31st SUMMER SCHOOL ON IMAGE PROCESSING (SSIP), NOVI SAD, 10-16th July 2023

PROJECTS

Teamwork:

- Scientist/researcher
- Programmer/coder (Matlab, Python, C, ...)
- Documenter/publicist (web page)
- Manager

You will be assessed in terms of:

- Ability to function as a team
- Scientific originality
- Use of resources
- Demonstration of function
- Quality of coding
- Quality of documentation
- Quality of web page

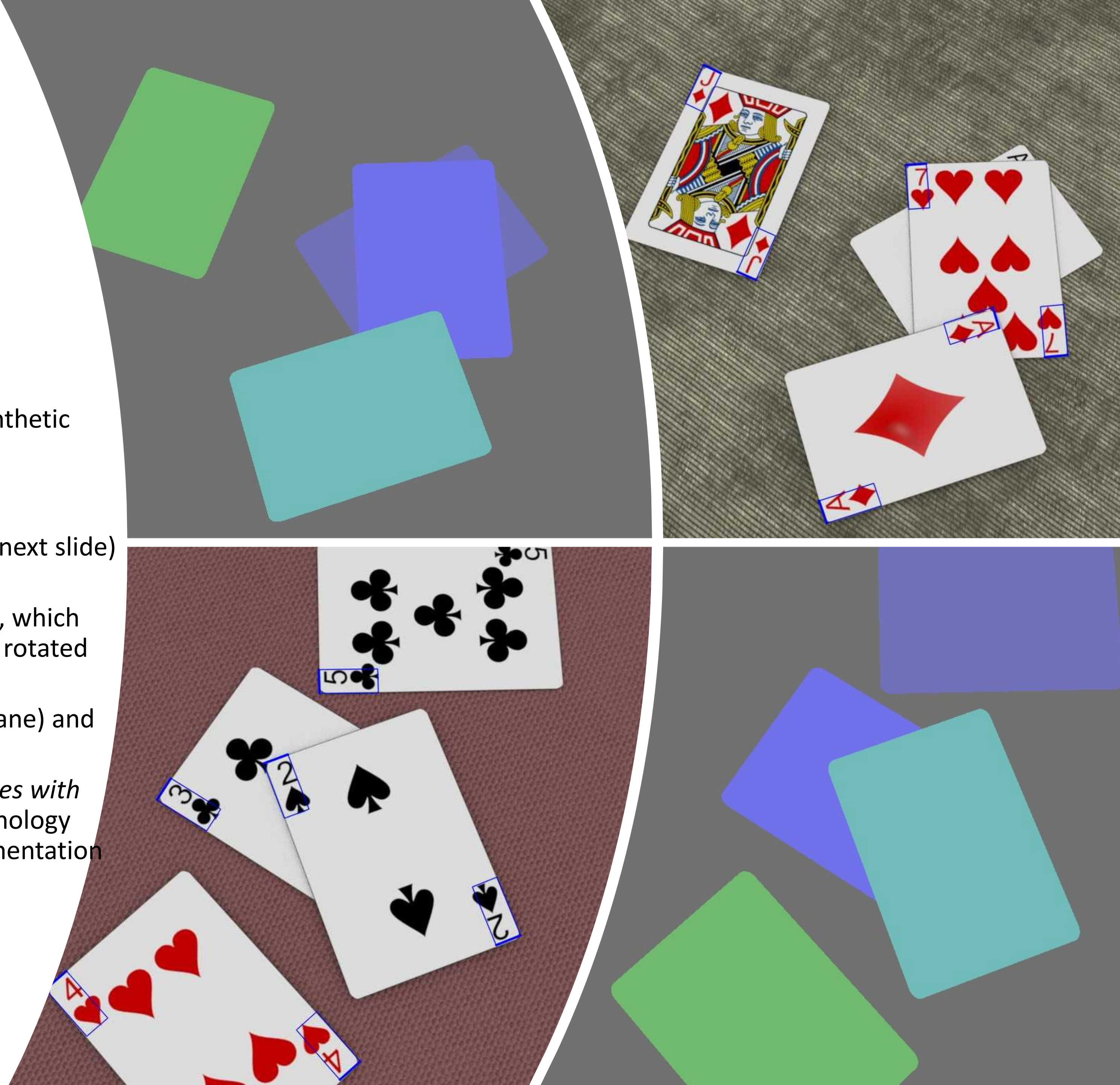
Project 1

Card recognition for automated card game annotation

Rotated object detection – playing card (52 class) recognition and card game assistant **Dataset:** SSIP 20K *playing card dataset*

- Keywords
  - Planar object pose, pose estimation, learning from synthetic data, endless hours of fun
- Short description
  - You are given a synthetic annotated card dataset (see next slide) which depicts realistic looking playing cards
  - Using this dataset, develop a card recognition scheme, which can recognize the individual cards (via recognizing the rotated value fields at opposite corners)
  - Estimate the 2D card pose (assuming it is lying on a plane) and its occlusion status (depth ordering for stacked cards)
  - Pick a card game (blackjack, etc. /Hint: search for *games with poker cards*/) and use the developed recognition technology for some fun demo application (combining the implementation with a webcam input. Slow computation speed is ok).

    Possible ideas:
    - Automated card game annotation
    - Card game strategy advisor (example strategy)
    - Augmented game



In case of questions, contact Czaba Beleznai: csaba.beleznai@ait.ac.at

Rotated object detection – Dataset information

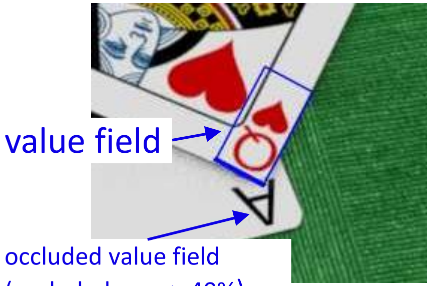
- Download location: https://drive.google.com/drive/folders/1s7UHyjlqnD-dW_Y1HkdoHPhs_i9n-ZQW?usp=sharing **~4.3 GB zip file**
- Dataset content:
  - **20000 images** containing 2-4 cards in various spatial configurations. [location: *./ssip_20k_cards/img*]
  - **20000 matching annotation yaml files** (see annotation format below) [location: *./ssip_20k_cards/gt*]
  - The card types represent 52 classes. During the dataset generation each class was picked with equal probability, resulting in an approximately equal occurrence frequency, approximately 1150 images-per-class (see: *./ssip_20k_cards/dataset_statistics.yml*)
  - Card class indices correspond to the following convention (python code snippet):

```
card_types = ['2', '3', '4', '5', '6', '7', '8', '9', '10', 'J', 'Q', 'K', 'A']
card_symbols = ['C', 'D', 'H', 'S’]                              # club, diamond, heart, spade = ['♣', '♦', '♥', '♠']
card_names = gen_cardnames(card_types, card_symbols)     # card class array (defined by card names)
where:
def gen_cardnames(card_types, card_symbols):
  inumsymb = len(card_symbols)
  inumtypes = len(card_types)
  card_names = []
  for ii in range(inumsymb):
    for jj in range(inumtypes):
      curr_name = card_types[jj] + card_symbols[ii]
      card_names.append(curr_name)
  return card_names
```

  - **Annotation format:** annotations were automatically generated, where each card has two value fields (see blue oriented rectangle). Each rectangle is represented by: [cx, cy, bwidth, bheight, ang_deg, card_id], where

cx, cy:	center of the value field in the image	[unit: pixel]
bwidth, bheight:	box width and height of the value field in the image	[unit: pixel]
ang_deg:	value field box orientation in degree	[unit: degree, 0-360]
card_id:	class index (see above how to map class index to card name)	[integer, 0-51]

Note: if a value field unoccluded or within the image bounds → each card generates two field annotations, otherwise, it might happen that only one or no field is annotated. Example, the black *ace card* generates no annotation →



occluded value field (occluded area > 40%), therefore ignored

  - **Visual debug folder is included:** it shows the individual value fields for each card, and also contains card segmentations with depth ordering (CARD_DBG_*index*.jpg and CARD_DBG_*index*_seg.jpg). It is only as additional information, for learning however, not needed [location: *./ssip_20k_cards/gt*]

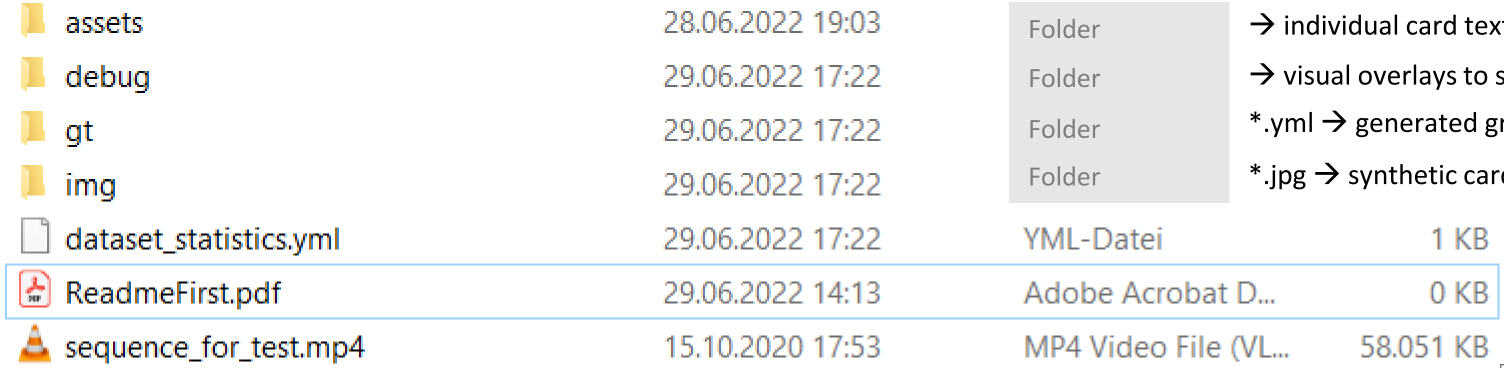
Rotated object detection – Additional information

Cards were generated using Blender + our own python script

View variations: camera elevation varied in [45°,90°], 90° == top view

Distance variations: [0.5m, 0.8m]

- Folder structure



assets	28.06.2022 19:03	Folder	
debug	29.06.2022 17:22	Folder	
gt	29.06.2022 17:22	Folder	
img	29.06.2022 17:22	Folder	
dataset_statistics.yml	29.06.2022 17:22	YML-Datei	1 KB
ReadmeFirst.pdf	29.06.2022 14:13	Adobe Acrobat D...	0 KB
sequence_for_test.mp4	15.10.2020 17:53	MP4 Video File (VL...	58.051 KB

→ individual card textures (maybe needed later on to print or to visualize cards in a demonstrator)

→ visual overlays to see existing annotations (not relevant for a learning task)

*.yml → generated ground truth for the individual card value regions

*.jpg → synthetic card images for learning (without any overlay)

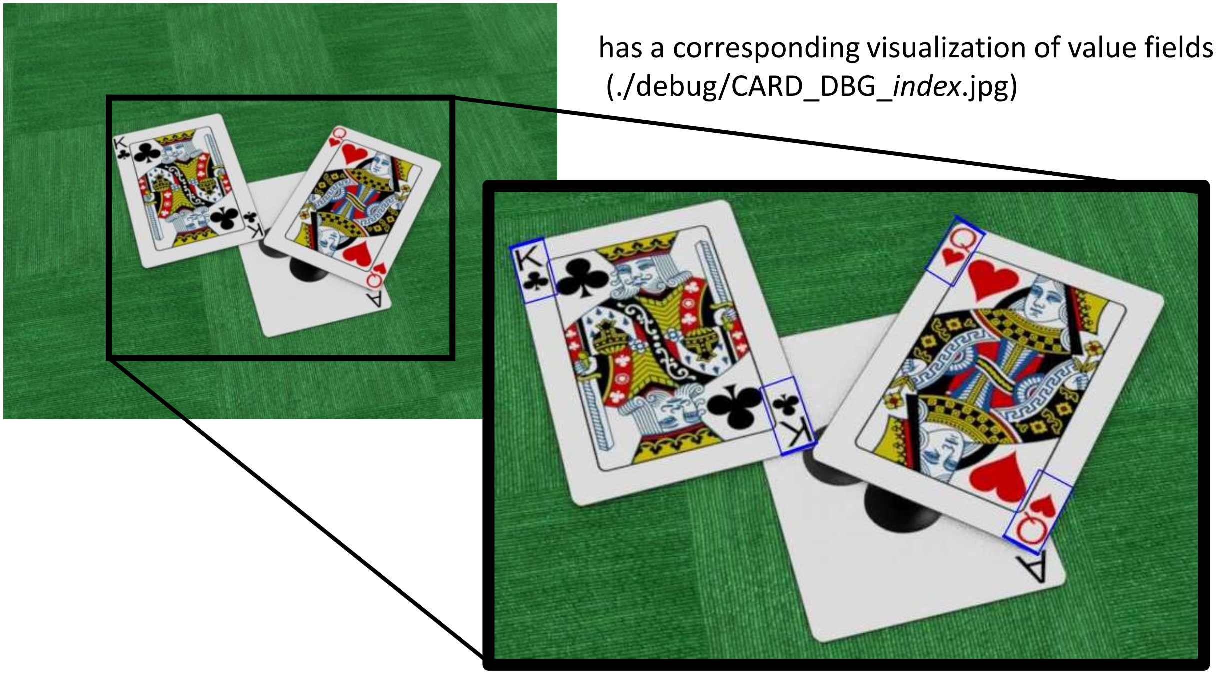
→ dataset statistics

→ this file as a pdf

→ a short video for testing a detector, depicting the same card designs* as used for data generation

Note: be aware, that although this a “standard” poker card dataset, commercially available card packs exhibit many design variations (fonts, scaling) Q Q Q ...

each synthetic card image (./img/*.jpg)



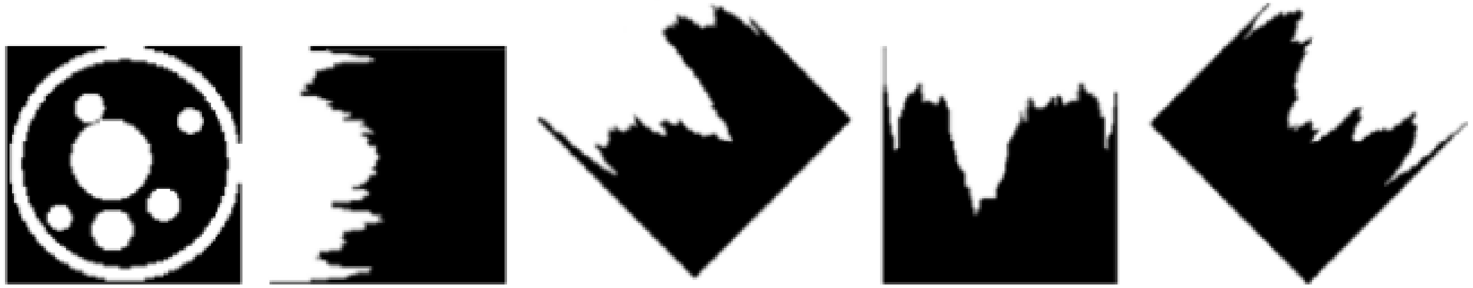
has a corresponding visualization of value fields (./debug/CARD_DBG_*index*.jpg)

short video for testing

Project 2

Binary tomography

- Calucalate projections of binary images in few directions (Matlab, Python, ImageJ: Radon Transform)
- Try to reconstruct the original image from projections (can be solved by optimization)
- Improve reconstruction quality by using priori knowledge: binary values, homogenity, structural information (Discrete Tomography)
- More challanges: noisy projection data
- Contact person: Peter Balazs pbalazs@inf.u-szeged.hu i Tibor Lukić



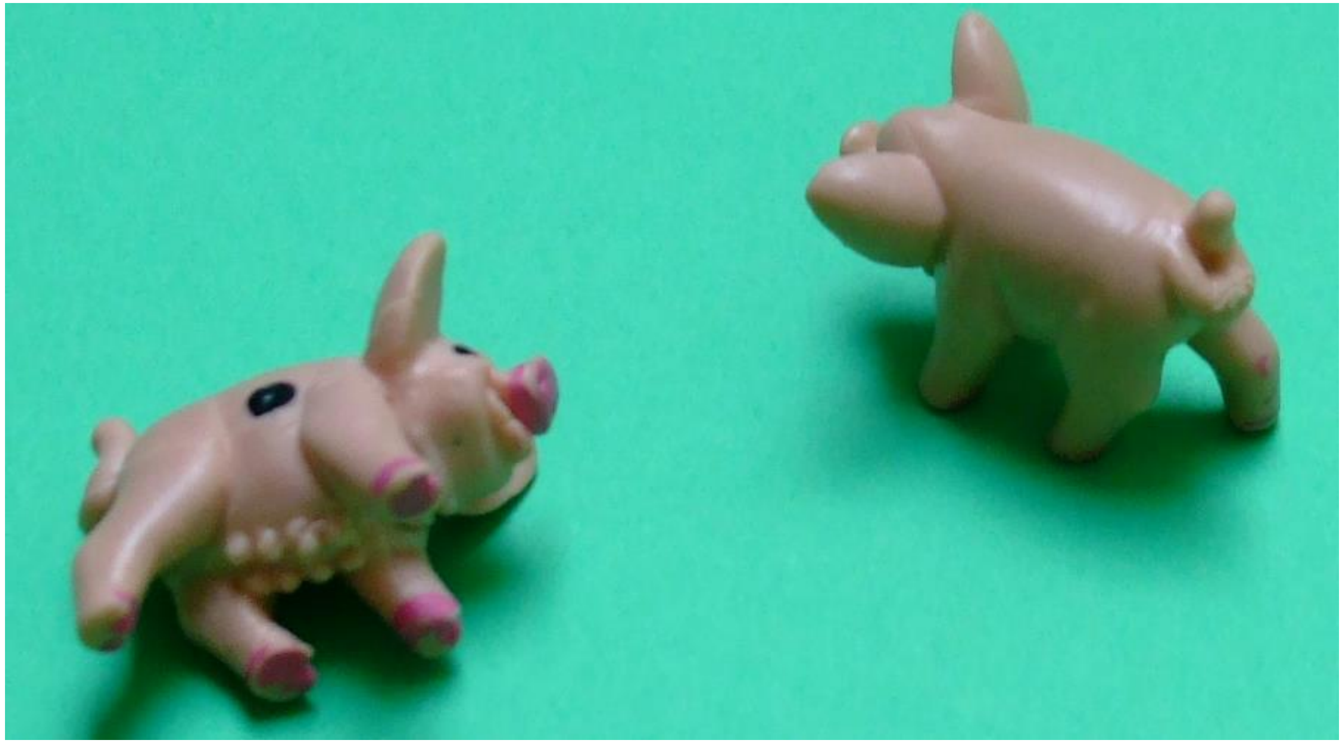
Project 3

Pass the pigs

PASS THE PIGS
Try Your Luck Using Pigs as Dice
Celebrating 35 Years!
WARNING:

- **Input**: still color images with pig-like dices
- **Objective**: recognize the pig-dice values based on some fixed poses the pigs landed in after the dice throw.
- **Tasks to do**: Try to classify the pig postures according to the possible fixed posterus and calculate the corresponding score.
- **Suggested readings**:
- https://en.wikipedia.org/wiki/Pass_the_Pigs
- https://pubsonline.informs.org/doi/pdf/10.1287/ited.1120.0088
- Contact person: Kalman Palagy palagyi@inf.u-szeged.hu

Test Images

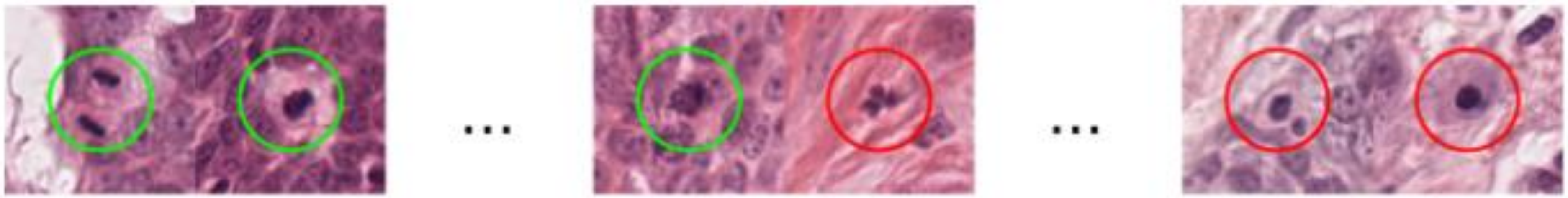


www.inf.u-szeged.hu/~palagyi/PassThePigs/

Project 4

Mitosis detection on histopathology images

- Digital pathology is a fast-growing field
- Accurate diagnosis and prognosis of tumors
- The detection of cells undergoing division (mitotic figures) in histological tumor images receives high attention
- The density of mitotic figures (mitotic count) is known to be related to tumor proliferation and is thus highly relevant for the prognostication. It is one of the most relevant parameters used for decision of appropriate therapy. The current gold standard method is visual assessment by a trained pathologist.
- MIDOG22 challenge for data and annotations: https://imig.science/midog/
- Contact person: Peter Horvath h938454@gmail.com



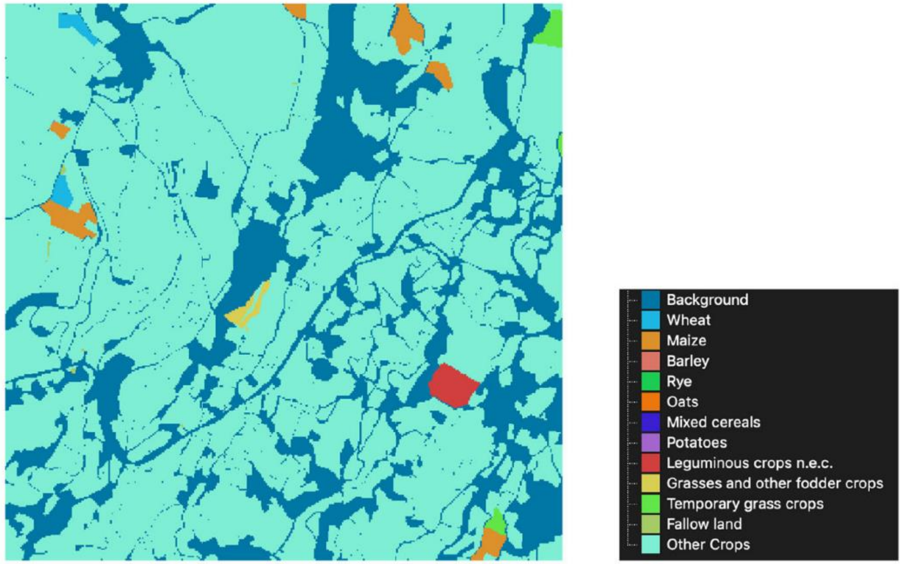
clear mitotic figures ... difficult to precisely categorize ... clear negative examples

Mitotic figures (left) to clear negatives (imposters). Source: Aubreville et al. Sci Data, 2020

Project 5

Crop type mapping

- Crop Type Mapping using Sen4AgriNet remote sensing dataset: https://github.com/Orion-AI-Lab/S4A-Models



- For more details: Sykas, Dimitrios, et al. "A sentinel-2 multiyear, multicountry benchmark dataset for crop classification and segmentation with deep learning." IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing 15 (2022): 3323-3339.
- Contact person: Teodora Selea teodora.selea@e-uvt.ro

Project 6

Food classification

Build an automated vision-based Food/Non-Food Image Classification and Food Categorization system. The system should recognize the content of a plate/bowl based on one (or few) input picture.

- - Define your own categorization granularity (for example the 11 major food categories of Food-11 dataset).
- - You can use the publically available Food-11 and Food-5K datasets (http://mmspg.epfl.ch/food-image-datasets), and Food Dataset (http://iplab.dmi.unict.it/madima2015/).
- - Evaluate your framework on independent data.
- - Think of aspects beyond classification, such as estimating quantities, linking classification results with nutritional data, etc.

Contact: Csaba Beleznai

Project 6

Project 6

Summary:

1. Card recognition
2. Binary tomography
3. Pass the pigs
4. Mitosis detection
5. Crop type mapping
6. Food classification

Now:

- Take a peice of paper
- Select your three favourite projects
- Order them – 1, 2, 3
- Write your name on the paper
- Hand it in