+0.1 to fin 3.5.25

+0.1 for A

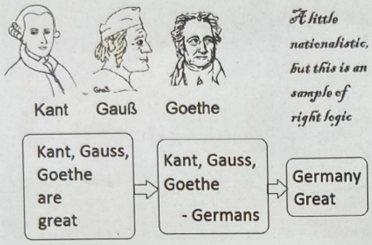
+0.2

+0.1 6.6.25

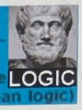
th H=Kbl(N)

Massachusetts Institute of Technology (MIT)

Lecture by Pr. Bob Gallagher Aristotle (384–322 BC), Boole (1815-1864) & Shannon (1916-2001)



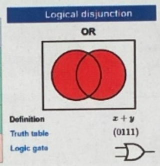
George Boole (1815-1864) developed
The principles of logical thinking have been understood (and occasionally used) since the Hellenic era.
Boole's contribution was to show how to systemize these principles and express them in equations (Boolean logic)

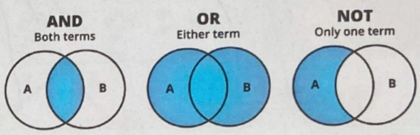


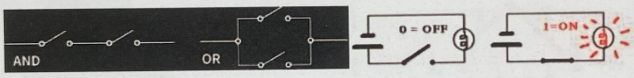
Logical addition (disjunction)

A	B	F=A∨B
0	0	0
0	1	1
1	0	1
1	1	1

A	B	A ∨ B
True	True	True
True	False	True
False	True	True
False	False	False







Claude Shannon (1916-2001) showed how to use Boolean algebra as the basic for swithing technology

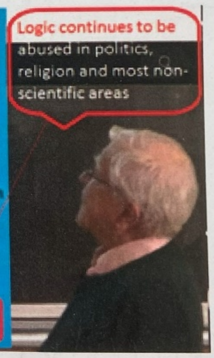
George Boole (1815-1864) developed Boolean logic

The principles of logical thinking have been understood (and occasionally used) since the Hellenic era.

Boole's contribution was to show how to systemize these principles and express them in equations (called Boolean logic or Boolean algebra).

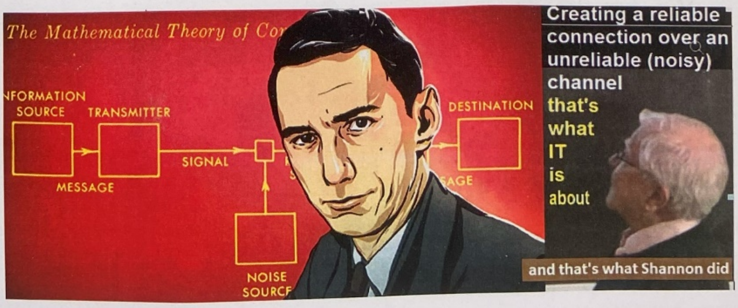
Claude Shannon (1916-2001) showed how to use Boolean algebra as the basis for switching technology. This conribution systemized logical thinking for computer and communication systems, both for the design and programming of the systems and their applications.

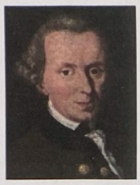
Logic continues to be abused in politics, religion, and most non-scientific areas.



Resume of Lecture by Pr. Bob Gallagher from MIT

Massachusetts Institute of Technology (MIT)





Sapere aude!

Boolean functions.

- $NOT(x) = \begin{cases} 1 & \text{if } x \text{ is } 0 \\ 0 & \text{if } x \text{ is } 1 \end{cases}$
- $AND(x, y) = \begin{cases} 1 & \text{if both } x \text{ and } y \text{ are } 1 \\ 0 & \text{otherwise} \end{cases}$
- $OR(x, y) = \begin{cases} 1 & \text{if either } x \text{ or } y \text{ (or both) is } 1 \\ 0 & \text{otherwise} \end{cases}$
- $XOR(x, y) = \begin{cases} 1 & \text{if } x \text{ and } y \text{ are different} \\ 0 & \text{otherwise} \end{cases}$

NOT

x	x'
0	1
1	0

AND

x	y	xy
0	0	0
0	1	0
1	0	0
1	1	1

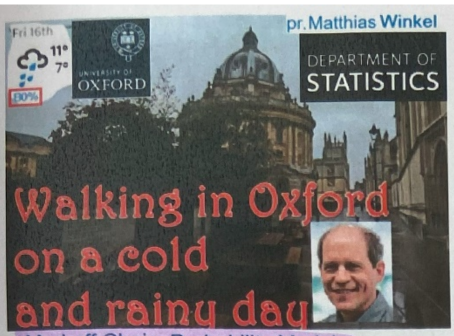
OR

x	y	x+y
0	0	0
0	1	1
1	0	1
1	1	1

XOR

x	y	$x \oplus y$
0	0	0
0	1	1
1	0	1
1	1	0

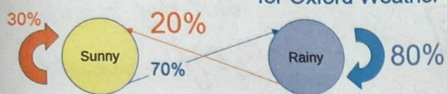
d: cd IT\Projects\01\



Markoff Chain Probability Model

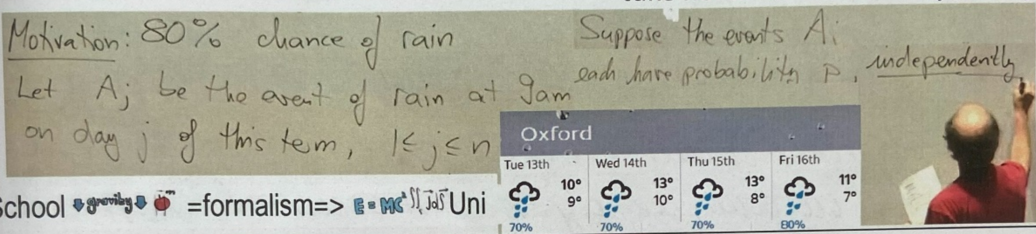
①listening
② first way of processing
③Writing, incl. sth., you're not quite sure about

for Oxford Weather



CHALK+TALK ink+think

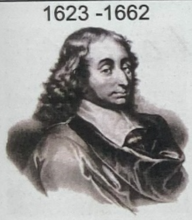
take notes on the lecture yourself

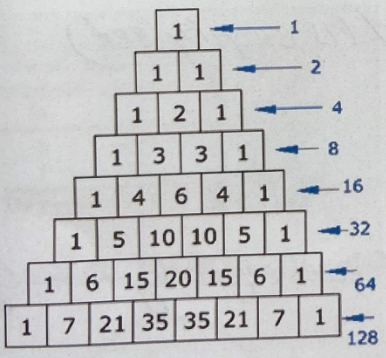


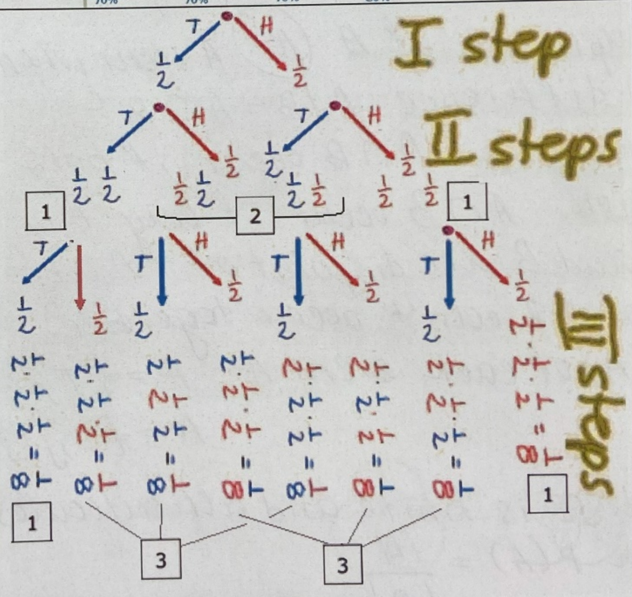
School ⇩gravity⇩ =formalism=> E=MC² Uni

1623 -1662

Pascal's triangle







$$(a+b)^0 = 1$$
$$(a+b)^1 = a + b$$
$$(a+b)^2 = a^2 + 2ab + b^2$$
$$(a+b)^3 = a^3 + 3a^2b + 3ab^2 + b^3$$
$$(a+b)^4 = a^4 + 4a^3b + 6a^2b^2 + 4ab^3 + b^4$$
$$(a+b)^5 = a^5 + 5a^4b + 10a^3b^2 + 10a^2b^3 + 5ab^4 + b^5$$

Newton's Binomial (1642–1727)

$(1+x)^p = \cdots$

$$H = \sum_{x=1}^{n} p(x) \log_2 \left(\frac{1}{p(x)}\right)$$

$I(x) = \log_2\left(\frac{1}{p(x)}\right)$ Quantifying information

$$H(x) = \sum_{x=1}^{n} p(x) H(x)$$

Events & probabilities

Consider an "experiment" which has a set of Ω of o... $w \in \Omega$. a) Tossing a coin $\Omega = \{H, T\}$ - a) coin comes u... $A = \{T\}$

b) throwing a dice  - b) $A = \{(3,6)\}$ - event

$\Omega = \{(i,j), i,j \in [1,2,3,4,5,6]\}$ set of possible outcomes

A subject of Ω is called event

$w \in \Omega$ is the outcome, we say that A occur of $w \in A$

Compliment of A: (A^c) $\bar{A}$ occur when A doesn't occur

Set difference: $A / B = A \cap B^c$

Intersection: $A \cap B$ occur if both A & B occur

Union: $A \cup B$ occur if any A or B occur

A and B are disjoint of $A \cap B = \varnothing$ (is empty set)

A and B can't occur together.

$P(A)$ of each event A $\quad A = \{T\}$

$A = \{(i,j)\}$

Case: Ω is finite and all outcomes are equally likel...

then $P(A) = \frac{|A|}{|\Omega|}$

a) coin $|\Omega| = 2$

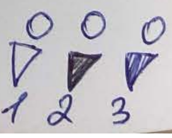
$|A| = 1 \quad P(A) = \frac{1}{2}$

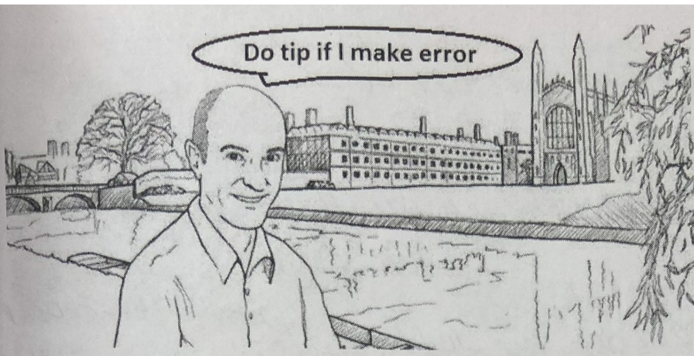
b) $|\Omega| = 6$

$|A| = 1 \quad P(A) = \frac{1}{6}$

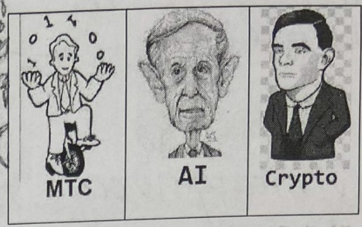
Elementary combinatories. Arrangement of distin... objects.

Suppose we have n dist-e objects

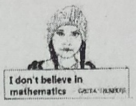


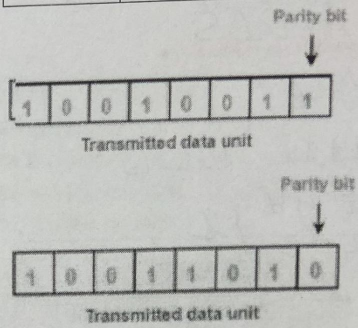


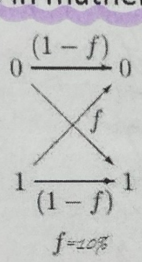
Sir **Dr. D. MacKay**,
University of Cambridge
(22 April 1967 – 14 April 2016)

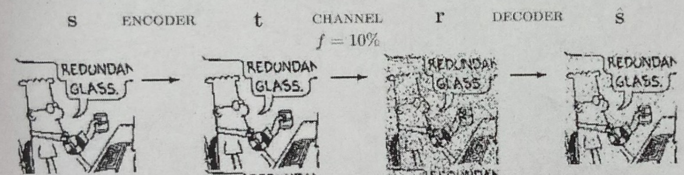


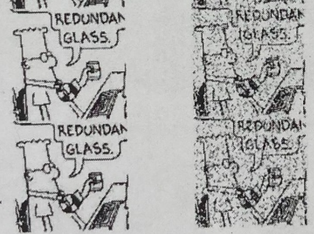
"I believe in clean energy,
but I also believe in mathematics"











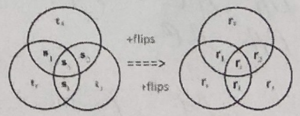
Source sequence s	Transmitted sequence t
0	000
1	111

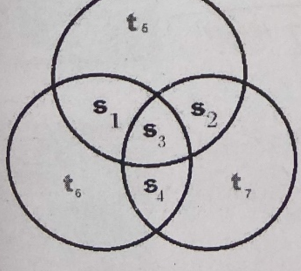
The repetition code R_3

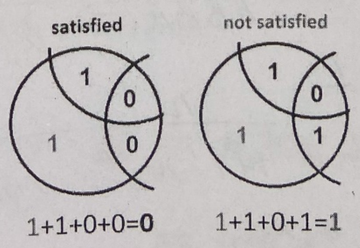
source message s	0	0	1	0	1	1	0
t	000	000	111	000	111	111	000
n	000	001	000	000	101	000	000
r	000	001	111	000	010	111	000
corrected errors		*					
undetected errors					*		

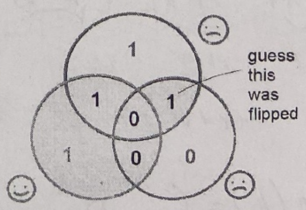
7.4. Hamming code.

$$\frac{4}{\Sigma} \rightarrow \frac{7}{t}$$









How many ways are there to order them

$3! = 1\cdot 2\cdot 3 = 6$

For n there are n options for 1st

then n-1 for the 2nd object

inductively n-(n-1)-with in all this are

$n(n-1)(n-2)\dots n\cdot 1 =$ permutation

How many ways to order the letters of GALOIS

$n! = 6!$

⊔⊔⊔ ⊔⊔⊔

a nd
a dn }2

a n d y → andy

1 ay nd }2
2 ya nd 3
1 ay dn }2
2 ya dn

2x2=4
4!

andy
nady
dyna

$C_n^k = \frac{n!}{k!(n-k)!} = \frac{A_n^k}{P_k}$

$A = (n-1)$

$$P(A) = \frac{m_1! \cdot m_2!}{n!}$$ — $n - m_1$

$m_1 + m_2 = n$

$n! = n(n-1)(n-2)\dots 2\cdot 1$

$A_1 A_2 A_3$ BCD ↓ 6!

BA DA AC
BA DA AC → 1! $\frac{6!}{3!}$
BA DA AC

L M T
$x_1 x_1$ $x_1 x_k$ $x_k x_k$
m_1 m_2 m_n -1

ABBAT → $\frac{5!}{2!2!1!}$

$n = m_1 + m_2 + \dots$

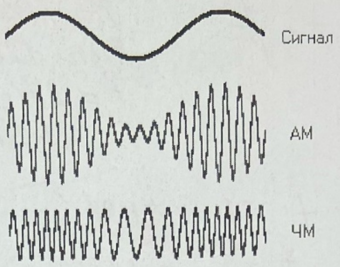
$$\frac{n!}{m_1! m_2! \dots m_n!}$$

$P_n(k) = C_n^k \cdot p^k \cdot q^{n-k}$

$(1-q)$

Reginald A. Fessenden

(October 6, 1866 – July 22, 1932)



(October 6, 1866 – July 22, 1932)

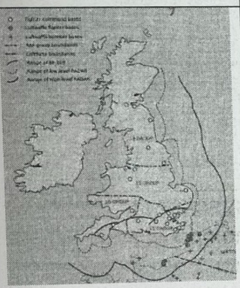
first transmission of speech by radio (1900), and the first two-way radiotelegraphic communication across the Atlantic Ocean (1906)

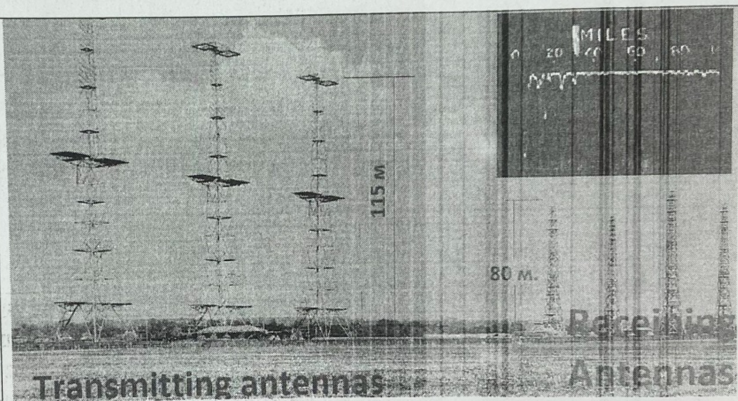
"Ни одна организация, занимающаяся какой-либо конкретной областью деятельности, никогда не изобретает какие-либо важные разработки в этой области или не внедряет какие-либо важные разработки в этой области до тех пор, пока она не будет вынуждена сделать это из-за внешней конкуренции.." Oxford University Press. The Quarterly Journal of Economics , Feb., 1926, p. 262.

Battle of Britain

(3 month 3 weeks)

10.07-31.10.1940





Radar played a major role in the Battle of England

H. Nyquist

$$W = K \log m$$

Where W is the speed of transmission of intelligence,

m is the number of current values,

and, K is a constant.

Ralph **Hartley**

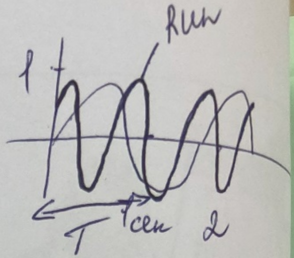
(81:1888-1970)

$$H = n \log s$$
$$= \log s^n.$$

$F_s \geq 2F_{max}$ ($T_s \leq T_{min}/2$)

$f=1$ $T=1$
$f=2$ $T=\frac{1}{2}$
$f=3$ $T=\frac{1}{3}$
} $T=\frac{1}{f}$

$f = 1Hz$
$T = 1$ сек.
Run 120
$f = 2Hz$
$T = 0,5$ сек



4 — — + + + + $\frac{4}{8}$ – 50%
5 – 6 ♠ ♠ $\frac{2}{8} \to \frac{1}{4} \to 25\%$
7 ✦ $\frac{1}{8}$ – 12,5%
8 ♥ $\frac{1}{8}$ – 12,5%

$\log_2(4)$ □□ + ♤
2 □□ ✧ ♡ 2 вопроса

0,5 · 1
0,25 · 2
0,125 · 3
0,125 · 3

□□□□
■■
□
■

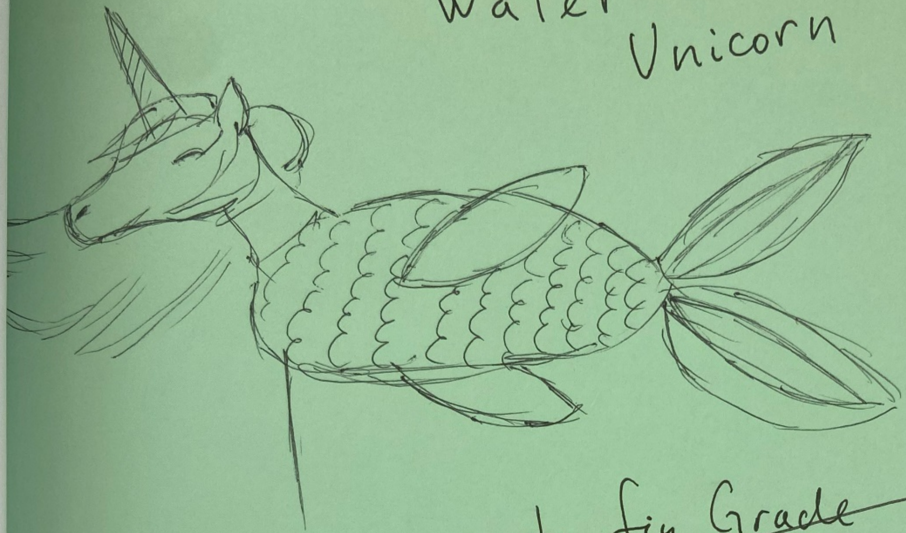
White ①
Black ②
□ ③

0,5
0,5
0,125 · 6
0,75

1,75

□ ■ + ♤
□ ■ ✧ ♡ 2 вопроса

Water Unicorn



+0.1 to fin Grade

Avg. num. of ?

□ □ □ ☒ ☒ $\frac{3}{8}$ 0,375
9+2+2+1 = 8

■ ■ $\frac{2}{8}$ 0,25

■ ■ $\frac{2}{8}$ 0,25 $\log_2 8 = 3$

□ $\frac{1}{8}$ 0,125

$$\sum_{i=1}^{N} p_i \log_2\left(\frac{1}{p_i}\right) \Rightarrow$$

$\frac{3}{8}\cdot 1$
$\frac{2}{8}\cdot 2$
(+) $\frac{2}{8}\cdot 2$ → 1,175
$\frac{1}{8}\cdot 3$

$\frac{5}{8}+\frac{2}{8}$ $\frac{3}{8}+\frac{3}{8}=\frac{13}{8}=\frac{6}{?}$

① ②

1 + + + + + + + $\frac{5}{8}$ 0,625
2 ♠ ♠ ♠ $\frac{1}{8}$
+ + + $\frac{1}{8}$
3 ♥ ♥ ♥ $\frac{1}{8}$

$\frac{5}{8}\cdot 1+\frac{1}{8}\cdot 2+\frac{1}{8}\cdot 3+\frac{1}{8}\cdot 3 = \frac{5+6}{8} = \frac{11}{8} =$
~~= 1,375~~ → 1,625

$\frac{2}{8}\cdot 4 = \frac{1}{1}$

Wrong

Хуже
1 · 0.25 · 2 · 0.25 3 · 0.25 + 3 0.25
0.25 0.5 0.75 0.75

2.25

Q 1. Красная (yes)
Q 2. Черва (No)
↑ Бубна

2 Questions

$\log_2(4) = 2$

Nighwist formula 0.625

$\log_2 1.6$

① $\sum_{i=1}^{N} p_i \cdot \log_2\left(\frac{1}{p_i}\right) =$
$\left(0,25\cdot\log_2\frac{1}{0,25}\right)\cdot 4 = 2$

② $\sum_{i=1}^{N} p_i \cdot \log_2\left(\frac{1}{p_i}\right) = 0,625\cdot\log_2\frac{1}{0,625}$
$+ 0,25\cdot\log_2\frac{1}{0,25} + \left(0,375\cdot\log_2\frac{1}{0,375}\right)\cdot 2$
$\approx 0,42 + 1,56 \approx 1,98$

5% >10%

8 | 5
5 | 1.625
30

0.~~67~~
0.575 2
0.452

$0.625\log\left(\frac{8}{5}\right) + 0.25\cdot\log_2\frac{8}{1}$
5
$0.5\cdot 0.75 + 0.25\cdot 3\cdot 3$
1.5

1.5
0.452
1.952