

# IA<sup>3</sup> 2020 Panel

Michela Becchi

# Heterogeneous systems: a challenge or an opportunity for irregular workloads

## ■ Successes

### » Irregular algorithms on GPU

- Algorithm-specific acceleration
- Graph benchmark suites (e.g., Lonestar GPU, Pannotia)
- Graph processing frameworks (e.g., TOTEM, CuSha, GunRock, Frog, ...)

### » Irregular algorithms on FPGA

- Algorithm-specific acceleration (mostly VHDL/Verilog)
- Some graph processing frameworks (e.g., GraphOps, GraVF, ForeGraph)

# Heterogeneous systems: a challenge or an opportunity for irregular workloads

## ■ Challenges

- » Irregular memory access patterns
- » Branch divergence
- » Work imbalance (dependent on graph topology)
- » Synchronization
- » Input-dependent behavior
- » Scaling to large graphs: multi-device solutions, partitioning, parallelization
- » Choice of graph processing model (e.g., vertex-centric, edge-centric, gather-apply-scatter, bulk-synchronous parallel, ...)

# Heterogeneous systems: a challenge or an opportunity for irregular workloads

## ■ Opportunities

- » Increasing heterogeneity (GPU+FPGA) with uniform programming interface (e.g., OpenCL, DPC++)
  - Compiler techniques: retarget OpenCL code to FPGA and optimize, automatically split computation
  - Runtime techniques: mapping & scheduling, partitioning,...
  - Alternative programming/execution models
- » Memory heterogeneity
  - Non-volatile memory
  - In-memory processing (e.g., GraphP, GraphQ)
- » Approximate computing
  - Definition of “acceptable accuracy”?
- » Integration in complex applications
  - Benchmark development?
- » Evolving graphs
- » Ad-hoc graph processing accelerators or GPU/FPGA/...?