THE UNIVERSITY OF MELBOURNE

Introduction

Semester 2, 2021

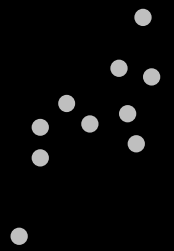
Kris Ehinger

Outline

- What is computer vision?
- Welcome to COMP90086
- Overview of computer vision

What is computer vision?

Demo



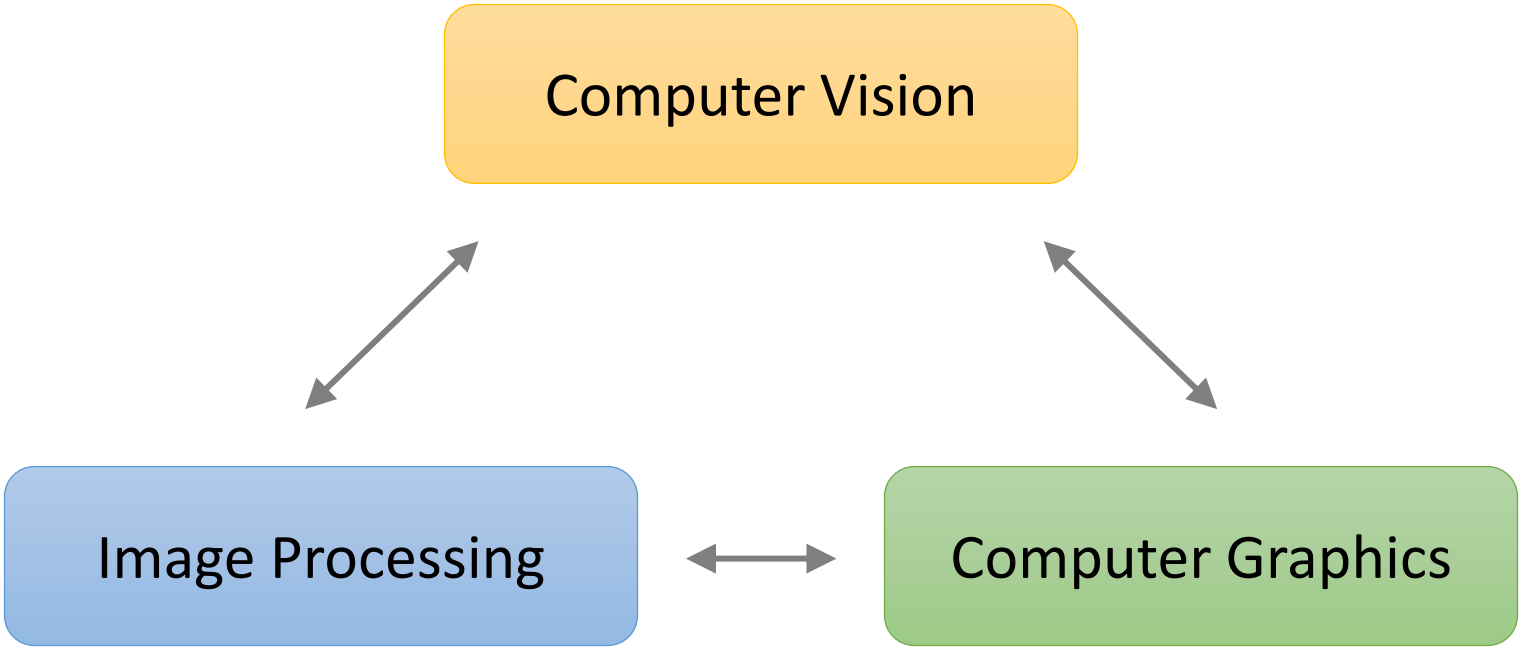
Computer vision

- Algorithms for high-level understanding of digital images or videos
- Simulate or replicate processes that a biological visual system can do
- Often interdisciplinary – AI, machine learning, physics (optics), neuroscience, psychology, art

Computer vision tasks

- Recognize images
- Localise and identify objects
- Segment image regions
- Model relations between images
- Recover 3D structure
- Perform visual navigation
- Perform visually-guided actions (e.g., grasping objects)

Related fields



Welcome to COMP90086

Lecturers

- Kris Ehinger (subject co-ordinator)
- kris.ehinger@unimelb.edu.au

- Qiuhong Ke
- qiuhong.ke@unimelb.edu.au

Recognizing objects and scenes
Relating images to 3D structure
Predicting object locations

Tutors

- Justin Tan (head tutor)

- Kazi Adnan
- Jiayang Ao
- Yujing Jiang
- Zihan Yang

Contacting us

- General inquiries: Ed forum on LMS
  - We encourage all students to join in discussions – answering other students' questions is one of the best ways to improve your own understanding
  - Please do not post sections of your code or reports publicly! If you must include these, private-message the instructors
- Personal/private concerns: Email the instructors
  - If you email us about a general inquiry, we may ask you to re-post your question in the forum
- Please include COMP90086 in email subject

Dual delivery

- Lectures are online only
- Exams are online only
- Choice of online or in-person workshops

Lectures

- Tuesdays and Thursdays, 2.15-3.15pm
- Online via Zoom – links on Canvas
- Lecture recordings will be posted on Canvas within 24 hours of the end of the lecture

Workshops (starting week 2)

Day	Start	End	Location
Monday	13:00	14:00	PAR-Elec. Engineering-124
Monday	15:15	16:15	PAR-Elec. Engineering-124
Tuesday	15:15	16:15	online
Tuesday	17:15	18:15	online
Wednesday	15:15	16:15	online
Wednesday	17:15	18:15	online
Thursday	13:00	14:00	PAR-Elec. Engineering-124
Thursday	16:15	17:15	online
Thursday	17:15	18:15	online
Friday	14:15	15:15	online
Friday	16:15	17:15	online

Coming to campus

- Before you come to campus for the first time:
  - Complete the COVIDSafe Campus online module in the LMS, which includes a health declaration (you only need to complete the module once)
  - Update your contact details: We need your contact details to quickly and effectively contact trace in case there is a COVID-19 case on campus
- Follow the latest guidelines:
  - https://students.unimelb.edu.au/student-support/coronavirus/return-to-campus

Subject material

- LMS is the primary portal for the subject
  - Lecture schedule, workshops schedule
  - Content page for each week
- Lecture content
  - Handouts will be posted before lecture
  - Slides and lecture capture available after lecture
- Workshops
  - Cover content from previous week's lecture
  - Handouts posted before the first workshop
  - Solutions posted after the last workshop

Assessment

- Assignments 1-3 (20%, weeks 3-10)
  - Implement algorithms, experiment on provided data sets, and answer questions
  - Individual work
- Final project (30%, week 12)
  - Design a method to solve an open-ended computer vision problem, present algorithm and experiments in a written report
  - Work in groups of 2
- Final exam (50%, during exam period)

Prerequisites

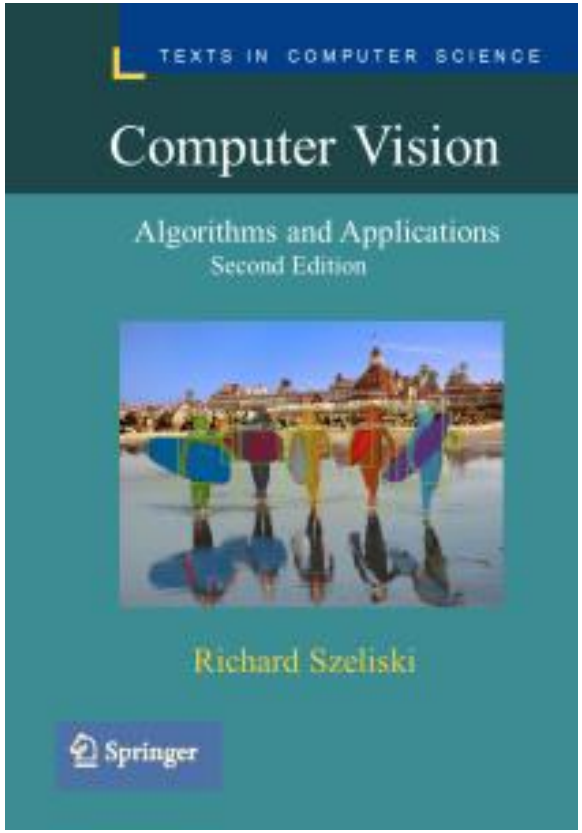
- Machine learning background
  - Training, testing, evaluating machine learning algorithms
  - Common methods like clustering, KNN, neural networks
- Programming skills
  - Workshops and assignments are in Python
- Mathematical skills
  - Basic familiarity with probability, geometry, linear algebra

Textbooks

- Suggested links and readings will be posted on LMS each week
- Readings are not required – optional links to expand your knowledge of the week's topics if you are interested

Recommended textbook

- *Computer Vision: Algorithms and Applications 2nd Ed*, Richard Szeliski (2021)
- Electronic copy available at https://szeliski.org/Book/



Other textbooks

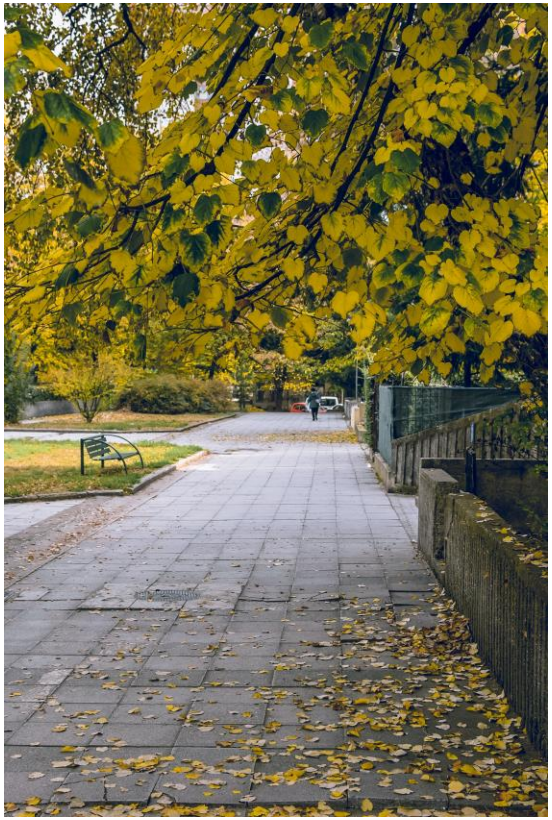
- *Pattern Recognition and Machine Learning* by Christopher Bishop
- *Computer Vision: Models, Learning, and Inference* by Simon J.D. Prince

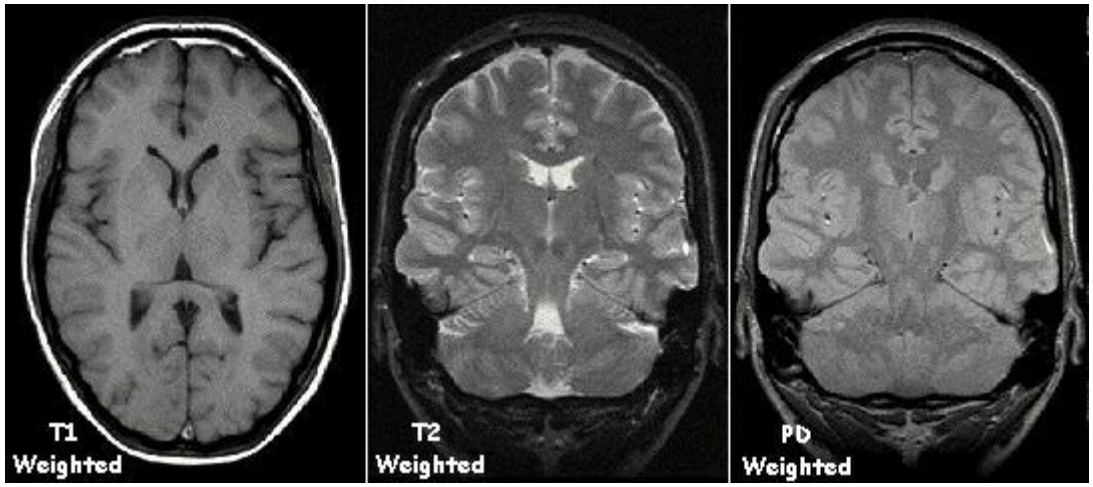
To do (this week!)

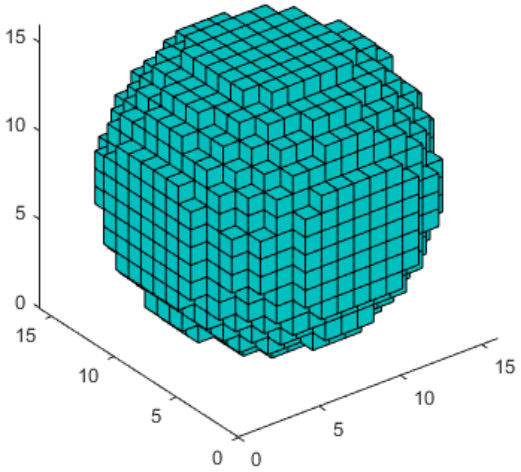
- Join the Ed forum (invite link in unimelb email)
- Install Jupyter Notebook
- If you will be attending campus for the first time this semester:
  - Complete COVIDSafe module and health declaration

Introduction to computer vision

What is an image?

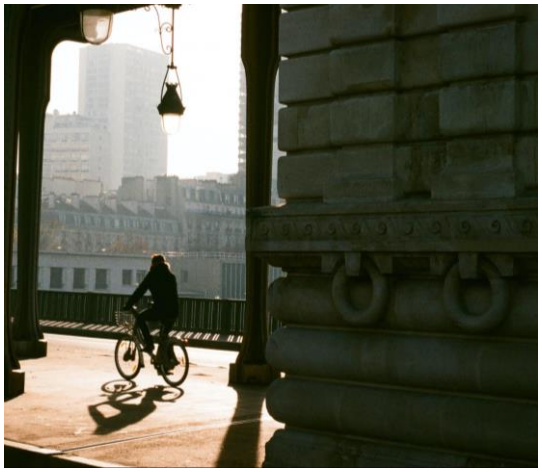






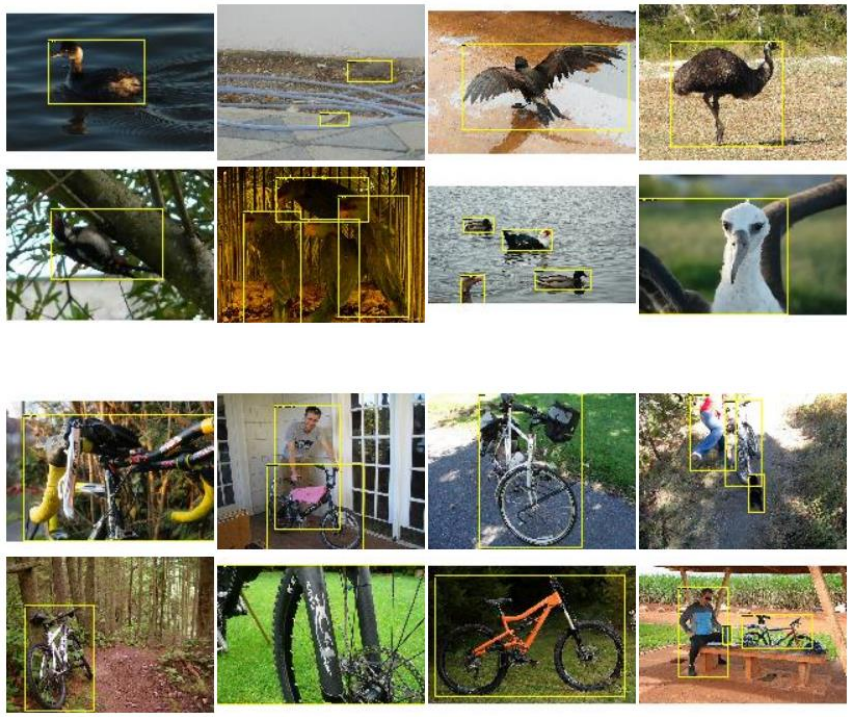
Computer vision as classification

- Example: object recognition task
  - Input: image
  - Label: object class (e.g., “bicycle”)
  - Attributes: ?

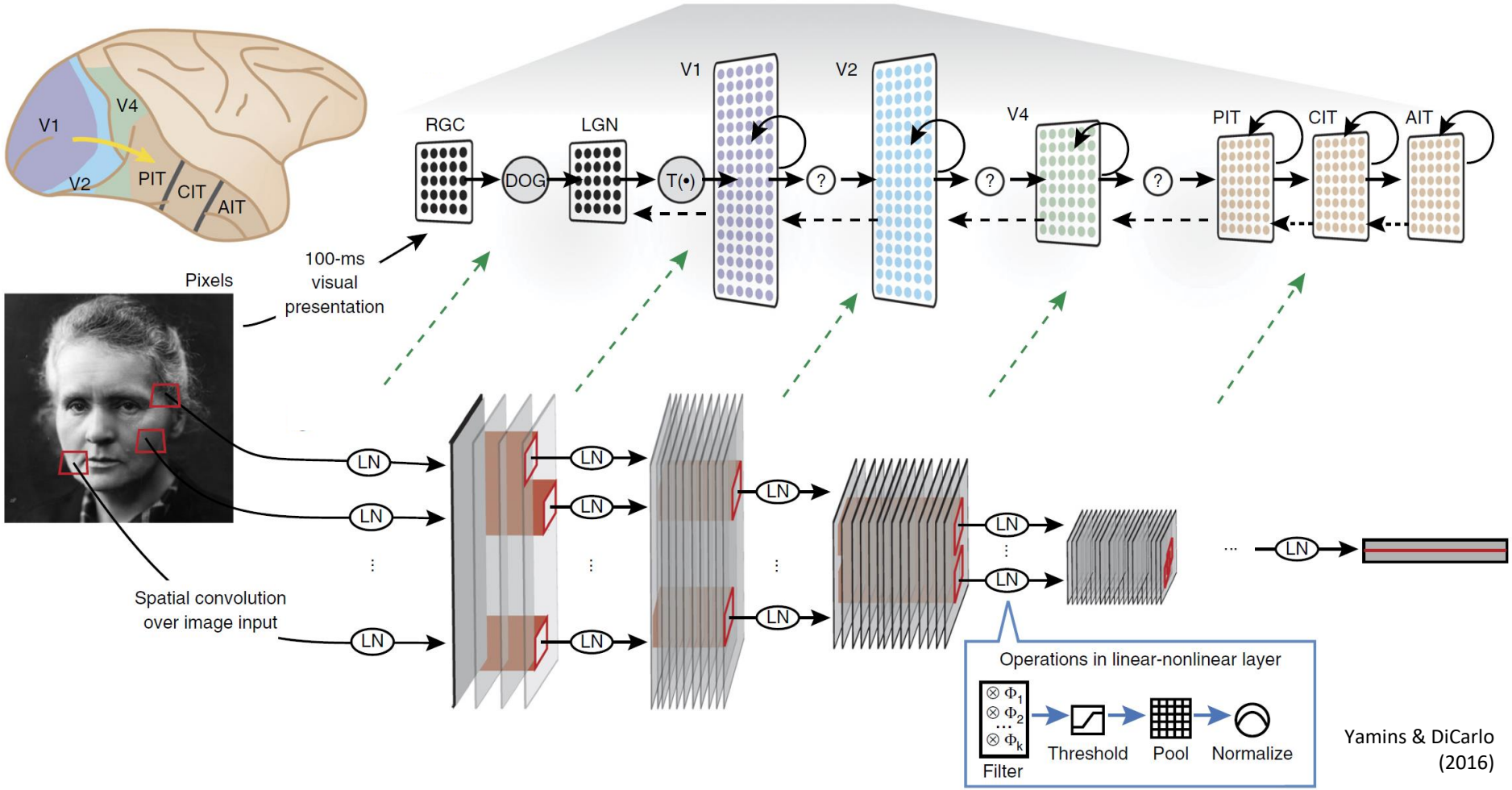

Difficulties

- Class similarity
- Within-class variation
  - Exemplars
  - Size
  - Position
  - Lighting
- Background clutter
- Occlusion



Images: PASCAL VOC2011

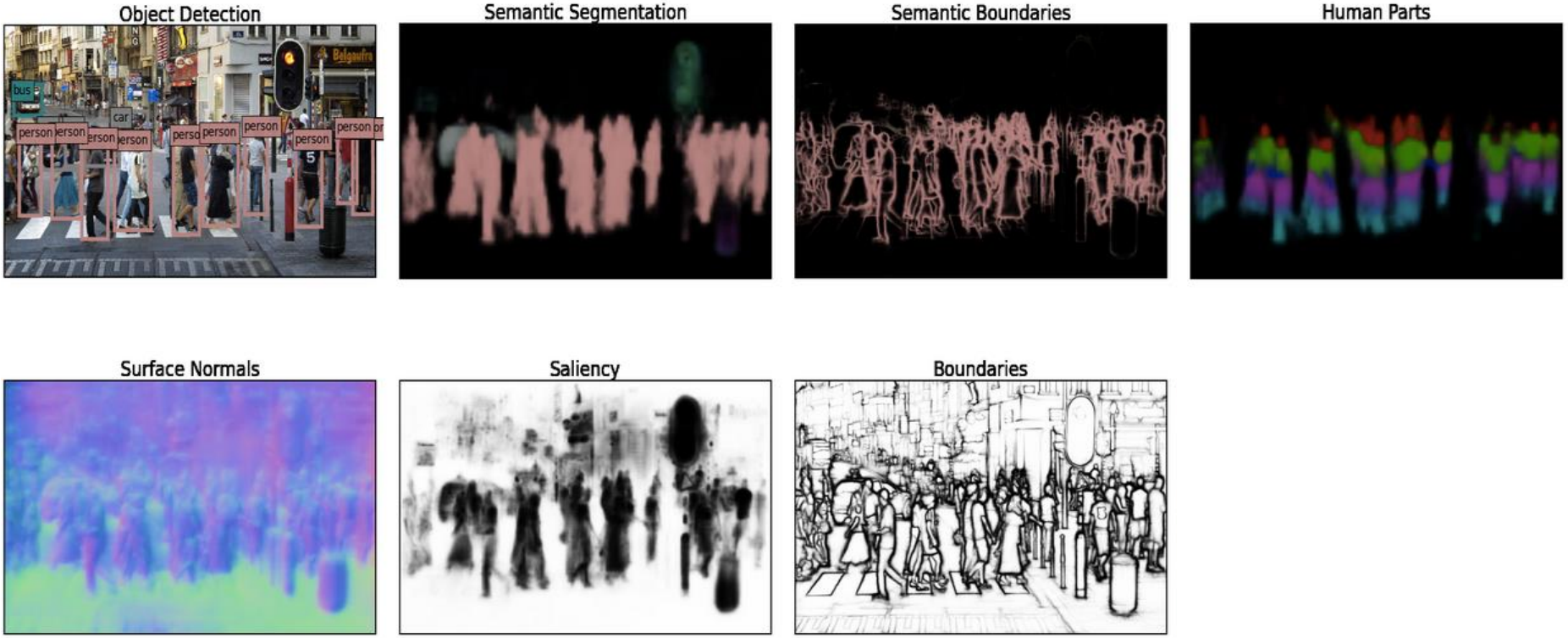
Visual encoding



Yamins & DiCarlo (2016)

Computer vision as classification

- Is computer vision just classification?

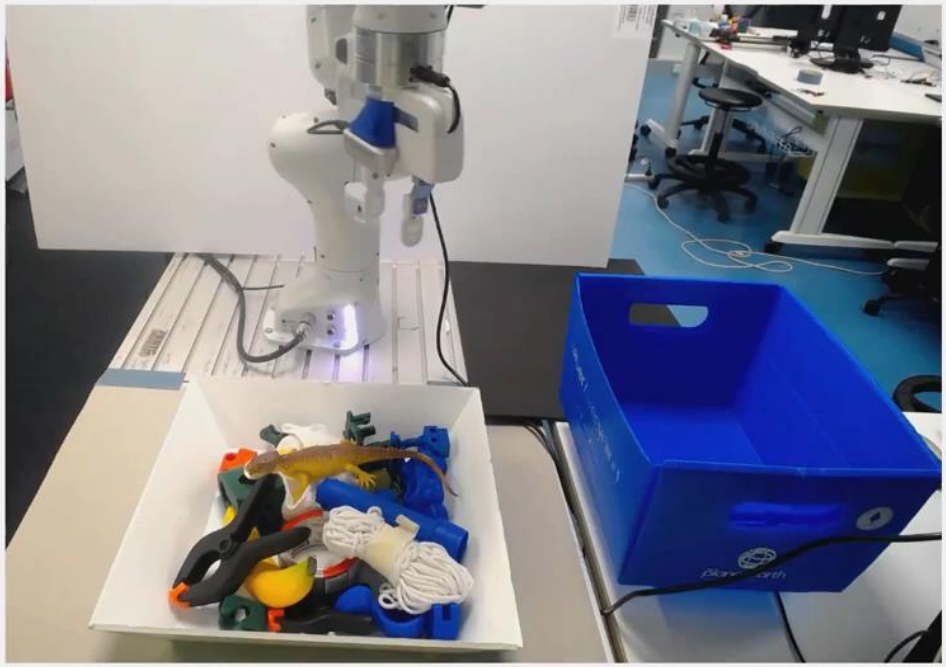


Kokkinos (2016)

https://grail.cs.washington.edu/rome/

https://www.youtube.com/watch?v=0Pj-jzy6ESE

Emptying a Cluttered Bin



5x

https://www.youtube.com/watch?v=daAvvAlCE5o

https://www.elderlab.yorku.ca/research/sensing/

Progressive Growing of GANs for Improved Quality, Stability, and Variation

Tero Karras
NVIDIA

Timo Aila
NVIDIA

Samuli Laine
NVIDIA

Jaakko Lehtinen
NVIDIA
Aalto University

https://www.youtube.com/watch?v=G06dEcZ-QTg

Content of this subject

Week 1	Image formation and image processing	
Week 2		
Week 3		
Week 4	Recognition	Asst 1 due
Week 5		
Week 6	Feature correspondence, stereo & 3D	
Week 7		Asst 2 due
Week 8	Shape and texture	
Week 9	Image generation	
Week 10	Image segmentation	Asst 3 due
Week 11	Object detection & attention	
Week 12	Revision & guest lecture	Final project due