

Welcome to the

# BOBIAAC



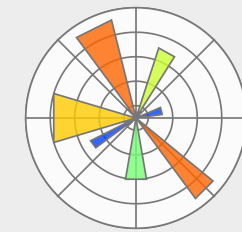
Boston Bioimage Analysis Course | 2026




**CITE:** [cite.hms.harvard.edu](http://cite.hms.harvard.edu)

 **Date:** 6th -11th July 2025, 9:00 am - 6:30 pm

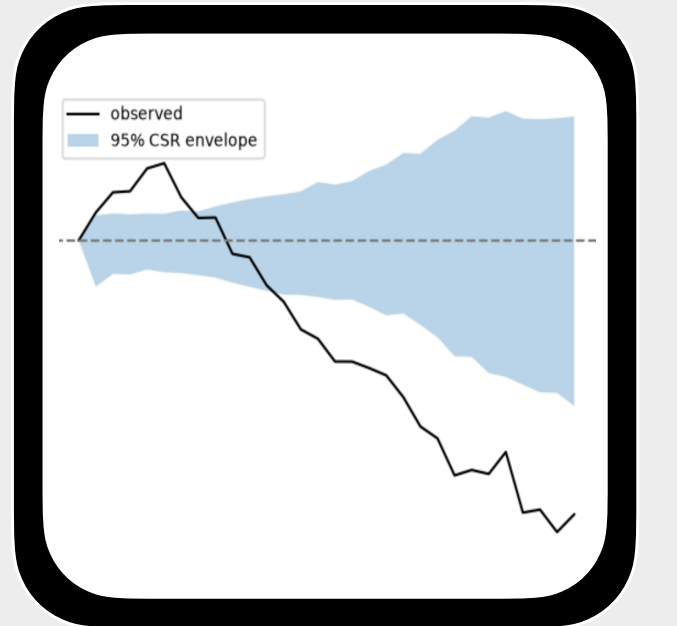
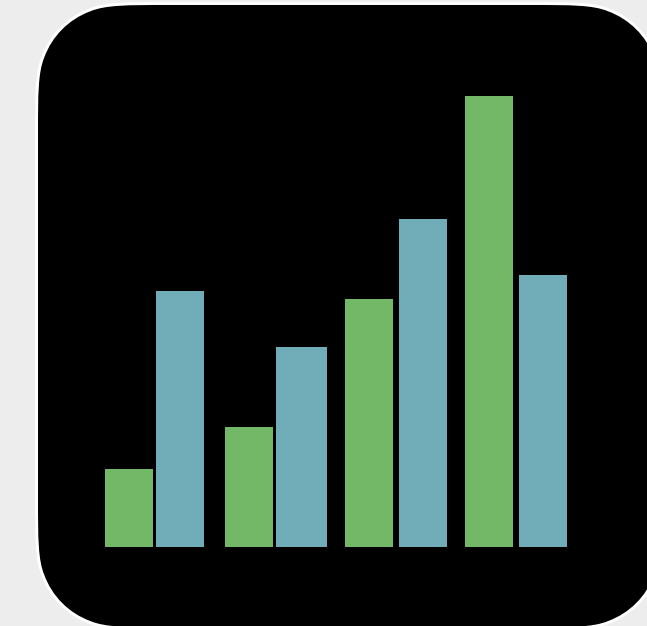
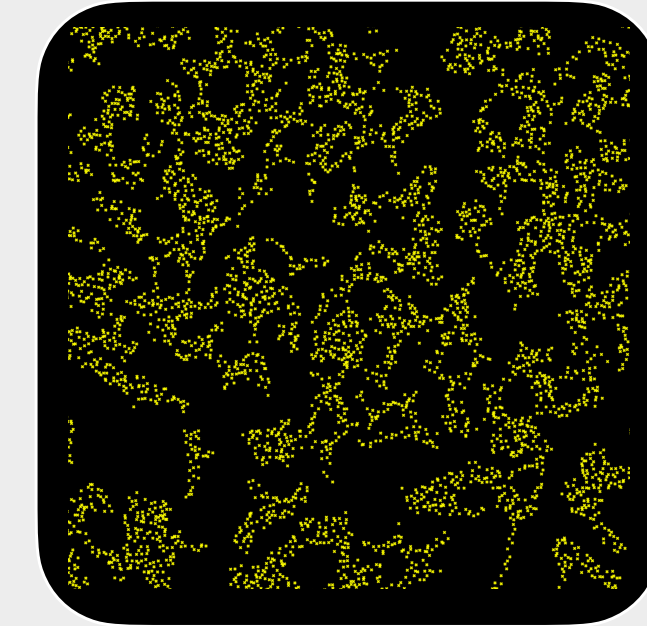
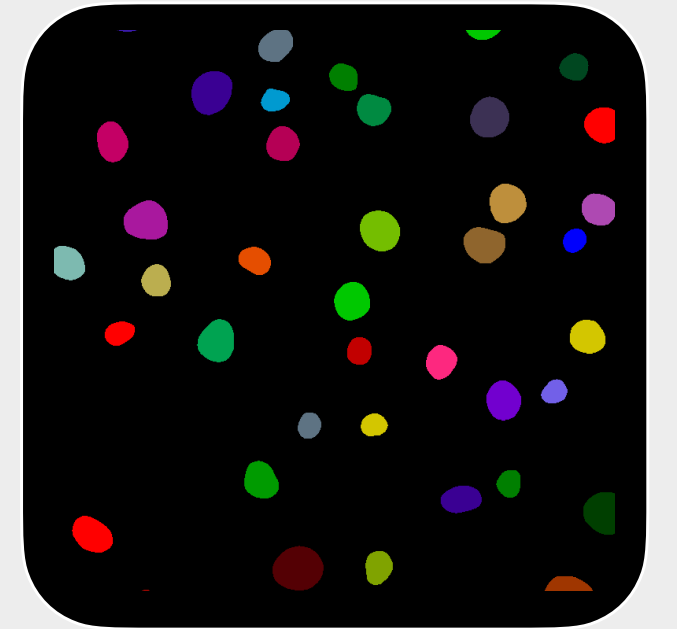
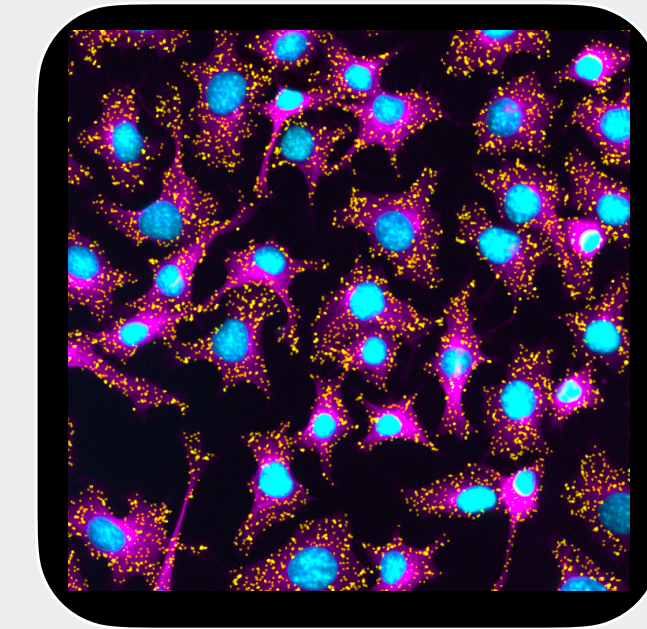
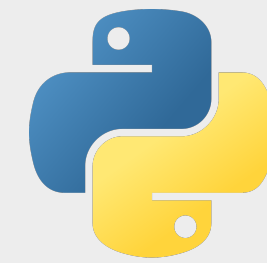
 **Time:** 9:00 am - 6:30 pm



 **location:** Gordon Hall - Harvard Medical School

 **website:** [bobiac.github.io](http://bobiac.github.io)

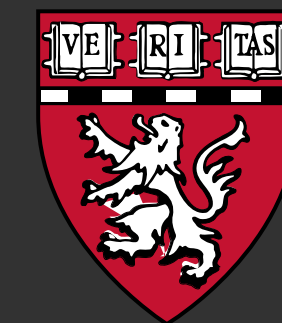
 **course material:** [bobiac.github.io/bobiac-book](http://bobiac.github.io/bobiac-book)



**CITE**  
Core for Imaging Technology & Education



**BioImaging  
North America**



**HARVARD  
MEDICAL SCHOOL**



# The BoBiAC Team



CITE: [cite.hms.harvard.edu](http://cite.hms.harvard.edu)



**Federico Gasparoli, PhD**

Director  
Core for Imaging Technology & Education  
Harvard Medical School



**Eva de la Serna, PhD**

Associate Director  
Core for Imaging Technology & Education  
Harvard Medical School



**Max Brambach, PhD**

Postdoc  
Oyler-Yaniv Lab  
Harvard Medical School

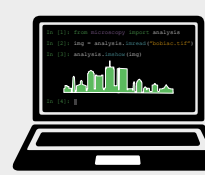


**Amelie Andreas**

Research Assistant  
Paulsson Lab  
Harvard Medical School

 Organizer & Instructor  Teaching Assistant





# General Information

## Internal communications:

- Slack channels (mainly #course-announcements & DMs)

## location:

- Harvard Medical School - Gordon Hall - Room 106

## time:

- 9:00 am - 6.30 pm
- optional office hours from 7:30 pm

## breakfast:

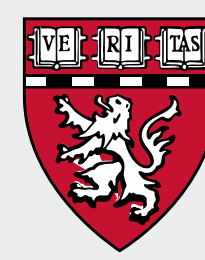
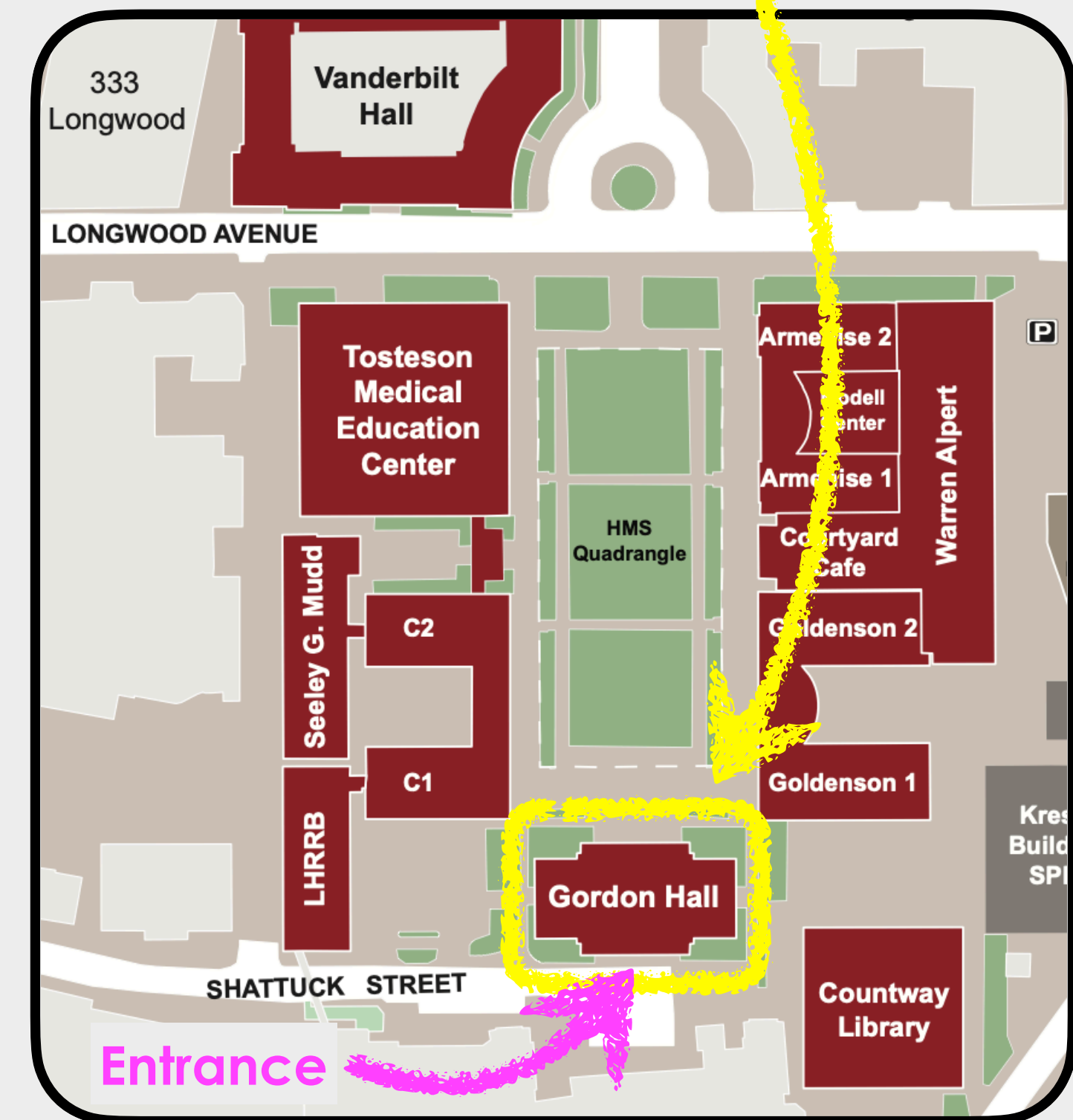
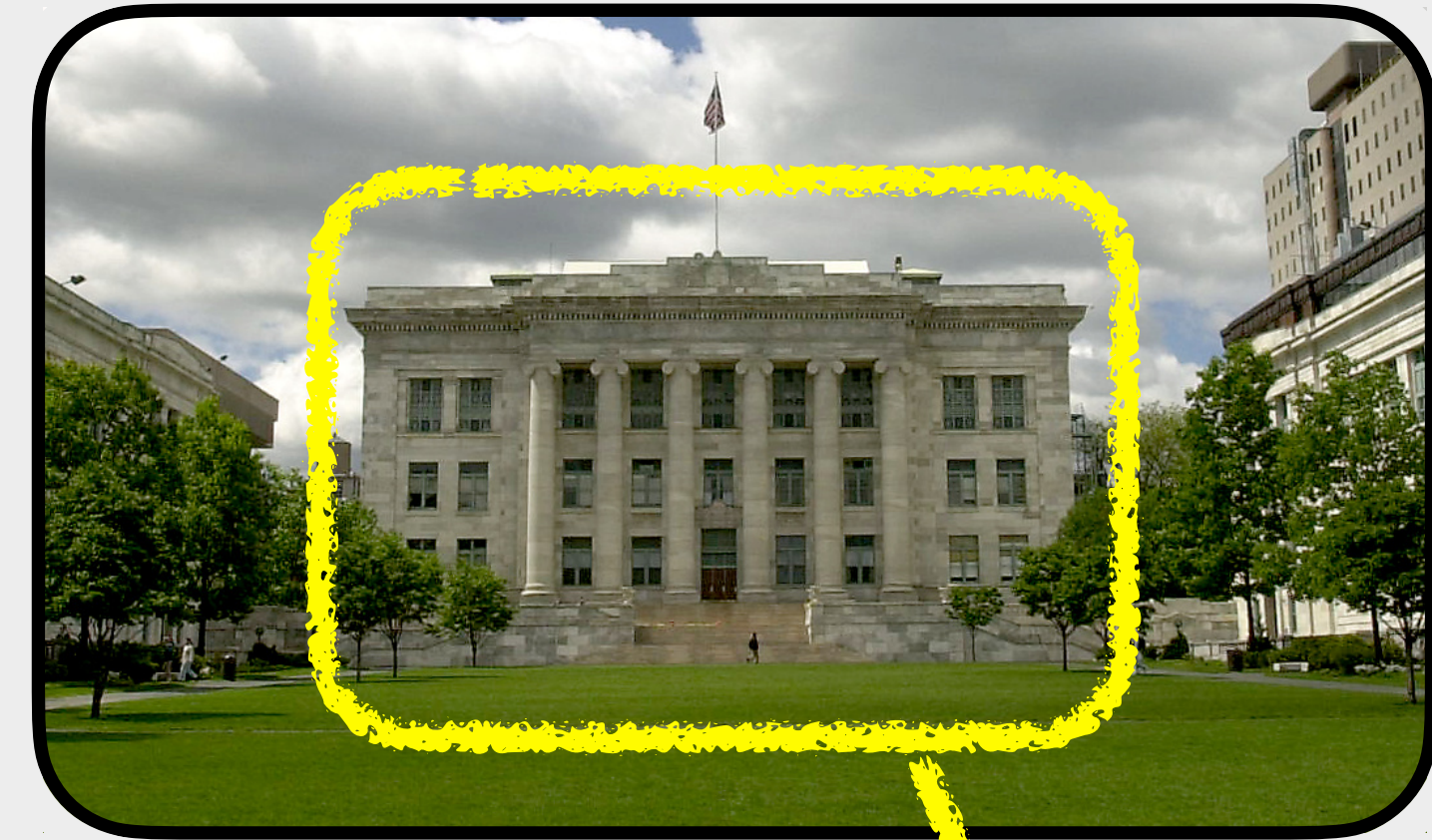
- bagels 🥯, coffee, tea & snacks @ 9:00 am

## lunch:

- 12:00 pm in Gordon Hall, Room 106

## social dinner:

- Thursday July 9th @ 7:00 pm
- Shy Bird (201 Brookline Ave, Boston - 10 min walk)
- we leave @ 6:30 pm 🚶





# WiFi Connection

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- ▶ **Harvard Secure:** if you have Harvard credentials
- ▶ **Eduroam:** if you have academic credential (edu)
- ▶ **Harvard Guest:** you will need to register your laptop for that (if you provided the MAC address in advance, you should be able to directly connect)
- ▶ If all of above do not work, let us know!



# Course Structure

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 [bobiac.github.io](https://bobiac.github.io)



- ▶ The course is designed for **beginners** in python and image analysis
- ▶ Each day consists of a **mix of lectures** explaining key bioimage analysis concepts, interspersed with **practical, hands-on exercises** using **Python**.
- ▶ Every morning, we will **start** the day **with coffee** and **open discussion** (Q&A).
- ▶ Most of these **exercises** will be completed either **step-by-step as a class** or in small groups.
- ▶ The course should be **interactive**, there are absolutely **no stupid questions**, you are encouraged to ask questions. During the practical exercise feel free to consult with your neighbors, you can help each other to understand concept.
- ▶ Each day (first four days), five participants will give a **brief 3–5 minute introduction** using their prepared slide (introduce yourself, your work, and the image analysis tasks you hope to perform).





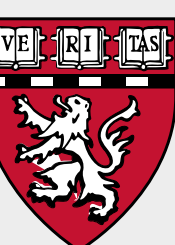
# Schedule



[bobiac.github.io](https://bobiac.github.io)



	Monday 6th July	Tuesday 7th July	Wednesday 8th July	Thursday 9th July	Friday 10th July	Saturday 11th July	
9:00am - 9:30am	Welcome + Intro	Coffee & Questions?	Coffee & Questions?	Coffee & Questions?	Coffee & Questions?	Coffee & Questions?	
9:30am - 10:00am	Coffee Break	Error Messages	Segmentation (Machine Learning)	Segmentation (Deep Learning)	Single Cell Measurements	Cell Population Measurements (Spatial Statistics & Colocalization)	
10:00am - 10:30am	Getting Started with Python	Python Bioimage Analysis					
10:30am - 11:00am							
11:00am - 11:15am	Laptops Setup	Coffee Break	Coffee Break	Coffee Break	Coffee Break	Coffee Break	
11:15am - 11:30am	The Python Basics	Segmentation (Classic)	Segmentation (Deep Learning)	Deep Learning Spot Detection	Single Cell Measurements	Cell Population Measurements (Spatial Statistics & Colocalization)	
11:30am - 12:00pm							
12:00pm - 12:30pm	Lunch	Lunch	Lunch	Lunch	Lunch	Lunch	
12:30pm - 1:00pm							
1:00pm - 1:30pm	Student Presentations (5x5min)	Student Presentations (5x5min)	Student Presentations (5x5min)	Student Presentations (5x5min)	Cell Population Measurements (Spatial Statistics & Colocalization)	Student Group Work	
1:30pm - 2:00pm	The Python Basics	Segmentation (Classic)	Segmentation (Deep Learning)	Managing your own Python Workflow			
2:00pm - 2:30pm				Introduction to Digital Images		Student Group Work	
2:30pm - 3:00pm	Coffee Break					Coffee Break	Coffee Break
3:00pm - 3:30pm							
3:30pm - 4:00pm							
4:00pm - 4:30pm	Python for Bioimage Analysis	Segmentation (Machine Learning)	Segmentation (Deep Learning)	Student Group Work	Cell Population Measurements (Spatial Statistics & Colocalization)	Using Python in the Real World	
4:30pm - 5:00pm				Measurements and Quantification			
5:00pm - 5:30pm							
5:30pm - 6:00pm	Coffee Break	Coffee Break	Coffee Break	Coffee Break	Coffee Break	Coffee Break	
6:00pm - 6:30pm	Python for Bioimage Analysis	Segmentation (Machine Learning)	Segmentation (Deep Learning)	Measurements and Quantification	Measurements and Quantification	Feedback & Wrap-Up	
6:30pm - 7:30pm				Social Dinner			
7:30pm - 8:30pm	Optional: Office Hour	Optional: Office Hour	Optional: Office Hour		Optional: Office Hour		
8:30pm - 9:30pm							

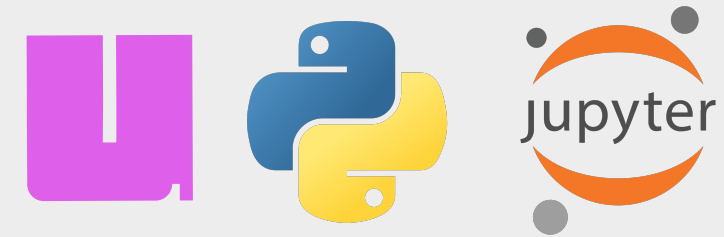


# Course Topics I

 [bobiac.github.io](https://bobiac.github.io)



## Learning Python Basics



- ▶ **Getting Started with Python and uv:** what is python? How do I install it? How do I use it?
- ▶ **The Python Basics:** how do I write python code? What is the syntax?



# Course Topics II

 [bobiac.github.io](https://bobiac.github.io)



## Learning Python for Bioimage Processing & Analysis



- ▶ **Digital Images & Python:** what is a digital image? How do I deal with it in python?
- ▶ **Image Segmentation with Python:** what are semantic and instance segmentation? how do I perform segmentation on my fluorescence images? [Classical Methods, Ilastik (ML) & Cellpose (DL)]
- ▶ **Spot Detection:** how can we detect small spot-like objects such as fluorescent puncta, foci, beads, or RNA spots in fluorescence images? [Spotiflow (DL)]
- ▶ **Object Classification:** how can I classify objects in my images into different categories (e.g., mitotic vs. non-mitotic cells) to enable class-specific analysis? [Ilastik]
- ▶ **Measurements & Quantification with Python:** how can I extract quantitative data from my fluorescence images for plotting and drawing conclusions from my experiments?
- ▶ **Colocalization analysis with Python:** what is colocalization in fluorescence microscopy? How can I quantify it?

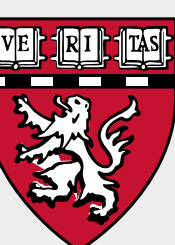
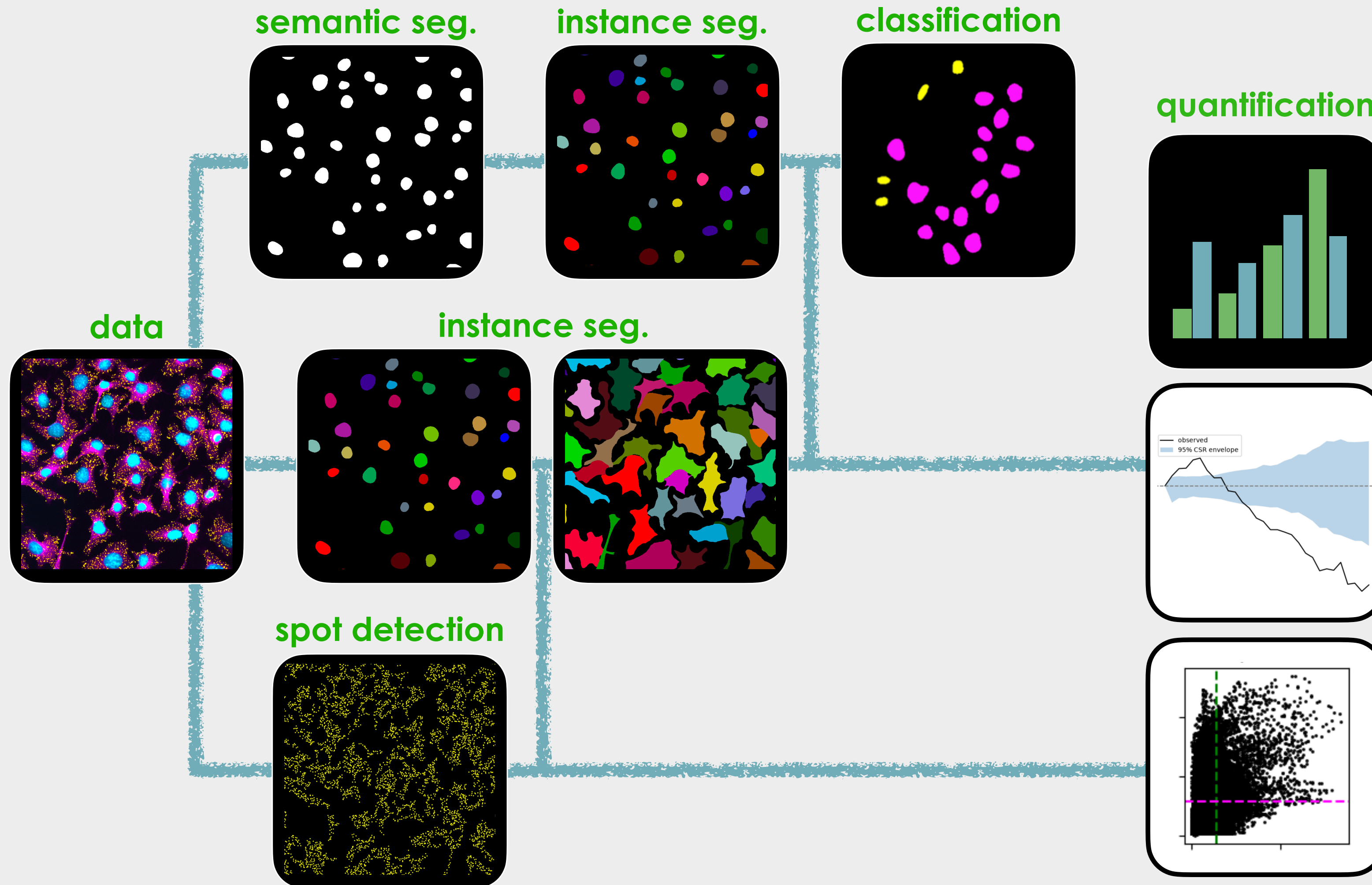


# Course Topics II

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## Learning Python for Bioimage Processing & Analysis



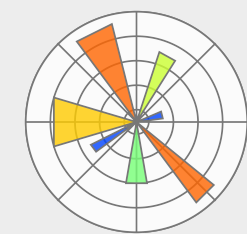
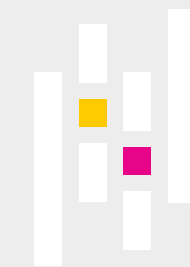
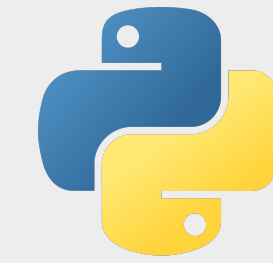
# Learning Objectives

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 [bobiac.github.io](https://bobiac.github.io)



▶ ~~Become a Python & Bioimage Analysis Expert!~~



# Learning Objectives

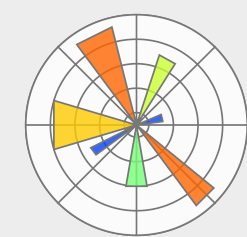
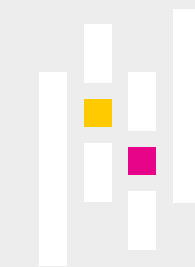
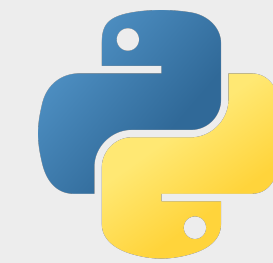
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## ▶ ~~Become a Python & Bioimage Analysis Expert!~~

- ▶ Gain a basic understanding of **what Python is**.
- ▶ Learn how to **get started with Python: installing Python**, setting up **virtual environments**, and launching **Jupyter Notebooks** and **.py** files.
- ▶ Get familiar with key **Python packages** commonly used in bioimage analysis.
- ▶ Learn how to **load, handle, and display images** using Python.
- ▶ Explore different approaches to **image segmentation** in Python, including classical methods, machine learning (Ilastik), and deep learning (Cellpose).
- ▶ Learn how to use deep learning for spot detection (Spotiflow).
- ▶ Understand the basics of **image quantification and measurements** and how to apply them using Python (e.g. single-cell measurements, spatial statistics, and colocalization).

( ▶ Improve LLM prompts)






# Course Material





[bobiac.github.io](https://bobiac.github.io)






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Home

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Boston Bioimage Analysis Course | 2026

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Welcome to the BoBiAC Book

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- 08 - Colocalization

**BoBiAC Exercises**

- BoBiAC Exercises

**Course Materials Downloads**

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**Links**

- [BoBiAC](#)
- [uv](#)
- [juv](#)
- [pyrunner](#)
- [Core for Imaging Technology & Education \(CITE\)](#)

**Past Editions**

- 2025 Edition

## Welcome to the BoBiAC Book

Welcome to the [BoBiAC Book](#) — your resource for the [Boston BioImage Analysis Course \(BoBiAC\)](#). This book is designed for **beginners** and provides a **hands-on introduction to image analysis using Python**. Inside, you'll find everything you need to follow the course: lecture slides, Jupyter notebooks, datasets, and step-by-step guidance through the material.

## Lecture Slides

All [Lecture Slides](#) within the book are available for download as PDFs. You can download the complete slide decks from the [Course Materials Downloads](#) section of this book. Additionally, each individual page that contains lecture slides has a [Download the Slides](#) button at the top for convenient access to slides for that specific topic.

## Jupyter Notebooks

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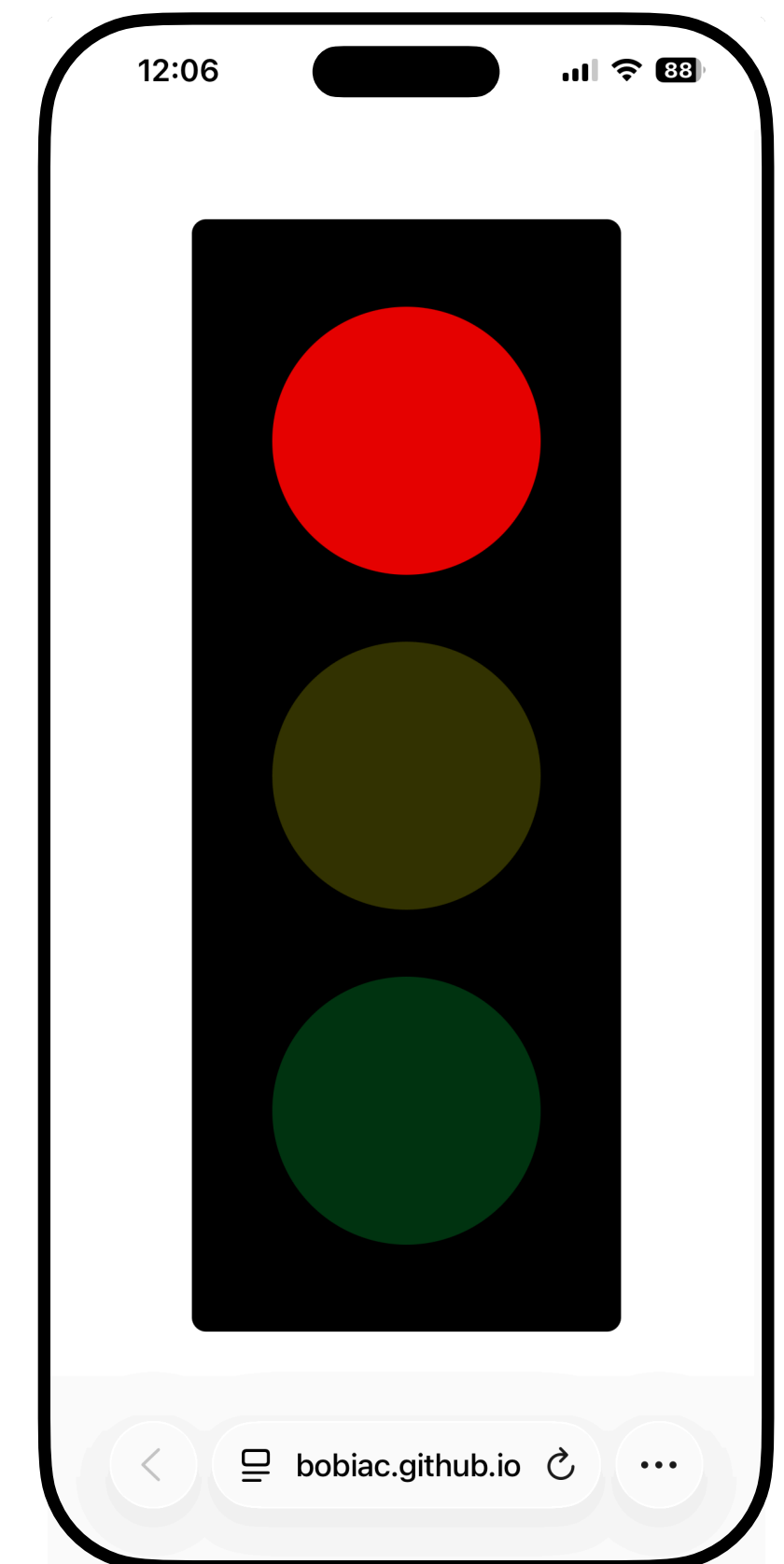
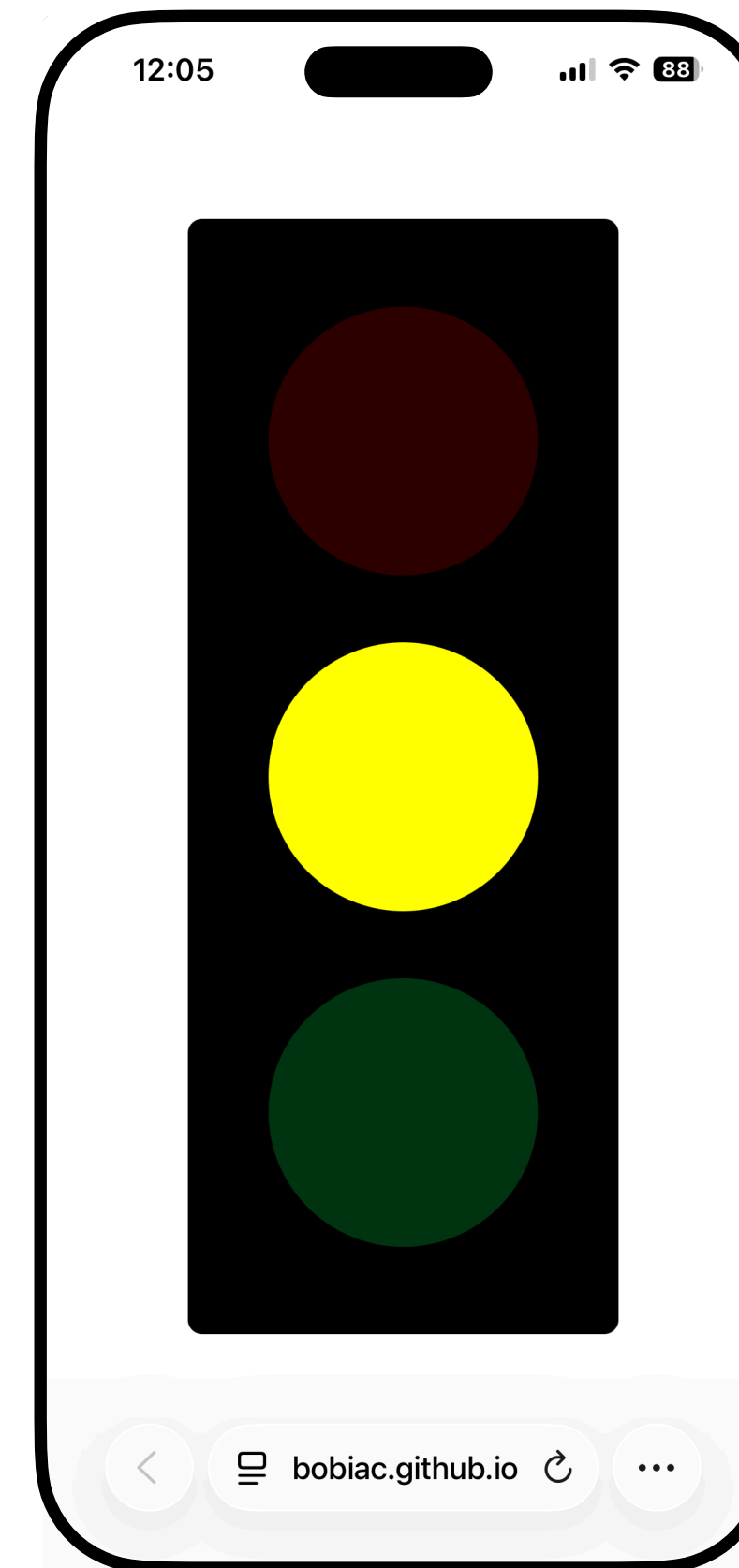
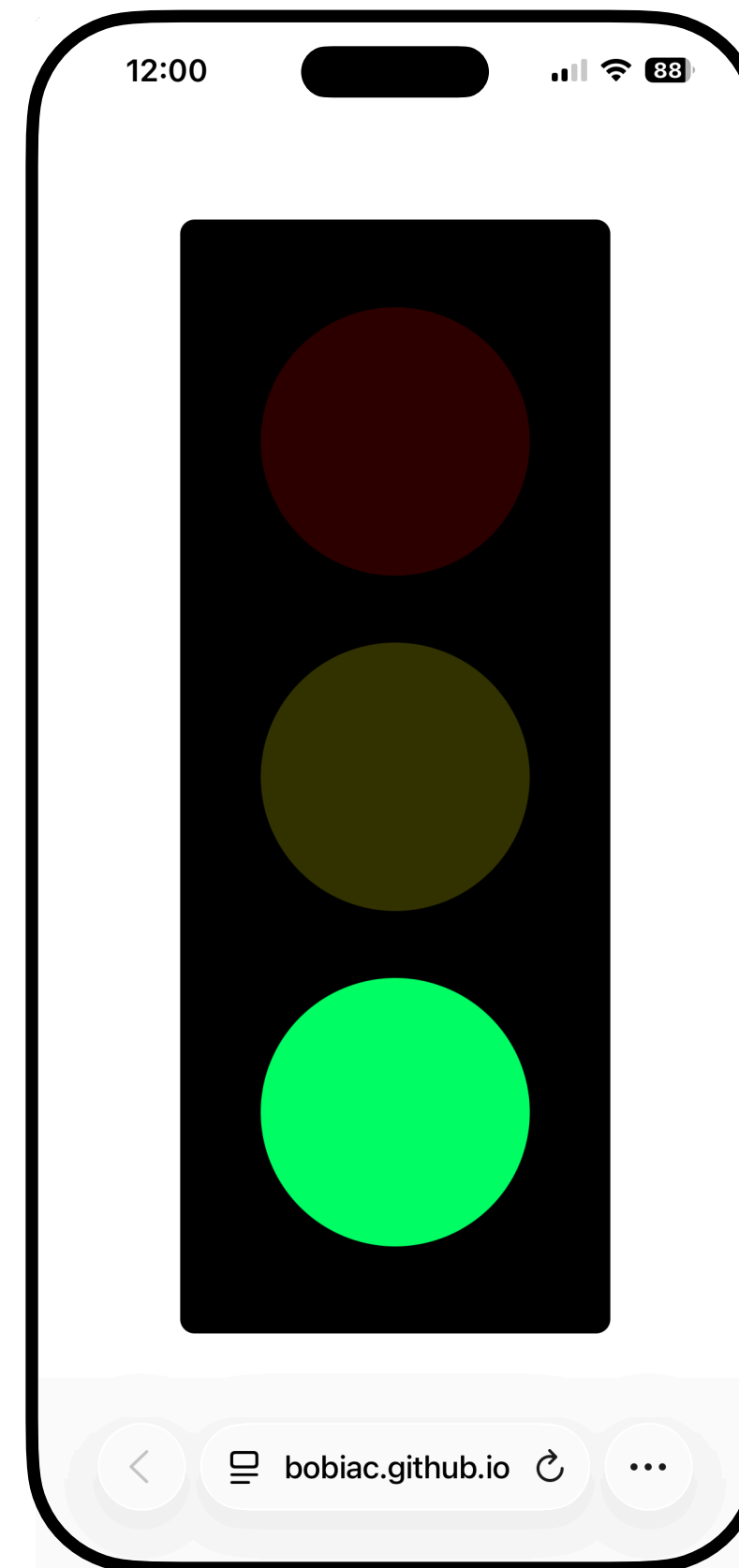
[bobiac.github.io/bobiac-book](https://bobiac.github.io/bobiac-book)





[bobiac.github.io/classlight/bobiac2026](https://bobiac.github.io/classlight/bobiac2026)

Realtime Feedback!



# ? Questions

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 [bobiac.github.io](https://bobiac.github.io)





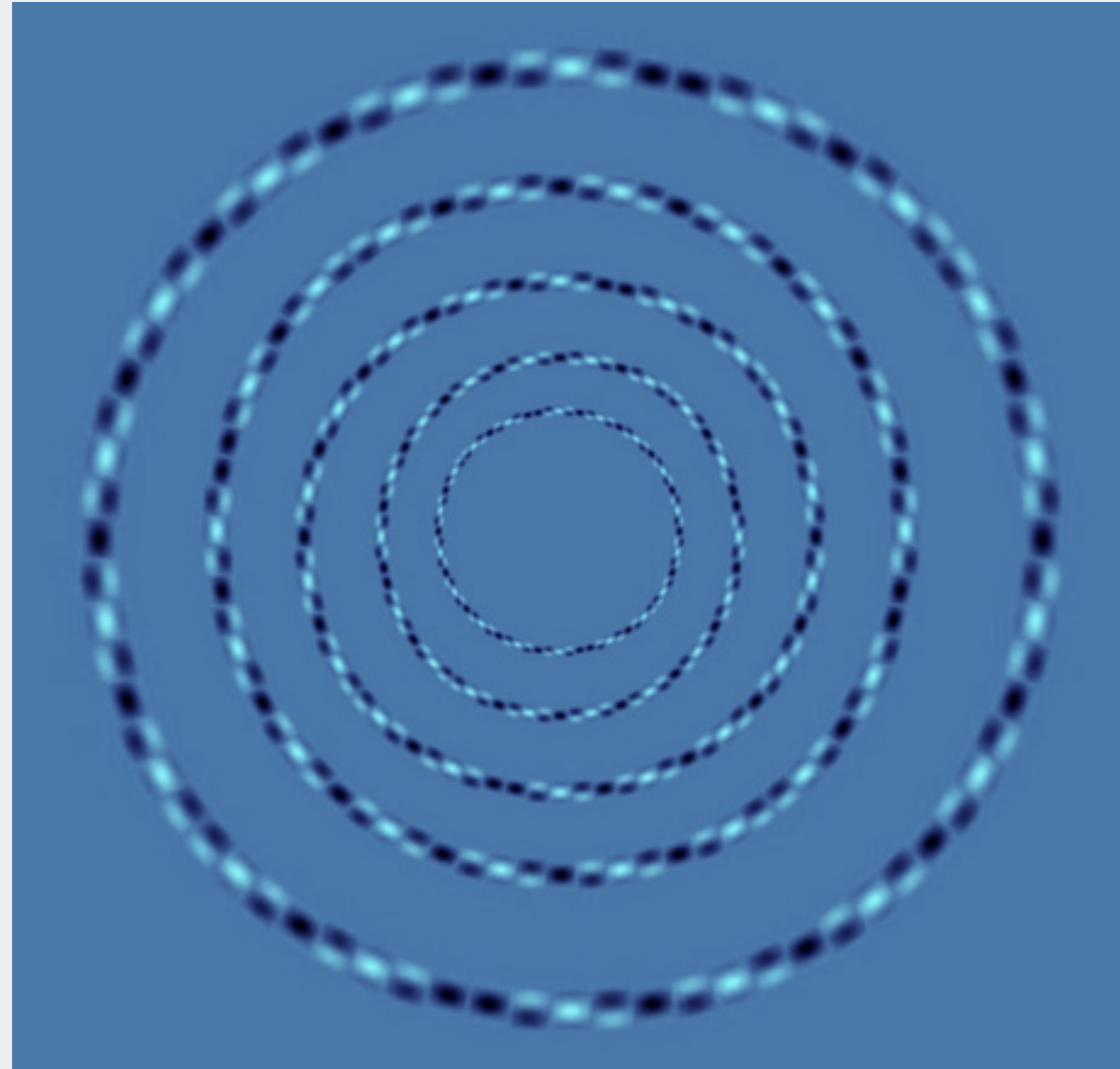
# Why should you analyze images with computers?

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# Why should you analyze images with computers?

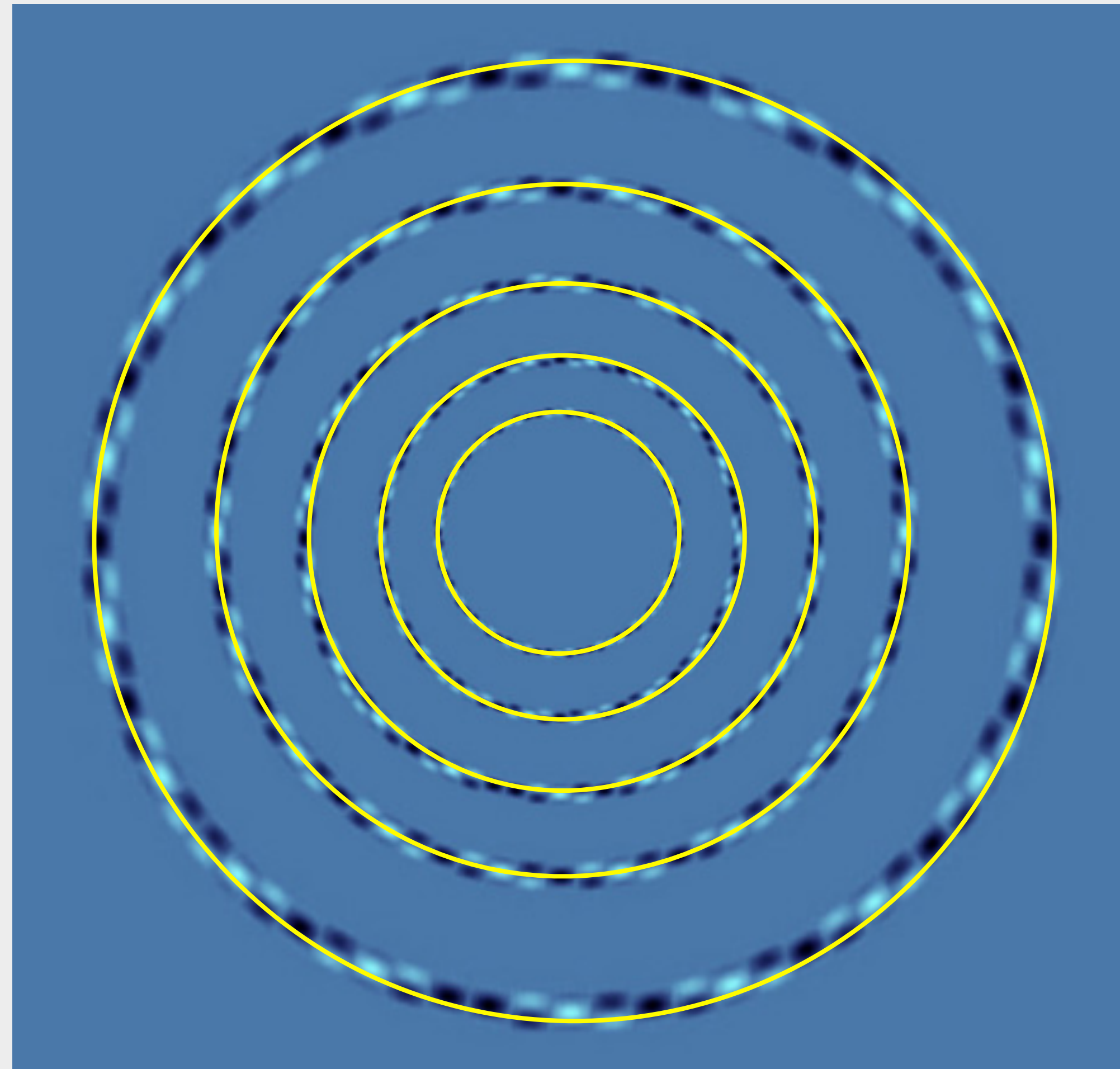
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concentric?



# Why should you analyze images with computers?



concentric?

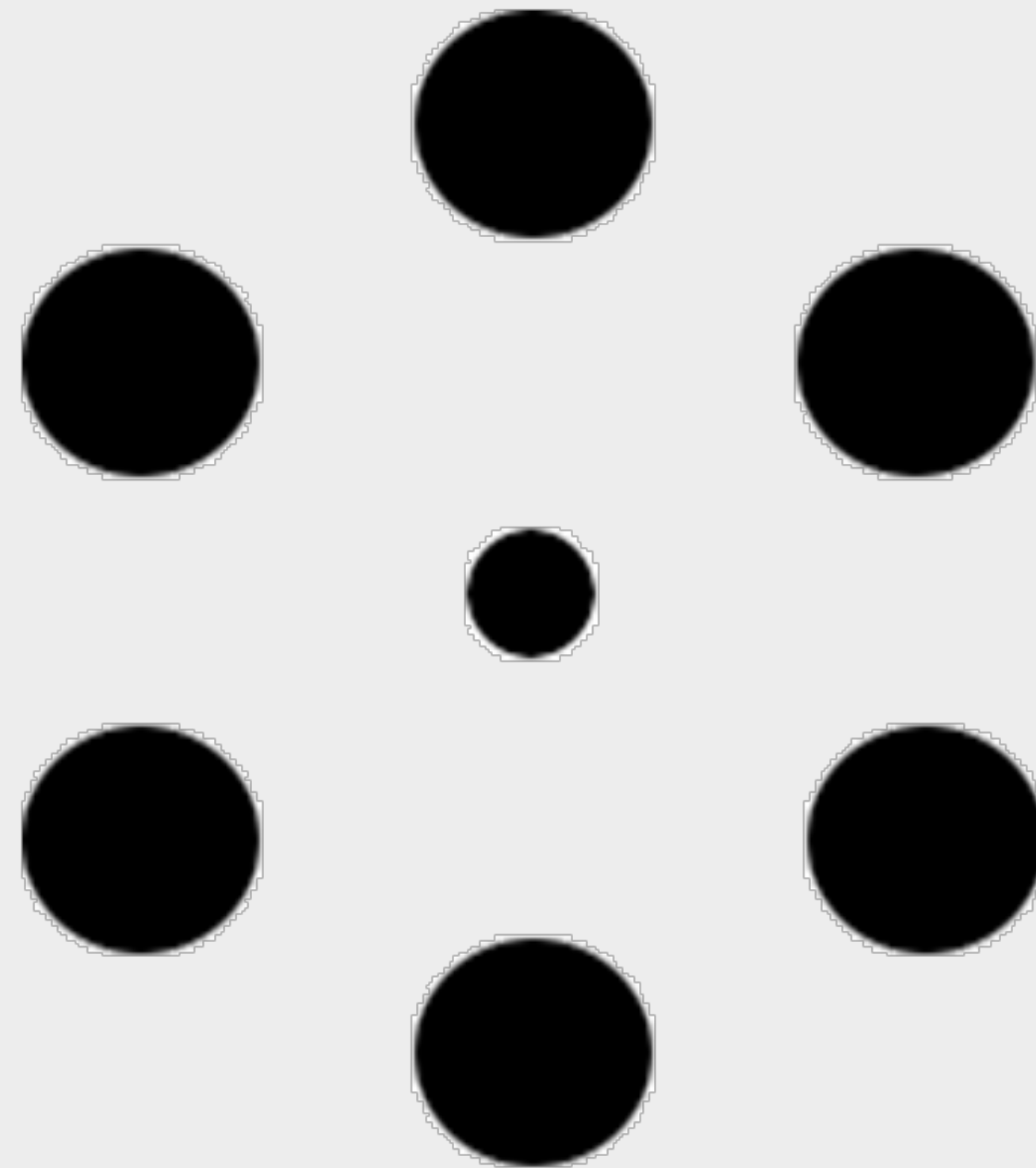
color perception and pattern recognition is individual, science less so.

<https://www.moillusions.com/perfect-circles-optical-illusion>

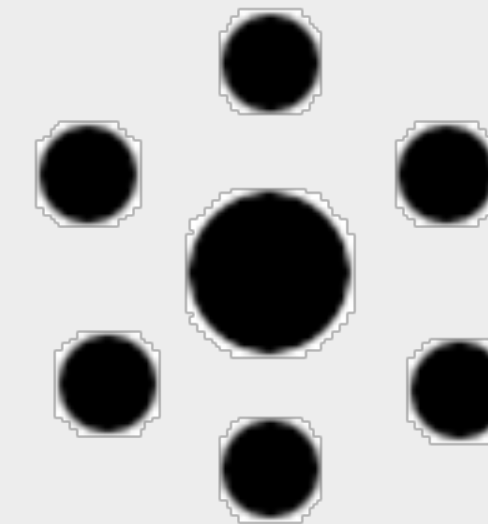


# Why should you analyze images with computers?

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identical central discs?

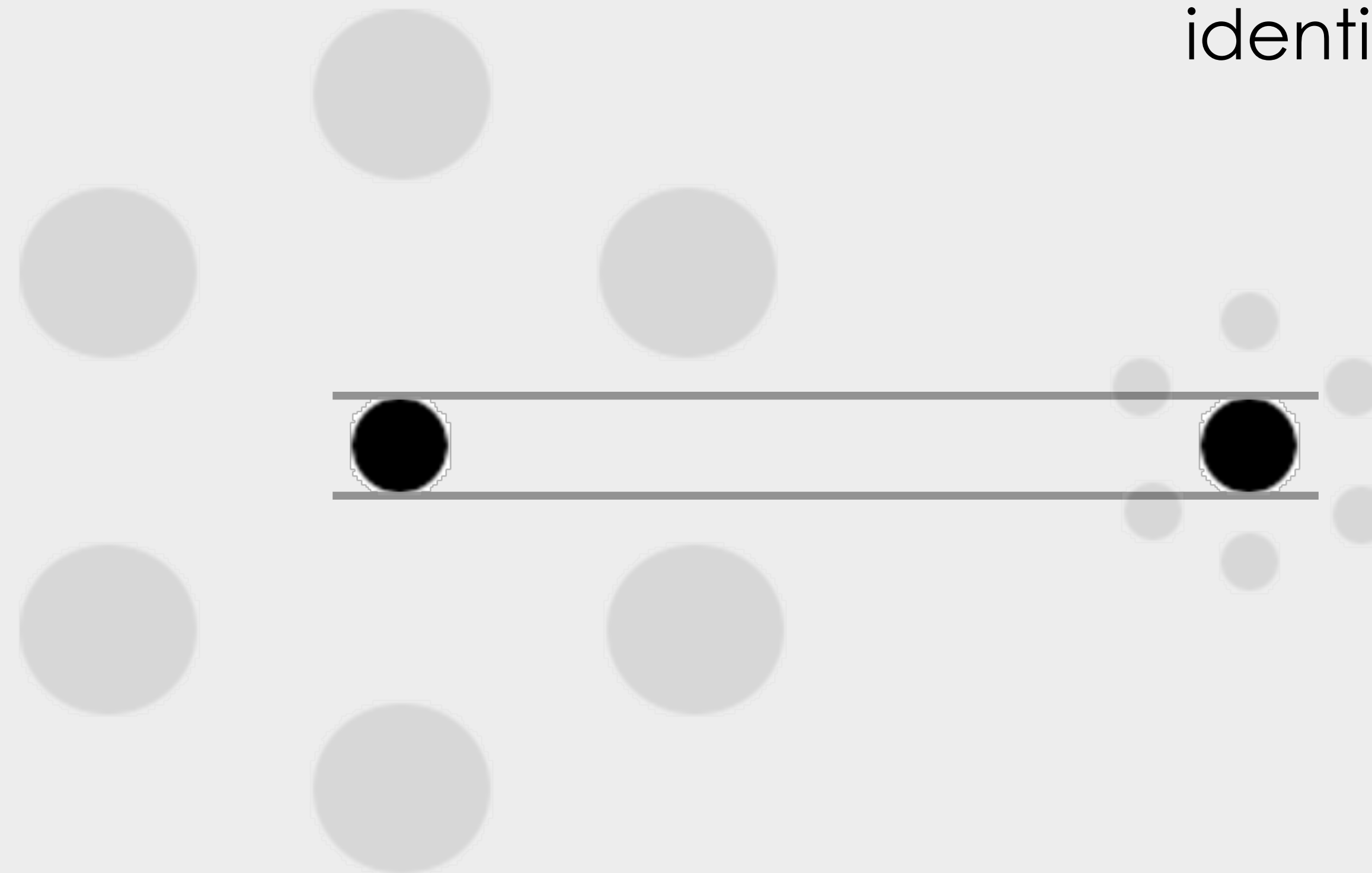


# Why should you analyze images with computers?

---



identical central discs?



our size estimate is strongly influenced by the local neighborhood.

<http://www.brainbashers.com>



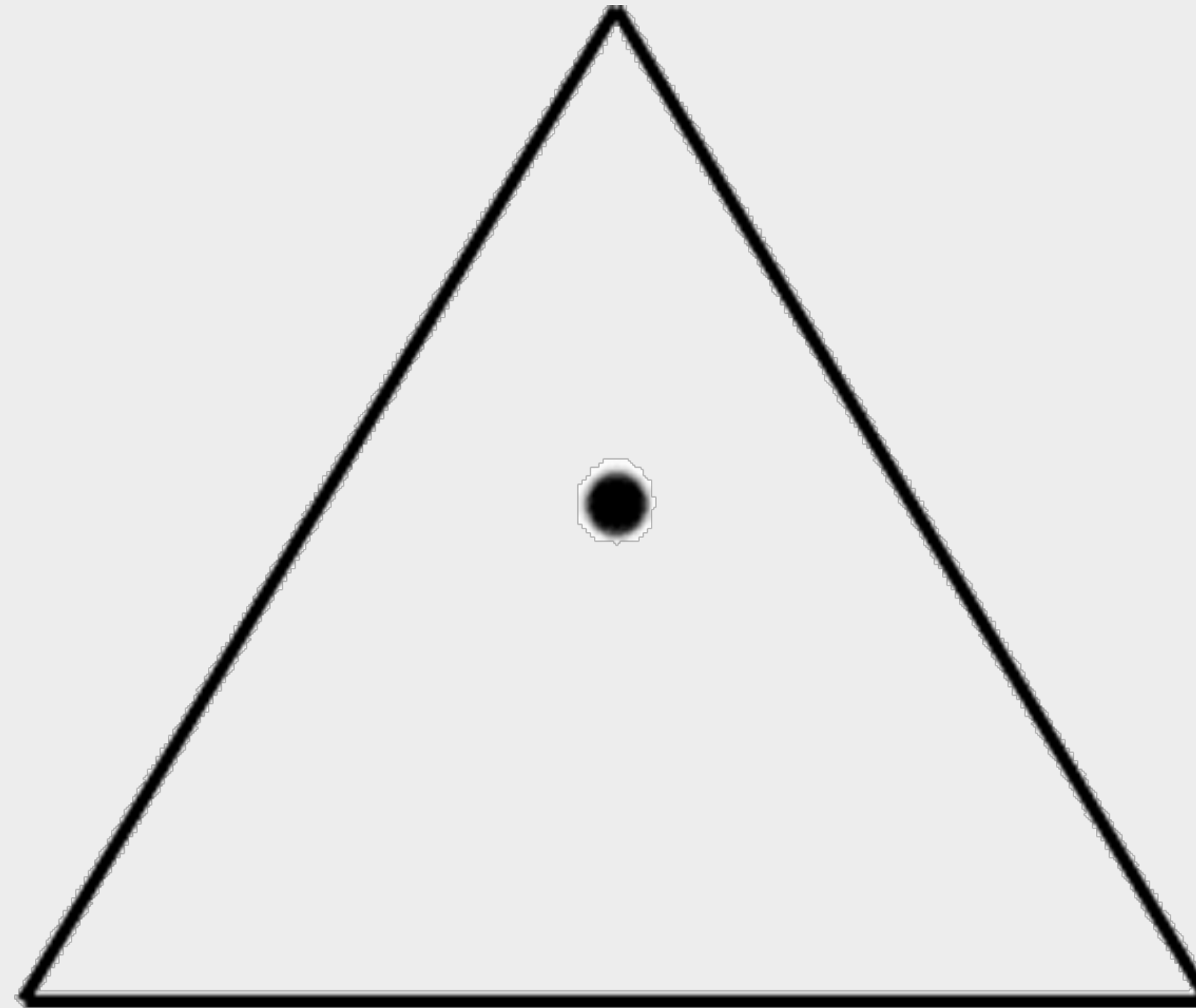


# Why should you analyze images with computers?

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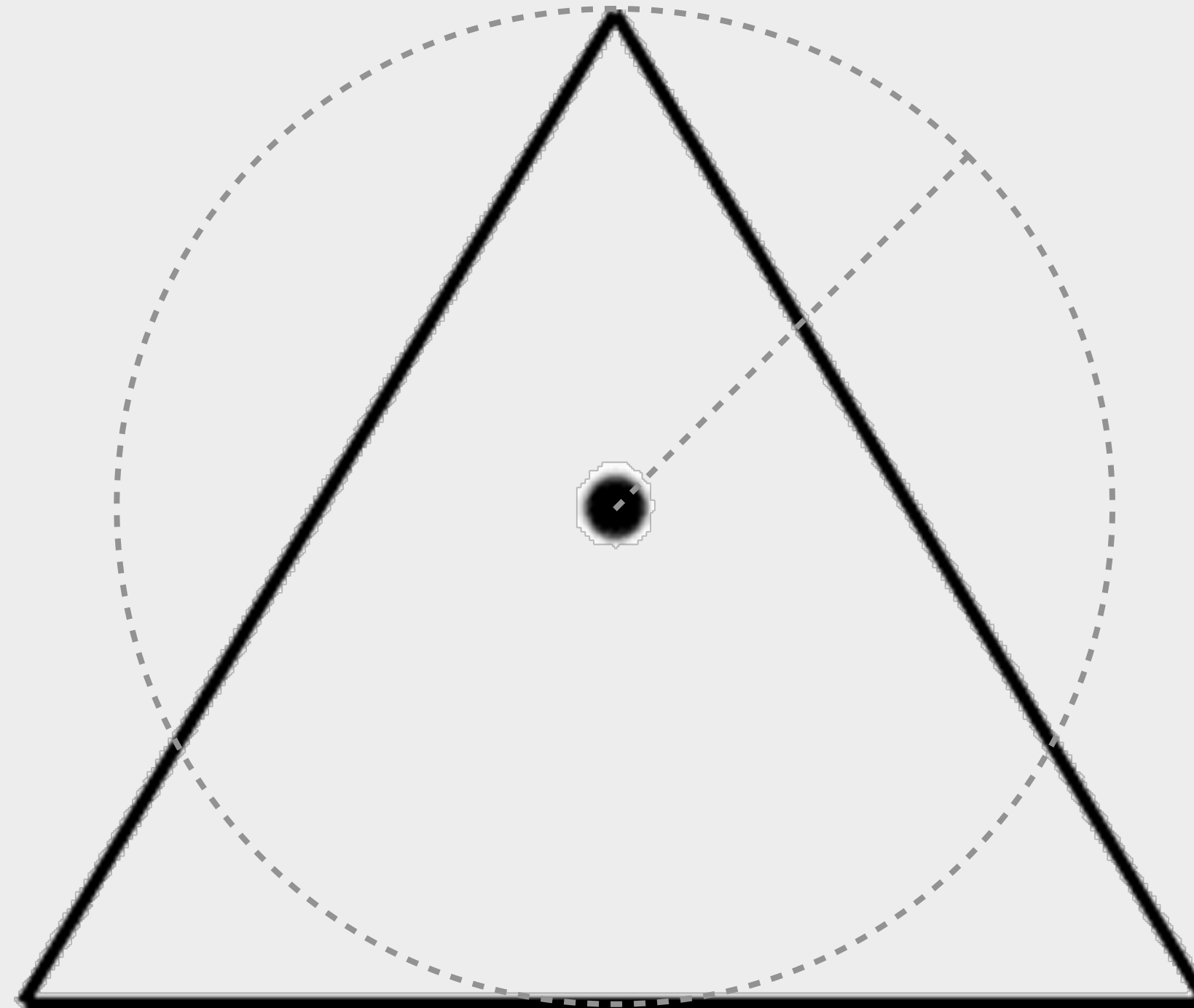
Is the dot half-way up?



# Why should you analyze images with computers?



Is the dot half-way up?



our sense of distance depends on neighborhood.

<http://www.brainbashers.com>

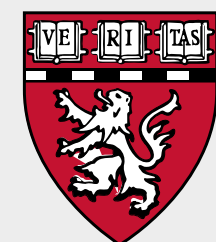




# Why should you analyze images with computers?

---

are discs equally grey?





# Why should you analyze images with computers?

---



are discs equally grey?



intensity perception depends strongly on neighborhood.

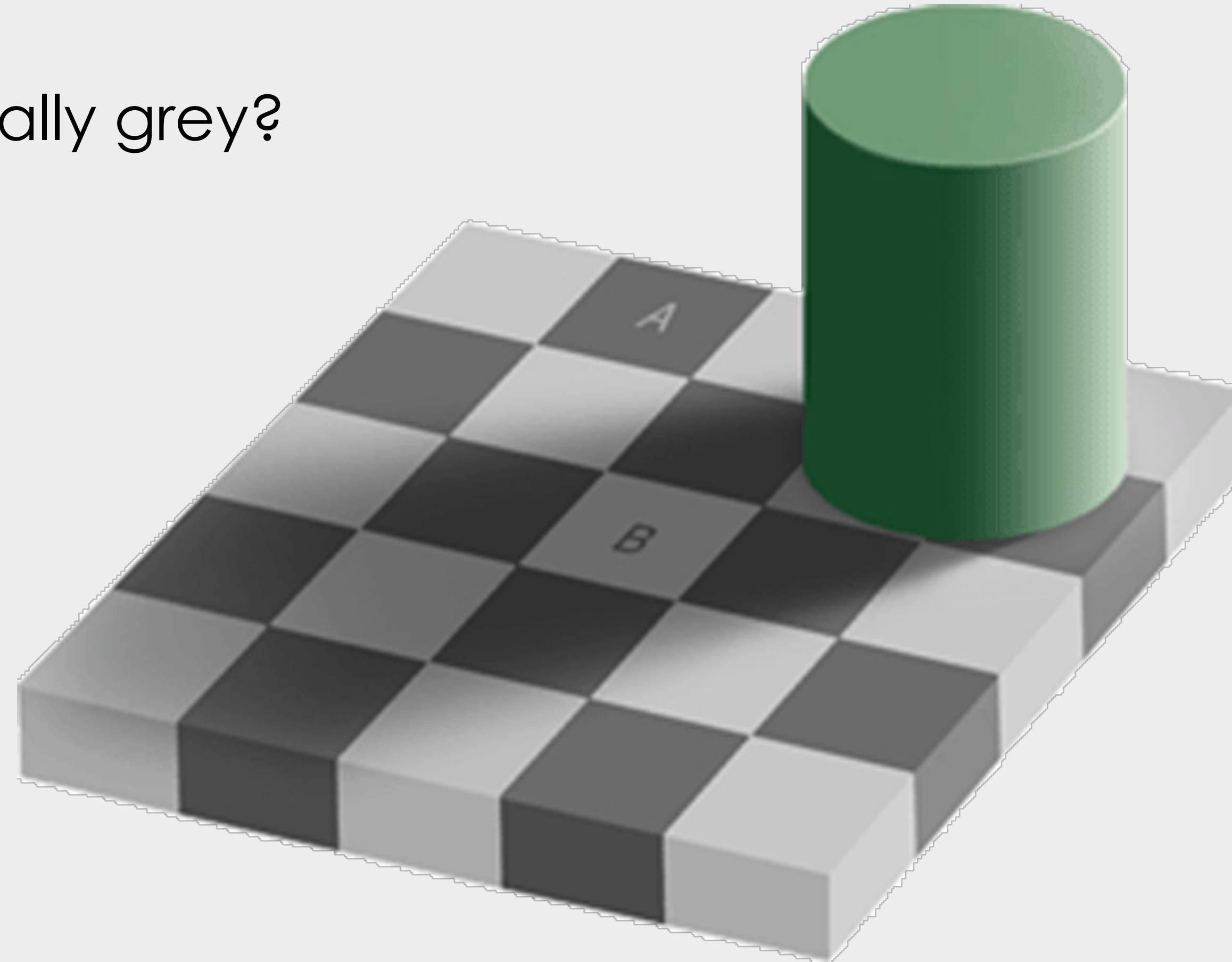
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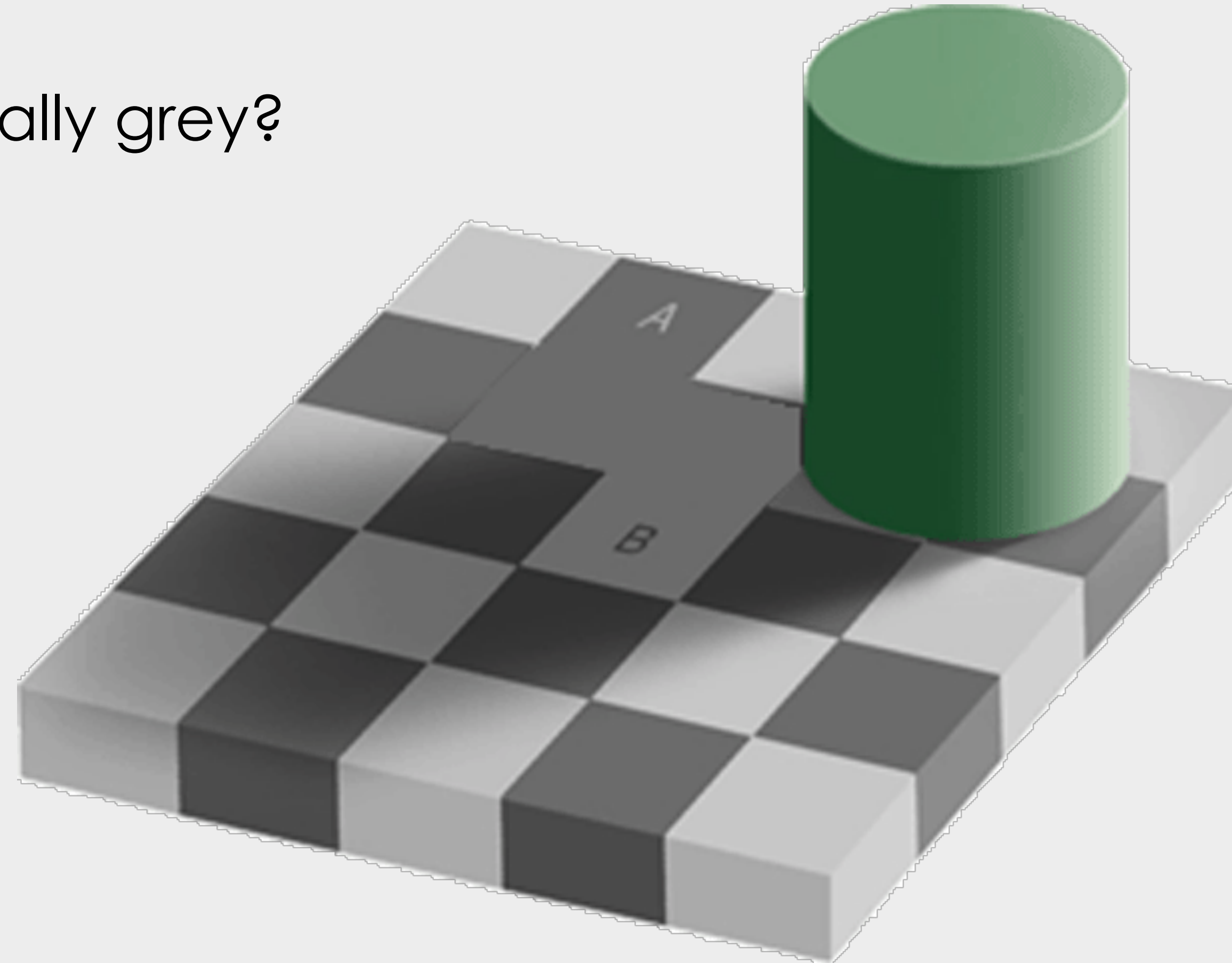
are **A** and **B** equally grey?



# Why should you analyze images with computers?



are **A** and **B** equally grey?



intensity perception depends strongly on neighborhood.

<http://www.brainbashers.com>





# Why should you still use your brain?

---

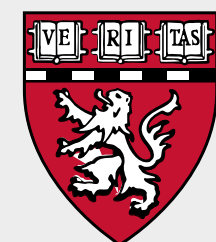




# Why should you still use your brain?

---

What do you see?



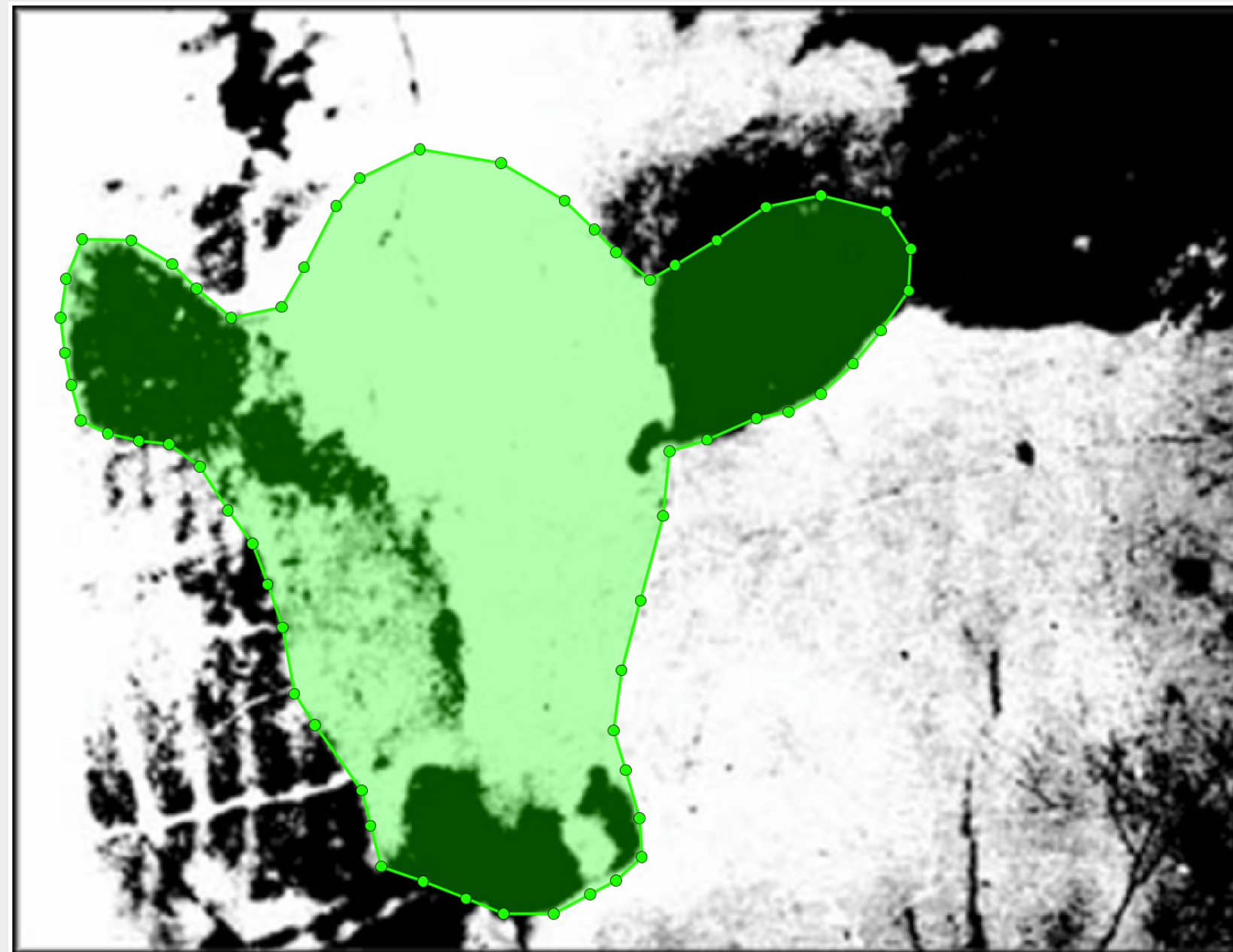


# Why should you still use your brain?

---



What do you see?



It's a cow!

<http://www.brainbashers.com>





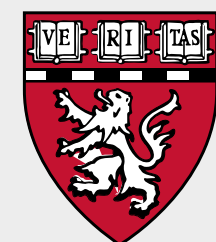
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<http://www.brainbashers.com>



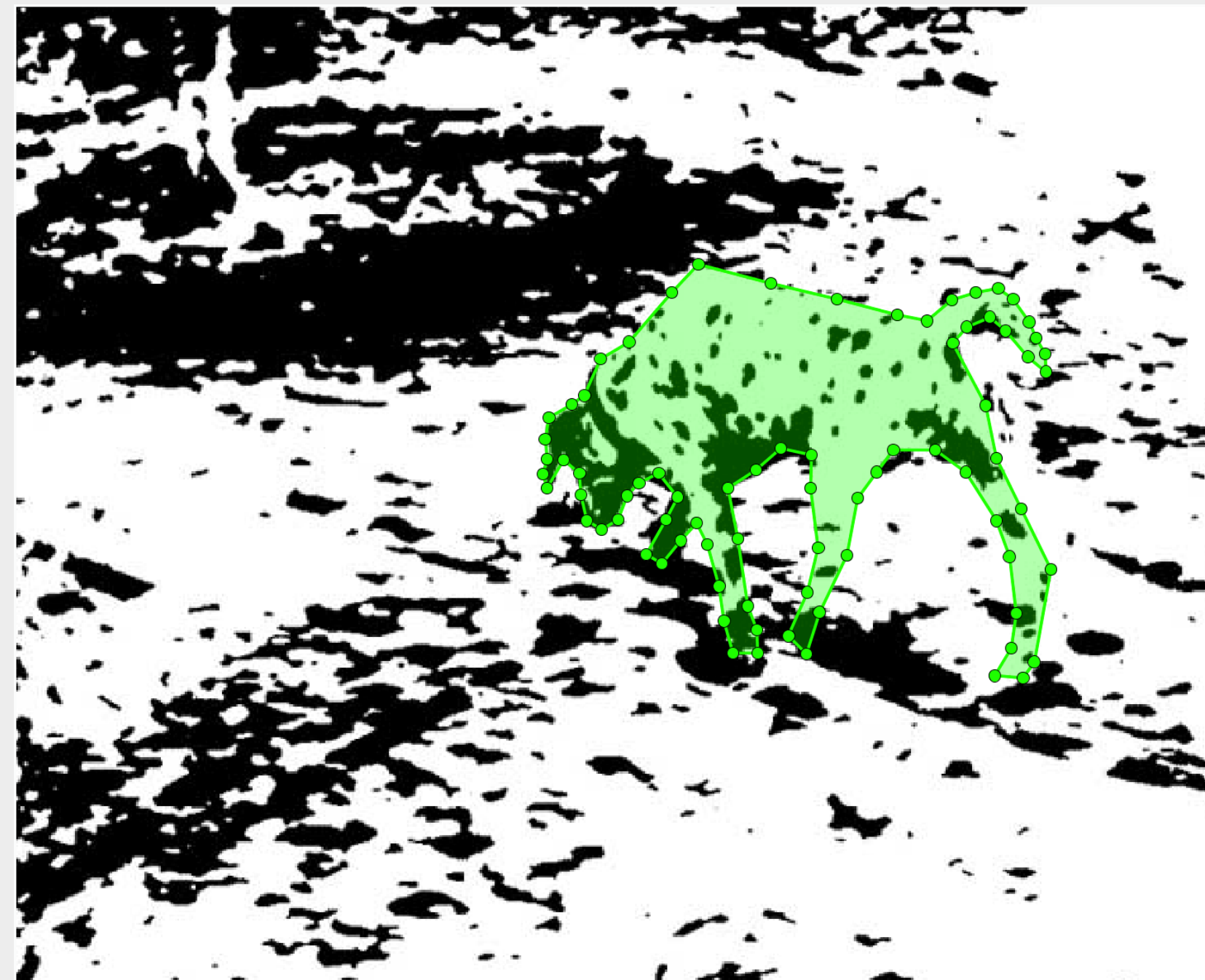


# Why should you still use your brain?

---



What do you see?



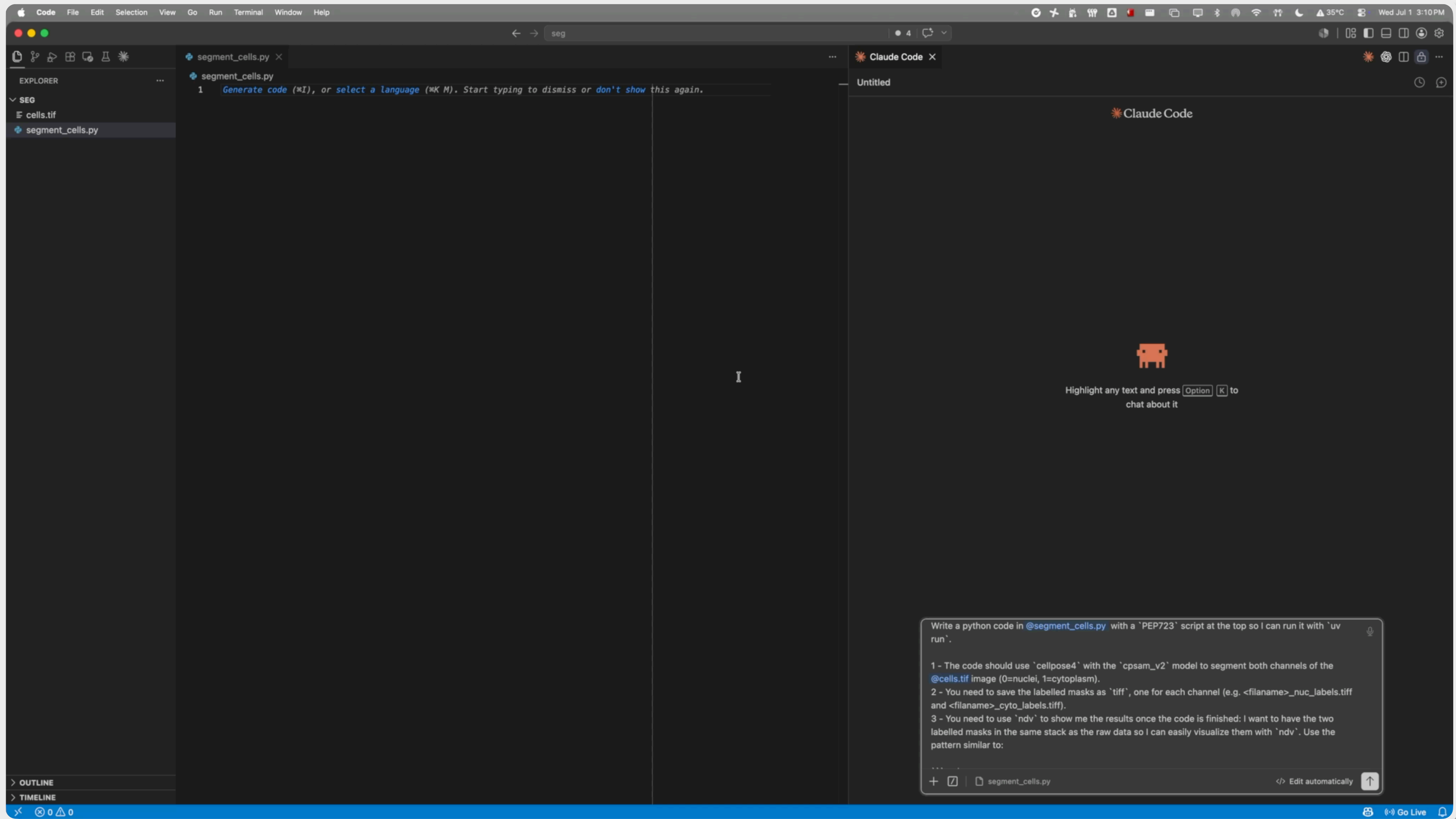
It's a Dalmatian dog!

<http://www.brainbashers.com>





# Why learn image analysis/Python if we have AI/LLMs?



The screenshot shows a code editor with a file named `segment_cells.py` open. The editor is dark-themed. On the right side, there is a chat window titled "Claude Code" with an "Untitled" document. The chat window contains the following text:

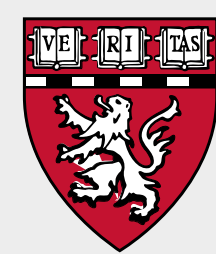
Highlight any text and press `Option` `K` to chat about it

Write a python code in `@segment_cells.py` with a "PEP723" script at the top so I can run it with ``uv run``.

- 1 - The code should use ``cellpose4`` with the ``cpsam_v2`` model to segment both channels of the `@cells.tif` image (0=nuclei, 1=cytoplasm).
- 2 - You need to save the labelled masks as ``tiff``, one for each channel (e.g. `<filename>_nuc_labels.tiff` and `<filename>_cyto_labels.tiff`).
- 3 - You need to use ``ndv`` to show me the results once the code is finished: I want to have the two labelled masks in the same stack as the raw data so I can easily visualize them with ``ndv``. Use the pattern similar to:

...

`+ [ ] | segment_cells.py` `</> Edit automatically` `↑`





# Why learn image analysis/Python if we have AI/LLMs?

The screenshot shows a code editor with a file named `segment_cells.py` open. The code editor is dark-themed. On the right side, there is a Claude Code chat window. The chat window contains the following text:

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Write a python code in `@segment_cells.py` with a `PEP723` script at the top so I can run it with `uv run`.`

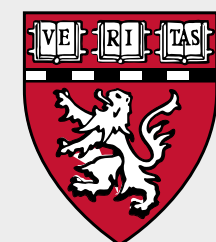
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....

`+` `segment_cells.py` `</>` Edit automatically `↑`

The prompt in the chat window is highlighted in yellow. A yellow arrow points from the text "The prompt is the key!" to the prompt in the chat window.

The prompt is the key!



# Brief Self-Introduction

---

 [bobiac.github.io](https://bobiac.github.io)



1. My **name** is Federico
2. My **position** is as a Director
3. My **lab** is the CITE@HMS in Boston, MA
4. My model **system** is a microscope
5. I **acquired** my **data** with any microscope

