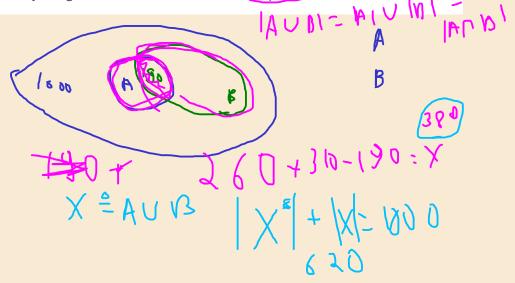


01 Two-annotator inclusion–exclusion $\mathscr S$

Out of 1,000 images, annotator A flags 260 as "elephant," annotator B flags 310 as "elephant," and both flag 190.

1. How many images at least one annotator called "elephant"?

2. How many images neither annotator called "elephant"?





You collected **200** images. Train set T has 140 indices; Test set S has 40. We noticed an overlap $|T\cap S|=4$.

- 1. Are the splits <u>disjoint?</u> If not, how many **unique** images actually exist across both sets?
- 2. How many items must be **moved** to make T and S **disjoint** with target sizes 140 and 40 (no duplicates)? Propose a minimal-move strategy.





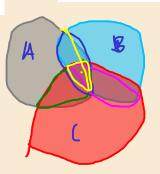


How many integers in $1, \ldots, 100$ are divisible by 5 or 7.



ø 6 04 Inclusion-exclusion principle for 3 sets

Figure out the equation of the inclusion-exclusion principle for 3 sets. You may find it useful to draw a Venn diagram.



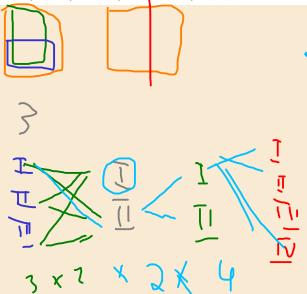


05 Augmentation pipeline counting

Context

An image pipeline does: random crop (3 sizes), color jitter (on/off), horizontal flip (on/off), and chooses one of 4 background textures.

Assuming independence, how many distinct augmentation "recipes" can be produced for a given image? Example recipe is (crop: 2nd size, flip: 1 (on), texture: 3rd type).





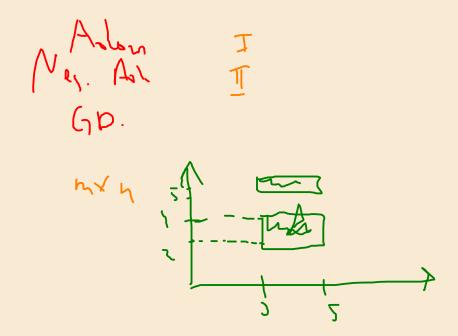
 \rangle

06 Two hyperparameters — combinations

Context

Let hyperparameter set H_1 have m options and H_2 have n options.

If we want to try the whole grid of options how many combinations do we have? How is the set of all combinations called?

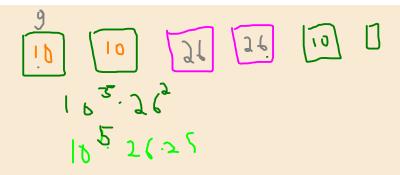




ø 6 07 Armenian car plates

Armenian cars have the format DD LL DDD, digits 0-9, letters A-Z, repetition allowed.

- 1. How many distinct plates exist?
- 2. How does the answer change if letters cannot repeat inside the same plate?

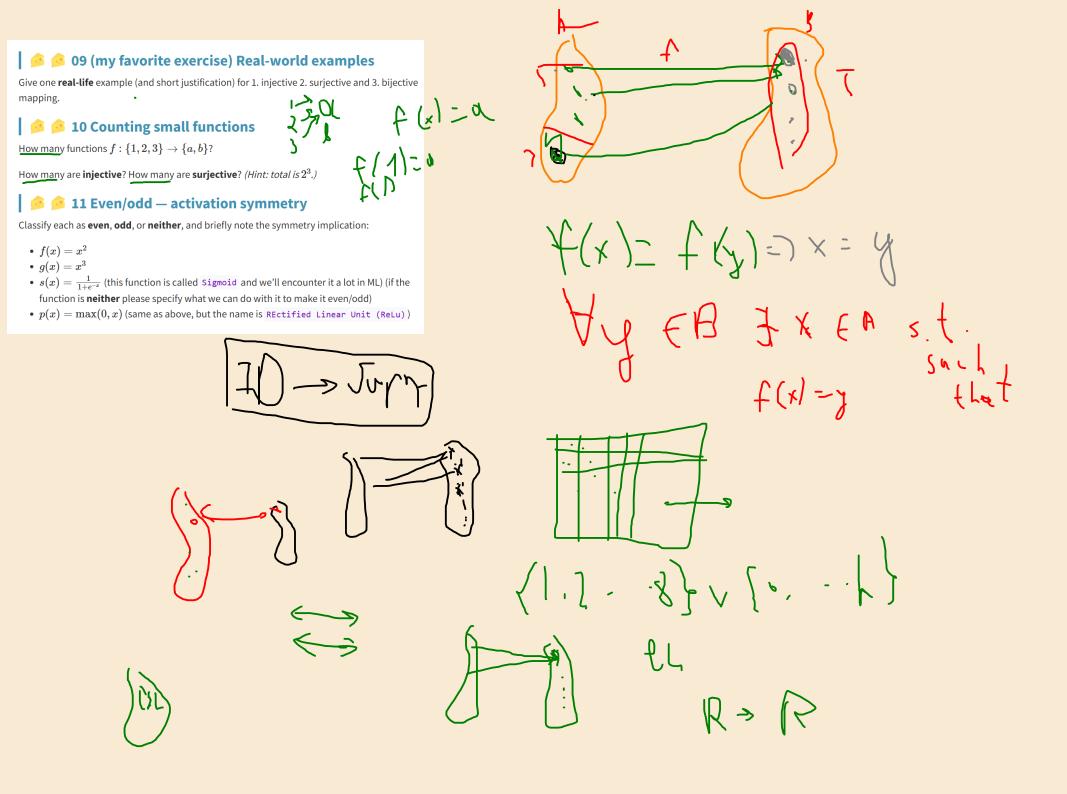






🧖 🍻 08 Anagrams of "cheese" 🔗

How many distinct words can you form by rearranging the letters of "cheese"? (Handle repeated letters carefully.)



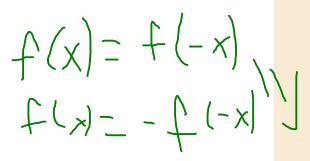




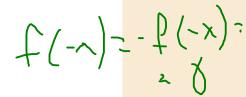
🧀 🧰 12 Function properties 🔗

Given $f(x) = x + 3x^2$, determine:

- Is it injective or not?
- Is it surjective or not?
- Is it bijective or not?
- What is the image of A under f, when A = [-1, 2]?
- What is the preimage of B under f, when B = [0, 5]?











🧰 🧀 13 Both even and odd

Describe **all** functions $f: \mathbb{R} \to \mathbb{R}$ that are simultaneously even and odd.







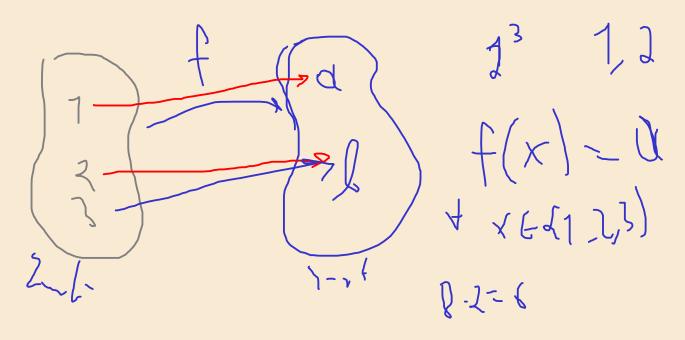


Count **surjective** functions $f:\{1,2,3,4\}
ightarrow \{a,b,c\}$ using inclusion–exclusion. Show your work.

6 6 10 Counting small functions

How many functions $f:\{1,2,3\} o \{a,b\}$?

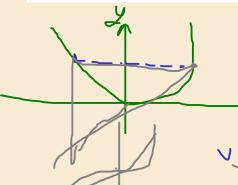
How many are **injective**? How many are **surjective**? (Hint: total is %).)



№ № 11 Even/odd — activation symmetry

Classify each as **even**, **odd**, or **neither**, and briefly note the symmetry implication:

- $ullet f(x) = x^2 \ ullet g(x) = x^3$
- ullet $s(x)=rac{1}{1+e^{-x}}$ (this function is called <u>Sigmoid</u> and we'll encounter it a lot in ML) (if the function is **neither** please specify what we can do with it to make it even/odd)
- $ullet^* p(x) = \max(0,x)$ (same as above, but the name is <code>REctified Linear Unit (ReLu)</code>)



KIL

Ax & D (t)

13. (-B)2

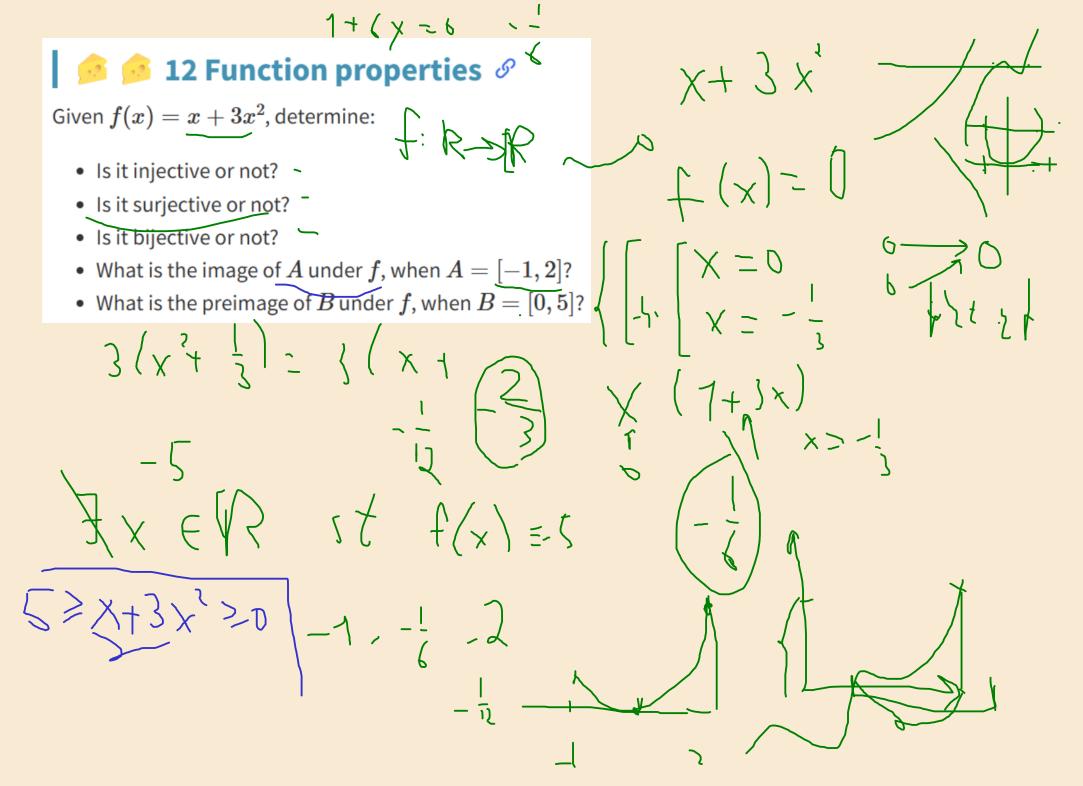


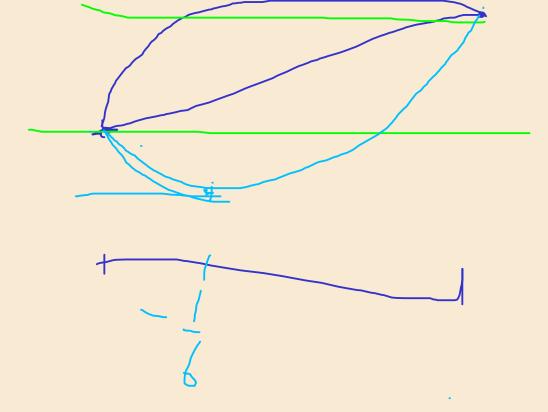
$$\frac{1}{1+e^{-x}} - \frac{1}{1} = -\left(\frac{1}{1+e^{x}} - \frac{1}{1}\right)$$

$$+ (x) - - + (-x)$$

$$f(x) = -f(-x)$$

$$\int (-x) = 1 - f(x)$$





🎁 🍺 🍺 🧀 14 Inclusion-exclusion for surjections

Count **surjective** functions $f:\{1,2,3,4\} o \{a,b,c\}$ using <u>inclusion-exclusion</u>. Show your work.

