(c) [6 points] Suppose that we are developing a new version of the AMD Barcelona processor with a 4GHz clock rate. We have added some additional instructions to the instruction set in such a way that the number of instructions has been reduced by 15%. The execution time is reduced to 700s and the new SPECratio is 13.7. Find the new CPI.

Given

cycle time = $\frac{1}{4\text{GHz}} = 0.25 \times 10^{-9}$ s

1 GHz = 10^{-9} s

exec-time = 700

exec-time = clock cycles × cycle time

clock cycles = $\frac{\text{exec time}}{\text{cycle time}} = \frac{700}{0.25 \times 10^{-9}} = 2.8 \times 10^{12}$

now I can find CPI, since I have clock cycles and number of instructions

$CPI = \frac{2.8 \times 10^{12}}{2.03 \times 10^{12}} = 1.38$

↑ instructions reduced by 15%

(d) [6 points] For a second benchmark, libquantum, assume an execution time of 960ns, CPI of 1.61, and clock rate of 3GHz. If the execution time is reduced by an additional 10% without affecting to the CPI and with a clock rate of 4GHz, determine the number of instructions.

Given

exec-time = 0.9 × 960ns = 864×10^{-9} s

CPI = 1.61

clock rate = 4×10^9

CPI = $\frac{\text{exec-time} \times \text{clock rate}}{\#\text{ of instruction}}$ ← solve for

$\#\text{ of instructions} = \frac{\text{exec-time} \times \text{clock rate}}{CPI}$

$= \frac{864 \times 10^{-9} \times 4 \times 10^9}{1.61}$

$= 2147$