

# COMP3204 Computer Vision

Welcome!

Jonathon Hare and Xiaohao Cai



**Book  
Intro**

**Department of  
Electronics and  
Computer Science**

UNIVERSITY OF  
**Southampton**  
School of Electronics  
and Computer Science

# We are back in person...



Jon Hare



Xiaohao Cai

# Welcome to Computer vision

- It's a great subject
- Covers wide area
- We really enjoy it
- We shall try and impart the same to you!!

# We are back in person...

Universities are learning communities in a research-led culture

**That means we chat**

..... We've been given lecture theatres to use and need **you** to help us make the most use of them

.... **You** asking questions is what makes this much more interesting for everyone

# What will the course include?

- Live lectures
  - Mon 12-1; Tuesday 2-3; and Fri 4-5
  - .... which will also be recorded and placed on Panopto  
(but please remind us! It's easy to forget to hit record)
- Live Demonstrations in the lectures
- Plenty of time for Q&A
- ... and bits we haven't thought of yet!

<http://comp3204.ecs.soton.ac.uk/>



## COMP3204 Computer Vision

2021-22

Maintained by [Dr Jonathon Hare](#) and [Dr Xiaohao Cai](#).

Welcome to the homepage for the ECS [COMP3204 "Computer Vision"](#) module.

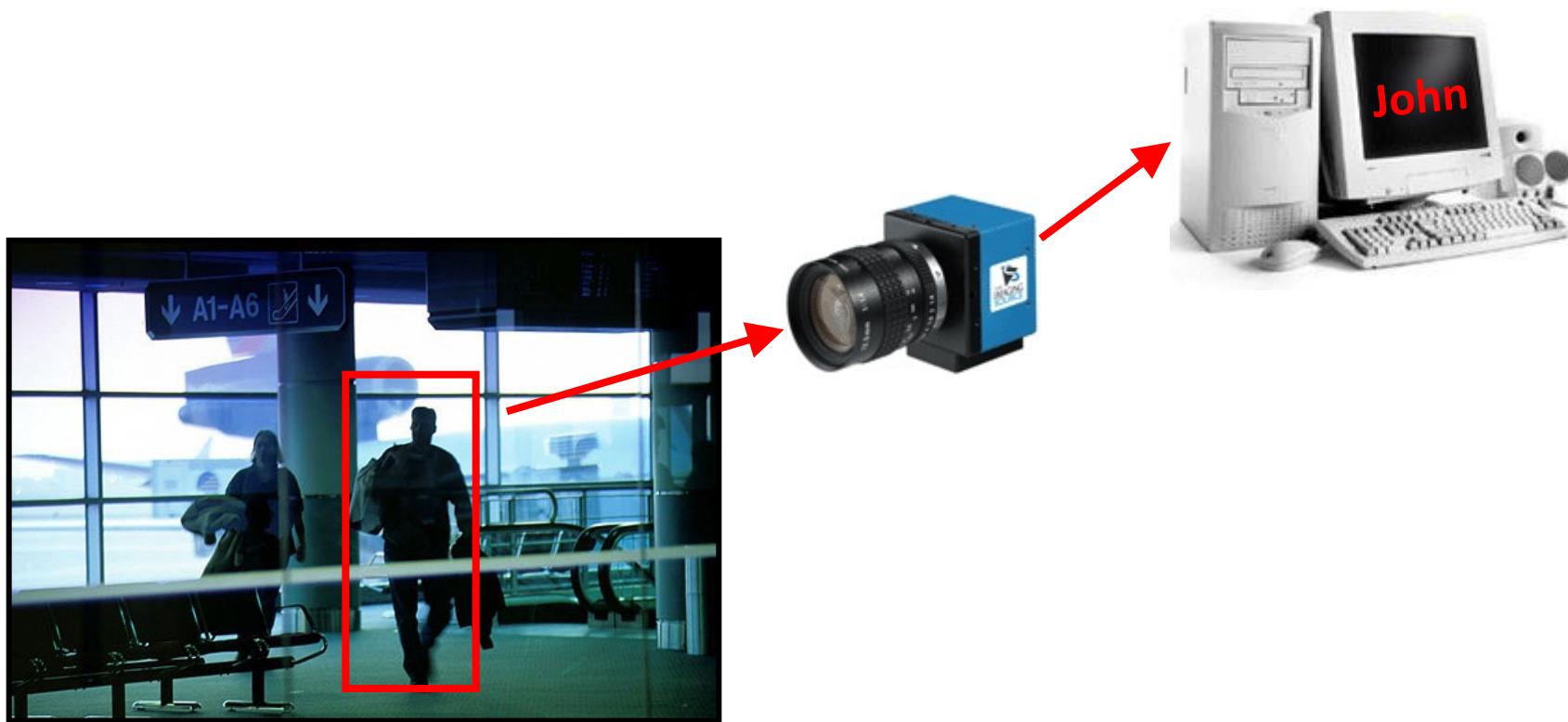
The challenge of computer vision is to develop a computer based system with the capabilities of the human eye-brain system. It is therefore primarily concerned with the problem of capturing and making sense of digital images. The field draws heavily on many subjects including digital image processing, artificial intelligence, computer graphics and psychology.

This course will explore some of the basic principles and techniques from these areas which are currently being used in real-world computer vision systems and the research and development of new systems.

### Lectures & Teaching

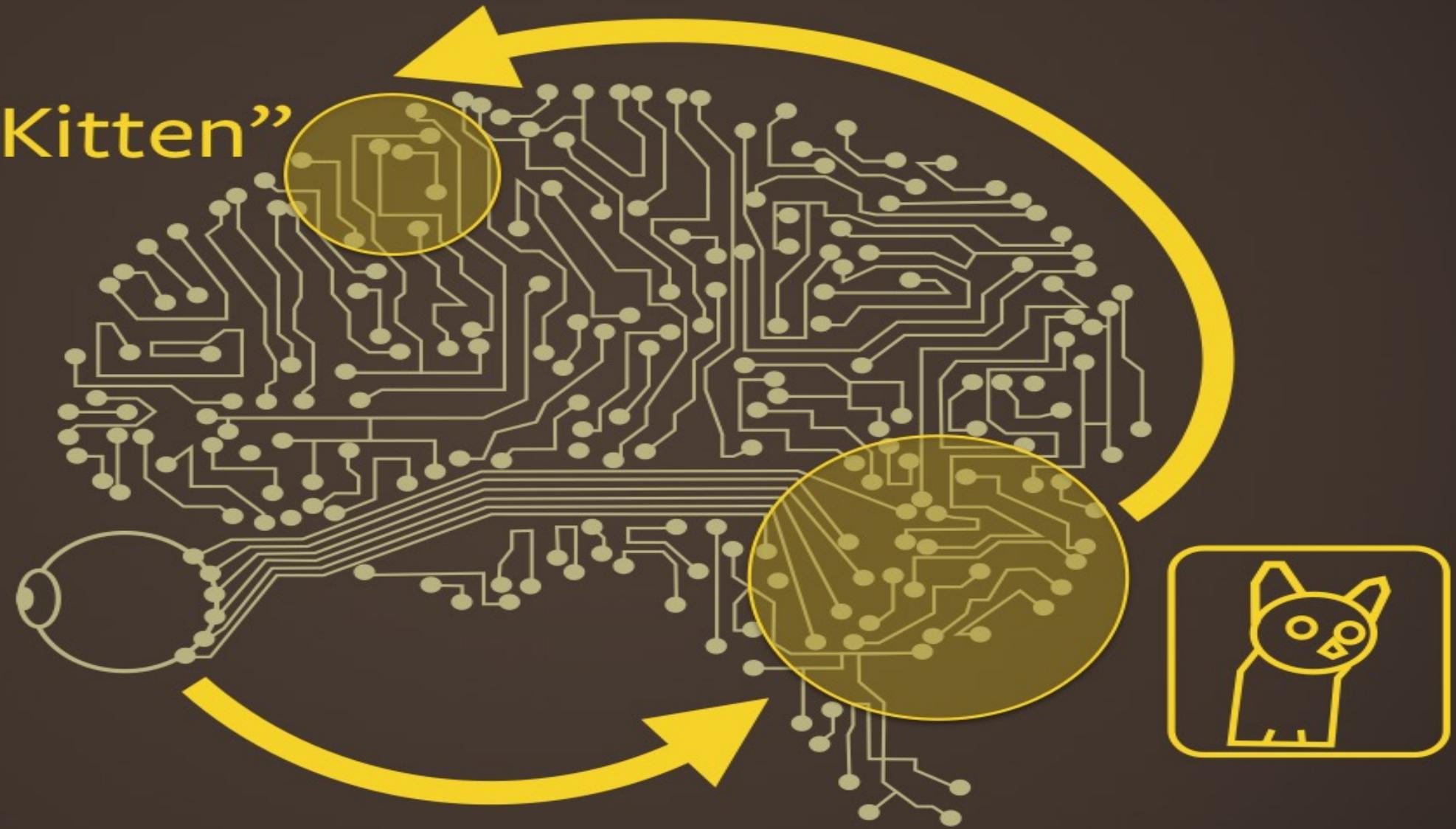
The lectures for this course will be given by [Dr Xiaohao Cai \(email\)](#) and [Dr Jonathon Hare \(email\)](#). Xiaohao will give the lectures for the first part of the course, and Jon will finish with the second half.

# Vision based biometrics





“Kitten”



# What can image analysis achieve?



# Key to our slides

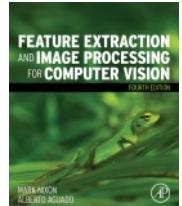
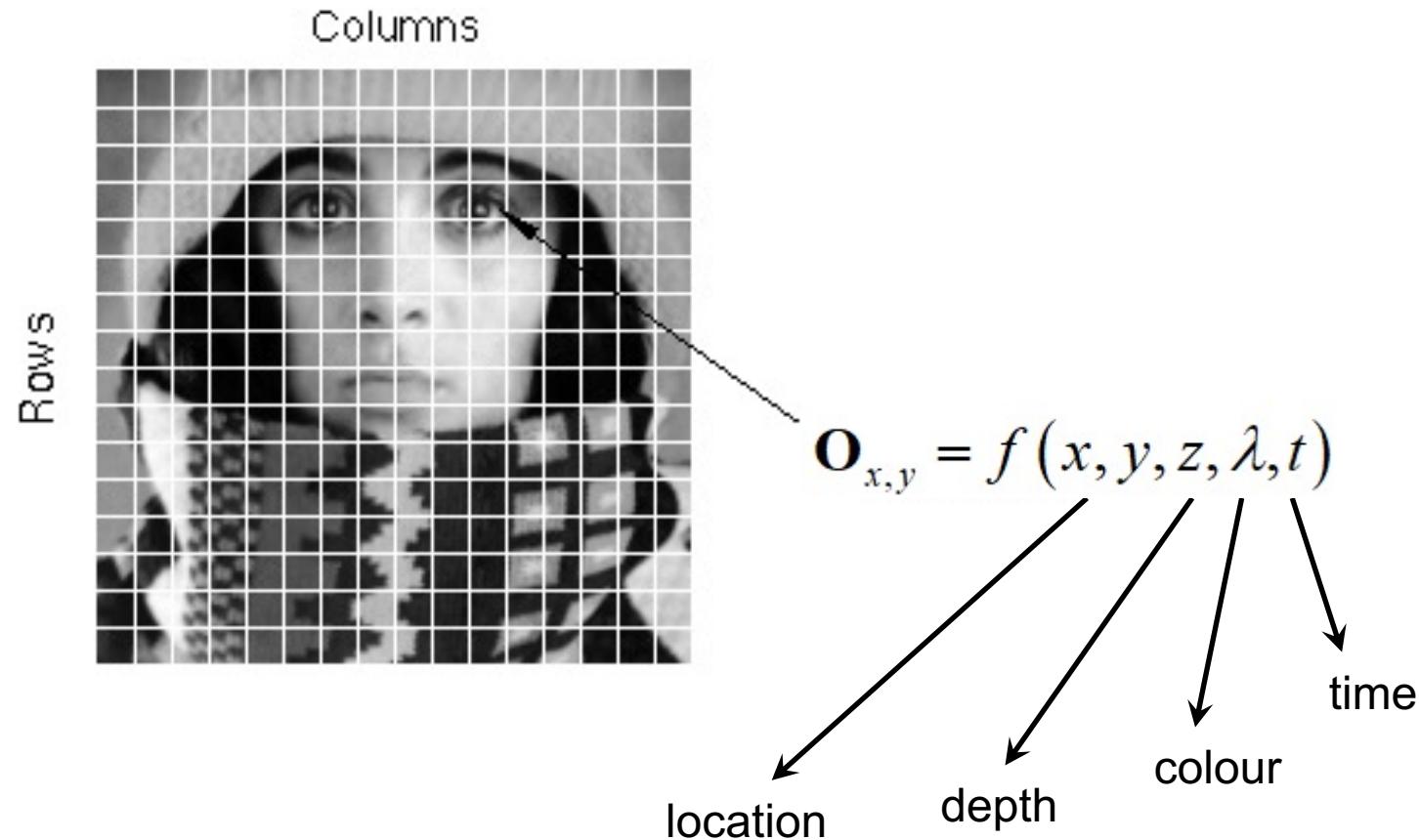
This bit is to be found in [Mark Nixon's book](#)

We expect you to [remember](#) this stuff

If [neither](#) of these are there, this is stuff to illuminate the course material (this doesn't mean it's not examinable, but the level of detail required is less than the "remember it" bits)



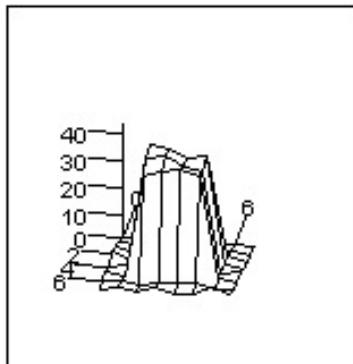
# Images consist of picture elements known as “pixels”



# 2D Images are matrices of numbers



Grey level  
image



3D view

pic =

|   |   |    |    |    |    |   |   |
|---|---|----|----|----|----|---|---|
| 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 |

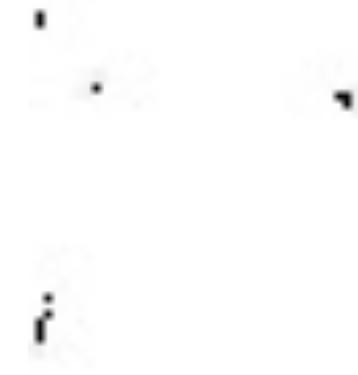
Corresponding  
Matrix

Pixel



# Point Operations

Recalculate point values



**Modify** brightness

**Find** Intensity

# Group Operations

Process neighborhoods



Image **filtering**



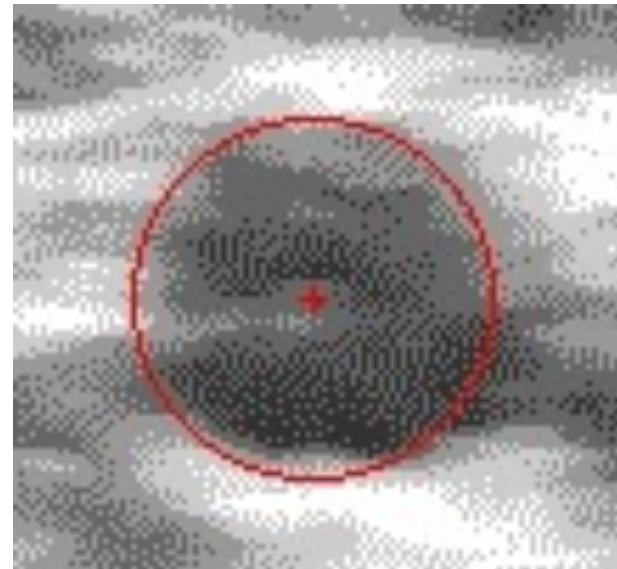
**Edge** detection

# Feature Extraction

Finds shapes



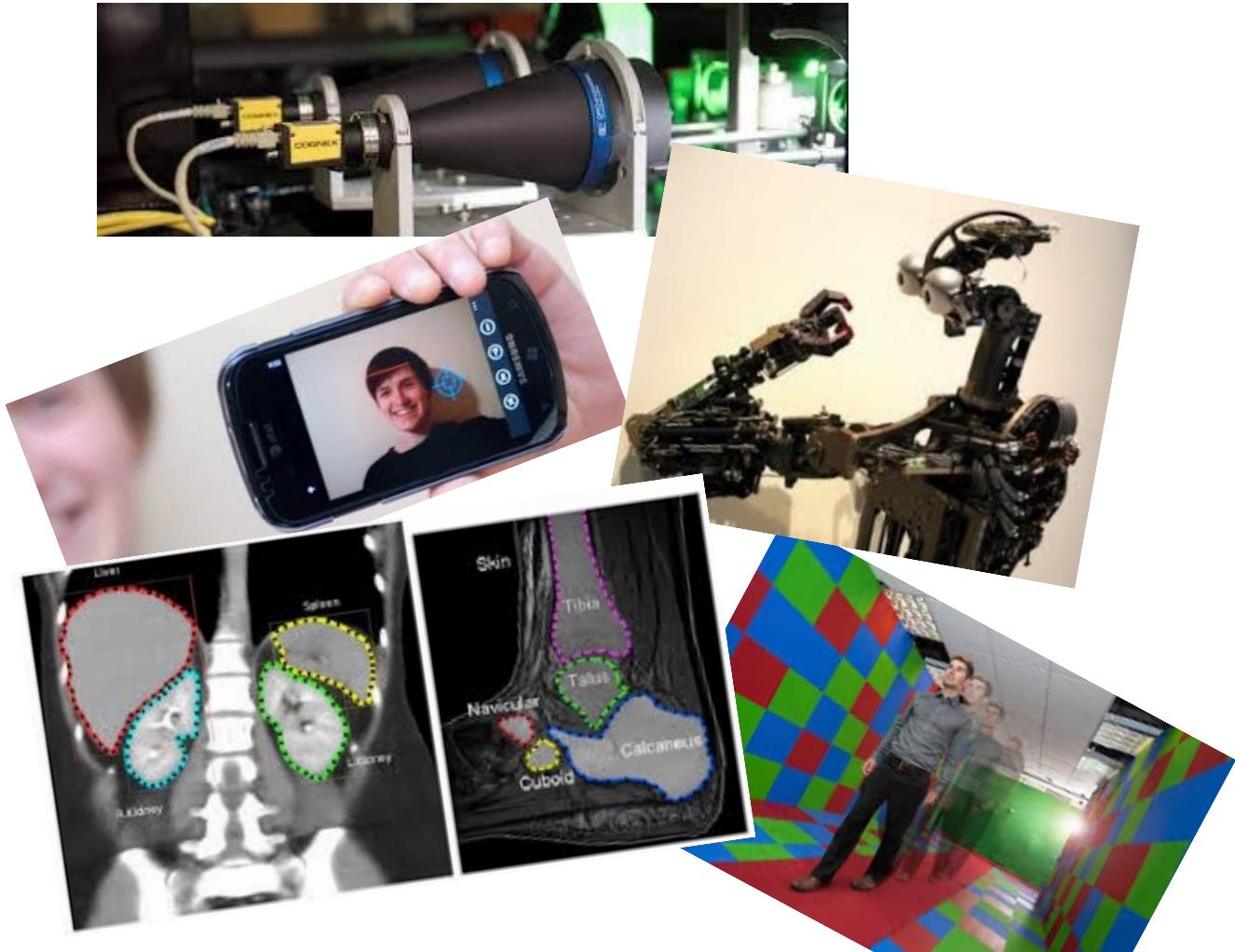
Roads in remotely-sensed image



Artery in ultrasound image

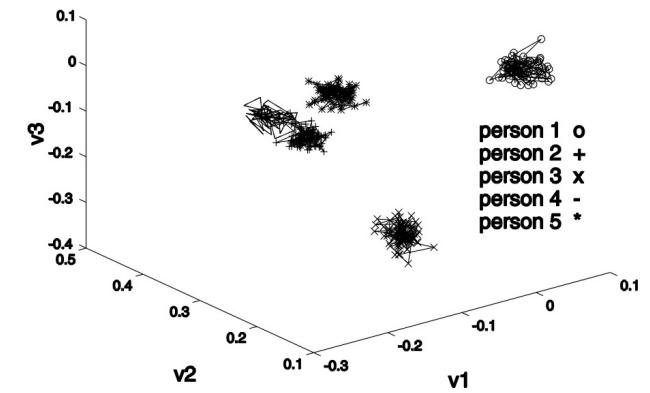
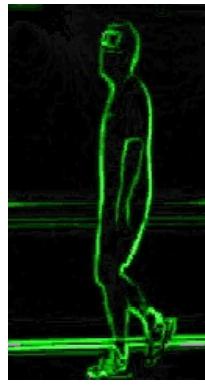
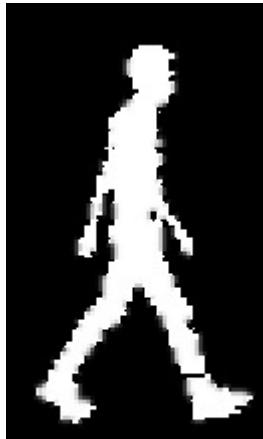
# Applications of Computer Vision

- Image **coding** (MPEG/JPEG)
- Product **inspection**
- **Robotics**
- **Modern cameras/ phones**
- **Medical imaging**
- **Demography** (applied politics?)
- **Biometrics** (recognising people)



# Gait Recognition

Recognising people from the motion of the **whole** body



silhouette

flow

edges

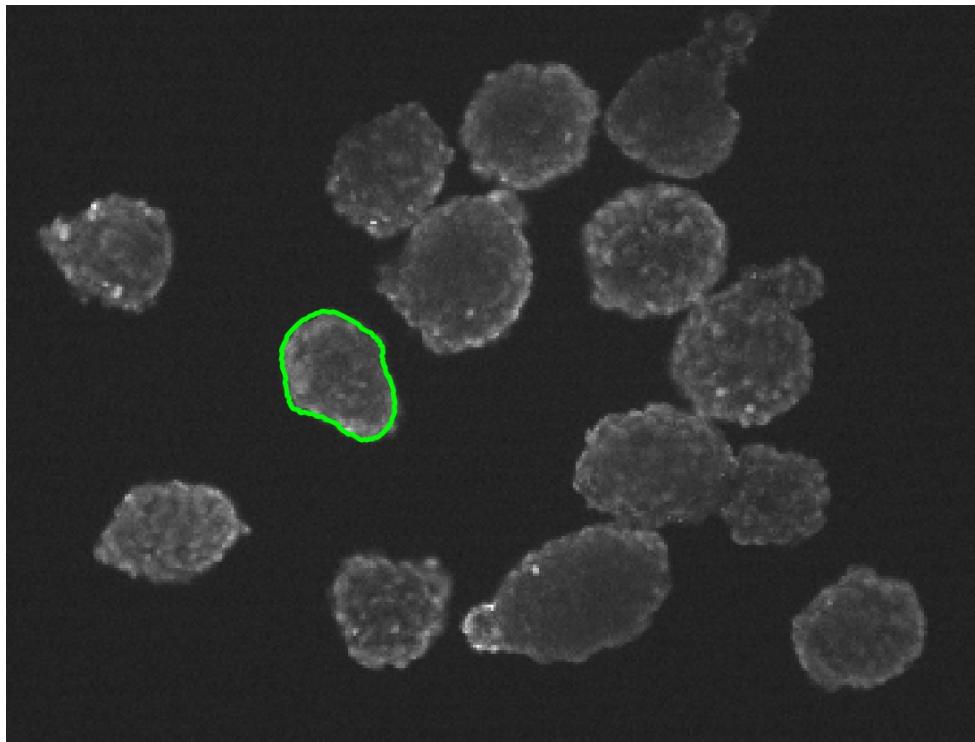
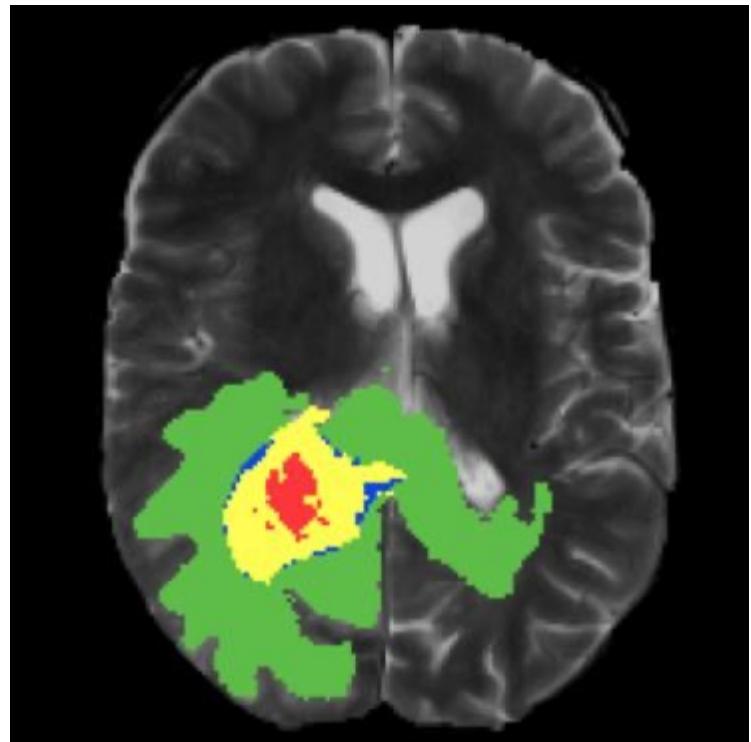
symmetry

acceleration

feature space



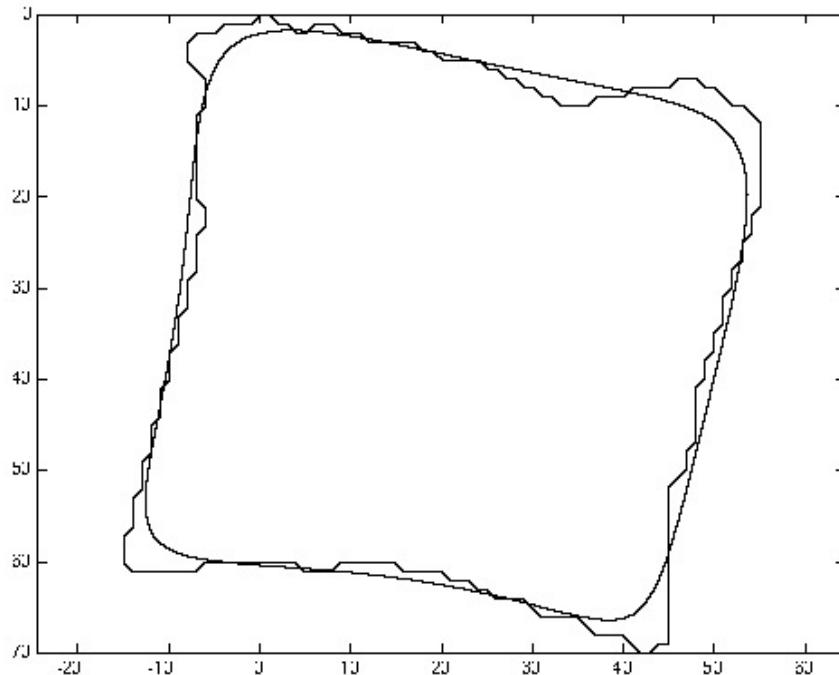
# Medical imaging



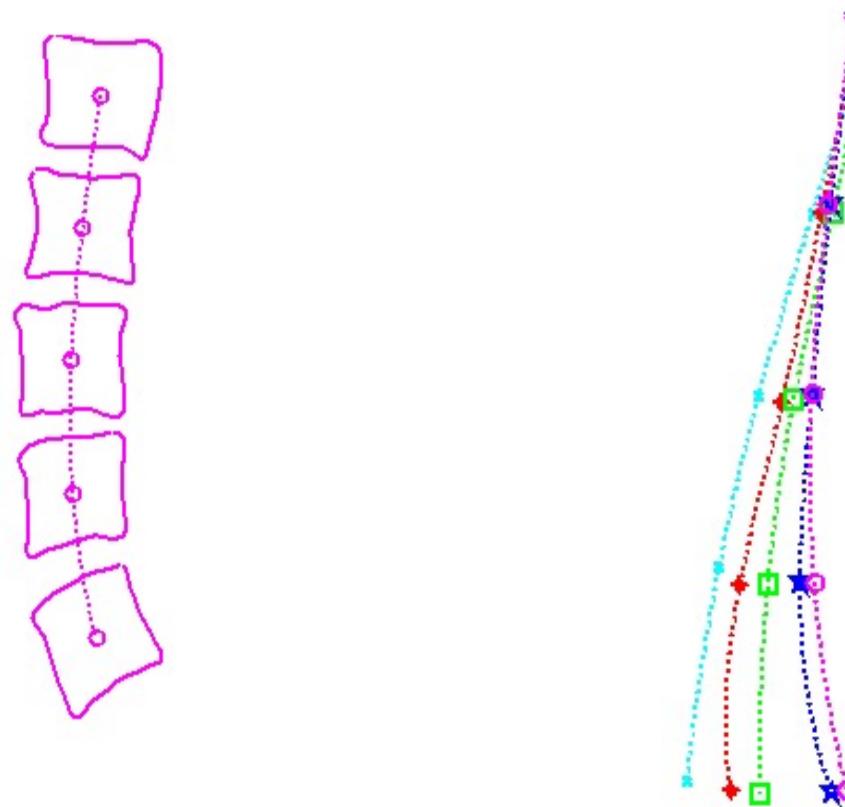
# Digital videofluoroscopic Imaging



# High level feature extraction



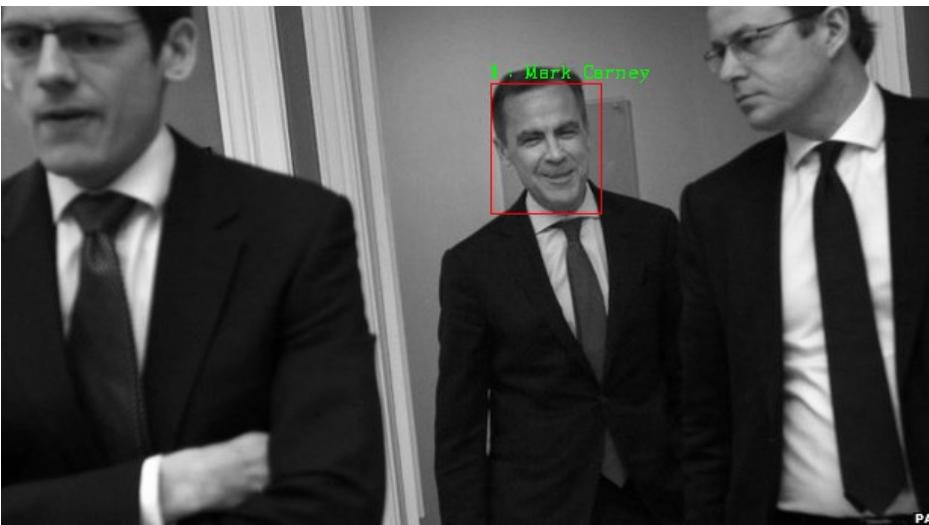
# Animated extraction



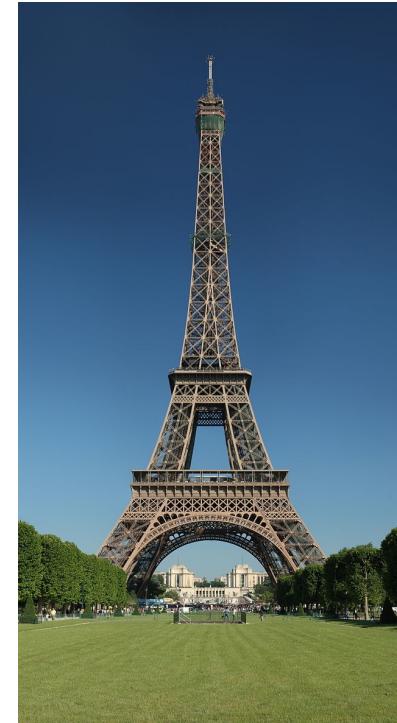
# Content-based retrieval and image matching



# Higher level visual cognition



Who?



Where?



What?

Why?

# Computer vision support

- WWW homepages  
<http://comp3204.ecs.soton.ac.uk>
- Lecture **support** materials
- **Links**
- **Notes**
- **Extra Tutorials** (on demand – we should have time near the end)
- **Mark's Book**

# Computer vision support

<https://www.southampton.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. Region Based Analysis
9. Moving Object Extraction and Description
10. Camera Geometry Fundamentals
11. Colour Images
12. Distance, Classification and Learning

1<sup>st</sup> Edition 2002; 2<sup>nd</sup> Edition 2008, 3<sup>rd</sup> Edition 2012 in Library (and electronic)

4<sup>th</sup> Edition 2019 in Library (and electronic)

(Current price ~£50 Amazon, Elsevier, etc.)

# Direct from the Library!!



## WebCat: library catalogue of the University of Southampton

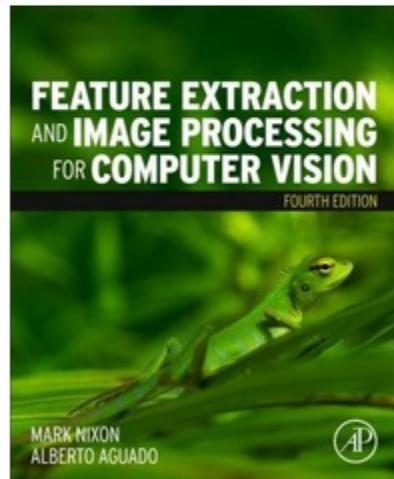
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record 5 of 13 for search **keywords "nixon feature"**

### Item Details

[Mark](#)



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**Title** [Feature extraction and image processing for computer vision 4th ed.](#)

**Author** Nixon, Mark S.

**ISBN:** 9780128149775

**Link:** [Click for access](#)

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# Lecture Support (Xiaohao)

- Slides available online
- Highlighted copy of book sections available
- Demos available

# 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 you get to Jon's lectures)
- Handouts

# Assessment

- Mixture of coursework and final ‘exam’ (format TBC – it will be ‘short duration’, but unclear yet if physical or online)
- 60% exam; 40% coursework

# Coursework

- Three courseworks:
  - 2 individual. One is automatically marked and requires you follow the spec...
  - 1 in groups of 4 (competition format)
- Much requested feature!
- Designed to support learning
- Has worked really well since introduced

# Coursework schedule

- **Coursework 1.** Set **today** 4th October. Due Friday 26th November, 16:00. Feedback by 17th December
- **Coursework 2:** Set Monday 15th October. Due Friday 12th November, 16:00. Feedback by 4th December
- **Coursework 3:** Set Tuesday 16th November. Due Thursday 16th January, 16:00. Feedback by 16th January

*Note the overlap in deadlines; you are responsible for planning appropriately!*

# Lecture Timetable

This course has 24 lectures of stuff

- Xiaohao will lead next from tomorrow for 3 and a bit weeks [9 lectures]
- Jon will then take over the lead for 4/5 weeks starting mid week 4
- Xiaohao will reappear later
- We'll run surgeries/revision lectures after Xmas

# A word on content

- You'll probably have read a lot about how “deep learning” is changing computer vision
  - This is only partially true... applications like industrial inspection still use traditional techniques and are unlikely to change
  - Those traditional techniques are still generally important because they can (and are) be used in combination with deep learning techniques
    - Just ask anyone building self-driving cars!
  - This module predominantly focusses on the traditional approaches, but we'll talk a little about deep learning right at the end (and you can try it for part of the final coursework if you want)
  - Jon teaches a “deep learning” module in the fourth year if you want to learn more...

Finally

✓ Enjoy!

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  - Office: 32/3011