NVIDIA/UIUC GPU Teaching Kit – Accelerated Computing

Quick Start Guide

1. Introduction

This guide introduces you to the main teaching content of the **GPU Teaching Kit for Accelerated Computing** and provides basic instructions on accessing other features of the Kit.

NVIDIA co-developed this GPU Teaching Kit with Professor Wen-Mei Hwu from the University of Illinois for a variety of academic disciplines that benefit from accelerated computing. This comprehensive package contains everything needed to teach a full-term curriculum course with GPUs.

The GPU Teaching Kit for Accelerated Computing covers both introductory and advanced accelerated computing topics. The material is useful for teaching parallel programming concepts in other academic disciplines, such as computer architecture, high-performance computing, robotics, machine learning, operating systems, and mathematics. It can also be used by computational domain sciences, such as biology, physics, and chemistry.

All materials are provided in electronic form for ease of use, either as-is and can be modified to meet the needs of your particular course.

1.1 Does the Kit include GPU compute resources for labs and projects?

The GPU Teaching Kit includes access to ***free online Deep Learning Institute (DLI) courses, electives, and certifications*** - a value of up to $90 per person per course (see "2.5 NVIDIA DLI Online Courses and Certification" below). Additionally, the GPU Teaching Kit comes with codes worth up to ***$150 of Amazon Web Services (AWS) GPU compute credit*** for each student in your course and ***$200 of AWS credit*** for yourself as an instructor. This provides a GPU compute platform to work on the open-ended Labs (see "2.6 Open-ended Labs/solutions" below). Aside from these provided GPU cloud platforms, students must have access to CUDA-capable GPU resources, such as a GPU card, or access to other remote clusters with GPUs.

1.2 Additional Requirements

You must also have the following in order to use the GPU Teaching Kit:

- **CUDA Toolkit:** *Module 2.4: CUDA Toolkit* includes a basic standalone tutorial on the CUDA Toolkit along with some basic labs. You may download the latest Toolkit version from https://developer.nvidia.com/cuda-toolkit.
- **Compatible C compiler:** The CUDA Toolkit documentation lists the supported C compilers and OS requirements for Windows, Linux and Mac OSX. It also includes a useful Quick Start Guide.

NOTE: *You should have received an email invitation to the Teaching Kit's private BitBucket repository that contains both the build scripts and the most recent version of the lab solutions. Please contact NVDLI@nvidia.com if you have not yet received this email invitation or if it has expired.*

2. GPU Teaching Kit Content

Not all GPU Teaching Kit content types apply to every module. For example, *Module 6: Memory Access Performance* does not have a lab because it's a relatively small module. Further, the final projects/solutions (Section 2.8 below) are not tied to any particular module because they are open-ended and cover any number of module topics.

2.1 Syllabus

The syllabus is available at http://syllabus.gputeachingkit.com/ (and also pointed to by *syllabus_and_videos.html)*. It outlines the module organization, including the content and the associated file name included in each module, as well as the suggested online DLI courses. You can stream or download the lecture recordings (see "2.4 Lecture Recordings" below) as separate .mp4 video files. ***The suggested DLI course at the end of the syllabus will typically take students around 6 hours, and offers project-based assessment and official DLI student certification.***

2.2 E-Book and Module-mapped Chapters

Included is an official electronic .pdf copy, as well as individual module-mapped .pdf chapters, of *Programming Massively Parallel Processors: A Hands-on Approach, 3rd Edition* by Wen-Mei Hwu and David Kirk. Much of the slide deck and lecture recording content is based on this textbook. Please DO NOT share or distribute these electronic chapters with anyone. Students are encouraged to purchase their own discounted copy (see *EBook Distr.pdf*).

2.3 Lecture Slides

The PowerPoint .ppt lecture slides supplement the e-book chapters for in-class lectures. These files contain embedded audio narration with examples of how you might present the slides (accessible in slideshow mode). This can also be useful for students because they can watch the lectures on their own time, thereby adding a "flipped" classroom aspect to your course.

You can disable the audio and/or presentation timing in PowerPoint by selecting **Slideshow** and then deselecting **Play Narrations** and/or **Use Timings**.

2.4 Lecture Recordings

You can stream or download lecture recordings as separate .mp4 video files from http://syllabus.gputeachingkit.com/ (and also pointed to buy *syllabus_and_videos.html).* These recordings contain the same content as the lecture slide shows with the embedded audio. These videos are also individually linked so that you can easily access them via a browser on your own class website for students to view on their own time, thereby adding a "flipped" classroom aspect to your course.

2.5 NVIDIA DLI Online Courses and Certification

The Teaching Kit includes access to **free** online DLI courses and certifications for students – **a value of up to $90 per person per course**. DLI training reinforces accelerated computing concepts presented in the Teaching Kit and teaches students how to apply those concepts to end-to-end projects. Through built-in assessments, students can earn certifications that prove subject matter competency and can be leveraged for professional career growth. Each course presents a self-paced learning environment with access to a GPU-accelerated workstation in the cloud. All you need is a web browser and Internet connection to get started. *Although these courses are designed to be taken online, you are free to administer them to your students in a live setting.*

The primary recommended course (with certification) for students learning through this Teaching Kit is Fundamentals of Accelerated Computing with CUDA C/C++.

Syllabus.pdf suggests students can also take parts of this course during your university semester course, or the entire full-day course upon near-completion of your semester course. It also suggests shorter courses that can be used as labs throughout your semester course.

To enable these or any other online DLI courses for your students please send your developer.nvidia.com account email address to NVDLI@nvidia.com with subject line "AC Teaching Kit DLI Online Course Access". You will then receive information about how to give free access to your students.

Detailed descriptions of all available DLI courses can be found at www.nvidia.com/dli.

2.6 Open-ended Labs/solutions

These labs/solutions are designed to be one- to two-week hands-on programming assignments for students, and come as .pdf files including solutions in an online repository (see below). Each lab begins with a description of the lab objectives and prerequisites. In most cases, the labs present pseudo-code and/or a solution code template as a starting point.

The GPU Teaching Kit comes with codes worth up to ***$150 of Amazon Web Services (AWS) GPU compute credit*** for each student in your course and ***$200 of AWS credit*** for yourself as an instructor. This provides a GPU compute platform to work on the open-ended Labs To request a code for your students, please send an email to NVDLI@nvidia.com with the subject line "AC Teaching Kit AWS Access". An Email will follow with your code and instructions for giving access to your students. ***Please note that students must use a credit card when creating a new AWS account in order to use the credits. If some or all of your students are not able to use a credit card for this purpose, please accordingly adjust the number of codes requested in the email request.***

The most recent version of the labs, solutions, and build scripts, are located in the Bitbucket repository linked from each lab. ***Additionally, the repository contains a docker image file with the lab solutions and basic instructions for running these using the AWS credits.***

2.7 Quizzes/solutions

Students should be able to answer quiz questions based on the information in the module slides and slide videos. Each question is multiple-choice and includes a rationale for the correct answer.

2.8 Projects/solutions

Final projects are designed to be open-ended, multidisciplinary, final semester projects that should take 3-4 weeks to complete. The purpose of the project is to apply data parallelism and CUDA concepts to a more substantial piece of code than possible in the labs. Please see *project_motivate_rubric.pdf* for more details and a sample example grading rubric. The GPU Teaching Kit contains real projects completed by students who took an applied parallel programming at UIUC. Some projects require special development tools and libraries not included in this kit, and not all will run completely "out-of-box". Still, they should be useful to motivate students and provide examples of previous successful projects.

3. About the NVIDIA Deep Learning Institute (DLI)

The NVIDIA Deep Learning Institute (DLI) offers hands-on training for developers, data scientists, and researchers looking to solve challenging problems with deep learning and accelerated computing. Through built-in assessments, students can earn certifications that prove subject matter competency and can be leveraged for professional career growth.

Become a DLI Certified Instructor

Join the University Ambassador Program to teach DLI courses at your university to students, faculty, and researchers at no cost. Educators can apply at developer.nvidia.com/dli/cip.

Attend Instructor-led Training

In addition to online, self-paced courses, DLI offers all fundamentals and industry-specific courses as in-person workshops led by DLI-certified instructors. View upcoming workshops near you at www.nvidia.com/dli.