AIL 862

Lecture 1

Course Content

Since this is first offering of this course, final content may vary depending on the pace.

Course Content

An image analysis course

With more focus on recent developments (e.g., foundation models).

And focus on applications (e.g., in Earth observation).

Pre-requisite

No pre prerequisite regarding any image analysis/computer course.

However, it is important to be moderately comfortable with Python (especially for the assignments).

Assignment brief instruction

Use Python + PyTorch unless otherwise instructed.

Course Content

- Introduction to course, introduction to image analysis, a brief introduction to EO as well

- Different architectures for classification, semantic segmentation, target detection and different learning paradigms

See next page

Course Content (contd.)

- ViT and variants, DINO, MAE, CLIP etc.
- Semantic segmentation (excluding SAM)
- Segment Anything and variants
- Efficient tuning like prompt tuning, task arithmetic
- Domain adaptation
- Diffusion and generative models

Evaluation

- Assignment – 40 (How many? Team?)
- Paper reading/presentation – 15
- Minor – 15
- Major – 30

Audit

- 40
- Attending all exams is not compulsory for audit
- For audit, 75% attendance is mandatory

TA

Not yet decided

Course Material Sharing

- On Moodle

Image

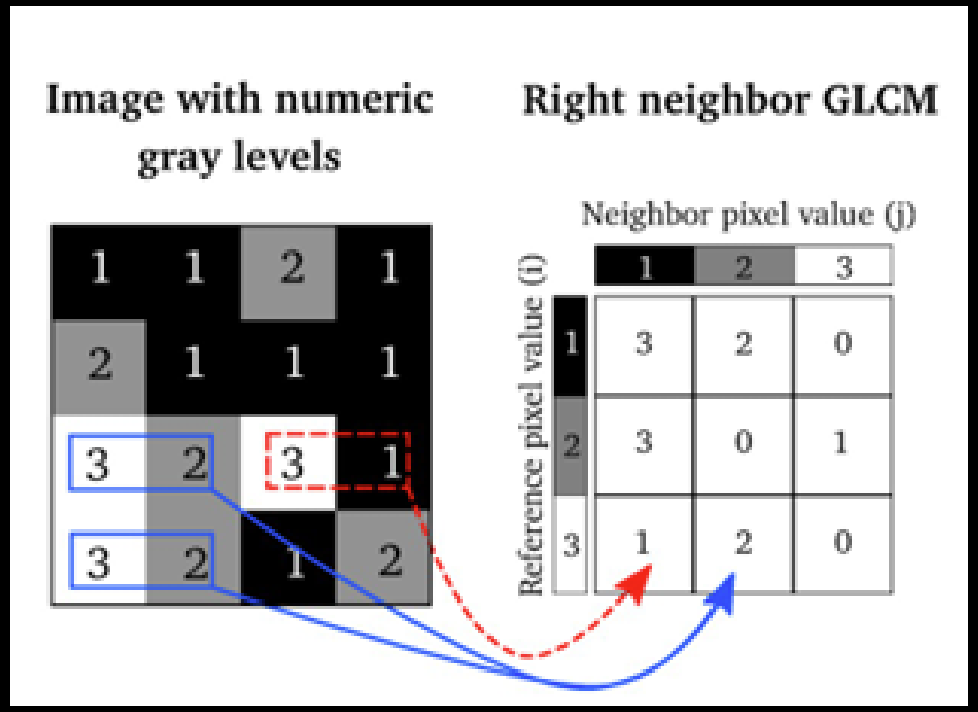
- How to define?

Color

Texture

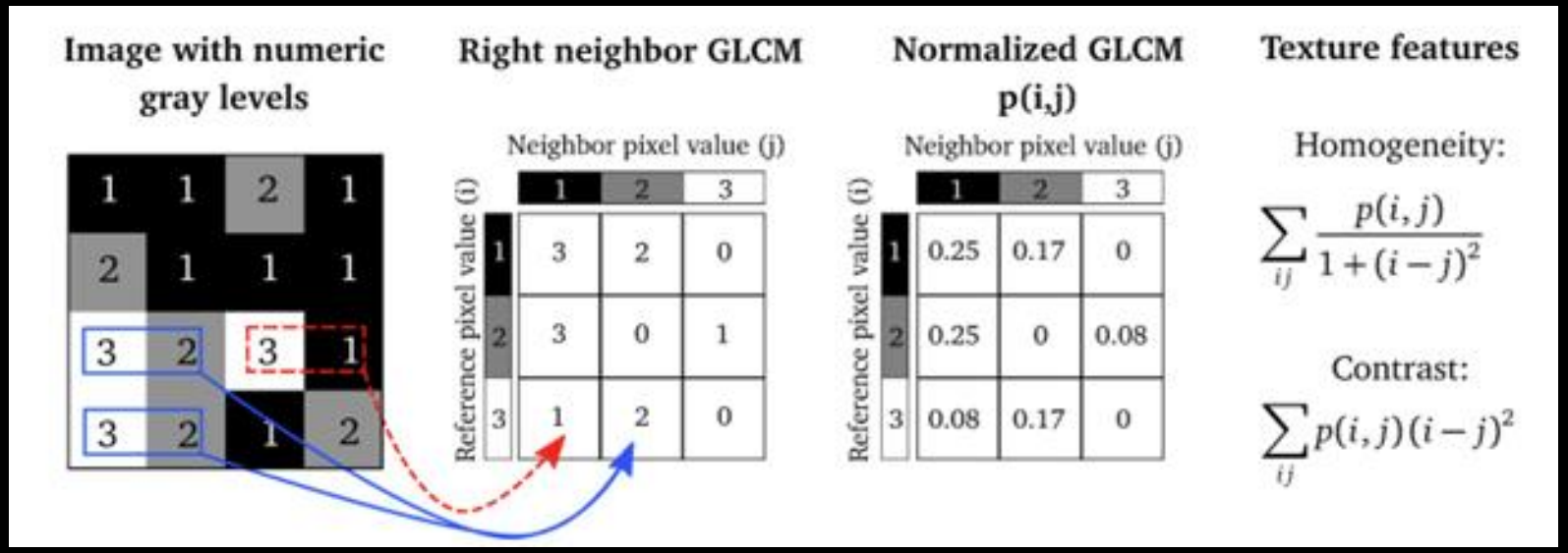
Image partly adopted from Jia-Bin Huang, Virginia Tech

Texture



Gray-level invariant Haralick texture features, Lofstedt et al.

Texture



Gray-level invariant Haralick texture features, Lofstedt et al.

Edge

Image partly adopted from Jia-Bin Huang, Virginia Tech

Is Edge Useful

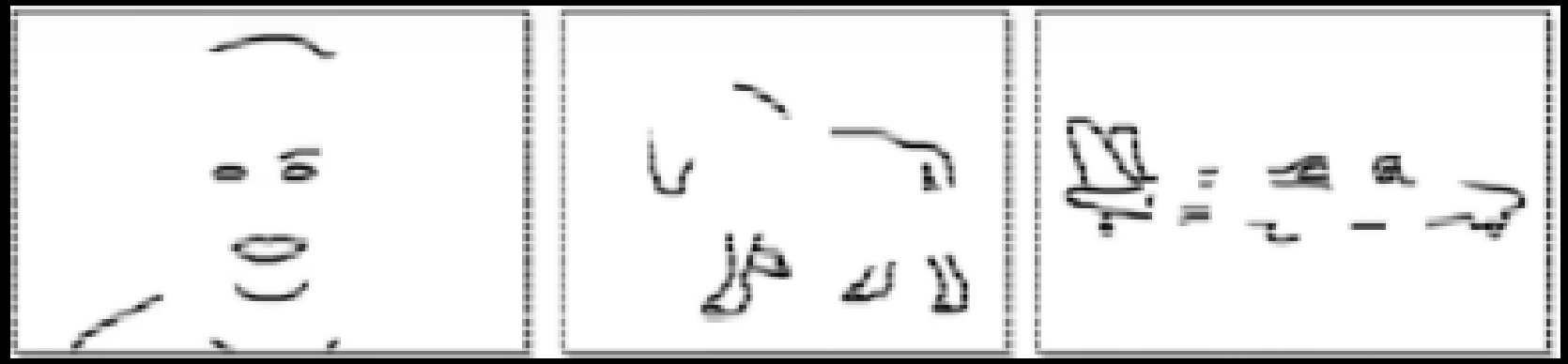
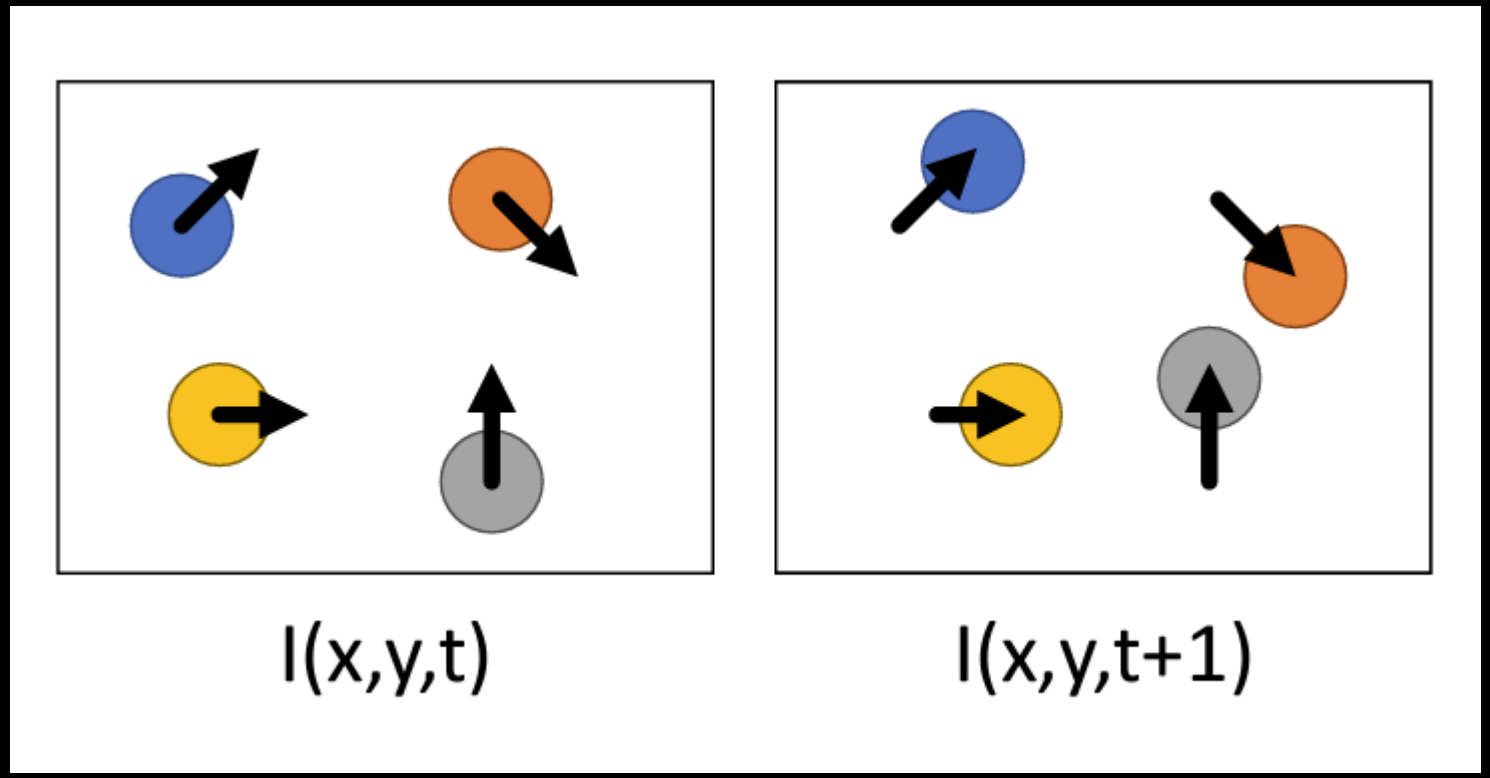


Image adopted from lecture of Vineeth Balasubramanian, IIT Hyd

Time



Example of an application area

Earth Observation

- Plethora of image sensors-satellite/ aerial/ UAV/ street-view
- Different types of sensors – passive / active
- Many applications

Earth Observation: Environmental Monitoring

- Forestry
- Urban Area
- Vegetation
- Sea and rivers
- Glaciers

Earth Observation: Forestry

- Species classification
- Deforestation detection
- Biomass detection
- Insect infection detection

Earth Observation: Infrastructure Monitoring

- Monitoring urban sprawl, informal settlements
- Post-disaster monitoring
- Solar panel detection
- Investment management of financial institutes

Passive Sensor Image

Active Sensor Image

Let’s go back to edge detection

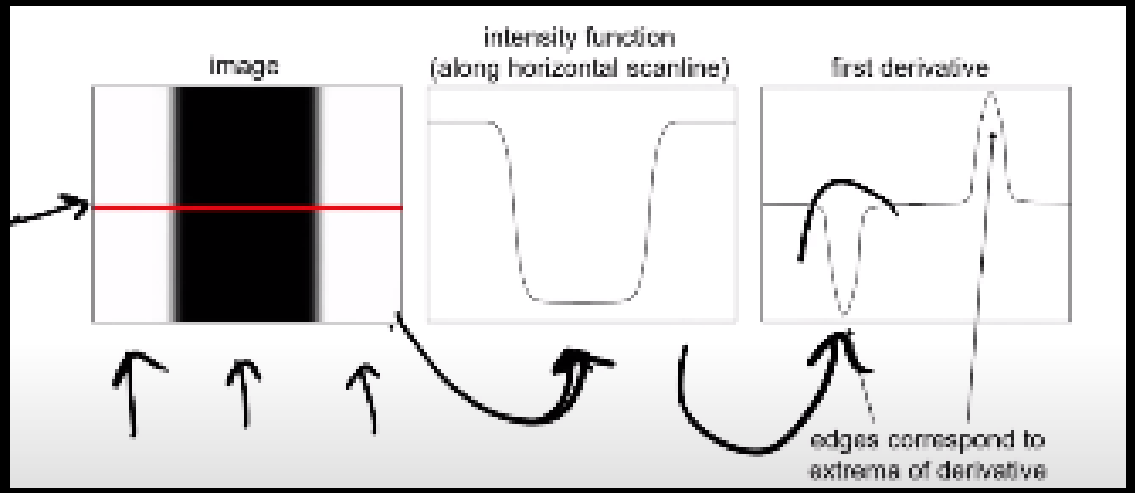


Image adopted from lecture of Vineeth Balasubramanian, IIT Hyd

Sobel Operator

$$\begin{bmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix} \qquad \begin{bmatrix} 1 & 2 & 1 \\ 0 & 0 & 0 \\ -1 & -2 & -1 \end{bmatrix}$$