
University of
Nottingham
UK | CHINA | MALAYSIA
COMP-2032
Introduction to
Image Processing
Lecture 12
Finale & Revision

Learning Outcomes

IDENTIFY

1. The Whiteboard Problem – revisited
2. What we have learned
3. What to expect in YOUR upcoming exam

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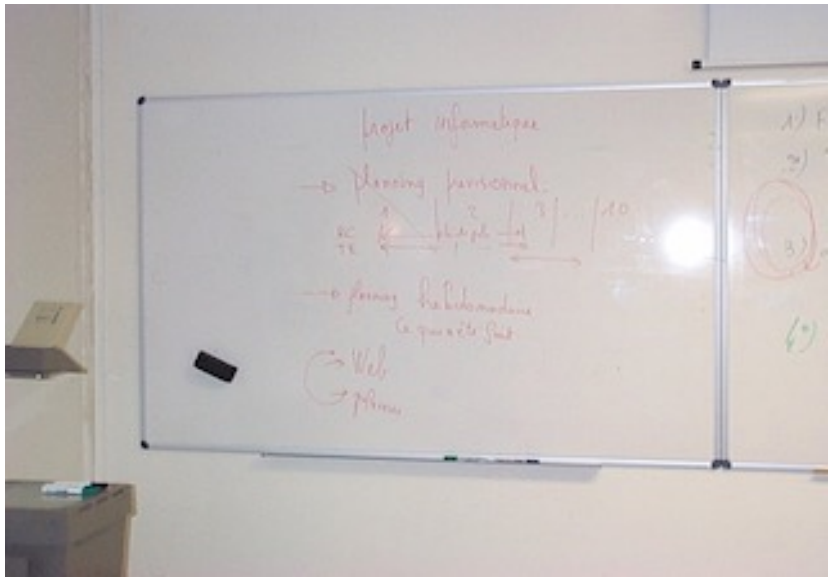
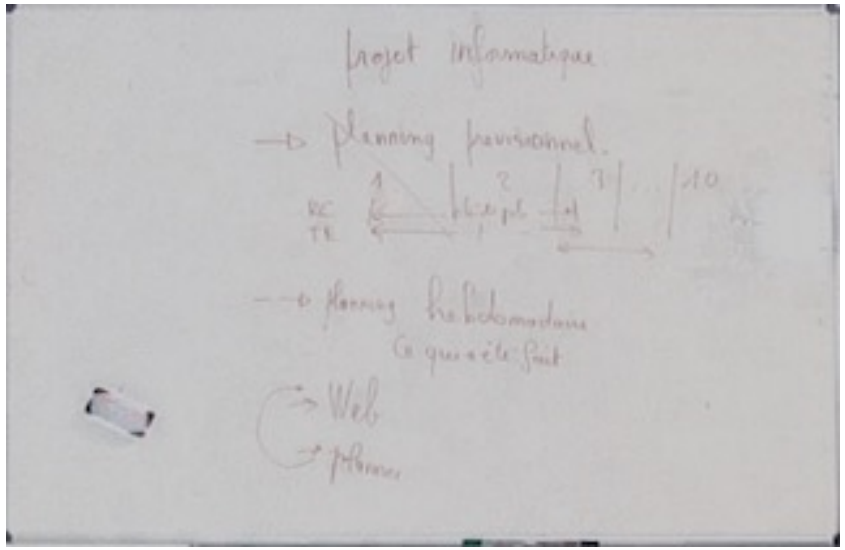
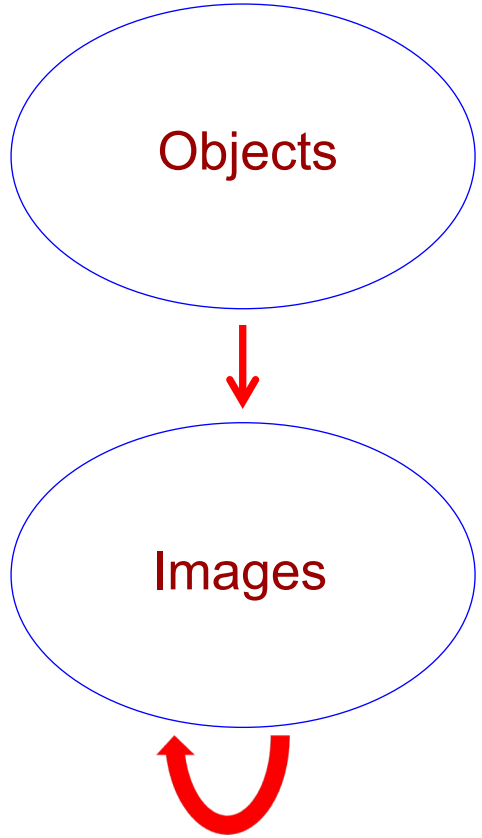
The Whiteboard Problem Revisited

Remember This?

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







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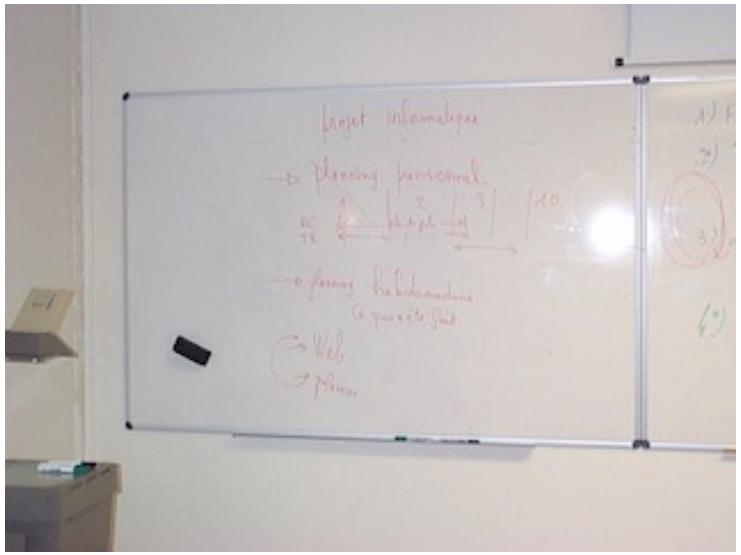
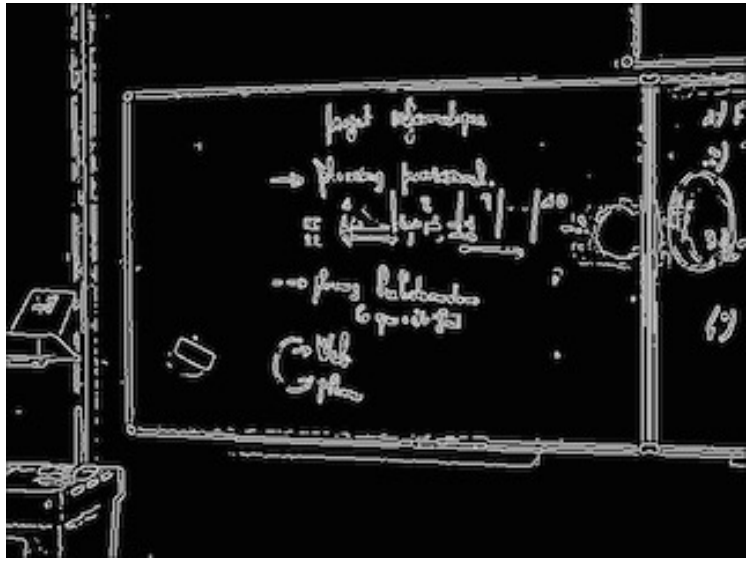
Whiteboard Problem Revisited

Step 1 Edge detection

Achieved here with a variation on the Canny operator





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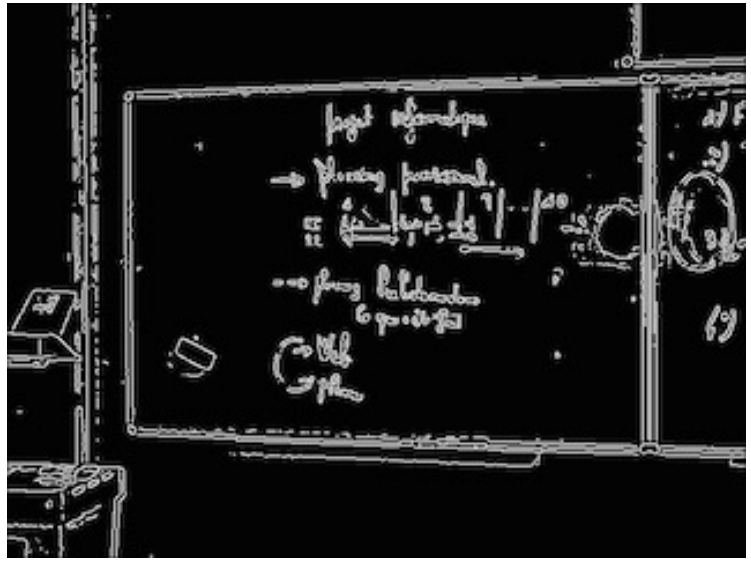
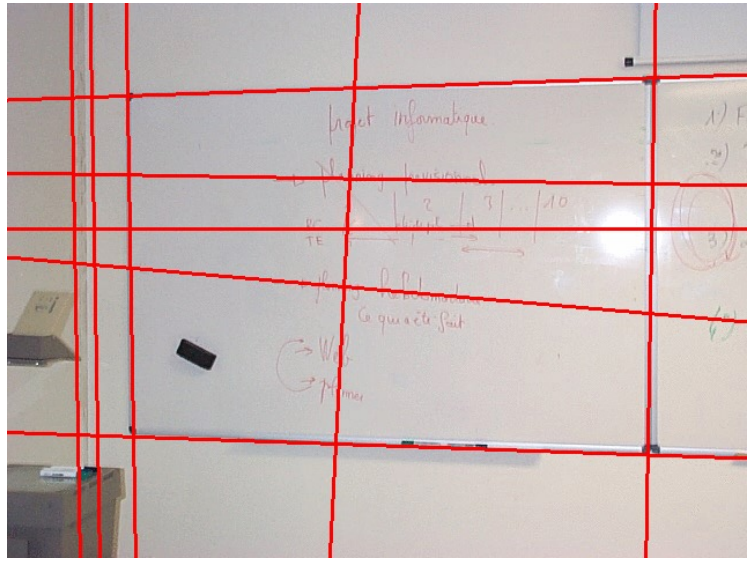
Whiteboard Problem Revisited

Step 2 — Line Finding

Two Hough Transforms: one detecting near horizontal (20º to -20º) and one near vertical (70º to 110º)





Keep only the 5 longest horizontal and vertical lines

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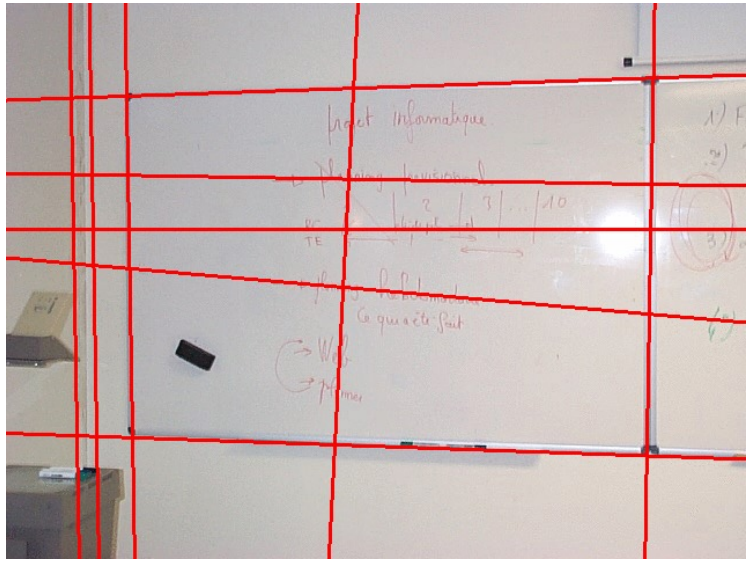
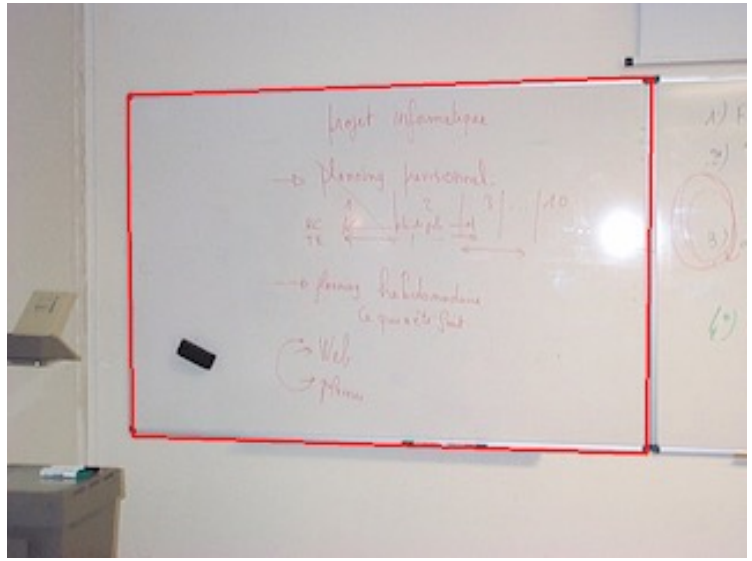
Whiteboard Problem Revisited

Step 3 Detect whiteboard border

Find quadrilaterals above threshold size with neighbouring edges at 90º and opposite sides oriented the same (+/- 30º)





Pick the one which lies over the most edges

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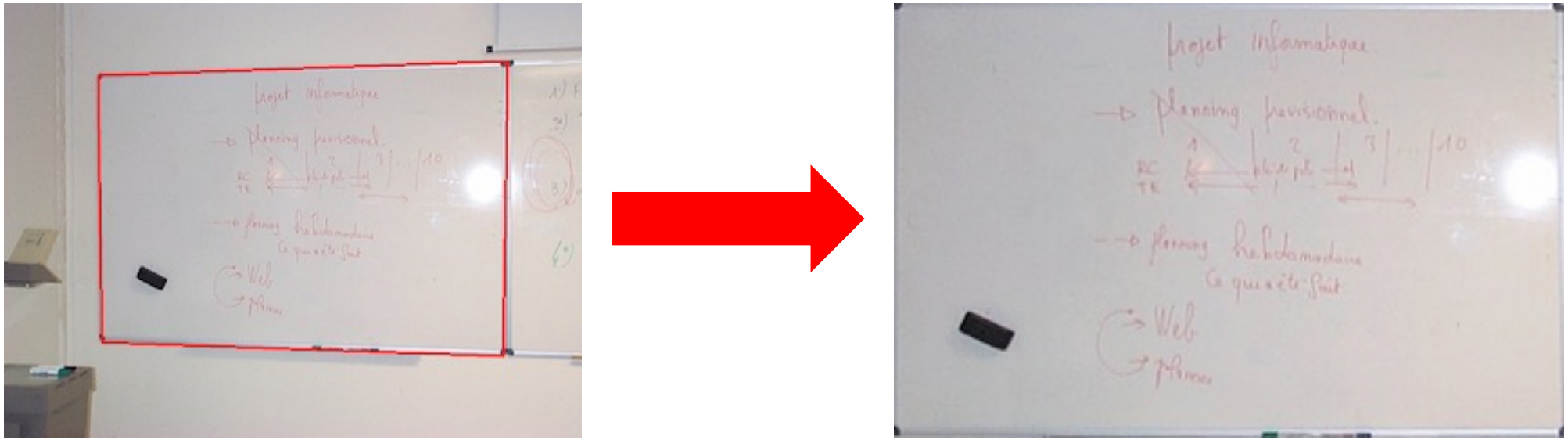
Whiteboard Problem Revisited

Step 4

Distortion Correction

This requires Geometric Transformation of the image



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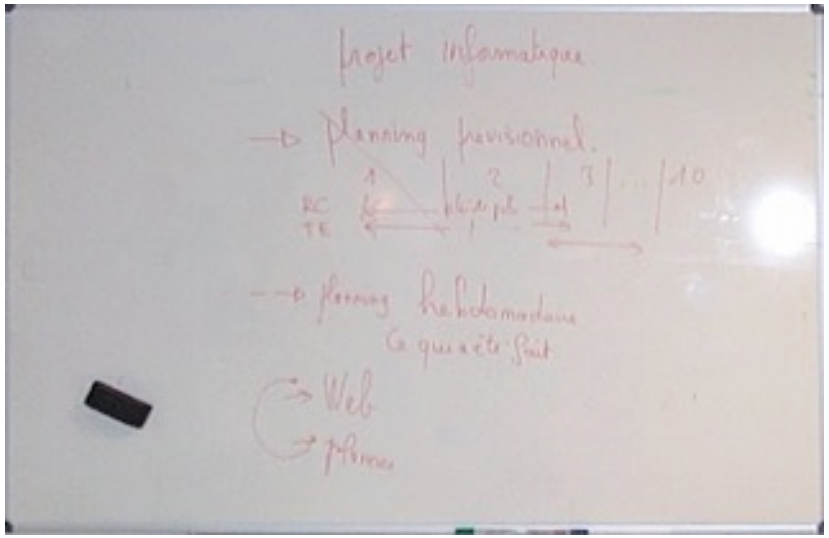
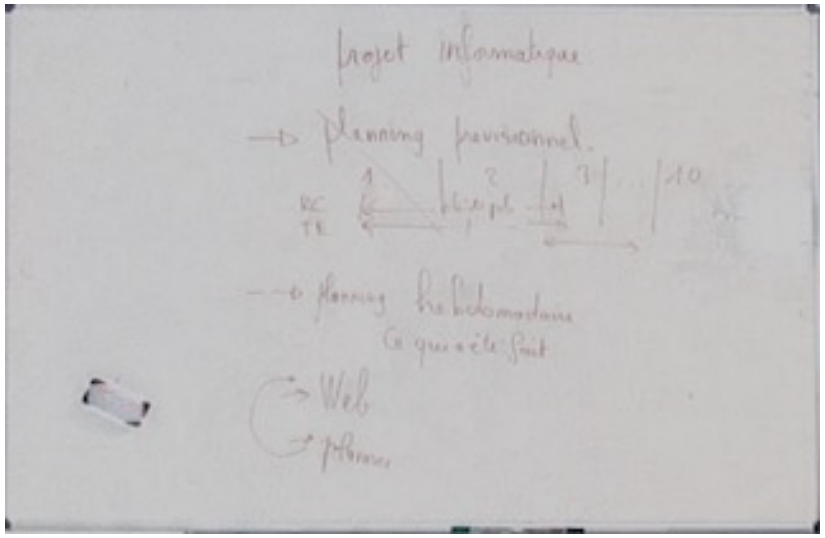
Whiteboard Problem Revisited

Step 5 — Illumination Correction

Need to enhance the high frequencies (writing)





- Frequency domain processing is one way
- In spatial domain:
  - Approximate low frequency component by smoothing
  - Subtract smoothed image from original to approximate high frequencies
  - Add mean of "low frequency" image to "high frequency" image to make it bright enough

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REWIND

A walk down MEMORY LANE…

Image formation and acquisition

- Background material: camera, Bayer patterns
- Basic terminology: sampling and quantisation
- A little image processing: re-sampling, re-sizing, re-quantisation

Colour spaces

- RGB, HSV, LAB etc.
- Image pre-processing: choosing a colour space is a key step in practical applications, but not really IP

Point transforms

- Gain, bias, contrast stretching, gamma correction
- Simplest methods, *but useful*

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A walk down MEMORY LANE…

Spatial filtering

- Convolution is key
- Noise removal: mean, Gaussian filtering
- Enhancement: unsharp masking, Laplacian filtering
- Edge detection: Roberts, Sobel, Marr-Hildreth, Canny

Non-linear filtering

- Median, anisotropic diffusion, bilateral filtering

Linear and non-linear filters are at the heart of the image processing toolbox

Thresholding and Binary Images

- Otsu, Unimodal thresholding
- Connected components, morphology (erosion, dilation)

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A walk down MEMORY LANE…

Histogram methods

- Histogram equalisation
- Comparing images: histogram intersection, histogram ratio
- An application: Image retrieval

Frequency domain

- An overview, broad structure of frequency domain methods
- Something you need to be aware of

Interactive methods and compositing

- Live-wire
- Blending (Distance transform)

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A walk down MEMORY LANE…

Compression

- *Increasingly important*
- Types of redundancy: coding, spatial, psychovisual
- Structure of compression systems
- Components and complete schemes: Huffman coding, GIF, JPEG

Segmentation and Line Finding

- Region growing, split and merge (quadtrees), watersheds
- Hough transforms

Geometric Transform (but not really)

A set of tools that can be used to create image processing pipelines

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Endgame

Module Aims

To introduce the fundamentals of digital image processing – theory & practice

Assessed by exam: how do techniques work, and what do they do

To gain practical experience in writing programs to manipulate digital images

Assessed by coursework – no coding in the exam

To lay the foundation for studying advanced topics in related fields

Computer Vision, Computer Graphics next year?

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Exam

- 1 hour exam
- Answer each of 3 questions
- Focus on image processing methods:
  - What they do
  - How they work
  - When they are appropriate
  - *Knowledge, Comprehension, Application*
  - Questions are (loosely) structured, topic area indicated

Read and answer the question

Take no. of marks available into account

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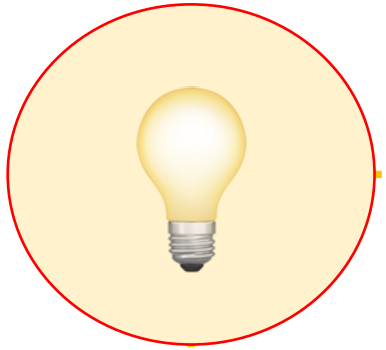
Summary



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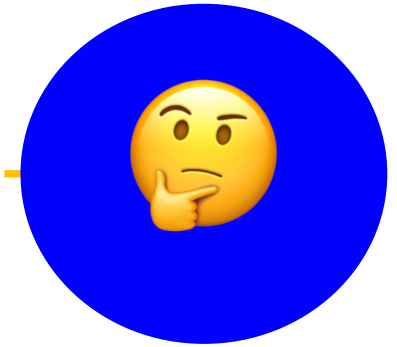


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Questions


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That’s ALL folks!