



# EcoFAB Phenomics

## Image Analysis & Object Detection

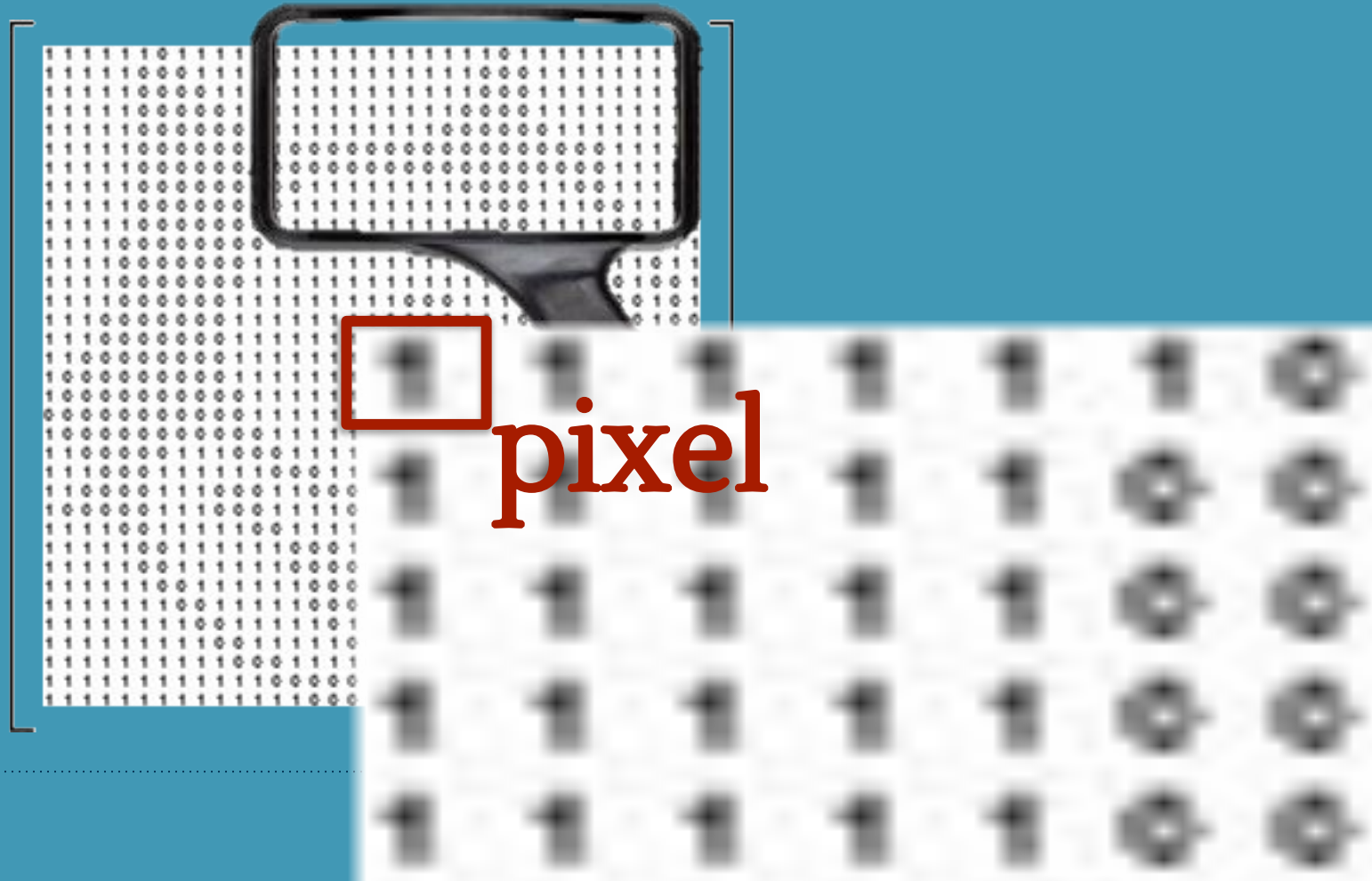
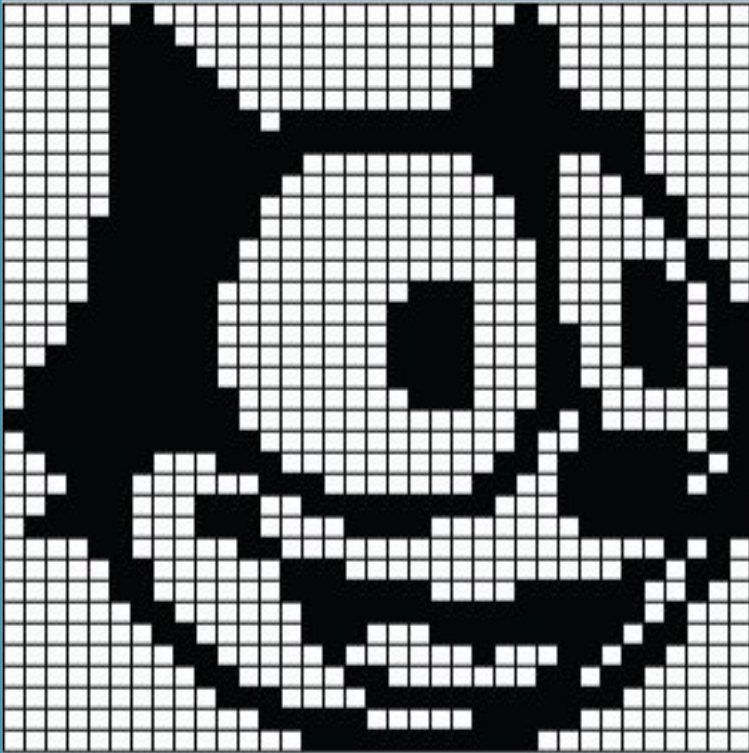
# What is image analysis?

- **Digital image analysis** is the process of using computer algorithms to process, analyze, and interpret visual information from digital images.
- **Goal:** extract meaningful information from images, such as identifying **patterns**, measuring **objects**, or detecting **changes**, which can be used in various applications like medical imaging, remote sensing, and robotic vision.
- **Recognize** content in a picture: Is it an animal or a vehicle?
- **Measure content:** How many objects?

# What is an image?

- Image is just a matrix of pixels

Matrix  $A_{m \times n}$



# Flavors of image

- Depends on the content of the cell matrix



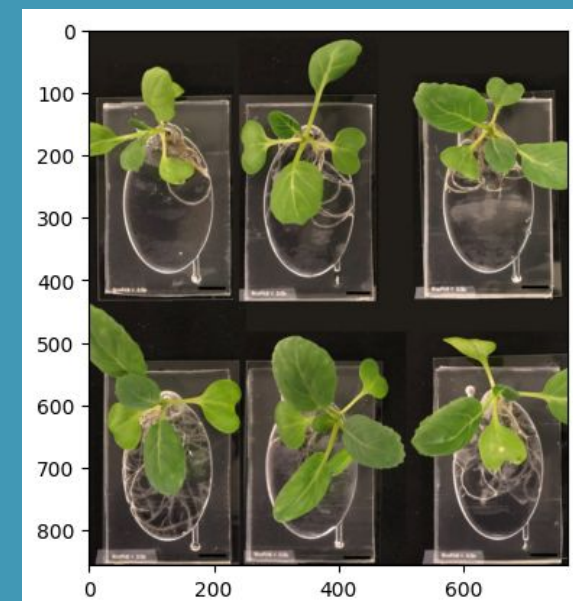
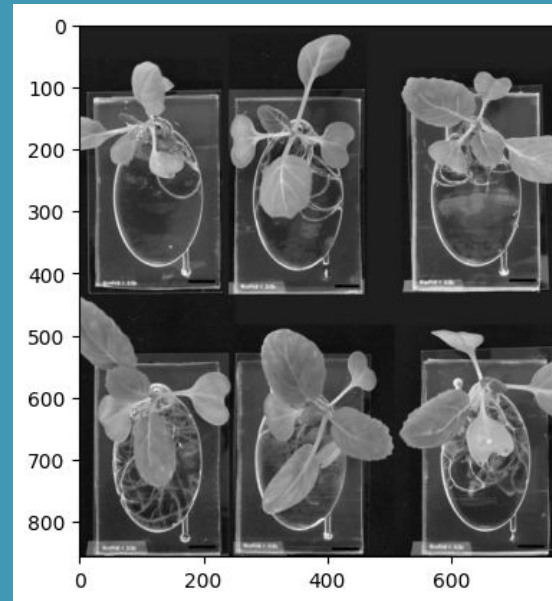
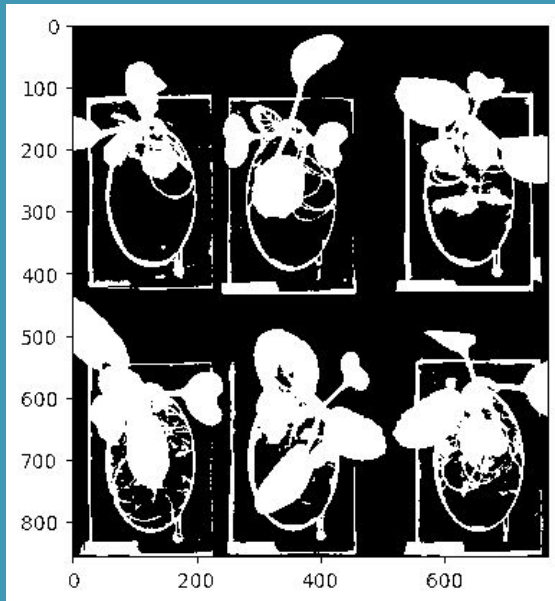
binary



grayscale

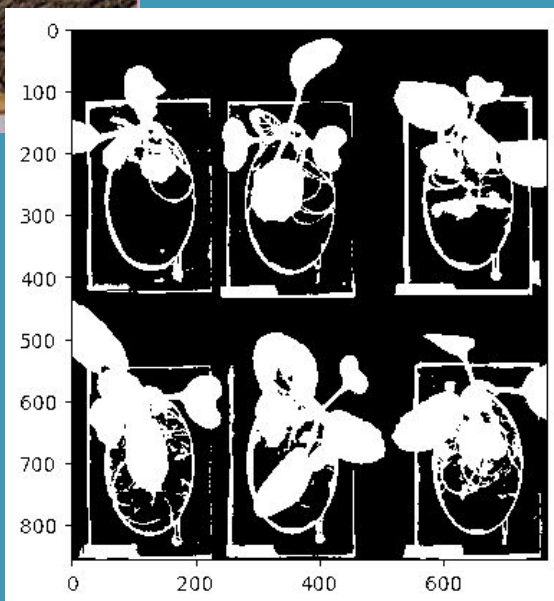


color





# Binary



Only two possible values (*bi-*), zero and one;  
Aka black-and-white, B&W, monochrome or monochromatic;

Each pixel needs 1 bit to hold this information;

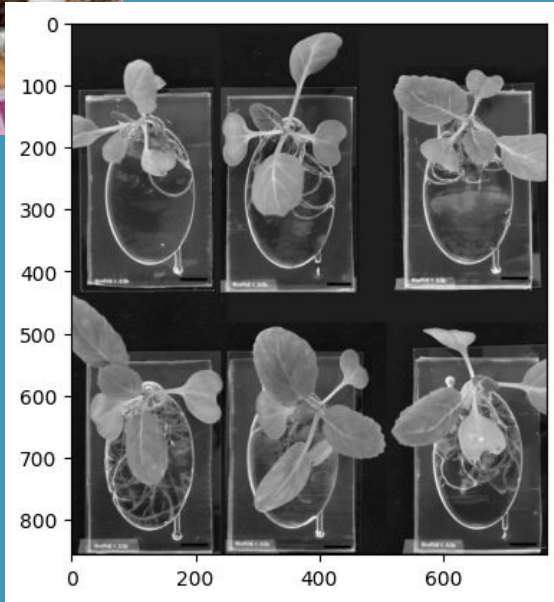
- Pixel depth = 2;
- Question: How many unique possible colors?

Very important in image recognition:

- OCR;
- Forensics: fingerprints.



# Grayscale



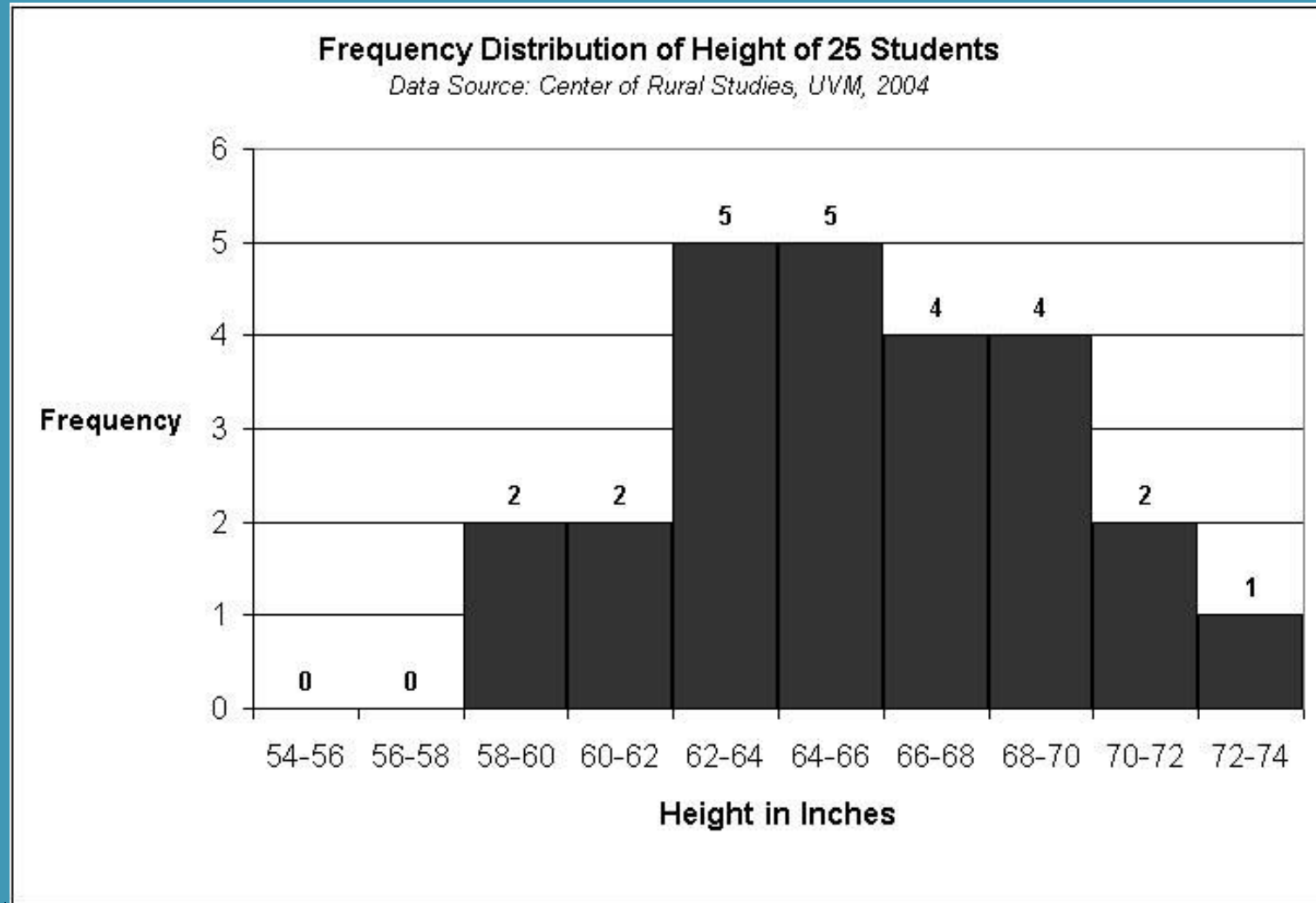
As the binary, it uses only one  $m \times n$  matrix;  
Each pixel needs several bits to hold different shades of gray;

- Ex: pixel depth = X;
- Question: how many shades if 5 bits?
- `>> img.shape` returns  $(m,n)$
- Common number of bits: 8, 16, 24

You can use grayscale images to obtain the binary image:

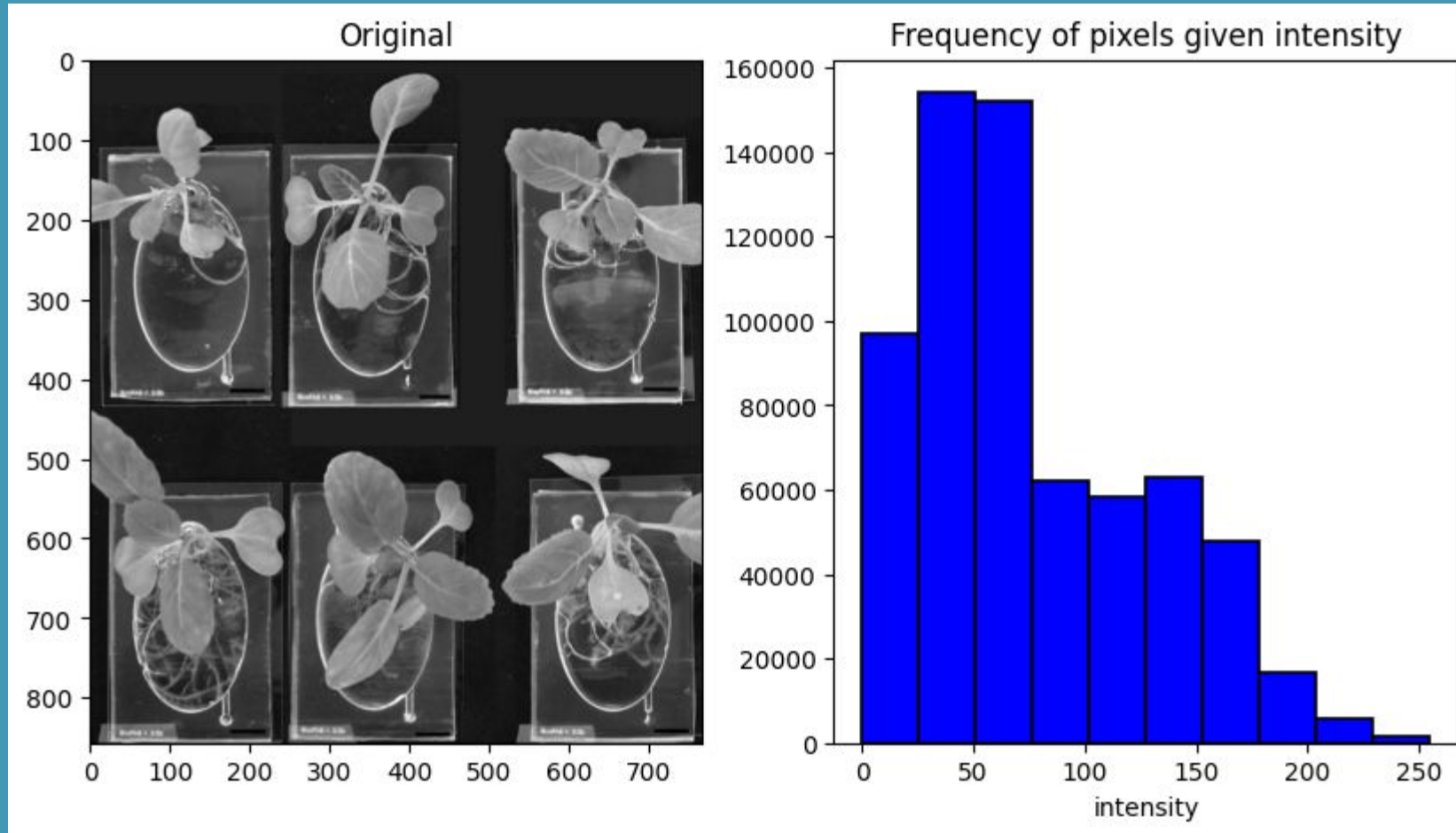
- Image histogram: a matrix is a set of numbers;
- Threshold: a value that splits the image into black and white.

# Histogram





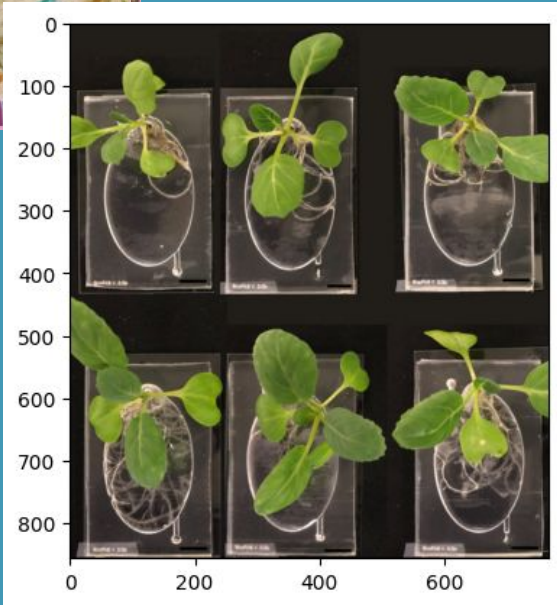
# Image Histogram







# Color



As the binary and grayscale, it uses  $m \times n$  matrix;

Because we need a triplet to code a colored pixel, we will have three  $m \times n$  matrices;

- How would you represent this triplet?
- Let's call our color Image C
- `>> C.shape` returns  $(m,n,3)$
- `>> C[0,0,0] = 0` assigns 0 to red channel top left corner

# Hands-on

Google colab:

<https://colab.research.google.com/drive/1OkoYEVa7O3jA8oLcLIXDeX5pSRPTef2d#scrollTo=QB3UPIBcKb51>

Requirements: participant must have a gmail account