

Emerging Opportunities in HPC Cloud & Collocation Services

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April 2017

Research reported in this publication was supported by an Institutional Development Award (IDeA) from the National Institute of General Medical Sciences of the National Institutes of Health under grant number 5P20GM109025.

Agenda

- **About the NSI @ Switch**
- **Computing Challenges**
 - Spotlight on Research
 - Other Research Areas that Benefit from HPC
- **Next Steps**

About the NSI

Full-service supercomputing facility

Mission for excellence in education and research in supercomputing and its applications

Provides supercomputing training and services to academic and research institutions, government and private industry

Supports energy, the environment, medical informatics and health care

Serves researchers at the University of Nevada Las Vegas and other statewide, nationwide and global research



NSI @ Switch

- 2014 - UNLV moved its NSCEE facilities to Switch facility in Las Vegas
- Hosted on Cherry Creek system – large Intel system for scientific and economic R&D
- > 26,000 compute cores
- Intel Xeon E5-2697v2 12C 2.700GHz, Intel Truscale, Intel Xeon Phi 7120P
- Dedicated Research Network (DMZ) with 200Gb/s potential



Cloud & Collocation



NSI Computing Challenges

Numerous and complex workloads

- Hundreds of projects
- Highly compute-intensive research

Massive data needs

- Users must access massive data remotely to do their work

Time-sensitive projects

- Many NSI projects have critical governmental and environmental significance, so timely and reliable performance is a key requirement



Powerful and reliable infrastructure is mandatory!

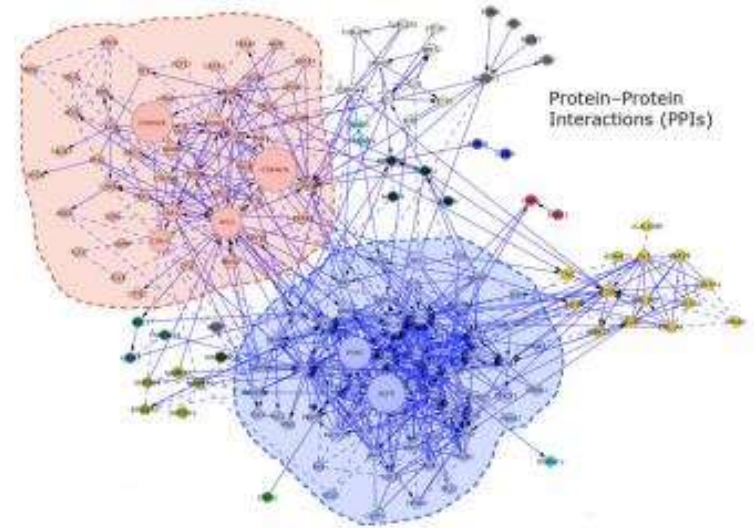
Spotlight: Alzheimer's Research

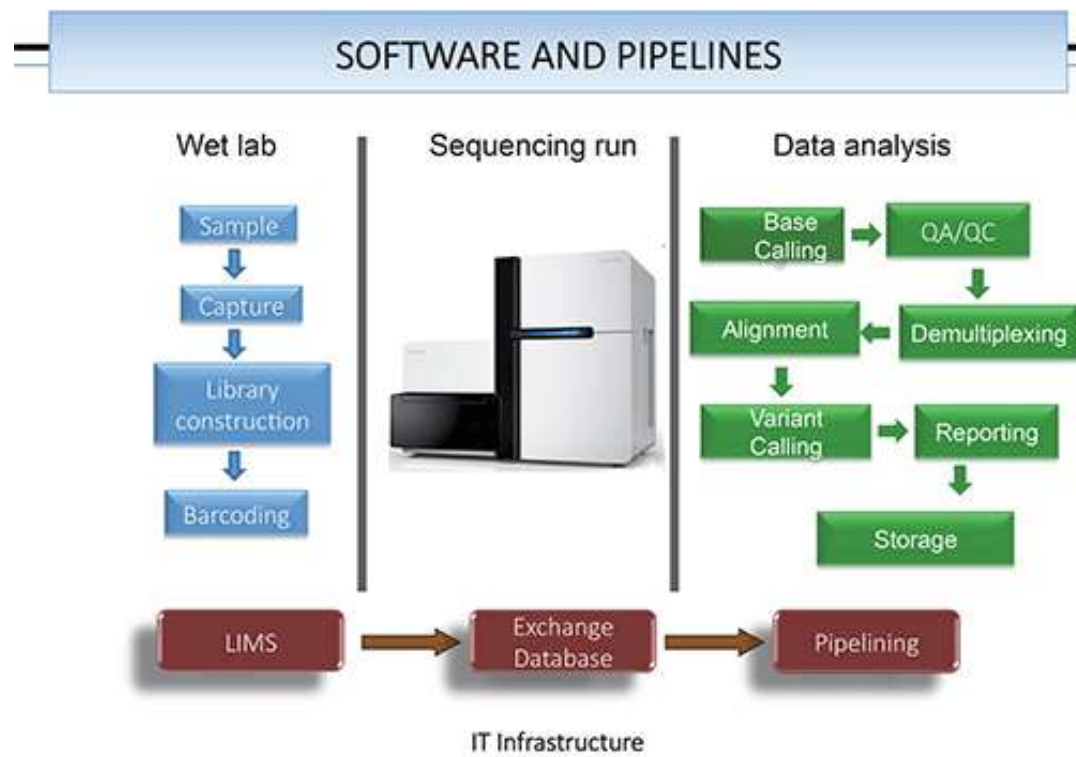
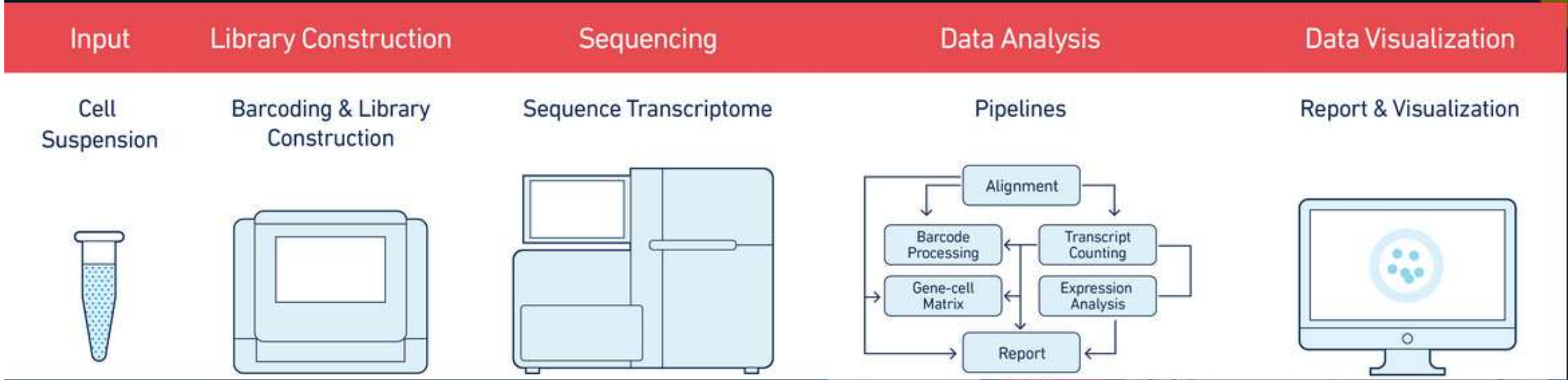
The need for innovation

- Alzheimer's Disease continues to cause tremendous family, social, and economic burdens to modern society
- Despite substantial progress, existing treatment approaches are limited – so new therapeutic approaches are desperately needed

The NSI project

- NSI works with researchers to compare genomes of Alzheimer's patients with normal patients
- **Challenge:** Researchers wanted to enhance the statistical power of previous analyses by including more than 10,000 additional patients (and thus genomic data sets) in the study – meaning a massive leap in computational requirements





Alzheimer's Project Results

- **Reduced overall runtimes for processing workload**
 - **Decreased processing time by more than 50%** using PBS Professional in conjunction with Rocks and an improved system with shared memory compute node
 - **3 hours instead of the 8+ hours** to process a genome
- **Fast, easy implementation**
- **Powerful, flexible customization capabilities** -- can be easily extended by adding site-specific processing plugins/hooks
- **Improved system manageability and extensibility:**
 - Lightweight solution
 - Very easy to manage
 - Not dependent on any specific operating system

Other NSI Research that Benefits from HPC...



Quantum Dynamics of Chemical Reactions

- HPC dramatically improves ability to understand how atoms and molecules interact and the chemical reactions that occur in different environments
- Researchers use complex theoretical calculations to explore how molecules behave at absolute zero temperatures and other conditions



Fracking

- Hydraulic fracturing often takes place >1 mile below groundwater supplies
- Mechanical engineers use sophisticated numerical models to more accurately predict prime locations for extraction and assess possible contamination associated with the process



Magnetically Dominated Jets in Gamma-Ray Burst

- Gamma-ray bursts are the most luminous, and violent, explosions in the universe -- they signify the deaths, collisions or swallowing up of stars
- Astrophysicists' computational research advances our understanding of the physical mechanisms behind GRBs and other high-energy astrophysical phenomena

Acknowledgements

Alzheimer's Research:

- Martin R. Schiller, Executive Director, Nevada Institute of Personalized Medicine and Professor School of Life Science
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Quantum Dynamics of Chemical Reactions:

- Balakrishnan Naduvalath, Professor of Chemistry
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Thank you for your attention!

Questions?

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