Chapter 1 - Computer Abstractions and Technology

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Exercise 1.1 *Aside from the smart cell phones used by a billion people, list and describe four other types of computers.*

Four other types of computers include desktop computers, embedded computer systems, video game consoles, and laptops, among many others.

Exercise 1.2 *The eight great ideas in computer architecture are similar to ideas from other fields. Match the eight ideas from computer architecture, Design for Moores Law, Use Abstraction to Simplify Design, Make the Common Case Fast, Performance via Parallelism, Performance via Pipelining, Performance via Prediction, Hierarchy of Memories, and Dependability via Redundancy to the following ideas from other fields:*

a. *Assembly lines in automobile manufacturing*
b. *Suspension bridge cables*
c. *Aircraft and marine navigation systems that incorporate wind information*
d. *Express elevators in buildings*
e. *Library reserve desk*
f. *Increasing the gate area on a CMOS transistor to decrease its switching time*
g. *Adding electromagnetic aircraft catapults (which are electrically powered as opposed to current steam-powered models), allowed by the increased power generation offered by the new reactor technology*
h. *Building self-driving cars whose control systems partially rely on existing sensor systems already installed into the base vehicle, such as lane departure systems and smart cruise control systems*

a. Performance via Pipelining
b. Dependability via Redundancy
c. Performance via Prediction
d. Make the Common Case Fast
e. Hierarchy of Memories
f. Performance via Parallelism
g. Design for Moore's Law
h. Use Abstraction to Simplify Design

Exercise 1.3 *Describe the steps that transform a program written in a high-level language such as C into a representation that is directly executed by a computer processor.*

First, the program is compiled down from the language, such as C, to assmebly code by a compiler. From there, it is assembled by an assembler into machine code, and in C's case linked by a linker into the final binary executable.

Exercise 1.4 *Assume a color display using 8 bits for each of the primary colors (red, green, blue) per pixel and a frame size of 1280 1024.*
a. *What is the minimum size in bytes of the frame buffer to store a frame?*
b. *How long would it take, at a minimum, for the frame to be sent over a 100Mbit/s network?*

a.

$$\frac{8bits}{color} \times \frac{3colors}{pixel} \times \frac{1280 \times 1024pixels}{frame} \times \frac{1byte}{8bits} = 3932160\frac{bytes}{frame}$$

$$3932160B \times \frac{1KB}{1024B} = 3840\frac{KB}{frame}$$

$$3840KB \times \frac{1MB}{1024KB} = 3.75\frac{MB}{frame}$$

It takes 3.75 MB to store one frame of that size in a frame buffer.

b.

$$\frac{1second}{100Mbit} = \frac{1second}{100 * 1024^2 bit} = \frac{1second}{104857600bits} \times \frac{31457280bits}{1frame} = 0.3\frac{second}{frame}$$

It would take 0.3 seconds to send one frame of that size over a 100 Mbit/second network connection.