

...or choosing between 2 items when the resources are limited

Step 5.

Now we need to compile the file using the compiler csc.exe which is in the folder
C:\Windows\Microsoft.NET\Framework\v3.5

C:\WINDOWS\Microsoft.NET\Framework\v3.5\csc.exe ABBA.cs

the result is a file ABBA.exe that can already be run (which is located in the same folder). If you have taken the 1st step, then this means that the education-process has begun. This is victory. csc /target:library ABBA.cs - will make ABBA.dll.

>ABBA
ABBA

Step 6. Modify the file as follows
using System;

```
class ABBA
{
    static int Factorial(int n)
    {
        if (n == 1) return 1;
        return n * Factorial(n - 1);
    }
}

static void Main(string[] args)
// Here's a method called main.
{
    System.Console.WriteLine("ABBA -"+
                             Factorial(4));
}

>C:\WINDOWS\Microsoft.NET\Framework\v3.5\csc.exe ABBA.cs
>ABBA
ABBA - 24
```

Step 7. Modify the file as follows

```
using System;

class ABBA
{
    static int Factorial(int n)
    {
        if (n == 1) return 1;
        return n * Factorial(n - 1);
    }
}

public static void Main()
{
    System.Console.WriteLine("ABBA");
    System.Console.Write("Enter number of Vowels:");
    string s = Console.ReadLine();
    int vowels=int.Parse(s);
    System.Console.Write("Enter number of Consonants:");
    s=System.Console.ReadLine();
    int consonants=int.Parse(s);
    Console.WriteLine(Factorial(vowels)*Factorial(consonants) );
}
}
```

>ABBA
ABBA
Enter number of Vowels:2
Enter number of Consonants:2
4

>ABBA
ABBA
Enter number of Vowels:3
Enter number of Consonants:3
36



This is the program we need to write today

```
class ABBA - название
{
    static void Main(string[] args)
        // Here's a method called Main.
    {
        System.Console.WriteLine("ABBA!");
    }
}
```

метод принадлежит классу, а не объекту

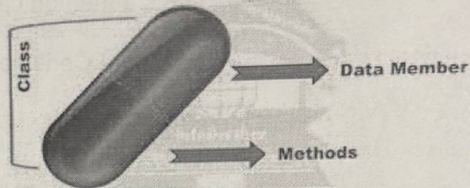
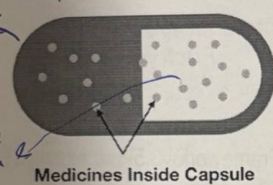


So there's the keyword class. Unlike C++, in C# all code must be placed in a class.

Encapsulated in a class.

класс

данные



A ≠ a
C# is case sensitive

C:\WINDOWS\Microsoft.NET\Framework\v3.5\ csc.exe

(C:) > Windows > Microsoft.NET > Framework > v3.5 >	
Имя	Дата изменения
AddInUtil.exe	03.08.2013 8:40
AddInUtil.exe.config	18.06.2013 16:24
csc.exe	03.08.2013 8:40

ABBA.cs => csc.exe = ABBA.exe
C# Compiler

Step 1. And on my HDD, I also make a folder with the same name D:\IT

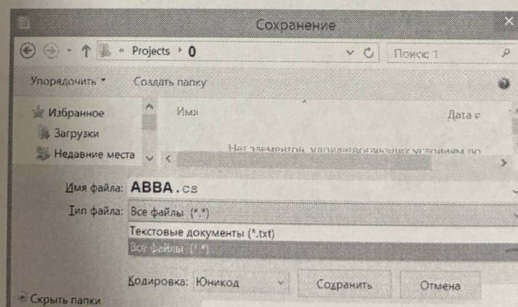
Step 2. In the folder E:\IT\ we make the folder of the Projects - E:\IT\Projects

And in the Project folder make folder 0 - E:\IT\Projects\0\ where our today's practical work will be stored

Step 3. As I mentioned

above, C# is a built-in language of Windows.

Notepad is enough to write a program



You need to switch from *.txt (Text documents) to * (all files)
Otherwise, notepad with *.txt extension

Step 4. Entering command mode

Start=>Run=>cmd

cd E: - After that go to the folder IT/Projects/0/
cd IT - Then go to the folder Projects
cd projects - Then go to the folder 0
cd 0 -

E:\>cd IT

E:\IT>cd Projects

E:\IT\Projects>cd 0

E:\IT\Projects\0>

гит E

A classical economic example of choosing between 2 items when the resources are limited
process of making decisions



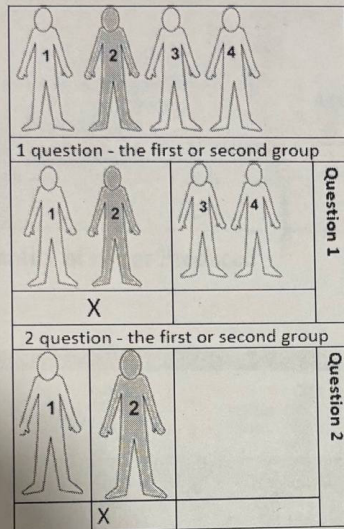
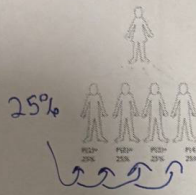
Say NO to the first



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



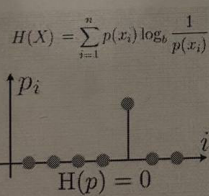
Average number of questions =
We need just 2 questions
 $2 \cdot 0.25 + 2 \cdot 0.25 + 2 \cdot 0.25 + 2 \cdot 0.25 = 2$

Average number of questions =

$1 \cdot 0.5 +$	$2 \cdot 0.25 +$	$3 \cdot 0.125 +$	$3 \cdot 0.125$

Question 1. Is this Zuckerberg?	50%	$1 \cdot 0.5$
Question 2. Is this Sergey Brin?	25%	$2 \cdot 0.25$
Question 3. Is this Stefan from BMW?	12,5%	$3 \cdot 0.125$
So Prince Saud	12,5%	$3 \cdot 0.125$
Average number of questions = 1,75		

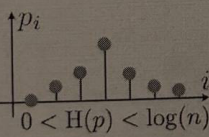
Сколько
раз
узнаем



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

Quantifying information

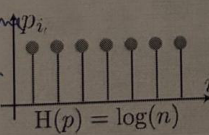
Сколько
раз
узнаем



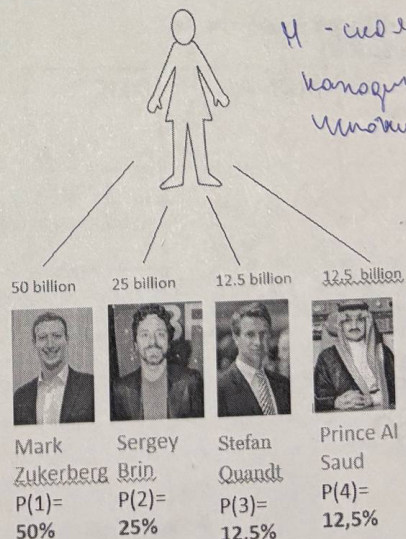
$$I(x_i) = \log_2 \left(\frac{1}{p_i} \right)$$

number of bits required to encode choice

switch
xt
o *.
stepad
nsion

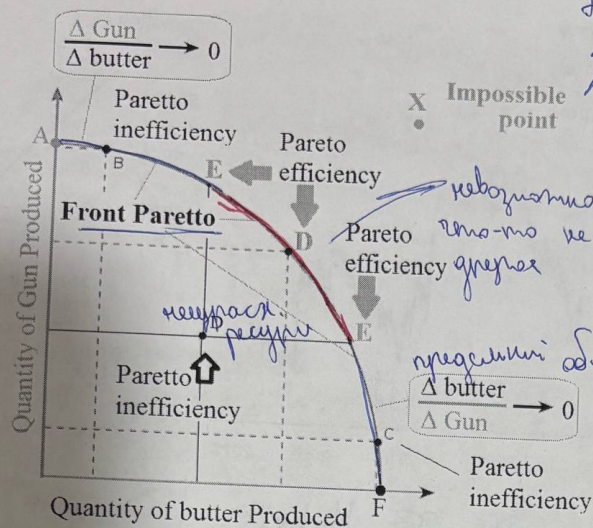


$$\sum_{i=1}^n p(x_i) I(x_i)$$



И - что это такое
каждому
известно

classical economic example of choosing between 2 items when the resources are limited



to reach we need more
of capital, technology, people, res.



by Vilfredo Pareto

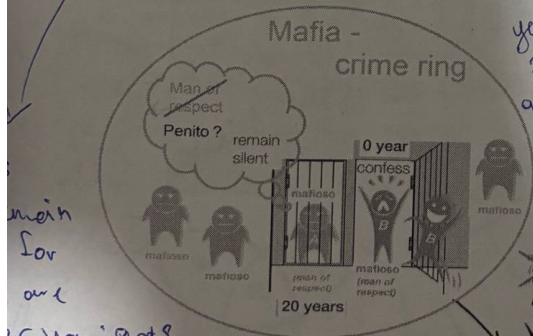
Оптичелен кабинет Топено

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

italian economist

		prisoner B			
		confess		remain silent	
prisoner A	confess	 5 years	 5 years	 0 year	 20 years
	remain silent	 20 years	 0 year	 1 year	 1 year

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mein
Iov
and

er variant?

positivity bias.

Game Theory

Nash Equilibrium



** => Nash equilibrium *palubene*

$H_2(x)$	$H_1(x)$	Recognition;	Non-recognition;
$H_1(x)$	$H_2(x)$	1	2
Recognition;	1	-5	0
Non-recognition;	2	-20	-1

Pareto Optimality

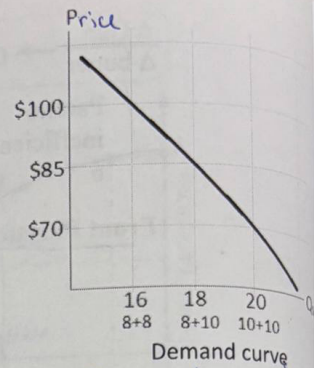
genouille
sune

определения

italian mafia
компанья - с похвальной

Oil price hits 18-year low

Brent crude, US dollars per barrel



Price higher - less
Price lower - more

Little amount $\rightarrow$ high price
Huge amount $\rightarrow$ lower price

Pay off Matrix (managing resources)

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

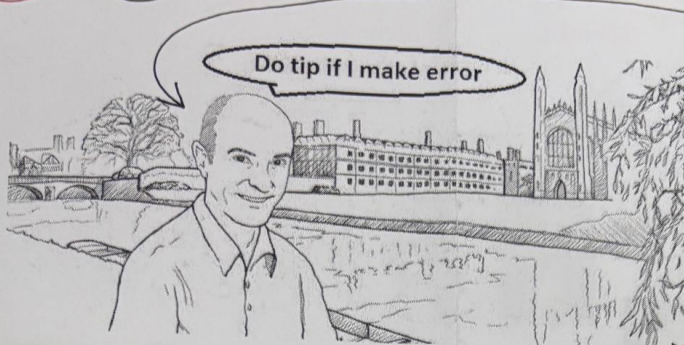
Pareto



John
no
se
ke
no
m
-h
gou
s

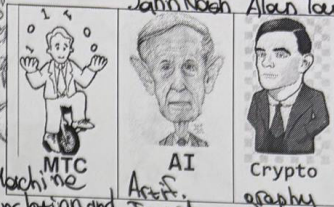
S2
y b
p

$+0.1$ $+0.1$

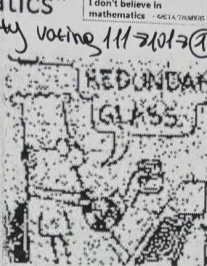
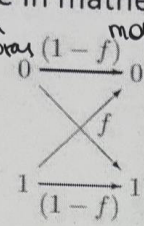


Sir Dr. D. MacKay,
University of Cambridge
(22 April 1967 – 14 April 2016)

John Nash Alan Turing



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



Machine
Transmission and
coding
Send message
1 0 0 1 0 0 1 1

Transmitted data unit

Parity bit

1 0 0 1 1 0 1 0

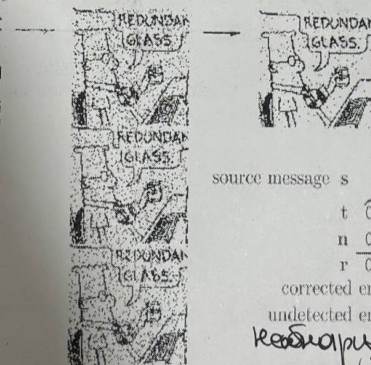
Transmitted data unit

one bit
changed

source code s ENCODE t CHANNEL f=10% RECEPTION DECODE s

Source sequence s	Transmitted sequence t
0	000
1	111

The repetition code R_3



Also process of error correction

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

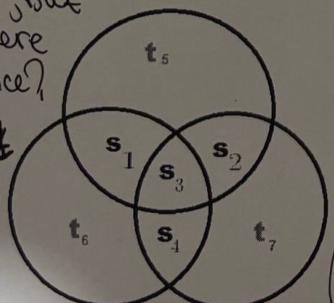
corrected errors *

undetected errors *

Redundancy

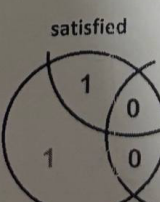
not only error, but where place?

defect
next bit

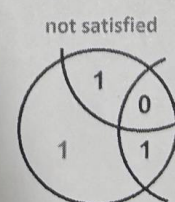


t_5, t_6, t_7 - parity bits
 s_1, s_2, s_3, s_4 - data bits
bit checks
parity bits.

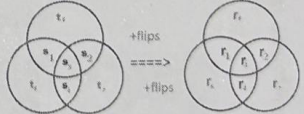
$$\frac{4}{\Sigma} \rightarrow \frac{7}{t}$$



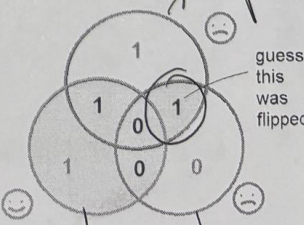
$$1+1+0+0=0$$



$$1+1+0+1=1$$



has problem

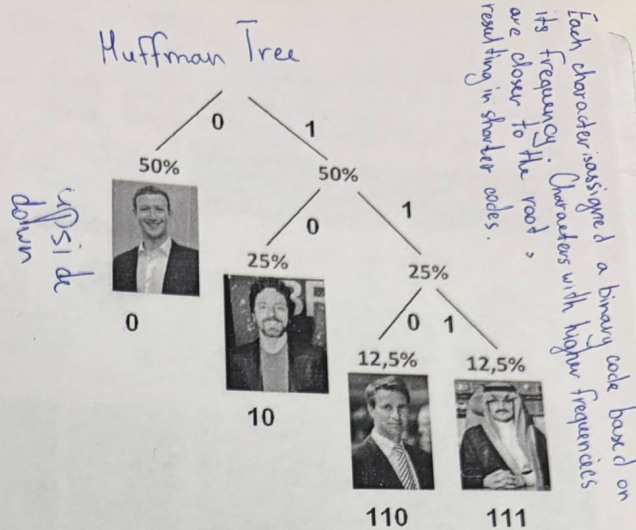


guess this was flipped

has no problem

has problem

Huffman Tree



probability of each
symbol appearing doesn't
depend on
previous symbols.

I - nonnegative
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

лла мама р

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

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

breaks down the sentence into ind. symbols

Using 5-order
approximation



9

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

ам ыл ла ам ма ра ма ыл ла ам мы

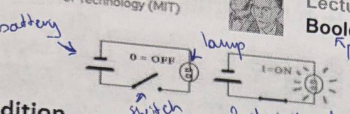
мылла рама



private land-grant
research cen. in Cambridge
est. in 1861



+0.1 Torn Thun



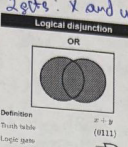
Lecture by Pr. Bob Gallagher
Boole (1815-1864) & Shannon (1916-2001)
"father of inf. theory"



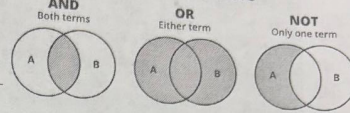
Logical addition (disjunction)

A	B	$F = A \vee B$
0	0	0
0	1	1
1	0	1
1	1	1

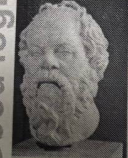
A	B	$A \vee B$
True	True	True
True	False	True
False	True	True
False	False	False



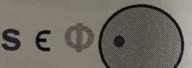
BOOLEAN LOGIC



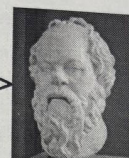
Good logic



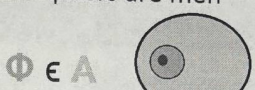
Socrates was a philosopher



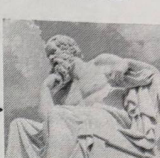
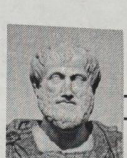
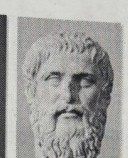
Socrates belongs to the set of philosophers (Φ)



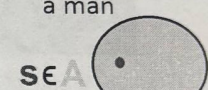
philosophers are men



Philosophers are a subset of men (A)



Socrates was a man

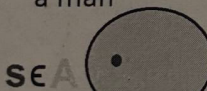


Socrates belong to the set of men

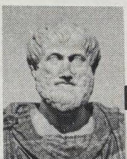
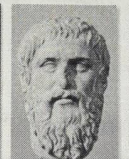
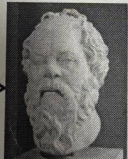
Bad logic



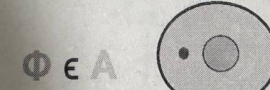
Socrates was a man



to the set of men

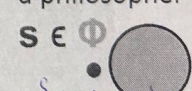


philosophers are men

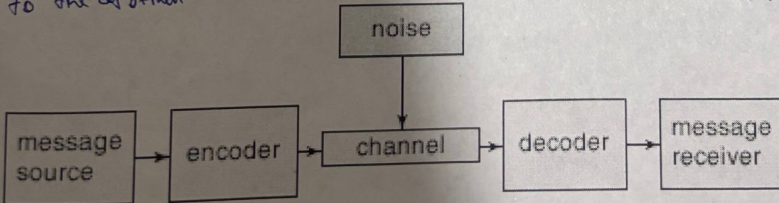


are a subset of men (A)

Socrates was a philosopher



Socrates belongs to Philosophers



Resume of Lecture by Pr. Bob Gallagher from MIT

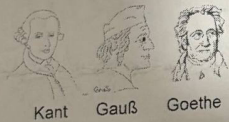
Massachusetts Institute of Technology (MIT)

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.

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

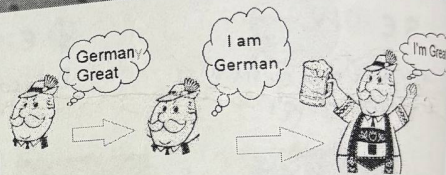


Kant, Gauss, Goethe are great

Kant, Gauss, Goethe - Germans

Germany Great

A little nationalistic. But this is an example of right logic

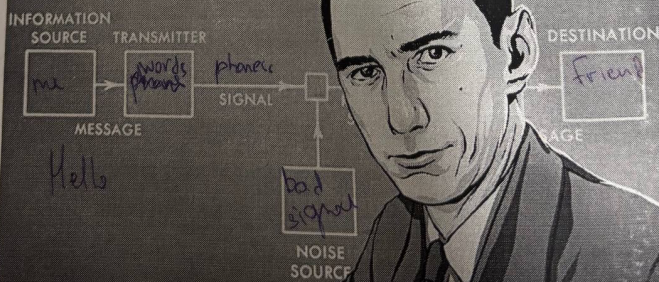


Bad logic (abuse of logic) An individual incorrectly generalizes attributes based on group identity

This logical structure is valid and follows a clear, correct reasoning path

+0.1

The Mathematical Theory of Communication

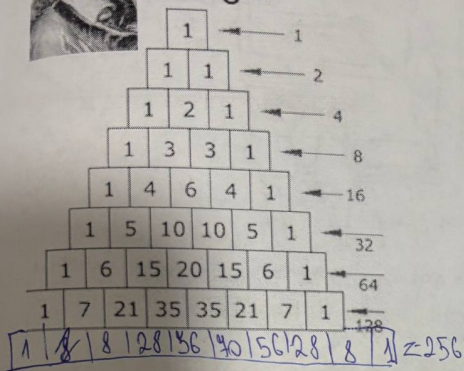


Creating a reliable connection over an unreliable (noisy) channel that's what IT is about

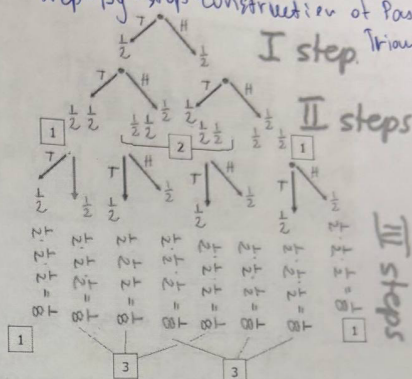
and that's what Shannon did



Pascal's triangle



a tree diagram to illustrate the step-by-step construction of Pascal's Triangle



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

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

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

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

$$(a + b)^4 =$$

$$(a + b)^5 =$$

$$(a + b)^7 =$$

$$+ \frac{7!}{2!5!} b^2$$

1

Newton's Binomial

$$a + b$$

$$a^2 + 2ab + b^2$$

$$a^3 + 3a^2b + 3ab^2 + b^3$$

$$a^4 + 4a^3b + 6a^2b^2 + 4ab^3 + b^4$$

$$a^5 + 5a^4b + 10a^3b^2 + 10a^2b^3 + 5ab^4 + b^5$$

$$(a + b)^7 = a^7 + 7a^6b + 21a^5b^2 + 35a^4b^3 + 35a^3b^4 + 21a^2b^5 + 7ab^6 + b^7$$



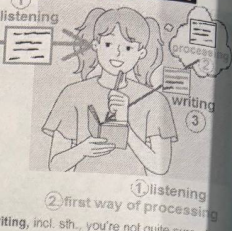
probability



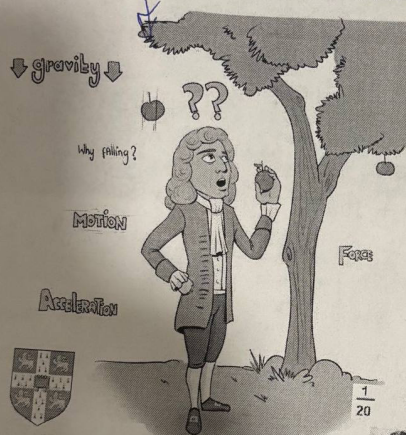
bad way
CHALK + TALK



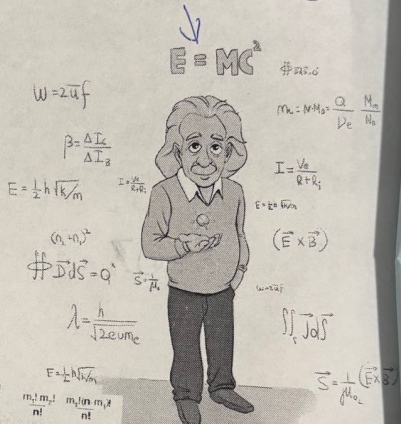
good way
ink + think



School $\rightarrow$ gravity $\rightarrow$ MOTION $\Rightarrow$ formalism $\Rightarrow$ University $E = MC^2$
 CONCRETE AND ABSTRACT THINKING



ISAAC NEWTON



ALBERT EINSTEIN

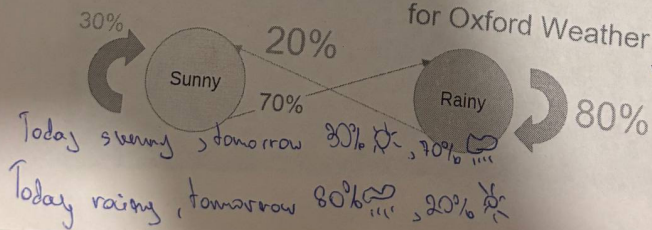
Motivation: 80% chance of rain
 Let A_j be the event of rain at 9am on day j of this term, $1 \leq j \leq n$
 Suppose the events A_j each have probability p , independently

Oxford				
Tue 13th	Wed 14th	Thu 15th	Fri 16th	
10° 9° 70%	13° 10° 70%	13° 8° 70%	11° 7° 80%	

ruussian mathematic

Markoff Chain Probability Model

for Oxford Weather



Single day prob. - 80%
 Every day is independent
 today's rain not affect tomorrow rain