Welcome to the

BoBiAC

Boston Bioimage Analysis Course | 2025

IAC: iac.hms.harvard.edu

CITE: cite.hms.harvard.edu

📅 **Date:** 14th -19th July 2025, 9:00 am - 6:30 pm

⌚ **Time:** 9:00 am - 6:30 pm

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

🔗 **website:** iac.hms.harvard.edu/bobiac/2025

📒 **course material:** hms-iac.github.io/bobiac

Image Analysis Collaboratory

CITE
Core for Imaging Technology & Education

BioImaging North America

HARVARD MEDICAL SCHOOL

The BoBiAC Team

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Director
Image Analysis Collaboratory
Harvard Medical School

ℹ️ General Information

📞 **Internal communications**:
- Slack channels (mainly #course-announcements & DMs)

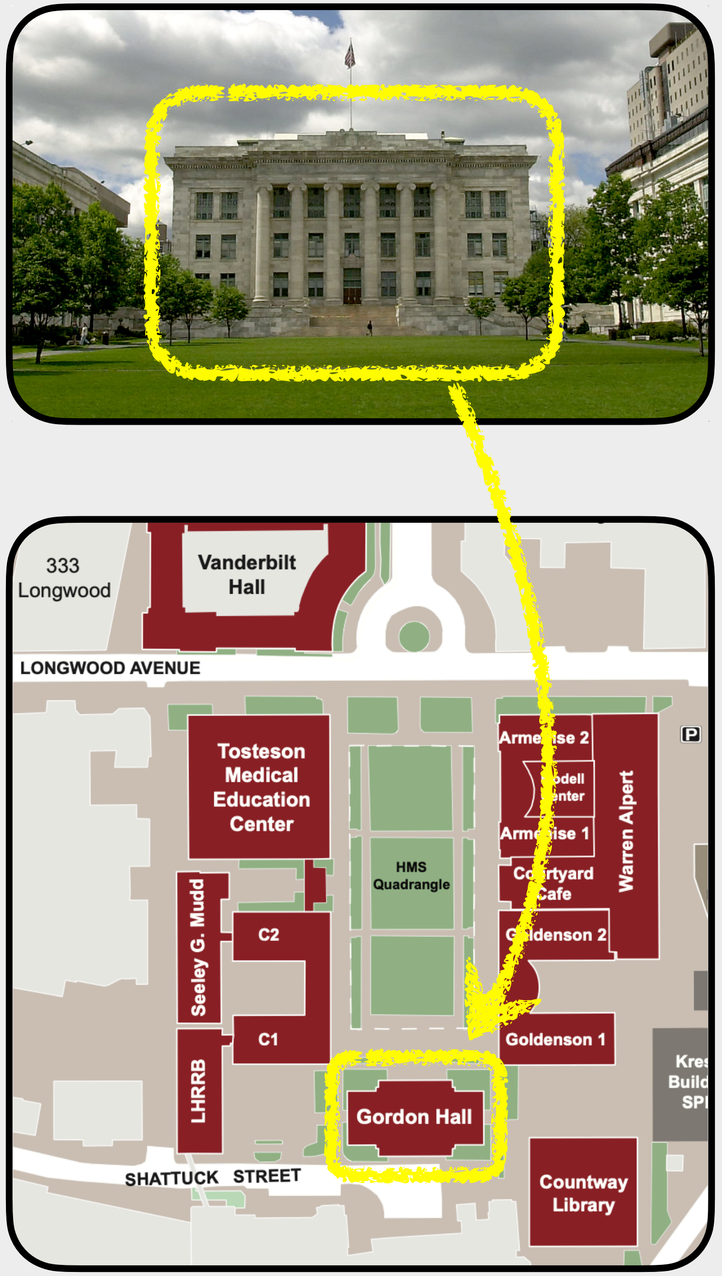
📍**location**:
- Harvard Medical School - Gordon Hall - Room 106

⌚ **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 17th @ 7:30 pm
- Shy Bird (201 Brookline Ave, Boston - 10 min walk)
- we leave @ 7:00 pm (🚶)



🌐 WiFi Connection

- **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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- 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**.
- 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, for the first four days of the course, five of you will give a **brief (3–5 minute) introduction about yourself**, your **work**, and the **image analysis tasks** you hope to perform—using the single slide you prepared as support.

Schedule

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	Monday 14th July	Tuesday 15th July	Wednesday 16th July	Thursday 17th July	Friday 18th July	Saturday 19th July
9:00am - 9:30am	Welcome	Coffee & Questions?	Coffee & Questions?	Coffee & Questions?	Coffee & Questions?	Coffee & Questions?
9:30am - 10:00am	Intro + Coffee	Introduction to Digital Images	Segmentation (Classic)	Segmentation (Deep Learning)	Student Group Work	Colocalization
10:00am - 10:30am	Intro + Coffee					
10:30am - 11:00am	Introduction to BioImage Analysis					
11:00am - 11:15am		Coffee Break	Coffee Break	Coffee Break	Coffee Break	Coffee Break
11:15am - 11:30am		Introduction to Digital Images	Segmentation (Machine Learning)	Segmentation (Deep Learning)	Student Group Work	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)	Student Group Work	Colocalization
1:30pm - 2:00pm	Getting Started with Python	Python for Bioimage Analysis	Segmentation (Machine Learning)	Measurements and Quantification		
2:00pm - 2:30pm						
2:30pm - 3:00pm						
3:00pm - 3:30pm	Laptops Setup					
3:30pm - 4:00pm	Coffee Break	Coffee Break	Coffee Break	Coffee Break	Coffee Break	Coffee Break
4:00pm - 4:30pm	The Python Basics	Segmentation (Classic)	Object Classification (Ilastik)	Measurements and Quantification	Student Group Results Presentation	Colocalization
4:30pm - 5:00pm						Reproducibility & Image Ethics
5:00pm - 5:30pm						
5:30pm - 6:00pm	Coffee Break	Coffee Break	Coffee Break	Coffee Break	Results Discussion	Coffee Break
6:00pm - 6:30pm	The Python Basics	Segmentation (Classic)	Object Classification (Ilastik)	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

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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

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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, ML & DL Methods
- **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?
- **Measurements & Quantification with Python**: after completing image processing, 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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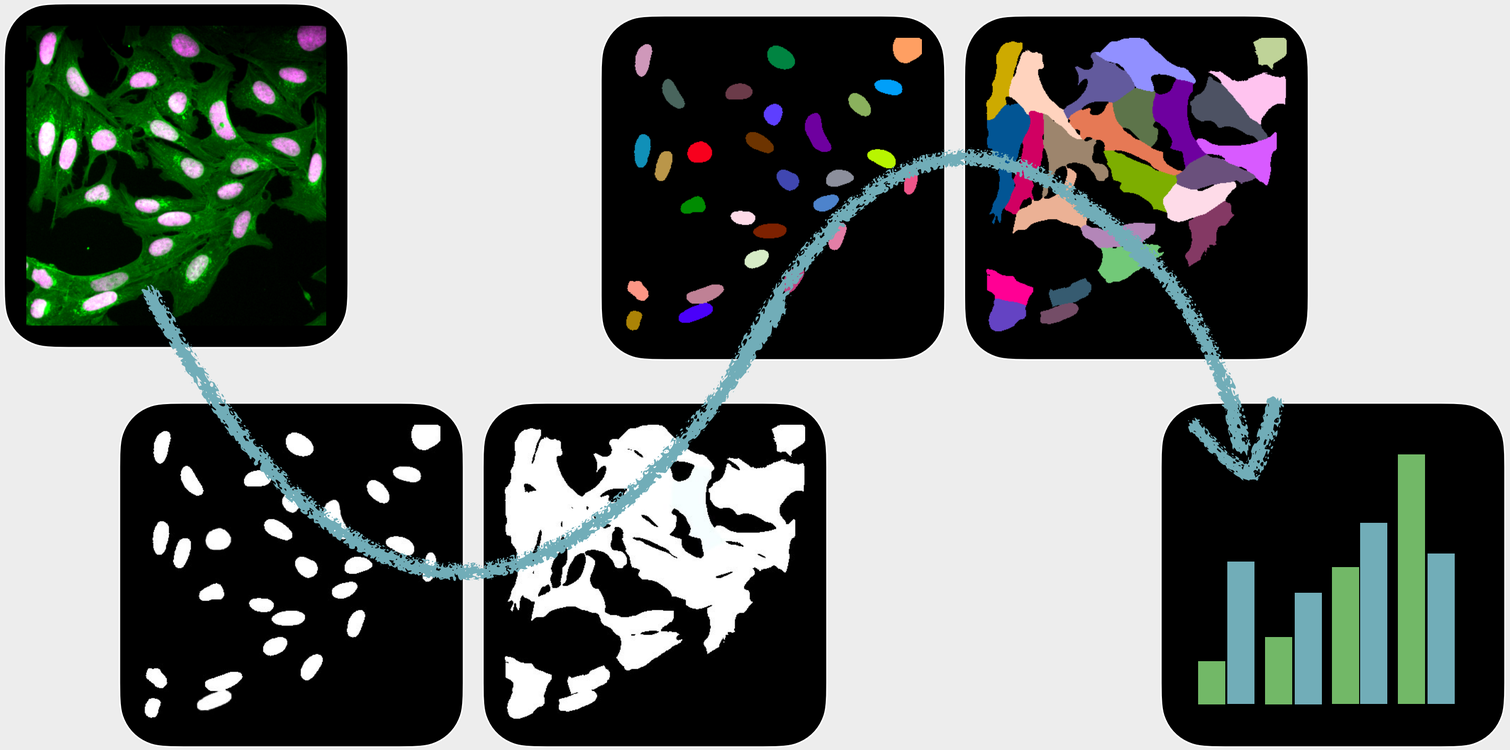
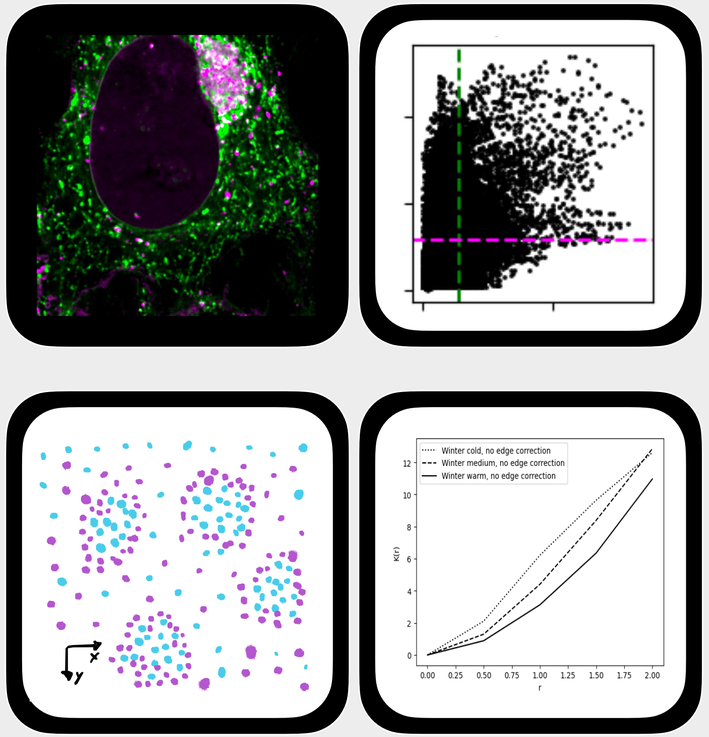
Learning Python for Bioimage Processing & Analysis





segmentation, classification, quantification

colocalization

🎓 Learning Objectives

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- ~~Become a **Python & Bioimage Analysis Expert!**~~

🎓 Learning Objectives

🔗 iac.hms.harvard.edu/bobiac/2025

- ~~Become a **Python & Bioimage Analysis Expert!**~~
- Gain a foundational understanding of **what Python is**.
- Learn how to **get started with Python**: **installing Python**, setting up **virtual environments**, and launching **Jupyter Notebooks**.
- Learn how to **load**, **handle**, and **display images** using Python.
- Get familiar with key **Python packages** commonly used in bioimage analysis.
- Explore different approaches to **image segmentation** in Python, including classical methods, machine learning (ML), and deep learning (DL)
- Understand the basics of **colocalization** analysis and how to apply it using Python.

Course Material

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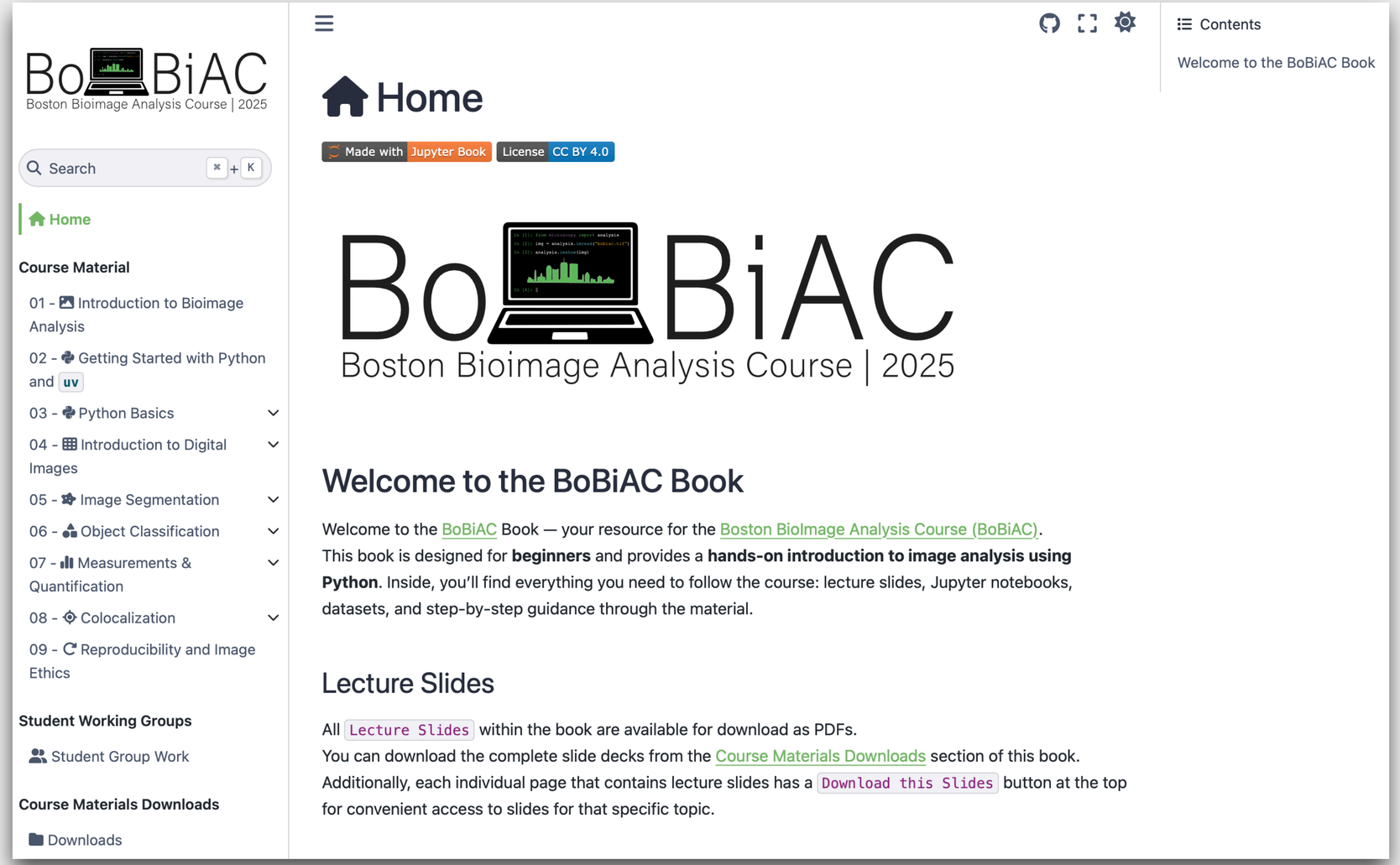

🔗 hms-iac.github.io/bobiac

? Questions

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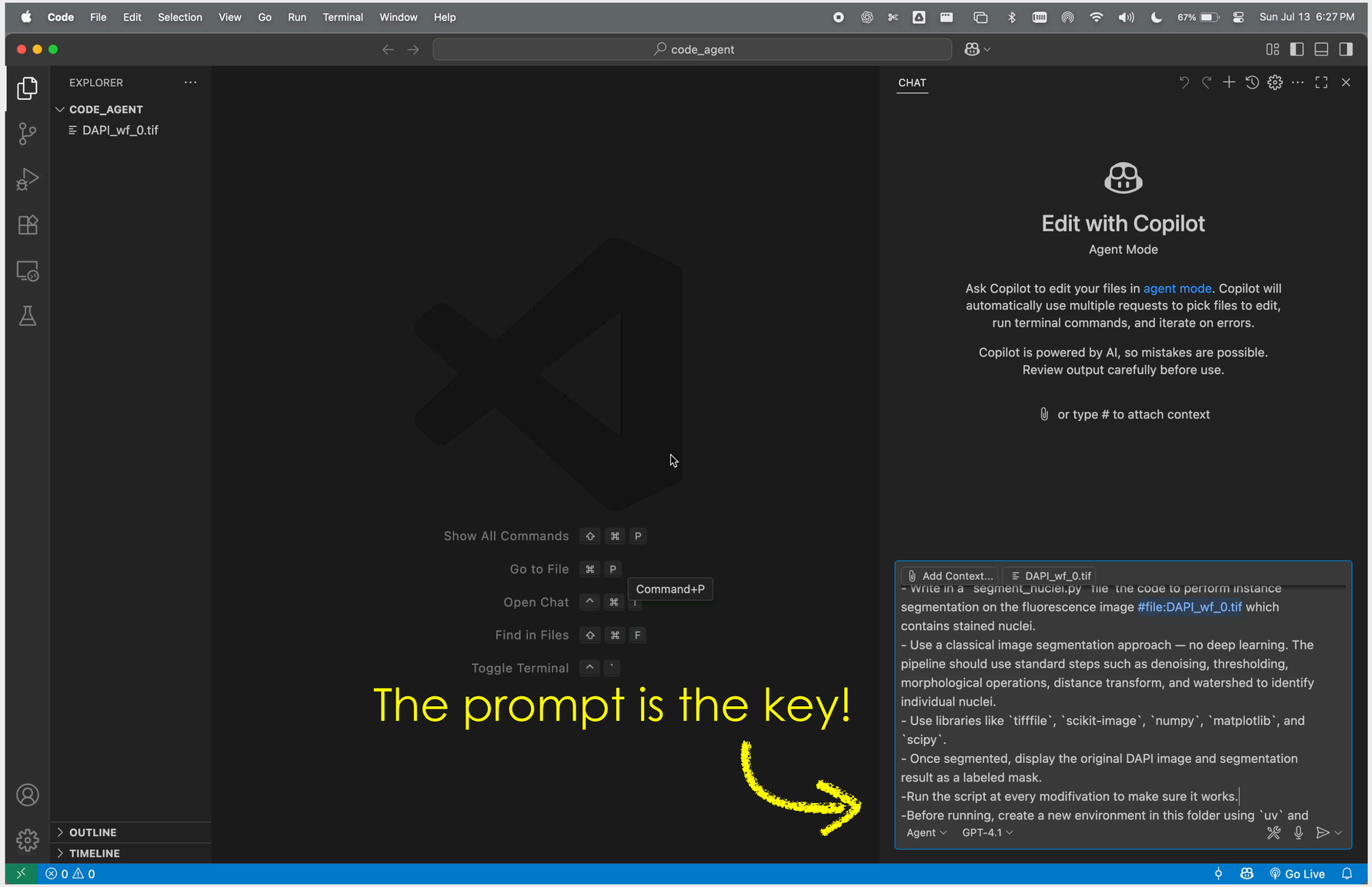
🗣️ Brief Self-Introduction

1. My **name** is *Federico*
2. My **position** is as a *Research Associate*
3. My **lab** is *the IAC@HMS*
4. My model **system** is *human iPSC-derived neurons*
5. I **acquired** my **data** with a *widefield microscope*

Why learn image analysis or Python if we have AI & LLMs?



Why should you analyze images with computers?

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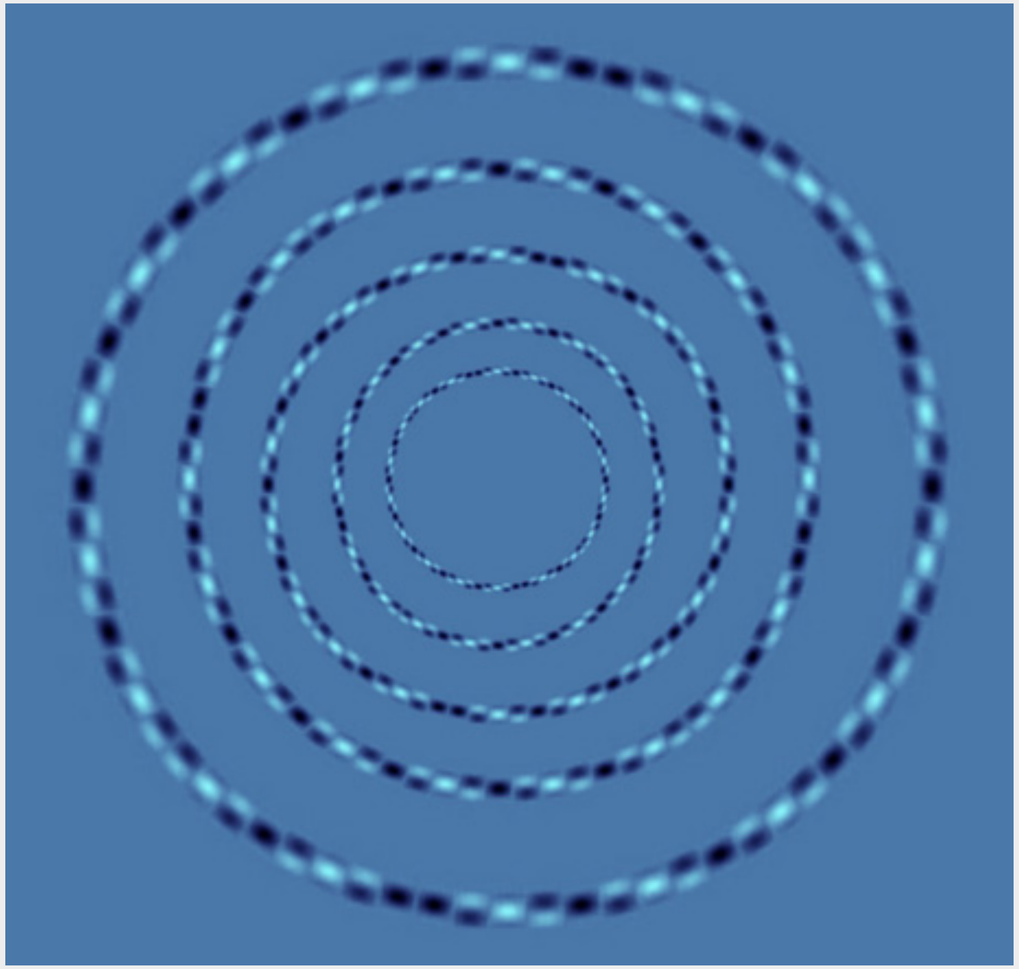

concentric?

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

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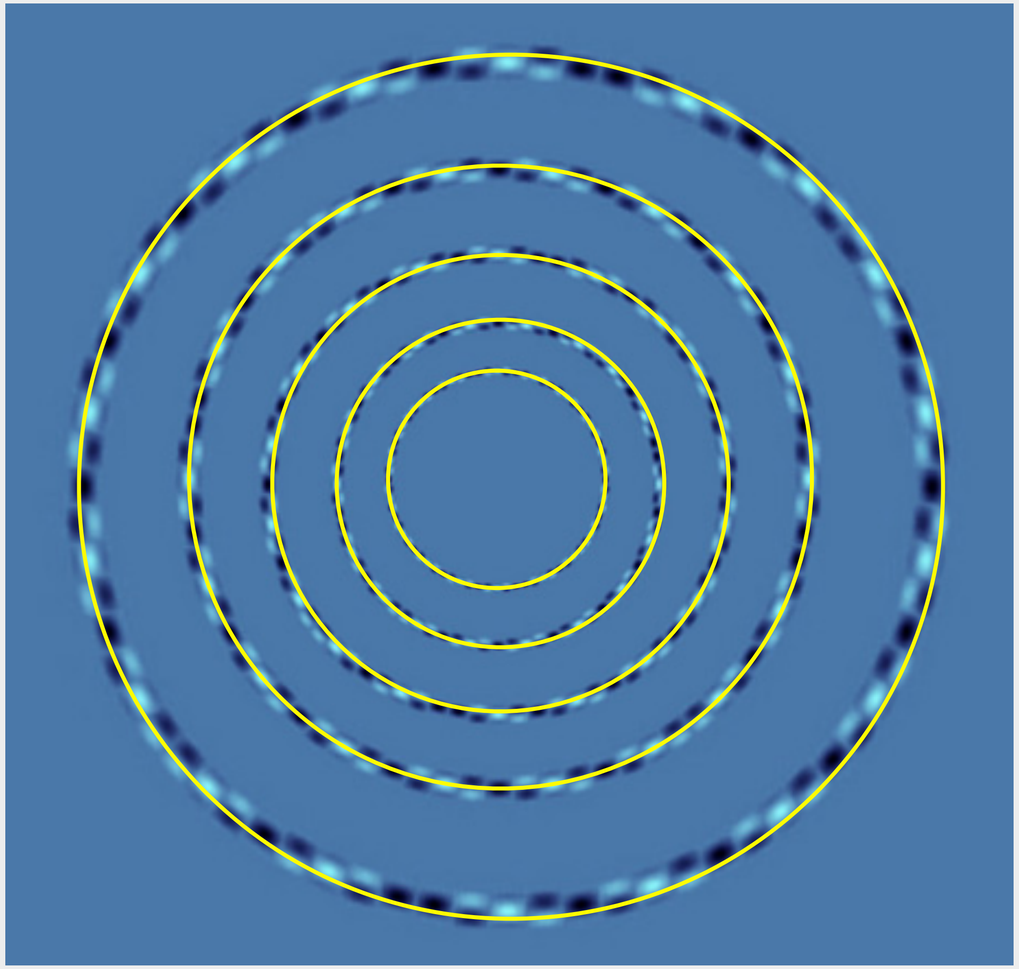


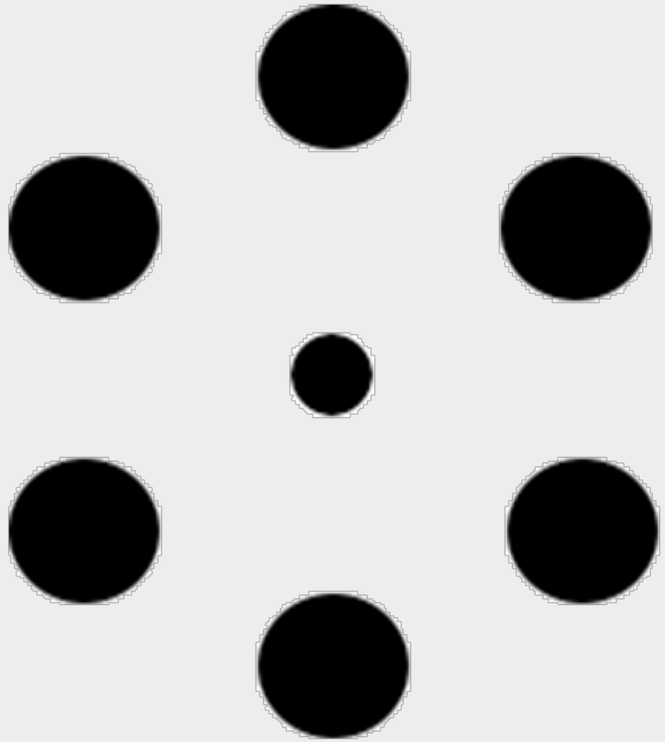
concentric?

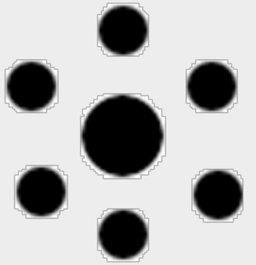
color perception and pattern recognition is individual, science less so.

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

Why should you analyze images with computers?

identical central discs?





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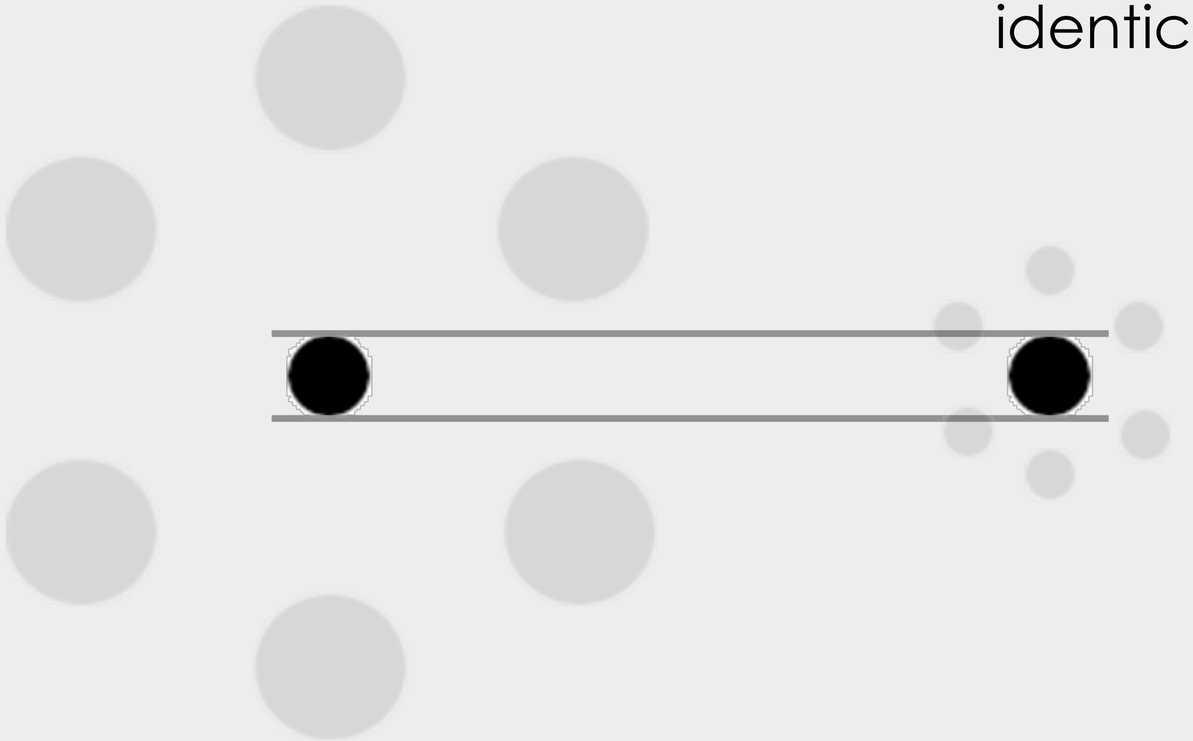
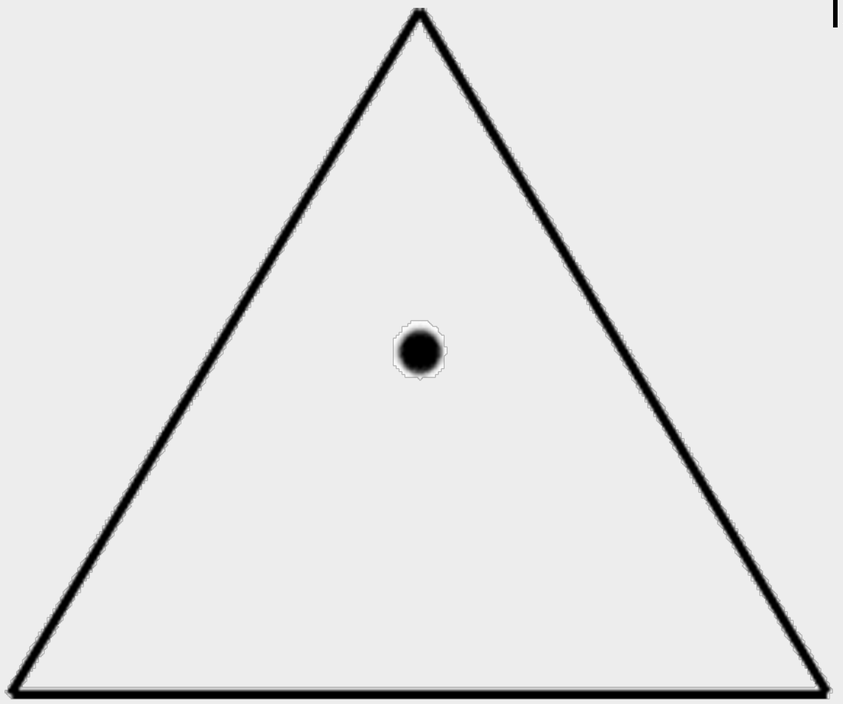


our size estimate is strongly influenced by the local neighborhood.

Why should you analyze images with computers?

Is the dot half-way up?



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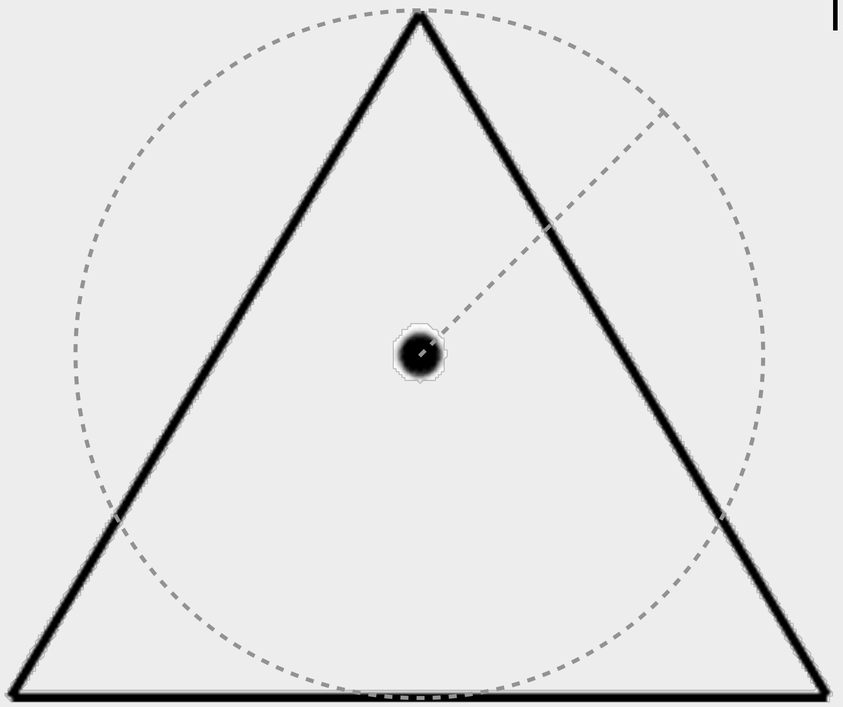


our sense of distance depends on neighborhood.

Why should you analyze images with computers?

are discs equally grey?

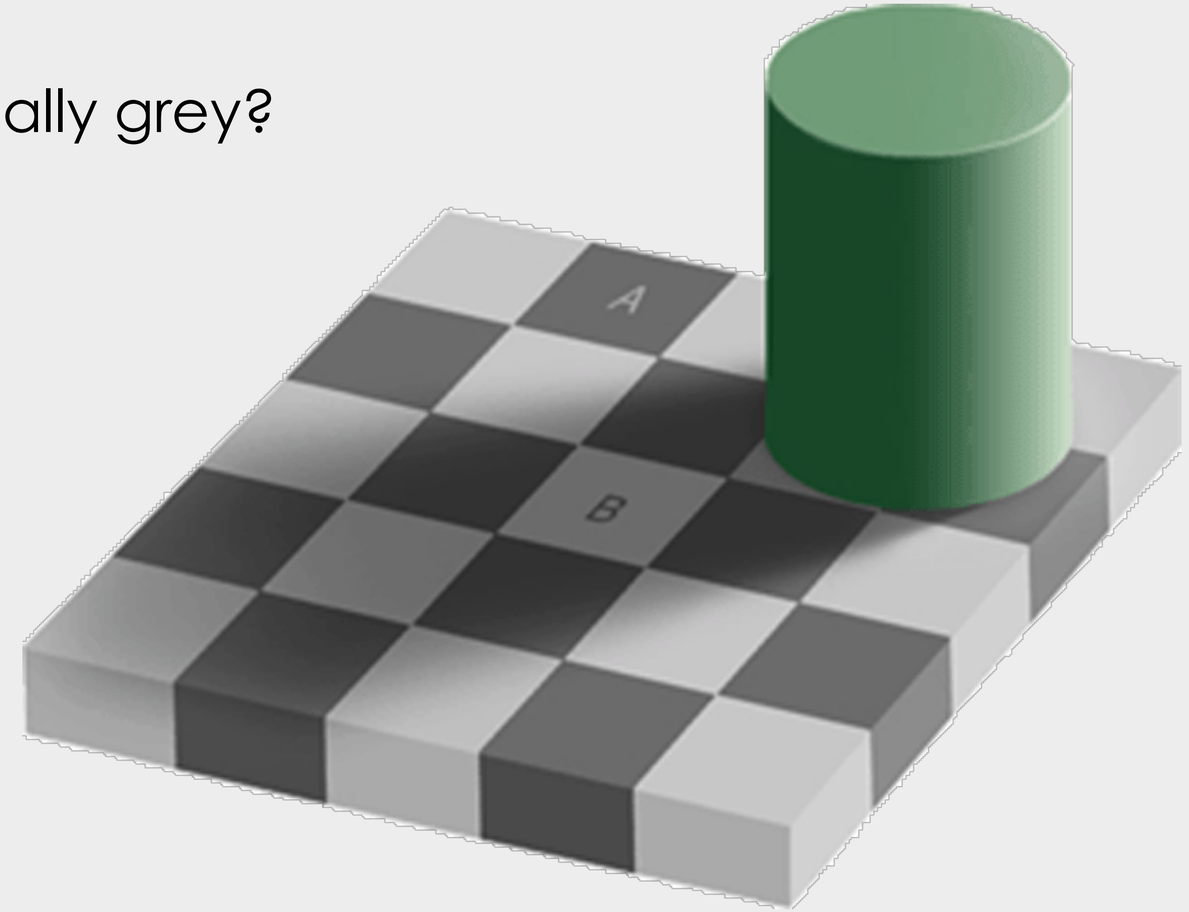
Why should you analyze images with computers?

are discs equally grey?

intensity perception depends strongly on neighborhood.

Why should you analyze images with computers?

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



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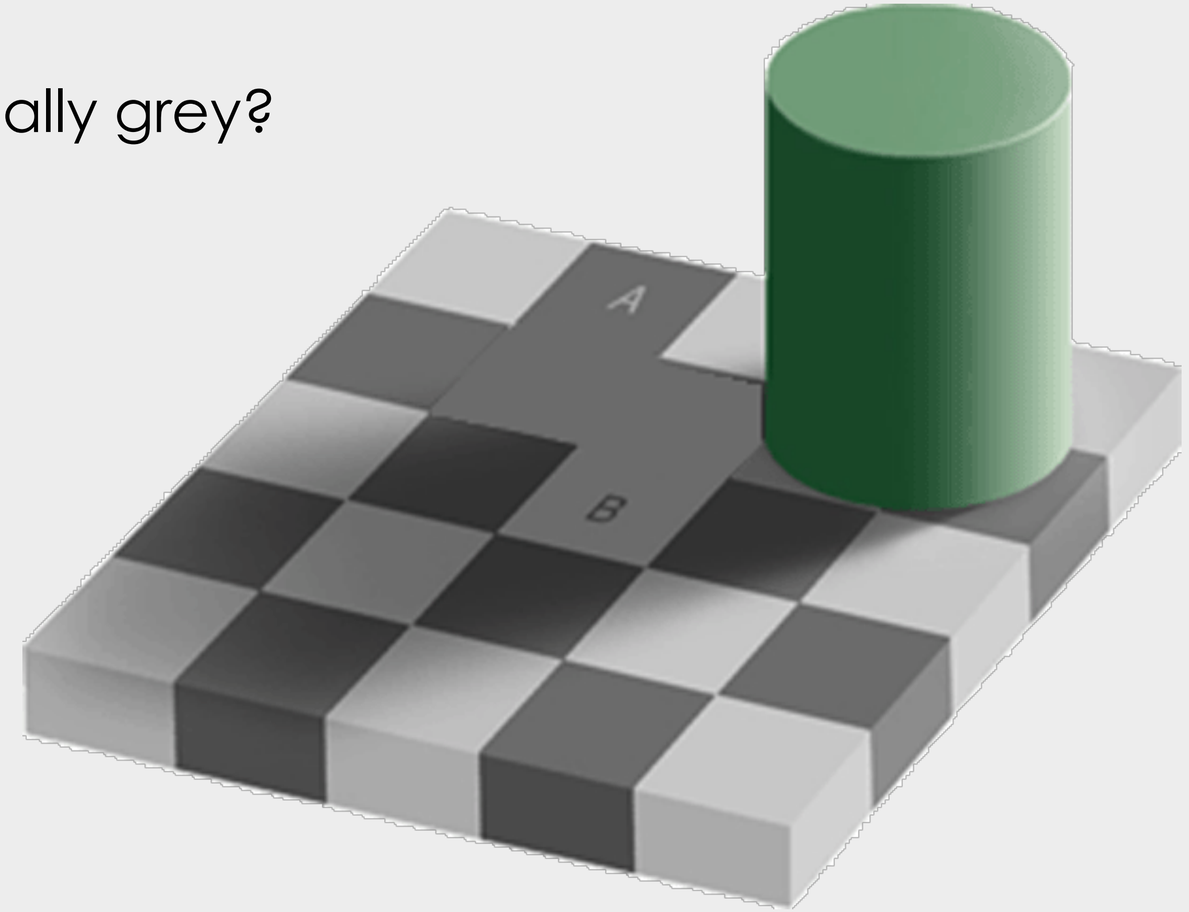


intensity perception depends strongly on neighborhood.

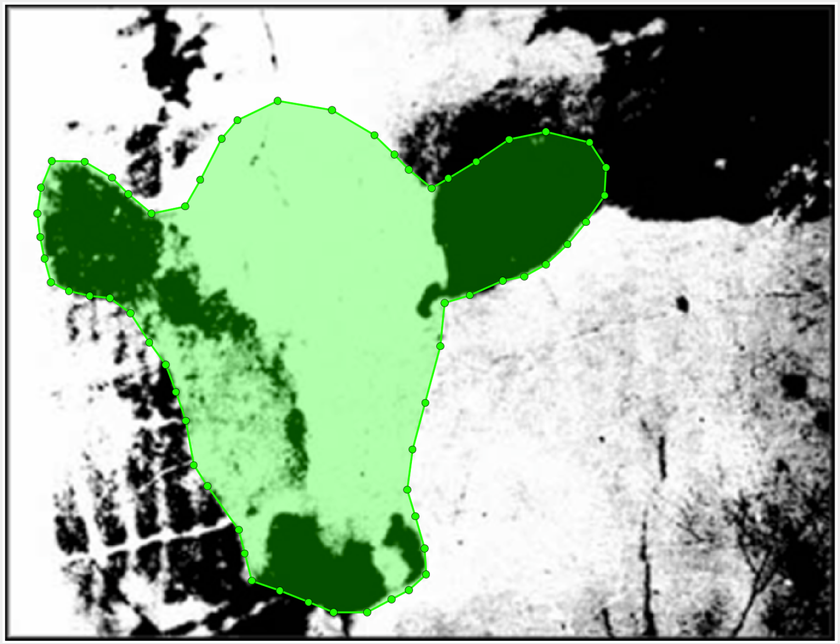
Why should still use your brain?

Why should still use your brain?

What do you see?

Why should still use your brain?

What do you see?



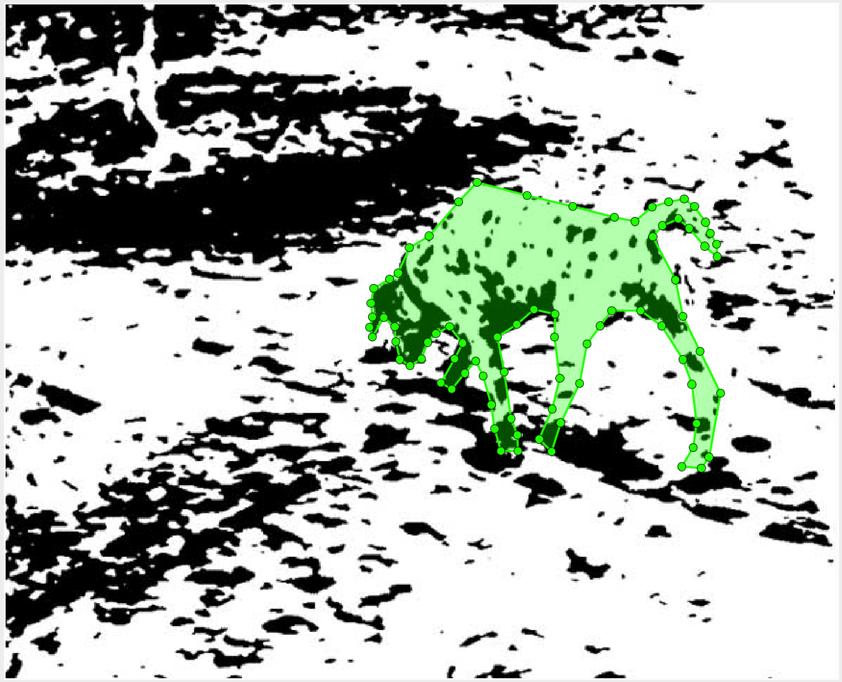
It’s a cow!

Why should still use your brain?

What do you see?

Why should still use your brain?

What do you see?



It’s a Dalmatian dog!