

# MATH:1260 Pokémath

## The Mathematics of Pokémon Go<sup>®</sup>

Week 4 Monday, Spring 24

Popular curve:

Litleo-like curve



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## Plan for Today

- Introduce Project 1!
- More HP, then CPM methods
  - Floor function

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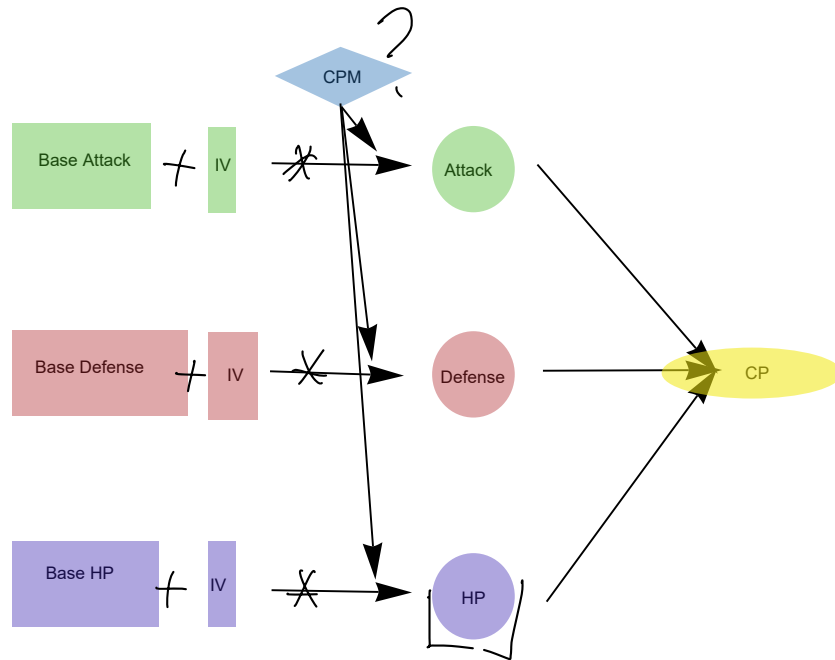
## Class Reminders

- **Project 1 Stage 1 due Friday**
  - You will need 20 of the same Pokemon species, so start catching!
- GW4 in discussion Thursday.
- HW3 due Wednesday at midnight.

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## Project 1: Investigating the Relationship Between 2 Variables

## How are the stats computed in the game code?



## HP is rounded: CORRECTION FROM LAST TIME

### Description of the function:

The unrounded HP stat is computed by adding the base HP and HP IV and then multiplying by the CPM. This result is then rounded down to the nearest integer and then it is set to 10 if it is less than 10.

### Formula for HP?

$$\lfloor (\text{Base HP} + \text{HP\_IV}) \cdot \text{CPM} \rfloor = \text{HP stat}$$

## Floor or “greatest-integer function”

The book calls this the “greatest-integer function.”

Most computer systems call it the “floor function.”

The rule is round down. The domain is real numbers. The range is integers (whole numbers).

### Notation

$\lfloor \rfloor$  (mathematician notation)

$[ ]$  (book notation)

### Example

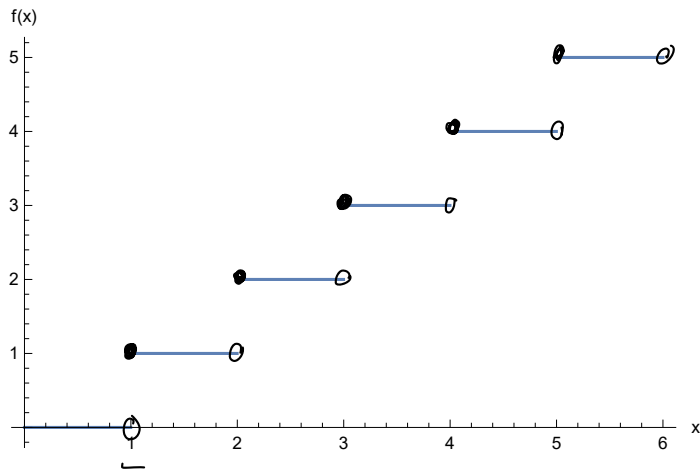
$$f(x) = \lfloor 3x - 2 \rfloor$$

Find  $f(1.2)$      $f(1.2) = \lfloor 3(1.2) - 2 \rfloor = \lfloor 3.6 - 2 \rfloor$

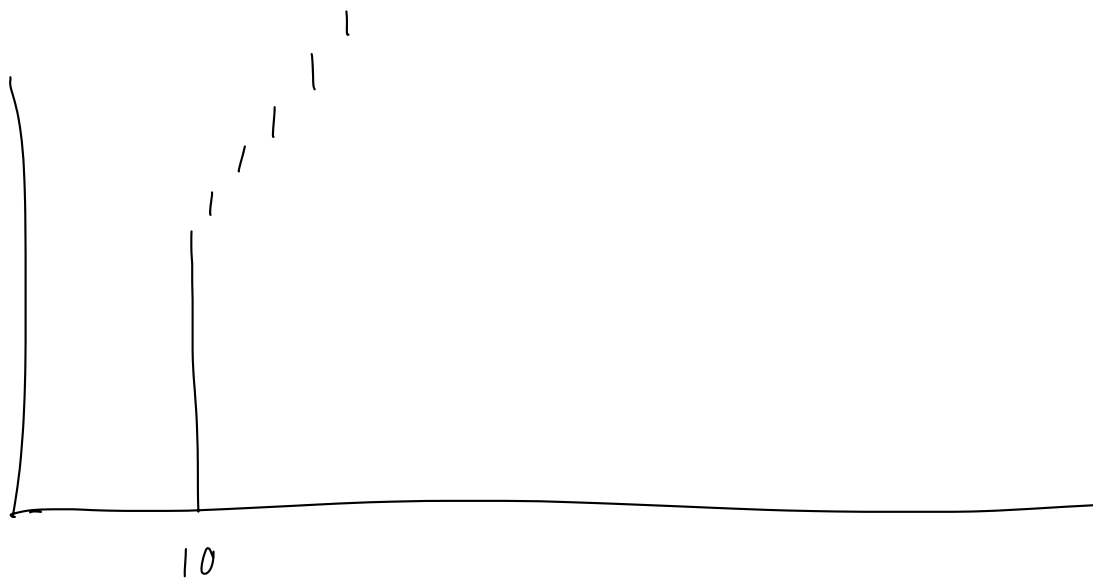
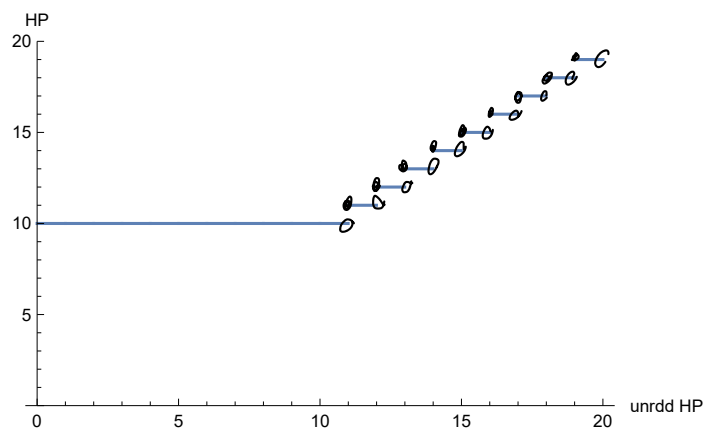
$$\lfloor 1.6 \rfloor = 1$$

Give it a try!

Visualization  $f(x) = \lfloor x \rfloor$  Do you notice something fishy here?



Smallest possible value is 10 for HP



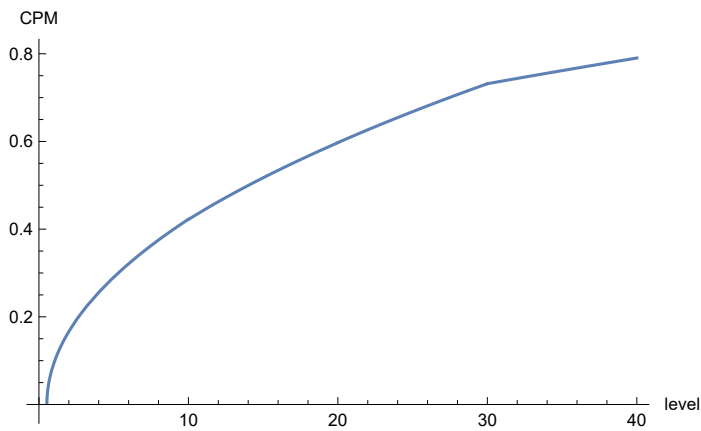


## Now let's talk CPM.

Piecewise defined functions have a different equation for different parts (disjoint subsets) of the domain.

A big shout out to a past TA, Quanqi, who deduced these formulas from the table!!!

$$\text{CPM}(\text{level}) = \begin{cases} \sqrt{.01885225 * \text{level} - .01001626} & 1 \leq \text{level} \leq 10 \\ \sqrt{.01783805 * \text{level} - .00012575} & 10 < \text{level} \leq 20 \\ \sqrt{.01784981 * \text{level} - .00010945} & 20 < \text{level} \leq 30 \\ \sqrt{.00891892 * \text{level} + .26781725} & 30 < \text{level} \leq 40 \end{cases}$$



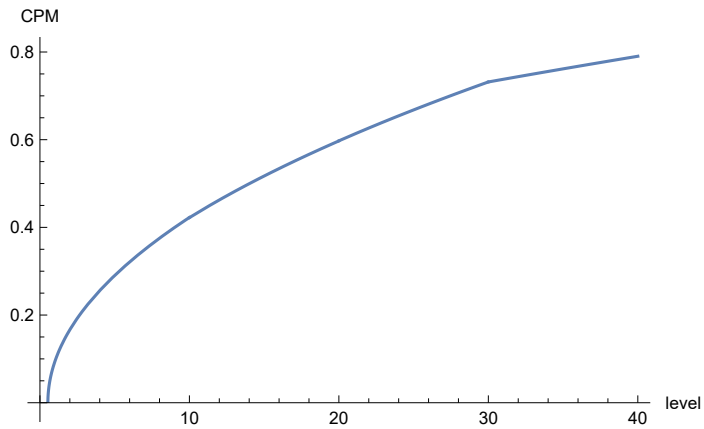
But there's an easier way!

<https://gamepress.gg/pokemongo/cp-multiplier>

## Level vs CPM

No vertical line intersects the graph of a **function**  $y=f(x)$  at more than one point.

Is CPM a function of level?



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## But to find CPM we still need level!

How can we determine the level of the Pokemon??? We will investigate 4 possibilities...

~~Method 1: The bar across the top~~

~~Method 2: HP work-back~~

Method 3: Power up Cost

Method 4: Power up Cost (Secret Technique)

# Level

Let's try the first method.

## Method 1: The bar across the top

Pyroar vs Blaziken

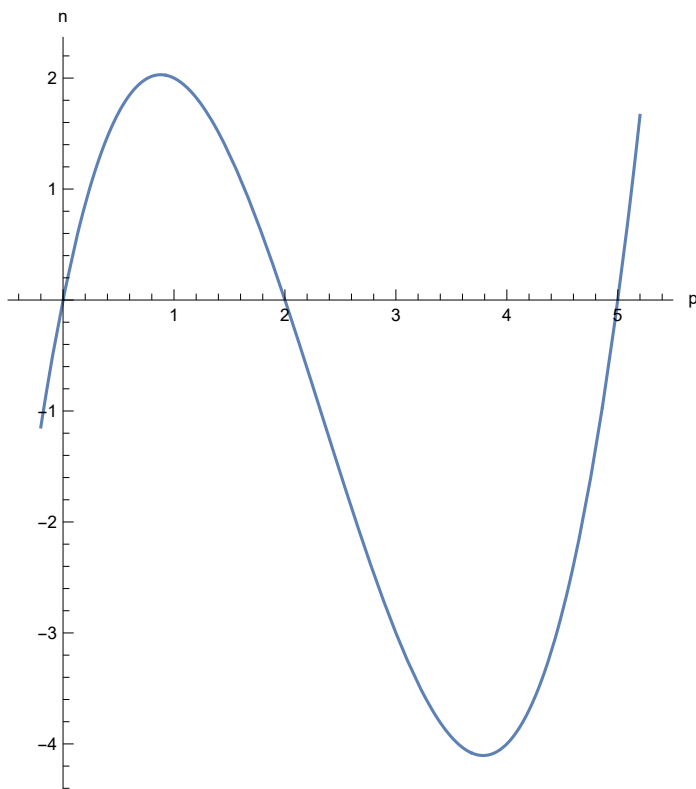


Tophat!

Something tells me this one doesn't work...

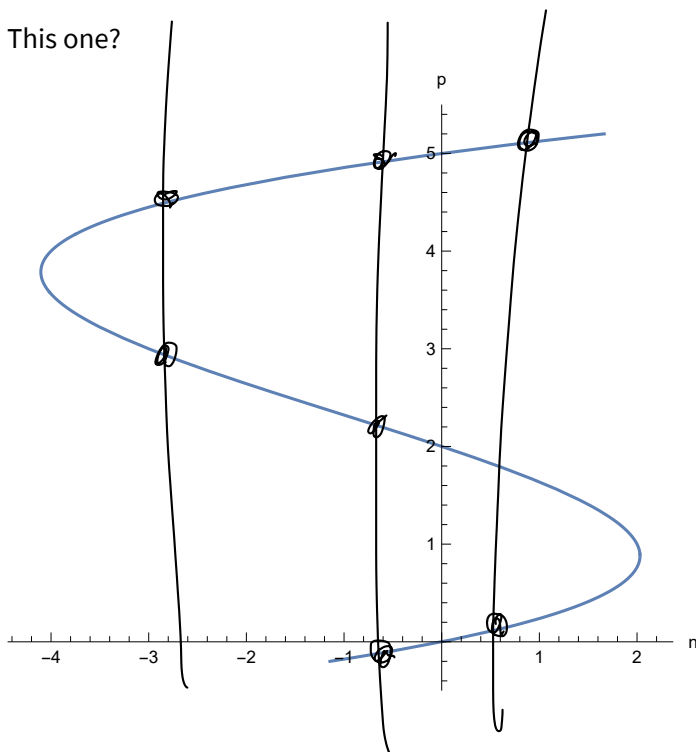
### The vertical line test (useful on the Homework!)

Is this a function?





vertical line test:  
If you can draw a vertical line that touches the graph twice or more, then the graph is not a function.

This one?



Magikarp: We have the HP stat and IV, can we find CPM?

			HP	Atk	Def
129		Magikarp	85	29	85
349		Feebas	85	29	85

Let's say I have a Magikarp with 20 HP and I used the appraisal chart from last week to find it has an HP IV of 14.

$$\lfloor (85 + 14) \text{CPM} \rfloor = 20$$

$$20 \leq (85 + 14) \text{CPM} < 21$$

$$\frac{20}{99} \leq \frac{99 \cdot \text{CPM}}{99} < \frac{21}{99}$$

$$.20 \leq \text{CPM} < .21$$

↳ Not an answer!