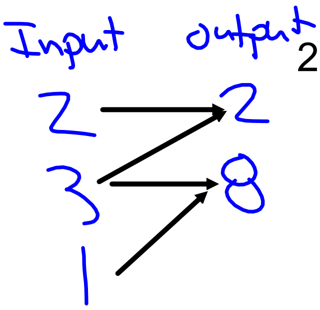
Warm-Up (10/31/17)

Determine if the following examples are representative of a function. Explain your reasoning:

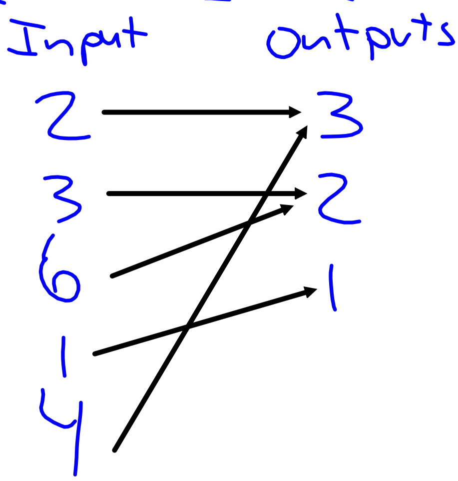
1.

x	y
2	2
3	8
~~2~~	~~2~~
1	8
3	2



No, this is NOT a function because one of our inputs has more than one output.

2. {(2, 3), (3, 2), (6, 2), (1,1), (4, 3)}



Yes, this is a function because every input has exactly one output.

Module 3: Lesson 15

Piecewise functions

What is a piecewise function?

A piecewise function is a function that contains more than one function. These multiple functions are set to a domain interval.

A domain interval is an interval for which that "section" of the piecewise function is "active."

Let's take a look of an example of a piecewise function:

- Two function
- Two Domains, one for each function

$$f(x) = \begin{cases} \underline{-x}, & \underline{x < 0} \\ \underline{x + 1}, & \underline{x \geq 0} \end{cases}$$

Let's state the domains of the piecewise function

Domain of $f(x) = -x$

Domain: $\underline{x<0}$

$(-\infty, 0)$

Domain of $f(x) = x + 1$

Domain: $x \geq 0$

$[0, \infty)$

Interval Notation

- $<, >$ then we use (L, G)
- $\leq, \geq$ then we use $[L, G]$

L = Lowest value
G = Greatest value

Evaluating Piecewise Functions

To evaluate a piecewise function we have to determine which function we will be using to evaluate based on which domain the input lies in.

$-2 < 0$

$$f(x) = \begin{cases} -x, & x < 0 \\ \cancel{x + 1,} & \cancel{x \geq 0} \end{cases}$$

$\cancel{-2 \geq 0}$

For example, if we wanted to evaluate the function for f(-2), we first must determine which function we have to use based on which domain -2 lies in. WE ONLY EVER USE ONE OF THE FUNCTIONS AT A TIME, OTHERWISE IT IS NOT A FUNCTION!

Evaluate f(-2) for the function $f(x) = \begin{cases} -x, & x < 0 \\ x + 1, & x \geq 0 \end{cases}$

$f(-2) = -(-2)$

$\boxed{f(-2) = 2}$

Fill out the following table of values for the function: $-x = -1 \cdot x$

$$f(x) = \begin{cases} -x, & x < 0 \\ x + 1, & x \geq 0 \end{cases}$$

x	f(x)
-1	1
0	1
1	2
-3	3
3	4
2	3

$f(-1) = -(-1) = 1$

$f(0) = (0) + 1 = 1$

$f(1) = (1) + 1 = 2$

$f(-3) = -(-3) = 3$

$f(3) = (3) + 1 = 4$

$f(2) = (2) + 1 = 3$

Example:

Consider the following function:

$$f(x) = \begin{cases} 1, & x \leq -2 \\ 2x - 1, & -2 < x \leq 4 \\ -\frac{1}{2}x + 2, & 4 < x \end{cases}$$

Fill out the following table of values:

x	-4	-2	0	2	4	6	8
f(x)	1	1	-1	3	7	-1	-2

$f(-4) = 1$

$f(-2) = 1$

$f(0) = 2(0) - 1 = -1$

$f(2) = 2(2) - 1 = 3$

$f(4) = 2(4) - 1 = 7$

$f(6) = -\frac{1}{2}(6) + 2 = -1$

$f(8) = -\frac{1}{2}(8) + 2 = -2$

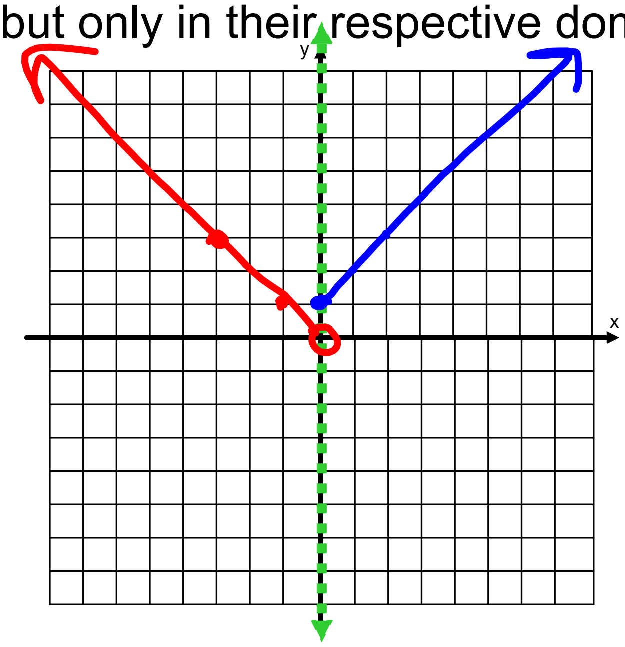
Graphing piecewise functions

To graph a piecewise function we will have to first set up the domains and graph "pieces" of the function. In other words, we graph each function, but only in their respective domains.

$<, > \longrightarrow \circ$

$\leq, \geq \longrightarrow \bullet$

$$f(x) = \begin{cases} -x, & x < 0 \\ x + 1, & x \geq 0 \end{cases}$$



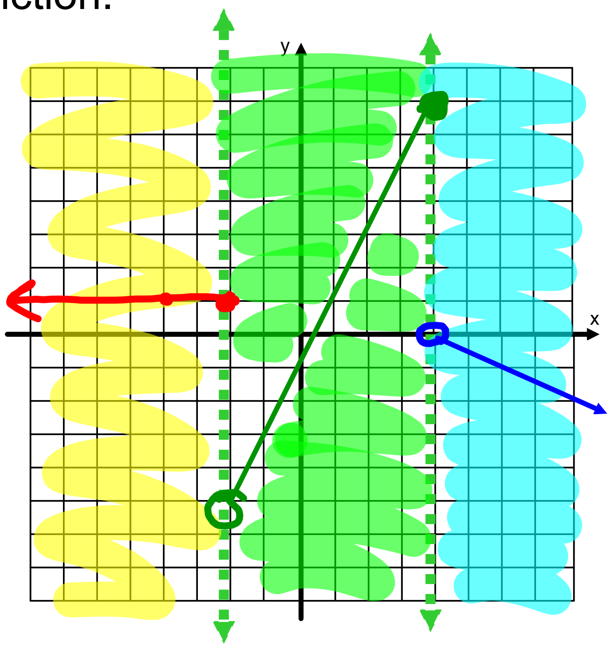
Here are some steps you can follow to help you graph piecewise functions.

1. We can begin by setting up our domains.
2. We graph each function one-by-one.
3. We erase everything before and after each functions respective domains.

Example:

Graph the following piecewise function.

$$f(x) = \begin{cases} 1, & x \leq -2 \\ 2x - 1, & -2 < x \leq 4 \\ -\dfrac{1}{2}x + 2, & 4 < x \end{cases}$$

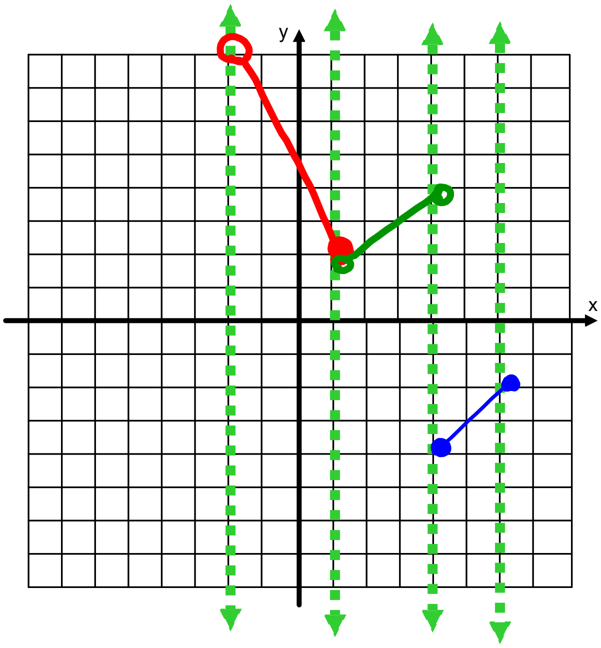


(Table of values are on slide 7)

Example:

Graph the following piecewise function. State the domain and range of the function.

$$f(x) = \begin{cases} -2x + 4, & -2 < x \leq 1 \\ \frac{2}{3}x + 1, & 1 < x < 4 \\ x - 8, & 4 \leq x \leq 6 \end{cases}$$



X	f(x)	
-2	$-2(-2)+4 = 8$	1st function
-1	$-2(-1)+4 = 6$	
0	$-2(0)+4 = 4$	
1	$-2(1)+4 = 2$	
1	$\frac{2}{3}(1)+1 = \frac{5}{3}$	2nd function
2	$\frac{2}{3}(2)+1 = \frac{7}{3}$	
3	$\frac{2}{3}(3)+1 = 3$	
4	$\frac{2}{3}(4)+1 = \frac{11}{3}$	
4	$(4)-8 = -4$	3rd function
5	$(5)-8 = -3$	
6	$(6)-8 = -2$	

Domain: $(-2, 6]$

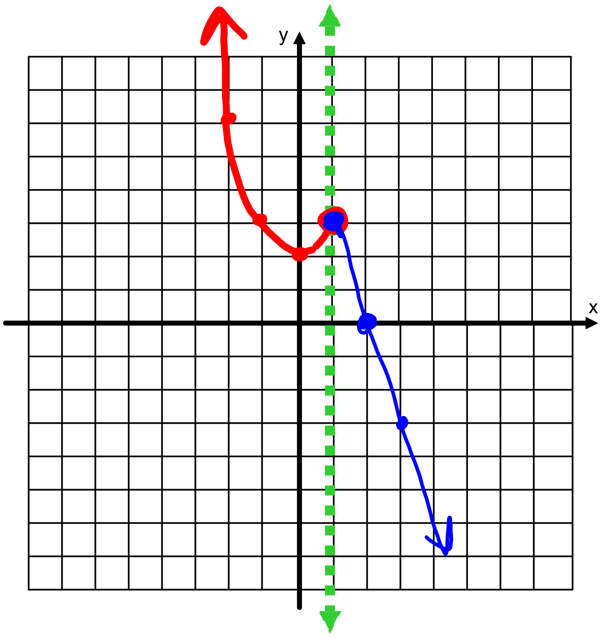
Range: $[-4, 8)$

Example:

Graph the following piecewise function. State the domain and range in interval notation.

$$f(x) = \begin{cases} x^2 + 2, & x < 1 \\ 6 - 3x, & x \geq 1 \end{cases}$$

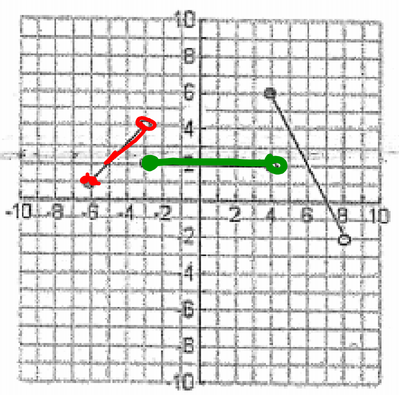
x	f(x)
-2	$(-2)^2+2 = 6$
-1	$(-2)^2+2 = 3$
0	$(0)^2+2 = 2$
1	$(1)^2+2 = 3$
1	$6-3(1) = 3$
2	$6-3(2) = 0$
3	$6-3(3) = -3$



Domain: $(-\infty, \infty)$

Range: $(-\infty, \infty)$

The following graph is called a **piecewise function** because the function is defined by two or more different equations applied to different parts of the function's domain.



* When we write domain/range in interval notation, we write it like an ordered pair.

<, > → o → (,) | ≤, ≥ → • → [,]

Notice that it appears to be composed of three segments, each a different linear function over a particular domain. Please note a filled circle includes that point, while an open circle does not include that point.

Domain: All possible inputs (x)

Range: All possible outputs (y)

1. What is the domain for the first (left) segment? [-6, -3) the range? [1, 4)
2. What is the domain for the second (middle) segment? ______ the range? ______
3. What is the domain for the third (right) segment? ______ the range? ______
4. How many equations do you think you would have to use to write the rule for the following piecewise function? ______