THIS PAPER IS NOT TO BE REMOVED FROM THE EXAMINATION HALLS

UNIVERSITY OF LONDON **CO3346 ZA**

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) Grouping and expectation are two cognitive processes that one might want to model. What is meant by grouping and expectation, in the context of music cognition? [4]

(b) State **ONE** Gestalt principle and explain how it can be used in models of **visual**, then **musical** cognition. [4]

(c) Describe Schellenberg's Two Factor model – what are the two factors and how are they used to model expectation? [4]

(d) i. Why is it useful to experimentally validate the predictions of a cognitive model of musical expectation? [2]

ii. Describe how a probe tone experiment could be carried out in a step by step process. [3]

iii. Describe a piece of software you could write to carry out this experiment, with an annotated diagram of its user interface. [5]

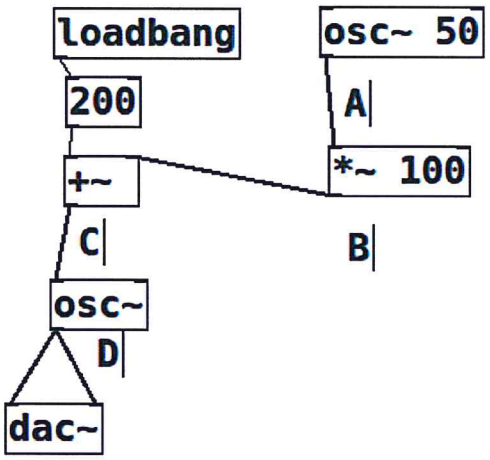
iv. What data would the experiment produce and how would you analyse the data to measure the validity of the model? [3]

Question 2 Interactive Sound using Pure Data

(a) List **FOUR** categories of component you can put in a Pure Data patch and explain what they are used for. Do not list individual object types such as 'line'. [4]

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

(c) Consider the diagram below:



i. Name the sound synthesis technique being used here, and explain, with reference to the patch shown, why you think it is using that technique. [2]

ii. State the ranges of the values at the labelled outlets A, B, C and D. [2]

iii. Explain how you would change the patch in order to play a note with a different pitch. [2]

(d) Do you think Pure Data is an appropriate tool for the development of interactive music software by musicians used to playing traditional musical instruments such as pianos and guitars? Justify your answer in terms of the technical skills required to use Pure Data, compared to other software development environments you have seen or used. [4]

(e) What is the difference between synthesizing sound and playing back sampled sound? [2]

(f) Name two Pure Data objects that you would use to play back sampled sound and explain what they would do in a patch that played back sampled sound. [4]

Question 3 Algorithmic composition and musical interaction

(a) Name and describe **THREE** characteristics of musical material that an algorithmic composition system might manipulate. [6]

(b) **FOUR** desirable characteristics of algorithmic music systems that improvise with human musicians are reflection, innovation, autonomy and transparency.

i. Consider an improvising computer system which reads notes from a human musician and computes a note distribution. It then plays back notes from the note distribution. The system is more likely to play notes that the human has played more often. Identify **ONE** characteristic from reflection, innovation, autonomy and transparency that the system does not have, and **ONE** that it does have. Justify your answer. [4]

ii. Consider an improvising computer music system which selects fragments of music from a video service such as YouTube and plays them back in response to the music played by a human musician. Choose **TWO** characteristics from reflection, innovation, autonomy and transparency and state how you would select musical fragments to maximise those characteristics. [6]

(c) Explain what is meant by a metrical hierarchy. Why do metrical hierarchies make beat tracking difficult? [3]

(d) Explain, with a diagram, the difference between a good and bad choice of period from a beat tracking system. Label the diagram clearly, stating what it represents. [3]

(e) 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) Consider the problem of identifying the genre of a piece of music. Does this problem have low specificity or high specificity? Justify your answer. [3]

(b) Compare the characteristics of the bag-of-frames and sequence approaches to content-based similarity search. [4]

(c) Would a bag-of-frames or a sequence approach be most appropriate to identify when a pop song changes from verse to chorus? Justify your answer. [4]

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

i. Give a high level description of how a music recommender system works that your friend, who is not a programmer, can understand. [3]

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

iii. There are often several versions of a given piece of music, for example, cover versions, live recordings and studio recordings. How would you deal with this problem when designing your music recommender system, if you do not want to recommend songs the user already owns? Mention specific music information retrieval techniques. [4]

iv. Draw a diagram showing the key components of a music recommender system. [5]

END OF PAPER