

Introduction to Calculus and Linear Algebra

Iñaki Rañó

The Mærsk Mc Kinney Møller Institute

2021

Iñaki (Ignacio) Rañó

- e-mail: igra@mmmi.sdu.dk
- Office hours: ask me
- Office: ø9-612a-1
- Education:
 - MSc in Physics
 - PhD in Computer Science & Artificial Intelligence
- Teaching experience:
 - Subjects: Robotics, Artificial Intelligence, Control Theory, Automation, Computer hardware, Calculus and Linear Algebra
 - By country: Spain, Germany, UK, Denmark

The Million Dollar Question

Do I need to know maths to be a programmer, software engineer...?

- Maybe not, but it might come in handy for:
 - Deep-learning or to do data analytics related work
 - 3D game, VR, AR programming
 - Many small programming problems
- But it will make you a better programmer
 - Problem solving skill
 - Step by step solutions
 - Logical thinking

It will have a positive effect, even if you don't use everything you'll learn

Useful and Useless Courses

“When I did my degree [in Comp. Sci.] I thought there were two types of courses: useful courses and useless courses. Programming courses, databases, web-based programming and so on were the useful ones. Statistics, numerical methods and so on were useless. Now I am using many of the things they taught me in the useless courses.”

Anonymous PhD student

You never know what you will need to know.

Understanding Calculus and Linear Algebra

“At a higher level, good students know that it is possible to get an ‘A’ in a university course in mathematics without understanding what the course is about”

V. Byers *“What does it mean to understand mathematics?”*

How is this possible? You need:

- To know the rules
- To find patterns
- To apply the rules
- ... and lots of practice

Learning Outcomes (Knowledge)

- Demonstrate familiarity with differentiation and integration as well as the use of these tools.
- Show familiarity with all the basic mathematical functions specified under “Content”.
- Set up and solve linear, ordinary differential equations of 1st order.
- Solve linear equation systems with associated calculations of matrices and determinants.
- Use a mathematical analysis tool to solve mathematical problems.

Learning Outcomes (Skills and Competences)

Skills:

- Apply mathematical skills such as integration and differentiation to set up and use equation in context within software systems.
- Use calculations in linear algebra to analyse the existence of solutions for equation systems.

Competences:

- Apply learned mathematical skills in the other activities of the semester.

Course Contents & Structure

- Review of arithmetic
- Vectors and vector spaces
- Linear algebra, matrices and determinants
- Linear systems of equations, Gaussian elimination
- Functions of real numbers
- Limits and continuity
- Differentiation and their applications
- Integration and their applications
- Functions in two dimensional spaces
- Linear ordinary differential equations of 1st order

Two main parts

- Coursework Portfolio (30%)
 - Three programming tasks
 - Application of the concepts
 - Coursework schedule
 - Week 40 (Week 42 hand in)
 - Week 46 (Week 48 hand in)
 - Week 49 (Week 51 hand in)
- Final exam (70%)
 - Duration 2h 30min
 - 7 points scale
 - Cheatsheet?

Last year statistics:

- First attempt: 76% pass, 24% fail
- Resit: 93% pass, 7% fail

Bibliography & Resources

- Robert A. Adams & Christopher Essex. “Calculus A Complete Course”. Pearson. (8th Edition)
- Erwin Kreyszig. “Advanced Engineering Mathematics”. Wiley. (Linear Algebra only)
- Slides and exercises on itslearning
- Solutions to exercises

Many books & resources online

- Wikipedia basic maths entries are really good
- https://encyclopediaofmath.org/wiki/Main_Page
- For fun:
 - 3Blue1brown
 - Numberphile

Questions?

