

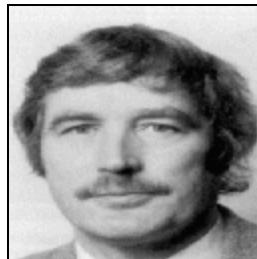
Introduction to Computer Vision

COMP3204 & COMP6223
2015/16

Mark Nixon and Jonathon Hare

Processing Scheme

Acquire image



Low-level
processing



High-level
processing



What can image analysis achieve?



WHEN A USER TAKES A PHOTO,
THE APP SHOULD CHECK WHETHER
THEY'RE IN A NATIONAL PARK...

SURE, EASY GIS LOOKUP.
GIMME A FEW HOURS.

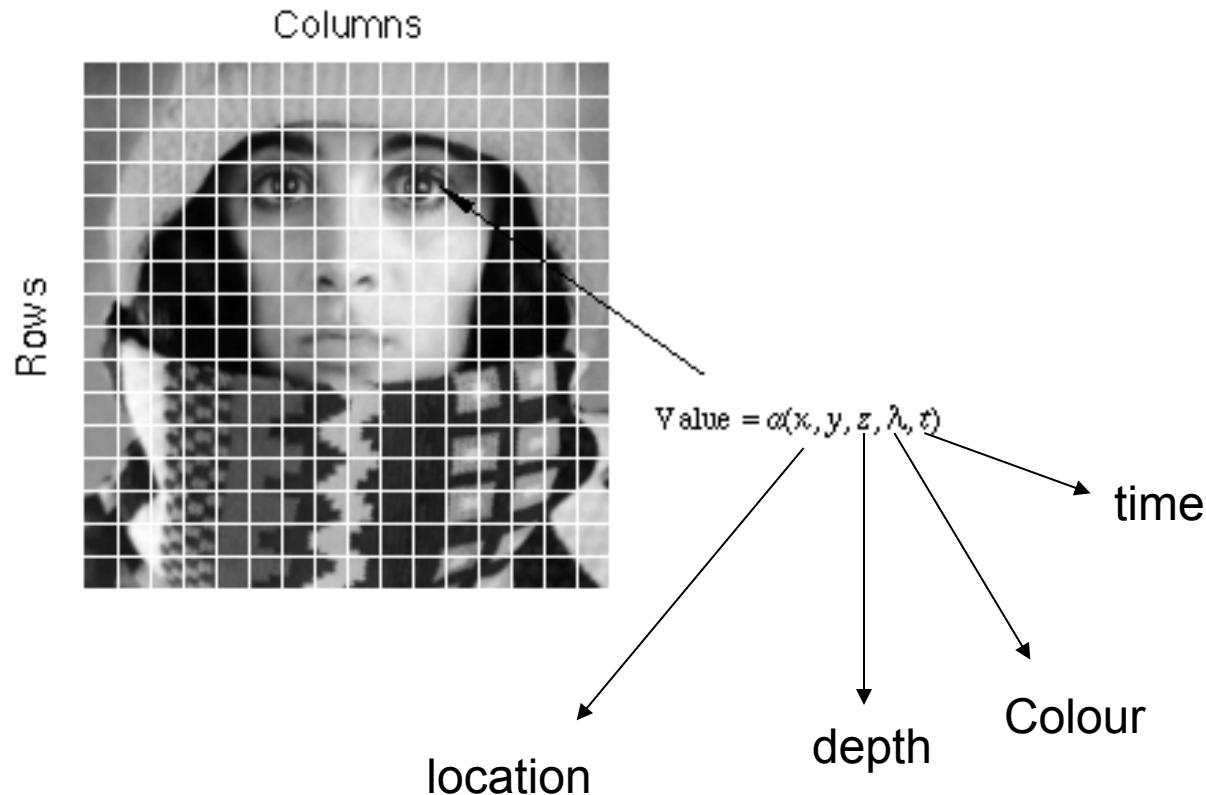
... AND CHECK WHETHER
THE PHOTO IS OF A BIRD.

I'LL NEED A RESEARCH
TEAM AND FIVE YEARS.

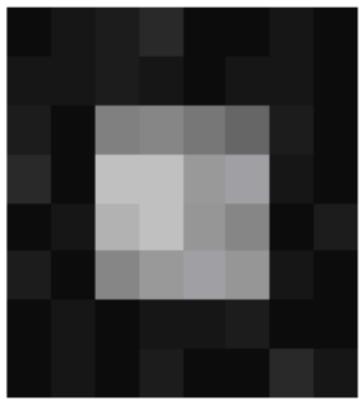


IN CS, IT CAN BE HARD TO EXPLAIN
THE DIFFERENCE BETWEEN THE EASY
AND THE VIRTUALLY IMPOSSIBLE.

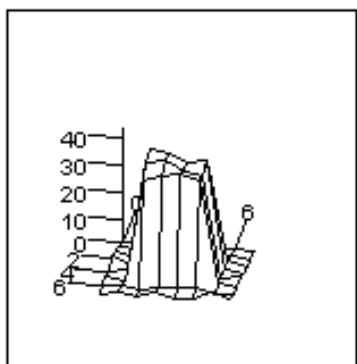
Images consist of picture elements known as “pixels”



2D Images are therefore matrices of numbers



Grey level image



pic

3D view

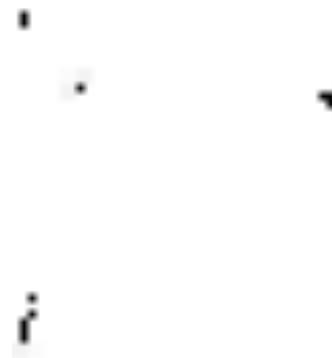
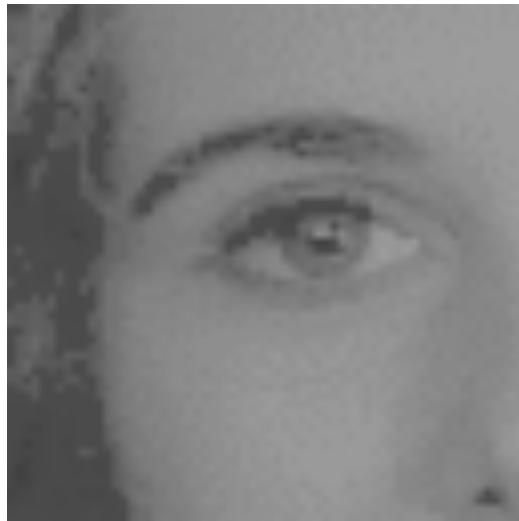
Pixel

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

Corresponding Matrix

Point Operations

Recalculate point values



Modify brightness

Find Intensity

Group Operations

Process neighborhoods

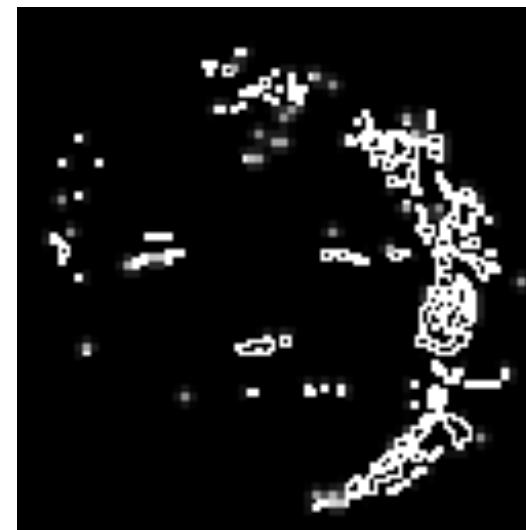


Image Filtering

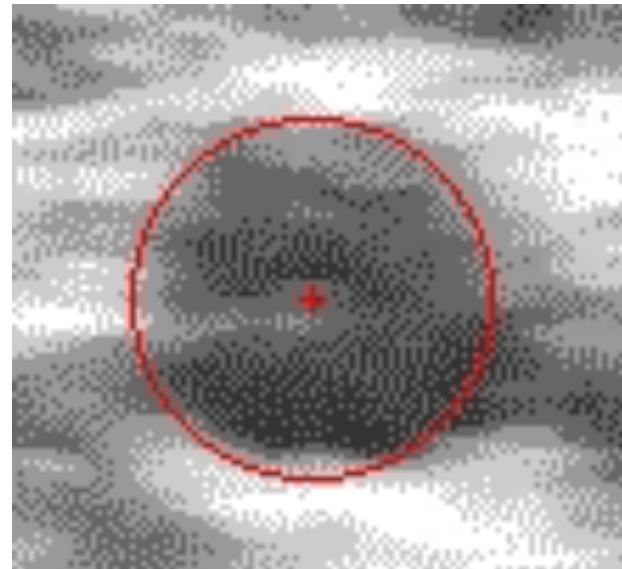
Edge Detection

Feature Extraction

Finds **shapes**



Roads in remotely-sensed image



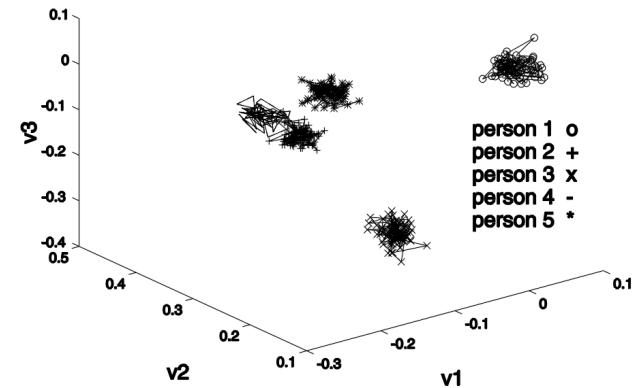
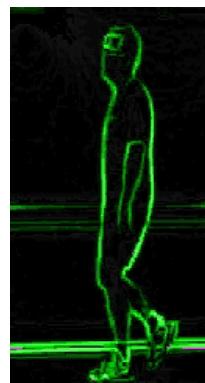
Artery in ultrasound image

Applications of Image Processing/Vision

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

Statistical Gait Recognition

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



Silhouette Flow Edges Symmetry Feature Space



Gait Recognition

- natural walking (well....)



Ear biometrics

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



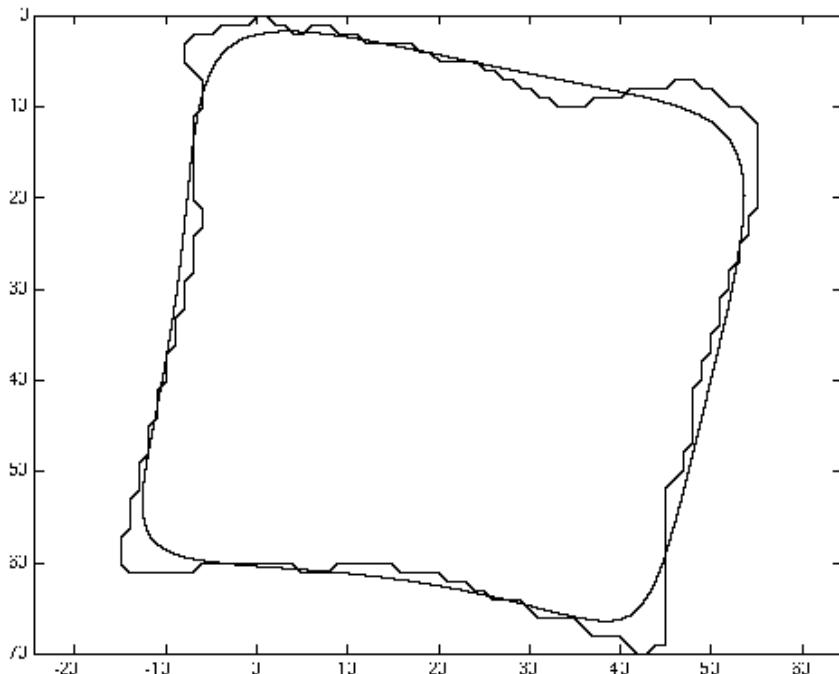
BBC1, 2005

Digital Videofluoroscopic Imaging



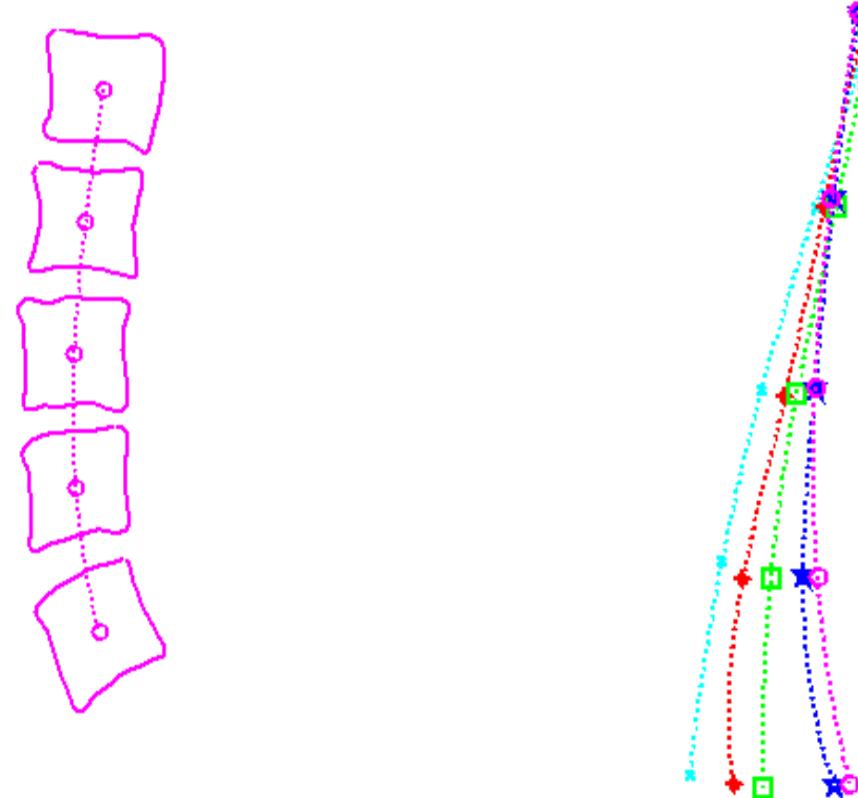
Zheng, Nixon and Allen,
IEEE TMI 2003

High Level Feature Extraction



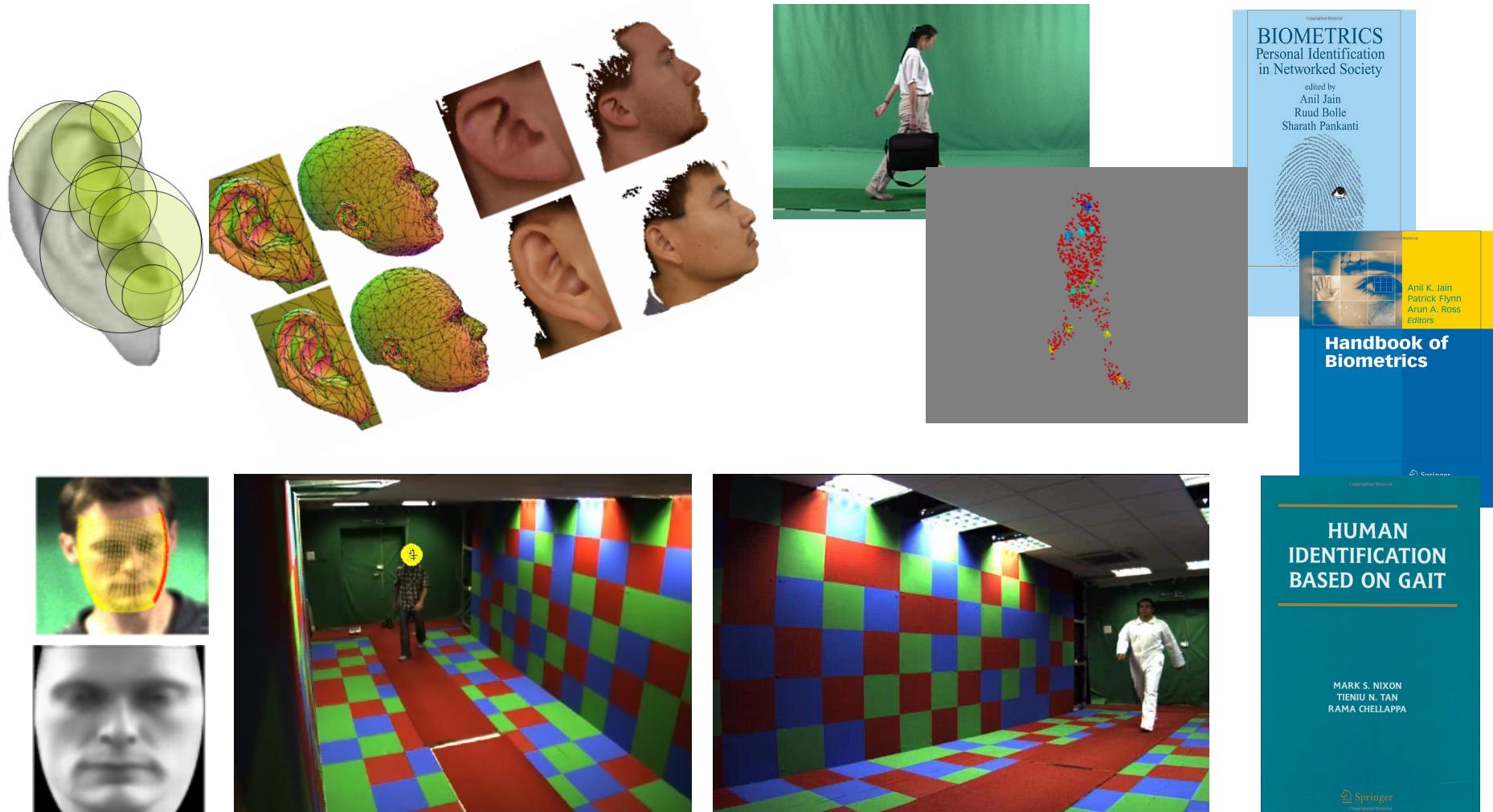
Zheng, Nixon and Allen,
IEEE TMI 2003

Animated Extraction



Zheng, Nixon and Allen,
IEEE TMI 2003

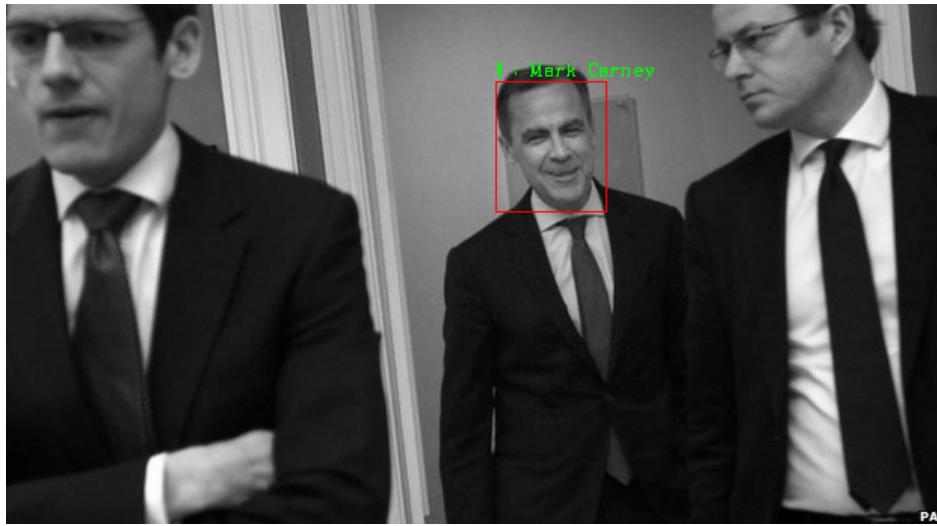
(Southampton's) Biometrics



Content-based Retrieval and Image Matching



Higher Level Visual Cognition



Who?



Where?



What?



Why?

Vision and Image Processing Support

- WWW homepages
 - <http://comp3204.ecs.soton.ac.uk> (for both 3204 & 6223)
- Worksheets & do-at-home exercises
- Demos:
 - http://www.ecs.soton.ac.uk/~msn/book/new_demo/
 - Interactive slides for Jon's part of the course
- Links
- Notes
- Tutorials (on demand)
- Book

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)

Worksheet Support (Mark)

- Mathcad
- Used in lectures
- Free download viewer
- Used for independent study
- Some Matlab, but incomplete

Coursework

- Last year we added coursework!
 - Much requested feature!
 - Worked really well
- Three courseworks
 - 2 individual
 - 1 in pairs (competition format)
- **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 6; fb wk 10
 - No 3: Set wk 8; handin wk 11; fb wk 12 (In pairs)
- COMP6223:
 - No 1: Set wk 3; handin wk 6; fb by wk 10
 - No 2: Set wk 5; handin wk 8; fb by wk 11
 - No 3: Set wk 8; handin wk 11; fb wk 12 (In pairs)

Finally

✓ Enjoy!

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