You have a system that contains a special processor for doing floating-point operations. You have determined that 50% of your computations can use the floating-point processor. The speedup of the floating pointing-point processor is 15.

a) Overall speedup achieved by using the floating-point processor.

F = 0.5 S = 15

$$\text{Overall speedup} = \frac{1}{(1-0.5)+\frac{0.5}{15}} = \frac{1}{0.5+0.033} = 1.876$$

b) Overall speedup achieved if you modify the compiler so that 75% of the computations can use the floating-point processor.

F = 0.75 S = 15

$$\text{Overall speedup} = \frac{1}{(1-0.75)+\frac{0.75}{15}} = \frac{1}{0.25+0.05} = 3.33$$

c) What fraction of the computations should be able to use the floating-point processor in order to achieve an overall speedup of 2.25?

F = ? S = 15

$$2.25 = \frac{1}{(1-F)+\frac{F}{15}}$$

$$= \frac{15}{15-15F+F} = \frac{15}{15-14F}$$

$$2.25(15-14F) = 15$$

$$33.75-31.5F = 15$$

$$31.5F = 18.75$$

$$F = \frac{18.75}{31.5} = 0.595 \quad \text{or} \quad 60\%$$

You have a system that contains a special processor for doing floating-point operations. You have determined that 60% of your computations can use the floating-point processor. When a program uses the floating-point processor, the speedup of the floating-point processor is 40% faster than when it doesn't use it.

a) Overall speedup by using the floating-point processor.

F = 0.6 S = 1.4

$$\text{Overall speedup} = \frac{1}{(1-0.6)+\frac{0.6}{1.4}} = \frac{1}{0.4+0.429} = 1.206$$

b) In order to improve the speedup you are considering two options:

- Option 1: Modifying the compiler so that 70% of the computations can use the floating-point processor. Cost of this option is $50K.

- Option 2: Modifying the floating-point processor . The speedup of the floating-point processor is 100% faster than when it doesn't use it. Assume in this case that 50% of the computations can use the floating–point processor. Cost of this option is $60K.

Which option would you recommend? Justify your answer quantitatively.

F = 0.7 S = 1.4

$$\text{Overall speedup} = \frac{1}{(1-0.7)+\frac{0.7}{1.4}} = \frac{1}{0.3+0.5} = 1.25$$

✓

$$Cost/Speedup = \frac{\$50K}{1.25} = \$40K \longrightarrow \text{Option 1}$$

F = 0.5 S = 2

$$\text{Overall speedup} = \frac{1}{(1-0.5)+\frac{0.5}{2}} = \frac{1}{0.5+0.25} = 1.33$$

$$Cost/Speedup = \frac{\$60K}{1.33} = \$45.1K \longrightarrow \text{Option 2}$$

Therefore, Option 1 is better because it has a smaller Cost/Speedup ratio.