Tutorial 2 | ES 215 Computer Organization and Architecture | 19/08/2024

1). Suppose that a task makes extensive use of floating-point operations, with 40% of the time consumed by floating-point operations. With a new hardware design, the floating-point module is sped up by a factor of K. Then what is the overall speedup?

2). Assume that a benchmark program executes in 480 seconds on a reference machine A. The same program executes on systems B, C, and D in 360, 540, and 210 seconds, respectively. Show the speedup of each of the three systems under test relative to A.

3). Consider a system that has a single bottleneck which occupies 20% of the total execution time. Suppose we add 4 more processors to the system. What would be the speedup achieved?

4). A system is composed of 4 components:

a). The performance of 5% of the system can be doubled. We will call this part component 1
b). The performance of 20% of the system can be improved by 80%. We will call this part component 2
c). The performance of 45% of the system can be improved by 50%. We will call this part component 3
d). The performance of the remaining part of the system cannot be improved. We will call this part component 4.

Which component is most worthy to work on to get the maximum overall improvement?

5). Assume a machine is enhanced, making all floating-point instructions **7** times faster. Originally, these floating-point instructions accounted for **65%** of the total execution time.

a). What will be the overall speedup of the machine after this enhancement? Additionally, calculate the percentage increase in speedup due to this change.

b). If the execution time of some benchmark program before the floating-point enhancement is **29** seconds, what will the speedup be if only **two-third** of the **29** seconds is spent executing floating-point instructions.

6). When parallelizing an application, the ideal speedup is speeding up by the number of processors. This is limited by two things: percentage of the application that can be parallelized and the cost of communication.Amdahl's law takes into account the former but not the latter.

a. What is the speedup with N processors if 80% of the application is parallelizable, ignoring the cost of communication?

b. What is the speedup with 8 processors if, for every processor added, the communication overhead is 0.5% of the original execution time.

c. What is the speedup with 8 processors if, for every time the number of processors is doubled, the communication overhead increases by 0.5% of the original execution time?

d. What is the speedup with N processors if, for every time the number of processors is doubled, the communication overhead increases by 0.5% of the original execution time?

e. Write the general equation that solves this question: What is the number of processors with the highest speedup in an application in which P% of the original execution time is parallelizable, and, for every time the number of processors is doubled, the communication is increased by 0.5% of the original execution time?