

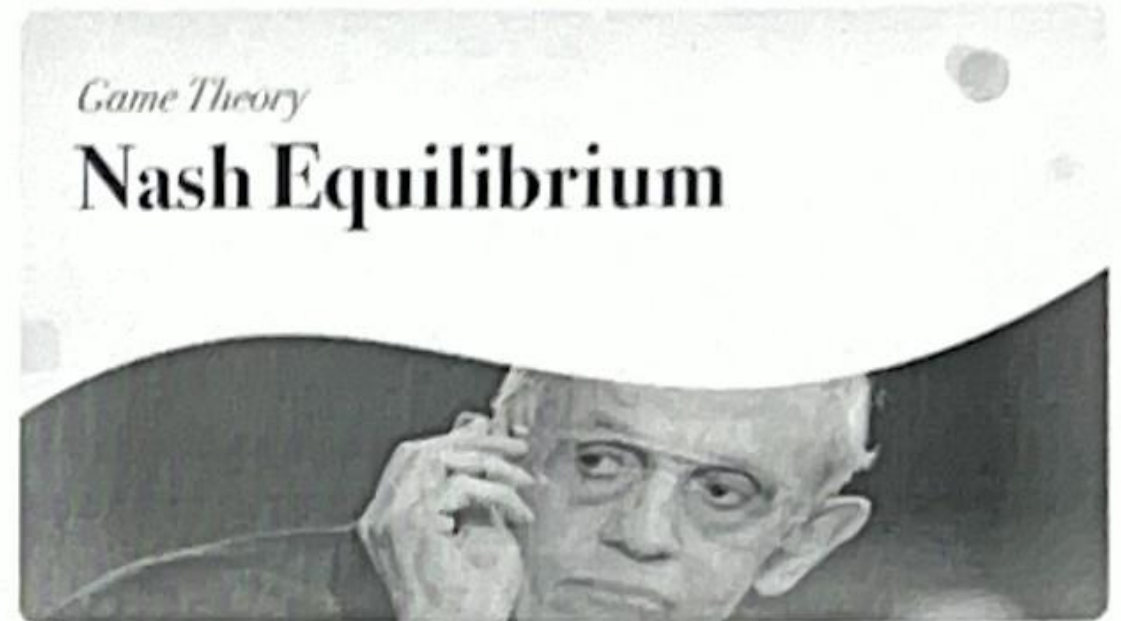
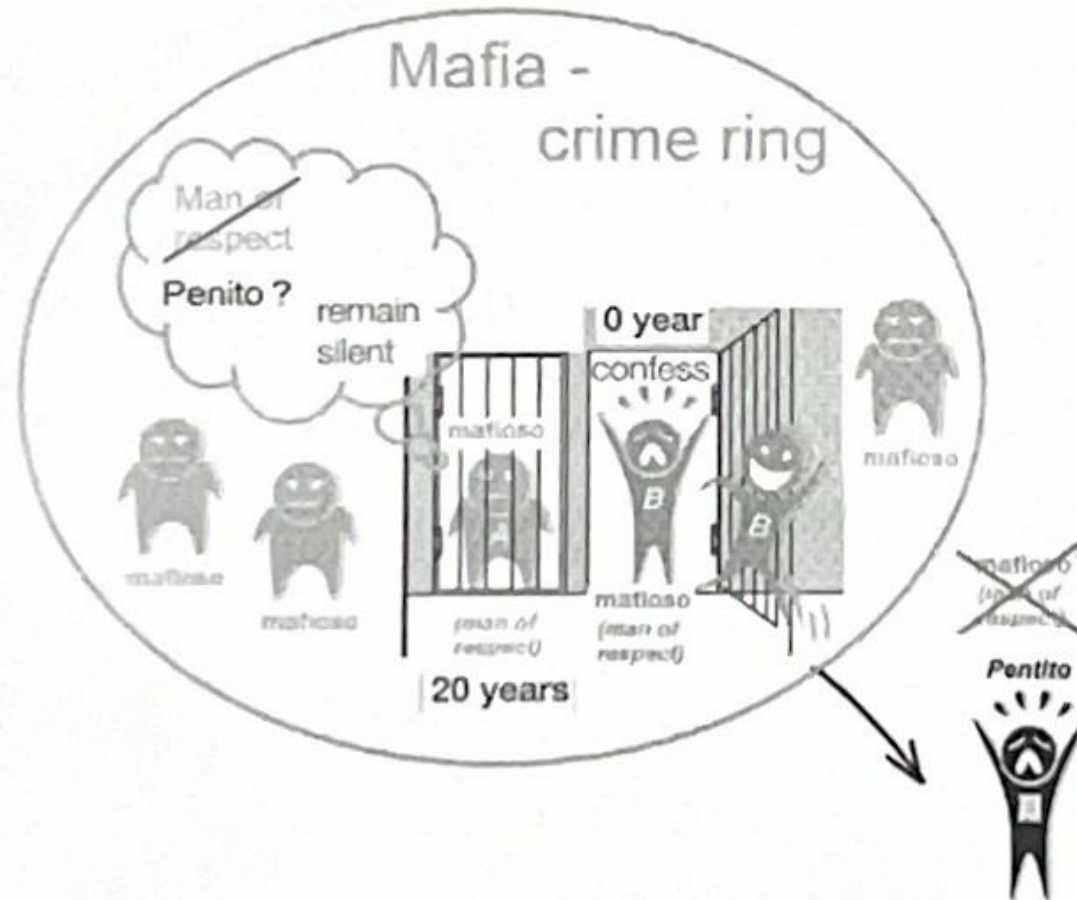
by Vilfredo Pareto
1848-1923

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

Prisoners' dilemma

		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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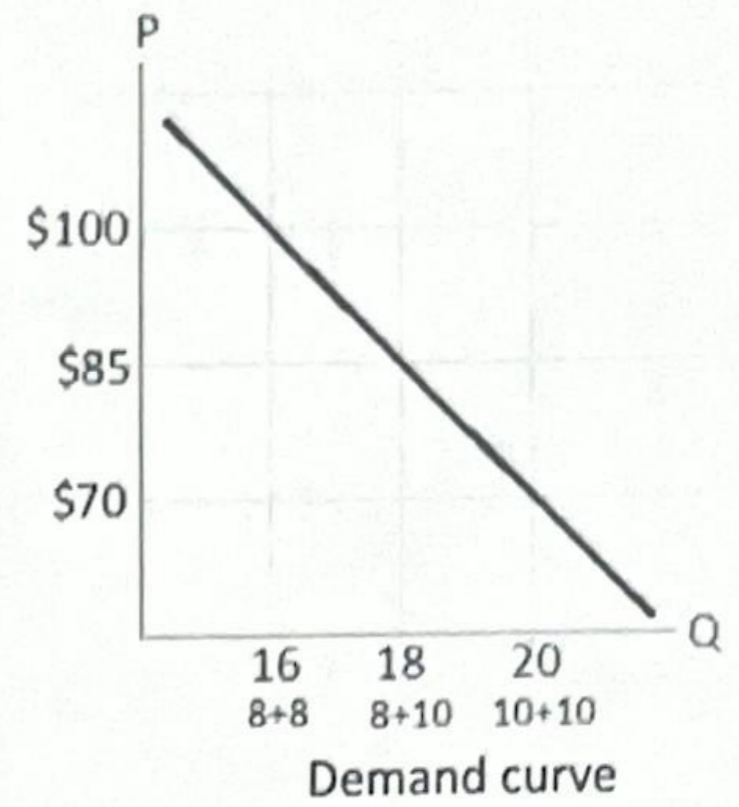
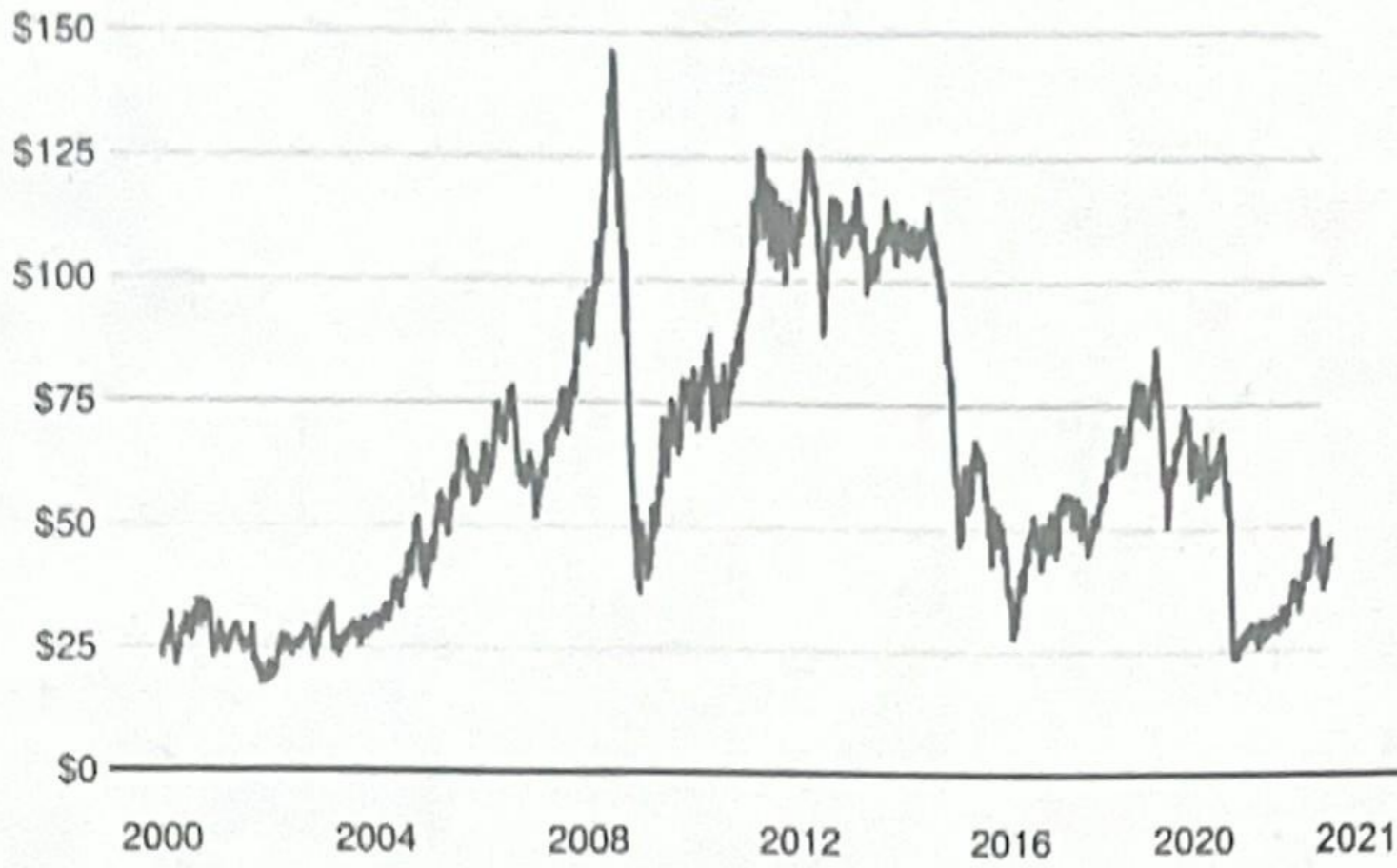
** => Nash equilibrium













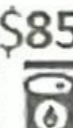




		Player 2	
		Recognition;	Non-recognition;
Player 1	Recognition;	1, -5*	2, -20
	Non-recognition;	2, -20	1, -1

-1-1
Pareto Optimality

Oil price hits 18-year low

Brent crude, US dollars per barrel



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



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`.



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);
    }
}
```

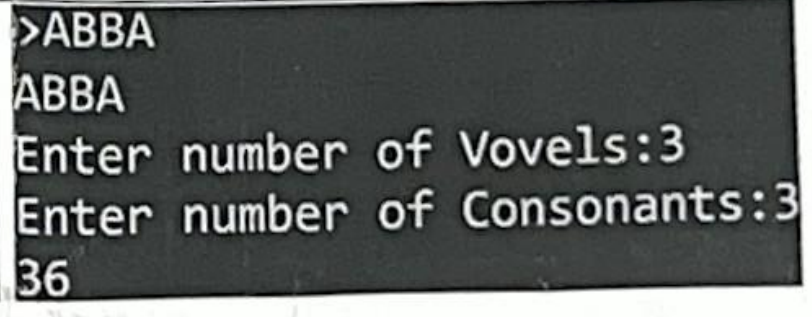
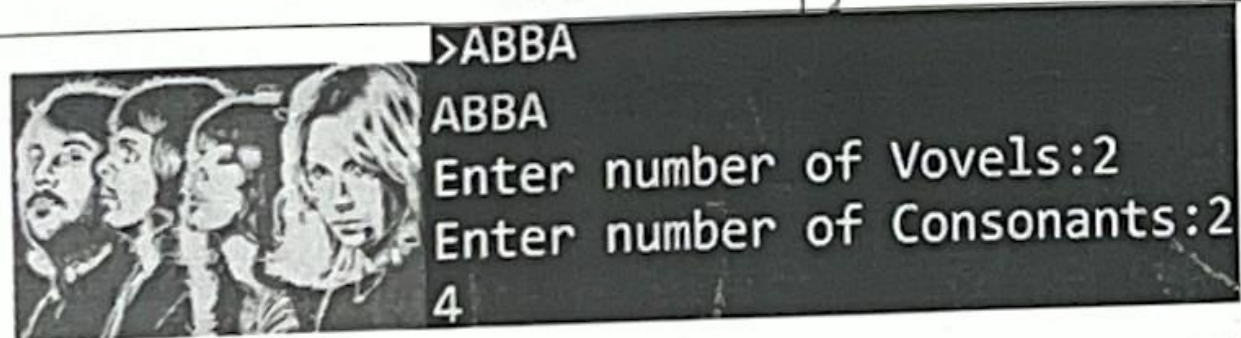
```
static void Main(string[] args)
// Here's a method called main.
{
    System.Console.WriteLine("ABBA -"+
        Factorial(4));
}
}
```

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

`>ABBA`
`ABBA - 24`

Step 7. Modify the file as follows

<pre>using System; class ABBA { static int Factorial(int n) { if (n == 1) return 1; return n * Factorial(n - 1); } }</pre>	<pre>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)); } }</pre>
---	---



1

2

3

4

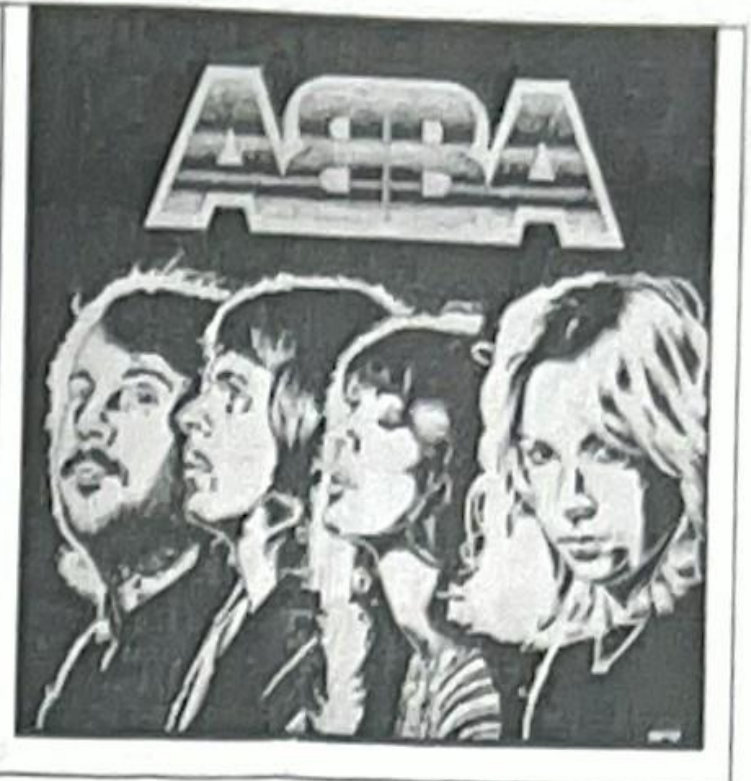


This is the program we need to write today

```

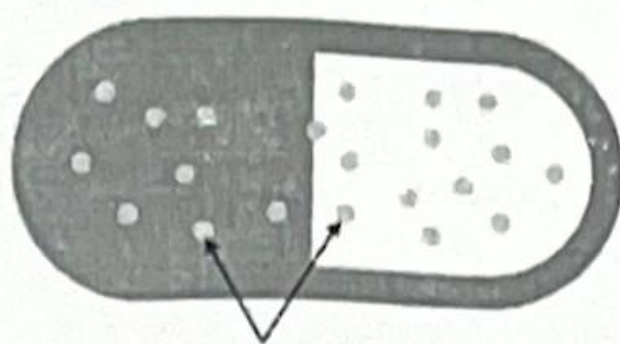
class ABBA
{
    static void Main(string[] args)
        // Here's a method called Main.
    {
        System.Console.WriteLine("ABBA!");
    }
}

```

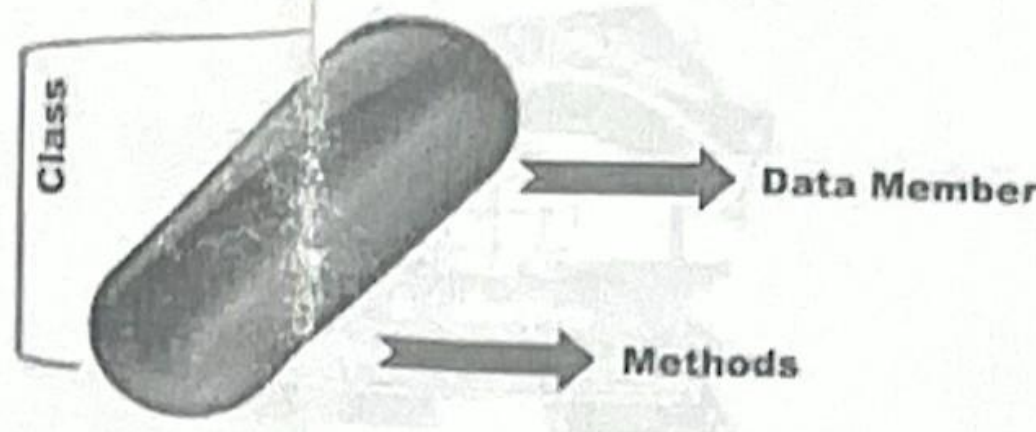


So there's the keyword class. Unlike C++, in C# all code must be placed in a class.

Encapsulated in a class.



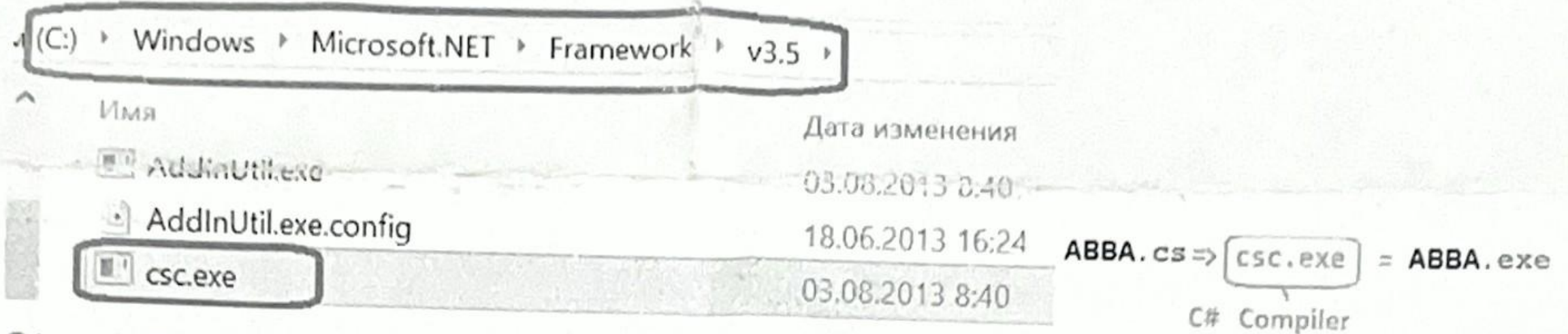
Medicines Inside Capsule



A ≠ a

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

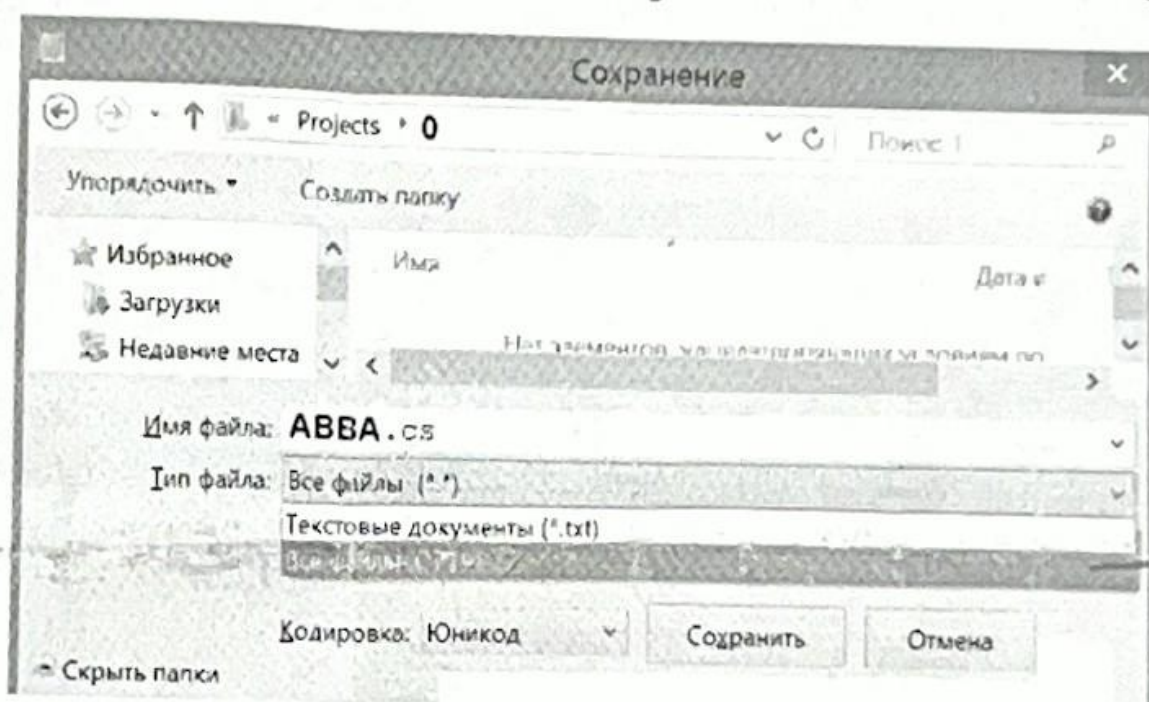
And in the Project folder make folder 0 - E:\IT\Projects\0\ where our today's practical work will be

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

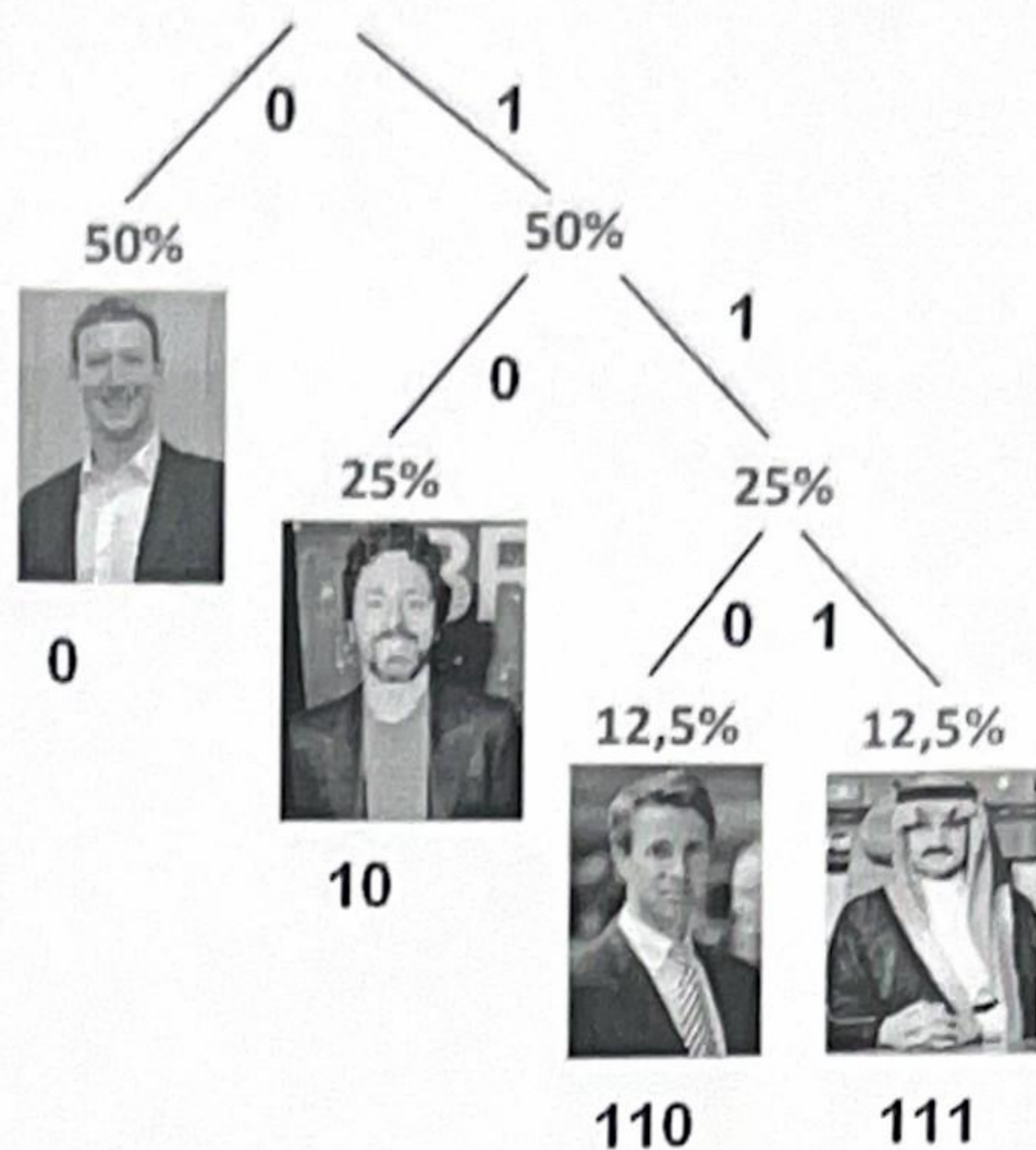
cd 0 -

E:\>cd IT

E:\IT>cd Projects

E:\IT\Projects>cd 0

E:\IT\Projects\0>



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		

ла мам ма р

Мама мыла ра

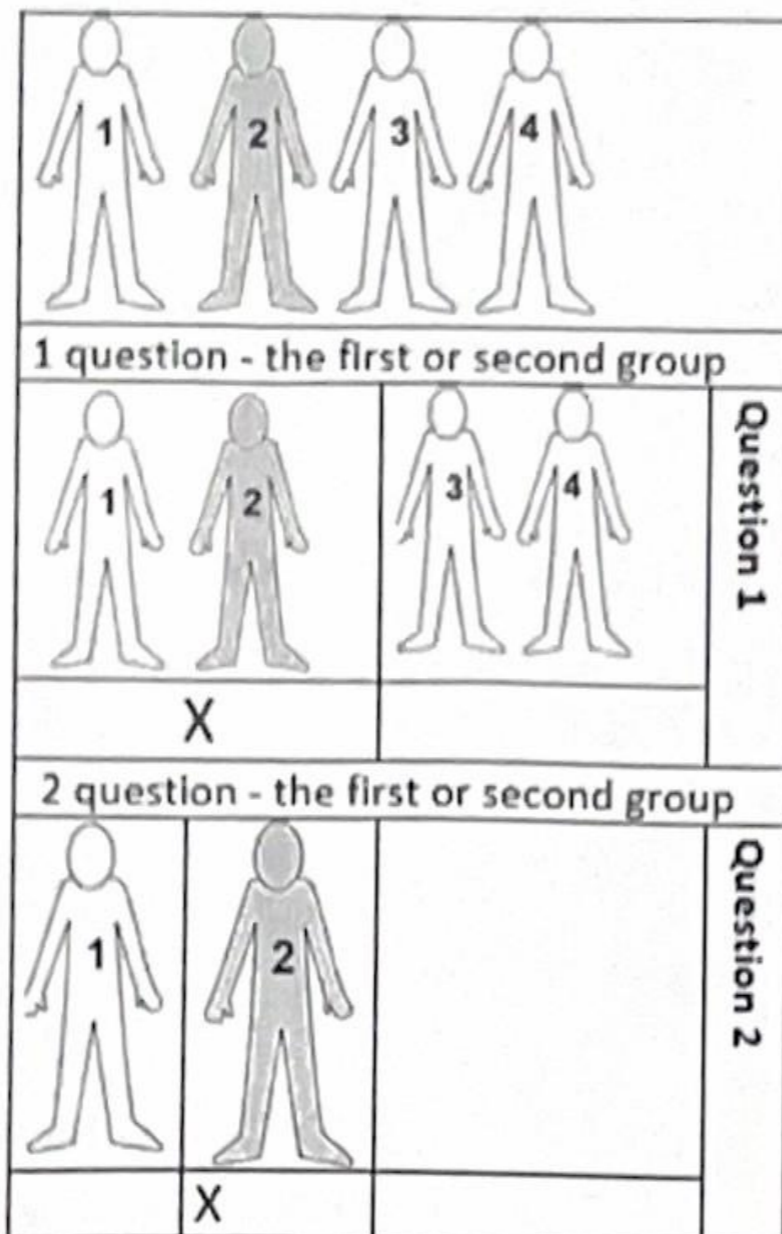
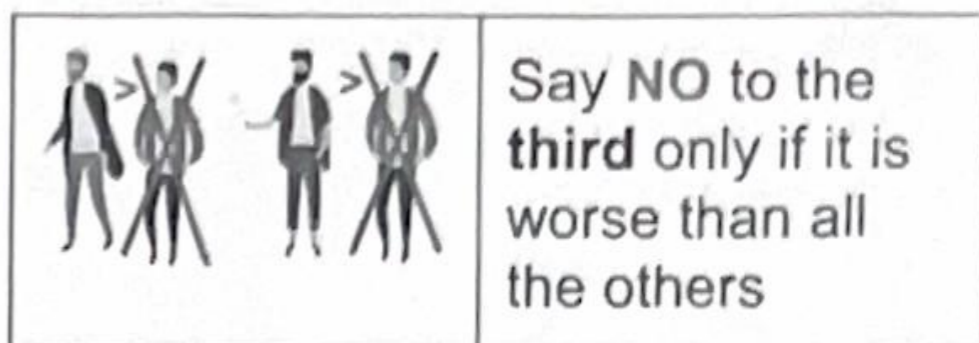
Ма - 2	22%	1-2 ма
ам - 2	22%	3-4 ам
мы - 1	11%	5 мы
ыл - 1	11%	6 ыл
ла - 1	11%	7 ла
ар - 1	11%	8 ар
ра - 1	11%	9 ра

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)

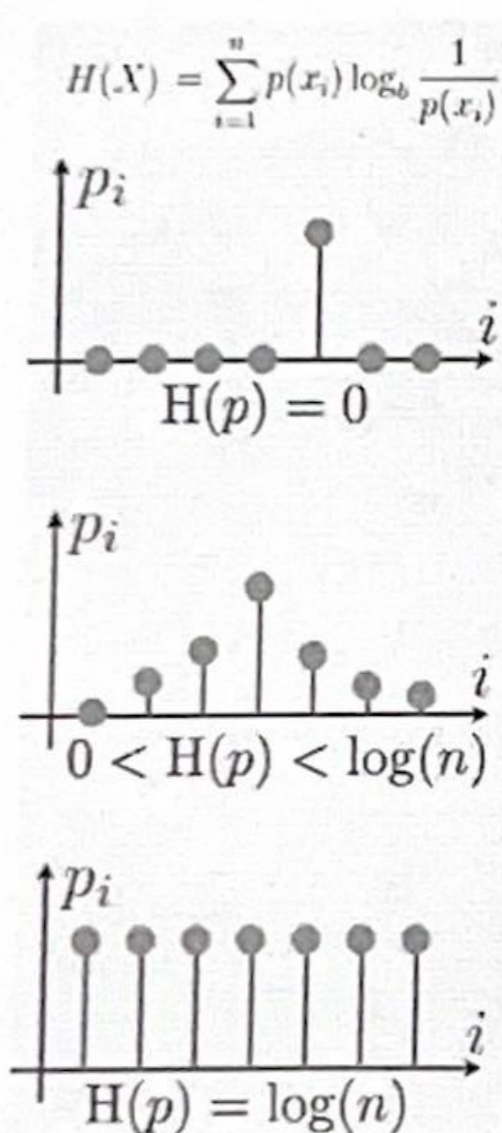


Average number of questions =
 $2 \cdot 0.25 + 2 \cdot 0.25 + 2 \cdot 0.25 + 2 \cdot 0.25 = 2$

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		



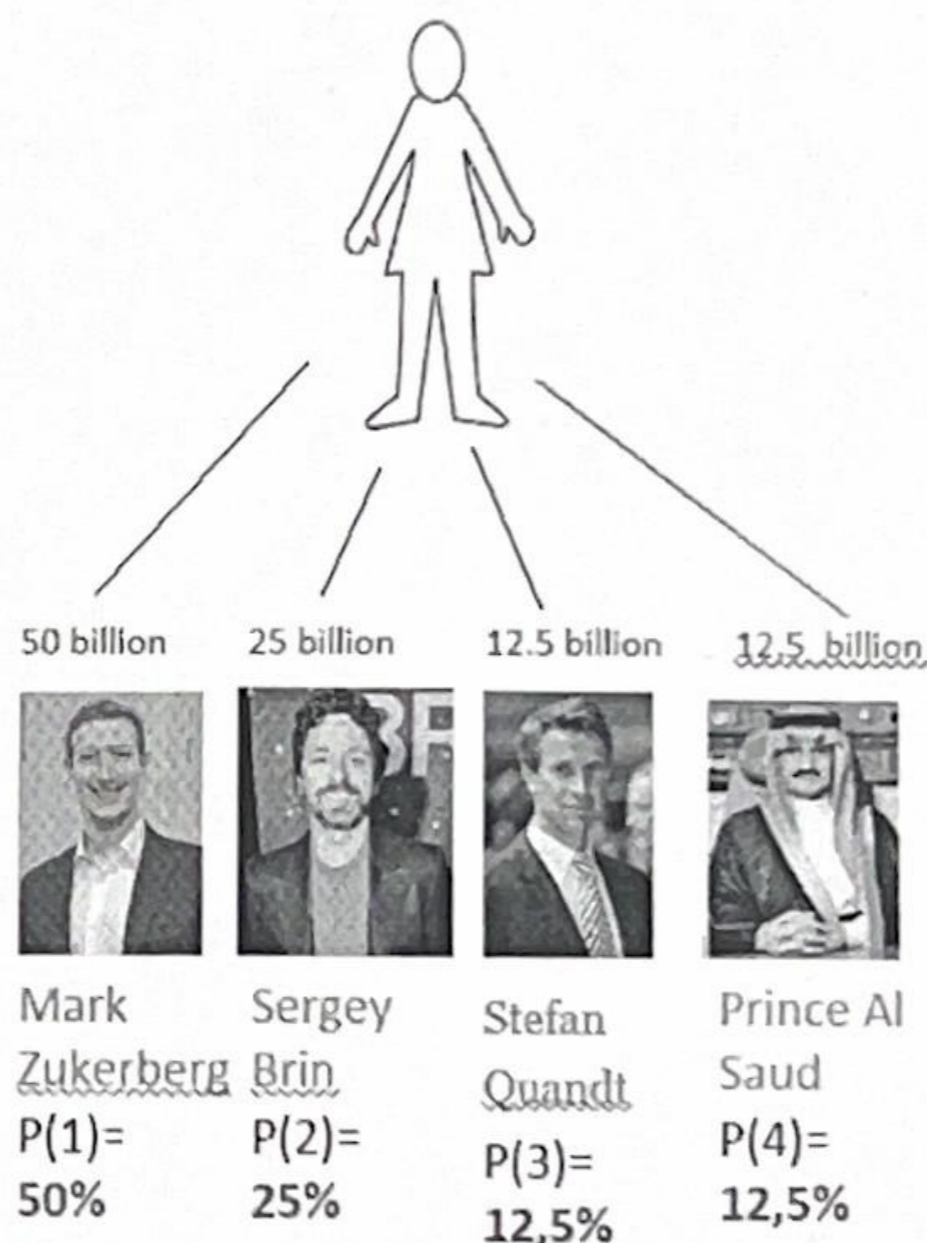
$$\sum_{i=1}^n p(i) \log_2 \frac{1}{p(i)}$$

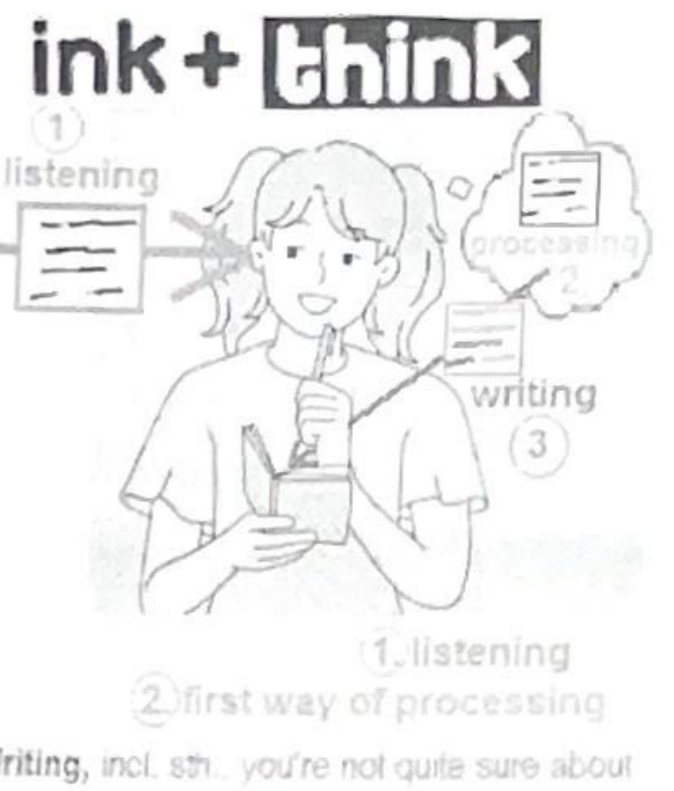
Quantifying information

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

number of bits required to encode choice

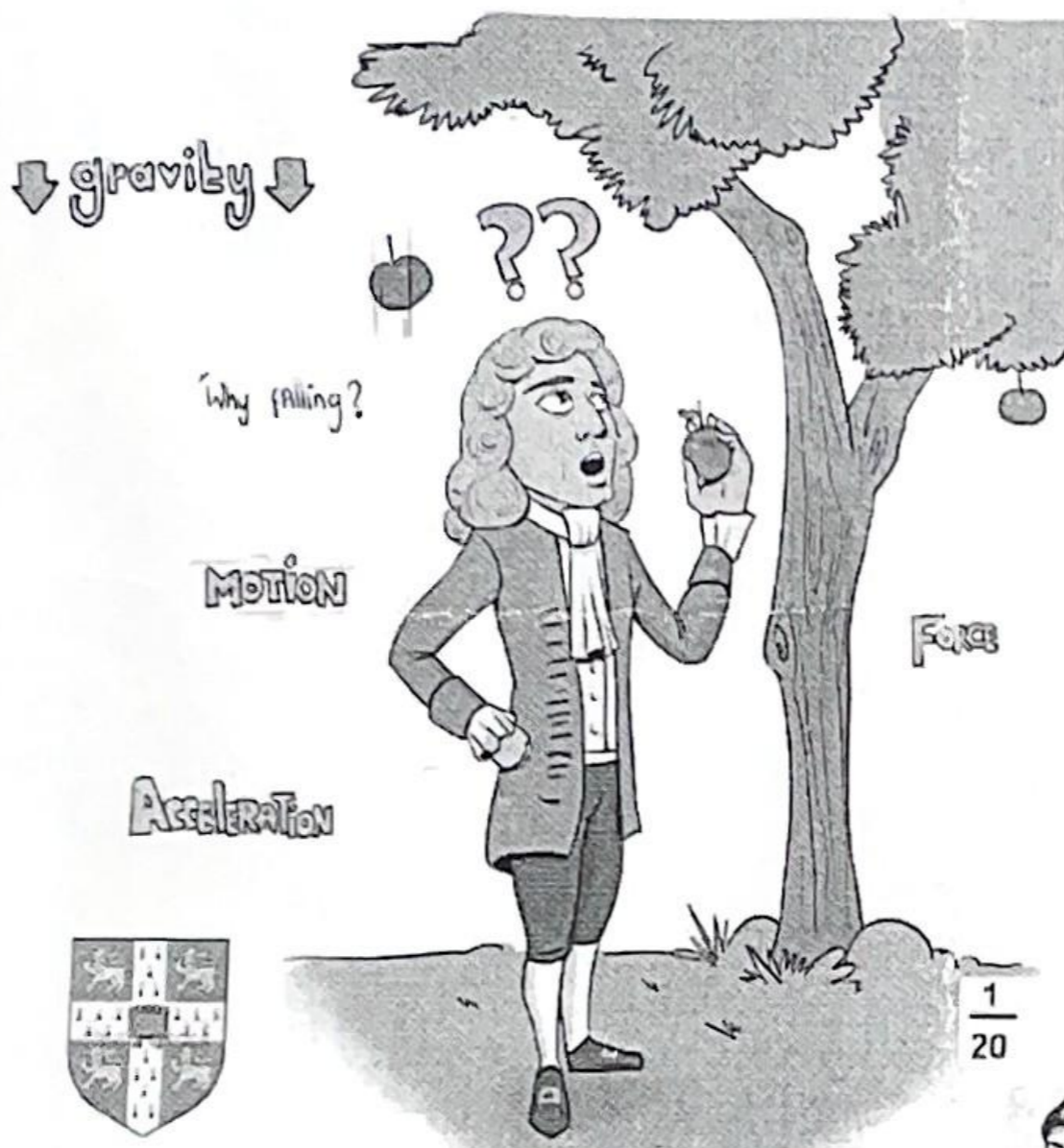
$$\sum_{i=1}^n p(x_i) I(x_i)$$



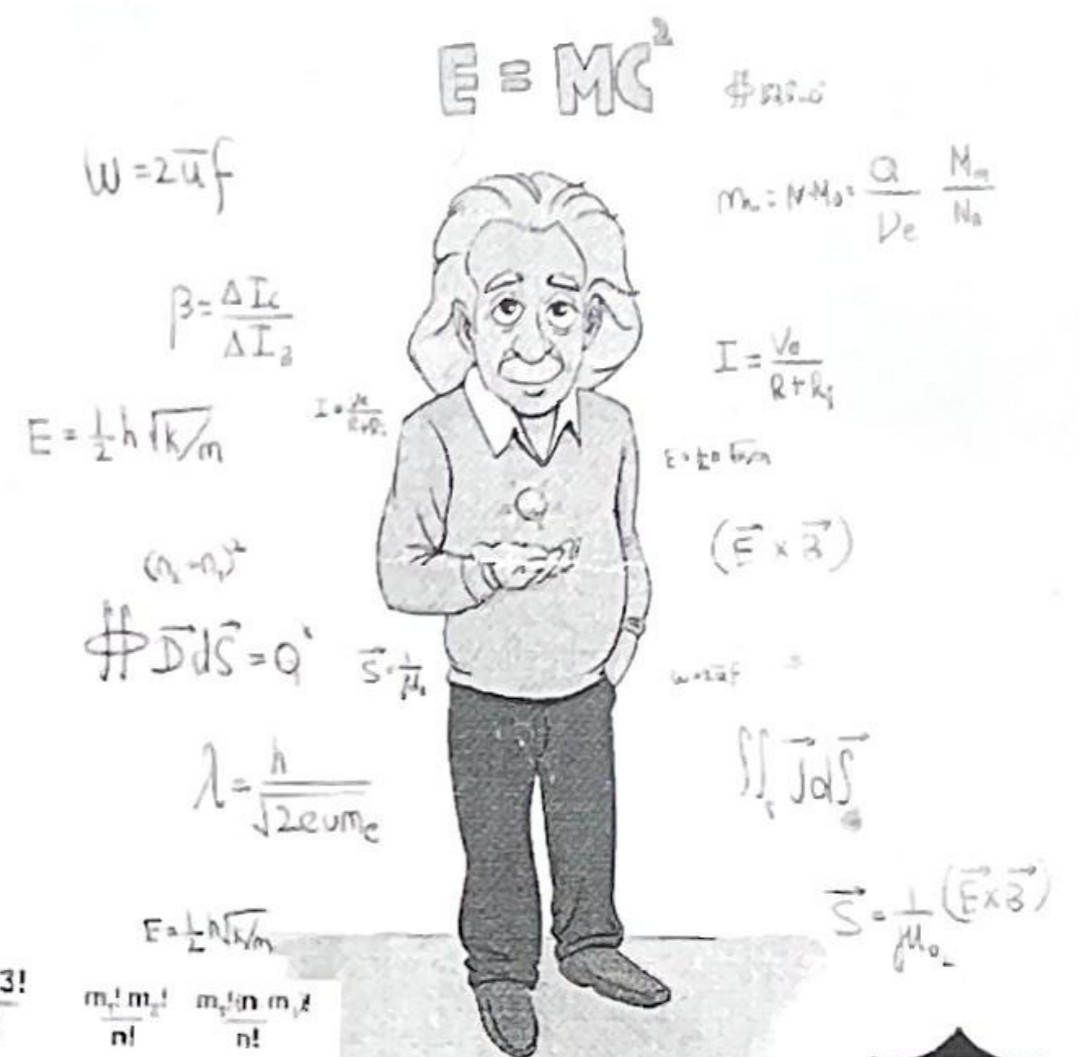


School \downarrow gravity \downarrow MOTION ==formalism==> University $E = MC^2$ $\int \vec{J} d\vec{s}$

CONCRETE AND ABSTRACT THINKING



ISAAC NEWTON



ALBERT EINSTEIN

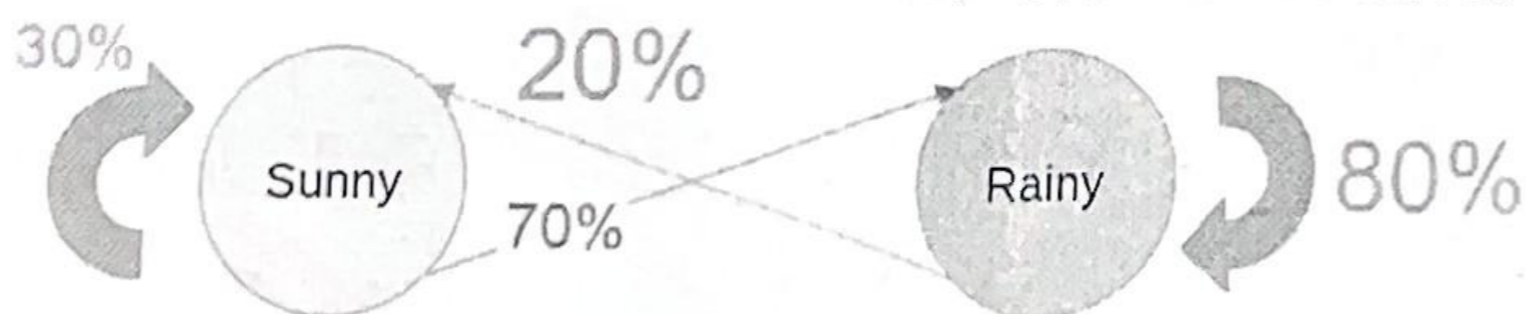
Motivation: 80% chance of rain
Let A_j be the event of rain at day j of this term, $1 \leq j \leq n$

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%

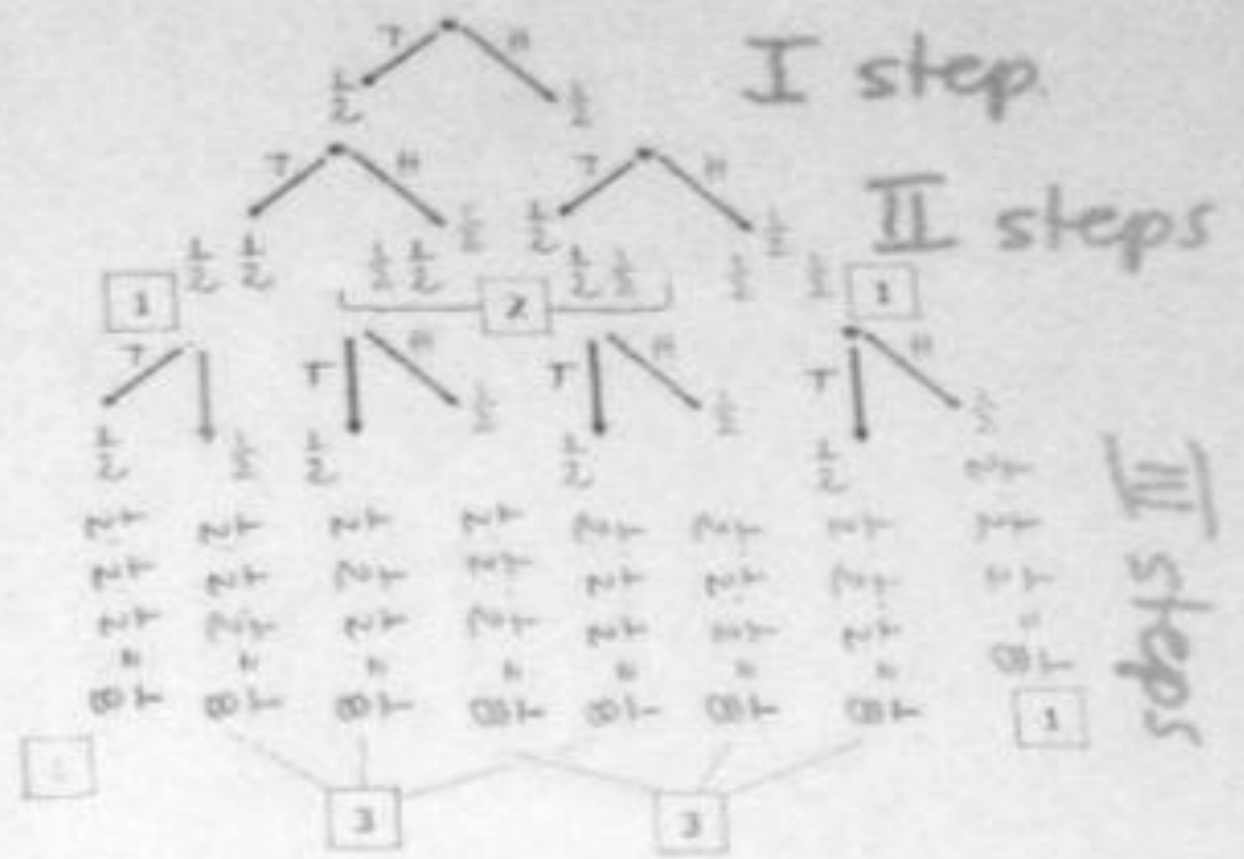
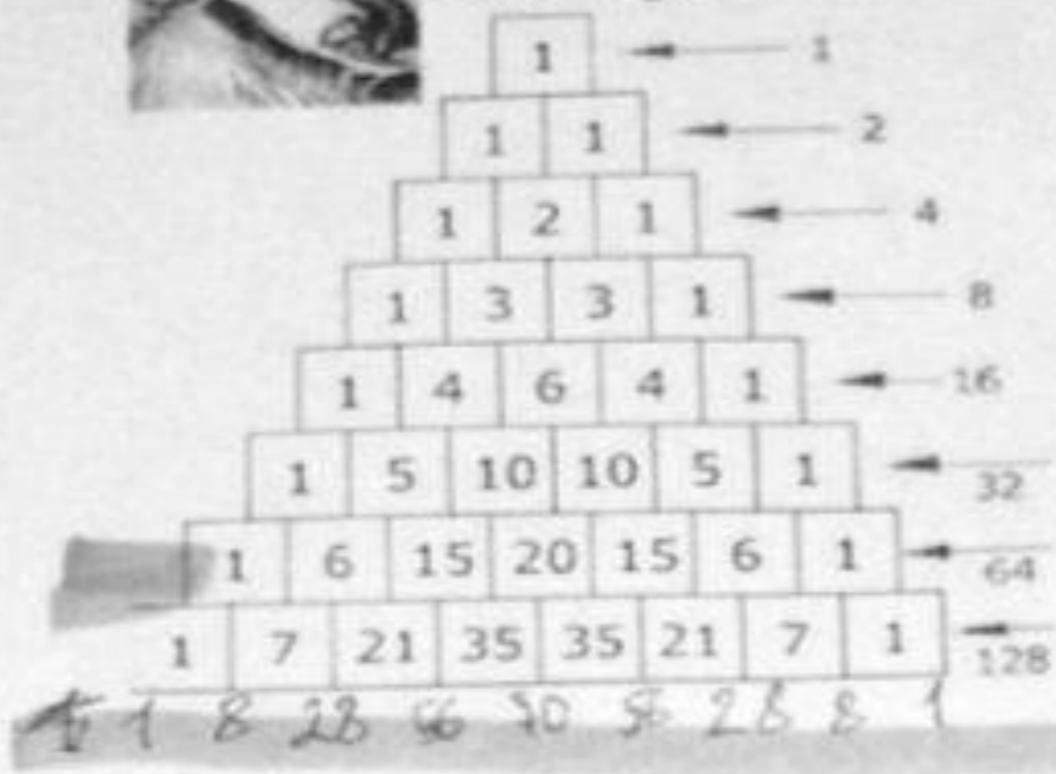
Markoff Chain Probability Model

for Oxford Weather





Pascal's triangle



$(a + b)^0 =$

$(a + b)^1 =$

$(a + b)^2 =$

$(a + b)^3 =$

$(a + b)^4 =$

$(a + b)^5 =$

$(a + b)^6 =$

$(a + b)^7 =$

1

Newton's Binomial



$a + b$

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

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

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

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

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

$a^7 + 7a^6b + 28a^5b^2 + 56a^4b^3 + 70a^3b^4 + 56a^2b^5 + 7ab^6 + b^7$

$P = 0,25$

$P = 0,25$

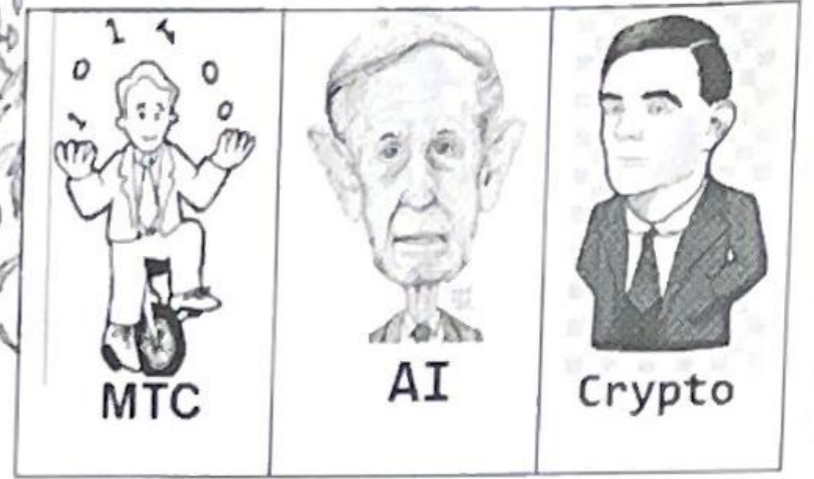
Entropy = $0,25 \cdot \log_2 \frac{1}{0,25} + 0,25 \cdot \log_2 \frac{1}{0,25} + 0,25 \cdot \log_2 \frac{1}{0,25} + 0,25 \cdot \log_2 \frac{1}{0,25}$

$= 0,5^4 = 0,0625$

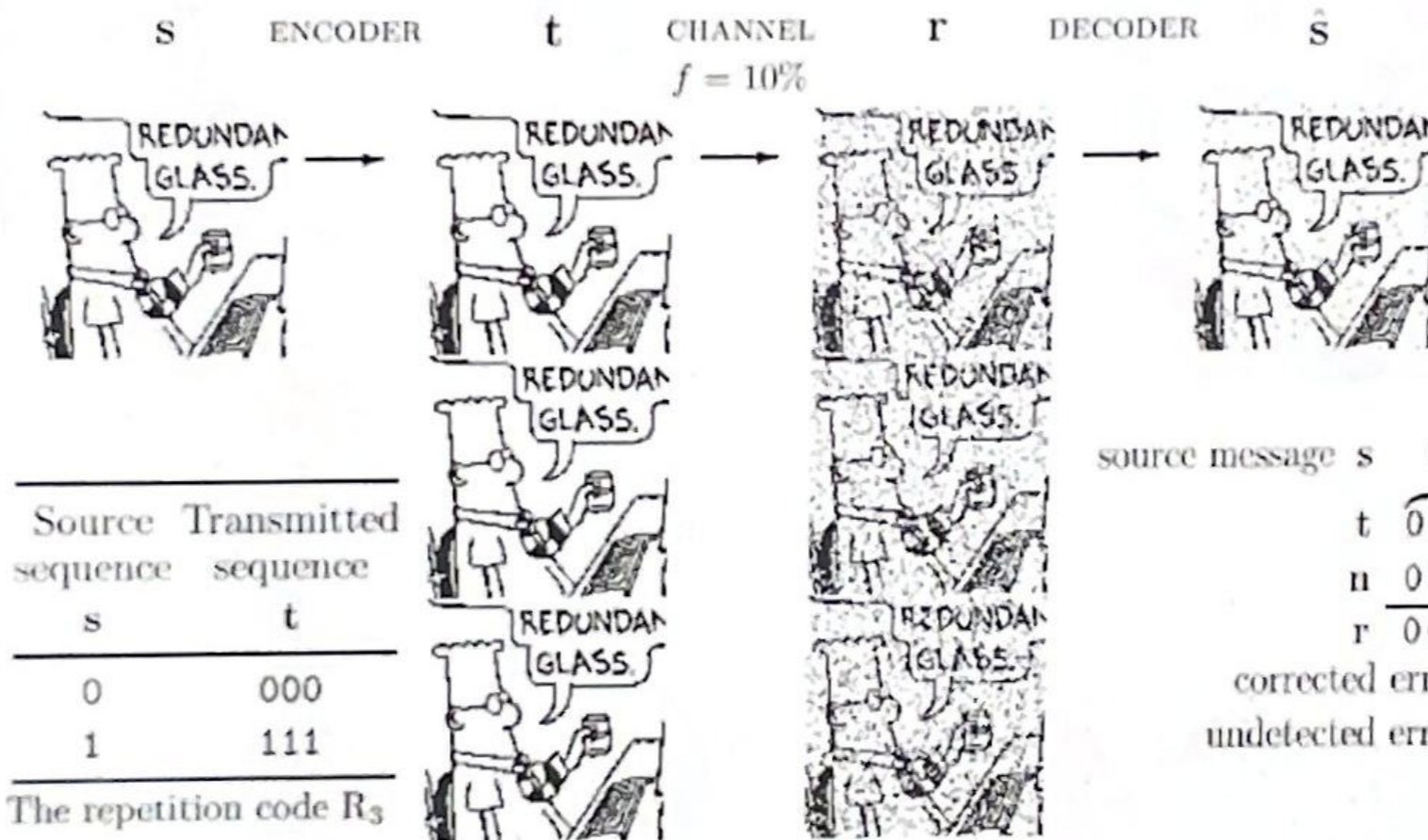
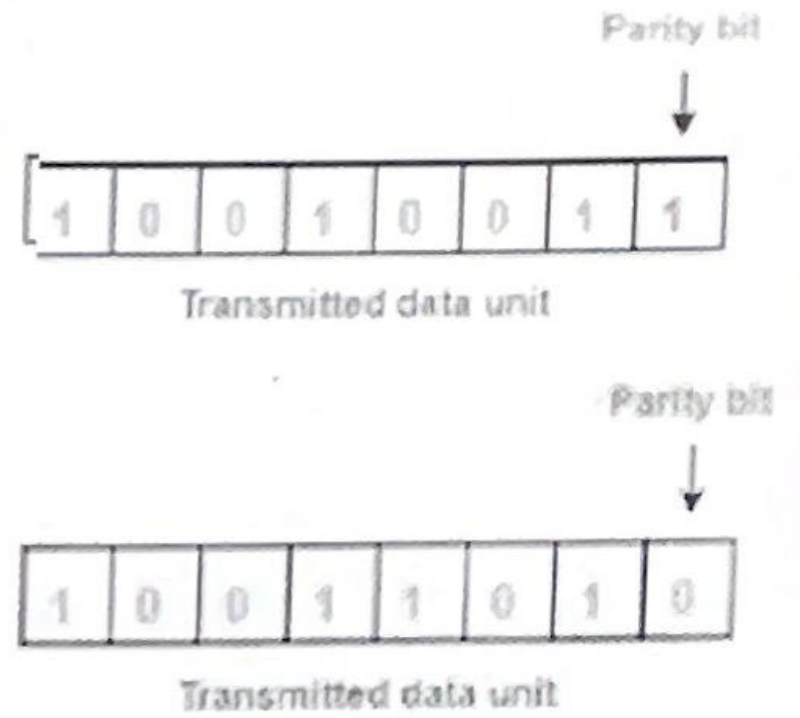
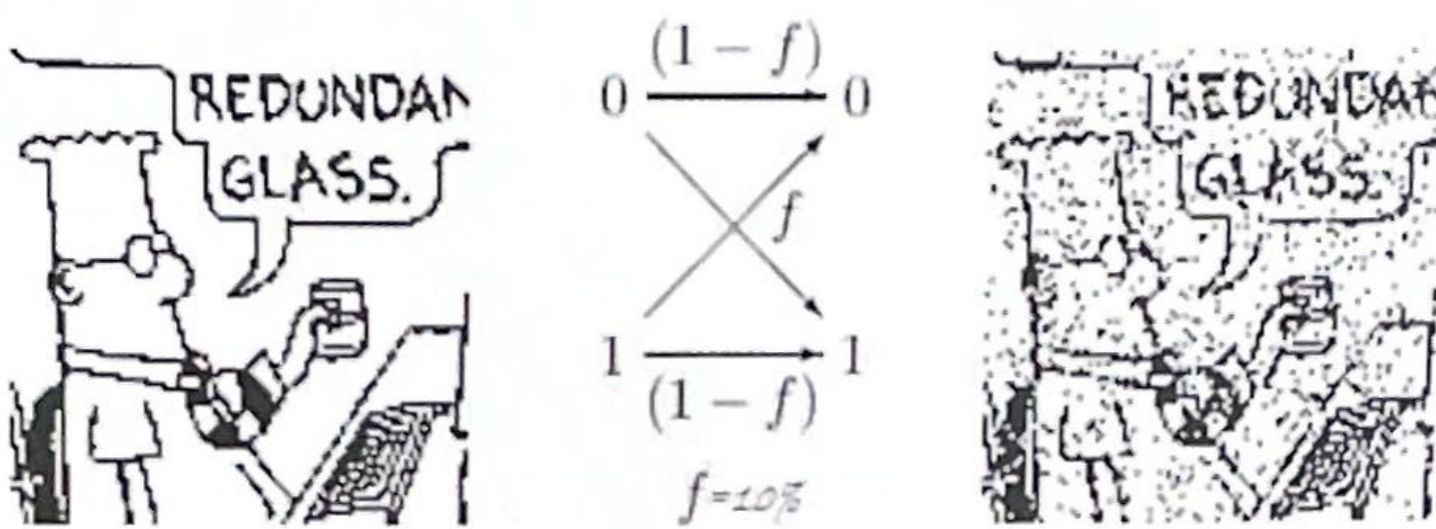
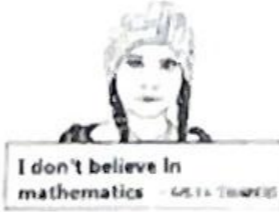
$P = 0,25$



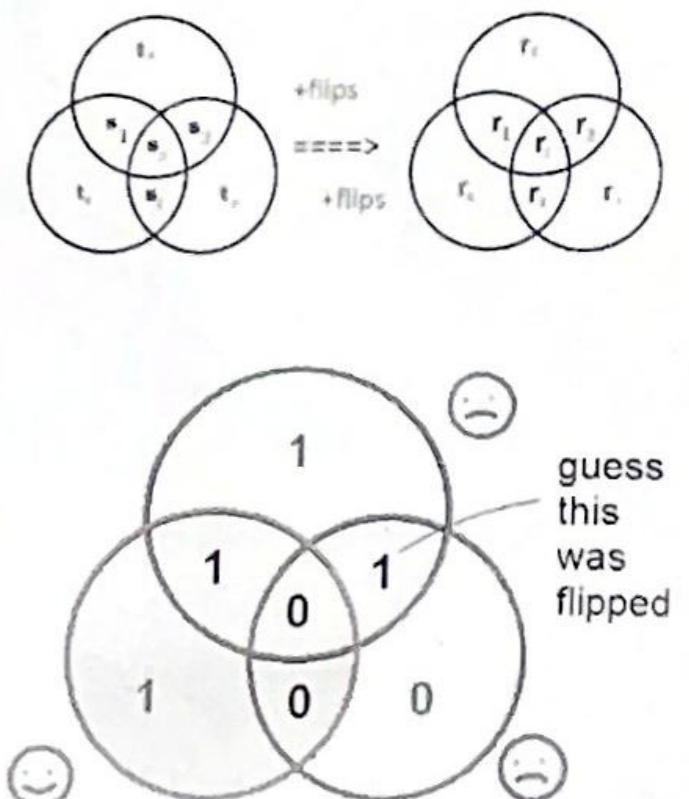
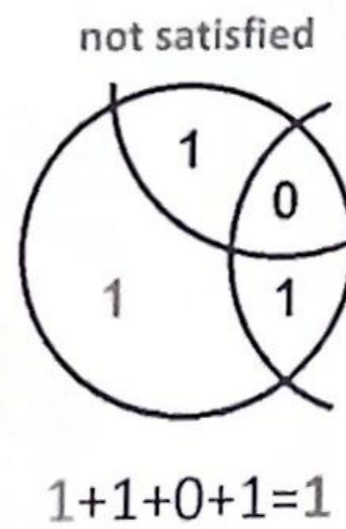
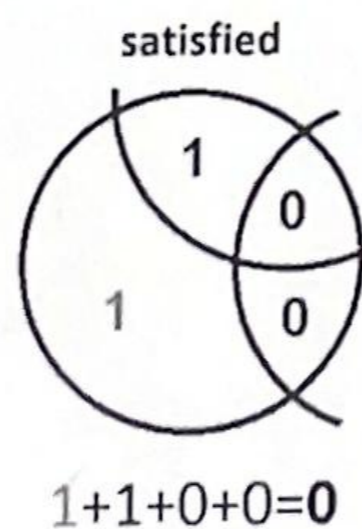
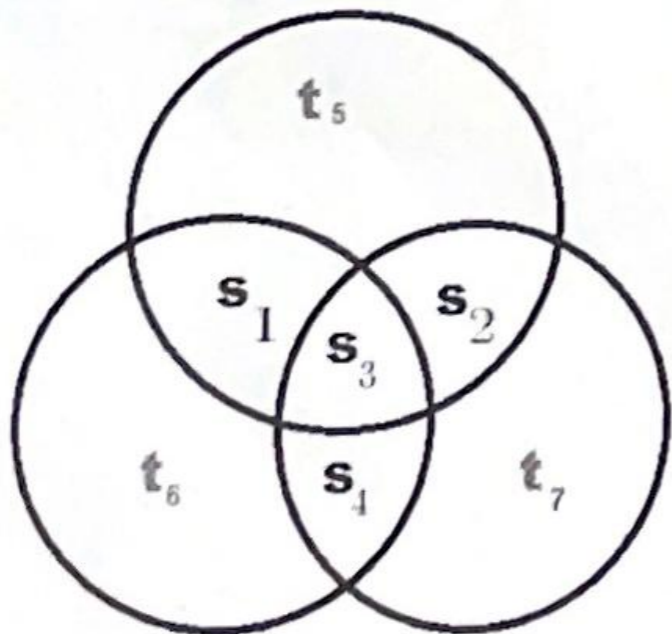
Sir Dr. D. MacKay,
University of Cambridge
(22 April 1967 – 14 April 2016)

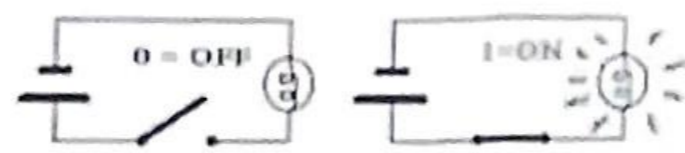


"I believe in clean energy,
but I also believe in mathematics"



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

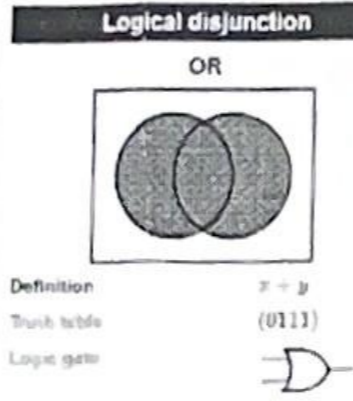




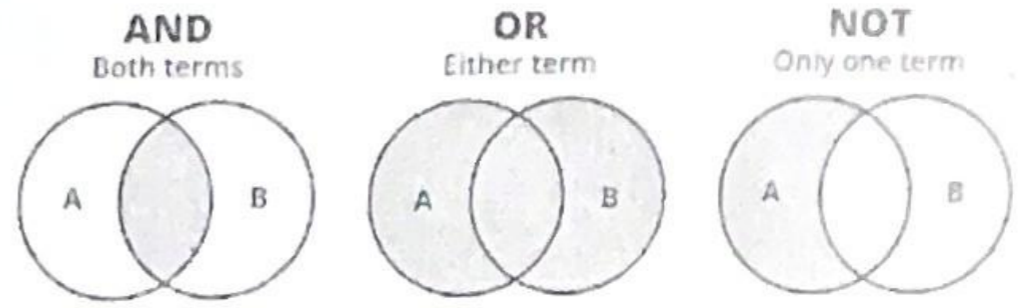
Logical addition (disjunction)

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



BOOLEAN LOGIC

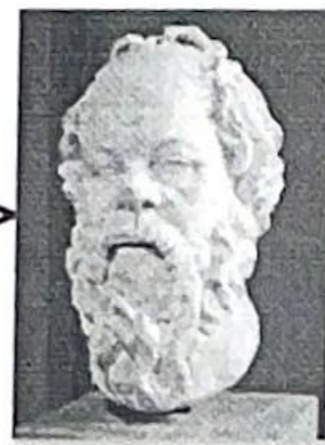


Good logic



Socrates

Socrates was a philosopher



Socrates

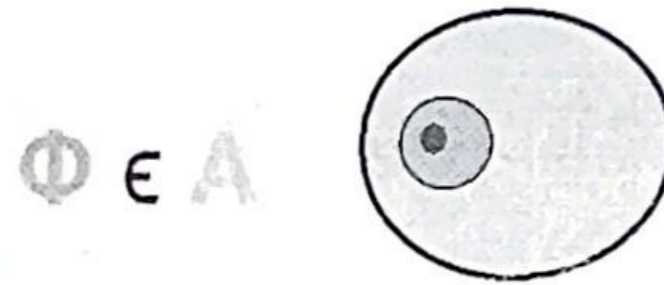


Plato



Aristotle

philosophers are men



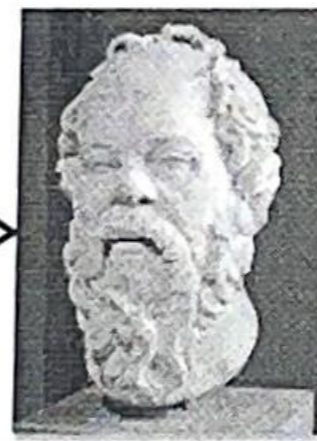
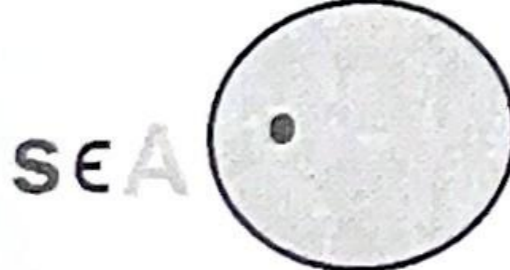
Socrates was a man



Bad logic



Socrates was a man



Socrates

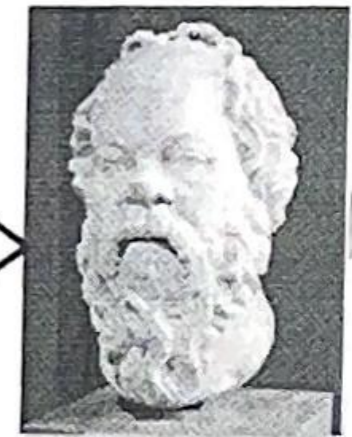


Plato



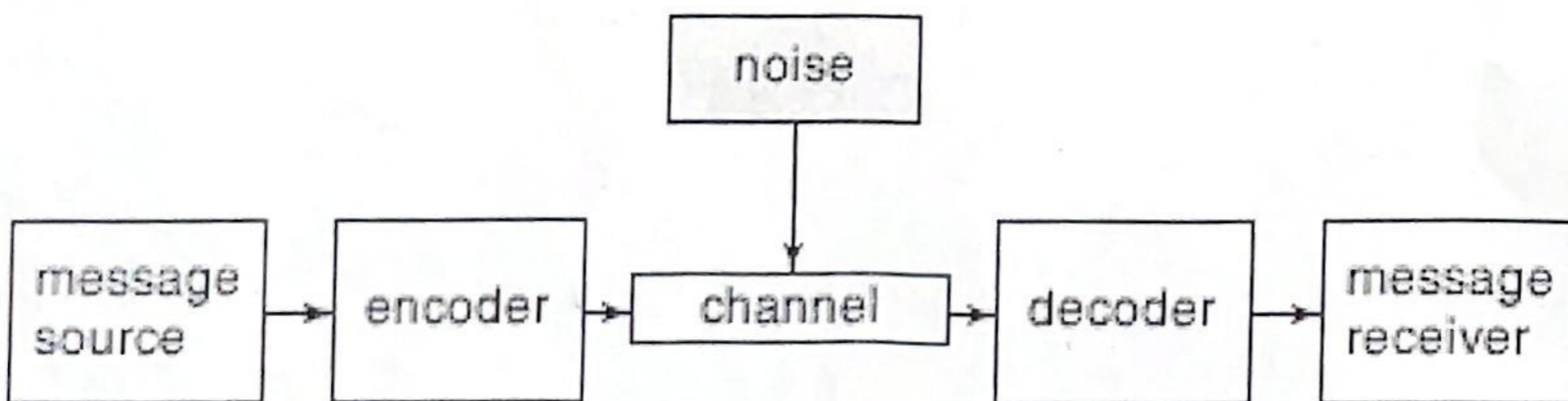
Aristotle

philosophers are men



Socrates

Socrates was a philosopher



Resume of Lecture by Pr. Bob Gallager from MIT

George Boole (1815-1864) developed Boolean logic

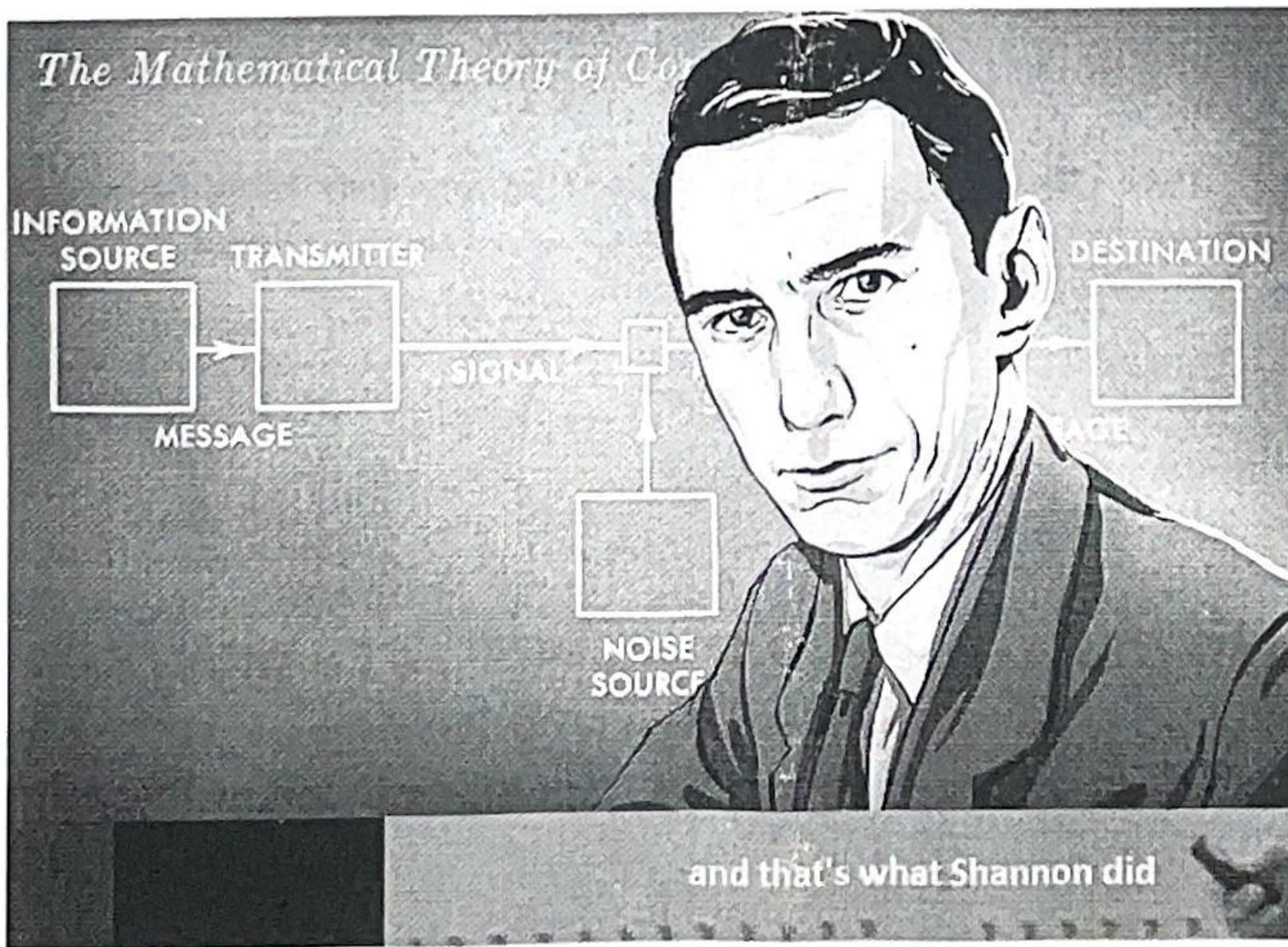
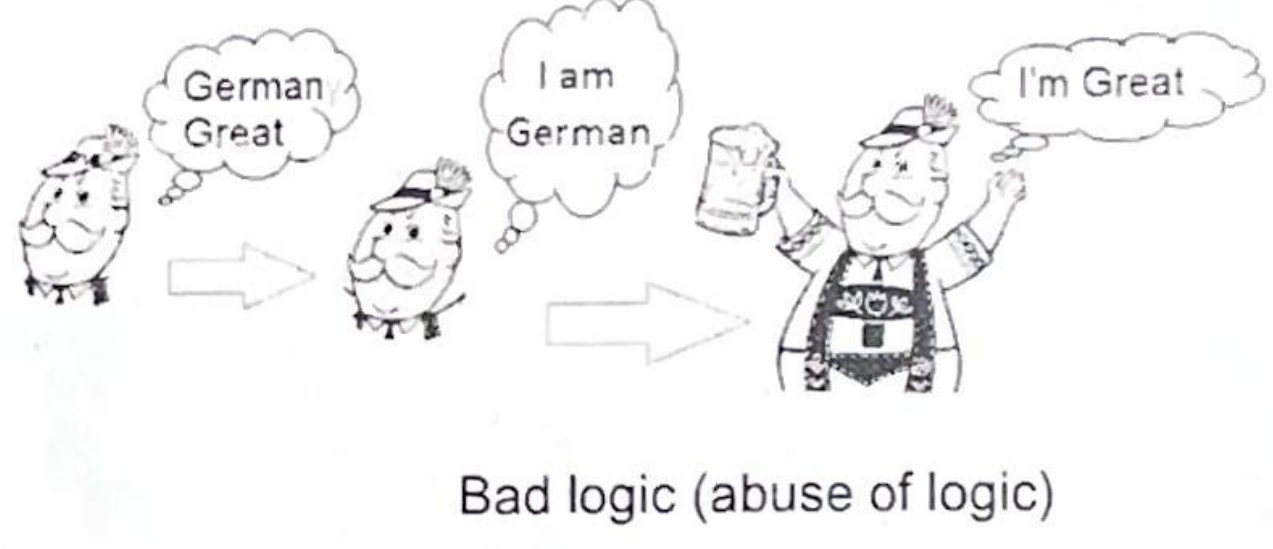
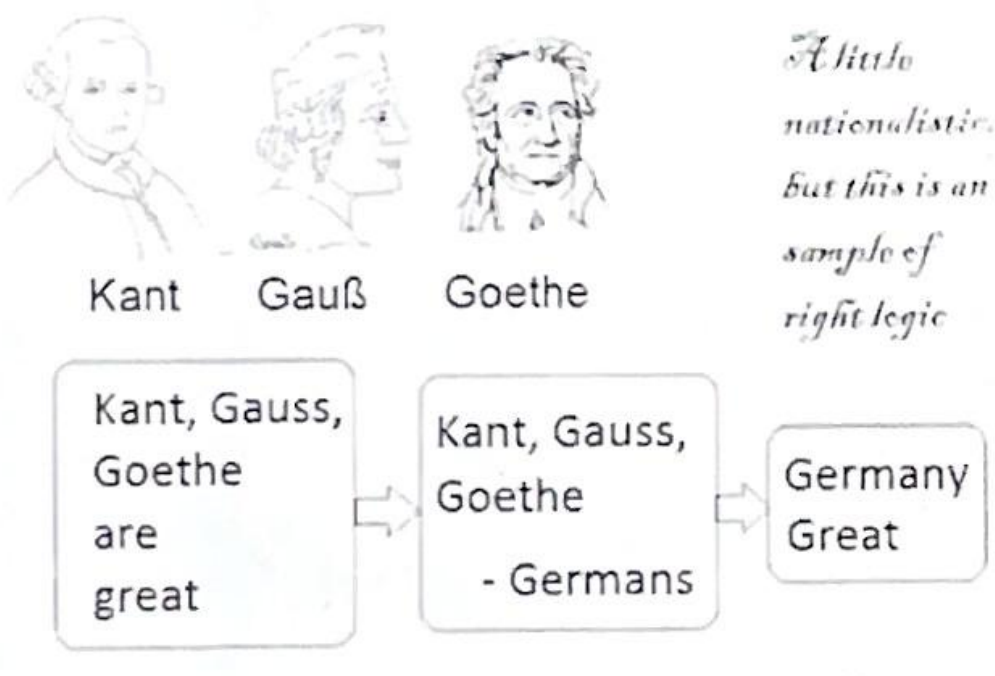
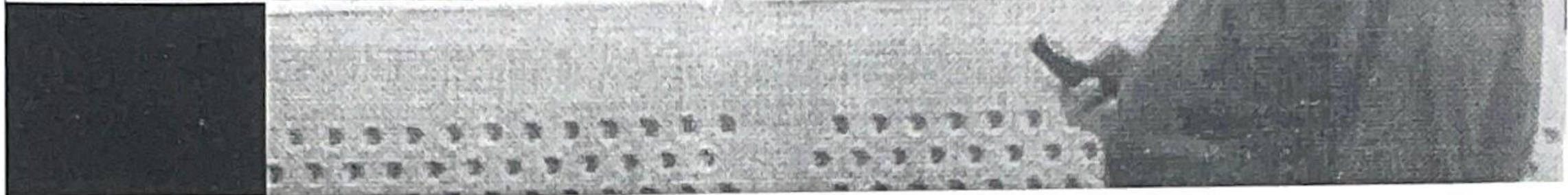
The principles of logical thinking have been understood (and occasionally used) since the Hellenic era.

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



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

and that's what Shannon did

