

15-213

“The course that gives CMU its Zip!”

Floating Point Sept 6, 2006

Topics

- IEEE Floating Point Standard
- Rounding
- Floating Point Operations
- Mathematical properties

Floating Point Puzzles

- For each of the following C expressions, either:
 - Argue that it is true for all argument values
 - Explain why not true

```
int x = ...;
float f = ...;
double d = ...;
```

Assume neither
d nor f is NaN

- `x == (int)(float) x`
- `x == (int)(double) x`
- `f == (float)(double) f`
- `d == (float) d`
- `f == -(-f);`
- `2/3 == 2/3.0`
- `d < 0.0 ⇒ ((d*2) < 0.0)`
- `d > f ⇒ -f > -d`
- `d * d >= 0.0`
- `(d+f) - d == f`

IEEE Floating Point

IEEE Standard 754

- Established in 1985 as uniform standard for floating point arithmetic
 - Before that, many idiosyncratic formats
- Supported by all major CPUs

Driven by Numerical Concerns

- Nice standards for rounding, overflow, underflow
- Hard to make go fast
 - Numerical analysts predominated over hardware types in defining standard