Here are the details for $\sqrt{10}$:

$$
\begin{array}{rl}
 & 3.\ 1\ \ 6\ \ d \\
 & \sqrt{10.000000} \\
 & \underline{9} \\
61 & 100 \\
 & \underline{61} \\
626 & 3900 \\
 & \underline{3756} \\
632d & 14400
\end{array}
$$

$(6322 \cdot 2 = 12644)$

$(6323 \cdot 3 > 14400)$

$\boxed{d = 2}$

As expected, to two-decimal places, $\sqrt{10} = 3.16$.

Suggested problems

Try approximating $\sqrt{107}$ and $\sqrt{1525}$ to two decimal places.

9.8596 is a perfect square. Evaluate $\sqrt{9.8596}$

An acre has originally defined so that exactly 640 acres was equivalent to 1 square mile.
To the nearest integer, what is the length (in feet) of the side of a square whose area is 1 acre?

The following diagram (2 small squares and 2 rectangles inside a larger square) hints at why this algorithm works. Try explaining why the algorithm works?

$$(a+d)^2 = a^2 + 2ad + d^2$$