I/O and disk systems

Topics today:
1. Amdahl's Law
2. I/O Architectures

① Amdahl's Law

Suppose we have a system that processes tasks at a fixed rate. (e.g. a database that processes 2,000 requests per second). Suppose we have the option to speed up some component of the system. (e.g. we could rewrite one particular type of query in the database system).
Suppose

f - is the fraction of time currently consumed by the component.

k - is the factor by which we can speed up the component

Then the speedup factor S from improving the component is

$$S = \frac{1}{(1-f) + f/k}$$ ← Amdahl's Law

Example: the queries under consideration occupy 30% of processing time. The rewrite will make them 50% faster. What is resulting speedup?

Solution: do as exercise

See worked example in Section 7.3 of the book for how to do a cost/benefit analysis of two different proposed improvements.

(2) I/O Architectures

Detailed knowledge is not required. We just need an awareness of the following basic facts:

- The most common form of I/O uses interrupts, as described earlier in the semester.
- An I/O device signals an interrupt when ready to send or receive data. CPU suspends regular operation of the fetch-decode-execute cycle and services the interrupt instead.
- Efficiency is greatly improved using direct-memory access (DMA) – a special piece of hardware that transfers data between devices and main memory. The CPU must initiate the transfer, but can then do other useful tasks while the transfer is being performed.