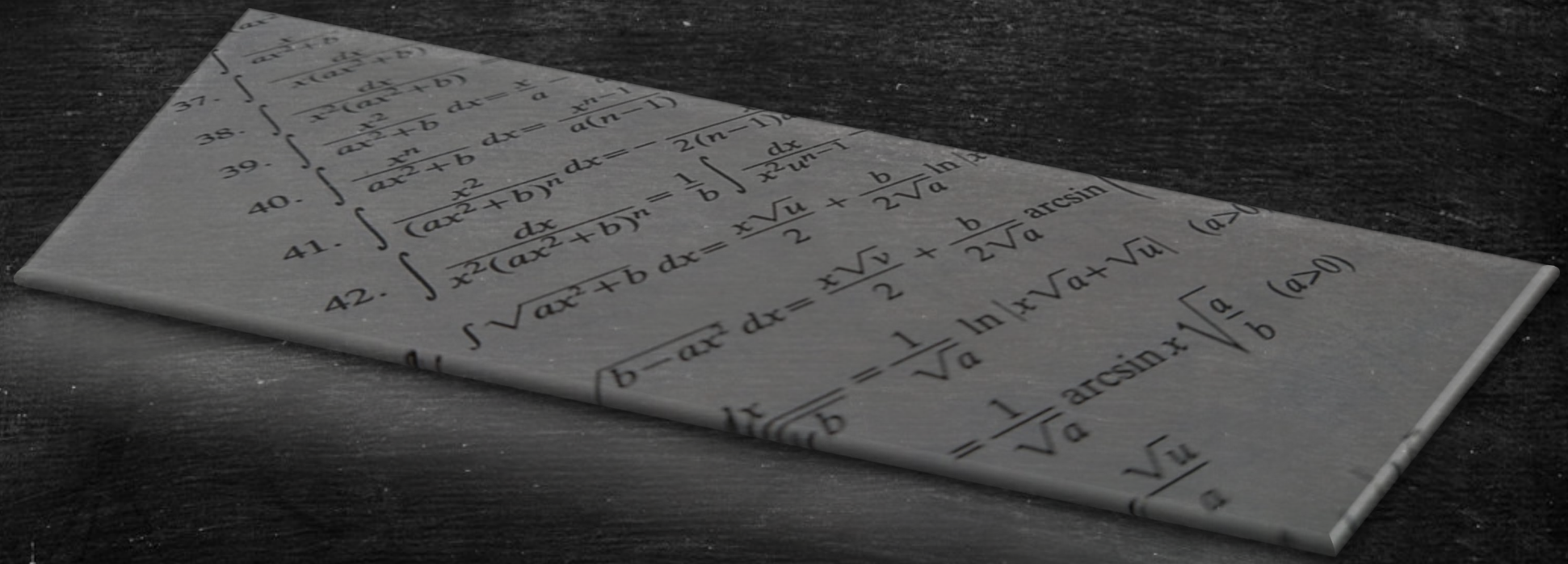

Module Introduction

COMP270: Mathematics for 3D Worlds and Simulations

Session Aim

- **Anticipate** the content of the module (and any gaps you may need to fill in yourself).
- **Understand** the module aim and learning objectives, and how it will support your work in other contexts.
- **Plan** your time management strategies for completing the assignments.

Module Aim

To **empower** you to leverage mathematics and mathematical modelling in the design and implementation of real-time 3D worlds and simulations.

Learning Outcome

ID	NAME	DESCRIPTION	ASSESSMENT CRITERIA CATEGORY
3	Solve	Apply knowledge of algorithms, data structures, and mathematics to solve well-defined problems.	PROCESS

Module Summary

On this module, you learn the fundamental mathematics involved in the design, development and maintenance of real-time 3D worlds and simulations. In doing so, you will leverage mathematics practically to generate and manipulate worlds and simulations relevant to a range of creative computing contexts. Indicatively, content spans topics such as linear algebra (vectors, matrices and quaternions), geometry, trigonometry, 3D transformations, collision detection, Newtonian mechanics, numerical control, calculus, and efficiency and optimisation of numerical methods.

Weekly Overview

Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
Revision • Numbers and spaces	**Geometry I** • Points, lines and triangles • Vectors • Functions and parameters • Curves	**Geometry II** • Dot product • Matrices • Types of transform • Combining transformations	**Mechanics I** • Calculus • Basic mechanics/ Newton's laws • Equations of motion • Projectiles	**Mechanics II** • Detecting collisions • Calculating distances • Collision response • Simplifying collisions	*Studio practice/ mid-term review*
Week 7	**Week 8**	**Week 9**	**Week 10**	**Week 11**	
3D Geometry I • Vectors in 3D • Lines and planes • Simple camera model • Coordinate spaces	**3D Geometry II** • Matrices in 3D • Coordinate transforms • More about rotations • Quaternions	**Intro to VFX** • Hardware and the graphics pipeline • Shaders and the material system • Geometry as meshes • Shaders	**Beyond 3D** • Applications of mathematics in other contexts	***VIVA***	

Teaching Methods

- Lecture
- Workshop
- Seminar

Teaching Methods

- Lecture
  - A series of short videos, with a combined total of approx. 1 hour, for asynchronous viewing.
  - Provides an overview of the week's topics: watch these before attending the timetabled sessions!
  - Videos will be accompanied by short LearningSpace quizzes for you to test your knowledge and understanding before moving on to the next topic.
    - You can complete the quizzes at any time, and in any number of attempts – have a go before watching the video to see what to look out for, or try them during the timetabled sessions if you need support.
- Workshop
- Seminar

Teaching Methods

- Lecture
- Workshop
  - 2-hour online synchronous activity as a timetabled Teams Live Event.
    - Recorded content will be posted on LearningSpace afterwards.
  - Solutions to sample “whiteboard” problems presented, and/or answers to questions raised in the forum (or via other channels).
  - Opportunity to work through further problems (from worksheet, LearningSpace quizzes or assignments) with (limited) interaction via e.g. Teams Q&A.
  - Combination of ‘pure’ mathematical (pencil-and-paper) and code-based tasks.
- Seminar

Teaching Methods

- Lecture
- Workshop
- Seminar
  - 1-hour synchronous activity as a timetabled Teams Meeting.
    - Recorded content will be posted on LearningSpace afterwards.
  - Working through more complex problems as a group, with opportunity for interactive discussion and presentation of solutions.
  - You can choose the content! Vote for any of the problems from the week's worksheet, or suggest one you've encountered elsewhere.

Additional Support

- Forum
  - A place for you to share insights, resources, questions and general thoughts on maths.
- Online courses
  - brilliant.org – offers a 30-day free trial and discounts for group memberships
  - Khan Academy – free online courses in geometry, trigonometry, linear algebra and more
- Text books
  - Dunn, F & Parberry, I 2011, *3D Math Primer for Graphics and Game Development*, CRC Press, Boca Raton, FL

Assignments

- Assignment 1: Worksheet Tasks [100%]
- **Four** worksheets (roughly one every two weeks)
  - Worksheets A-C: test your mathematical problem solving and C++ programming
  - Worksheet D: apply your mathematical skills in engine
- See LearningSpace for assignment brief, worksheets and formative deadlines
  - Submit pull request to GitHub before the deadline for formative feedback
- See MyFalmouth for summative deadline

Worksheet Schedule

Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
Revision	Geometry I	Geometry II	Mechanics I	Mechanics II	*Studio practice/ mid-term review*

Worksheet A: race car	Worksheet B: tank

Week 7	Week 8	Week 9	Week 10	Week 11
3D Geometry I	3D Geometry II	Intro to VFX	Beyond 3D	*VIVA*

Worksheet C: ray caster	Worksheet D: VFX

Now what…

- Post a message on the introduction forum, to tell us:
  - What you like most about maths,
  - What you like least, and
  - What you hope to get out of this module.
- Take a look at the content for Week 1: watch the videos and try the quizzes to see how much you can remember!