

作业1

1. (1) **Personal computer**: the best known form of computing, which emphasize delivery of good performance to single users at low cost and usually execute third-party software.
- (2) **Servers**: Servers are oriented to carrying large workloads, which may consist of either single complex applications or handling many small jobs.
- (3) **supercomputers**: at the present consist of tens of thousands of processors and many terabytes of memory, usually used for high-end scientific and engineering calculations.
- (4) **Embedded computers**: the largest class of computers and span the widest range of applications and performance, designed to run one application or one set of related applications that are normally integrated with the hardware and delivered as a single system.

2. a. Assembly lines in automobile manufacturing: Performance via Pipelining
- b. Suspension bridge cables: Dependability via Redundancy
- c. Aircraft and marine navigation systems that incorporate wind information: Performance via Prediction
- d. Express elevators in buildings: Make the Common Case Fast
- e. Library reserve desk: Hierarchy of Memories
- f. Increasing the gate area on a CMOS transistor: Performance via Parallelism
- g. Adding electromagnetic aircraft catapults: Design for Moore's Law
- h. Building self-driving cars whose control systems partially rely on existing sensor systems: Use Abstraction to Simplify Design

5. (a) P1每秒指令数: $3 * 10^9 / 1.5 = 2 * 10^9$

P2每秒指令数: $2.5 * 10^9 / 1.0 = 2.5 * 10^9$

P3每秒指令数: $4 * 10^9 / 2.2 = 1.8 * 10^9$

所以P2性能最好

(b)运行十秒时

对于P1: cycle个数: $3 * 10^9 * 10 = 3 * 10^{10}$, instruction个数: $3 * 10^{10} / 1.5 = 2 * 10^{10}$

对于P2: cycle个数: $2.5 * 10^9 * 10 = 2.5 * 10^{10}$, instruction个数:
 $2.5 * 10^{10} / 1.0 = 2.5 * 10^{10}$

对于P3: cycle个数: $4 * 10^9 * 10 = 4 * 10^{10}$, instruction个数: $4 * 10^{10} / 2.2 = 1.8 * 10^{10}$

(c) 由 $CPU\ Time = IC * CPI / Clock\ Time$, 可知 $Clock\ Time$ 正比与 $CPI / CPU\ Time$

则P1: $3 * 10^9 * 1.2 / 0.7 = 5.1GHZ$

则P2: $2.5 * 10^9 * 1.2 / 0.7 = 4.3GHZ$

则P3: $4 * 10^9 * 1.2 / 0.7 = 6.8GHZ$

6. (a) 对于P1: $global\ CPI = 0.1 * 1 + 0.2 * 2 + 0.5 * 3 + 0.2 * 3 = 2.6$

对于P2: 由于A, B, C, D的CPI均为2, 则 $global\ CPI = 2.0$

(b) 由于总共有 $1e6$ 条混合命令, 由(1)得出了 $global\ CPI$

对于P1: $cycles = 2.6 * 10^6$

对于P2: $cycles = 2.0 * 10^6$

7.(a) $CPI = CPU\ Time / (Ic * Tc)$

对于A, $average\ CPI = 10^9 * 1.1 / 10^9 = 1.1$

对于B, $average\ CPI = 10^9 * 1.5 / 1.2 * 10^9 = 1.25$

(b) 由于A的原时间为1.1s, B的原时间为1.5s, 假设A的时钟比B快n倍

由于这两个程序计时相等, 则 $1.1 * n = 1.5$, 解得 $n = 1.37$

(c) 由 $CPU\ Time = IC * CPI / Clock\ Rate$, 则 $CPU\ Time$ 正比于 $IC * CPI$

比A: $10^9 * 1.1 / (6 * 10^8 * 1.1) = 1.67$

比B: $1.2 * 10^9 * 1.5 / (6 * 10^8 * 1.1) = 2.73$

8. (1) 由书上公式 $P = \frac{1}{2} * C * V^2 * f$:

$Pentium4\ C : 2 * 90 / (1.25 * 1.25 * 3.6 * 10^9) = 3.2 * 10^{-8} F$

$Corei5IvyBridge\ C : 2 * 40 / (0.9 * 0.9 * 3.4 * 10^9) = 3.2 * 10^{-8} F = 2.9 * 10^{-8} F$

(2) $Pentium4 : 10/100 = 0.1$

$Corei5IvyBridge : 30/70 = 0.43$

(3)由 $Dynamic = \frac{1}{2} * C * V^2 * f$, $Static = V * I$

以及 $(Dynamic\ new + static\ new) / (Dynamic + static) = 0.9$

得到 $V_2 + \frac{1}{2} * C * V_2^2 * f = 0.9 * (V + \frac{1}{2} V^2 * f)$

$Pentium4\ C$: 解方程得 $V_2 = 0.85V$

$Corei5IvyBridge$: 解方程得 $V_2 = 0.64V$