SIGGRAPH ASIA 2015 KOBE

Symposium on Visualization in High Performance Computing

High Performance Heterogeneous Computing for Collaborative Visual Analysis

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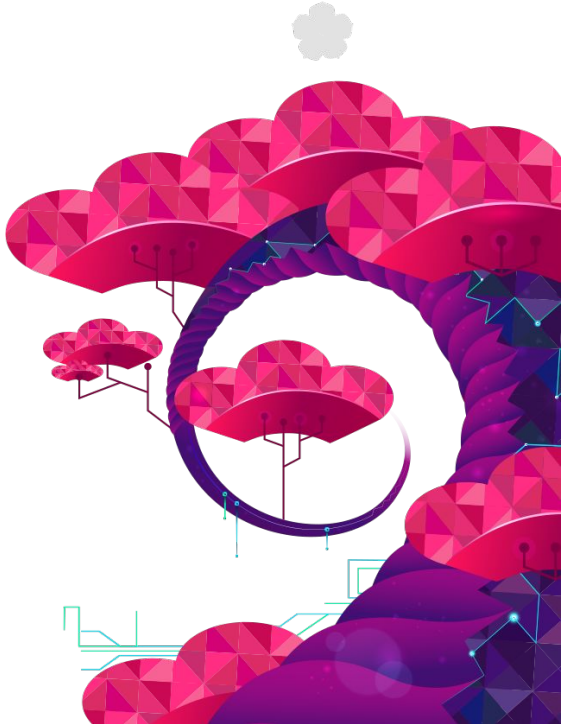
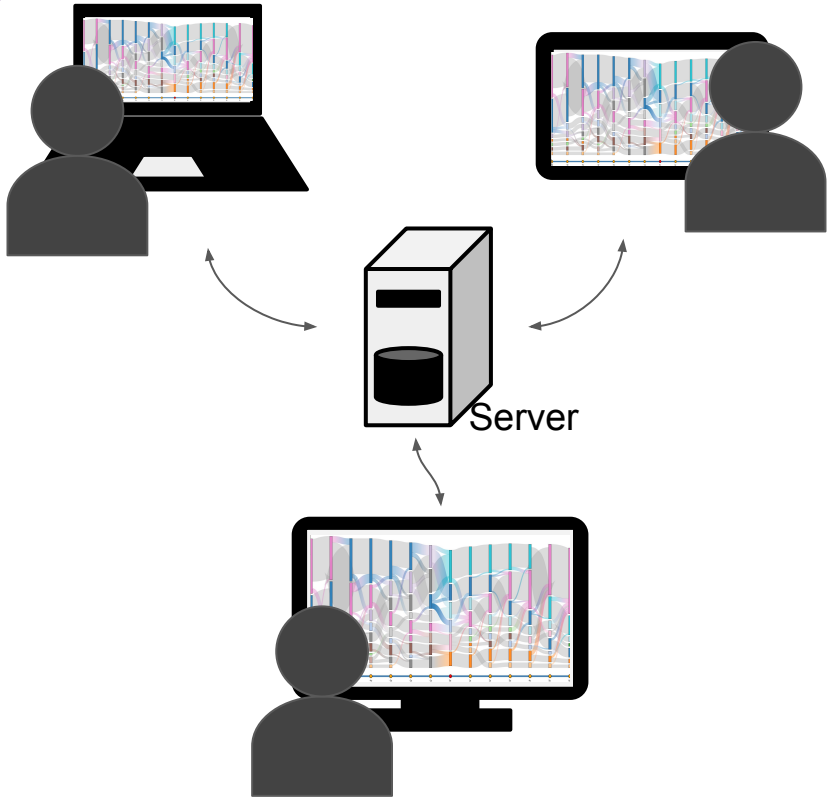


Collaborative Visual Analysis

- Multiple users analyze data using shared visualizations
- Synchronous and distributed (same time, different places)
- Solve complex problems with diverse expertise



HPC and Collaborative Visual Analysis

- Transform and visualize large, complex data
- Minimize wait time of user interactions
- Improve system performance and usability

Collaborative Visualization Systems

- Web-based, current and future trends [Mouton et al. 2013]
- Distributed computing, multiple servers [i.e. Chan et al. 2008]
- Cloud services and grid systems [i.e. Sherif et al. 2014]

Opportunity for Heterogeneous Computing

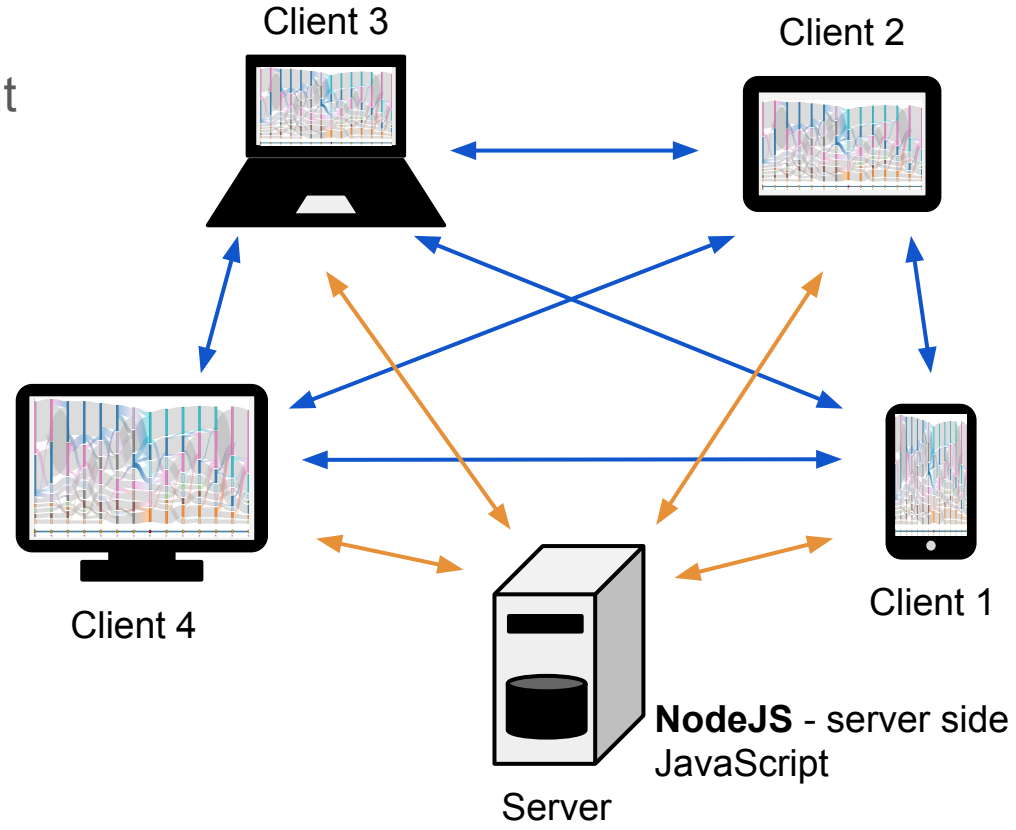
- Client side devices can be used to share the computation workload
- Relentless advancement in personal computing
- Heterogeneous computing using the server and multiple client devices

Our Contribution

- Web-based heterogeneous computing framework
- Prototype implementation for collaborative visual analysis of massive time series
- Experiment tests for evaluating the performance and applicability

Leveraging Modern Web Technologies

- **WebSocket** - fast server-client communications
- **WebRTC** - real-time communications between browsers
- **WebWorker** - parallel processing
- **SVG** - hardware accelerated rendering



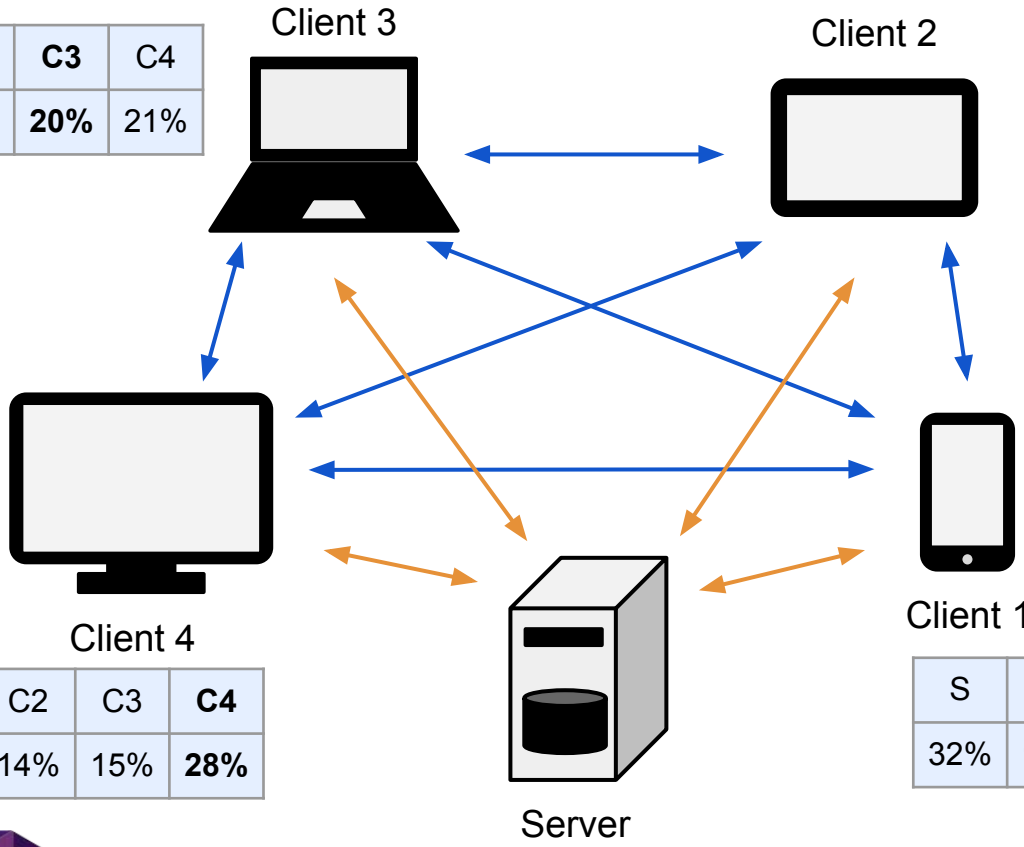
Distribution of Computations

- Load balancing, equal completion time for each client node
- Algorithm based on [Beaumont et al. 2001]
- Challenges for web applications:
  - limited access to hardware and OS info.
  - unknown processor speeds and network bandwidth

Relative Computing Speeds

S	C1	C2	**C3**	C4
32%	12%	15%	**20%**	21%

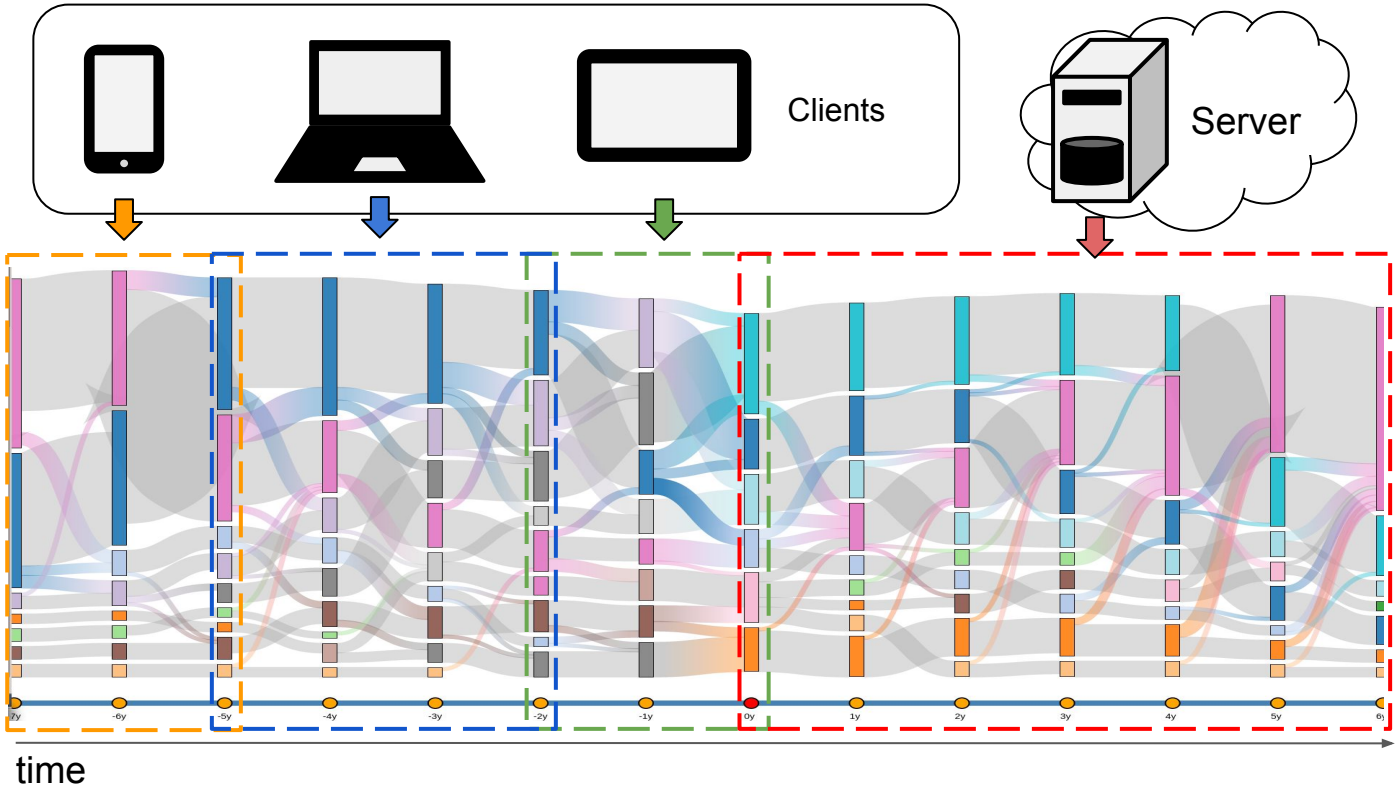
S	C1	**C2**	C3	C4
32%	10%	**22%**	16%	22%



S	C1	C2	C3	**C4**
32%	14%	14%	15%	**28%**

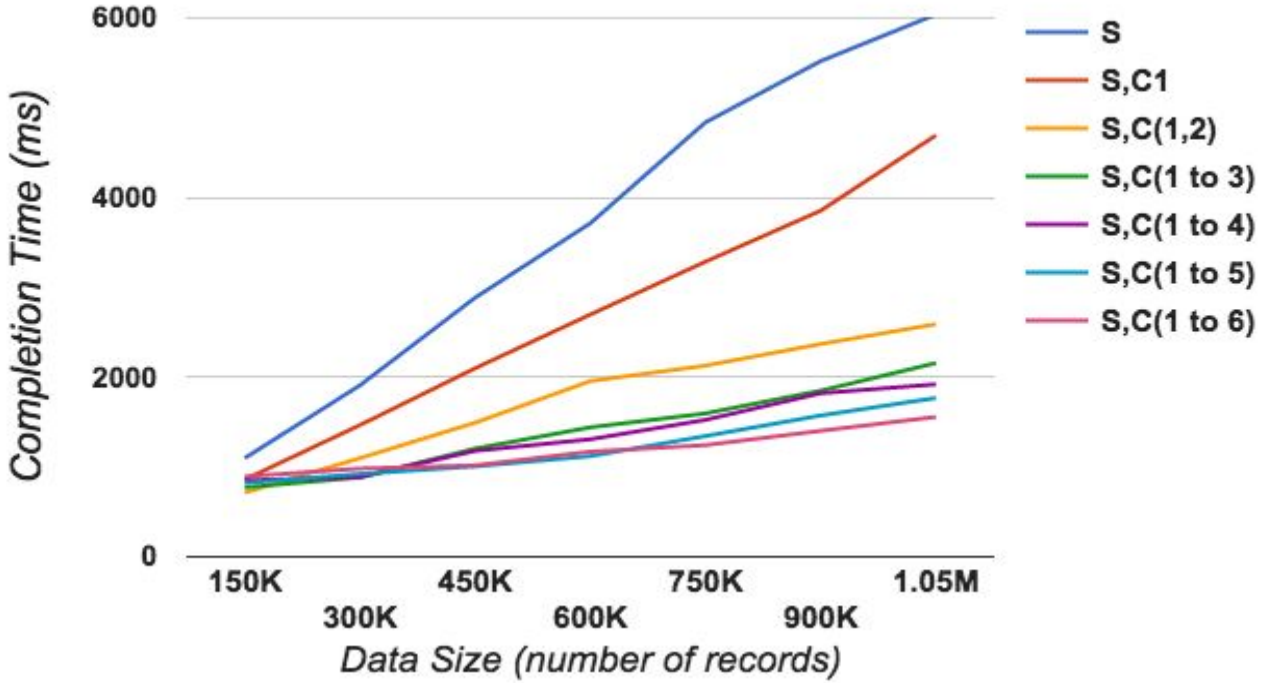
S	**C1**	C2	C3	C4
32%	**18%**	16%	15%	19%

Visual Analysis of Massive Time Series



Test Results

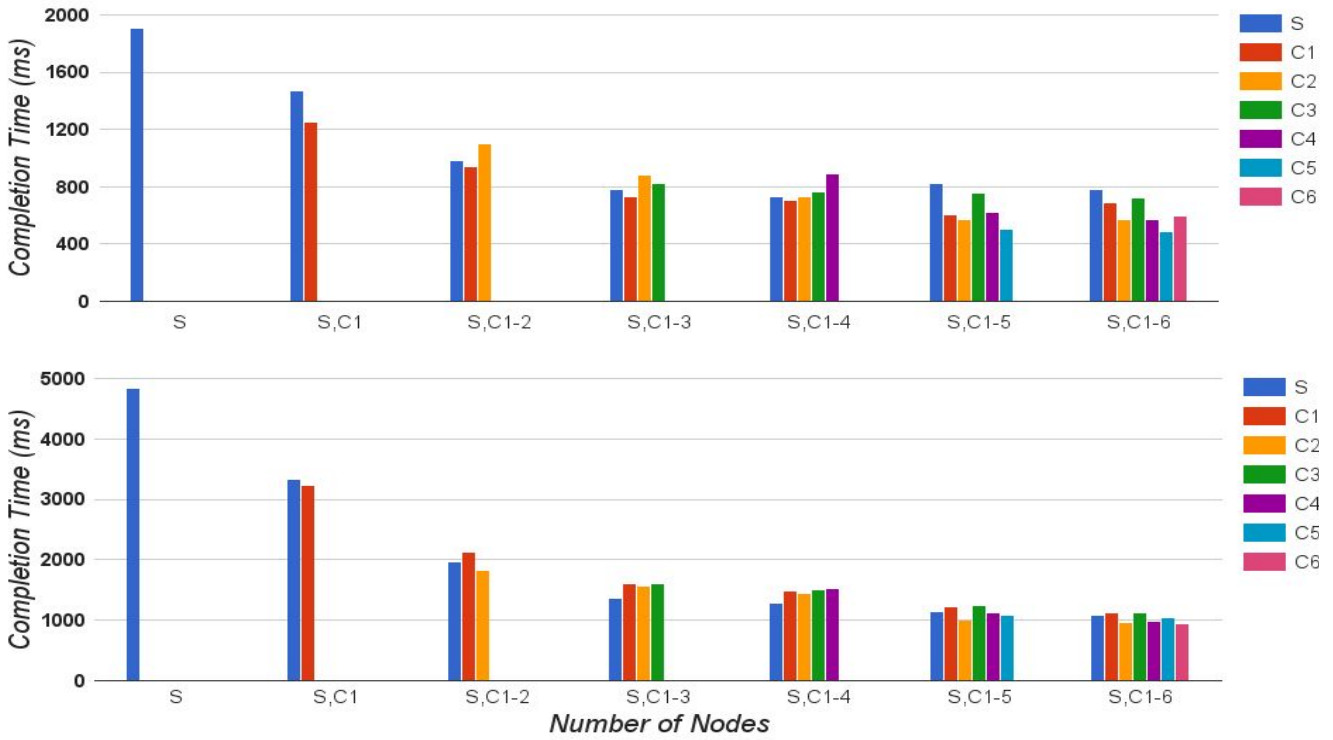
Node	Type	Processor	Speed	cores / threads
S	server	AMD FX-8320	3.2 GHz	8 / 8
C1	laptop	Intel Core i5	1.4 GHz	2 / 4
C2	desktop	Intel Core i7	3.6 GHz	4 / 8
C3	desktop	Intel Core i7	2.4 GHz	4 / 8
C4	phone	Qualcomm Snapdragon	2.5 GHz	4 / 4
C5	desktop	Intel Core i7	3.5 GHz	4 / 8
C6	desktop	Intel Core i7	4.0 GHz	4 / 8



Completion Time of Each Computing Node

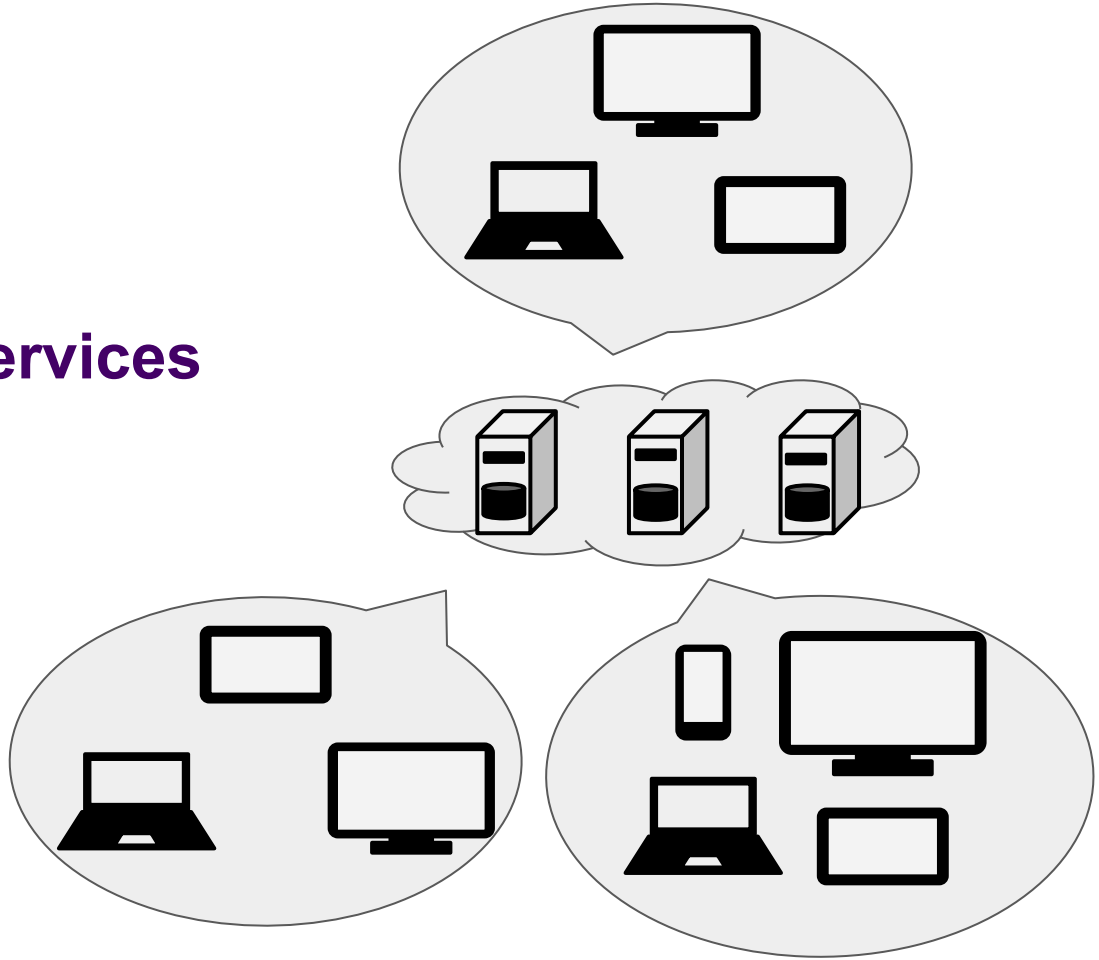
300K records

750K records



Scaling

- Flexibility in scaling
- Multiple groups and services
- Server-side scaling



Conclusion and Future Work

- A web-based heterogeneous computing framework
  - Parallel and distributed data transformations and visualizations
  - Effective utilization of client side devices for improving system performance
- Future Work:
  - Many user groups, multiple datasets and services
  - GPU computing

We look forward to delivering high performance systems for supporting collaborative visual analysis.

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Symposium on Visualization in High Performance Computing

Thank You !

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