3D Graphics Programming Tools

Module Introduction

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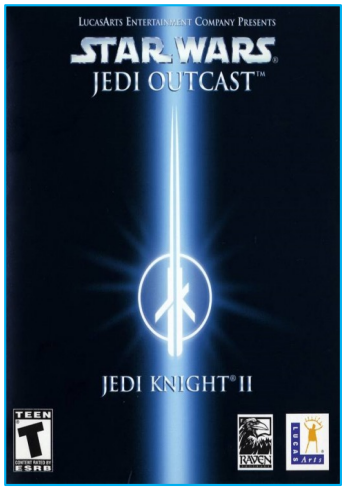
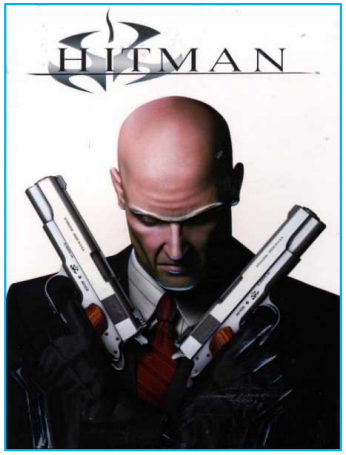
Learning Aims and Outcomes

- LO1 – Understand 3D Computer Graphics' mathematical and computational fundamental principles;
- LO2 – Describe rendering techniques for the creation of 3D Computer Graphics;
- LO3 – Apply OpenGL programming principles;
- LO4 – Generate and comment OpenGL code;
- LO5 – Implement 3D graphics animations using a variety of programming tools.

Notable Games that Use OpenGL





More can be found at https://www.pcgamingwiki.com/wiki/List_of_OpenGL_games

Practical & Theoretical Contents

Practical	Unit 1	OpenGL Basics
	Unit 2	OpenGL Production
Theoretical	Unit 3	Modelling, Transformations, Colours
	Unit 4	Projection, Rasterisation

- The rationale of delivering practical content before the theoretical part is so that you can start doing your coursework rather quickly.
- After learning the practical use of OpenGL in Unit 1 & Unit 2, you will gain a better understanding of how everything works in theory in Unit 3 and Unit 4.

Teaching Schedule

2021-2022

Week	3	4	5	6	7	8	9	10	11	12	13	14	15
w/c:	13-Sep	20-Sep	27-Sep	04-Oct	11-Oct	18-Oct	25-Oct	01-Nov	08-Nov	15-Nov	22-Nov	29-Nov	06-Dec
EBU7405		XC				XC		PH	PH	CS	PH	PH	CS
1	Live	Live	Live		Live	Live	Tut	Rec	Rec	Live	Rec	Rec	Live
2	Live	Live	Tut		Live	Live	Tut	Rec	Rec	Live	Rec	Rec	Live
3	Rec	Rec	Rev		Rec	Rec	Rev	Rec	Live	Live	Rec	Live	Live
4	Rec	Rec	OH		Rec	Rec	OH	Rec	OH	Live	Rec	OH	Live
Labs:		L1				L2			L3			L4	
Assessments:													CW

Class Days, Times and Room Number			
Telecom_M_G1		Telecom_M_G2	
Mon	16:35-17:20	Mon	19:20-20:05
	17:25-18:10		20:10-20:55
Thu	16:35-17:20	Wed	19:20-20:05
	17:25-18:10		20:10-20:55

Teaching Schedule – Practice

	WK	Commencing	Day	Activities	Mode
Unit 1. OpenGL Basics	3	13 Sept	Mon	Lecture 1. Module Introduction Lecture 2. OpenGL Drawing – Part 1	[Live]
			Wed/Thu	Lecture 2. OpenGL Drawing – Part 2	[Recorded]
	4	20 Sept (Lab 1)	Mon	Lecture 3. OpenGL Coordinates and Viewing	[Live]
			Wed/Thu	Lecture 4. OpenGL Events and Animation Lecture 5. OpenGL 3D Drawing	[Recorded]
	5	27 Sept	Mon	Coursework Handout Tutorial 1. OpenGL 2D Exercises	[Live]
			Wed/Thu	Revision Office Hours	[Live]
Unit 2. OpenGL Production	7	11 Oct	Mon	Lecture 6. OpenGL Interactive Events	[Live]
			Wed/Thu	Lecture 7. Colours and Lighting Lecture 8. Programming Techniques	[Recorded]
	8	18 Oct (Lab 2)	Mon	Lecture 9. OpenGL Camera and Transformations	[Live]
			Wed/Thu	Lecture 10. WebGL	[Recorded]
	9	25 Oct	Mon	Tutorial 2. OpenGL 3D Exercises	[Live]
			Wed/Thu	Revision Office Hours	[Live]

Delivered by Dr Xianhui Che

Subject to further updates.

Teaching Schedule – Theory

	WK	Commencing	Day	Activities	Mode
Unit 3. Modelling, Transformations, Colours	10	1 Nov	Mon	Lecture 11. Modelling	[Recorded]
			Wed/Thu	Lecture 12. Geometric Transformations	[Recorded]
	11	8 Nov (Lab 3)	Mon	Lecture 13. Colour	[Recorded]
			Wed/Thu	Revision Office Hour	[Live]
	12	15 Nov	Mon	Tutorial 3. The Basics of Matrix Algebra	[Live]
			Wed/Thu	Tutorial 4. Geometric Primitives	[Live]
Unit 4. Projection, Rasterisation	13	22 Nov	Mon	Lecture 15. Projection_1	[Recorded]
			Wed/Thu	Lecture 16. Projection_2	[Recorded]
	14	29 Nov (Lab 4)	Mon	Lecture 17. Rasterisation	[Recorded]
			Wed/Thu	Revision Office Hour	[Live]
	15	6 Dec (CW Due)	Mon	Tutorial 5. The Rendering Pipeline	[Live]
			Wed/Thu	Tutorial 6. MCQ & Key Concept Examples	[Live]

Delivered by Dr Pengwei Hao & Dr Chao Shu

Subject to further updates.

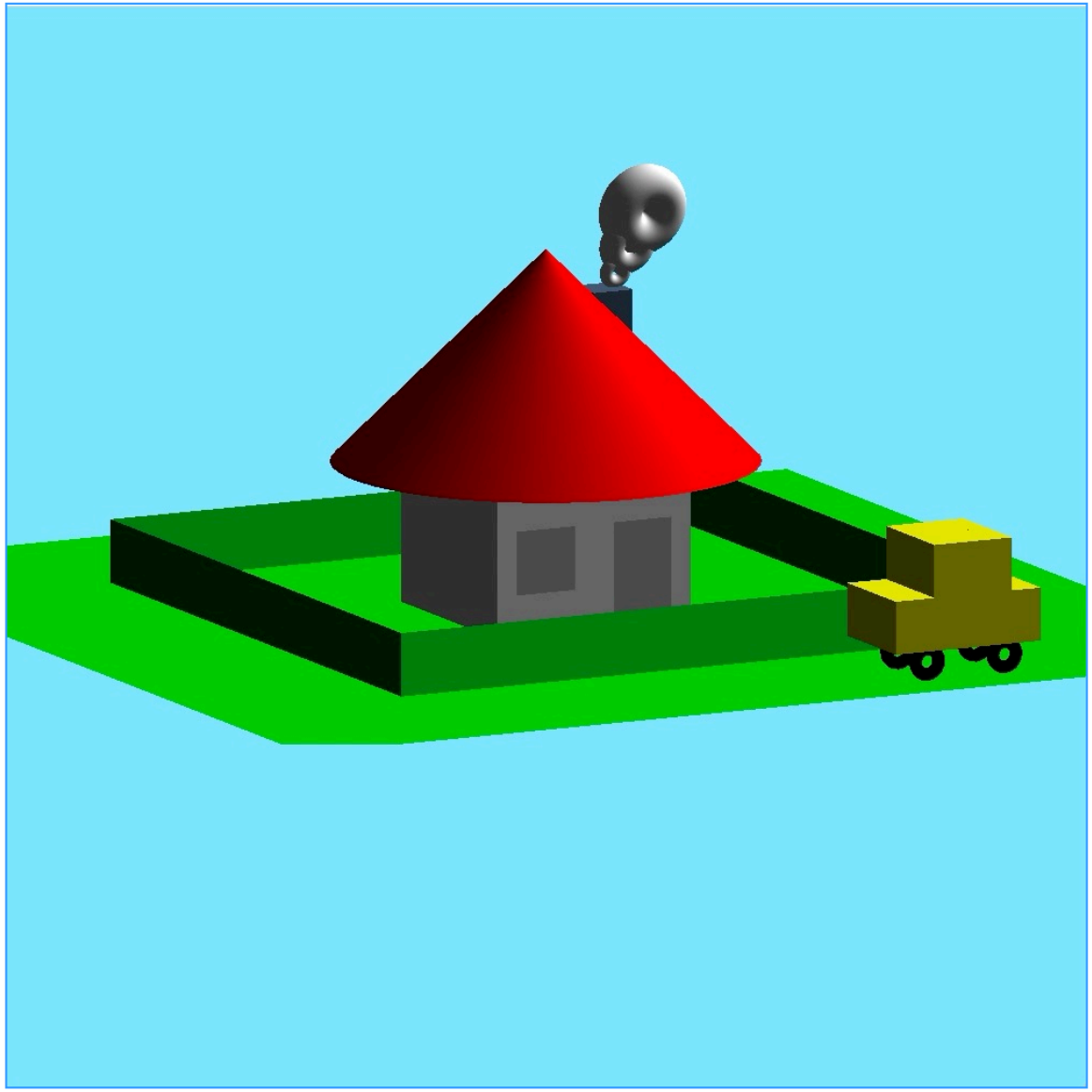
Labs

- Lab 1. 2D Graphics
- Lab 2. 3D Graphics
- Lab 3. Camera, Animation, and Interaction
- Lab 4. Polishing & Stretch Features

- The work of the four labs will help and contribute to the production of the coursework.
- The labs will be led by TAs.

Coursework

- 3D graphics and animation with OpenGL
- Individual work
- To be briefed in week 5

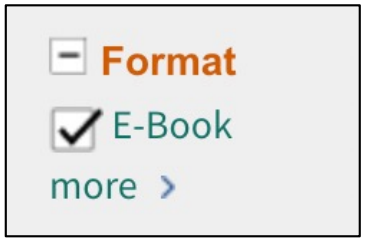


Module Assessment

Coursework	20%	Deadline: 6th December 2021
Exam	80%	To be confirmed by the school
Total	100%	

Library in QMUL

- Access link: https://www.qmul.ac.uk/library/

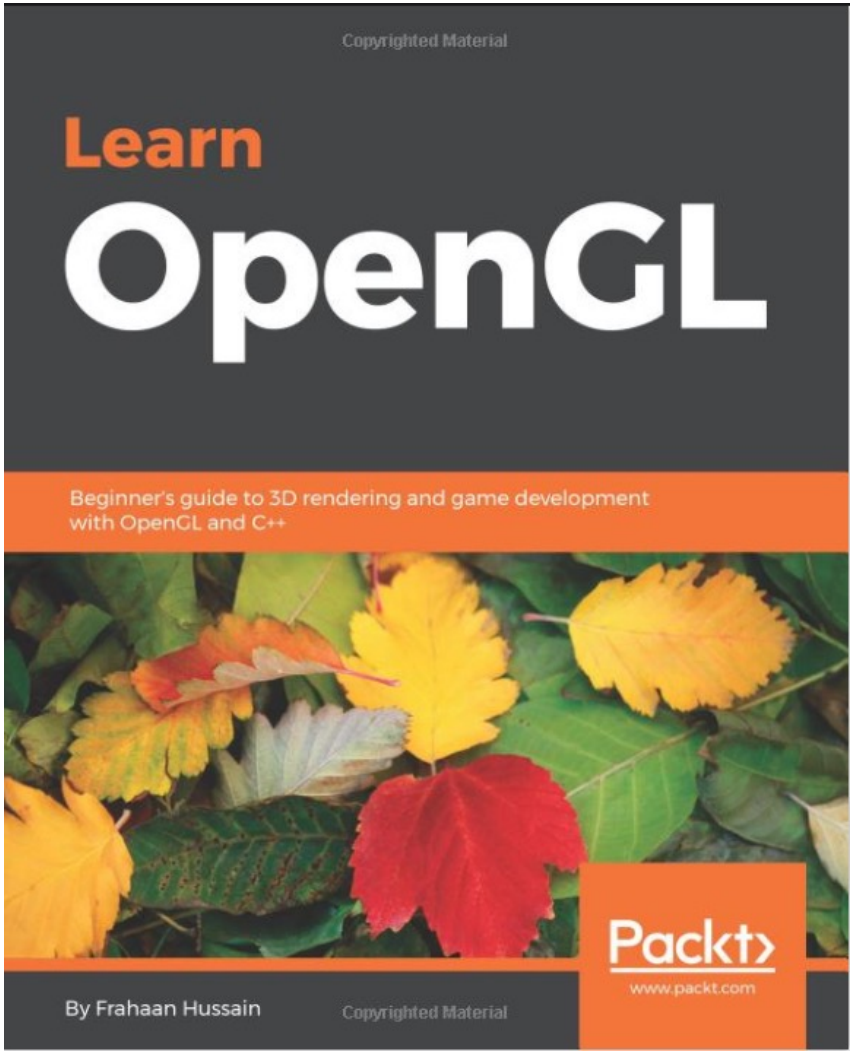


- E-books are free to access remotely.
- Adobe Digital Edition needs to be installed on your local computer in order to download the e-books. Alternatively you can choose to read online.
  - To install Adobe Digital Edition: https://www.adobe.com/uk/solutions/ebook/digital-editions/download.html
  - For help: https://www.qmul.ac.uk/library/using-the-library/e-resources-news-and-help/

Background Reading

Note this is NOT a textbook!

Learn OpenGL : beginner's guide to 3D rendering and game development...
Hussain, Frahaan, author
eBook | 2018
Please log in to see more details



Practical Tools

- C++ programming platforms that support OpenGL:

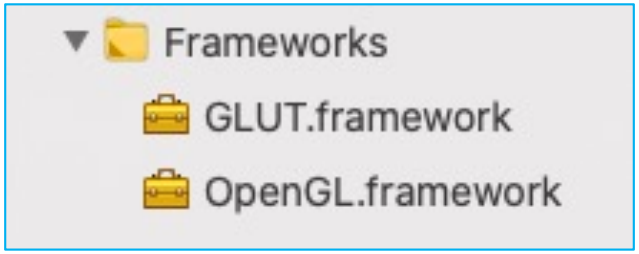
Using Visual Studio for OpenGL

- Visual Studio Community is sufficient.
- Steps:
  1. Install Desktop Development with C++
  2. Install GLUT header files, etc.
  3. Configure Visual Studio file paths

- Lab 0.1. Setting up OpenGL with Visual Studio

Using Xcode for OpenGL

- Two frameworks need to be added:



- Header:

```
#include <GLUT/glut.h>
```

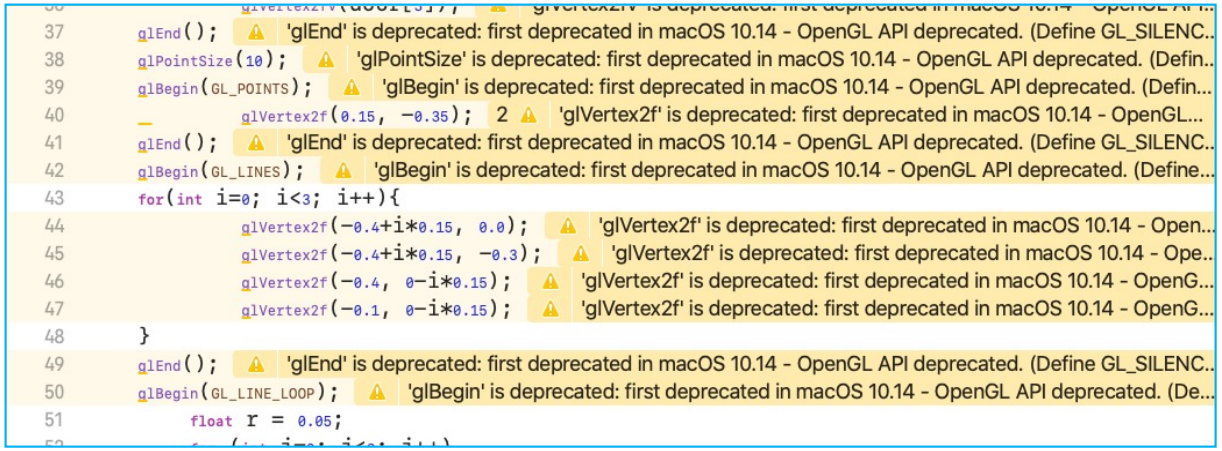
- A more thoughtful code:

```
#ifdef __APPLE__
#include <GLUT/glut.h>
#else
#include <GL/glut.h>
#endif
```

- Lab 0.2. Configuring Xcode for OpenGL.pdf

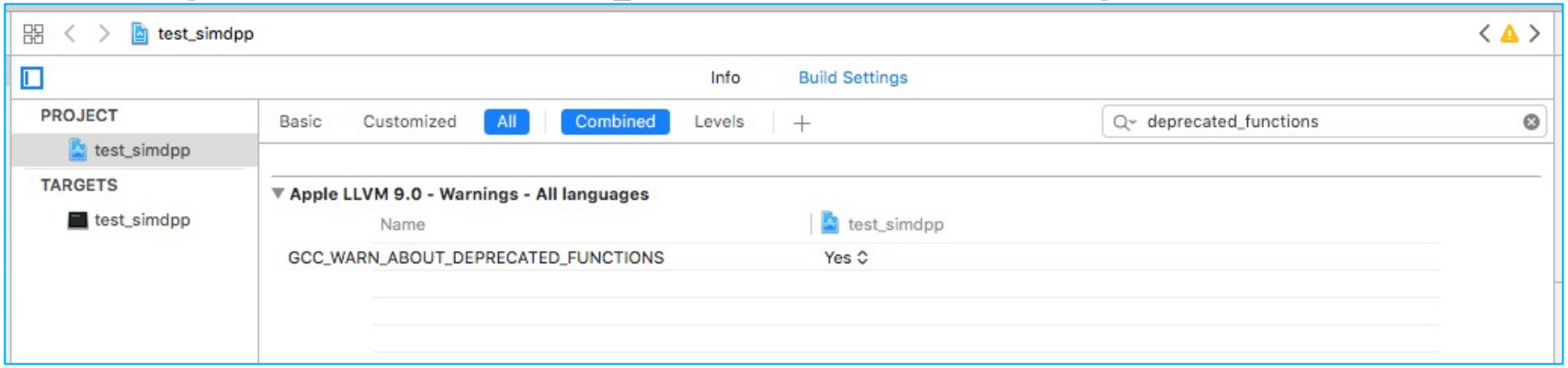
Using Xcode for OpenGL

- Apple has migrated low level graphics to **Metal**.
- You may receive a lot of deprecation warnings when using OpenGL:



Everything still works despite the warnings. No worry at all!

- To get rid of the deprecation warnings:



Reference Documents

- **GL** and **GLU** Functions:
  https://www.khronos.org/registry/OpenGL-Refpages/gl2.1/
- **GLUT** Functions:
  QMPlus: Background Reading – GLUT Documentation
- **WebGL**:
  - https://www.khronos.org/registry/webgl/specs/latest/2.0/
  - https://www.khronos.org/files/webgl/webgl-reference-card-1_0.pdf

Questions?

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