COMP2005 - IIP
Introduction to Image Processing

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COMP2005

- **Lectures**
  - Fridays 10:00 - 11:00 - Exchange LT1
  - Fridays 15:0 - 16:00 - Exchange C03

- **Lab**
  - Tuesdays 17:00 - 18:00 – A32
  - **STARTING WEEK 2, 3^{6h} FEB**

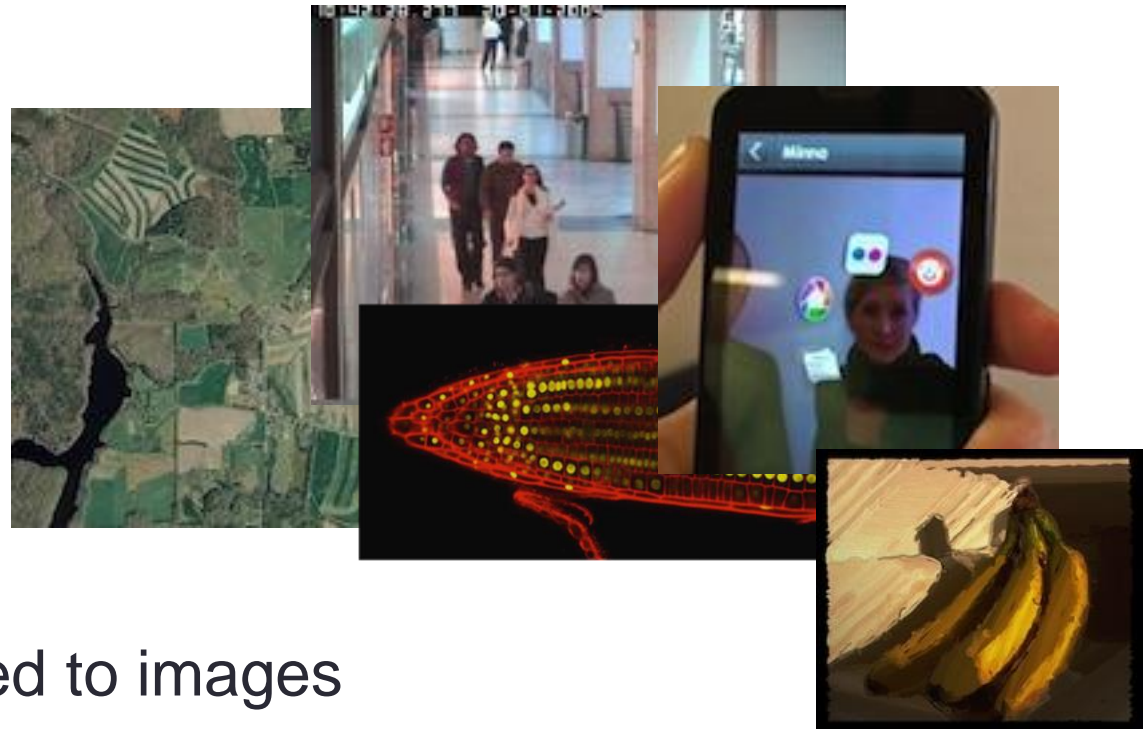armaghan.moemeni@nottingham.ac.uk

Dr Magan Moemeni

What is Image Processing?

- Collection of topics and techniques related to the use of computers to
  - Acquire
  - Store
  - **Manipulate**
 - **Model**
  - **Analyse/Interpret**
  - Display

digital images

- Generic techniques that are applied to images from most sources

Know Your Limitations

- Four terms are often used together, and some are sometimes confused
  - Image Processing
  - Image Analysis
  - Computer Vision
  - Computer Graphics
- All share representations, underlying mathematics and some algorithms
- Their goals are very different
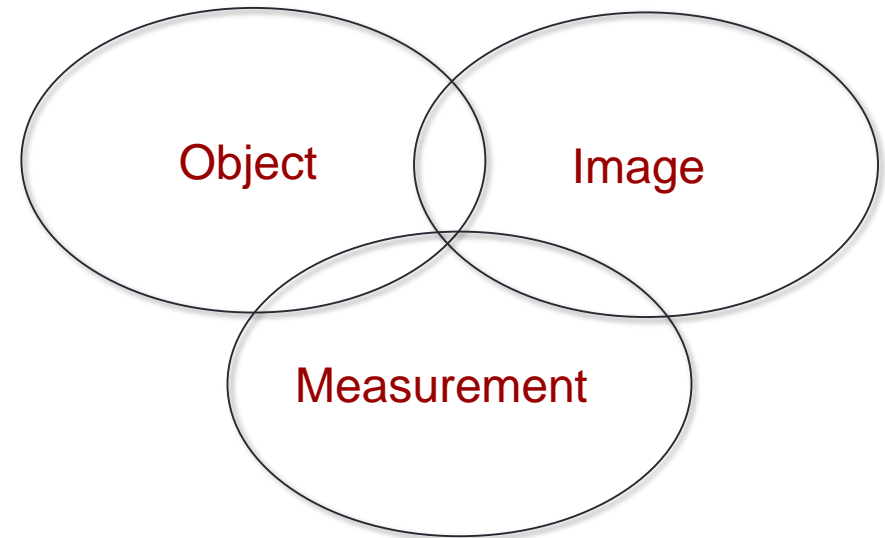
This is an Image Processing module, with some Image Analysis

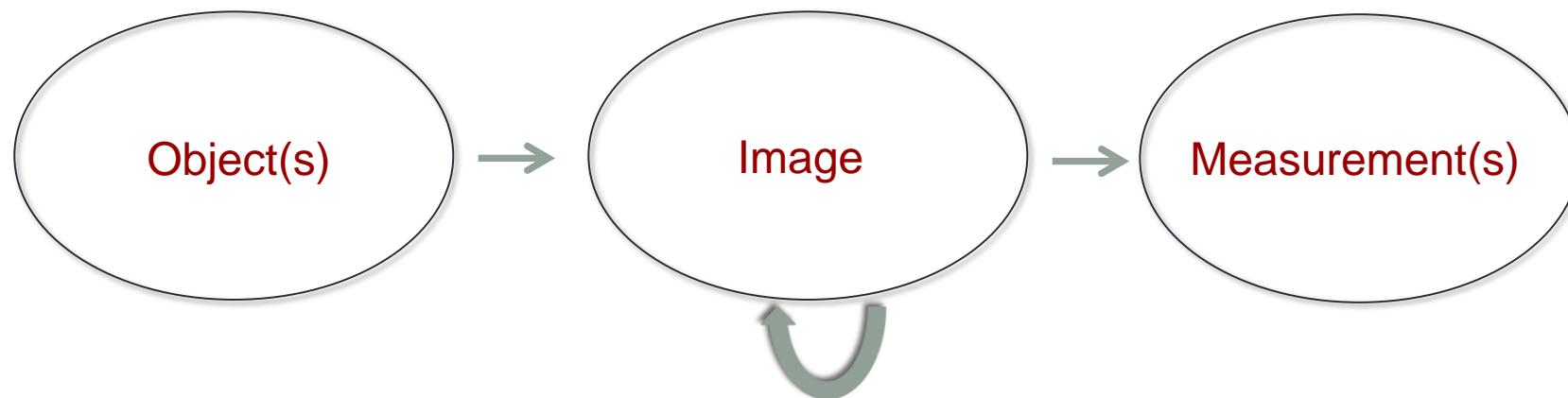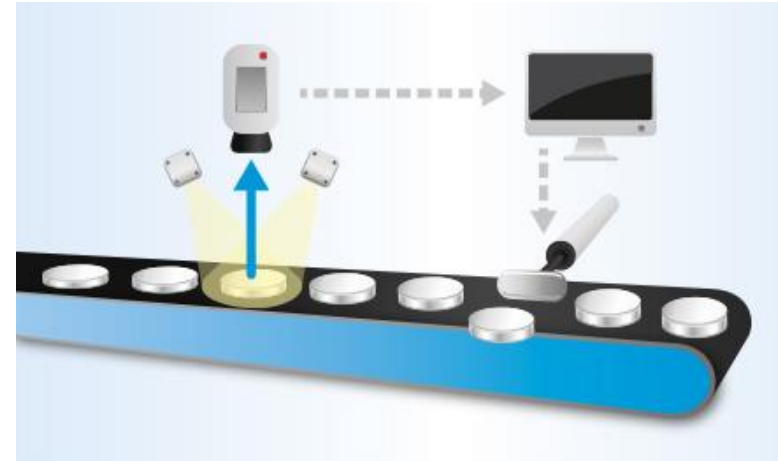Object   Image

Measurement

Image Processing

Object(s)
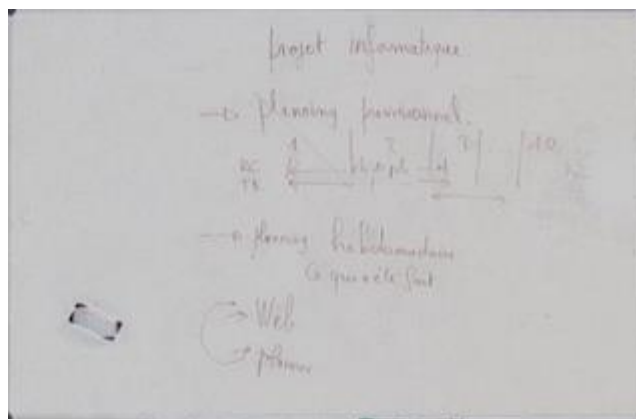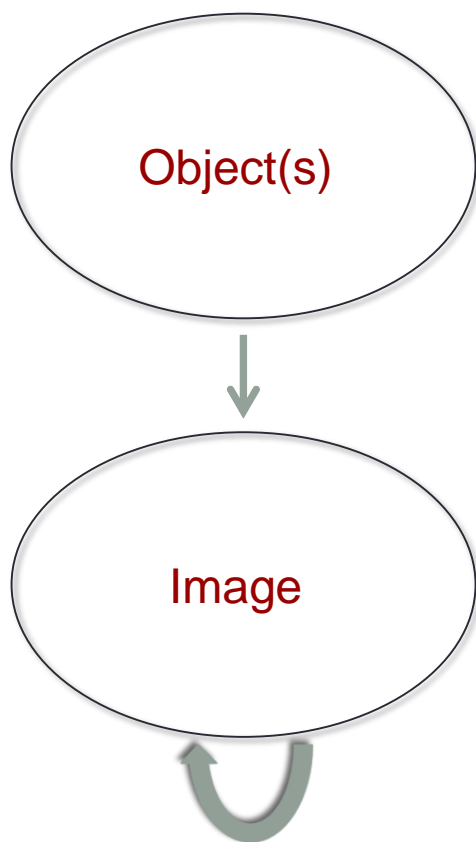
Image

- Image in, image out
- Key information more easily seen/extracted
- More aesthetically pleasing

Image Analysis

- Concerned with making quantitative measurements on images:
  - Image acquisition is constrained so that image measurements are a proxy for some real world value
  - Sits between image processing and computer vision

Object(s) → Image → Measurement(s)

It's not Computer Vision

- Aims to invert image formation & recover information about the viewed world: 3D shape, motion, identity…

Objects

Objects → Measurements
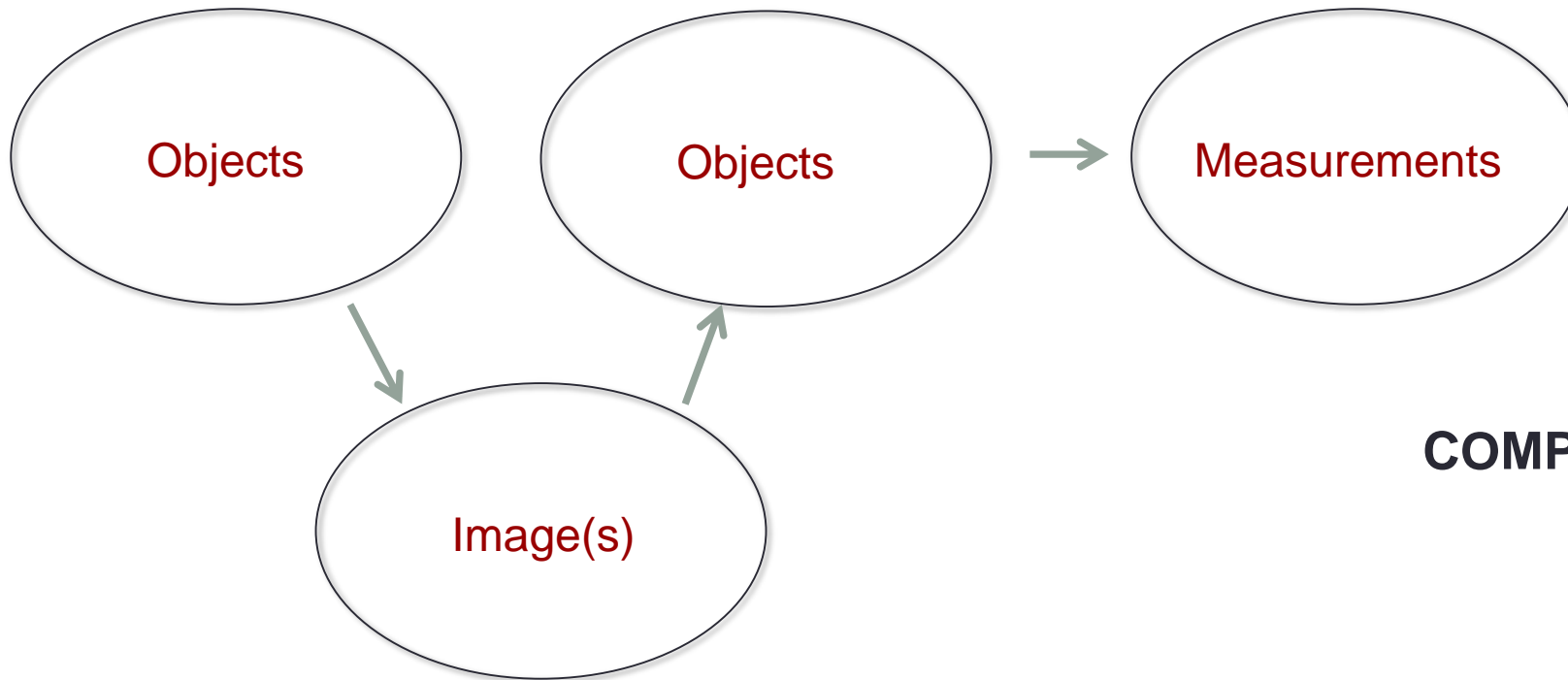
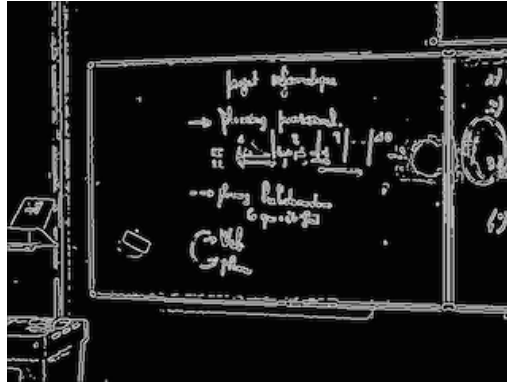Image(s)

COMP3007: Computer Vision

Its not Computer Graphics

- Focus is on creating images from object models:
  - Lighting and shading modeling
  - Volume modeling
  - Curve and surface modeling
  - Visibility modeling
  - Texture synthesis
  - Character animation
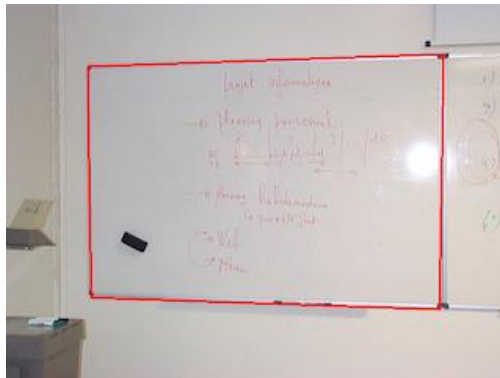 - Modeling terrain, liquids, fire/smoke, cloth, hair/fur, feathers, skin etc

THE MAKING OF
AVATAR
Jody Duncan and Lisa Fitzpatrick

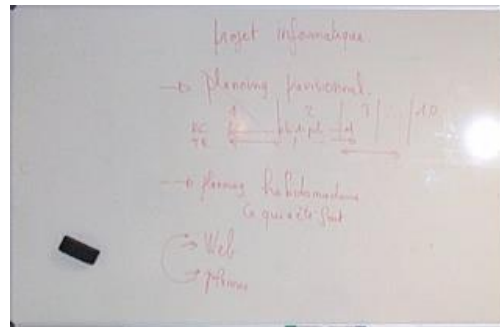**COMP3011: Computer Graphics**
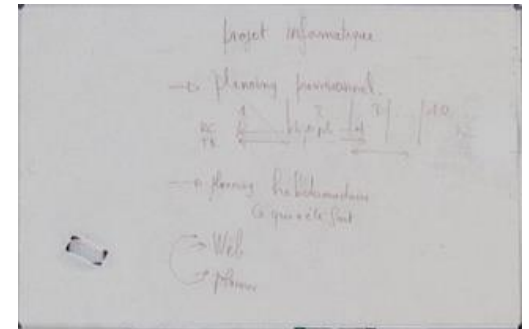
Its a toolkit

Edge detection


Line finding

Distortion correction

Illumination correction

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- To introduce the fundamentals of digital image processing - theory and practice.

- To gain practical experience in writing programs to manipulate digital images.

- To lay the foundation for studying advanced topics in related fields.

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- Image formation, acquisition, representing colour
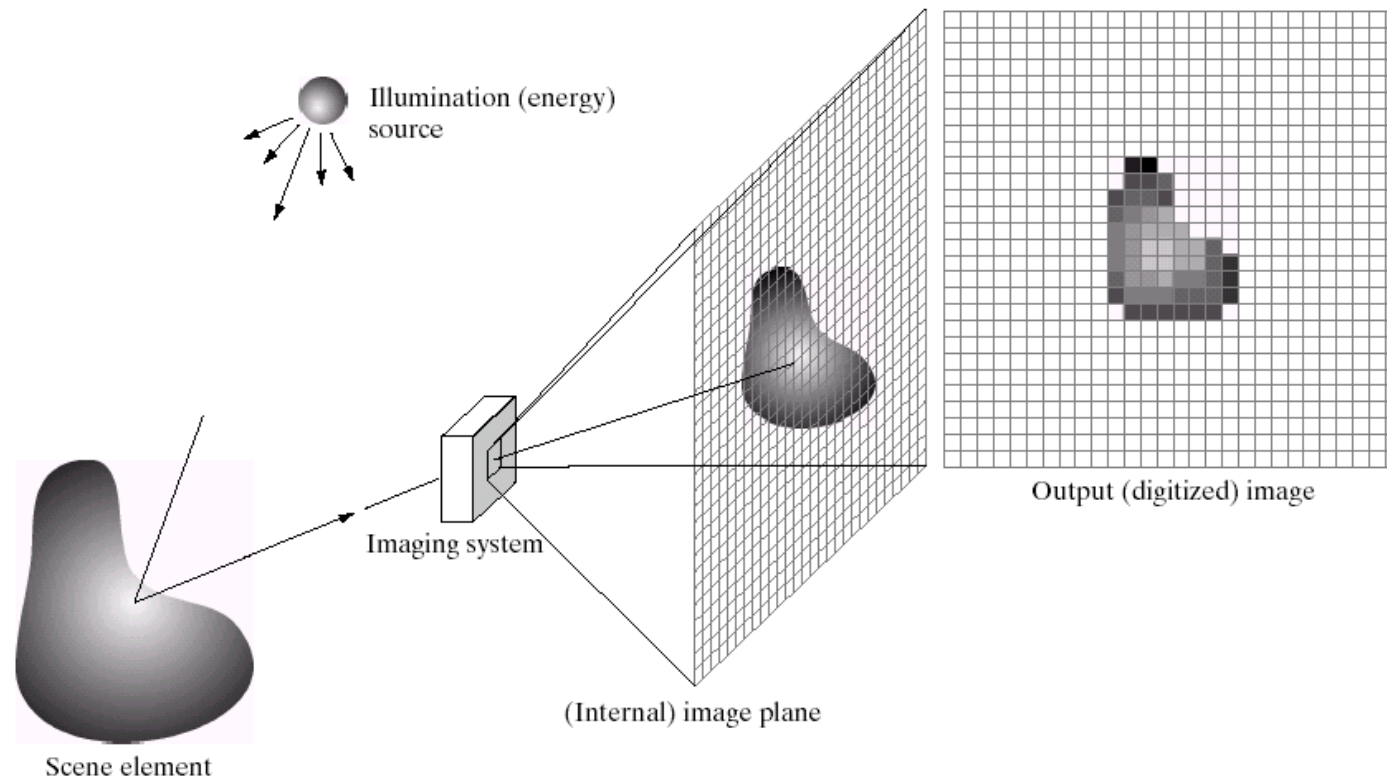
Digital Images

- A common, low-level representation of the viewed world

123 33 234 45
67 90 12 134 34
56 89 54 67 98
111 56 67 90 65
34 ....

Pixel values represent the brightness and colour of the viewed objects, but give no indication of what object, e.g., books, monitors, these numbers refer to – hence low-level

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- Redundancy & image compression – efficiently
represent image data for storage (minimise disk space) and communication (minimise network bandwidth)
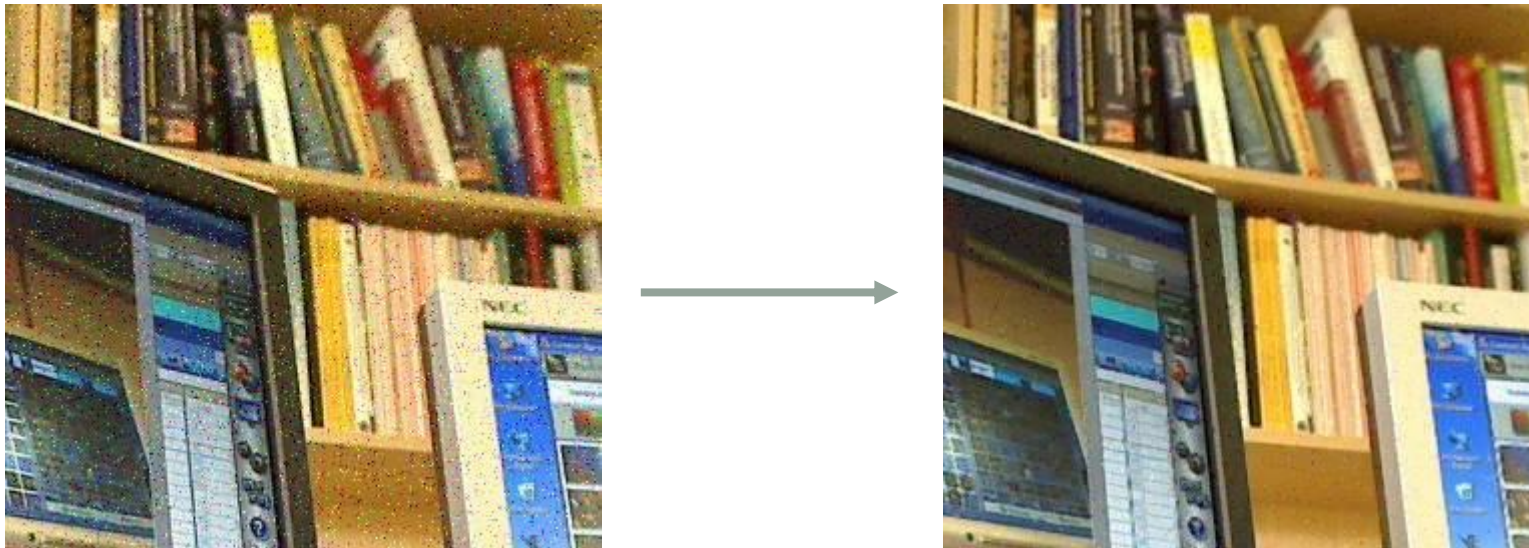

245,760 bytes   69,632 bytes   5,951 bytes
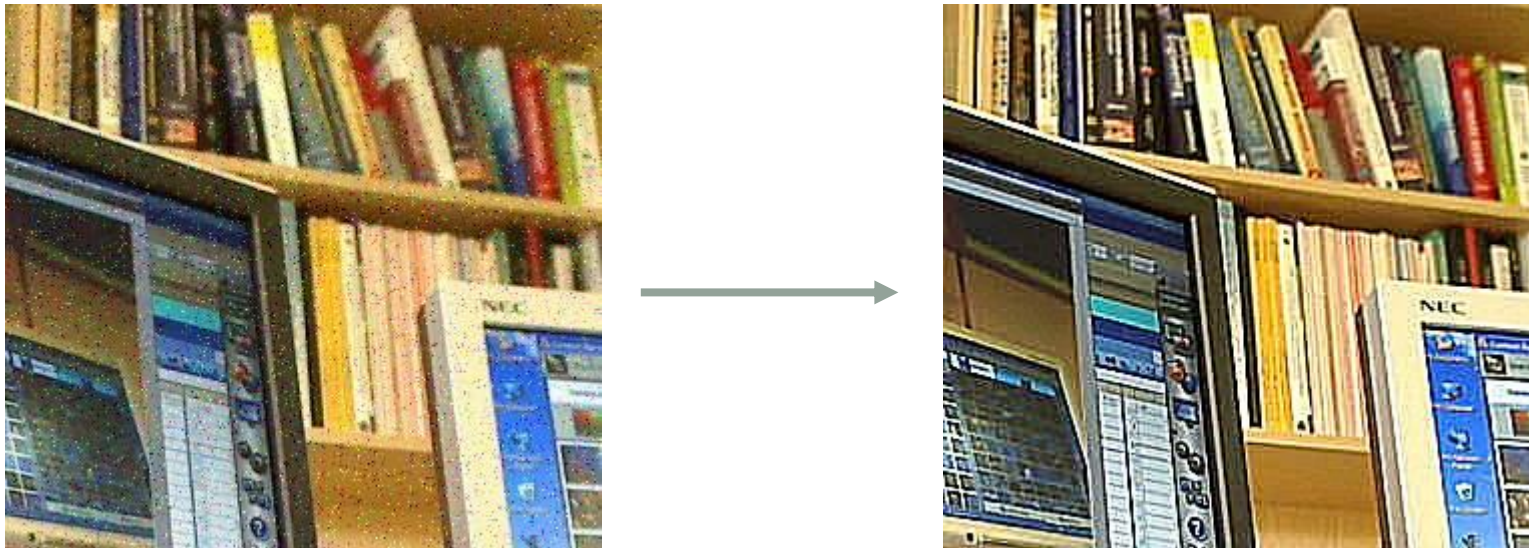
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- Image manipulation – noise removal, smoothing, contrast enhancement, etc.
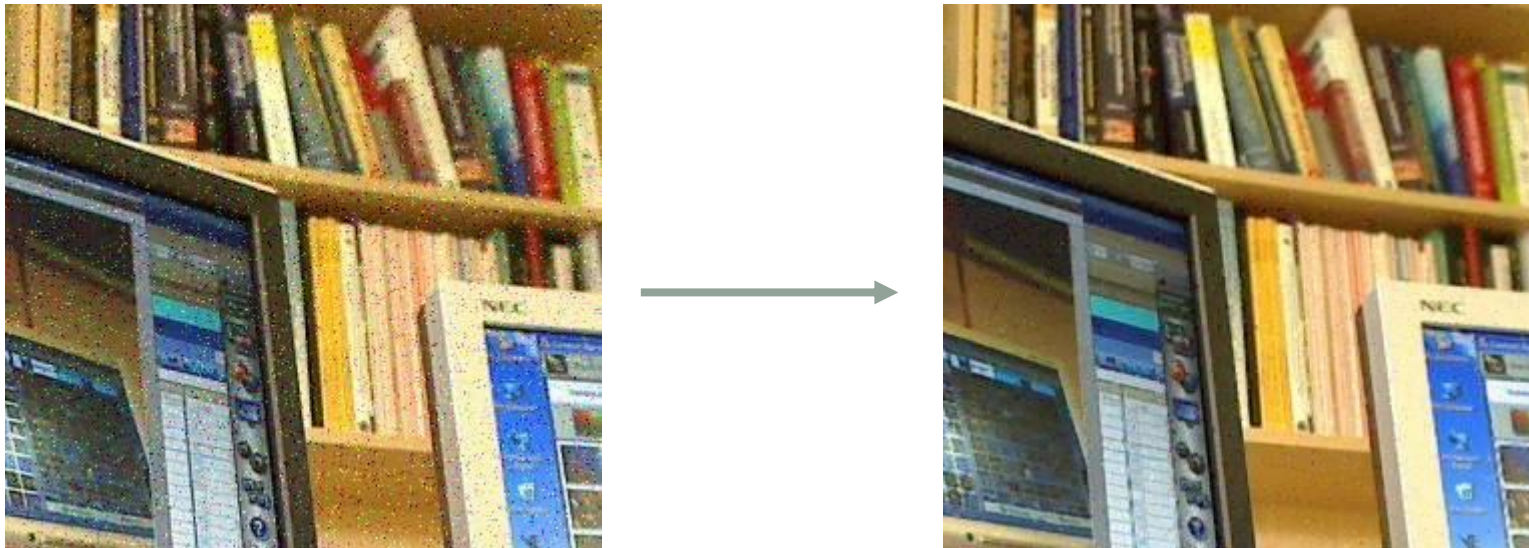

Noise reduction

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- Image manipulation – noise removal, smoothing, contrast enhancement, etc.
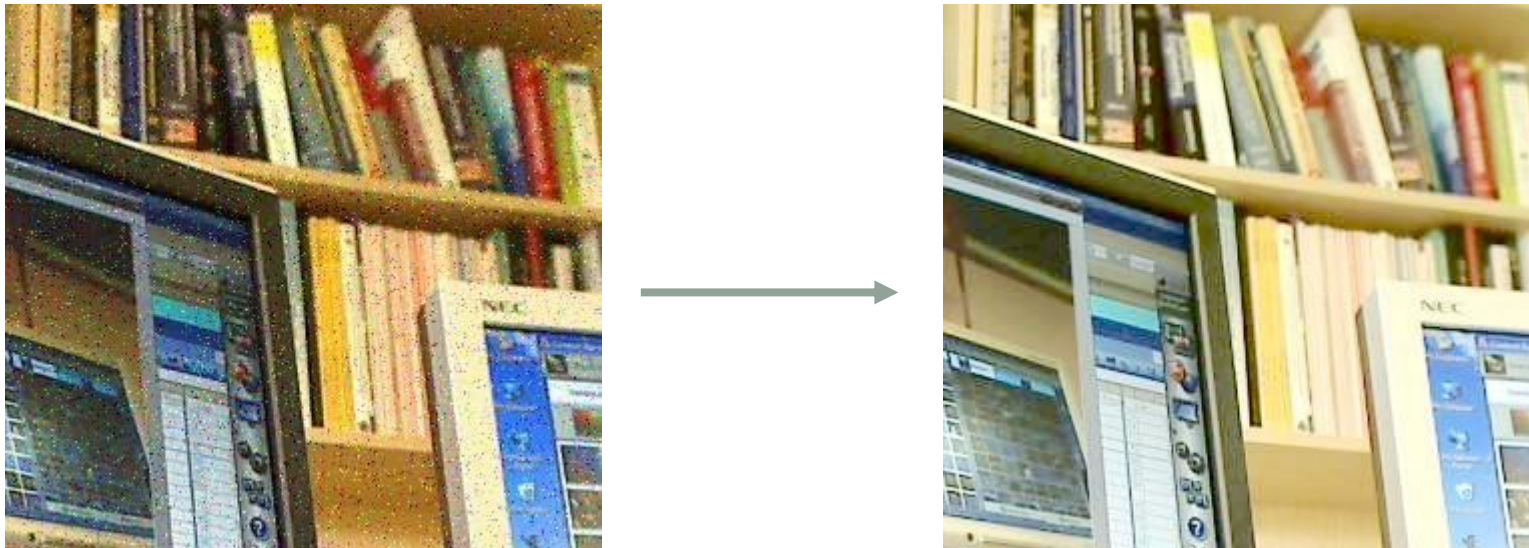

Sharpening

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- Image manipulation – noise removal, smoothing, contrast enhancement, etc.
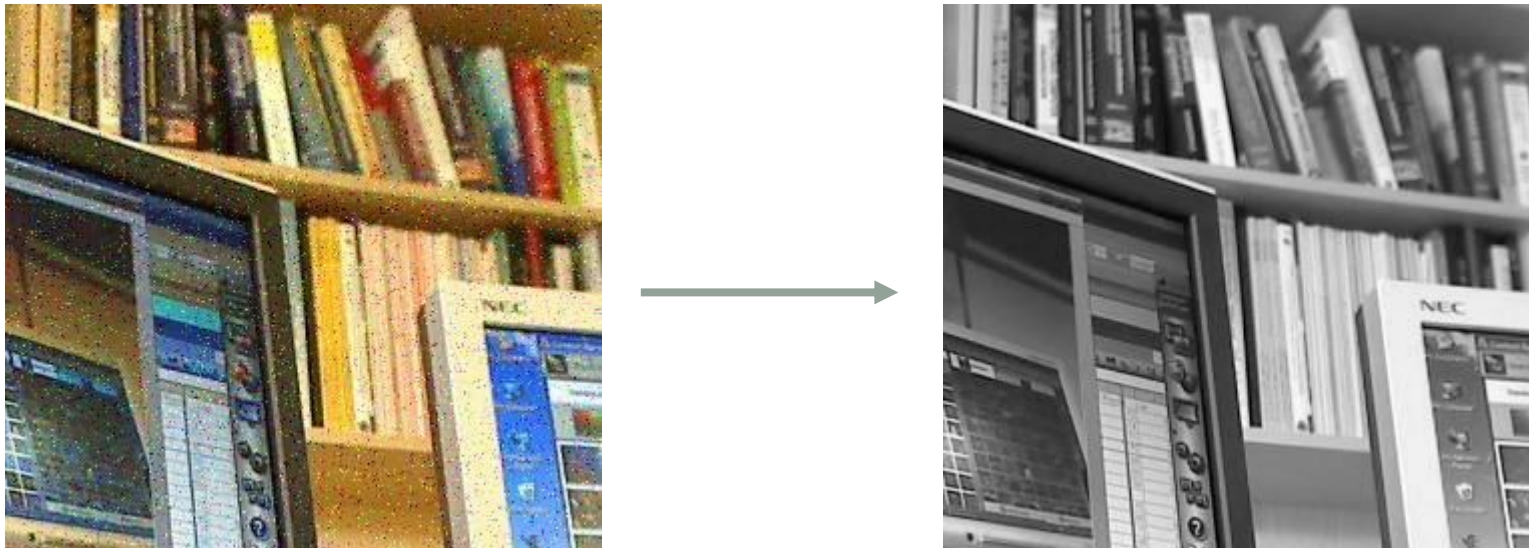

Smoothing

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- Image manipulation – noise removal, smoothing, contrast enhancement, etc.
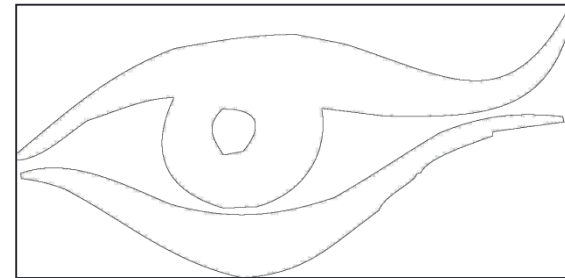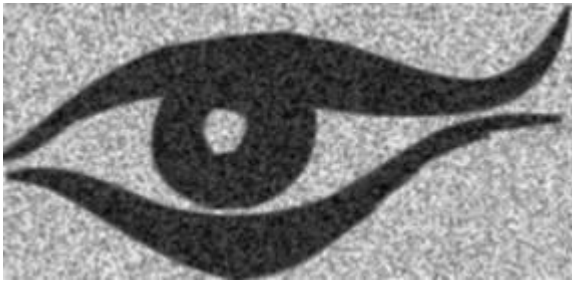

Contrast Enhancement

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- Image manipulation – noise removal, smoothing, contrast enhancement, etc.

Changing image appearance

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- Edge detection and image segmentation

- Underlying theory
- Some useful algorithms

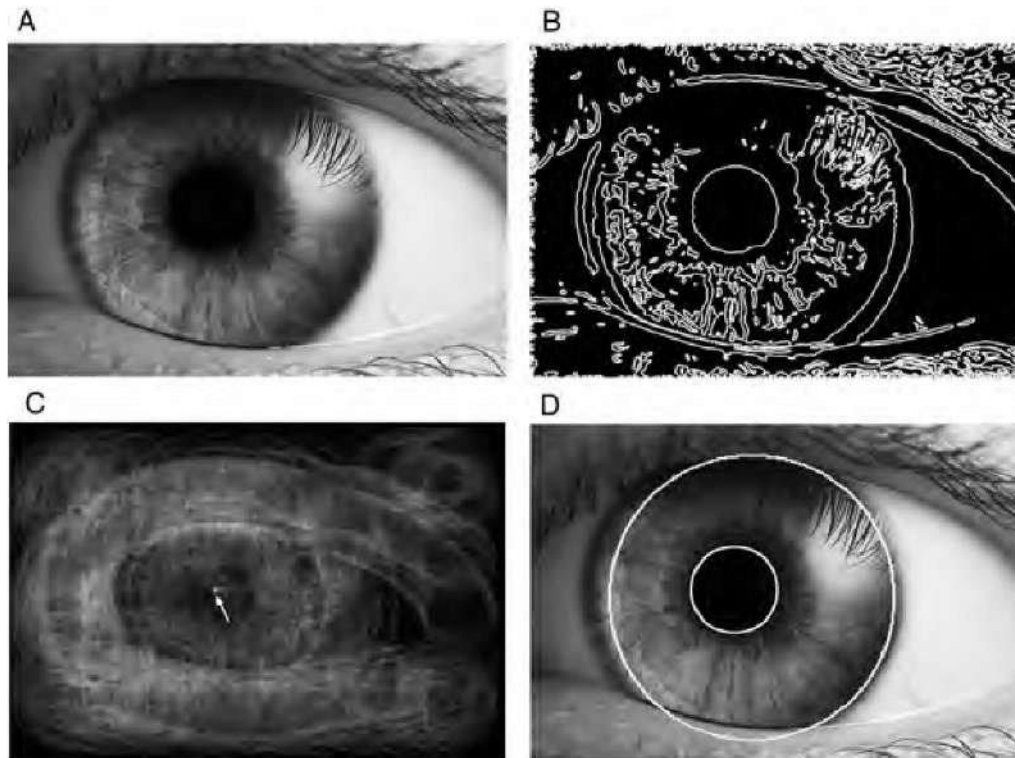A step towards image analysis & computer vision

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- Superpixels

- an increasingly popular intermediate representation
- fewer data points = less work

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- Finding geometric objects

The Hough Transform

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- **Focus** on spatial domain methods (operating directly on the image)
  - Point operations
  - Area operations

- **Overview** of frequency domain methods (One Lecture)
  - Compute the power spectrum of the image
  - Process the power spectrum
  - Reconstruct a new image from the modified power spectrum
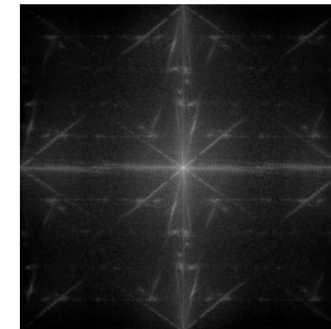
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- Geometric operations – manipulate the array structure underlying the image, not just the pixel values
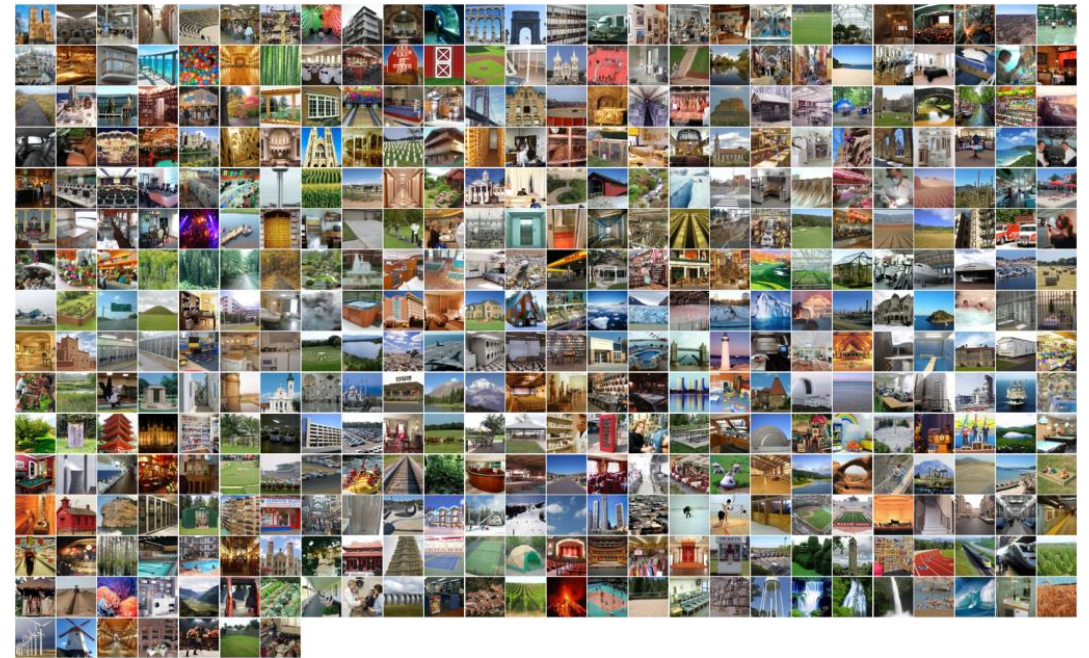

- Rotation, translation, scaling and affine transformations

Some Applications

- Content-based Image Retrieval

- Show me all the images
  like this…

in here →

Some Applications

- Painterly Rendering
  - Process images to give a painted feel
  - Aims to reproduce a particular artist or
    movement's style, e.g. Impressionism

Some Applications

- Interactive Tools & Compositing

Joe Marquette / AP file

COPM2005 - Assessment

- **Group Project**
  - Python application
  - Explanation & evaluation of results (report)
  - Presentation

Coursework

- 1 hour exam
  - Answer **ALL** questions

Exam