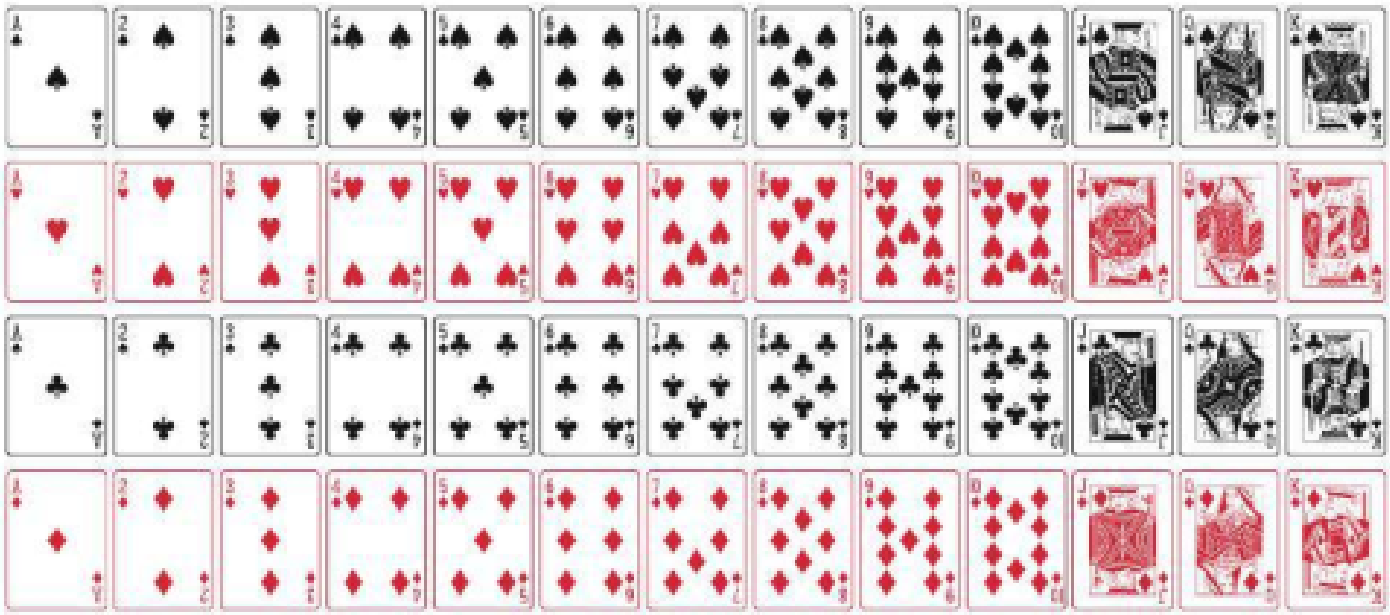
Events

An **event** is a collection of outcomes.

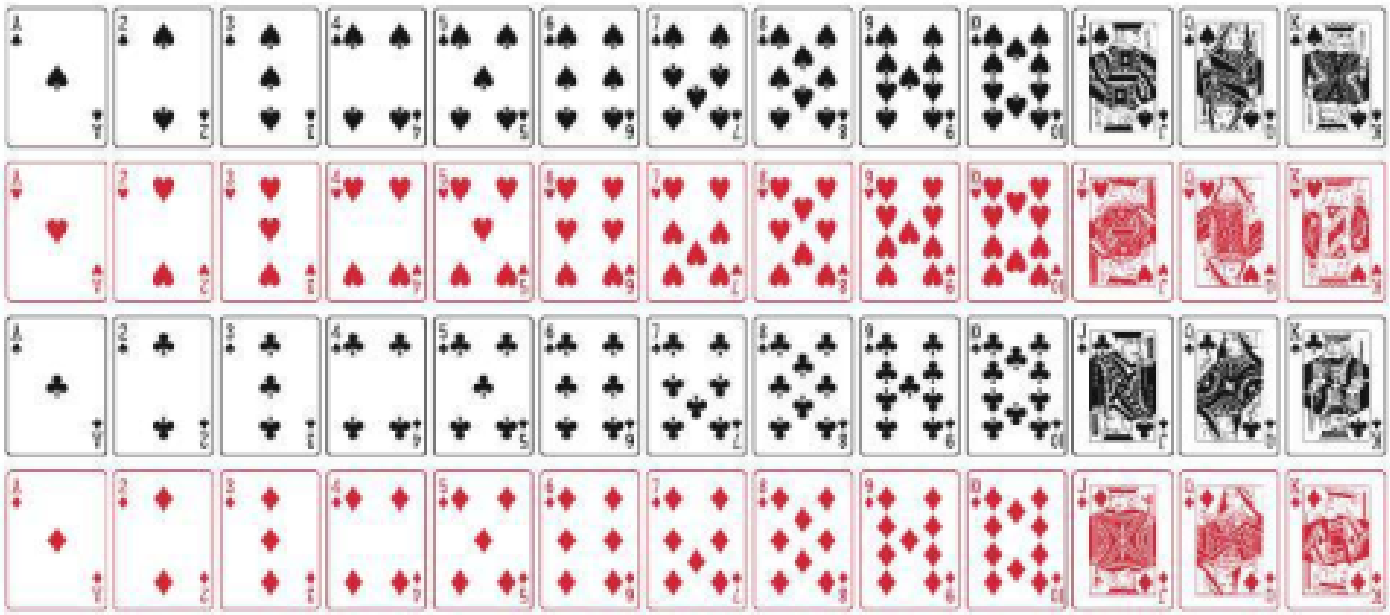
- In general, it is the outcome or outcomes we are interested in.

The **sample space** is the collection of all possible outcomes.

Consider a 52 card deck:

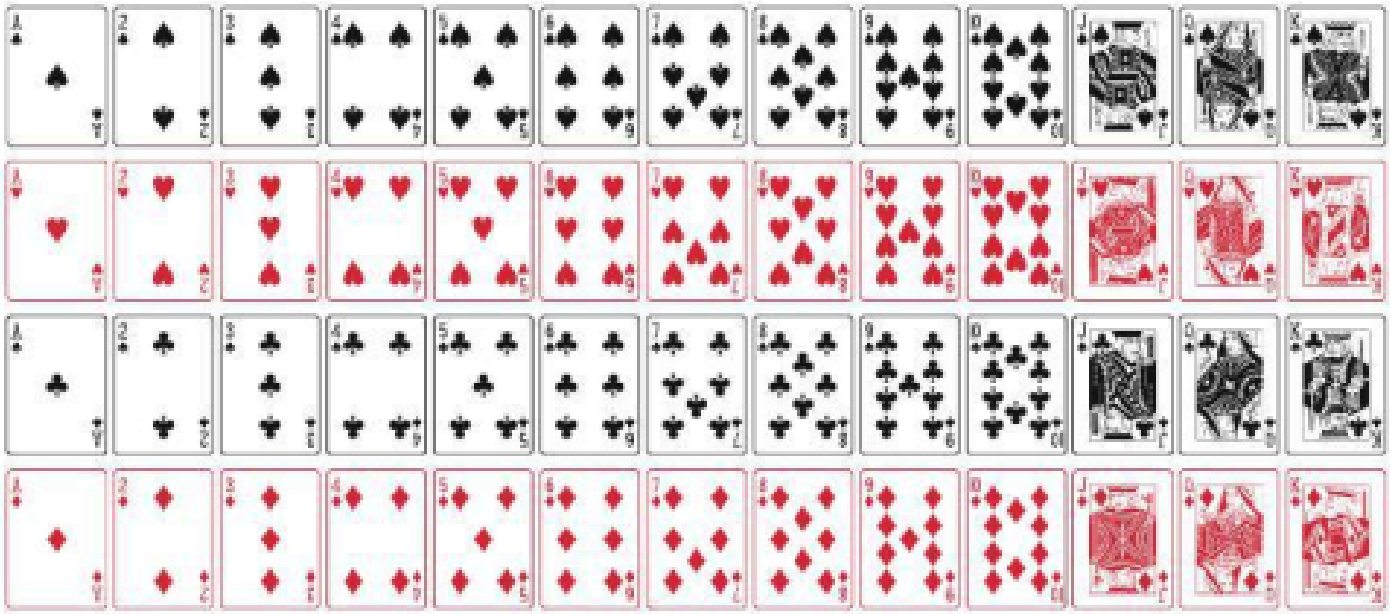


The **sample space** is the collection of all 52 cards.



Some possible **events** are

- the event that the card drawn is the king of hearts.
- the event that the card drawn is a king.
- the event that the card selected is a spade.



- The event that the card drawn is the king of hearts **consists of a single outcome**.
- The event that the card drawn is a king **consists of four outcomes**.
- The event that the card selected is a spade **consists of 13 outcomes**.

An event **occurs** if that event contains the card selected.

- The event that the card drawn is the king of hearts.
- The event that the card drawn is a king.
- The event that the card selected is a spade.

If we draw the king of spades, the second and third events occur, but the first does not.

Notation and Graphical Displays for Events

We use capital letters (starting at the top of the alphabet) to represent events:

- $A =$ the event that the card drawn is the king of hearts.
- $B =$ the event that the card drawn is a king.
- $C =$ the event that the card selected is a spade.

Venn Diagrams

We can represent events and the relationships between them using **Venn Diagrams**.

Venn Diagrams

Venn Diagrams

Consider

- **(not E)**: The event "E does not occur"
- **(A & B)**: The event "both A and B occur"
- **(A or B)**: The event "either A or B or both occur"

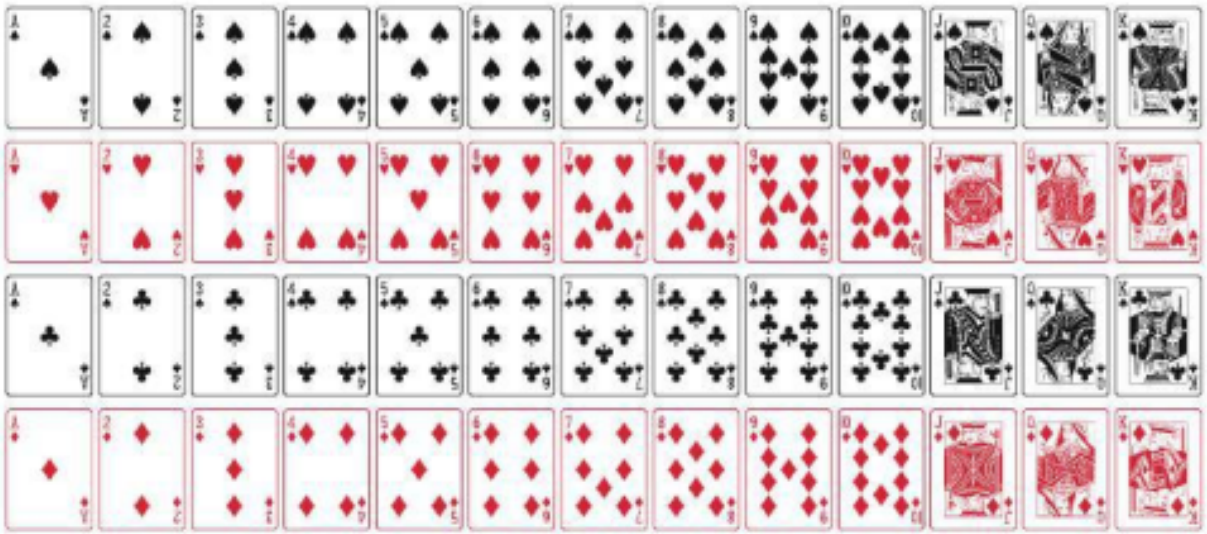
(not E): The event "E does not occur"

This is called the **complement** of the event E.

(A & B): The event "both A and B occur"

(not E): The event "E does not occur"

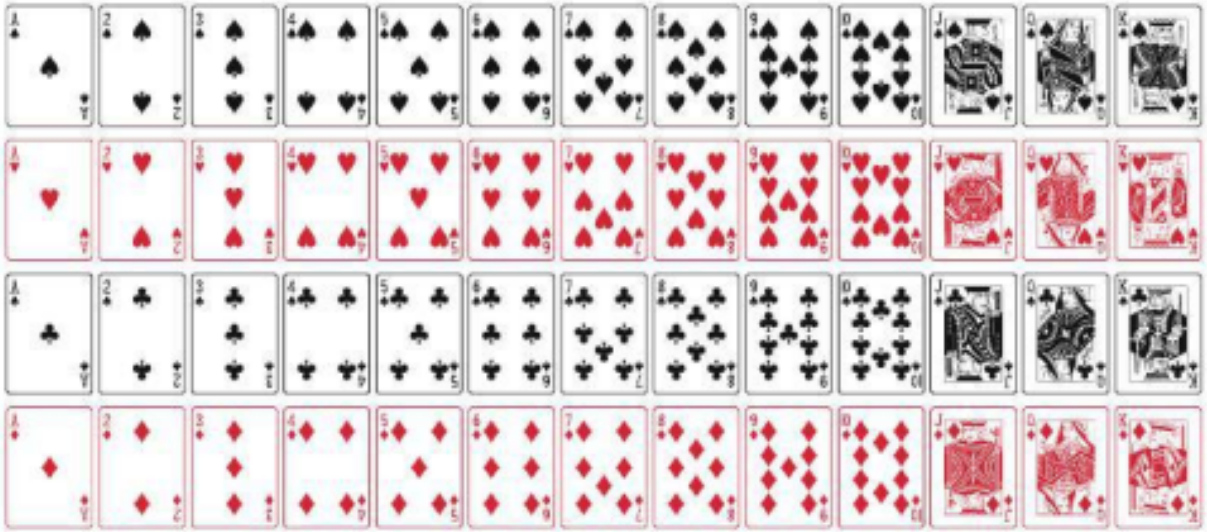
Example



- A = the event that the card drawn is the king of hearts.
- B = the event that the card drawn is a king.
- C = the event that the card selected is a spade.

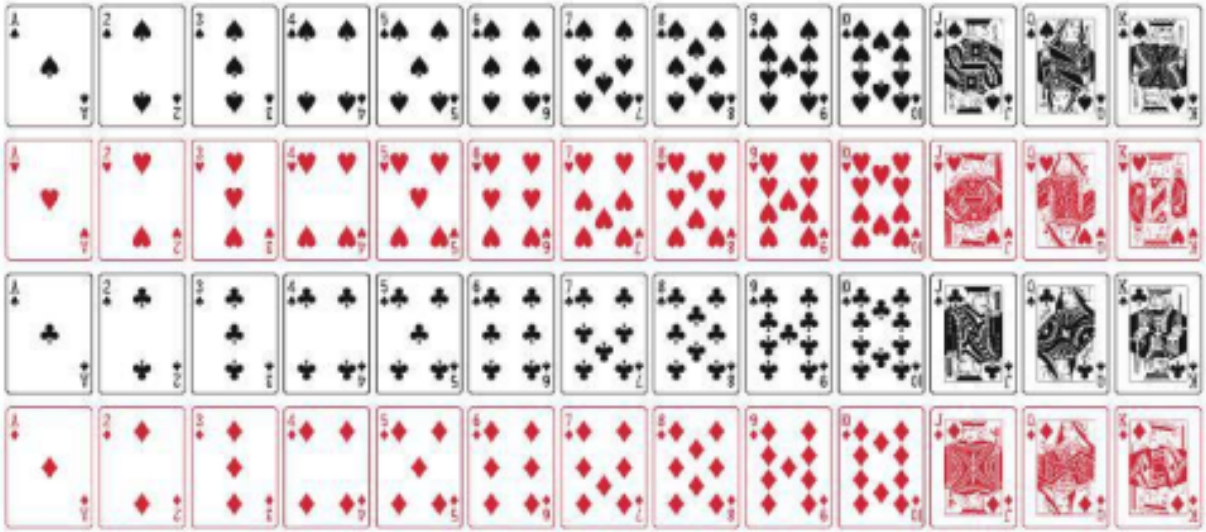
Find the events (not C), (B & C), and (B or C)

(not C)



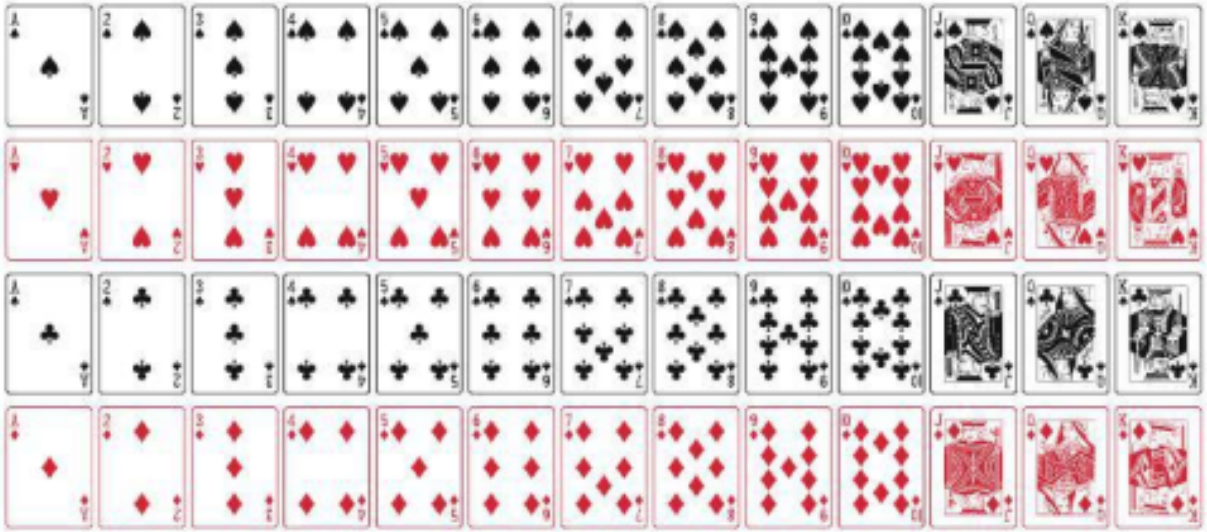
- C = the event that the card selected is a spade.

(B & C)



- B = the event that the card drawn is a king.
- C = the event that the card selected is a spade.

(B or C)



- B = the event that the card drawn is a king.
- C = the event that the card selected is a spade.

Example

Age	Frequency
17	1
18	1
19	9
20	7
21	7
22	5
23	3
24	4
26	1
35	1
36	1

Let

- A = event the student selected is under 21
- B = event the student selected is over 30
- C = event the student selected is in their 20s
- D = event the student selected is over 18

Find (not D), (A & D), (A or D), (B or C)

(not D)

Age	Frequency
17	1
18	1
19	9
20	7
21	7
22	5
23	3
24	4
26	1
35	1
36	1

- D = event the student selected is over 18

(A & D)

Age	Frequency
17	1
18	1
19	9
20	7
21	7
22	5
23	3
24	4
26	1
35	1
36	1

- A = event the student selected is under 21
- D = event the student selected is over 18

(A or D)

Age	Frequency
17	1
18	1
19	9
20	7
21	7
22	5
23	3
24	4
26	1
35	1
36	1

- A = event the student selected is under 21
- D = event the student selected is over 18

(B or C)

Age	Frequency
17	1
18	1
19	9
20	7
21	7
22	5
23	3
24	4
26	1
35	1
36	1

- B = event the student selected is over 30
- C = event the student selected is in their 20s

At Least, At Most, Inclusive

- "At least x" = "greater than or equal to x"
- "At most x" = "less than or equal to x"
- "Between x and y, inclusive" = "x, y and everything in between"

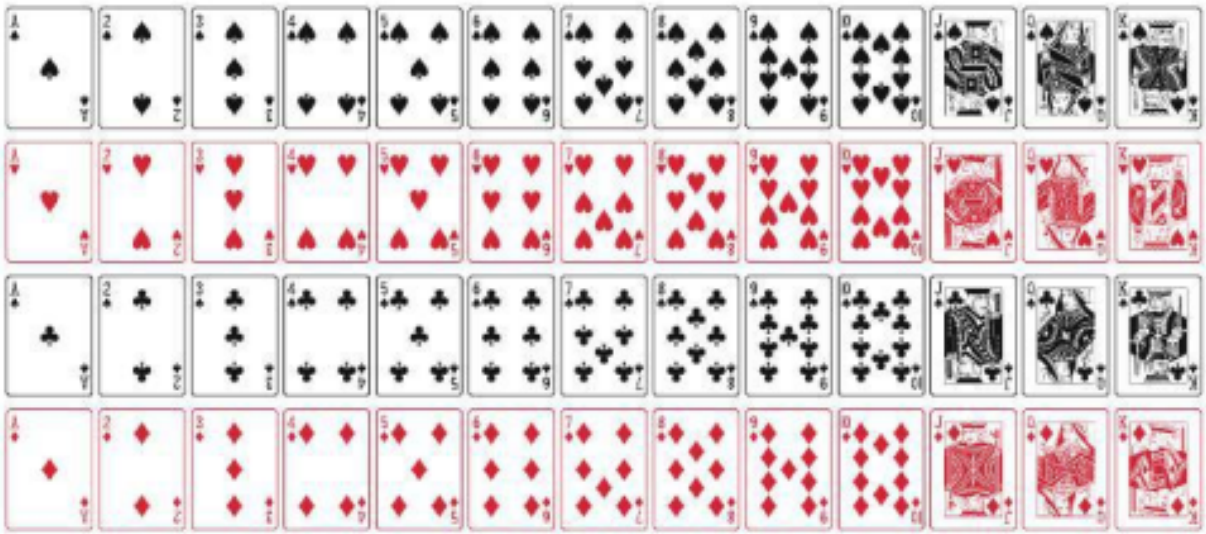
Mutually Exclusive Events

Two or more events are **mutually exclusive events** if no two of them have outcomes in common.

We can also think of two events being mutually exclusive if they *cannot happen at the same time.*

Mutually Exclusive Events

Mutually Exclusive Events



Let

- C = event the card selected is a spade
- D = event the card selected is a face card
- E = event the card selected is a 10 or a jack

Consider (C and D), (C and E), and (C, D, and E).