Enhancing the Computing Side of the Mathematics Student Journey

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Based on five years’ experience

• Teaching XX10190 “Programming and Discrete Mathematics”
• To 250-300 first year Mathematics students
• Many of whom aren’t particularly keen on programming
Why teach (first year) mathematics students programming?

• Because they’ll need it in later life
• Because they’ll need it in their sandwich placements (roughly 1/2 of the BSc cohort)
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- Because they’ll need it in their sandwich placements (roughly 1/3 of the cohort)
- Because they’ll need to program later in their studies (Numerical Analysis, Statistics and elsewhere)

However, all these are “jam tomorrow” reasons
How to teach programming?

+ “They must have seen it before”
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+ Have Computer Science teach it (our previous approach)
- Seen as disconnected from the rest
Our Approach (2009—)

• Teach programming integrated with relevant mathematics
• (Therefore we use a team of professors and a team of tutors, from both departments)
• Start with simple weekly exercises, just as in all the mathematics courses
• We expect all students to do all the exercises
• Carrot of help, stick of mark deduction
Team Teaching: 3 out of five tutors visible
Links to other modules

- Linear Algebra is taught simultaneously, over an arbitrary field, but all examples (as at school) are over \( \mathbb{R} \) or \( \mathbb{C} \)
Links to other modules (I)

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• XX10190 does coding theory, which is linear algebra over finite fields,

• And provides practical uses for “kernel”
Links to other modules (2)

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• Normally, Analysis introduces “\(O\)-notation”, and this seems gratuitous at first: yet another piece of notation

• XX10190 introduces “\(O\)-notation” early, for algorithm complexity: it seems natural — \(O(n^2)\) formalises “grows quadratically”

• Students can see the simplification: \(O(n)\) rather than \(15n-163\)
Links to other modules but above all

• XX10190 introduces proof by induction as a natural counterpart of programming by recursion

• There are a lot of non-trivial induction proofs

• Which have “real” applications in programming, showing the efficiency of algorithms
Relevance to the future curriculum

- We chose to use MatLab for the programming.
- Used in second year Numerical Analysis.
- Very similar to R, used in Statistics.
- (we give a 1-page handout on differences.)
Relevance to the future curriculum

• We chose to use MatLab for the programming
• Used in second year Numerical Analysis
• Very similar to R, used in Statistics
• This fitted our curriculum, others may vary
• The point is that the language is not necessarily a mainstream Computer Science one (previously Java)
But also

• We spend a few minutes in problem classes just talking about the relevance of computing to mathematics

• Sometimes by research students (whom the students know as tutors)

• Sometimes by colleagues whom they wouldn’t otherwise see
Met Office accuracy

Accuracy

RMS surface pressure error over the NE Atlantic
Conclusion

• Relevance is visible: better student feedback
• Competence is visible: better 2\textsuperscript{nd} and 3\textsuperscript{rd} year lecturer feedback
• Good for generic skills
• \textbf{But} it takes effort from both Departments
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