

**Week 12: Review of MA313, and Preview of the Exam**

Dr Niall Madden

**25, November, 2022**

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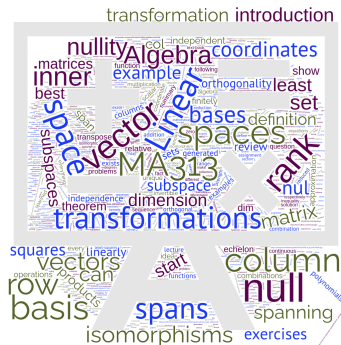
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# Outline

- 1 Part 1: reminders
  - Assignments
  
- 2 Part 2: What was all that about?
  
- 3 Part 3: Overview of the exam
  - Preparation
  - Good and bad
  
- 4 Part 4: The End!
  - That was Linear Algebra

## MA313

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## **PART 1:** Usual reminder

**Assignment 5**

Assignment 5 opened Thursday 10 Nov.

Deadline is 5pm, Friday, 25th of November (today!).

## Part 2: What was all that about?

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## **PART 2:** What was all that about?

*A list of topics we covered*

## Part 2: What was all that about?

Here is a short summary of everything we covered in MA313.

1. **Vectors** : what are they?
2. Collections of vectors: *vector spaces*
3. **Subspaces** and how to identify them.

## Part 2: What was all that about?

4. **Linear combinations**

5. **Spans** and Spanning sets

6. **Null space** and Left Null Space of a matrix

7. **Column space** and Row space of a matrix

## Part 2: What was all that about?

8. Reduced **Row Echelon Form**
9. **Linear Transformations**, and their link to matrices.
10. **Linear Independence**
11. **Bases**, for spaces and certain subspaces.



## Part 2: What was all that about?

- 12. Finitely generated vector spaces.
- 13. **Coordinate vectors** and coordinate mappings
- 14. **Isomorphisms**
- 15. **Dimension**

## Part 2: What was all that about?

16. **Rank** and Nullity, of  $A$  and  $A^T$
17. **Inner products**, and angles between vectors.
18. **Orthogonality**, the theorem of Pythagoras.
19. Cauchy-Schwarz and the Triangle inequality.

## Part 2: What was all that about?

- 20. **Length** (norm) of a vector, and the distance between two vectors.
- 21. **Orthogonal Projections** and unique representation.
- 22. **Orthogonal bases** and Gram-Schmidt
- 23. Orthogonal matrices

## Part 2: What was all that about?

24. **Best approximation**

25. **Least squares 1**: writing down the linear system for fitting a data set.

26. **Least squares 2**: constructing and solving the normal equations.

## Part 3: Overview of the exam

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**PART 3: Assessment**

## Part 3: Overview of the exam

MA313 is assessed by

- ▶ Assignments: 30%:
  - ▶ WeBWork Assignment 1: 3%
  - ▶ WeBWork Assignment 2: 5%
  - ▶ WeBWork Assignment 3: 6%
  - ▶ Written Assignment 4: 10%
  - ▶ WeBWork Assignment 5: 6%
- ▶ Communication skills: 20%
  - ▶ If you are not taking MA335, this based just on the proposal (2%), progress report (2%) and essay (16%).
  - ▶ If you are doing both MA313 and MA335, it will be proposal (1%), progress report (1%) and essay (9%), and presentation (9%).
- ▶ Final exam: 50%

## Part 3: Overview of the exam

The exam is structured very similarly to last year's exam.

- ▶ There are 4 questions; answer all 4 correctly for full marks. All carry equal marks.
- ▶ Each question has 3 or 4 sub-parts: the marks for each will be clearly indicated.
- ▶ Topics covered appear on the exam in roughly the order covered in class.
- ▶ The emphasis is on skills and insights and on providing examples and explanations, but not on memory or proofs.
- ▶ Specifically, you will not be asked to state any definitions and reproduce any proofs, though you might be asked to explain some concept in your own words.

To prepare, I suggest that you do:

- ▶ The sample paper I've posted to Blackboard under "Exam preparation". I've also posted solutions and a video explaining them.
- ▶ Last year's exam paper: it is also on Blackboard under "Exam preparation", again with solutions.

To get good marks, you should answer questions carefully, and **write in full sentences**.



In last year's exam, there were examples of good and bad practice.

- ▶ **Good:** Most students were skilled at row reduction. That proved quite useful.
- ▶ **Bad:** Error in matrix-vector multiplication, and, especially, matrix-matrix multiplication. *This was alarmingly common. If you are not confident, please practice!!*
- ▶ **Bad:** Mixing up spanning sets and bases (which is understandable: Basis = Spanning Set + Linear Independence).
- ▶ **Good:** Providing explanation, not just calculations.

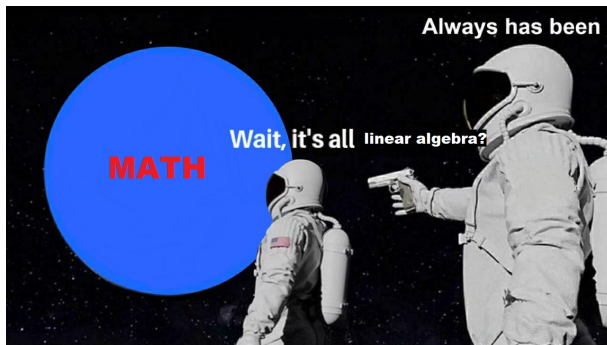
# Part 4: The End!

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**PART 4: Final comments**



**Linear Algebra** is perhaps to most ubiquitous (and useful) area of mathematics: it pervades all areas of pure mathematics, applied mathematics, and statistics. It is becoming increasingly crucial in data science.

If you'd like to read a little more about applications to data science, I suggest

*Nonnegative Factorization of a Data Matrix as a Motivational Example for Basic Linear Algebra. Pearlmutter, Barak A. and Šmigoc, Helena (2018). In: Challenges and Strategies in Teaching Linear Algebra. Earth: Springer International Publishing.*

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Thanks!

Thanks for your contributions to MA313 – especially the questions asked in class. I hope you find the material we covered interesting and useful. Good luck with the exam(s).

Questions?