第二章作业

2.10 A benchmark program is run on a 40 MHz processor. The executed program consists of 100,000 instruction executions, with the following instruction mix and clock cycle count:

Instruction Type	Instruction Count	Cycles per Instruction
Integer arithmetic	48,000	1
Data transfer	34,000	2
Floating point	13,000	2
Control transfer	5000	2

Determine the effective CPI, MIPS rate, and execution time for this program.

解:

$$\text{CPI} = \text{CPI} \times \text{I}_\text{C}/\text{f} = (48000 \times 1 + 34000 \times 2 + 13000 \times 2)/100000 = 1.52$$
$$\text{MIPS} = \text{I}_\text{C}/(\text{T} \times 1000000) = 100000/3800 = 26.32$$
$$\text{T} = \text{CPI} \times \text{I}_\text{C}/\text{f} = 1.52 \times 100000/40000000 = 0.0038\text{s} = 3.8\text{ms}$$

2.12 Early examples of CISC and RISC design are the VAX 11/780 and the IBM RS/6000, respectively. Using a typical benchmark program, the following machine characteristics result:

Processor	Clock Frequency (MHz)	Performance (MIPS)	CPU Time (seconds)
VAX 11/780	10	2	12x
IBM RS/6000	20	16	x

The final column shows that the VAX required 12 times longer than the IBM measured in CPU time.

a. What is the relative size of the instruction count of the machine code for this benchmark program running on the two machines?

b. What are the CPI values for the two machines?

解:

a.

$$\text{Inst}_\text{VAX} = \text{MIPS} \times \text{CPU time} = 2 \times 12\text{x} = 24\text{x}$$
$$\text{Inst}_\text{IBM} = \text{MIPS} \times \text{CPU time} = 16 \times \text{x} = 16\text{x}$$
$$\frac{\text{Inst}_\text{VAX}}{\text{Inst}_\text{IBM}} = \frac{24\text{x}}{16\text{x}} = 1.5$$

b.

$$\text{CPI} = \frac{\text{CPU time} \times \text{clock frequency}}{\text{number of instructions}}$$
$$\text{CPI}_\text{VAX} = \frac{12\text{x} \times 10\text{MHz}}{24\text{x}} = \frac{120\text{x}}{24\text{x}} = 5$$
$$\text{CPI}_\text{IBM} = \frac{\text{x} \times 20\text{MHz}}{16\text{x}} = \frac{20\text{x}}{16\text{x}} = 1.25$$