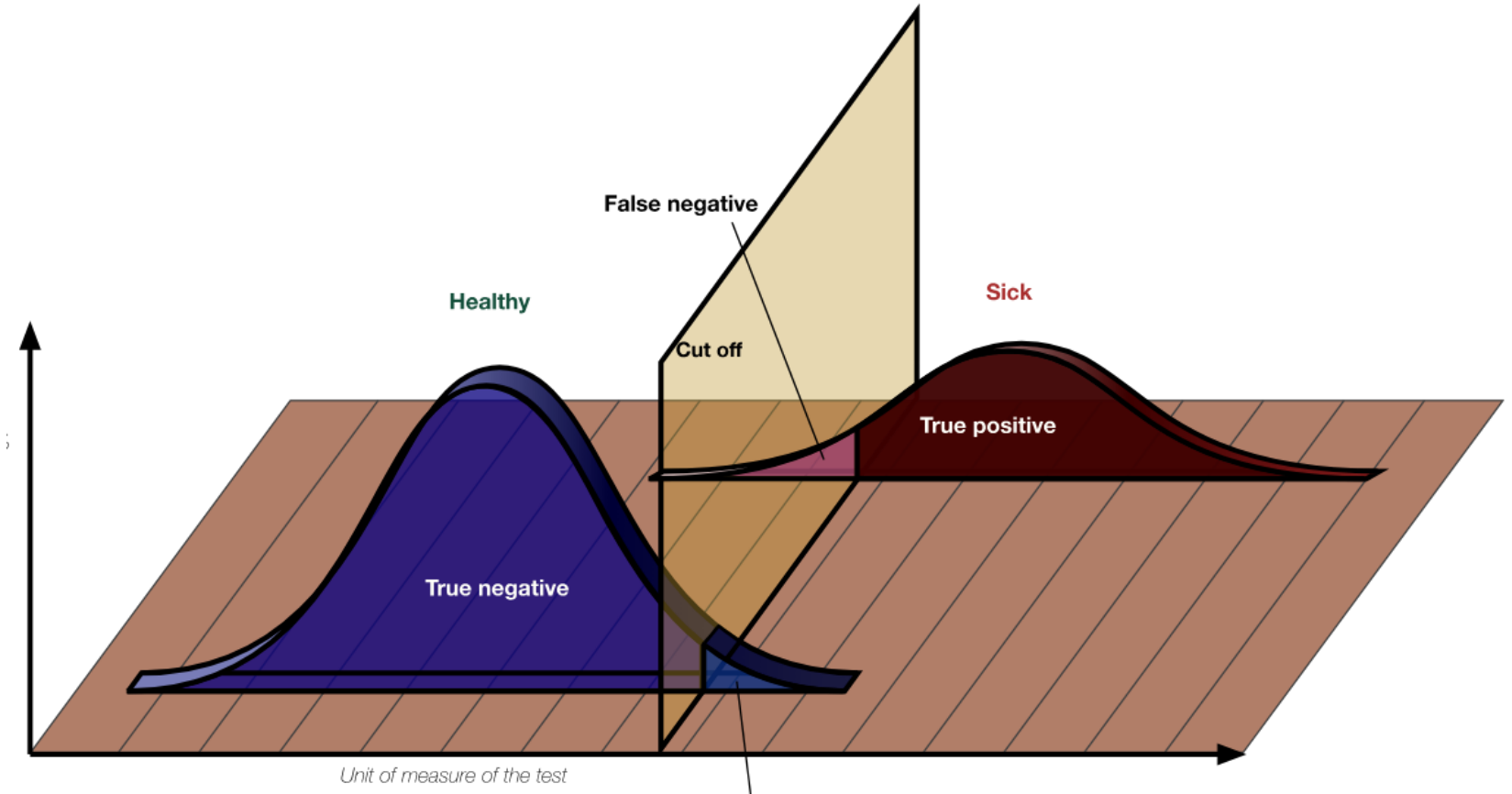
- Sensitivity & Specificity
- Probabilities & Combinations
- Bayesian Updating
- Q. Assignment 2

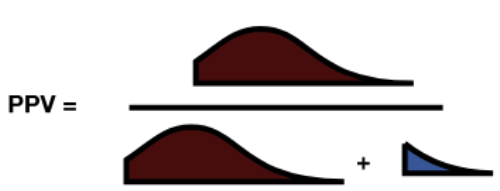
Tutorial 3
CS-473

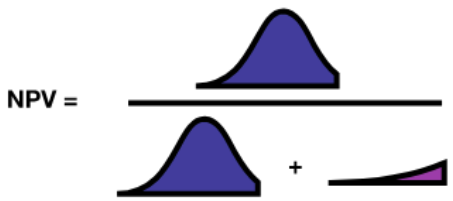
Sensitivity and specificity

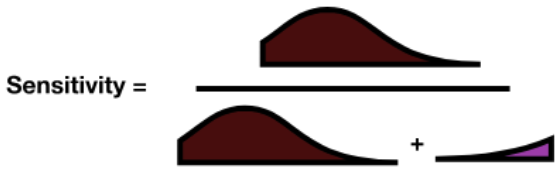


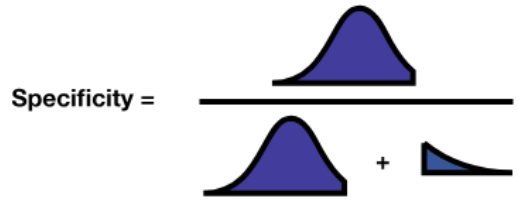
Sensitivity: P(+|D)

Specificity: P(-|not D)



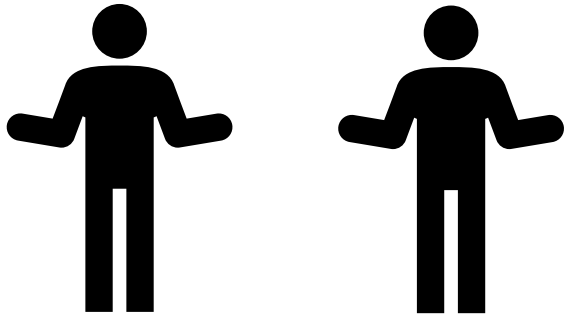


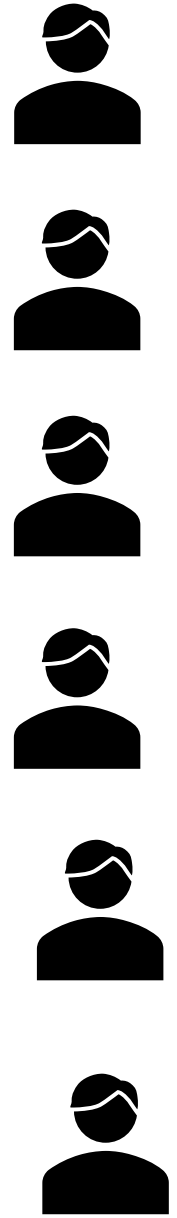




Two Boys Selecting the Same Girl as Their Match

Imagine **2 boys**, Ray and John, using a dating app where **6 girls** are available as potential matches. Each boy picks a girl randomly.





Questions:

1. What is the probability that both boys (Ray and John) select the same girl?

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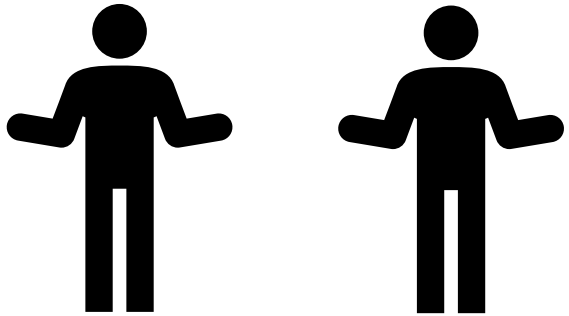

1 

2 

3 

4 

5 

6 

Questions:

1.What is the probability that <u>both boys</u> (Ray and John) <u>select the same girl</u>?

A.1: Ray picks a girl randomly. Ray selects a girl n, where n = [1,6] (e.g n =2). Does anything changed? Do I have something to compute…?

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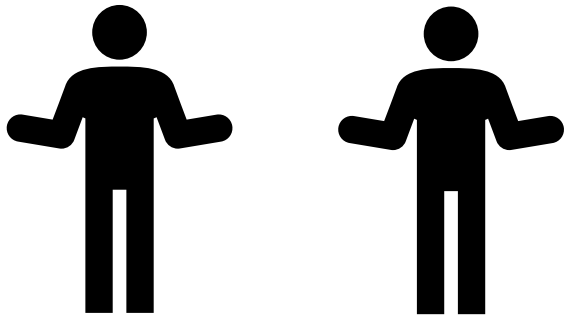

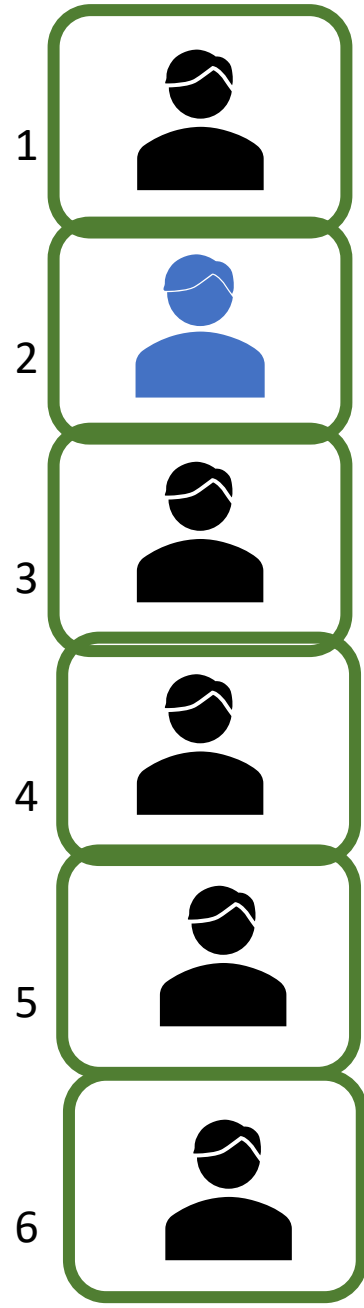

Questions:

1.What is the probability that <u>both boys</u> (Ray and John) <u>select the same girl</u>?

A.1: Ray picks a girl randomly. Ray selects a girl n, where n = [1,6] (e.g n =2). Does anything changed? Do I have something to compute…?

Now its John's turn. What is the probability to select the same girl? Meaning, what is the probability to select n. Meaning….what is the probability to select the 2nd girl?

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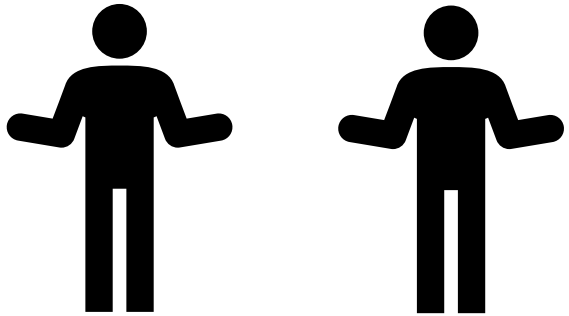

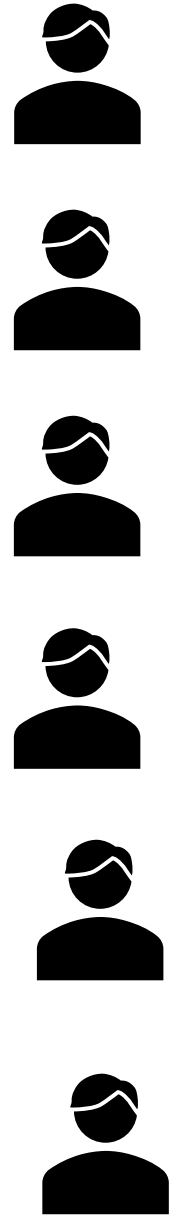

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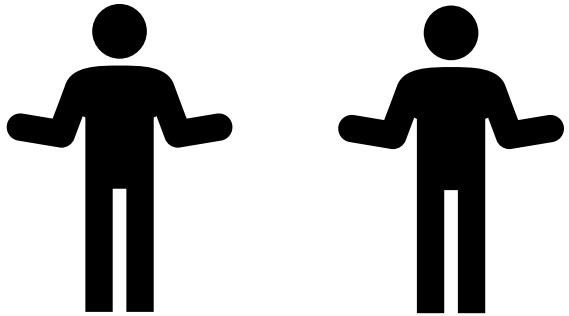

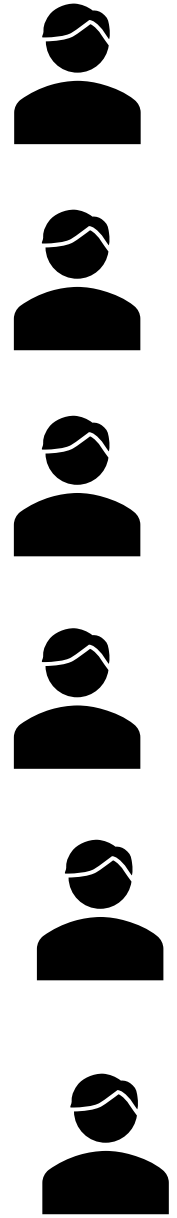

Questions:

1. What is the probability that both boys (Ray and John) select the same girl?
2. What is the probability that they pick different girls?

A2: I am smart! Read Q1 and its answer. Should then I know now?

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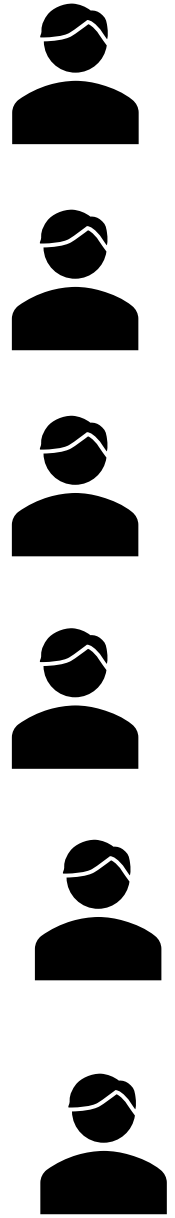

Questions:

1. What is the probability that both boys (Ray and John) select the same girl?
2. What is the probability that they pick different girls?
3. If a third boy (David) joins, what is the probability that all three pick the same girl?

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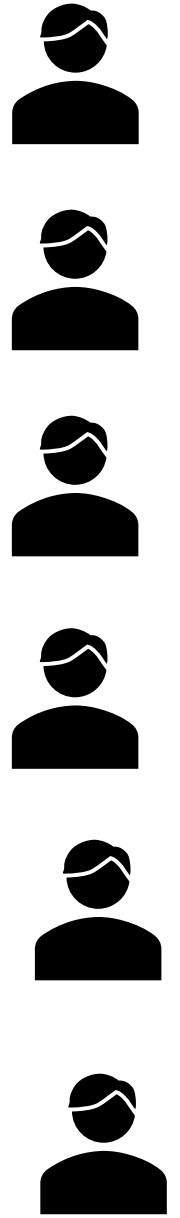

Questions:

1. What is the probability that both boys (Ray and John) select the same girl?
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A3: Follow steps from Q1.

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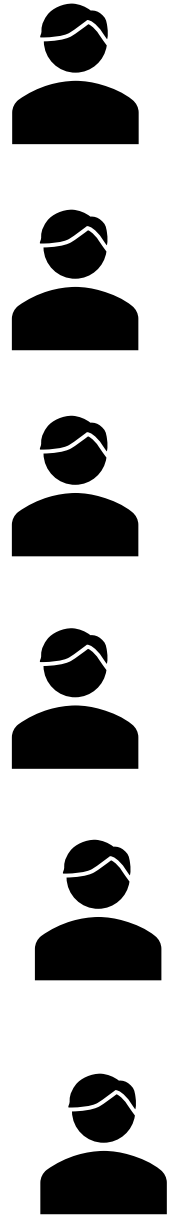


Questions:

1. What is the probability that both boys (Ray and John) select the same girl?
2. What is the probability that they pick different girls?
3. If a third boy (David) joins, what is the probability that all three pick the same girl?
4. Which is the probability that all three pick different girls?

Understanding Combinations

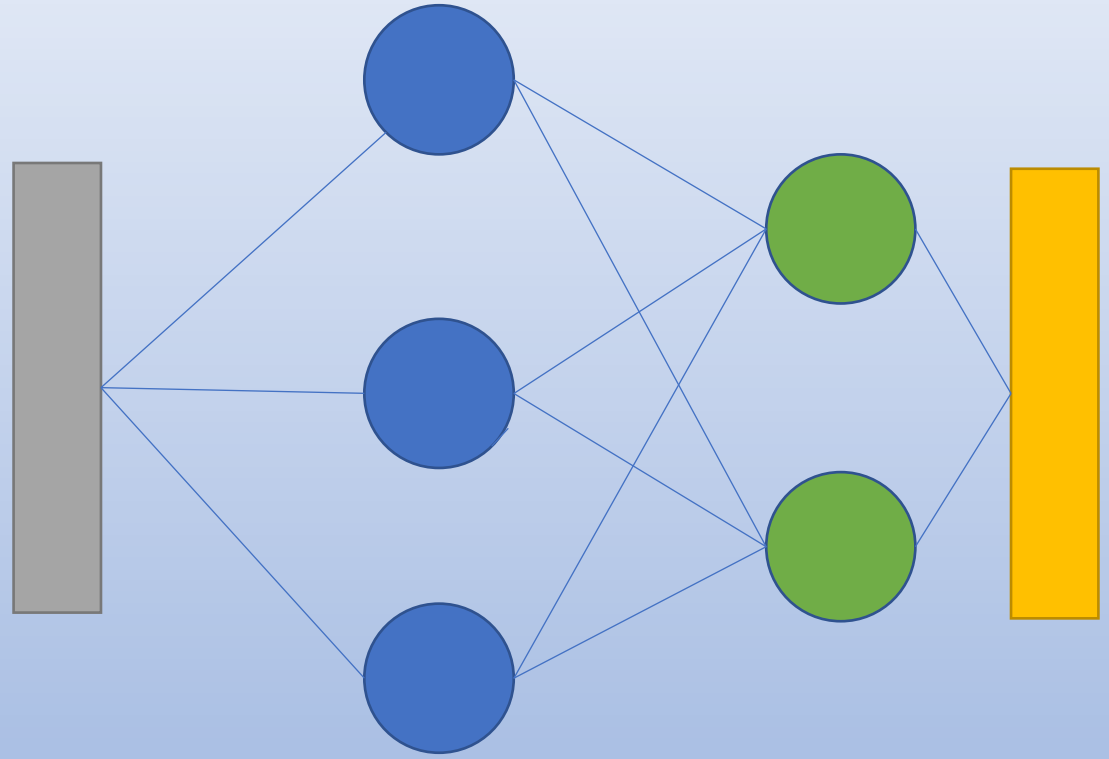
Combinations help us count how many ways we can select objects without considering order.

Choosing Outfits in a Store

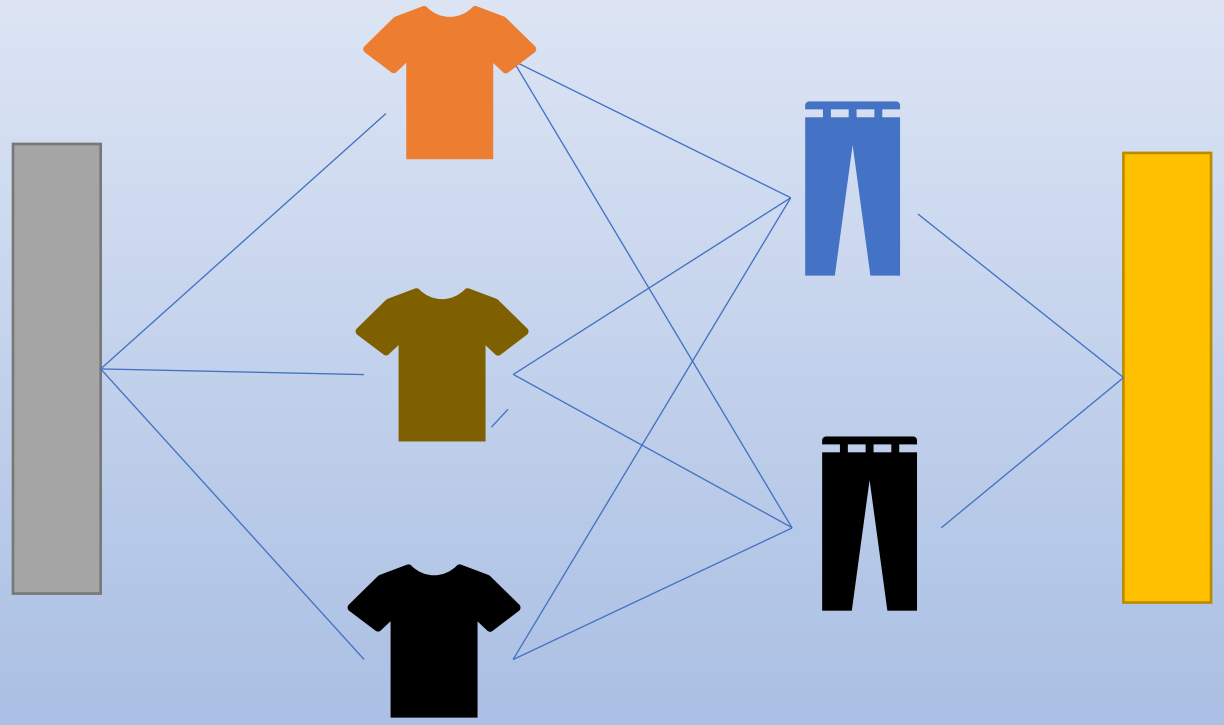
Imagine a store with **8 different shirts** **and** **6 different pants**.

- How many ways can you pick **one shirt and one pair of pants**?
- What if you can pick **two shirts**?
- How many ways can two friends randomly pick a shirt each from the 8 shirts?
- What is the probability they both pick the same shirt?

CNN



Or Combinations?



Understanding Combinations

Combinations help us count how many ways we can select objects without considering order.

Bag contains red and green balls

Imagine a bag with **4 red** **and** **5 green** balls. 3 balls are drawn with replacement.

Which is the probability to pick 2 greens and 1 red?

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Combinations help us count how many ways we can select objects without considering order.

Bag contains red and green balls

Imagine a bag with **4 red** **and** **5 green** balls.
3 balls are drawn with replacement.

Which is the probability to pick 2 greens and 1 red?

And what about the order?

- GGR
- GRG
- RGG

Combinations

$$ {}^{n}C_{r} = \frac{n!}{r!(n-r)!} $$

where,

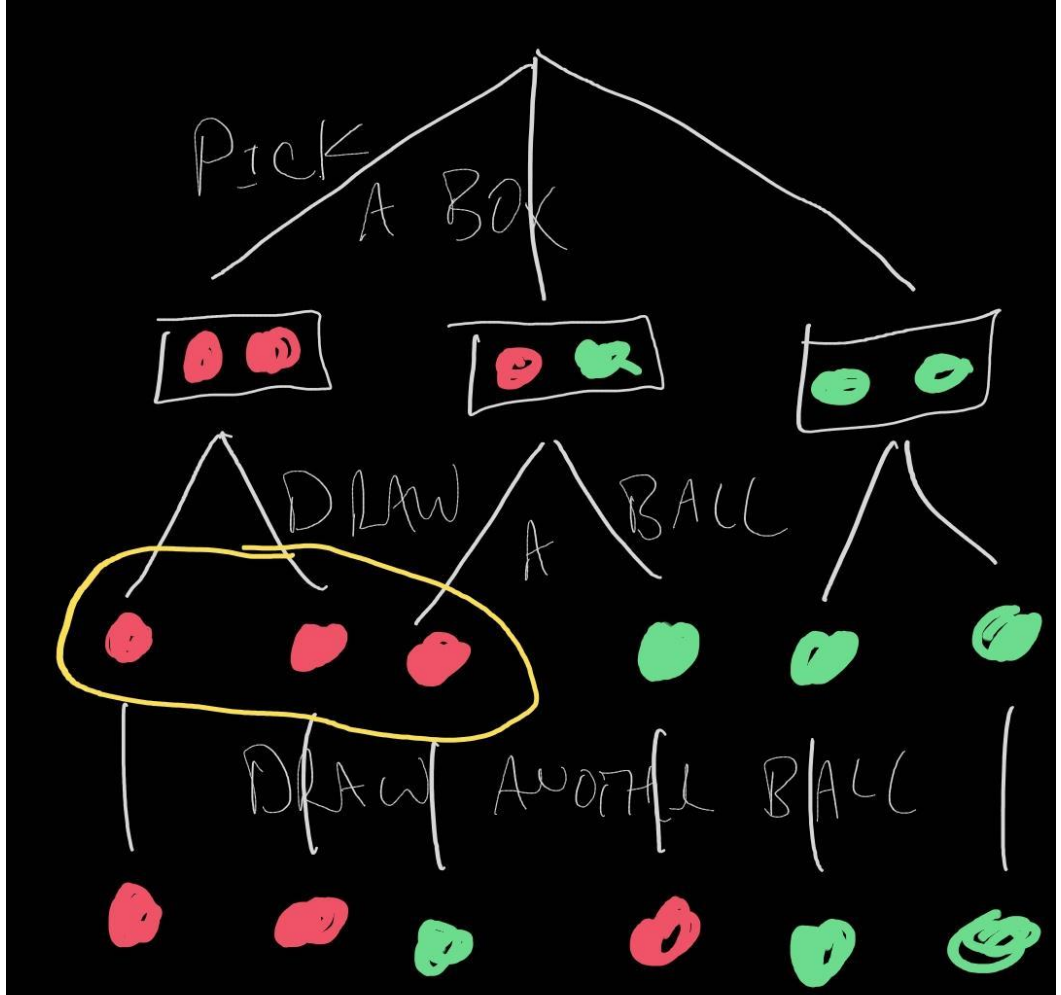
- n = Number of Total Objects
- r = Number of Objects Chosen at Once
- $0 \leq r \leq n$

There are three boxes. Each box contains 2 balls.

One box contains 2 green balls,
One box contains 2 red balls,
One box contains 1 green ball and 1 red ball.

You pick a box at random. Then you take out a random ball from that box without looking into it. It's a green ball. What is the probability that the other ball in that box is also green?

Note: You cannot see into any of the boxes.



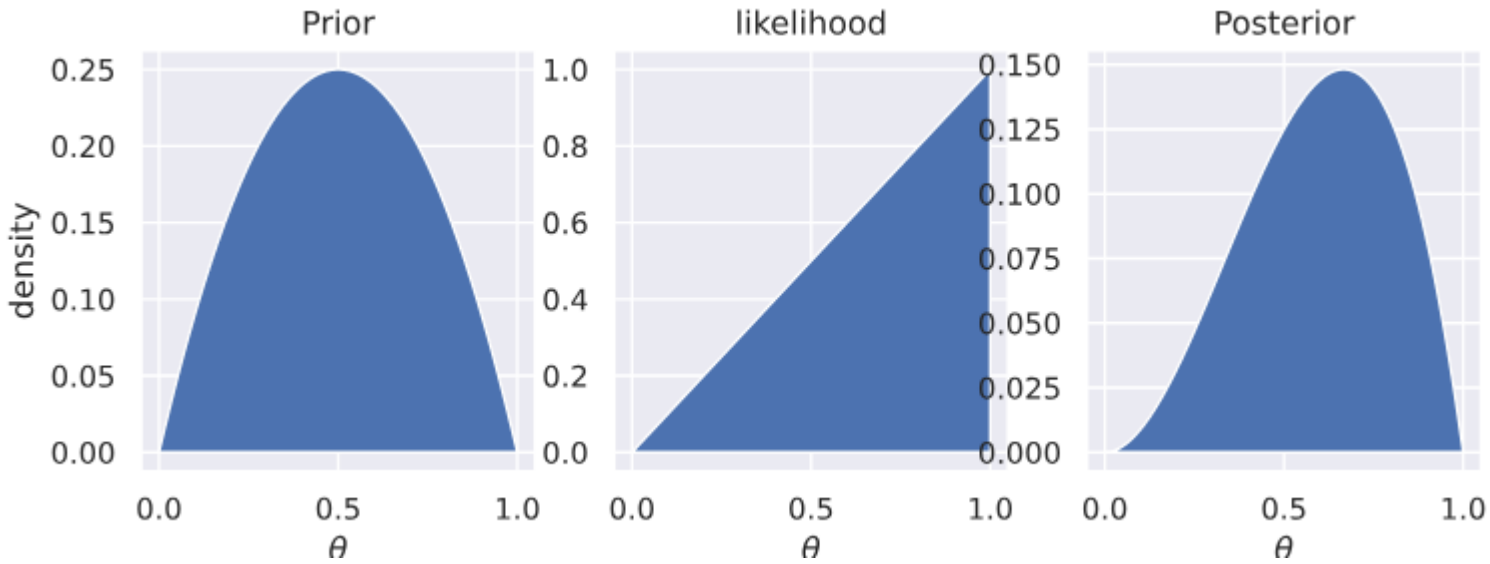
GIVEN A RED BALL,

$P(\text{NEXT BALL RED}) = 2/3$

Bayesian Updating

"When a new evidence comes, update your belief (prior)."

e.g.:



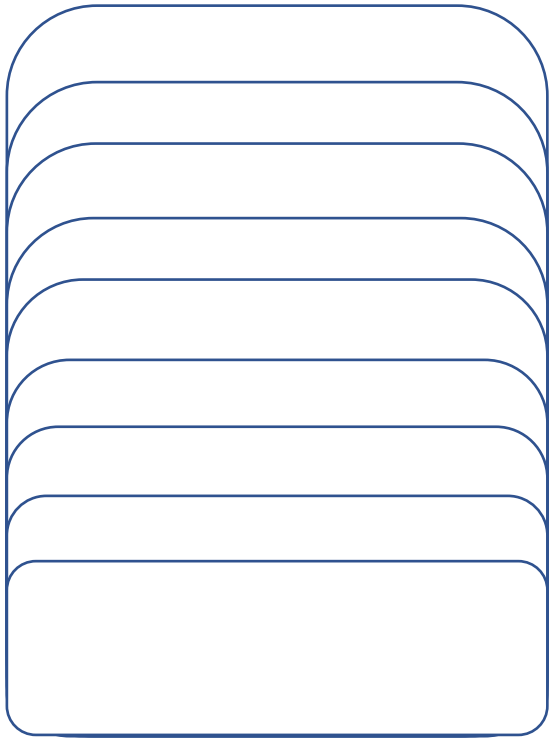
MIT and Dice

Sample Class: Class 12--Bayesian Updating: Discrete Priors

https://www.youtube.com/watch?v=DyuQsaqXhwU

Mug: 4-sided, 6-sided, 8-sided, 12-sided, 20-sided

Pick one and… roll it! Which die I picked?



The Birthday Paradox

Fun Fact: The **Birthday Paradox** states that in a group of just **23 people**, there's a **50% probability** that at least two of them share a birthday.

- What is the idea of P(Left|x), P(Right|x)?
- What about combinations?

Guess what: Children plays a game to guess their teacher's birthday (a number in [1, 365]).

Check this: **Proving the 'Birthday Paradox' with Python Data Visualization**
https://michaelblack-2306.medium.com/proving-the-birthday-paradox-with-python-and-data-visualization-2c0153e980e