

HPCC - Providing Computing Hardware to Researchers

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Dreamworks Video

- <http://www.youtube.com/watch?v=TGSRvV9u32M&hd=1>



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Types of Systems

Local Resources

- Special Use Systems
 - SMP – Symmetric Multiprocessor (fat node)
 - GPGPU (General Purpose Graphics Processing Unit)
- Typical HPC cluster
 - Commodity computers
 - High speed backbone
 - High speed network storage

National and Commercial

- Advanced HPC
 - Specialty hardware
 - High speed backbone
 - High speed storage
- Grid
 - Many HPC systems linked together by high speed network
- Cloud
 - Lots of definitions
 - Typically refers to computing as a service using highly flexible virtual machines

1957 MISTIC Mainframe

- MSU's first mainframe
- Hand built by grad students
 - Dick Reid
 - Glen Keeney



Computing and MSU

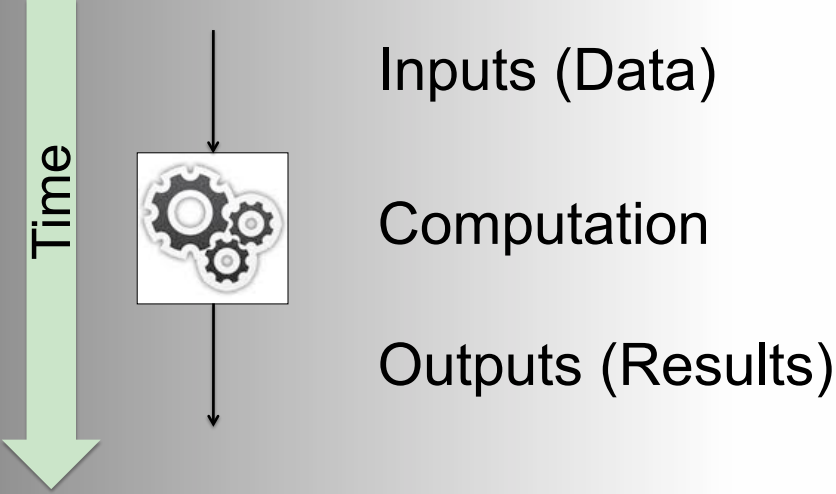


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Scientific Programming





Time

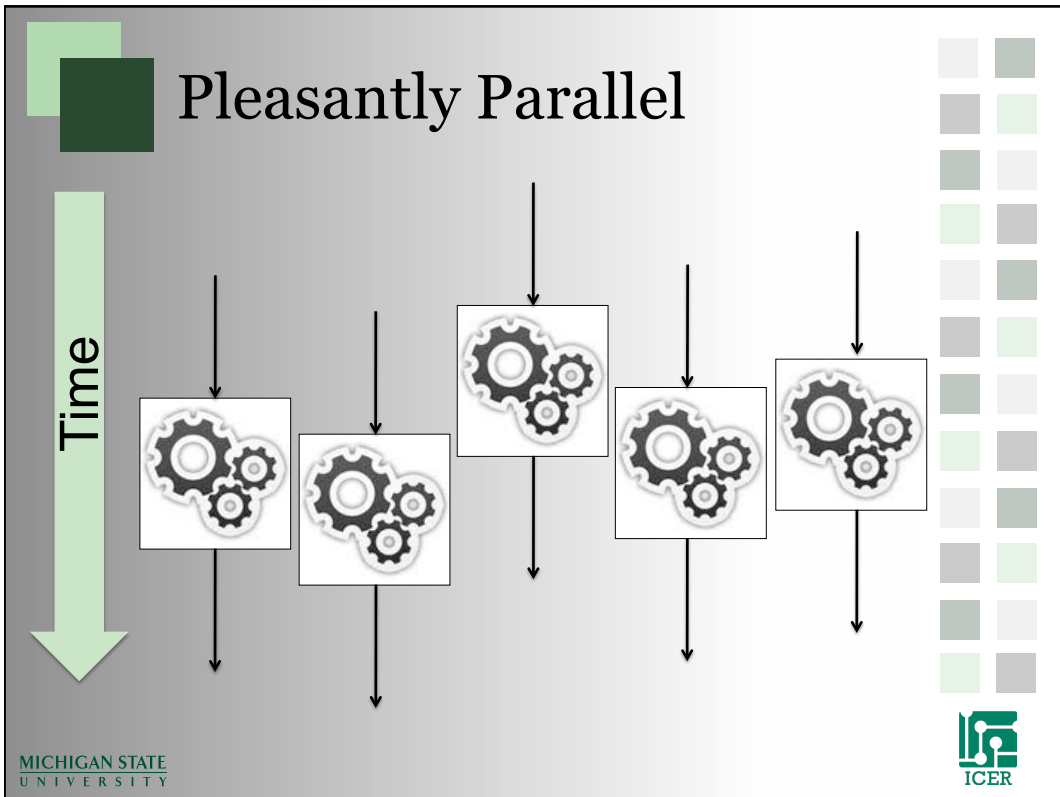
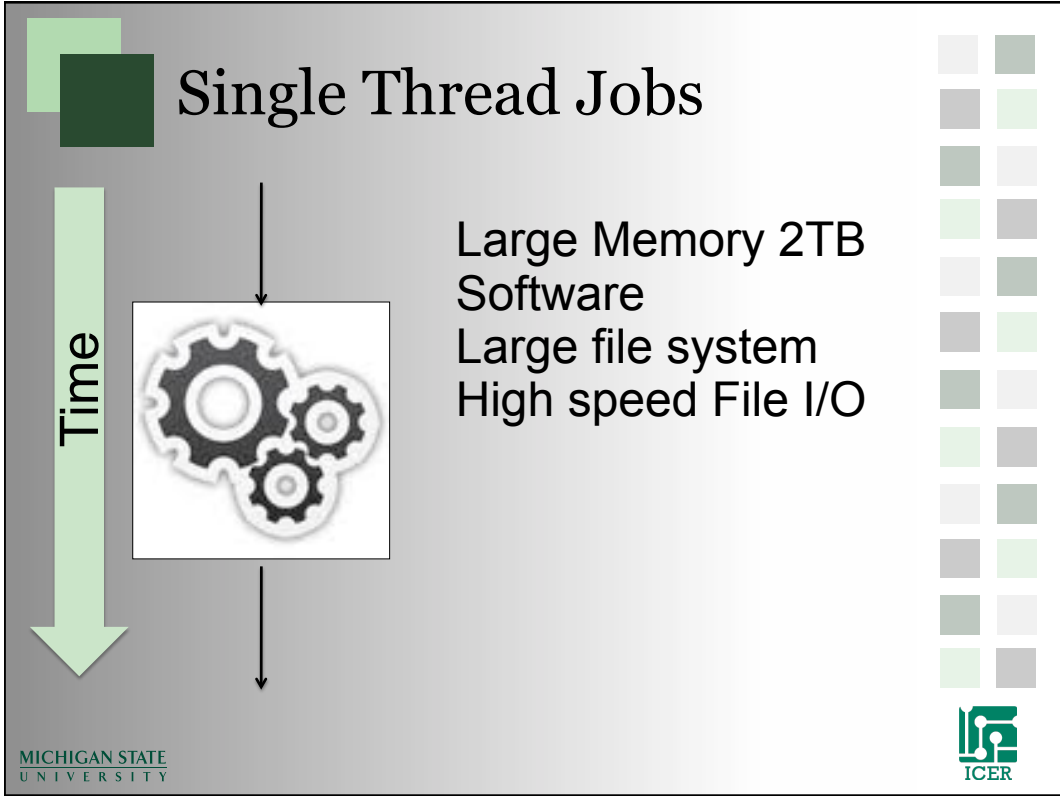
Inputs (Data)

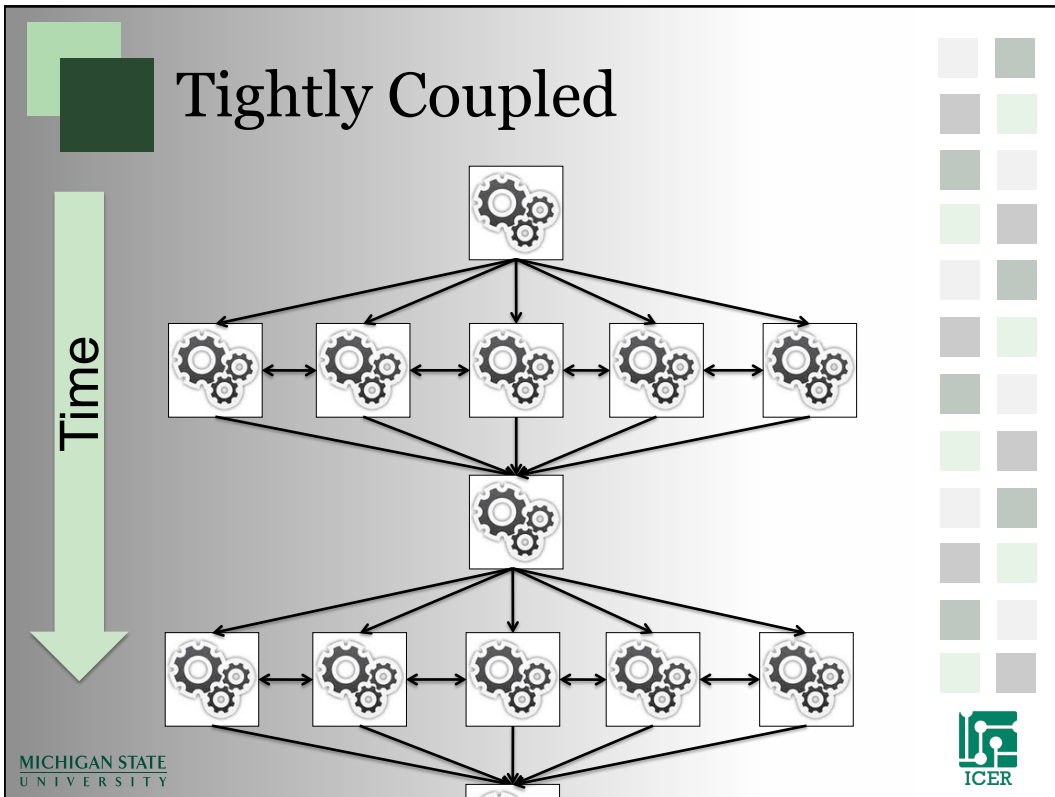
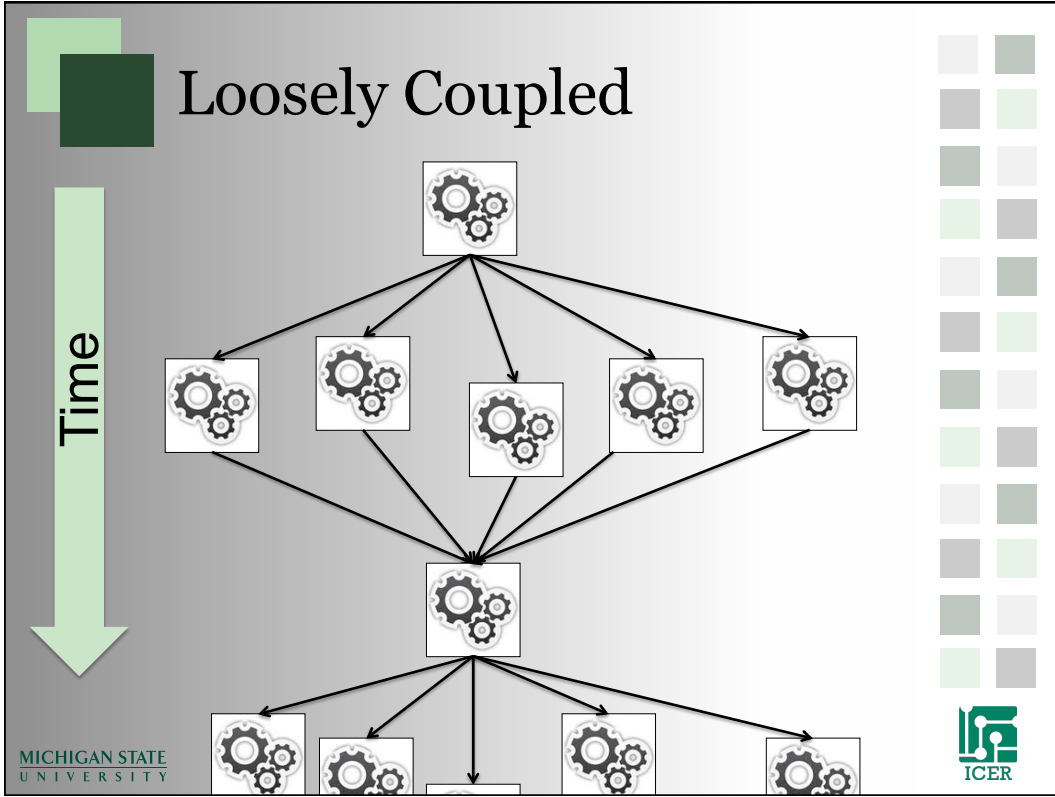
Computation

Outputs (Results)



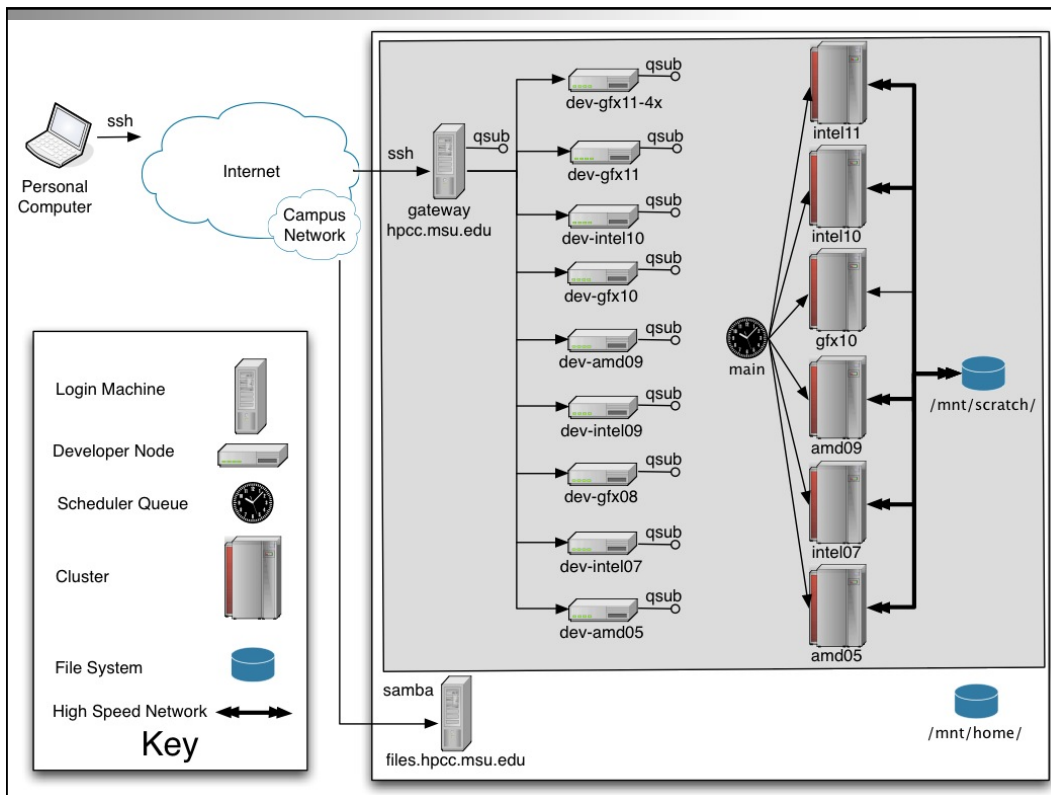
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Types of systems

- Fat Nodes
- Commodity Clusters
- GPGPU
- Condor



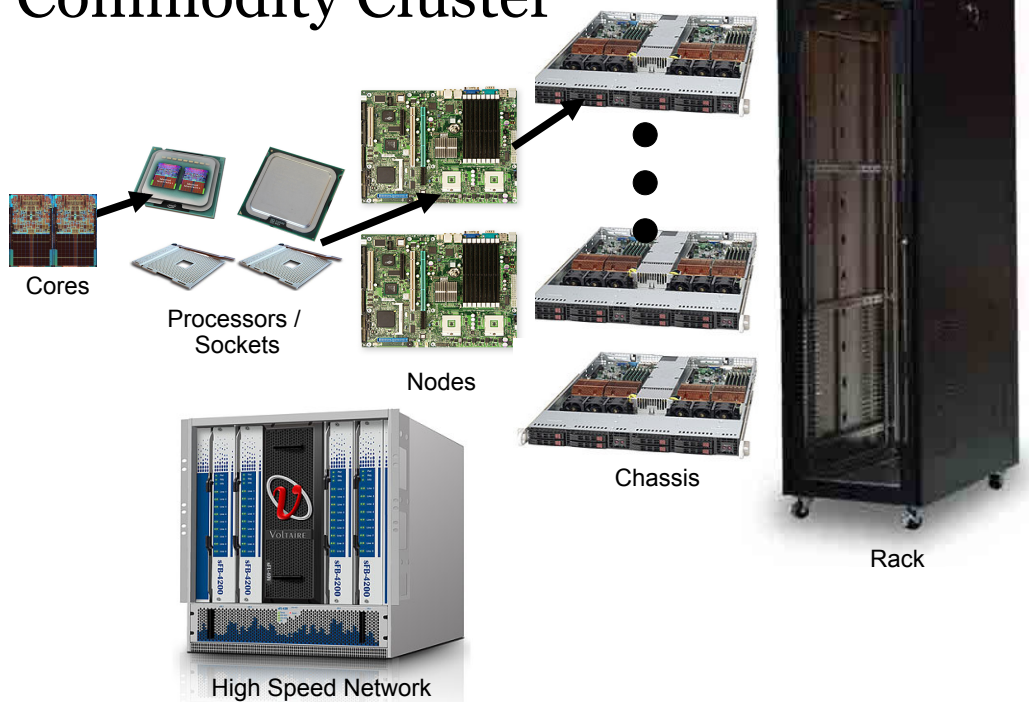
Fat Nodes

- Lots of Memory
 - 256GB – 2TB RAM
- Lots of cpu cores
 - 32 – 64 cores
- Shared memory Communication
 - Easy to write software
 - Very fast
- Expensive

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Commodity Cluster



HPCC Commodity Clusters

Year	Name	Description	ppn	Memory	Nodes	Total Cores
2005	amd05	Dual-core 2.2GHz AMD Opteron 275	4	8GB	96	384
2007	intel07	Quad-core 2.3GHz Intel Xeons E5345	8	8GB	124	992
2010	intel10	Intel Xeon E5620 (2.40 GHz)	8	24GB	192	1536

GPGPU Programming

- Card you add-on to a compute node
- Developed for gaming



HPCC Systems

'GFX10', 15,616-core GPGPU cluster



The 'GFX10' cluster consists of 32 compute nodes with two 240-core nVidia Tesla M1060 GPGPU accelerators, eight Intel Xeon cores and 18 GB of RAM per node. The peak aggregate performance of the entire cluster is 59 trillion single-precision floating-point operations per second.



Condor High Throughput Computing

- Job submission system
- Runs like a screen saver
- Steals CPU Cycles




Hardware

High speed network interconnect

- MPI jobs
- High Speed Parallel Scratch Space

**InfiniBand
inside**

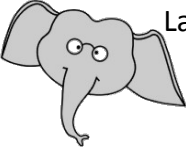
General Purpose Graphics Cluster



512 core, 128 node cluster installed in 2005. Each node contains four 2.2 GHz AMD Opteron cores, 8 GB of RAM, and 146 GB of local disk.


Large Capacity "FAT" Nodes

- Up to 2TB of RAM
- Up to 64 cores



Common OS Image

- RHEL6.0
- Compile once
- Run anywhere





2010

2010

2005



2011

1
512GB - 2TB RAM nodes
64 core 2.66 GHz Xeon
processors.

Cluster Resources

Year	Name	Description	ppn	Memory	Nodes	Total Cores
2005	amd05	Dual-core 2.2GHz AMD Opteron 275	4	8GB	96	384
2007	intel07	Quad-core 2.3GHz Intel Xeons E5345	8	8GB	124	992
2009	amd09	Sun Fire X4600 (Fat Node)	16	128GB	1	16
			32	256GB	4	128
2010	gfx10	Nvidia Cuda Node (no IB)	8	18GB	41	256
2010	intel10	Intel Xeon E5620 (2.40 GHz)	8	24GB	192	1536
2011	intel11	Intel Xeon 2.66 GHz E7-8837	32	512GB	1	32
			32	1TB	1	32
			64	2TB	2	128





Bigger Science

- The goal of iCER is NOT
 - Kflops / second
- Instead, the goal of icer IS:
 - KSciences / second
- Doing More Science, Faster
 - Reducing the “Mean time to Science”
- HPCC is designed to help researchers do their science and when appropriate scale them up to one of the national labs

Beyond MSU


- National resources
 - NSF (TerraGrid, blue waters)
 - DOE (Jaguar)
 - Others
- Commercial Resources (cloud computing)
 - Amazon
 - Azure
 - Liquid web
 - Others



HPCC DEC. 18th
training workshop

- No-cost seminars to faculty and graduate students on technology topics
 - Morning sessions run from 8:30 to 11:30 am
 - Afternoon sessions run from 1:30 to 4:30 pm
 - Lunch is provided that will feature guest speakers on instructional technology
- Introduction to HPC
- Advanced HPC
- Also Introduction to MATLAB (Dec 19th)

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We are here to help

- www.hpcc.msu.edu/contact
 - Questions
 - Schedule Consultations
 - Code Reviews
 - Programming help
 - Hardware Purchasing
 - Help with Grants
 - Support for Grants

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