Introduction to visualization with

Hank Childs, LBNL
July 18, 2011
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<th>Day 1 (7/18)</th>
<th>Monday</th>
<th>Speaker</th>
<th>Location</th>
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<tbody>
<tr>
<td>8:30 – 9:00</td>
<td>Morning coffee</td>
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<tr>
<td>9:00 – 10:00</td>
<td>Welcome - Intro to explosive astrophysics</td>
<td>Nugent/Kasen</td>
<td>Open Lecture: Building 66 Auditorium</td>
</tr>
<tr>
<td>10:00 – 11:00</td>
<td>Intro to High Performance Computing/NERSC</td>
<td>Antypas</td>
<td>Open Lecture: Building 66 Auditorium</td>
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<tr>
<td>11:00 – 11:20</td>
<td>Break</td>
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<tr>
<td>11:20 – 12:20</td>
<td>Intro to Visualization and Visit</td>
<td>Childs</td>
<td>Open Lecture: Building 66 Auditorium</td>
</tr>
<tr>
<td>12:20 – 2:00</td>
<td>Lunch provided (building 66/67 courtyard)</td>
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<tr>
<td>2:00 – 5:00</td>
<td>Workshop: Using NERSC; logging in, submitting jobs, visualizing data</td>
<td>Childs</td>
<td>UCB campus: Sutardja Dai Hall, Room 250</td>
</tr>
<tr>
<td>evening, 7:00PM</td>
<td>Group dinner, Bistro Liaison (Shattuck and Hearst Avenue)</td>
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</table>
VisIt is an open source, richly featured, turn-key application for large data.

- **Used by:**
  - Visualization experts
  - Simulation code developers
  - Simulation code consumers

- **Popular**
  - R&D 100 award in 2005
  - Used on many of the Top500
  - >>>100K downloads

217 pin reactor cooling simulation
Run on ¼ of Argonne BG/P
Image credit: Paul Fischer, ANL
Terribly Named!!!

... intended for much more than just visualization
What sort of analysis is appropriate for **VisIt**?

- General analysis techniques (e.g. integration, volumes, surface areas, etc.)
- Specialized analysis (e.g. hohlraum flux at AGEX)
VisIt has a rich feature set.

- **Meshes**: rectilinear, curvilinear, unstructured, point, AMR
- **Data**: scalar, vector, tensor, material, species
- **Dimension**: 1D, 2D, 3D, time varying
- **Rendering (~15)**: pseudocolor, volume rendering, hedgehogs, glyphs, mesh lines, etc...
- **Data manipulation (~40)**: slicing, contouring, clipping, thresholding, restrict to box, reflect, project, revolve, …
- **File formats (~110)**
- **Derived quantities**: >100 interoperable building blocks
  - +,-,*,/, gradient, mesh quality, if-then-else, and, or, not
- **Many general features**: position lights, make movie, etc
- **Queries (~50)**: ways to pull out quantitative information, debugging, comparative analysis
VisIt employs a parallelized client-server architecture.

- Client-server observations:
  - Good for remote visualization
  - Leverages available resources
  - Scales well
  - No need to move data

- Additional design considerations:
  - Plugins
  - Multiple UIs: GUI (Qt), CLI (Python), more...

You don’t have to run VisIt this way!
You can run all on localhost
You can tunnel through ssh and run all on the remote machine
VisIt recently demonstrated good performance at unprecedented scale.

- Weak scaling study: ~62.5M cells/core

<table>
<thead>
<tr>
<th>Machine</th>
<th>Model</th>
<th>Problem Size</th>
<th>#cores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Franklin</td>
<td>Cray XT4</td>
<td>1T, 2T</td>
<td>16K, 32K</td>
</tr>
<tr>
<td>Dawn</td>
<td>BG/P</td>
<td>4T</td>
<td>64K</td>
</tr>
<tr>
<td>JaguarPF</td>
<td>Cray XT5</td>
<td>2T</td>
<td>32K</td>
</tr>
<tr>
<td>Juno</td>
<td>X86_64</td>
<td>1T</td>
<td>16K</td>
</tr>
<tr>
<td>Purple</td>
<td>IBM P5</td>
<td>0.5T</td>
<td>8K</td>
</tr>
<tr>
<td>Ranger</td>
<td>Sun</td>
<td>1T</td>
<td>16K</td>
</tr>
</tbody>
</table>

Two trillion cell data set, rendered in VisIt by David Pugmire on ORNL Jaguar machine.
The VisIt team focuses on making a robust, usable product for end users.

- **Manuals**
  - 300 page user manual
  - 200 page command line interface manual
  - “Getting your data into VisIt” manual

- **Wiki for users (and developers)**

- **Revision control, nightly regression testing, etc**

- **Executables for all major platforms**

- **Day long class, complete with exercises**

![Slides from the VisIt class](image)
VisIt is a vibrant project with many participants.

- Over 75 person-years of effort
- Over 1.5 million lines of code
- Partnership between: Department of Energy’s Office of Science, National Nuclear Security Agency, and Office of Nuclear Energy, the National Science Foundation XD centers (Longhorn XD and RDAV), and more....
VisIt: What’s the Big Deal?

- Everything works at scale
- Robust, usable tool
- Features that span the “power of visualization”:
  - Data exploration
  - Confirmation
  - Communication
- Features for different kinds of users:
  - Vis experts
  - Code developers
  - Code consumers
- Healthy future: vibrant developer and user communities
“How to make VisIt work after you get home”

- How to get VisIt running on your machine
  - Downloading and installing VisIt
  - Building VisIt from scratch
- How to get VisIt to read your data
  - Support for shapefiles, NetCDF, HDF5, and 100+ more
- How to get help when you run into trouble

Summary

- VisIt is a richly featured visualization tool that is capable of visualizing data from many different application areas.
  - Truth in advertising: a general interface & it sometimes takes a lot of effort to get the visualization you want.
- VisIt has excellent built in support for large data sets.
- User resources:
  - Main website: http://www.llnl.gov/visit
  - Wiki: http://www.visitusers.org
- Contacts:
  - Hank Childs, hchilds@lbl.gov
  - General VisIt user email list: visitusers@ornl.gov
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- How to run client-server
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Can I use a pre-built VisIt binary or do I need to build it myself?

- Pre-built binaries work on most modern machines.
- ... but pre-built binaries are serial only.
  - Why the VisIt team can’t offer parallel binaries:
    - Your MPI libraries, networking libraries are unlikely to match ours
  - ... and it is difficult to use your own custom plugins with the pre-builts.

- Recommendation: try to use the pre-builts first and build VisIt yourself if they don’t work.
- Also: all VisIt clients run serial-only. If you want to install VisIt on your desktop to connect to a remote parallel machine, serial is OK.
How do I use pre-built VisIt binaries?

A: Go to http://www.llnl.gov/visit
How do I use pre-built VisIt binaries?

Downloads

**Executables**—This page contains versions of VisIt that you can download for Unix and Windows systems.

**Source Code**—This page contains the VisIt source code that you can download if you would like to build a version of VisIt for another system or to modify the source code.

**Manuals**—This page contains the user's manuals that are available, including a getting started manual and user's manual.

**Data Files**—This page contains links to interesting datasets that you can plot with VisIt.
How do I use pre-built VisIt binaries?

**VisIt Executables**

This page contains links to download VisIt executables for Unix, Windows, and Mac OS X systems. The page contains several versions of VisIt, organized from the most recent to the oldest. The unix and Mac OS X executables require downloading an install script along with the file containing the executable. The Windows executables are packaged in a self contained installer. Instructions for installing VisIt can be found in the install notes. Md5 and sha1 checksums, as well as file sizes are provided for checking that the files were properly downloaded if corruption of the files is suspected during the download process.

**VisIt 2.1.0**

- VisIt release notes
- VisIt install script
- VisIt install notes
- VisIt md5 checksums
- VisIt sha1 checksums
- VisIt file sizes

<table>
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<tr>
<th>platform</th>
<th>executable</th>
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<tbody>
<tr>
<td>Linux - x86 32 bit</td>
<td></td>
</tr>
<tr>
<td>Redhat Enterprise Linux 3, hoth.llnl.gov 2.4.21-27.0.2c.ELsmp, gcc 3.2.3</td>
<td></td>
</tr>
<tr>
<td>Will work on most Linux x86 systems.</td>
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<tr>
<td>Linux - x86_64 64 bit</td>
<td></td>
</tr>
<tr>
<td>Ubuntu 8.04, pion.llnl.gov 2.6.24-19, gcc 4.2.4</td>
<td></td>
</tr>
<tr>
<td>Linux - x86_64 64 bit</td>
<td></td>
</tr>
<tr>
<td>Redhat Enterprise Linux 4, photon.llnl.gov 2.6.9-89.0.20.ELsmp, gcc 3.4.6</td>
<td></td>
</tr>
<tr>
<td>Will work on most Linux x86_64 systems.</td>
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</tbody>
</table>
**How do I use pre-built VisIt binaries?**

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<thead>
<tr>
<th>Platform</th>
<th>Description</th>
<th>Download</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Linux - x86_64 64 bit</strong></td>
<td>Ubuntu 8.04, plon.ornl.gov 2.6.24-19, gcc 4.2.4  <strong>Will work on most Linux x86_64 systems.</strong></td>
<td><img src="download" alt="download" /></td>
</tr>
<tr>
<td><strong>Linux - x86_64 64 bit</strong></td>
<td>Redhat Enterprise Linux 4, photon.ornl.gov 2.6.9-89.0.20.ELsm, gcc 3.4.6  <strong>Will work on most Linux x86_64 systems.</strong></td>
<td><img src="download" alt="download" /></td>
</tr>
<tr>
<td><strong>Linux - x86_64 64 bit</strong></td>
<td>Redhat Enterprise Linux 5, yana.ornl.gov 2.6.18-76chaos, gcc 4.1.2  <strong>Will work on most Linux x86_64 systems.</strong></td>
<td><img src="download" alt="download" /></td>
</tr>
<tr>
<td><strong>Linux - x86_64 64 bit</strong></td>
<td>Scientific Linux SL release 5.4, euclid.nersc.gov 2.6.18-164.9.1.el5-bsdv3, gcc 4.1.2</td>
<td><img src="download" alt="download" /></td>
</tr>
<tr>
<td><strong>Windows (Xp / Vista / 7) 32 bit</strong></td>
<td>MSVC8, Visual Studio 2005  <strong>Includes parallel VisIt compatible with MacOS X 10.5’s default MPI</strong></td>
<td><img src="download" alt="download" /></td>
</tr>
<tr>
<td><strong>Mac OS X - Intel</strong></td>
<td>Darwin 10.5, Darwin Kernel Version 9.7.0, gcc 4.0.1, OpenMPI  <strong>Includes parallel VisIt compatible with MacOS X 10.5’s default MPI</strong></td>
<td><img src="download" alt="download" /></td>
</tr>
<tr>
<td><strong>Mac OS X - Intel 64 bit</strong></td>
<td>Darwin 10.6.3, Darwin Kernel Version 10.3.0, gcc 4.2.1, OpenMPI  <strong>Includes parallel VisIt compatible with MacOS X 10.6’s default MPI</strong></td>
<td><img src="download" alt="download" /></td>
</tr>
<tr>
<td><strong>Mac OS X - Intel</strong></td>
<td>Darwin 10.4</td>
<td><img src="download" alt="download" /></td>
</tr>
<tr>
<td><strong>AIX - 32 bit</strong></td>
<td>AIX 5.3, up.ornl.gov 00C5D6DD4C00, xlc</td>
<td><img src="download" alt="download" /></td>
</tr>
<tr>
<td><strong>AIX - 64 bit</strong></td>
<td>AIX 5.3, up.ornl.gov 00C5D6DD4C00, xlc</td>
<td><img src="download" alt="download" /></td>
</tr>
<tr>
<td><strong>Java client library (jar file, compiled classes, source code, examples)</strong></td>
<td></td>
<td><img src="download" alt="download" /></td>
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</table>
How do I use the pre-built VisIt binaries?

- **Unix:**
  - Download binary
  - Download install script
  - Run install script
  - --or—
  - Download binary
  - Untar
  - Good for host profiles, maintaining multiple versions, multiple OSs
  - Quick & easy

- **Mac:**
  - Download and open disk image.
  - Follow instructions in the README file: run included install script

- **Windows:**
  - Download installer program & run

- **Full install notes:**
  - [https://wci.llnl.gov/codes/visit/2.2.1/INSTALL_NOTES](https://wci.llnl.gov/codes/visit/2.2.1/INSTALL_NOTES)
Important step: choosing host profiles

- Many supercomputing sites have set up “host profiles”.
  - These files contain all the information about how to connect to their supercomputers and how to launch parallel jobs there.

- You select which profiles to install when you install VisIt.

- Profiles that come with VisIt:
  - NERSC, LLNL Open, LLNL Closed, ORNL, Argonne, TACC, LBNL desktop network, Princeton, UMich CAC

- Other sites maintain profiles outside of VisIt repository.
  - If you know folks running VisIt in parallel at a site not listed above, ask them for their profiles.
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Building VisIt from scratch

- Building VisIt from scratch on your own is very difficult.
- ... but the "build_visit" script is fairly reliable.

Automatically build VisIt with the build_visit script!

Download build_visit script here.

VisIt can now be built automatically using the build_visit script on many Linux, MacOS X, and AIX platforms (more to come). The build_visit script takes care of downloading relevant VisIt and 3rd party source code, configuring, and building it all using your C++ compiler. We encourage users to build VisIt using the build_visit script when our binary distributions have trouble running on some systems. We also recommend using the build_visit script on your system if you plan to:

- Modify the VisIt source code.
- Run a parallel compute engine. Building a parallel version of VisIt on your system allows you to configure VisIt so it uses your MPI library, avoiding incompatibilities.
- Create your own VisIt plugins. Building VisIt on your system ensures that it is built with the same C++ compiler that you will use to develop your plugin, minimizing the chance for runtime library incompatibilities.
What “build_visit” does

- Downloads third party libraries
- Patches them to accommodate OS quirks
- Builds the third party libraries.
- Creates “config-site” file, which communicates information about where 3rd party libraries live to VisIt’s build system.
- Downloads VisIt source code
- Builds VisIt
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How to get help when you run into trouble

- Six options:
  - FAQ
    - http://visit.llnl.gov/FAQ.html
  - Documentation
    - https://wci.llnl.gov/codes/visit/doc.html
    - http://www.visitusers.org
  - VisIt-users mailing list
  - VisIt-users archives
  - VisIt users forum
  - VisIt-help-XYZ mailing list
FAQ: http://visit.llnl.gov/FAQ.html

Frequently Asked Questions

1. Contact information
2. Supported platforms
3. Optimal hardware/software
4. Debugging problems starting VisIt or opening files
5. Stereo rendering
6. VisIt won't run on Linux
7. Slow performance on Linux
8. Slow performance using SSH
9. No output in visualization window
10. Accessing data on remote machine
11. Running VisIt in parallel
12. Supported data file formats
13. Getting your data into VisIt
14. Making a movie of your data
15. Setting your user name to connect to a remote machine
16. Cannot connect to a remote computer
17. Building VisIt on a Windows computer
18. Installing VisIt on a MacOS X computer
19. Hanging at 12% on Windows computers
20. Getting the Plugin Developer's Guide
21. Writing a plugin for VisIt
22. When new versions of VisIt are released
23. What is new in the latest version of VisIt
24. Compilers that can be used to build VisIt
25. VisIt's licensing agreement
26. Slow performance with ATI cards on Linux
27. Custom plugins with a downloaded VisIt binary
28. Getting HDF5 data into VisIt
29. Getting NETCDF data into VisIt
30. When I run VisIt on my Linux machine, I get a black screen
31. I get the message 'Publisher cannot be verified' when installing VisIt on Windows
32. Which libraries should I enable in build_visit?
Manuals & other documentation

- Getting started manual
- Users manual (old, but still useful)
- Python interface (to be updated in two weeks)
- Getting Data Into VisIt
- VisIt Class Slides
- VisIt Class Exercises
- This Tutorial
Visitusers.org

- Users section has lots of practical tips:
  - “I solved this problem with this technique”
  - “Here’s my script to do this functionality”
- In practical terms, this is a staging area for formal documentation in the future.

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<td>- Using derived data functions (DDFs)</td>
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<td>- Using the command line interface</td>
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<td>- How volume rendering works in VisIt</td>
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<td>- Using cross-mesh field evaluations ... how to do differences, access other time slices, etc</td>
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<td>- Keyframing example</td>
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<td>- Using the VisIt Python API with a standard Python interpreter</td>
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<td>- Pages that contain instructions specific to certain user groups and needs</td>
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<td>- Issues related to running VisIt on Windows under cygwin</td>
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<td>- VisIt's Camera model</td>
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<td>- Using VisIt's mpeg2encode</td>
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<td>- Molecular data features</td>
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<td>- Extracting alpha</td>
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<td>- (Very) High resolution rendering</td>
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<td>- Elevating shapefiles</td>
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<td>- Raytracing your visualizations with POV-Ray and a tutorial</td>
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<td>- POV-Ray exporting example</td>
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</table>
VisIt-users mailing list
You may only post to mailing list if you are also a subscriber
Approximately 400 recipients, approx. 300 posts per month.
Developers monitor mailing list, strive for 100% response rate
Response time is typically excellent (O(1 hour))

International community really participates … not unusual for a question from Australia to be answered by a European all while I’m asleep

List: visit-users@ornl.gov
More information: https://email.ornl.gov/mailman/listinfo/visit-users
Archive: https://email.ornl.gov/pipermail/visit-users/
VisIt User Forum

Increasingly popular option; you can post without receiving 300 emails a month. But it is viewed by less people and less well supported.

http://www.visitusers.org/forum

Google searches these pages.

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pseudocolor plot legend attributes in python (Read 18 times)

Jennifer [YaBB Newbies]

11/07/10 at 19:06:30

Hello. I want to set the attributes for a pseudocolor plot legend in a python script such as the location of the legend (turn off Let VisIt manage legend position), the X-scale & Y-scale, the number of Tic Marks, and the label appearance (number format, font height). Is it possible to set these properties in a python script? If so, how can I do this?

I tried to use the Command Control to record these changes, but the output states:
"# Logging for AddAnnotationObject is not implemented yet.
# Logging for SetAnnotationObjectOptions is not implemented yet."

Thanks,
Jennifer

---

Hank Childs [YaBB Moderator]

11/07/10 at 19:47:03

Hello Jennifer,

Each plot has an index and the plot's legend is referred to through that same index.

```python
>>> GetAnnotationObjectNames()
('Plot0003',)
>>> a = GetAnnotationObject("Plot0003")
>>> a
active = 1
managePosition = 1
position = (0.05, 0.9)
xScale = 1
yScale = 1
```
Visit-help-xyz

- Some customer groups pay for VisIt funding and get direct support.
  - These customers can post directly to visit-help-xyz without being a subscriber
  - The messages are received by all VisIt developers and supported collectively

- Lists:
  - Visit-help-asc, visit-help-scidac, visit-help-gnep, visit-help-ascem
Introduction to visualization with

Hank Childs, LBNL
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