



## Workshop #5

Heterogeneous Computing: Architectures, Tools, Applications

**Organizer:** Maya Gokhale (Los Alamos National Laboratory)

**Additional** Pat McCormick (LANL)

**Presenters:** Justin Tripp (LANL)

*Additional presenters from DOE and academia to be confirmed*

Co-processor accelerators can deliver exceptionally high performance for application kernels, suggesting that clusters approaching petascale may be assembled from hybrid nodes consisting of a general-purpose CPU paired with an accelerator. Co-processors with a wide range of architectures and capabilities have emerged, including Field Programmable Gate Arrays (FPGAs), Floating Point Arrays, and multimedia/graphics processors. Co-processors can deliver speedups of 10-100× over conventional microprocessors on equivalent application kernels.

In this workshop, we discuss research challenges associated with using co-processors to accelerate high performance computing applications. Topics include:

- designing system architectures that balance conventional and co-processors
- developing analysis and compiler tools to automatically map algorithm kernels to co-processors
- minimizing communications costs between co-processor accelerator and high performance microprocessor
- designing highly parallel computational kernels for co-processor (micro)architectures
- scheduling and managing co-processors units in large systems

The workshop will be organized into two half-day sessions. The morning session will present introductory topics and applications. The afternoon session will include research topics in co-processor-augmented architectures, systems, tools, and future directions:

1. Survey of co-processor architectures and systems (90 minutes)
  - IBM Cell, Clearspeed, graphics processor, FPGAs
  - Systems: Co-processors, Memories, Interconnect
  - Tools and compilationC
  - Application partitioning
2. Applications (90 minutes)
  - Scientific simulations
  - Visualization and Data Analysis

- Bioinformatics
- Image/Signal Processing
- 3. Research Topics (PM session)
  - Compilers
  - Analysis and Partitioning Tools
  - Debug
  - Operating Systems