
SHOP

$$A^{2} = \{(a,b) \mid a \in A \wedge b \in A\}$$

$$A^* = A^0 \cup A^1 \cup A^2 \cup A^3 \cup \dots$$

$$|\{0,1\}^*| = \infty$$

$()$

$(0,0,0)$

$(1,0,1,0,1,1,1,0)$

$\vdots$

$\{\}^0 = \{\}$ / $\{()\}$?

$\{\}^2 = \{\}$

$A = \{1\}$ $\quad B = \{1,2\}$

$A^2 = \{(1,1)\}$ $\quad B^2 = \{(1,1), (1,2), (2,1), (2,2)\}$

$A^0 = \{()\}$ $\quad B^0 = \{()\}$

$() = \varepsilon$ $\quad \{\} = \emptyset$

$C = \{a, b\}$

$C^3 = \{\text{"aaa"}, \text{"aab"}, \text{"abb"} \dots\}$

$A = \{1, 2, \{\}\}$

$A^3 = \{(1,1,1),$
$(1,1,2),$
$(1,1,\{\}),$
$(1,2,1)$
$\vdots$

$|A \times B| = |A| \cdot |B|$

$|A^n| = |A|^n$

$$\boxed{\forall x \in A^n .\ |x| = n}$$

$(\quad , \quad)$

Pick for A **and** Pick for B $\rightarrow$ $\boxed{\times}$

Pick a digit **or** pick a letter

10 $\boxed{+}$ 26

number of Permutations of a seq of n distinct elements is $n!$

Pick a spot for 1st element $\longrightarrow n$

$\times$

and a spot for 2nd elem $\longrightarrow n-1$

and ...

$\vdots$

How many permutations are there of

"$\overbrace{aaa}^{3}\,\overbrace{bbb}^{3}\,cccc\,\overbrace{d}^{1}$"

$\underbrace{\underbrace{aaa}_{3}\,bbb\,\underbrace{cccc}_{4}\,d}_{11}$

$3!$ and $3!$ and $4!$ and $1!$

$\times \quad \times \quad \times$

$$\frac{11!}{3!\,3!\,4!}$$

How many 3-elem subsets of $\{\boxed{1,2,3}, 4,5,6,7,8\}$ are there?

$$\frac{8!}{3!\,5!} = \frac{8!}{3!\,(8-3)!} = \binom{8}{3}$$

Passwords

a b   8-letters long $|\{a,b\}^8| = 2^8 = 256$

this
is
a
simple
example

52 - letter - case
10 - digits
38 - symbols on English keyboard

100   8-letter long $100^8 = 10{,}000{,}000{,}000{,}000{,}000$

double letters   8-letter sm 26^8

| a | z | p | a | b | a | a | a |

$26 \cdot (25^7)$

25 25

26 25 25

repeat letters $\frac{26!}{(26-8)!}$ $26 \cdot 25 \cdot 24 \cdot 23 \cdot 22 \cdot 21 \cdot 20 \cdot 19$

$\frac{\text{\# of guesses}}{\text{\# of pw possible}}$

6-word passphrase

10,000 $(10{,}000)^6$

6 consecutive words from ~~wikipedia~~ w/ no repeat phrases

1T word

1,000,000,000,000 $-\ 5$

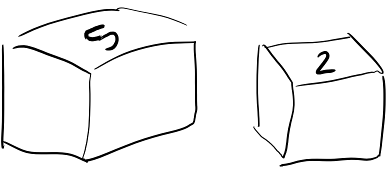
(6-1)

Probability

0 ... 1

won't happen

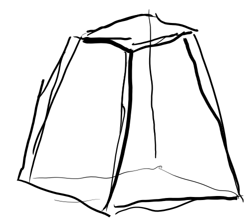
always happen



Prob roll 2 dice sum to 5

$$\frac{\text{desired outcomes}}{\text{all possible outcomes}}$$

all cases are equally likely



$$\frac{4}{6 \cdot 6}$$

1	4
2	3
3	2
4	1

$$\frac{4}{36} = \frac{1}{9}$$