2) (10 pts) ANL (Algorithm Analysis)

For a certain known data structure a lookup takes O($\sqrt{n}$) time, where n is the number of stored items. For a data set of 8,000,000 items the runtime for a look up was approximately 10ms. On a different data set the look up took 40ms. About how many **items** do you expect to be stored in the second data set?

The runtime is in milliseconds can be expressed as $c\sqrt{n}$ where c is some constant. We can find the c by plugging in n=8,000,000 10ms. We find that

$$10ms = c\sqrt{8{,}000{,}000}$$
$$\frac{10ms}{2000\sqrt{2}} = c$$
$$c = \frac{1}{200\sqrt{2}}ms$$

Let m equal the size of the data set for which a search takes 40 ms. This gives us the following equation:

$$40ms = \frac{1}{200\sqrt{2}}\sqrt{m}$$
$$40 \times 200 \times \sqrt{2} = \sqrt{m}$$

Square both sides

$$40^2 200^2 2 = m$$
$$1600(40000)(2) = m$$
$$\underline{\mathbf{128{,}000{,}000 = m}}$$

It follows that the number of items expected is 128 million.

Grading:

Find c, 4 pts.
Setting up a variable for the answer, 2 pts
Plugging in 40ms, 1 pt.
Square both side, 2 pts.
Correct answer, 1 pts.