial application of algorithmic composition. Explain how algorithmic composition could be used to enhance the experience of a game player. [3]

(c) Reflection, innovation, autonomy and transparency are four desirable characteristics of algorithmic music systems that improvise with human musicians.

i. Consider a computer program that looks at a window when it is raining. Each time it sees a rain drop on the window, it plays a note, where the pitch of the note is dictated by the size of the rain drop. Identify **ONE** characteristic from reflection, innovation, autonomy and transparency that the system does not have, and one that it does have. Justify your answers. [4]

ii. Consider an improvising music system which plays a sequence of notes. The time interval between the notes is sampled from a uniform random distribution, and so is the pitch. Choose **TWO** characteristics from reflection, innovation, autonomy and transparency and suggest how you would change the system to maximise these characteristics. [6]

(d) Explain what is meant by a metrical hierarchy. [1]

(e) Explain how a metrical hierarchy could be extracted from a sequence of note onset times. [4]

(f) Why would beat detection be difficult if the input data was a recording of a classical orchestra playing? [1]

(g) You are working on an algorithm that estimates the size of the beat interval. It takes as its input an array of time offsets representing the occurrence of drum hits (which happen when the drummer hits a drum) in a piece of music. It produces as its output a single value which is its estimate of the beat interval. Describe a step by step process to identify the most likely beat interval. [3]

Question 4 Music Information Retrieval

(a) Describe the task of music identification. Name and describe an approach to music identification. [4]

(b) Consider the problem of recommending music to someone. Does this problem have high or low specificity? Justify your answer. [3]

(c) What is content-based music similarity? How does it differ from metadata based music similarity? [2]

(d) Describe how music is represented in a bag-of-frames, content-based model. [2]

(e) Would a content-based or metadata-based approach be most appropriate to identify when a pop song changes from verse to chorus? Justify your answer. [4]

(f) You have been asked to design a music recommender system for a friend who has started a new music streaming company.

i. Provide a diagram showing how a music recommender system works that your friend, who is not a programmer, can understand. [4]

ii. Describe the data your system will need to store about the music and explain why. [2]

iii. The company will hire music experts who can provide curated musical playlists. Describe how you would generate playlists that are similar to those of the experts but include other, related music. Provide technical details and examples. [4]

END OF PAPER