



Announcements

- Due date for Project 2B was noon today
- If you haven't already used it, you may use the 1-1-1 rule:
 - * One project part
 - One day late
 - Once during the quarter




Announcements

- Quiz is canceled this week
- Extra-Credit usability study
 - * Jay will be contacting you next week




Announcements

| Assignment | Awarded by Catalyst | | | Awarded by TAs | | Total Possible with XC |
|-----------------|---------------------|--------------|------------|----------------|--------------|------------------------|
| | Regular | Extra Credit | Total Quiz | Regular | Extra Credit | |
| Labs 5/6 | 36 | | 36 | 4 | | 40 |
| Labs 7/8 | 24 | | 24 | | | 24 |
| Labs 7/8 part 2 | 6 | | 6 | 10 | 10 | 26 |
| Project 2A | 30 | | 30 | 20 | | 50 |
| Project 2B | 50 | 5 | 55 | 50 | 5 | 110 |
| Lab 9 | 12 | | 12 | 8 | 6 | 26 |




Announcements

- Grading questions
 - * Talk to your TA first
 - * Talk to me second

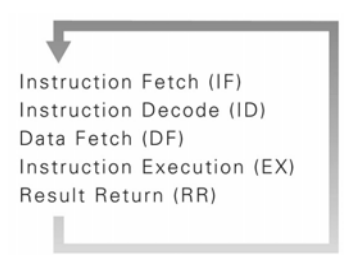


Computer Basics

Continued

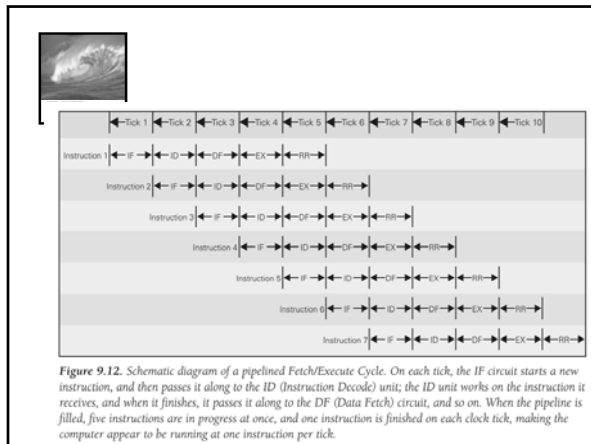



Fetch/Execute Cycle



Instruction Fetch (IF)
 Instruction Decode (ID)
 Data Fetch (DF)
 Instruction Execution (EX)
 Result Return (RR)

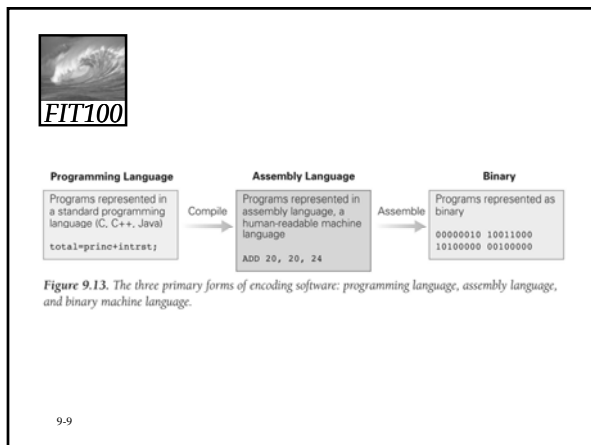

Figure 9.1. The Fetch/Execute Cycle.

Software

- A computer's view of software
 - * Sees *binary object file*, a long sequence of 4-byte words (0's and 1's)
- *Assembly language*
 - * Alternative form of machine language using letters and normal numbers so people can understand it
 - * Computer scans assemble code, as it encounters words it looks them up in a table to convert to binary, converts numbers to binary, then assembles the binary pieces into an instruction


9-8

Operating Systems

- Basic operations that are necessary for the effective use of computer, but are not built into the hardware
- Three most widely used Operating Systems:
 - * Microsoft Windows
 - * Apple's Mac OS X
 - * Unix / Linux
- OS performs booting, memory management, device management, Internet connection, file management


9-10



Programming

- Programmers build on previously developed software to make their jobs easier
- Example: GUI Software
 - * Frame around window, slider bars, buttons, pointers, etc. are packaged for programmers and given with OS


9-11



Integrated Circuits

- Miniaturization:
 - * Clock speeds are so high because processor chips are so tiny
 - Electrical signals can travel about 1 foot in a nanosecond


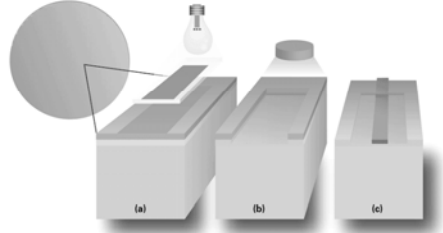
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Integrated Circuits


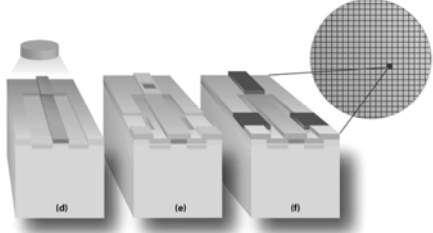
- Photolithography
 - * Printing process
 - Instead of hand-wiring circuits together, photograph what is wanted and etch away the spaces
 - * Regardless of how complicated the wiring, cost and amount of work are the same

9-13


9-14

Figure 9.16 Early steps in the fabrication process. (a) A layer of photoresist (blue) is exposed to UV light through a pattern mask (light blue), hardening the exposed areas; (b) after washing away the unexposed photoresist, hot gases etch away (nearly all of) the exposed layer; (c) the remaining resist is washed away and other layers are created by repeating the patterning and etching processes. In later stages of the fabrication process, (d) “impurities” (boron) such as

9-15


Figure 9.16 Continued boron are diffused into the silicon surface in a process called doping, which improves the availability of electrons in this region of the silicon. (e) After additional layering, etching exposes contact points for metal wires, and (f) a metal (dark blue) such as aluminum is deposited creating “wires” to connect to other transistors. Millions of such transistors form computer chips occupying a small square on the final fabricated wafer.



How Semi-Conductor Technology Works

- Integration:
 - * Active components and the wires that connect them are all made together of similar materials in a single process
 - * Saves space and produces monolithic part for the whole system, which is more reliable
- Silicon is a semi-conductor—sometimes it conducts electricity, sometimes not
 - * Ability to control when semi-conductor conducts is the main tool in computer construction

9-16




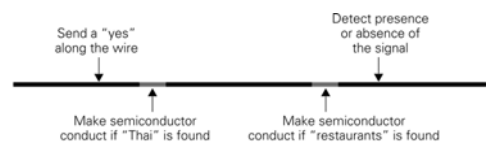
The On-Again, Off-Again Behavior of Silicon

- A circuit is set to compute x and y for any logical values x and y
- If x is true, the x circuit conducts electricity and a signal passes to the other end of the wire; if x is false, no signal passes

Logic gates

- Same process for y
- If both circuits conduct, x and y are true—logical AND has been computed

9-17

9-18

Figure 9.17 Computing Thai AND restaurants using a semiconducting material.



Combining these Ideas

1. Start with information processing task
2. Task is performed by application, implemented as part of a large program in a high-level language like C or Java
3. Program performs specific operations; standard operations like print or save are done by OS

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Combining these Ideas (cont'd)

4. Program's commands are compiled into assembly language instructions
5. Assembly instructions are translated into binary code
6. Binary instructions are stored on hard disk (secondary memory)
7. Application instructions move into RAM (primary memory)

9-20



Combining these Ideas (cont'd)

8. Fetch/Execute Cycle executes the instructions
9. All the computer's instructions are performed by the ALU circuits, using the transistor model previously described, under the control of the Control Unit

9-21



Quick Write

- Clear your desks except for a pen
- Put away
 - * Books, notebooks, backpacks, etc.
 - * Phones, laptops, pda's, etc.
- No talking—except to the TA or instructor if you don't understand the question
- You will have five minutes




Data

*Storage, Transfer, and Retrieval
and Keeping Your Private
Information Private*



Unit III: Data

- Storage
 - * Format—physical and logical
- Retrieval
 - * Getting just the information you need
- Transfer
 - * Between people, departments, organizations
 - * Media—spreadsheets, databases, XML




Test Your Tech

A spread sheet:

- A. Only happens on laundry day.
- B. Is covered with food during holiday meals.
- C. Helps answer "what-if" questions.

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Test Your Tech

A spread sheet:


- A. Only happens on laundry day.
- B. Is covered with food during holiday meals.
- C. Helps answer "what-if" questions.

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Spreadsheets


Spreadsheets are a powerful abstraction for organizing data and computation



An Array of Cells

A spreadsheet is a 2-dimensional array of cells...it's 3D with multiple cells

- The idea is that the rows or columns represent a common type of data
 - They will be operated on similarly, so that's easy to do
 - Adding more data of the same type means adding more rows or columns
 - Often spreadsheets contain numbers, but text-only spreadsheets are useful, too




Looking for Similar Ideas

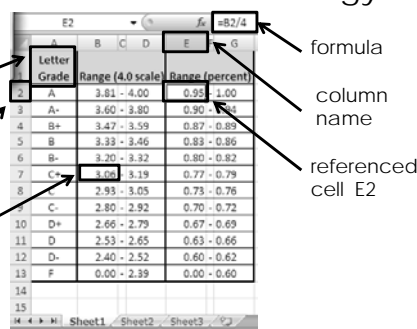
Spreadsheets are not so unusual

- The position (row/column) names the data, as with memory locations, variables, forms, etc.
- Operating on all elements of a column (or row) is an iteration, though not usually a WFI
- Setting a cell to a formula is an (unevaluated) *assignment statement* with cells as variables
- The formula is an expression
- Functions are built-in expressions


Think of spreadsheets as a handier interface for computing than JavaScript



Familiar Terminology



| Letter Grade | Range (4.0 scale) | Range (percent) |
|--------------|-------------------|-----------------|
| A | 3.81 - 4.00 | 0.95 - 1.00 |
| A- | 3.60 - 3.80 | 0.90 - 0.95 |
| B+ | 3.47 - 3.59 | 0.87 - 0.89 |
| B | 3.33 - 3.46 | 0.83 - 0.86 |
| B- | 3.20 - 3.32 | 0.80 - 0.82 |
| C+ | 3.00 - 3.19 | 0.77 - 0.79 |
| C | 2.93 - 3.05 | 0.73 - 0.76 |
| C- | 2.80 - 2.92 | 0.70 - 0.72 |
| D+ | 2.66 - 2.79 | 0.67 - 0.69 |
| D | 2.53 - 2.65 | 0.63 - 0.66 |
| D- | 2.40 - 2.52 | 0.60 - 0.62 |
| F | 0.00 - 2.39 | 0.00 - 0.60 |




Formulas

The data in a spreadsheet can be manipulated using formulas

| | A | B | C | D |
|---|------------------|---------------|-----------------|----------------|
| 1 | Common Name | Distance (km) | Body Length (m) | Distance (mi.) |
| 2 | Swainson's Haw | 13500 | 0.52 | 8383.5 |
| 3 | Wheatear | 13500 | 0.16 | |
| 4 | Willow Warbler | 15500 | 0.11 | |
| 5 | Short-tailed She | 12500 | 0.43 | |
| 6 | Long-Tailed Sku | 16000 | 0.51 | |
| 7 | Arctic Tern | 19000 | 0.35 | |

The value in D2 (selected cell) is the value in B2 times 0.621...the result is shown but the cell has the formula.




Apply Formula Again

The data in a spreadsheet can be manipulated using formulas

| | A | B | C | D |
|---|------------------|---------------|-----------------|----------------|
| 1 | Common Name | Distance (km) | Body Length (m) | Distance (mi.) |
| 2 | Swainson's Haw | 13500 | 0.52 | 8383.5 |
| 3 | Wheatear | 13500 | 0.16 | 8383.5 |
| 4 | Willow Warbler | 15500 | 0.11 | 9625.5 |
| 5 | Short-tailed She | 12500 | 0.43 | 7762.5 |
| 6 | Long-Tailed Sku | 16000 | 0.51 | 9936 |
| 7 | Arctic Tern | 19000 | 0.35 | 11799 |

Notice the formula.




Filling Replicates Formulas

Fill is a spreadsheet shortcut for copy-and-paste.

| | A | B | C | D |
|---|------------------|---------------|-----------------|----------------|
| 1 | Common Name | Distance (km) | Body Length (m) | Distance (mi.) |
| 2 | Swainson's Haw | 13500 | 0.52 | 8383.5 |
| 3 | Wheatear | 13500 | 0.16 | 8383.5 |
| 4 | Willow Warbler | 15500 | 0.11 | 9625.5 |
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| 6 | Long-Tailed Sku | 16000 | 0.51 | 9936 |
| 7 | Arctic Tern | 19000 | 0.35 | 11799 |


Grab the fill tab and pull in the direction to be pasted. It's magic!



Relative & Absolute Addressing

- References to cells happens in two ways: Relative and Absolute (with \$)
 - F2 relative column, relative row
 - F\$2 relative column, absolute row
 - \$F2 absolute column, relative row
 - \$F\$2 absolute column, absolute row


Relative references change when pasted/filled; absolute references do not! Your intent determines which to pick.



A Powerful Translation

| | A | B | C | D |
|---|------------------|---------------|-----------------|----------------|
| 1 | Common Name | Distance (km) | Body Length (m) | Distance (mi.) |
| 2 | Swainson's Haw | 13500 | 0.52 | =B2*0.621 |
| 3 | Wheatear | 13500 | 0.16 | =B3*0.621 |
| 4 | Willow Warbler | 15500 | 0.11 | =B4*0.621 |
| 5 | Short-tailed She | 12500 | 0.43 | =B5*0.621 |
| 6 | Long-Tailed Sku | 16000 | 0.51 | =B6*0.621 |
| 7 | Arctic Tern | 19000 | 0.35 | =B7*0.621 |

- * The graphic shows the equations in the cells with the translation:
- * The row changes going down but the column doesn't.



An Example

Creating a discount table is case of using both relative and absolute refs

- Consider store credit of \$1 per \$10 spent
- \$3 store credit for every 2 CDs (1 earns \$1)

| Spent | CDs Purchased | | | | | | | |
|-------|---------------|--------|---------|---------|---------|---------|---------|---------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| \$10 | \$2.00 | \$4.00 | \$5.00 | \$7.00 | \$8.00 | \$10.00 | \$11.00 | \$13.00 |
| \$20 | \$3.00 | \$5.00 | \$6.00 | \$8.00 | \$9.00 | \$11.00 | \$12.00 | \$14.00 |
| \$30 | \$4.00 | \$6.00 | \$7.00 | \$9.00 | \$10.00 | \$12.00 | \$13.00 | \$15.00 |
| \$40 | \$5.00 | \$7.00 | \$8.00 | \$10.00 | \$11.00 | \$13.00 | \$14.00 | \$16.00 |
| \$50 | \$6.00 | \$8.00 | \$9.00 | \$11.00 | \$12.00 | \$14.00 | \$15.00 | \$17.00 |
| \$60 | \$7.00 | \$9.00 | \$10.00 | \$12.00 | \$13.00 | \$15.00 | \$16.00 | \$18.00 |

A cell is based on first column, top row data in that row and column...must mix relative and absolute references



Series

- Another handy property of fill is that it can make a series based on constants
 - Fill Sunday => Monday, Tuesday, Wed...
 - Fill 22 Feb => 23 Feb, 24 Feb, 25 Feb...
- More generally
 - Series fill will even count using a constant
 - Counting by odd sizes: give 1st two items



Demo