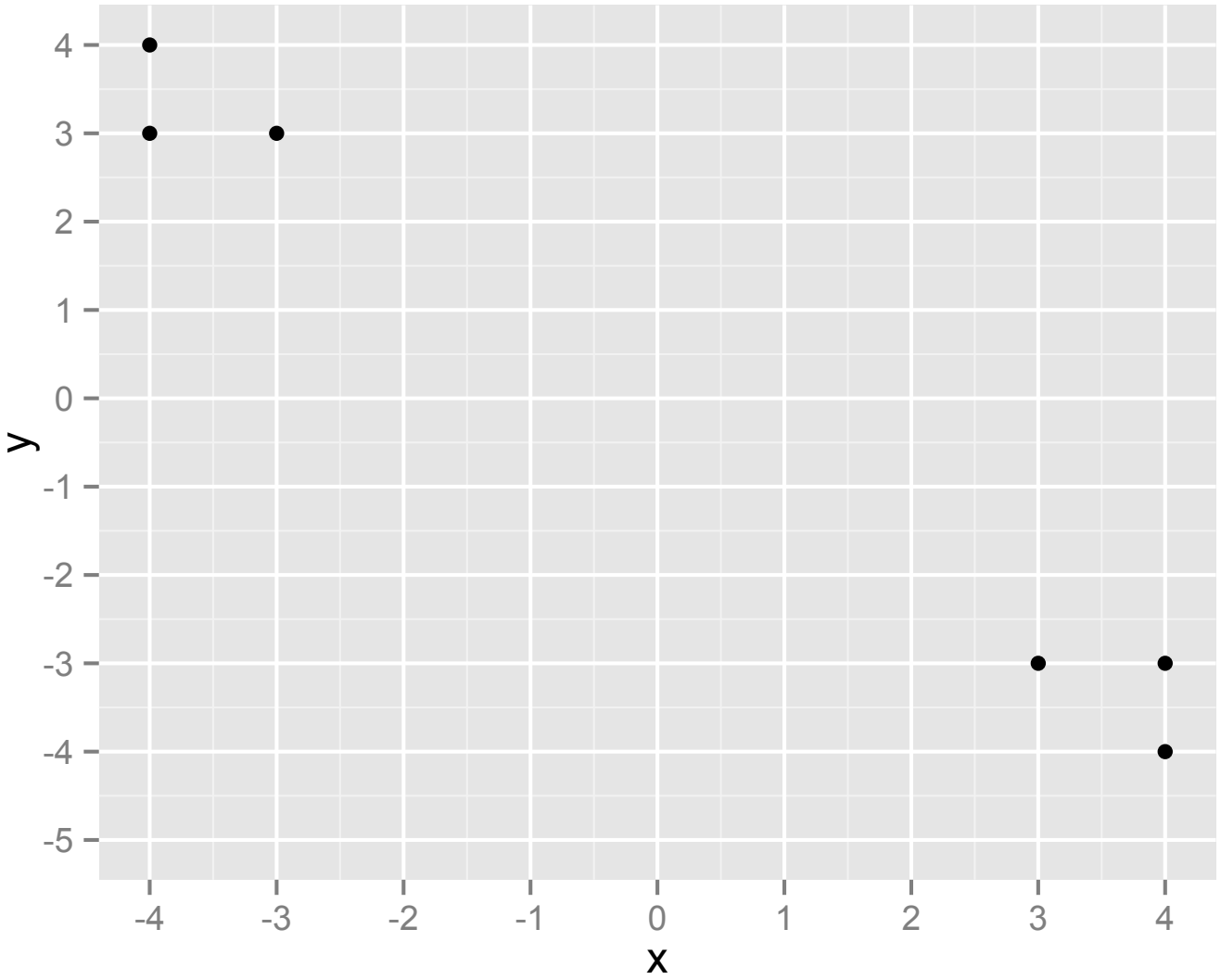
Clustering

Introduction to Data Science Algorithms

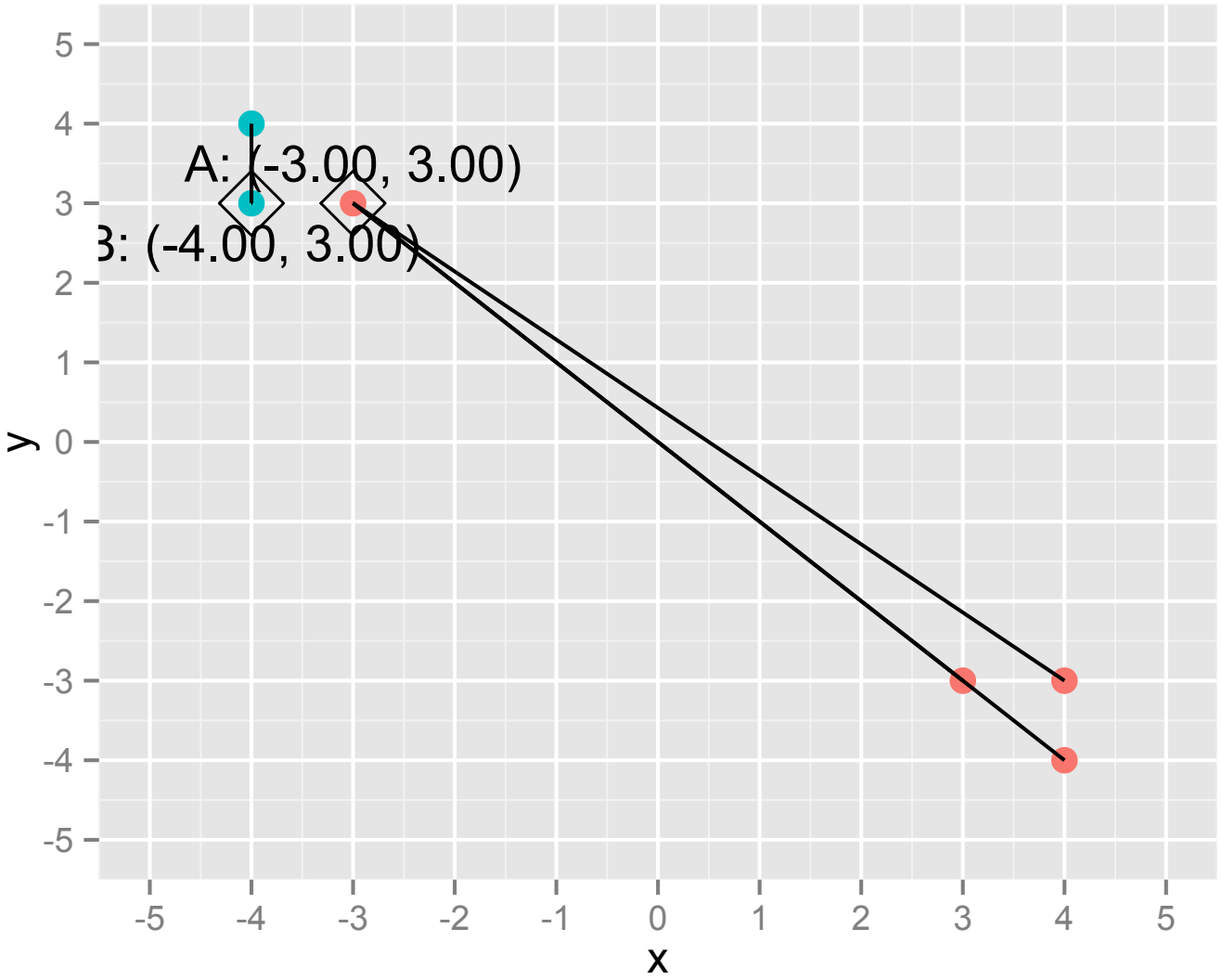
Jordan Boyd-Graber and Michael Paul

K-MEANS EXAMPLE

Two Points



Two Points



Two Points

$$\mu_A = \frac{1}{4}((-3,3)+(3,-3)+(4,-3)+(4,-4))$$

$$=$$

$$\mu_B = \frac{(-4,3)+(-4,4)}{2}$$

$$=$$

Two Points

$$\mu_A = \frac{1}{4}((-3,3)+(3,-3)+(4,-3)+(4,-4))$$

$$= (2,-1.75)$$

$$\mu_B = \frac{(-4,3)+(-4,4)}{2}$$

$$=$$

Two Points

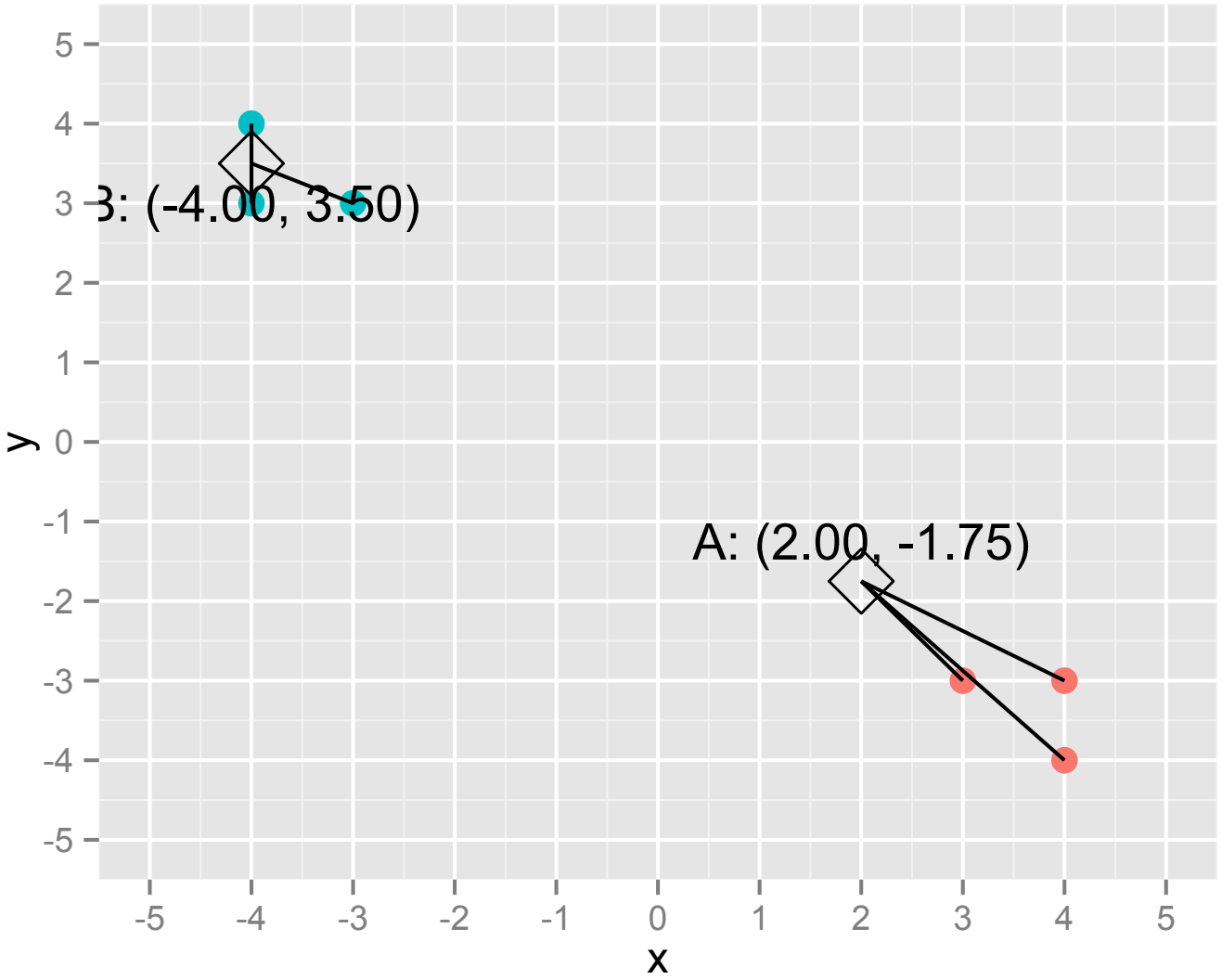
$$\mu_A = \frac{1}{4}((-3,3)+(3,-3)+(4,-3)+(4,-4))$$

$$= (2,-1.75)$$

$$\mu_B = \frac{(-4,3)+(-4,4)}{2}$$

$$= (-4,3.5)$$

Two Points



Two Points

$$\mu_A = \frac{(3,-3)+(4,-3)+(4,-4)}{3}$$

$$=$$

$$\mu_B = \frac{(-4,3)+(-4,4)+(-3,3)}{3}$$

$$=$$

Two Points

$$\mu_A = \frac{(3,-3)+(4,-3)+(4,-4)}{3}$$

$$= (3.67,-3.33)$$

$$\mu_B = \frac{(-4,3)+(-4,4)+(-3,3)}{3}$$

$$=$$

Two Points

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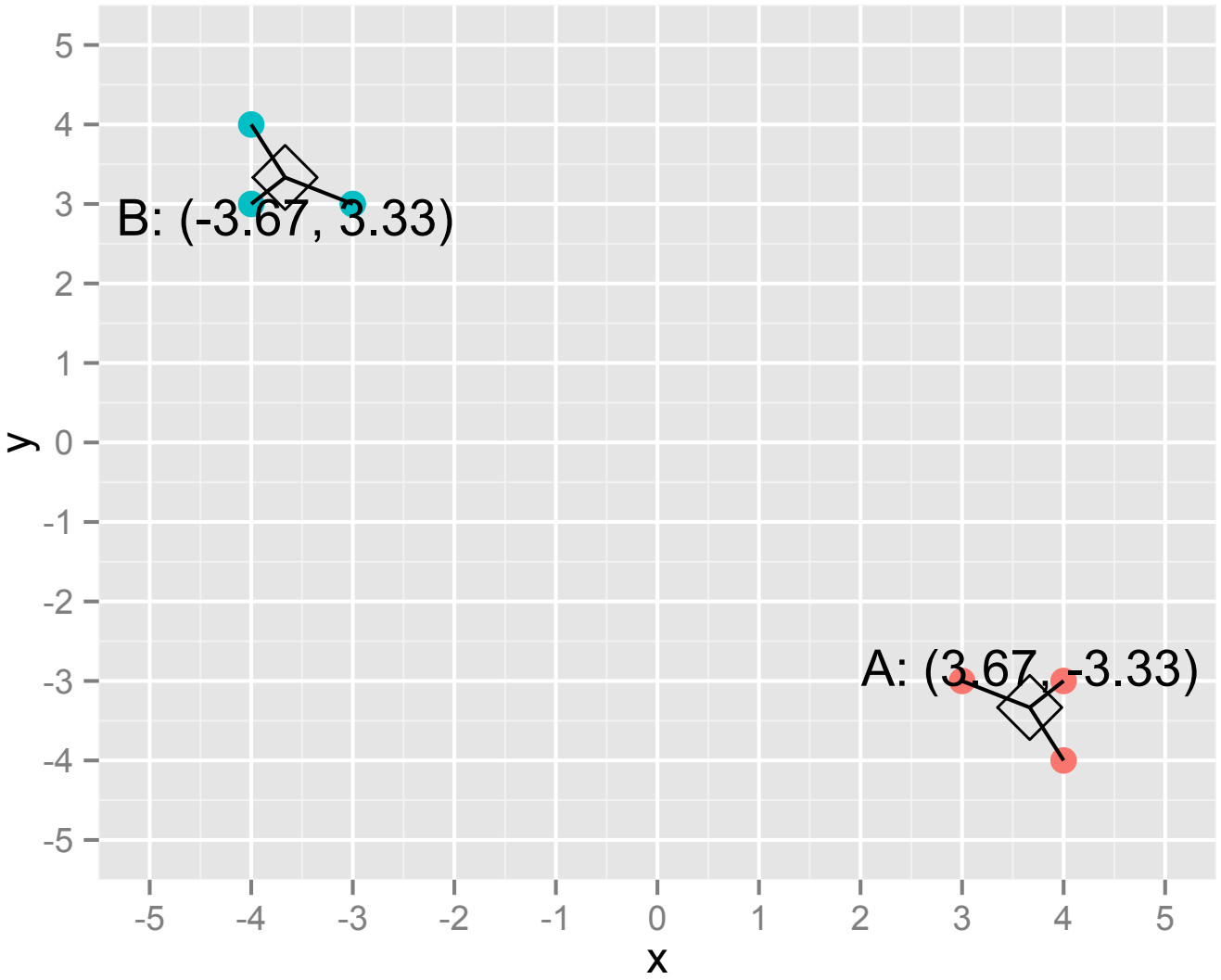
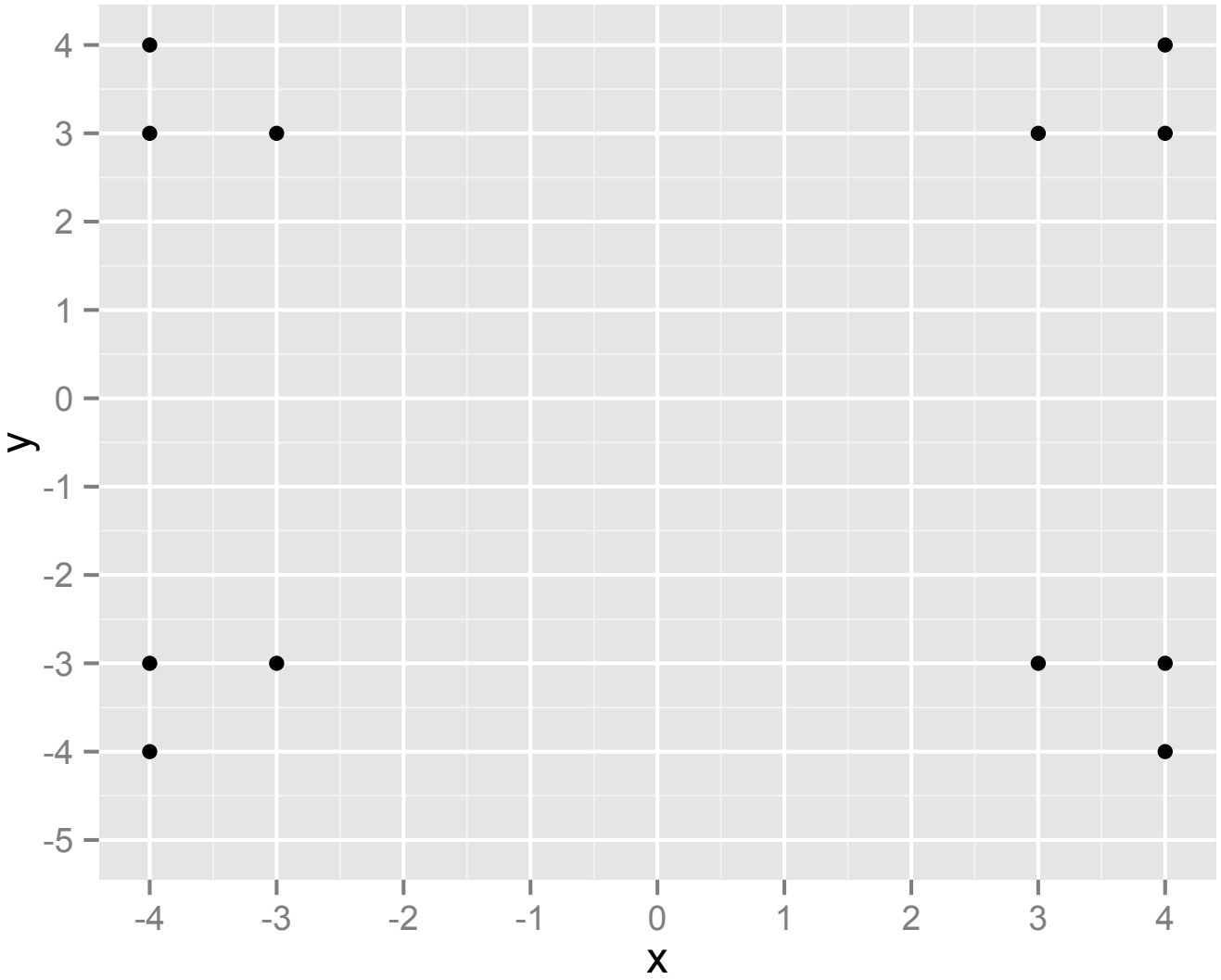
Two Points



Four Points



Four Points

The observation at $(3,3)$ is the same distance from μ_A and μ_C. If you look at Line 10 in the algorithm, the **first** mean with the smallest distance gets the assignment. So $(3,3)$ gets assigned to cluster A.

$$\mu_A =$$
$$\mu_B =$$
$$\mu_C =$$
$$\mu_D =$$

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$$\mu_A = (-1,1)$$
$$\mu_B =$$
$$\mu_C =$$
$$\mu_D =$$

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$$\mu_B = (-4,0)$$
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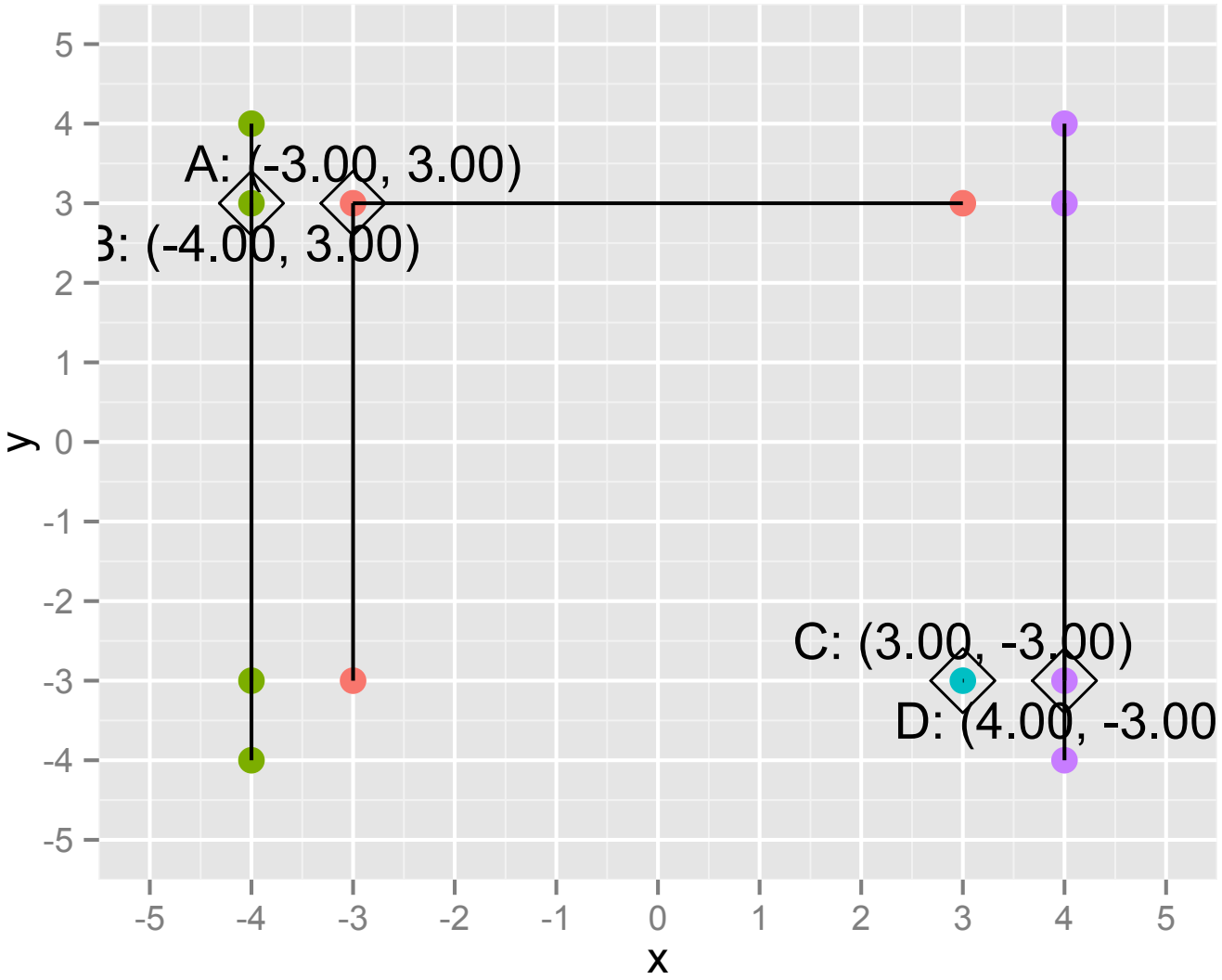
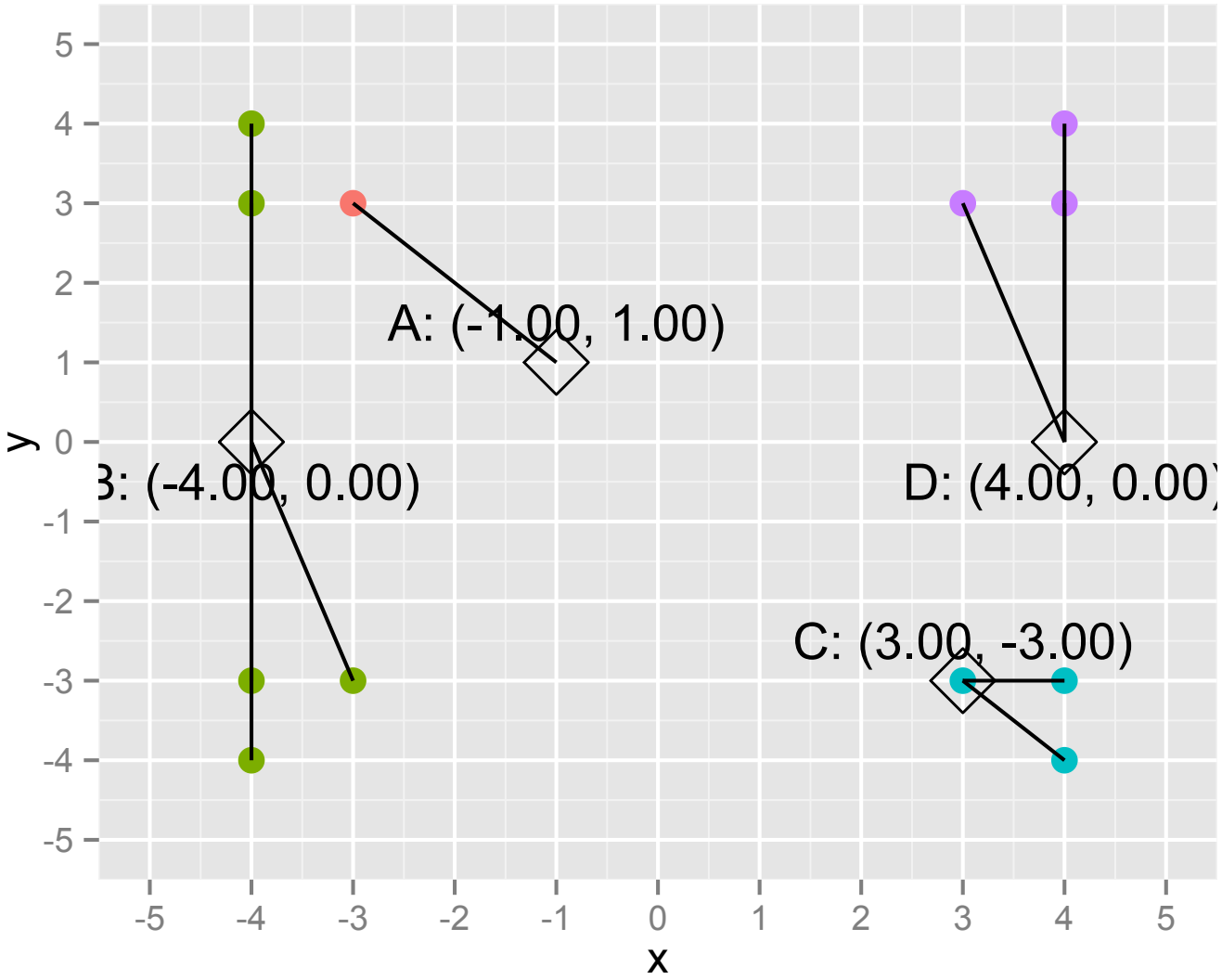
$$\mu_C = (3,-3)$$
$$\mu_D = (4,0)$$

Four Points



Four Points



Four Points

$$\mu_A =$$

$$\mu_B =$$

$$\mu_C =$$

$$\mu_D =$$

Four Points

$$\mu_A = (-3, 3)$$

$$\mu_B =$$

$$\mu_C =$$

$$\mu_D =$$

Four Points

$$\mu_A = (-3, 3)$$
$$\mu_B = (-3.8, -0.6)$$
$$\mu_C =$$
$$\mu_D =$$

Four Points

$$\mu_A = (-3, 3)$$
$$\mu_B = (-3.8, -0.6)$$
$$\mu_C = (3.67, -3.33)$$
$$\mu_D =$$

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$$\mu_B = (-3.8, -0.6)$$
$$\mu_C = (3.67, -3.33)$$
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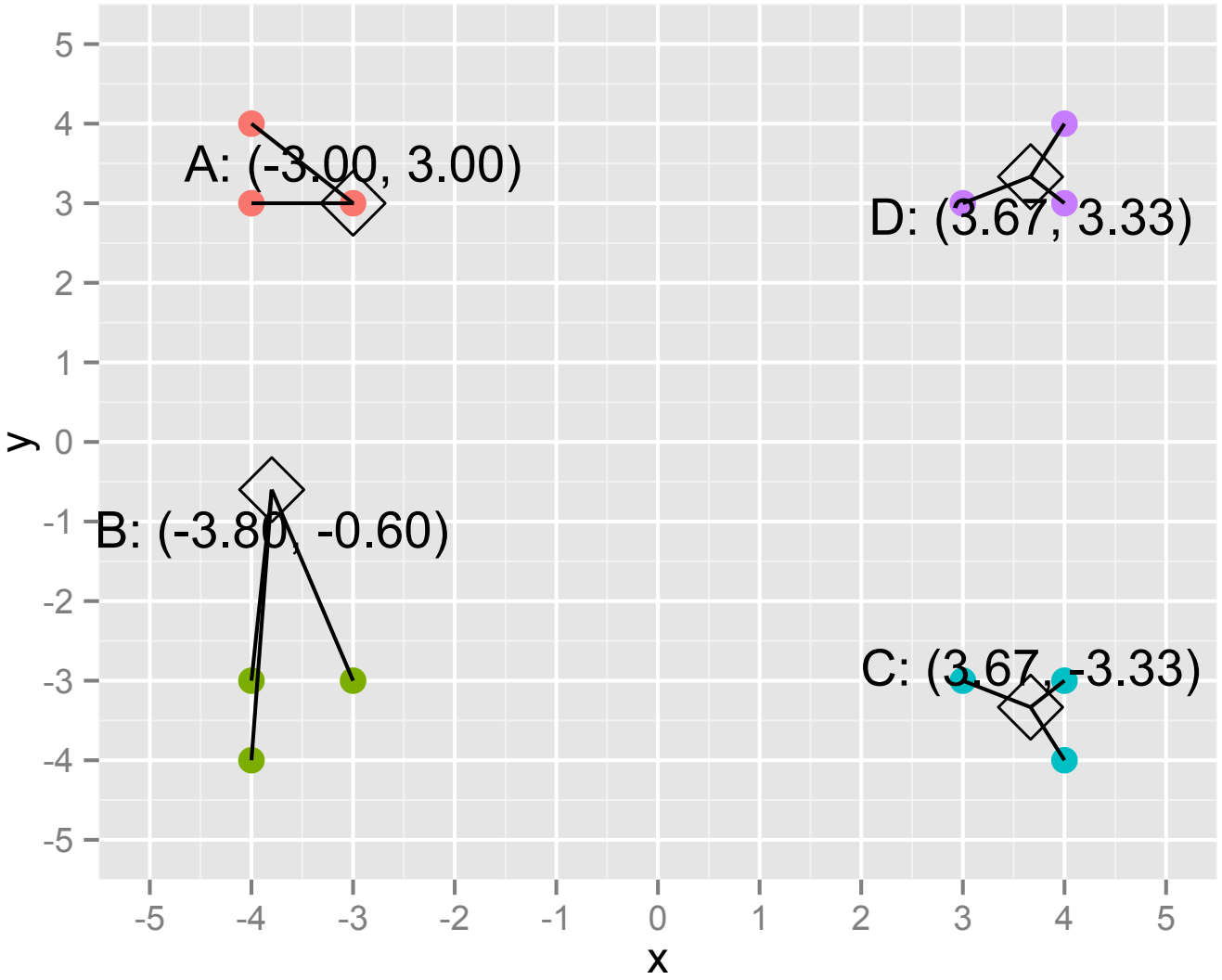
Four Points


A: (-3.00, 3.00)
B: (-3.80, -0.60)
C: (3.67, -3.33)
D: (3.67, 3.33)
y
x
5
4
3
2
1
0
-1
-2
-3
-4
-5
-5
-4
-3
-2
-1
0
1
2
3
4
5

Four Points

$$\mu_A =$$

$$\mu_B =$$

$$\mu_C =$$

$$\mu_D =$$

Four Points

$$\mu_A = (-3.67, 3.33)$$

$$\mu_B =$$

$$\mu_C =$$

$$\mu_D =$$

Four Points

$$\mu_A = (-3.67, 3.33)$$
$$\mu_B = (-3.67, -3.33)$$
$$\mu_C =$$
$$\mu_D =$$

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$$\mu_B = (-3.67, -3.33)$$
$$\mu_C = (3.67, -3.33)$$
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$$\mu_B = (-3.67, -3.33)$$
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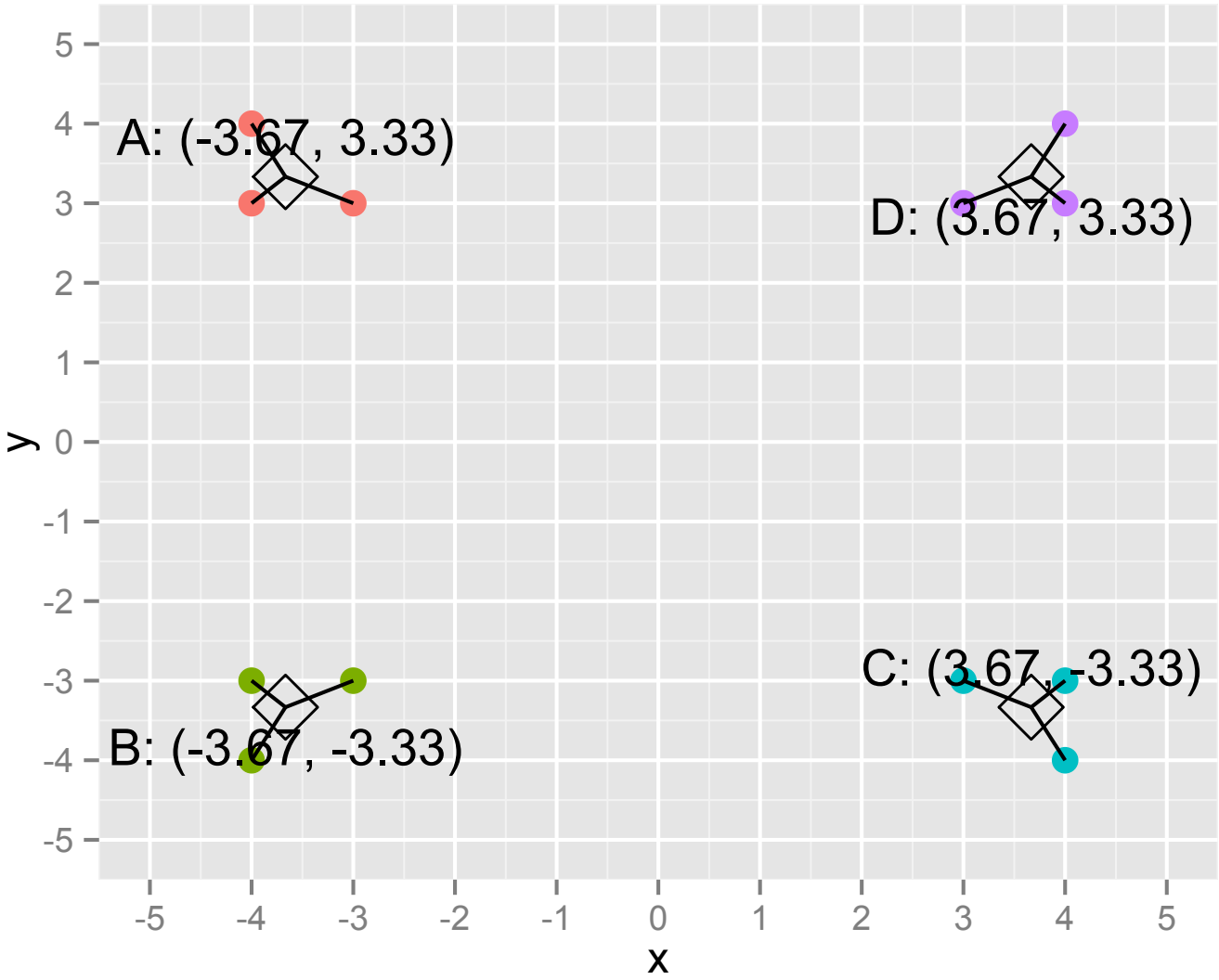
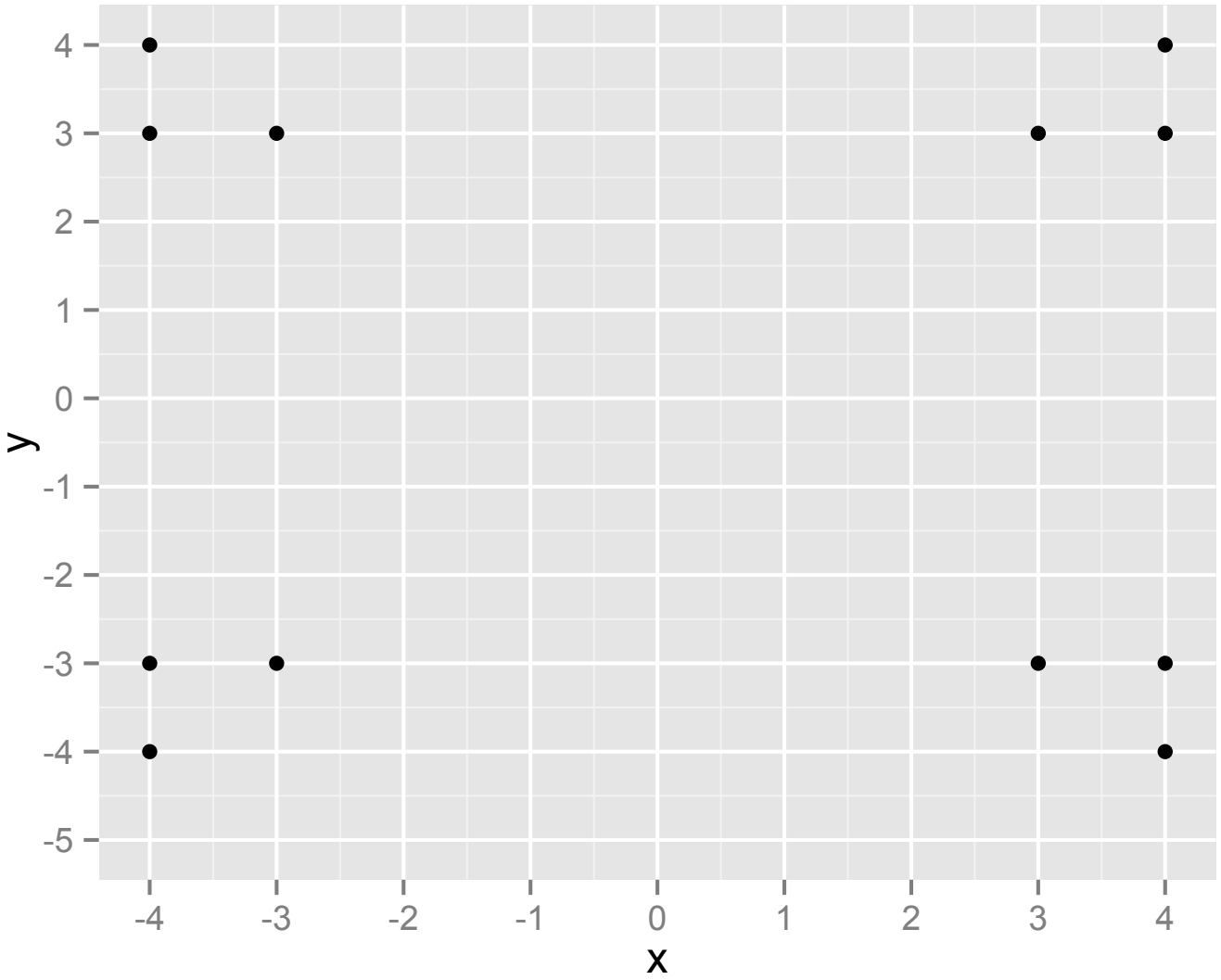
$$\mu_D = (3.67, 3.33)$$

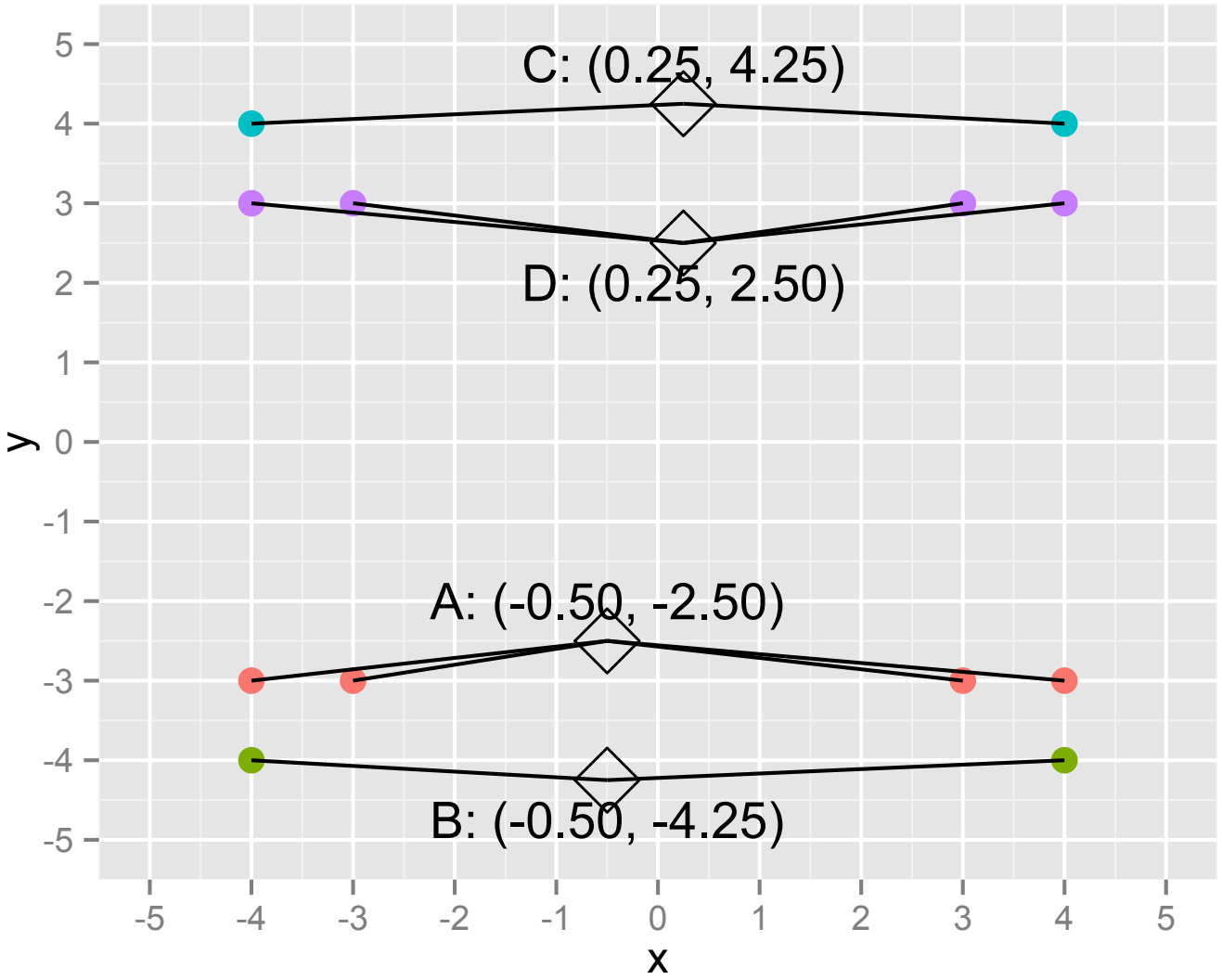
Four Points


A: (-3.67, 3.33)
B: (-3.67, -3.33)
C: (3.67, -3.33)
D: (3.67, 3.33)
y
x
5
4
3
2
1
0
-1
-2
-3
-4
-5
-5
-4
-3
-2
-1
0
1
2
3
4
5

Bad Initialization



Bad Initialization



Bad Initialization