

DEVELOPMENT + IoT = ?

UNIVERSITÀ DEGLI STUDI DI SALERNO – MAY 3, 2023

Automatic Musaic ACLU Whirlpool Refrigerator MyQ Neom Home

Luigi De Russis
@luigidr

MyWakes Total Connect 2.0 BUCKY Bucky Nest Cam Orion - Voice for Teams

TESCO Tailwind Samsung Refrigerator SSG Smart GarageWiFi & Gates tado° Hot Water

Songkick MeisterTask Foobot Space RescueTime Manything

4th JULY U.S. Independence Day Weebly SIGNUL Beacon Sense Energy Monitor SkylinkNet Chieko Bell

GO tracMO Misfit Neuro ClickSend SMS

Politecnico di Torino GO

e-Lite



Associate Professor
Politecnico di Torino, Italy
Background: Computer Engineer

@luigidr (on social media)
❤️ sci-fi, coffee, travel, nature, running
Motto: "*Be kind*"



1

2

3

4



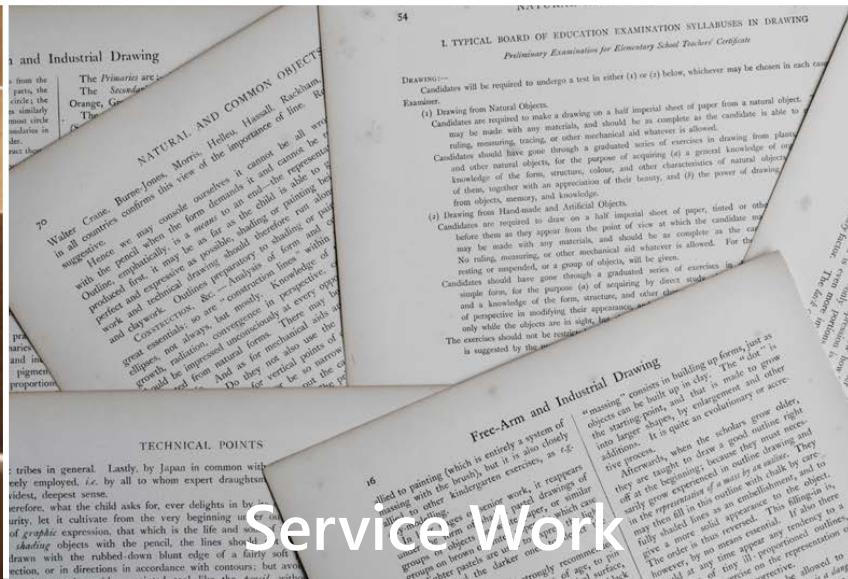
Research



Teaching



Industry/Projects



Service Work



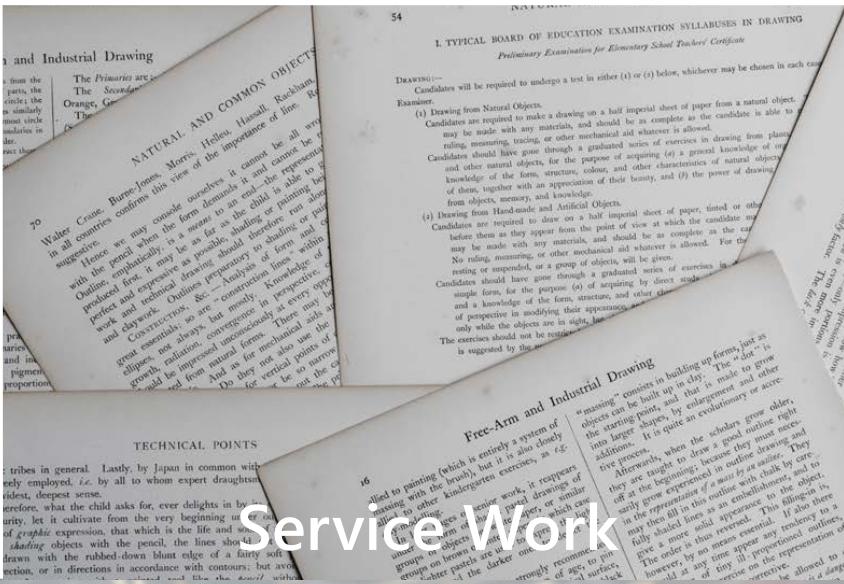
Research



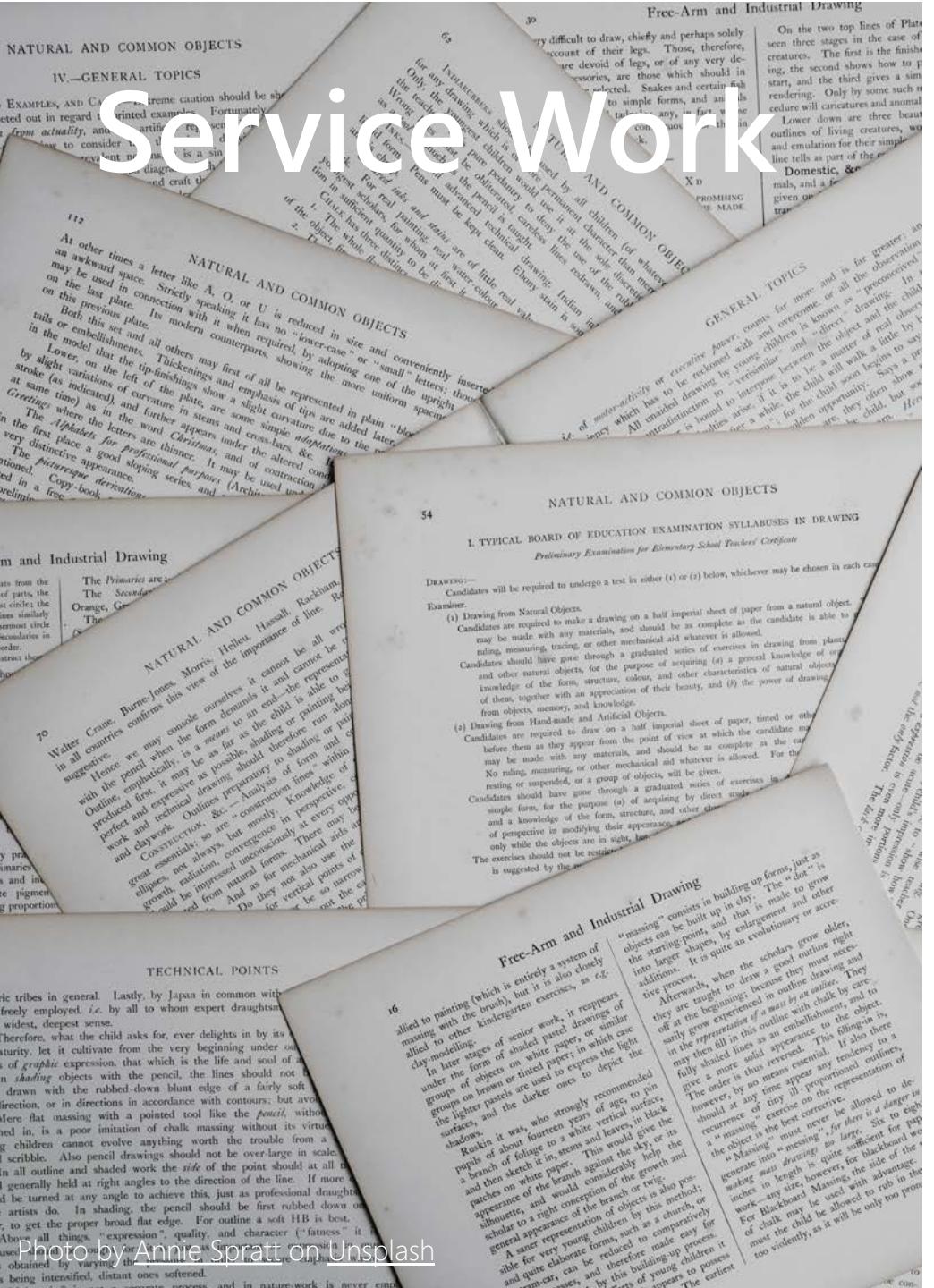
Industry/Projects



Teaching



Service Work



NATURAL AND COMMON OBJECTS

IV.—GENERAL TOPICS

EXAMPLES, AND CANVAS, extreme caution should be sh
eted out in regard to printed examples. Fortunately
from actuality, and the artist's sense of what is
to consider is that the object is a simple
rely a diagram, or a sketch, or a
and craft the

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NATURAL AND COMMON OBJECTS
At other times a letter like A, O, or U is reduced in size and conveniently inserted
in awkward space. Strictly speaking it has no "lower-case" or "small" letters; those
on the last place. Its modern counterparts, showing the more uniform spacing
on this previous plate.

Both this set and all others may first of all be represented in plain "block"
tails or embellishments. Thickening show a slight curvature due to the
stroke (as indicated) and the word *Christian*, and of contraction
at same time) in the letters are thinner. It may be used in
Greetings where the letters are thicker. It may be used in
The Alphabets a good sloping series, and
in the first place for professional purposes (Arch
The picturesque derivations
in a free

Free-Arm and Industrial Drawing

The Primaries are
The Secondary
The Orange, Green
The

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Walter Crane, Burne-Jones, Morris, Helleu, Hassall, Buckham,
in all countries confirms this view of the importance of line. Re
with the pencil when may consider ourselves it cannot be all wrong
Outline, emphatically, is a means to an end; and the child is able to get
produced first, it may be as far as the child is able to get
perfect and expressive drawing should be shading or painting before
work and technical drawing. Outlines preparatory to shading or painting
and daywork. Outlines, so are — Analysis of form and colour
construction; so are — Construction lines within
great essentials; so are — great knowledge at every opportunity
ellipses, not always, but mostly. Knowledge of
growth, radiation, convergence, perspective, etc.
should be impressed unconsciously in perspective, a
and from natural forms. There are aids to
growth and radiation, convergence, perspective, etc.
And they not also use the
for vertical points of
is suggested by the

TECHNICAL POINTS

tribes in general. Lastly, by Japan in common with
freely employed, i.e. by all to whom expert draughtsmen
widest, deepest sense. Therefore, what the child asks for, ever delights in its
curiosity, let it cultivate from the very beginning under
of graphic expression, that which is the life and soul of all
shading objects with the pencil, the lines should not be
drawn with the rubbed-down blunt edge of a fairly soft
direction, or in directions in accordance with contours; but av
More flat massing with a pointed tool like the pencil, without
being in, is a poor imitation of chalk massing without its virtue
children cannot evolve anything worth the trouble from a
scribble. Also pencil drawings should not be over-large in scale;
in all outline and shaded work the side of the point should at all times
be held at right angles to the direction of the line. If more
be turned at any angle to achieve this, just as professional draughtsmen
artists do. In shading, the pencil should be first rubbed down on
to get the proper broad flat edge. For outline a soft HB is best.
About all things "expression", quality, and character ("finesse") it
useless to speak, for these qualities are obtained by varying the
being intensified, distant ones softened.

Photo by Annie Spratt on Unsplash

the entire process, and in nature-work is never emulo
the entire process, and in nature-work is never emulo

Free-Arm and Industrial Drawing

On the two top lines of Plate
see three stages in the case of
creatures. The first is the finishing
the second shows how to p
start, and the third gives a sim
rendering. Only by some such a
procedure will caricatures and animal
Lower down are three beau
outlines of living creatures, w
and emulation for their simple
line tells as part of the c

Domestic, &c.
mals, and a few
given on

63
I. TYPICAL BOARD OF EDUCATION EXAMINATION SYLLABUSES IN DRAWING
Preliminary Examination for Elementary School Teachers' Certificate

DRAWING:—
Candidates will be required to undergo a test in either (1) or (2) below, whichever may be chosen in each case
Examiner.

(1) Drawing from Natural Objects.
Candidates are required to make a drawing on a half imperial sheet of paper from a natural object.
may be made with any materials, and should be as complete as the candidate is able to
ruling, measuring, tracing, or other mechanical aid whatever is allowed.

Candidates should have gone through a graduated series of exercises in drawing from plants
and other natural objects, for the purpose of acquiring (a) a general knowledge of our
knowledge of the form, structure, colour, and other characteristics of natural objects,
of them, together with an appreciation of their beauty, and (b) the power of drawing
from objects, memory, and knowledge.

(2) Drawing from Hand-made and Artificial Objects.
Candidates are required to draw on a half imperial sheet of paper, tinted or otherwise
before them as they appear from the point of view at which the candidate may
may be made with any materials, and should be as complete as the candidate is able to
No ruling, measuring, or other mechanical aid whatever is allowed. For the
Candidate should have gone through a graduated series of exercises in
and a knowledge of the form, structure, and other characteristics of
only while the objects are in sight, but also when they are out of sight.
The exercises should not be restricted.

is suggested by the

"massing" comes in building up forms, just as
objects can be built up in clay. The "dot" is
into larger shapes, and that is made to grow
additions. It is quite an evolutionary or accre
process. Afterwards, when the scholars grow older,
they are taught to draw a good outline right
off the beginning; because they must nec
early in the growth experienced in outline drawing necess
in the representation of a man by an outline. They
may then fill in this outline with chalk by care
give a more solid appearance to the object, and to
give a more solid appearance to the object, and to
However, by no means essential. This filling-in is
should at any time appear any tendency to a
recurrence of tiny ill-proportioned outlines to
a "massing" exercise on the representation of

"Massing" must never be allowed to de
generate into "messing", for there is a danger in
making mass drawing too large. Six to eight
inches in length is quite sufficient for paper
work any size, however, for blackboard we
For blackboard Massing, for the side of the
of chalk may be used with advantage,
must the child be allowed to rub in the
too violently, as it will be only too prone

To give back to the community!

Also, a good way to meet people and network

Not "just" reviewing papers

Scientific organizations' committees

Conferences' committees

Workshops/Special issues organization

Example: SIGCHI has open calls for various
committees at <https://sigchi.submittable.com>

My (Service) Story So Far...



2012	2017	2018	2019	2020	2021	2022	2023-2024
✓ ACM XRDS Department Editor ✓ Reviewer	✓ IEEE COMPSAC 2017 Student Research Symposium Chair ✓ ACM Future of Computing Academy Member ✓ IEEE Young Professional representative for the IEEE Italy Section	✓ SIGCHI Conferences Working Group Member	✓ Workshop organizer at ECSCW 2019 ✓ ACM Future of Computing Academy Vice-Chair ✓ CHI 2019 LBW Associate Chair ✓ Associate Editor for IJHCS ✓ Associate Editor for IEEE Access ✓ Guest/Associate Editor for IEEE IoT Journal	✓ CHI 2020 LBW Associate Chair ✓ Workshop organizer at AVI 2020 ✓ ACM SIGCHI Development Fund Committee Member	✓ CHI 2021 Associate Chair ✓ CHIItaly 2021 Proceedings Chair ✓ CSCW 2021 Associate Chair ✓ INTERACT 2021 Associate Chair ✓ SIGCHI Italy Extended Board Member ✓ SIGCHI AC for Community Support	✓ CHI 2022 Associate Chair ✓ DIS 2022 Subcommittee Chair ✓ IUI 2022 Associate Chair ✓ Workshop organizer at AVI 2022 ✓ Guest Editor for IJHCS ✓ SIGCHI VP for Finance	✓ CHI 2023 Associate Chair ✓ IUI 2023 Associate Chair ✓ IS-EUD 2023 Demo Chair ✓ MobileHCI 2023 Workshop Chair ✓ CHIItaly 2023 Program Chair ✓ TEI 2024 Work-in-progress Chair ✓ ECSCW 2024 General Chair



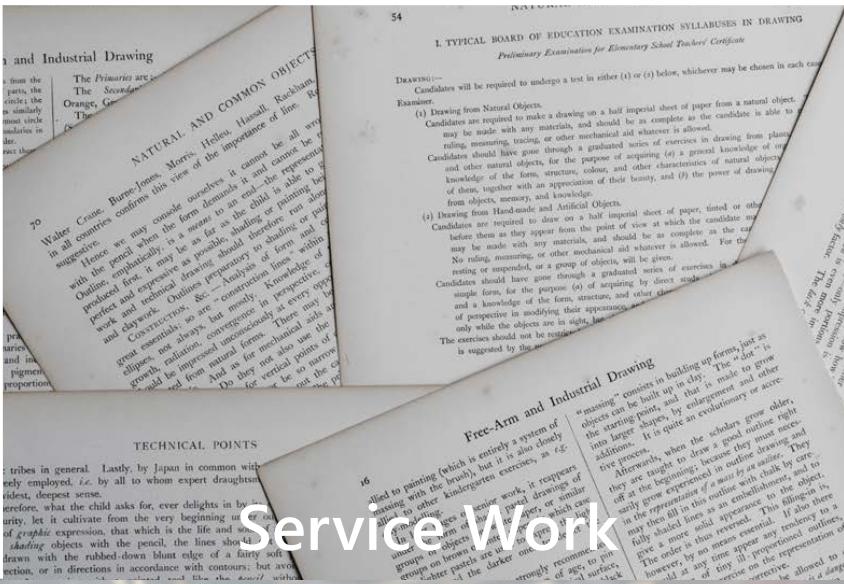
Research



Industry/Projects



Teaching



Service Work

Research



“ How can people make their experiences with computers more personal(ized)? ”



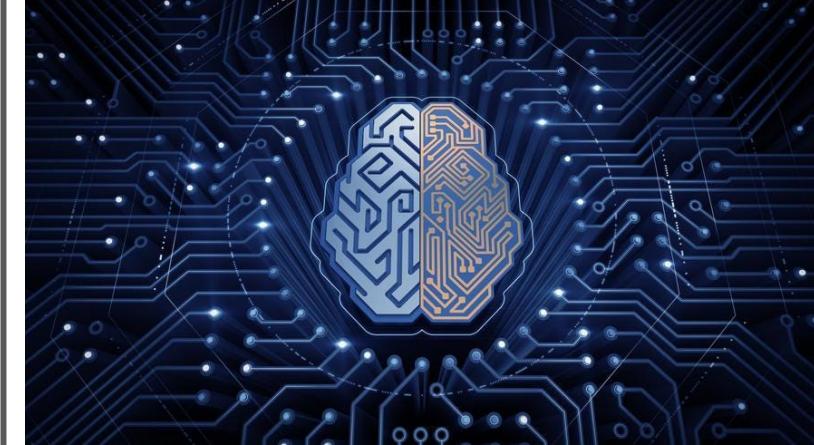
Digital Wellbeing



Internet of Things



Human-centered AI



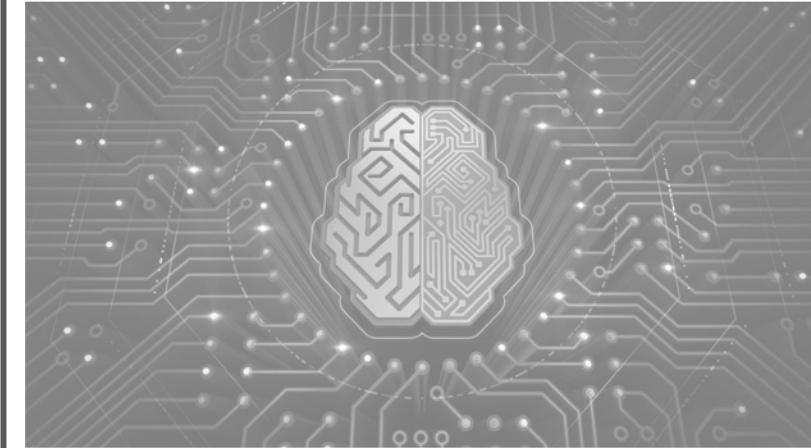
Digital Wellbeing

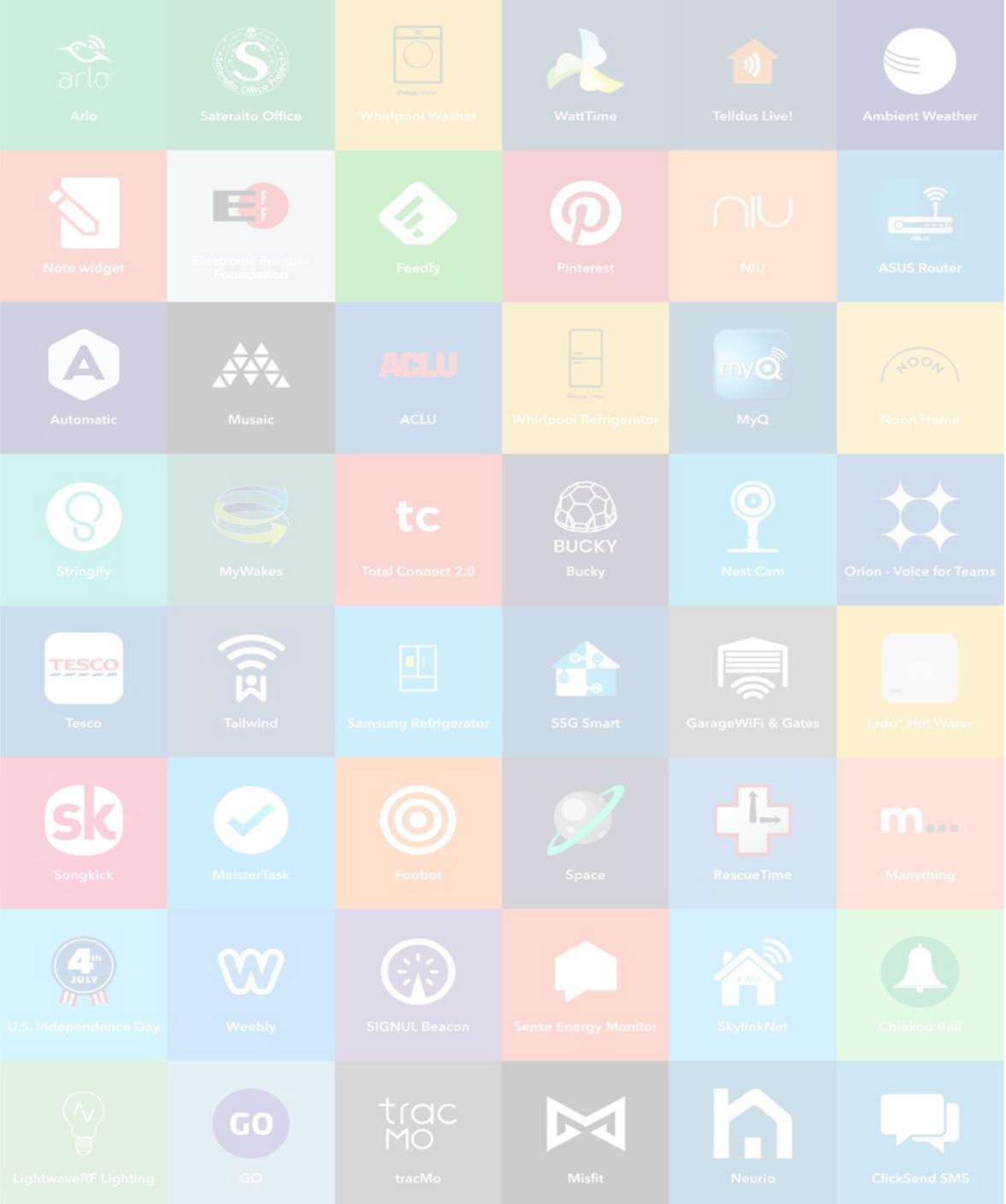


Internet of Things



Human-centered AI





“

What is the Internet of Things

?

”



Arlo



Internet of Things



Note widget



Electronic Frontier Foundation



Feedly



Pinterest



NIU



ASUS Router



Automatic



Mosaic



ACLU



Whirlpool Refrigerator



MyQ



Noon Home



Stringify



MyWakes



Total Connect 2.0



BUCKY



Bucky



Nest Cam



Orion - Voice for Teams



Tesco



Tailwind



Samsung Refrigerator



SSG Smart



GarageWiFi & Gates



tado° Hot Water



Songkick



MeisterTask



Foobot



Space



RescueTime



m...



U.S. Independence Day



Weebly



SIGNUL Beacon



Sense Energy Monitor



SkylinkNet



Chieko Bell



LightwaveRF Lighting



GO



tracMo



Misfit



Neurio



ClickSend SMS

The **Internet of Things (IoT)** refers to the ever-growing network of physical objects that feature an IP address for internet connectivity, and the communication that occurs between these objects and other Internet-enabled devices and systems.

What Is Internet of Things (IoT)? Webopedia Definition
www.webopedia.com/TERM/I/internet_of_things.html

Table 1: Internet of Things Units Installed Base By Category				
Category	2013	2014	2015	2016
Automotive	80.0	101.0	112.0	131.0
Consumer	1,045.1	2,045.5	3,074.8	5,172.3
Industrial Segment	345.2	479.4	625.9	1,078.0
Control Systems	400.7	610.3	1,000.4	1,349.3
Grand Total	3,035.6	5,790.0	8,488.6	15,395.6

Source: Gartner (November 2014)

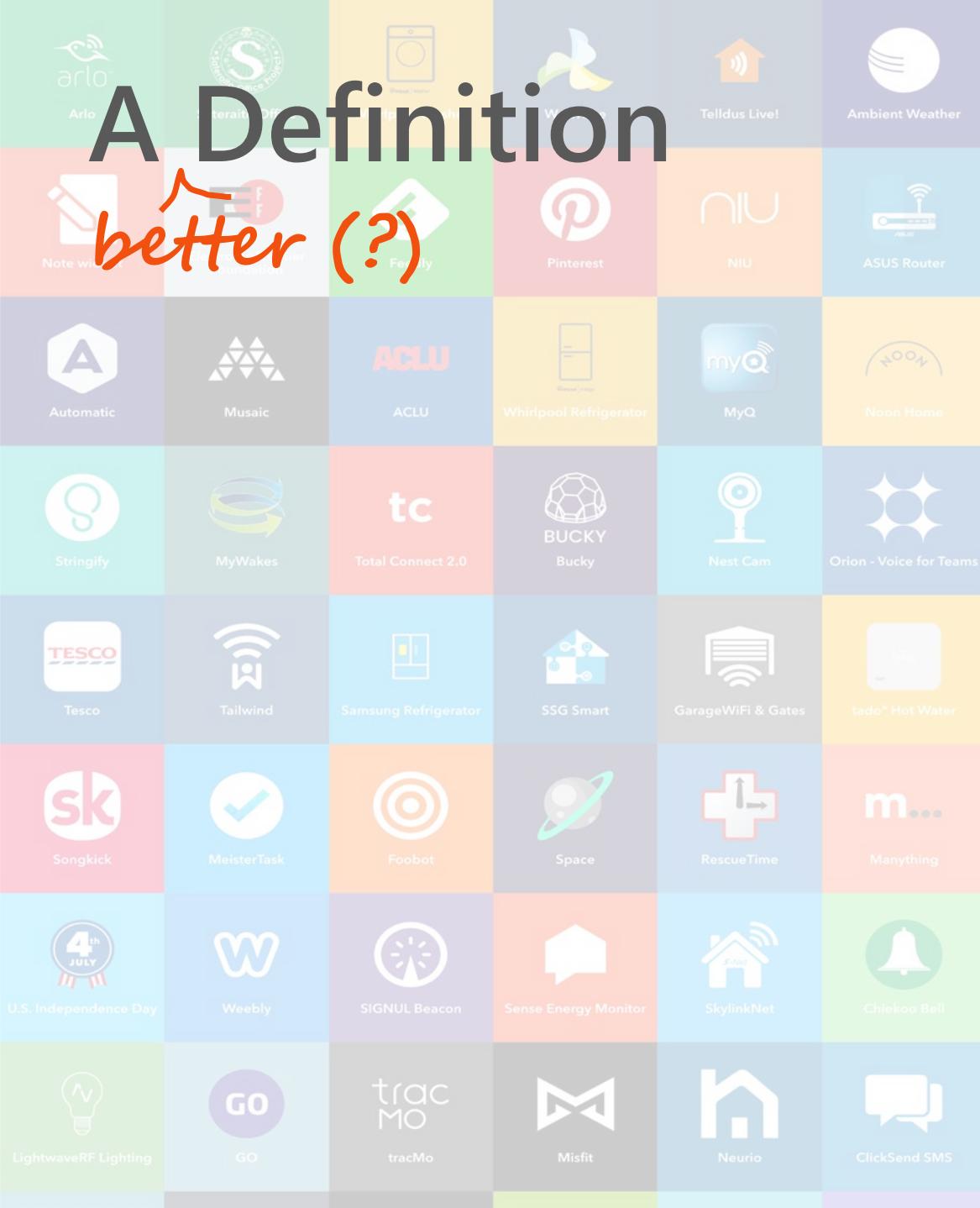
[About this result](#) • [Feedback](#)



Define the Internet of Things in two sentences



The Internet of Things (IoT) is a network of physical devices and objects embedded with sensors, software, and connectivity to enable them to collect and exchange data. These devices communicate with each other and with other systems to perform tasks and make decisions, creating a more connected and efficient world.



A Definition

better (?)

“ A complex network of physical and virtual entities, involving **developers** and **end users**. ”

Developers + IoT

How **complex** are the software development tasks needed to build an IoT system?

Which are the software development tasks that are perceived as the most **challenging** to complete?

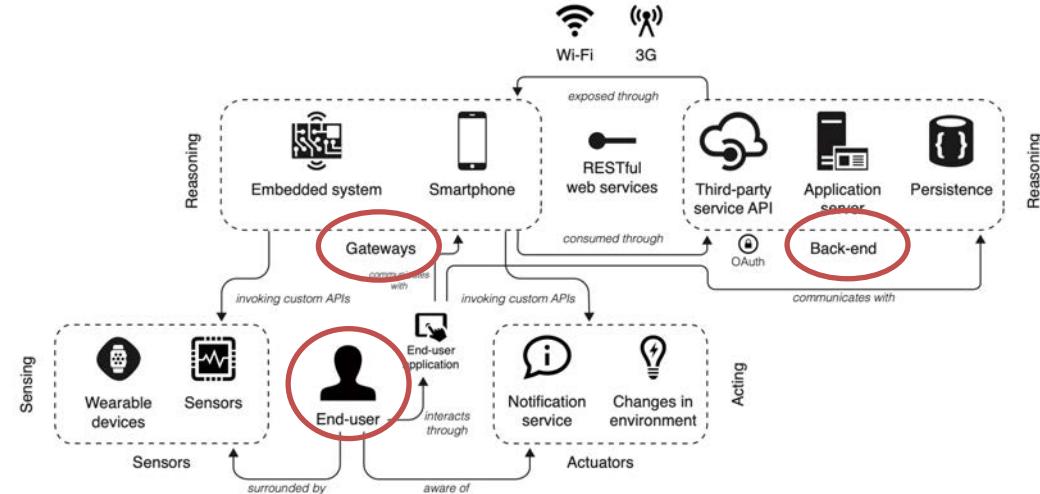
Why are these tasks **perceived** as the most challenging?

Understanding Developers' Challenges

Pilot study:

- 7 students
- completed at least one IoT course at university level
(novice IoT developers)

Survey with 40 **novice IoT developers**



Rank	Section A: End-user	Difficulty					Time spent				
Develop a native end-user mobile application											
	Become familiar with the mobile application platform-specific programming language	1	2	3	4	5	1	2	3	4	5
	Configure the development environment	1	2	3	4	5	1	2	3	4	5
	Develop the models' classes	1	2	3	4	5	1	2	3	4	5
	Develop the controllers' classes	1	2	3	4	5	1	2	3	4	5
	Develop the user interface (views)	1	2	3	4	5	1	2	3	4	5
	Connect the push notification module with the platform notification service	1	2	3	4	5	1	2	3	4	5
	Handle the notifications received in the end-user's smartphone	1	2	3	4	5	1	2	3	4	5

Main Challenges*

Heterogeneous environments – IoT developers need to program with/learn multiple languages and platforms

Docs + code – Lack of well-structured documentation, especially linked to suitable code

IoT Notebook

Extension for Jupyter

Built on the literature

Code cells can be:

- Executed together with others
- Marked as prerequisite

The screenshot shows the JupyterLab interface with the title bar "JupyterLab" and address "localhost:8888/lab/workspaces/auto-M". The menu bar includes File, Edit, View, Run, Kernel, Tabs, Settings, and Help. A sidebar on the left has icons for IOT, sound-level-sensor.ipynb, and other Jupyter features. The main area displays a notebook titled "sound-level-sensor.ipynb" with the following content:

```
[ ]: #include <MQTT.h>
#include <WiFiNINA.h>

#define BROKER_IP      "test.mosquitto.org"
#define DEV_NAME       "MV_MKR1010_mqttdevice"
#define MQTT_USER      "mqtt_user"
#define MQTT_PW        "mqtt_password"
```

Below the code cell, there are three checkboxes: Install library, Is prerequisite, and Execute together with the previous cell.

The status bar at the bottom shows "0 s_ 6 Arduino | I... Saving comple..." and "Mode: Comm...".

The title of the notebook is "Implementing the sound level sensor in Arduino". The text in the notebook states:

In the next cell, we will be importing the libraries we have just installed, and we will define a set of constant values that we will be using across the code.

The **BROKER_IP** corresponds to the URL where our MQTT broker is located, the **DEV_NAME** is the identifier that we will assign to the device from which MQTT messages are being sent, and **MQTT_USER** and **MQTT_PW** are optional values in case the broker had some authentication. Since our broker doesn't have any authentication mechanism, we won't modify these values.

Notice that in this cell, we have selected the checkbox '**Is prerequisite**' below the cell. By doing so, we are saying that it is mandatory to execute this cell to make the Arduino implementation work.

JupyterLab

localhost:8888/lab/workspaces/auto-M

File Edit View Run Kernel Tabs Settings Help

sound-level-sensor.ipynb

Markdown IoT Architectural Element Devices

Installing the required libraries

In this implementation we will be using two Arduino libraries: [MQTT](#) and [WiFiNINA](#).

As their name suggests, the MQTT library will manage the communications using that protocol, and WiFiNINA will enable us to use the WiFi capabilities of the board. Feel free to explore the documentation of these libraries by clicking on the links.

In order to execute the following cell, please connect your Arduino and click on the '**Board**' button on the top left part of this document.

Would you please execute the cell below by clicking the '**RUN**' button to install the MQTT Arduino library?

```
[27]: arduino-cli lib install MQTT
```

Install library Is prerequisite Execute together with the previous cell

RUN

Command 'arduino-cli lib install MQTT' return with error (code 1): b'MQTT@2.4.7 already downloaded\nError: MQTT@2.4.7 is already installed\nError installing library: MQTT@2.4.7\n'

Once executed, the outcome from the cell might indicate that the library has been successfully installed or that it was already installed.

6 Arduino | I... Saving comple... Mode: Comm... Ln 1, Co... sound-level-sensor.ip...

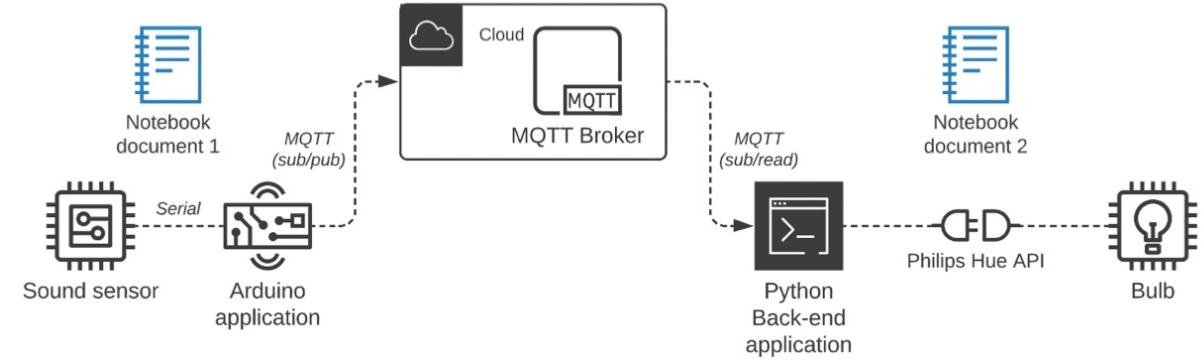
Notebook doc can:

- Be **grouped** together according to their architectural elements
- Identify and connect to **devices**
- Support multiple **programming languages**

Configuration cells, to install dependencies

Key Findings

Exploratory **user study**
13 **novice** IoT developers



Appreciated for **prototyping** IoT applications
Features were **easy** to understand and **useful**

Missing: graphical representation of the components' interactions

What's Next?



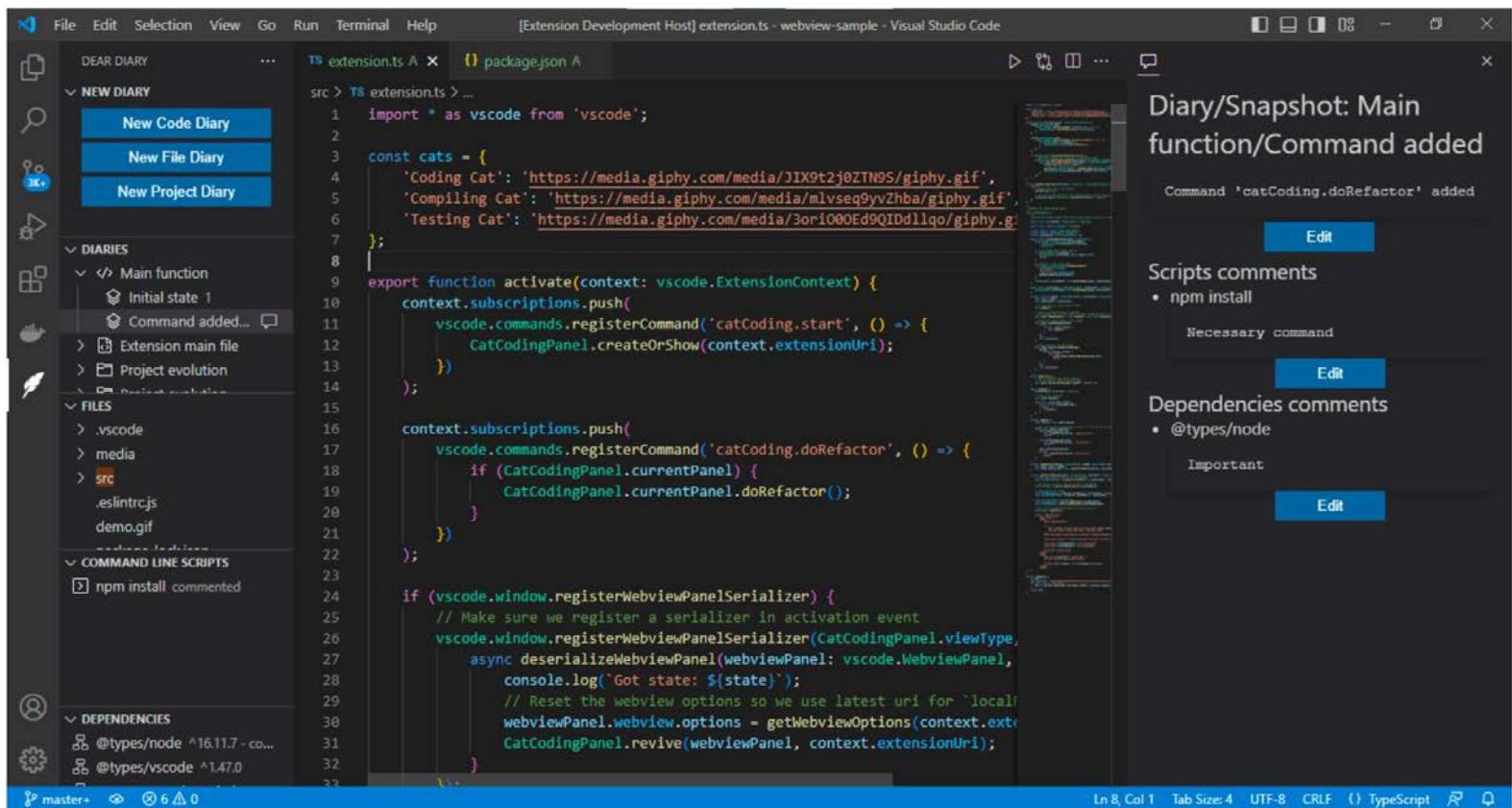
Developers

What about building on the **diary** metaphor so that they can collect

- Background information
- Rationale for the solution
- Used environments and libraries about (complex) code projects?

Dear Diary: documenting novices' development processes

Visual Studio Code extension to support the creation of “diaries” of development



The screenshot shows the Visual Studio Code interface with the "DEAR DIARY" extension installed. The left sidebar displays a tree view with sections like "NEW DIARY" (New Code Diary, New File Diary, New Project Diary), "DIARIES" (Main function, Initial state 1, Command added...), "FILES" (.vscode, media, src, .eslintrc.js, demo.gif), "COMMAND LINE SCRIPTS" (npm install commented), and "DEPENDENCIES" (@types/node ^16.11.7, @types/vscode ^14.7.0). The main editor tab shows "extension.ts" with TypeScript code for a "catCoding" command. The right panel shows a "Diary/Snapshot: Main function/Command added" section with a "Edit" button, and a "Scripts comments" section listing "npm install" as a necessary command. The bottom status bar shows "Ln 8, Col 1 Tab Size: 4 UTF-8 CRLF {} TypeScript".

```
import * as vscode from 'vscode';

const cats = [
  'Coding Cat': 'https://media.giphy.com/media/JIX9t2j0ZTN95/giphy.gif',
  'Compiling Cat': 'https://media.giphy.com/media/mlvseq9yvZhba/giphy.gif',
  'Testing Cat': 'https://media.giphy.com/media/3ori0BOEd9QIDllqo/giphy.gif'
];

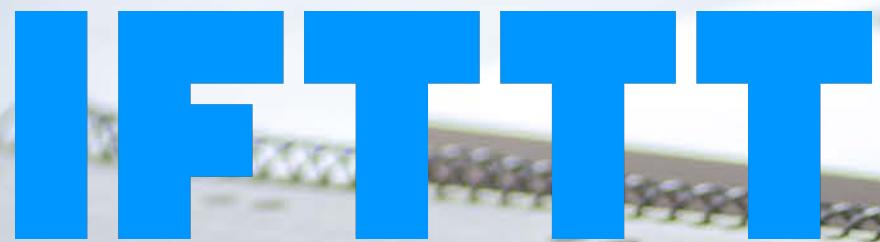
export function activate(context: vscode.ExtensionContext) {
  context.subscriptions.push(
    vscode.commands.registerCommand('catCoding.start', () => {
      CatCodingPanel.createOrShow(context.extensionUri);
    })
  );

  context.subscriptions.push(
    vscode.commands.registerCommand('catCoding.doRefactor', () => {
      if (CatCodingPanel.currentPanel) {
        CatCodingPanel.currentPanel.doRefactor();
      }
    })
  );
}

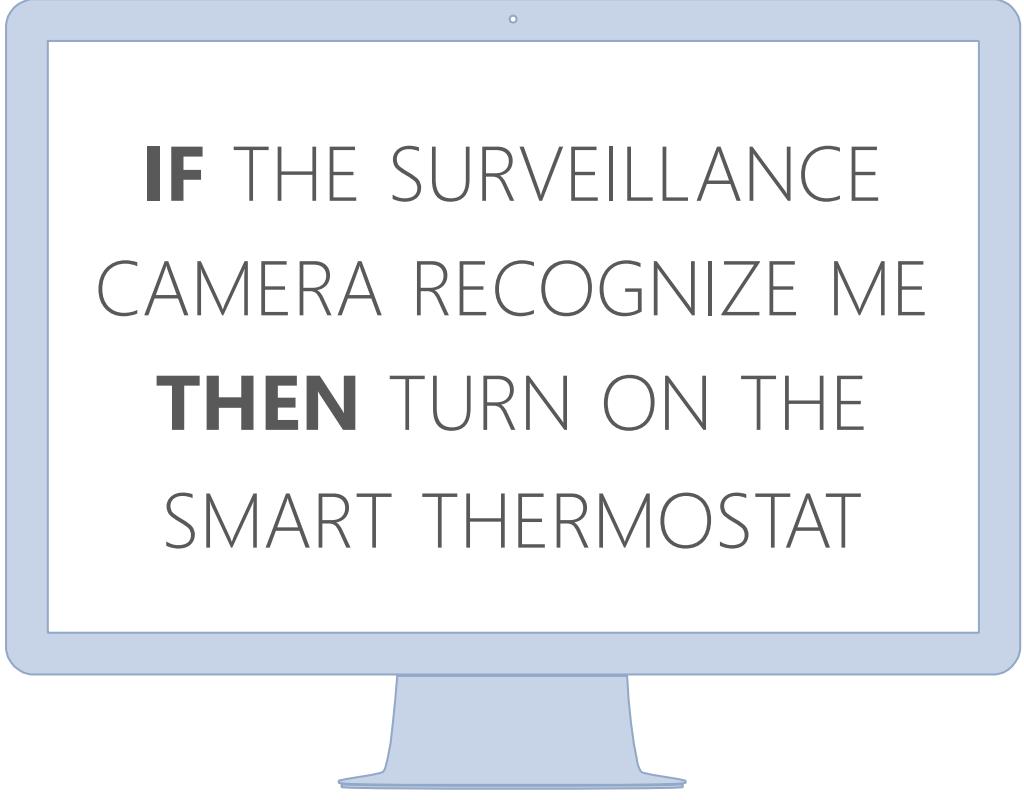
if (vscode.window.registerWebviewPanelSerializer) {
  // Make sure we register a serializer in activation event
  vscode.window.registerWebviewPanelSerializer(CatCodingPanel.viewType,
    async deserializeWebviewPanel(webviewPanel: vscode.WebviewPanel,
      console.log(`Got state: ${state}`);
      // Reset the webview options so we use latest uri for `local`!
      webviewPanel.webview.options = getWebviewOptions(context.extensionUri);
      CatCodingPanel.revive(webviewPanel, context.extensionUri);
    )
  );
}
```



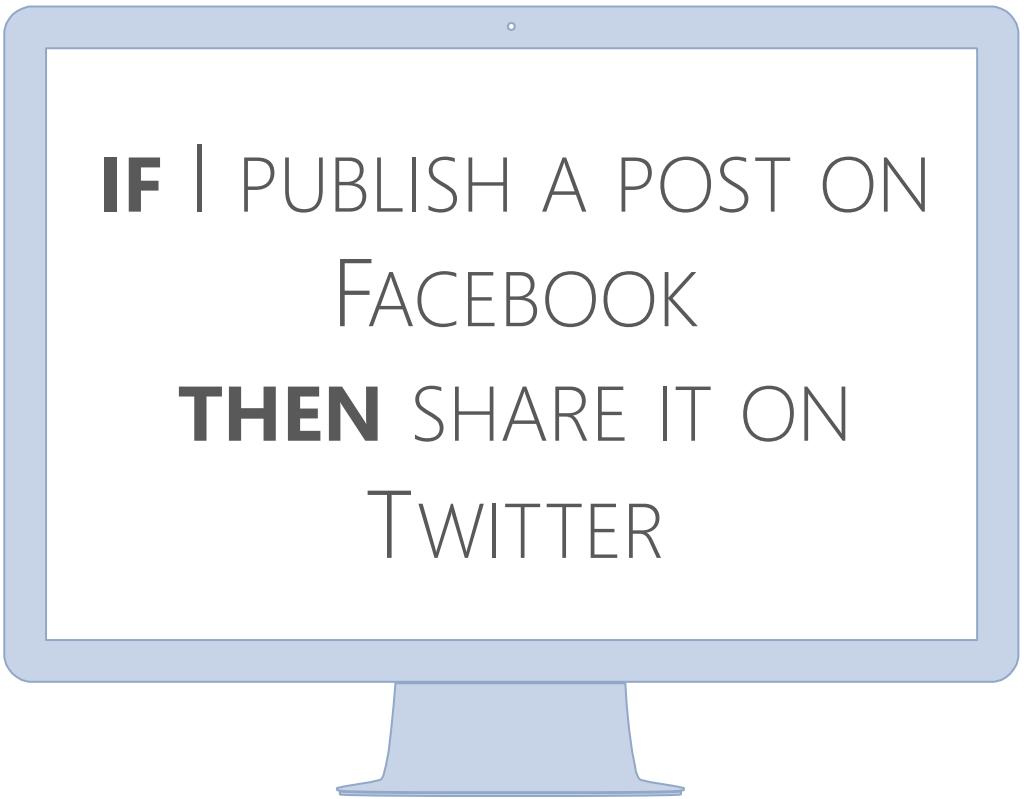
End users can program the IoT through **trigger-action rules**



Microsoft Flow



IF THE SURVEILLANCE
CAMERA RECOGNIZE ME
THEN TURN ON THE
SMART THERMOSTAT



IF I PUBLISH A POST ON
FACEBOOK
THEN SHARE IT ON
TWITTER

if **+this** then **that**

Main Challenges

Abstraction – end users create lot of rules, and they need to know lots of details

Support – end users need ways to discover new rules, and debug misbehaving rules

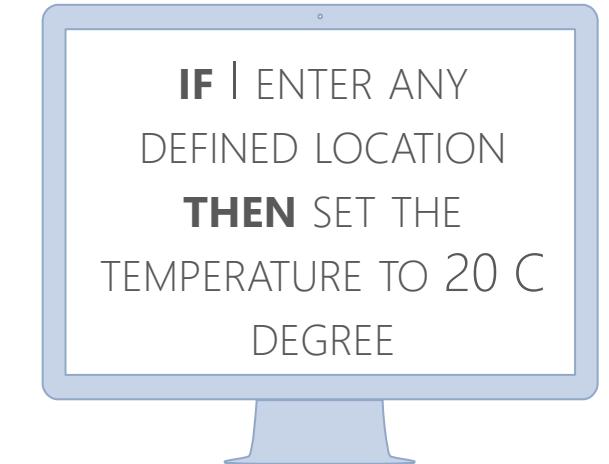
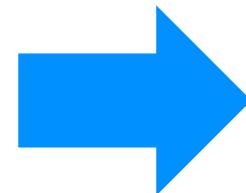
Abstraction



John is always hot, especially in summer. He loves air conditioning, and he would like to set a low temperature wherever it is possible.

At home, John has an intelligent Nest thermostat, that he controls through his Android smartphone.

John goes to work by his BMW smart car. There, all the offices are equipped with a Samsung air conditioner.

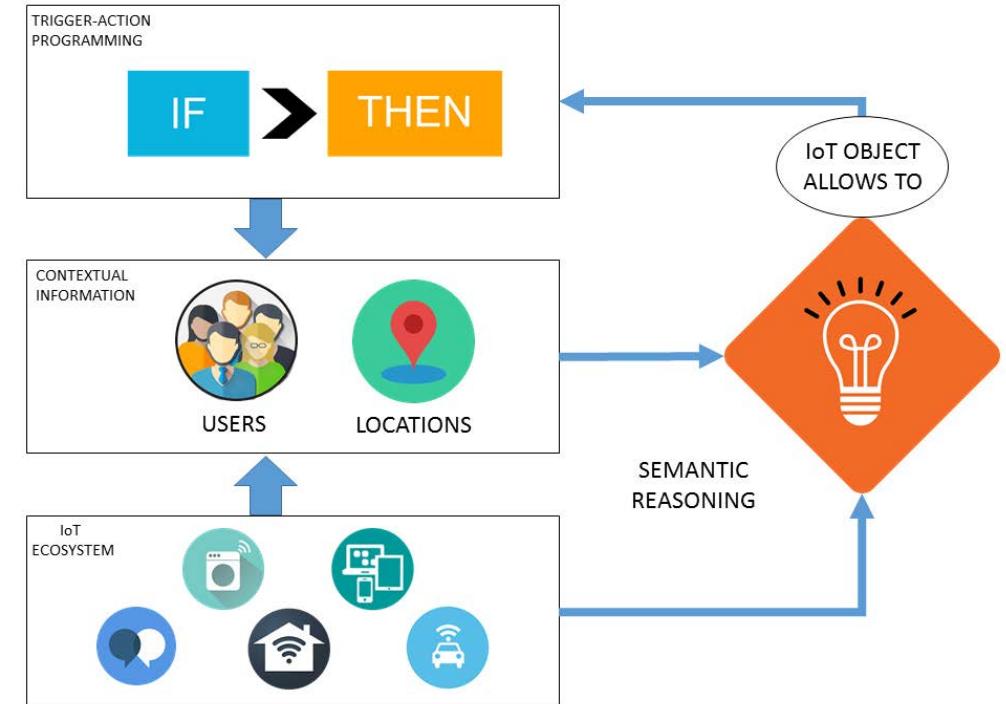


EUPont

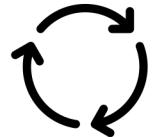
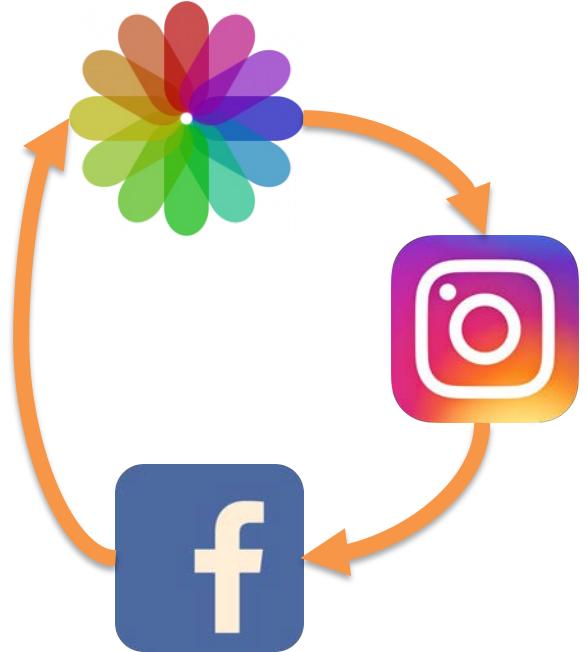
End User Programming ontology

Goals

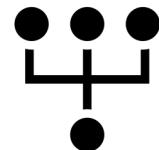
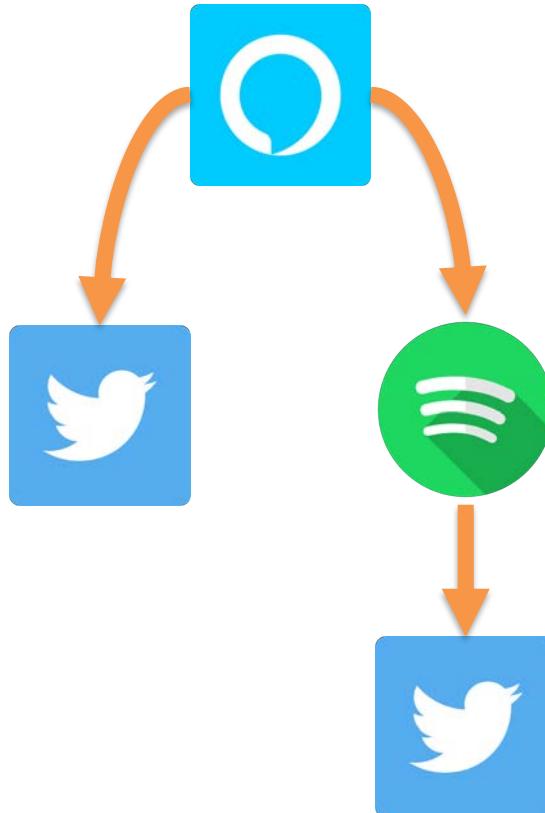
- Higher level of abstraction
- Programming by functionality
- Context dependent rules



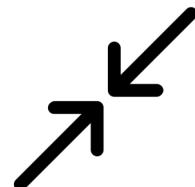
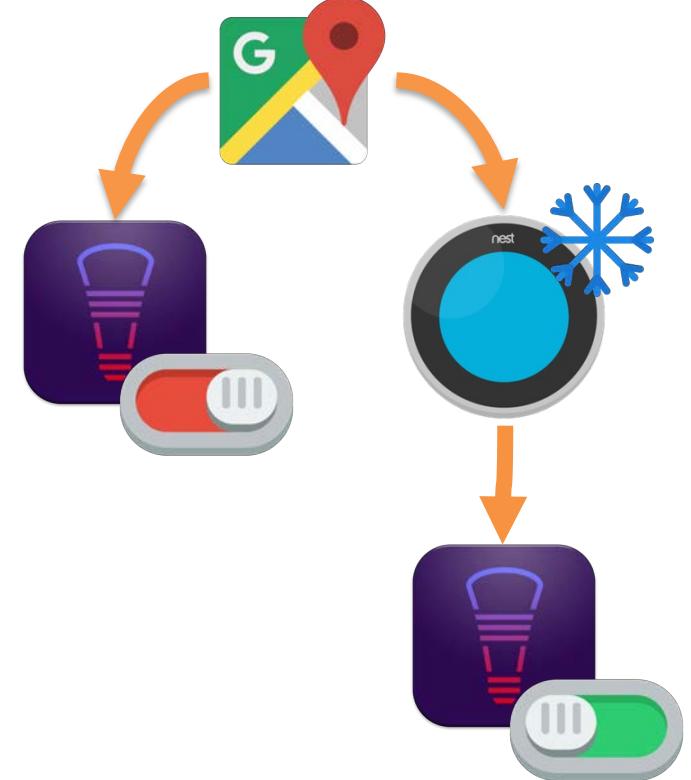
Problems To “Debug”



Infinite Loops

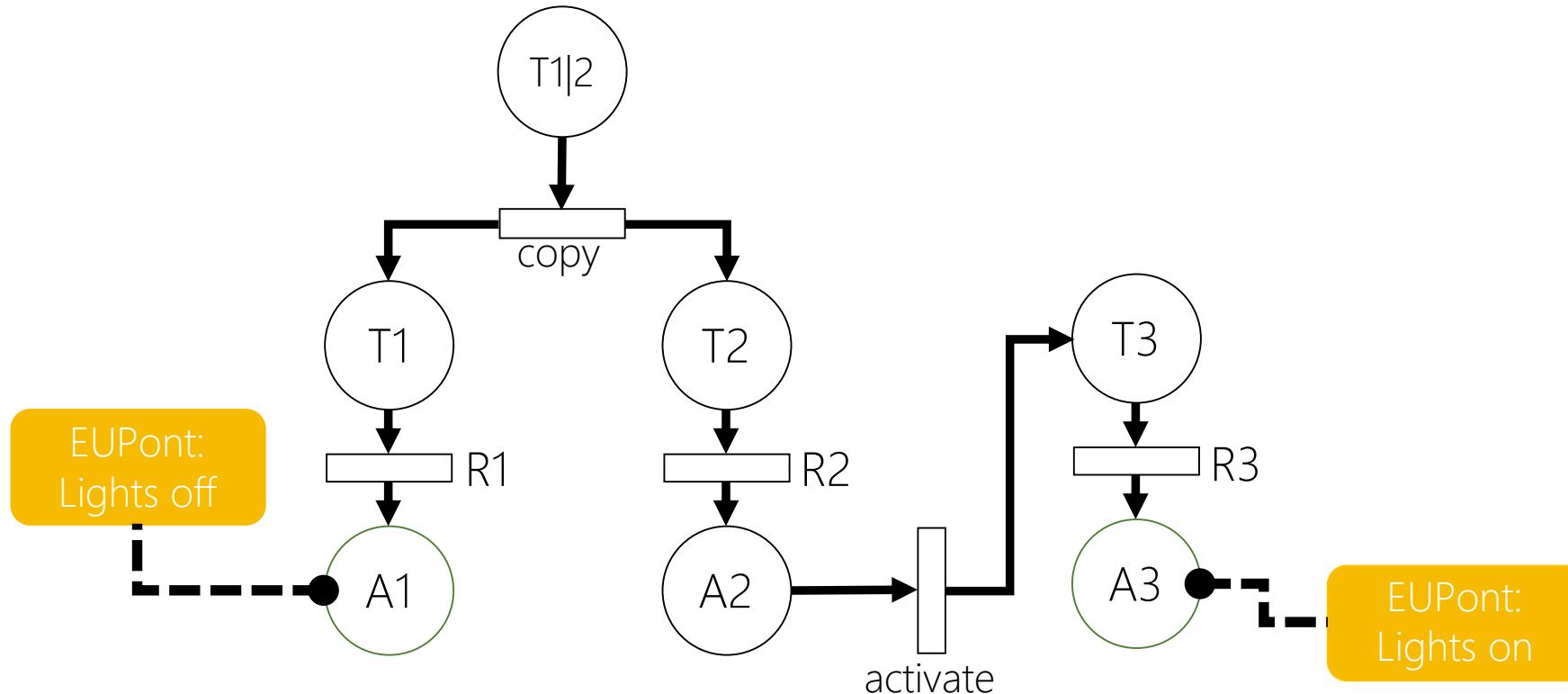


Redundancies



Inconsistencies

EUDebug



IF I exit home (T1)
THEN turn off the kitchen Philips Hue lamp (A1)

IF I exit home (T2)
THEN set the Nest to Away mode (A2)

IF the Nest is set to Away Mode (T3)
THEN turn on the kitchen Philips Hue lamp (A3)

The defined rule could generate some problems

Are you sure to save it?

* It could activate the following **INCONSISTENT** rules



Explanation

Save anyway

Don't save

STRATEGY 1: Identifying rule conflicts

STRATEGY 2: Simulating rule conflicts



Key Findings

Exploratory **user study**

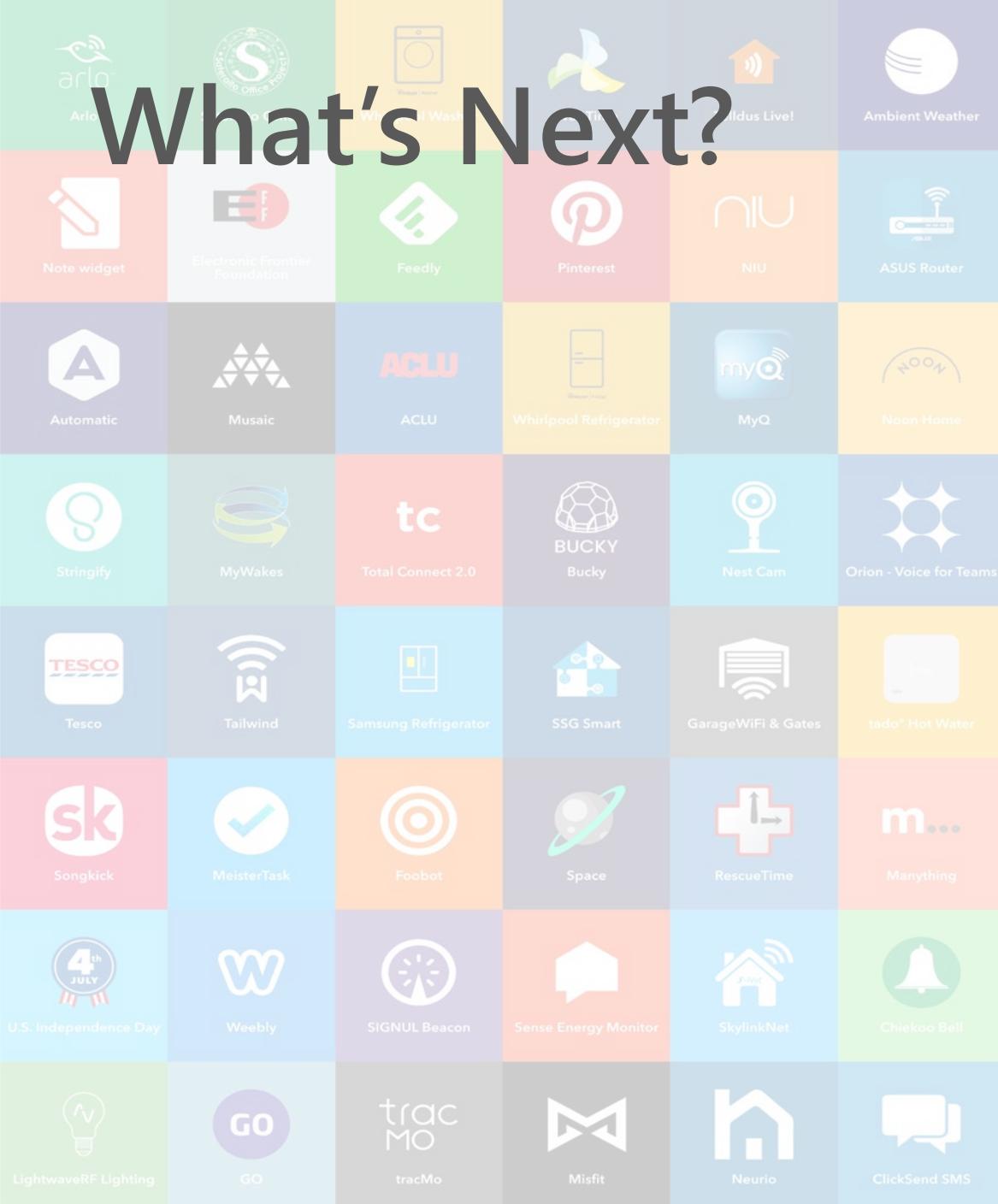
15 **end users**, 12 **trigger-action rules** (2 inconsistencies, 2 redundancies, 1 loop)

Different **perceptions**:

- Inconsistencies and loops are perceived as **dangerous**
- Redundancies can be even **acceptable**

Loops are **harder** to understand and identify

Step-by-step simulation helped understanding problems



What's Next?

End users

Can we leverage **conversational agents** to

- Compose
- Explain and debug rules?

HeyTAP²: a
conversational and
semantic search and
recommendation platform

Map abstract users' needs
(intentions) into
executable IF-THEN rules

