HeGaPa 2012

Welcome

C-DAC Five Days Technology Workshop

ON

Heterogeneous Computing – CPU/GPU HPC Cluster - Algorithms & Performance of Application Kernels

HeGaPa-2012

Venue : CMSD, University of Hyderabad

Date: July 16-20, 2012

HeGaPa-2012

- Aimed to understand emerging parallel processing technology platforms, focusing on various programming paradigms & rich set of tools from end-users point of view
- One of our Objective is to make strong foundation to enhance the performance of applications on emerging parallel processing platforms (Multi-Core Processors,; GPU Computing-CUDA Programming & OpenCL, GPGPUs – NVIDIA –PGI-OpenACC; Prog, on AMD APUs; HPC GPU Cluster - AMD GPUs & NVIDIA GPUs)
  - Use Software Development tools to understand performance bottleneck issues of programs
- Most importantly, Hybrid Adaptive Computing Hardware/ Software - Mixed Programming on Multi-Core Processors with HPC GPU Accelerators will be taken up as new initiatives

HeGaPa-2012 : Hybrid Prog. - HPC GPU Cluster (Hardware/ Software - Mixed Programming)

An overview of Hybrid Adaptive Computing Hardware/ Software - Mixed Programming with Hands-on Session & Keynote talks from Industry/Academic/Res. Develop. Organizations and Demonstration

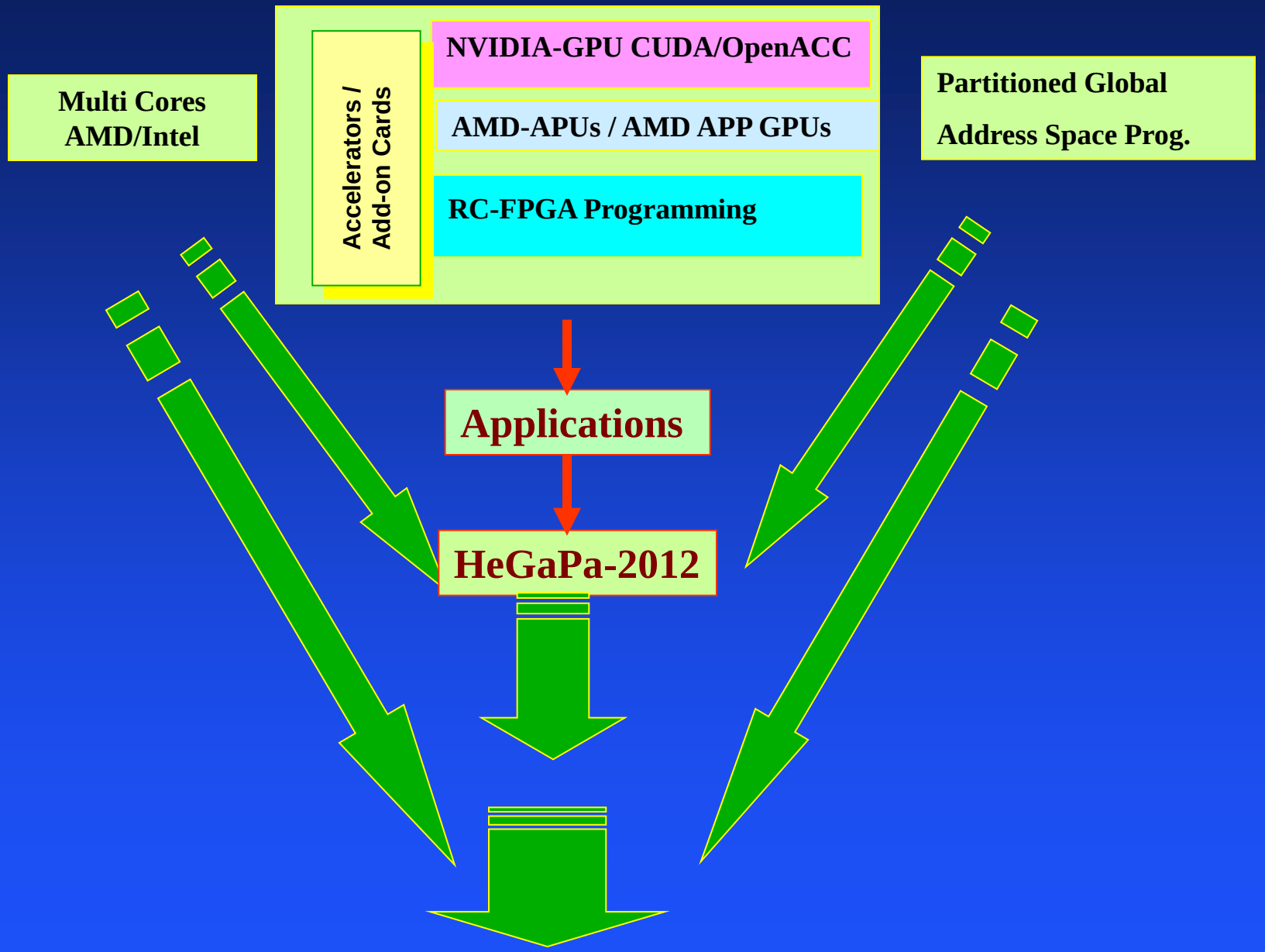
Sponsors : The IT companies and government organisations partial sponsors for HeGaPa-2012. The sponsors provided partial financial assistance, access to their computing systems, use of their software in this technology workshop.

HeGaPa-2012

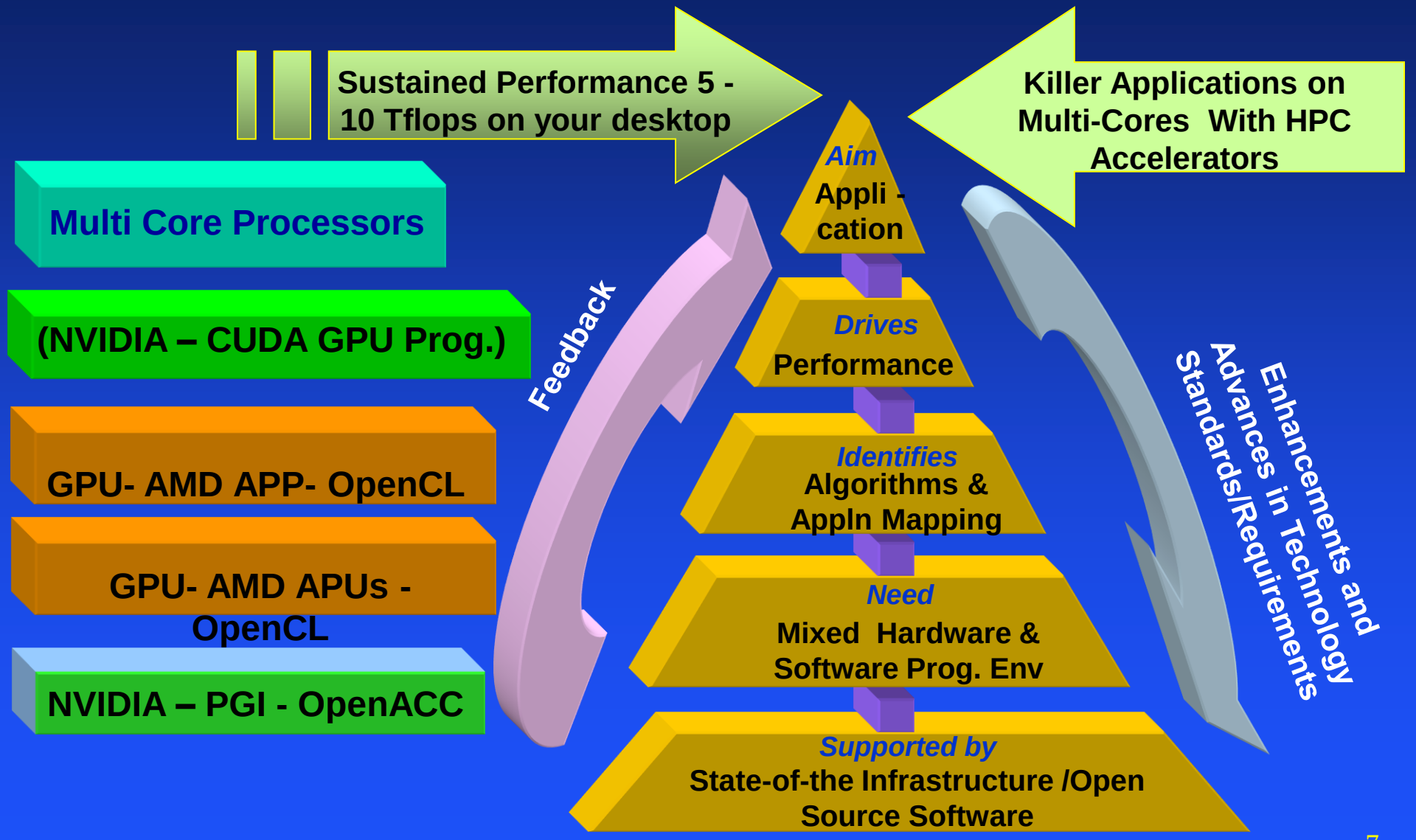
- **HeGaPa-2012** covers an overview of Hybrid Adaptive Computing Hardware/ Software - Mixed Programming with Hands-on Session & Keynote talks from Industry / Academic / Research Development Organizations and Demonstration of software on emerging parallel processing platforms

- C-DAC High Performance Computing – Frontier Technologies Exploration (HPC-FTE) group members will deliver “Class-room lectures” and assist in Hands-on Session with the help of Project trainees (IIIT-Roorkee, NIT-Warangal, NIT-Rourkela) of C-DAC, in collaboration with CMSD, UoH.

HeGaPa-2012

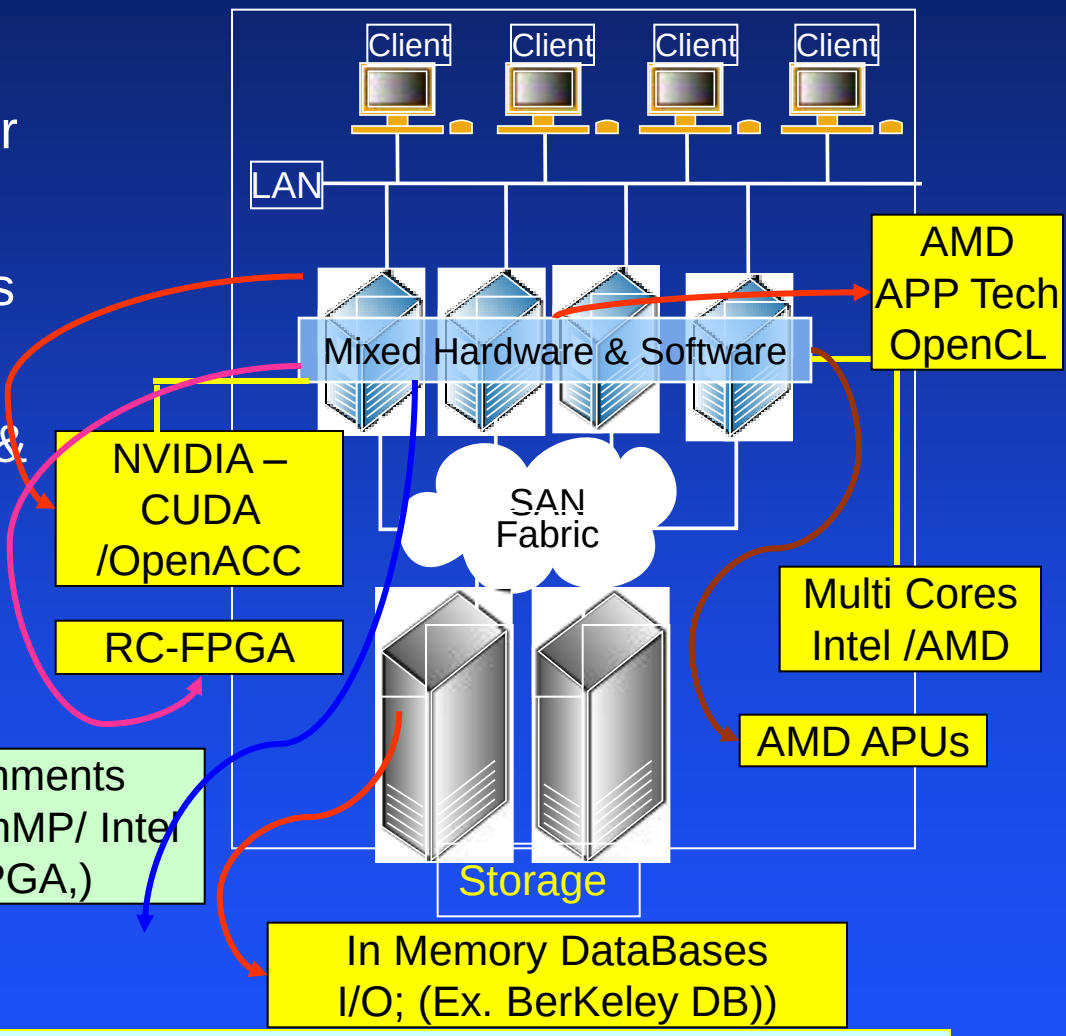

Multi Cores
AMD/Intel
Accelerators /
Add-on Cards
NVIDIA-GPU CUDA/OpenACC
AMD-APUs / AMD APP GPUs
RC-FPGA Programming
Partitioned Global
Address Space Prog.
Applications
HeGaPa-2012

HeGaPa-2012 : Hybrid Prog. - HPC GPU Cluster (Hardware/ Software - Mixed Programming)



HeGaPa-2012 : Hybrid Prog. - HPC GPU Cluster (Hardware/ Software - Mixed Programming)

- Multi -node hybrid Adaptive Cluster (HPC GPU Cluster) for Hands-on Session
- Efficient Mapping of Algorithms on suitable Architectures
- Economics – Easily Migration & Adoption
- Performance on AMD APUs



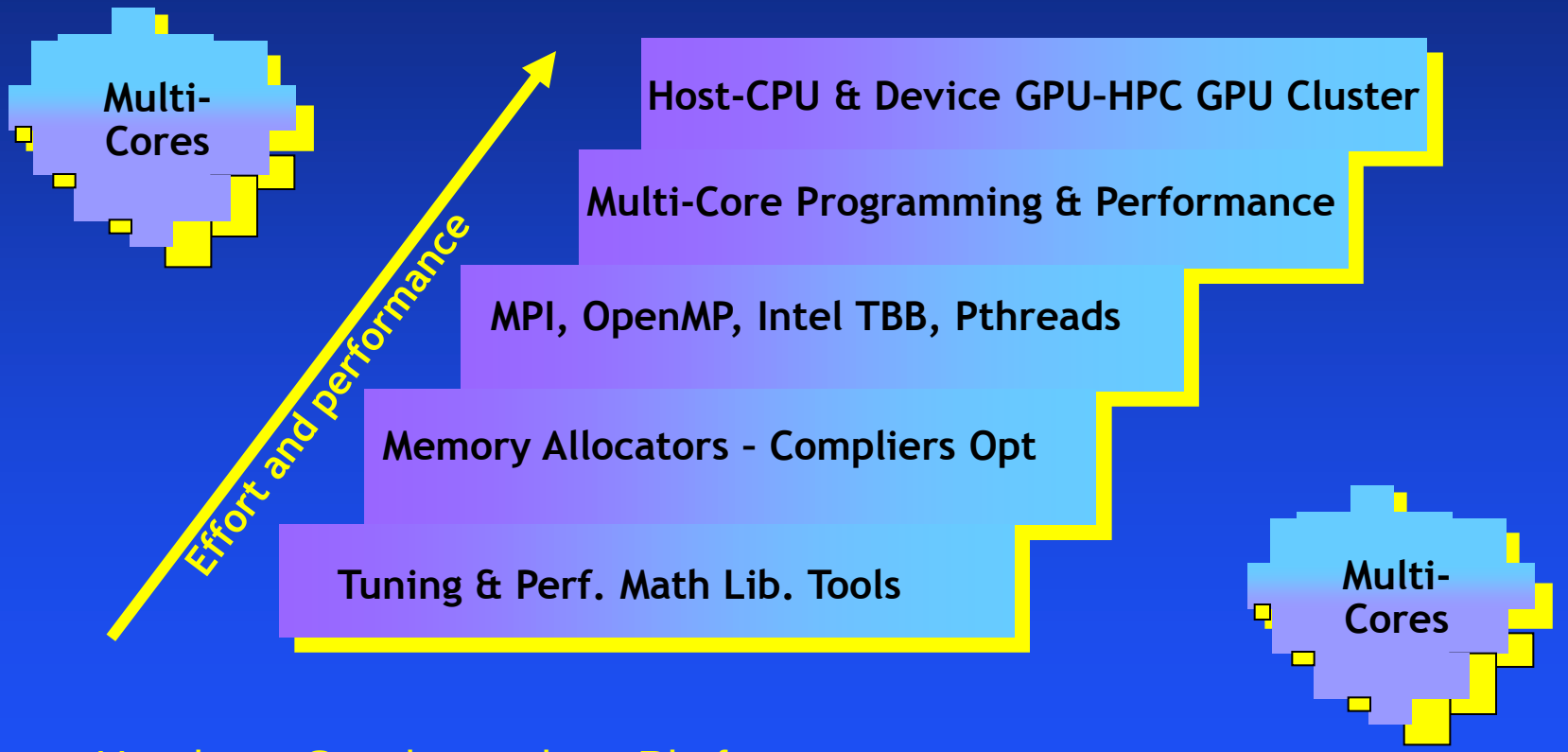
HPC Tools and Programming Environments (OpenCL, CUDA, OpenACC; MPI/OpenMP/ Intel AMD APUs- OpenCL, TBB, RC-FPGA,)

Automatic Parallelizing Compilers & Parallel Debugging & New Programming Paradigms

HeGaPa-2012 : Hybrid Prog. - HPC GPU Cluster (Hardware/ Software - Mixed Programming)

HeGaPa-2012 (Mode-1 : Multi-cores)

Enhance the performance of applications on emerging parallel processing platforms (Multi-Cores, GPGPUs, GPU Comp.-CUDA, PGI - OpenACC /OpenCL) Hybrid Prog.- HPC GPU Cluster

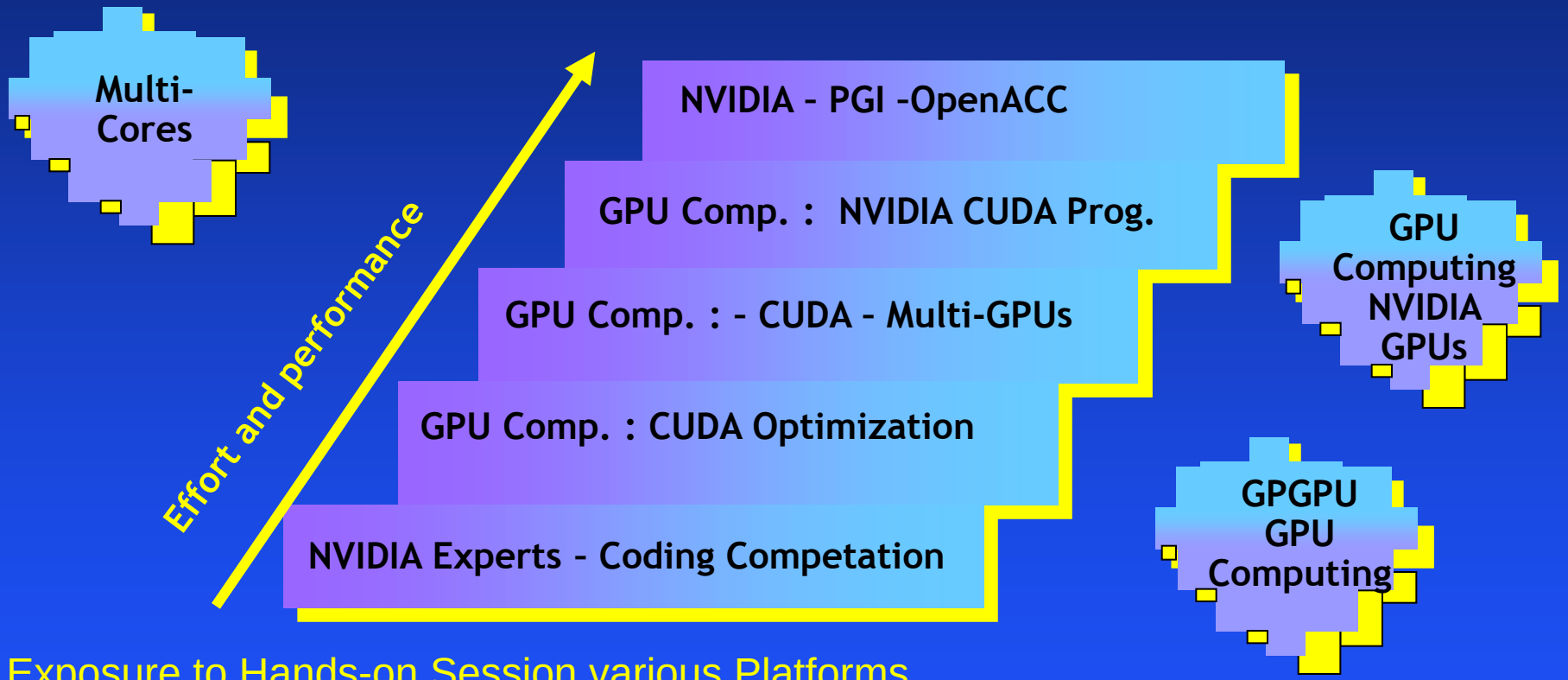


Exposure to Hands-on Session various Platforms

Multi-Cores – software Threading – Tuning & Performance

HeGaPa-2012 (Mode-2 & Mode-3 – HPC GPU Cluster)

Enhance the performance of applications on emerging parallel processing platforms (Multi-Cores, GPGPUs, GPU Comp.-CUDA, /OpenCL) Hybrid Programming.- HPC GPU Cluster

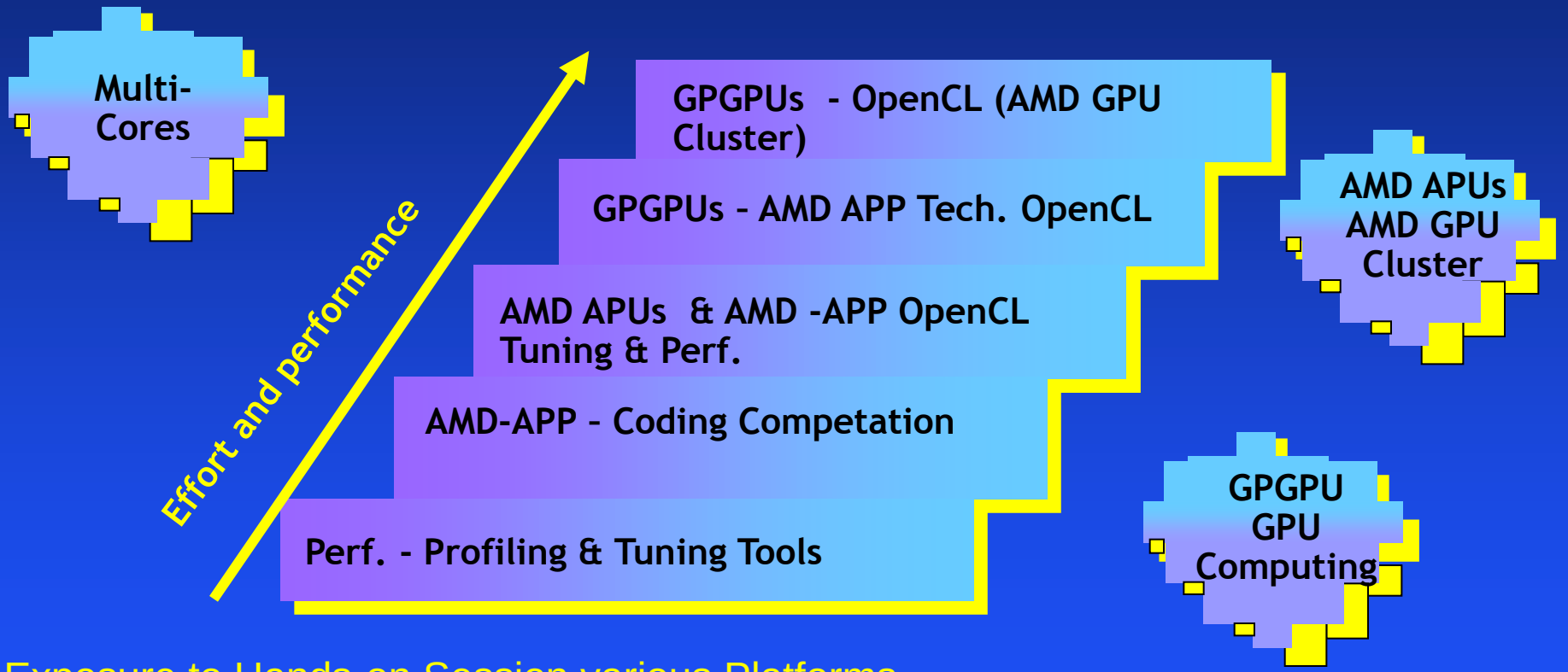


Exposure to Hands-on Session various Platforms

Multi-Cores, GPGPUs-AMD APP Tech – OpenCL , GPU Computing-CUDA & NVIDIA -PGI - OpenACC

HeGaPa-2012 (Mode-2 & Mode-3 – HPC GPU Cluster)

Enhance the performance of applications on emerging parallel processing platforms (Multi-Cores, GPGPUs, GPU Comp.-CUDA, /OpenACC; AMD-APU OpenCL) Hybrid Prog.- HPC GPU Cluster AMD Fire Stream/Fire Pro



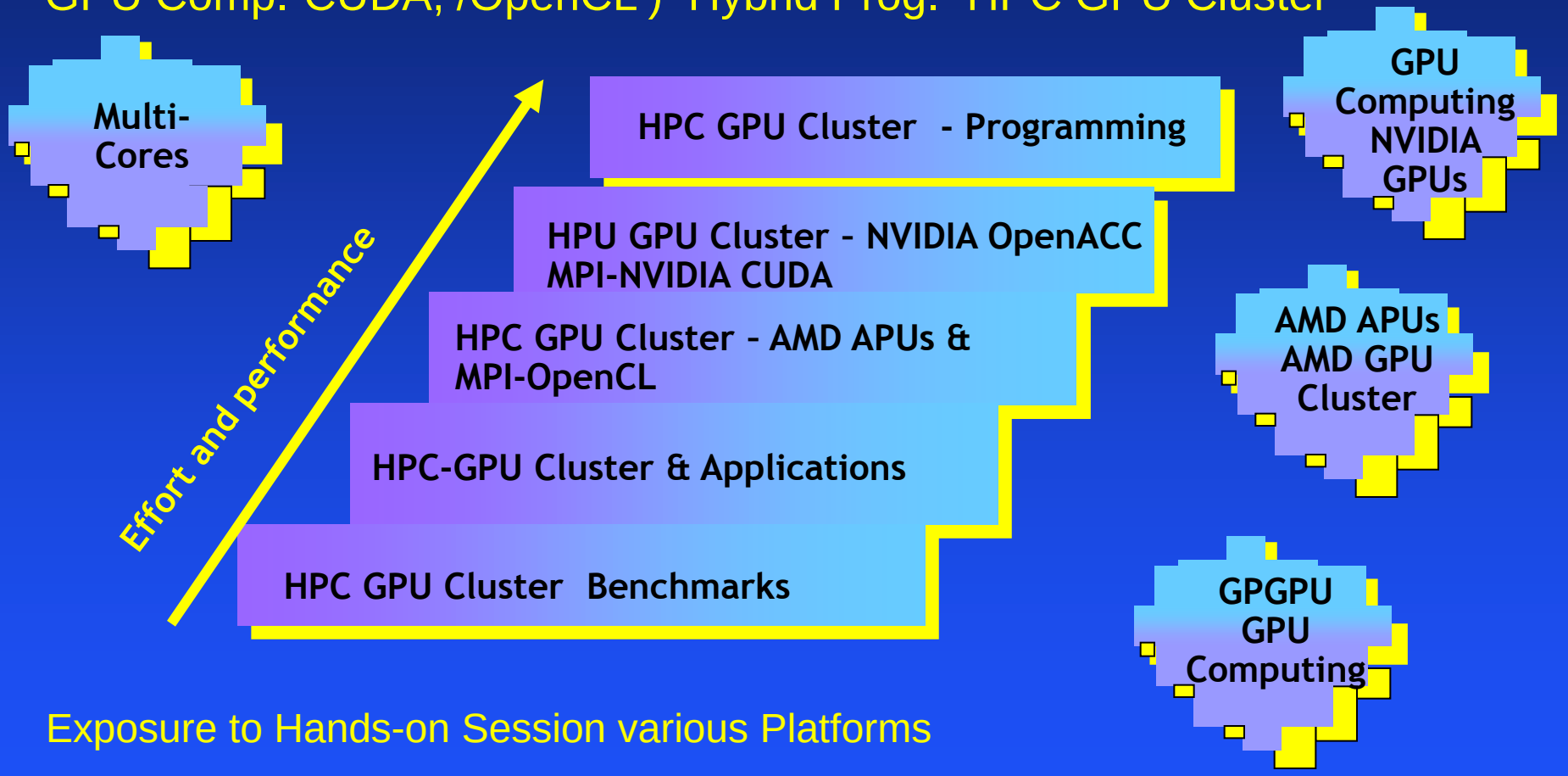
Exposure to Hands-on Session various Platforms

Multi-Cores, GPGPUs-AMD APUs & AMD APP Tech – OpenCL ,

GPU Computing NVIDIA CUDA & NVIDIA-PGI - OpenACC

HeGaPa-2012 (Mode-2 & Mode-3 – HPC GPU Cluster)

Enhance the performance of applications on emerging parallel processing platforms (Multi-Cores, Distributed Shared Memory (PGAS) GPGPUs, GPU Comp.-CUDA, /OpenCL) Hybrid Prog.- HPC GPU Cluster



Exposure to Hands-on Session various Platforms

Multi-Cores, GPGPUs-AMD APP Tech – OpenCL , GPU Computing-CUDA

HeGaPa-2012 (Mode-1: Multi-Core)

An overview of Hybrid Adaptive Computing Hardware/ Software - Mixed Programming with Hands-on Session & Keynote talks from Industry/Academic/Res. Develop. Organizations and Demonstration

Hands-on Session : Quad Core Systems (6)

- Multi-Core: Introduction & Challenges in Applications
- Multi-Core : An Overview of Architecture (Part -I, & II)
- Multi-Core:
  - An Overview of Multi-threading - OpenMP (Part -I, II, & III)
  - An Overview of Multi-threading - Intel Threading Building Blocks
  - **An Overview of Multi-threading - Pthreads (Part -I,II,III & IV)**
- Multi-Core : Tools, Debuggers, Libraries (Part-I, & II)
- Multi-Core : Tuning & Performance (Part -I, & II)
- Multi-Core : Prog. Env. & Application & Algorithms Design (Part -I & II)
- Multi-Core : Programming Environment (MPI 1.0/2.0 Part - I II,III, & IV)
- Multi-Core : Benchmarks (Part- I, II, & III)

HeGaPa-2012 (Mode-2 & Mode-3 – HPC GPU Cluster)

An overview of Hybrid Adaptive Computing (HPC GPU Cluster) Hardware/ Software - Mixed Programming with Hands-on Session & Keynote talks from Industry/Academic/Res. Develop. Organizations and Demonstration

Hands-on Session – GPUs / Hybrid Computing Systems (4-6)

- GPUs : An Overview of GPU Computing
- GPUs : NVIDIA – GPU Comp. – CUDA – OpenACC
- GPUs : AMD APUs **&** AMD – APP Tech OpenCL
- GPUs : Open Computing Language (OpenCL)
- HPC GPU Cluster Hybrid Computing – Mixed Programming (MPI, OpenMP, Intel TBB, GPU – CUDA)
- HPC GPU Cluster Hybrid Computing – Mixed Programming (MPI, OpenMP, Intel TBB, GPU – OpenCL)

HeGaPa-2012 : Hybrid Prog. - HPC GPU Cluster (Hardware/ Software - Mixed Programming)

Touch upon Current Trends

HeGaPa-2012 Lab : Commodity Components can be used which brings *few* to *Many* *Teraflops* on your Desk top with Accelerators (GPUs - Number Crunching Horse Power)

- AMD APUs & AMD APP GPU Cluster with AMD Opteron and AMD Fire-Stream GPUs & AMD Fire-Pro GPUs
- CUDA enabled NVIDIA GPU Cluster – Fermi GPUs & Intel Processors and NVIDIA –CUDA – PGI - OpenACC

HeGaPa-2012 : Host-CPU Programming in HPC GPU Cluster (NVIDIA GPUs & AMD APUs/ AMD- GPUs)

HeGaPa-2012 : Hybrid Prog. - HPC GPU Cluster (Hardware/ Software - Mixed Programming)

Day 1 :

- Classroom Lectures /Hands-on : An Overview of Programming on Host-CPUs (Multi-Core Programming) & OpenCL on AMD APUs

- Class-room Lectures :
  - Multi-core Architectures – Hardware and Software
  - Prog. on Multi-Core Processors : Part-I - Pthreads & OpenMP
  - Performance Enhancement through Software Multi-threading
  - Introduction to OpenCL on APUs

- Hands-on Session : Programming : Pthreads, Open MP, Intel TBB, MPI, Mixed Programming - Performance Issues

- OpenCL Example Programs – AMD APUs & AMD Cluster

HeGaPa-2012 : Hybrid Prog. - HPC GPU Cluster (Hardware/ Software - Mixed Programming)

Mode-1 & Mode-2 Day 1-5 (Multi-Core/ GPU OpenCL)

Day 1 :

- Key-note Talk (Industry) : Dr. Srinidhi, Director, AMD Bengaluru
  Topic : Heterogeneous Computing on Accelerating Processing Units (APUs) – OpenCL – Application Perspective
  Speaker : Dr. Srinidhi, K , Director, AMD, India

- AMD CUDA Code Competition Challenge Announcement

- Hands-on Session : Based on OpenCL on APUs or AMD – APP GPU Cluster ; (MPI, OpenMP, Intel TBB , Pthreads) on Host-CPU and OpenCL Programming on Heterogeneous Computing Platforms
- NVIDIA –PGI – CUDA OpenACC (Complier Directives) Programming

HeGaPa-2012 : Hybrid Prog. - HPC GPU Cluster (Hardware/ Software - Mixed Programming)

Mode-2 & Mode-3:HPC-GPU Cluster AMD & NVIDIA GPUs)

Day-1:

- Invited Talk (Academic) : An Overview of Prog. on Host-CPUs
  Speaker : Prof. Rajeev Wankar, Dept. of Comp. Sc, UoH

Class-room lectures : (1) Based on OpenCL on APUs or AMD – APP GPU Cluster (2) NVIDIA –PGI – CUDA OpenACC (Complier Directives
Speaker: Nisha Agarwal and VCV.Rao

Hands-on Session : Prog. (MPI, OpenMP, Intel TBB , Pthreads) on Host-CPU and OpenCL; An Overview of Prog. on Multi-Core Processors :- Pthreads & OpenMP, Intel Performance Issues - & Benchmarks - OpenCL

HeGaPa-2012 : Hybrid Prog. - HPC GPU Cluster (Hardware/ Software - Mixed Programming)

Mode-2 & Mode-3:HPC-GPU Cluster AMD & NVIDIA GPUs)

Day-2

- Key-note talks : An overview of CUDA enabled NVIDIA GPUs
  Speaker : Priyanka NVIDIA, Hyderabad
- Invited talk : An overview of CUDA NVIDIA-PGI OpenACC
  Speaker : PGI Mr. Shankarang, PGI & GTE-India

NVIDIA CUDA Code Competition Challenge Announcement

- Invited Talk s: Prof. Venu : HPC – Computational Physics, Visiting Professor, School of Physics, University of Hyderabad
- Class-room Lectures : An overview of CUDA enabled NVIDIA GPUs
  Speaker : C-DAC HPC-FTE Group members
- Hands-on Session : NVIDIA – Fermi – Multi-GPU & – HPC GPU (NVIDIA) Cluster; Prog. for Numerical Linear Algebra (NLA)

HeGaPa-2012 : Hybrid Prog. - HPC GPU Cluster (Hardware/ Software - Mixed Programming)

Mode 2 & Mode-3 : Day 1-5 (GPGPUs & HPC GPU Cluster)

Day-3 :

- Classroom Lecture & Lab. Session : Performance Issues- CUDA Streams & Concurrent Asynchronous Execution on GPUs Speaker : Sonia Bansal, C-DAC, Pune
- Invited talk (Academic) : Tuning & Performance on NVIDIA GPUs - Memory Coalescing and Warp level Parallelism;
  Speaker : Ajit Padyna,; SSSIHL Prashanti Nilyam, A.P ;
- Class-room Lectures : An overview of CUDA enabled NVIDIA GPUs
  Speaker : C-DAC HPC-FTE Group members
- Hands-on Session : NVIDIA – Fermi – Multi-GPU & – HPC GPU (NVIDIA) Cluster; Prog. for Numerical Linear Algebra (NLA)

HeGaPa-2012 : Hybrid Prog. - HPC GPU Cluster (Hardware/ Software - Mixed Programming)

Mode 2 & Mode-3 : Day 1-5 (GPGPUs & HPC GPU Cluster)

Day-3 :

- Invited Talk (Academic) : Topic : GPU enabled solution of Partial Differential Equations (PDEs)
  Speaker : Mr. Pavan Kumar (IIIT-Allahabad)

- Invited Talk (Academic): Topic : GPU enabled Image Processing algorithms – Image inpainting & Face Detection Systems –
  Speaker : Mr.Jithendra Bajiya IIIT-Allahabad

- Class-room Lectures : An overview of HPC – GPU Cluster – NVIDIA GPUs – Application Kernels
  Speakers : C-DAC HPC-FTE Group members

Hands-on Session : NVIDIA – Fermi – Multi-GPU & – HPC GPU (NVIDIA) Cluster; Prog. for Numerical Linear Algebra (NLA)

HeGaPa-2012 : Hybrid Prog. - HPC GPU Cluster (Hardware/ Software - Mixed Programming)

Mode-2 & Mode-3 : Day 1-5 (GPGPUs & HPC GPU Cluster)

Day-4 :

- Classroom Lecture : An overview of GPGPUs : APUs AMD-APP Tech. / An overview of Hybrid Computing; Hands-on HPC GPU Cluster
- Key-note Talks (INDUSTRY): Topic: AMD APUs & AMD APP – OpenCL Speaker : Mr.Jayaprakash Velu, AMD Bengaluru
- Key-note Talk (Academic): Accelerators are here to stay with us in the HPC world
  Speaker : Rajesh Chhabra, Director, Altair
- Class-room Lectures : An overview of OpenCL –
  Speakers : Nisha Agarwal, C-DAC HPC-FTE Group members
- Lab Session : AMD ATI Fire Stream 9250 /9350 & HPC GPU Cluster - GPUs Lab & AMD APUs

HeGaPa-2012 : Hybrid Prog. - HPC GPU Cluster (Hardware/ Software - Mixed Programming)

Mode-2 & Mode-3 : Day 1-5 (GPGPUs & HPC GPU Cluster)

Day- 4 :

- Classroom Lecture : An overview of GPGPUs : APUs & AMD-APP GPUs / OpenCL Tuning & Performance – Numerical Linear Algebra
  Speaker : C-DAC HPC-FTE Group members
- Hands-on Session : AMD ATI Fire Stream 9250 /9350 & HPC GPU Cluster - GPUs Lab & AMD APUs
- Invited Talk : An Overview of High Performance Computing Facility (HPC) at CMSD, University of Hyderabad
  Speaker : Shri Vinod Kumar, Systems Manager, CMSD, UoH
- Invited Talks: HPC - Monte Carlo Simulations-Issues& Challenges
  Speaker : Prof. KPN Murthy : Director, CIS, University of Hyderabad

HeGaPa-2012 : Hybrid Prog. - HPC GPU Cluster (Hardware/ Software - Mixed Programming)

Mode-2 & Mode-3:HPC-GPU Cluster AMD & NVIDIA GPUs)

Day-5 :

- Classroom Lecture :Topic: An Overview OpenCL Code Walk-through on HPC GPU Cluster – Prog, on host-CPU and device-GPUs in an HP GPU Cluster
- Classroom Lecture : Topic: Tuning & Performance of OpenCL Prog. on AMD GPUs - C-DAC Experts
- Invited Talk (Academic):Image Processing – Video High Resolution Algorithms on GPUs
  Speaker : Prof. Pallav Baruah, DMACS, Sri Sathya Sai Institute of Higher Learning, SSSU, Prashanti Nilyam, A.P
- Class-room Lectures : An overview of OpenCL - Tuning & Performance
  Speakers : C-DAC HPC-FTE Group members
- Hands-on Session : AMD-APUs, AMD ATI 9230 9240 /AMD FirePro V5900 /AMD FirePro V7900 – HPC GPU Cluster & AMD APUs

HeGaPa-2012 : Hybrid Prog. - HPC GPU Cluster (Hardware/ Software - Mixed Programming)

Mode-2 & Mode-3:HPC-GPU Cluster AMD & NVIDIA GPUs)

Day-5 :

- Classroom Lecture :Topic: Performance of NLA algorithms based on OpenCL /CUDA in HP GPU Cluster
- Invited Talk (Industry): Power management- The new Holy Grail of HPC
  Speaker : Subhasis Bhattacharya, Altair Indi
- Invited Talk : (Academic) : Tuning & Performance Top-500 Benchmarks (LINPACK) on NVIDIA GPUs & HPC GPU Cluster
  Speaker : Samrit M
- Hands-on Session : Programming on HPC GPU Cluster – for Numerical Linear Algebra Applications on AMD-APUs, HPC GPU Cluster - AMD GPUs
- Invited Talk (Academic): Topic : HPC GPU Cluster Power Management - HPC Issues
  Speaker : Dr.VCV.Rao

Thank you