THIS PAPER IS NOT TO BE REMOVED FROM THE EXAMINATION HALL

UNIVERSITY OF LONDON

CO3346 ZA

BSc EXAMINATION

Creative Computing

Sound and music

Wednesday 8 May 2019: 14.30 – 16.45

Time allowed: 2 hours and 15 minutes

DO NOT TURN OVER UNTIL TOLD TO BEGIN

There are FOUR questions in 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) What is a computational model? Why are computational models important for the field of cognitive science? [3]

(b) Why do researchers create computational models of music cognition? State and briefly explain **TWO** reasons. [4]

(c) Computational models of music cognition require representations of music. Describe **TWO** possible representations of music that might be used by a computational system. Describe an appropriate data structure for storing these representations in a computer's memory. [4]

(d) Provide **TWO** reasons why you might want to *group* musical information. [2]

(e) Describe two Gestalt grouping principles and explain how they relate to musical information. [4]

(f) What is a statistical model? Give an example of a statistical model that is used in musical cognition studies. [2]

(g) What is an n-gram model? What does the data in an n-gram model consist of? [3]

(h) What is the Krumhansl-Schmuckler key-finding algorithm for? What does it take as an input? The final output is the key it has found, but what is the data it generates just before that in its process? [3]

Question 2 Computer Music and Pure Data

(a) Based on your experience using Pure Data, describe **THREE** features of the programming environment. For each feature, state how it might be an advantage and how it might be a disadvantage. Consider different potential users of the environment such as programmers and musicians in your answer. [9]

(b) Write step by step instructions explaining how to build a simple synthesizer in Pure Data which has at least two sliders to control its sound. Draw diagrams to illustrate your steps, showing how the patch is built. There should be at least **FIVE** steps. [10]

(c) What is sampled sound? How is it different from synthesized sound? [2]

(d) Draw a Pure Data patch which loads an audio file from disk and plays it back. Annotate the patch to say how it works. [4]

Question 3 Algorithmic Composition

(a) Algorithmic composition can be called meta-composition. What is the difference between meta-composition and composition? Give an example of what meta-composers do that composers do not do. [3]

(b) Name a composer who has used algorithmic composition. [1]

(c) Rowe, a well known computer music researcher, states the opinion that algorithmic composition can make use of a wider range of techniques, with less need for in-depth evaluation than other areas of computational music. Why is this? [2]

(d) What is live coding in the field of computer music? [1]

(e) Do you think it is possible to livecode in Java? Justify your answer. [2]

(f) Explain each of the following terms, referring to properties of algorithmic music systems which are designed to improvise along with human musicians:

i. Reflection [2]

ii. Innovation [2]

iii. Autonomy [2]

iv. Transparency [2]

(g) For each of the terms you defined above, state and explain why a swarm music system does or does not have that characteristic. [4]

(h) Consider a DJ playing music to an audience. The DJ has a large number of tracks on their computer and they select the sequence in which the tracks should be played, as well as mixing from one track to another. Mixing involves syncing the two tracks so they are in time with each other, then cross-fading from one to the other. State and explain why this DJ does or does not possess the characteristics listed above. [4]

Question 4 Music Information Retrieval

(a) What does it mean to say that a task for a retrieval algorithm is very specific? [2]

(b) Explain how a genre classification system works. What is the input? What is the output? How is the data structured? Draw a diagram if that helps your explanation. [6]

(c) Cepstrum coefficients describe the timbre of the music they are extracted from. Do you think that timbre is an appropriate way to differentiate between different genres of music? Justify your answer. [2]

(d) What is the difference between content-based and metadata-based musical document retrieval? [2]

(e) Which approach (content or metadata) would be most appropriate for retrieving all different versions of the same track, for example, cover versions and live versions? Justify your answer. In your answer, consider what would happen if the data was incomplete. [4]

(f) Consider a music streaming service such as Spotify, Apple Music or Amazon Music. Users of these services can type in a textual search term and they are then presented with various tracks that match the search term. These tracks can be selected in different ways, depending on the search term. For each of the following search terms, explain how the system might select tracks matching that term, mentioning the kind of data and algorithms that might be needed, and if it would be a content-based or a metadata-based search.

i. The user types in 'Mozart'. [3]

ii. The user types in 'guitar'. [3]

iii. The user types in 'most popular tracks'. [3]

END OF PAPER