The probability

Which side the first ball will fall down? To the left (0) or to the right (I)?

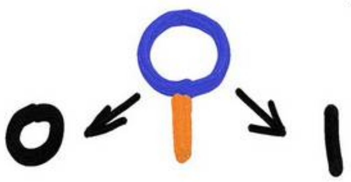

Fig.1 – the fair conditions

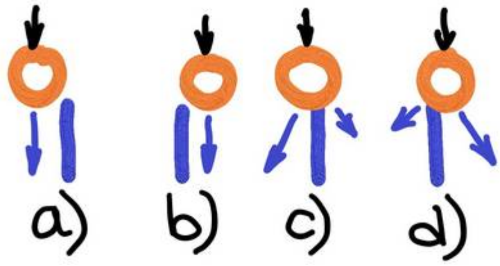

Fig.2 – the unfair conditions

In fair conditions we don´t know in every case in which side the ball will fall down.
In unfair conditions :
a) the ball always fall down to the left
b) the balls always fall down the right
c) the ball mostly fall down to the left
d) the ball mostly fall down to the right

In fair conditions we use the probability. In our case (Fig.1) there are two events – left (0) or right (I) for one experiment. Events are independent to each other. The two events which could be realized are called possible outcomes **(A)**. When the experiment (or a trial) is over - one event which has been realised is called a favourable outcome **(n)**. The equation for the probability **(P)** of one event (an outcome or set of outcomes) is the ratio of favourable **(n)** to possible outcomes **(A)**.

$$P=\frac{n}{A}$$ **Eq. 1**

0000	0I00	I000	II00
000I	0I0I	I00I	**II0I**
00I0	0II0	I0I0	**III0**
00II	**0III**	**I0II**	**IIII**

Tab. 1 – the possible outcomes (marked bold) for an experiment in which a coin is tossed four times (or for the experiment with four balls – see Fig.1), I is a head and 0 is a tail

Solve the Probability **P** for table 1 – we know the possible outcomes **A = 16** , where the favourable outcomes (at least three heads are obtained) **n = 4**

then

$$P=\frac{4}{16}=\frac{1}{8}$$ **Eq. 2**

if favourable outcome is **n = 1** (four heads **– I**) against to possible outcomes **A = 16**
then

$$P=\frac{1}{16}$$ **Eq. 3**

How many trials with coin we must do there to get the progress *IIII* inside a long list of possible outcomes. We must do 16 trials. Really? Are there all possible outcomes? Or there is another number of trials? Prove it!

16 trials means such progress of outcomes: 0,I,I,0,0,0,I,I,I,0,I,0,0,0,I,0

There are not of all possible outcomes. All possible outcomes are written in tab. 1? I believe we must do 16 x 4 t= 64. We must do 64 trials (or 16 sets with 4 trials inside it) to have a big chance for the pure progress **IIII.**

See more

$$2^4 * 4 = 64$$ **Eq.4**

The number 2 means the two sides of the coin. The number 4 means the number of positions in a binary code (e.g. 000I).

For a polyhedron with 16 sides marked at every side with **0000, 000I,..., III0, IIII** we must do really only 16 trials to get the side with . Go on. For N-hedron with N-sides marked from 00000......0, 00000......I, ... , IIIII.......I we must do N trials to obtain one of N-sides. Go on. If N is close to infinity. Then we obtain an ideal ball with infinity points. How many trials we must do? Infinity? Which kind of infinity?

$$P=\frac{1}{\infty}$$ **Eq. 5**

What does it mean the number 1? One point of the surface of the ball? Remember infinitesimals. We could go closer to zero (0).

The real probability in our universe - we need a dimension.

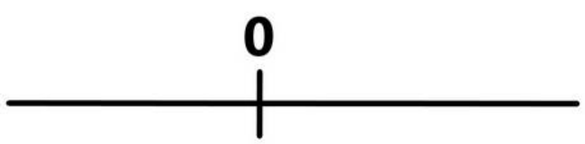

Fig. 3 – one event with a zero lenght to a line with an infinity lenght

The Probability

$$P=\frac{0}{\infty}$$

Eq. 6

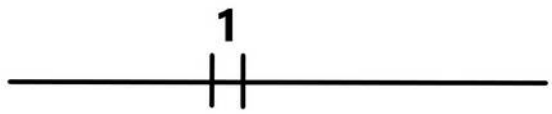

Fig. 4 – one event with a per unit lenght to a line with an infinity lenght

The probability

$$P=\frac{1}{\infty}$$

Eq. 7

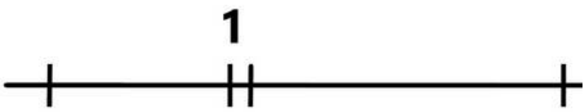

Fig. 5 – one event with a per unit lenght to a line with a dimension 24 unit lenght

The probability

$$P=\frac{1}{24}$$

Eq. 8

Now, we are able to solve the probability cases. We have a dimension of one event and we have a dimension of all events, either. If we want quantifiability then we have to quantify.

Is it possible to get the favourable progress of outcomes **IIIIIIIII** – for 10 trials with the ball - to fall down only to one side? Or 100 times to get only 0? Or more?

It depends how many balls we put down.We have only one edge. The first ball went down by the right side – **I**. We expect the second one have to go down to the left side. It´s only our imagination. In fact - the probability is the same for the second ball! And for the next ball until one hundred millions balls. The probability is fixed at **½.** Nothing else. If the ball went down for six hundred times to the left there is no mark why the probality could change.

Explain this by using of the next figure.

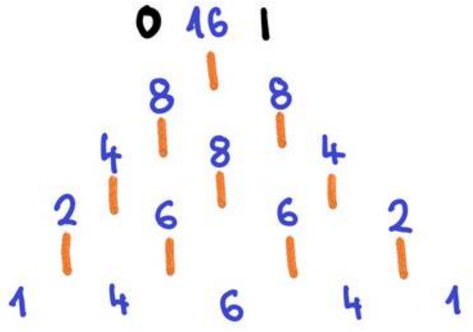

Fig. 6 – 16 balls with 4 rows with edges

The distribution of balls is arranged in the fig. 6. If the conditions are fair. Every portion of balls must be divided to the half on every edge. Only one ball went only to the right through 4 rows with edeges. Becuse there is only one path, instead of the middle part, where is 6 paths.

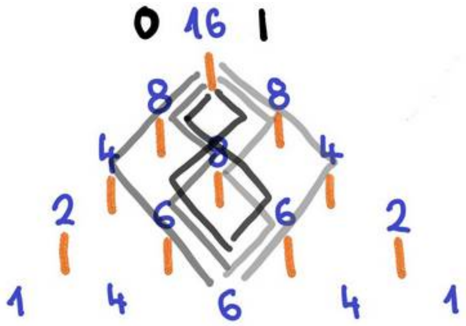

Fig. 7 – 6 paths from the top

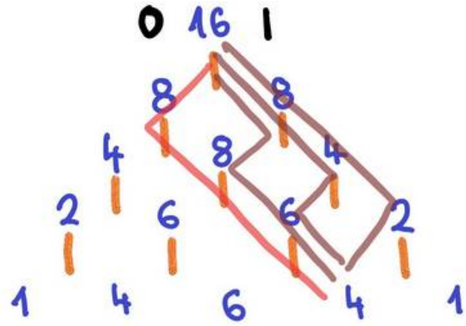

Fig. 7 – 4 paths from the top to each side

We replace the concrete number of balls in the top by a number 1 then we get the following distribution

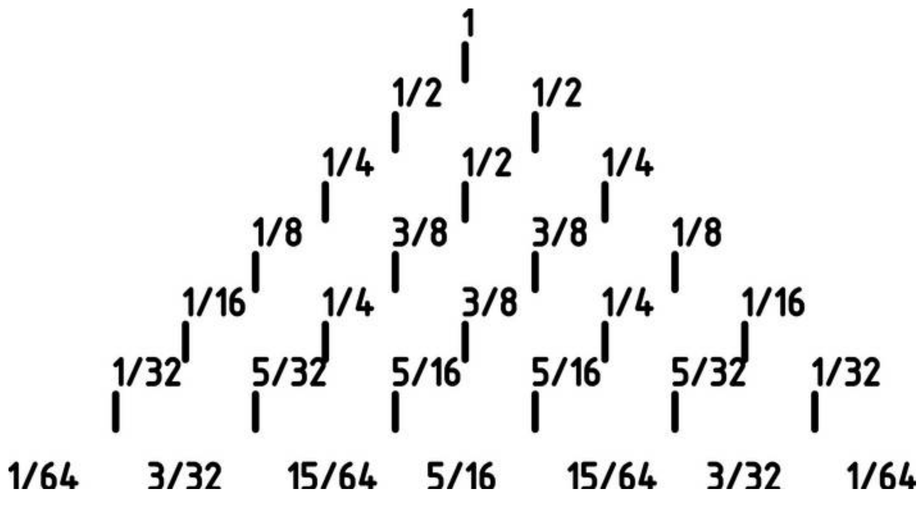

Fig. 8 – 1 ball on the top edge with 6 rows

The sum of fractions must be equal to the number 1 in every row. In the graph the situation seems like the next curve

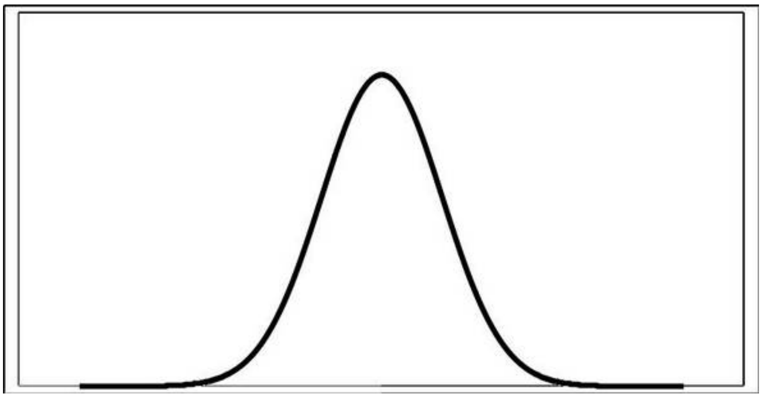

Fig. 9 – the distribution´curve

Finally the balls will be distributed closely to our curve – fig. 9. It is impossible for us to say exactly the path of every ball through the rows with edges. We are suprised at every moment. Is it possible to have 10 balls with the progress **IIII** ? Of course. In the beginning there must be 160 balls (16x10) on the top (possible outcomes). Or is it possible to have 1000 balls with the favourable outcomes **IIII**. Then must be in the beginning 16 000 balls (possible outcomes). And what about 1 ball with the favourable outcomes **IIIII IIIII** (10 times to the right). There is no problem – See fig.10

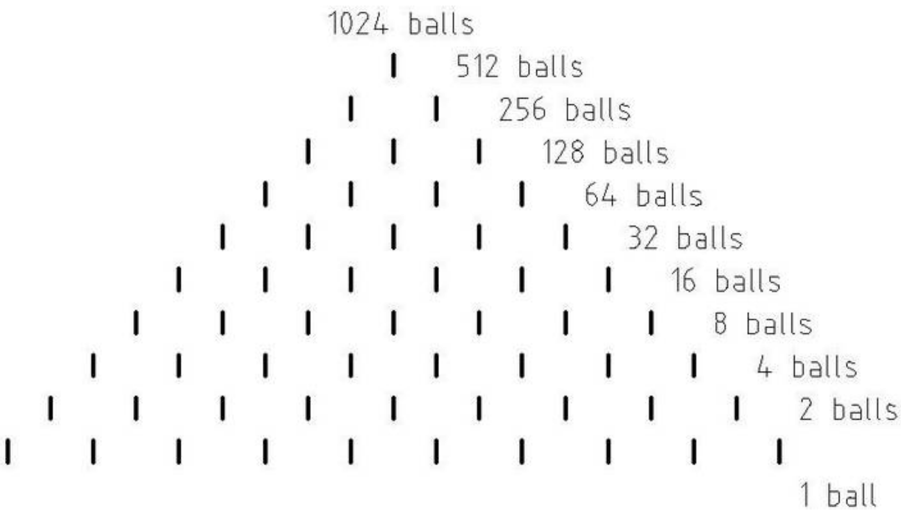

Fig. 10 – 1024 balls with 10 rows

To get 1 ball down 10 times to the right we must have 1 024 balls up. As you see – binary code.2^{10} = 1 024. We could fill the triangle by numbers - to use the dividing and the sum. That´s all.

Go on - If we get outcomes only with **IIIIIIIIIIIIIIIIIIIIIIII.....IIIIIIII**. What does it mean? The condition are "unfair" or tip the edge?

For the favourable outcomes only with **IIIIIIIIIIIIIIII ....** - (100 x times to the right). How many balls there must to be up? The answer 2^{100} = 1 267 650 600 228 229 401 496 703 205 376 balls.

For the outcomes only with **IIIIIIIIIIIIIIIIIIIIIIIIIIIIIII ....** - (1 000 times to the right). There must be such number of balls $2^{1\ 000}$ = 1,07150860718626732094842504906E+301. I belive that number has no meaning in our universe.

And what about $2^{1\ 000\ 000}$ or more – difficult what to say. Perhaps – pure mathematics.

But what about following favourable outcomes **00I0I0IIII0I....I0I0I0I0I0I0I0I0I0I0I0I0I0I0I0I0I0I0I0I0I0...I00I0III0III00III00000I**

We see – there is an order in the middle – the sequence I0I0I0… with the same lenght. Why not – it is possible. Every order has its beginning and its end.

The favourable outcomes only with 0,I,0,I,0,I, ... (call it **the base unit**). There are not random numbers. We know what number follows. There is a pure order there. That progress would be a "basic unit" for us. In the other hand a distribution with pure random numbers would has the same distribution as the pure order numbers. The law of big numbers.

We can measure by using of the basic unit the distribution of random series or other series: e.g. the series **e** or **√2**.