Problem 1

Suppose that a CPU can be enhanced so it can execute floating point instructions \( x \) times faster than a given implementation.

a. What is the minimal frequency of floating point instructions in a given program that will yield an overall speedup of 1.7, as a function of \( x \)?

b. Suppose that the relative frequency of floating point instructions in an application program is 50%. How high need \( x \) to be in order to achieve an overall speed-up of 1.25?

Problem 2

Assume that we make an enhancement to a computer that improves some mode of execution by a factor of 10. Enhanced mode is used 50% of the time, measured as a percentage of the execution time when the enhanced mode is in use. In other words, after the enhancement, 50% of the execution time uses the enhanced mode. Recall that Amdahl’s law depends on the fraction of the original, unenhanced execution time that could make use of enhanced mode. Thus, we cannot directly use this 50% measurement to compute speedup with Amdahl’s law.

a. What is the speedup we have obtained from the fast mode?

b. What percentage of the original execution time has been converted to fast mode?

Problem 3

Show that for any two positive rates, \( r \) and \( s \), the arithmetic mean is always greater than or equal to the harmonic mean. When are the two equal?