The Edit-Compile-Run Cycle

EECS 211
Winter 2019
So you’ve written a C program:

```c
#include <stdio.h>

int main()
{
    printf("Hello, EECS 211!\n");
}
```

What now?
Compilation

We need to translate our program from

- source code (e.g., C, human readable)

To

- machine code (machine executable).
What does machine code look like?

```
55
48 89 e5
48 83 ec 10
48 8d 3d 37 00 00 00
b0 00
e8 0e 00 00 00
31 c9
89 45 fc
89 c8
48 83 c4 10
5d
c3
```
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pushq %rbp
movq %rsp, %rbp
subq $16, %rsp
leaq 55(%rip), %rdi
movb $0, %al
callq 14
xorl %ecx, %ecx
movl %eax, -4(%rbp)
movl %ecx, %eax
addq $16, %rsp
popq %rbp
retq
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shell  The main program for controlling a Unix computer, using textual commands.
Using Unix

For the first few weeks of class, we are going to develop and test our programs under Unix.

Unix  A style of multi-user operating system invented 50 years ago. (Modern variants include Linux and Mac OS X.)

shell  The main program for controlling a Unix computer, using textual commands.

terminal  A program (or historically, device) for displaying textual interactions, often remote, with a Unix computer.
Advantages of the Unix shell (1/2)

Compared to point-and-click, you can say more with less:

$ mkdir backup
$ cp *.docx backup
Advantages of the Unix shell (1/2)

Compared to point-and-click, you can say more with less:

$ mkdir backup
$ cp *.docx backup

$ mkdir thumbs
$ foreach i ( *.png )
  convert -geometry 128x128 "$i" "thumbs/$i"
end
Advantages of the Unix shell (2/2)

You can automate repeated tasks by putting common sequences of commands in _shell scripts_: 

```bash
#!/bin/sh

for dir in "*"; do
    ( 
        cd "$dir"
        mkdir -p thumbs
        for file in *.png; do
            convert -geometry 128x128 "$file" \
                "thumbs/$file"
        done
    )
done
```
Compilation in the Unix shell

```bash
$ exec scl enable devtoolset-6 tcsh
$ mkdir eecs211
$ cd eecs211
$ emacs -nw hello.c
$ ls
hello.c
$ cc hello.c -o hello
$ ls
hello hello.c
$ ./hello
Hello, EECS 211!
```

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Build management

As programs get larger, builds get more complicated:

- More files to compile, in complex combinations
- Want to just recompile the changed files
- Different compilers/machines want different options and work differently

We'll use a software building system called Make to automate builds for us.
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Introduction to Make

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(Meaning: *To build hello from hello.c, run the command cc -o hello hello.c.*)
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Using Make:

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$ make hello
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Using Make:

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$ make hello
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$ make hello
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    cc -o hello hello.c
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(Meaning: To build hello from hello.c, run the command cc -o hello hello.c.)

Using Make:

```
$ make hello
cc -o hello hello
$ make hello
make: `build/hello' is up to date.
$
Cleaning up

$ cd$
$ rm -Rf eecs211$
$ mkdir eecs211$

$
Cleaning up

$ cd
Cleaning up

$ cd

$
Cleaning up

$ cd
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Cleaning up

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Getting a Make project onto EECS

You can download an example Make project from the course website:

```
$ cd eecs211
$ wget URL211/lec/01compile.tgz
$ tar zxf 01compile.tgz
$ cd 01compile
$ ls
Makefile src
$ ls src
hello.c
```
Getting a Make project onto EECS

You can download an example Make project from the course website:

```sh
$ cd eecs211
```

Getting a Make project onto EECS

You can download an example Make project from the course website:

```
$ cd eeecs211
```

```
Getting a Make project onto EECS

You can download an example Make project from the course website:

$ cd eecs211
$ wget $URL211/lec/01compile.tgz

...
Getting a Make project onto EECS

You can download an example Make project from the course website:

```
$ cd eecs211
$ wget $URL211/lec/01compile.tgz
...
$
```

Getting a Make project onto EECS

You can download an example Make project from the course website:

```
$ cd eecs211
$ wget $URL211/lec/01compile.tgz
...
$ tar zxf 01compile.tgz
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Getting a Make project onto EECS

You can download an example Make project from the course website:

```
$ cd eecs211
$ wget $URL211/lec/01compile.tgz
...
$ tar zxf 01compile.tgz
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```
Getting a Make project onto EECS

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$ cd eecs211
$ wget $URL211/lec/01compile.tgz
...
$ tar zxf 01compile.tgz
$ cd 01compile
Getting a Make project onto EECS

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```bash
$ cd eecs211
$ wget $URL211/lec/01compile.tgz
...
$ tar zxf 01compile.tgz
$ cd 01compile
$`
Getting a Make project onto EECS

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$ ls
Makefile  src
$ ls src
hello.c
$
Another Makefile

```bash
CFLAGS = -std=c11 -pedantic -Wall
all: build/hello
build/hello: src/hello.c
    mkdir -p build
    cc -o $@ $< $(CFLAGS)
clean:
    rm -Rf build
.PHONY: all clean
```

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Another Makefile

$ cat Makefile
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Building the project using Make

```bash
$ make
mkdir -p build
cc -o build/hello src/hello.c -std=c11 -pedantic -Wall
build/hello
Hello, EECS 211!
sed -i 's/EECS 211/everyone/' src/hello.c
build/hello
Hello, everyone!
$ make
mkdir -p build
cc -o build/hello src/hello.c -std=c11 -pedantic -Wall
build/hello
Hello, everyone!
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