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# Deep Learning and GPU Programming Workshop

6 – 8 November 2023



# Overview



- The workshop is co-organised by LRZ and NVIDIA Deep Learning Institute (DLI).
- NVIDIA Deep Learning Institute (DLI) offers hands-on training for developers, data scientists, and researchers looking to solve challenging problems with deep learning.
- The online workshop combines lectures about Accelerated Computing with OpenACC and CUDA with lectures about Fundamentals of Deep Learning.
- Learn how to accelerate your applications with OpenACC and CUDA and how to train and deploy a neural network to solve real-world problems.
- The lectures are interleaved with many hands-on sessions using Jupyter Notebooks. The exercises will be done on a fully configured GPU-accelerated workstation in the cloud.



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## DEEP LEARNING INSTITUTE

**DLI Mission: Help the world to solve the most challenging problems using AI and deep learning**

We help developers, data scientists and engineers to get started in architecting, optimizing, and deploying neural networks to solve real-world problems in diverse industries such as autonomous vehicles, healthcare, robotics, media & entertainment and game development.

# Lecturers



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- **Lecturers:**

- Dr. Momme Allalen (LRZ)
- PD Dr. Juan Durillo Barrionuevo (LRZ)
- Dr. Volker Weinberg (LRZ)



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All instructors are NVIDIA certified University Ambassadors.

1<sup>st</sup> day:

# Fundamentals of Accelerated Computing with OpenACC



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- On the 1<sup>st</sup> day you learn the basics of OpenACC, a high-level programming language for programming on GPUs. Discover how to accelerate the performance of your applications beyond the limits of CPU-only programming with simple pragmas.
- You'll learn:
  - How to profile and optimize your CPU-only applications to identify hot spots for acceleration
  - How to use OpenACC directives to GPU accelerate your codebase
  - How to optimize data movement between the CPU and GPU accelerator
- Upon completion, you'll be ready to use OpenACC to GPU accelerate CPU-only applications.

# 2<sup>nd</sup> day: Fundamentals of Accelerated Computing with CUDA C/C++



- The CUDA computing platform enables the acceleration of CPU-only applications to run on the world's fastest massively parallel GPUs. On the 2<sup>nd</sup> day you experience C/C++ application acceleration by:
  - Accelerating CPU-only applications to run their latent parallelism on GPUs
  - Utilizing essential CUDA memory management techniques to optimize accelerated applications
  - Exposing accelerated application potential for concurrency and exploiting it with CUDA streams
  - Leveraging command line and visual profiling to guide and check your work
- Upon completion, you'll be able to accelerate and optimize existing C/C++ CPU-only applications using the most essential CUDA tools and techniques. You'll understand an iterative style of CUDA development that will allow you to ship accelerated applications fast.

# 3<sup>rd</sup> day: Fundamentals of Deep Learning



- Explore the fundamentals of deep learning by training neural networks and using results to improve performance and capabilities.
- During this day, you'll learn the basics of deep learning by training and deploying neural networks. You'll learn how to:
  - Implement common deep learning workflows, such as image classification and object detection
  - Experiment with data, training parameters, network structure, and other strategies to increase performance and capability
  - Deploy your neural networks to start solving real-world problems
- Upon completion, you'll be able to start solving problems on your own with deep learning.

# Tentative Agenda Day 1: Fundamentals of Accelerated Computing with OpenACC



10:00-10:15 Intro

10:15-12:00 Profiling

**12:00-13:00 Lunch Break**

13:00-14:20 OpenACC Directives

**14:20-14:30 Coffee Break**

14:30-15:45 GPU Programming and Data Management

15:45-16:00 Q&A, Final Remarks



**All times are in CET**



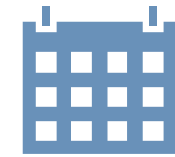
# Tentative Agenda Day 2: Fundamentals of Accelerated Computing with CUDA C/C++



10:00-10:15 Introduction CUDA C/C++

10:15-12:00 Accelerating Applications with CUDA C/C++

**12:00-13:00 Lunch Break**



**All times are in CET**

13:00-14:20 Managing Accelerated Application Memory with CUDA unified memory and nsys

**14:20-14:30 Coffee Break**

14:30-15:45 Asynchronous Streaming and Visual Profiling for Accelerated Applications with CUDA C/C++

15:45-16:00 Q&A, Final Remarks

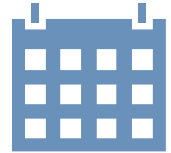
# Tentative Agenda Day 3: Fundamentals of Deep Learning



10:00-10:20 Welcome and Intro

10:20-12:00 Introduction to Deep Learning and Convolutional Neural Networks

**12:00-13:00 Lunch Break**



**All times are in CET**

13:00-14:20 Data Augmentation, Deployment and Pre-Trained Models

**14:20-14:30 Coffee Break**

14:30-15:45 Advanced Architectures

15:45-16:00 Q&A

# Workshop Webpage



- All slides will be made available during the workshop under:

- <https://tinyurl.com/hdli3w23>



- Further information on:

- Agenda
- Training Setup
- Slides
- Documentation



# Training Setup



- To get started, follow these steps:
- Create an NVIDIA Developer account at <http://courses.nvidia.com/join> Select "Log in with my NVIDIA Account" and then "Create Account".
- If you use your own laptop, make sure that WebSockets works for you:  
Test your Laptop at <http://websocketstest.com>
  - Under ENVIRONMENT, confirm that "WebSockets" is checked yes.
  - Under WEBSOCKETS (PORT 80]. confirm that "Data Receive", "Send", and "Echo Test" are checked yes.
  - If there are issues with WebSockets, try updating your browser.  
We recommend Chrome, Firefox, or Safari for an optimal performance.
- Visit <http://courses.nvidia.com/dli-event> and enter the event code provided by the instructor.
- You're ready to get started.

- To ensure a pleasant experience with Zoom Meeting, we encourage participants to **download and install the latest Zoom application** via <https://zoom.us/download>.
- If you have problems with your computer audio, you can also **join by phone**.  
Find your local number: <https://us02web.zoom.us/j/kdKozJPtKk>

Zoom Meeting

00:12:30 View

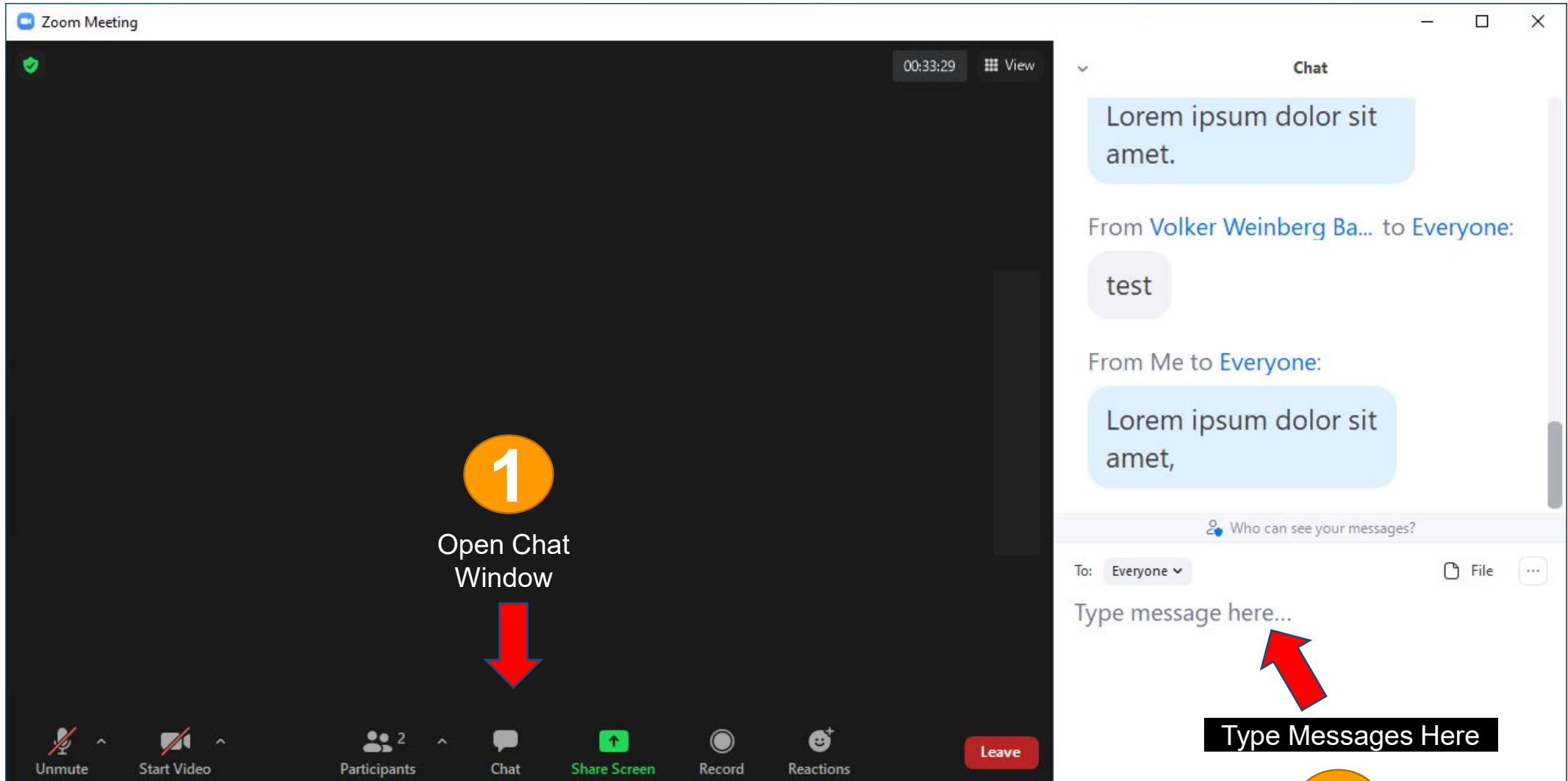
Switch between Speaker View / Gallery View / Fullscreen Mode

Start / Stop Video / Select Virtual Background

Un-/Mute

Unmute Start Video Participants Chat Share Screen Record Reactions Leave

The screenshot shows the Zoom meeting interface. A red arrow points from the text 'Switch between Speaker View / Gallery View / Fullscreen Mode' to the 'View' dropdown menu, which is open and shows 'Speaker View', 'Gallery View' (checked), and 'Fullscreen'. Another red arrow points from the text 'Start / Stop Video / Select Virtual Background' to the 'Start Video' button in the bottom toolbar. A third red arrow points from the text 'Un-/Mute' to the 'Unmute' button in the bottom toolbar. The bottom toolbar also includes 'Participants', 'Chat', 'Share Screen', 'Record', 'Reactions', and 'Leave' buttons.



Zoom Meeting

00:33:29 View

Chat

Lorem ipsum dolor sit amet.

From Volker Weinberg Ba... to Everyone:

test

From Me to Everyone:

Lorem ipsum dolor sit amet,

Who can see your messages?

To: Everyone File ...

Type message here...

Type Messages Here

1

Open Chat Window

2

Unmute Start Video Participants Chat Share Screen Record Reactions Leave

# zoom

## Participants List

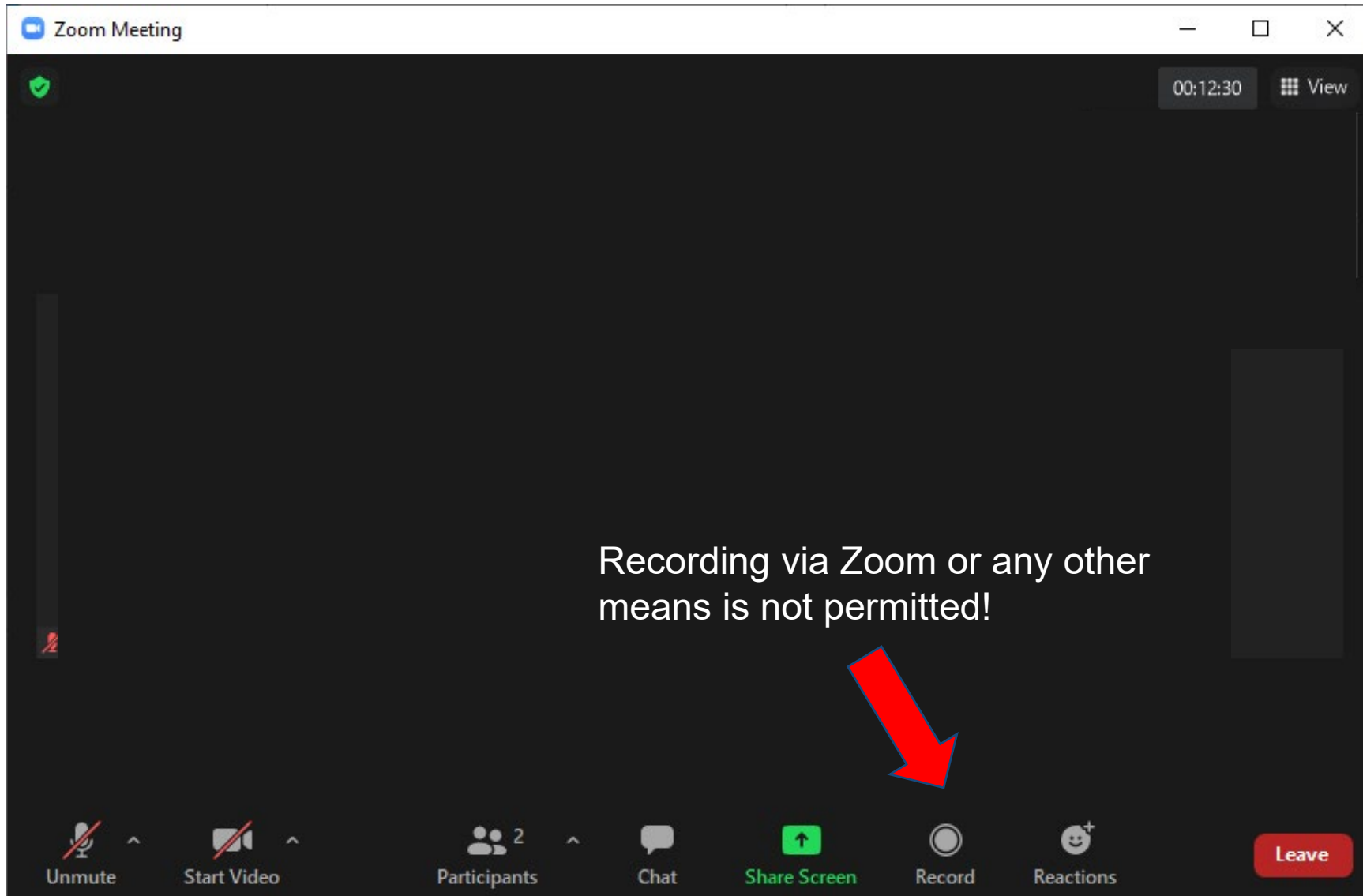


Kindly use “<first name> <last name> (<institute>)” as your screenname.

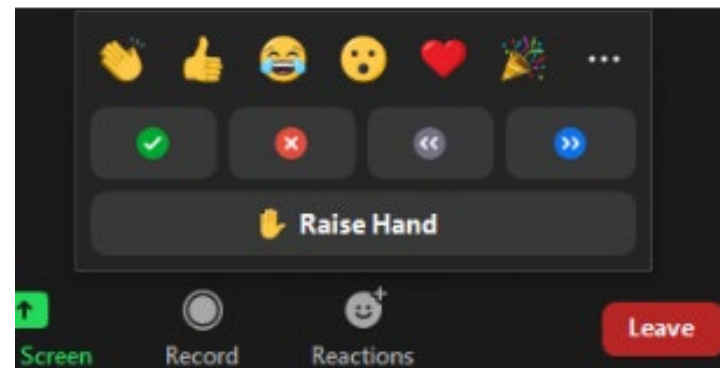
Otherwise you will not receive a certificate of attendance after the course.

The screenshot shows a Zoom meeting window with a dark theme. The top bar displays 'Zoom Meeting', a green checkmark, a timer at '00:19:17', and a 'View' button. The main area is mostly black. At the bottom, there is a toolbar with icons for Unmute, Start Video, Participants (with a '2' next to it), Chat, Share Screen, Record, Reactions, and a red 'Leave' button. On the right side, a 'Participants (2)' panel is open, showing two entries: 'Volker Wei... (Me)' with an 'Unmute' button and a 'More >' button, and 'Volker Weinberg Backup (Host)' with a muted icon and a video-off icon. A blue-bordered context menu is open over the 'More >' button for the first participant, containing 'Edit Profile Picture' and 'Rename' options. A red arrow points from a black box labeled 'Rename Yourself' to the 'Rename' option. A large orange circle with the number '1' is positioned over the 'Participants' icon in the toolbar, with the text 'Open Participants List' and a red arrow pointing down to the 'Participants' icon. Another large orange circle with the number '2' is positioned below the 'Rename Yourself' box.





- Please **raise your hand** if you have questions (of general interest).
- You can also use **chat window** to ask questions.
- If you do not mind, please **show your video when asking questions** to make this course as interactive as possible.
- **Push to Talk:** The Push to Talk feature allows you to remain muted throughout the Zoom meeting and only if you hold down the spacebar you will be unmuted.
- **Instant Feedback:**



And now ...



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**Enjoy the workshop!**