

Fri 9 Nov 2018

Guess a # 0-15.

You can only ask Yes/No questions

How many questions will you need?

Best: Divide  $\frac{1}{2}$  The interval



Answer: Yes/No  
4 questions

# From 0-15 require  
in binary 4 bits

0000 1111 = 15

Hence, this problem is  
tantamount to determining  
the value of the 4-bits  
needed to represent  
each of those 16's.

List of 16 Movies: Find The one I'm thinking on  
How many yes/no questions will you need?

Answer: In the worst case, we'll need 16 questions  
 $15 = 16 - 1$

→ ok, doesn't  
make big diff.

Information:

Is the # yes/no questions  
needed to solve the problem

Each yes/no question  
gives us 1-bit of  
information!!

# INFORMATION is

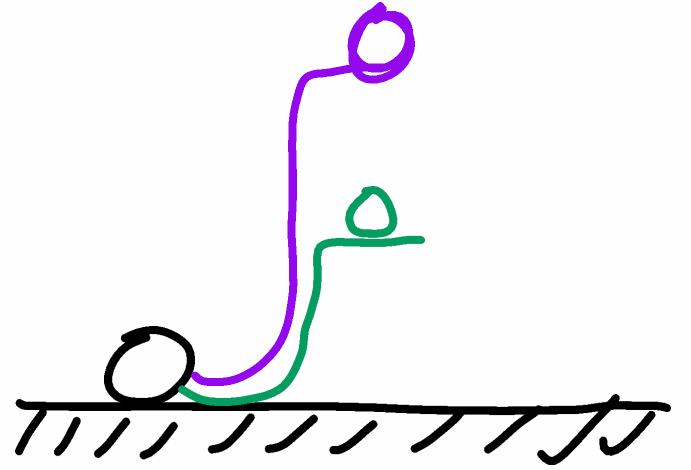
- 1) Quantifiable
- 2) Depends on the type of problem

e.g. Problem 1 & 2

both have 16 possibilities

Yet #1 requires 4-bits of Information

#2 " " 16-bits " " "



0 LOGARITHMS  
 1  
 2 0000 1111  
 :  
 :  
 15

How many times can we divide 16 by  
 2 w/o getting smaller than 1? 4

32? 0010 0000  
 0001 0000 → 1  
 0000 1000 → 2  
 0000 0100 → 3  
 0010 → 4  
 0001 → 5

45? 0010 1101  
 0110  
 1011  
 1011  
 (5)

Integer  
 logarithm  
 $\log_2 16 = 4$   
 $\log_2 32 = 5$   
 $\log_2 45 = 5$

Calculators have 2 types of logarithms

$\log$   $\equiv$  Means logarithm in base 10

$\ln$   $\equiv$  " " " " " "  $e$  (Euler #)

Exercise in calculator type following

$$a) \log(32) \div \log(2) = 5$$

$$b) \ln(32) \div \ln(2) = 5$$

c) Use your calculator to evaluate  $\log_2(45) = \frac{\ln(45)}{\ln(2)} \approx 5.49$

d) How many Yes/No Questions  
will we need to guess a # 0-15

Ans: 66 possibilities

Since  $\log_2 16 = 4$

e) How much INFORMATION do we need  
in order to guess a # 0-15

Ans: Information =  $\log_2 16 = 4 \text{ bits!}$

# Homework

We have a hash table

Animals	Cars	Planes	Boats
A Id1	C Id1	P Id1	B Id1
A Id2	:	:	:
A Id3	:	:	:
:	:	:	:
A Id8	C Id8	P Id8	B Id8

Sorted in each category

How much information  
do we need in order  
to guess a given Id?

$$(4 + 3) \text{ bits} \\ = 7 \text{ bits}$$

## HOMEWORK 2 The same problem but now all categories

have  $\neq$  # of ID's

Ambals	Cars	Planes	Boats
AId1	CId1	PId1	BId1
.	.	.	.
.	.	.	.
.	.	.	.
AId8	CId6	PId4	BId32

On average,  
how much  
Info do we  
need in order to  
guess an Id?