## Lesson 2: Transformations as Functions

* Let’s compare transformations to functions.

### 2.1: Math Talk: Transforming a Point

Mentally find the coordinates of the image of $A$ under each transformation.



* Translate $A$ by the directed line segment from $\left(0,0\right)$ to $\left(0,2\right)$.
* Translate $A$ by the directed line segment from $\left(0,0\right)$ to $\left(-4,0\right)$.
* Reflect $A$ across the $x$-axis.
* Rotate $A$ 180 degrees clockwise using the origin as a center.

### 2.2: Inputs and Outputs



1. For each point $\left(x,y\right)$, find its image under the transformation $\left(x+12,y−2\right)$.
	1. $A=\left(-10,5\right)$
	2. $B=\left(-4,9\right)$
	3. $C=\left(-2,6\right)$
2. Next, sketch triangle $ABC$ and its image on the grid. What transformation is $\left(x,y\right)\rightarrow \left(x+12,y−2\right)$?
3. For each point $\left(x,y\right)$ in the table, find $\left(2x,2y\right)$.

| * $\left(x,y\right)$
 | * $\left(2x,2y\right)$
 |
| --- | --- |
| * $\left(-1,-3\right)$
 | *
 |
| * $\left(-1,1\right)$
 | *
 |
| * $\left(5,1\right)$
 | *
 |
| * $\left(5,-3\right)$
 | *
 |

1. Next, sketch the original figure (the $\left(x,y\right)$ column) and image (the ($2x,2y)$ column). What transformation is $\left(x,y\right)\rightarrow \left(2x,2y\right)$?

### 2.3: What Does it Do?



1. Here are some transformation rules. Apply each rule to quadrilateral $ABCD$ and graph the resulting image. Then describe the transformation.
	1. Label this transformation $Q$: $\left(x,y\right)\rightarrow \left(2x,y\right)$
	2. Label this transformation $R$: $\left(x,y\right)\rightarrow \left(x,-y\right)$
	3. Label this transformation $S$: $\left(x,y\right)\rightarrow \left(y,-x\right)$

#### Are you ready for more?



1. Plot the quadrilateral with vertices $\left(4,-2\right),\left(8,4\right),\left(8,-6\right),$ and $\left(-6,-6\right)$. Label this quadrilateral $A$.
2. Plot the quadrilateral with vertices $\left(-2,4\right),\left(4,8\right),\left(-6,8\right),$ and $\left(-6,-6\right)$. Label this quadrilateral $A^{′}$.
3. How are the coordinates of quadrilateral $A$ related to the coordinates of quadrilateral $A^{′}$?
4. What single transformation takes quadrilateral $A$ to quadrilateral $A^{′}$?

### Lesson 2 Summary

Square $ABCD$ has been translated by the directed line segment from $\left(-1,1\right)$ to $\left(4,0\right)$. The result is square $A^{′}B^{′}C^{′}D^{′}$.



Here is a list of coordinates in the original figure and corresponding coordinates in the image. Do you see the rule for taking points in the original figure to points in the image?

| original figure | image |
| --- | --- |
| $A=\left(-1,1\right)$ | $A^{′}=\left(4,0\right)$ |
| $B=\left(1,1\right)$ | $B^{′}=\left(6,0\right)$ |
| $C=\left(1,-1\right)$ | $C^{′}=\left(6,-2\right)$ |
| $D=\left(-1,-1\right)$ | $D^{′}=\left(4,-2\right)$ |
| $Q=\left(-0.5,1\right)$ | $Q^{′}=\left(4.5,0\right)$ |

This table looks like a table that shows corresponding inputs and outputs of a function. A transformation is a special type of function that takes points in the plane as inputs and gives other points as outputs. In this case, the function’s rule is to add 5 to the $x$-coordinate and subtract 1 from the $y$-coordinate.

We write the rule this way: $\left(x,y\right)\rightarrow \left(x+5,y−1\right)$.



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