

# 1.2: FUNCTIONS

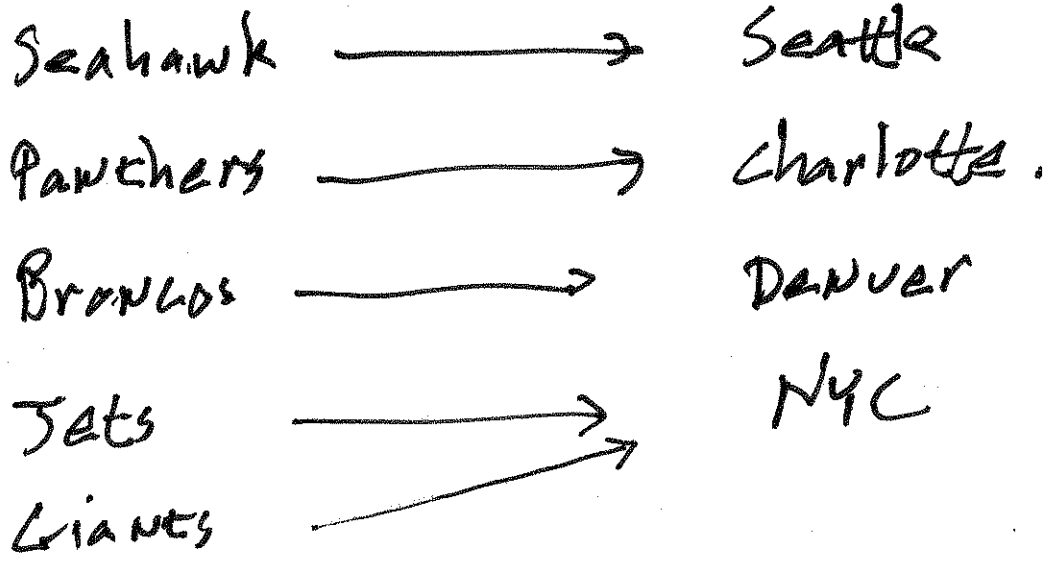
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Q: What is a function?

A relation for which each input has only one output.

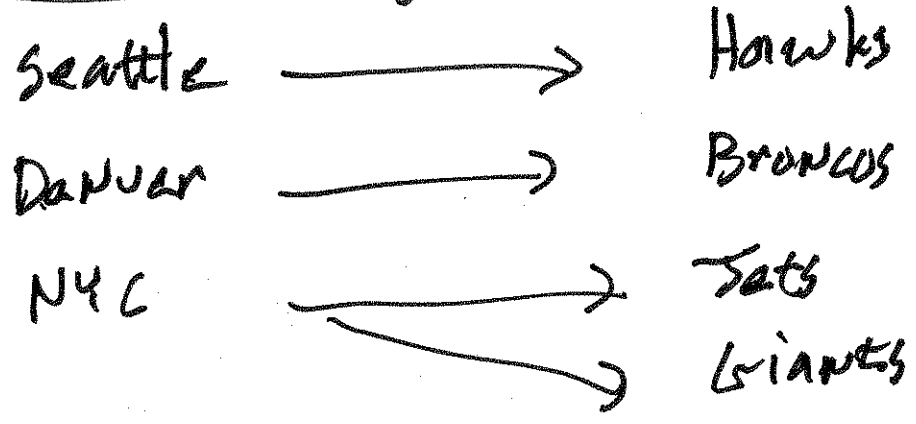
ex:

Input: NFL team      Output: City

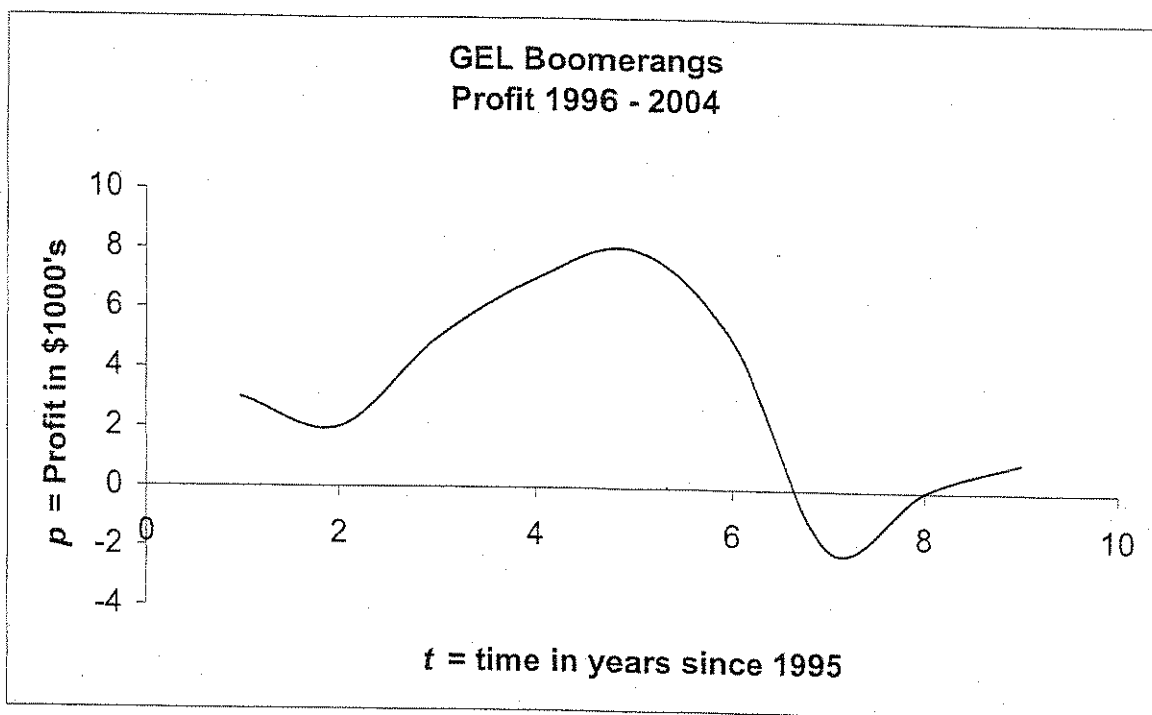


Yes -  
a fct.

Input: City      Output: Team



No -  
not a fct.



**Instructions:** Answer each question using a complete sentence.

1.) What does  $t=3$  represent?

year 1998

2.) What does  $p=5$  represent?

profit \$5000

3.) For what values of  $t$  do we have information?

$[1, 9]$   $1 \leq t \leq 9$

4.) For what values of  $p$  do we have information?

$[-2, 8]$   $-2 \leq p \leq 8$

Domain  
Range

For those values of  $t$  that have corresponding  $p$  values, we say that profit is a function of time. We write this using the notation  $p(t)$ . ← read, "p of t"

5.) Find and interpret  $p(2)$

$p(2) = 2$  in 1997 there was \$2000 of profit.

6.) Find and interpret  $p(7)$

$p(7) = -2$ . in 2002 the company lost \$2000.

7.) What is meant by the algebraic equation  $p(t) = 8$ ?

In what year(s) did the company have \$8000 profit?

8.) Solve and interpret  $p(t) = 5$

$t = 3$  or  $t = 6$ . The profit was \$5000 in 1998 & 2001.

9.) Could there be more than one value of  $p$  for any given value of  $t$ ? Explain your answer.

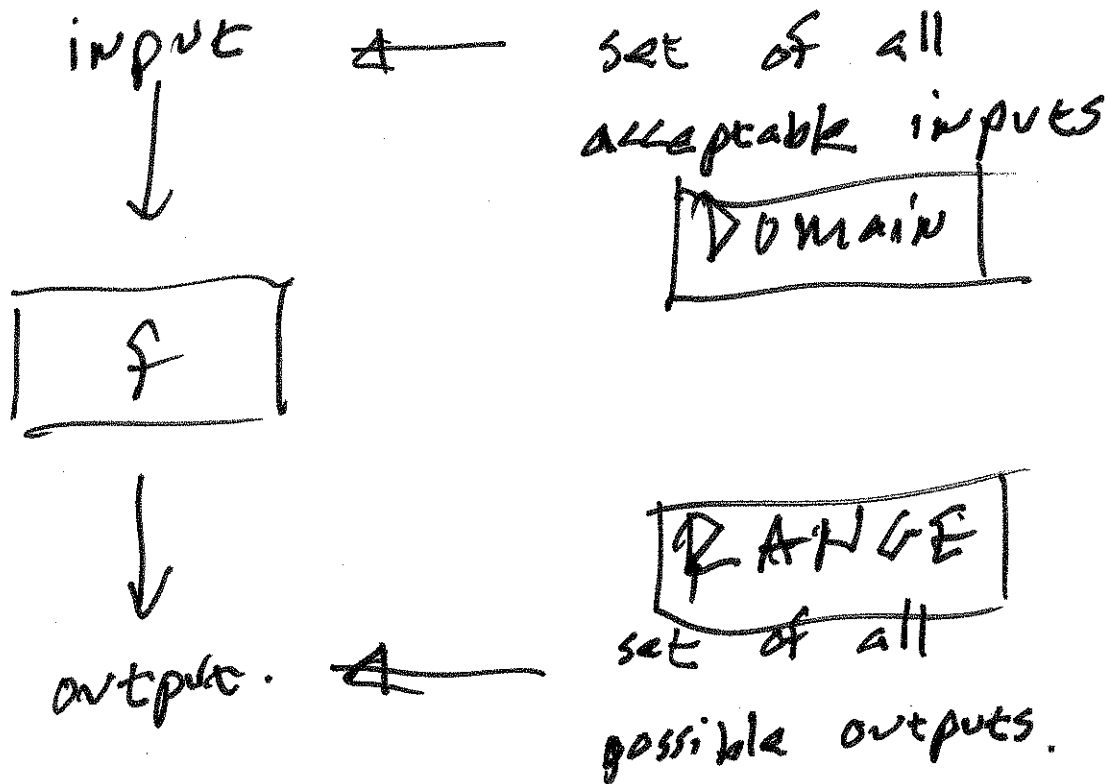
No, it wouldn't be a fct

10.) Explain the similarities and difference on the graph between  $t=2$  and  $t=7$ .

both minimums. one profit one loss.

fct is like a black box

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FUNCTION NOTATION:  $y = f(x)$

x input

f NAME of fct

y output.

ex:  $f(x) = 3x^2 - 6x$

(a)  $f(1) = 3(1)^2 - 6(1) = -3$

(b)  $f(-2) = 3(-2)^2 - 6(-2) = 24$

(c)  $f(a) = 3a^2 - 6a$

(d)  $f(b) = 3b^2 - 6b$

$(-2)^2 = 4$   
 $-2^2 = -4$

(a)  $f(\text{☺}) = 3 \text{☺} - 6 \text{☺}$

(f)  $f(\text{HAWK}) = 3 \text{HAWK}^2 - 6 \text{HAWK}$

(g)  $f(q) = 3q^2 - 6q$

ex:  $g(x) = 4x - 7$

(a)  $g(a) = 4a - 7$

(b)  $g(a+b) = 4(a+b) - 7$

(c)  $g(x+h) = 4(x+h) - 7$   
 $= 4x + 4h - 7$

(d)  $\underline{g(x+h)} - \underline{g(x)} = \underline{4x+4h-7} - \underline{(4x-7)}$   
 $= 4x + 4h - 7 - 4x + 7$   
 $= 4h$

(e)  $\frac{g(x+h) - g(x)}{h} = \frac{4h}{h}$   
 $= 4 \leftarrow \text{slope of } g(x).$

ex: If  $f(x) = 5x^2 - 3x$ , find  $\frac{f(x+h) - f(x)}{h}$  <sup>1.2</sup> <sub>5/8</sub>

$$\begin{aligned}\frac{f(x+h) - f(x)}{h} &= \frac{5(x+h)^2 - 3(x+h) - (5x^2 - 3x)}{h} \\ &= \frac{5(x^2 + 2xh + h^2) - 3x - 3h - 5x^2 + 3x}{h} \\ &= \frac{\cancel{5x^2} + 10xh + 5h^2 - 3h - \cancel{5x^2}}{h} \\ &= \frac{10xh + 5h^2 - 3h}{h} \\ &= 10x + 5h - 3. \quad \leftarrow \text{helpful} \\ &\quad \text{next QTR.}\end{aligned}$$

How can we combine fcts?

(1) Arithmetic of fcts.

ex: Let  $f(x) = (x-1)^2$  and  $g(x) = 1-2x$   
find  $f+g$ ,  $f-g$ ,  $f \cdot g$ ,  $f/g$ .

$$\begin{aligned}\text{(a)} \quad (f+g)(x) &= f(x) + g(x) \\ &= (x-1)^2 + 1 - 2x\end{aligned}$$

$$\text{(b)} \quad (f-g)(x) = f(x) - g(x)$$

$$(c) (f \cdot g)(x) = (x-1)^2 \cdot (1-2x)$$

$$(d) \left(\frac{f}{g}\right)(x) = \frac{(x-1)^2}{1-2x}$$

(2) Composition of fcts.

ex: Let  $f$  &  $g$  be as given above.

find  $f \circ g$ ,  $g \circ f$ ,  $f \circ f$ ,  $f^2$

$$\begin{aligned} (a) (f \circ g)(x) &= f(g(x)) \\ &= f(1-2x) \\ &= ((1-2x)-1)^2 \end{aligned}$$

$$\begin{aligned} (b) (g \circ f)(x) &= g(f(x)) \\ &= g((x-1)^2) \\ &= 1 - 2(x-1)^2 \end{aligned}$$

$$\begin{aligned} (c) (f \circ f)(x) &= f(f(x)) \\ &= f((x-1)^2) \\ &= ((x-1)^2 - 1)^2 \end{aligned}$$

$$\begin{aligned}
 (d) \quad (f^2)(x) &= (f \cdot f)(x) \\
 &= f(x) \cdot f(x) \\
 &= (x-1)^2 \cdot (x-1)^2
 \end{aligned}$$

more on domain.

ex. Find the domain of the following fcts.

$$(a) \quad f(x) = \frac{x-2}{x}$$

$f(0)$  is "undefined."

Domain: All values of  $x$  except  $x=0$ .

$\mathbb{R}$  and not  $x=0$

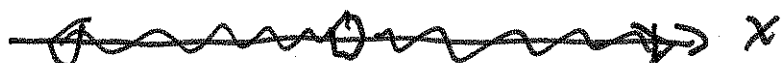
$\mathbb{R}$  and  $x \neq 0$ .

$(-\infty, 0) \cup (0, \infty)$

$$(b) \quad g(x) = \frac{x}{x-2}$$

Domain:  $\mathbb{R}$  and  $x \neq 2$

$(-\infty, 2) \cup (2, \infty)$

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(c)

$$L(t) = 3 - \sqrt{t+2}$$

solve  $t+2 \geq 0$

$$\Rightarrow t \geq -2$$

$$[-2, \infty)$$

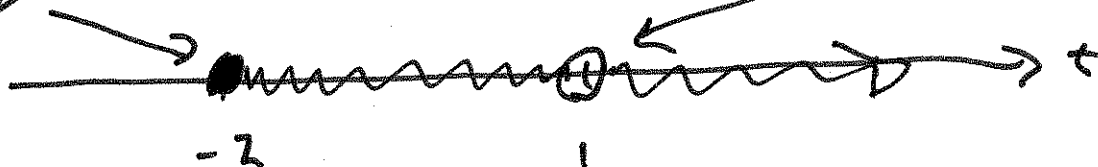


(d)  $m(t) = \frac{\sqrt{t+2}}{t-1}$

$t \geq -2$  and  $t \neq 1$

$$[-2, 1) \cup (1, \infty)$$

solid included.



hole/excluded.