Administrivia

Slide 1

- Homework 1 on Web, due next Thursday.

  A request: You will turn in almost all work for this course by e-mail. Please do include the name or number of the course in the subject line of your message, plus something about which assignment it is, to help me get it into the correct folder for grading.

- More information about remote access to machines available via course Web page — start at course "Useful links" page and follow link to "More useful links".

Binary Numbers

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- We humans usually use the decimal (base 10) number system, but other (positive integer) bases work too. (Well, maybe not base 1.) Binary (base 2) is more widely used in computers because it makes the hardware simpler.
- In base 10, there are ten possible digits, with values 0 through 9.

  In base 2, there are 2 possible digits (*bits*), with values 0 and 1.

- In base 10, 1010 means what? What about in base 2?

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Converting Between Bases

- Converting from another base to base 10 is easy if tedious (just use definition).
- Converting from base 10 to another base? Let's try to develop an algorithm for that . . .

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Decimal to Binary, Take 1

- One way is to first find the highest power of 2 smaller than or equal to the number, write that down, subtract it from the number, and continue.
- We could write this in *pseudocode* thus (letting n be the number we want to convert:

while $(n > 0)$
    find largest p such that $2^p \leq n$
    write a 1 in the p-th output position
    subtract 2^p from n
end while

- Is this okay? What's not quite right about it? (We don't say what to put in the positions that don't have ones in them.)
- (Example.)

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Decimal to Binary, Take 2

- Another way produces the answer from right to left rather than left to right, repeatedly dividing by 2 (again n will be the number we want to convert):

  while $(n > 0)$

      divide n by 2, giving quotient q and remainder r

      write down r

      set n equal to q

  end while

- Is this okay? What's not quite right about it? (We don't say to write down the remainders from right to left.)
- (Example.)

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Octal and Hexadecimal Numbers

- Binary numbers are convenient for computer hardware, but cumbersome for humans to write. Octal (base 8) and hexadecimal (base 16) are more compact, and conversions between these bases and binary are straightforward.
- To convert binary to octal, group bits in groups of three (right to left), and convert each group to one octal digit using the same rules as for converting to decimal (base 10).
- Converting binary to hexadecimal is similar, but with groups of four bits. What to do with values greater than 9? represent using letters A through F (upper or lower case).
- (Examples.)

Minute Essay

- What is 110_2 in base 10?
- What's the (base 10) value of the largest number you can represent with 4 bits? (E.g., the largest number you can represent with 2 bits is 11_2, or 3_{10}.)

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Minute Essay Answer

- 110_2 is 6_{10}.
- 15 (1111_2).

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