

# INTRODUCTION TO MOBILE GRAPHICS 2020 EDITION

## Introduction

Graphics technologies are often taught as part of games development or computer science degrees but are usually based on games console or PCs. This is diverging from everyday life since consumers increasingly interact with graphics on their mobile devices via games and user interfaces (UIs). It is important that developers understand the specific constraints of mobile devices where power-efficient rendering is a must. This course module is designed to introduce real-time rendering on mobile devices to students who have little or no prior experience with 3D graphics programming.

The course consists of lecture slides, practical exercises (including model solutions) and example exam questions, giving you the flexibility to choose between a practical and an exam-based structure for the course at your faculty.

The lectures introduce the specifics of mobile graphics, GPU architectures, and 3D rendering with OpenGL ES and GLSL ES shaders. The PowerVR SDK is used throughout the material to provide OS-agnostic API setup, shutdown, and render loop entry points, so students can easily develop on Windows, OS X or Linux using Imagination's OpenGL ES emulator, then deploy to a number of mobile operating systems, including iOS and Android, without having to worry about OS specific behaviour. Examples to deploy lab practicals to a Chromebook and the BeagleBone® Black are included in the module materials. Additionally, Imagination's PowerVR Tools are used in many of the exercises to demonstrate how industry-standard development tools can help students quickly implement robust and efficient 3D graphics applications.

## The Author

The course materials were developed by Darren McKie, Fellow of the Higher Education Academy, Lecturer of Computer Science, Department of Computer Science and Technology, at The University of Hull, UK.

## Target Courses

BSc 2<sup>nd</sup> or 3<sup>rd</sup> year; MSc; Gaming (and related courses) & Computer Science programmes.

## Duration

The course module runs for a semester or term with each Lecture having a complimentary Lab practical to illustrate the key points and give students hands-on experience.

## Required Tools

### Software

- The [PowerVR SDK](#) (Software Development Kit) is free of charge to download
- The emulator can be used to complete the course without any PowerVR hardware
- Suitable iOS, Android or Linux PowerVR devices are widely available, so we encourage students to deploy their applications to real devices.

### Hardware

- The minimum required hardware is a PC (Windows, OS X or Linux) that meets the minimum requirements of our OpenGL ES emulator, [PVRFrame](#)
- Using PowerVR SDK to build a project for the [BeagleBone® Black](#), or for the Acer Chromebook R 13
- iPhone, iPad, and many Android phones and tablets

## Contents

Lecture Topic	Week	Details
Introduction to mobile graphics technologies	1	Introduction to the different graphics APIs available and how they compare.
Basics of the PowerVR Framework, and simple Object Orientated Design	1-2	How the simple triangle graphics program has been written using the PowerVR SDK. How to separate the triangle code out of the main drawing function and into its own class.
Introduction to mobile graphics architectures	2-3	Comparison of mobile's dominant graphics hardware, an introduction to the concerns relating to power consumption and performance, and to understand the cross-platform/cross-compilation benefits of OpenGL ES. The PowerVR Graphics architecture case study will be outlined.
Introduction to mobile graphics SDKs and forums	3-4	Learn about the main technologies used in mobile graphics SDKs up to OpenGL ES 3.2 and to learn how to use some of the SDK utilities and how to use forums for help.
Texturing	4-5	How texturing works, including the coordinate system and performance concerns.
Transformations	5	How transformations can be applied to vertices, including how to use the Model matrix for translations and rotations, and to understand the use of the View and Projection matrices.



OpenGL ES basics	6-7	Learn the basics of the OpenGL ES commands and Shader Language.
OpenGL ES lighting	7-8	Learn how to use different lighting models to illuminate objects in a scene.
Reflection and Refraction	9	Learn how cubemaps can be created and how they are used for calculating reflections and refractions.
Introduction to Vulkan	9-10	Introduction to Vulkan and a comparison with OpenGL ES.

### Languages:

- The materials are available in 5 languages: Chinese (Simplified), Chinese (Traditional), Korean, Japanese & English

### Online Learning:

- Dr. Yang of Peking University (PKU) presents an online self-study version of this course at [here](#)
- 北京大学的杨博士在学堂在线介绍了该课程的在线自学版本。

### Complementary Materials:

- A series of video tutorials presented by Darren McKie: <https://university.imgtec.com/introduction-to-mobile-graphics-online-workshop-videos/>
- Relevant textbooks: <http://university.imgtec.com/resources/books/>

### Support:

- The PowerVR developer forum [here](#) is a thriving centre for technical questions with frequent interactions with Imagination experts
- For curriculum and other discussions, there is the IUP (Imagination University Programme) forum [here](#)

### Partners:

We have teamed-up TI, makers of the OMAP™ system-on-chip which contains the Imagination SGX PowerVR GPU on the Beagleboard and BeagleBone Black platforms



## One Day Workshop:

- The Author is hosting a One-Day Workshop in London on 21 April 2022.  
<https://www.eventbrite.co.uk/e/introduction-to-mobile-graphics-workshop-tickets-255950032437>
- The workshop will be recorded and posted alongside the current video tutorials.

## Press Release:

- <https://imaginationtech.com/news/imagination-announces-new-mobile-graphics-teaching-course-for-2020/>

## Join the IUP and access these materials:

1. Click 'Register' or 'Join IUP' on the landing page: <http://university.imgtec.com>
2. Complete the IUP registration form
3. A verification email will be sent to your inbox for activation.  
(Please also check your spam mailbox in case of filtering)
4. Then, to request the materials, visit the IUP>Teaching Resources  
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