Exam Hints

As mentioned in lectures, the CS4102 exam will consist of four questions, and students should attempt all questions. However, each question involves some choice. The CS4103 exam will have the same structure. Templates for the two exams, with questions removed, are attached below.

Masters students taking MA500 Geometric Foundations of data analysis take both the CS4102 and CS4103 exams.

The CA counts towards 50% of the assessment, and the written exam counts towards the remaining 50%.

As mentioned in lectures, the exam questions will be closely based on the questions in the problem sheet which, in turn, are closely based on the online lecture notes. The exam was approved by the external examiner before the alternative exam aarrangements for Covid-19 were introduced.

I've been asked by one student for tutorial help with the questions. But I'm not too ken on writing out explicit answers to the questions on the problem sheet, as then these could just be tweaked and returned as exam answers!! So what I'll do is simply indicate which lectures correspond to which problem sheet questions.

- Questions 1.1 and 1.2 are covered in Lecture 1.
- Question 1.3 is covered in Lecture 2.
- Question 1.4 is covered in Lecture 3.
- As mentioned in the problem sheet, questions similar to the final two questions of Section 1 will not be asked in the exam.
- Question 2.1 is covered in Lectures 5 and 6.
- Questions 2.2 and 2.3 are covered in Lecture 7.
- Question 2.4 is a straighforward application of the theory proved in Lecture 7. It'll help to reinforce your understanding of the theory.

- Question 2.5 is trying to make you realize that PCA does depend on units. If you change the units on one axis without changing them on other axes then the eigenvalues and eigenvectors will change. Try to see why.
- Question 2.6 will test your understanding!! The two constructed planes will differ – but why?
- Question 3.1 is covered in Lectures 10 and 11.
- Questions 3.2 and 3.3 are covered in Lecture 9.
- Question 3.4 is covered in Lecture 8.
- Question 3.5 is covered in Lecture 10.
- To asnwer Question 3.6 is suffices to note that the barcodes are derived from the pairwise distances between points in a sample, and these distances do not change under an orthogonal transformation.
- Question 4.1 is covered in Lecture 11.
- Questions 4.2 and 4.3 are covered in Lecture 12.
- Questions 4.4 and 4.5 are not being covered in the course or exam this year.
- The questions in Section 5 relate to Emil's lectures/workshops.
- Questions 6.1 and 6.2 are covered in Lectures 13 and 14.
- Question 6.3 relates to the clique complex K_ϵ which was described in Lecture 14. The *Euler characteristic* $\chi(K_\epsilon)$ is the number $\alpha_0 - \alpha_1 + \alpha_2 - \alpha_3 + \cdots$ where α_k denotes the number of k-simplices in K_ϵ.
- Question 6.4 relates to the nerve of a collection of sets, which was introduced and illustrated in Lectures 16 and 17.
- Questions 6.5-6.9 relate to the notion of homotopy, which was covered in lecture 15.
- Question 6.10 is covered in Lecture 16.

- Questions 6.11 and 6.12 are covered in Lectures 17 and 18.
- Question 7.1 is covered in Lecture 19 and 20.
- Question 7.2 is based on the fact that homotopy equivalenct simplicial complexes have the same homology.
- Questions 7.3 and 7.4 are covered in 21 (which was motivated by Lecture 20).