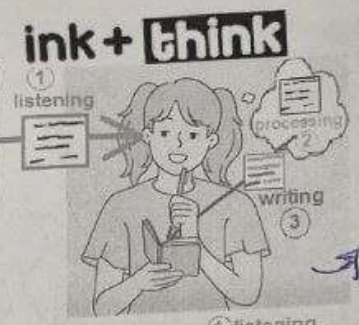


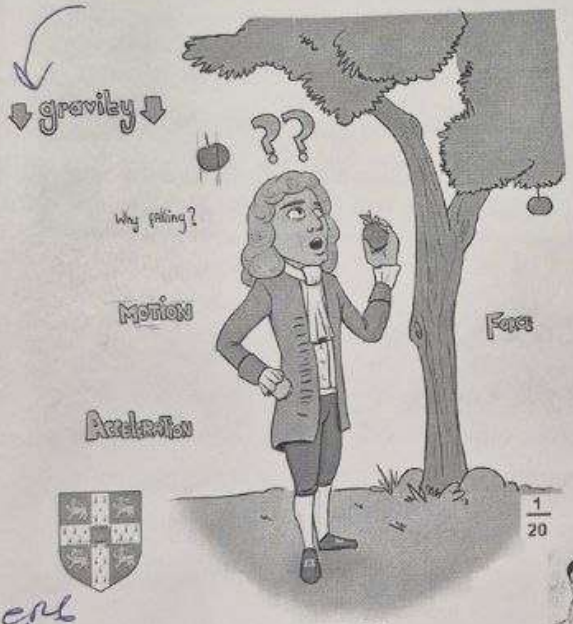
good girl

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

bad way

School → gravity → MOTION ==formalism==> University

CONCRETE AND ABSTRACT THINKING



ISAAC NEWTON

ALBERT EINSTEIN

основатель современной высшей алгебры (Эварист Галуа)

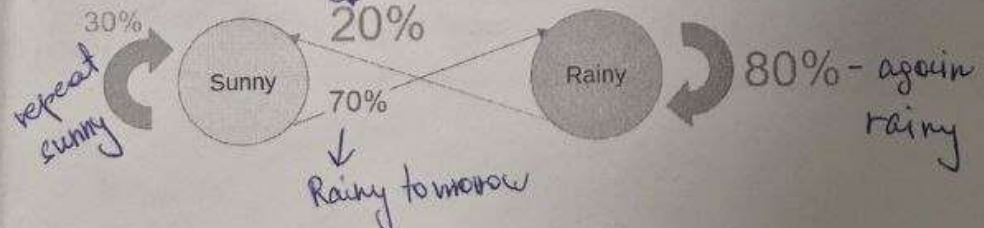
Motivation: 80% chance of rain

Let A_j be the event of rain on day j of this term, $1 \le j \le n$

Suppose the event's A_j are independent

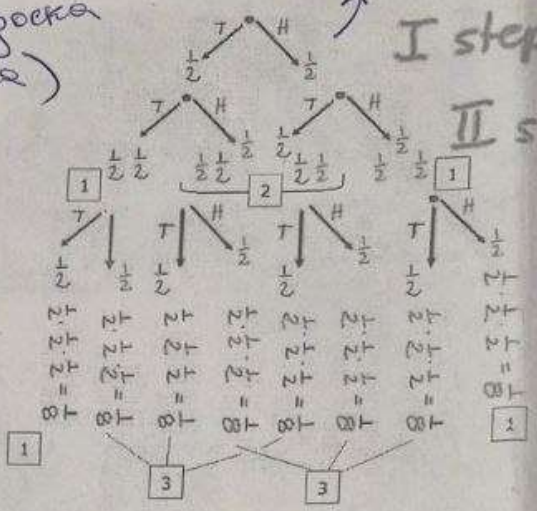
predict the fucture based on the past

Markoff Chain Probability Model for Oxford Weather

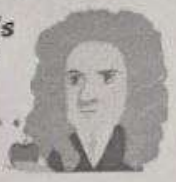


Pascal's triangle

По этому принципу (на основе) ~~этой пр~~ работают Beam machine (доска Гальтона)



1									1
1	1								2
1	2	1							4
1	3	3	1						8
1	4	6	4	1					16
1	5	10	10	5	1				32
1	6	15	20	15	6	1			64
1	7	21	35	35	21	7	1		128
1	8	28	56	70	56	28	8	1	



1665

$$(a+b)^0 = 1$$

$$(a+b)^1 = a+b$$

$$(a+b)^2 = a^2+2ab+b^2$$

$$(a+b)^3 = a^3+3a^2b+3ab^2+b^3$$

$$(a+b)^4 = a^4+4a^3b+6a^2b^2+4ab^3+b^4$$

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

$$(a+b)^6 = a^6+6a^5b+15a^4b^2+20a^3b^3+15a^2b^4+6ab^5+b^6$$

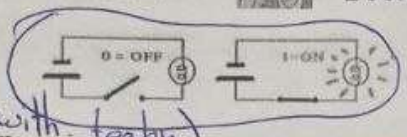
$$(a+b)^8 = a^8+8a^7b+28a^6b^2+56a^5b^3+70a^4b^4+56a^3b^5+28a^2b^6+$$

$$+8ab^7+b^8$$

Massachusetts Institute of Technology (MIT)

Lecture by Pr. Bob Gallagher
Boole (1815-1864) & **Shannon** (1916-2001)

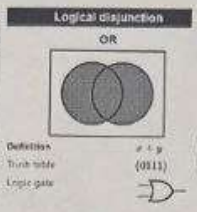
Shannon
(how to use B. logic (algebra) as the basic for swith. techn.)

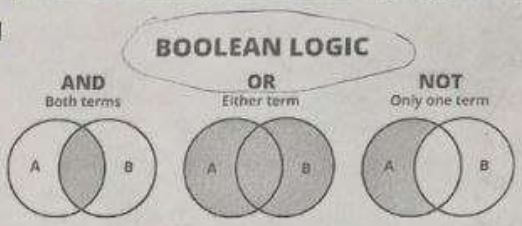


Logical addition (disjunction)

A	B	F=A∨B
0	0	0
0	1	1
1	0	1
1	1	1

A	B	$A \vee B$
True	True	True
True	False	True
False	True	True
False	False	False





For ancient Greece (without woman philosophers)

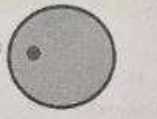
For Germany wasn't sure

Good logic

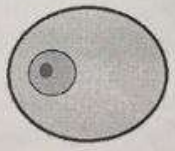
Socrates was a philosopher

philosophers are men

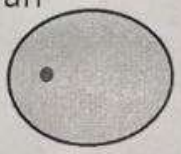
Socrates was a man



$S \in \Phi$



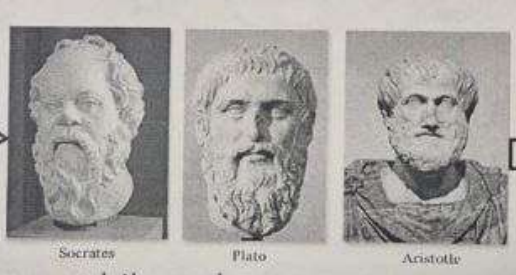
$\Phi \in A$



$S \in A$

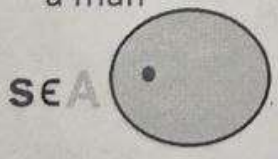
Bad logic

Socrates was a man

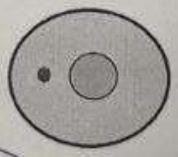


philosophers are men

Socrates was a philosopher



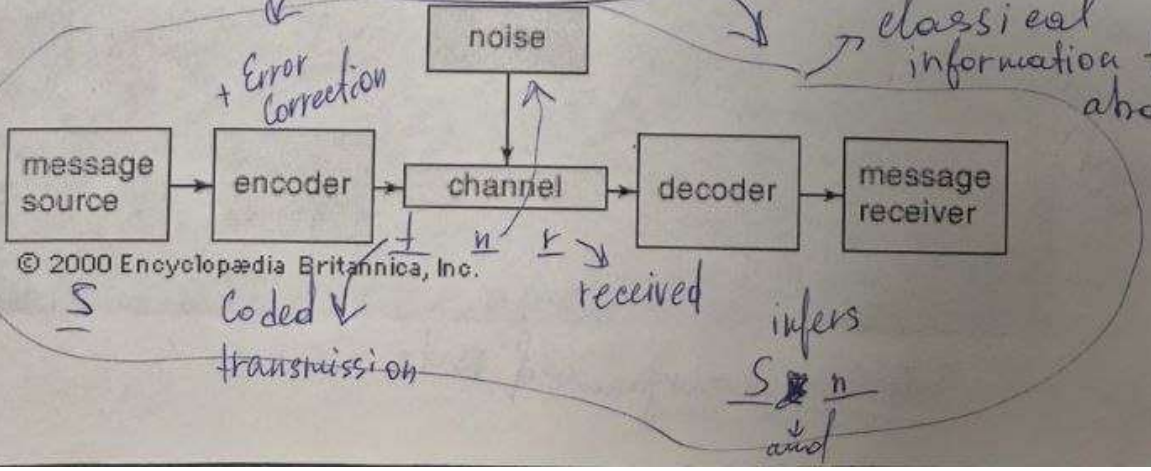
$S \in A$



$\Phi \in A$

$S \in \Phi$

Shannon



classical information theory about...

S — Coded — transmission — n — r — received

infers S and n

Resume of Lecture by Pr. Bob Gallagher from MIT

Massachusetts Institute of Technology (MIT)

But logic has been understood since the time of Aristotle

created Information theory, his major work

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 contribution 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.

MIT Bob Gallagher

Good logic

A little nationalistic, but this is an example of right logic

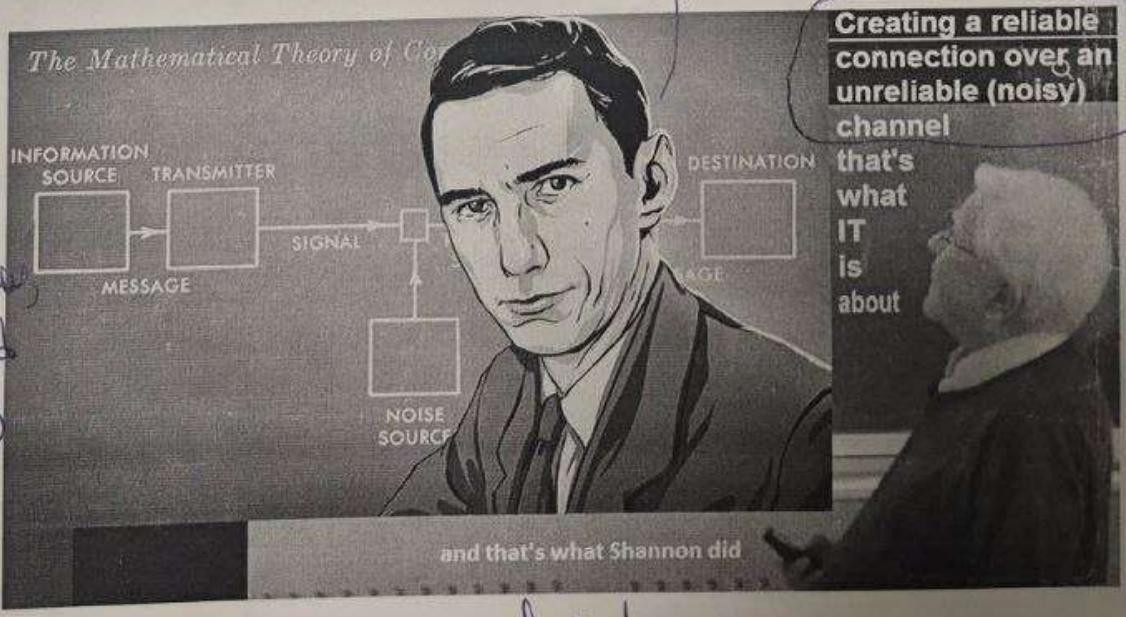
But a little nationalistic

Kant, Gauss, Goethe are great ⇨ Kant, Gauss, Goethe - Germans ⇨ Germany Great

Bad logic (abuse of logic)

Father of Inf. Age

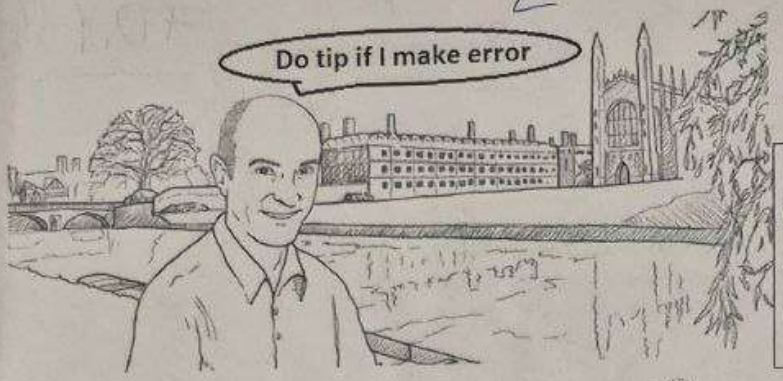
main idea



Data is raw facts (need processed)

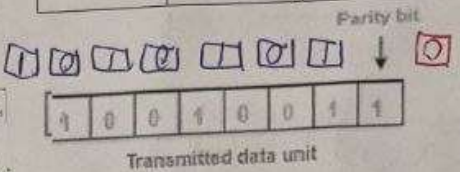
Information ⇒ organized Data

+0.1

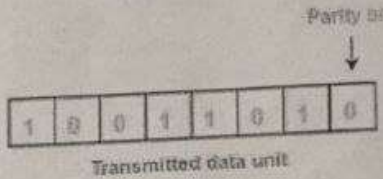


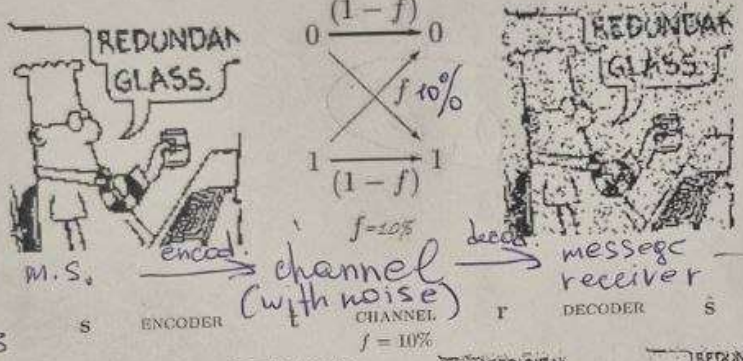
Sir **Dr. D. MacKay,**
University of Cambridge
(22 April 1967 – 14 April 2016)

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



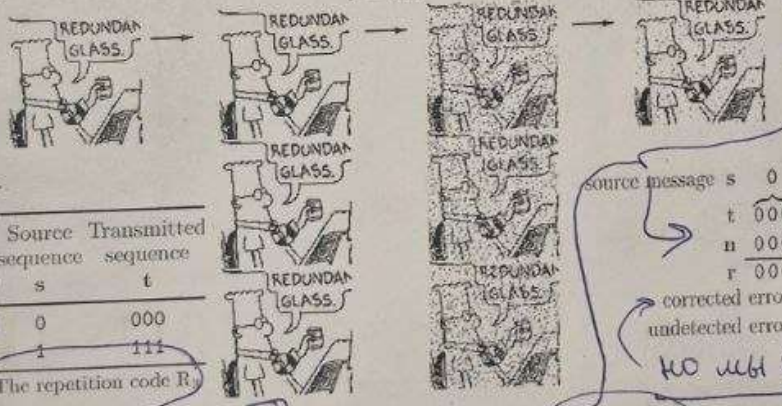
+0.1 31.3





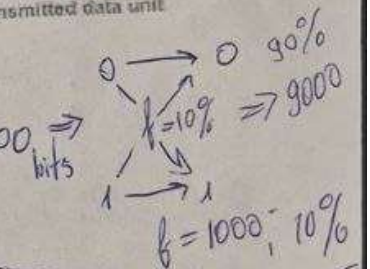
more than one channels is better (in real life too)

(например: слушать, смотреть (читать)



Source sequence s	Transmitted sequence t
0	000
1	111

The repetition code R_3



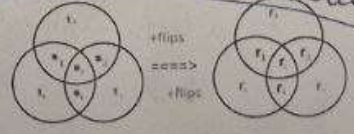
source message s	0	0	1	0	1	1	0
t	000	000	111	000	111	111	000
n	000	001	000	000	101	000	000
r	000	001	111	000	010	111	000

corrected errors *
undetected errors

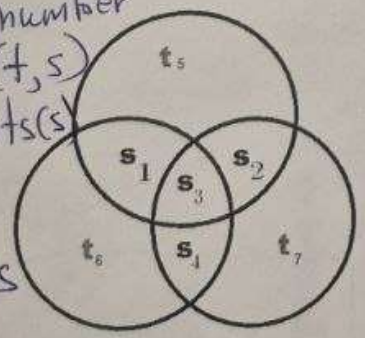
но мы избежали еще 1 ошибки

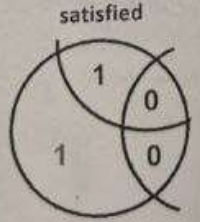
7.4. Hamming code.

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

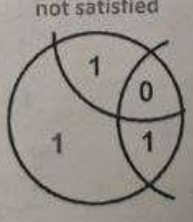


7 - total number of bits (t, s)
4 - data bits (s)
7 - 4 = 3 - parity bits

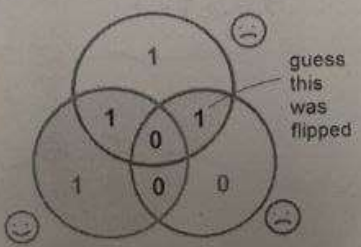




1+1+0+0=0



1+1+0+1=1



~~$n = 2^m - 1$~~, $m = 3$ (m - parity bits)

$n = 2^m - 1 = 2^3 - 1 = 7$

$\sigma^2 = npq$; npf

n - ко-во исходов

p - probability

$a/(f) = 0,1$

$\sigma^2 = 900$

$\sigma = \sqrt{900}$

9000 ± 30

$C_2^3 = \frac{3!}{2!(3-2)!}$

+0,1 !(.)

+0,2

0.9 0.1 0.9

0.1 0.9 0.1 = 0.027

0.9 0.1 0.1

0.027 + 0.001 = 0.028 - ошибка

0.9 0.9 0.1 = 0,081

0.9 0.1 0.9 = 0,081

0.1 0.9 0.9 = 0,081

0.9 0.9 0.9 = 0,729

3(0,9 · 0,9 · 0,1) +

0,972

$P(x) = \frac{n!}{(n-x)!h!} p^x q^{n-x}$ q=f or $\binom{n}{x} p^x f^{n-x}$

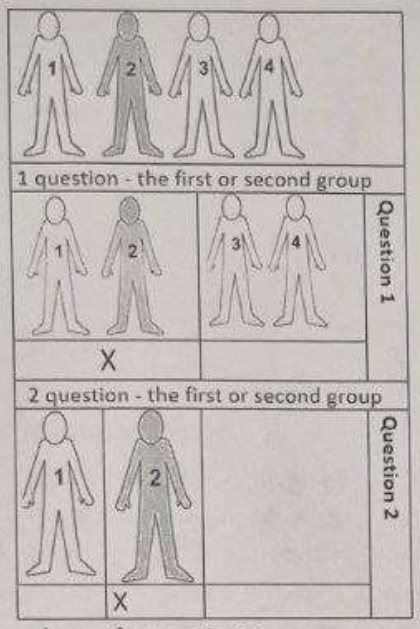
for choosing a partner:

1. Say **NO** to the **first**

2. Say **YES** to the **second** if it is better than the first

Say **NO** to the **third** only if it is worse than all the others

если у нас одинаков. шансы по получении вариант.



Average number of questions =

Question 1. Is this Zuckerberg? — 50% — 1*0.5

Question 2. Is this Sergey Brin? — 25% — 2*0.25

Question 3. Is this Stefan from BMW? — 12,5% — 3*0,125

So Prince Saud — 12,5% — 3*0,125

Average number of questions = 1,75

Average number of questions =

2*0.25+ 2*0.25+ 2*0,25+ 2*0,25 =2

1*0.5+ 2*0.25+ 3*0.125+ 3*0,125

если шансы не одинаковы изначально спроси про вариант с наибольшим %.

$$0,5 \cdot \log_2\left(\frac{1}{0,5}\right) + 0,25 \cdot \log_2\left(\frac{1}{0,25}\right) + 2\left(0,125 \cdot \log_2 \frac{1}{0,125}\right) = 1,75$$

$$H(X) = \sum_{i=1}^{n} p(x_i) \log_b \frac{1}{p(x_i)}$$

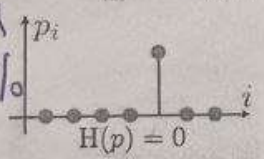
$$\sum_{i=1}^{n} p(i) \log_2 \frac{1}{p(i)}$$

Quantifying information (Claude Shannon)

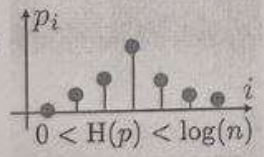
$$I(x_i) = \log_2\left(\frac{1}{p_i}\right)$$

number of bits required to encode choice

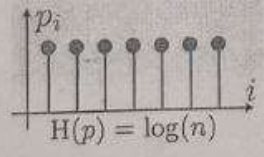
$$\sum_{i=1}^{n} p(x_i)\, I(x_i)$$



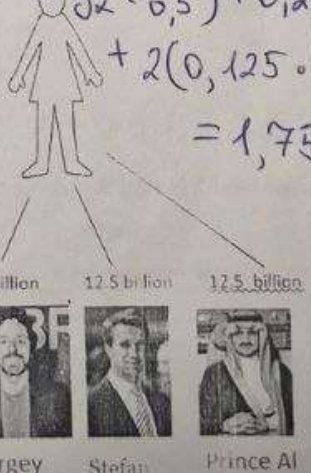
P для 1 = 100%



разная P.



одинак. P.

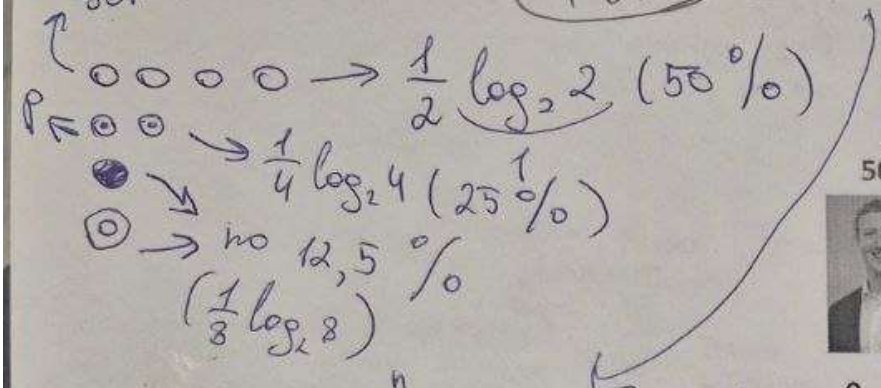


or

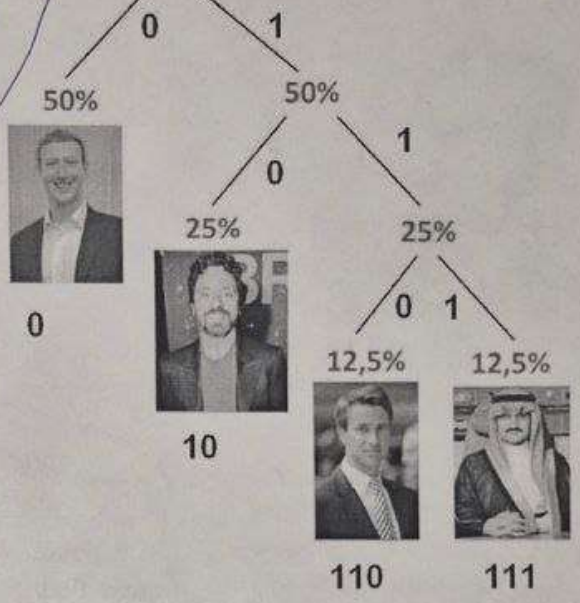
$$H = -\sum_{x} p(x) \log p(x) \quad \text{(for binar 2 } \log_2\text{)}$$

Ser. m.

+0.1 Entropy



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



First-order approximation (symbols independent but with frequencies of Belarusian txt).

Мама мыла ра

М - 3 — 30%	1-3	М
а - 4 — 40%	4-7	а
ы -1 — 10%	8	-ы
л - 1 — 10%	9	-л
р - 1 — 10%	10	-р

10

лламаммар

Мама мыла ра

Ма - 2 22%	1-2	ма
ам - 2 22%	3-4	ам
мы - 1 11%	5	мы
ыл - 1 11%	6	ыл
ла - 1 11%	7	ла
ар - 1 11%	8	ар
ра - 1 11%	9	ра

9

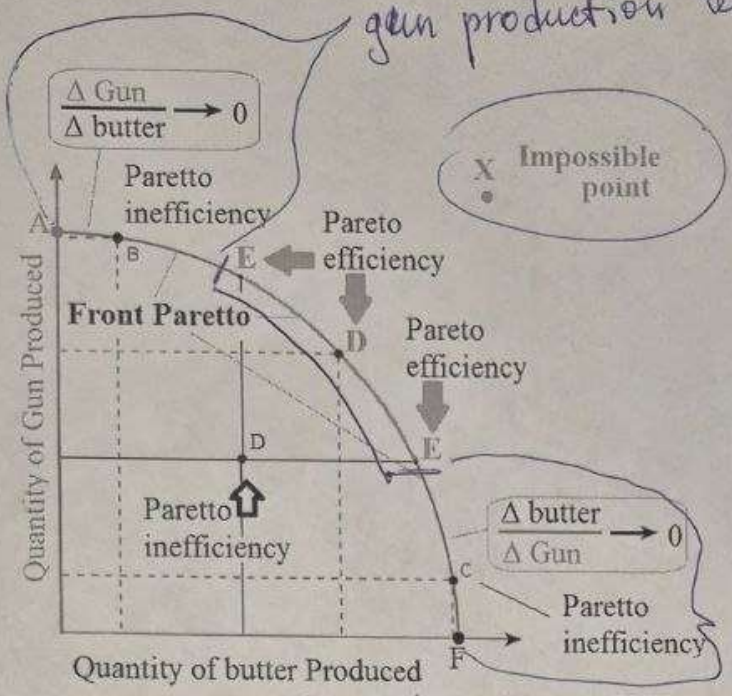
Second-order approximation (digram (2-symbols) structure as in Belarusian)

0. 4 6 7 3 1 9 1 6 7 3 5

ам ыл ла ам ма ра ма ыл ла ам мы

мылла рама

gun production leads



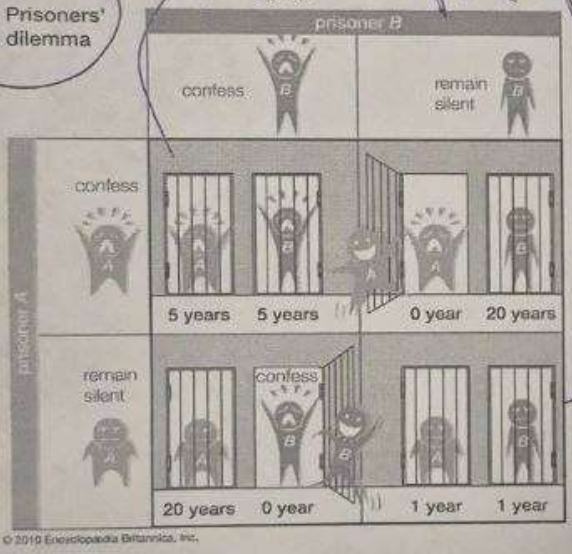
by Vilfredo Pareto
1848-1923

The orange sector E-D-E is the most Pareto efficient - since an increase in one indicator leads to a decrease in another.

butter production leads

Nash opt. (+ psychology)

Prisoners' dilemma



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Game Theory

Nash Equilibrium

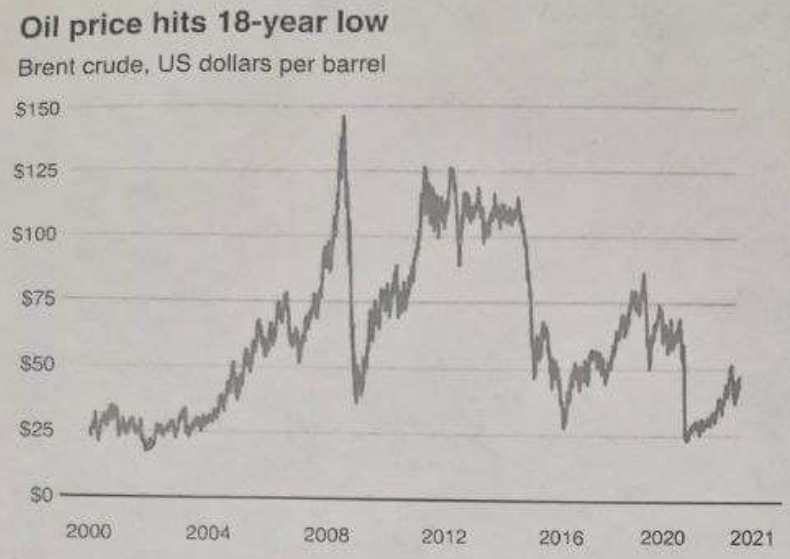
Pareto opt.** => Nash equilibrium

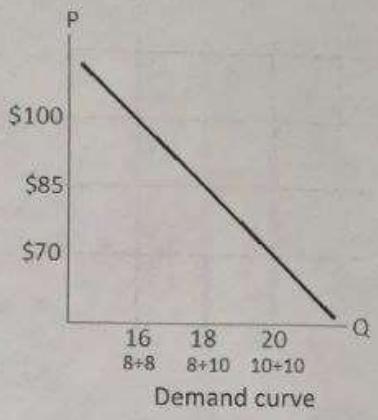
$H_2(x)$ / $H_1(x)$	Player 2	Recognition:	Non-recognition:
Player 1		1	2
Recognition:	1	-5 / -5	-20 / 0
Non-recognition:	2	0 / -20	-1 / -1

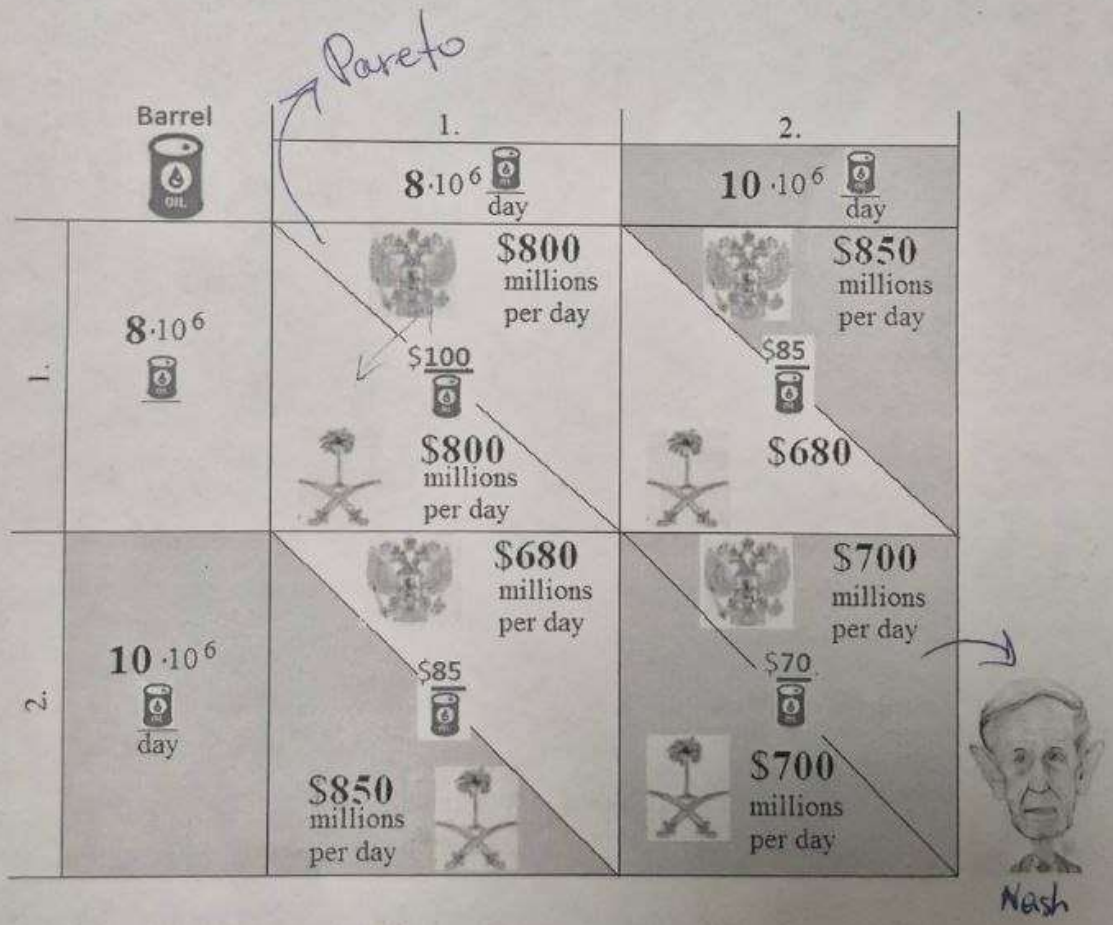
-1-1 Pareto Optimality

crime ring делает возможным Pareto-optimality, но страх может остаться (но 20 лет, возможно, место лучше, чем отдать жизнь как предатель)

а если он (другой человек сознается? я отсижу 20 лет ... лучше 5) можно сказать что Nash подключает психологию


Oil price hits 18-year low
Brent crude, US dollars per barrel
$150
$125
$100
$75
$50
$25
$0
2000
2004
2008
2012
2016
2020
2021


P
$100
$85
$70
Q
16
8+8
18
8+10
20
10+10
Demand curve


Pareto
Barrel
1.
2.
$8 \cdot 10^6$ / day
$10 \cdot 10^6$ / day
$8 \cdot 10^6$
$10 \cdot 10^6$ / day
$800 millions per day
$100
$800 millions per day
$850 millions per day
$85
$680
$680 millions per day
$85
$850 millions per day
$700 millions per day
$70
$700 millions per day
Nash