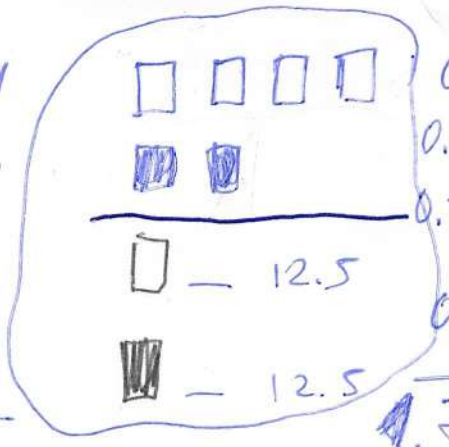
0.5 - 1
0.25 2
0.125 3
0.125 3



0.5
0.5
0.375
0.375
1.750

entropy

$n = \frac{4!}{2!(4-2)!} = \frac{24}{2 \cdot 2} = 6$

$P_i = \frac{1}{6}$

$\sum_{i=1}^{6} P_i \cdot \log_2 \frac{1}{P_i}$

Avg No Questions

Энтропия

$6 \cdot \left(\frac{1}{6} \cdot \log_2 6\right)$

$6 \log_2 6$

$n = 1$

$P_i = \frac{1}{1} = 1$

$\sum_{i=1}^{1} 1 \cdot \log_2 1$

$1 \cdot 1 \cdot \log_2 1 = 0$

$\log_2 0{,}5 = \log_2 \frac{1}{2} =$

1

$2^x = \frac{1}{2}$

$x = -1$

7 70% 1 - 0.7 0.7

1 10% 2 - 0.15 + 1 2 0.2

1 10% 3 - 0.075 2 · 0.15 = 0.3 0.3

1 10% — 0.075 3 · 0.075 = 0.225 0.3

= 1.45 1.5

1 · 0.7 0.7

+0.1 Entropy

+0.1 Binary

≈ 14.29%

□□□□ – 4; 57.16 %

□ – 2; 14,29%

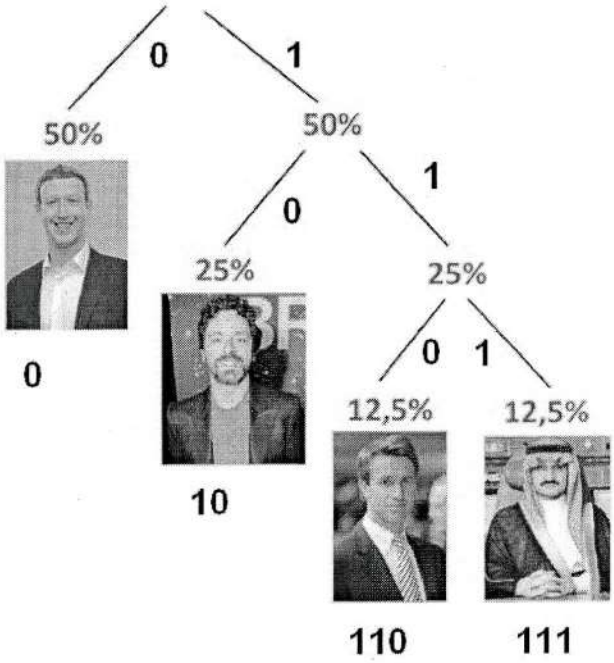
▨ – 3; 14,29%

□ – 3; 14,29%

0,5716
+
0,2858
+
0,4287
+
0,4287
=
1,2861

+0.1

Похоже



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 мамма 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
а р - 1	11%	8	ар
ра - 1	11%	9	ра

9

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

ам ыл ла ам ма ра ма ыл ла ам мы

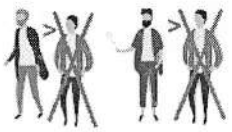
мылла рама

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

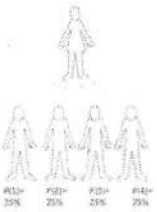
+0,2 log

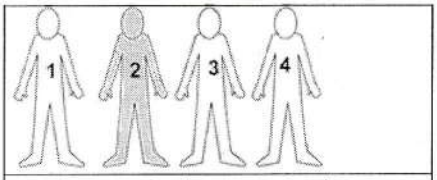
Say **NO** to the **first**

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

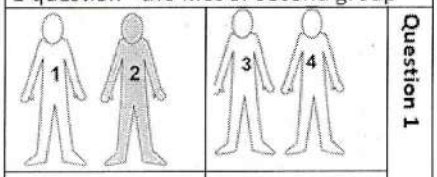


Say **NO** to the **third** only if it is worse than all the others



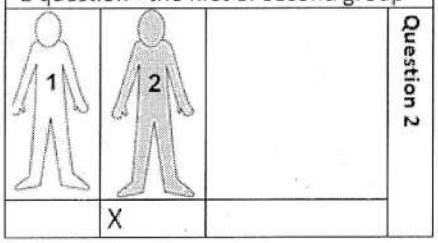


1 question - the first or second group



X

2 question - the first or second group



X

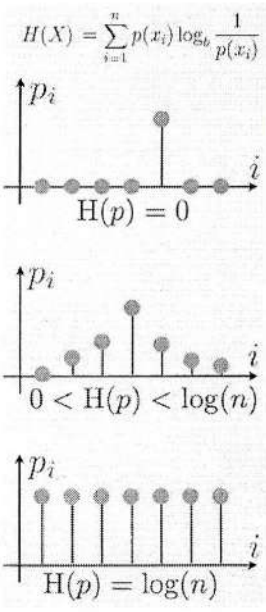
Average number of questions =

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

Average number of questions =

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

Question 1. Is this Zuckerberg?	 50%	1*0.5 Easy choice
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 worst choice
Average number of questions =1,75		



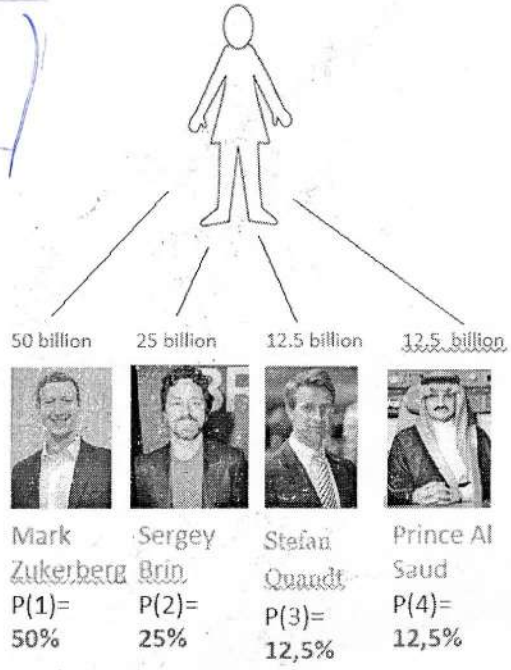
$$\sum_{i=1}^{n} p(i) \log_2 \frac{1}{p(i)}$$

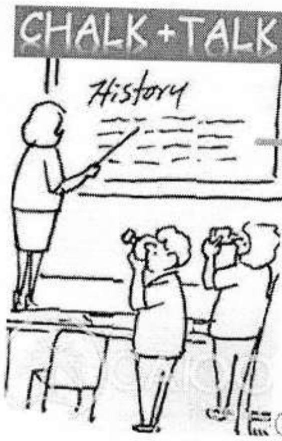
Quantifying information

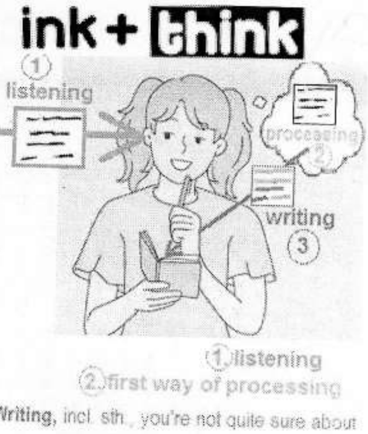
$$I(x_i) = \log_2\left(\frac{1}{p_i}\right)$$

number of bits required to encode choice

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

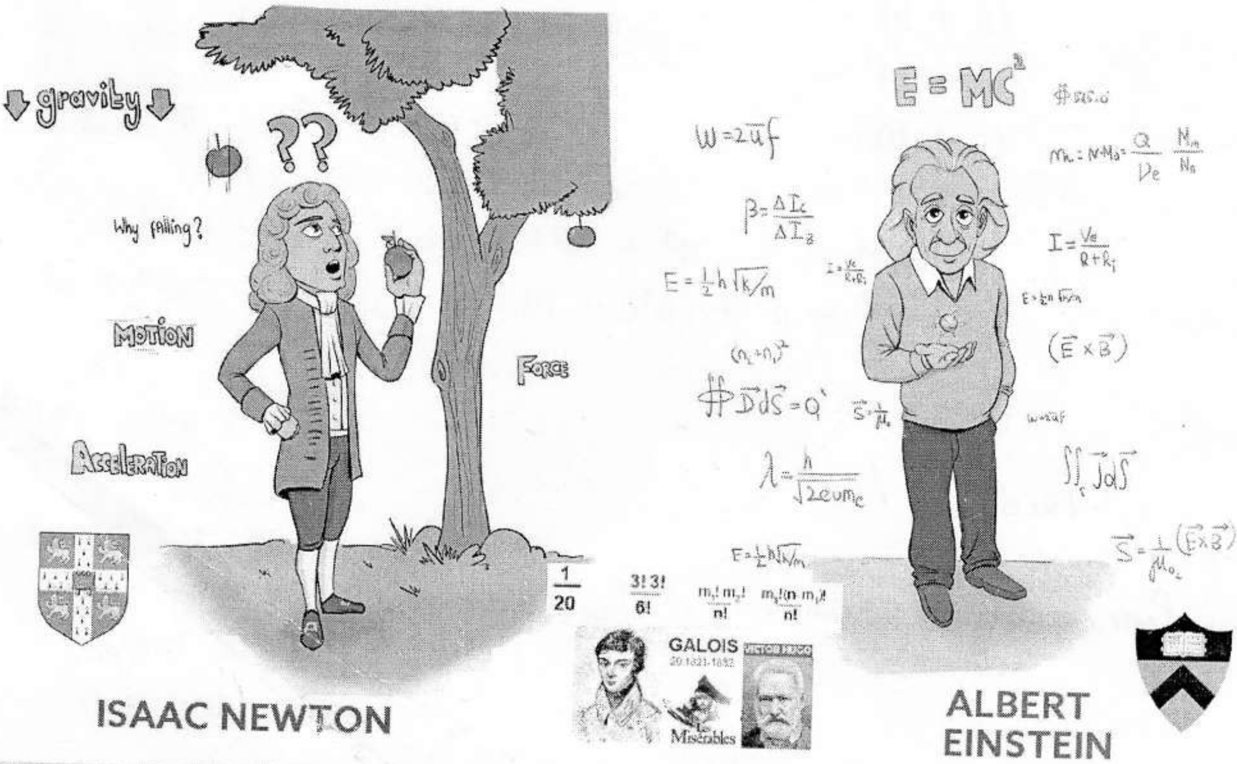






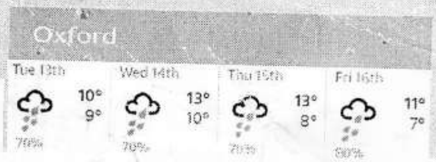
School ⇩ gravity ⇩ MOTION ==formalism==> University $E=MC^2$ $\oint \vec{D}d\vec{S} = Q$ $\iint \vec{J}d\vec{S}$

CONCRETE AND ABSTRACT THINKING

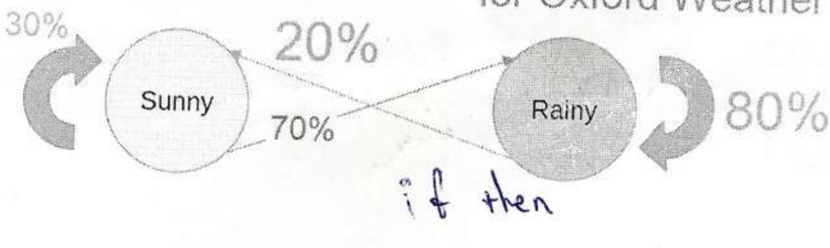


Motivation: 80% chance of rain   Suppose the events A_j each have probability p independently

Let A_j be the event of rain at 9am on day j of this term, $1\le j\le n$



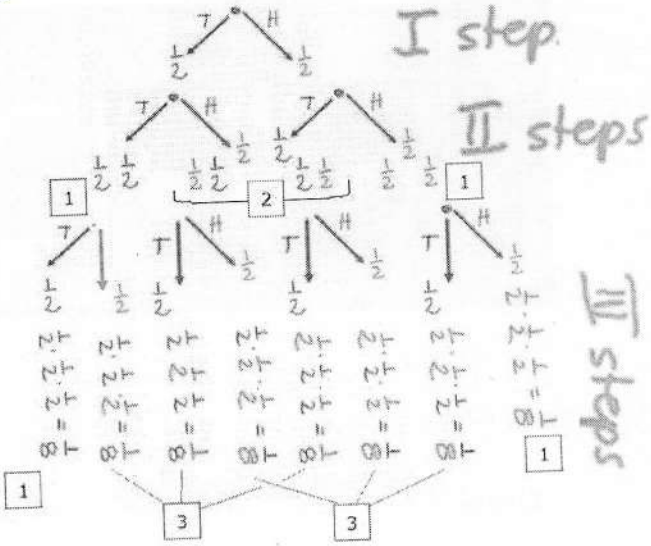
Markoff Chain Probability Model for Oxford Weather



+0.1 +0.1 11.2.26 +0.1 +0.1 12.2.26

Pascal's triangle

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



Newton's Binomial

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

(a+b)7

Oxford <= MS

Peter Theil - co-founder of PayPal

2025 univ. ranks:

1. Oxford
2. MIT
3. Princeton
3. Cambridge
5. Harvard

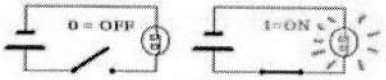
People who shape our world — you're beautiful

Statistics can predict future based on the past

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

Massachusetts Institute of Technology (MIT)

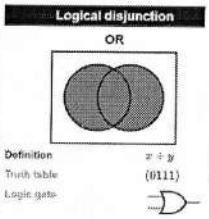
Lecture by Pr. Bob Gallagher
Boole (1815-1864) & **Shannon** (1916-2001)

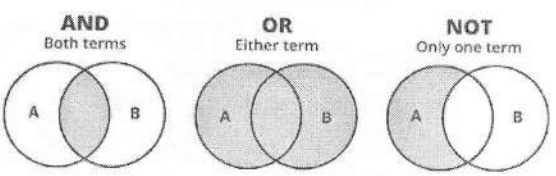


Logical addition (disjunction)

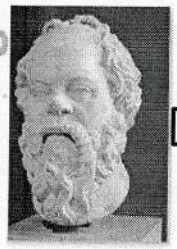
A	B	F=A∨B
0	0	0
0	1	1
1	0	1
1	1	1

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

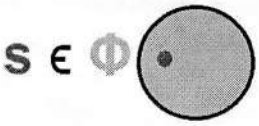


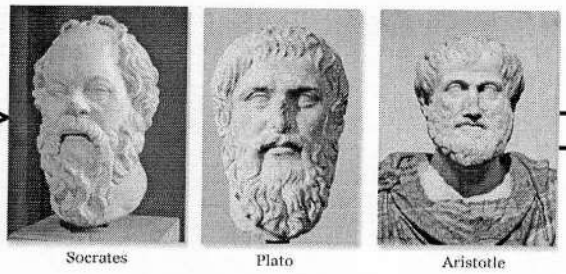


Good logic

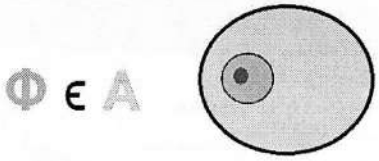

Socrates

Socrates was a philosopher

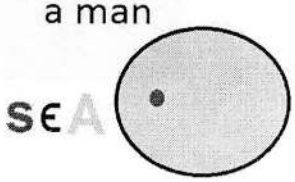




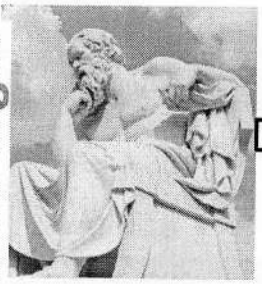
philosophers are men



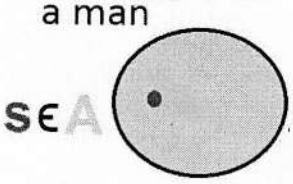
Socrates was a man

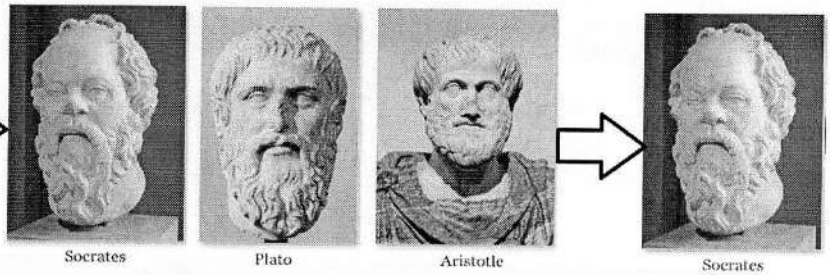


Bad logic

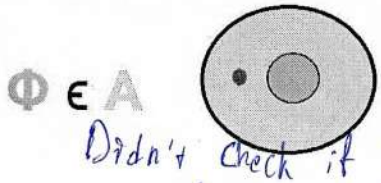


Socrates was a man

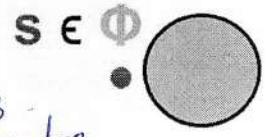




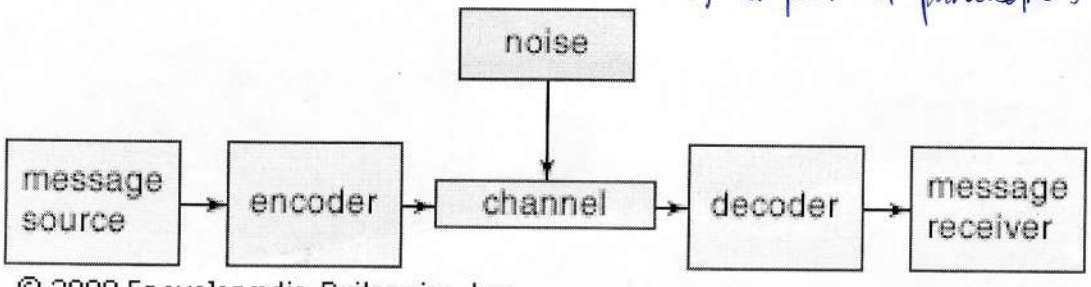
philosophers are men



Socrates was a philosopher



Didn't check if Socrates is a part of philosophers



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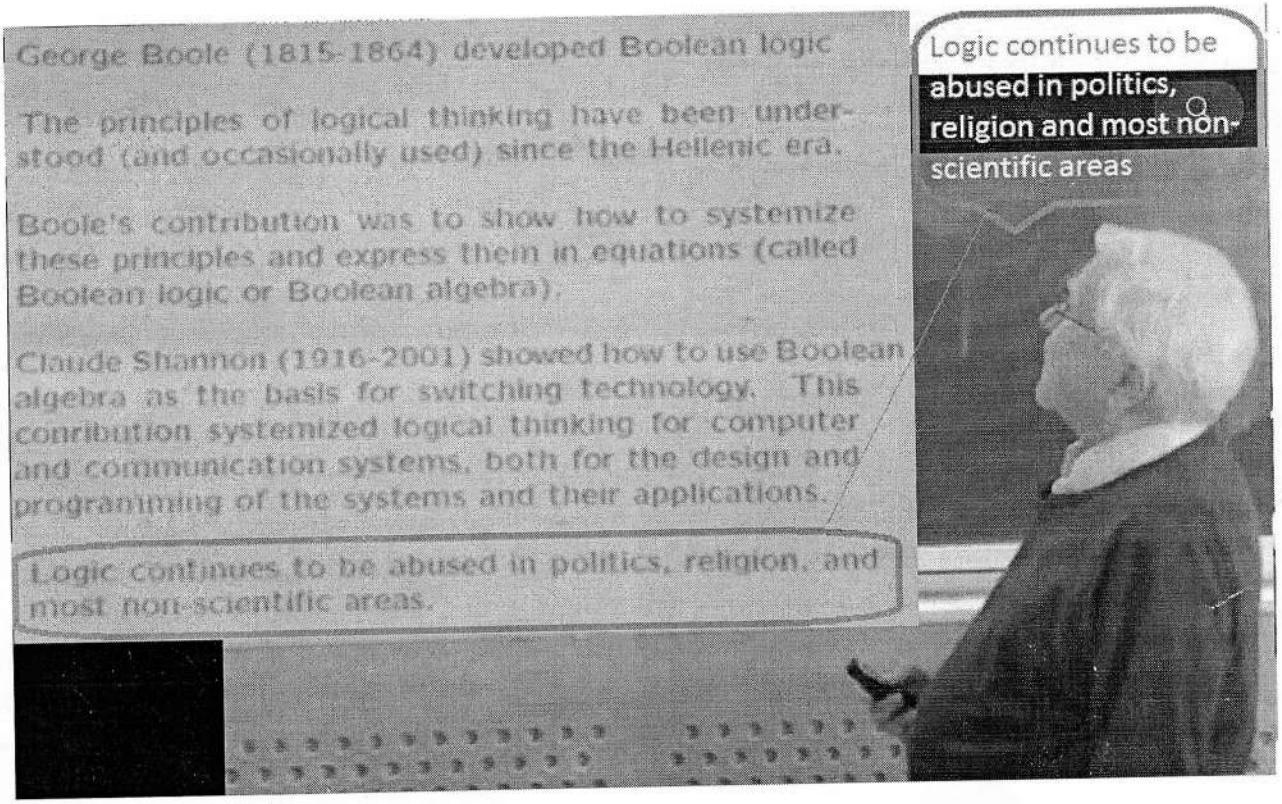
Resume of Lecture by Pr. Bob Gallagher from MIT

Massachusetts Institute of Technology (MIT)



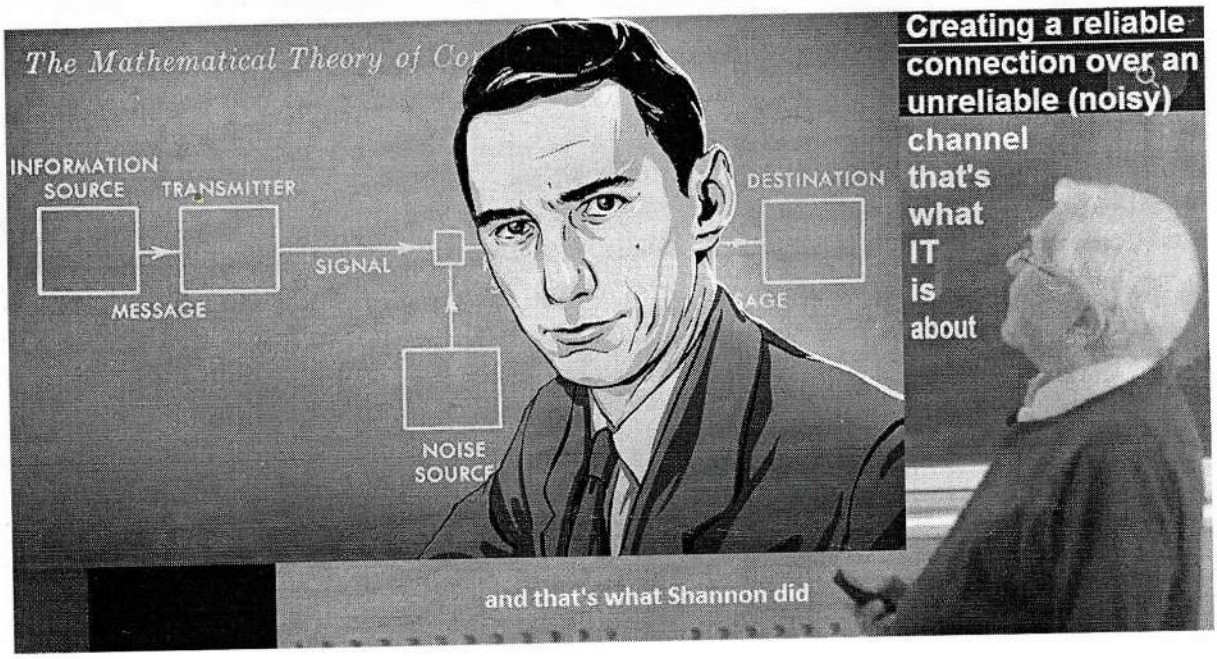
A little nationalistic, but this is an sample of right logic

Kant, Gauss, Goethe are great

Kant, Gauss, Goethe - Germans

Germany Great

Bad logic (abuse of logic)



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 Vovels:");
  string s = Console.ReadLine();
  int vovels=int.Parse(s);
  System.Console.Write("Enter number of Consonants:");
  s=System.Console.ReadLine();
  int consonants=int.Parse(s);
  Console.WriteLine(Factorial(vovels)*Factorial(consonants) );
  }
}
```

3!.3!

```
>ABBA
ABBA
Enter number of Vovels:2
Enter number of Consonants:2
4
```

```
>ABBA
ABBA
Enter number of Vovels:3
Enter number of Consonants:3
36
```

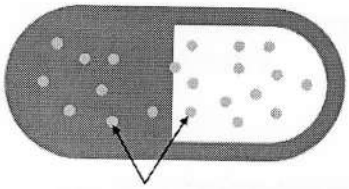
1 2 3 4

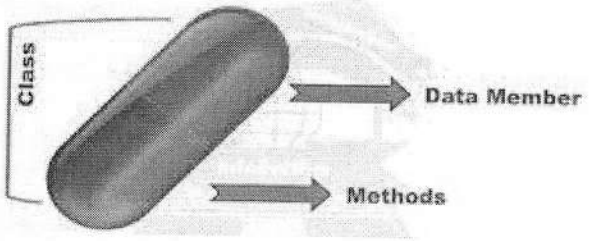
This is the program we need to write today

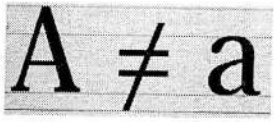
```
class ABBA      -
  {
  static void Main(string[] args)
                    // Here's a method called Main.
  {
      System.Console.WriteLine("ABBA!");
   }
  }
```

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

Encapsulated in a class.

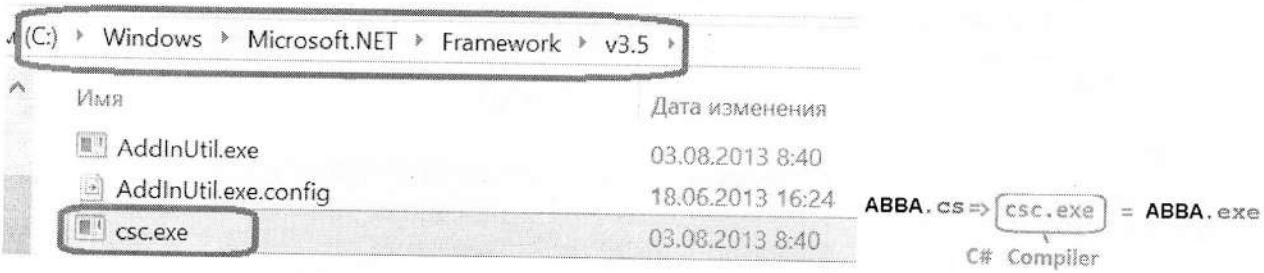






C# is case sensitive

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

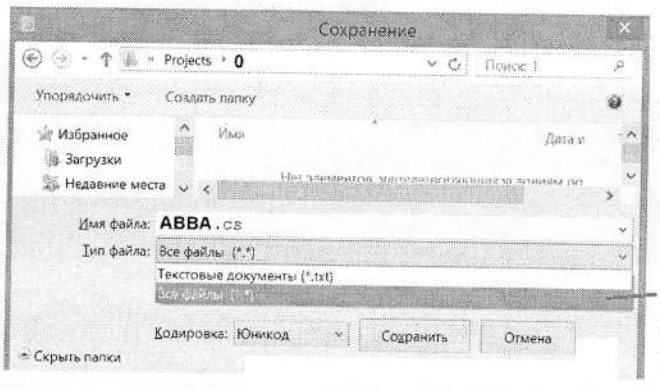


Step 1. And on my HDD, I also make a folder with the same name D:\ IT

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/

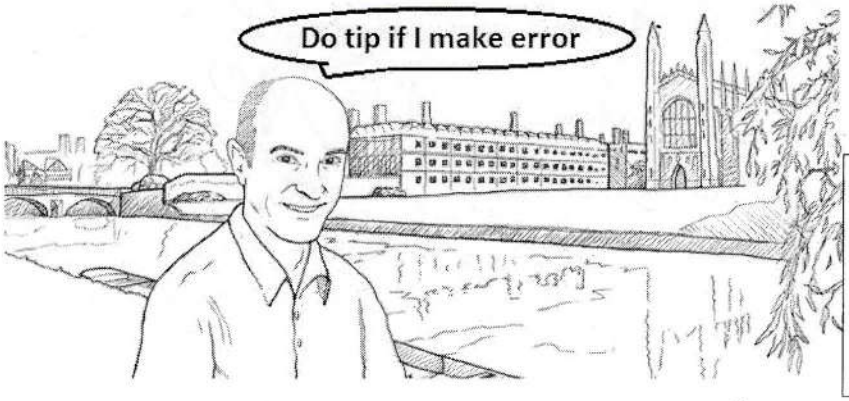
cd IT -Then go to the folder Projects

cd projects - Then go to the folder 0

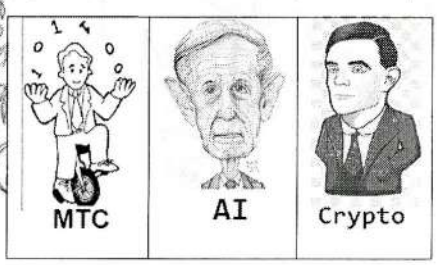
cd 0 –

```
E:\>cd IT

E:\IT>cd Projects

E:\IT\Projects>cd 0

E:\IT\Projects\0>
```

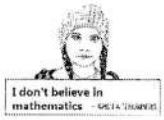
+0.1

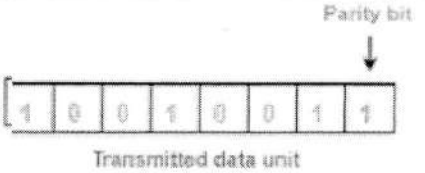


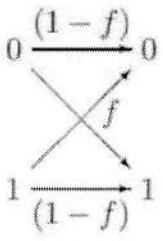
Sir **Dr. D. MacKay,**
University of Cambridge
(22 April 1967 – 14 April 2016)

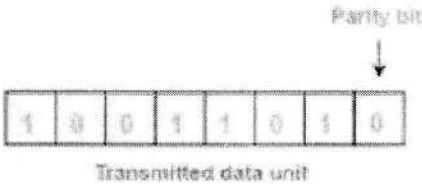


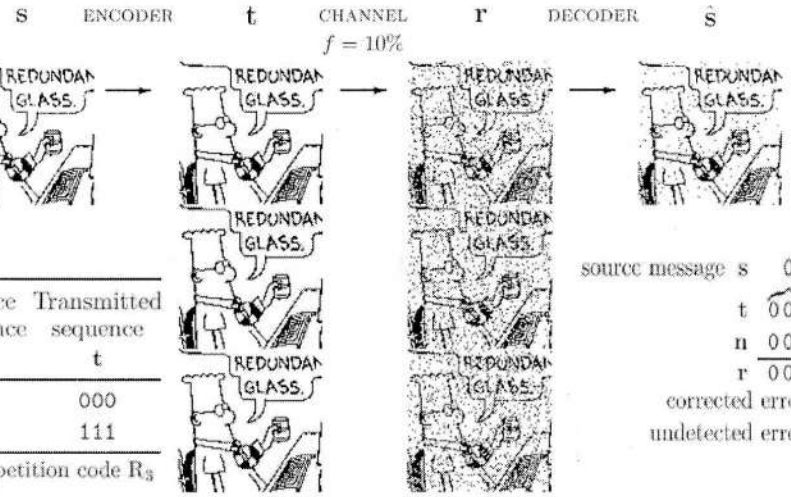
"I believe in clean energy,
but I also believe in mathematics"









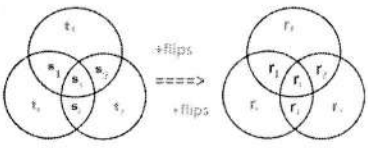


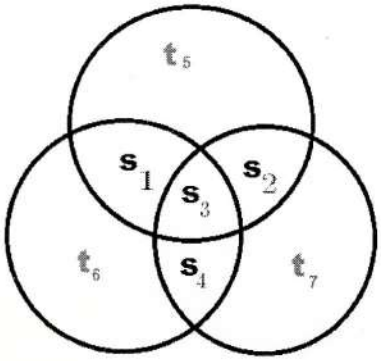
Source sequence s	Transmitted sequence t
0	000
1	111

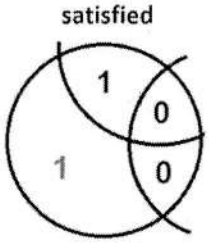
The repetition code R_3

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					*		

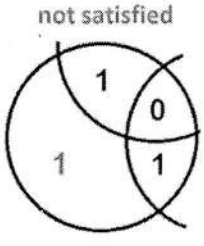
7.4. Hamming code. $\frac{4}{\Sigma} \rightarrow \frac{7}{t}$



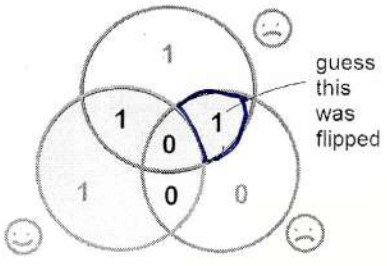


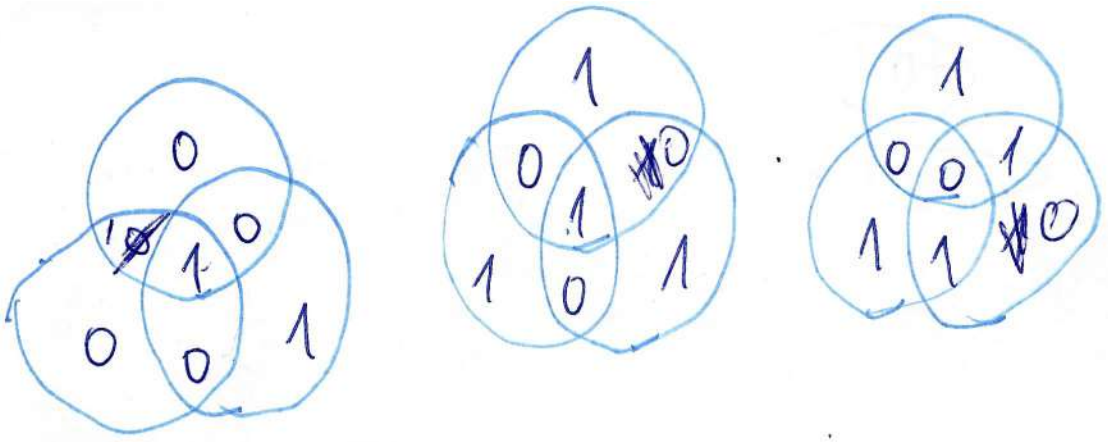


1+1+0+0=**0**



1+1+0+1=1




0
1
0
0
0
1
1
0
1
1
0
1
1
0
1
1
1
0