

# Exam Performance Feedback Form

## COMP11120, Semester 1

2015/2016

First some general remarks. The exam was sat by 177 students. The median mark was 39 out of 60 (or 65%), and the average 37 (62%).

Overall we were very pleased with the vastly improved performance shown by the students for Semester 2. Many students were able to construct rigorous arguments, and some submitted answers that were good enough to act as model answers.

Twenty-six students had a failing mark, that is a mark of less than 24 out of 60, or a mark of less than 40%. Of these, thirteen students had a mark below 18 (which is below 30% and so not compensatable), with a lowest mark of 2. Eighteen students had a mark between 24 and 29 (or 40%–49%), twenty-four students had a mark between 30 and 35 (or 50%–59%), and thirty-seven students had a mark between 36 and 41 (or 60%–69%). On the top end, seventy-two students achieved first class marks with a top mark of 58 (achieved four times), which is 97%.

Statistical analysis of individual questions:

**Question 1.** Overall this question was well answered. The average mark was 12.4 out of 20, or 62%. Twenty-one students had a failing, and seventy-six a first class mark, with nine gaining full marks.

- a) Most students could answer this question. Some forgot the base case, and students who did not write justifications at least where the induction hypothesis is used lost a mark. Ironically in many cases the arguments students made for the base case was weaker than for the step case.
- b) Most people could define a suitable function. The step case that makes the final part the easiest is

$$\text{rpt}(s : l) = s : (s : \text{rpt } l).$$

Other correct versions exist, but they employ the append operation and require extra facts to be established in part iii).

The second part was more problematic, with many students being unable to give a syntactically correct else case. Here is one:

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return new List (l.value, new List (l.value, rpt(l.next)));
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Some students forgot the base case for iii), and in quite a few cases that case was incomplete. Students did lose a mark if they did not give justifications for their steps, if the justifications were wrong, or if their definition required them applying properties they did not justify.

- c) Some students picked  $n = 1$  for their base case, although the question claims the property for all elements of  $\mathbb{N}$ . Many students struggled to find a suitable transformation to be able to establish the step case, although there is quite a short argument (splitting  $8^{n+1} = 8 \cdot 8^n$  into  $3 \cdot 8^n$  and  $5 \cdot 8^n$ ). Some students presented a proof which had them depend on the induction hypothesis for  $n$  and  $n - 1$ : This requires there to be two base cases, one for  $n = 0$  and one for  $n = 1$ , and if one of these was missing they lost a mark.

**Question 2.** Overall this was well answered, in particular part d). The average mark was 13 out of 20, or 65%. Seventeen students had a failing, and more than half a first class mark, with five students gaining full marks.

- a) There is no multiplicative inverse in the first case (because the two numbers have a common divisor other than 1), and in the second case it is 13. Some students had problems applying the algorithm correctly. A mistake frequently made was to deduce that the inverse is 2, when it is  $-2$ , which is equal to 13 when calculating modulo 15.
- b) The first relation is neither reflexive (the empty list is not related to itself) nor transitive (most students could see that). Arguing either one of those secured two marks. The second relation is an equivalence relation. Some students were very cavalier when arguing about the empty set (often dropping that case from what they wrote), but I was fairly generous in marking that. The equivalence class of the list  $[1]$  is the set of all lists whose most recently added element is 1, which can also be described as

$$\{l : l \mid l \in \text{Lists}_{\mathbb{N}}\},$$

but an answer in English was fine. Many students forgot this part.

- c) Many students could not remember the definition of the argument of a complex number, which made it impossible for them to answer this correctly for the first relation. The argument of a complex number is the angle enclosed by the line from the origin to the number with the positive real axis. The first relation is a partial order. The difficult part of the proof is establishing anti-symmetry, which holds since the absolute and argument of a complex number uniquely determines it. Students who did not do that in sufficient detail lost one of the three marks for this part. The second relation is not reflexive, no number in  $\mathbb{N}$  that is at least 2 is related to itself.
- d) This was very well answered. There is no greatest or least element, the minimal elements are  $a$  and  $d$ , the maximal ones  $g$  and  $f$ , which are also the two upper bounds of the set  $\{c, e\}$ , and since these are incomparable there is no least upper bound. There's only one lower bound for the set  $\{b, f\}$ , namely  $a$ , which is the greatest lower bound of that set.

**Question 3.** The overall average for this question was 63%, and three students got full marks. In a noticeable number of cases the answers seemed to become more rushed towards the end of this questions, or some subquestions were not attempted (mostly d) and/or e)), which is likely an indication that time ran out for some students.

- a) Average mark: 87%. 80% of students achieved full marks

This question posed few problems. Common mistakes in answers: not making clear the answers are vectors or "vague descriptions" or drawing a vector or assuming the relevant vector space is the two-dimensional real space. For example, just writing 0 without underlining it, or just writing zero is strictly wrong in answer to part i). The origin as an answer is wrong.

- b) Average mark: 83%. 48% of students achieved full marks

Part i) was mostly answered correctly. Common mistakes in part ii) were incorrect transposition or mistakes in the calculations. Part iii) posed most problems. The overwhelming majority of students gave strictly speaking

incorrect explanations. For example, it is WRONG to say "a matrix can't be subtracted from a number", even worse is "a matrix can't be subtracted from a natural number" (please work out why).

- c) Average mark: 49%. 20% of students achieved full marks

Most students got part i) right. Part ii) was harder and full workings together with a correct answer were required for full marks. Guessing and checking the answer gained 2/3 marks. Just the correct answer was awarded 1/3 marks.

- d) Average mark: 53%. 22% student achieved full marks

Part i) was intended to be an easy question and many students had perfect answers, but surprisingly many students misunderstood the given definition and were not able to correctly identify which matrices are diagonal and which are not. These students subsequently did badly in part ii). Marks were lost for not saying for each matrix whether it was diagonal or not. For part ii) the quality of the marks ranged from very poor to beautiful. Marks were lost for absent or wrong or imprecise descriptions. Marks were lost for an absent or a bad example. For example, since the question asked for the effect on matrices, marks were lost if the example only showed the effect on vectors.

- e) Average mark: 59%. 18% of students achieved full marks

Part i). Most students could write down the augmented matrix, but some students did not know what this is. For part ii) full marks were only awarded for perfect answers and calculations making use of Gaussian elimination, at least partially. 2/3 marks were awarded for the correct solution set but informal calculations, and the all zero answer gained 1/3 marks. A common mistake in part iii) was to give a homogeneous system as an answer.