

## A Human Counter

Select five students from the class. They must stand in a line facing the class, like this:

E   D   C   B   A

Someone else (the teacher, preferably), must give "signals" to the machine, say by clapping his hands together. Only the person on the right, marked A above, hears these signals, or takes any notice of them. Every time he hears a clap he moves his right arm up, or if he already has it up, he puts it down. His job is quite easy. All the others take no notice of the claps, but each keeps his eye on the person to his immediate left - that is, B watches A, C watches B, D watches C, and E watches D. Each person changes his position (down to up or up to down) **ONLY WHEN THE PERSON TO HIS IMMEDIATE LEFT PUTS HIS ARM DOWN.**

For instance, if you are B, you will wait until A puts his arm down before you put your arm up; you will keep it there while A puts his up again, and then put yours down when he does. (This may take a bit of practice. It takes a while for the student to get used to taking no notice when the individual to his immediate left puts his arm up, and only changing position when said individual puts an arm down. Then the student has to remember that he is to change his own position, and not just copy the position of the individual on his immediate left.)

When the "machine" is working properly, announce to the class that it is actually a human counter, registering one after the other, a finite number of natural numbers. Have the students try to guess how it counts before proceeding any further.

Now proceed to give each person of our "human counter" a card to show like his.

**16   8   4   2   1**  
E   D   C   B   A

Now when the person raises his arm, he also shows his card. The students should be able to see that machine works thanks to a remarkable property of the binary sequence. Each natural number from 1 up can be formed by adding certain terms of the sequence without using any term more than once.

### A Few Questions For The Class

What number can the machine count up to?

What number can you count up to with only 4 people?

How would you count up to larger numbers?

What number would a 6<sup>th</sup> person have on his card? a 7<sup>th</sup>? an 8<sup>th</sup>? a 9<sup>th</sup>?