

Introduction

CSE 361S

Contact Information

- Course web page:
 - www.cse.wustl.edu/~roger/361s.html
- Email:
 - cse361s@cse.wustl.edu
 - roger@wustl.edu
- Lab spaces:
 - Lopata 400 (Linux lab)
 - Lopata 401 (Windows lab -> Linux VM)

Course Topics

- Understanding “complete system” with a big picture viewpoint
- How does machine interact with system software and application software?
- How does system software serve machine and application software?
- How does application software take maximum advantage of system software and machine?

What is System Software?

- Operating System (OS)
 - Kernel, scheduler
 - Filesystem
 - BIOS, drivers
 - Networking
- Utilities
 - Compiler, debugger, performance monitor
- User I/O
 - Shell (command line), Windowing system

Loose Description of Course

“bottom half of OS,
dealing with the real machine”

Topics

- Data representations
 - bits, bytes → information
- Instruction set architecture (ISA)
 - contract between HW and SW development teams
- Memory hierarchy
 - cache memory
 - virtual memory
- High-level lang. (HLL) vs. assembly
- Linking and loading

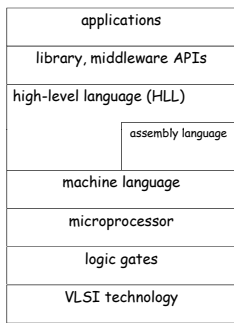
Applicability of Material

- General-purpose, desktop systems
- Servers
 - Compute clusters
 - Cloud systems
- Embedded systems
 - Handheld devices (phones, etc.)
 - Control systems (e.g., fly-by-wire aircraft)

Secondary Benefits

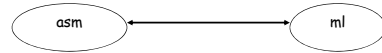
- Understand pointers (more than you expect!)
- Ease transition from Java to C/C++
- Experience with Linux OS
 - Both as user and as programmer
- Experience with GNU tools
 - gcc, gdb
- Experience with TAU performance monitor
- Basics of “Makefile” build system

Abstraction Levels



HLLs, assembly, vs. machine language

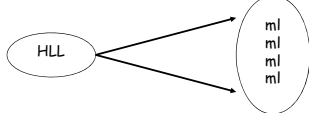
- machine language = binary (i.e., computer readable) image of program code
- assembly language = human readable (and writeable) syntax directly representing machine language



- one-to-one mapping between asm and machine language

HLLs, assembly, vs. machine language

- high-level language = designed for human specification of algorithms and applications

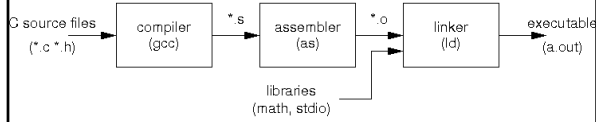


- one-to-many mapping between HLL and machine language
- Assembly/machine language is very much architecture dependent
- HLLs are (largely) architecture independent

Why use assembly language?

- Direct control over the hardware
 - “I want the machine to execute these exact instructions.”
- Historical reasons
 - execution efficiency (speed, code size, etc.)
 - lack of suitable HLL compiler (embedded)
- Today
 - Limited need as an authoring language
 - Very useful for investigation – understanding!

gcc workflow



Command line usage

- Compile "hello.c" to executable "hello"
 - > gcc -o hello hello.c
- Compile "hello.c" to assembly "hello.s"
 - > gcc -S hello.c
- Compile "hello.c" to object code "hello.o"
 - > gcc -c hello.c
- Link object file to executable
 - > gcc -o hello hello.o
- Assemble assembly language code to executable
 - > gcc -o hello hello.s

Logistics

- Lab A is in two rooms – Lopata 400 and 401
 - Everyone needs to setup Linux VM
 - We have help to do that today, so do it today!
- Lab 1 is intro to Linux environment
 - Due Thursday, Sept. 8
- Student work includes
 - Written work (solo), submit electronically
 - Lab work (some groups allowed, see instructions)
- Midterm after fall break, Final during finals week

Grading

- | | |
|-----------------------|------|
| • Written assignments | 20% |
| • Lab assignments | 25% |
| • Final project | 20% |
| • Midterm exam | 15% |
| • Final exam | 20% |
|
 | |
| • Total | 100% |

Lectures

- I will go at the pace allowed by the class
 - Feel free to slow me down! Ask questions!
- There will be interactive activities in class
 - Group discussion (you have to discuss!)
 - Practice problems (try what was just described)
 - Small group assignments (work with neighbor)
- Previous semester lectures available on web
 - This is stable material, doesn't change much

Today in Lab

- Login, ensure your passwd is correct
 - Help desk is next door if needed
- Setup Linux VM in Lopata 401
 - Limited seats, need to go in rounds
 - Feel free to start on Lab 1 in Lopata 400 if waiting
 - Please give up seat in Lopata 401 as soon as VM is operational