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THE CHINESE UNIVERSITY OF HONG KONG
Print Course Catalog Details

May 10, 2023
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<u>Academic Org: Div of Computer Science & Engg – Subject: Computer Science</u>

Course: CSCI5390　　　　**Course ID:** 002641　　　　**Eff Date:** 2022-07-01　　　　**Crse Status: Active**　　　　**Apprv. Status:** Approved　　　　【Course Rev】

Advanced GPU Programming 高級圖形處理器編程

The evolution of consumer graphics hardwares leads to the introduction of parallel, programmable GPUs (Graphics Processing Units). The strong parallel computational power of GPUs not only supports real-time and realistic rendering, but also the cost- effective platform for scientific computing, such as physical simulation, numerical analysis, evolutionary computation, image processing, and computer vision, etc. This course introduces the evolution of shading language and GPU, the basic concept in GPU programming and the recent advanced usage of GPU in computer graphics and general- purpose computing. Topics covered include: shader programming, procedural texture and modelling, programmable graphics pipeline, modern shading language, GPGPU (general-purpose computing in GPU), limitations of GPU, and case studies of advanced usages of GPU.

圖形硬體的發展帶來新一代平行及可編程的圖形處理器。圖形處理器的快速平行計算能力不但可支持實時像真渲染，亦提供一個有成本效益的科學計算平台用作，物理學模擬，數值分析，演化式計算，圖像處理，及計算機視覺等。本科介紹著色語言及圖形處理器的發展，圖形處理器編程的基本概念，圖形處理器於計算機圖形及通用計算的先進用法。課題包括著色子編程，過程紋理及模型，可編程的圖形處理流程，現代著色語言，圖形處理器的通用計算，圖形處理器的局限，及圖形處理器先進使用的個案探討。

Grade Descriptor:　　A

EXCELLENT – exceptionally good performance and far exceeding expectation in all or most of the course learning outcomes; demonstration of superior understanding of the subject matter, the ability to analyze problems and apply extensive knowledge, and skillful use of concepts and materials to derive proper solutions.

有關等級說明的資料，請參閱英文版本。

B

GOOD – good performance in all course learning outcomes and exceeding expectation in some of them; demonstration of good understanding of the subject matter and the ability to use proper concepts and materials to solve most of the problems encountered.

有關等級說明的資料，請參閱英文版本。

C

FAIR – adequate performance and meeting expectation in all course learning outcomes; demonstration of adequate understanding of the subject matter and the ability to solve simple problems.

有關等級說明的資料，請參閱英文版本。

D

MARGINAL – performance barely meets the expectation in the essential course learning outcomes; demonstration of partial understanding of the subject matter and the ability to solve simple problems.

有關等級說明的資料，請參閱英文版本。

F

FAILURE – performance does not meet the expectation in the essential course learning outcomes; demonstration of serious deficiencies and the need to retake the course.

有關等級說明的資料，請參閱英文版本。

Equivalent Offering:
Units: 3 (Min) / 3 (Max) / 3 (Acad Progress)
Grading Basis: Graded
Repeat for Credit: N
Multiple Enroll: N
Course Attributes: MSc Computer Science
MPhil-PhD Computer Sci & Erg

Topics:

COURSE OUTCOMES

Learning Outcomes:

At the end of the course of studies, students will have acquired the ability to
1. understand the design rationale of the hard-to-learn GPU programming.
2. understand how leading researchers in various fields making use of GPU for advanced research.
3. use GPU.

Course Syllabus:

The evolution of consumer graphics hardwares leads to the introduction of parallel, programmable GPUs (Graphics Processing Units). The strong parallel computational power of GPUs not only supports real-time and realistic rendering, but also the cost- effective platform for scientific computing, such as physical simulation, numerical analysis, evolutionary computation, image processing, and computer vision, etc. This course introduces the evolution of shading language and GPU, the basic concept in GPU programming and the recent advanced usage of GPU in computer graphics and general- purpose computing. Topics covered include: shader programming, procedural texture and modelling, programmable graphics pipeline, modern shading language, GPGPU (general-purpose computing in GPU), limitations of GPU, and case studies of advanced usages of GPU.

Assessment Type:

Essay test or exam	:	30%
Others	:	30%
Presentation	:	40%

Feedback for Evaluation:

1. Quiz and examinations
2. Course evaluation and questionnaire
3. Reflection of teachers
4. Question-and-answer sessions during class
5. Student consultation during office hours or online

Required Readings:

To be provided by course teacher.

Recommended Readings:

1. Anthony A. Apodaca & Larry Gritz, "Advanced RenderMan: Creating CGI for Motion Pictures", Morgan Kaufmann Publishers (2000)
2. Steve Upstill, "The RenderMan Companion: A Programmer's Guide to Realistic Computer Graphics", Addison Wesley, 1990.
3. David S. Ebert, F. Kenton Musgrave, Darwyn Peachey, Ken Perlin, Steven Worley, "Texturing & Modeling: A Procedural Approach", Third Edition, Morgan Kaufmann, 2002.
4. Randima Fernando, "GPU Gems: Programming Techniques, Tips and Tricks for Real-Time Graphics", Addison Wesley, 2004.
5. Matt Pharr & Randima Fernando, "GPU Gems 2: Programming Techniques for High-Performance Graphics and General-Purpose Computation", Addison Wesley, 2005.

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6. Hubert Nguyen, "GPU Gems 3", Addison Wesley, 2007.
To keep the course materials updated, part of the lecture materials will also be compiled from the web or from difference sources.

OFFERINGS

1. CSCI5390	Acad Organization=CSEGV; Acad Career=RPG

COMPONENTS

LEC : Size=30; Final Exam=Y; Contact=3
TUT : Size=30; Final Exam=N; Contact=1

ENROLMENT REQUIREMENTS

1. CSCI5390 **Enrollment Requirement Group:**
   For students in MSc Computer Science; or
   For students in MPhil-PhD Computer Science & Engineering; or
   For students in UG Computer Science; or
   For students in UG Computer Engineering;
   Prerequisite: CSCI2100 or ESTR2102 or CSCI2520 or equivalent

CAF

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