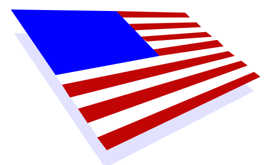
Lecture #5 for
Computer Tools for Engineers



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Today's agenda:

- Miscellaneous and review from last lecture
- What's under the hood (review and conclusion)
  - Components of a computer
  - Overview of client/server
  - How memory works
  - Machine language to assembly language to high-level language
- Design methods
  - The four steps
  - Flow charting
  - Divide-and-conquer
  - Successive refinement
  - Phases of a programming project
- Review and strategy for Exam #1

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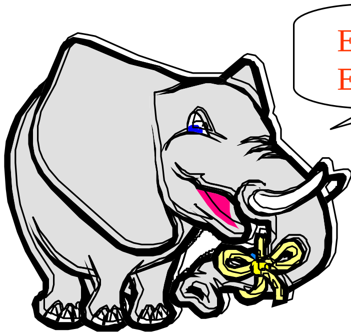
Miscellaneous:



Excel quiz is this week and Exam #1 is next week.

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Miscellaneous: (continued)

- Grading errors...
  - If there is a grading error on your quiz or exam, ***we want to fix it!***
  - Please see me or a TA if too many, ***or too few***, points were deducted for a problem
  - You need to do this within ***one week*** of receving your quiz back

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Review from last lecture:

- A histogram shows ______________________
- A macro is ___________________________
- The solver does ______________________________________
- It is easy to import __________ data files
- Use _________________ to typeset equations
- Cut-and-paste allows one to ___________________
- A good idea poorly presented is __________________

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Review from last lecture: (continued)

- To do a curve fit in Excel, use the ______________ feature
- In a curve fit the ______ number shows goodness of fit
- Given a good fit, future results can always be predicted - TRUE / FALSE
- Use _________ to reduce the amount of viewed data (by some criterion)
- Electronic computers were invented around ____________
- The logical model for a computer is called the _______________ model
- A "good" PC has about a _______ speed processor, about _______ amount of memory, and about _______ amount of storage.

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Review from last lecture: (continued)

- A Mhz = __________________
- A Kbyte = _________________
- A Mbyte = _________________
- A Gbyte = _________________
- The binary number 1011 = _______ (in base 10)
- An ALU is the _________________________ and needs to perform only two fundamental operations which are __________ and ________

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Review from last lecture: (continued)

- A client is a __________________ and typically runs a ______________ operating system such as ___________
- A server is a ________________ and typically runs a ____________ operating system such as _______________
- An example of a server is __________________
- A type of network connecting clients and servers is ____________ and it runs at a data rate of _________________

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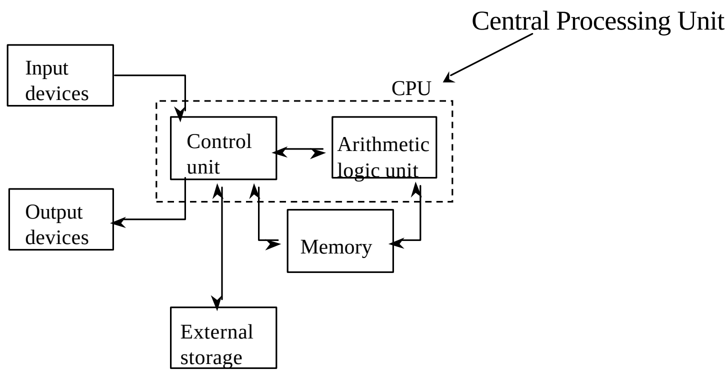
The Von Neumann model:

Review

- The organization of components in a computer
  - A logical view



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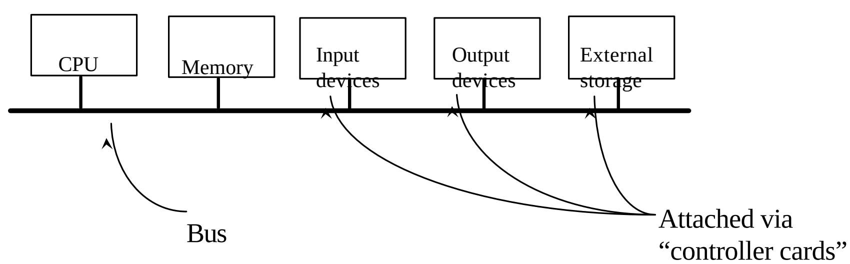
Components of a computer: (continued)

Review

- A typical implementation has all components attached to a bus
  - A physical view



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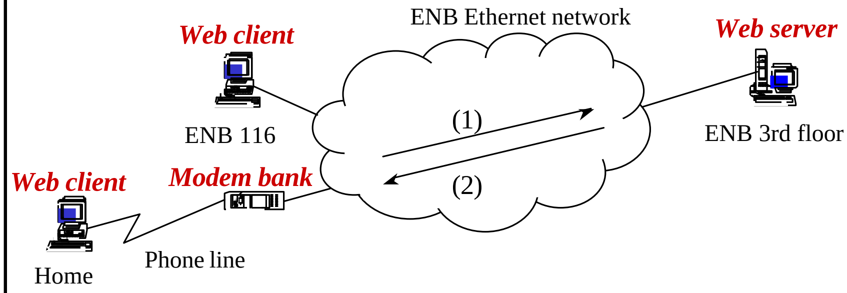
Client/server: **(continued)**

Review

- Typically, a network connects clients and servers
  - An example is the Web



(1) = *Request* from client to server for a Web page
(2) = *Response* from server (Web page, inline images, download files, etc.)

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How memory works:

Review

- Everything in a computer is binary
  - Binary means two states, 0 or 1
  - A bit = one state
  - A byte equal 8 bits
  - A byte can represent 256 values (00000000, 00000001, … 11111111)
- Each digit in a binary number represents a power of 2 (base 2)
  - N bits can represent 2^N values
  - 011 = 3
  - 101 = 5
  - 1001 = 9
  - 10000011 = 131
- Standard "codes" exist to represent letters of alphabet, etc.
  - The ASCII code is standard for characters

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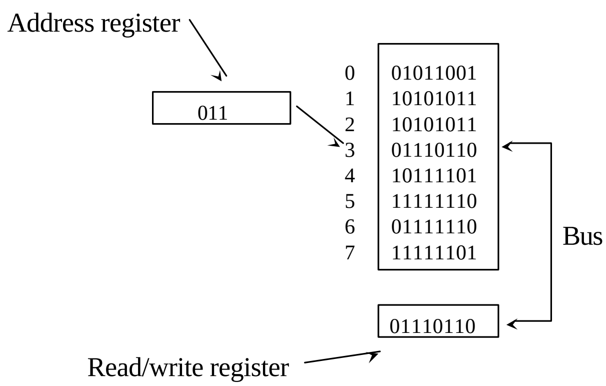
How memory works: (continued)

Review

- Memory is a grid (analogous to a spreadsheet)
  - Each grid location has an address
  - At each address 8, 16 , or 32-bits are stored
  - A register is a one word memory (found in the CPU)



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How memory works: (continued)

Review

- Memory contains *instructions* and *data*
  - Instructions tell the CPU what to do
  - Data is what the CPU operates on
- Random Access Memory (RAM)
  - Can both read and write
  - But, when power is removed the contents are deleted
- Read Only Memory (ROM)
  - Can only read
  - But, contents are retained even when power is removed
  - Typically used for “boot-up” programs

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Machine language:

- *Machine language* is defined as bit patterns that control the CPU
  - Each bit pattern causes a specific action to occur
- CPU operations include
  - Moving data from memory to CPU
  - Move data from CPU to memory
  - Arithmetic operations on data when in the CPU
  - Also, decision and branch instructions
- Every brand of CPU has its own machine language
  - RISC = Reduced Instruction Set Computer (e.g., UNIX workstation)
  - CISC = Complex Instruction Set Computer (e.g., PC)

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Assembly language:

- In the old days (1950's through 1960's)…
  - Programmed directly in machine language
  - Entered 1's and 0's into computer memory via a panel of switches
- First step was to invent *assembly language*
  - Assembly language gives each bit pattern a mnemonic
  - Mnemonic was easier to remember than a bit pattern

Example:

```
mov a, b                    ; Move contents of register b to a
mov a, addr = 11000110      ; Adds memory to a register
add a, data = 01101111      ; Adds data value to a register
```

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Assembly language: **(continued)**

- An *assembler…*
  - Is a program itself
  - Translates assembly language to machine language
    - » Very easy to do -- direct table-driven translation

- Why not program directly in machine language?
  - Programming languages make programming easier for *humans*

- The final result of any programming language is…
  - Machine language
  - Also called the “object code” or “executable code”

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High-level language:

- Programming in assembler is not,
  - Easy
  - Or, *portable* between processor types

- *Portability* is an important consideration
  - Do you want your program to run on only one type of computer?

- High-level languages were invented to simplify programming
  - High-level languages are application specific
  - And, are portable between different types of computers

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High-level language: (continued)

- Procedural languages
  - FORTRAN
  - COBOL
  - Pascal
  - Ada
  - C
- Objected Oriented Programming
  - A new way of thinking about data and procedures together
    - » C++
    - » Smalltalk
    - » Java

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High-level language: (continued)

- FORTRAN
  - Formula Translation - for engineering and scientific applications
- COBOL
  - Common Business Oriented Language - for business applications
- C
  - For writing operating systems and other "systems programs"
- Ada
  - Mandated by Department of Defense
- C++
  - An object oriented flavor of C for easier team programming
- Java
  - Very similar to C++ for ??? application

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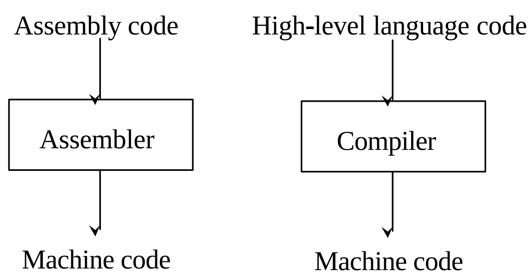
High-level language: (continued)

- The concept of an assembler and compiler



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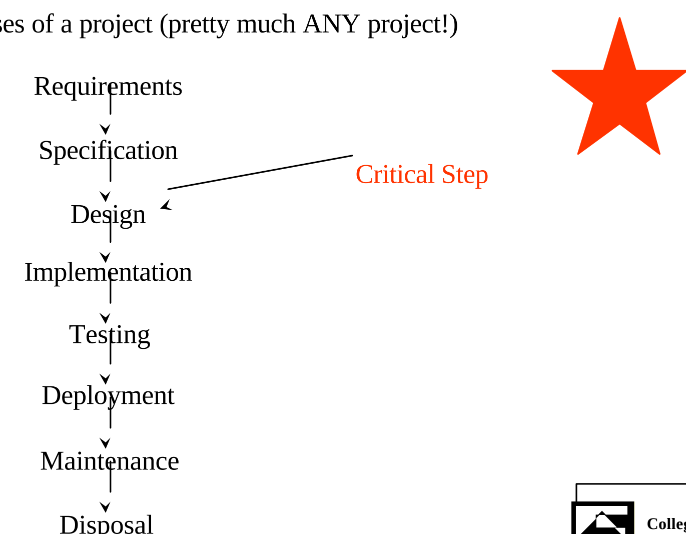
Design methods:

- Phases of a project (pretty much ANY project!)



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Design methods: (continued)

- Flow charting
  - Simple way to describe an *algorithm* for a small task
- Divide-and-conquer
  - Method of breaking a big problem into small tasks
- Successive refinement
  - Method of adding detail to a small, but ambiguous task

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What is an algorithm?

- An algorithm is simply a set of steps to accomplish something
  - A cooking recipe
  - Instructions to assemble a tricycle
  - Procedure to overhaul an engine

Formally, an algorithm is defined as...
1) Described in a finite sequence of instructions
2) Each instruction is executable
3) Execution always terminates

Hint: If it is in red (like the above is), then it is important!

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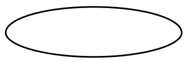
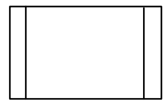
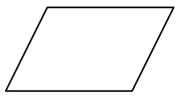
Flow charting:

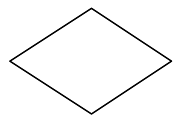
Memorize these!

- Flow charting symbols

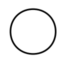

- Begin/End


- Subprogram (i.e., another flowchart)


- Input/output


- Decision


- Assignment or computation


- Continuation

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Flow charting:

- Flow charting symbols (have you memorized ‘em yet???)

- Begin/End
- Subprogram (i.e., another flowchart)
- Input/output
- Decision
- Assignment or computation
- Continuation

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Flow charting:

- Do some examples on the board

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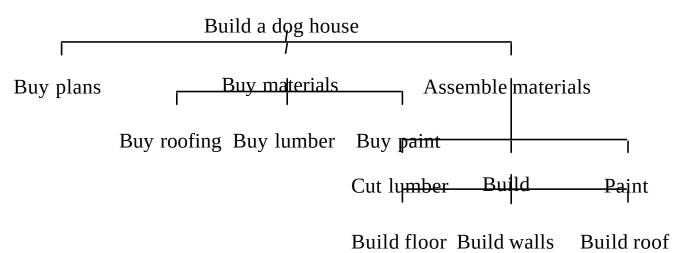
Divide-and-conquer:

- Results in a *structure diagram*
  - Useful for breaking a large project into manageable tasks
  - Procedure - repetitively partition a job into small tasks



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Divide-and-conquer: (continued)

- Divide-and-conquer example
  - See pages 27 and 28 in book

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Successive refinement:

- Go from ambiguous to precise
  - Start with a general, albeit small, task
  - Can initially “hide” details
  - Then, add detail until we have a flowchart that can be implemented

You will use this method a lot
for your programming problems.

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Successive refinement: (continued)

- Do cook-a-turkey example on the board

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Successive refinement: (continued)

- Example - Determine if N is prime
  - A little complex for now… but you should understand the idea

```
Step #1: Determine if N is prime

Step #2: Input N
         Divide N by all numbers from 2 to (N - 1)
         If N divides evenly then output "N is not prime"
         If N does not divide evenly then output "N is prime"

Step #3: J is an integer counter variable
         Input N
         Loop J = 2 to (N - 1)
           Test if N divides evenly by J
           If yes output "N is not prime" and halt
         EndLoop
         Output "N is prime"
         Halt
```

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Coverage for Exam #1:

From Notices page

```
09/23/99 - Add to the below list of exam coverage areas one more
area:
       Basic DOS commands from lab #0

09/22/99 - It is not too early to begin to think about the
exam #1 (which will be on Monday, 10/4/99). The exam will
cover:
       ASEE paper (found here)
       Mathcad
       Excel
       "Under the hood"
       Design methods including flowcharting
The last two topics are chapter 1 of the text. So, yes,
chapter 1 will be "on the test". I would suggest that you today
begin downloading the old exams (found here) and start planning
your study strategy. We will further discuss the exam and possible
study strategies in class.
```

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Coverage for Exam #1: (continued)

- Approximate problem breakdown (*no lawyers, please*!)
  - 1 short answer problem with about 12 fill-ins
  - 1 DOS problem
  - 1 multipart Mathcad problem
  - 2 or 3 Excel problems
  - 2 or 3 "under the hood" problems
  - 2 design problems
  - 1 "anything goes" extra credit problem

  (10 problems total)

- So, what am I responsible for?
  - Everything covered in the ASEE paper
  - Everything covered in lab
  - Everything covered in class
  - Everything in chapter 1 except the FORTRAN code
    - » But, certainly the flowcharts and design stuff are "in"

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Coverage for Exam #1: (continued)

- What will the test look like?
  - See the old exams with solutions posted on the Web
- Will the exam be easier or harder than the posted exams?
  - Some students claim that each year is harder
    - » Certainly, each year will be DIFFERENT
- Will the exam be hard?
  - If you want to do well in ANY exam, then there is no such thing as an "easy exam" before an exam is taken and passed
- Are there is a predtermined number of "A" (or "F") grades?
  - Nope, there is ***no*** quota on any grade for this course
    - » Historical data predicts an average around 70

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Coverage for Exam #1: (continued)

- So, then there is no way to get an 'A' in this course
  - Negative thinking will hurt your performance
- OK, how should I study?
  - I would…
    - » Tuesday **-** re-read and underline the ASEE paper
    - » Wednesday **-** review all labs and study DOS cheat sheet
    - » Thursay **-** review all lectures (include supplement .xls and .mcd)
    - » Friday **-** read chapter 1 again <u>and see Dr. Christensen with my list of questions (he'll be in the office all day)</u>
    - » Saturday **-** go to the beach
    - » Sunday **-** re-review all lectures and supplements and get to bed early
    - » Monday **-** eat a good breakfast, grab my lucky rabbit's foot, and plan to get to ENA105 no later than 10:45am

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The End (for now):

- Study for your exam #1

- See me (or the TA's) with your list of questions
  - I find it very odd to see more students AFTER an exam than BEFORE an exam - think about it!

Do you want some additional office hours?
Tell me now… and I'll be there!

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