



# THE BEAT OF THE BITS

COMMUNICATION: COMPOSITION OF LETTERS FROM BINARY SEQUENCES

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# THE BEAT OF THE BITS

## Amyotrophic lateral sclerosis (ALS)

**Amyotrophic lateral sclerosis (ALS)**, often referred to as “Lou Gehrig’s Disease,” named in honor of the famous baseball player who had it, is a **progressive neurodegenerative disease**.



**Lou Gehrig** was the first patient who presented with amyotrophic lateral sclerosis.



# THE BEAT OF THE BITS

On July 4, 1939, Lou Gehrig bid farewell to baseball, forced to retire due to the onset of the terrible ALS disease

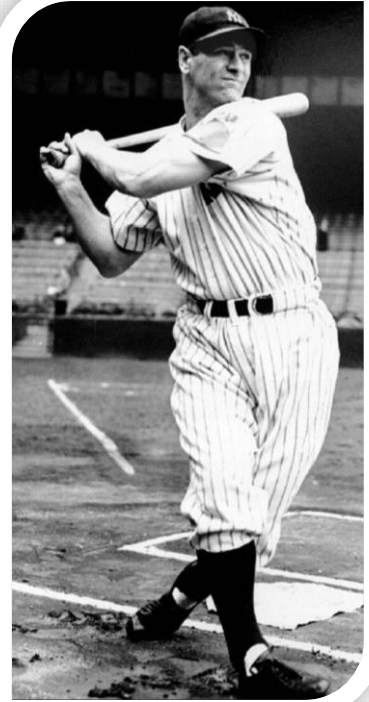
*“For the past two weeks you have been reading about a bad break. Yet today **I consider myself the luckiest man on the face of the earth.***

*I have been in ballparks for seventeen years and have never received anything but kindness and encouragement from you fans.”*



*“When you look around, wouldn't you consider it a privilege to associate yourself with such a fine looking men as they're standing in uniform in this ballpark today? **Sure, I'm lucky.***

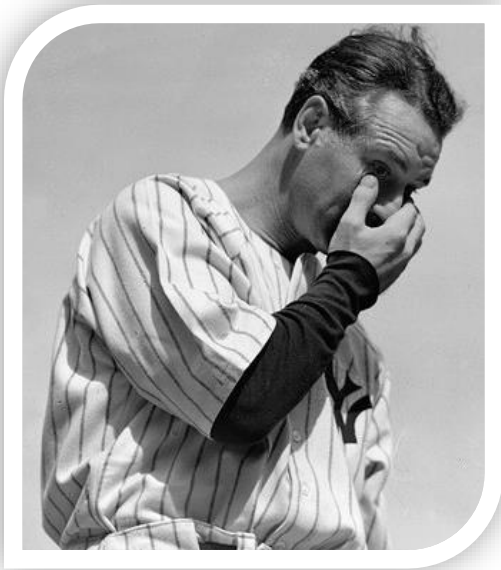
*Who wouldn't consider it an honor to have known Jacob Ruppert? Also, the builder of baseball's greatest empire, Ed Barrow? To have spent six years with that wonderful little fellow, Miller Huggins? Then to have spent the next nine years with that outstanding leader, that smart student of psychology, the best manager in baseball today, Joe McCarthy? **Sure, I'm lucky.”***





# THE BEAT OF THE BITS

*“When the New York Giants, a team you would give your right arm to beat, and vice versa, sends you a gift – that’s something. When everybody down to the groundskeepers and those boys in white coats remember you with trophies - that's something.”*



*“When you have a wonderful mother-in-law who takes sides with you in squabbles with her own daughter - that's something.”*



*“So I close in saying that I might have been given a bad break, but **I’ve got an awful lot to live for.** Thank you.”*

**Lou Gehrig**

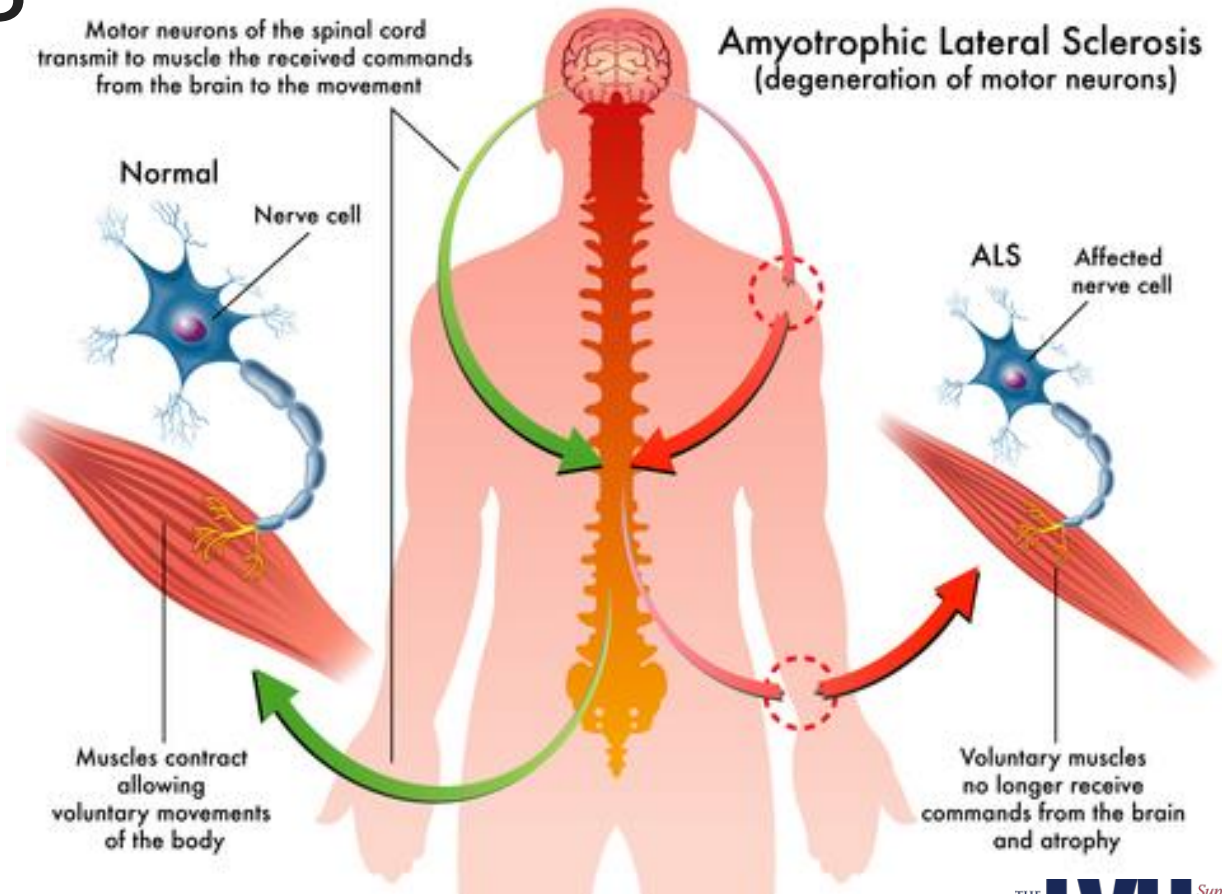




# THE BEAT OF THE BITS

## Amyotrophic lateral sclerosis (ALS)

It affects nerve cells in the brain and the spinal cord through **progressive degeneration of the body's motor neurons**, which reach from the brain to the spinal cord and then to all muscles throughout the body.

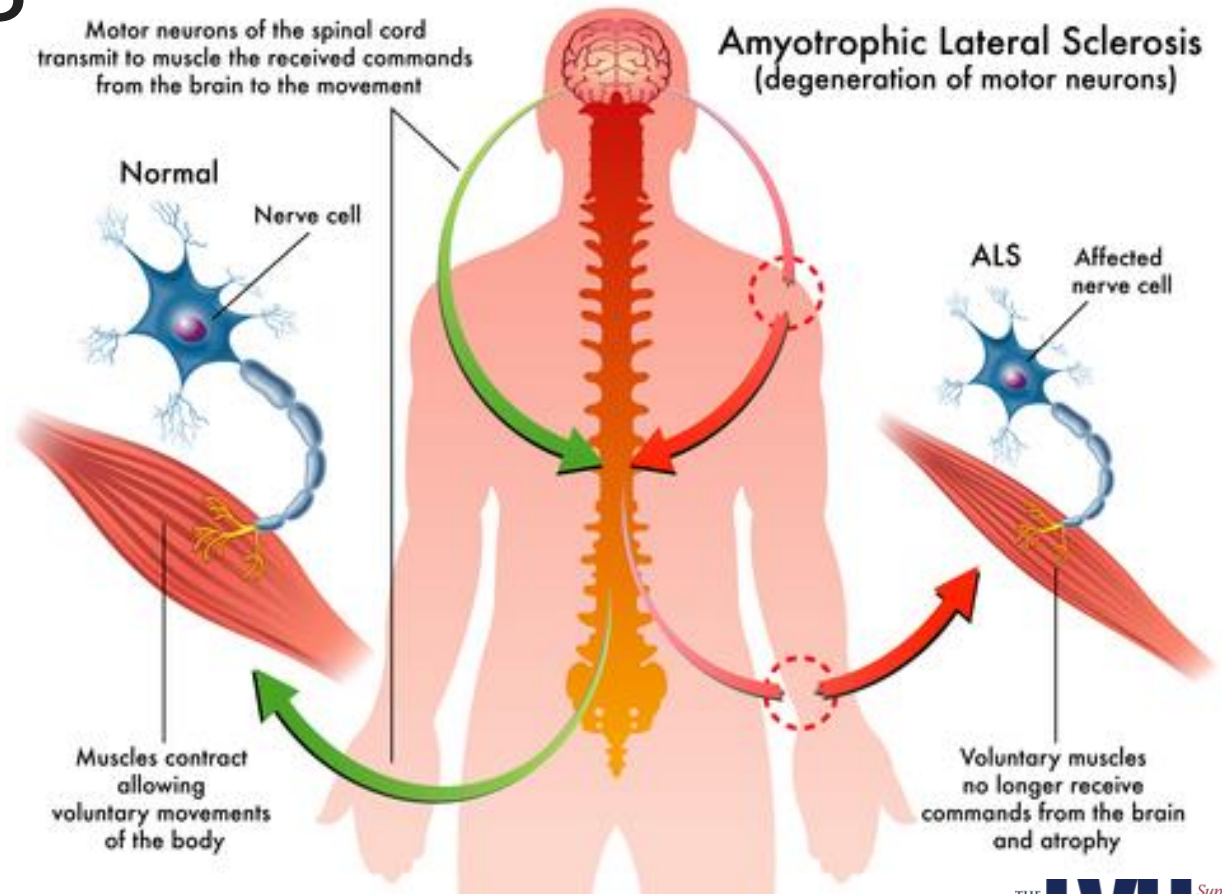




# THE BEAT OF THE BITS

## Amyotrophic lateral sclerosis (ALS)

With the degeneration of motor neurons, the ability of the brain to initiate and control muscle movement is lost. As voluntary muscle action is progressively affected, patients in the later stages of the disease may become totally paralyzed.





# THE BEAT OF THE BITS



**Stephen William Hawking**  
(cosmologist, physicist,  
mathematician, astrophysicist)  
Oxford, 8 January 1942 –  
Cambridge, 14 March 2018

In 1963, Hawking was diagnosed with an early-onset slow-progressing form of motor neurone disease (ALS) that gradually paralysed him over the decades.

After the loss of his speech, he was able to communicate through a speech-generating device, initially through use of a handheld switch, and eventually by using a single cheek muscle.

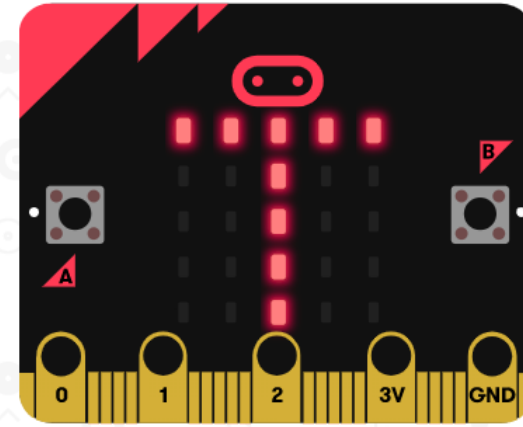
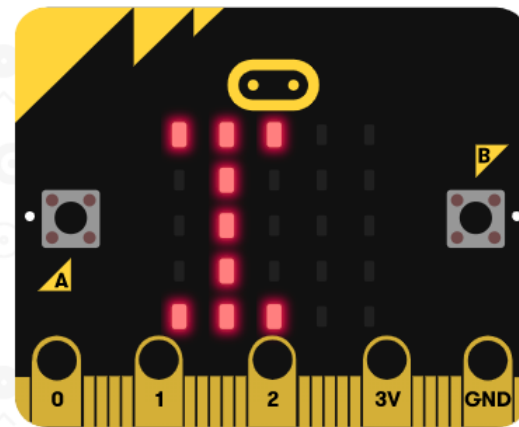
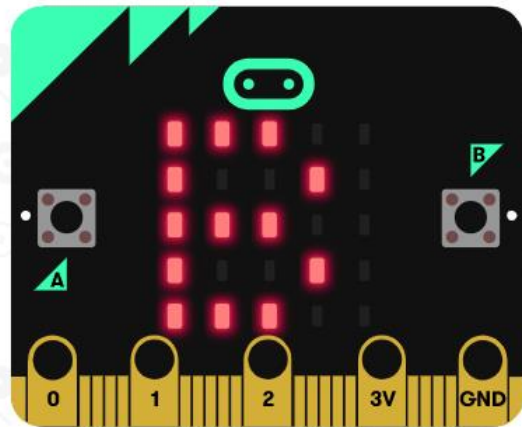






# THE BEAT OF THE BITS

**Communicate with Micro:bit microcontroller  
by composing letters from bit sequences**







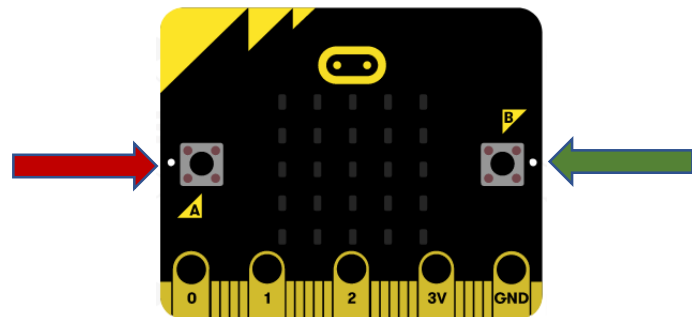
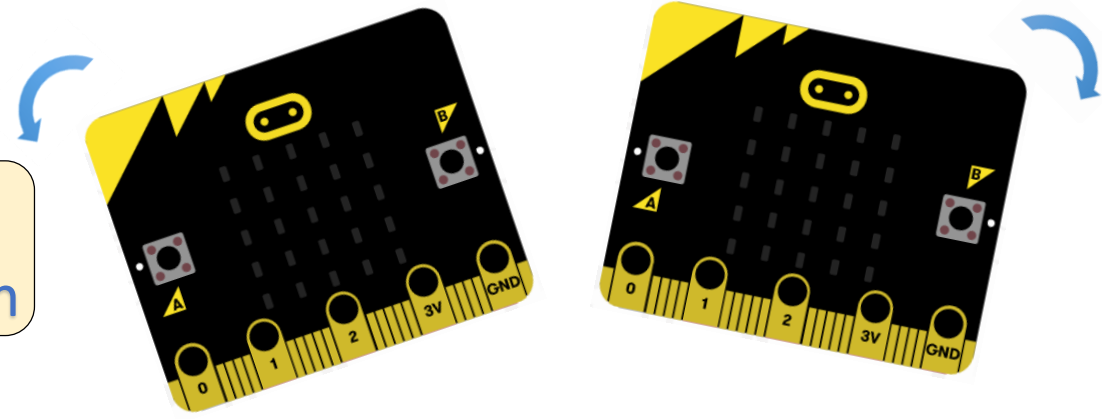
# THE BEAT OF THE BITS



**Display letters  
corresponding  
to sequences  
of bits as a  
function of ...**

Left and right  
microcontroller's rotation

OR



Press button **A** and button  
**B** on the microcontroller's board

# THE BEAT OF THE BITS

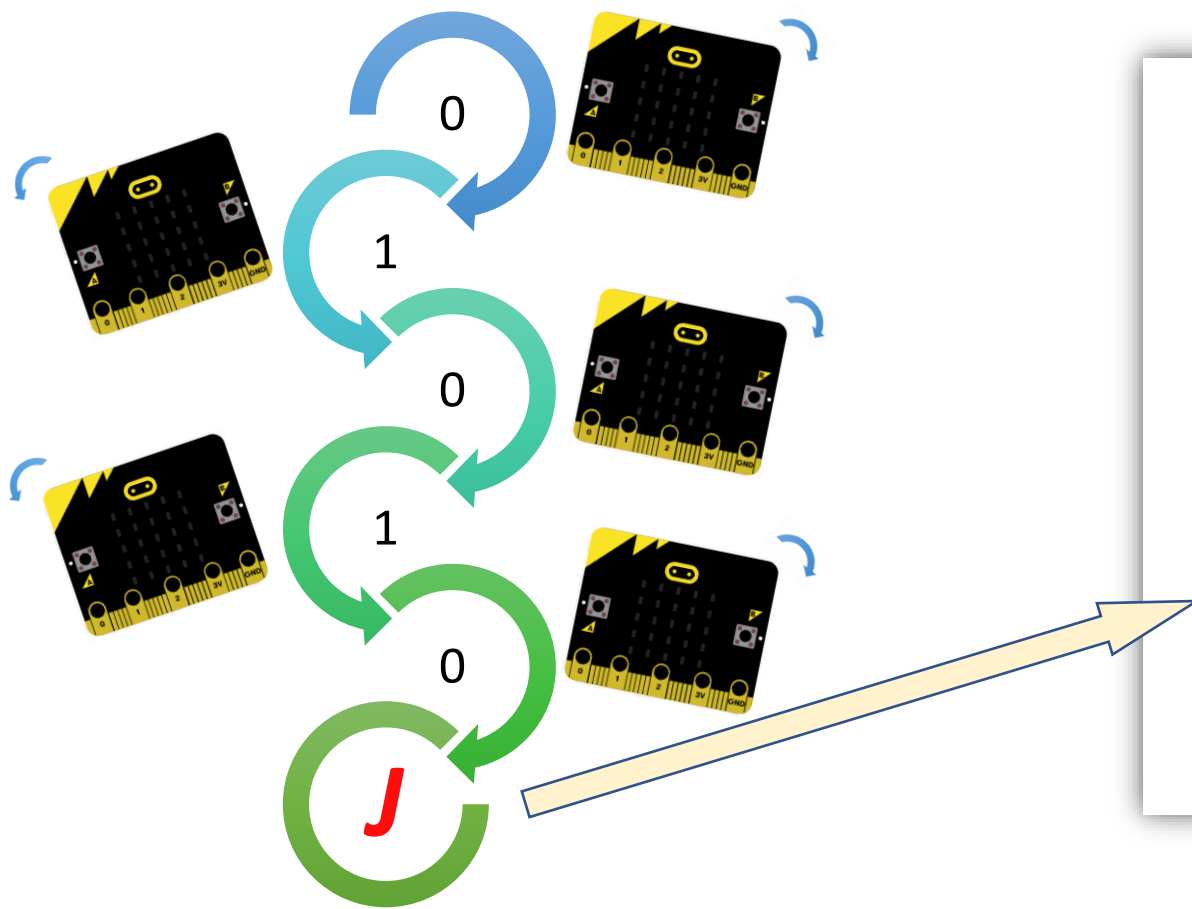
Possible correspondence  
of the alphabet in binary  
sequences on 5 bits

With 5 bit  $2^5$  (i.e. 32)  
configurations are possible

A	1	00001
B	2	00010
C	3	00011
D	4	00100
E	5	00101
F	6	00110
G	7	00111
H	8	01000
I	9	01001
J	10	01010
K	11	01011
L	12	01100
M	13	01101

N	14	01110
O	15	01111
P	16	10000
Q	17	10001
R	18	10010
S	19	10011
T	20	10100
U	21	10101
V	22	10110
W	23	10111
X	24	11000
Y	25	11001
Z	26	11010

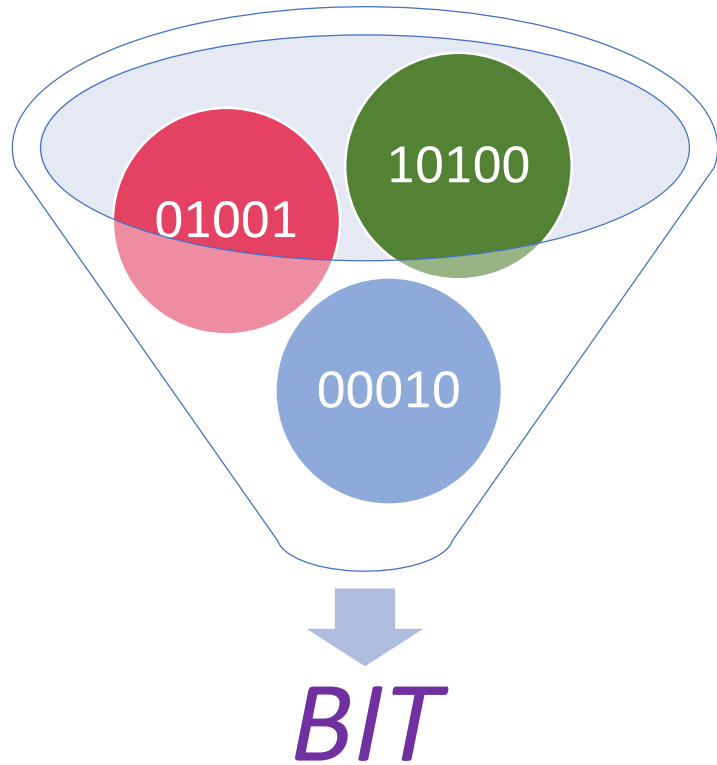
# THE BEAT OF THE BITS



A	1	00001
B	2	00010
C	3	00011
D	4	00100
E	5	00101
F	6	00110
G	7	00111
H	8	01000
I	9	01001
<b>J</b>	10	01010
K	11	01011
L	12	01100
M	13	01101

N	14	01110
O	15	01111
P	16	10000
Q	17	10001
R	18	10010
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# THE BEAT OF THE BITS

CONVERSION BINARY  $\rightarrow$  DECIMAL

The binary sequence

$b_4 b_3 b_2 b_1 b_0$

corresponds to  
the polynomial  
form

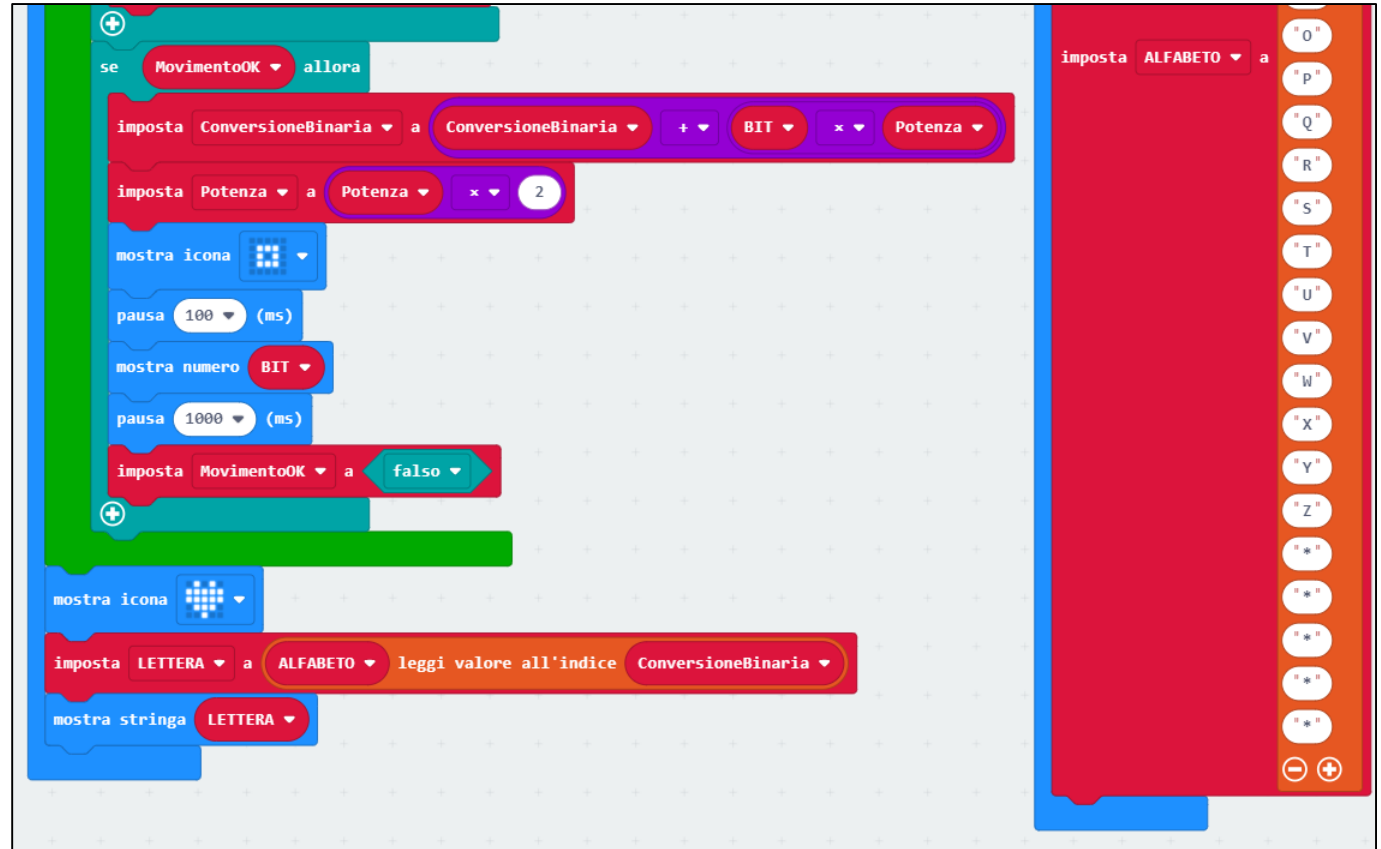
$$b_4 * 2^4 + b_3 * 2^3 + b_2 * 2^2 + b_1 * 2^1 + b_0 * 2^0$$

Example:

$$10110_2 \rightarrow 1 * 2^4 + 0 * 2^3 + 1 * 2^2 + 1 * 2^1 + 0 * 2^0 = 22_{10}$$

# THE BEAT OF THE BITS

*Version with 1 micro:bit*



# THE BEAT OF THE BITS

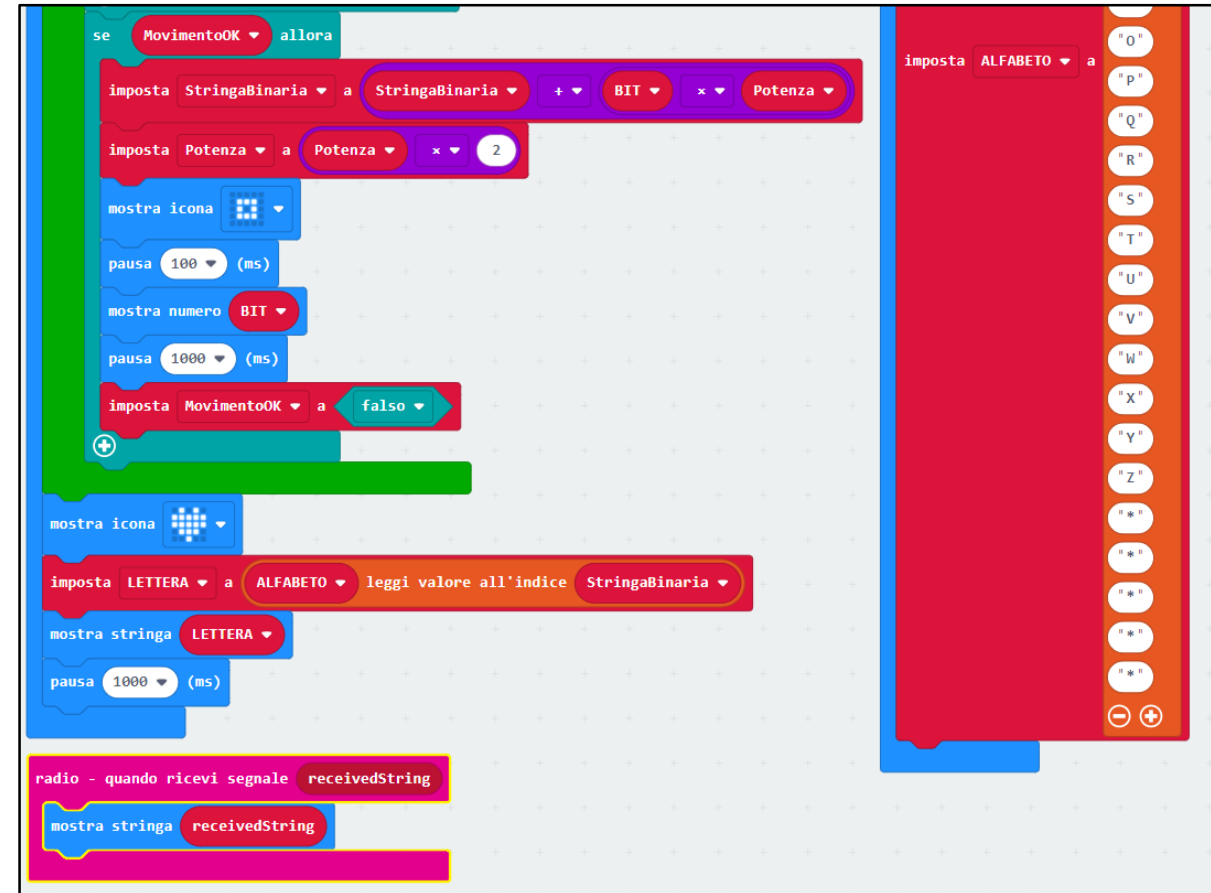
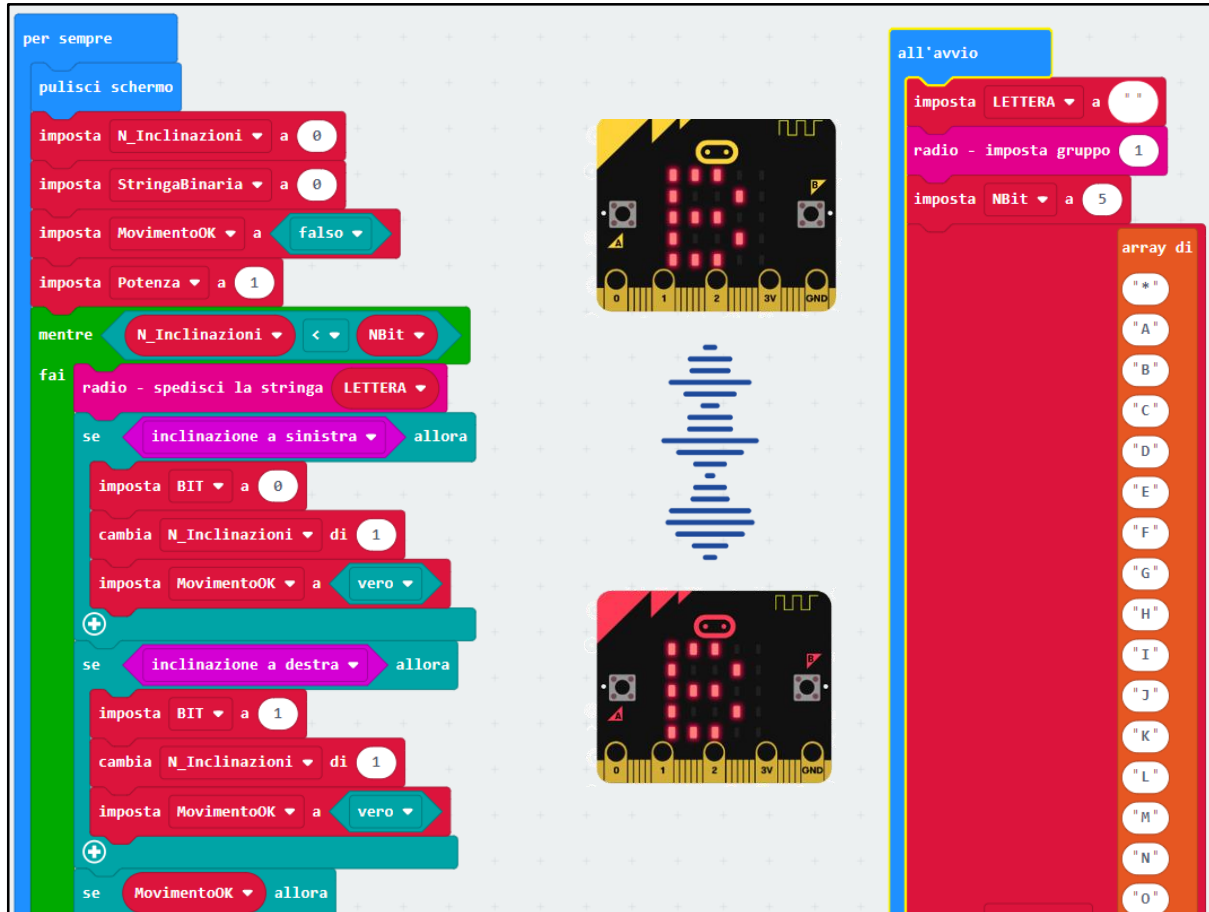


*Version with 1 micro:bit*

```
1 let LETTERA = ""
2 let BIT = 0
3 let Potenza = 0
4 let MovimentoOK = false
5 let ConversioneBinaria = 0
6 let N_Inclinazioni = 0
7 let NBit = 5
8 let ALFABETO = ["*", "A", "B", "C", "D", "E", "F", "G", "H", "I", "J", "K", "L", "M", "N", "O", "P", "Q", "R", "S", "T", "U", "V", "W", "X", "Y", "Z", "*", "*", "*", "*", "*"]
9 basic.forever(function () {
10     N_Inclinazioni = 0
11     ConversioneBinaria = 0
12     MovimentoOK = false
13     Potenza = 1
14     while (N_Inclinazioni < NBit) {
15         if (input.isGesture(Gesture.TiltLeft)) {
16             BIT = 0
17             N_Inclinazioni += 1
18             MovimentoOK = true
19         }
20         if (input.isGesture(Gesture.TiltRight)) {
21             BIT = 1
22             N_Inclinazioni += 1
23             MovimentoOK = true
24         }
25         if (MovimentoOK) {
26             ConversioneBinaria = ConversioneBinaria + BIT * Potenza
27             Potenza = Potenza * 2
28             basic.showIcon(IconNames.SmallSquare)
29             basic.pause(100)
30             basic.showNumber(BIT)
31             basic.pause(1000)
32             MovimentoOK = false
33         }
34     }
35     basic.showIcon(IconNames.Heart)
36     LETTERA = ALFABETO[ConversioneBinaria]
37     basic.showString(" " + (LETTERA))
38 })
```

# THE BEAT OF THE BITS

*Version with 2 micro:bit  
in radio transmission*

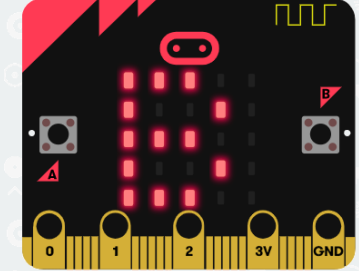
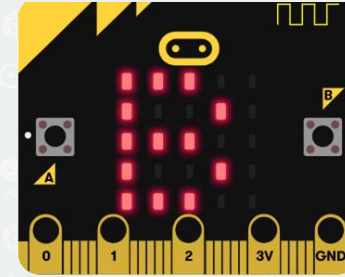




# THE BEAT OF THE BITS



*Version with 2 micro:bit  
in radio transmission*



```
1  radio.onReceivedString(function (receivedString) {
2      basic.showString(receivedString)
3  })
4  let BIT = 0
5  let Potenza = 0
6  let MovimentoOK = false
7  let StringaBinaria = 0
8  let N_Inclinazioni = 0
9  let LETTERA = ""
10 radio.setGroup(1)
11 let NBit = 5
12 let ALFABETO = ["*", "A", "B", "C", "D", "E", "F", "G", "H", "I", "J", "K", "L", "M", "N", "O", "P", "Q", "R", "S", "T", "U", "V", "W", "X", "Y", "Z", "*", "*", "*", "*", "*"]
13 basic.forever(function () {
14     basic.clearScreen()
15     N_Inclinazioni = 0
16     StringaBinaria = 0
17     MovimentoOK = false
18     Potenza = 1
19     while (N_Inclinazioni < NBit) {
20         radio.sendString("" + (LETTERA))
21         if (input.isGesture(Gesture.TiltLeft)) {
22             BIT = 0
23             N_Inclinazioni += 1
24             MovimentoOK = true
25         }
26         if (input.isGesture(Gesture.TiltRight)) {
27             BIT = 1
28             N_Inclinazioni += 1
29             MovimentoOK = true
30         }
31     }
32     if (MovimentoOK) {
33         StringaBinaria = StringaBinaria + BIT * Potenza
34         Potenza = Potenza * 2
35         basic.showIcon(IconNames.SmallSquare)
36         basic.pause(100)
37         basic.showNumber(BIT)
38         basic.pause(1000)
39         MovimentoOK = false
40     }
41     basic.showIcon(IconNames.Heart)
42     LETTERA = ALFABETO[StringaBinaria]
43     basic.showString("" + (LETTERA))
44     basic.pause(1000)
45 }}
```