SCANDAL! EXCLUSIVE! CELEBRITIES CAUGHT DOING BINARY “ARITHMETIC”

Behind that smile... you know that she's guilty of using base 17!

The Shocking Tale as Discovered by Asad B. Sayeed.

Getting to base 8 and 16

- Base 10: Your usual decimal numbers.
- Base 2: Your usual binary numbers.
- You can have all kinds of bases.
  - two particularly handy bases are 8 (octal) and 16 (hexadecimal).
  - Counting to ten in octal: 1, 2, 3, 4, 5, 6, 7, 10.
  - Octal 10 is just 8 in the decimal world. Octal 12 is decimal 10.
  - Counting to ten in base 16: 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F, 10.
  - Hex 10 is decimal 16. Hex A is decimal 10.

Handy conversions

- Every three binary digits is one octal digit:

  111000010101_2

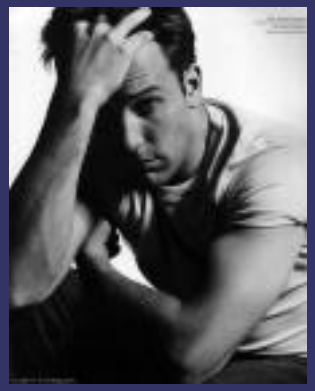
  $= \quad 7 \quad 0 \quad 2 \quad 5_8$

- Every four binary digits is one hexadecimal digit.

  111000010101_2

  $= \quad E \quad 1 \quad 5_{16}$

- Why does this work?



Jen was on to his base conversion plan all along!

Three and Four

- Every octal digit corresponds to three binary digits.
- This works because there are $2^3 = 8$ possibilities for three binary digits AND there are 8 possibly values for one octal digits.
- Same for hexadecimal, but with $2^4 = 16$.
- Does NOT work for decimal: no correspondence.

Conversions: SHOCKER!

- We are not evil robots: we still think in decimal! How to convert?
- Simple: use definition of number system. Calculate in decimal for every digit: $value * base^{position-1}$ and take sum.
- Try:
  - $AFBF_{16}$
  - 4056_{8}
  - 1011101111110100_{2}—it may be faster to convert to another base.
  - For fun, GE4F in base 17...

Conversions: SHOCKER!

- We do, of course, want to go from decimal to other bases.
- Use repeated integer division:
  - divide by the desired base
  - record remainder as least significant digit.
  - keep doing this to the quotient until the quotient is zero.
- Try it
  - 4539 to octal
  - 23466 to hexadecimal
  - 193 to base 17

Addition

- Addition of hex or octal numbers is easy: just like decimal numbers. Carry, etc, etc.
- Try:
  - base 16: 1AF6 + EF22
  - base 8: 477 + 213
  - base 36: 12Z + QDE
  - ...

Negatives

"I did NOT USE 1's complement with that program!"

- Obviously, representing negatives is easy: just take your negative representation in binary and...convert it to octal or hex digits!
- Taking the 2's complement negative of an octal number: subtract every digit from seven:
  - Try negating 312 in octal and comparing it to the binary representation in 2's complement.
  - Try the same thing in base 16...

Floats

- They consist of a mantissa and an exponent.
- You represent them separately...so you convert them separately to octal and/or hex.

Mantissa and exponent?
What will Charles think?!