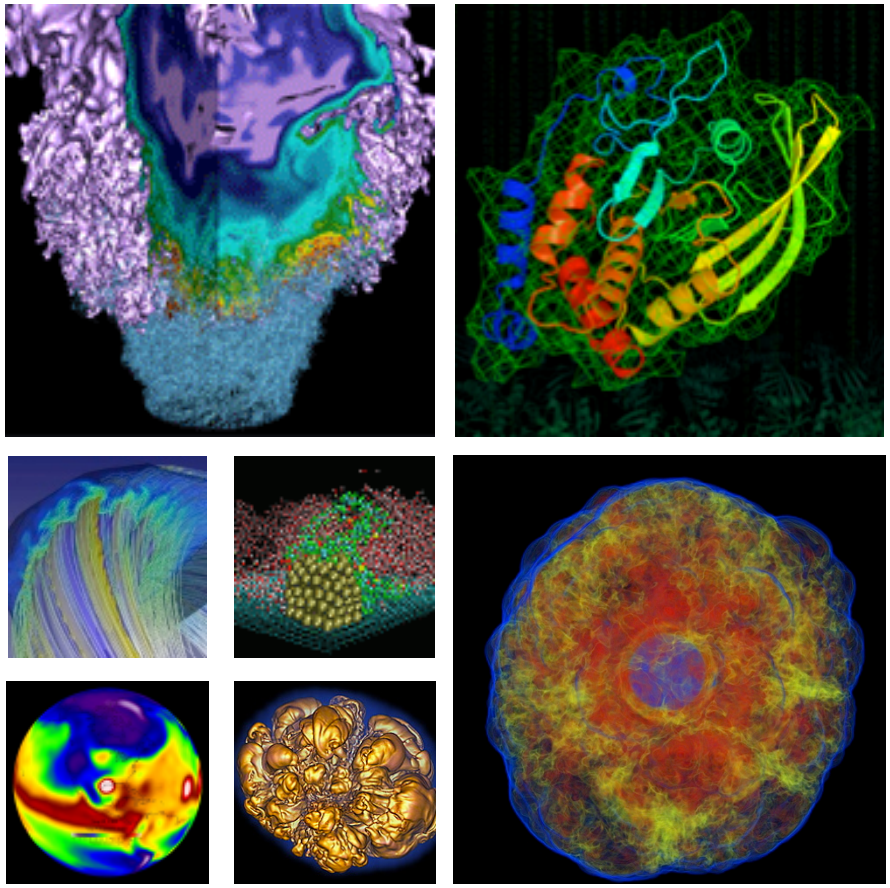
Git + Docker tutorial



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Preamble

- **This presentation, the tutorial material**
  - https://bitbucket.org/TWildish/git-docker-tutorial/get/master.zip
  - https://www.nersc.gov/users/computational-systems/genepool/genepool-training-and-tutorials/
- **Pre-requisites**
  - See https://bitbucket.org/TWildish/git-docker-tutorial/overview
  - Please tell me you did that already ☺
- **Today:**
  - 3:00 – 4:00: git overview + hands-on exercises
  - 4:00 – 5:00: docker overview + hands-on exercises
  - Familiarity with what's possible, rather than a deep-dive
  - Worked examples of how to do things

This tutorial

- **Git**
  - Basics of repositories, local and remote
  - How to recover from mistakes
  - Working with branches
  - Working with teams
- **Docker**
  - Various ways to run & manage docker containers
  - A real bioinformatics application example
    - Thanks to Michael Barton
  - How to get data into/out of a docker container
  - How to build a simple docker container
  - Shifter – docker on Cori, Edison, and (eventually) Genepool

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Git history

- **Git is a 'Version Control System', (VCS)**
- **Git manages collections of files (text, small binaries)**
  - Tracks their history, versions
  - Tracks multiple development paths
  - Lets you recover previous versions
- **Git is *the* VCS, don't bother with anything else**
  - **CVS**: Concurrent Version System -> completely obsolete
  - **SVN**: SubVersioN -> mostly obsolete (should be!)
- **Designed by Linus Torvalds (he who gave us Linux!)**
- **Q: What does 'git' stand for?**

Why use git?

- **Security**
  - Never lose your code again
  - Code is safe against disk failure/earthquakes/meteors
- **Convenience**
  - Easily deploy your code in several places
  - Easily manage several versions (prod, dev, …)
- **Community**
  - Share your code with others
  - Accept bug-fixes & contributions in controlled manner
- **Did I mention…**
  - Never lose your code again

Git components

- **Command-line interface, the 'git' command**
- **Server 'hosting' platforms, web-interface, API**
  - Github.com: the original git hosting service
  - Bitbucket.com: used by LBNL/JGI
  - Gitlab.com: recent platform with continuous integration
- **Hosting platforms bring added value**
  - Issue tracking: bug reports, coupled to git history
  - Wiki: managing documentation
  - Team mgmt: different roles (admin, developer, user)
  - Access mgmt: read/write, read-only, private, public
  - 'web-hooks': perform custom actions based on triggers

Git concepts

- **Repository**
  - **Local** or **remote**, a place where git keeps your files
    - On your **local** disk, or on a **remote** server
- **Working area**
  - Part of your local repository, you edit your code there
- **Staging area**
  - Part of the local repository where git tracks changes to your working area
- **Branches, tags**
  - Ways to manage sub-groups of files in a repository

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Git workflow

- **Change files in your working area**
- **Tell git about the changes**
  - This adds the files to the 'staging area'
  - At this point, still possible to undo, leaving no trace
- **Commit those changes**
  - Make them permanent, add them to the repository
  - Now those changes can be recovered, anytime later
- **Push the changes to a remote repository**
  - Copy your local repository to a remote server
  - Now you have a remote backup

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More git concepts

- **Clone**
  - A local copy of a remote repository
  - You can change the clone – you own it
  - Access to remote repository controlled by its owner
- **Fork**
  - A remote copy of another remote repository
  - You own the fork, which you can now clone and change
- **A non-concept: 'The Central Repository'**
  - Git is completely decentralized
  - Can work with multiple remote repositories, simultaneously
- **Confused?**
  - Let's get stuck into the exercises...

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Git exercises

- **Cookbook approach:**
  - Can cut-&-paste, but better to type in commands yourself
- **Today: do exercises 1, 3, and 4 if you have time**
  - **1) Basic Commit and Tag**
  - 2) Undoing Mistakes
  - **3) Using A Remote Repository**
  - **4) Using Branches**
  - 5) Working in Teams
- **Feel free to work through the rest at your own pace**

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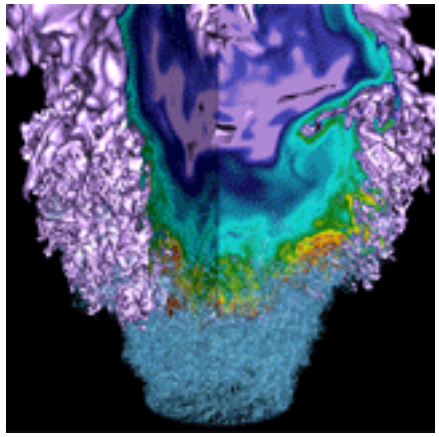
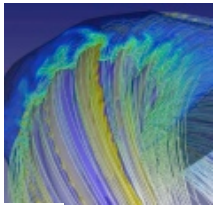
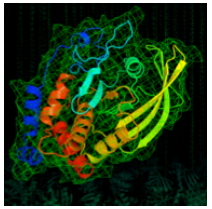
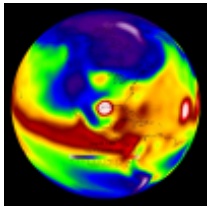
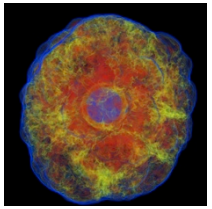
Docker

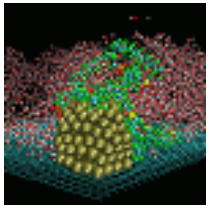












Docker overview

- **Docker is a 'container technology'**
  - Linux-specific
    - can't run Mac OSX, Windows in docker containers
    - But *can* run docker containers on Mac OSX & Windows
- **Similar to virtual machines, but more lightweight**
  - Smaller, faster to start, easier to maintain and manage
  - Lighter on system resources => vastly more scalable
- ***Not* a virtual machine**
  - Shares the underlying host operating system
  - Less fully isolated from the host => security concerns
  - More of an application-wrapper on steroids

Docker components

- **The 'docker' command-line tool**
  - A bit of a kitchen-sink, your one-stop shop for everything docker
- **The docker-daemon**
  - Works behind the scenes to carry out actions
  - Manages container images, processes
  - Builds containers when requested
  - Runs as root, not a user-space daemon
- **Docker.com**
  - All things docker: installation, documentation, tutorials
- **Dockerhub.com**
  - Repository of docker containers. Many other repositories exist

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Docker concepts

- **Image**
  - A shrink-wrapped chunk of s/w + its execution environment
- **Image tags**
  - Identify different versions of an image
  - A namespace for separating your images from other peoples
- **Image registry**
  - A place for sharing images with a wider community
  - Dockerhub.com, plus some domain-specific registries
- **Container**
  - A process instantiated from an image
- **Dockerfile**
  - A recipe for building an image: download, compile, configure…
  - Can share either the Dockerfile, or the image, or both

Docker images: layers

- **Images use the 'overlay filesystem' concept**
  - Image is built by adding layers to a base
  - Each command in the Dockerfile adds a new layer
  - Each layer is cached independently
  - Layers can be shared between multiple images
  - Change in one layer invalidates all following layers
    - Forces rebuild (similar to 'make' dependencies…)
- **Performance considerations**
  - Too many layers can impede performance
  - Too few can cause excessive rebuilding
  - Building production-quality images takes care, practice

Docker exercises

- **Again, a cookbook approach**
- **Today: 1, 3 and 4 are most interesting**
  - **1) Running Images**
  - 2) Cleaning up
  - **3) Running a Biobox Container**
  - **4) Creating a Docker Image**
  - 5) Running on Cori with Shifter

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