

## Liverpool John Moores University

Title: Maths and Graphics  
Status: Definitive  
Code: **4209COMP** (127969)  
Version Start Date: 01-08-2021

Owning School/Faculty: Computer Science and Mathematics  
Teaching School/Faculty: Computer Science and Mathematics

Team	Leader
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**Academic Level:** FHEQ4      **Credit Value:** 20      **Total Delivered Hours:** 44  
**Total Learning Hours:** 200      **Private Study:** 156

### Delivery Options

Course typically offered: Semester 2

Component	Contact Hours
Lecture	22
Tutorial	11
Workshop	11

**Grading Basis:** 40 %

### Assessment Details

Category	Short Description	Description	Weighting (%)	Exam Duration
Artefacts	AS1	Implementation of an interactive 2D computer graphics application	50	
Test	AS2	In-class test	50	

### Aims

*To provide mathematical principles in computer graphics.  
To explain the underpinning concepts within computer graphics.  
To teach 2D computer graphics operations using a modern graphical API.*

To develop programming skills in computer graphics.

## Learning Outcomes

After completing the module the student should be able to:

- 1 Describe the primary stages of the programmable graphics pipeline in 2D context.
- 2 Apply relevant mathematical principles to solve problems in real-time computer graphics.
- 3 Implement logical expressions and arithmetic models to represent the decisions and actions that form the mechanics an interactive 2D graphical application.
- 4 Construct mathematical models and apply them programmatically to control graphical primitives.
- 5 Use a modern graphics 2D API in conjunction with a high-level programming language to develop an interactive graphical 2D application.

## Learning Outcomes of Assessments

The assessment item list is assessed via the learning outcomes listed:

Implementation of 2D graphic	3	4	5
In-class test	1	2	

## Outline Syllabus

*Elementary numerical and algebraic processes: fractions, indices, algebraic manipulation.*

*Two-dimensional Cartesian co-ordinates, equation of a straight line and quadratic curve, solution of linear equations containing one and two variables. Elementary trigonometry and trigonometric functions.*

*Multi-dimensional vectors, vector algebra including scalar product.*

*Matrix multiplication for vector transformations.*

*Parametric equations.*

*Set theory and discrete maths.*

*Logic: simple propositional and predicate logic.*

*Introduction to 2D graphics via the programmable pipeline.*

*Applied Mathematics for 2D Computer Graphics: Affine Transformations in 2D.*

*Introduction to the rendering pipeline: Coordinates and Model, World and Screen Spaces.*

*Vector and Raster representation of 2D primitives within the Programmable Pipeline*

*Vertex and graphics primitives in a 2D environment – Buffers and Resources*

*Mapping Sprites via Buffers and Resources – Basic Texture Mapping and Quadrilateral Formation.*

*Quadrilateral-based Text Rendering.*

*Handling Transparency on 2D Texture mapped surfaces.*

*Homogeneous coordinates.*

*Cameras and Orthographic Projections.*

*Applying Orthographic Representation to a 2D graphics application.*

*The Interactive Loop, Timing and Measuring Time.*  
*Event Driven Input Handling and Spatial and Temporal Predicates applied to Input.*  
*Representations of graphical data and logical state using Object-Oriented Programming techniques.*  
*Basic Collision Detection: Broad phase.*

## **Learning Activities**

Lectures – to deliver the theoretical concepts on mathematics applied to interactive 2D computer graphics.

Practical Workshop – Tutor-led practical session in the computer laboratory.

Tutorial – Tutor-led practice session in solving maths problems.

Further exercises – additional exercises for students to work on in their own time.

Directed learning – provides additional reading to enable practical work to be completed.

Learning materials can be accessed digitally via University Virtual Learning Environment (VLE).

## **Notes**

This module teaches the fundamental of, and specifically 2D, computer graphics and its underlying mathematical principles. Students will recap on a number of elementary mathematics concepts before being introduced to more complex ones and how to utilise them to solve computer graphics problems. The module teaches the practical aspects of computer graphics through a series of programming workshop using modern graphics API.