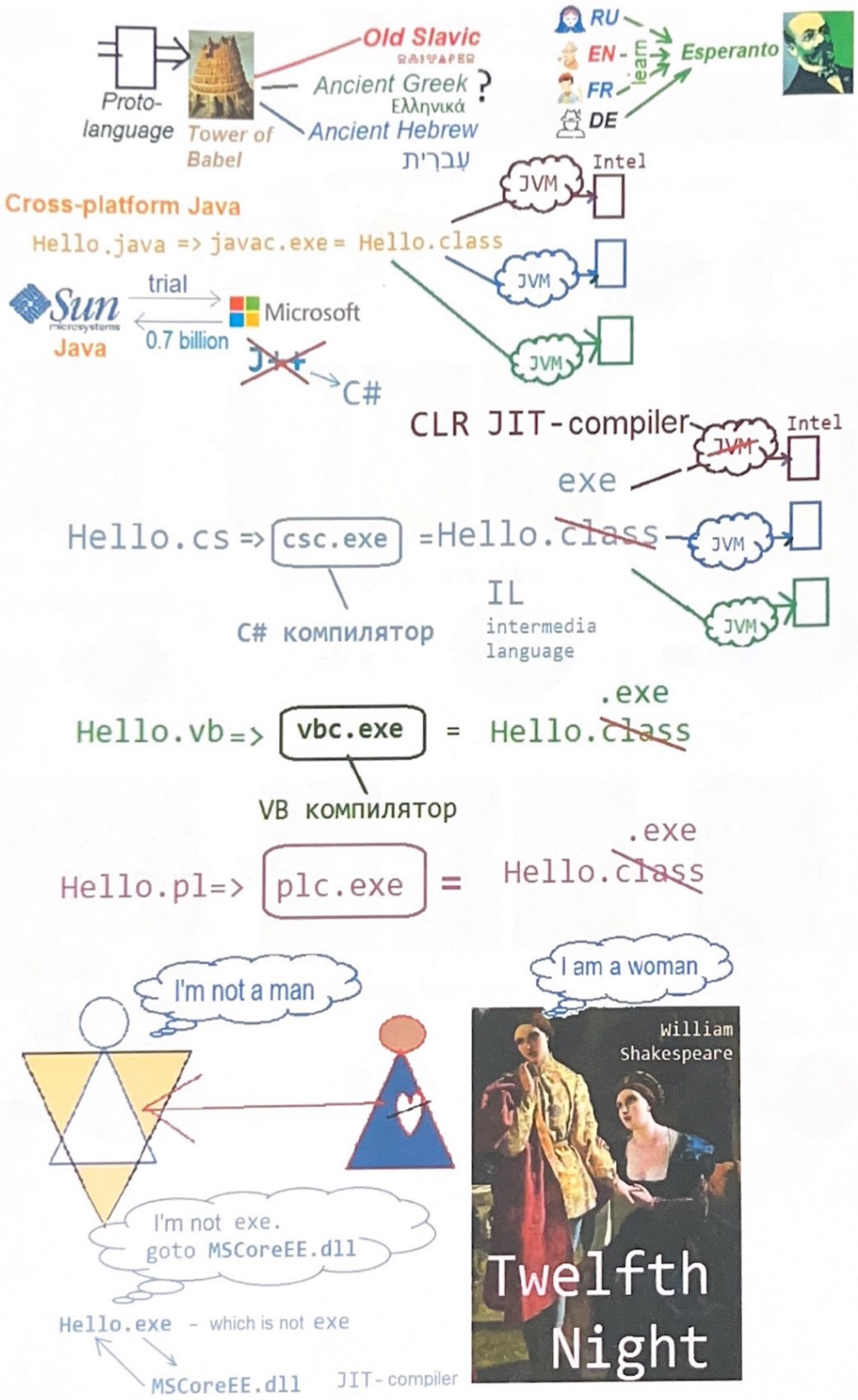
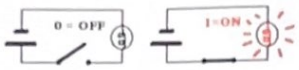

Proto-language
Tower of Babel
Old Slavic
Ancient Greek
Ελληνικά
Ancient Hebrew
עברית
RU
EN
FR
DE
learn
Esperanto
Cross-platform Java
Hello.java => javac.exe = Hello.class
JVM
Intel
Sun microsystems
Java
trial
0.7 billion
Microsoft
J++
C#
CLR JIT-compiler
exe
Hello.cs => csc.exe =Hello.class
C# компилятор
IL
intermedia language
Hello.vb => vbc.exe = Hello.class
.exe
VB компилятор
Hello.pl=> plc.exe = Hello.class
I'm not a man
I am a woman
William Shakespeare
Twelfth Night
I'm not exe.
goto MSCoreEE.dll
Hello.exe - which is not exe
MSCoreEE.dll
JIT-compiler

Massachusetts Institute of Technology (MIT)

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

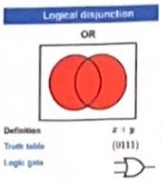




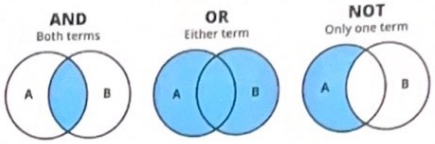
## Logical addition (disjunction)

| 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 |



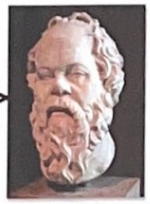

## BOOLEAN LOGIC



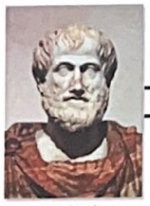

## Good logic


Socrates

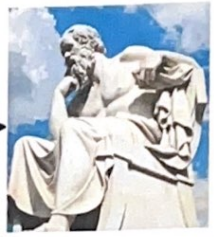
Socrates was a philosopher


Socrates

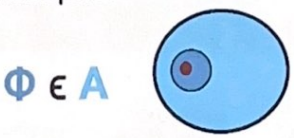

Plato

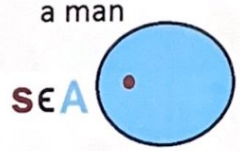

Aristotle

philosophers are men



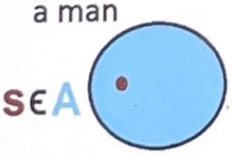
Socrates was a man

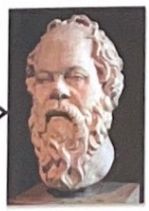



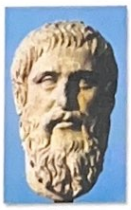



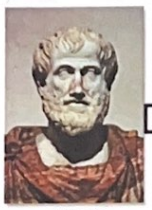

## Bad logic

Socrates was a man

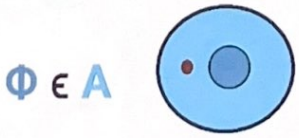




Socrates


Plato


Aristotle

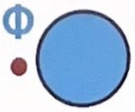
philosophers are men





Socrates

Socrates was a philosopher




3.0.1

## Resume of Lecture by Pr. Bob Gallagher from MIT

Massachusetts Institute of Technology (MIT)

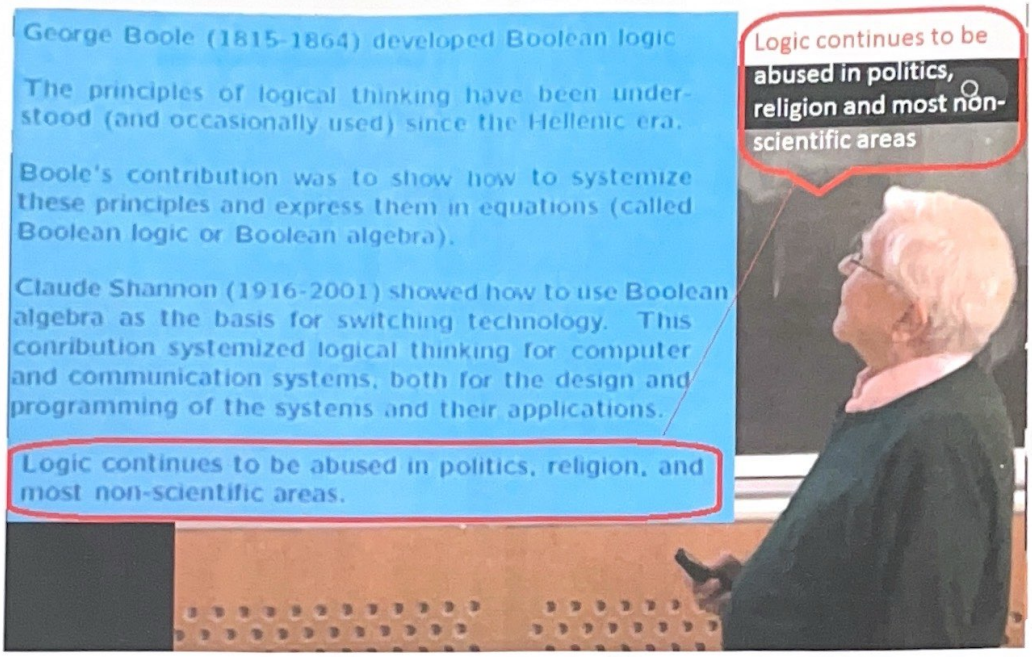
George Boole (1815-1864) developed Boolean logic

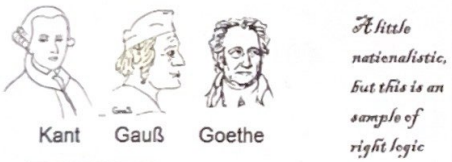
The principles of logical thinking have been understood (and occasionally used) since the Hellenic era.

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 conribution 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.



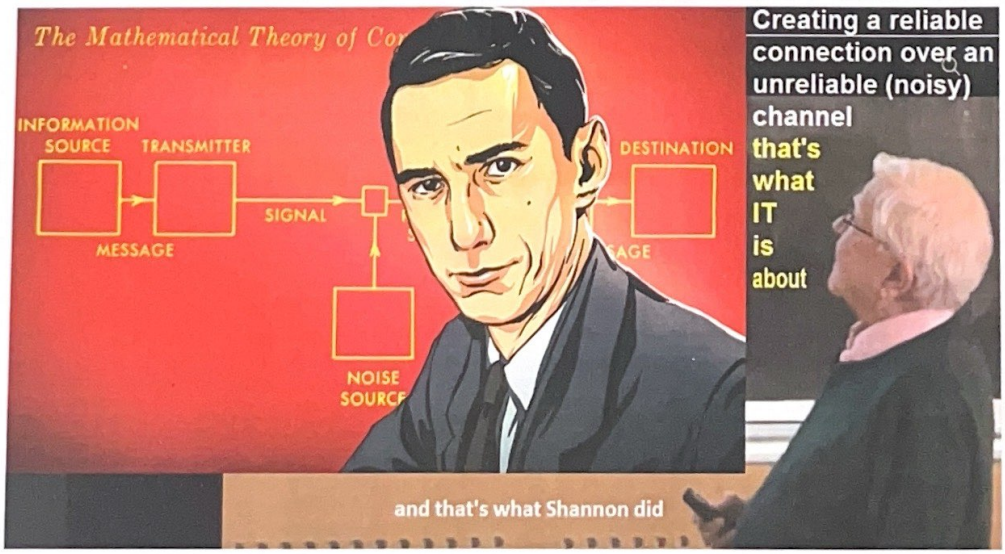



Kant Gauß Goethe

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

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

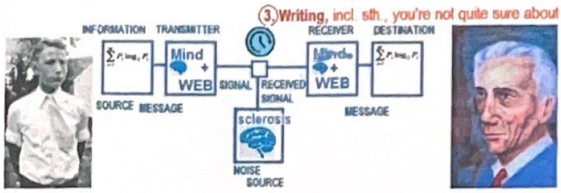

Bad logic (abuse of logic)



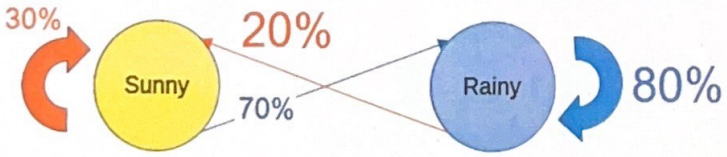

**80%** chance of rain

says the Met Office in its weather forecast for Oxford.

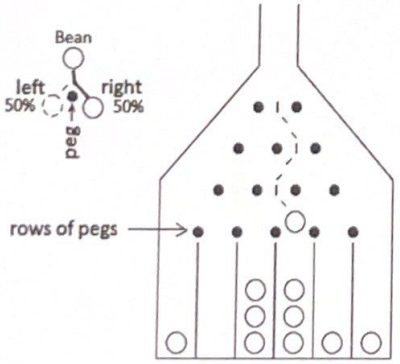


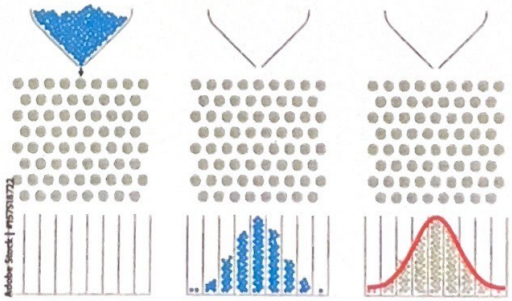



## Markoff Chain Probability Model for Oxford Weather




If it is Rainy today => there is an 80% chance that it will be rainy tomorrow.



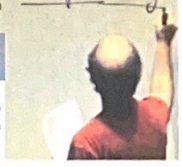



School gravity MOTION == formalism ==> University $E = mc^2$ $\Phi_{BS} \cdot \vec{a}$ $W = \vec{F} \cdot \vec{s}$ $\iint \vec{J} \cdot d\vec{S}$

Motivation: 80% chance of rain

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

Suppose the events $A_j$ each have probability $p$, independently

*then take notes on the lecture yourself*

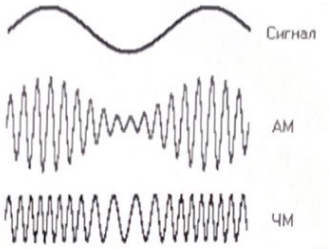
80% chance of rain

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

$0 \leq j \leq n - 40$
$39$

# Information of continuos signals





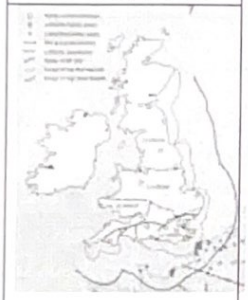

Reginald A. Fessenden

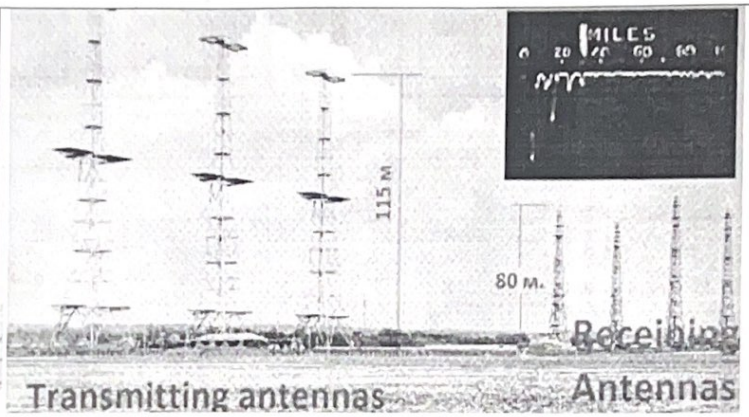
(October 6, 1866 – July 22, 1932)

first transmission of speech by radio (1900), and the first two-way radiotelegraphic communication across the Atlantic Ocean (1906)

"No organization engaged in any specific field of work, ever invents any important development in that field, or adopts any important development in that field, until forced to do so by outside competition." Oxford University Press. The Quarterly Journal of Economics , Feb., 1926, p. 262.

**Battle of Britain**
(3 month 3 weeks)
10.07-31.10.1940






Radar played a major role in the Battle of England

H. Nyquist

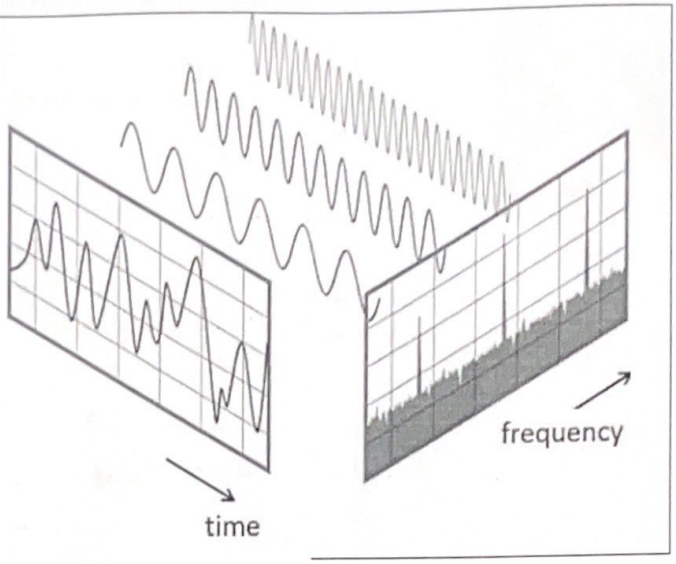
$$W = K \log m$$

Where $W$ is the speed of transmission of intelligence,
$m$ is the number of current values,
and, $K$ is a constant.

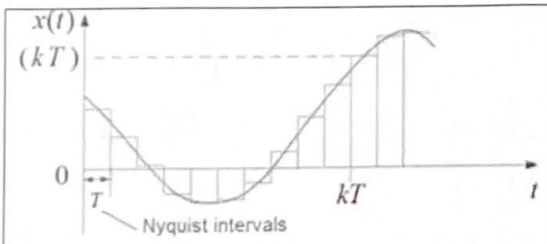
$$H = n \log s$$

$$= \log s^n.$$

## Fourier transform

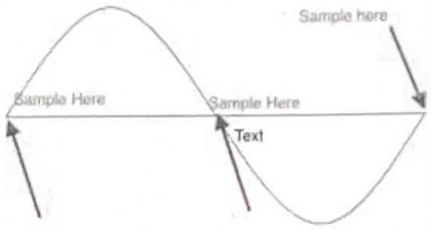


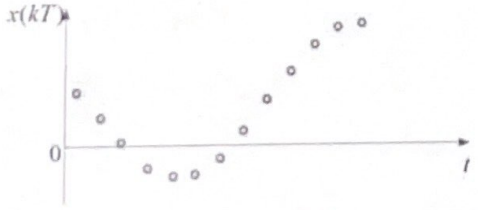

## Sampling. Kotelnikov-Nyquist Theorem



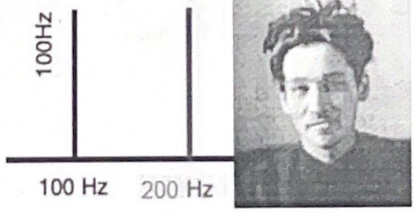

Time intervals T, through which readings s (kT) are taken, are called Nyquist intervals.

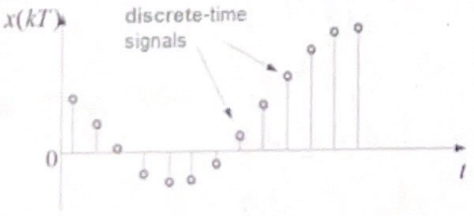
**Sine with period T** — **Sampling at T/2**




frequency Sample

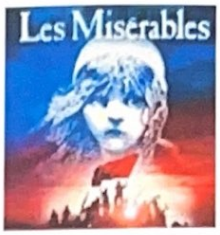



$F_{sample} >= 2 * F_{max}$

$(T_{sample} <= T_{min}/2)$

**É. Galois** (1811-1832) **Les Misérables | Do You Hear the People Sing?**




Example

There are $6!$ ways to order the letters of GALOIS

If randomly reorder the letters what is probability that the vowels (A, O, I) are all before consonants (G, L, S)?

$$\frac{(3! \cdot 3!)}{6!} = \frac{36}{720} = \frac{1}{20}$$

1st aoi gl
aai lg

$3! = 6$

2nd oai gl
oai lg

3rd oia ge
oia lg
3 2
1st 2nd

i $1 \cdot 3!$ $1 \cdot 6$
oi $2 \cdot 3!$ $2 \cdot 6$
aoi $3! \cdot 3!$ $3 \cdot 6$

$P_{vc} = \frac{3! \cdot 2!}{5}$

6th gl
lg

$\Rightarrow 6 \cdot 2$
$3! \cdot 2$

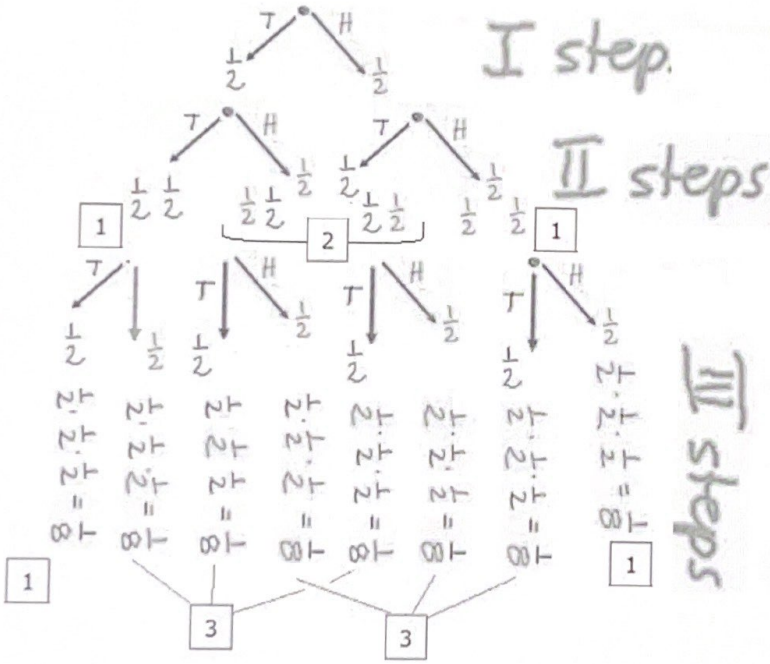
6
AAA BCD
same different

if we had
$A_1 A_2 A_3$ B C D
$BA_1DA_2A_3C$ ← corresponds to the same
$BADAAC$ ← ambiguity
$BA_2DA_3A_1C$ ←
1st 2nd 6th

$A_1 A_2 A_3$
$A = A = A$

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 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 |

Pascal's triangle




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

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

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

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

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

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

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 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 | 1 |

## Shannon Hartley Theorem

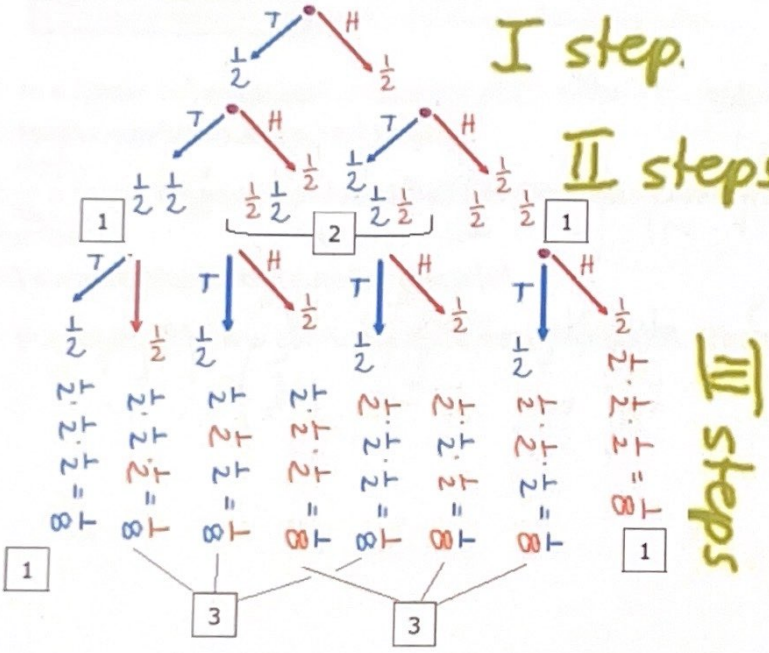
This is a measure of the *capacity* on a channel; it is impossible to transmit information at a faster rate without error.

$$C = B\log_2(1+S/N)$$

- C = capacity (in bit/s)
- B = bandwidth of channel
- S = signal power (in W)
- N = noise power (in W)

It is more usual to use SNR (in dB) instead of power ratio (as with terrestrial and commercial communications syste S/N >> 1, then rewriting in terms of log10.

$$C = B\frac{\log_{10}(S/N)}{\log_{10}2} = B\frac{10\log_{10}(S/N)}{10.\log_{10}2} = B\frac{SNR}{3.01}$$




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

$(1+x)^5 = 1^5 + 5\cdot 1^4\cdot x + 10\cdot 1^3\cdot x^2 + 10\cdot 1^2\cdot x^3 + 5\cdot 1\cdot x^4 + x^5 =$

$= 1 + 5x + 10x^2 + 10x^3 + 5x^4 + x^5$

$(y+x)^7 = y^7 + 7xy^6 + 21x^2y^5 + 35x^3y^4 + 35x^4y^3 + 21x^5y^2 +$

$+ 7x^6y + x^7$

To Exam

ABBA - $\frac{4!}{2! \cdot 2!}$

The number of arrangements of the N objects

$\underbrace{x_1, \ldots, x_1}_{m_1}$ $\underbrace{x_2, \ldots, x_2}_{m_2}$ $\underbrace{x_k, \ldots, x_k}_{m_k}$

where $n = m_1 + m_2 + \ldots + m_k$

$$\frac{n!}{m_1! \, m_2! \ldots m_k!}$$

$n = m_1 + m_2 + \ldots + m_k$

$$\frac{n!}{m! \, m_2! \ldots m_k!}$$

$$\boxed{\frac{n!}{m! \, (n-m)!}}$$ ← binomial coefficient $\binom{n}{m}$ Newton binomial

$$(1+x)^4 = \underset{\binom{4}{0}}{1} + \underset{\binom{4}{1}}{4x} + \underset{\binom{4}{2}}{6x^2} + \underset{\binom{4}{3}}{4x^3} + \underset{\binom{4}{4}}{x^4}$$

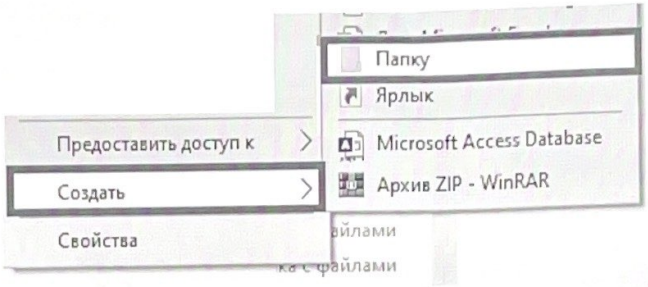
$C_4^m$

**What should you do in class:**

0. Come up with a good name for your site.

I came up with a name for my site - Confucius (in my opinion, this is a good name)
www.**confucius**.bsite.net

1.On a disk or on a flash drive, make a folder that matches the name of the site www.**confucius**.bsite.net


2. In a folder **D:\www.confucius.bsite.net** create a folder for Projects
**D:\www.confucius.bsite.net\Projects**

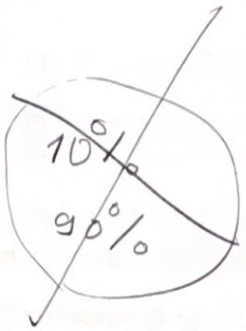
3. In a folder **D:\www.confucius.bsite.net\Projects** create a folder for Projects Number 0
**D:\www.confucius.bsite.net\Projects\0**

4. In a folder **D:\www.confucius.bsite.net\Projects\0** create file ***index.htm***

Hi
www.Bsite.net
Web-server
IIS (internet information server)
Windows hosting
esperanto.bsite.net → where located

↑ 5.161.102.56
same confucious.bsite.net
↓ 5.161.102.56

Exam toefel – 90%
fail – 10%




You pass Toefel 2 times
what is probability of fail

$p = 0,9 \quad q = 0,1$

$P_2 = 0,9 \cdot 0,9 = 0,81$
$P_1 = 1 - P_2 = 1 - 0,81 = 0,19$ 19%

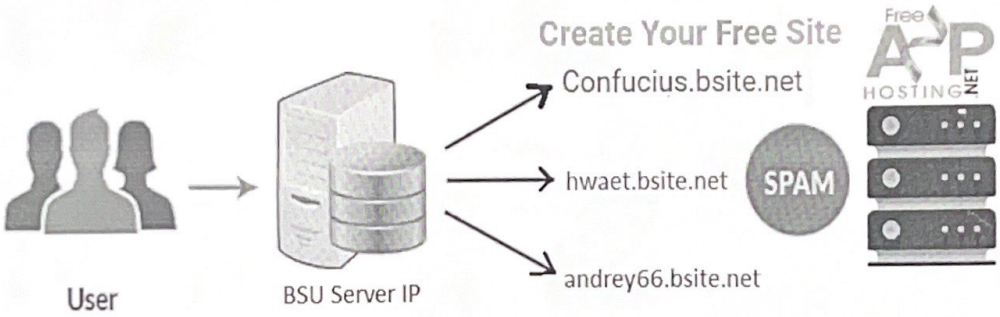
1) Pass Exam Succ → 0.9
2) fail Succ → 0.1 · 0.9 +

0,1 · 0,9 + 0,9 = 0,99 OK
0,09
success

i) 2 false
false false = 0.1 · 0.1 = 0.01
S = 1 − 0.01 = 0.99

**What should you do at home:**
Register free hosting on **freeasphosting.net**
At home because many hosting services do not register from one IP address.


If several dozen hosting attempts to register from one IP address, the **freeaspohosting.net** server may decide that this is a SPAMer and block it.




And if registration is carried out from different computers (with different IP addresses), then the freeasphosting.net server does not raise any suspicions.


After you have registered on the server, send me your address (which you received during registration) by email.

During 3 days

D:\ www. confucius. by

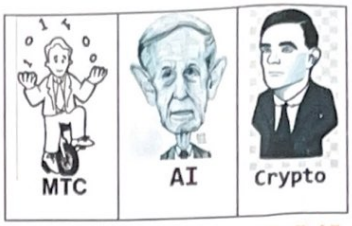
Images / image.jpg

index.html

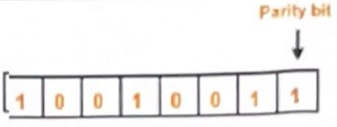
Notepad
Visual Studio

+0,2 from 15.4.24

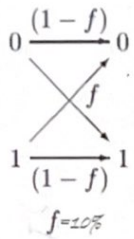

Sir **Dr. D. MacKay,**
University of Cambridge
(22 April 1967 – 14 April 2016)



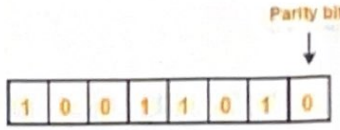

"I believe in clean energy,
but I also believe in mathematics"









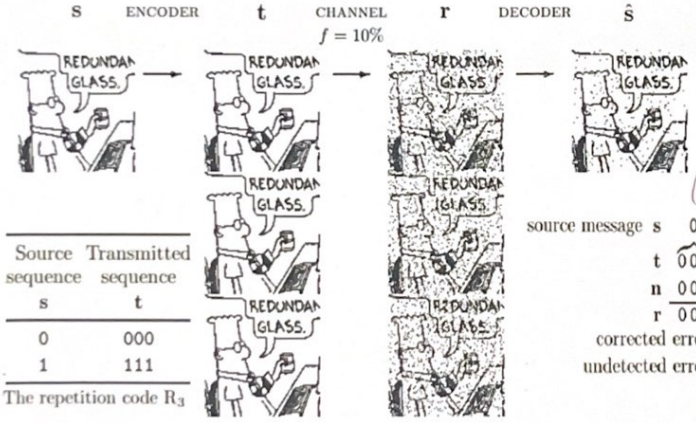

10%

p=0,1 q=0,9

$F = 0,9 \cdot 0,9 \cdot 0,9 = 0,729$

$S = 1 - 0,729 = 0,271$

0,999

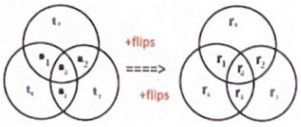


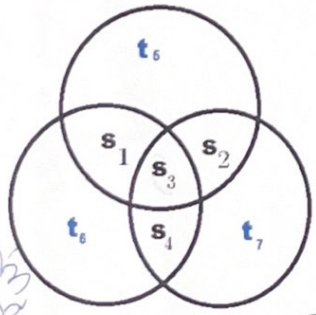

| Source sequence s | Transmitted sequence t |
|---|---|
| 0 | 000 |
| 1 | 111 |

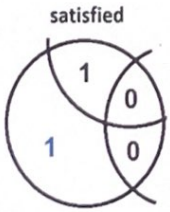
The repetition code $R_3$

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 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 | | | | | * | | |

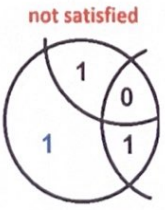
## 7.4. Hamming code. $\frac{4}{\Sigma} \rightarrow \frac{7}{t}$



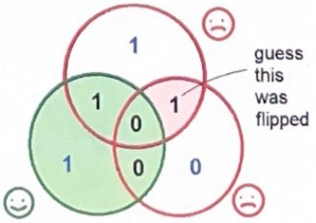




1+1+0+0=**0**




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



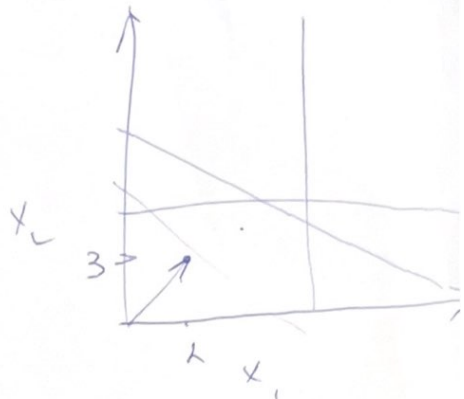



+0,1 to Exam

~~max F(x1, x2~~

3.

$$\begin{cases} \max F(x_1, x_2) = 2x_1 + 6x_2 \\ x_1 + x_2 \geq 4 \\ x_1 + 2x_2 \leq 6 \\ 2x_1 - 2x_2 \leq 5 \\ x_1 \geq 0 \\ x_2 \geq 0 \end{cases}$$




1. $\begin{cases} x_1 + x_2 = 4 \\ x_1 + 2x_2 = 6 \end{cases}$

$\begin{cases} x_1 = 4 - x_2 \\ 4 - x_2 + 2x_2 = 6 \end{cases}$ $\begin{cases} x_1 = 2 \\ x_2 = 2 \end{cases}$

2. $\begin{cases} x_1 + x_2 = 4 \\ 2x_1 - 2x_2 = 5 \end{cases}$ $\begin{cases} x_1 = 4 - x_2 \\ 8 - 2x_2 - 2x_2 = 5 \end{cases}$

$\begin{cases} x_1 = \frac{13}{4} \\ x_2 = \frac{3}{4} \end{cases}$

3. $\begin{cases} x_1 + 2x_2 = 6 \\ 2x_1 - 2x_2 = 5 \end{cases}$ $\begin{cases} x_1 = 6 - 2x_2 \\ 12 - 4x_2 - 2x_2 = 5 \end{cases}$

$\begin{cases} x_1 = \frac{11}{3} \\ x_2 = \frac{7}{6} \end{cases}$

4. $\begin{cases} x_1 = 0 \\ x_1 + 2x_2 = 6 \end{cases}$ $\begin{cases} x_1 = 0 \\ x_2 = 3 \end{cases}$

5. $\begin{cases} x_2 = 0 \\ x_1 + 2x_2 = 6 \end{cases}$ $\begin{cases} x_2 = 0 \\ x_1 = 6 \end{cases}$

6. $\begin{cases} x_1 = 0 \\ 2x_1 - 2x_2 = 5 \end{cases}$ $\begin{cases} x_1 = 0 \\ x_2 = -\frac{5}{2} \end{cases}$

7. $\begin{cases} x_2 = 0 \\ 2x_1 - 2x_2 = 5 \end{cases}$ $\begin{cases} x_2 = 0 \\ x_1 = \frac{5}{2} \end{cases}$

8. $\begin{cases} x_1 = 0 \\ x_1 + x_2 = 4 \end{cases}$ $\begin{cases} x_1 = 0 \\ x_2 = 4 \end{cases}$

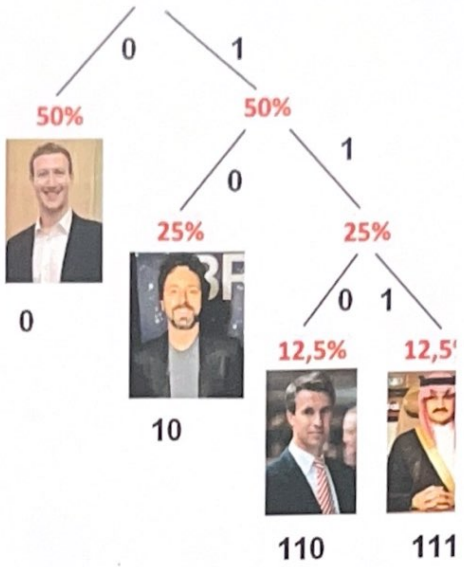
9. $\begin{cases} x_2 = 0 \\ x_1 + x_2 = 4 \end{cases}$ $\begin{cases} x_2 = 0 \\ x_1 = 4 \end{cases}$

$F_1 = 2 \cdot 2 + 6 \cdot 2 = 16$, $F_2 = 2 \cdot \frac{13}{4} + 6 \cdot \frac{3}{4} = 11$, $F_3 = 2 \cdot \frac{11}{3} + 6 \cdot \frac{7}{6} = \frac{43}{3}$

$F_4 = 2 \cdot 0 + 6 \cdot 3 = 18$, $F_5 = 2 \cdot 6 + 6 \cdot 0 = 12$, $F_6 = 2 \cdot 0 + 6 \cdot \left(-\frac{5}{2}\right) = -15$

$F_7 = 2 \cdot \frac{5}{2} + 6 \cdot 0 = 5$ $F_8 = 2 \cdot 0 + 6 \cdot 4 = 24$, $F_9 = 2 \cdot 4 + 6 \cdot 0 = 8$

$F_1$ $F_2$ $F_3$




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

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

ам ыл ла ам ма ра ма ыл ла ам мы

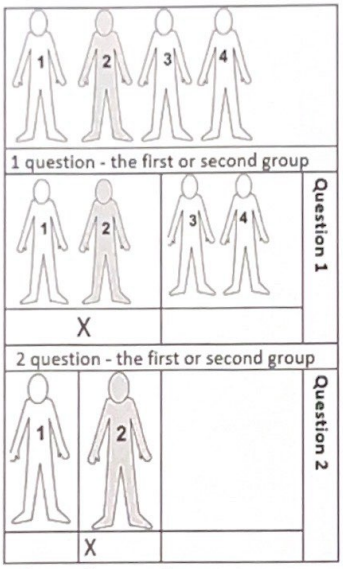
мылла рама


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***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 |
| 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** | | |

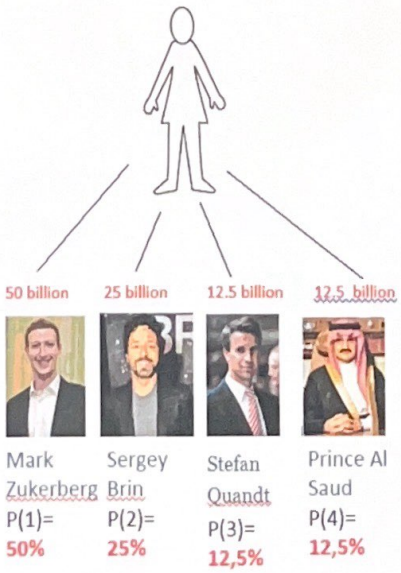
Quantifying information

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

Quantifying information

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

number of bits required to encode choice




ce