Lecture 26: Community Modeling Developments

The current state,
The shape of things to come
and maybe some pie in the sky
Agenda

- A Quick Survey of What’s Happening on the Horizon.
  - Distributed Computing
    - We’ve played with it already
  - Earth System Modeling Framework
    - You’ve already used some of it
  - The GRID and Earth Systems Grid & BGC Grids
    - You may be doing it now, wittingly or unwittingly
  - Petascale Computing
    - Which some of you may never want to get near

- ... these are in order of when you may be expected to encounter them...
What’s ahead for you
The Models

☐ Many of you are working now with high-demand models or may do so in the future

☐ Others of you may find yourself working with complex integrated modeling environments that, in and of themselves, are not resource demanding but may be dependant on other models or may be able to couple with them

☐ All you will be working with others
What’s ahead for you
The Infrastructure

- Though individual computer resources are getting increasing pound for pound, expectations from models are not staying the same nor getting smaller
- Information sources and dataset sizes are getting bigger
- Networking infrastructure is also growing
- And some people are beginning to realize that to make the most of it, new resources are required
The first step ahead is easy

☐ And half of you have already done it.

☐ Distributed LOCAL computing
☐ AKA Clusters and local fleets
Distributed Computing (LOCAL)

- One Program – Distributed on Multiple Computers
  - “Distributed Memory” (MPICH)
  - Multiple Machines (similar configurations)
Distributed Computing (LOCAL)

- Tasks are granularized
  - For example
    - One Time Step
    - Spatial or task oriented blocks

\[ \begin{align*}
A[x(t - 1)] \\
B[x(t - 1)] \\
C[x(t - 1)] \\
D[x(t - 1)] \\
+ E[x(t - 1)] \\
\hline
x(t)
\end{align*} \]
Is more better?
As Rotang

\[
\text{rotang} = -\arctan\left(\frac{\text{lon}}{\cos(\text{lat})}\right)
\]
Our local estimates for MM5
(and the local user is more interested in time and girth anyway!)
Requirements to run DM Tasks

- MPI (Message Passing Interface)
  - We have this on most of our Linux boxes as well as our cluster (MPICH)
  - Responsible for parsing out tasks between the master node and the slaves

- Compilers
  - GNU is free

- Reasonable networking infrastructure between node machines
  - For example, our cluster is more tightly coupled than our Linux fleet

- Code that has been set up to run with MPI
  - You can make your own (CSC 410)
  - Or use community MPI code (CCM, MM5, CLM, WRF, ARPS)
Requirements to run DM Tasks

- Oh yeah.

Permission!
Authorization!
Permission vs Forgiveness
Local Distributed Systems

- Many local (small departments and local empires) systems are regulated by simple solutions
  - Quotas for disk space and job time
  - Agreed upon jurisdictions
    - Tom uses nodes 4-3
    - Dick uses 2-6
    - Harry uses 7-16 from 0000-1200
    - Sally uses 7-16 from 1200-0000
    - Real Time Automatic Model uses 17-128
  - The Honor System
    - The Borden Paradigm
Permission vs Forgiveness
Community Distributed Systems

- Community systems (e.g., NERSC & NCAR) use more complex systems but follow similar models
  - Quotas for disk space and job time
  - Established Queues
    - For user and application families
  - GAUS (General Accounting Units)
    - Computing Credit Chits
  - Much tighter security
    - Axe handles are only 2-3 feet long
Introduction
The GAU page displays graphs and charts that indicate the current GAU charging status for all of the active projects to which you can charge.

Click Change Content on the navigation bar above to choose the GAU reporting features you would like to see.

GAU Use by User: UNIV Project 35641047

Unable to draw graph due to insufficient data

Total MSS GAU: UNIV Project 35641047

Charges for the last 12 months

100%

MSS Read: 0 GAUs

Bluevista Job Accounting
Data for May is not yet available.
You did not execute any jobs on bluevista in the last month.

GAU Charges by Project
Date data was last updated: Apr 29, 2007 12:00 AM
Active Project Number: 35641047
GAU allocation: 3000.0 Allocation period of use: LIFETIME
GAU usage: 120.752 Usage period of use: LIFETIME
GAU remaining: 2870.248

Default project: COMMUNITY_YES
Machines available to project: Bluesky Tempest Icecube Bluevista Otto Blueice

Lightning Job Accounting
Data for May is not yet available.
You did not execute any jobs on lightning in the last month.

GAU History: UNIV Project 35641047

Unable to draw graph due to insufficient data
Blueice Portal

CISL Portal

Home GAU Lightning Bluevisa Blueice Manage Tabs

Blueice Summary

You must activate your portal connection to this supercomputer. Please see the Activate Page Help for instructions. Once you activate your portal connection, up-to-date information will be displayed below.

Active Job Queues

Jobs

Running Pending

Queries

bms_ded bms_log
bms_pnm bms_wu
bms_sky debug

economy held

economy reg_mem

bms_reg_mem

bms_regular

bms_chase

bms_special

bms_standby

Remote Computer Messages

Standard Out Messages

No messages.

Standard Error and Warning Messages

No errors.

Blueice File Upload and Job Submission

You must activate your portal connection to this supercomputer. Please see the Activate Page Help for instructions. Once you activate your portal connection, you'll be able to upload and submit jobs to this supercomputer.

Blueice Job Accounting

Data for May is not yet available.

You did not execute any jobs on blueice in the last month.

bms_ded Queue

You must activate your portal connection to this supercomputer. Please see the Activate Page Help for instructions. Once you activate your portal connection, up-to-date information will be displayed below.

Job Id Job Name Owner Submitted Status Cancel Job

Reset

bms_log Queue

You must activate your portal connection to this supercomputer. Please see the Activate Page Help for instructions. Once you activate your portal connection, up-to-date information will be displayed below.

Job Id Job Name Owner Submitted Status Cancel Job

Reset

Done
ESMF
Earth System Modeling Framework

The developing framework for complex model systems

SOFTWARE and Middleware

You’ve also used it in WRF

http://www.esmf.ucar.edu/
What is ESMF

- ESMF is a suite of middleware and software to facilitate interaction between models and model components
- The idea is to create a framework to drive the next generation of models that incorporates the current and pending infrastructure developments
What is ESMF

- Coupling Infrastructures facilitating “Plug and Play” architectures to swap in ready-made components each made with ESMF standards
- Data structure support for manipulating arrays and other important code components that facilitate community use and modification/development of common code
- Parallelization support
- Message Logging (you appreciate this when working in DM models)
- Mapping and Regridding Support
- Time management (WRF has this!)
What is ESMF
ESMF Applications

- Coupled Systems
  - ATM-Chemistry Modeling

02 May 2007

ATM 515: Intro Env Modeling : Hydro Modeling
ESMF Applications

☐ Coupled Systems
  ■ Ice-Ocean modeling
The GRID

Distributed Community Infrastructure beyond the walls of a given institution or network

http://www.gridcomputing.com/
Examples on the cheap

- The@Home Franchise
- ClimatePrediction.net
- And others that you don’t know about that you probably should, because you may already be involved
  - “The Underground GRID”
How the GRID works

- Tom @ SDSMT has a cluster
- Dick @ SDSU has an observational network
- Harry @ DSU has a web supported visualization infrastructure
- Sally @ NERSC has a mass storage system
- Bob, Carol, Ted and Alice @ several NWS offices each have radar
- And all of them have the internet.
NSF Network for Earthquake Engineering Simulation (NEES)

Transform our ability to carry out research vital to reducing vulnerability to catastrophic earthquakes
Earth Systems Grid

http://www.earthsystemgrid.org/

Access to modeling resources, output and utilities
ESG: U.S. Collaborations & Development

LBNL: Climate storage facility

LLNL: Model diagnostics & inter-comparison

USC/ISI: Computational grids, & grid-based applications

NCAR: Climate change predication and scenarios

LANL: Next generation coupled models & computing

ORNL: Climate storage & computational resources

May 6, 2002

Earth System Grid - Williams
Benefits of ESG

- Ready access to certified climate model data. Recreating the wheel or pestering the wheelmakers is no longer required.
- Community utilities (NCAR Graphics Command Language) are available at a “single” portal
- Access to several facilities in what (hopefully) should be rather transparent