Notes for 9/23/09

Amdahl's Law

$$Overall\,speedup = \frac{1}{(1-f)+\frac{f}{s}}$$

f is fraction of overall execution time that you can to speed up.
s is speedup of the above fraction

For example:
Say you want to go from having one to four processors, but only 60% of the program is parallelizable. So the overall speedup would be...

$$Overall\,speedup = \frac{1}{(1-0.6)+\frac{0.6}{4}} = 1.8181\ldots$$

What if you had as many cores as you want?

$$Overall\,speedup = \lim_{s\to\infty} \frac{1}{(1-0.6)+\frac{0.6}{s}} = 2.5$$

Another example:
You want to see a 5% overall speedup. How much must you speed up integer division to achieve this goal if integer division is 10% of your overall execution time?

$$1.05 = \frac{1}{(1-0.1)+\frac{0.1}{s}}$$
$$\Rightarrow 1.05(0.9)+1.05\left(\frac{0.1}{s}\right) = 1$$
$$\Rightarrow \frac{0.1}{s} = \frac{1-1.05(0.9)}{1.05}$$
$$\Rightarrow \frac{s}{0.1} = \frac{1.05}{1-1.05(0.9)}$$
$$\Rightarrow s = \frac{0.1(1.05)}{1-1.05(0.9)}$$
$$\Rightarrow s = 1.9090\ldots$$

Amdahl's law sanity checks:
f should be between 0 and 1, inclusive
overall speedup and *s* should be nonnegative

Lesson from Amdahl's law: make the common case fast.