Computing in the US Snowmass Process

Peter Onyisi

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Introduction to Snowmass

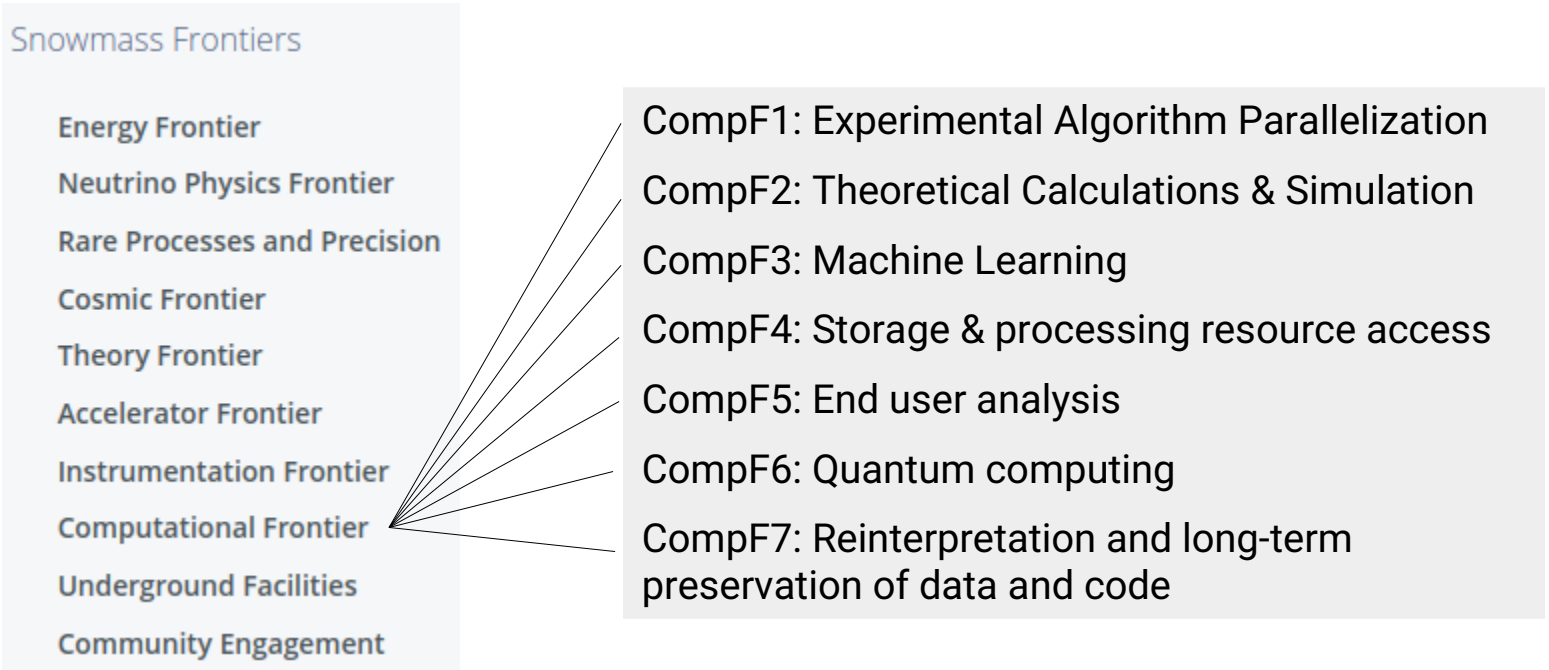
- Snowmass is the US particle physics decadal planning process
  - sponsored by the American Physical Society's Division of Particles and Fields
  - aims to compile a list of compelling physics goals and capabilities to address them
  - actual strategic plan is derived from Snowmass outputs by P5 ("Particle Physics Project Prioritization Panel") which is then input to US funding agencies
  - HEP is a global enterprise: international input is very welcome
- Snowmass process recognizes the importance not only of abstract "physics goals" but also of the ability to reach them
  - need to consider state of and advances in detector instrumentation, facilities & accelerator technology, theory precision, personnel development, and computing

Snowmass 2021*

- Snowmass process began basically at the start of the pandemic, aiming to produce reports in early 2021 and have a major meeting in summer 2021
- The disruption of the pandemic, and desire to have a face-to-face meeting at the end of the process, caused us to have a “pause” in activities
  - as of September 2021 activities have resumed
  - white papers & reports to be prepared first half of 2022
  - new plan is to hold the Community Summer Study at the University of Washington Seattle, July 17-27, 2022
- “Snowmass Day” held in September to mark the restart of activity

Snowmass “Frontiers”

- Discussions are organized through “frontiers”
  - within broad frontiers there are working groups for specific topics
- Many discussions need to cross frontiers: designated liaisons



Contributing to Snowmass

- It is still very much possible to contribute to the Snowmass process!
- The key products of Snowmass are the white papers and the reports
  - white paper deadline is 15 March 2022
  - although anyone can contribute white papers on topics of their specific interest, we strongly encourage broad community collaboration
  - you are strongly encouraged to contact the conveners of the relevant working group(s) to learn how they would prefer to organize white papers
  - you can also consult the letters of intent that were submitted to Computational Frontier back in 2020
  - the report writing process will also vary by working group

Overall Computational Frontier

- Main scope is computation in the next 10 years
  - so not quite computation as needed for new HEP experiments, although we have considered that
- Work is primarily happening in working groups (see remainder of slides)
  - liaisons to various other frontiers to help bridge gaps
- Discussions via:
  - Slack channels
  - Email lists (given at this link)
  - Instructions to sign up here
- Worth looking at the CompF workshop, August 2020: contributions & plans from various working groups
- Inputs that can help drive concrete funding recommendations are especially welcome

Conveners: Steve Gottlieb, Daniel Elvira, Ben Nachman
web page

CompF1

Experimental Algorithm Parallelization
Conveners: Giuseppe Cerati, Katrin Heitmann, Walter Hopkins
web page

- Focus on parallelization of computation for experiments
- Means a lot of different things
  - use of parallel accelerators e.g. GPU
  - high performance vs high throughput computing environments
  - partitioning of single event computations across nodes (e.g. handling a DUNE supernova event?)
  - portability & longevity of solutions, ease of programming

CompF2

Theoretical Calculations and Simulation
Conveners: Peter Boyle, Ji Qiang
web page

- Broad range of communities and toolkits represented here
  - Geant4, accelerator modeling, perturbative calculation tools, event generators, lattice QCD, cosmological simulations…
- Therefore also a broad range of needs
  - maintaining support of broadly-used libraries, retaining key personnel
  - parallelization + improved efficiency
  - scaling to latest HPC
  - domain-specific issues (improved systematics, data volumes …)

CompF3

Machine Learning
Conveners: Phiala Shanahan, Kazuhiro Terao, Daniel Whiteson
web page

- Covers many topics in machine learning
  - innovative applications of ML (generative models, anomaly detection, differentiable programming, ...)
  - interpretability and validation
  - tools, ecosystem, and implementation in HEP software (firmware, hardware ... ?)
  - resources for model training (cloud, HPC, ...) and evaluation

CompF4

Storage and Processing Resource Access
Conveners: Wahid Bhimji, Rob Gardner, Frank Wuerthwein
web page

- How to provide storage and CPU for central processing workflows & end user analysis
  - different storage technologies: latency vs capacity
  - what mix of CPU + accelerators + memory + specialized architectures?
  - network connections, data transfer
  - “topology” of services (edge services, analysis facilities, content delivery networks…)
  - who provides? HEP-specific facilities, university and lab clusters, national HPC centers, commercial providers?

CompF5

End user analysis
Conveners: Gavin Davies, Peter Onyisi, Amy Roberts
web page

- Covers topics related to how physicists access and process data for final analysis
  - centralized analysis facilities vs user hardware
  - data access & bookkeeping
  - programming languages, ecosystems, working environments
  - analysis libraries, data storage formats
  - “real-time” analysis
  - collaborative software

CompF6

Quantum computing
Conveners: Travis Humble, Gabriel Perdue, Martin Savage
web page

- Most speculative topic of the working groups
  - many aspects still theoretical or have only very simple proofs of principle
  - can expect acceleration of capability in the near future
- Discussing:
  - quantum algorithms for HEP (quantum simulation, parton showering, quantum machine learning ...)
  - form of required quantum computing hardware & best access model
- Not directly discussing quantum sensing (although there can be overlaps)

CompF7

Reinterpretation & Long-Term Preservation
Conveners: Kyle Cranmer, Mike Hildreth, Matias Carrasco Kind
web page

- Maximize reusability of data and analysis code
  - Public data releases and curation: HepData, likelihoods, simplified analysis data, …
  - Combining results across experiments
  - Archiving and rerunning analyses, possibly with different signals
- What infrastructure needs to be provided? How can overhead on physicists be lowered?

Summary

- Snowmass process is ongoing, aiming for reports and a Community Summer Study in 2022
- Still lots of scope to contribute to process via white papers and engagement in the working groups
  - white papers targeted for mid-March
- Computational Frontier covers a very broad range of topics
  - from the prosaic to the speculative
  - has a home for your contribution – talk to the conveners