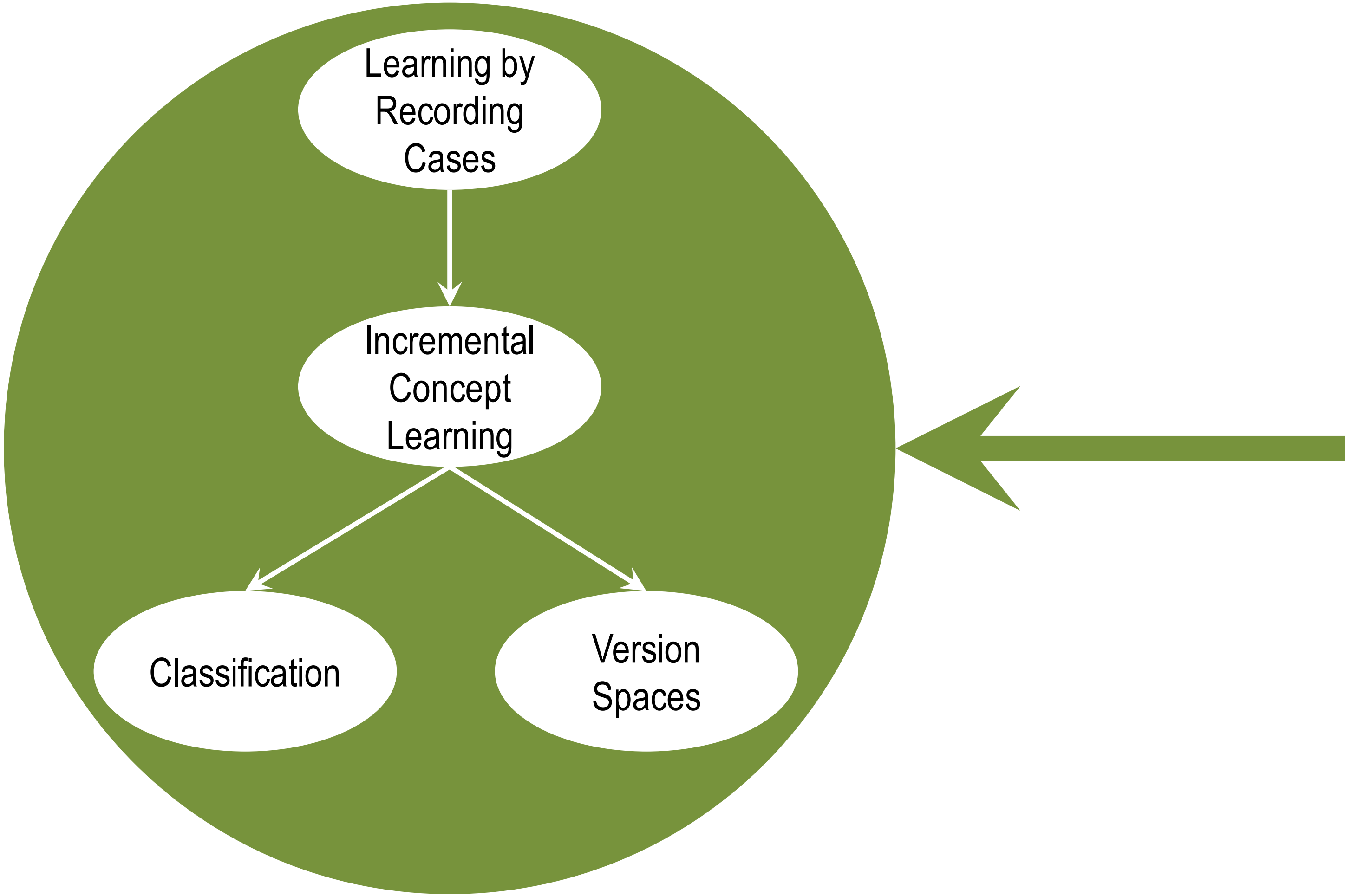
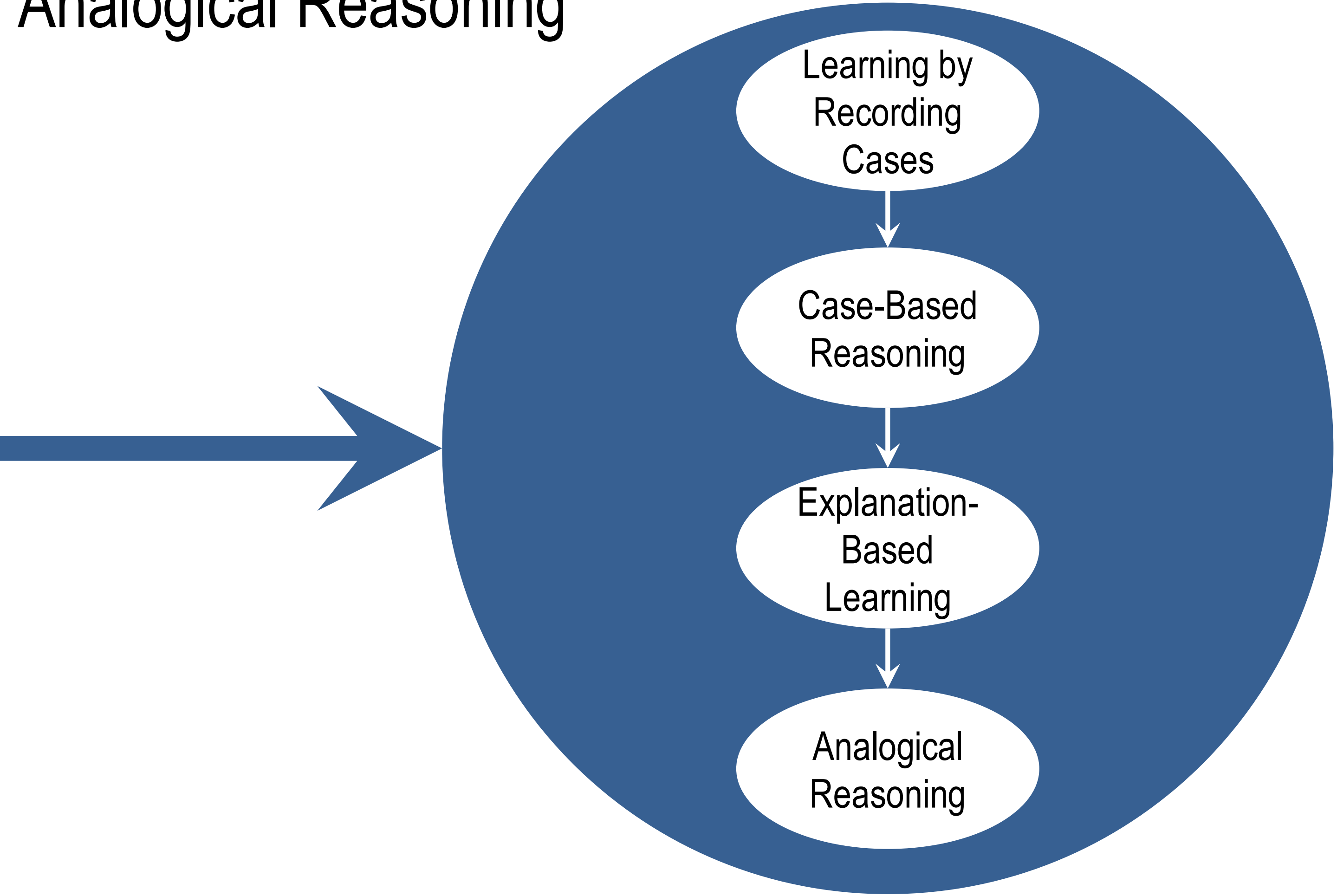
Learning by Recording Cases

Learning

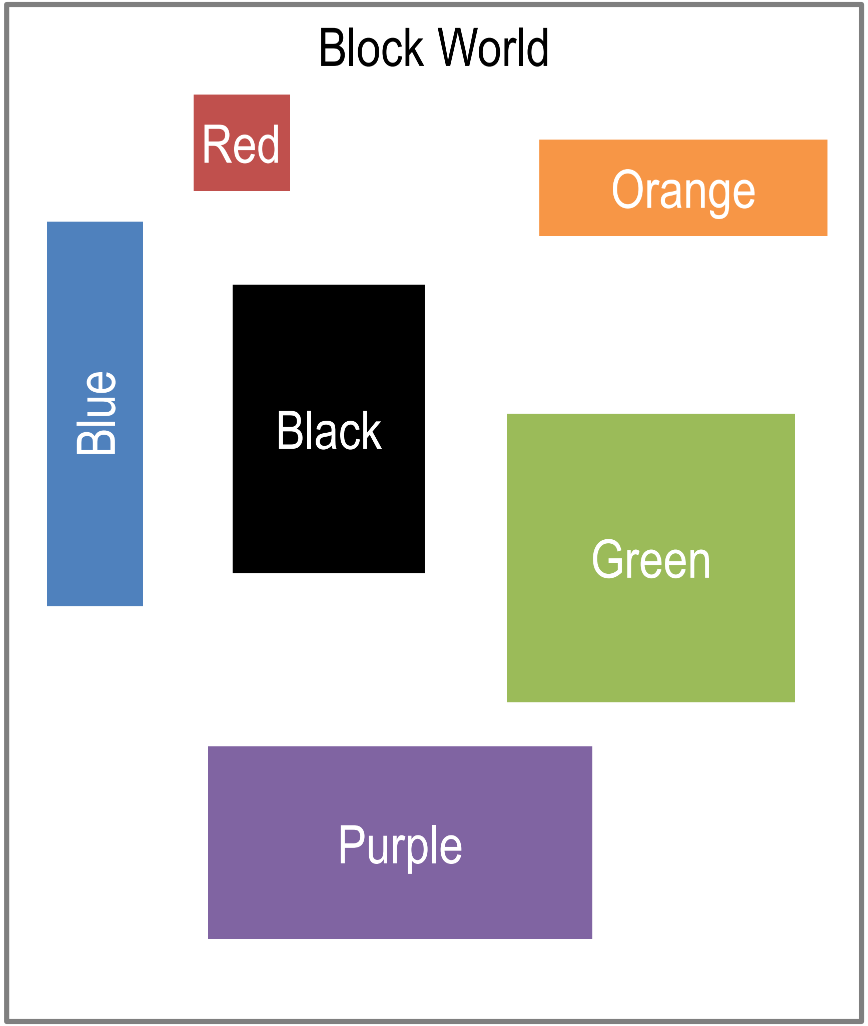

Learning by Recording Cases
Incremental Concept Learning
Classification
Version Spaces

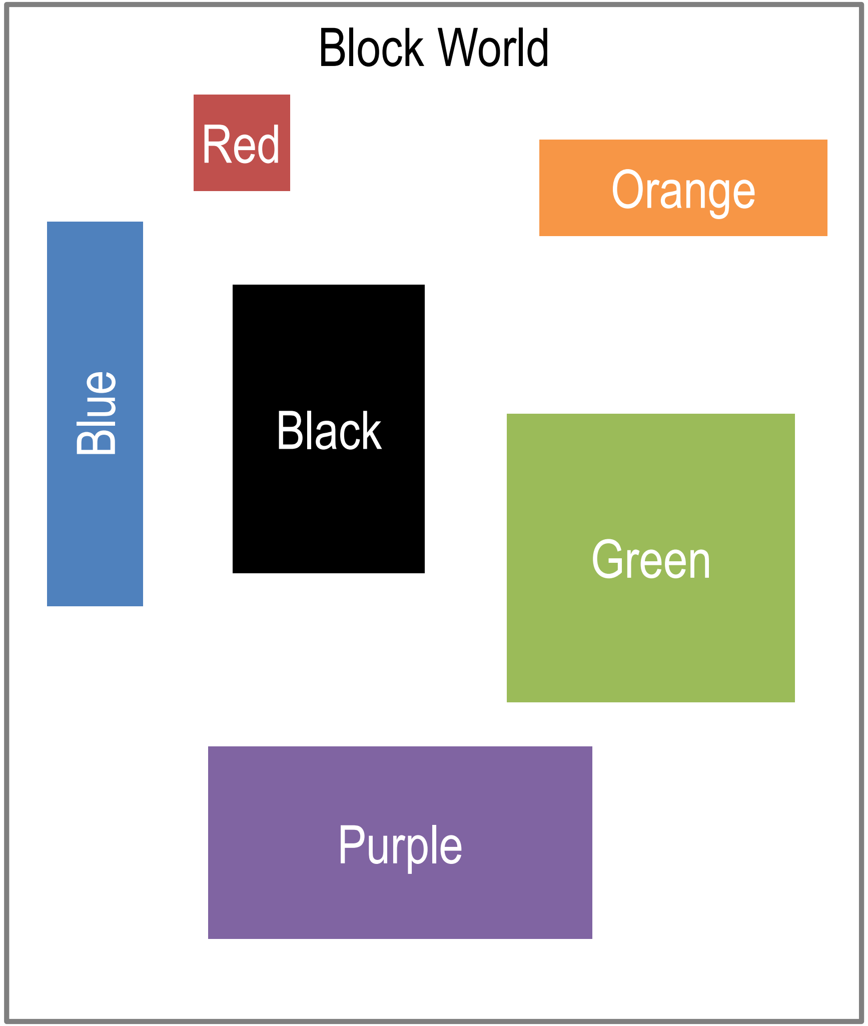
Analogical Reasoning



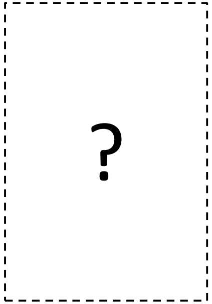
Lesson Preview

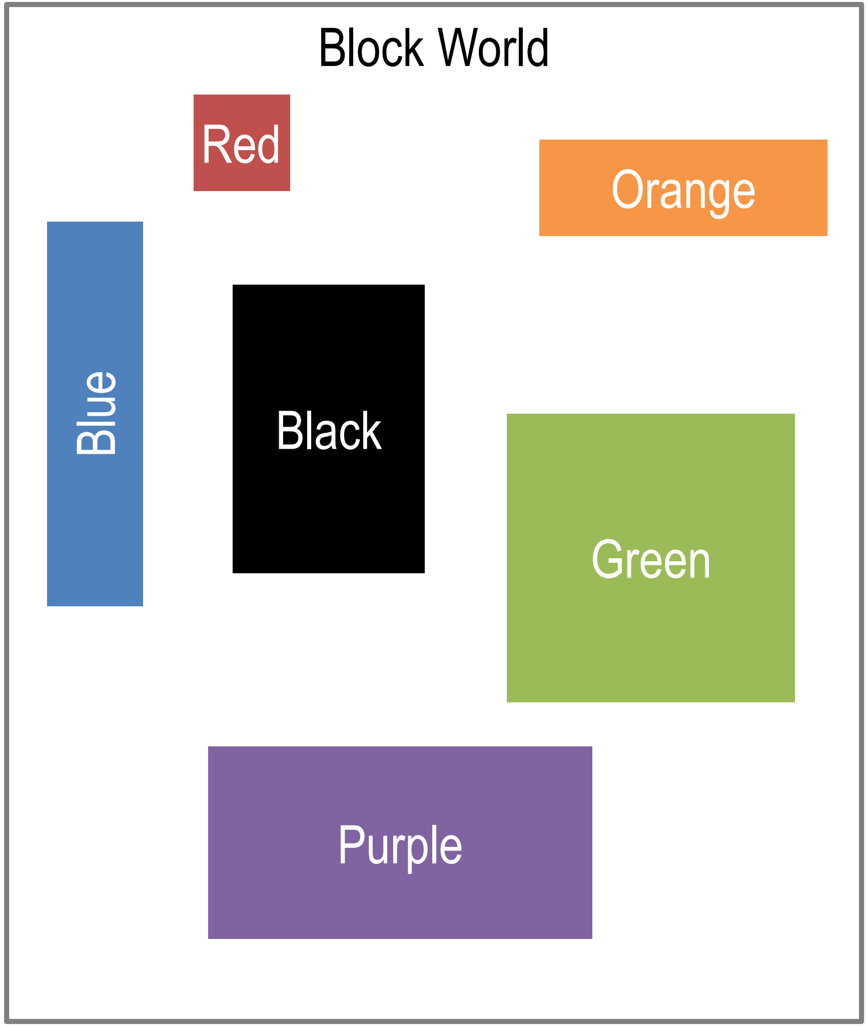
- Learning by recording cases
- Nearest neighbor method
- Cases in the real world
- k-Nearest Neighbor


Block World
Red
Orange
Blue
Black
Green
Purple



What color is this block?





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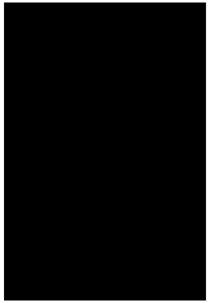
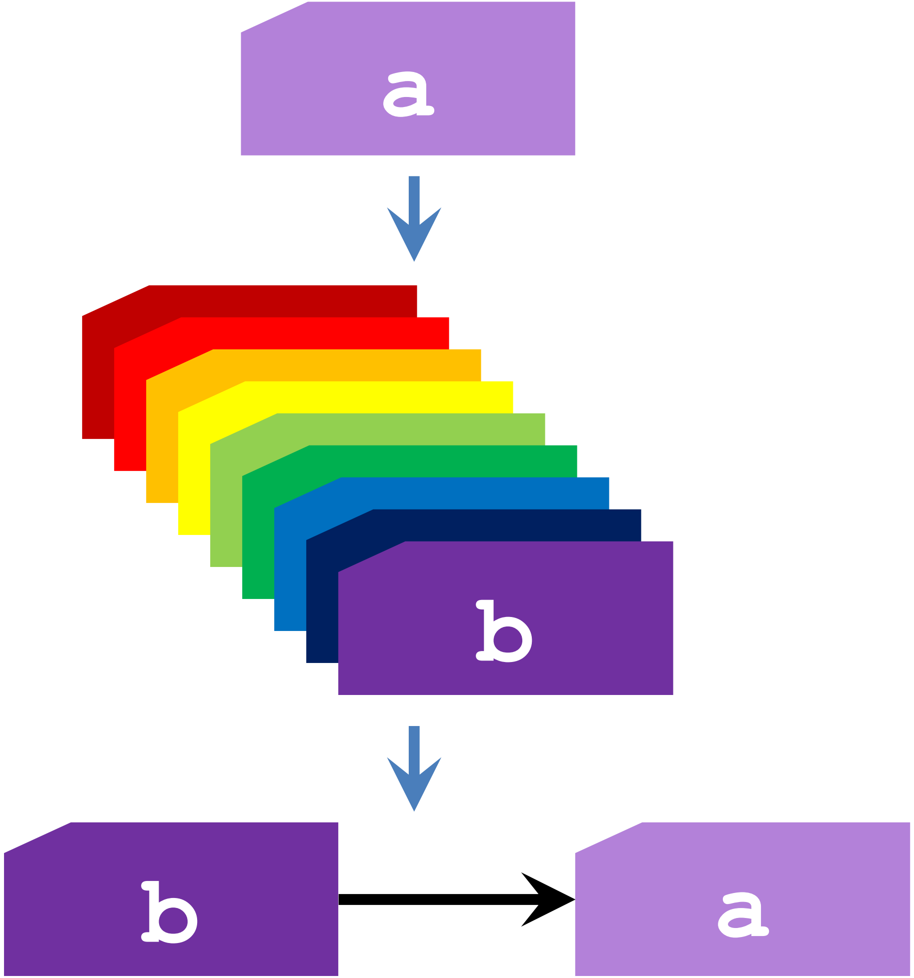


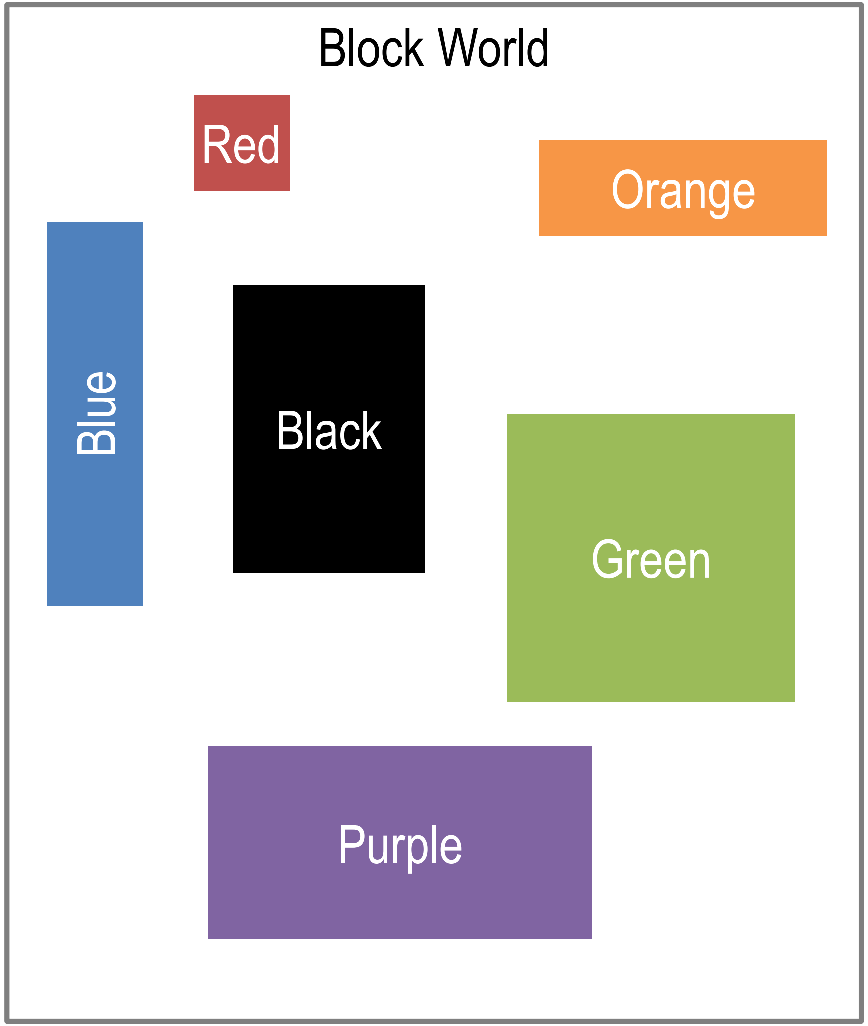
Black



Given new problem **a**

Retrieve most similar prior problem, **b**, from memory

Apply **b**'s solution to problem **a**


Block World
Red
Orange
Blue
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Green
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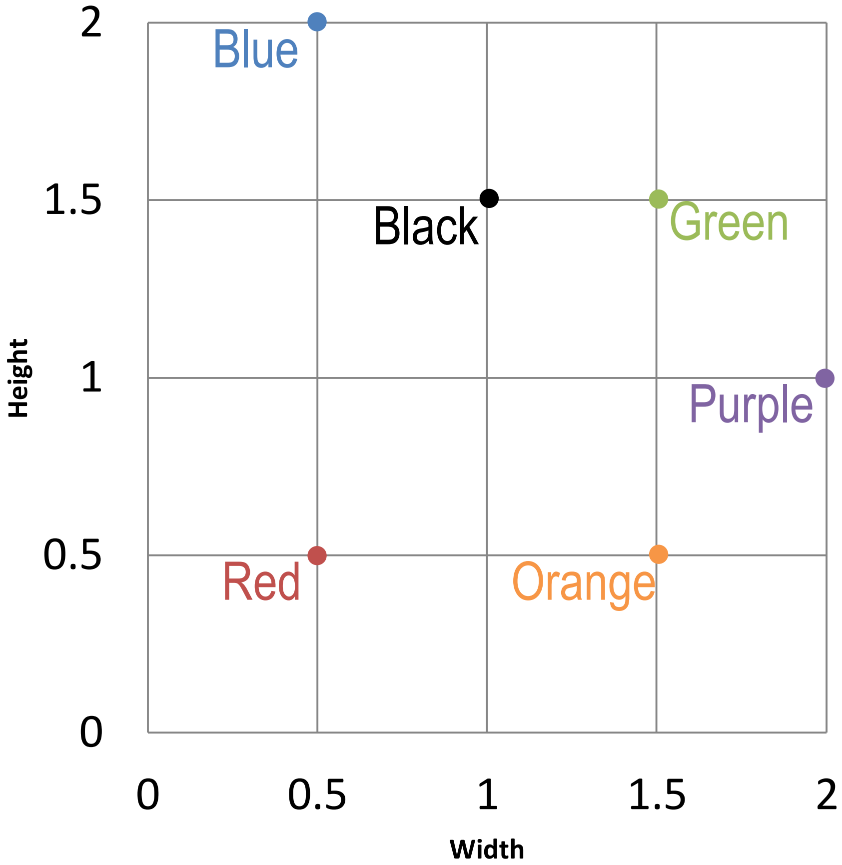
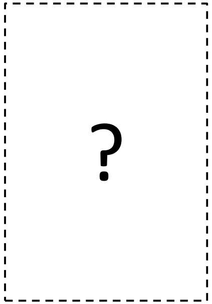
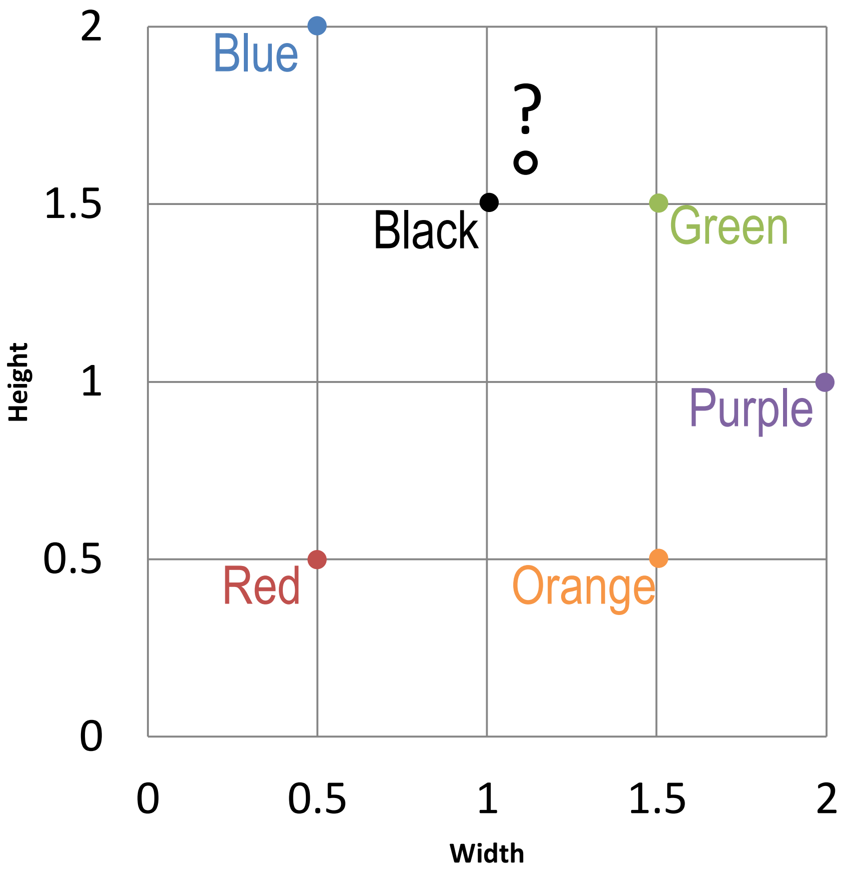

2
1.5
1
0.5
0
Height
Blue
Black
Green
Purple
Red
Orange
0
0.5
1
1.5
2
Width

What color is this block?

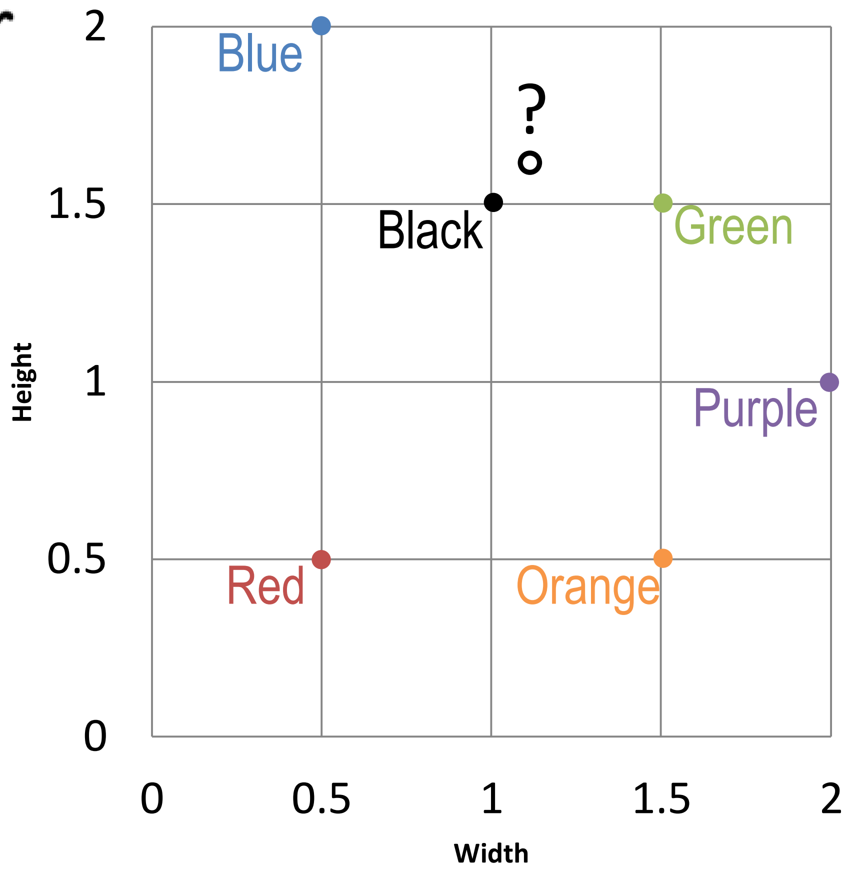




Finding the Nearest Neighbor

Given existing case at (x_c, y_c)
and new problem at (x_n, y_n)

$$d = \sqrt{(y_c - y_n)^2 + (x_c - x_n)^2}$$



Finding the Nearest Neighbor

Given existing case at (x_c, y_c)
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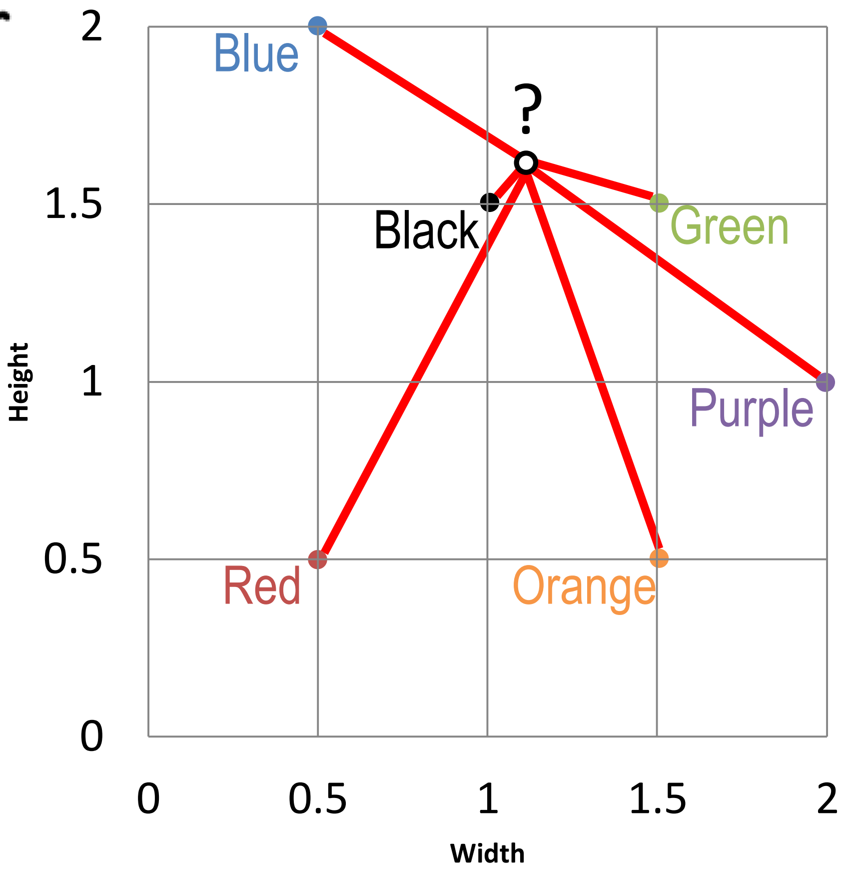
$$d = \sqrt{(y_c - y_n)^2 + (x_c - x_n)^2}$$

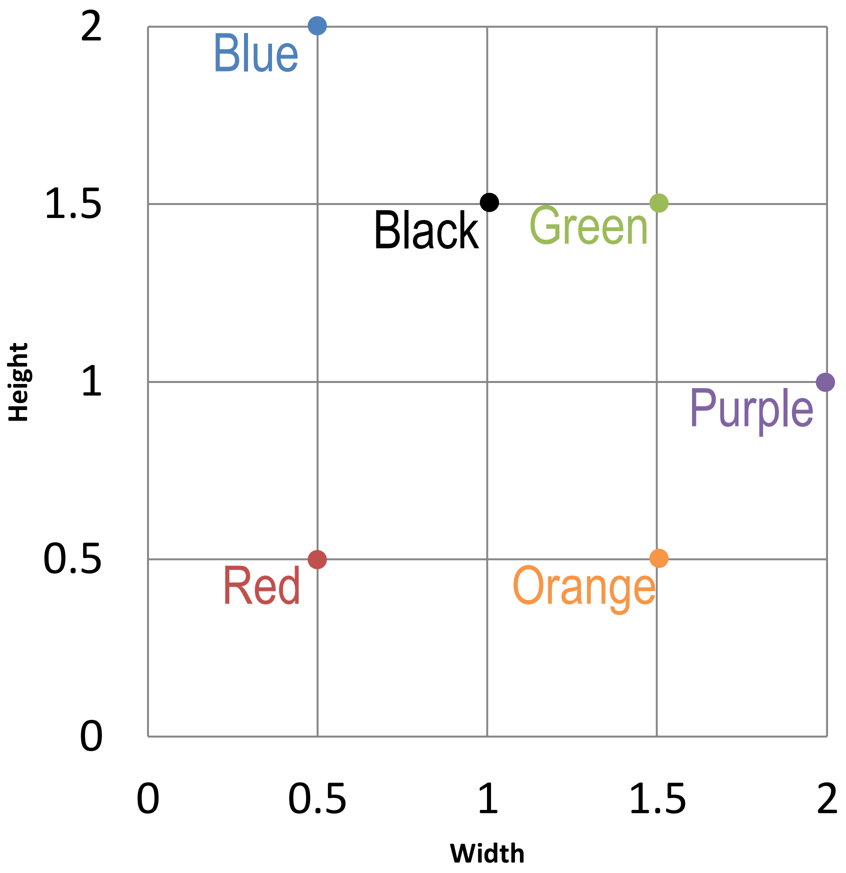
Block	x_c	y_c	x_n	y_n	d
Blue	0.5	2.0	1.1	1.6	0.72
Red	0.5	0.5	1.1	1.6	1.25
Black	**1.0**	**1.5**	**1.1**	**1.6**	**0.14**
Green	1.5	1.5	1.1	1.6	0.41
Orange	1.5	0.5	1.1	1.6	1.17
Purple	2.0	1.0	1.1	1.6	1.08



What color is this block?

?

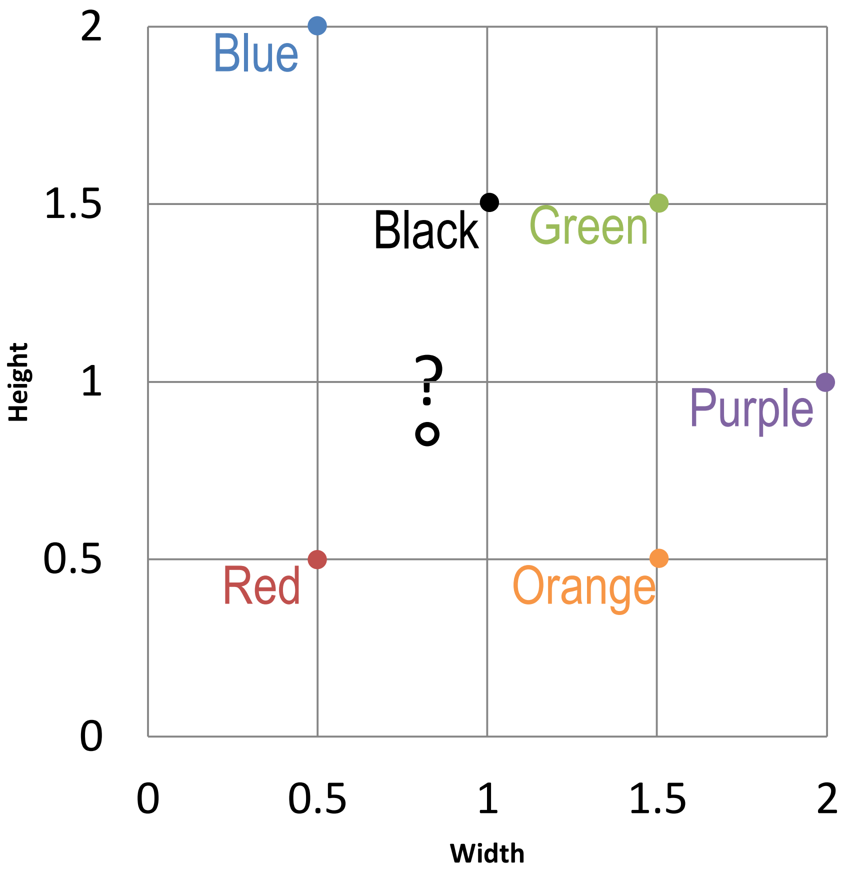
Width = 0.8
Height = 0.8



What color is this block?

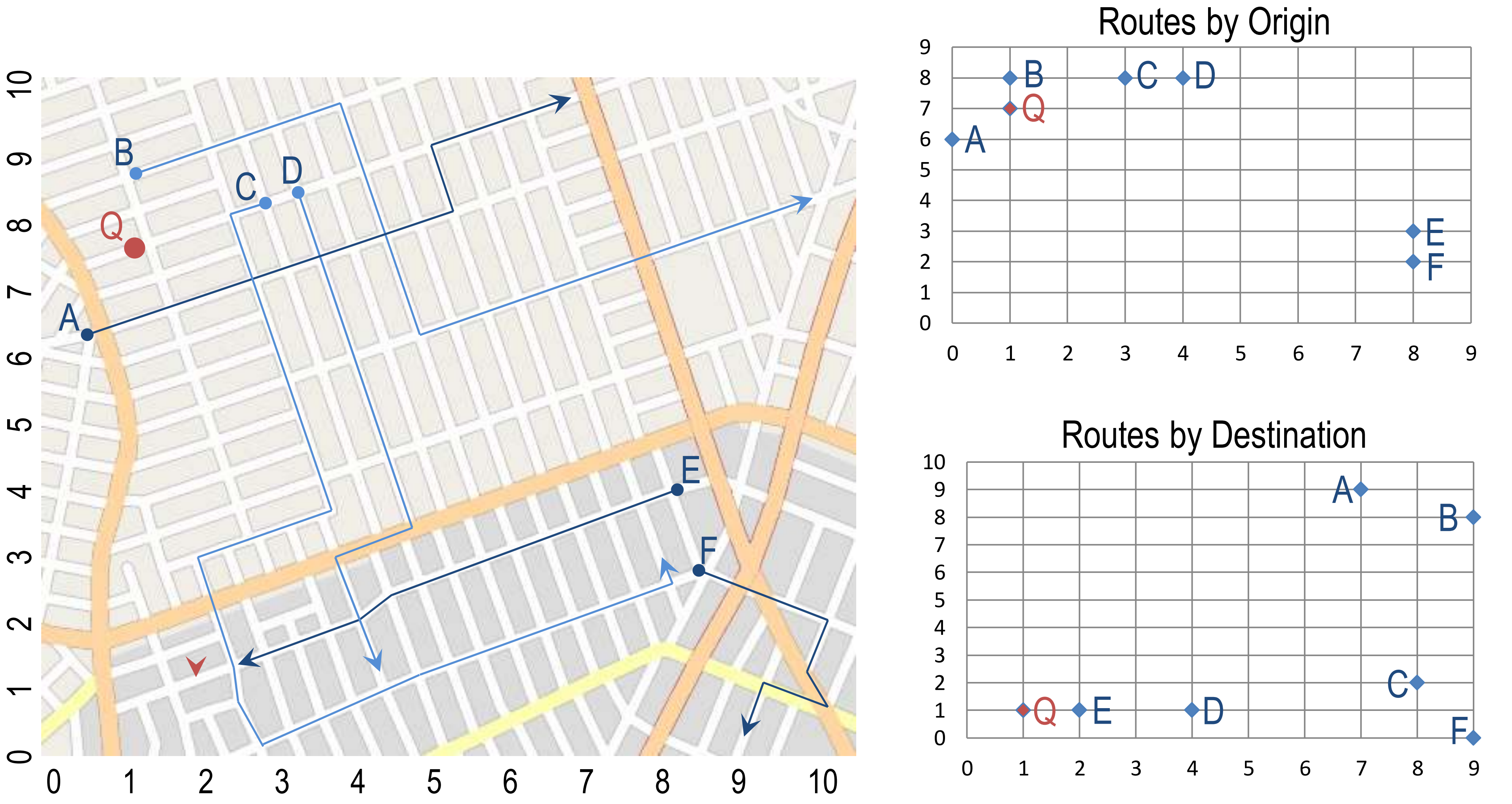
?

Block	x_c	y_c	x_n	y_n	d
Blue	0.5	2.0	0.8	0.8	1.24
Red	**0.5**	**0.5**	**0.8**	**0.8**	**0.42**
Black	1.0	1.5	0.8	0.8	0.72
Green	1.5	1.5	0.8	0.8	0.98
Orange	1.5	0.5	0.8	0.8	0.76
Purple	2.0	1.0	0.8	0.8	1.22

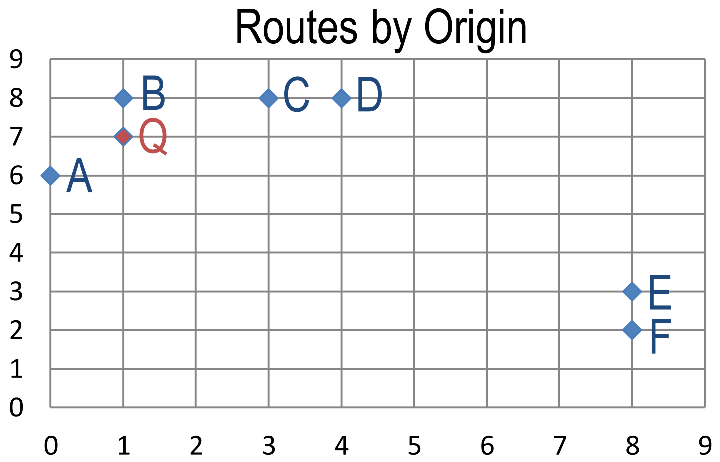


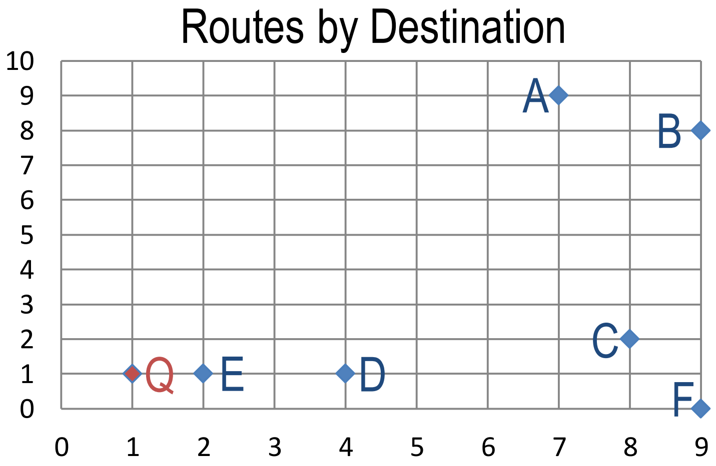
A
B
C
D
E
F

What route is most similar to this new problem?


B
C
D
Q
A
E
F
0 1 2 3 4 5 6 7 8 9 10
Routes by Origin
B
C
D
Q
A
E
F
0 1 2 3 4 5 6 7 8 9
Routes by Destination
A
B
C
Q
E
D
F
0 1 2 3 4 5 6 7 8 9 10

Route	Origin x_o	y_o	d_o	Destination x_d	y_d	d_d
A	0	6	1.41	7	9	10.00
B	**1**	**8**	**1.00**	9	8	10.63
C	3	8	2.24	8	2	7.07
D	4	8	3.16	4	1	3.00
E	8	3	8.06	**2**	**1**	**1.00**
F	8	2	8.60	9	0	8.06
Q	1	7	-	1	1	-

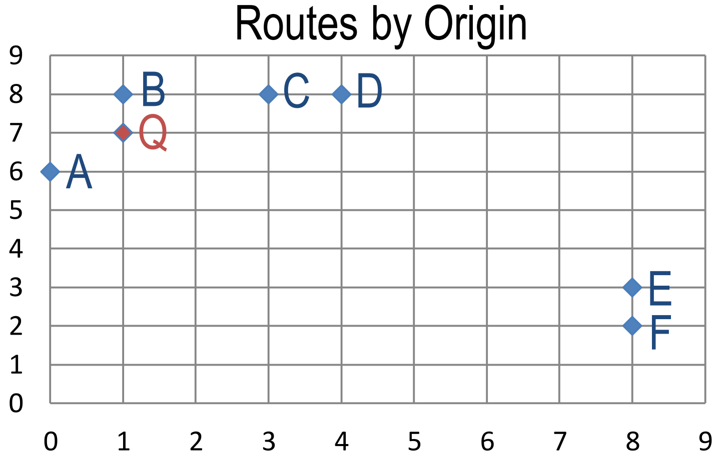


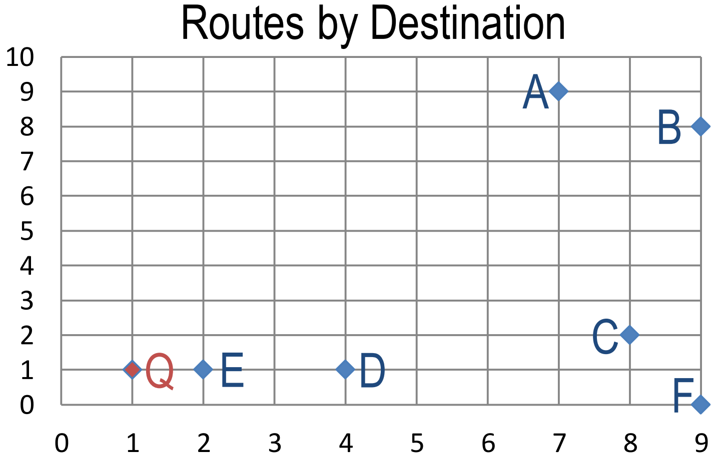


Finding the Nearest Neighbor

Given existing case at (x_c, y_c)
and new problem at (x_n, y_n)

$$d = \sqrt{(y_c - y_n)^2 + (x_c - x_n)^2}$$





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Given existing case at (x_c, y_c)
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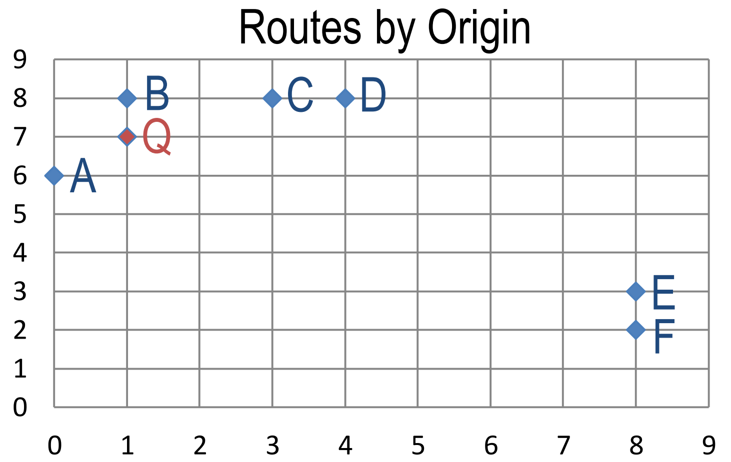
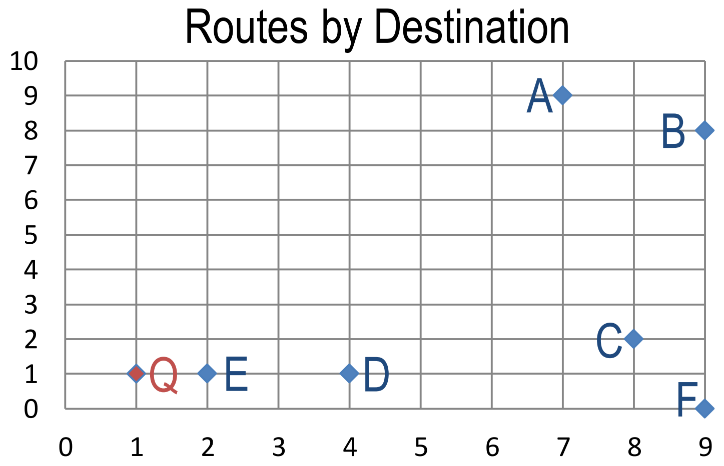
$$d = \sqrt{(y_c - y_n)^2 + (x_c - x_n)^2}$$

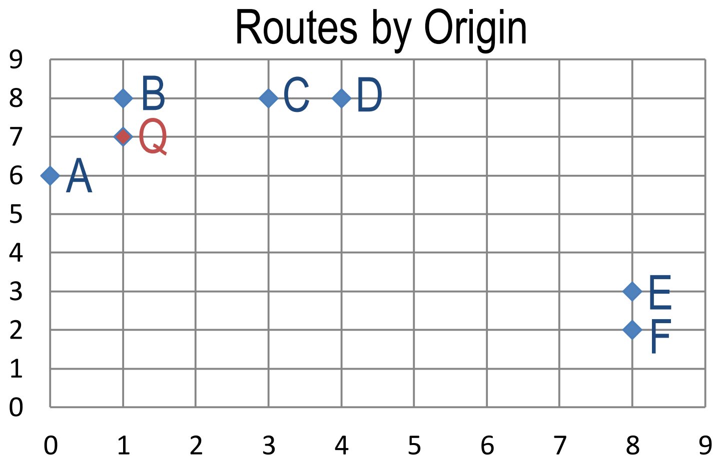
Given existing case at $(c_1, c_2 \ldots c_k)$
and new problem at $(p_1, p_2 \ldots p_k)$

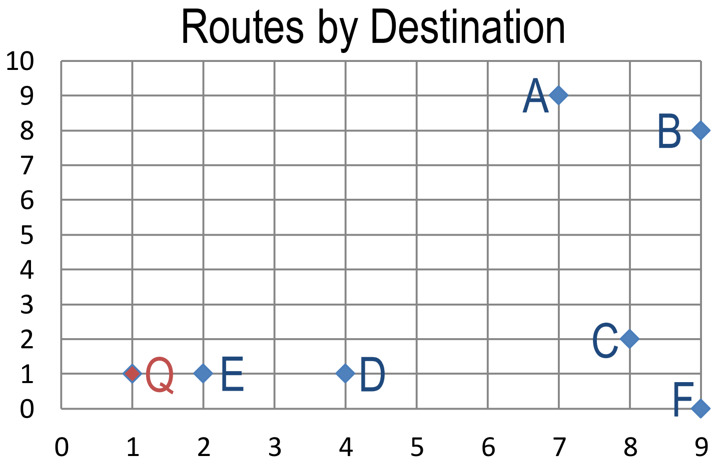
$$d = \sqrt{\sum_{i=1}^{k} (c_i - p_i)^2}$$





Route	c_1	c_2	c_3	c_4	d_k
A	0	6	7	9	10.10
B	1	8	9	8	10.68
C	3	8	8	2	7.42
D	**4**	**8**	**4**	**1**	**4.36**
E	8	3	2	1	8.12
F	8	2	9	0	11.80
Q	1	7	1	1	-





Assignment

How would you use recording cases to design an agent that could answer Raven's Progressive Matrices?

To recap...

- Recording and using cases
- Nearest neighbor method
- Cases in real-world problems
- Nearest neighbor in k-dimensional problems

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and new problem at (x_n, y_n)

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Block	x_c	y_c	x_n	y_n	d
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Black	1.0	1.5	0.8	0.8	0.72
Green	1.5	1.5	0.8	0.8	0.98
Orange	1.5	0.5	0.8	0.8	0.76
Purple	2.0	1.0	0.8	0.8	1.22

Route	c_1	c_2	c_3	c_4	d_k
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E	8	3	2	1	8.12
F	8	2	9	0	11.80
Q	1	7	1	1	-

	Origin			Destination		
Route	x_o	y_o	d_o	x_d	y_d	d_d
A	0	6	1.41	7	9	10.00
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F	8	2	8.60	9	0	8.06
Q	1	7	-	1	1	-

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$$d = \sqrt{(y_c - y_n)^2 + (x_c - x_n)^2}$$

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	Origin			Destination		
Route	x_o	y_o	d_o	x_d	y_d	d_d
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