The Edit-Compile-Run Cycle

EECS 211

Winter 2019
So you’ve written a C program:

```c
#include <stdio.h>

int main()
{
    printf("Hello, \texttt{EECS}\texttt{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
What does machine code look like?

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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
```
Using Unix

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

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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
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```
$ 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*:

```
#!/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

```
$ 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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hello hello.c
$ ./hello
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hello  hello.c
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hello.c
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hello hello.c
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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
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We’ll use a software building system called Make to automate builds for us.
Introduction to Make

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The simplest possible Makefile:

```makefile
hello: hello.c
    cc -o hello hello.c
```

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

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

Cleaning up

```bash
$ cd
$ rm -Rf eecs211
$ mkdir eecs211
```
Cleaning up

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Cleaning up

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$
Cleaning up

$ cd
$ rm -Rf eecs211
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$
Getting a Make project onto EECS

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

```bash
$ cd eecs211
$ wget $URL211/lec/01compile.tgz
$ tar zxf 01compile.tgz
$ cd 01compile
$ ls
Makefile src
$ ls src
hello.c
```

$
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```
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$ ls
$ ...
```

```bash
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$ ...
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$ cd eecs211
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...
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...
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$ ls
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Makefile  src
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Makefile src
$ ls src
hello.c
$ 
```
Another Makefile

```bash

cat Makefile

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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    mkdir -p build
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clean:
    rm -Rf build

.PHONY: all clean
$

Another Makefile
Building the project using Make

$ make
mkdir -p build
c -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
c -o build/hello src/hello.c -std=c11 -pedantic -Wall
$ build/hello
Hello, everyone!
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$ make

Hello, EECS 211!

sed -i 's/EECS 211/everyone/'

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$ build/hello
Hello, EECS 211!
$ sed -i 's/EECS 211/everyone/' src/hello.c
$ build/hello
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