Plaintext $\xrightarrow{\text{mono}}$ Cyphertext $\xrightarrow{\text{Vig}}$ cyphertext
18 distinct 18 distinct 26 distinct

\# of monoalphabetic keys assuming 18 distinct letters $= 26 \cdot 25 \cdots\cdots 9 = \dfrac{26!}{(26-18)!} = \dfrac{26!}{8!}$

\# Vigenere keys w/6 letters $= 26^6$

total \# of keys $= \dfrac{26^6 \cdot \frac{26!}{8!}}{26}$

\# Vigenere first $= 26^6$ keys

\# monoalphabetic keys $= 26!$

total \# of keys $= \dfrac{26^6 \cdot 26!}{26}$

~~Eg~~ Plaintext $\xrightarrow{\text{Vig}}$ Cyphertext $\xrightarrow{\text{mono}}$ cyphertext
18 distinct 26 distinct 26 distinct

plaintext, 18 different chars

monalph

cyphertext 18 diff chars

Vigenere

cyphertext with 26 possible

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plaintext $\boxed{18}$ different chars

Vigenere

cyphertex 26 different

monaphabet 26!

cyphertext with 26 possible again

Vernam with key

$p = (p_1, p_2, p_3)$
$q = (q_1, q_2, q_3, q_4)$

0	20	15	0	20	15	0	20	15	0	20	15	0	20	15
p_1	p_2	p_3	p_1	p_2	p_3	p_1	p_2	p_3	p_1	p_2	p_3	p_1	p_2	p_3

7	2	14	5	7	2	14	5	7	2	14	5	7	2	14
q_1	q_2	q_3	q_4	q_1	q_2	q_3	q_4	q_1	q_2	q_3	q_4	q_1	q_2	q_3

R:	7	22	3	5	1	17	14	25	22	2	8	20	7	22	3
	K_1														
P:	0	13	0	17	19	8	18	19	13	4	21	4	17	17	4
	A	W	A	R	T	I	S	T	N	E	V	E	R	R	E
C:	7	9	3	22	20	25	6	18	9	6	3	24	24	13	7
	H	J	D	W	U	Z	G	S	J	G	D	Y	Y	N	H

A	0	F	5	K	10	P	15	U	20	Z	25
B	1	G	6	L	11	Q	16	V	21		
C	2	H	7	M	12	R	17	W	22		
D	3	I	8	N	13	S	18	X	23		
E	4	J	9	O	14	T	19	Y	24		

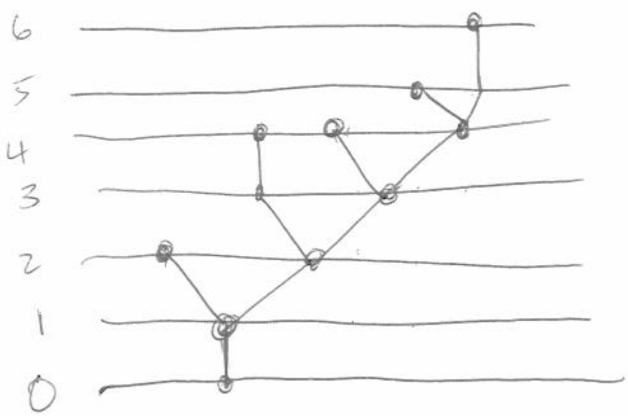
given Vernam 3 & 4 length of keys

more:

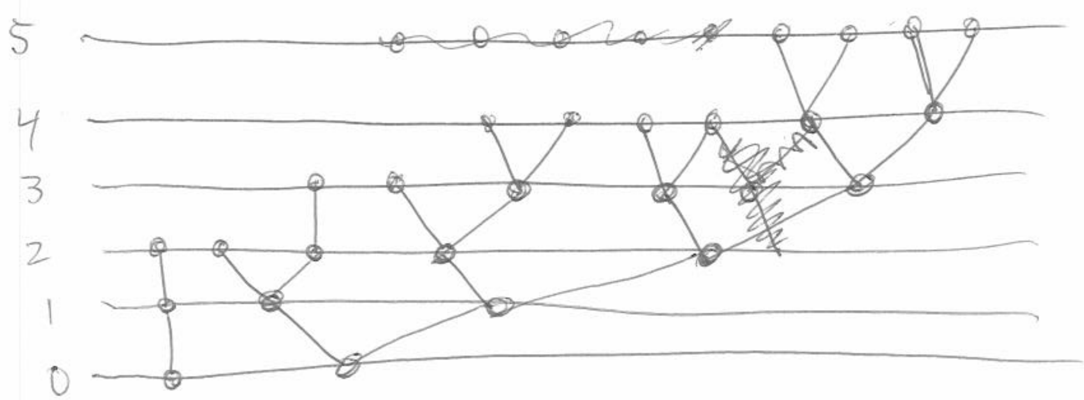
FMCME EPQMO AVMJJ KNNM

If we have a list of heights

2 4 4 5 6



2 2 3 3 4 4 4 4 5 5 5 5



If we have a list of heights

$h_1, h_2, h_3, \ldots\ldots, h_n$

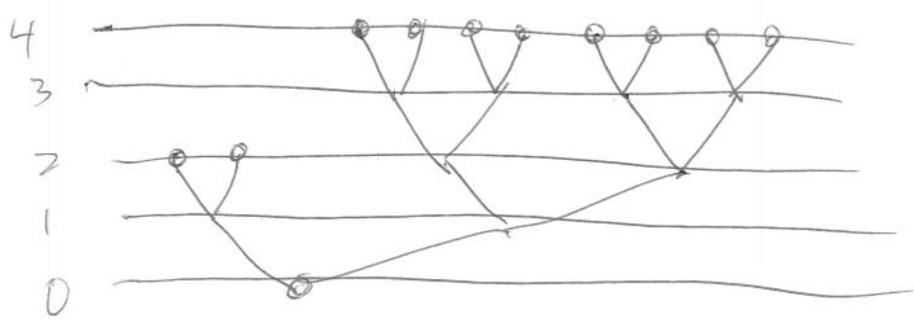
if $\sum \frac{1}{2^{h_i}} \leq 1$ then
it makes a binary tree

if $\sum \frac{1}{2^{h_i}} > 1$ then
it is <u>not</u> a binary tree

if $\sum \frac{1}{2^{h_i}} = 1$ then
the binary tree is complete.

$$\frac{1}{2^2} + \frac{1}{2^2} + \frac{1}{2^4} + \frac{1}{2^4} + \frac{1}{2^4} + \frac{1}{2^4} + \frac{1}{2^4} + \frac{1}{2^4} + \frac{1}{2^4} + \frac{1}{2^4} = 1$$

$$\underbrace{\frac{1}{4} + \frac{1}{4}}_{1/2} + \underbrace{\frac{1}{16} + \frac{1}{16} + \frac{1}{16} + \frac{1}{16} + \frac{1}{16} + \frac{1}{16} + \frac{1}{16} + \frac{1}{16}}_{1/2} = 1$$



there are 14 possible events in this scenario 7 coins one is lighter OR 7 coins one is heavier

$H(\text{event}) = \log_2 14 = 1 + \log_2 7 \approx 3.8$ something

= the amount of information you learn about the coin

gives $\log_2 3$ bits per weighing. $\log_2 3 \approx 1.7$