

# IoT Software Foundation for Hackwil

The Mean Squares – PolyHACK 2020

ASUS Robotics & AI Center Challenge

# Our mission

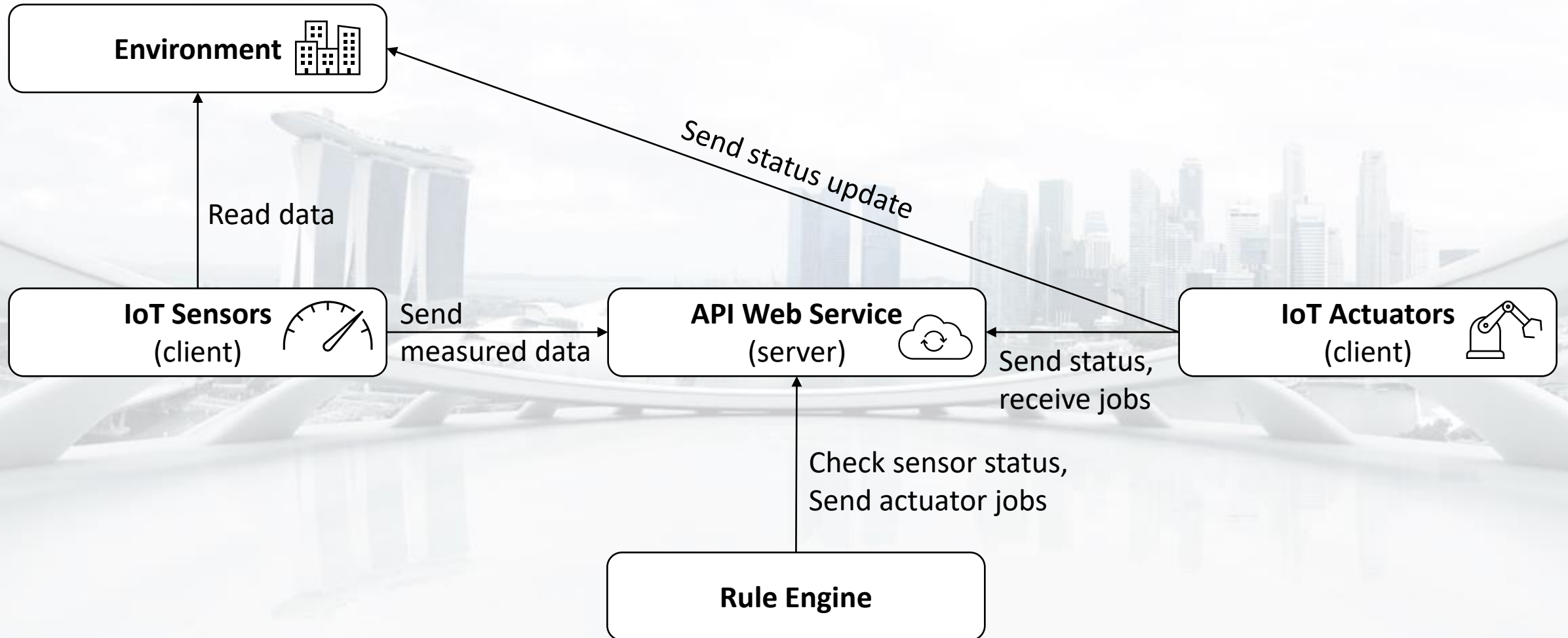
*We, The Mean Squares*, are representatives of the company Polycraft.

Our goal is to provide the software to automate IoT devices throughout Hackwil.

To proof our technical competence we have build an MVP with various types of sensors and actuators communicating via a server that act in a simulated environment.

# System Overview

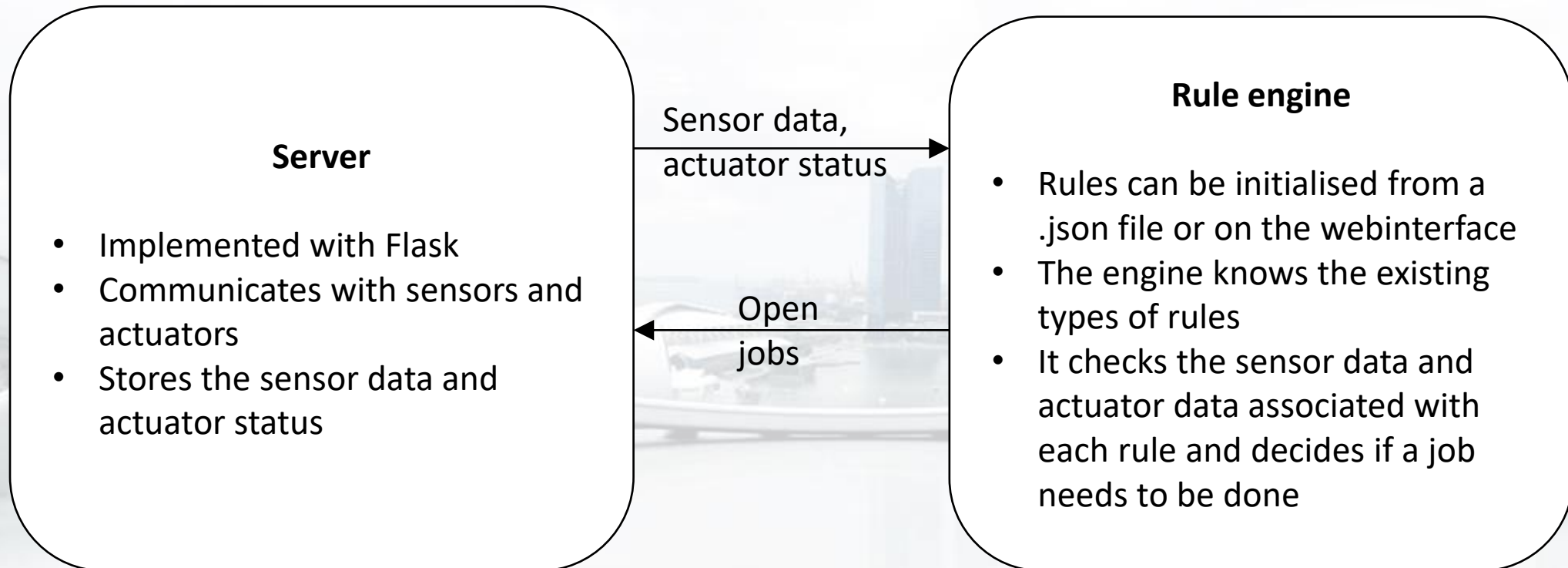
Fat server with thin clients implemented using Flask





# API Web Service & Rule engine

Fat server containing most of the application's logic





# Client-Server Communication Protocols

## Client side communication

All clients communication must contain the following fields:

- 'id': a unique identifier for the device
- 'ancestors': a list of inheritance of the device in question, in order from youngest to oldest (e.g. ['TemperatureSensor', 'Sensor', 'IOT\_Device'])

Clients are Sensor or Actuator.:

- A Sensor has a data entry, which contains a dictionary of measured values
- An actuator instance has a status entry, containing a dictionary describing the state of the device.

## Server side communication

The server receives messages from the client, and stores the received data locally.

Sensor:

- The sensor only sends data

Actuator:

- If an actuator needs actuating, the server will wait until the next time the actuator contacts the server, and will return the job to do be executed by the actuator.
- The response from the server is a list of jobs from the rules engine as a dictionary .
- If there is nothing to do, the dictionary is empty. If there is something to do, the dictionary will list what values to change. E.g. if a door should be unlocked, the response will be: {'DoorLocked': False}.



# IoT Sensors



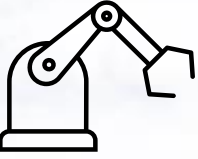
Sensors are Thin clients that read from the environment and send their data to the server

## Implemented sensor types:

- Temperature sensor
- Humidity sensor
- Brightness sensor
- Proximity sensor
- Noise sensor
- Motion sensor
- Distance sensor
- Airquality sensor

## Initialisation:

- Each sensor has an ID, a type and a position
- The number and type of sensors in Hackwil can be configured in a .json file



# IoT Actuators

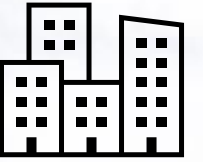
Actuators are thin clients that sent their status to the server and receive jobs to execute

## **Implemented actuator types:**

- Smart lamp
- Smart door lock
- Motor position
- Smart heating
- Smart sprinkler

## **Initialisation:**

- Each actuator has an ID, a type, a position and a status
- The number and type of sensors in Hackwil can be configured in a .json file



# Simulated Environment

- The environment is a class simulating the input data for each sensor
- Each sensor can read a feed of random variables that are scaled according to its type
- The actuators can influence the environment (e.g. a heater increases the temperature in its surrounding)
- Due to the modular implementation, the environment can easily be replaced by real input data



# Try our MVP

Our sourcecode: <https://github.com/Karko93/Polyhack2020-Project.git>

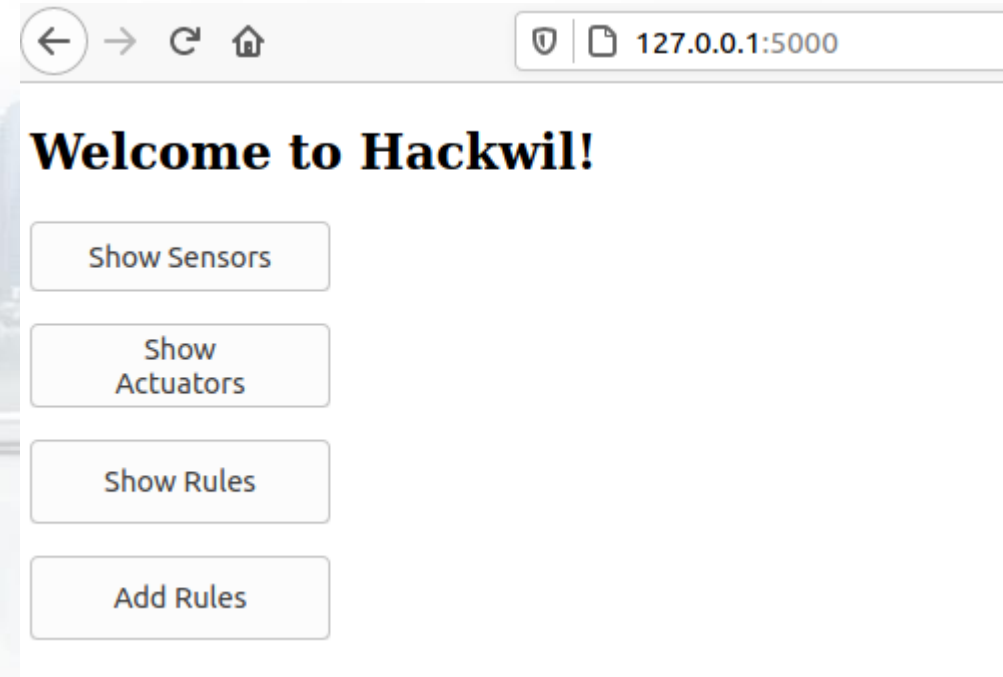
Run the code according to the readme.md

Go to the webpage <http://127.0.0.1:5000/> to see the simulations of Hackwil



# The Webinterface

With our interactive webinterface the state of our IoT system can be monitored. New Rules for interaction between actuators and sensors can be added on the fly.





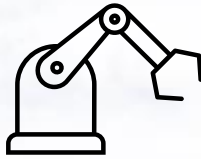
# The Sensor

	ID	Type	Timestamps
0	001	BrightnessSensor	2020-11-08 09:21:23.097778
5	002	TemperatureSensor	2020-11-08 09:21:23.166324
1	003	ProximitySensor	2020-11-08 09:21:23.111367
8	004	NoiseSensor	2020-11-08 09:21:23.207680
2	005	DistanceSensor	2020-11-08 09:21:23.125170
6	006	MotionSensor	2020-11-08 09:21:23.180323
3	007	HumiditySensor	2020-11-08 09:21:23.139115
9	008	HumiditySensor	2020-11-08 09:21:23.220761
4	009	AirQualitySensor	2020-11-08 09:21:23.152817
7	010	TemperatureSensor	2020-11-08 09:21:23.194027

Overview over all connected sensor with last interaction

	brightness	timestamp
0	63.404223	2020-11-08 09:20:59.391306
1	46.725644	2020-11-08 09:21:00.571086
2	43.405267	2020-11-08 09:21:01.708654
3	44.516281	2020-11-08 09:21:02.918431
4	42.976452	2020-11-08 09:21:04.052620
5	41.632564	2020-11-08 09:21:05.164620
6	75.103981	2020-11-08 09:21:06.223578
7	38.688601	2020-11-08 09:21:07.304736
8	32.736825	2020-11-08 09:21:08.348638
9	46.672818	2020-11-08 09:21:09.510994
10	44.745092	2020-11-08 09:21:10.648388
11	54.738702	2020-11-08 09:21:11.740789
12	32.605155	2020-11-08 09:21:12.949979

The measurement data for each sensor given an ID



# The Actuator

	ID	Type	jobs
0	100	SmartLamp	{}
1	200	SmartDoorLock	{}
2	300	MotorPosition	{}
3	400	Heating	{}
4	500	Sprinkler	{}

Overview over all connected actuators with assigned jobs

	intensity	timestamp
0	0	2020-11-08 09:20:59.513107
1	0	2020-11-08 09:21:00.689211
2	0	2020-11-08 09:21:01.847277
3	0	2020-11-08 09:21:03.035147
4	0	2020-11-08 09:21:04.125799
5	0	2020-11-08 09:21:05.206190
6	0	2020-11-08 09:21:06.290141
7	0	2020-11-08 09:21:07.334318
8	0	2020-11-08 09:21:08.471834
9	0	2020-11-08 09:21:09.619535
10	0	2020-11-08 09:21:10.724443
11	0	2020-11-08 09:21:11.879709

The record of the latest state of each actuator by ID

# The Rules

127.0.0.1:5000/rules

	uniq_id	actuator_ids	actuator_output	actuator_value_False	actuator_value_True	comparisons	requirement	sensor_ids	sensor_reading	thresholds
0	000000	[000030, 000032]	[intensity]	[0]	[1]	[=, =]	all	[000015, 000010]	[motion, noise_detector]	[True, True]

Overview over all assigned rules with the relevant actuator and sensor IDs. Furthermore the type of sensor and rule is shown.

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127.0.0.1:5000/rules\_generator

Choose sensor

Choose reading

Choose condition

threshold:

Choose actuator

Choose action

Actuator value: if true:

if false:

Submit Query

Interface to live add rules to the system. All available sensors and actuators can be selected and a variety of conditions can be applied.



# The Mean Squares



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