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.

\[ F = 0.5 \quad S = 15 \]

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

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

\[ F = 0.75 \quad S = 15 \]

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

\[ F = ? \quad S = 15 \]

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

\[
= \frac{15}{15 - 15F + F} = \frac{15}{15 - 14F}
\]

\[
2.25(15 - 14F) = 15
\]

\[
33.75 - 31.5F = 15
\]

\[
31.5F = 18.75
\]

\[
F = \frac{18.75}{31.5} = 0.595 \quad \text{or} \quad 60%\]
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.

\[ F = 0.6 \quad S = 1.4 \]

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

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

\[
\text{Cost/Speedup} = \frac{\$50K}{1.25} = \$40K \quad \rightarrow \quad \text{Option 1}
\]

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

\[
\text{Cost/Speedup} = \frac{\$60K}{1.33} = \$45.1K \quad \rightarrow \quad \text{Option 2}
\]

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