Assembly Language – Introduction

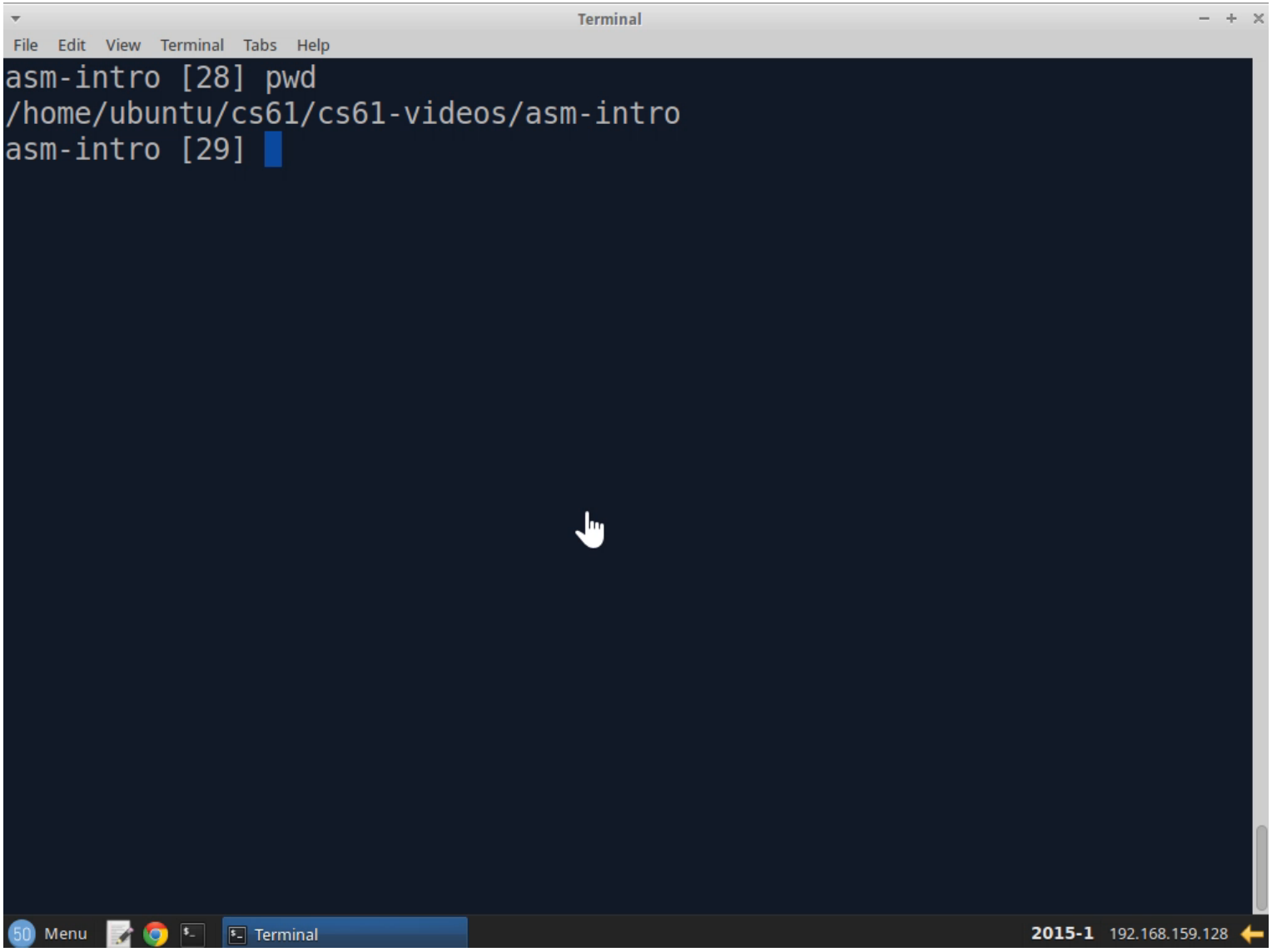
- Learning Objectives
  - Explain what assembly language is
  - Define
    - Registers
    - Instruction
    - Operands
  - Produce assembly from C

What is assembly?

- Yet another layer of abstraction!
- When you strip away C, the assembly language is a human readable representation that more closely matches the hardware.
- Typically each assembly instruction corresponds to a machine instruction.
- Assembly doesn't really manipulate variables; it expresses computation in terms of:
  - Registers
  - Memory
  - Instructions

A Note on our Assembly

- We are using Intel x86 assembly and assuming a 32-bit processor.
- The 3rd edition of the book uses a 64-bit architecture in most sections, but still has some remnants of the 32-bit architecture as well.
- The two are quite similar, but keep in mind that we're using 32 bits.
- Three ways to see assembly output:
  - cc –S –O3 x.c
  - objdump –d x.o
  - In gdb: disassemble <address>


Terminal
File Edit View Terminal Tabs Help
asm-intro [28] pwd
/home/ubuntu/cs61/cs61-videos/asm-intro
asm-intro [29]
Menu
Terminal
2015-1
192.168.159.128

Example

```
        .file   "1.c"
        .text
        .globl  func
        .align  16, 0x90
        .type   func,@function
func:                                   # @func
# BB#0:
        ret
.Ltmp0:
        .size   func, .Ltmp0-func


        .ident  "Ubuntu clang version 3.4-1ubuntu3 …"
        .section ".note.GNU-stack","",@progbits
```

Registers

- Registers are fast memory in the processor.
  - Processors typically execute most instructions in a single cycle; accessing memory can take 10's or 100's of cycles; placing data in registers allows the processor to execute things more quickly.
  - Most processors have a few tens of registers.
  - The Intel x86 has eight 32-bit registers:
    - %eax, %ebx, %ecx, %edx, %edi, %esi, %esp, %ebp
    - There are conventions for how some of the registers are used.
    - For example: %esp is the stack pointer
    - %ax is the lower 16 bits of register %eax
    - %al is the low order byte of register %eax
    - %ah is the second lowest order byte of %eax

Kinds of instructions

- Move data around
- Perform arithmetic operations
- Perform logical operations
- Compare things (sets condition flags)
- Flow control