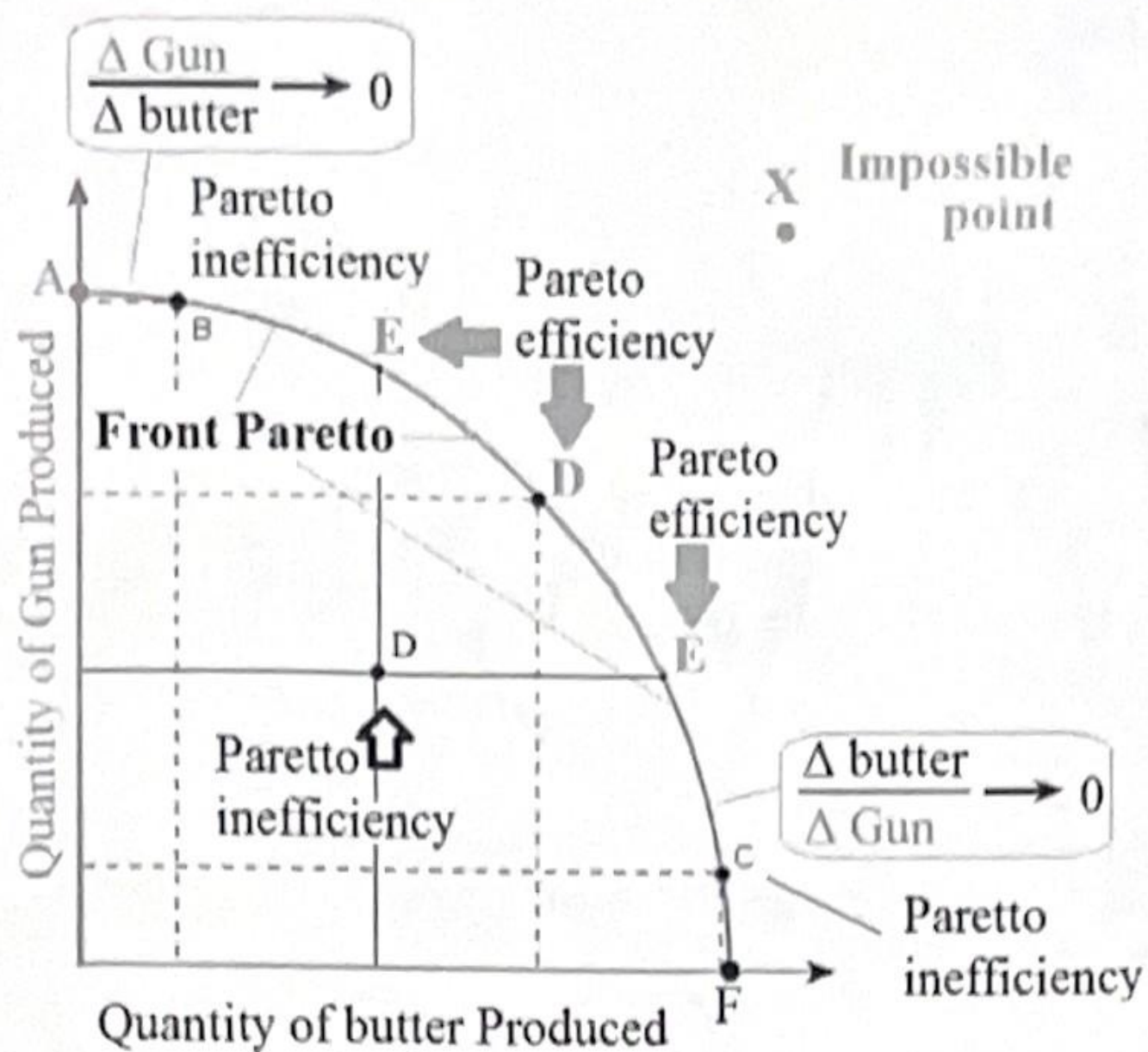




by Vilfredo Pareto  
1848-1923

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   |

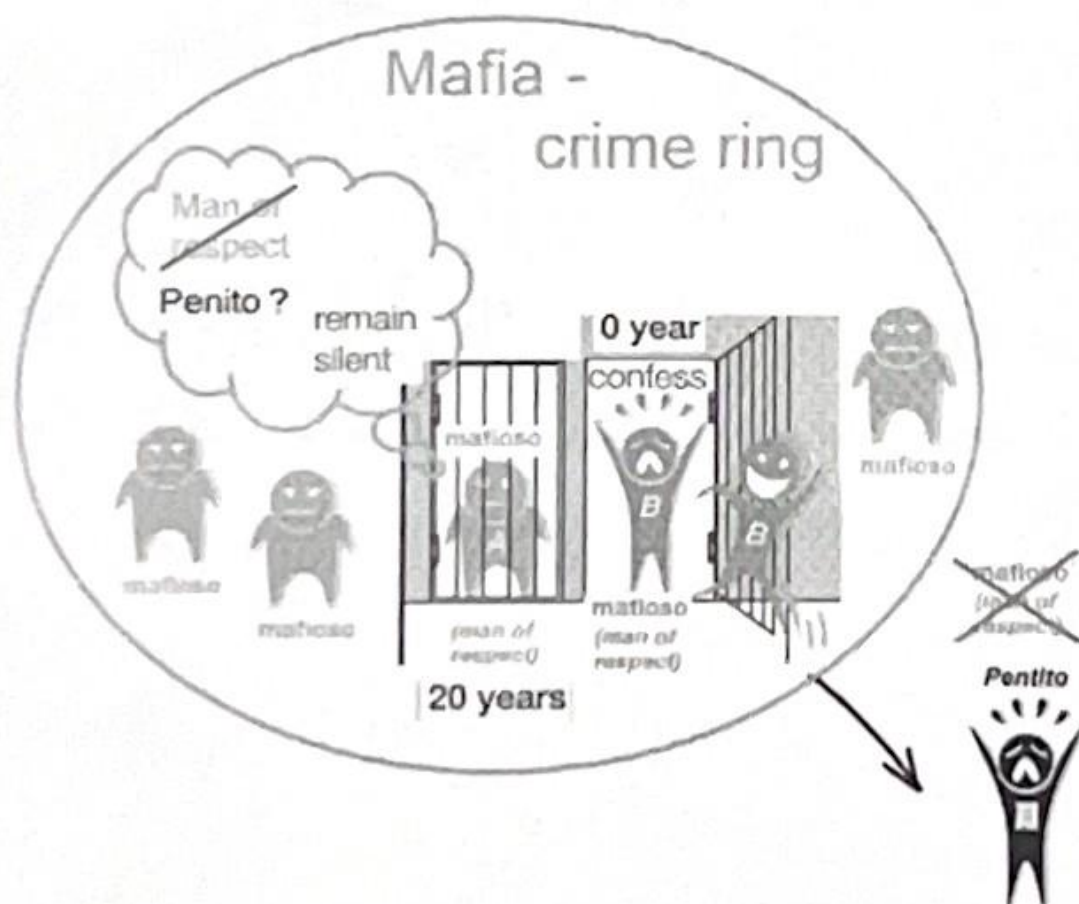
© 2010 Encyclopædia Britannica, Inc.



\*\* => Nash equilibrium

|                  |                    | Player 2     |                  |
|------------------|--------------------|--------------|------------------|
|                  |                    | Recognition; | Non-recognition; |
| Player 1         | H <sub>2</sub> (x) | 1            | 2                |
|                  | H <sub>1</sub> (x) |              |                  |
| Recognition;     | 1                  | -5, -5       | -20, 0           |
| Non-recognition; | 2                  | -20, -5      | -1, -1           |

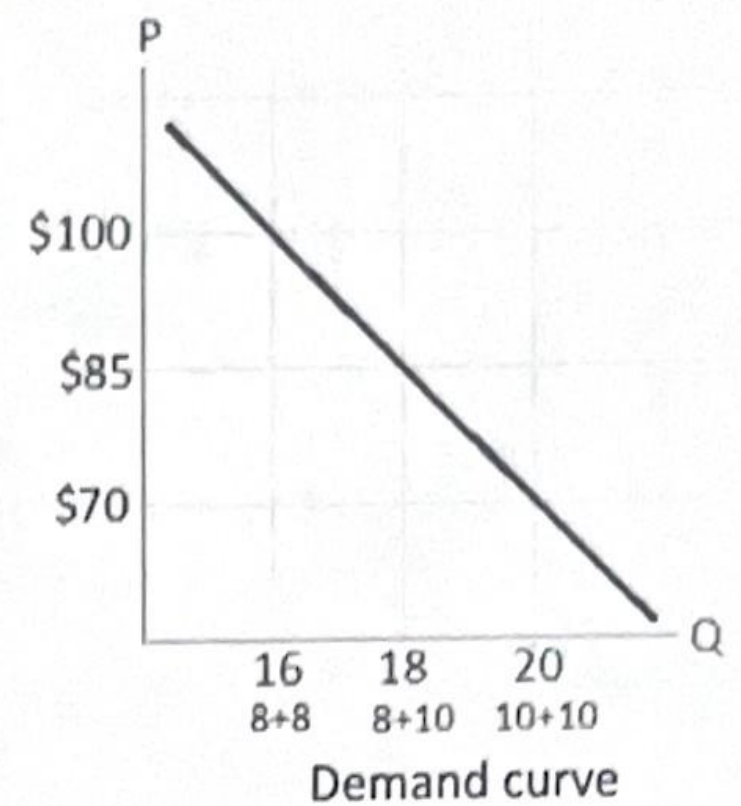
-1-1  
Pareto Optimality





# 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.     | $8 \cdot 10^6$       |  <b>\$800</b> millions per day<br> <b>\$800</b> millions per day<br><b>\$100</b>  |  <b>\$850</b> millions per day<br> <b>\$680</b><br><b>\$85</b>                   |                                                                                                           |  |
|        | $10 \cdot 10^6$  day |  <b>\$680</b> millions per day<br> <b>\$850</b> millions per day<br><b>\$85</b>  |  <b>\$700</b> millions per day<br> <b>\$700</b> millions per day<br><b>\$70</b>  |                                                                                                           |  |





### 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



GALOIS  
20 1821-1832

Misérables

1

2

3

4





40.1 12.2

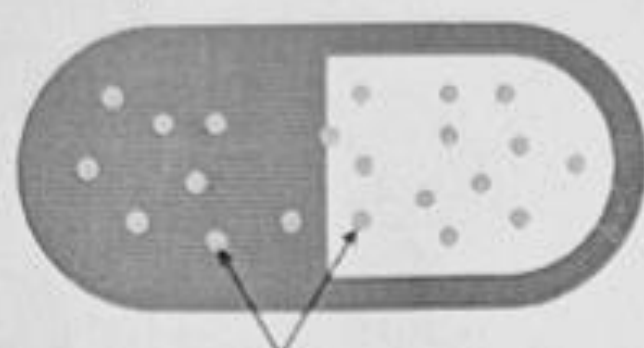
This is the program we need to write today

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

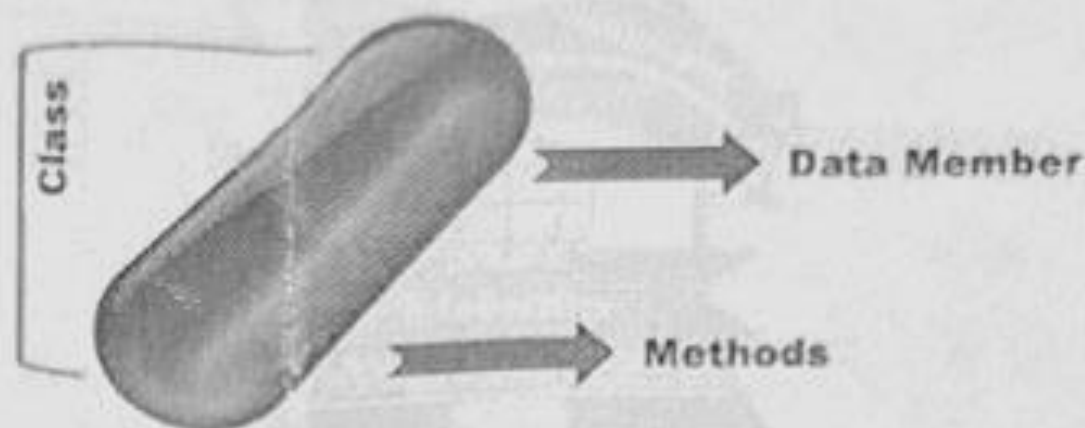


So there's the keyword class. Unlike C++, in C# all code must be placed in a class.

Encapsulated in a class.



Medicines Inside Capsule



A ≠ a

C# is case sensitive

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

(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  |

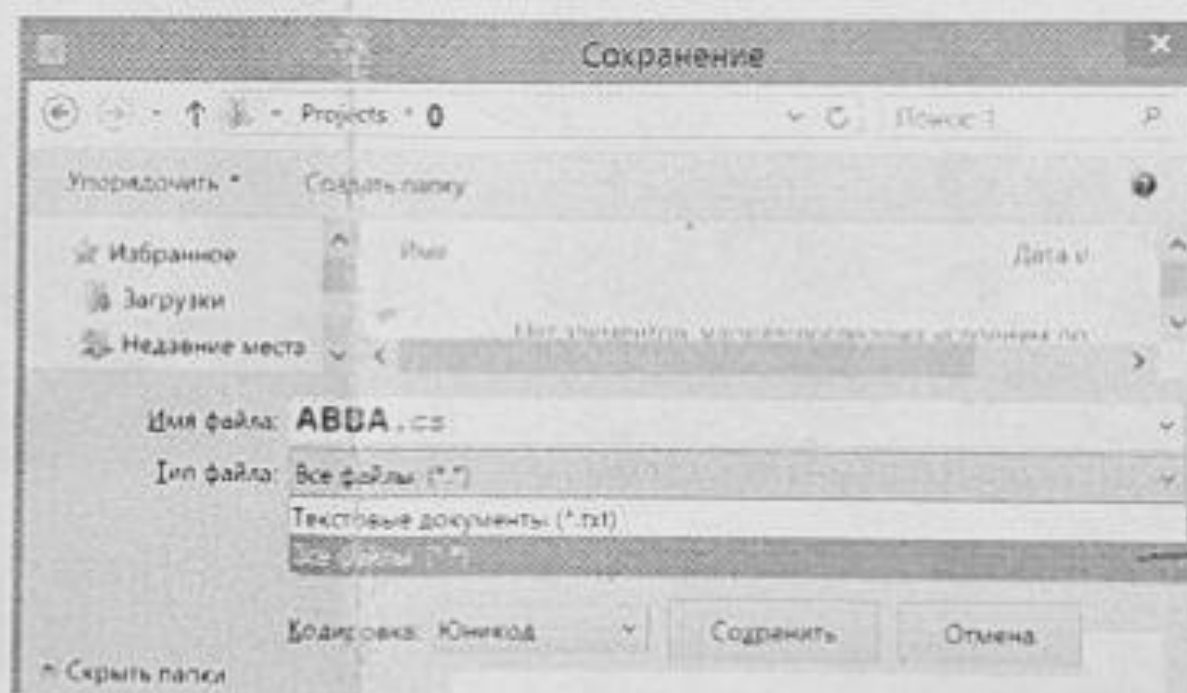
ABBA.cs => csc.exe = ABBA.exe  
C# Compiler

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 -

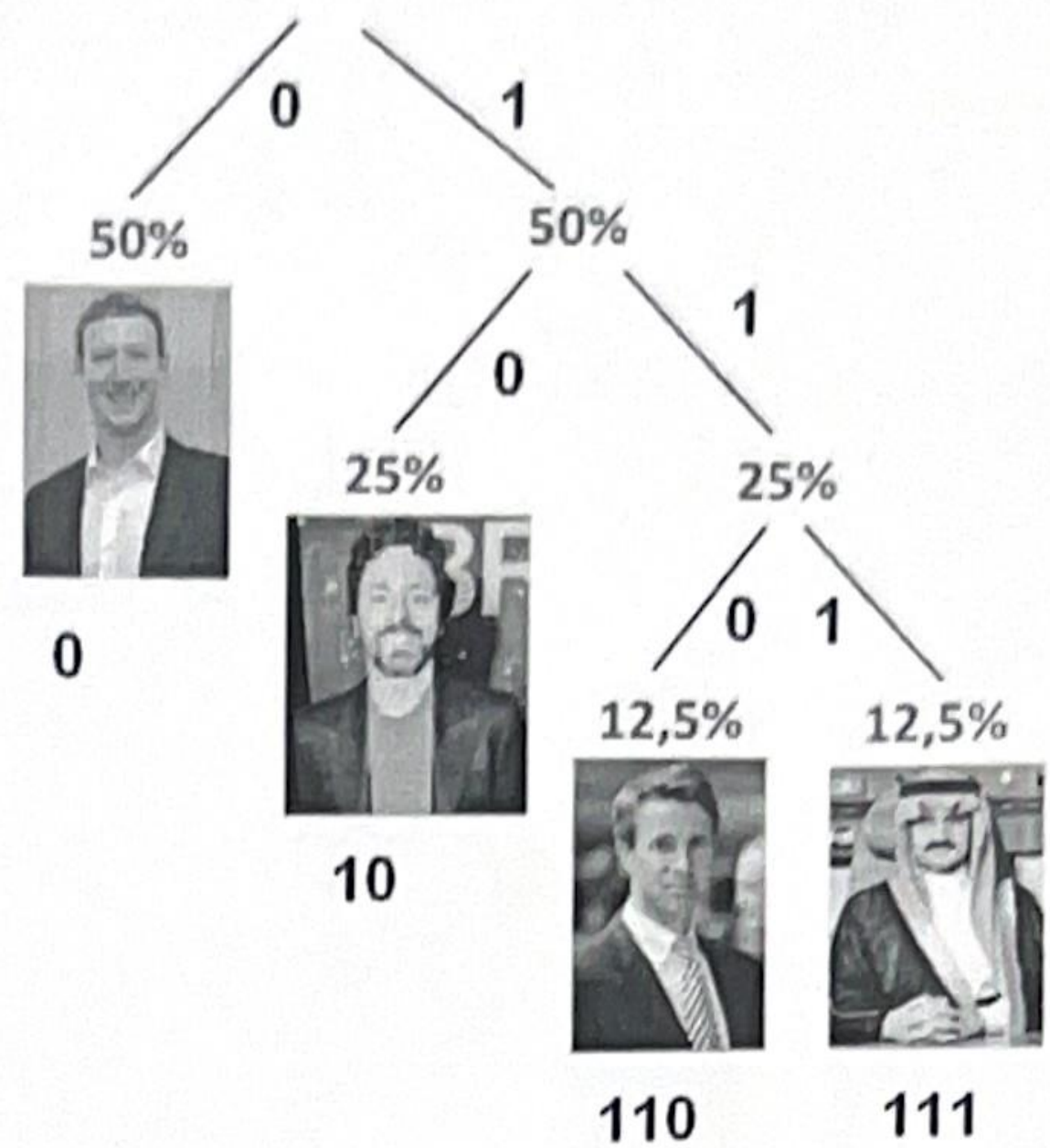
E:\>cd IT

E:\IT>cd Projects

E:\IT\Projects>cd 0

E:\IT\Projects\0>





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 **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   |
| 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)





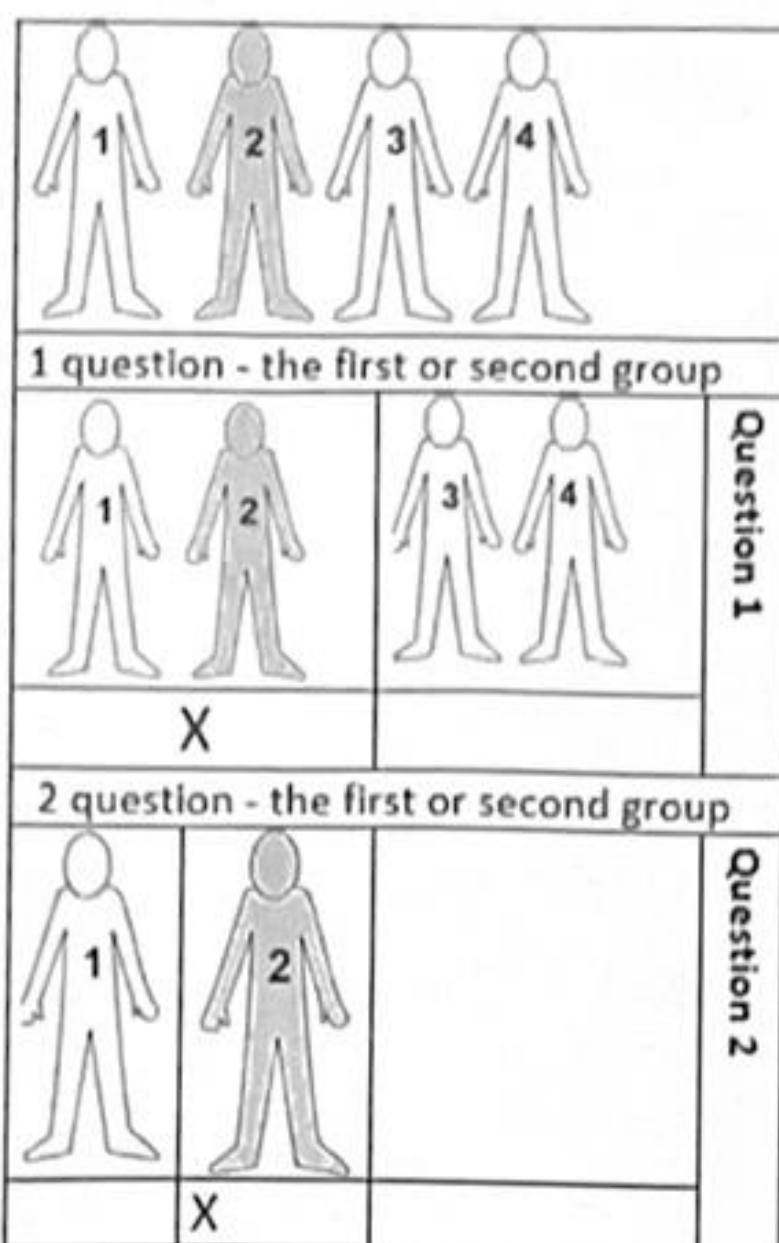
Say NO to the first



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



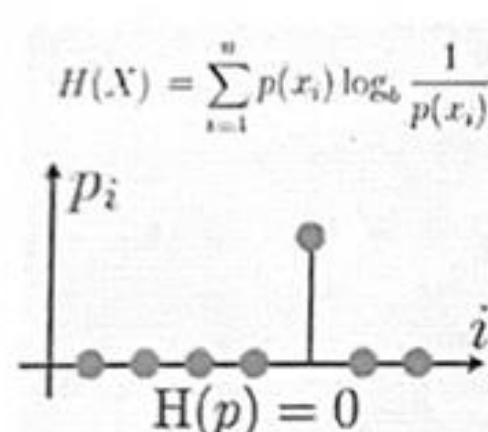
Average number of questions =

$$2 \cdot 0.25 + 2 \cdot 0.25 + 2 \cdot 0.25 + 2 \cdot 0.25 = 2$$

Average number of questions =

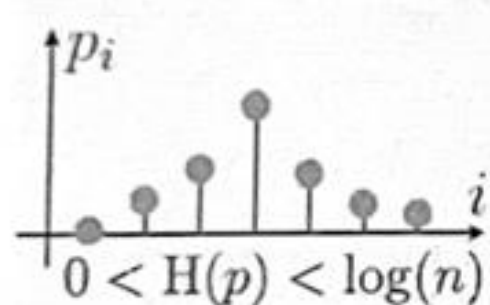
|                                                                                     |                                                                                     |                                                                                     |                                         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

|                                         |                                                                                             |                 |
|-----------------------------------------|---------------------------------------------------------------------------------------------|-----------------|
| Question 1.<br>Is this Zuckerberg?      |  50%     | $1 \cdot 0.5$   |
| Question 2.<br>Is this Sergey Brin?     |  25%   | $2 \cdot 0.25$  |
| Question 3.<br>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      |                                                                                             |                 |



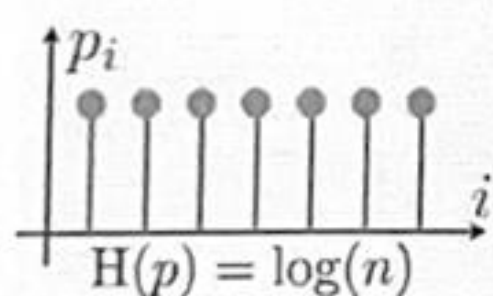
$$\sum_{i=1}^n p(i) \log_2 \frac{1}{p(i)}$$

Quantifying information

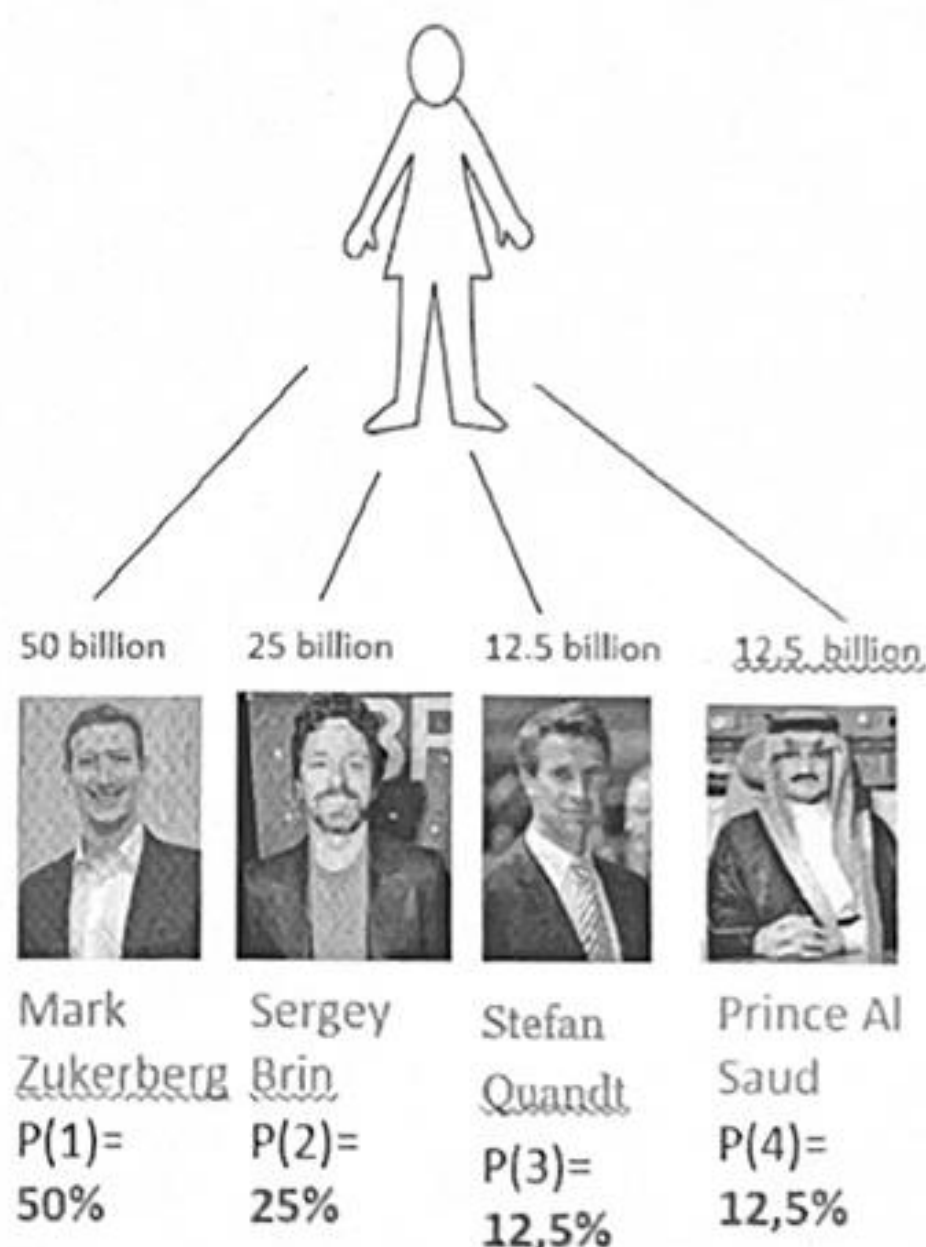


$$I(x_i) = \log_2 \left( \frac{1}{p_i} \right)$$

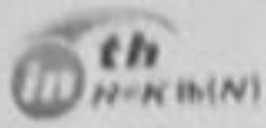
number of bits required to encode choice



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



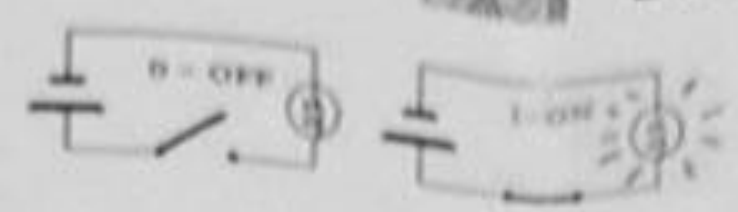
+0.1 Thorne



Massachusetts Institute of Technology (MIT)



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



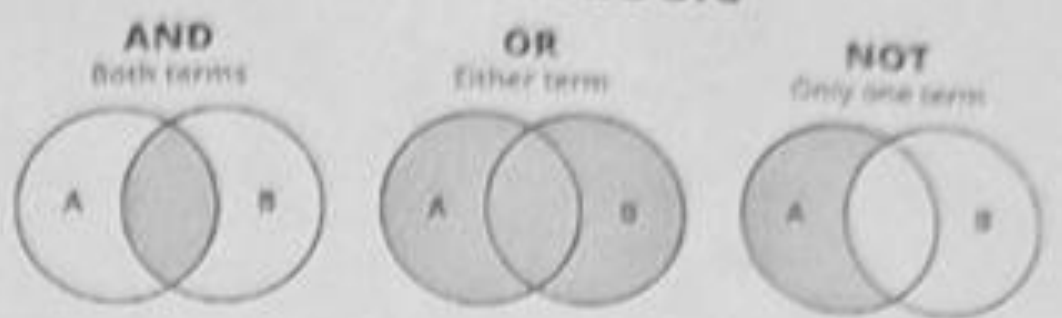
Logical addition  
(disjunction)

| 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      |



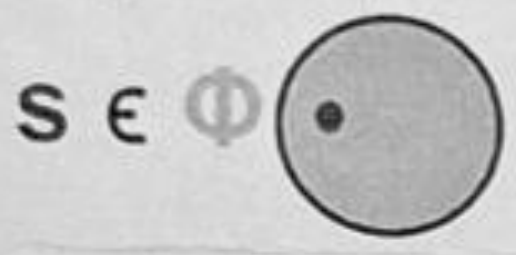
BOOLEAN LOGIC



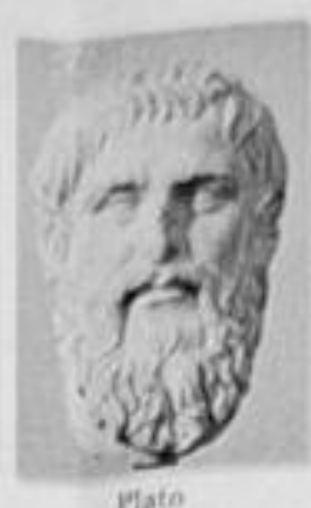
Good logic



Socrates was a philosopher



Socrates



Plato

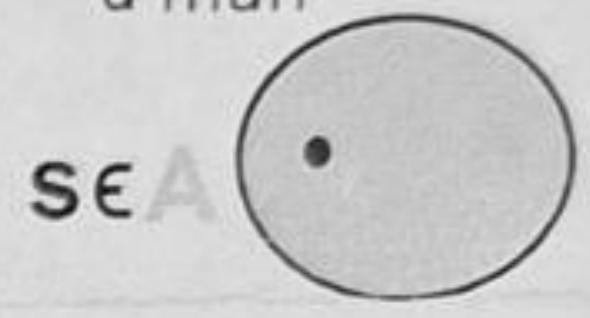


Aristotle

philosophers are men



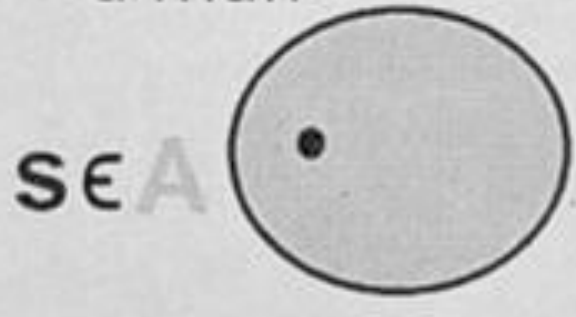
Socrates was a man



Bad logic



Socrates was a man



Socrates

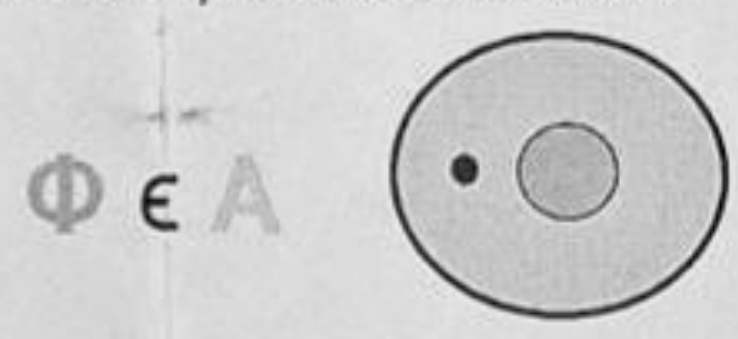


Plato



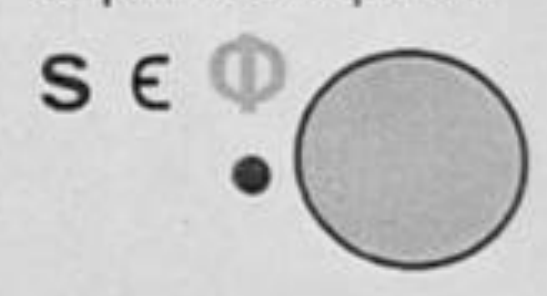
Aristotle

philosophers are men

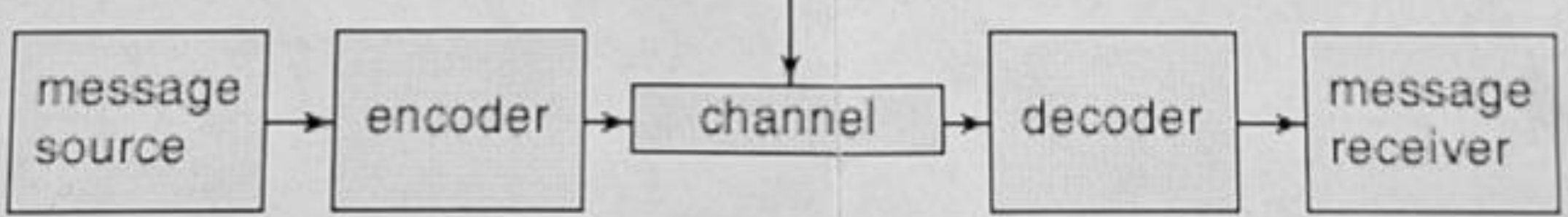


Socrates

Socrates was a philosopher



noise





# 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

*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)

*The Mathematical Theory of Communication*

INFORMATION SOURCE

TRANSMITTER



MESSAGE

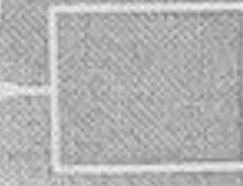


SIGNAL



NOISE SOURCE

DESTINATION



MESSAGE

**Creating a reliable connection over an unreliable (noisy) channel**

that's what IT is about

and that's what Shannon did