1.2 [5] <§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 Moore’s 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

1.8 The Pentium 4 Prescott processor, released in 2004, had a clock rate of 3.6 GHz and voltage of 1.25 V. Assume that, on average, it consumed 10 W of static power and 90 W of dynamic power.

The Core i5 Ivy Bridge, released in 2012, had a clock rate of 3.4 GHz and voltage of 0.9 V. Assume that, on average, it consumed 30 W of static power and 40 W of dynamic power.

1.8.1 [5] <§1.7> For each processor find the average capacitive loads.

1.8.2 [5] <§1.7> Find the percentage of the total dissipated power comprised by static power and the ratio of static power to dynamic power for each technology.

1.8.3 [15] <§1.7> If the total dissipated power is to be reduced by 10%, how much should the voltage be reduced to maintain the same leakage current?

Note:

Dynamic Power = \( \frac{1}{2} C \times V^2 \times F \), Static Power = \( I \times V \)
The results of the SPEC CPU2006 bzip2 benchmark running on an AMD Barcelona has an instruction count of 2.389E12, an execution time of 750 s, and a reference time of 9650 s.

1.11.1 [5] <§1.6, 1.9> Find the CPI if the clock cycle time is 0.333 ns.

1.11.2 [5] <§1.9> Find the SPECratio.

1.11.4 [5] <§1.6, 1.9> Find the increase in CPU time if the number of instructions of the benchmark is increased by 10% and the CPI is increased by 5%.

1.11.6 [10] <§1.6> Suppose that we are developing a new version of the AMD Barcelona processor with a 4 GHz clock rate. We have added some additional instructions to the instruction set in such a way that the number of instructions has been reduced by 15%. The execution time is reduced to 700 s and the new SPECratio is 13.7. Find the new CPI.

1.11.7 [10] <§1.6> This CPI value is larger than obtained in 1.11.1 as the clock rate was increased from 3 GHz to 4 GHz. Determine whether the increase in the CPI is similar to that of the clock rate. If they are dissimilar, why?

1.11.8 [5] <§1.6> By how much has the CPU time been reduced?

1.11.9 [10] <§1.6> For a second benchmark, libquantum, assume an execution time of 960 ns, CPI of 1.61, and clock rate of 3 GHz. If the execution time is reduced by an additional 10% without affecting to the CPI and with a clock rate of 4 GHz, determine the number of instructions.

1.11.11 [10] <§1.6> Determine the clock rate if the CPI is reduced by 15% and the CPU time by 20% while the number of instructions is unchanged.

Note:
1.11.3, 1.11.5 及 1.11.10 不用寫
1.11.11 是承 1.11.9