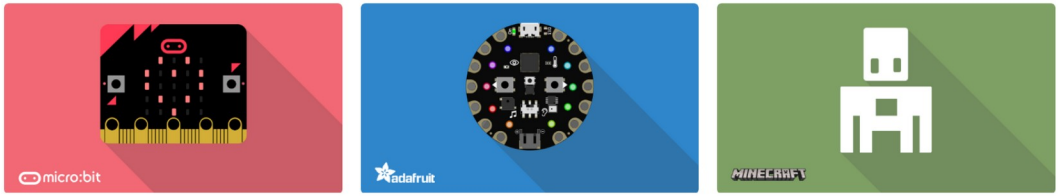
Robotics with Lego EV3 + MS Makecode

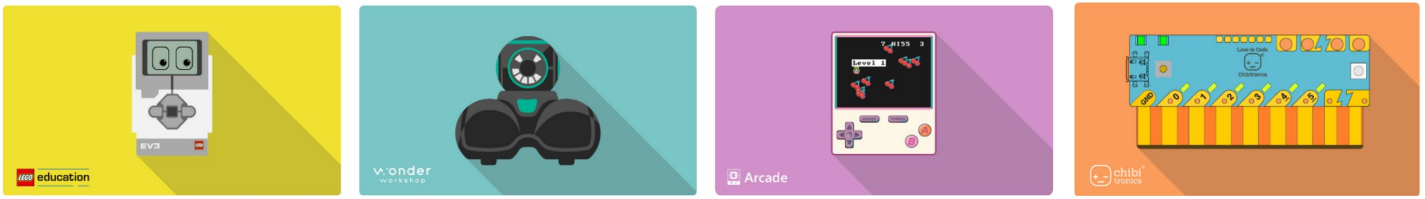
Andrea Sterbini – sterbini@di.uniroma1.it

Microsoft Makecode.com

Many development systems supported (embedded/robotics/game)



micro:bit Adafruit Minecraft



Lego EV3 Cue Arcade Chibi chip

Blockly-based visual programming

More systems in https://makecode.com/labs

MS Makecode: EV3 robotics

https://makecode.mindstorms.com

INSTALLATION

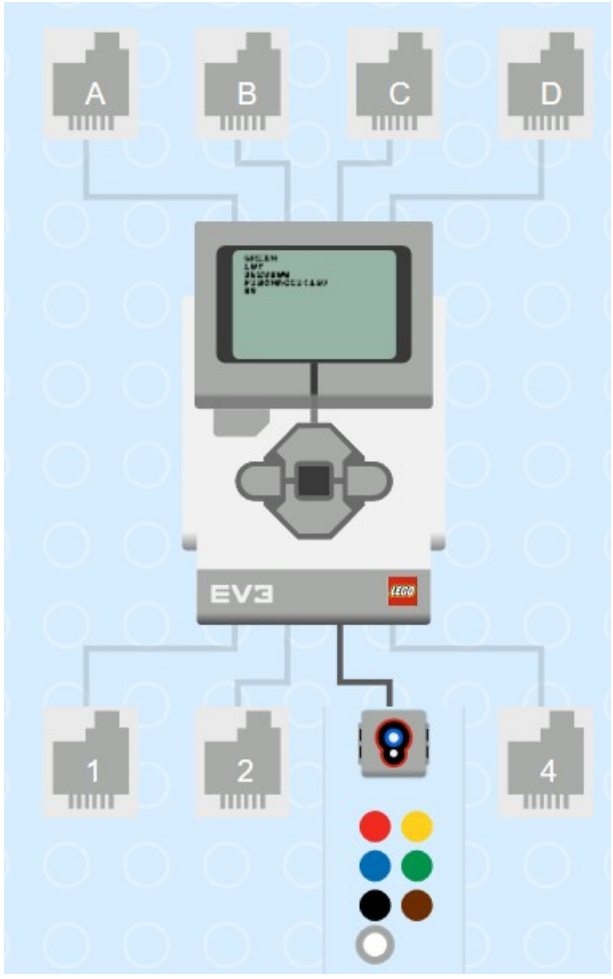
- just upgrade the EV3 firmware to 1.10E
- the IDE runs in the browser

EXECUTION

- EV3 is seen as a disk when connected by USB
- Just download the generated code to the EV3
    - (BUT: in Linux there is a mount error)

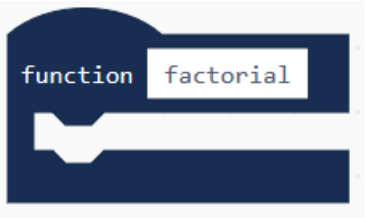
DEBUG

- browser-based minimal simulator (AUTO-CONFIGURED)



Makecode standard blocks

Types!!!	integers, strings, floats, lists	
Lists of any?	YES	
Functions?	YES	
Function args?	NO	(YES in TypeScript mode)
Return?	NO	(YES in TypeScript mode)
Variables?	GLOBAL	(LOCAL also in TypeScript mode)
Messages?	YES	
Message params.?	YES	
Static TypeScript?	YES	(NEW!!!!)



Makecode EV3-specific blocks

Brick buttons:

- on button XXX pressed event
- pause until ...
- is button … ?

Brick LCD screen:

- clear, show image, show text
  show number, show port

Touch sensor:

- on touch XXX event
- pause until ...
- is touch … ?

Color sensor:

- on color XXX detected event
- on color sensor X dark/light
- pause until …
- color

Ultrasonic sensor:

- on US X object detected
- pause until …
- distance

Gyroscope sensor:

- rate, angle, reset

EV3 Sensor Calibration blocks

Calibrate color sensor XXX for reflected/ambient light

Set color sensor XXX dark/bright to THRESHOLD

Set ultrasonic sensor XXX object detected/near to THRESHOLD

Set infrared sensor XXX object detected/near to THRESHOLD

EV3 Motors

Run motor X/XY at V speed for N rotations/degrees/seconds/msec

Drive motors XY at V1,V2 speeds for N rot/deg/sec/msec

Steer motors XY at Y ratio V speed for N rot/deg/sec/msec

Pause until motor X/XY ready

Motor X speed/angle

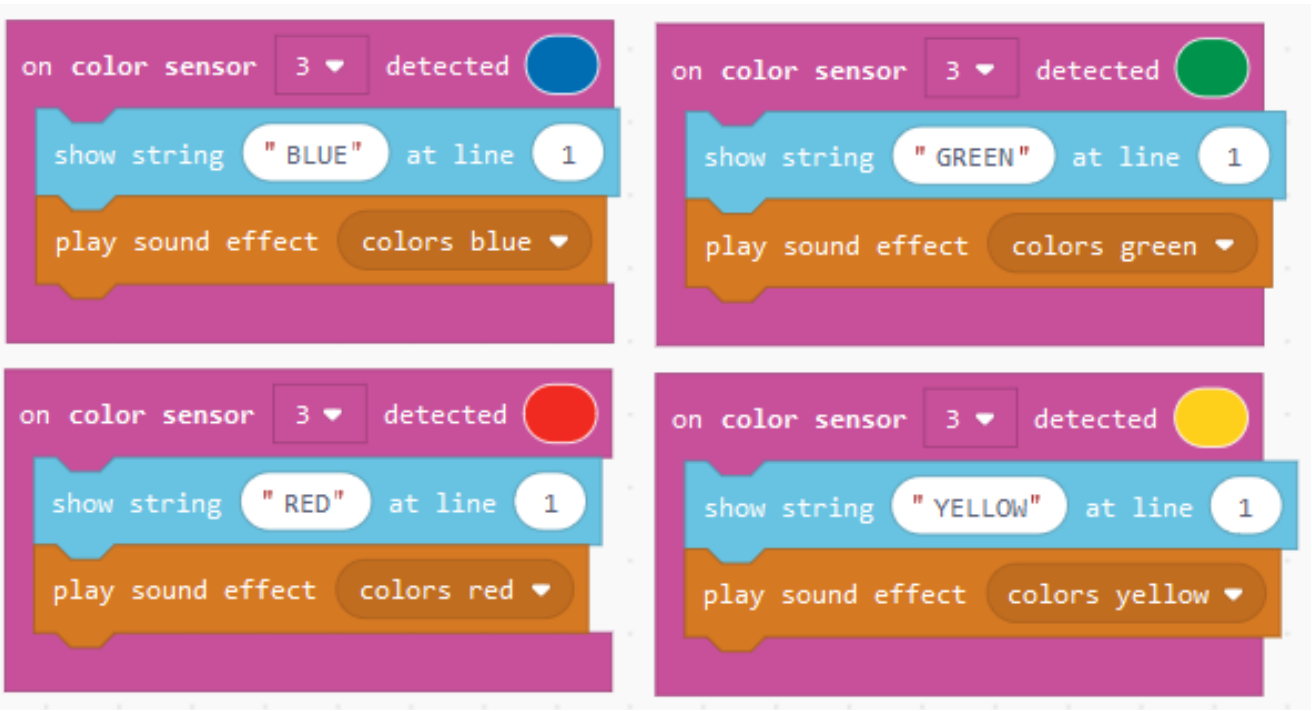
Set motor X brake/pause/inverted/regulated ON/OFF

Control flow (blocks)

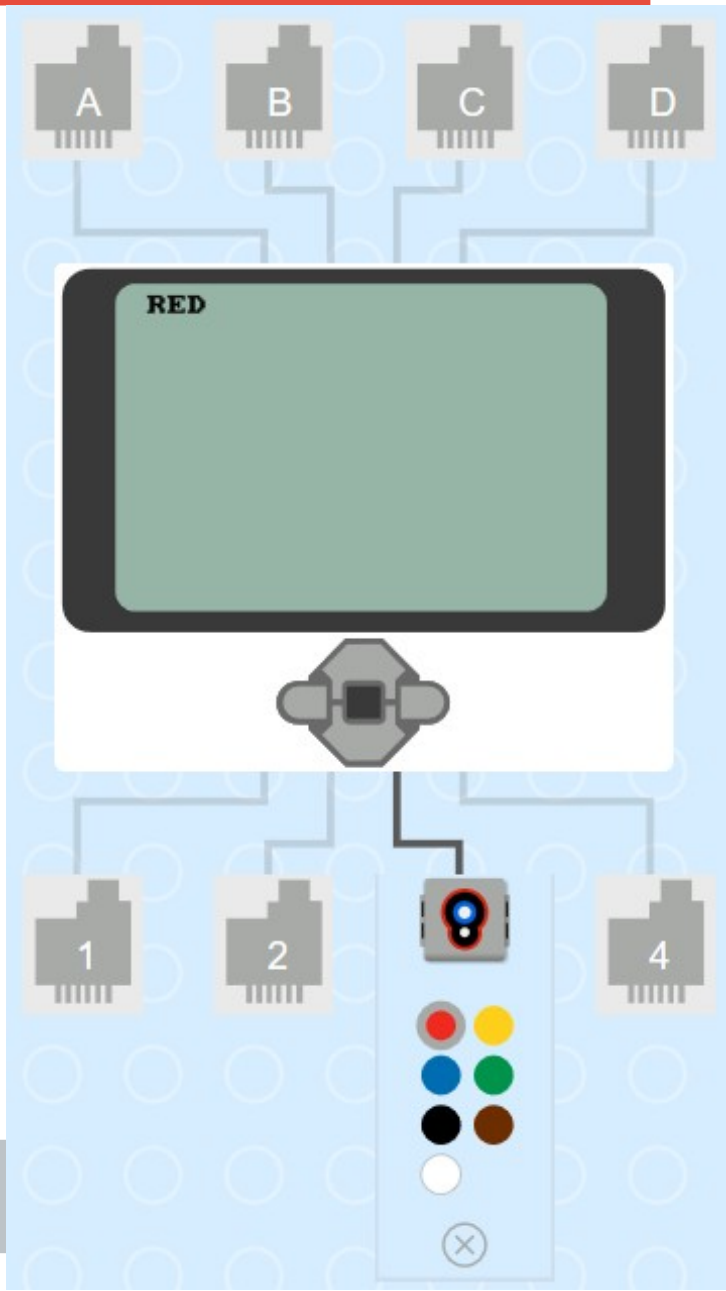
One main thread	NO MULTI
One forever loop	NO MULTI
Sensor events	ONE EACH
Counted loops?	YES
Foreach?	YES
Do-while?	NO
While-do?	YES

Parallel threads?	EXPLICIT
("run in parallel" block)	
Wait for all threads?	YES
New (numeric) events?	YES
Parametric events?	YES
Wait for event?	YES
Timers?	YES

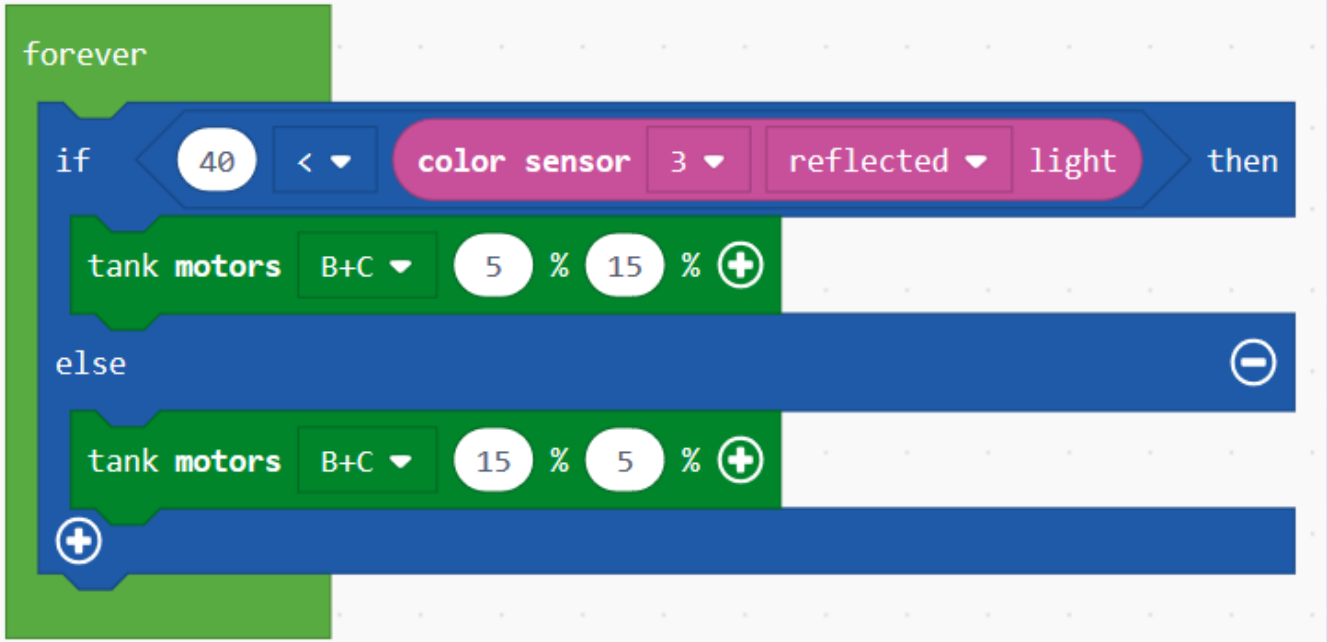
Color recognizer example



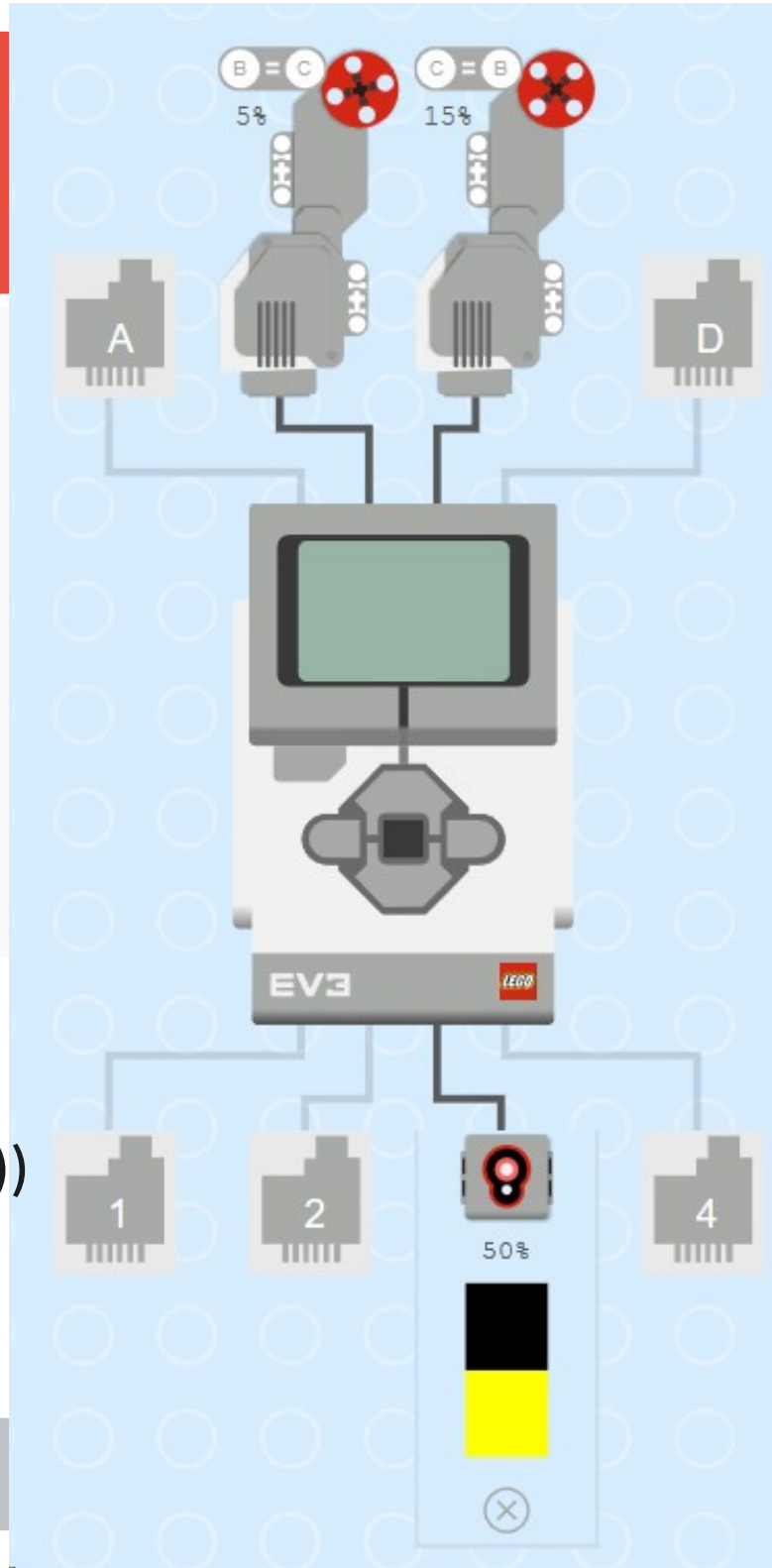

```
sensors.color3.onColorDetected(ColorSensorColor.Blue, function
(){
    brick.showString("RED", 1)
    music.playSoundEffect(sounds.colorsBlue)
})
```



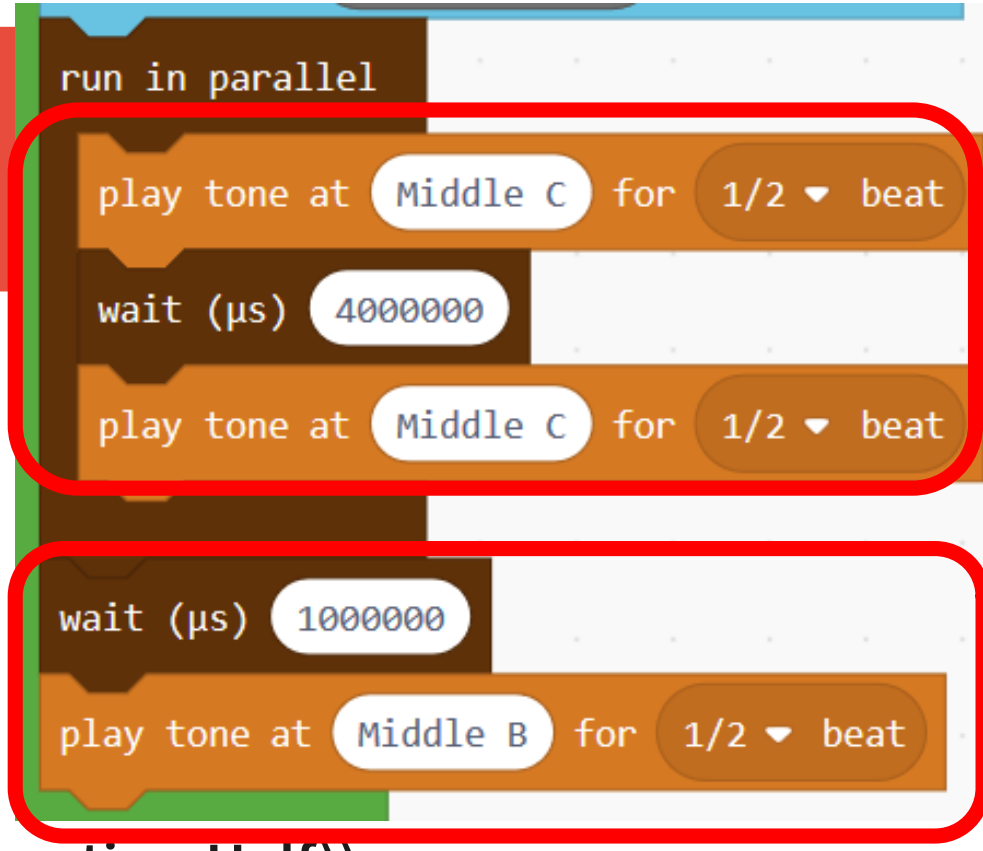
Line follower example




```
forever(function () {
   if (40 <
sensors.color3.light(LightIntensityMode.Reflected))
         {       motors.largeBC.tank(5, 15)   }
else    {    motors.largeBC.tank(15, 5)   }})
```



Parallel thread example



“run in a parallel/different thread”

In parallel:

- beep, wait then beep (other thread)
- wait then beep

```
control.runInParallel(function () {
    music.playTone(262, music.beat(BeatFraction.Half))
    control.waitMicros(4000000)
    music.playTone(262, music.beat(BeatFraction.Half))
})
control.waitMicros(1000000)
music.playTone(494, music.beat(BeatFraction.Half))
```

TypeScript mode

Editor with colour highlight, autocompletion and documentation

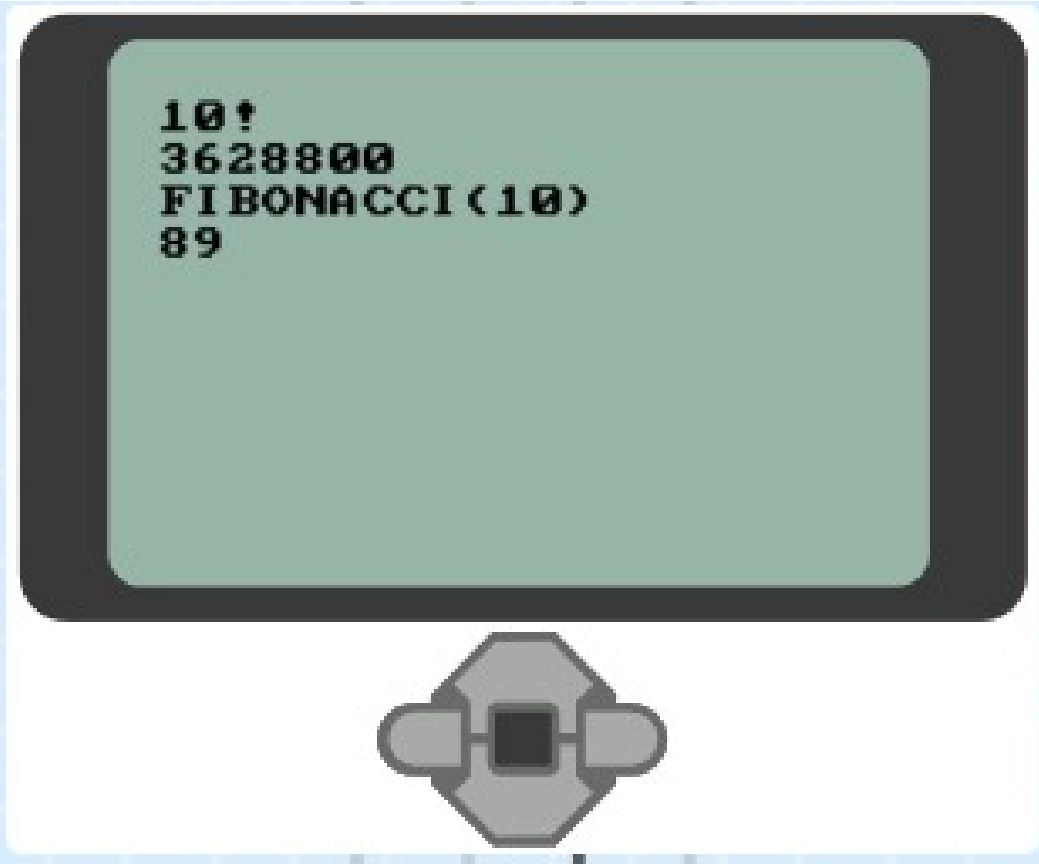
Static TypeScript (Typed JavaScript)

Object-oriented! (to be investigated)

A sequence of statements and declarations
FOLLOWED by an infinite loop

Static Python in a near future?

Recursion example




```
on start
function factorial(N: number): number {
    if (N < 2)  return 1
    else        return N * factorial(N - 1)
}
function fibonacci(N: number): number {
    if (N < 2)  return 1
    else        return fibonacci(N - 2) + fibonacci(N - 1)
}
show string "10!" at line 2
show number factorial(10) at line 3
show string "FIBONACCI(10)" at line 4
show number fibonacci(10) at line 5
```

Extensions

MESSAGES!

- onMessage XXX Received EVENT
- sendMessage XXX
- sendMessage XXX andWait

(NAMED Messages without value)

STORAGE (files on USB stick)

- permanent / temporary

AUTOMATION

- use a PID (Proportional Integral Derivative) to control a robot

Demo

https://makecode.mindstorms.com

DEMO