5.2 Addition and Compliment Rule

A compound event is an event composed of more than one simple event.

Ex Toss a coin then roll a die

$\underbrace{\text{Toss a coin}}_{A}$ then $\underbrace{\text{roll a die}}_{B}$

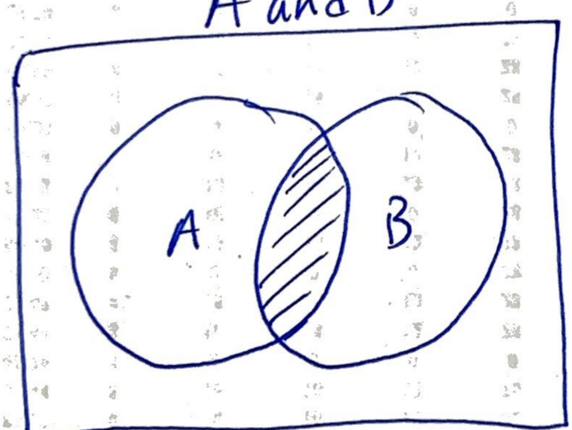
- Double Event Probability:

Def: P(A or B occuring)
= P(A occuring OR B occuring OR both occuring)

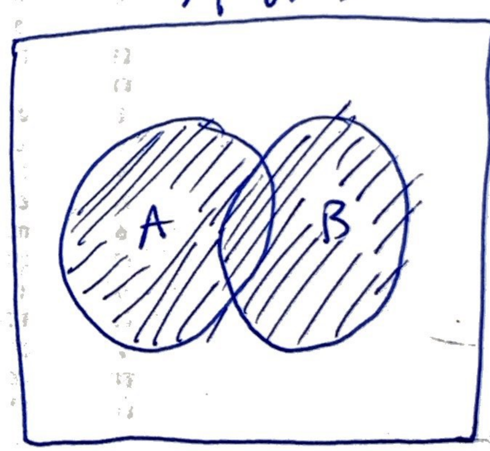
{ if only A or B, but not both, can occur we call that an exclusive OR }

- Venn Diagram

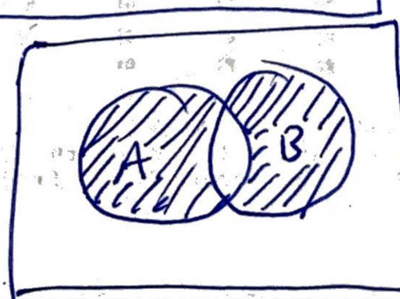
both
A and B



A or B



{ exclusive OR

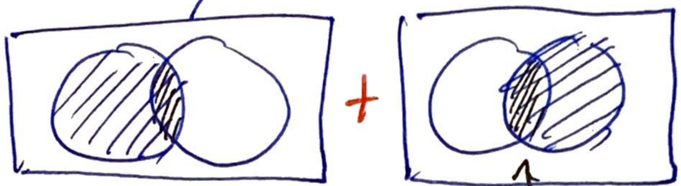


}

- Addition Property "Don't Count Twice" Law

$$\boxed{P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)}$$

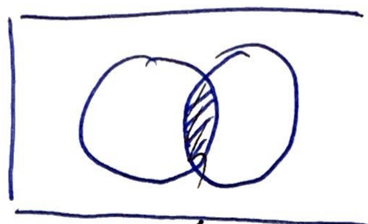
we subtract off one of the double counted



A and B

A and B gets counted twice!!

−



A and B

Ex Consider the "Contingency Table", a table that categorizes different subjects, portraying voting sentiments:

Sentiment \ Choices	In favor of measure M	Not in favor of measure M	Undecided	Total
Likely to Vote	372	262	87	721
Not Likely to Vote	151	103	25	279
Total	523	365	112	1000

What is the probability that a randomly selected individual of voting age is ...

(a) $P(\text{likely to Vote AND in favor}) = \frac{\text{specific}}{\text{generic}} = \boxed{\frac{372}{1000}}$

(b) $P(\text{Likely to Vote}) = \boxed{\frac{721}{1000}}$

(c) $P(\text{not likely to Vote OR are Undecided})$

$= P(\text{not likely to Vote}) + P(\text{undecided}) - P(\text{not Likely AND}$

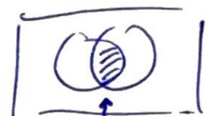
$= \frac{279}{1000} + \frac{112}{1000} - \boxed{\frac{25}{1000}}$ don't double count!!

$= 0.279 + 0.112 - 0.025 = 0.366$, 36.6%

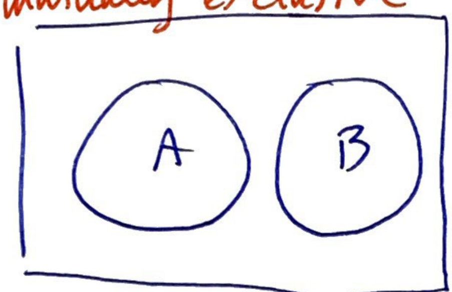
⊛ mutually Exclusive Events

when a compound event does not have an overlapping outcome with any other simple events in the compound event, we say that the **events are mutually exclusive**

- venn diagram



mutually exclusive



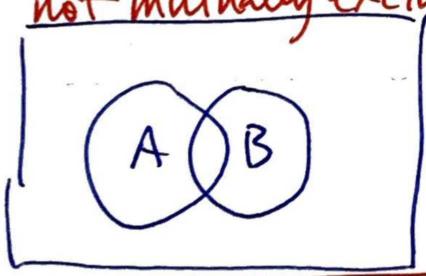
$P(A \text{ and } B) = 0$

No overlap

$\Longrightarrow$ $\boxed{P(A \text{ or } B) = P(A) + P(B)}$

The word "OR" means add together

not mutually exclusive

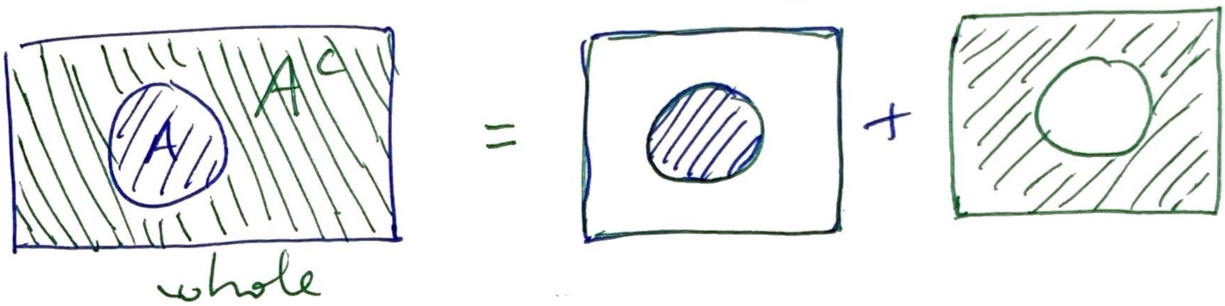


$$\boxed{P(A \text{ or } B) = P(A) + P(B) - P(\underline{A \text{ and } B})}$$

* Complementary Rule

If A is any event the complement of A is all events devoid of A, denoted A^c {a.k.a. $\bar{A}$ or $\sim A$}

$$\boxed{P(A^c) = 1 - P(A)} \rightarrow P(A) + P(A^c) = 1$$



Ex From the previous example find:

P (a randomly selected athlete is Not from North Am)

$= 1 - P$(they are from N. Am.)

$= 1 - \frac{993}{11544}$

$= 1 - 0.0860$

$= \boxed{0.9140}$

EX In the 2016 Olympic Games a total of 11,544 athletes participated 4

Some data

$$
\begin{array}{rl}
554 & \text{represented the US} \\
314 & \text{represented Canada} \\
+\ 125 & \text{represented Mexico} \\
\hline
993 &
\end{array}
$$

(a) what is the prob. of randomly selecting a person from North America and they are from US or Canada

$$P(\text{US or Canada}) = P(\text{US}) + P(\text{Canada}) - \cancel{P(\text{US and Canada})}$$

@ ~~same time~~

$$= \frac{554}{993} + \frac{314}{993}$$

$$= \frac{868}{993} = 0.874 \text{ or } \boxed{87.4\%}$$

(b) what is the prob. in general that we randomly select a US or Canadian athlete?

$$P(\text{US or Canada}) = P(\text{US}) + P(\text{canada})$$

$$= \frac{554}{11,544} + \frac{314}{11544} = \frac{868}{11544} = 0.075 \text{ or } \boxed{7.5\%}$$

(c) $P(\text{North American}) = \frac{993}{11544} = 0.086 \text{ or } \boxed{8.6\%}$