Tyler Andrews, tja0023, 903807885

COMP 4300: Homework 1

Points Possible: 100

Note: You do not need to submit hard copies.

Goals:

- To learn how to report computer performance.
- To apply the Amdahl's law to solve problems.

Benchmarks	Ultra 5 Time (sec)	Opteron Time (sec)	SPECRatio	Itanium 2 Time (sec)	SPECRatio	Opteron/Itanium Times (sec)	Itanium/Opteron SPECRatios
wupwise	1600	51.5	31.06	56.1	28.53	0.92	0.92
swim	3100	125.0	24.73	70.7	43.85	1.77	1.77
mgrid	1800	98.0	18.37	65.8	27.36	1.49	1.49
applu	2100	94.0	22.34	50.9	41.25	1.85	1.85
mesa	1400	64.6	21.69	108.0	12.99	0.60	0.60
galgel	2900	86.4	33.57	40.0	72.47	2.16	2.16
art	2600	92.4	28.13	21.0	123.67	4.40	4.40
equake	1300	72.6	17.92	36.3	35.78	2.00	2.00
facerec	1900	73.6	25.80	86.9	21.86	0.85	0.85
ammp	2200	136.0	16.14	132.0	16.63	1.03	1.03
lucas	2000	88.8	22.52	107.0	18.76	0.83	0.83
fma3d	2100	120.0	17.48	131.0	16.09	0.92	0.92
sixtrack	1100	123.0	8.95	68.8	15.99	1.79	1.79
apsi	2600	150.0	17.36	231.0	11.27	0.65	0.65
Geometric mean			20.86		27.12	1.30	1.30

Figure 1.14 SPECfp2000 execution times (in seconds) for the Sun Ultra 5—the reference computer of SPEC2000—and execution times and SPECRatios for the AMD Opteron and Intel Itanium 2. (SPEC2000 multiplies the ratio of execution times by 100 to remove the decimal point from the result, so 20.86 is reported as 2086.) The final two columns show the ratios of execution times and SPECratios. This figure demonstrates the irrelevance of the reference computer in relative performance. The ratio of the execution times is identical to the ratio of the SPECRatios, and the ratio of the geometric means (27.12/20.86 = 1.30) is identical to the geometric mean of the ratios (1.30).

Questions:

1. Your company is trying to choose between purchasing the Opteron or Itanium 2. You have analyzed your company's applications, and 60% of the time it will be running applications similar to wupwise, 20% of the time applications similar to ammp, and 20% of the time applications similar to apsi.

1.1. [15 points] If you were choosing just based on overall SPEC performance, which would you choose and why?

I would choose Intanium based on overall SPEC performance. Since the Geometric mean for Opeteron/Intanium (sec) is greater than 1, that means that on average Opeteron will take longer to run a program than Intanium.

[20 points] What is the weighted average of execution time ratios for this mix of applications for the Opteron and Itanium 2? (0.92*0.6) + (1.03 * 0.2) + (0.2*0.65) = 0.552 + .206 + 0.13 = 0.888

1.3. [15 points] What is the speedup of the Opteron over the Itanium 2?

Operon = 0.6(51.5) + 0.2(136) + 0.2(150) = 88.1

Intanium = 0.6(51.5) + 0.2(132) + 0.2(231) = 103.5

Speedup = 103.5/88.1 = 1.17

2. Speeding up one computing element normally comes at the cost of slowing down the performance of other elements. For example, a fast floating point unit can speed up the performance of floating point instructions; however, the fast floating point unit may add a few cycles delay for other types of instructions.

2.1 [15 points] If the new floating point unit improves the floating point instructions by a factor of 3 (i.e., speedup is 3); the floating point instructions take 35% of the program execution time. What is the overall speedup (assuming there is no performance penalty of the new floating point unit)?

1 / (.35/3+ 0.65) = 1.3

2.2 [20 points] If the floating point unit slows down the memory access instructions (i.e., 2 slowdown or 1/2 speedup). The memory access instructions account for 15% of the program execution. What is the overall speedup when we consider the performance penalty imposed by the floating point unit?

1 /(.35/3 + 0.15/.5 + .50) = 1.09

2.3 [15 points] After we incorporate the fast floating point unit, what percentage of the execution time is contributed by floating point instructions? What percentage of the time is consumed by memory access instructions?

Total Time = 50 + (35/3) + (15*2) = 97.5

Floating Point: 11.667/97.5 = 11.9%
Memory Access: 7.5/97.5 = 7.69%