Using Git and CMake to bring order out of chaos

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Fall 2012 Training Session – November 5th, 2012

Introduction

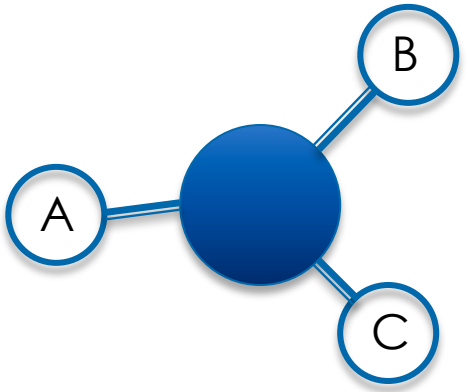
- Principles of revision control
  - Reasons and methods of revision control
  - Existing systems and Git's place among them
  - Git basics
  - Local and remote repositories, free services
  - The way of collaboration
- Principles of a build system
  - From the source to the results
  - Overview of the build systems
  - Introduction to Cmake
  - Sample workflow walk-through

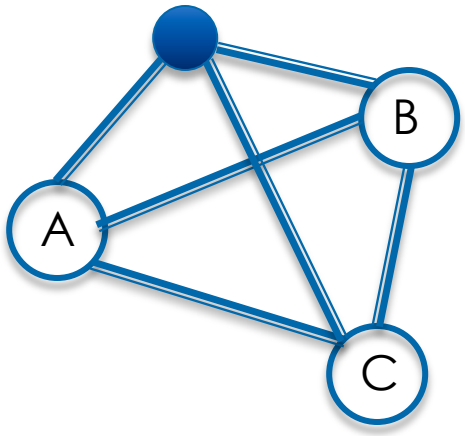
Revision Control Systems

- Goals:
  - Preserve, display and replay history
    - Undo
    - Backup
    - Track
    - Find problems
  - Enable concurrent development:
    - Version all changes
    - Accept changes from multiple developers
    - Resolve conflicting changes
    - Enable multiple branches of development

Types of RCSs

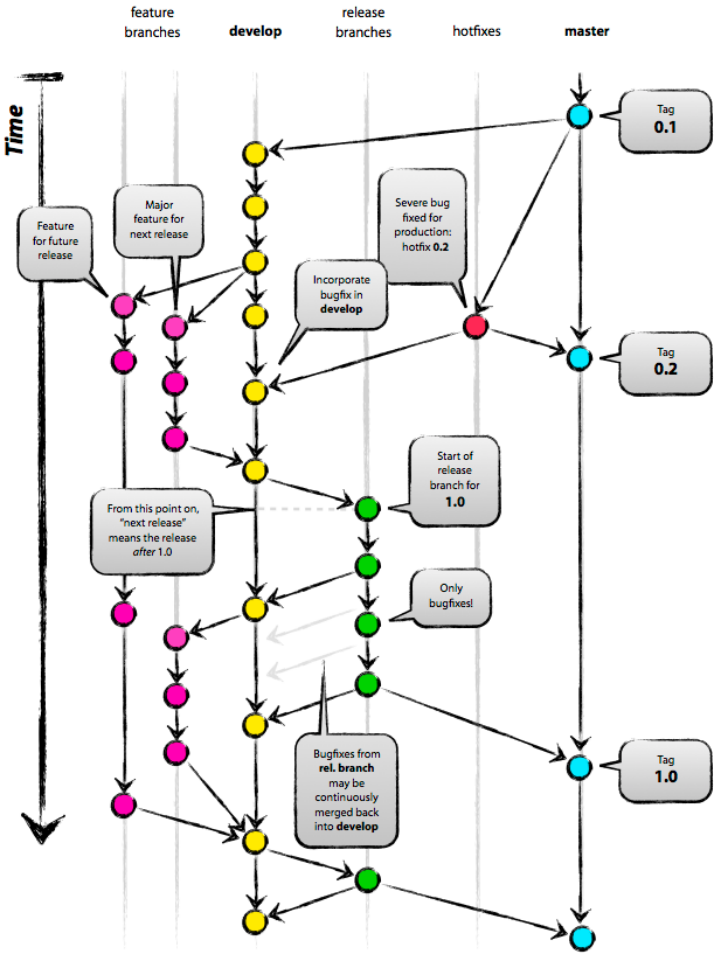
- Centralized:
  - CVS
  - Subversion
  - Perforce
- Distributed:
  - Svk
  - Mercurial
  - Bazaar
  - Git





Git – king of the hill

- Distributed:
  - Decentralized but centralized
- Flexible
- Documented
- Scalable
- Supported
- Services
- Branch/merge model



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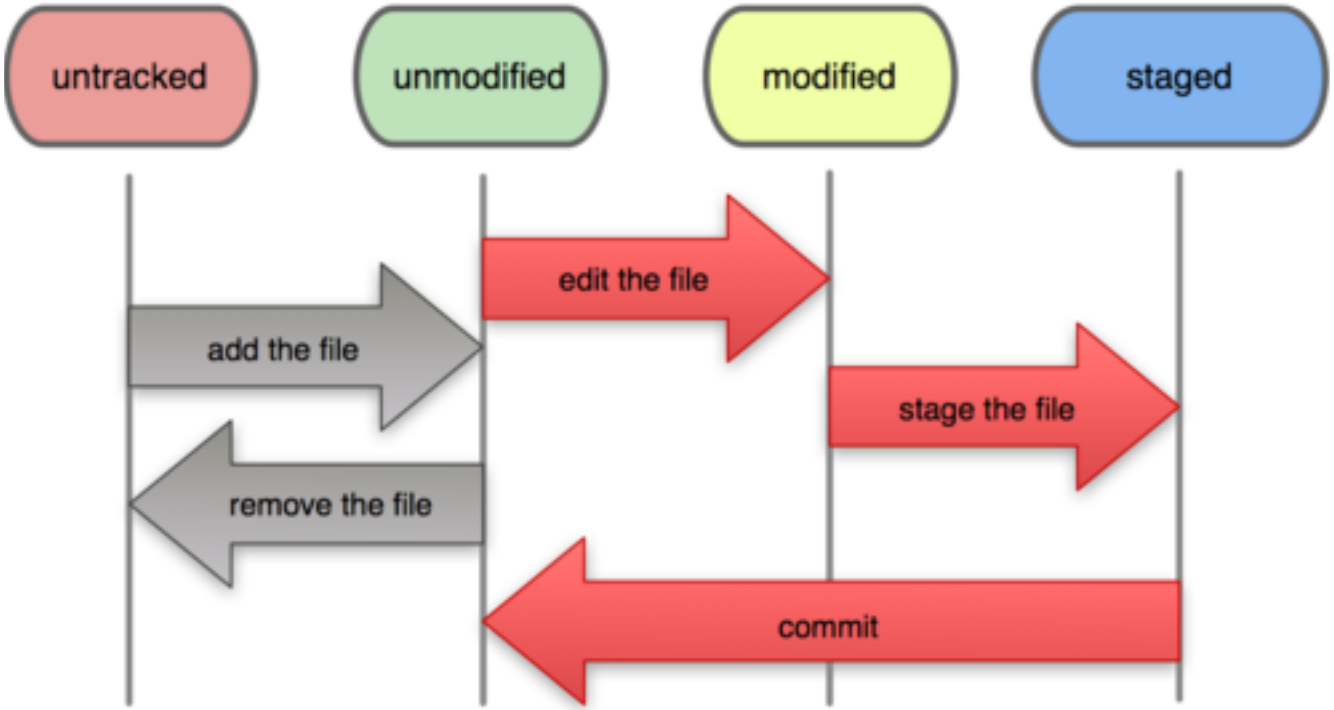
The "Git" cycle



The "Git" cycle

Hands on

Hosting services

- Github
  - https://github.com/
  - Unlimited free public repositories
  - $7/Mo/5 private repositories and up
- Gitorious
  - http://gitorious.org/
  - Free public repositories
- Bitbucket
  - https://bitbucket.org/
  - Unlimited private repositories for up to 5 users
  - $10/Mo/10 users and up

Hosting Git repositories - DIY

- Filesystem
  - "git clone file:///scratch/hpc/$USER/git/project.git"
- Access-control systems (Gitosis, Gitolite)
  - "git clone ufrc@git.hpc.ufl.edu:training.git"

  or
  - git remote add ufrc ufrc@git.hpc.ufl.edu:training.git
  - git push

Git – find problems

- git bisect start
- git bisect good 852df3c
- git bisect bad 185e4a2

  Use

- git bisect good

  and

- git bisect bad

Until the offending revision is located

- git bisect reset

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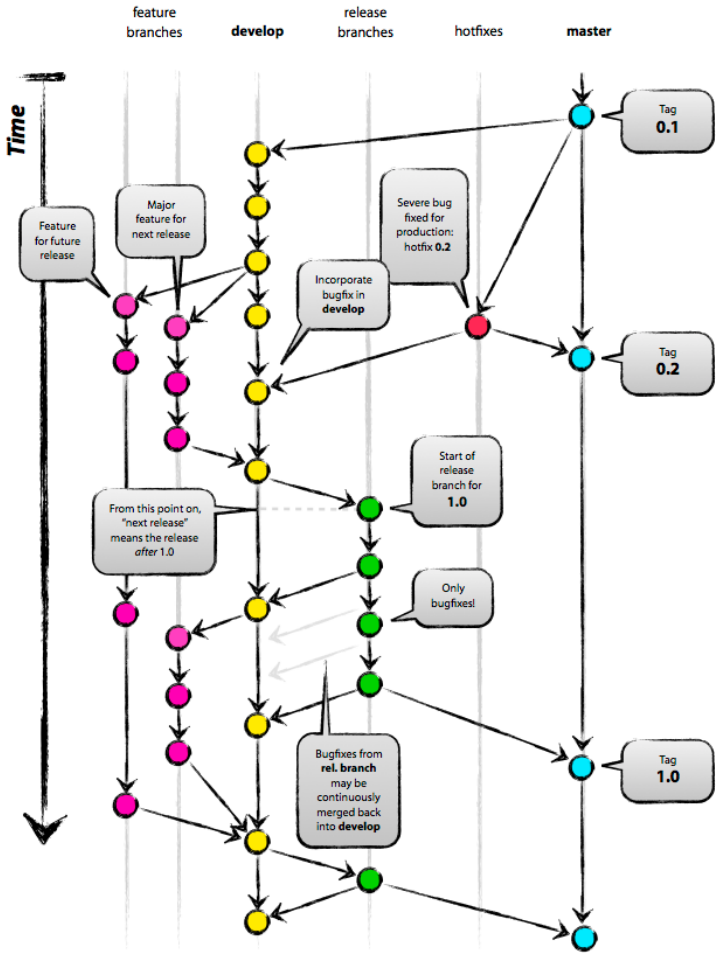
Collaboration with Git



Collaboration with Git

Hands on

Git collaboration - conflicts

- Strategy depends on activity
  - Infrequent changes:
    - Pull, resolve, commit, push
  - Frequent changes
    - Choose a designated driver who will
    - Pull from other people's repositories
    - Merge and push into the master repository

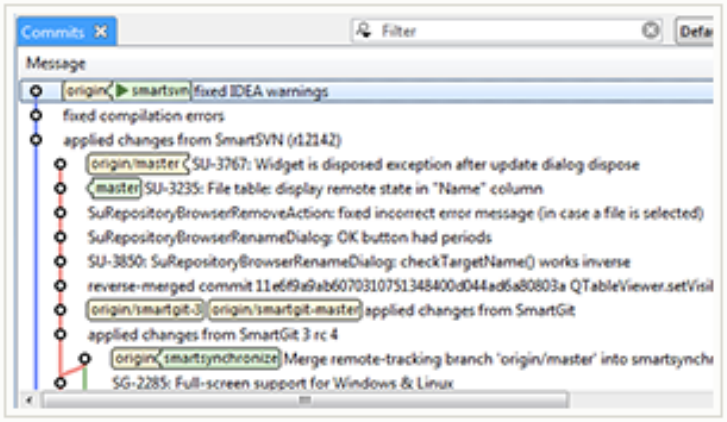
Branching is wonderful!

GUI Client software - Mac

http://git-scm.com/downloads/guis

http://www.sourcetreeapp.com/

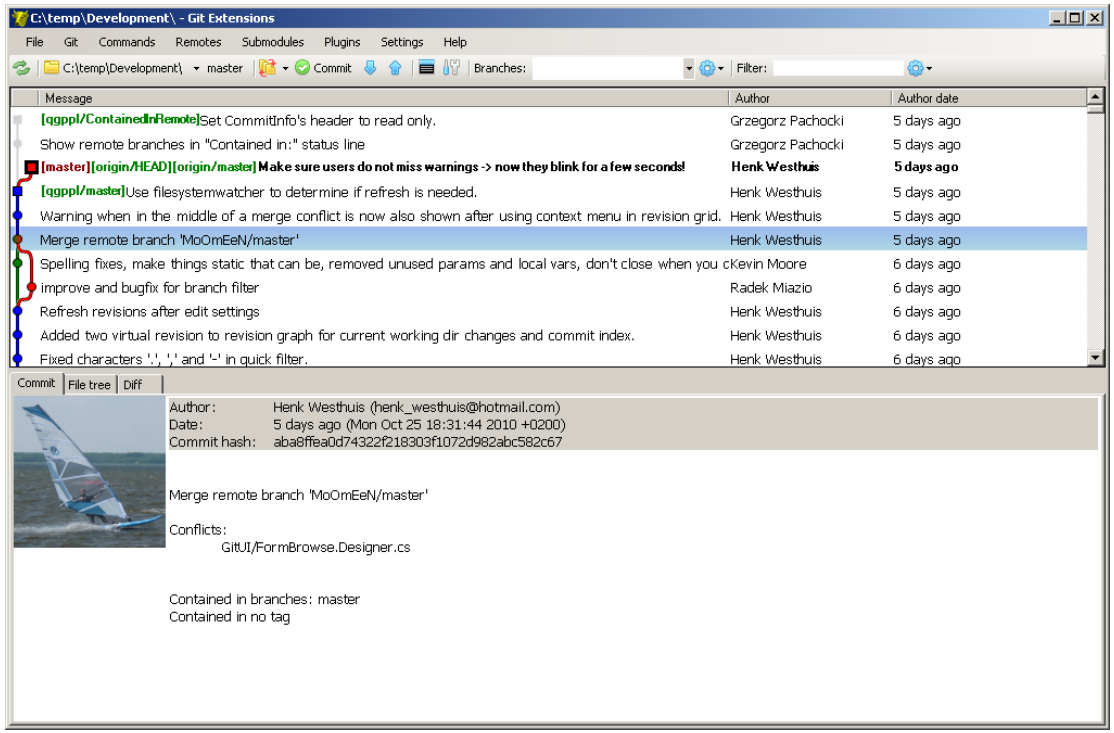
SourceTree
Platforms: Mac
Price: Free



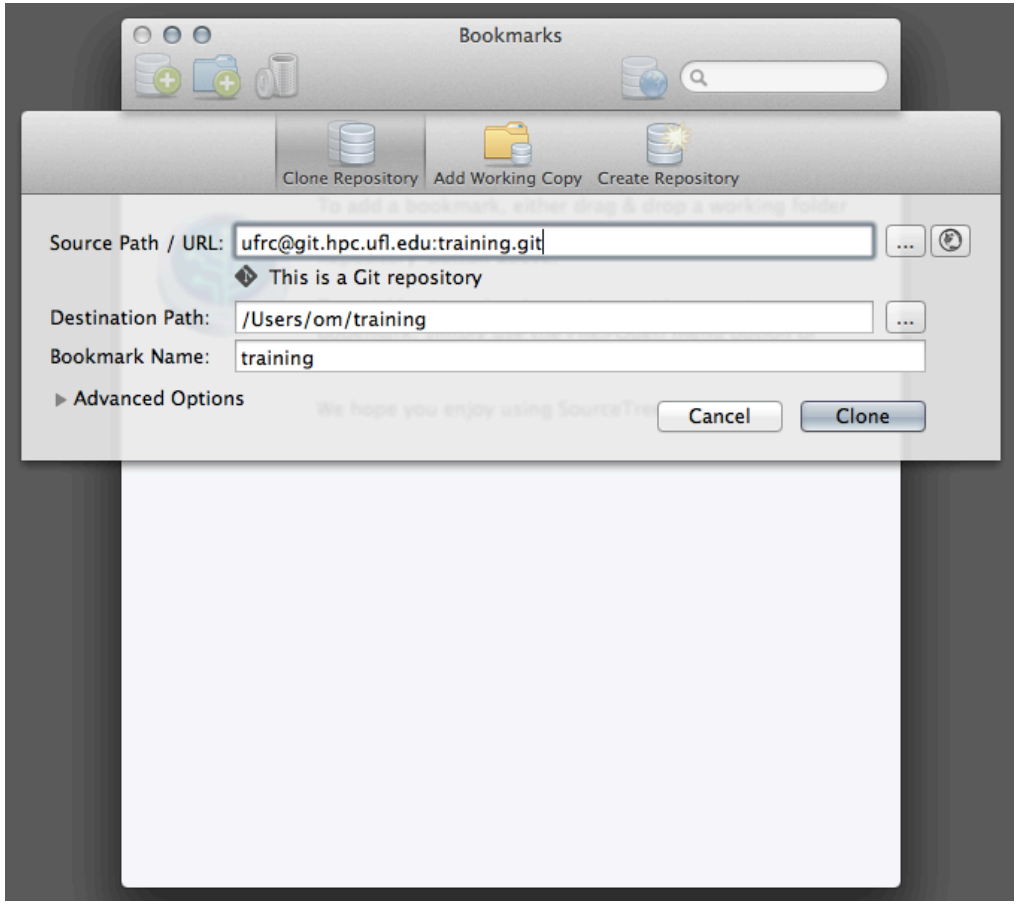
GUI Client software - Win

http://git-scm.com/downloads/guis

http://git-cola.github.com/ http://code.google.com/p/gitextensions/



GUI Client software - SourceTree



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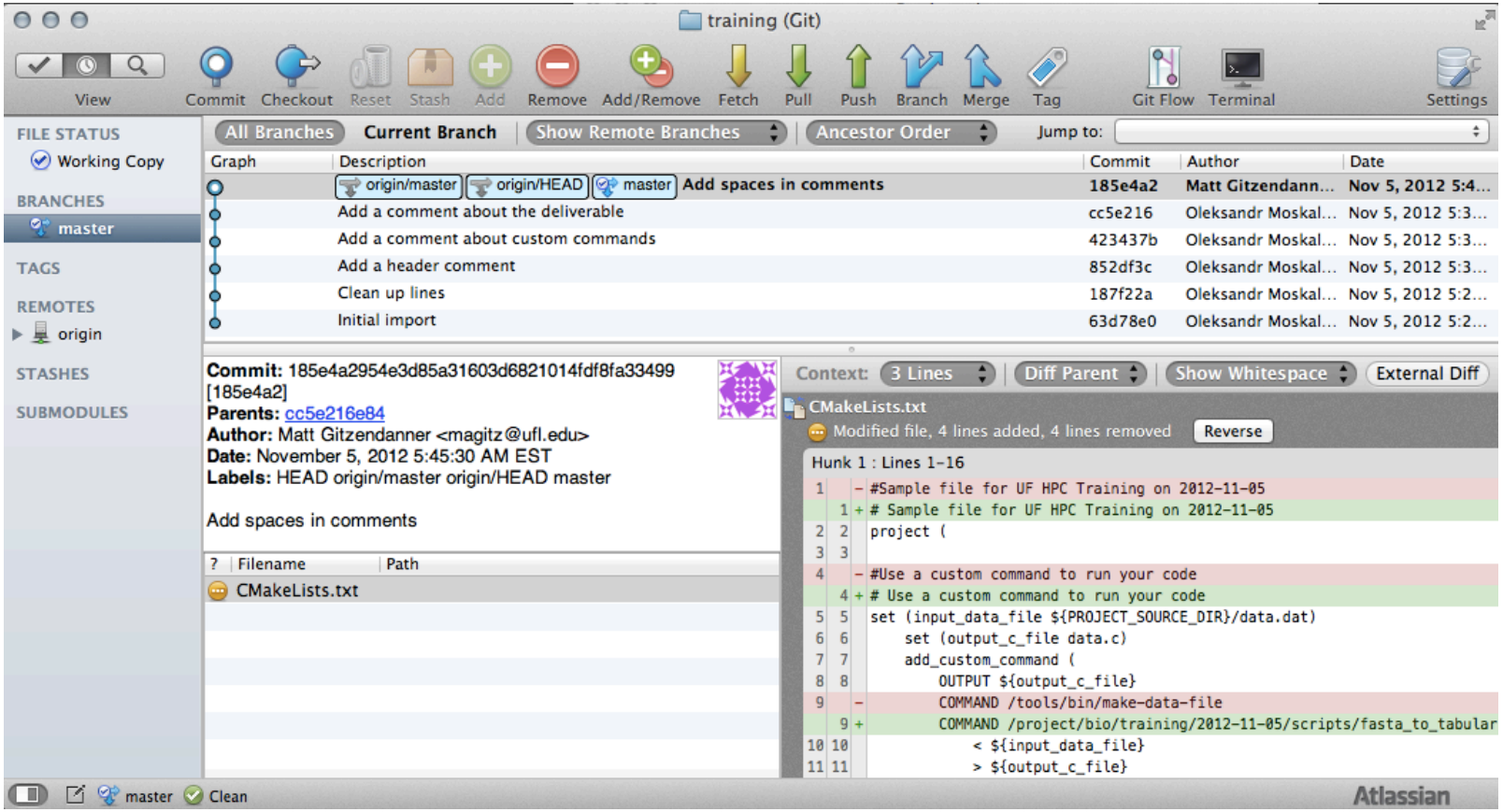
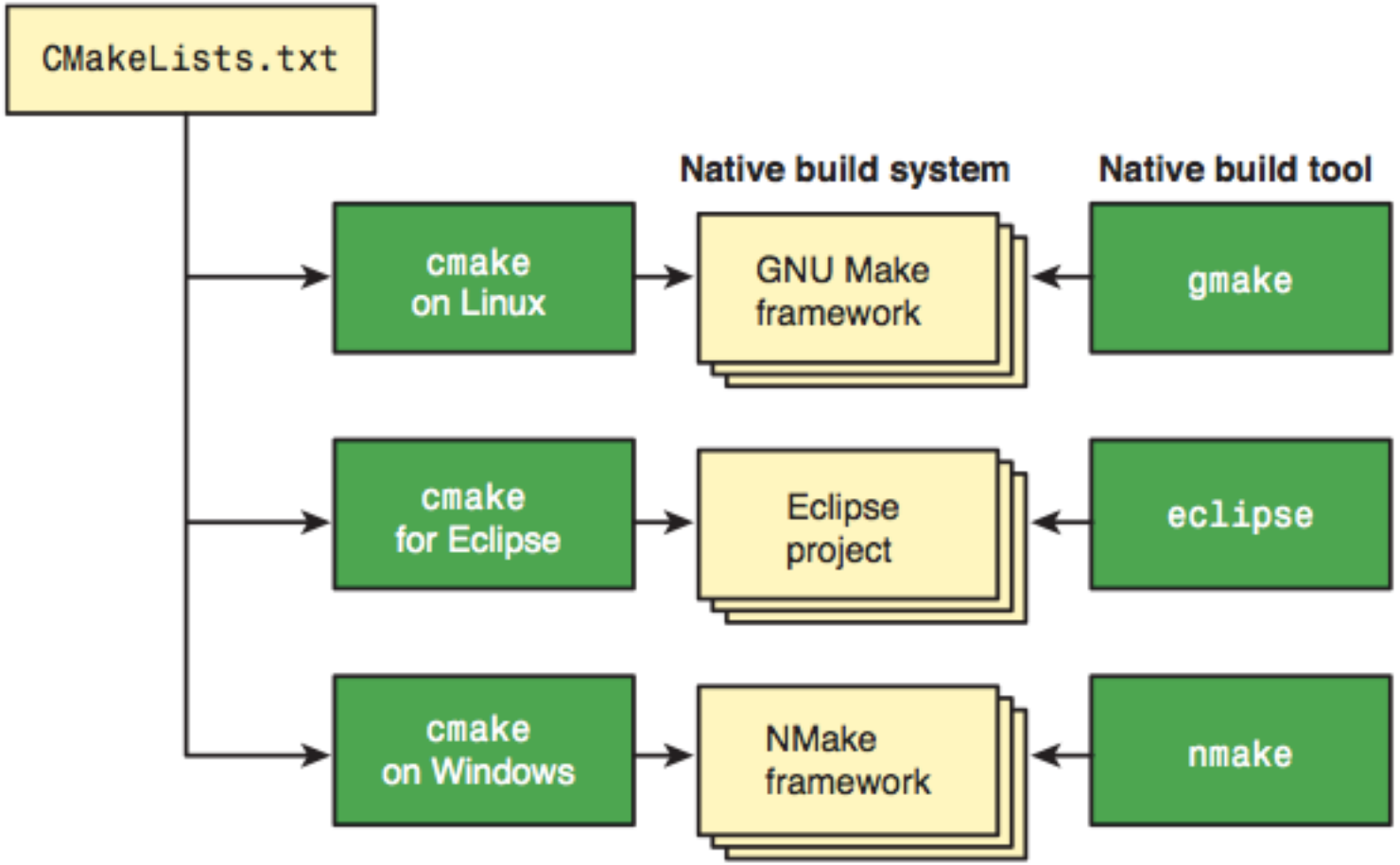


Build Systems

- Goal:
  - Convert data from inputs into outputs
  - Software development
    - Compile source code into executable binaries
    - Package scripts
    - Build and package web applications
    - Run tests on the code
    - Run analysis tools
    - Generate documentation

Sounds familiar?

CMake workflow overview



Peter Smith, Software build systems: Principles and Experience, 2011

CMake Usage - Introduction

- Contains all directives for building your project
- Allows in and out of tree builds
- Creates a native build system i.e.
- “make” on Linux, “nmake” on Windows etc

CMake Usage – directory structure

- /project/bio/training/2012-11-05:
  - CMakeLists.txt
  - bin
  - input
  - output
  - work

Append path to the "bin" directory to $PATH in the environment or use "FIND_PROGRAM" commands in CMakeLists.txt

CMake Usage – run commands

- mkdir output
- cd output
- cmake ..
- make

CMakeLists.txt sample

```
CMAKE_MINIMUM_REQUIRED(VERSION 2.8.0)
PROJECT (MetagenomicsStart)
SET(CMAKE_PREFIX_PATH ${CMAKE_SOURCE_DIR})

 FIND_PROGRAM(TRIM_SEQ short_reads_trim_seq.py)
 ADD_CUSTOM_COMMAND(
    COMMENT "Select high-quality sequences"
    OUTPUT ${CMAKE_SOURCE_DIR}/work/high_quality.fa
    COMMAND ${TRIM_SEQ} 20 50 ${CMAKE_SOURCE_DIR}/work/high_quality.fa $
{CMAKE_SOURCE_DIR}/input/input.fa ${CMAKE_SOURCE_DIR}/input/input.qual ye + s
    DEPENDS ${CMAKE_SOURCE_DIR}/input/input.fa
    )
 ADD_CUSTOM_TARGET(high_qual_fa ALL DEPENDS ${CMAKE_SOURCE_DIR}/work/
high_quality.fa)

/and so on/
```

CMake Run

```
Scanning dependencies of target high_qual_fa
[  6%] Select high-quality sequences
[  6%] Built target high_qual_fa
Scanning dependencies of target high_qual_read_fa
[ 13%] Convert HQ fasta to tab
[ 20%] Add 'readXX' column
[ 26%] Convert tab to fasta
[ 33%] Built target high_qual_read_fa
Scanning dependencies of target high_qual_read_len
[ 40%] Compute length
[ 66%] Built target high_qual_read_len
Scanning dependencies of target high_qual_tab
[ 80%] Built target high_qual_tab
Scanning dependencies of target high_qual_tab_read
[100%] Built target high_qual_tab_read
```

CMake Outputs

high_quality.fa
high_quality_read.fa
high_quality_read.len
high_quality_read.tsv
high_quality.tsv

CMake – to bash or not to bash?

- A simple build looks like more complex then an equivalent shell script
- Advantages:
  - More consistent rules when pipelines get bigger
  - Automatically provided variables
  - Build proceeds along a dependency graph
  - If a step fails – subsequent builds will continue from the correct step automatically
  - Out of tree builds are clean automatically
  - Portable – native build system generation
  - ?

Questions?

Thank you?