Computers
Fundamentals of Programming

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Understanding your application

- While developing/maintaining code, it is extremely important!!
- Have in mind:
  - Goal of the application
  - Algorithms
  - Data structures
  - Which services it uses from the system
  - Structure of the source code
    - Directory structure
    - Header files
    - Source files
  - Structure of the binary files
    - When compiled

Understanding your application

- Example...  Geany git

data	Theme improvements (#1382)
doc	manual: added documentation about replacement of 'untitled.ext' with ...
icons	icon: regenerate png/ico files based on the svg
m4	Update Scintilla to version 3.7.5 (#1503)
plugins	filebrowser: Don't change directory on project save
po	Small update of German translation
scintilla	Update Scintilla to version 3.7.5 (#1503)
scripts	Update Scintilla to version 3.7.5 (#1503)
src	Merge pull request #1748 from kugel-/msgwin-api
tests	bash may not found in the system (#1574)

Understanding your application

- autotools
- src
- include
- libs

Makefile.am	Merge pull request #1095 from eht16/issue1076_win32_build_working_dir...
about.c	Remove a space (#1790)
about.h	Normalize use of header guards and extern "C" guards
app.h	Add utils_get_real_path() and use it
build.c	Work around a `-Wformat-overflow` warning
build.h	doxygen: various doxygen-related fixes in preparation for gtkdoc gene...
callbacks.c	Show status message on attempt to execute empty context action.
callbacks.h	Allow to set a keybinding for File->Properties
dialogs.c	Fix canceling keybinding overriding by discarding the dialog
dialogs.h	Protect private definitions by the GEANY_PRIVATE macro in headers
document.c	Add missing space in string. Fixes #1789
document.h	Added option to auto reload files changed on disk (#1246)
documentprivate.h	Add support for Keyed Data Lists for documents
editor.c	Remove some unused variables

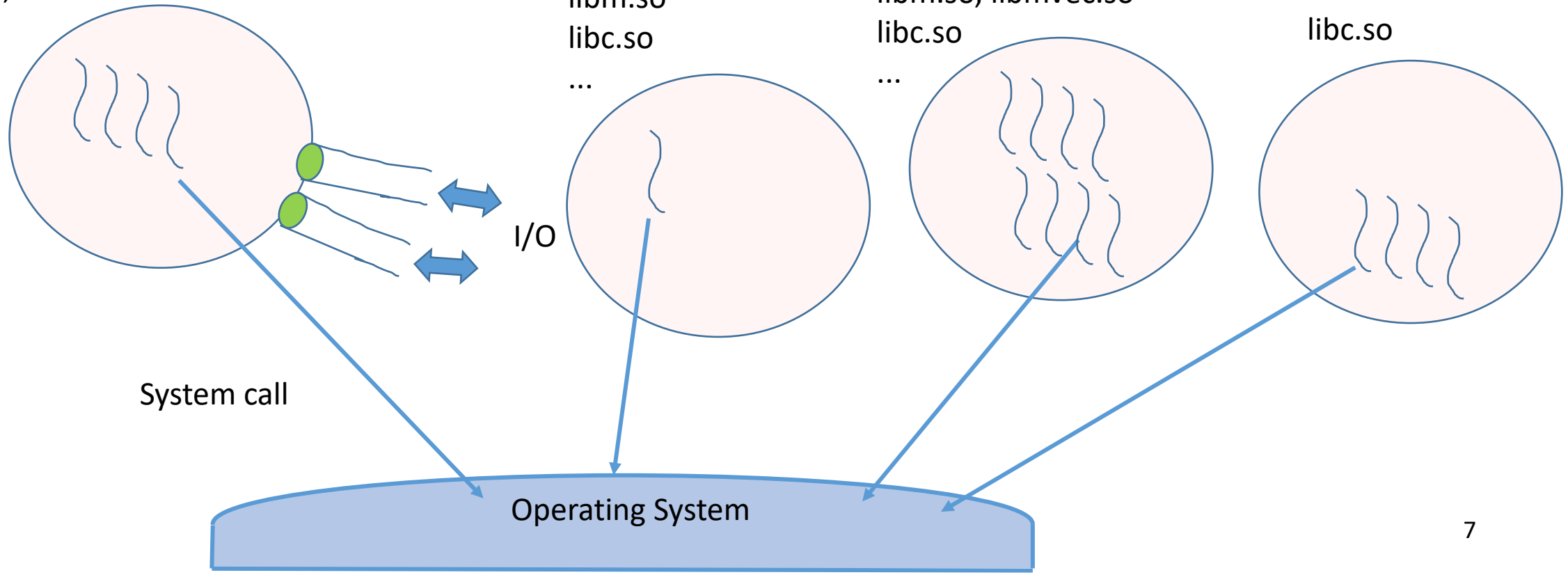
Library support according to language and OS

python: **libpython3.6m.so**
libpthread.so
libdl.so
libm.so, libmvec.so
libc.so

xclock: **libX11.so**
libXext.so
libm.so
libc.so
...

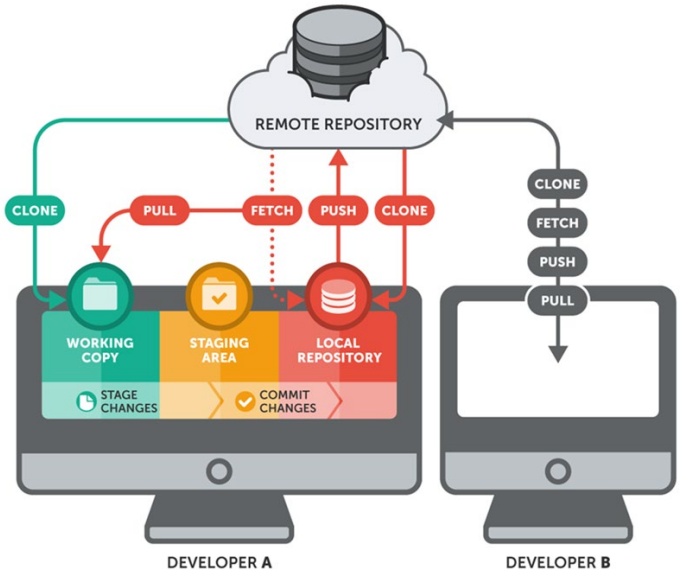
cpmd.x.omp: libmpi.so
libgfortran.so
libpthread.so, **libgomp.so**
libm.so, libmvec.so
libc.so
...

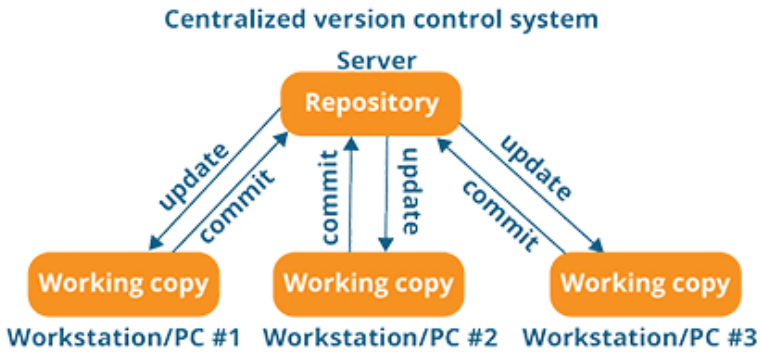
perl: libdl.so
libcrypt.so
libpthread.so
libm.so
libc.so

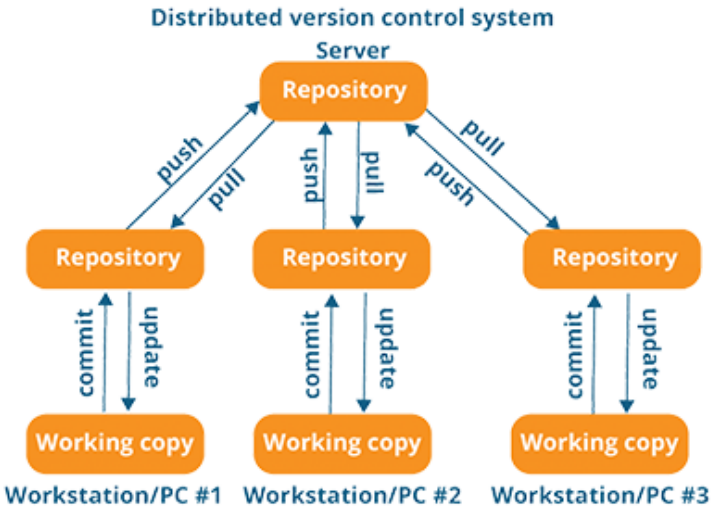


Code Version Management

- Version Control tools
  - A set of tools that help to keep track of changes in code using a hierarchy of internal structures and files that help to manage different concurrent versions of code
    - Centralized Version Control System (e.g. cvs, svn): there is a single copy of the **repository** (i.e. all code versions)
    - Distributed Version Control System (e.g. **git**, Mercurial): there are multiple copies of the repository
  - There are web-accessible repositories where people/companyies manage code
    - E.g.: Github, Gitlab







https://www.atlassian.com/blog/software-teams/version-control-centralized-dvcs

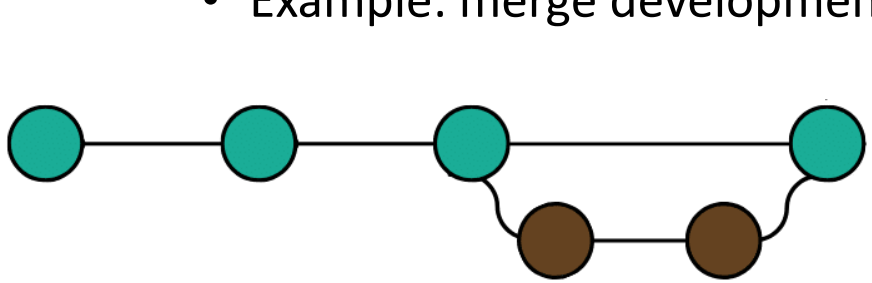
Basic concepts (examples based on Git)

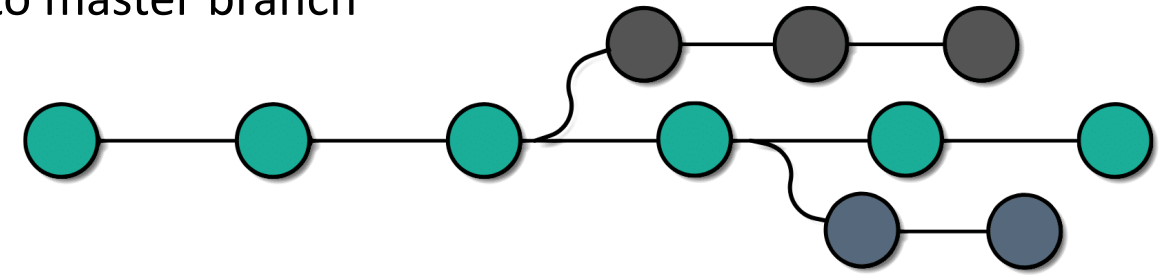
- Repository
  - The tracking of all changes done in docs of a Project
    - “.git” folder
  - **Clone** operation
    - Copy an existing repository into a new local repository
- Basic workflow of git like environment

  Working Directory → Staging Area → Git Repository
  - **Add** operation
    - Add a change from the working directory to the staging area
  - **Commit** operation
    - Capture a change that has been previously promoted to the staging area
      - Additional related details (e.g. timestamp)
  - **Push** operation
    - Updates remote repository: upload commits
  - **Pull** operation
    - Updates local repository: download commits

Basic concepts (examples based on Git)

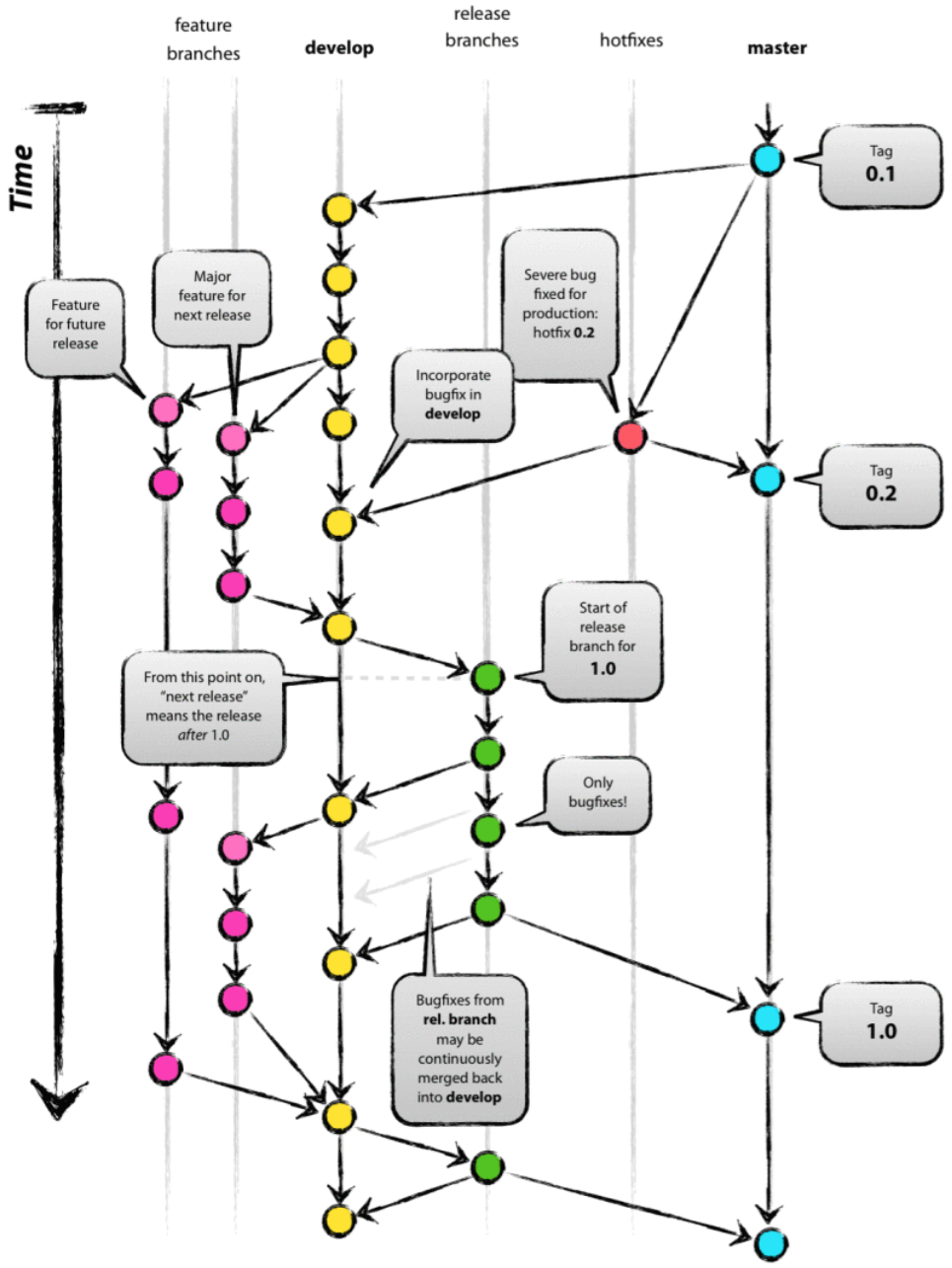
- Branch
  - It is a working line (that is, a similar to a path) to develop in a Project
    - Modifications in a branch don’t impact on other branches
  - At least there is one branch in a repo: the **master**
    - It is the main Branch
  - Management of branches
    - Example: merge development branch to master branch





- You can switch either from branch to branch and from commit to commit

Ex. Code Management



Compilation and code management toolchains

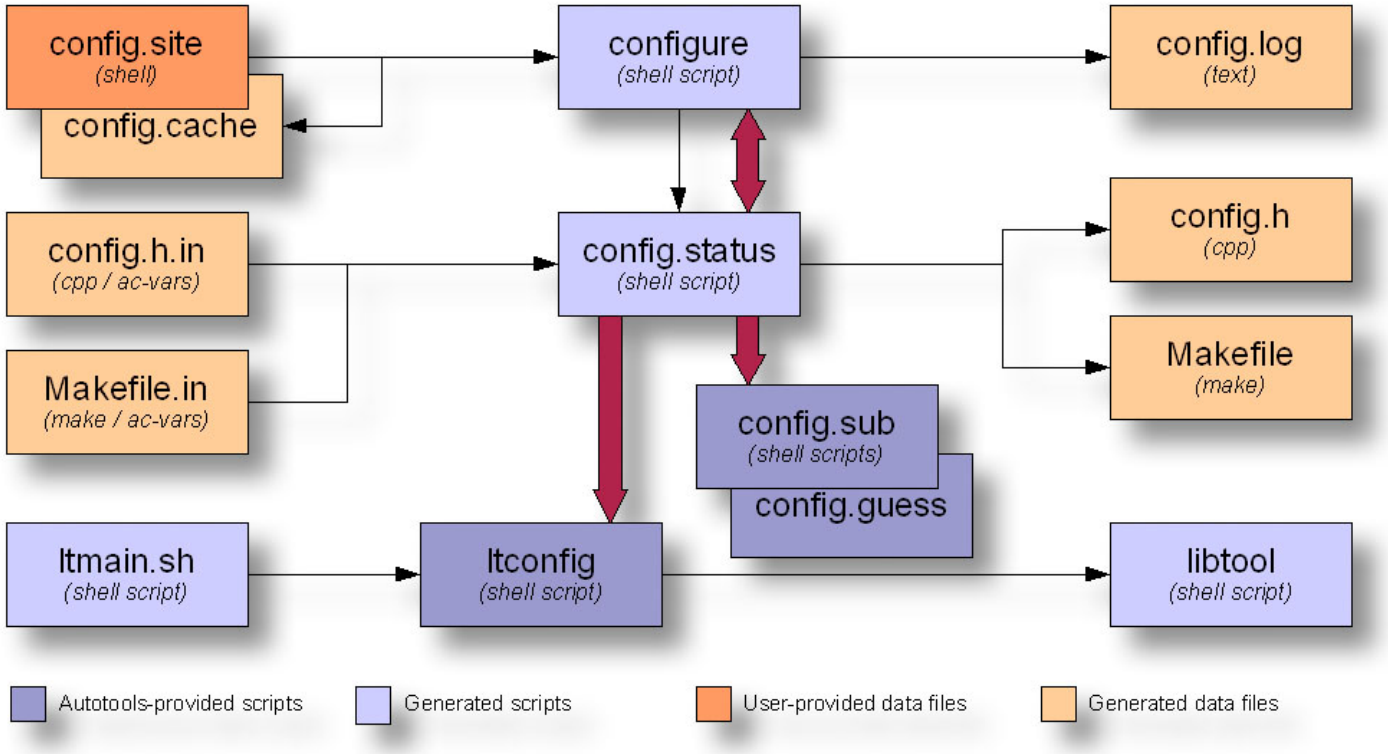
- Software Version Formats
  - (X.Y.Z)
    - X: Major changes, usually incompatible with previous versions;
    - Y: Minor changes, new functionalities added in a backwards-compatible manner;
    - Z: Revision/Patch (bug fixing)
  - Odd-even System
    - Odd numbers for development and even numbers for stable releases

- Build Process Tools
  - A set of tools for software developers to create/distribute automatically buildable source code and make software packages portable
  - Autotools (by GNU) make it easier to suport portability, (build configuration) based on common build conventions (e.g. well known paths), and automate dependency tracking to create the makefile
    - autotools = autoconf + automake + libtool + ...
  - Cmake is the next generation of autotools

Example of compile and install process

(terminal point of view)

```
#> Download source code
...
#> ./configure
```



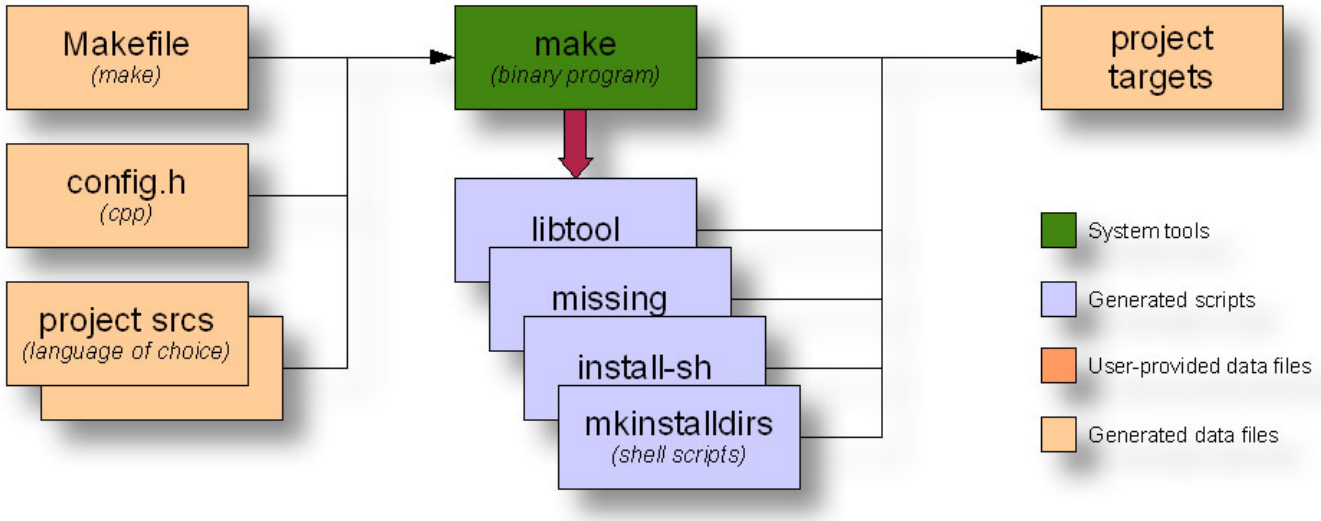
Configure data flow diagram

http://freesoftwaremagazine.com/articles/brief_introduction_to_gnu_autotools/

Example of automated build process

(terminal point of view)

```
#> Download source code
...
#> ./configure
#> make all
#> make install
```



Make data flow diagram

http://freesoftwaremagazine.com/articles/brief_introduction_to_gnu_autotools/

Debugging

- A Debugger is a tool that can execute a process under controlled conditions to help programmers to find bugs
  - It can pause/resume the execution and analyse critical values, such as variables, parameters, memory addresses, among other capabilities
  - But it has some limitations and requirements, such as difficulties to analyse parallel executions, some debuggers depend on the language, and complexity to know how to properly use it
- A program…
  - without debug information can also be debugged, but it is difficult
  - with debug information, the debugger shows information that relates high level source code to the low level source code of the execution to ease the debug process
- An interpreted code is easier to be debugged to find a bug since there is no low level code
  - But this simplicity can hide low level issues
- Examples: **GDB – The GNU Debugger**, PDB (The Python Debugger), Visual Studio

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- Understanding your application
- Control Version Management
- Compilation, debugging, and code management toolchains
- **Testing is really worthy**
- Automated Software Deployment

Types of Testing

- From **isolated to integrated** and from **faster to slower** approaches
  - **Unit Test**: a single unit of code
  - **Integration Test**: two or more units communicated with each other
  - **Functional Test**: a feature
  - **User Acceptance Test**: a feature, but from the user point of view
  - **Smoke Test**: the system is operational
  - **Regression Test**: other functionalities previously implemented
  - **Usability Test**: related to User eXperience (UX)
  - **Exploratory Test**: the tester itself manually discovers and learns the different checks to the system
- Test automation: implement automated testing tasks

Development Methodologies

- Waterfall
  - Work broken down into sequential phases
    - Requirements->Design->Development->Testing->Deployment->Final Outcome
  - When time/cost are limited, and producto scope/requirements are clear from the beggining
- Agile
  - Cross-functional teams discovering and building through iterative process
    - Scrum approach: Broken down into sprints (a.k.a. iterations)
  - When the details are not clear from the beggining, deliver micro-outcomes and requirements are discovered/adapted through the different iterations
- Hybrid Model

Automated Software Deployment

- Everytime there are new code developments, the mainline code has to be updated in a secure way. That is, the code needs to be tested
  - There are software projects that need to automate this task

- There are different procedures depending on the target
  - **Continuous Integration:** automates built and test of new code. The main goal is to integrate it to the mainline code. Thus, it has to be tested before and after the integration
  - **Continuous Delivery:** automates a new software release. The main goal is to be sure it can be delivered (e.g. go to productiu). Thus, it is key the user acceptance tests
  - **Continuous Deployment:** is a step up, since it deploys the results of Continuous Delivery into the deployment environment (e.g. production environment). It is assumed all automated tests are passed.

- There are tools that integrates multiple tools to perform these tasks
  - E.g. Jenkins

Bibliography

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