Session 1

No-Code Programming for Biology

1. Welcome!
2. Turn off your video and mute yourselves for now
3. Feel free to introduce yourselves in the chat
4. As we go along, ask any questions in the chat

No-Code Programming for Biology

Today’s Session

17:00 Welcome!

17:05 Lesson 1: Introduction

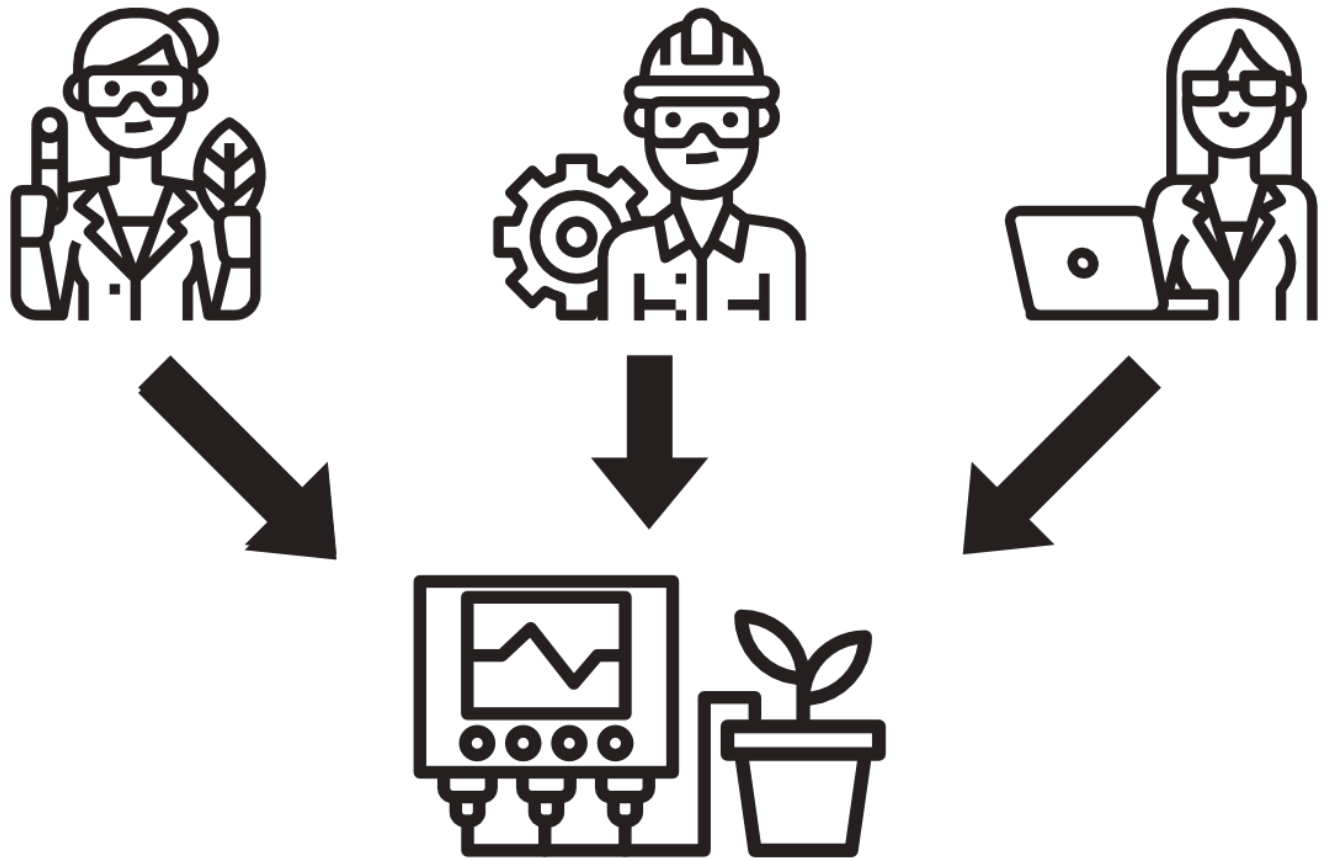
An introduction to the grove board, microcontrollers and the XOD IDE

17:30 Lesson 2: Getting Started (hands-on session)

Get started with using your board. We’ll start with some simple tasks like flashing an LED, pressing a button and sounding a buzzer

18:25 Round-up

Biomaker



No-Code Programming for Biology

seeed studio

Before we Start

1. Downloaded the XOD Software

   www.xod.io

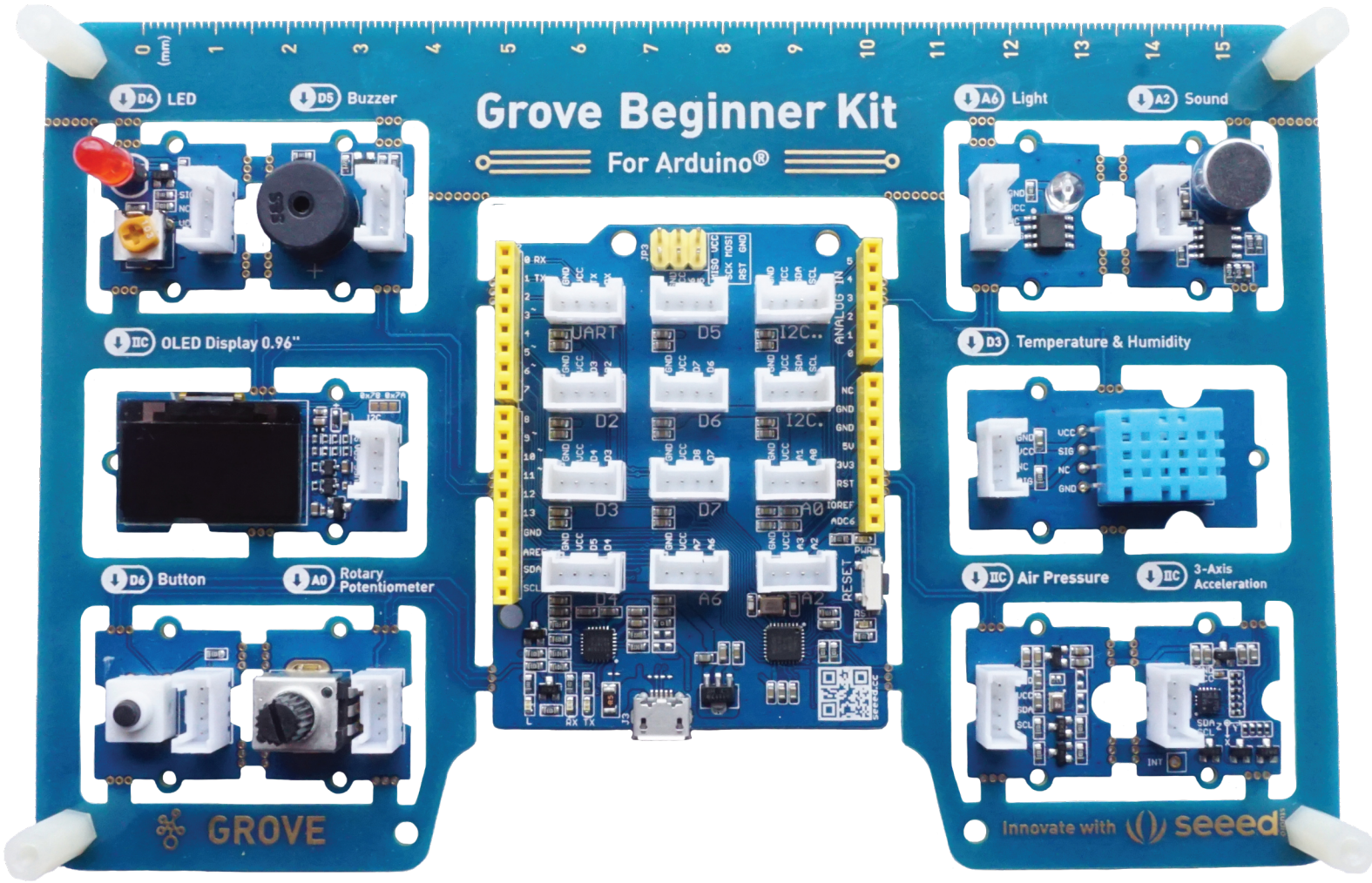
2. Downloaded the No-Code Programming Beginner's Guide

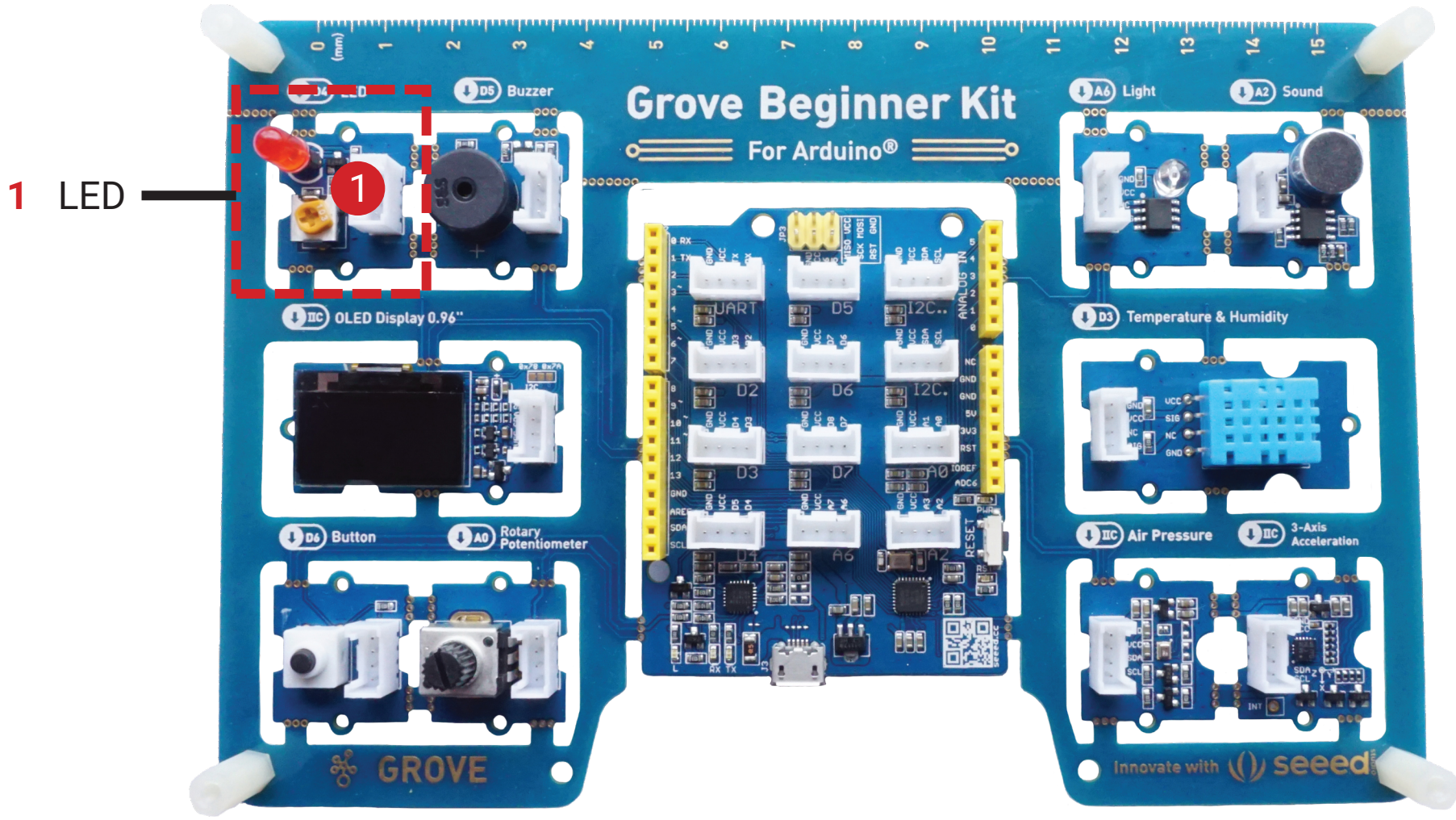
   www.biomaker.org/nocode-programming-for-biology-handbook

3. Installed USB Drivers (if required)

   www.silabs.com/developers/usb-to-uart-bridge-vcp-drivers

The Starter Kit


Grove Beginner Kit
For Arduino®
D4 LED
D5 Buzzer
A6 Light
A2 Sound
IIC OLED Display 0.96"
D3 Temperature & Humidity
D6 Button
A0 Rotary Potentiometer
IIC Air Pressure
IIC 3-Axis Acceleration
GROVE
Innovate with seeed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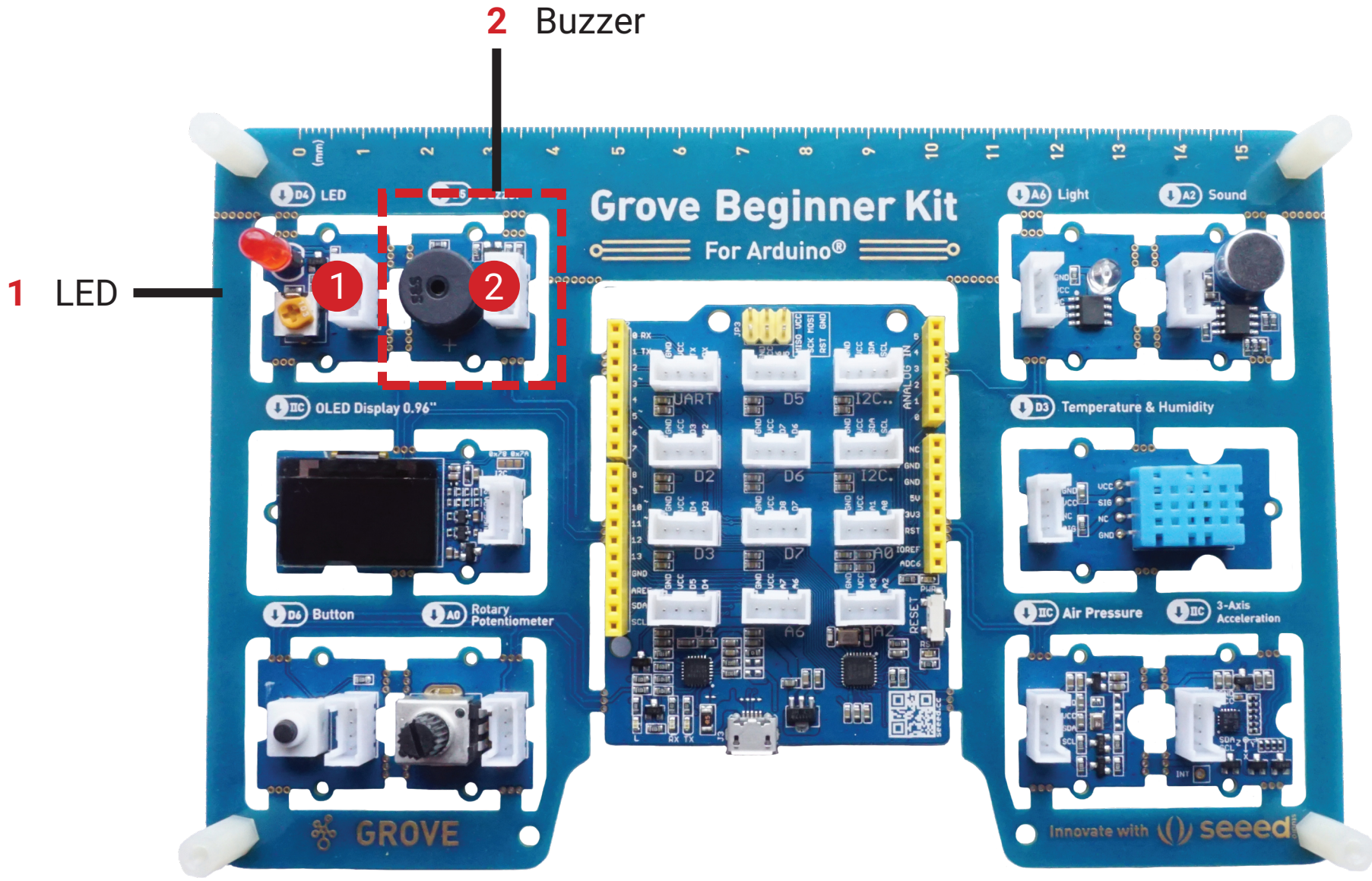
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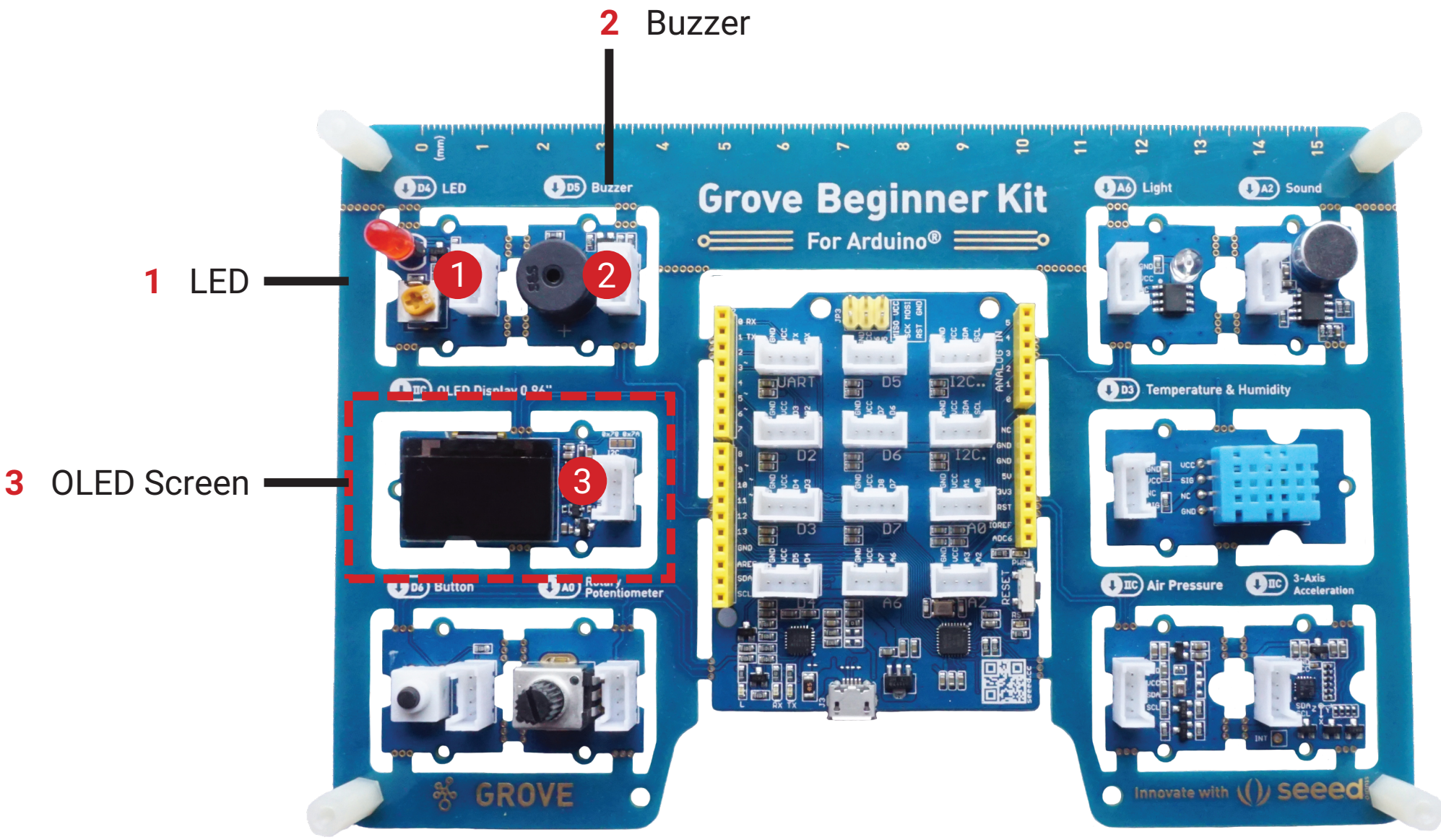
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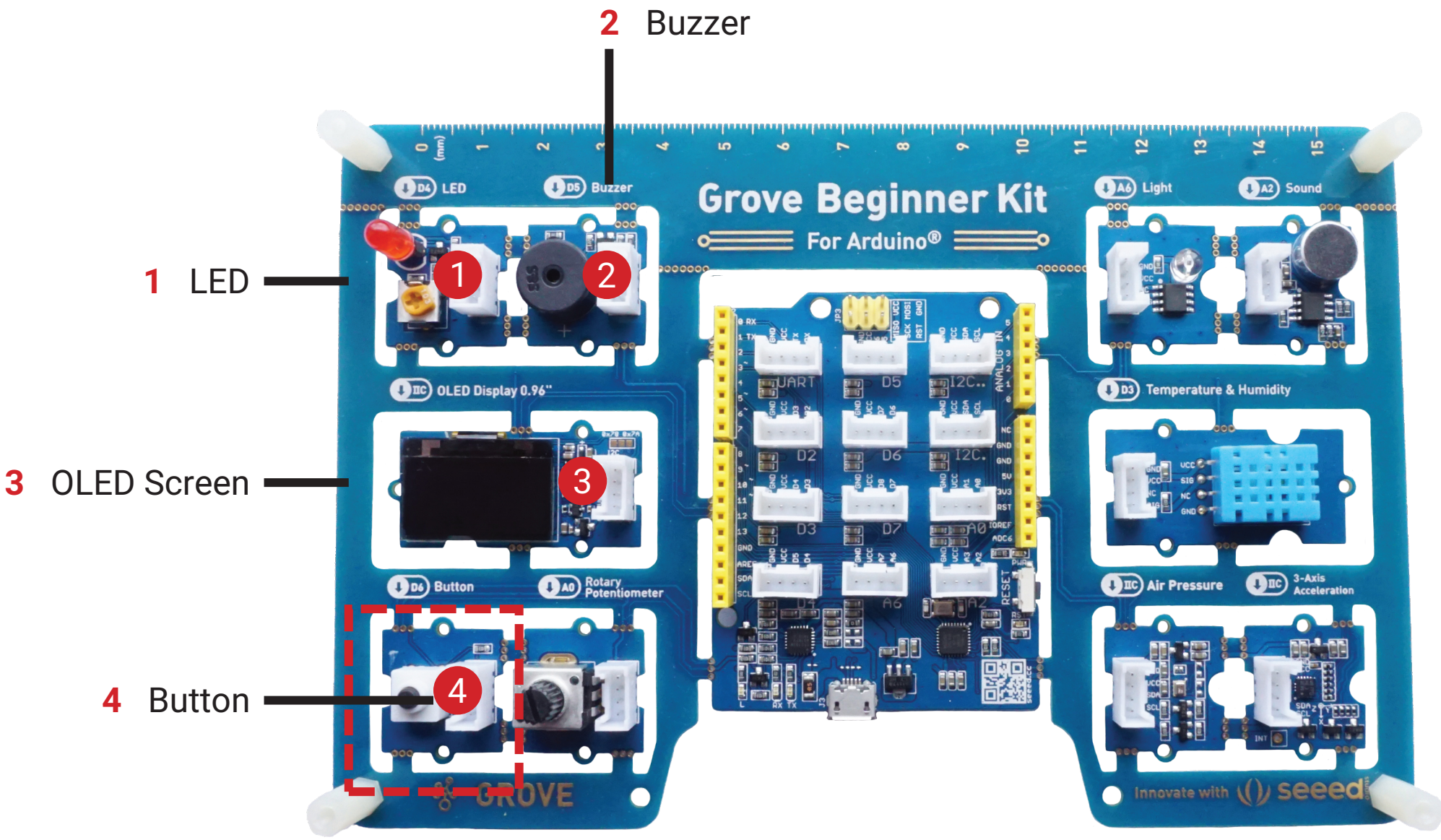
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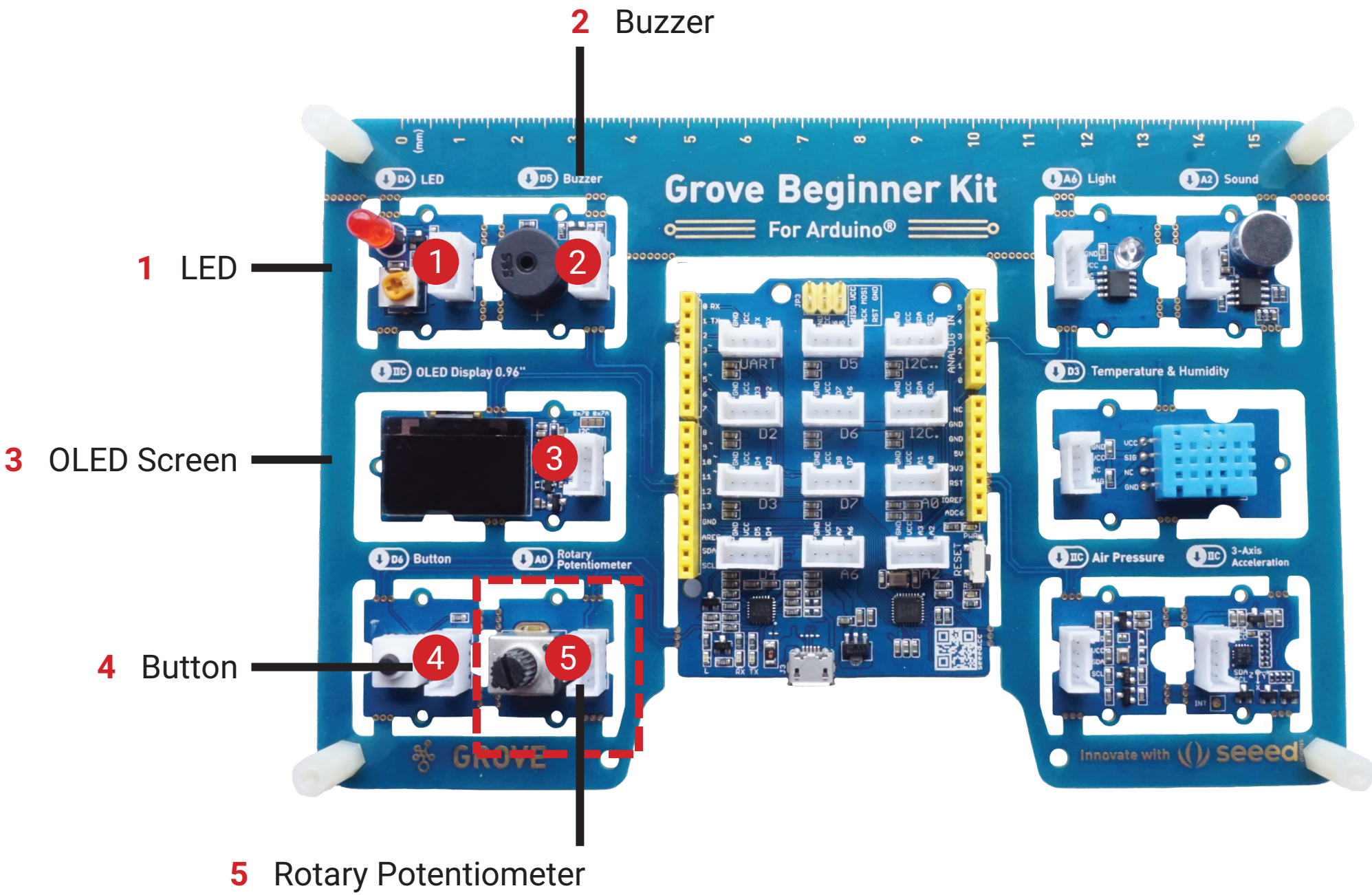
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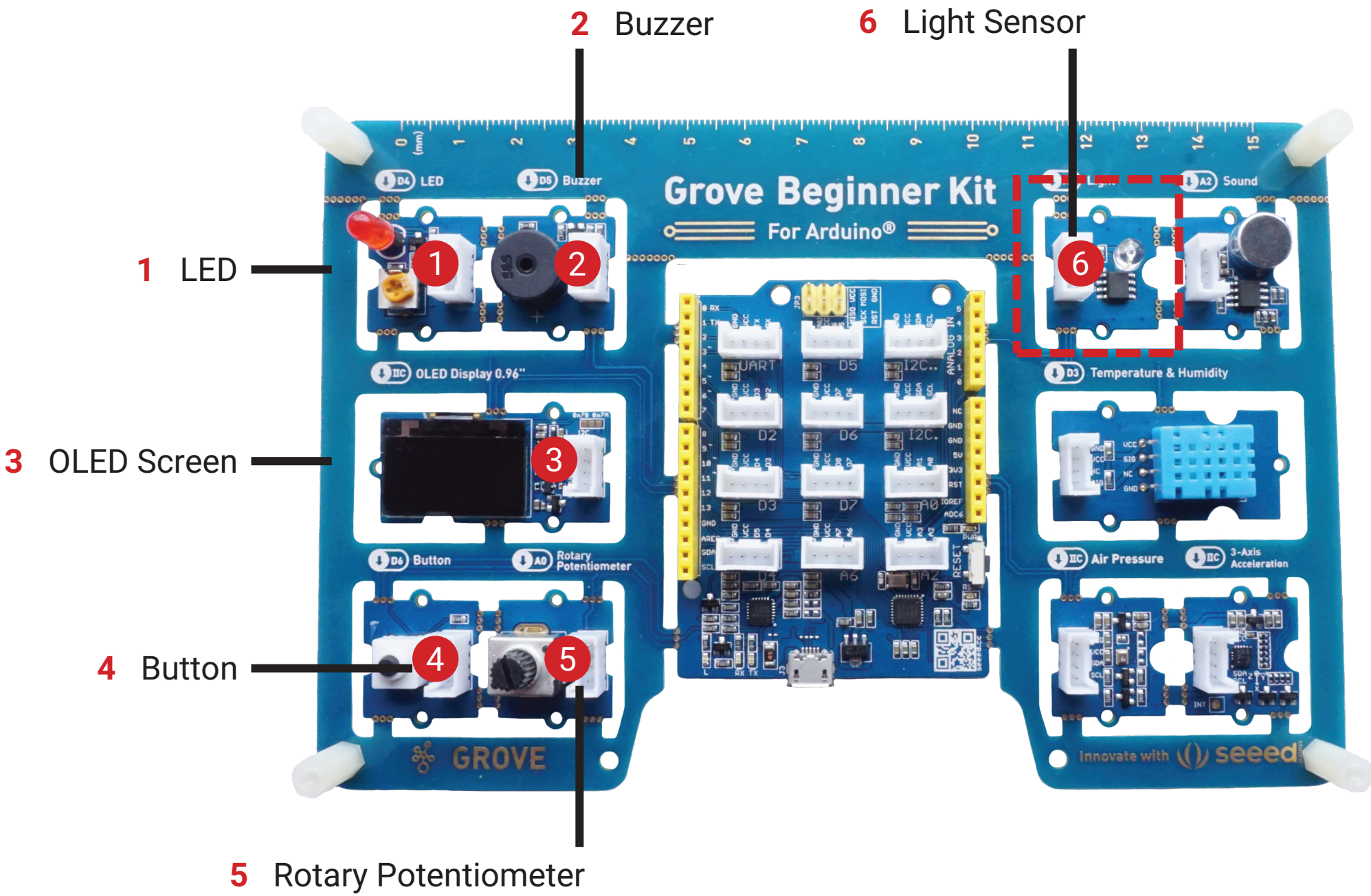
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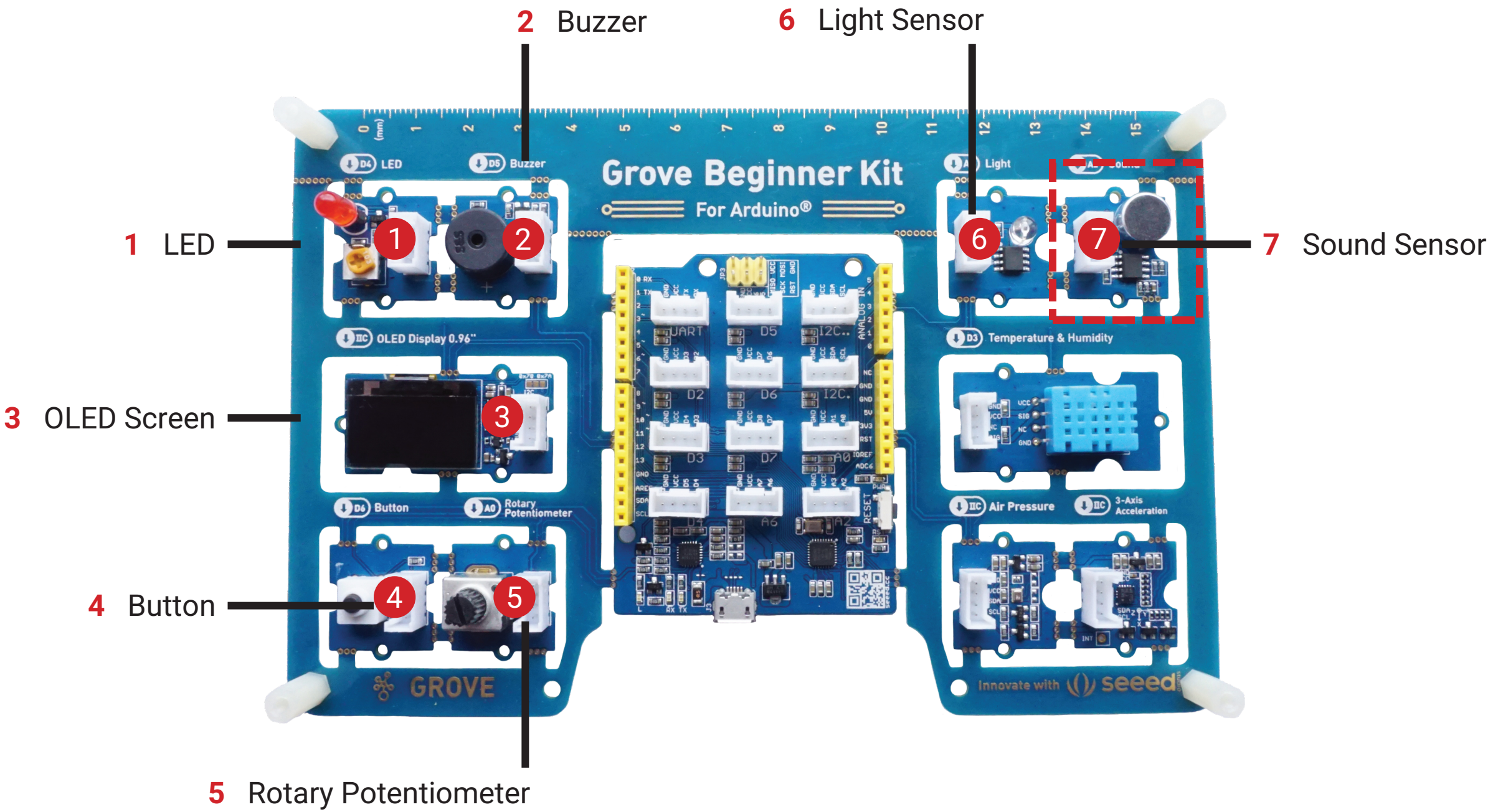
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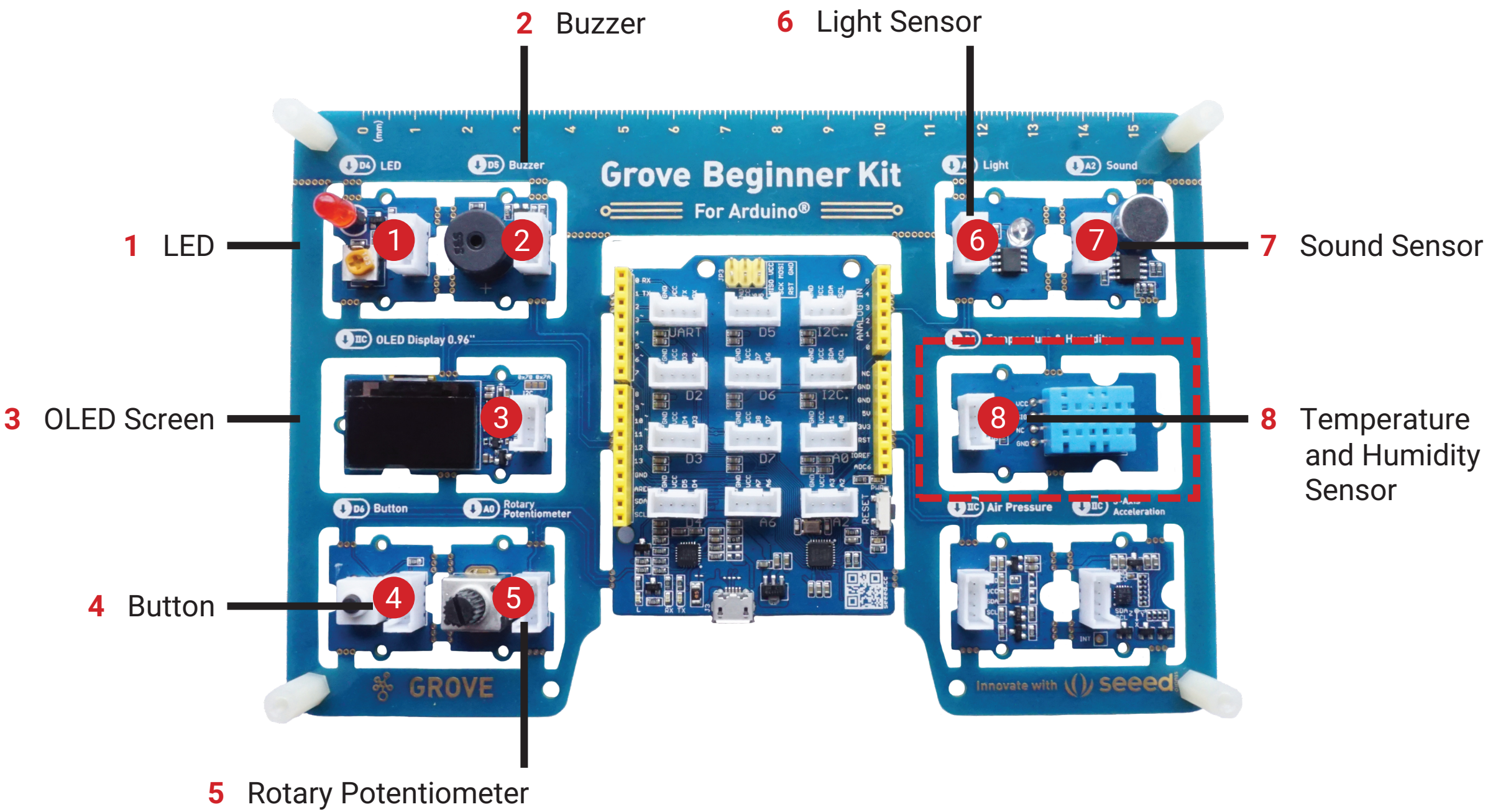
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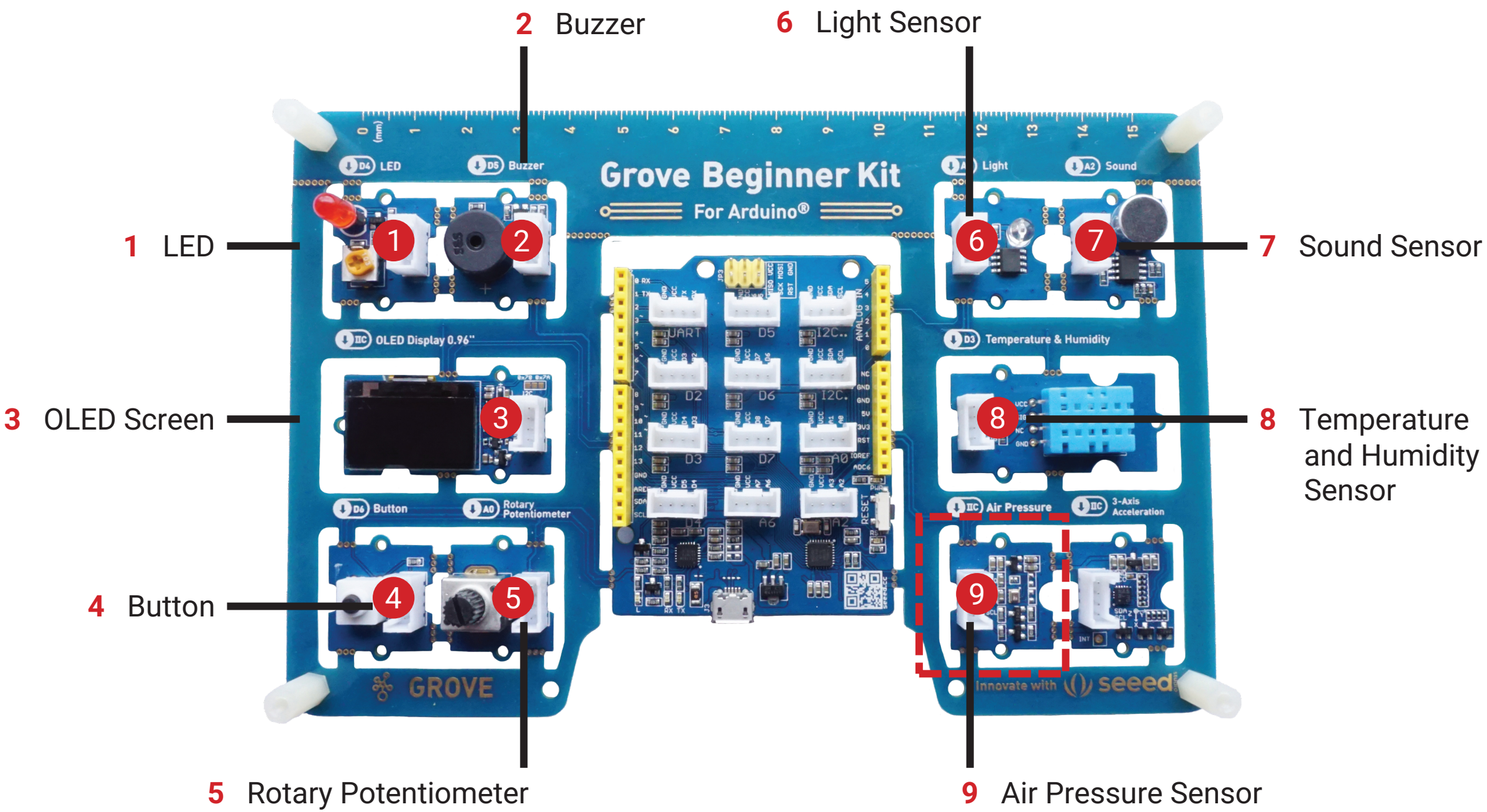
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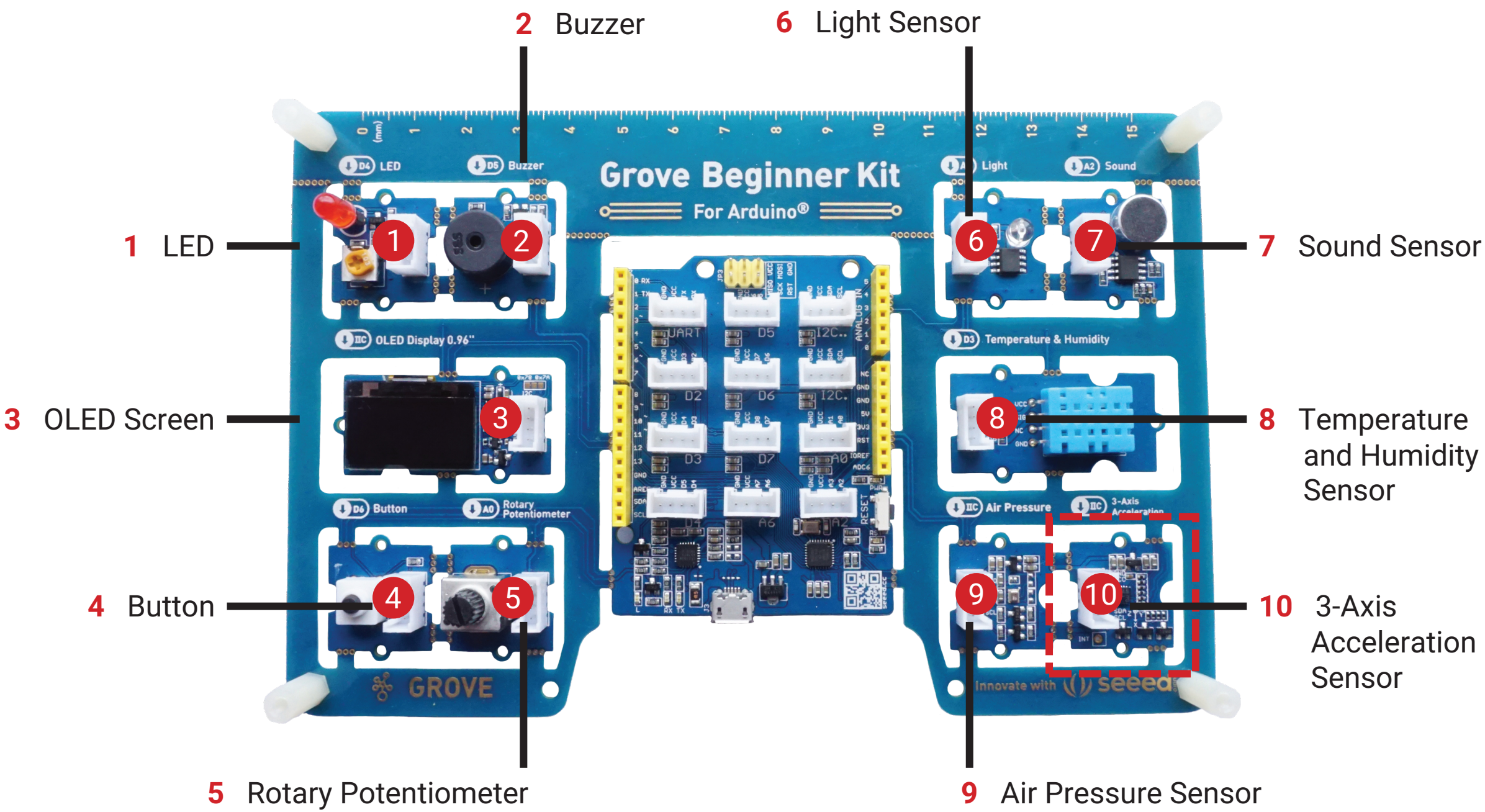
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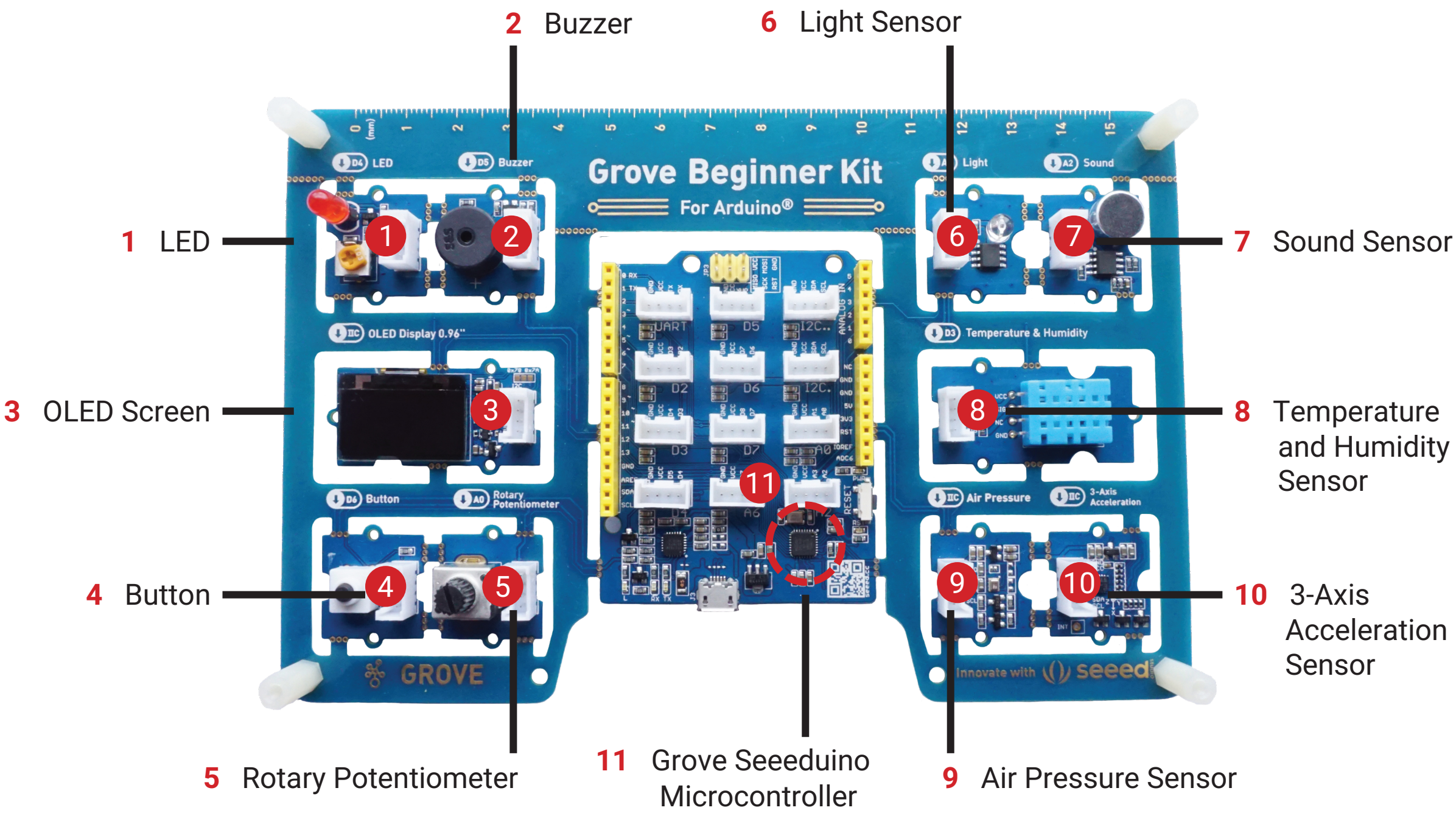
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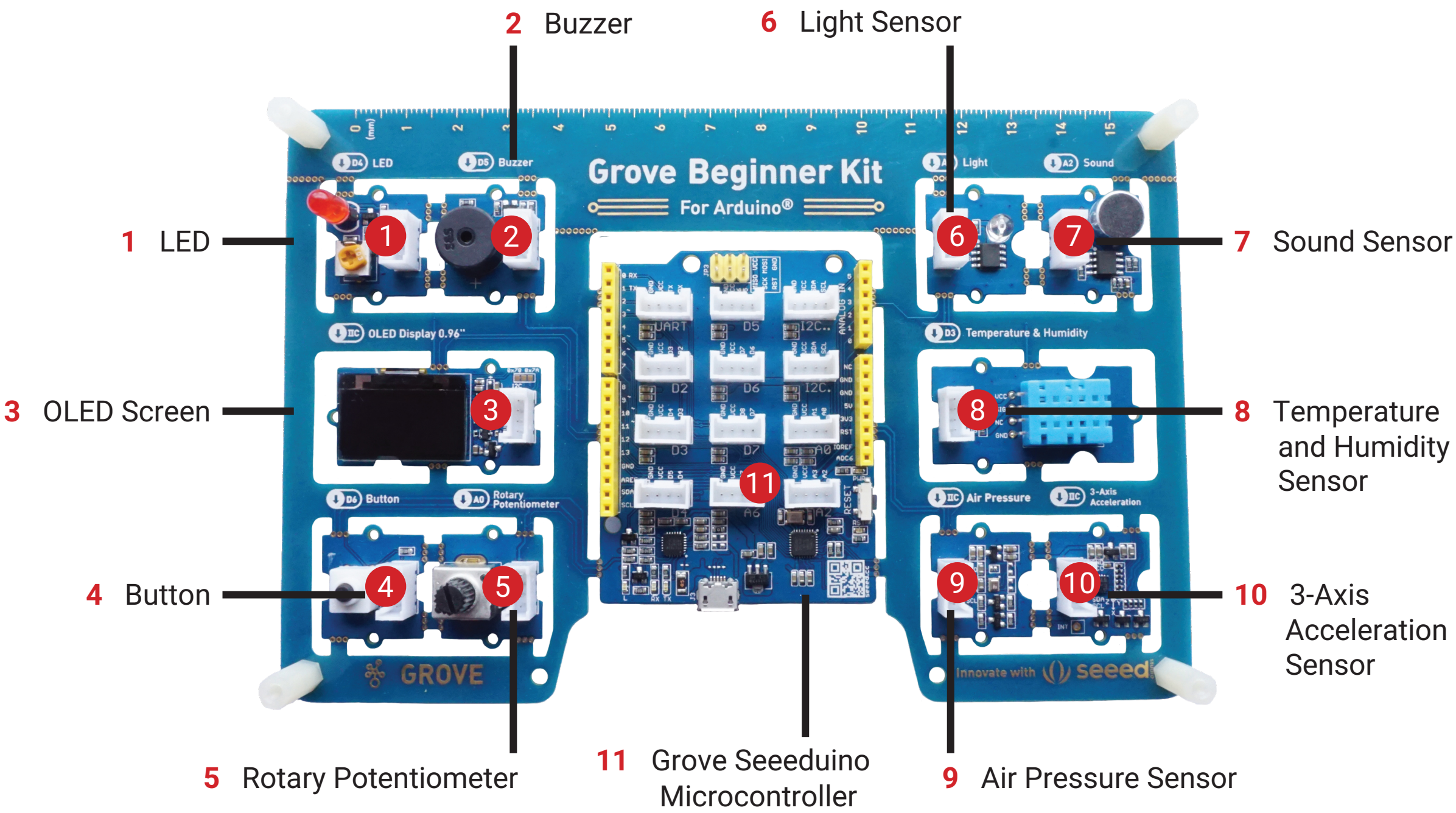
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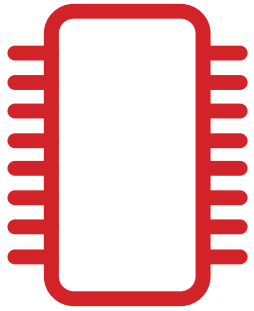
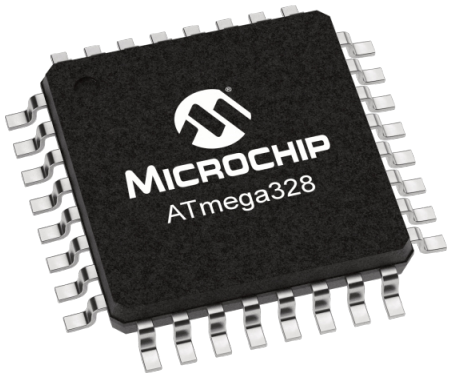


The Microcontroller

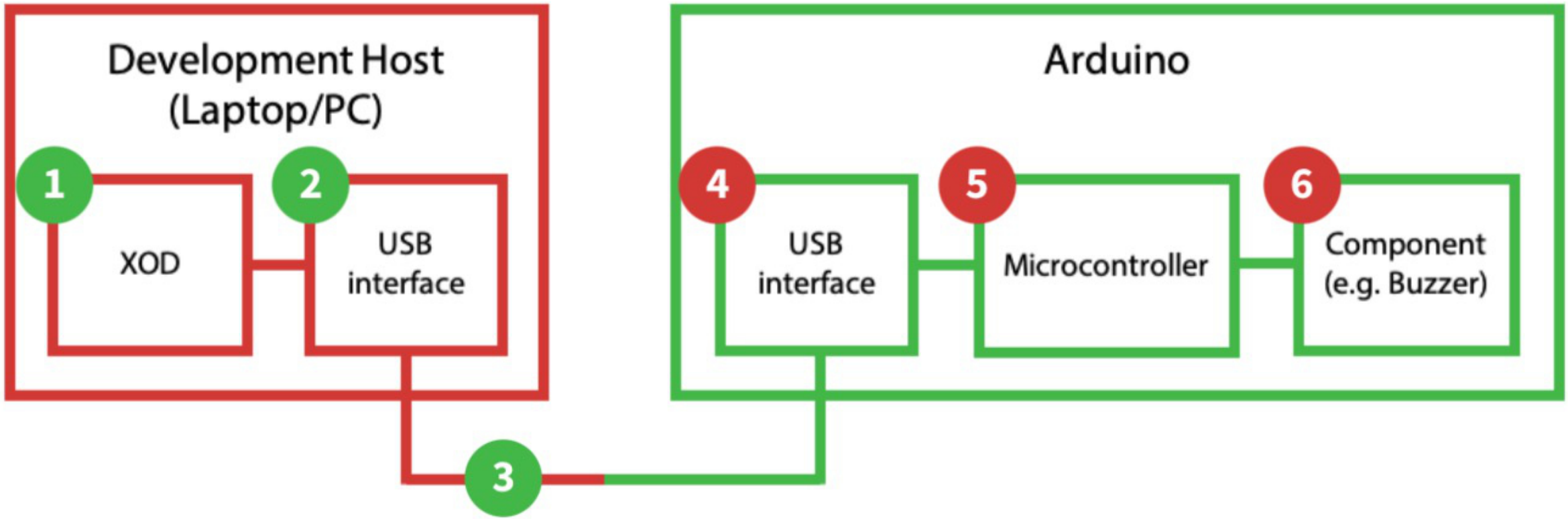


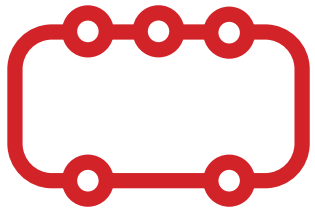
A0-A6 Analog

D0-D13 Digital

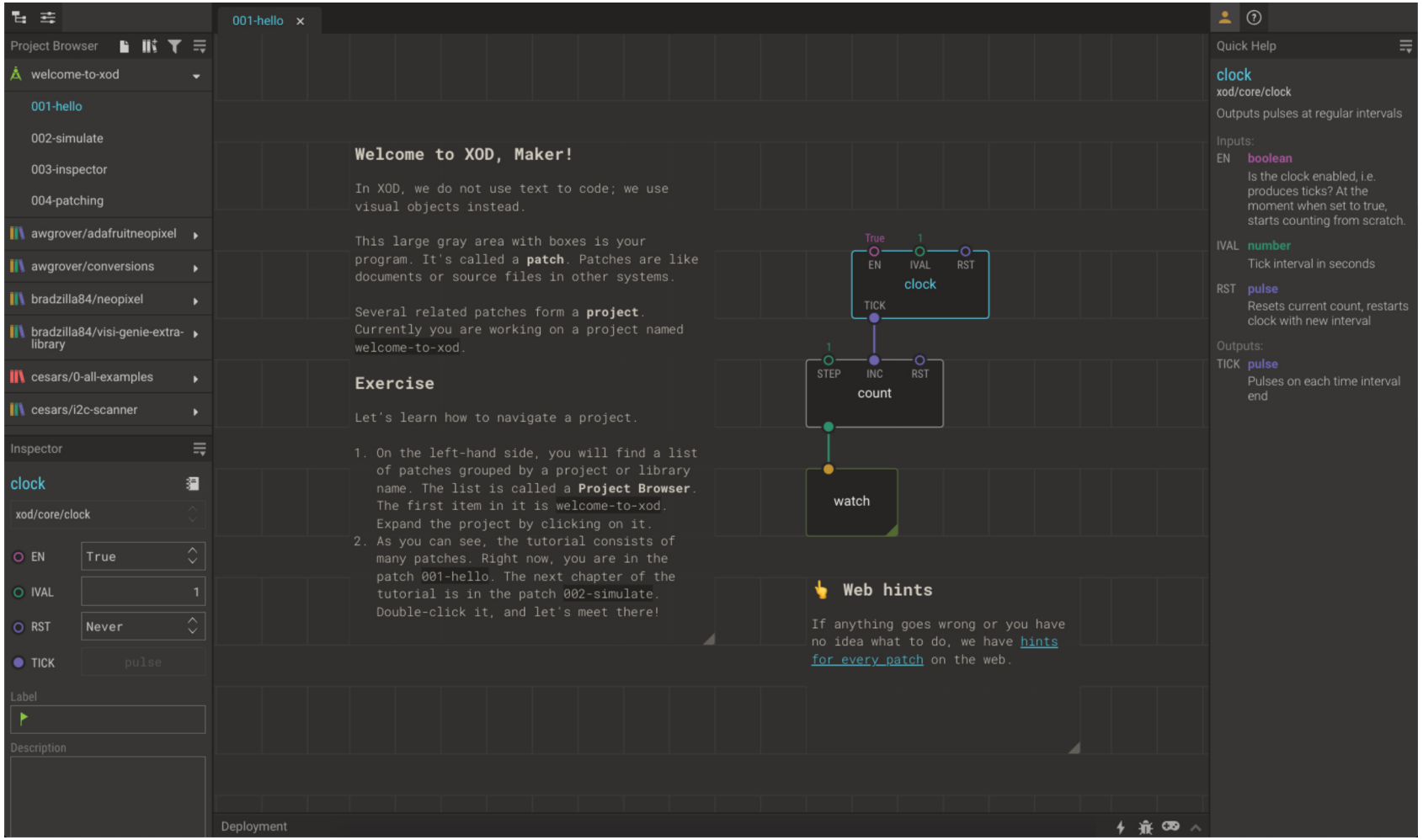
I2C I2C (require address)

PIN	DEVICE
A0	Rotary Potentiometer
A2	Sound Sensor
A6	Light Sensor
D3	Temperature and Humidity Sensor
D4	LED
D5	Buzzer
D6	Button
I2C (19h)	Three-Axis Accelerator
I2C (77h)	Air Pressure Sensor
I2C (3Ch)	OLED Screen

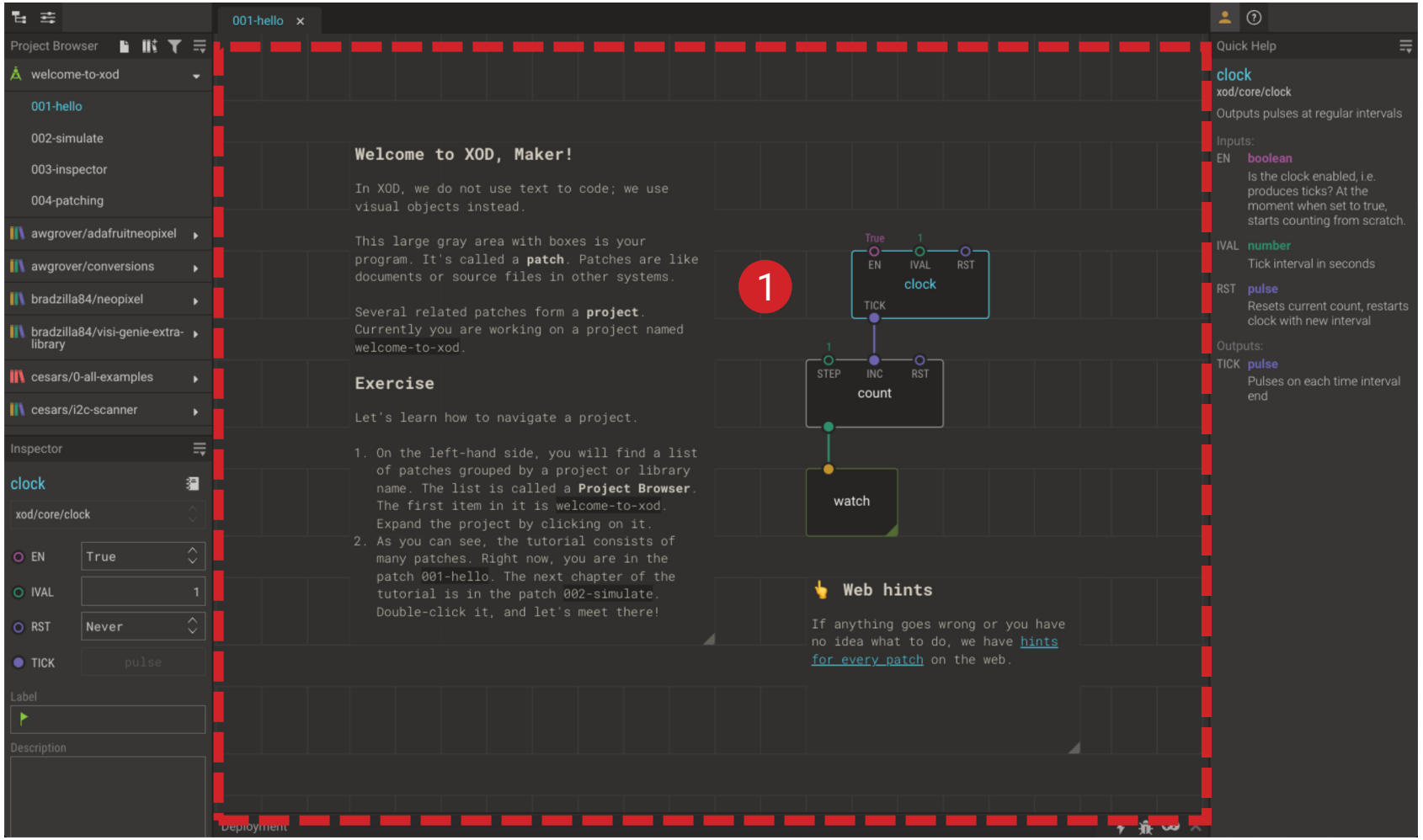

Development Host
(Laptop/PC)
1
XOD
2
USB
interface
3
Arduino
4
USB
interface
5
Microcontroller
6
Component
(e.g. Buzzer)



The XOD IDE


001-hello
Project Browser
welcome-to-xod
001-hello
002-simulate
003-inspector
004-patching
awgrover/adafruitneopixel
awgrover/conversions
bradzilla84/neopixel
bradzilla84/visi-genie-extra-library
cesars/0-all-examples
cesars/i2c-scanner
Inspector
clock
xod/core/clock
EN True
IVAL 1
RST Never
TICK pulse
Label
Description
Welcome to XOD, Maker!
In XOD, we do not use text to code; we use visual objects instead.
This large gray area with boxes is your program. It's called a patch. Patches are like documents or source files in other systems.
Several related patches form a project. Currently you are working on a project named welcome-to-xod.
Exercise
Let's learn how to navigate a project.
1. On the left-hand side, you will find a list of patches grouped by a project or library name. The list is called a Project Browser. The first item in it is welcome-to-xod. Expand the project by clicking on it.
2. As you can see, the tutorial consists of many patches. Right now, you are in the patch 001-hello. The next chapter of the tutorial is in the patch 002-simulate. Double-click it, and let's meet there!
True
1
EN
IVAL
RST
clock
TICK
1
STEP
INC
RST
count
watch
Web hints
If anything goes wrong or you have no idea what to do, we have hints for every patch on the web.
Deployment
Quick Help
clock
xod/core/clock
Outputs pulses at regular intervals
Inputs:
EN boolean
Is the clock enabled, i.e. produces ticks? At the moment when set to true, starts counting from scratch.
IVAL number
Tick interval in seconds
RST pulse
Resets current count, restarts clock with new interval
Outputs:
TICK pulse
Pulses on each time interval end

1 Your Patch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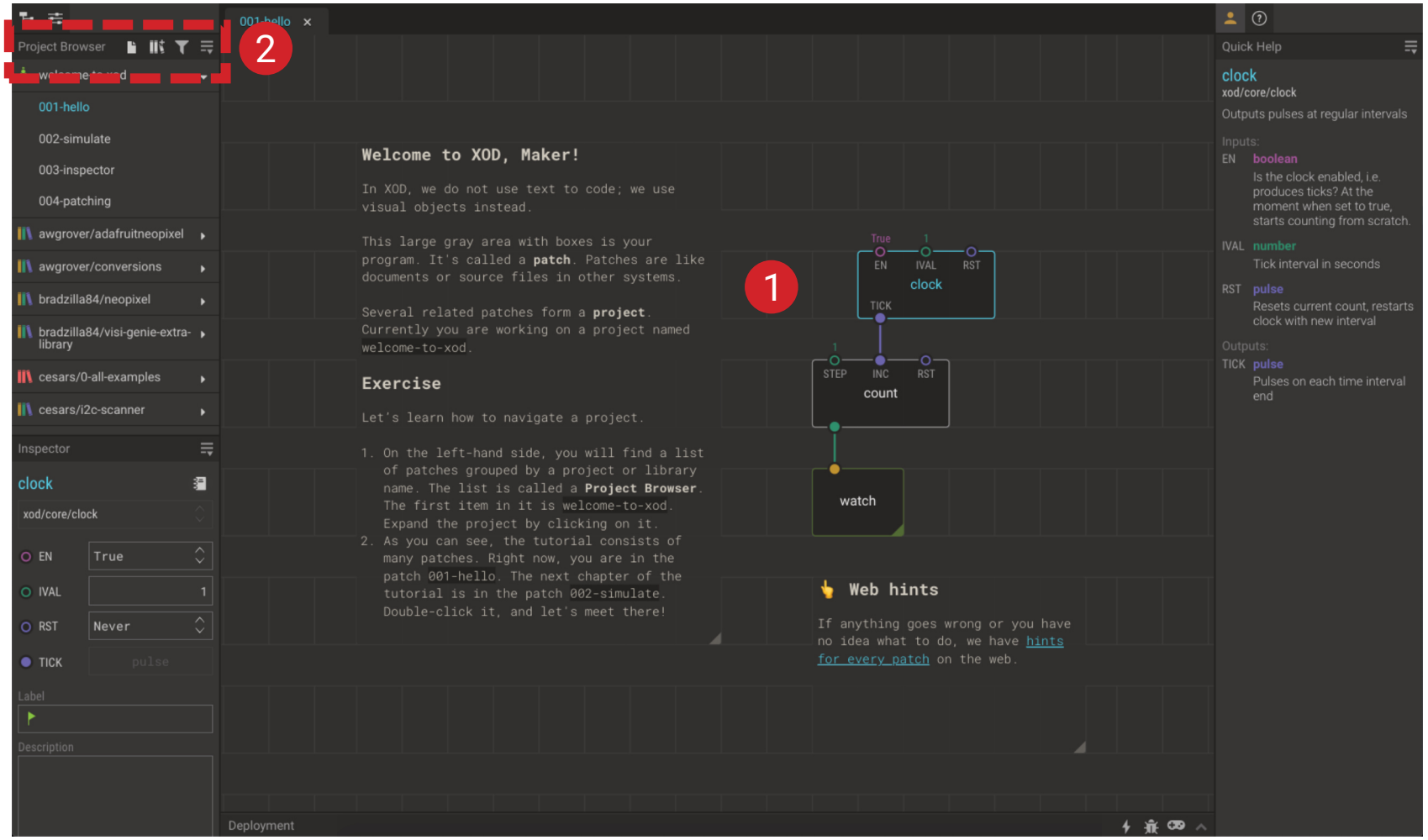
Deployment

New Patch Add Library

1 Your Patch

2 Project Browser: Buttons

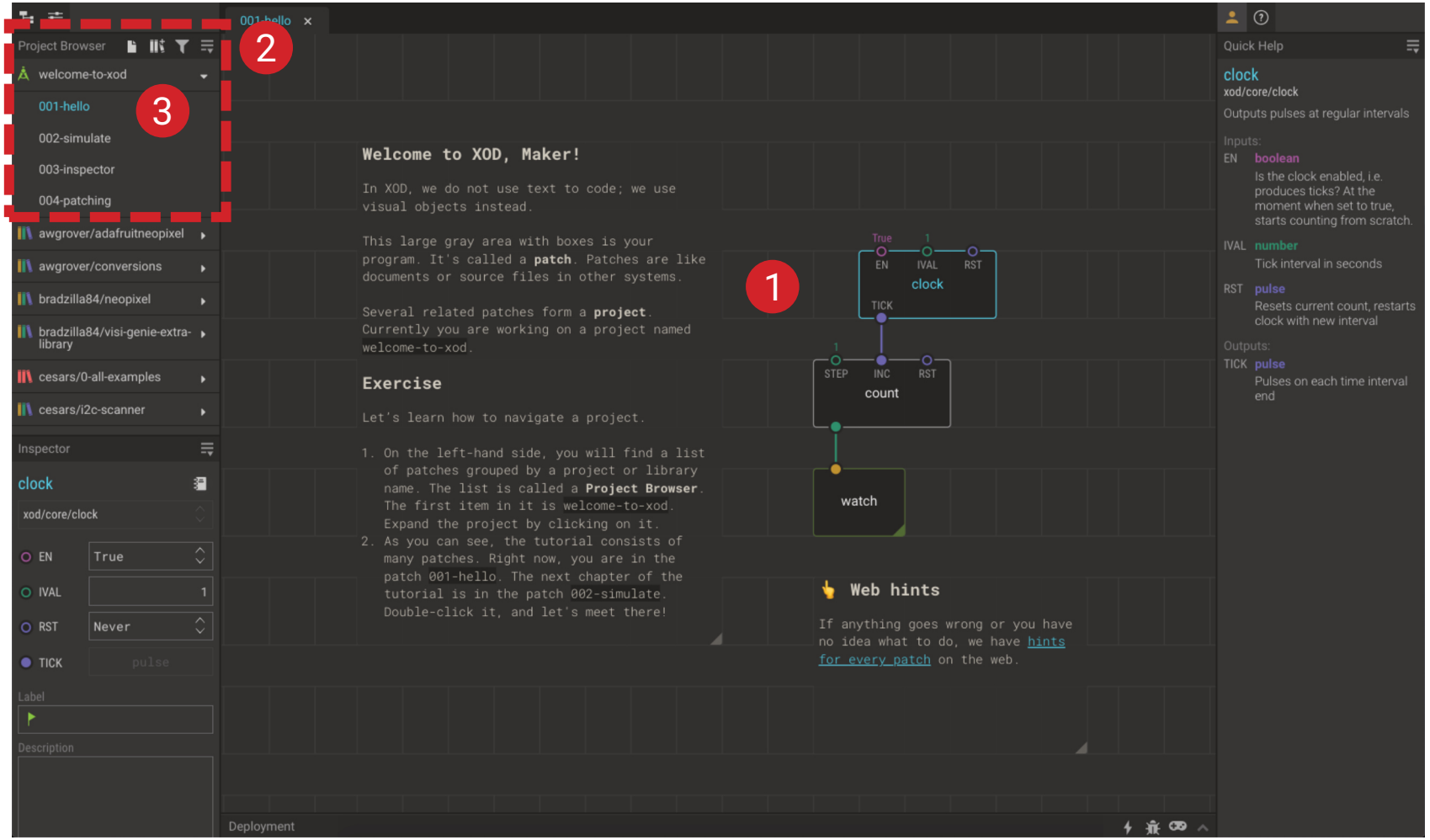


New Patch Add Library

1 Your Patch

2 Project Browser: Buttons

3 Project Browser: Project Patches



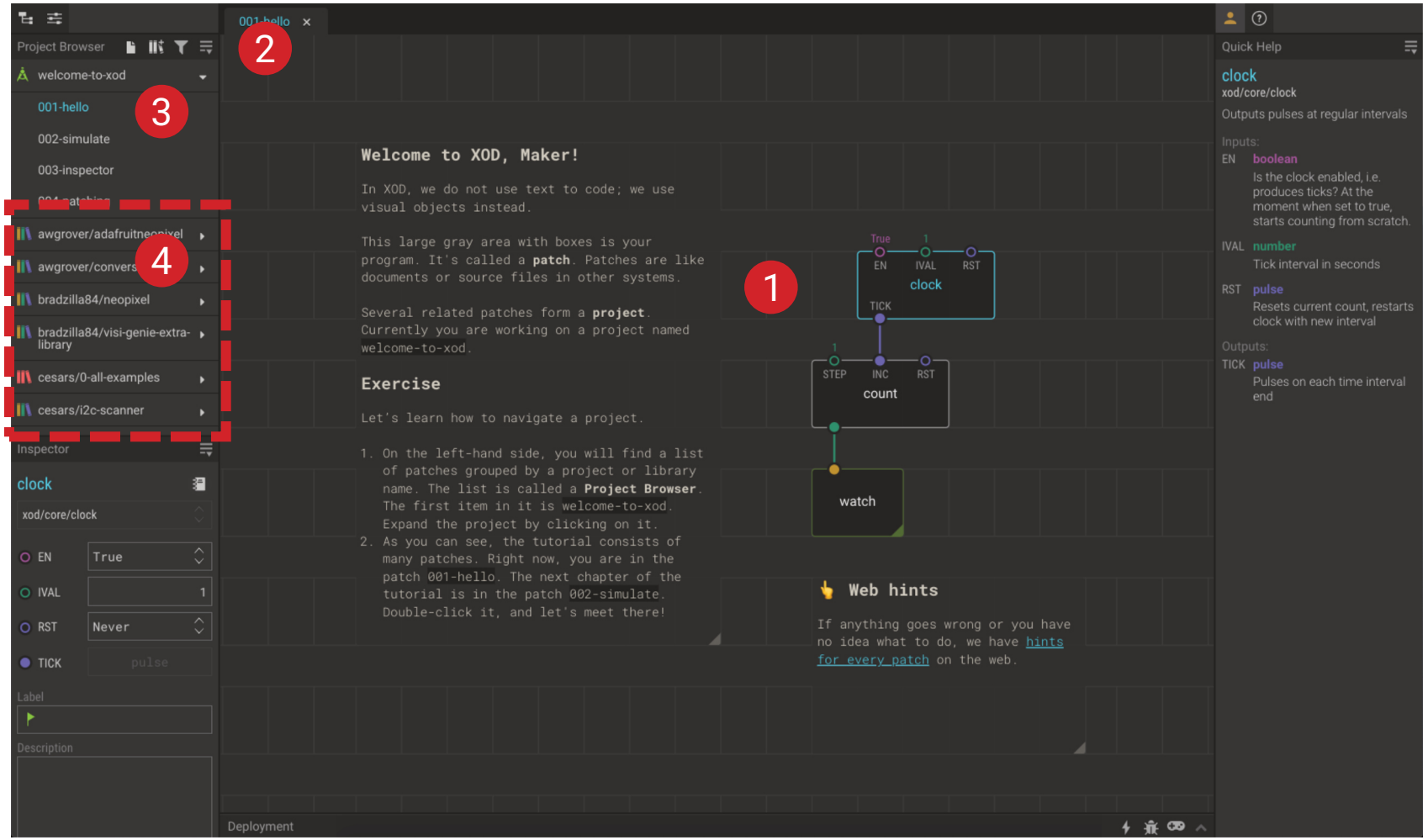
New Patch Add Library

1 Your Patch

2 Project Browser: Buttons

3 Project Browser: Project Patches

4 Project Browser: Libraries



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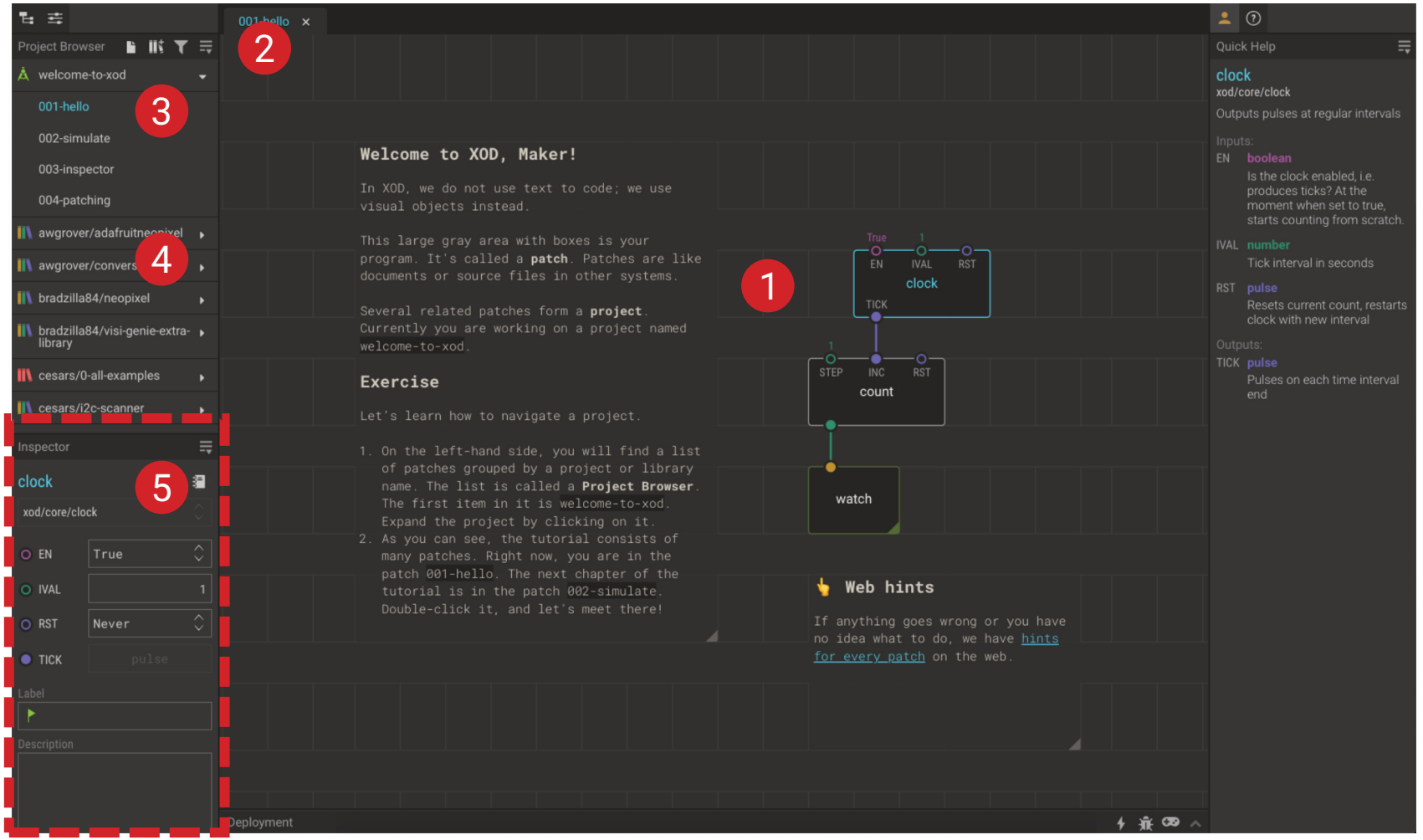


2 Project Browser: Buttons

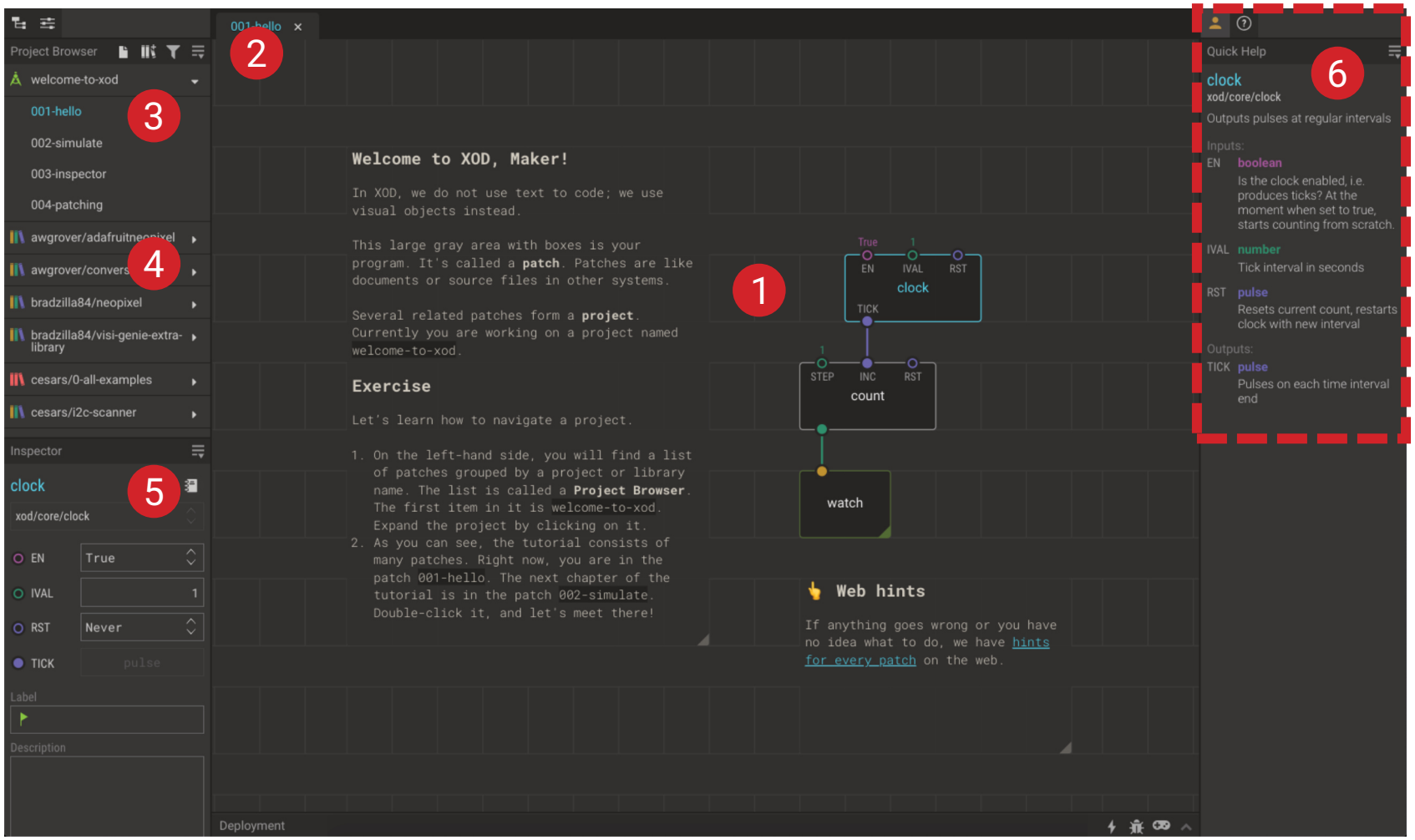
3 Project Browser: Project Patches

4 Project Browser: Libraries

5 Inspector

New Patch Add Library

1 Your Patch



2 Project Browser: Buttons

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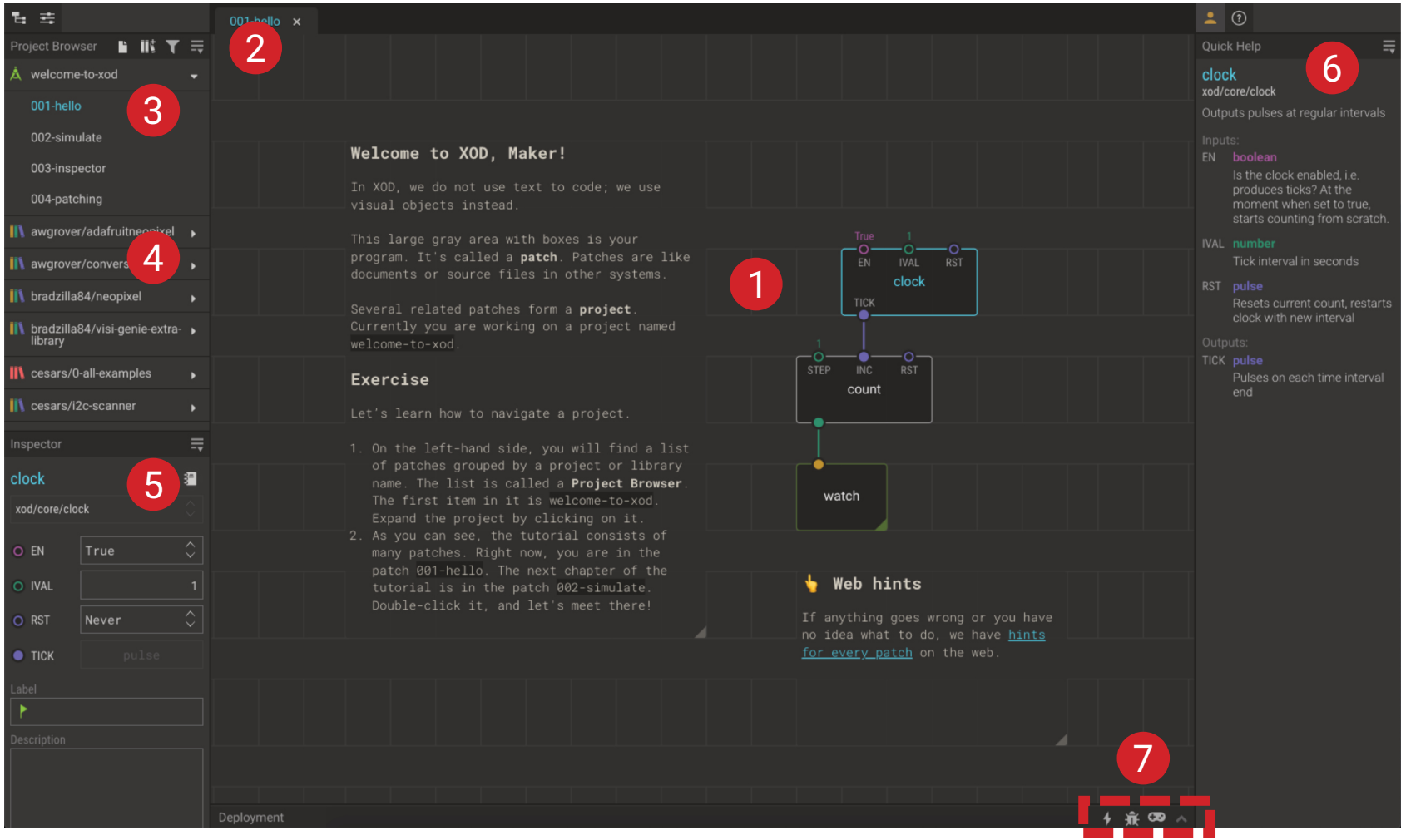
5 Inspector

6 Quick Help

New Patch

Add Library

1 Your Patch



2 Project Browser: Buttons

3 Project Browser: Project Patches

4 Project Browser: Libraries

5 Inspector

6 Quick Help

7 Upload Buttons

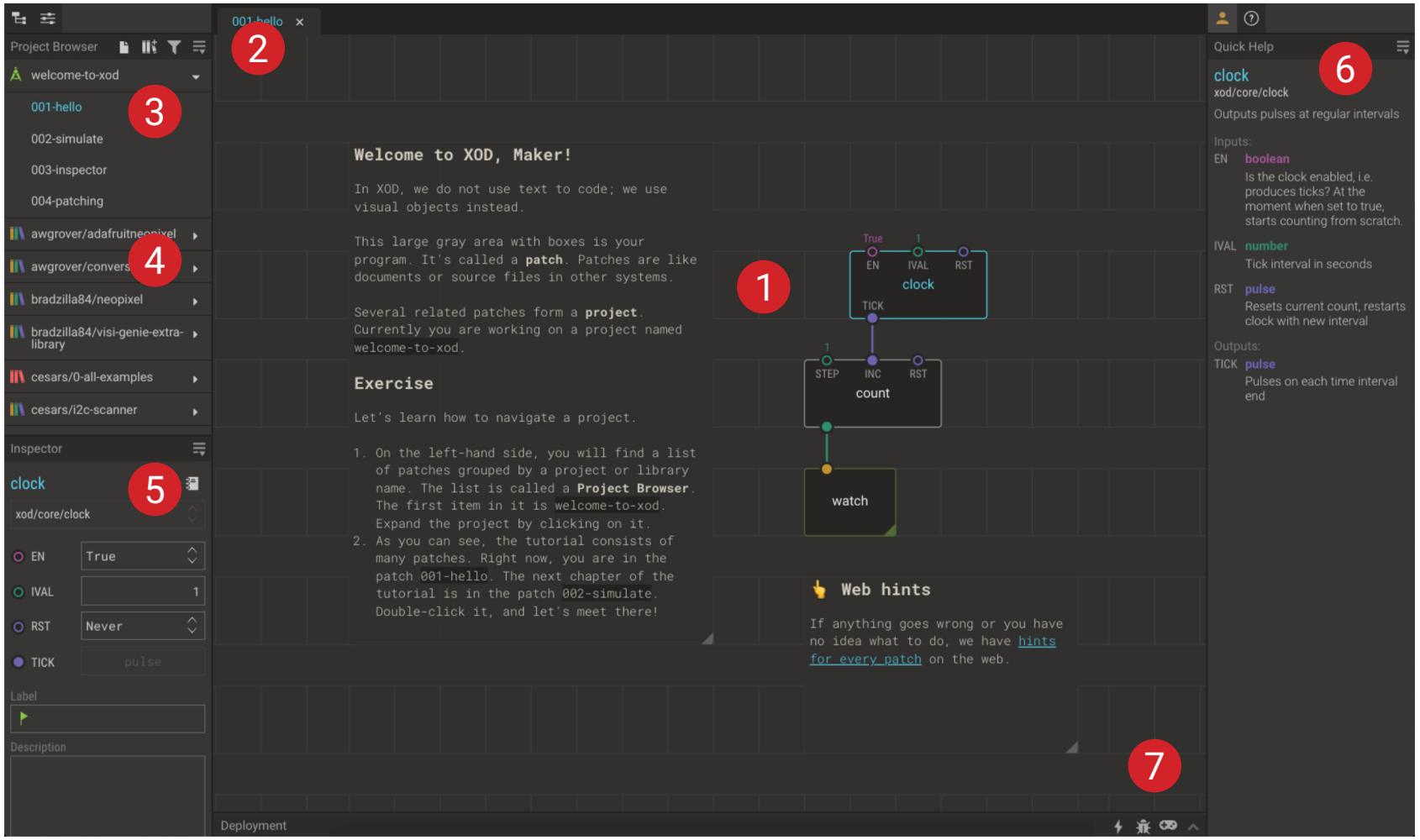
Upload

Upload And Debug

New Patch

Add Library

1 Your Patch



2 Project Browser: Buttons

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4 Project Browser: Libraries

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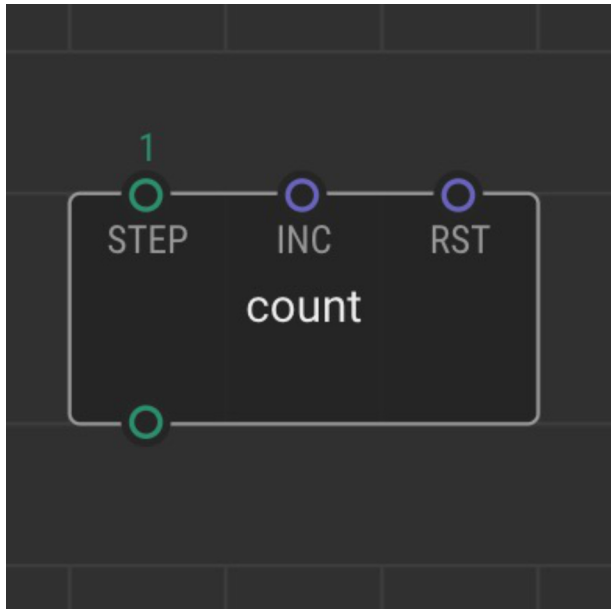
7 Upload Buttons

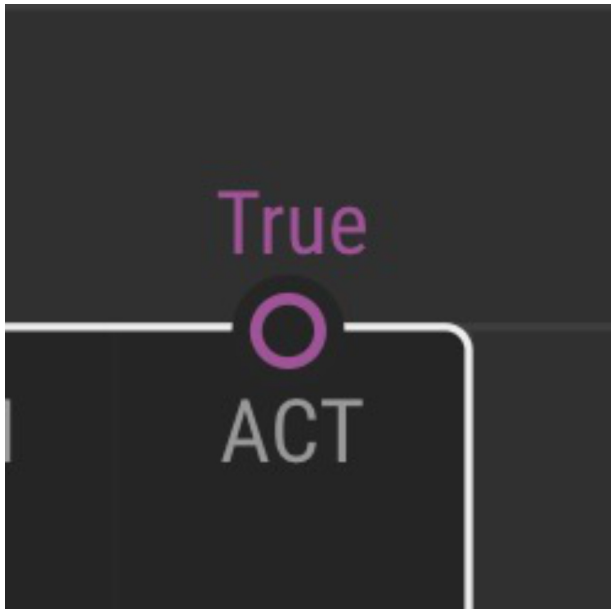
Upload

Upload And Debug

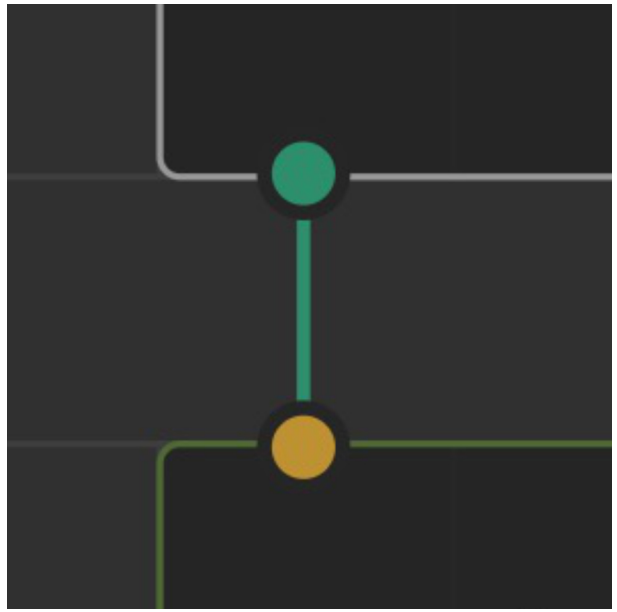
Nodes



Pins



Links

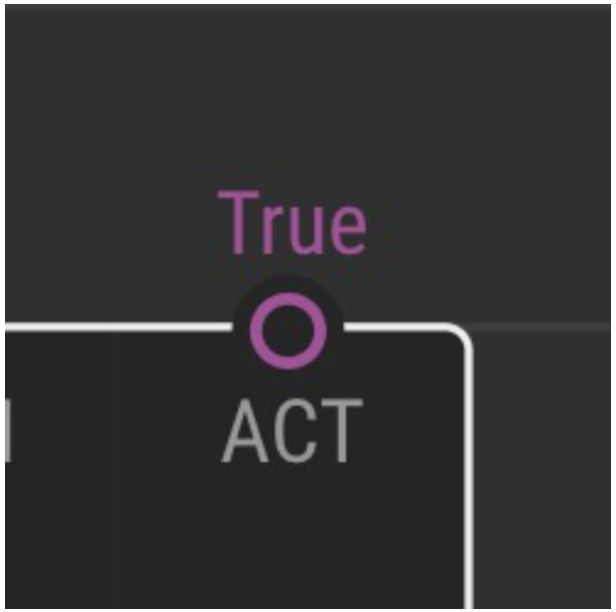


Pins

Pulse

String

Boolean

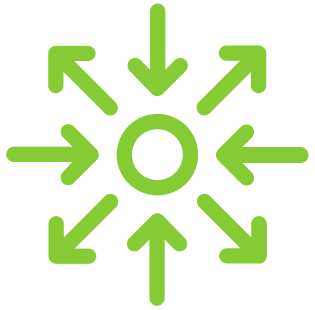


Port

Number

Byte

Testing Your Board



Inputs and Outputs

Breakout Groups – 35min

1. Introduce yourselves
2. Work together and see if each of you can complete the tasks
3. Step-by-step instructions are in the Guide (**p20-29**)
4. Use the ’Ask for Help’ button if necessary

Congratulations!

You can now programme an Arduino Board!

Homework Challenge!

1. How can you expand on your simple programme?
2. Can you use the potentiometer to turn the buzzer on?
3. Can you make the buzzer turn on and the LED turn off when the button is pressed?
4. Can you get your light to flash?
5. Work through Lesson 3 in the Guide (p32-45)

Next Week

17:00 Welcome and Recap

17:05 Lesson 3: Explore XOD

Get to grips with some of the most useful nodes in XOD

17:25 Lesson 4: Building Devices (hands-on session)

Learn how to tidy and simplify complex programmes by building new nodes and using buses, then use these new skills to programme the inbuilt OLED display screen

16:25 Round-up

Thank You

More info:

www.biomaker.org

Session 2

No-Code Programming for Biology

1. Welcome!
2. Turn off your video and mute yourselves for now
3. Feel free to introduce yourselves in the chat
4. As we go along, ask any questions in the chat

No-Code Programming for Biology

Today’s Session

17:00 Welcome and Recap

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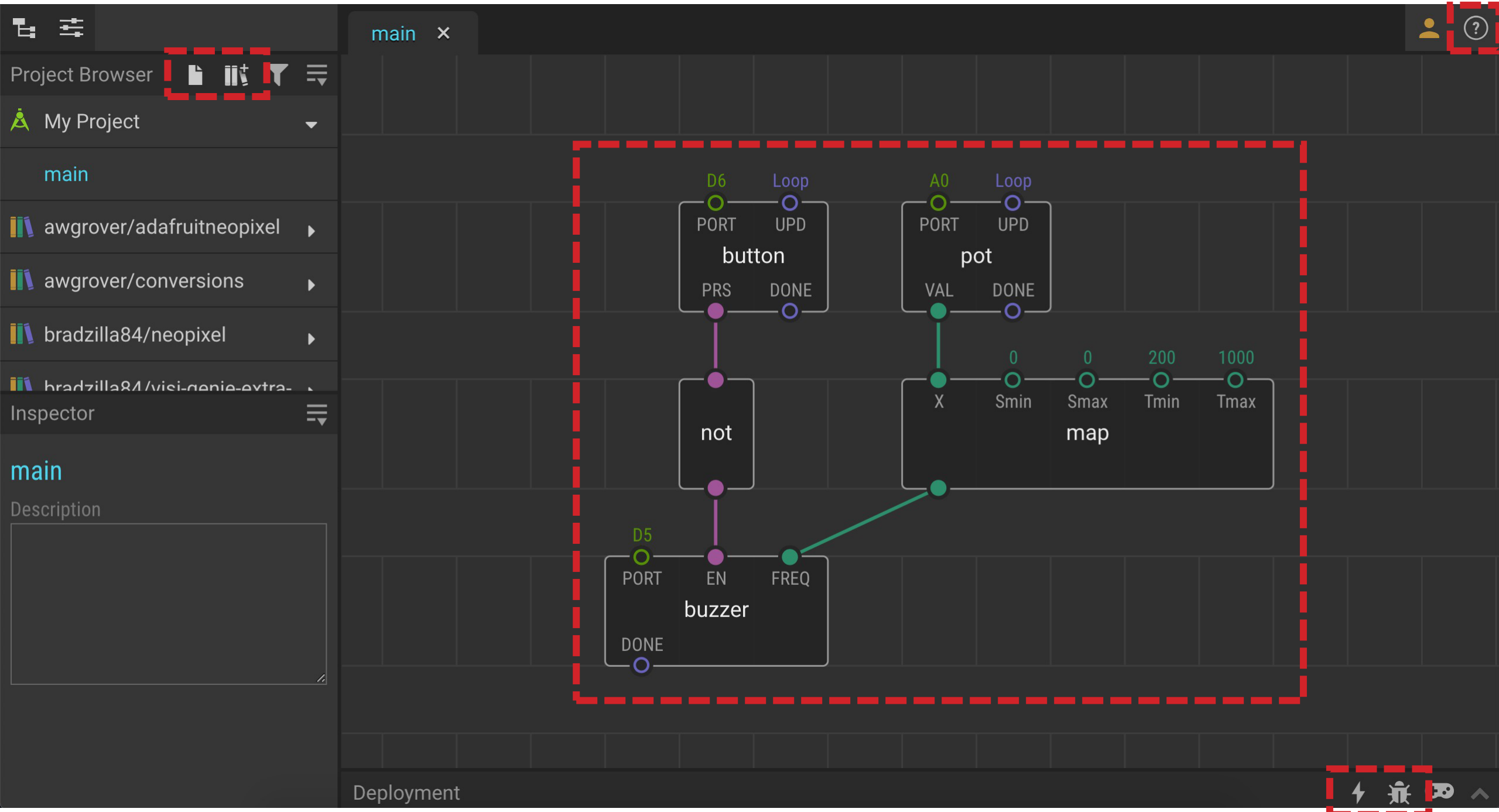
16:25 Round-up

Last Week's Session

1. The Grove Board (**p6-7**)
2. The Microcontroller (**p8-11**)
3. The XOD IDE (**p12-15**)
4. Turned the LED on using the button (**p20-25**)
5. Controlled the buzzer using the button and potentiometer (**p26-29**)


main
Project Browser
My Project
main
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awgrover/conversions
bradzilla84/neopixel
Inspector
main
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UPD
button
PRS
DONE
A0
Loop
PORT
UPD
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D5
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buzzer
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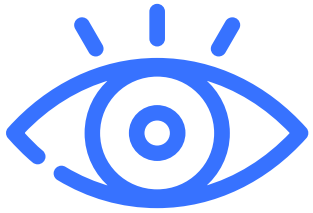
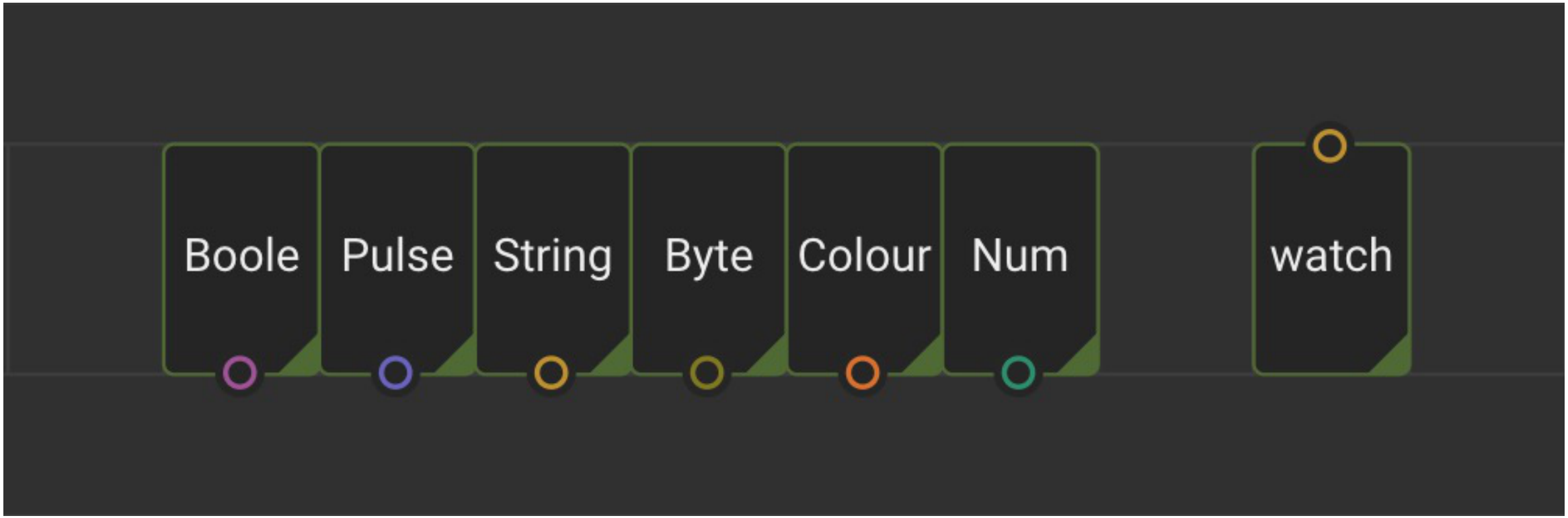
Deployment



Tweak and Watch Nodes


Boole
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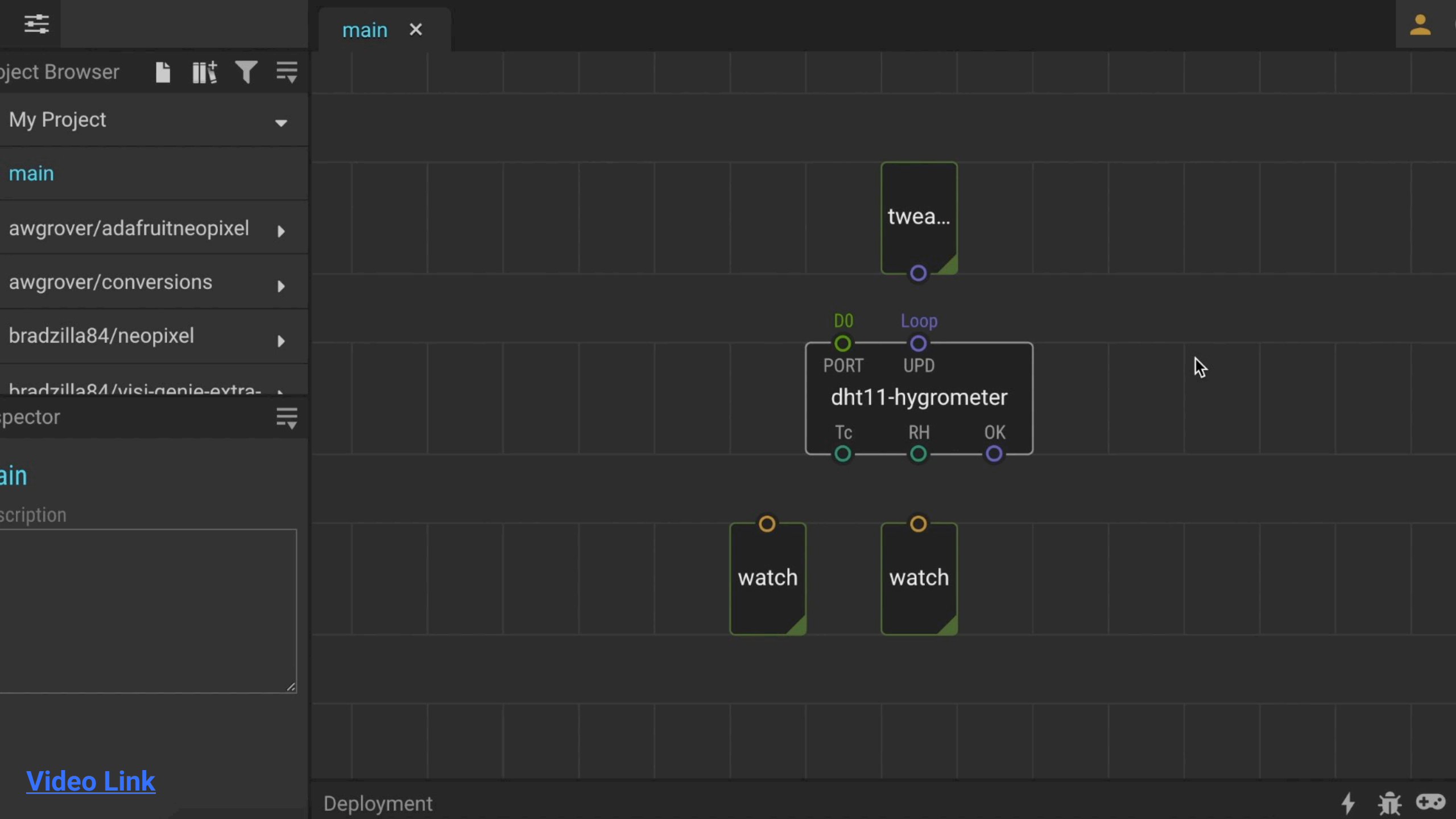
watch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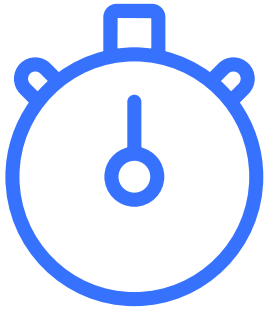
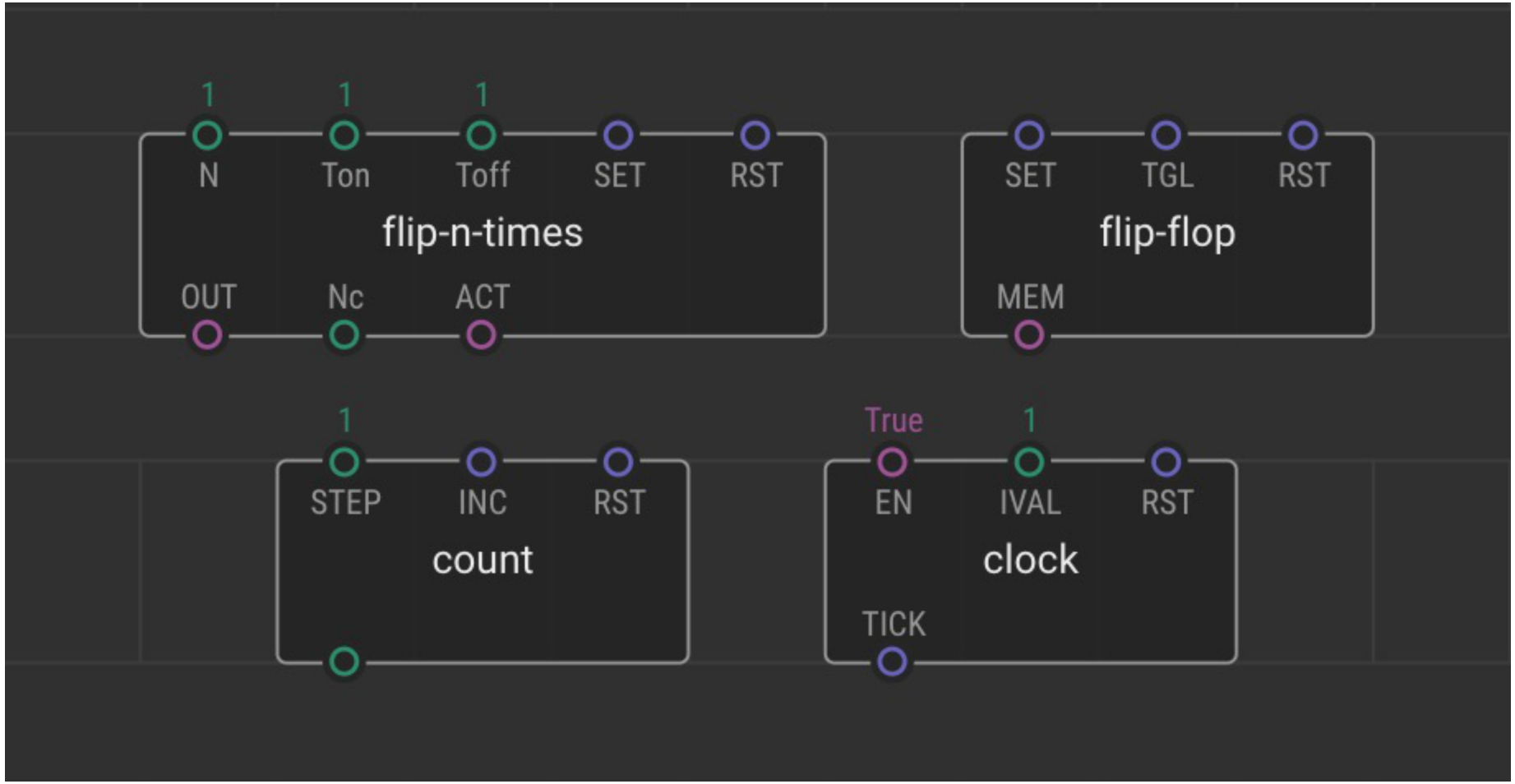
Deployment

Video Link



Flip, Clock and Count Nodes


1
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1
N
Ton
Toff
SET
RST
flip-n-times
OUT
Nc
ACT
SET
TGL
RST
flip-flop
MEM
1
STEP
INC
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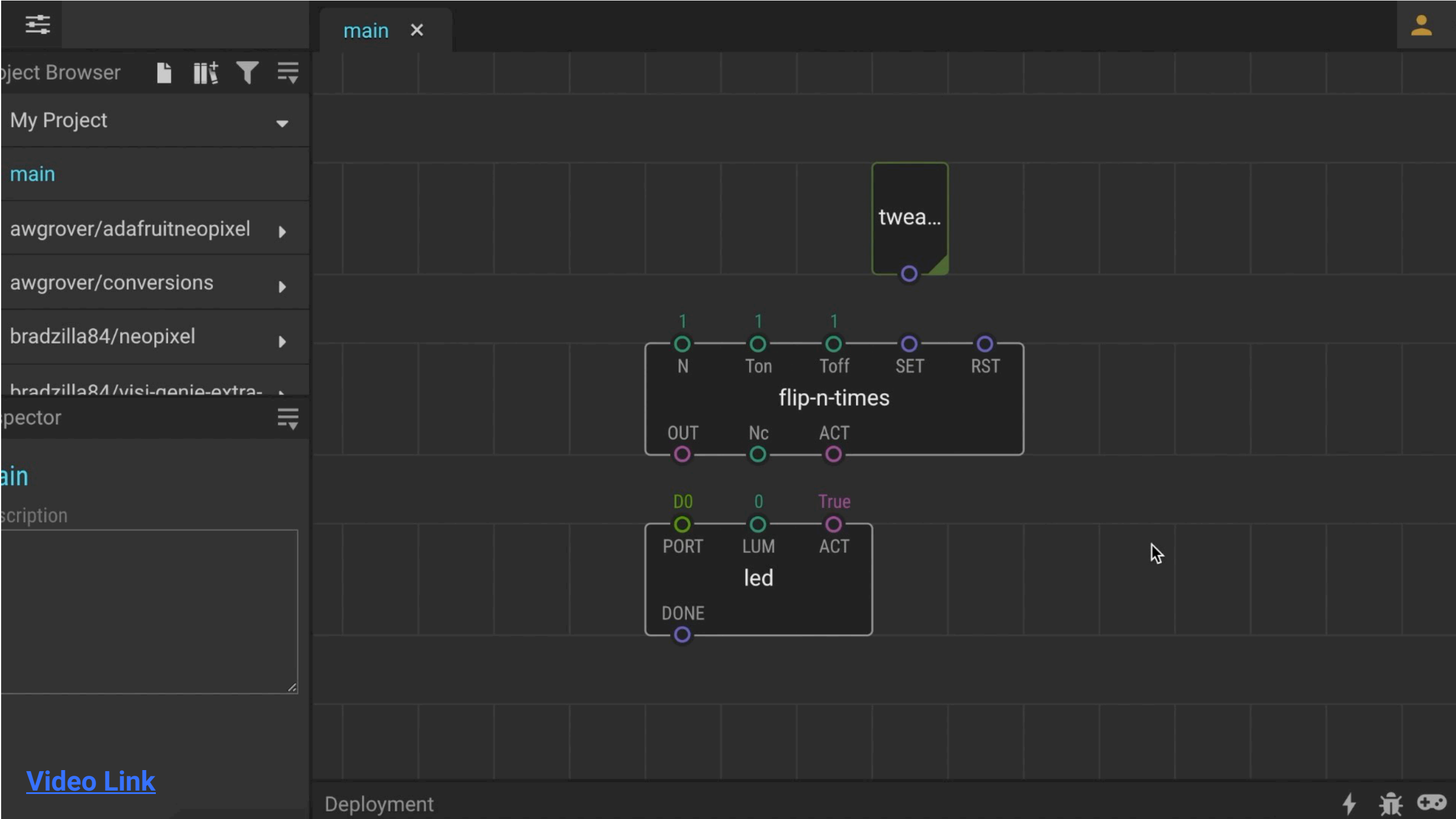
count
True
1
EN
IVAL
RST
clock
TICK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True
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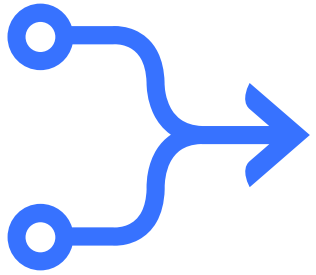
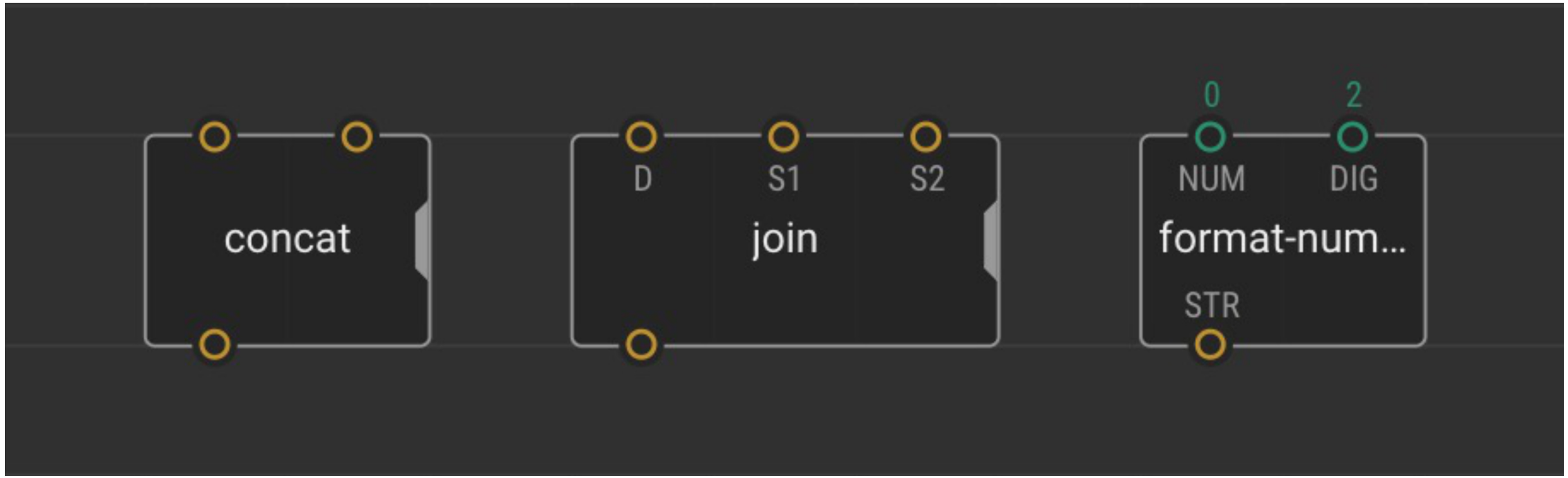
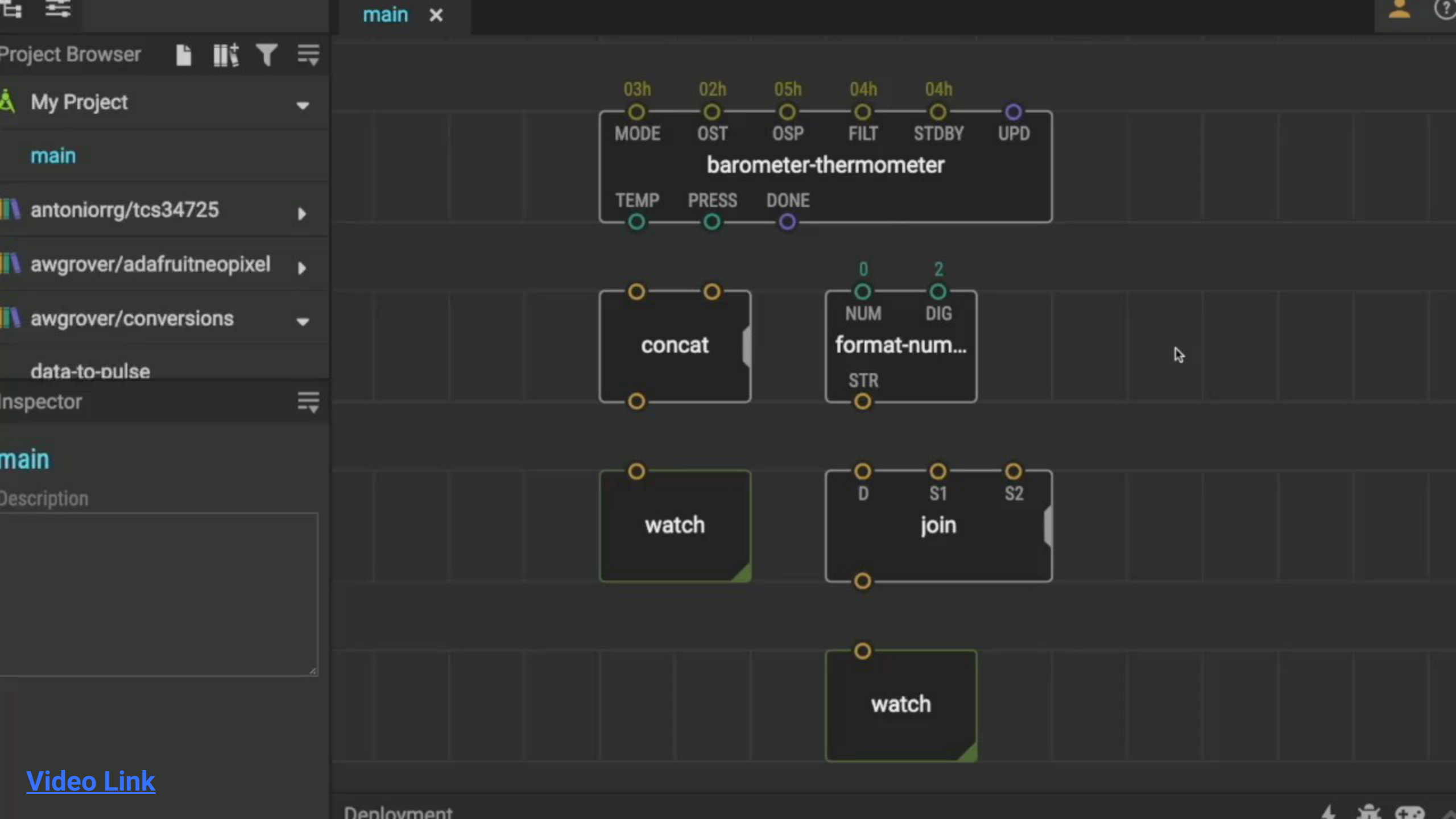
ACT
led
DONE
Deployment

Video Link



Concat, Join and Format-Number Nodes


concat
D
S1
S2
join
0
2
NUM
DIG
format-num...
STR


main
Project Browser
My Project
main
antoniorrg/tcs34725
awgrover/adafruitneopixel
awgrover/conversions
data-to-pulse
Inspector
main
Description
03h
02h
05h
04h
04h
MODE
OST
OSP
FILT
STDBY
UPD
barometer-thermometer
TEMP
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concat
0
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DIG
format-num...
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watch
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S1
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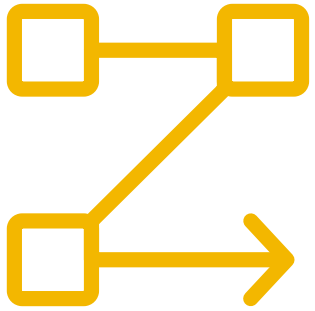
join
watch
Deployment

[Video Link]

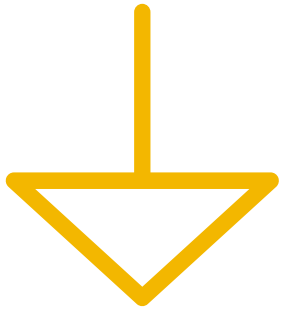


Creating New Nodes

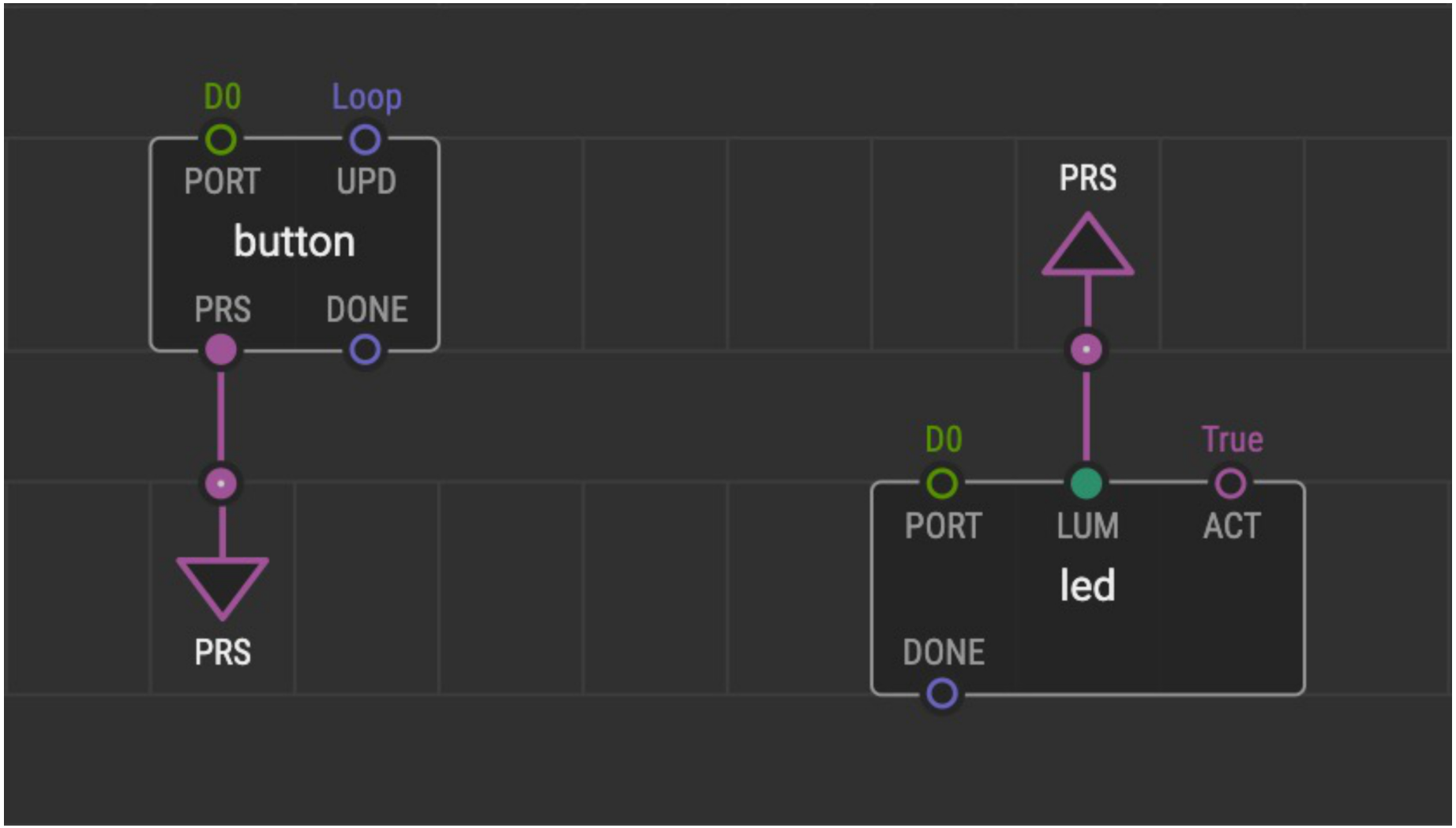
IN1
IN2
IN3
IN4
IN5
IN6
IN7
False
00h
0
D0
OUT1
OUT2
OUT3
OUT4
OUT5
OUT6
OUT7

Breakout Groups – 30min

1. Meet your new group and introduce yourselves
2. Work through Task 6 together
3. Step-by-step instructions are in the Guide (**p50-54**)
4. Use the ‘Ask for Help’ button if necessary



Using Buses


D0
Loop
PORT
UPD
button
PRS
DONE
PRS
PRS
D0
True
PORT
LUM
ACT
led
DONE

Homework Challenge!

1. How can you use this new node in other ways?
2. What is the most interesting device you can build using the OLED screen and onboard devices?
3. What other nodes might you want to build?
4. Work through Lesson 7 in the Guide (**p56-59**)

Next Week

17:00 Welcome and Recap

17:05 Lesson 4: Building Devices (hands-on session)

Learn how to make more complex programmes in XOD using logic nodes, sequences and loops.

16:05 Lesson 5: Next Steps

Learn how to expand your programming and hardware building capabilities to start building your own devices, and take a look at some previous projects.

16:25 Round-up

Thank You

More info:

www.biomaker.org

Session 3

No-Code Programming for Biology

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No-Code Programming for Biology

Today’s Session

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16:05 Lesson 5: Next Steps

Learn how to expand your programming and hardware building capabilities to start building your own devices, and take a look at some previous projects.

16:25 Round-up

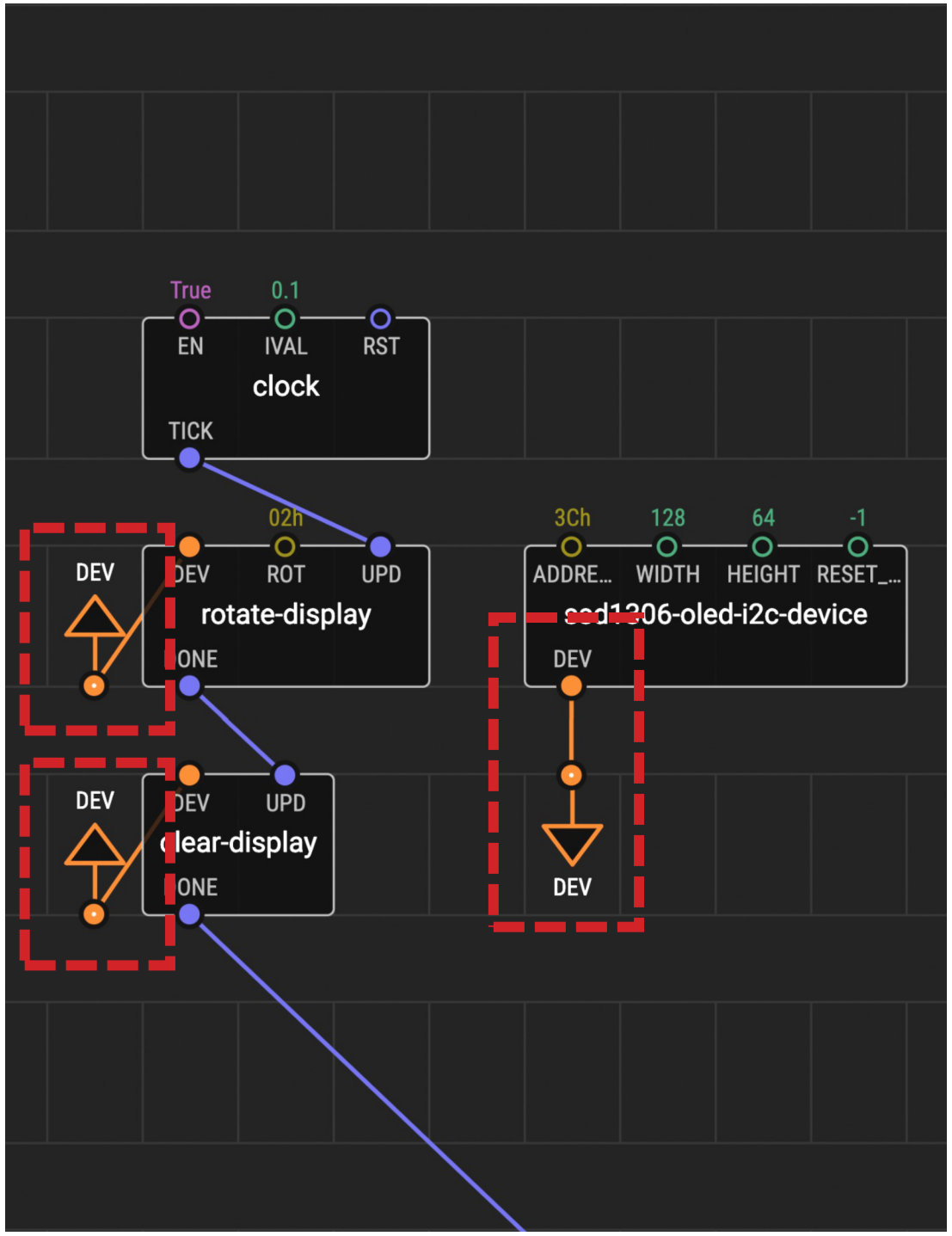
Last Week's Session

1 Learned about some useful nodes in XOD (p31-45)

Tweak, watch, flip, clock, count, concat, join and format-number

2 Made a new node to write text to the OLED screen (p49-55)

5 Learned how to use buses to simplify complex programmes (p56-59)


True
0.1
EN
IVAL
RST
clock
TICK
02h
DEV
DEV
ROT
UPD
rotate-display
ONE
DEV
DEV
UPD
clear-display
ONE
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128
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-1
ADDRE...
WIDTH
HEIGHT
RESET_...
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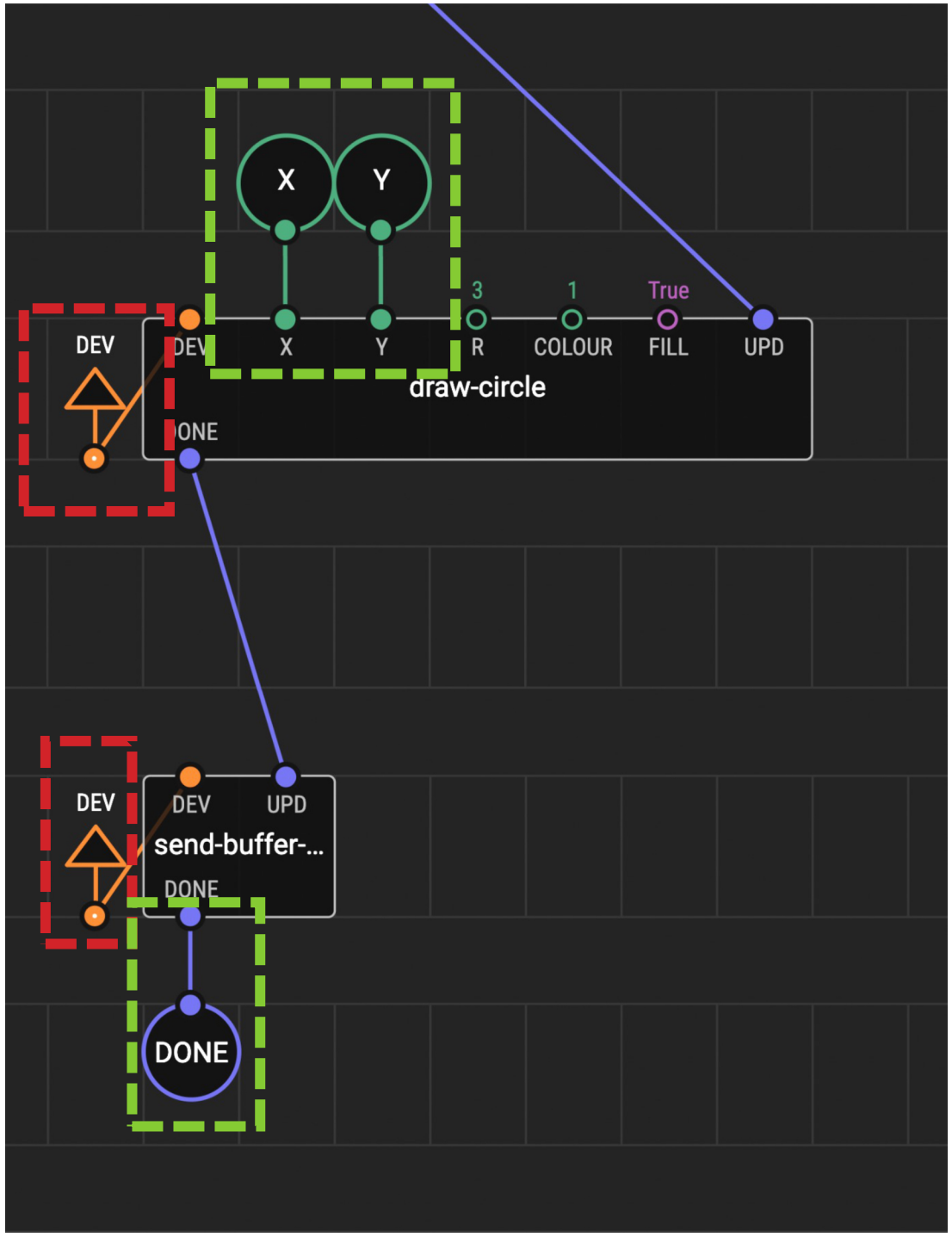
DEV


X
Y
DEV
DEV
X
Y
3
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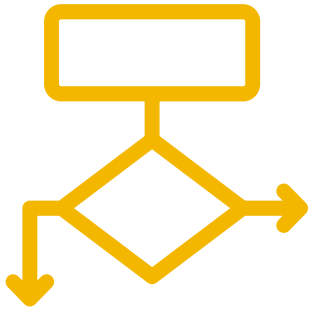
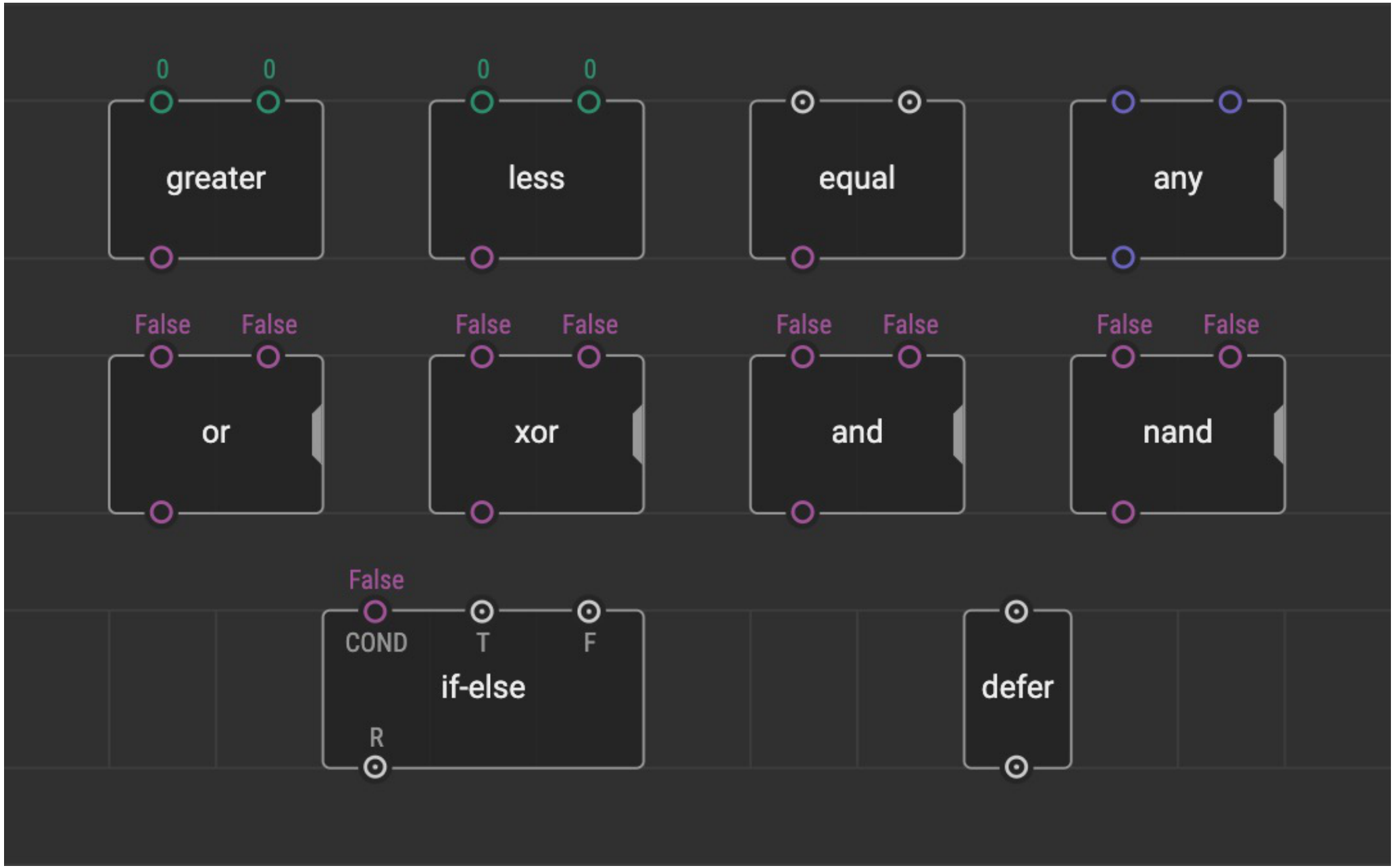
COLOUR
True
FILL
UPD
draw-circle
ONE
DEV
DEV
UPD
send-buffer-...
DONE
DONE



Logic Programmes

Sequences and Loops


0
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greater
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0
less
equal
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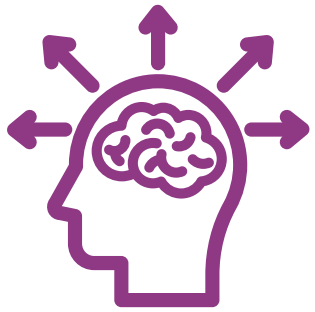
or
False
False
xor
False
False
and
False
False
nand
False
COND
T
F
if-else
R
defer

Breakout Groups – 35min

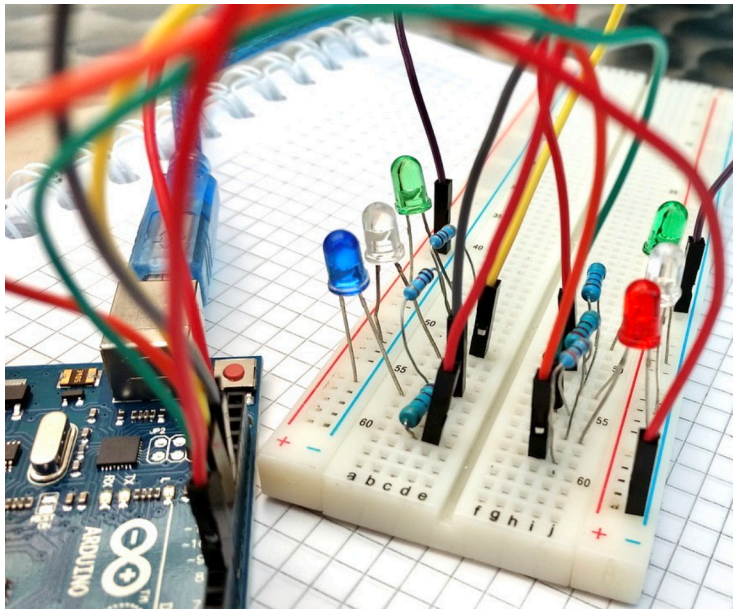
1. Meet your new group and introduce yourselves
2. Work through Tasks 8 and 9 together
3. Step-by-step instructions are in the Guide (**p60-70**)
4. Use the ‘Ask for Help’ button if necessary



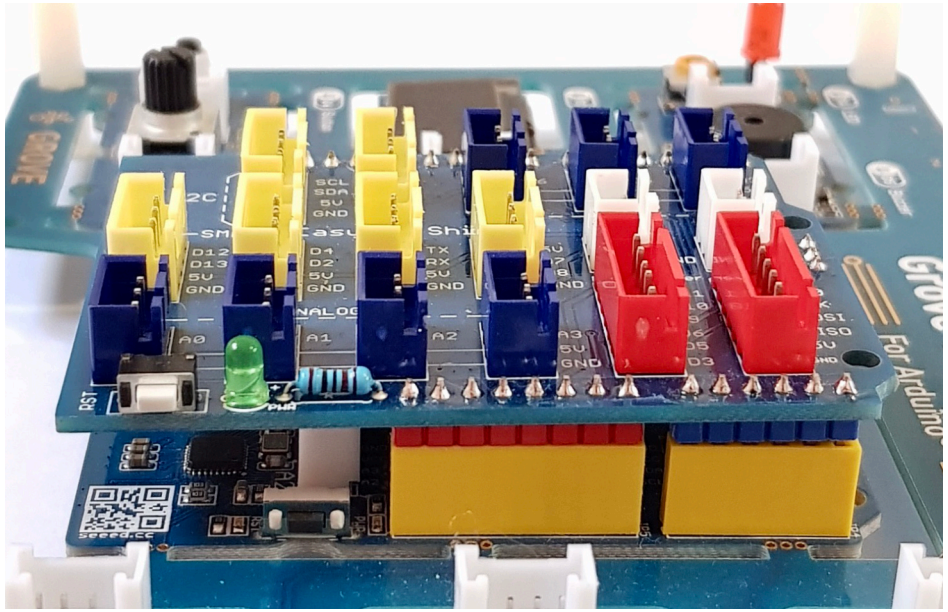
Expanding Your Capacity

Expanding Your Capacity

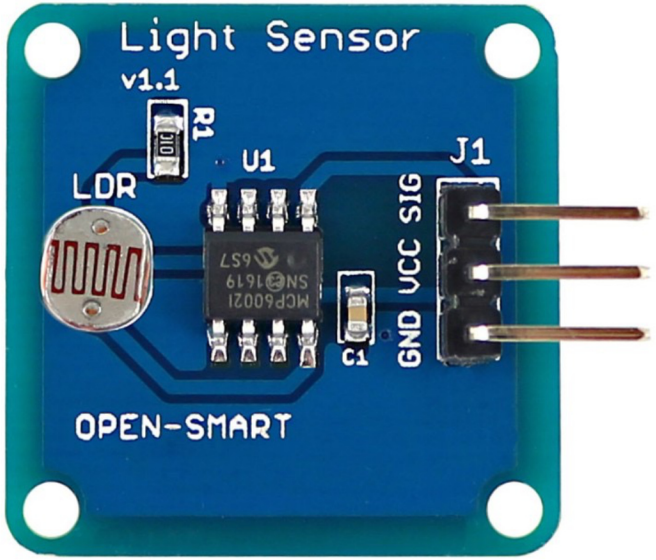
Wires



Shields



Breakout Boards



Plug-and-Play Components

seeed studio
The IoT Hardware Enabler

[www.seeedstudio.com > Shop > Grove](www.seeedstudio.com)

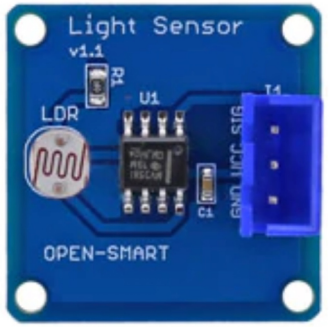
M5STACK

[www.m5stack.com > Store > Unit](www.m5stack.com)

Plug directly into white sockets on the board

OPEN-SMART

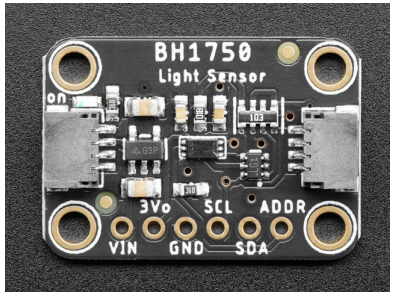
[open-smart .aliexpress.com](open-smart.aliexpress.com)



Plug into Open Smart Expansion Shield (or use JST PH to JST XH cables)

adafruit

[www.adafruit.com > Products > STEMMA/STEMMA QT](www.adafruit.com)

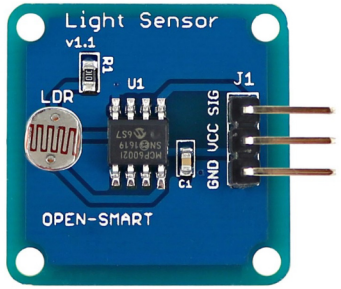


Plug directly (STEMMA 4 pin) Plug with JST PH to JST SH cable (STEMMA QT 4 pin)

Wired Breakout Boards

OPEN-SMART

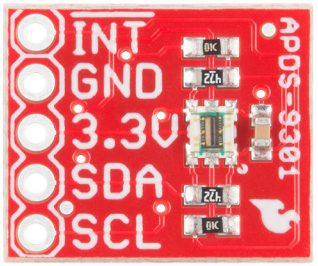
[open-smart .aliexpress.com]



Connect using expansion shield or Grove-to-female wires (make sure pin labels match up)

sparkfun ELECTRONICS

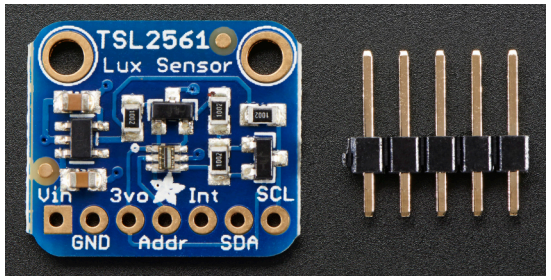
[www.adafruit.com]



Solder pins to board. Connect using Grove-to-female wires (make sure pin labels match up)

adafruit

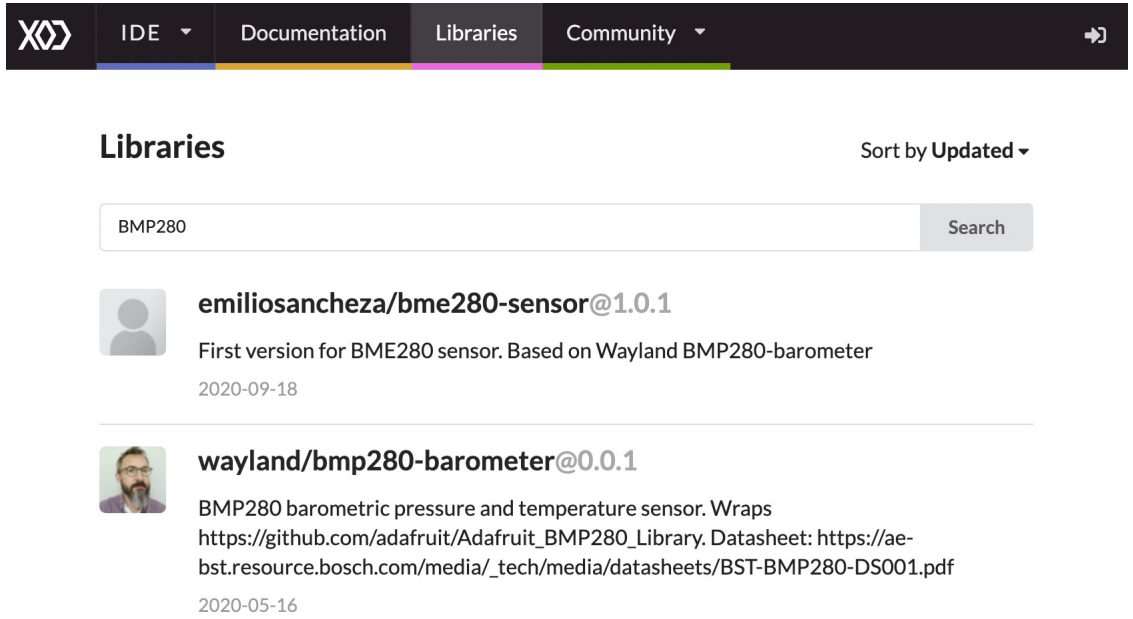
[www.adafruit.com]



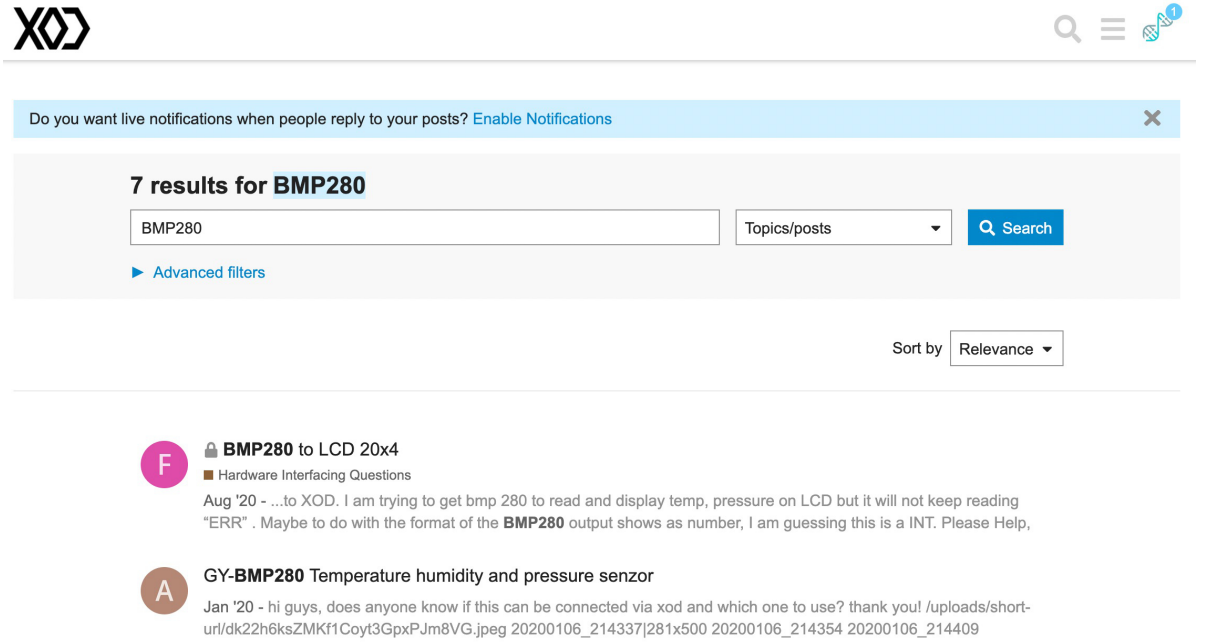
Finding XOD Nodes

Search using ‘reference designator’
e.g. BMP280 (barometer) or SSD1306 (OLED screen)

www.xod.io/libs

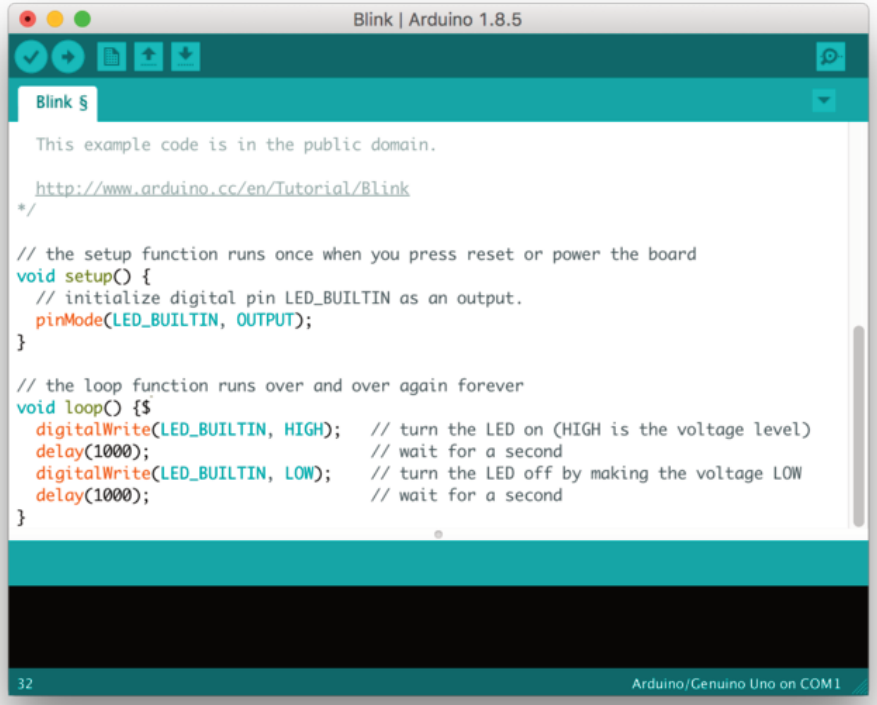


forum.xod.io



Arduino IDE

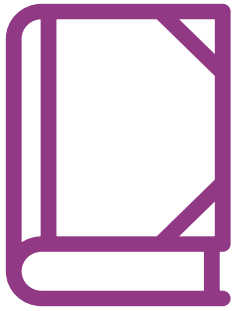
Arduino provides it's own free IDE software, which uses
C++ coding language to programme the board.
www.arduino.cc/en/software



Converting Arduino libraries for use in XOD
bit.ly/arduino-to-xod

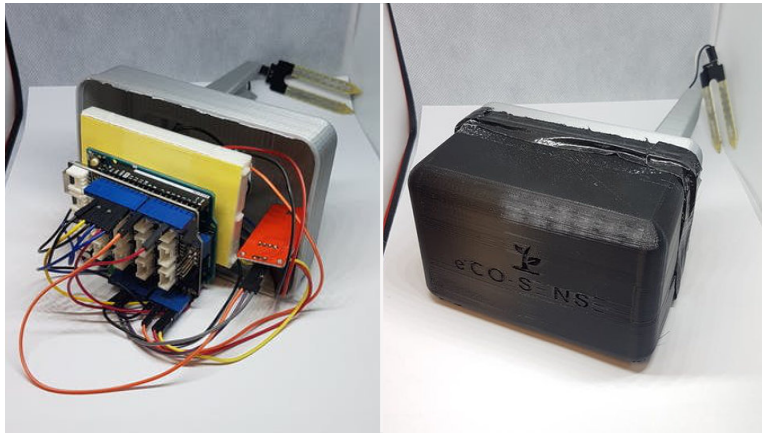
Combining XOD and Arduino IDE
XOD menu > Deploy > 'Show Code for Arduino'

More complex programming
www.arduino.cc/en/Tutorial/HomePage

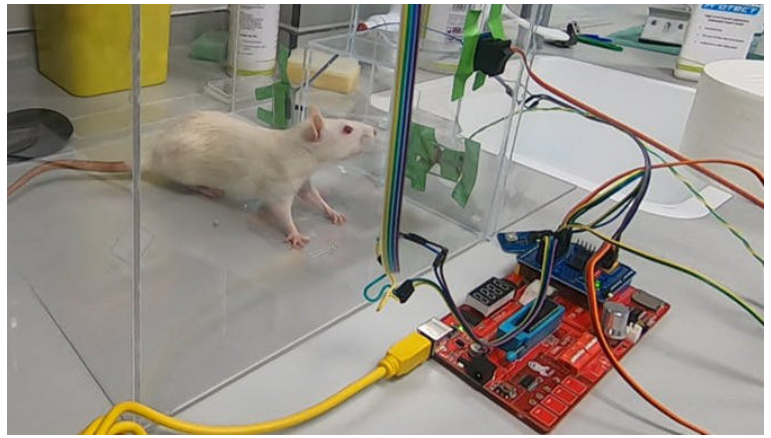


Case Studies

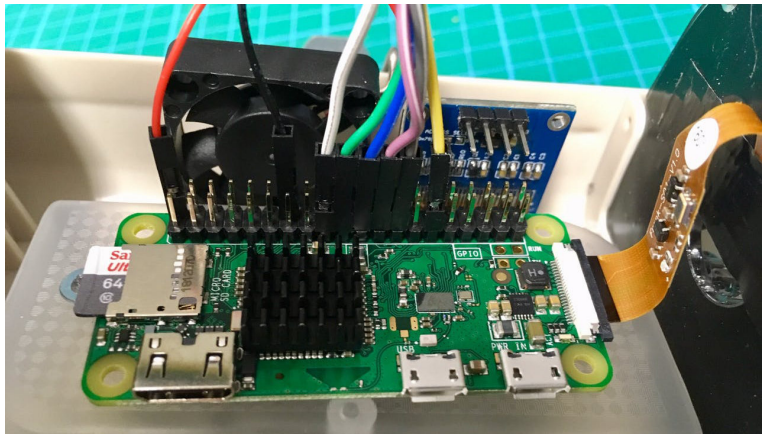
eCO-SENSE: Soil Sensors Powered by Plant Photosynthesis



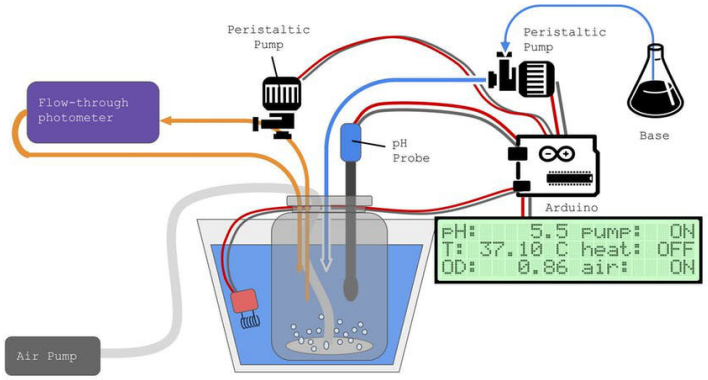
Behavioural Chamber to Evaluate Rodent Forelimb Grasping



Camera for Monitoring Plant Pollination Events



Open Source Microbial Bioreactor



www.hackster.io/biomaker

Discussion – 10min

1. In groups, pick and read through a case study (**p80-83**)
2. Discuss which case study you find most interesting
3. What instruments might be useful in your own research?
4. Think about how you might us what you've learned to build your own instrument – what additional hardware and programming skills would you need?

Thank You

More info:

www.biomaker.org