Speedup

1 Exercise

A computer spends 30% of its time accessing memory, 20% performing multiplications and 50% executing other instructions. As a computer architect you have to choose between improving the memory system, multiplication hardware or execution of non multiplication instructions. There is space on chip for only one improvement. Each of the improvement will improve its associated part of computation by a factor of 2.

1. Without performing calculations, which improvement would you expect to give the largest performance increase and why?
2. What speedup would making each of these three changes give?

2 Exercise

A computer architect is designing the memory system for the next version of a processor. If the current version of the processor spends 40% of its time processing memory references, by how much must the architect speed up the memory system to achieve an overall speedup of 1.2?

3 Exercise

Consider an architecture that has four types of instructions: additions, multiplications, memory operations and branches. The following table gives the number of instructions of each type in your program, the number of cycles it takes to execute each instruction and the speedup in the execution from a proposed improvement. Rank the improvements in terms of their impact on overall performance.

Instruction type	Number	Execution time	Speedup to type
Addition	10 million	2 cycles	2.0
Multiplication	30 million	20 cycles	1.3
Memory	35 million	10 cycles	3.0
Branch	15 million	4 cycles	4.0

4 Exercise

A computer for rendering digital special effects has 8 processor cores. The rendering program has 20% serial portion and the rest of the rendering is parallelizable and can be run on any number of cores. You have an option of increasing the number of cores to 16 or improve rendering program so that the serial portion of the program is dropped to 10%. Which of the improvements should you choose?