

# Overview PRACE CUDA Course 2021

26-30 April 2021 | Andreas Herten | Forschungszentrum Jülich, Jülich Supercomputing Centre



### **Jülich Supercomputing Centre**

- Forschungszentrum Jülich
- Part of Institute for Advanced Simulation (IAS), Gauss Centre for Supercomputing (GCS),
   PRACE, ...

Slide 1114

- Operates supercomputers and connected infrastructure
- Researches in next-gen supercomputers
- Supports applications leveraging machines
- Supercomputers
  - JUWELS Cluster, JUWELS Booster
  - JURECA DC, JURECA Booster
  - DEEP
  - JUSUF



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#### **JSC CUDA Course**

#### **About**

- Since 2010
- Second time: online course
- First time on Europe's fastest supercomputer

- Interactive course many hands-ons
- There are other many-core courses in JSC training program

#### **Tutors**



Kaveh Haghighi-Mood
Application-Oriented
Technology Development, JSC



Markus Hrywniak NVIDIA Application Lab at Jülich, NVIDIA



Jan Meinke Computational Science, SimLab Biology, JSC



Andreas Herten NVIDIA Application Lab at Jülich, JSC



**Jiri Kraus**NVIDIA Application Lab
at Jülich, NVIDIA



#### **Timetable**

- Every day from 9:00 until 13:00
- 30 minute break around 10:45

#### Day 1 Basics

- GPU Introduction
- CUDA Introduction

#### Day 2 Tools, Matrix Multi

- GPU Tools: Debug, Profile
- Matrix Multiplication Part 1

#### Day 3 Multi-GPU

- Q&A
- Multi-Node GPU Programming

#### Day 4 Performance, Matrix Multi

- Performance Optimization
- Matrix Multiplication Part 2

#### Day 5 Advanced CUDA

- Cooperative Groups
- CUDA C++, pSTL, CUB
- CUDA Fortran



#### **More Technicalities**

- Supercomputer for this course: JUWELS Booster
- Infrastructure for tasks
  - Already done for Profound Proverb Challenge
  - Jupyter-JSC: https://jupyter-jsc.fz-juelich.de
  - Project: training2110; Partition: LoginBooster
  - Remember to bootstrap or manually source environment (tasks rely on environment variables)
- Tasks
  - Sorted by session
  - Solutions are always given, you decide how long you tinker before peeking into solutions (Hint: The longer, the more benefit you will get from this course!)
  - Re-sync once might be needed now, call jsc-material-sync More commands: jsc-material-sync-force, jsc-material-reset-01,...



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#### Let's Get Started!

Questions?



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# Questions!



# My favorite programming language is:

С	C++	Fortran	Python
Java	JavaScript	Julia	Haskell
Go	Rust	Bash	Assembly

## What's a lambda?





# I've used a debugger before



# I've used MPI before



### I've used a GPU before



## I programmed a GPU before

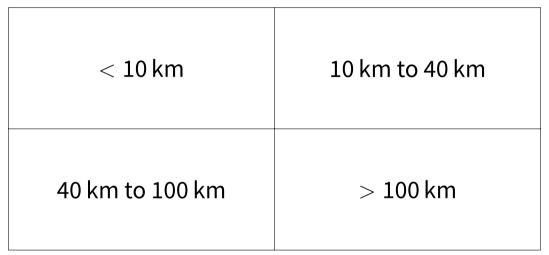


## I programmed a GPU before

Other SYCL, HIP, OpenGL,	OpenACC	No	
OpenCL	CUDA	INO	



### Last week, I moved a total distance of...







### The current COVID-19 incidence (cases per 100 000 population) here is...

< 100 100 to 150 150 to 200 > 200

