TOPICS for PROJECTS

Team work
Team work

4 members, 4 roles

• Scientist/researcher
• Programmer/coder
• Documenter/publicist (web page)
• Manager
You will be assessed in terms of:

• Ability to work as a team
• Originality of the proposed solution
• Implemented functions
• Quality of the implementation
• Quality of the documentation
• Web page design
• Quality of the presentation
Project 1: Vessel tracking

Simulation and tracking

Proposer: prof. Antal Nagy, University of Szeged
nagya@inf.u-szeged.hu
Project 1: Vessel tracking - Description

- Create a binary vessel software phantom
  - Contains
    - At least two vessels
    - With branches
      - In the upper region
  - Parameters
    - Resolution
      - X, Y
      - Axial slices
    - Z
      - Space between slices
    - Noise
      - Spots with different size around the vessels
Project 1: Vessel tracking - Aim

• Use the simulated data on simulated data
  • Tracking the spots with different parameters

• Basically you have to find the vessels on the input volumes

• Additional real data is available on request
  • Segmentation results of head and neck images
    • See next slides
  • Details can be obtained from: nagya@inf.u-szeged.hu
Project 1: Vessel tracking - Example Slices
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Project 2: Food Classification

Proposer: dr. Csaba Belesznai, AIT Austria

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Project 2: Food Classification - Aim

• Build an automated vision-based food classification 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).
Project 2: Food Classification - Details

• You can use the publicly 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.
Marker based identification by computer vision

Proposer: dr. Csaba Belesznai, AIT Austria

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Project 3: Marker based identification - Aim

• Elaborate a visual tag encoding 1..N identities

• Try to push the limits of visual perception when designing the tag: possibly large distance, rotational invariance, low computational cost

• Think of including some kind of redundancy (error correction code) to make visual readout reliable

• Print and test your marker based identification system on photos and even with live camera feed (if time permits)
Project 3: Marker based identification - Remark

• Do not re-implement existing concepts (bar code, QR code), but come up with original designs/ideas.

• Analyze your tag concept, why you think it has advantages.

• Try to find its weak aspects, as well.
Project 4: Identify Pneumotorax disease in chest x-rays

Proposer: prof. Ernst Schwarz, Medical University of Vienna, Austria
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Project 4: Identify Pneumotorax disease - Aim

• Develop a model to classify (and if present, segment) pneumothorax from a set of chest radiographic images

• Description and Data: https://www.kaggle.com/c/siim-acr-pneumothorax-segmentation/
Project 5: Scanned pages contour detection

Proposer: dr. Flavia Micota, West University of Timișoara
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Project 5: Scanned pages - Aim

• Input: nonprofessional scanned book pages
• Output: the scanned pages without free space

• The input data are PDF files that contain scanned pages from books. The problem is the scan quality, i.e. there is a lot of “free space” around the actual book. The main requirement is to remove the extra space around pages and transform the pages such that they contain only the scanned page.
Pe urmele lui Gherasim, primul traducător de limbă franceză

Ioana Bălăzăs

Cine este Gherasim? Gherasim a fost unul dintre cei mai cunoscuți și admirati traducători de literatură franceză în România. A fost unul dintre cei mai importanți traducători din istoria literaturii franceze. Atras prin inteligență și pasiune, a avut o carieră impresionantă, contribuind la traducerea în limba română a unor texte de mare valoare literară. De fapt, a fost primul traducător de limbă franceză din istoria literaturii române.

Roma Bălăzăs

Cine este Gherasim? Gherasim a fost unul dintre cei mai cunoscuți și admirati traducători de literatură franceză în România. A fost unul dintre cei mai importanți traducători din istoria literaturii franceze. Atras prin inteligență și pasiune, a avut o carieră impresionantă, contribuind la traducerea în limba română a unor texte de mare valoare literară. De fapt, a fost primul traducător de limbă franceză din istoria literaturii române.
Project 6: Classify gastro-intestinal lesions

Proposer: assoc. prof. Darian Onchis, West University of Timișoara

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Project 6: Classify gastro-intestinal lesions - Aim

• Given the following public colonoscopic dataset:
  http://www.depeca.uah.es/colonoscopy_dataset/

• Try to design an image processing system that is able to classify gastrointestinal lesions at least with the accuracy of a human beginnner.

• More informations could be found in the following paper:

Project 7: Topology-based descriptor for textural recognition

Proposer: prof. Pedro Real, Universidad de Sevilla, Spain

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Project 7: Topology-based descriptor - Aim

• Elaborate a descriptor for n-dimensional biomedical images, exclusively based on topological ideas and which could be of interest in textural recognition. Analyze this descriptor using the open-source visualization software Slicer 3D (https://www.slicer.org/) in a public database of biomedical images. (Previous knowledge of Python or Matlab required for programming).

• Topology-based ideas means here ideas exclusively involving relations (or counting of them) between objects (n-xels, regions,...), without employing notions coming from calculus, algebra or (differential) geometry. In other words, the project moves on the fields of Topology and Statistics.
Project 7: Topology-based descriptor - Aim

• These descriptors could be numbers, vector, matrices or weighted or unweighted trees or particular graphs.

• Examples: Euler-Poincaré characteristic, Adjacency Tree for a binary nD digital images, histogram of connected components of constant grey-level, fractal dimension, topological Local Binary Patterns (topological LBPs), Region-Adjacency-Graphs,...
Project 8: Detect Human Hands in Images

Proposer: prof. Vasile Gui, Politehnica University of Timișoara & Everseen, Romania

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Project 8: Detect Human Hands in Images

Database: Open Images Dataset V5:
• https://storage.googleapis.com/openimages/web/factsfigures.html

Context
• Hand detection is a major component in many computer vision applications like human – computer communication or activity recognition.

Requirements
• Detection involves recognition of the hand and localization (at bounding box level). Multiple hand instances may be present and need to be detected in the image. Evaluate detection performance.
Project 9: Binary Tomography

Proposer: prof. Tibor Lukic, University of Novi Sad, Serbia
tibor@uns.ac.rs
Project 9: Binary Tomography

- Calculate projections of binary images in few directions (MATLAB, ImageJ: Radon transform)
- Try to reconstruct the original image from the projections (can be solved by optimization)
- Improve reconstruction quality by using prior knowledge: binary values, homogeneity, structural information (Discrete Tomography)
- More challenges: noisy projection data
Project 10: Lesion Segmentation using Unsupervised Techniques

Proposer: prof. Debora Gil, Computer Vision Center, Spain
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dr. Carles Sanchez, Computer Vision Center, Spain
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Project 10: Lesion Segmentation using Unsupervised Techniques

- This project should address the development of a strategy for the segmentation of pulmonary lesions in CT scans. The project should include a comparison between Otsu intensity thresholding and k-means over feature space with a discussion about advantages and disadvantages of each approach:
  - Influence of pre and post processing.
  - Discussion on how to fix parameters
  - Perform qualitative (visual) and quantitative statistical analysis
  - Finally, students should propose a strategy for pulmonary lesion segmentation based on the previous analysis.

- Data: https://drive.google.com/drive/folders/1ArbLoxyYWwq07IZuerXrA8YysAlZQJXv?usp=sharing
Project 11: ROI localisation in knee MRI scans

Proposer: prof. Ivan Stajduhar, University of Rijeka, Croatia

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Project 11: ROI localisation in knee MRI scans

• Data
  • MRI exams of a knee (3D)
  • Focus on the cruciate ligament region
  • Manually segmented rectangular regions of interest

• Goal
  • Develop a ROI localisation engine
Project 11: ROI localisation in knee MRI scans

- Method
  - Use supervised learning

- Labels
  - roiX, roiY, roiZ, roiHeight, roiWidth, roiDepth

- Regions loosely bound (error)
Project 11: ROI localisation in knee MRI scans

• The dataset is given at the following URL: http://www.riteh.uniri.hr/~istajduh/projects/kneeMRI/. The knee MR volumes are saved as Python pickle objects for easy access.

• Manually-assigned labellings for the ROI enveloping a larger cruciate ligament area are given in a csv file.
Project 11: ROI localisation in knee MRI scans

• There are several tasks and questions to ponder on (point ordering is not strict, as there are some points that need to be considered simultaneously):
  • Try to visualise individual scans and their ROIs.
  • What would be an adequate measure of ROI-locator model performance?
  • How would you make your model-performance estimates unbiased?
  • Is this a regression or a classification problem?
  • Feel free to explore different supervised learning techniques.
  • Can you improve model performance by choosing different hyperparameters?
  • What happens to bias and variance when using more/less complex models?
Project 11: ROI localisation in knee MRI scans

- By selecting a model representation, learning technique and hyperparameter set by trial and error, are you still keeping the experiment unbiased?
- How would you assess if the most promising technique would benefit from more data?
- Is there a benefit to mirroring left knee representations so they resemble right knees (or vice-versa)?
- How do you deal with the noise in the inputs (images)? How do you deal with the noise in the outputs (ROI labels)?
- Can you boost model performance by applying prior data-preprocessing techniques (noise filtering or hand-crafted feature extraction)?
- If you were to compare two complete approaches on this dataset statistically, what would be the adequate test(s)? What about comparing five complete approaches?
Project 12: Smile!

Proposer: prof. Attila Fazekas, University of Debrecen, Hungary

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Project 12: Smile!

- Design a software tool that takes a photo, only when everyone smiles in front of the camera.

- **Minimum requirement**: The program reads an image with up to 5 people's faces visible to the camera in front of a diverse background. The program detects faces and determines the number of smiling faces.

- If everyone smiles, give a special "message".

- **Advanced solution**: Control a webcam to take a real-life still images, if everyone smiles.

- Building a database of required photos is part of the task.
Project 13: “Read the Text”

Proposer: Slavoljub Mijovic

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Project 13: Read the text

• Choose appropriate methods of the image deblurring and analyze their strengths and limitations.

• First, the students will try their own methods and then will be provided with blurred matrices to try

• Different deconvolution techniques should be analyzed and ways how to compare obtained solutions should be found

• At least, the students will be able to read the blurred text.
Project 14: “Land Cover classification”

Proposer: Gabriel Iuhasz, West University of Timisoara
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Marian, West University of Timisoara
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Project 14: Land Cover classification

• Motivation: increased volume of satellite data -> sustainable development, autonomous agriculture, and urban planning

• Online competitions featuring remote sensing data:
  • http://deepglobe.org/challenge.html
  • https://www.kaggle.com/c/dstl-satellite-imagery-feature-detection
  • https://spacenetchallenge.github.io/

• Semantic segmentation to identify different land cover regions: agriculture, urban, forest etc.

• Dataset: https://land.copernicus.eu/pan-european/corine-land-cover
Project 15: “Deforestation”

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Project 15: Deforestation

• Motivation: illegal deforestation
• Online competitions featuring remote sensing data:
  • https://www.kaggle.com/c/planet-understanding-the-amazon-from-space
• Semantic segmentation to identify forest areas + identify deforestation zones
• Dataset – extract forest classes from https://land.copernicus.eu/pan-european/corine-land-cover
Project 16: “Sponsor’s proposal”
Proposer: Here
octavian.borcan@here.com
Project 16: Sponsor’s proposal

- Motivation: Here technologies offers free location based APIs for
  - Web app
  - Mobile app
- Come with your OWN idea for an application using Here’s location API:
Your options 😊

Mark the three project in order of your preferences using the form at:

https://forms.gle/k3Fdi4rAnniRPZm7A