CS 211 RECITATIONS WEEK 4

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Content

GDB

Don’t forget to compile with –g for debug information!

- `gdb myProgram` (in shell)
- `run arg1 arg2 ...` (in gdb)

`break`	set a breakpoint
`run`	run program
`list`	show original source code
`step`	step to next line (into a function)
`next`	step to next line (over function calls)
`continue`	continue running after stopping
`kill`	kill program being debugged
`quit`	exit gdb and kill program
`print`	evaluate source expression
`x`	display memory contents
`bt`	show call stack
`frame`	select stack frame

Helpful resources: http://csapp.cs.cmu.edu/3e/docs/gdbnotes-x86-64.pdf

C project and Makefile

Object files (.o)

- A .c file can also be **compiled** into an *object (.o) file* with **`-c`** :

```
$ gcc -c part1.c
$ ls
part1.c    part1.o    part2.c
```

$\xrightarrow{\text{produces}}$ `part1.o`

  - a `.o` file is a binary "blob" of compiled C code that cannot be directly executed, but can be directly **linked** into a larger *executable* later

- You can **compile** and **link** a mixture of `.c` and `.o` files:

```
$ gcc -o myProgram part1.o part2.c
```

$\xrightarrow{\text{produces}}$ `myProgram`

Avoids recompilation of unchanged partial program files (e.g. **`part1.o`**)

Header files (.h)

- **header** : A C file whose only purpose is to be #included (#include is like java import statement)
  - generally a filename with the `.h` extension
  - holds shared variables, types, and function declarations
  - similar to a java interface: **contains function *declarations* but *not implementations***

- key ideas:
  - every ***name*`.`**c intended to be a module (not a stand alone program) has a ***name*`.`**h
  - ***name*`.`**h declares all global functions/data of the module
  - other `.`c files that want to *use* the module will #include ***name*`.`**h

C project and Makefile

- Compiling *multi-file* programs repeatedly is cumbersome:

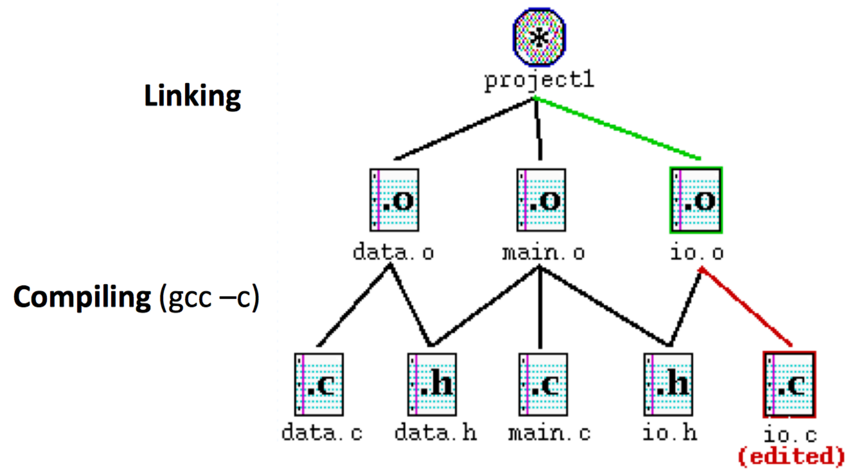
```
$ gcc -o myprogram file1.c file2.c file3.c
```

- What is make?
  - *A utility for automatically compiling ("building") executables and libraries from source code.*
  - *A very basic compilation manager*
- What is a makefile?
  - *A script file that defines rules for what must be compiled and how to compile it*
- Note that we can specify variables in makefile externally when running make
  - *CFLAGS=-g –Wall –fsanitize=address –std=c99 (no spaces before and after =)*
  - *make CFLAGS="-g –Wall –fsanitize=address –std=c99"*

C project and Makefile

Dependencies

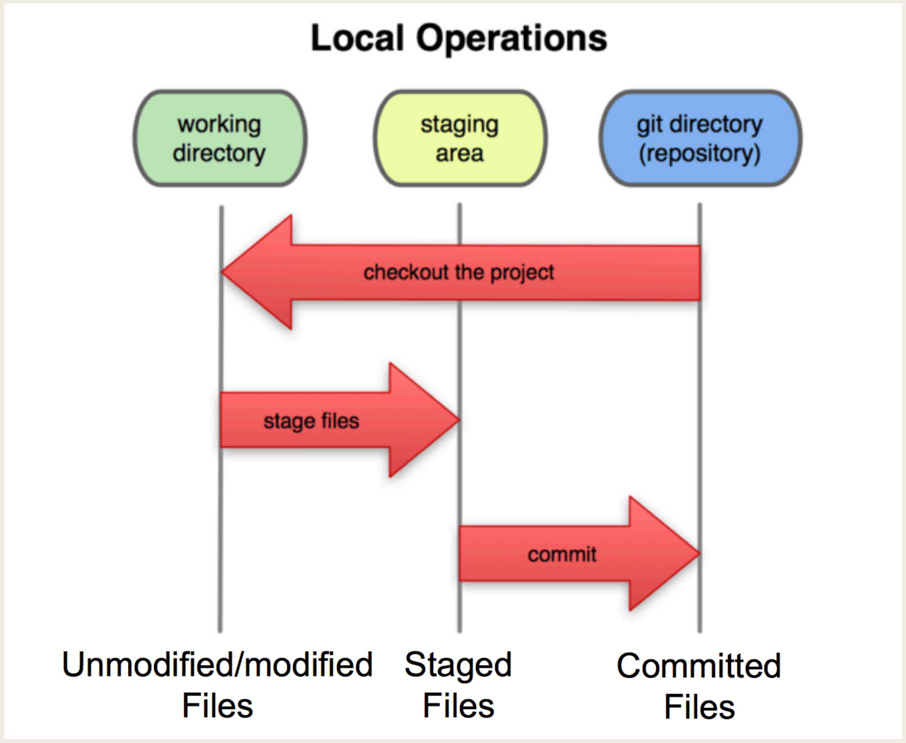
- **dependency** : When a file relies on the contents of another.
  - can be displayed as a *dependency graph*
  - to build `main.o`, we need `data.h`, `main.c`, and `io.h`
  - if any of those files is updated, we must rebuild `main.o`
  - if `main.o` is updated, we must update `project1`



Version control with git

- git is not GitHub
  - *git is a version control tool, can be used locally or upload your repositories on the cloud*
  - *GitHub is the cloud ☺*
- Basic commands:
  - *git init*
  - *git add .* *(or git add *)*
  - *git commit –m "your comments here"*
  - *git log* *(show the commit history)*
  - *git branch* *(create new branch)*
  - *git checkout <branch/tags/commits>*

    (HEAD pointer move to different place)



VERSION CONTROL WITH GIT

Version control with git

- Configure
  - *git config (- - global) user.name [your_name]*
  - *git config (- - global) user.email [your_email]*

- Using git on the cloud
  - *git clone (clone the entire repo to local)*
  - *git pull (keep your local repo updated)*
  - *git push (push the local changes to your remote repo)*

- Diferences
  - *git diff (find the differences)*
- Tagging
  - *git tag –a v1.0 -m “version 1.0 is done.”*
  - *git tag –d v1.0*

https://training.github.com/downloads/github-git-cheat-sheet.pdf

Version control with git

- .gitignore
  - *We only want to include code and documents, not binary, other intermediate trash files.*
  - *Once we declare what we don’t need, it won’t be added to this repo*
  - *What file should we dismiss? (https://github.com/github/gitignore)*
  - *Other unnecessary huge files, e.g., pdf, pptx, docx, etc.*
  - *Your repo grows! Every changes you made will be recorded, every (even deleted) files can be accessed.*
- git will not commit empty directories
  - *mkdir empty_dir*
  - *git add . (nothing happends, and git commit will not work)*
  - *what if we really want to keep the directory?*
  - *cd empty_dir*
  - *touch keep.txt (or any other names, e.g., gitkeep.txt, etc)*
  - *So that we made the difference!*

typedef

- An example of typedef struct

```
typedef struct my_struct {
            int a;
            char b;
} my_struct;
```

- typedef is associated with the semantics
  - *size, never negative, must huge enough*

```
typedef unsigned long long size_t // for 64-bits machines
typedef unsigned long size_t // for 32-bits machines
```

- Underscore t ("_t") is usually a size type!
  - *time_t*
  - *clock_t*
  - *many important data structures in Linux kernels has their own types*

C preprocessor

- #include
- #define SIZE 10
- #undef SIZE

- #define DEBUG
- #ifdef DEBUG
  * /* your code here */*
  * /* e.g., print something */*
- #endif // always don’t forget to end your if