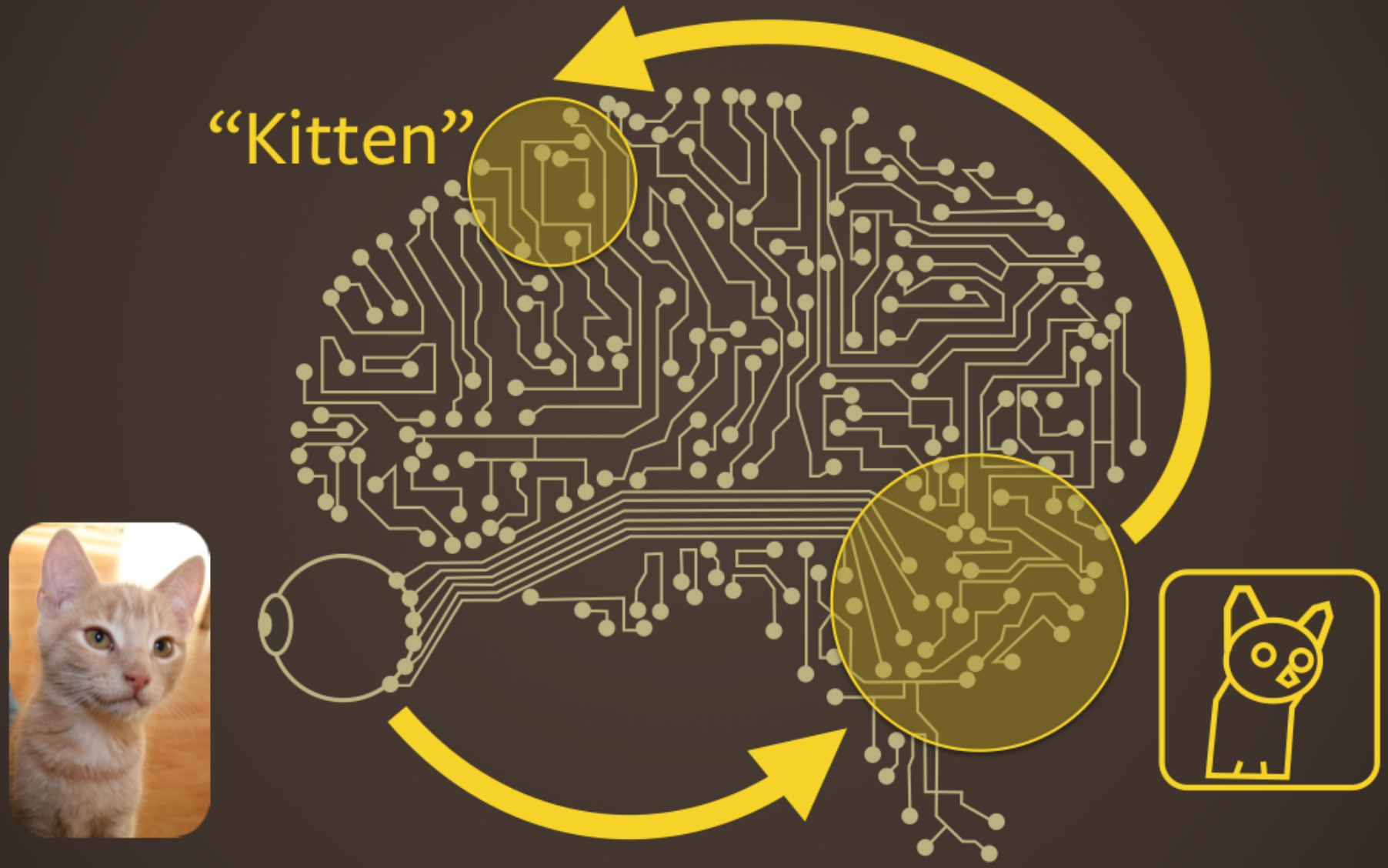
Introduction to Computer Vision

COMP3204 & COMP6223 2017/18



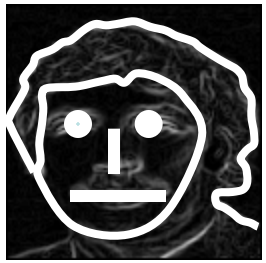
Mark Nixon and **Jonathon Hare**

Processing Scheme

Acquire image

Low-level processing

High-level processing



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What can image analysis achieve?

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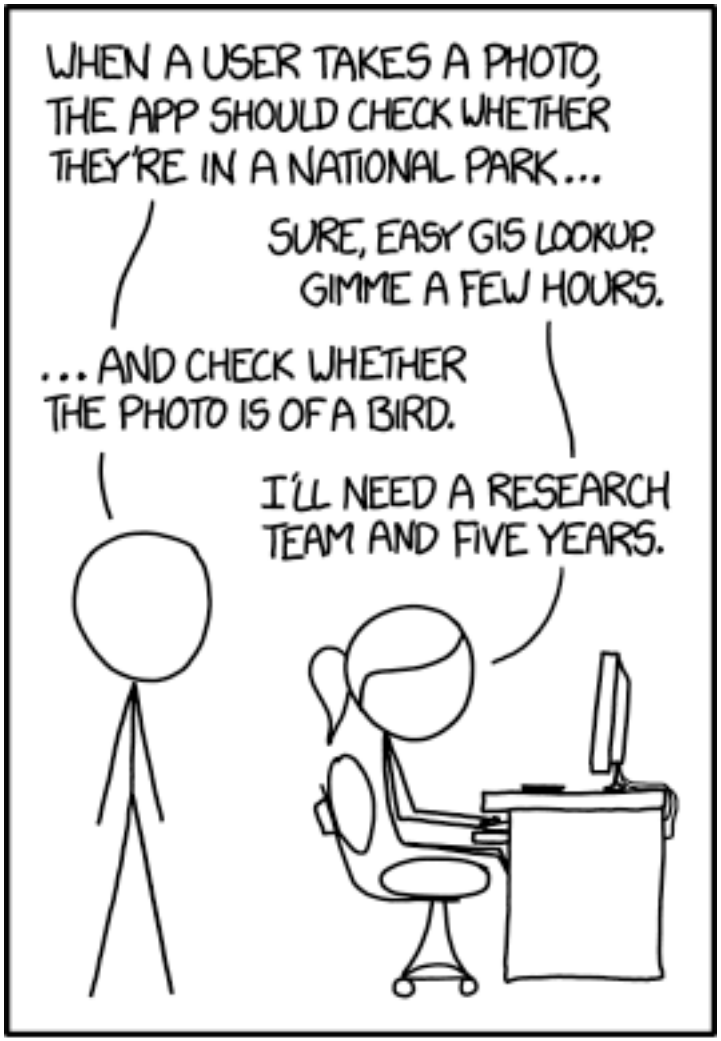

IN CS, IT CAN BE HARD TO EXPLAIN THE DIFFERENCE BETWEEN THE EASY AND THE VIRTUALLY IMPOSSIBLE.

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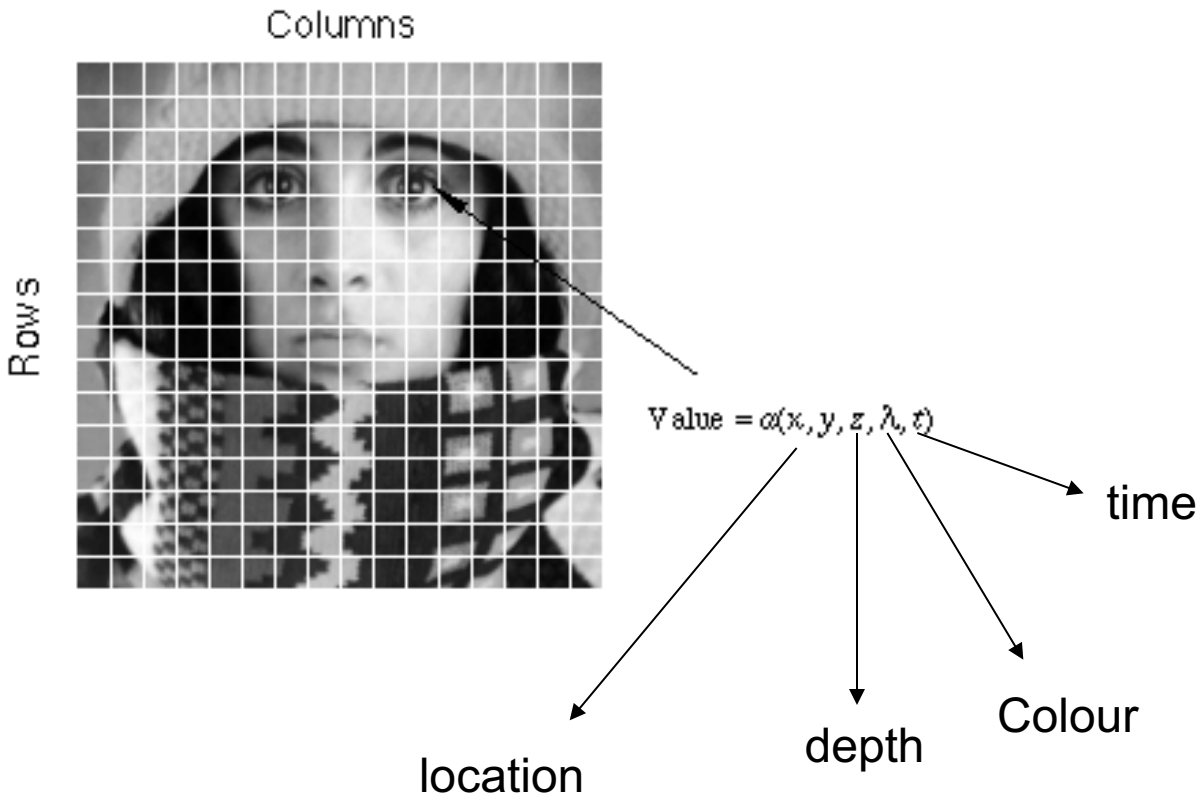
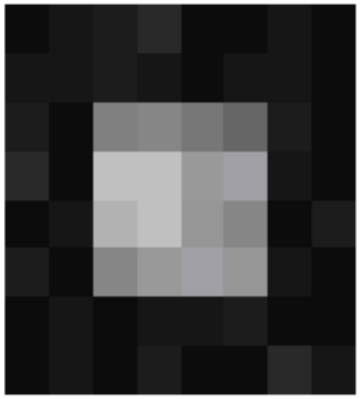
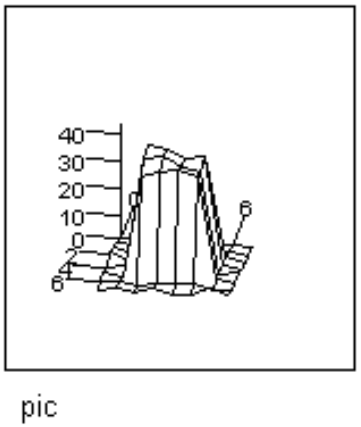
Images consist of picture elements known as "pixels"



2D Images are therefore matrices of numbers



Grey level image



3D view

$$pic := \begin{bmatrix} 1 & 2 & 3 & 4 & 1 & 1 & 2 & 1 \\ 2 & 2 & 3 & 2 & 1 & 2 & 2 & 1 \\ 3 & 1 & 38 & 39 & 37 & 36 & 3 & 1 \\ 4 & 1 & 45 & 44 & 41 & 42 & 2 & 1 \\ 1 & 2 & 43 & 44 & 40 & 39 & 1 & 3 \\ 2 & 1 & 39 & 41 & 42 & 40 & 2 & 1 \\ 1 & 2 & 1 & 2 & 2 & 3 & 1 & 1 \\ 1 & 2 & 1 & 3 & 1 & 1 & 4 & 2 \end{bmatrix}$$

Corresponding Matrix

Pixel

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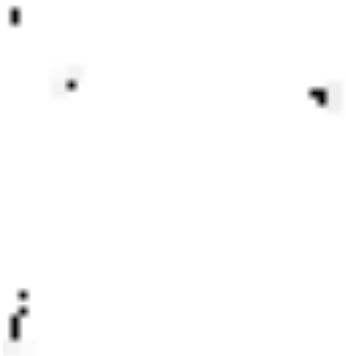
Point Operations

Recalculate point values



Modify brightness

Find Intensity

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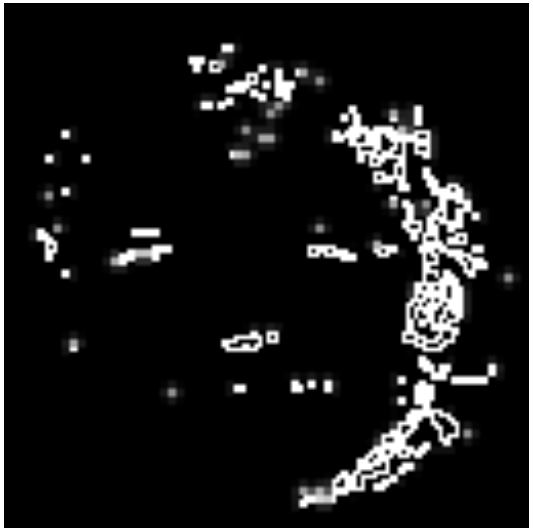
Group Operations

Process neighborhoods

Image Filtering



Edge Detection

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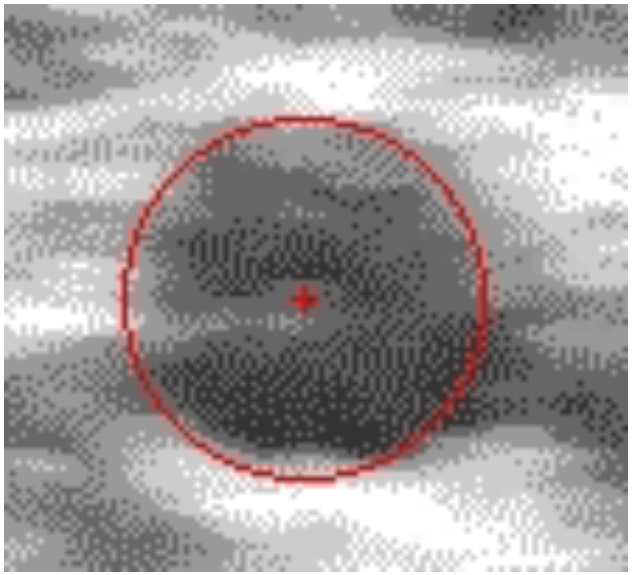
Feature Extraction

Finds shapes

Roads in remotely-sensed image



Artery in ultrasound image

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Applications of Image Processing/Vision

- ☆ Image Coding (MPEG/JPEG)
- ☆ Product Inspection
- ☆ Robotics
- ☆ Modern Cameras
- ☆ Medical imaging
- ☆ Demography (applied politics?)
- ☆ Biometrics (recognising people)

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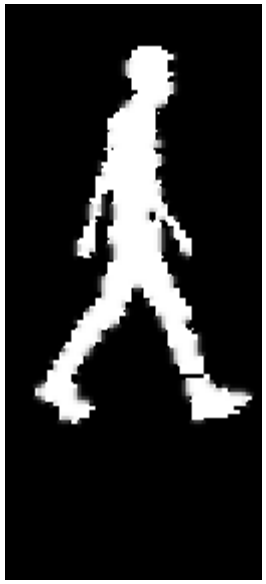
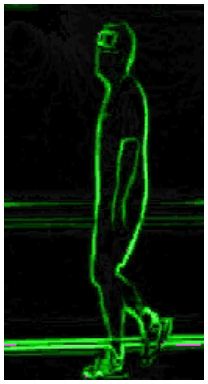
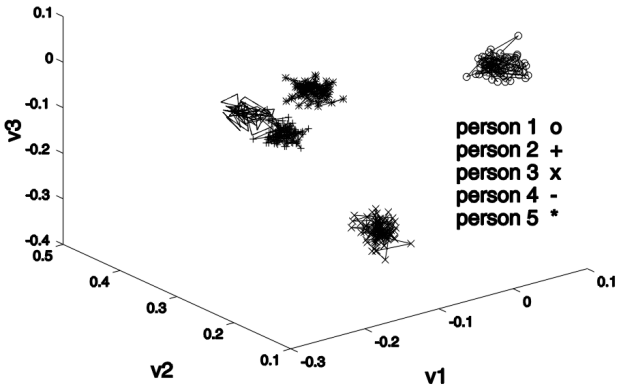
Statistical Gait Recognition

Recognising people from the motion of the whole body







Silhouette Flow Edges Symmetry Feature Space

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Gait Recognition

- natural walking (well….)

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Ear biometrics

- Person identification from ear image
- Uniqueness: used in forensics
- Unique advantage: age invariant
- Unique disadvantage: hair!
- Much smaller field than gait recognition

BBC1, 2005

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Digital Videofluoroscopic Imaging

Zheng, Nixon and Allen,
IEEE TMI 2003

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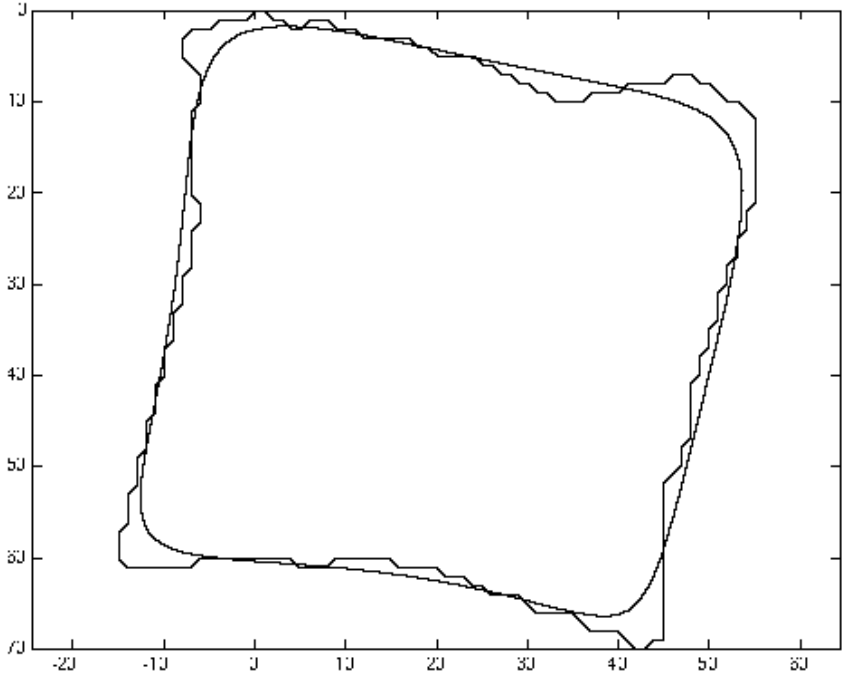
High Level Feature Extraction



Zheng, Nixon and Allen,
IEEE TMI 2003

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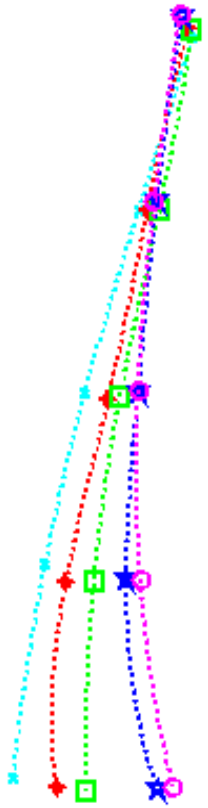
Animated Extraction



Zheng, Nixon and Allen,
IEEE TMI 2003

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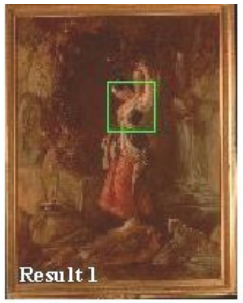
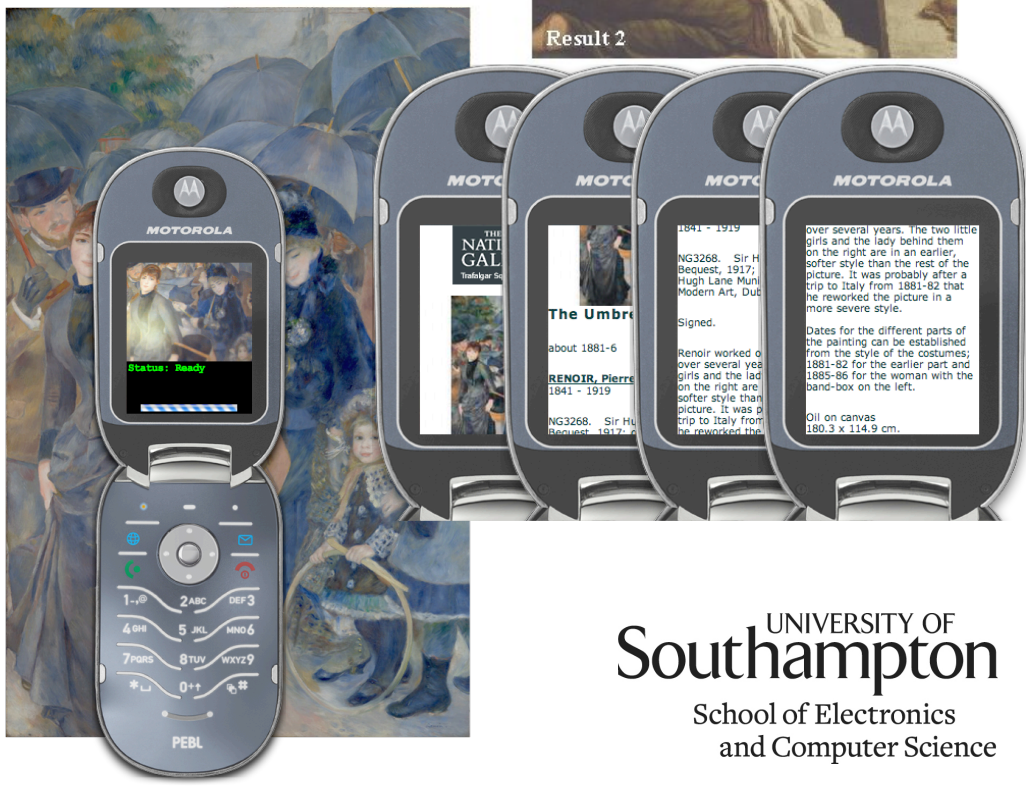
Content-based Retrieval and Image Matching





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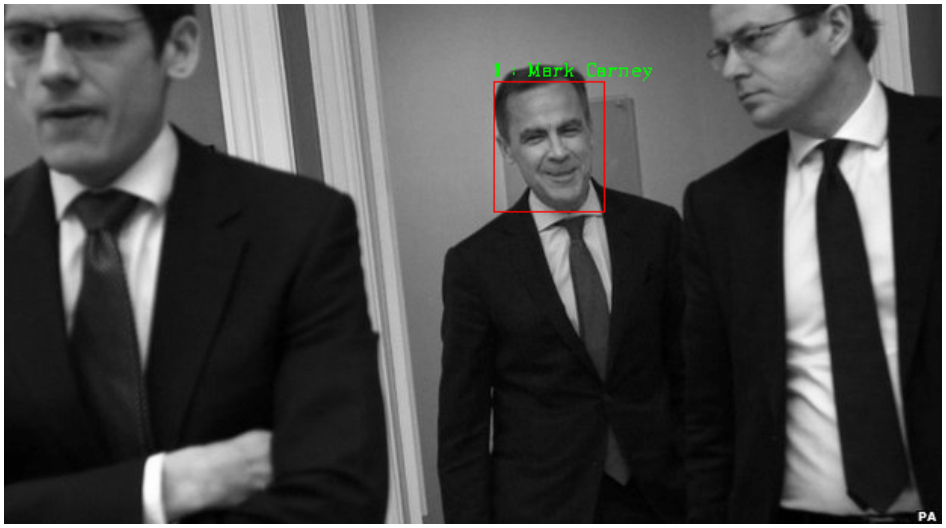
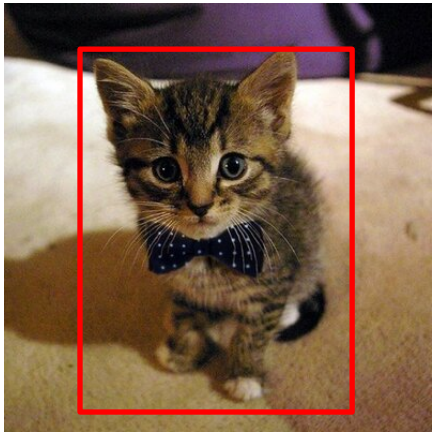
Higher Level Visual Cognition



Who?

Where?

What?



Why?

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Vision and Image Processing Support

- WWW homepages
  - http://comp3204.ecs.soton.ac.uk (for both 3204 & 6223)
- Lecture support materials
- Links
- Notes
- Tutorials (on demand)
- Book

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Lecture Support (Mark)

- Slides available online
- Worksheets
  - Mathcad
  - Used in lectures
  - Free download viewer
  - Used for independent study
  - Some Matlab, but incomplete
- Handouts*

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Lecture Support (Jon)

- Interactive slides with many demos (often using a webcam to capture images)
  - Available for you to download and run
  - Source code on github
  - (more info when we get to my lectures)
- Handouts*

Recommended Textbook

http://www.ecs.soton.ac.uk/~msn/book

CONTENTS

1. **Introduction**
2. **Images, sampling and frequency domain processing**
3. **Basic image processing operations**
4. **Low-level feature extraction (including edge detection)**
5. **Feature extraction by shape matching**
6. **Flexible shape extraction (snakes and other techniques)**
7. **Object description**
8. **Introduction to texture description, segmentation and classification**
9. **Moving Object Extraction and Description**
10. **Appendices**

1st Edition 2002; 2nd Edition 2008 in Library

3rd Edition 2012 (Current price ~ £47 Amazon)

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Assessment

- Mixture of coursework and final exam

- COMP3204: 60% exam; 40% coursework
- COMP6223: 55% exam; 45% coursework

- (exam questions are the same!)

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Coursework

- Three courseworks
  - 2 individual
  - 1 in pairs (competition format)

  - Much requested feature!
  - Designed to support learning
    - Has worked really well since introduced 3 years ago

- **Different coursework assignments for COMP3204 and COMP6223 students**

- COMP3204:
  - **No 1: Set today! handin wk 9; fb wk 11**
  - No 2: Set wk 3; handin wk 7; fb wk 10
  - No 3: Set wk 8; handin wk 11; fb wk 12 (In pairs)

- COMP6223:
  - No 1: Set wk 3; handin wk 7; fb by wk 10
  - No 2: Set wk 4; handin wk 9; fb by wk 11
  - No 3: Set wk 8; handin wk 11; fb wk 12 (In pairs)

Finally

✓ Enjoy!

- Mark Nixon
  - msn@ecs.soton.ac.uk
  - Office: 1/2021
- Jonathon Hare
  - jsh2@ecs.soton.ac.uk
  - Office: 1/2003

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Lecture Timetable

- No more lectures this week (e.g. on Friday)
- Mark will start next Tuesday for 3 weeks [9 lectures]
- I'll then take over for 4 weeks [plus a couple of extra lectures in later weeks]
- We'll run revision lectures after xmas

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