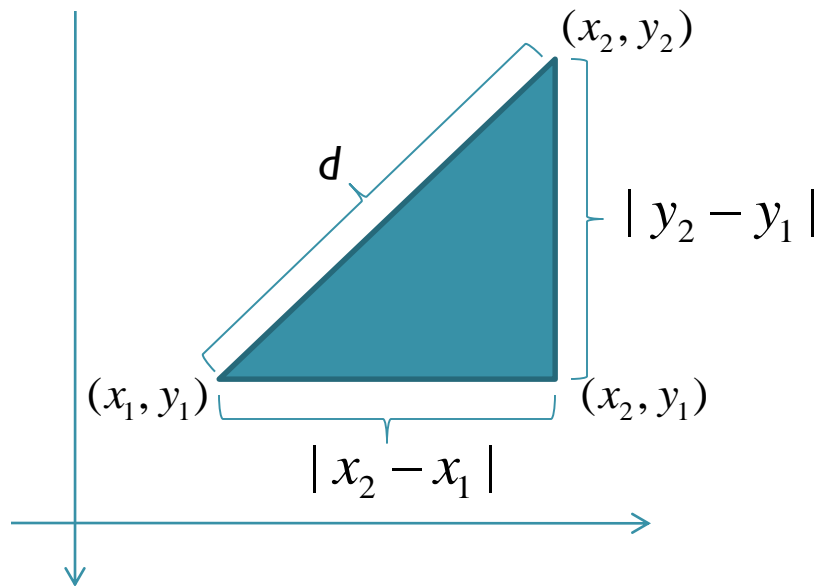




Distance Formula and Midpoint Formula

Distance Formula

The *distance formula* is derived from the Pythagorean theorem $c^2 = a^2 + b^2$.



Substituting d for c ,
 $|x_2 - x_1|$ for a ,

and $|y_2 - y_1|$ for b in the Pythagorean equation, you get

$$d^2 = |x_2 - x_1|^2 + |y_2 - y_1|^2$$

Parentheses can replace the absolute value symbols since we are squaring.

$$d^2 = (x_2 - x_1)^2 + (y_2 - y_1)^2$$

Taking the principal square root yields the distance formula.

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

The **distance** d between any two points (x_1, y_1) and (x_2, y_2) is given by

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}.$$

Example: Find the distance between the points $(2, 2)$ and $(-3, -5)$.

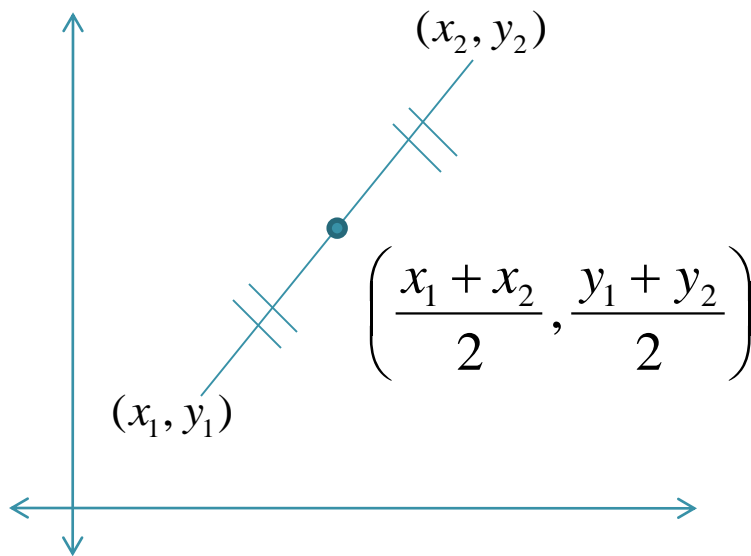
$$d = \sqrt{(-3 - 2)^2 + (-5 - 2)^2}$$

$$d = \sqrt{(-5)^2 + (-7)^2} = \sqrt{25 + 49}$$

$$d = \sqrt{74} \approx 8.6$$

The Midpoint Formula

If the endpoints of a segment are (x_1, y_1) and (x_2, y_2) , then the coordinates of the **midpoint** are $\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$.



Midpoint Formula

If the endpoints of a segment are (x_1, y_1) and (x_2, y_2) , then the coordinates of the **midpoint** are

$$\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right).$$

Example: Find the midpoint of a segment whose endpoints are $(-5, -6)$ and $(4, 4)$.

$$\begin{aligned} & \left(\frac{-5+4}{2}, \frac{-6+4}{2} \right) \\ & = \left(\frac{-1}{2}, \frac{-2}{2} \right) \\ & = \left(\frac{-1}{2}, -1 \right) \end{aligned}$$