



Massachusetts Institute of Technology (MIT)



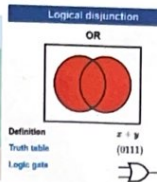
Lecture by Pr. Bob Gallagher
Boole (1815-1864) & Shannon (1916-2001)



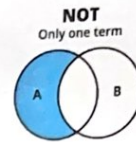
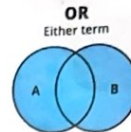
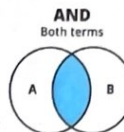
Logical addition
(disjunction)

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

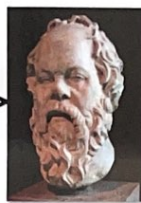


Good logic

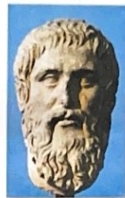


Socrates

Socrates was
a philosopher



Socrates



Plato

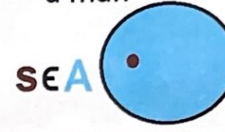


Aristotle

philosophers are men



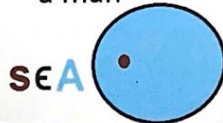
Socrates was
a man



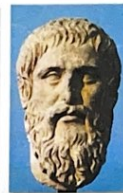
Bad logic



Socrates was
a man



Socrates



Plato



Aristotle

philosophers are men



Socrates

Socrates was
a philosopher



Example of logical conclusion

To save information we should store it in 3 places:

HDD 1 90% - 10% of fail

site 2 90%

www 3 90%

$$1 \cdot 0, 1 \cdot 0, 1 \cdot 0, 1 = 0,999$$

99,9% - probability of saving information

Resume of Lecture by Pr. Bob Gallagher from MIT Massachusetts Institute of Technology (MIT)

George Boole (1815-1864) developed Boolean logic

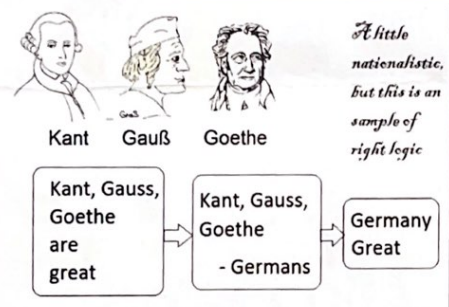
The principles of logical thinking have been understood (and occasionally used) since the Hellenic era.

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



Bad logic (abuse of logic)

The Mathematical Theory of Communication

The diagram shows the flow of information in a communication system. It starts with an "INFORMATION SOURCE" which produces a "MESSAGE". This message is sent to a "TRANSMITTER". The transmitter sends a "SIGNAL" to a "RECEIVER". The receiver then sends a "MESSAGE" to the "DESTINATION". A "NOISE SOURCE" is shown with an arrow pointing into the signal path between the transmitter and the receiver.

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

and that's what Shannon did

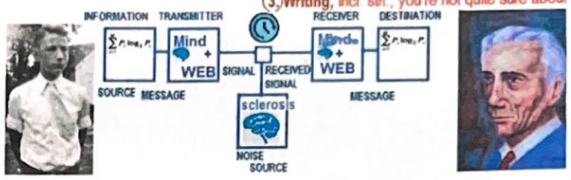
Walking in Oxford on a cold and rainy day

With prof. Matthias Winkel

DEPARTMENT OF STATISTICS

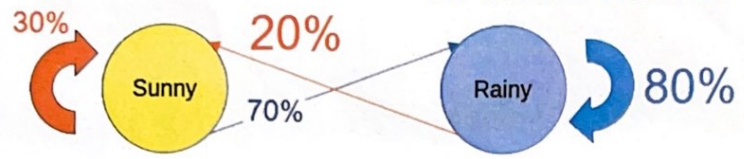


80% chance of rain
says the Met Office in its weather forecast for Oxford.

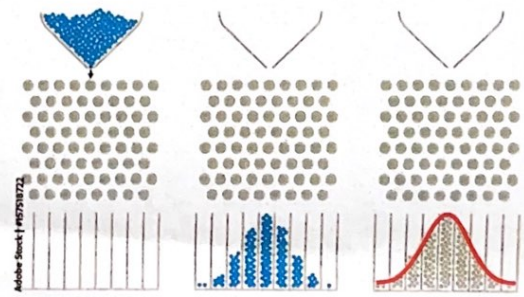
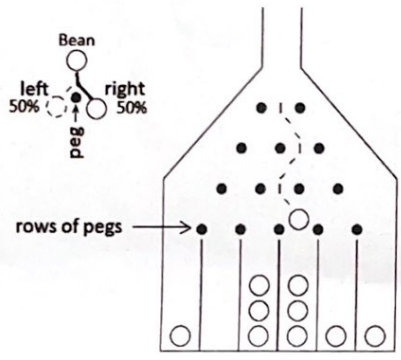


Markoff Chain Probability Model

for Oxford Weather



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



School \rightarrow gravity \rightarrow Motion == formalism ==> University $E = MC^2$ $\nabla \cdot \mathbf{J} = \rho$ $W = 24f$ $\frac{1}{J} \frac{dJ}{dt}$

Motivation: 80% chance of rain
Let A_j be the event of rain at Jam 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° 100%

then take notes on the lecture yourself

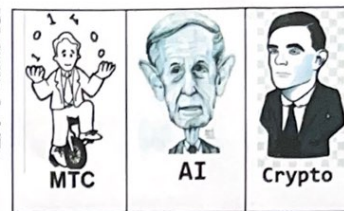
60% chance of rain

Let A_j be event of rain at Gam. on
day j this term

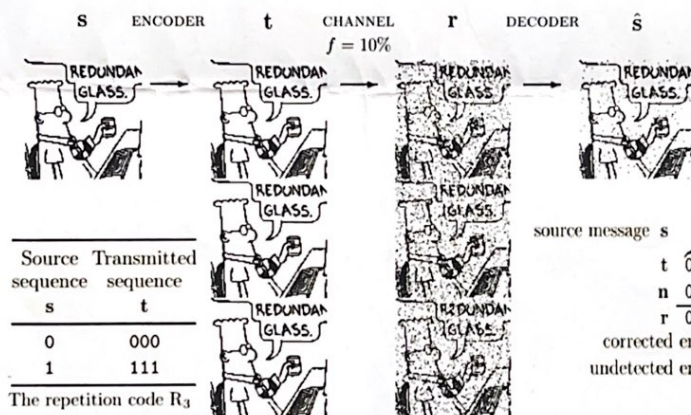
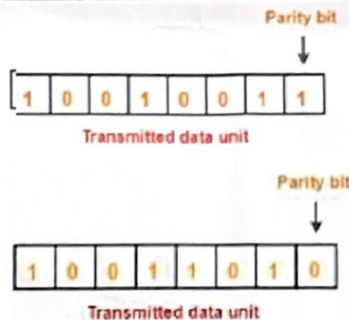
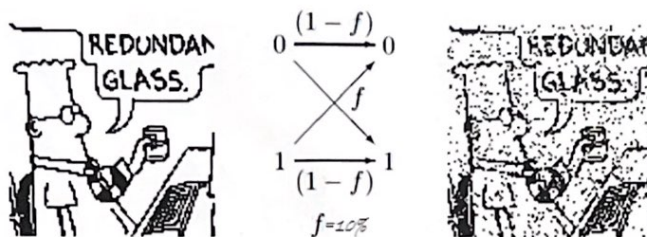
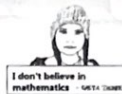
$$0 \leq j \leq n - \frac{40}{39}$$



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



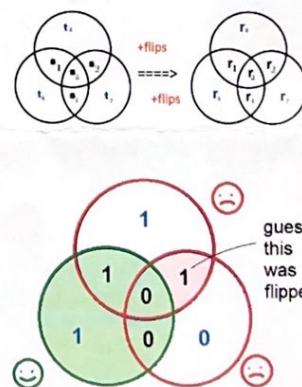
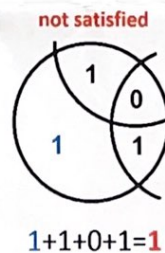
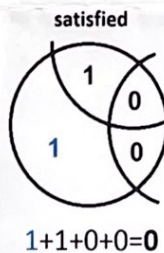
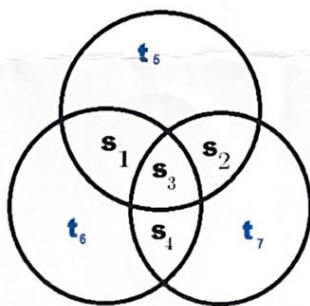
"I believe in clean energy,
but I also believe in mathematics"

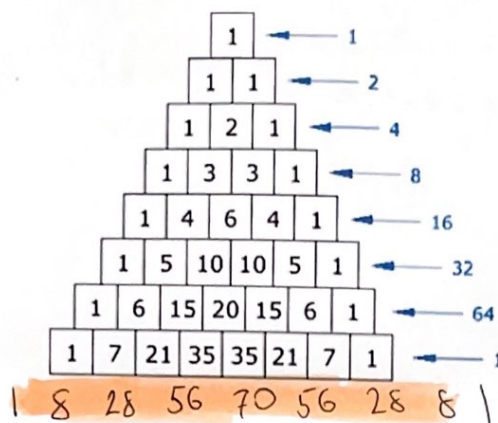


source message s	0	0	1	0	1	1	0
t	000	000	111	000	111	111	000
n	000	001	000	000	101	000	000
r	000	001	111	000	010	111	000
corrected errors		*					
undetected errors					*		

7.4. Hamming code.

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





Shannon Hartley Theorem

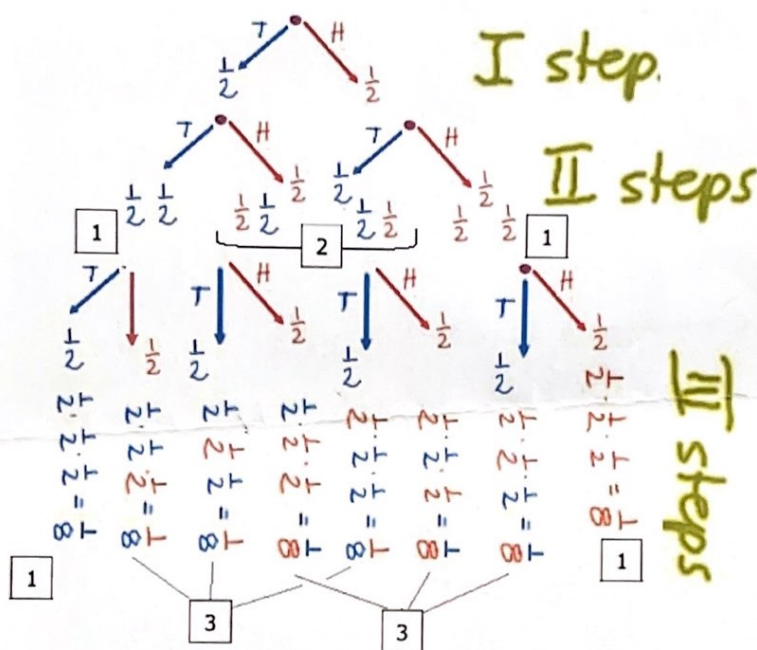
This is a measure of the *capacity* on a channel; it is impossible to transmit information at a faster rate without error.

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

- 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 systems). $S/N \gg 1$, then rewriting in terms of \log_{10} .

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



$$\begin{aligned}
 (a+b)^0 &= 1 \\
 (a+b)^1 &= a+b \\
 (a+b)^2 &= a^2 + 2ab + b^2 \\
 (a+b)^3 &= a^3 + 3a^2b + 3ab^2 + b^3 \\
 (a+b)^4 &= a^4 + 4a^3b + 6a^2b^2 + 4ab^3 + b^4 \\
 (a+b)^5 &= a^5 + 5a^4b + 10a^3b^2 + 10a^2b^3 + 5ab^4 + b^5 \\
 (1+x)^4 &= 1 + 4x + 6x^2 + 4x^3 + x^4
 \end{aligned}$$

(4) symmetrical
(1) — eq — (3)

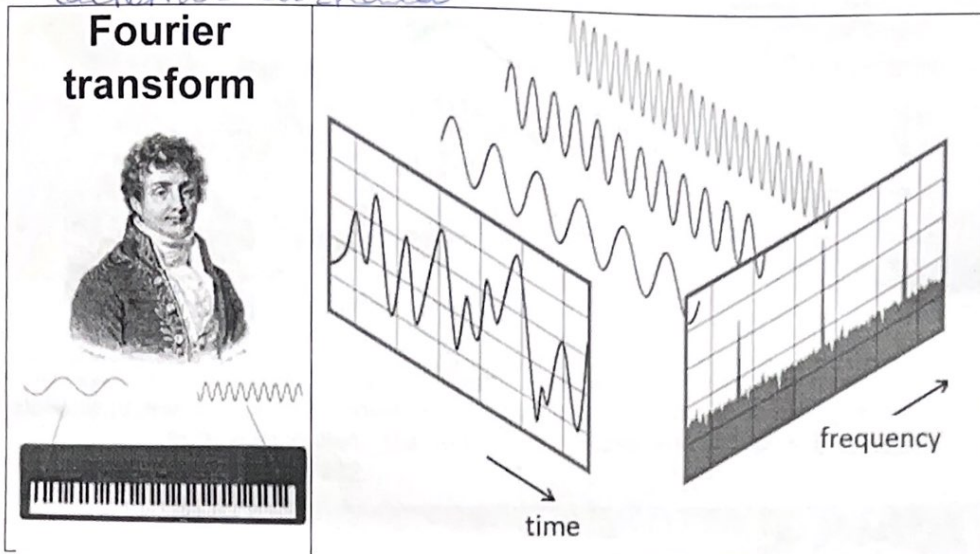
symmetrical

$$\begin{aligned}
 (y+x)^8 &= y^8 + 8xy^7 + 28x^2y^6 + 56x^3y^5 + 70x^4y^4 + 56x^5y^3 \\
 &\quad + 28x^6y^2 + 8x^7y + x^8
 \end{aligned}$$

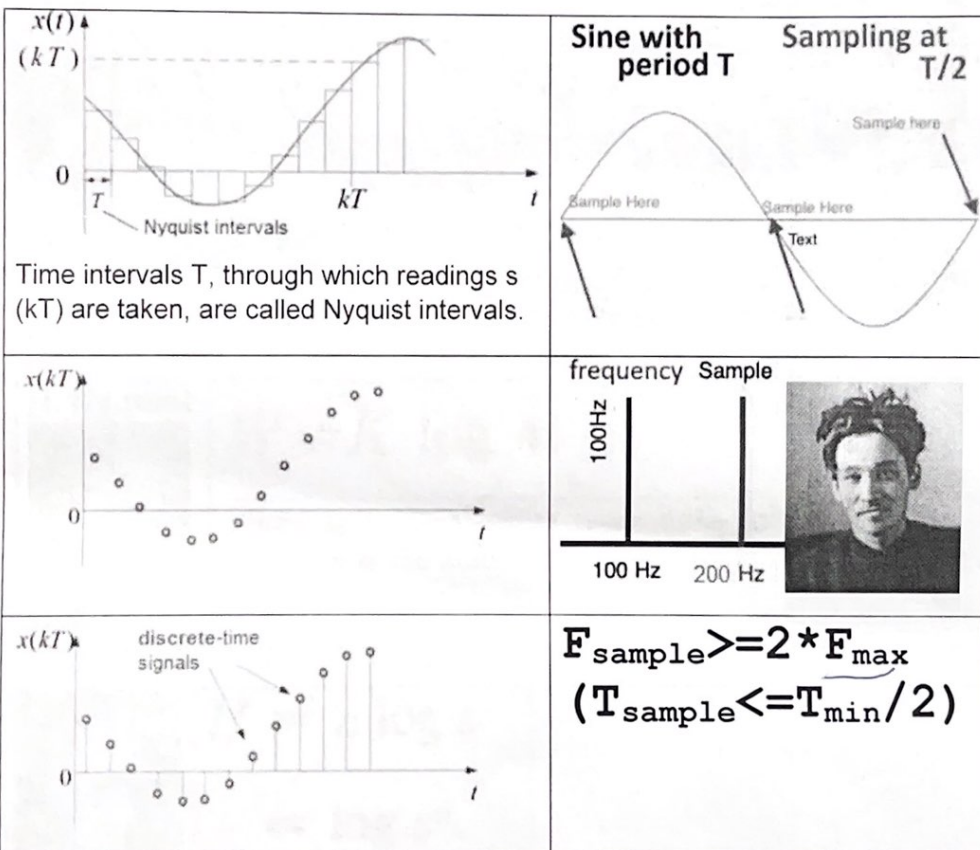
+0.2

To Exam

Изменение высоты звука как анализ звуковых сигналов




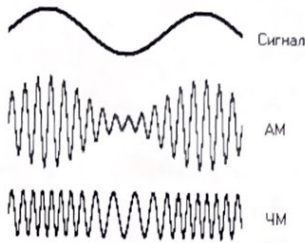
Sampling. Kotelnikov-Nyquist Theorem




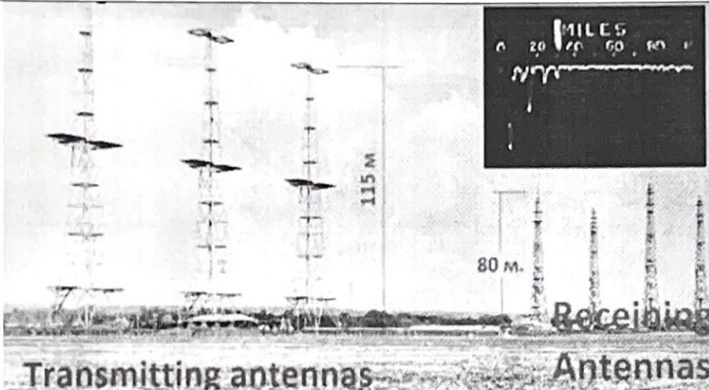
$s = 8 \cos(2\pi 5t) \times \sin(7.2\sqrt{t}) + 0.2 \sin(100\pi t)$


Kotelnikov - Nyquist Freq.


Annotations: $2.5 \rightarrow 10$, 14 , 30 , 50 , 80 , 100 Hz

		<p>Reginald A. Fessenden</p> <p>(October 6, 1866 – July 22, 1932)</p> <p>first transmission of speech by radio (1900), and the first two-way radiotelegraphic communication across the Atlantic Ocean (1906)</p>
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"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.

<p>Battle of Britain (3 month 3 weeks) 10.07-31.10.1940</p> 	 <p>Transmitting antennas Receiving Antennas</p> <p>Radar played a major role in the Battle of England</p>
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<p>H. Nyquist</p> 	$W = K \log m$ <p>Where W is the speed of transmission of intelligence, m is the number of current values, and, K is a constant.</p>
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	$H = n \log s$ $= \log s^n.$
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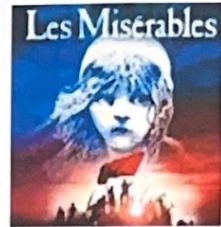
+0,1

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)?



$$\frac{aoi}{3!}$$

$$\frac{ge}{2!}$$

$$i \quad 1 \cdot 3!$$

$$1 \cdot 6$$

$$oi \quad 2 \cdot 3!$$

$$2 \cdot 6$$

$$aoi \quad 3! \cdot 3!$$

$$3 \cdot 6$$



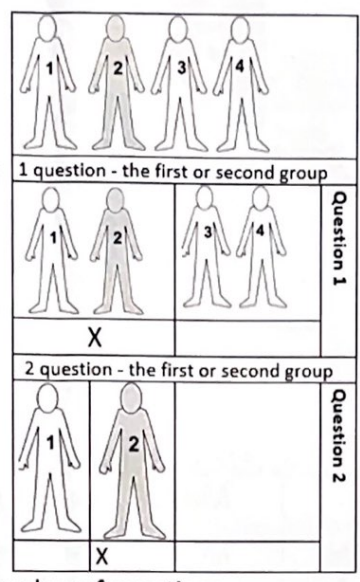
Say **NO** to the first



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. 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

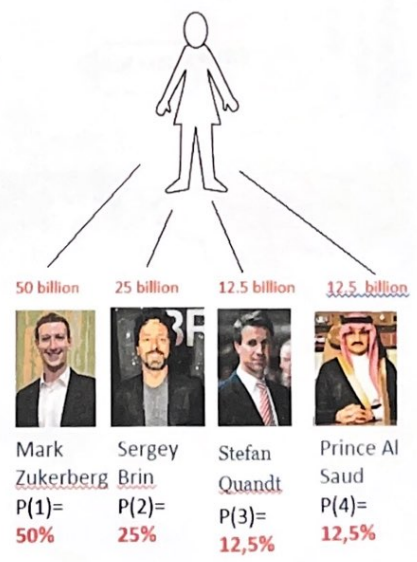
Quantifying information

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

Quantifying information

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

number of bits required to encode choice



+0.2 to Exam
 31.5.29

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

Новый том (D:) >

www.confucius.bsite.net

Предоставить доступ к >

Создать >

Свойства

Папку

Ярлык

Microsoft Access Database

Архив ZIP - WinRAR

айлами

ка с файлами

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*

10.160.26.25
==



W.A.N.

+ 0.2 to Exam

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

freeasp hosting.net

ASP.NET Hosting .NET 7

FREE ASP.NET Hosting
FREE Domain Hosting
FREE MS SQL Database
INCLUDES .NET Core
Full Trust Permissions

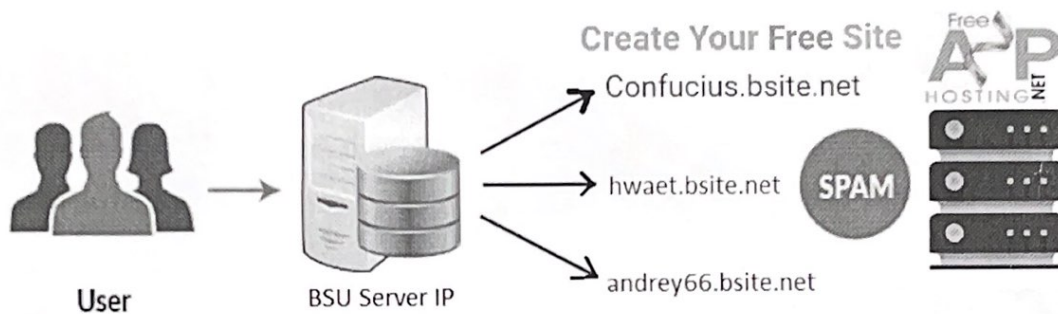
SIGN UP FOR FREE

Create Your Free Site

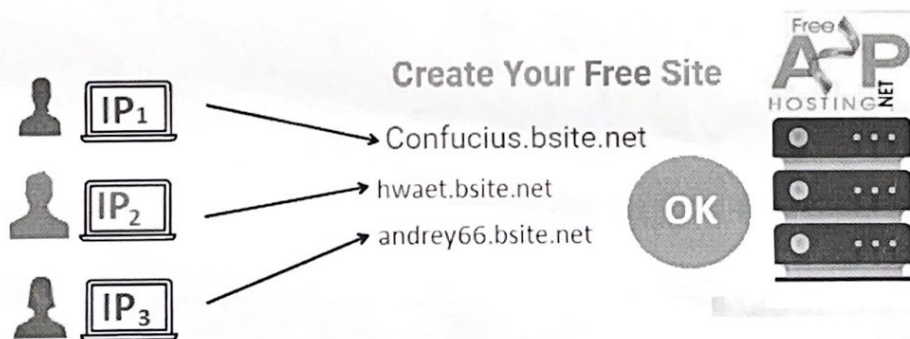
By signing up with our service you agree to our [Terms & Conditions](#).

Create Site

If several dozen hosting attempts to register from one IP address, the **freeasp hosting.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 **freeasp hosting.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.