MIMUW-hats Software Architecture Document

Version 0.2, last modified 25.04.2020

Michał Borowski, Michał Makowski, Michał Tyrolski, Szymon Tworkowski

Glossary

- moderator: user assigned by system administrators whose role is removing inappropriate content
- post: image of lost item along with optional text description, user name (only with user's approval)
- feed: list of all posts containing currently lost items; users will be able to "react" to posts with a preset of Facebook-like reactions, bringing the post higher in the feed where they will be sorted according to a combination of post age and activity
- item: hat (any kind)
- valid/invalid item: item which respectively is/is not a hat

Introduction

MIMUW-hats is a project meant to help fight against the plague of hats and other items lost in the MIMUW building. It will incorporate novel solutions such as ML, REST APIs and responsive web design to tackle this issue.

Fig. 1. Normal day at MIMUW.

The project will provide a web app which allows users to post found hats as well as report their finds. The system will automatically match images and/or textual descriptions, notifying the owners of the lost items. There will be the option to register their hats to be automatically matched if they are found. There will also be an element of gamification by means of awarding productive users with experience points as well as a very simple feed for viewing, bumping and reacting to posts about lost and found items. The project can also be modified to suit current market demand, for example handling face masks in addition to hats.

Fig. 2. Happy MIMUW people enjoying their hats.

Technical overview

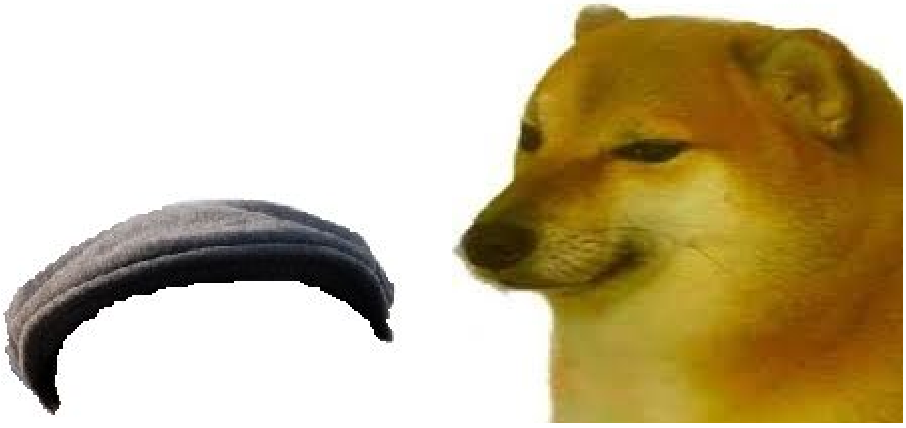


Fig. 3. Example of good input after separation and incorrect input uploaded by mistake.

Technical details

The project will be composed of three major parts: a responsive web client interface written in React, a REST API backend utilizing Express.js and Node.js, and Machine Learning infrastructure built with Keras in Python.

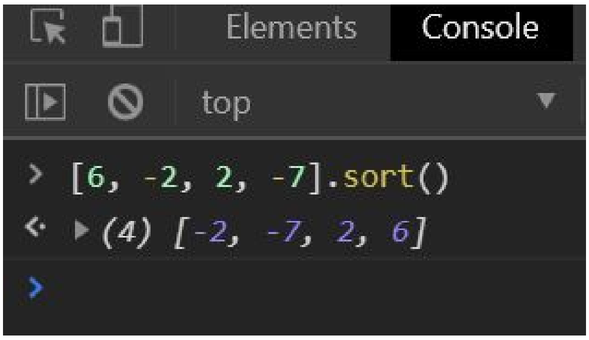
Frontend

The frontend will be based on React.js version 16. It will be responsive and function both on mobile and desktop.

Backend

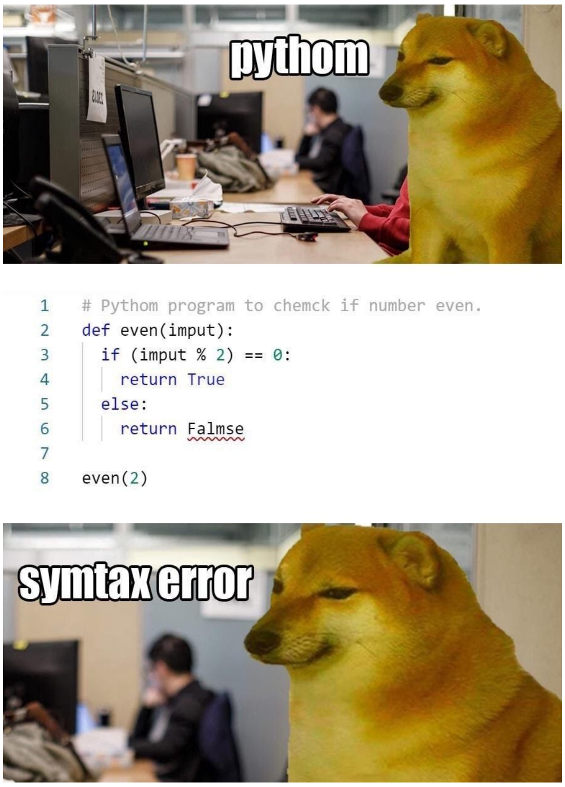
Technologies:

1. TypeScript 3.8
2. Node.js 12
3. Express.js 4
4. SQLite 3
5. TypeORM
6. ~~Javascript ES7~~



```
> [6, -2, 2, -7].sort()
<· ▸ (4) [-2, -7, 2, 6]
>
```

Fig. 6. **JavaScript** is a flexible and **powerful** programming **language** that is implemented consistently by various web browsers.



```
# Pythom program to chemck if number even.
def even(imput):
  if (imput % 2) == 0:
    return True
  else:
    return Falmse

even(2)
```

Fig. 4. **Backemd developer**

The backend will be entirely REST-based, including authentication. All HTML rendering will be done client-side in React.

A SQLite relational database coupled with TypeORM will be used for persistence.

Authentication will be done with JWT. In order to limit the app’s usage to MIMUW students, a MIMUW email address will be connected to each account (Nodemailer).

Notification of users will primarily be done by email and push notification done with web-push library.

Machine Learning

We will use convolutional neural networks (CNNs) to solve the problem of detecting hats in pictures. To be more specific, our neural network (NN) will be able to find bounding box of potential hat. Initially, a sequential model with ~ 10 network layers will be used. If increased detail is needed, we will move to another type of CNN, namely the YOLO v3 (https://arxiv.org/abs/1804.02767) model from the well-known scientific article. The implementation will be carried out in keras 2.3.1 (python3) in a version with tensorflow 2.0 backend.

We don't have 100% certainty about NN correctness. If prediction fails, posts can be still verified by moderators.

For rapid testing, Proofs-of-Concept (PoC-s) provided by the fast.ai library will be used.

Datasets come from two sources: 1) photos from MIMUW groups on Facebook about missing things 2) scraping Google images using simple scripts (in JavaScript and Python). Dataset size will be about n 10k <= 100k images.

Due to the complexity of the problem, the training will take place on Google Colab - the free version gives access to NVIDIA Tesla K80, P4, T4, P100, and V100 GPUs (Google Colab assigns specific models without the possibility of choosing them by us).

Additional constraints

Security – Moderation

To limit malicious usage, each account will be linked to a MIMUW email by sending a confirmation. The system will automatically detect posts not related to hats. Users designated as moderators will have the ability to delete inappropriate posts not detected by the system as well as allow posts flagged by mistake.

Speed

Since information is sent to users mostly by notification, speed of matching items does not have to be very high. Notifying a user of their image being removed due to being inappropriate should be reasonably fast as to provide a better user experience.

User rewards

User participation will be encouraged by awarding active players with experience points. When accumulated, they will allow users to gain ranks. Ranks will be named by MIMUW courses according to their difficulty, e.g. Rank 1 - PO, Rank 5 - MD, Rank 10 - WPI.

$\Delta x \Delta p \geq \hbar/2$
FUW
$\nabla \cdot \mathbf{B} = 0$

Fig. 5. Hats escaping their bad owners.