

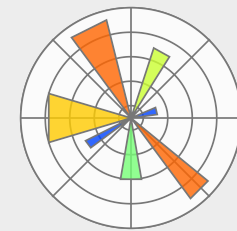
Welcome to the


BoBiAC

Boston Bioimage Analysis Course | 2025

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

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



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

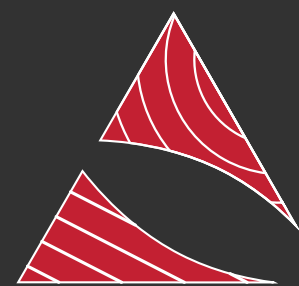
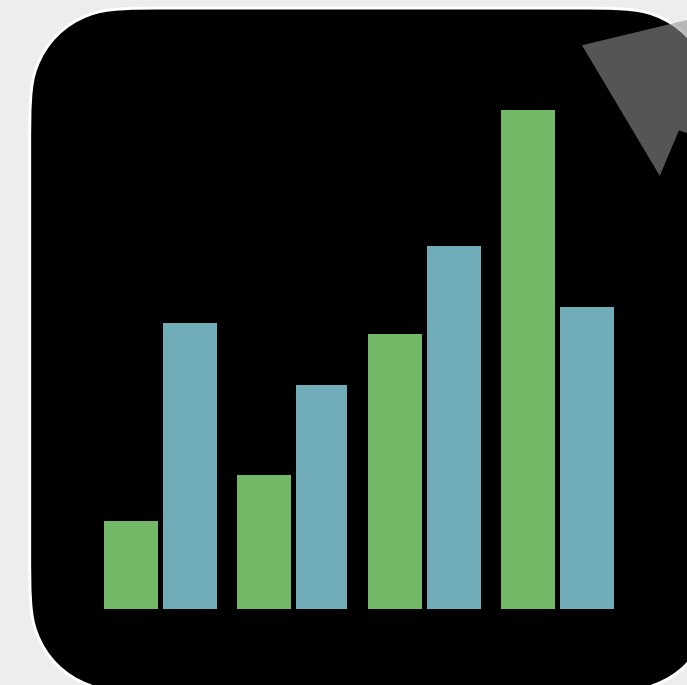
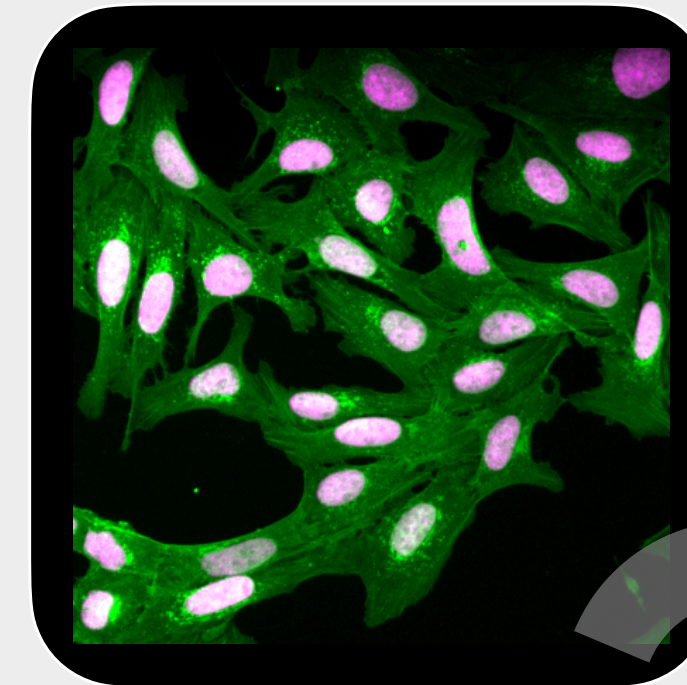
 **website:** iac.hms.harvard.edu/bobiac/2025

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



 **IAC:** iac.hms.harvard.edu

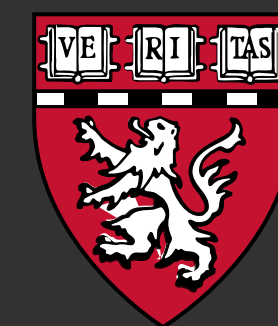
 **CITE:** cite.hms.harvard.edu



CITE
Core for Imaging Technology & Education



**BioImaging
North America**



HARVARD
MEDICAL SCHOOL



The BoBiAC Team



IAC: iac.hms.harvard.edu



CITE: cite.hms.harvard.edu



Federico Gasparoli, PhD

Research Associate
Image Analysis Collaboratory
Harvard Medical School



Eva de la Serna, PhD

Advanced Imaging Fellow
Core for Imaging Technology &
Education
Harvard Medical School



Ranit Karmakar, PhD

Specialist Postdoc
Image Analysis Collaboratory
Harvard Medical School



Maria Theiss, PhD

Specialist Postdoc
Image Analysis Collaboratory
Harvard Medical School



Antoine Ruzette, MSc

Associate
Image Analysis Collaboratory
Harvard Medical School



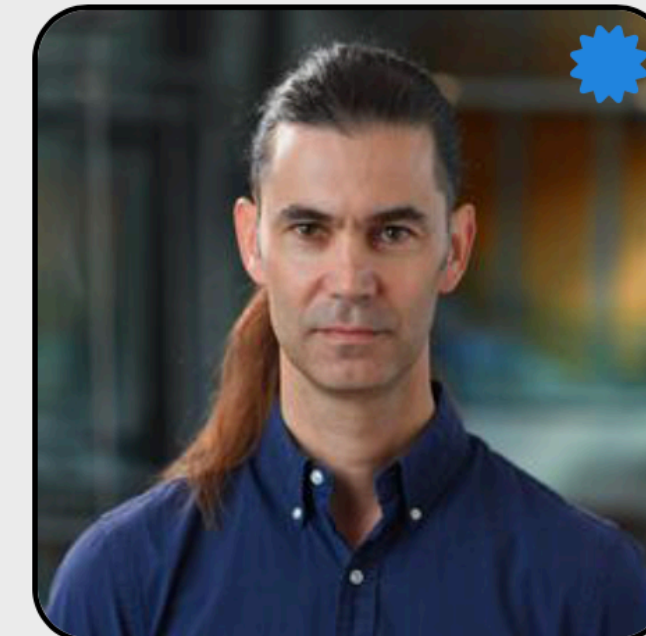
Talley Lambert, PhD

Associate Director
Core for Imaging Technology &
Education
Harvard Medical School



Max Brambach, PhD

Postdoc
Oyler-Yaniv Lab
Harvard Medical School



Simon Nørrelykke, PhD

Director
Image Analysis Collaboratory
Harvard Medical School

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:

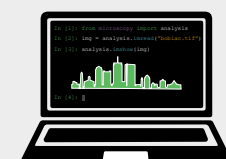
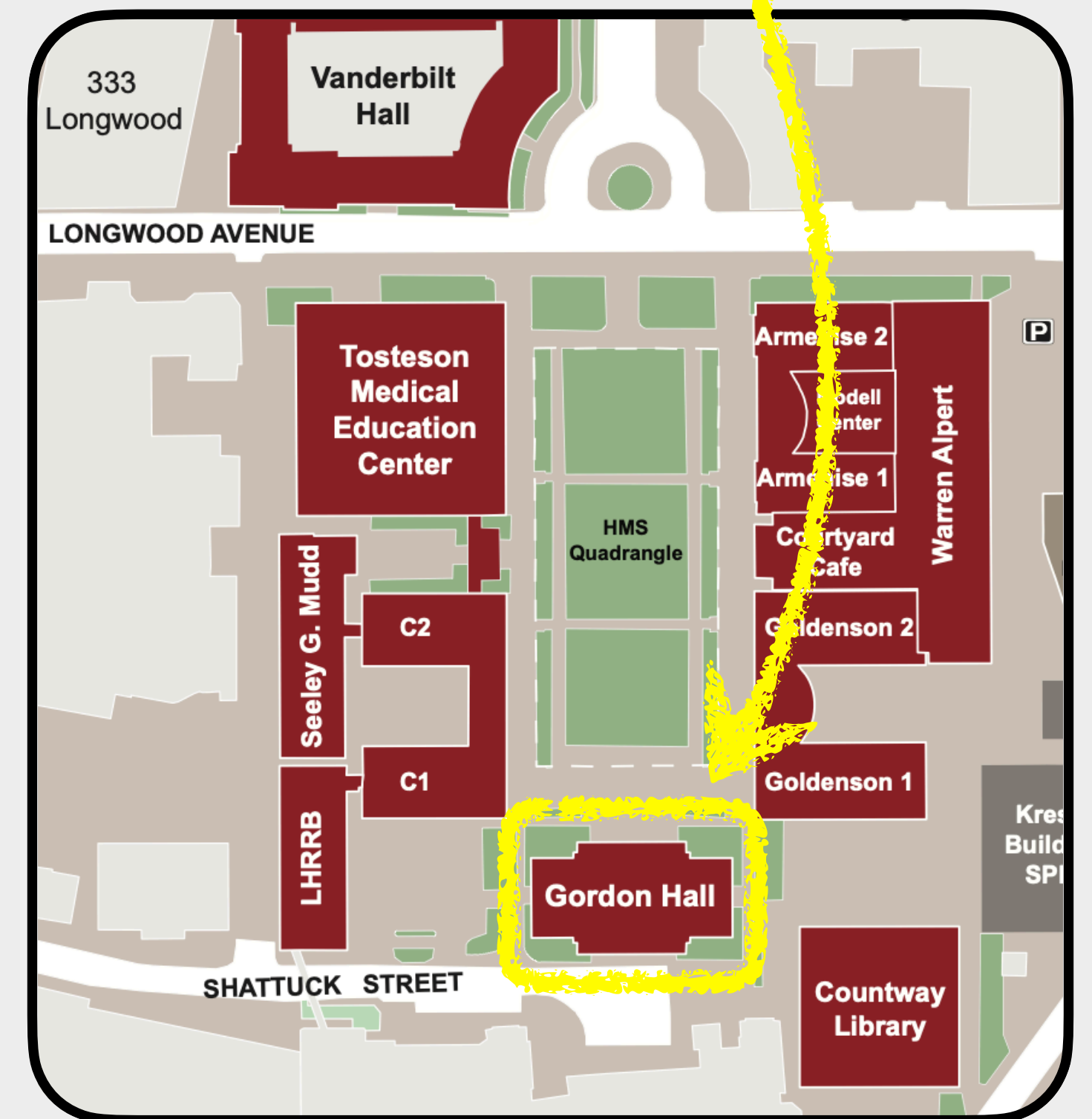
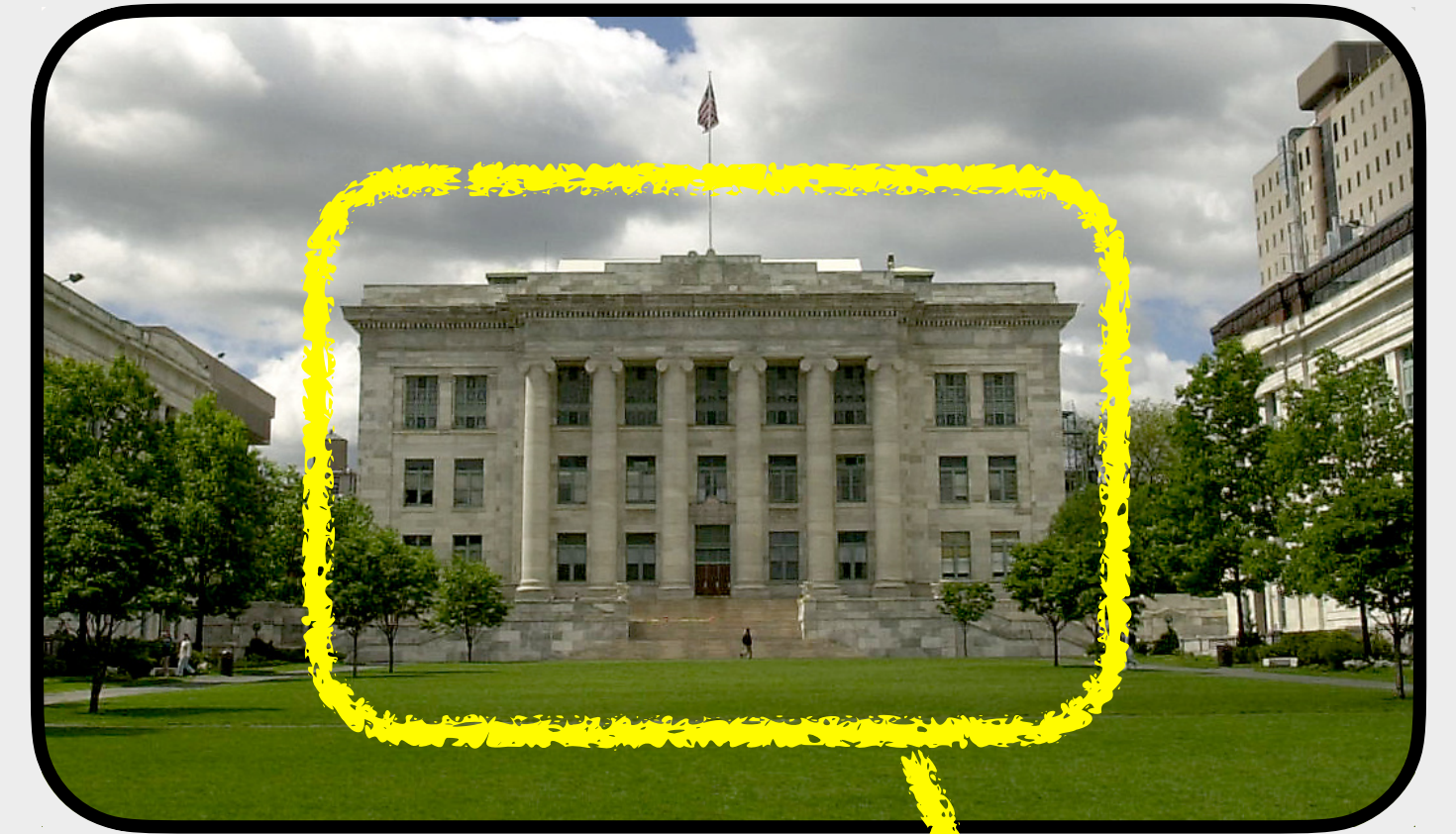
- bagels 🥯, coffee, tea & snacks @ 9:00 am

lunch:

- 12:00 pm in Gordon Hall, Room 106

social dinner:

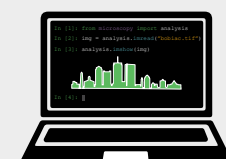
- Thursday July 17th @ 7:30 pm
- Shy Bird (201 Brookline Ave, Boston - 10 min walk)
- we leave @ 7:00 pm 🚶





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!



- ▶ 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		Introduction to Digital Images	Segmentation (Machine Learning)	Segmentation (Deep Learning)	Student Group Work	Colocalization
11:15am - 11:30am						
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						

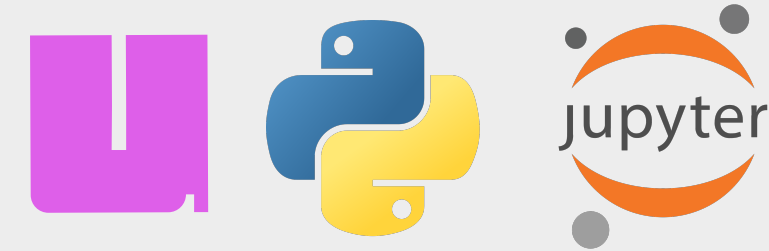




Course Topics I

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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?





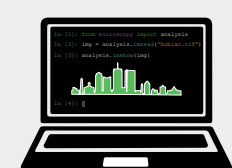
Course Topics II

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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?

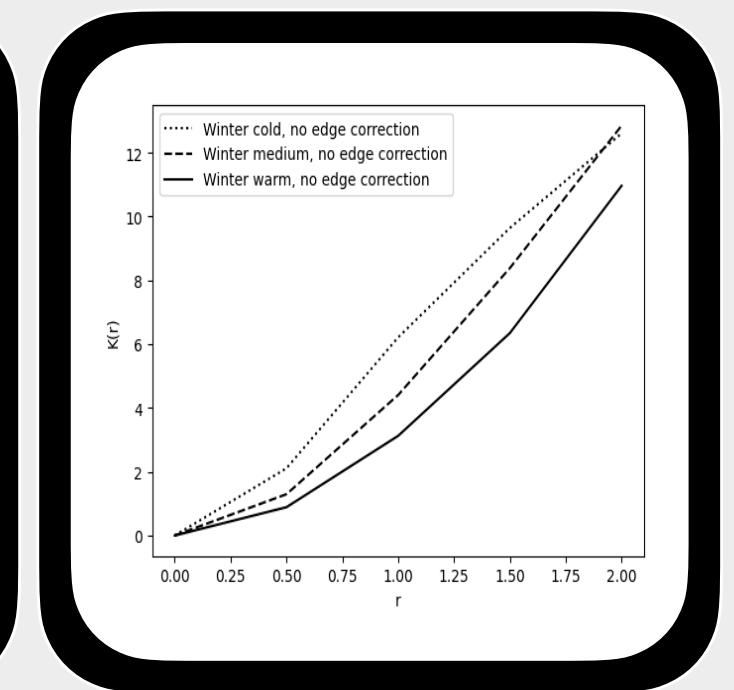
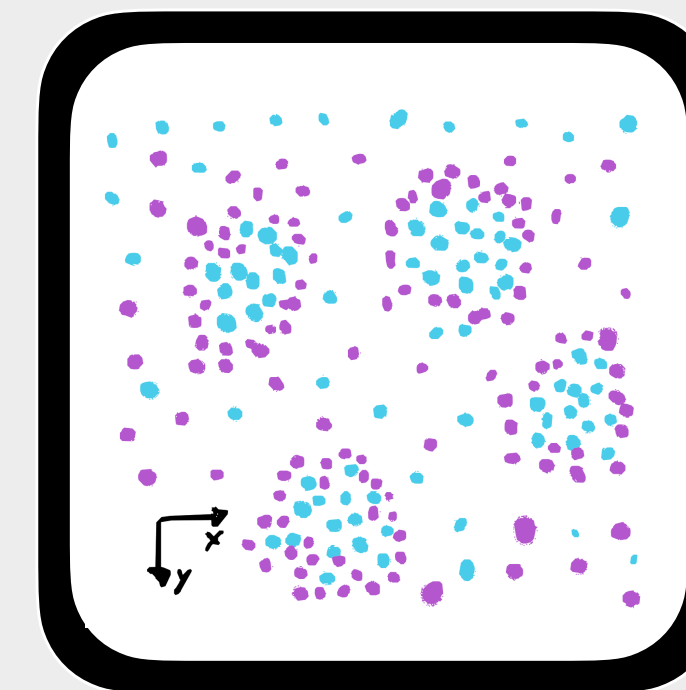
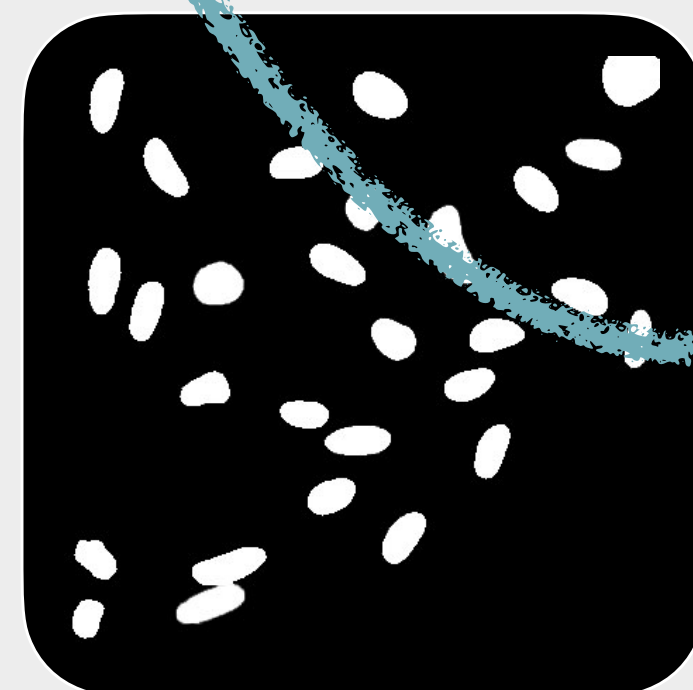
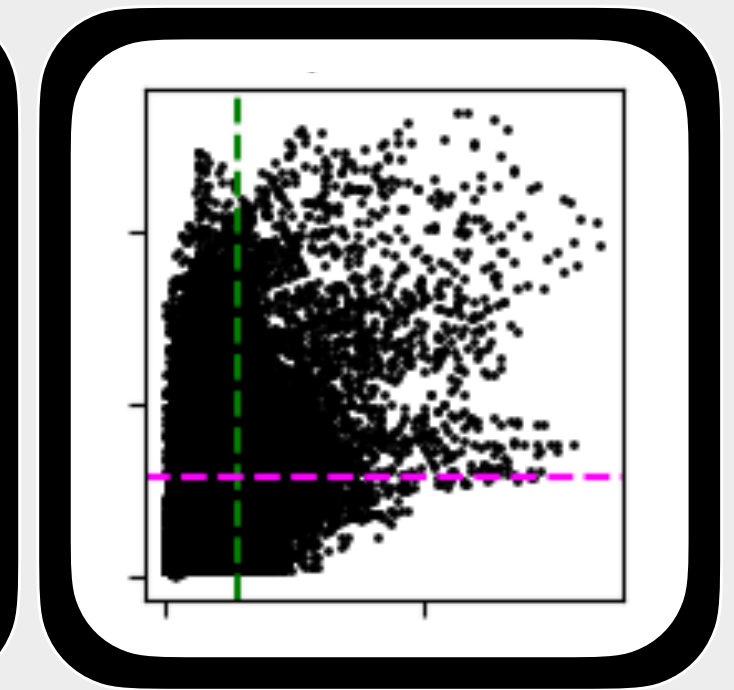
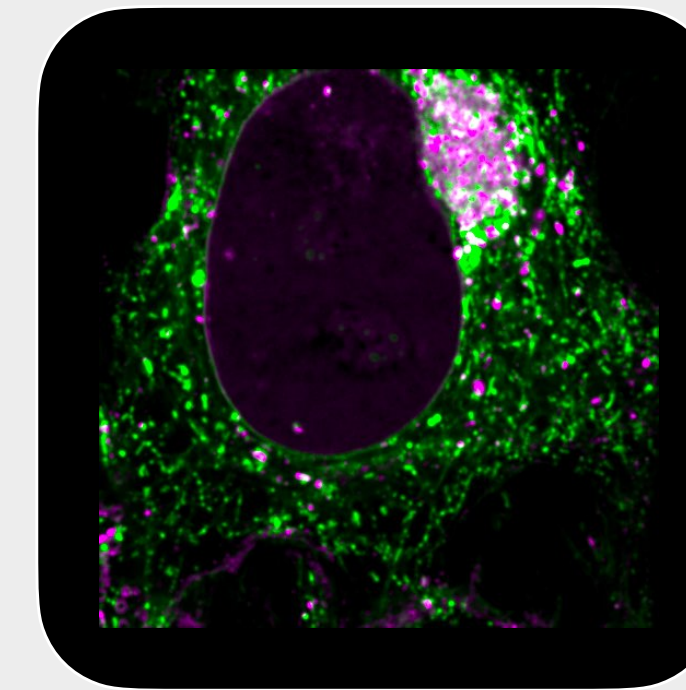
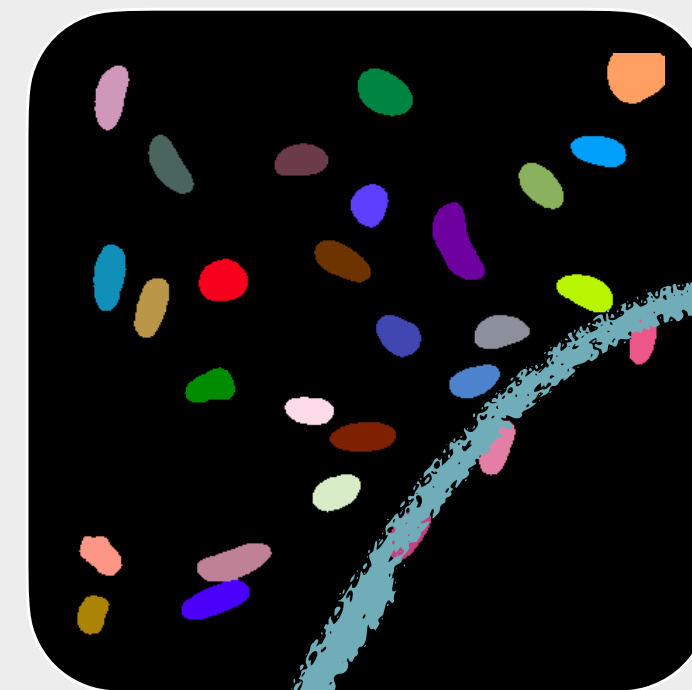
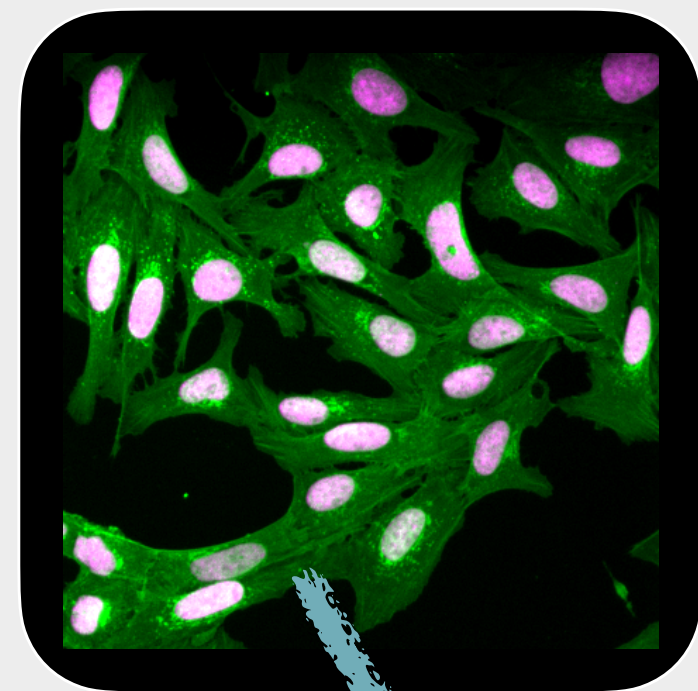
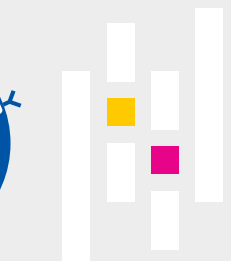
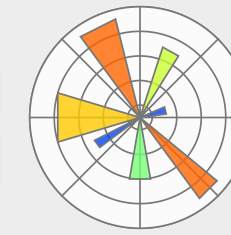




Course Topics II

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Learning Python for Bioimage Processing & Analysis



segmentation, classification, quantification

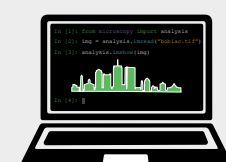
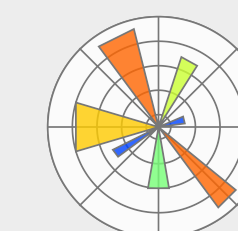
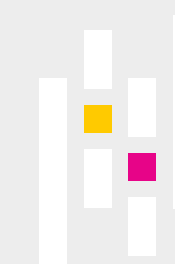
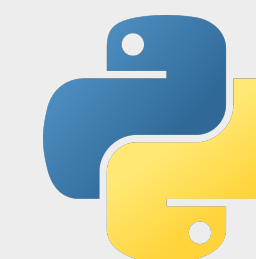
colocalization



Learning Objectives

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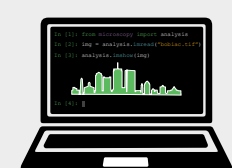
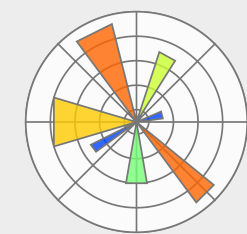
► ~~Become a Python & Bioimage Analysis Expert!~~



Learning Objectives

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- ▶ ~~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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Boston Bioimage Analysis Course | 2025

[Home](#)

Course Material

- 01 - Introduction to Bioimage Analysis
- 02 - Getting Started with Python and
- 03 - Python Basics
- 04 - Introduction to Digital Images
- 05 - Image Segmentation
- 06 - Object Classification
- 07 - Measurements & Quantification
- 08 - Colocalization
- 09 - Reproducibility and Image Ethics

Student Working Groups


- Student Group Work

Course Materials Downloads

- Downloads

Made with **Jupyter Book**

License **CC BY 4.0**



Boston Bioimage Analysis Course | 2025

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 this Slides](#) button at the top for convenient access to slides for that specific topic.

Contents

Welcome to the BoBiAC Book



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?

Code

File

Edit

Selection

View

Go

Run

Terminal

Window

Help

code_agent

EXPLORER

CODE_AGENT

DAPI_wf_0.tif

CHAT

Edit with Copilot

Agent Mode

Ask Copilot to edit your files in [agent mode](#). Copilot will automatically use multiple requests to pick files to edit, run terminal commands, and iterate on errors.

Copilot is powered by AI, so mistakes are possible. Review output carefully before use.

or type # to attach context

Add Context...

DAPI_wf_0.tif

- Write in a `segment_nuclei.py` file the code to perform instance segmentation on the fluorescence image `#file:DAPI_wf_0.tif` which contains stained nuclei.

- Use a classical image segmentation approach — no deep learning. The pipeline should use standard steps such as denoising, thresholding, morphological operations, distance transform, and watershed to identify individual nuclei.

- Use libraries like ``tiffle``, ``scikit-image``, ``numpy``, ``matplotlib``, and ``scipy``.

- Once segmented, display the original DAPI image and segmentation result as a labeled mask.

-Run the script at every modifivation to make sure it works.

-Before running, create a new environment in this folder using ``uv`` and

Agent GPT-4.1

Show All Commands

Go to File

Open Chat

Find in Files

Toggle Terminal

Command+P

OUTLINE

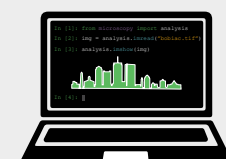
TIMELINE

0 0 0

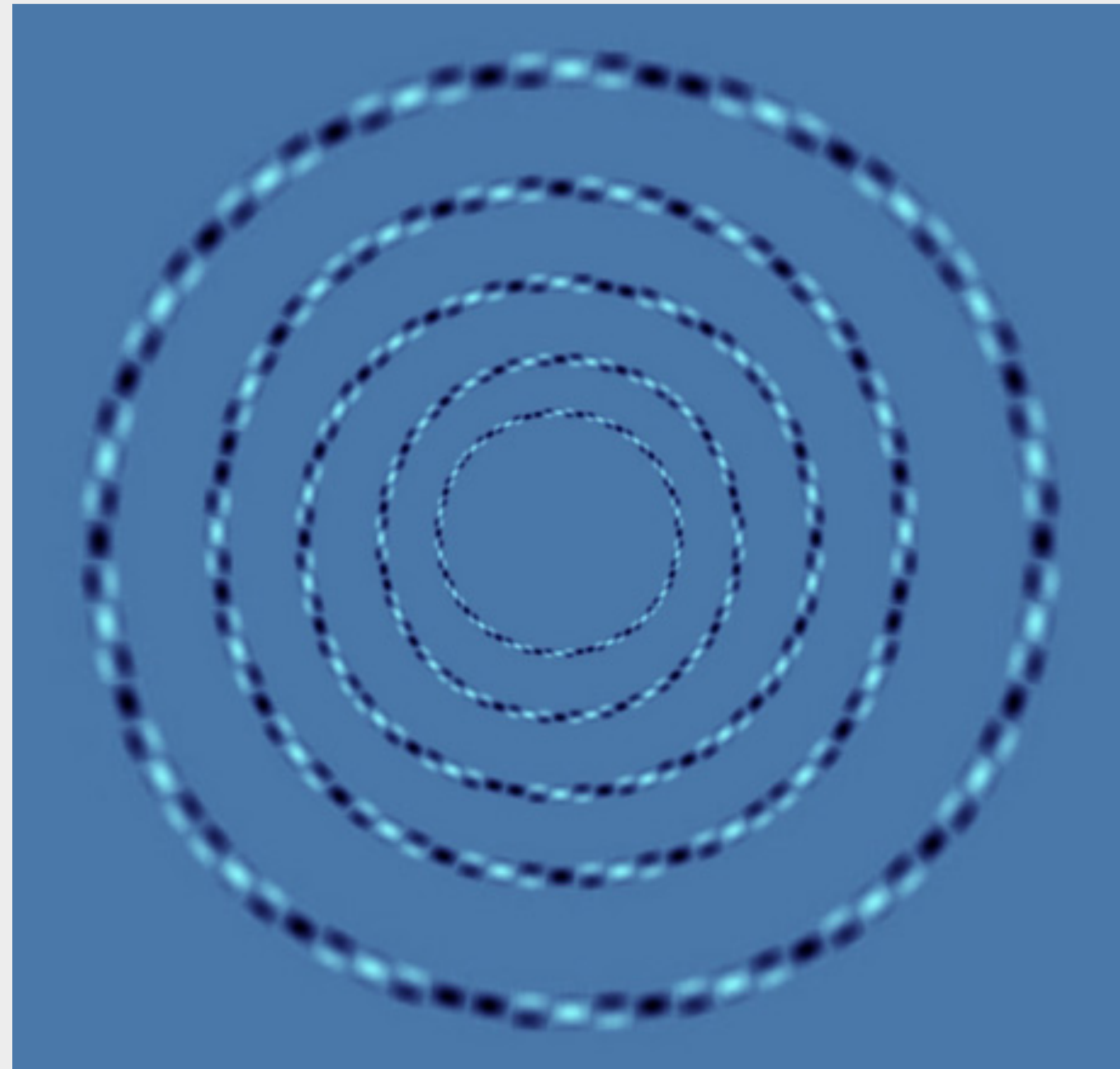
The prompt is the key!



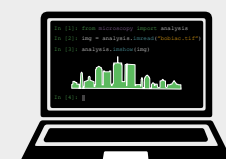
Why should you analyze images with computers?



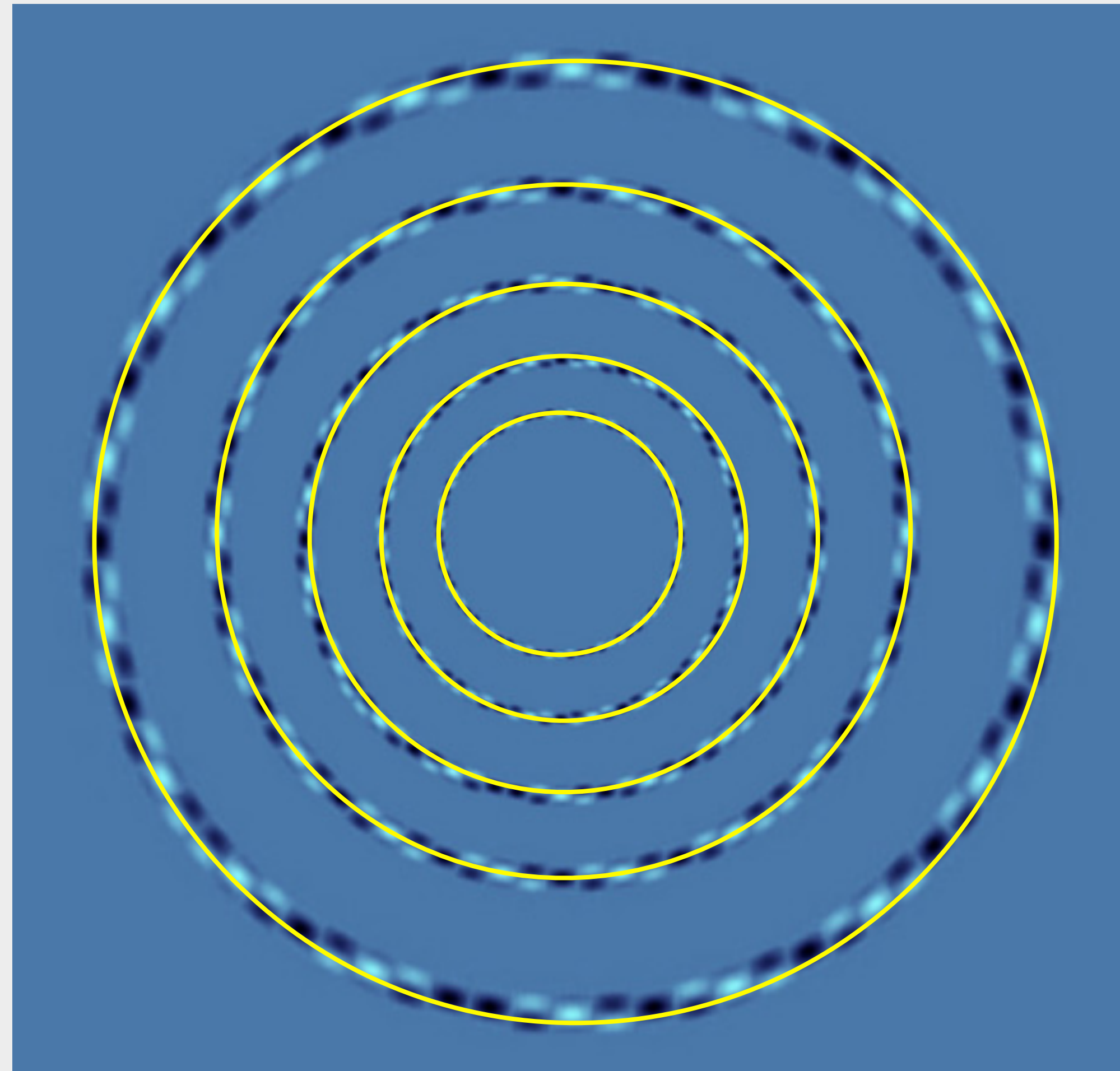
Why should you analyze images with computers?



concentric?



Why should you analyze images with computers?

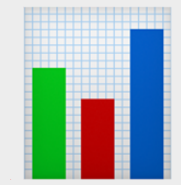


concentric?

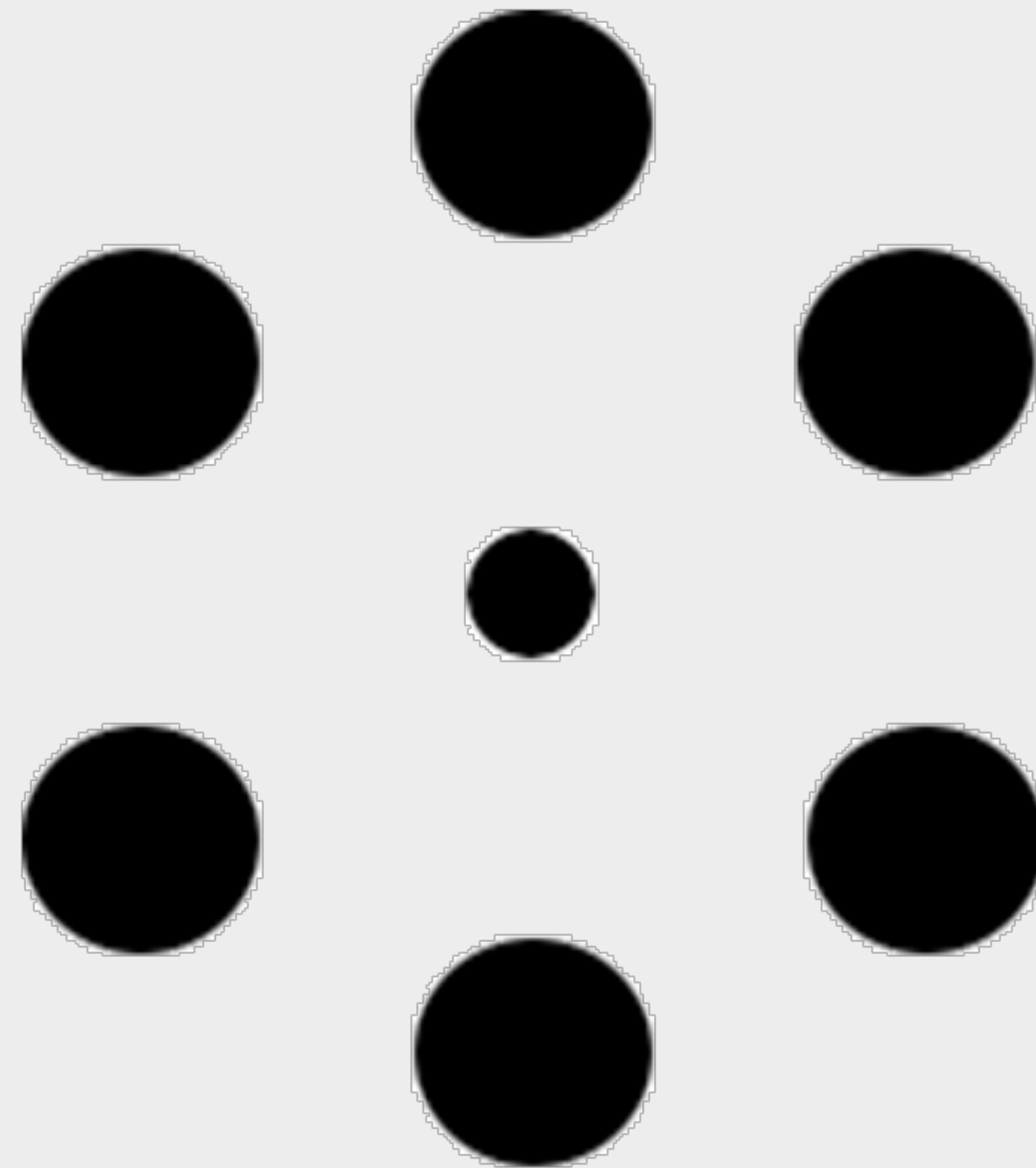
color perception and pattern recognition is individual, science less so.

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

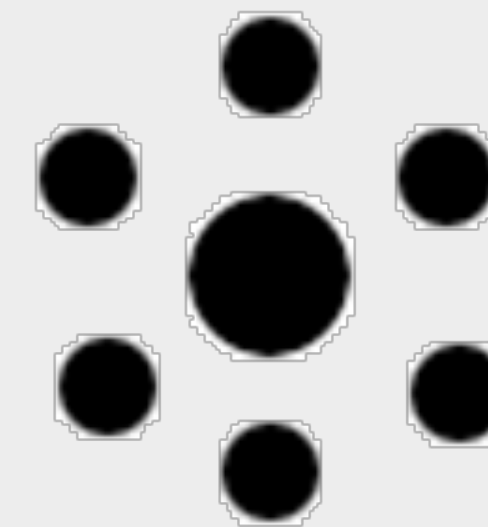




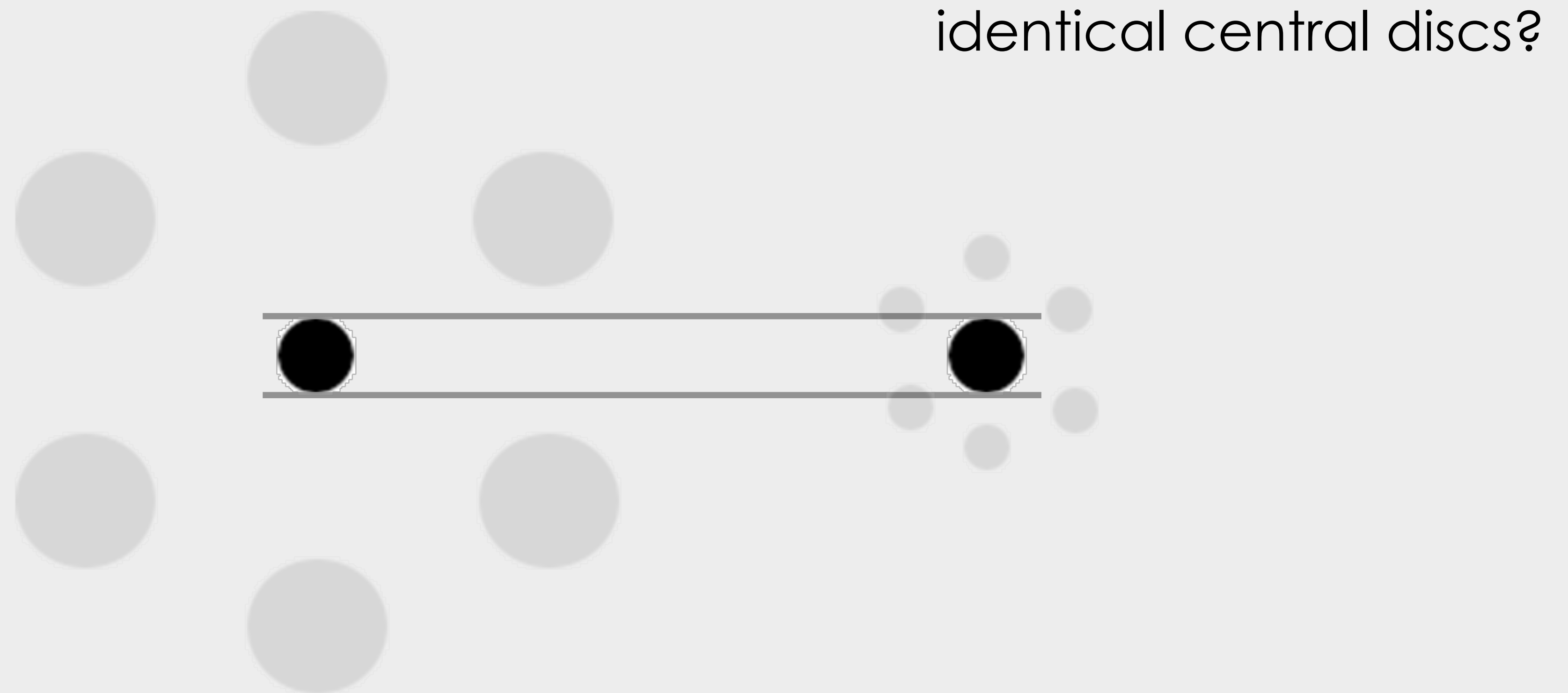
Why should you analyze images with computers?



identical central discs?



Why should you analyze images with computers?

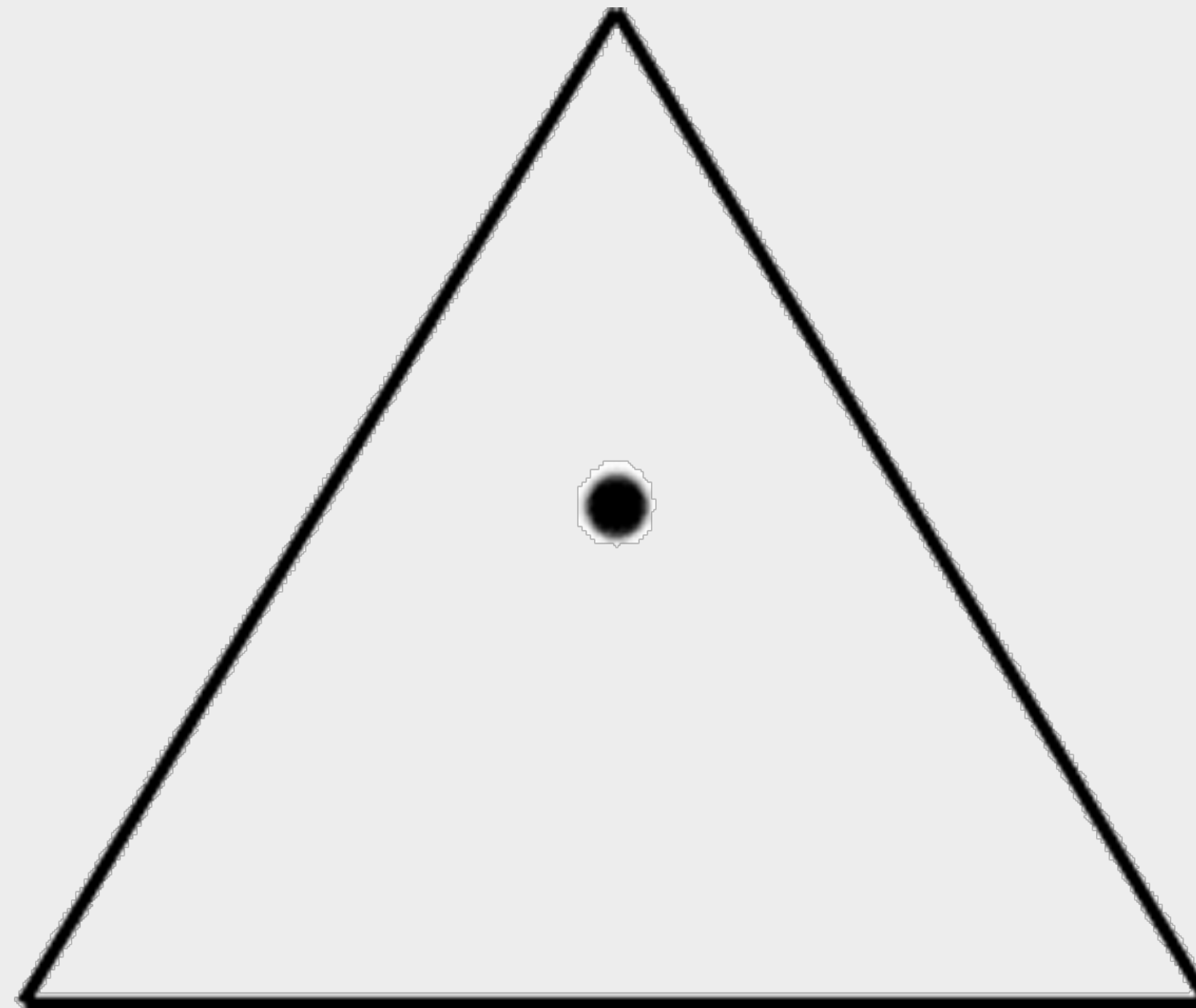


our size estimate is strongly influenced by the local neighborhood.





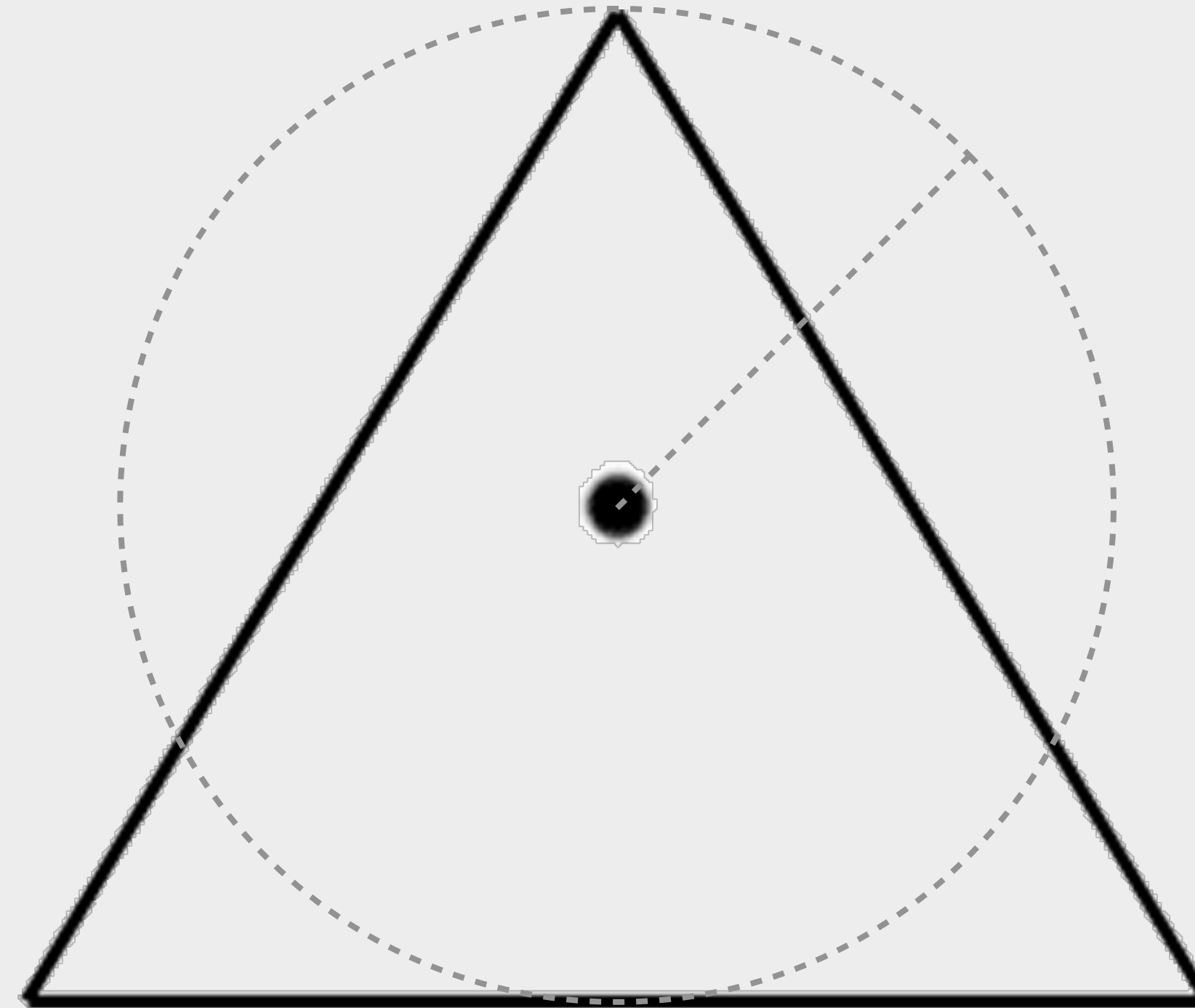
Why should you analyze images with computers?



Is the dot half-way up?



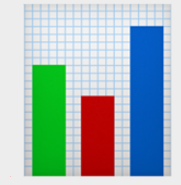
Why should you analyze images with computers?



Is the dot half-way up?

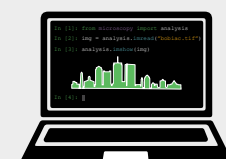
our sense of distance depends on neighborhood.





Why should you analyze images with computers?

are discs equally grey?





Why should you analyze images with computers?

are discs equally grey?

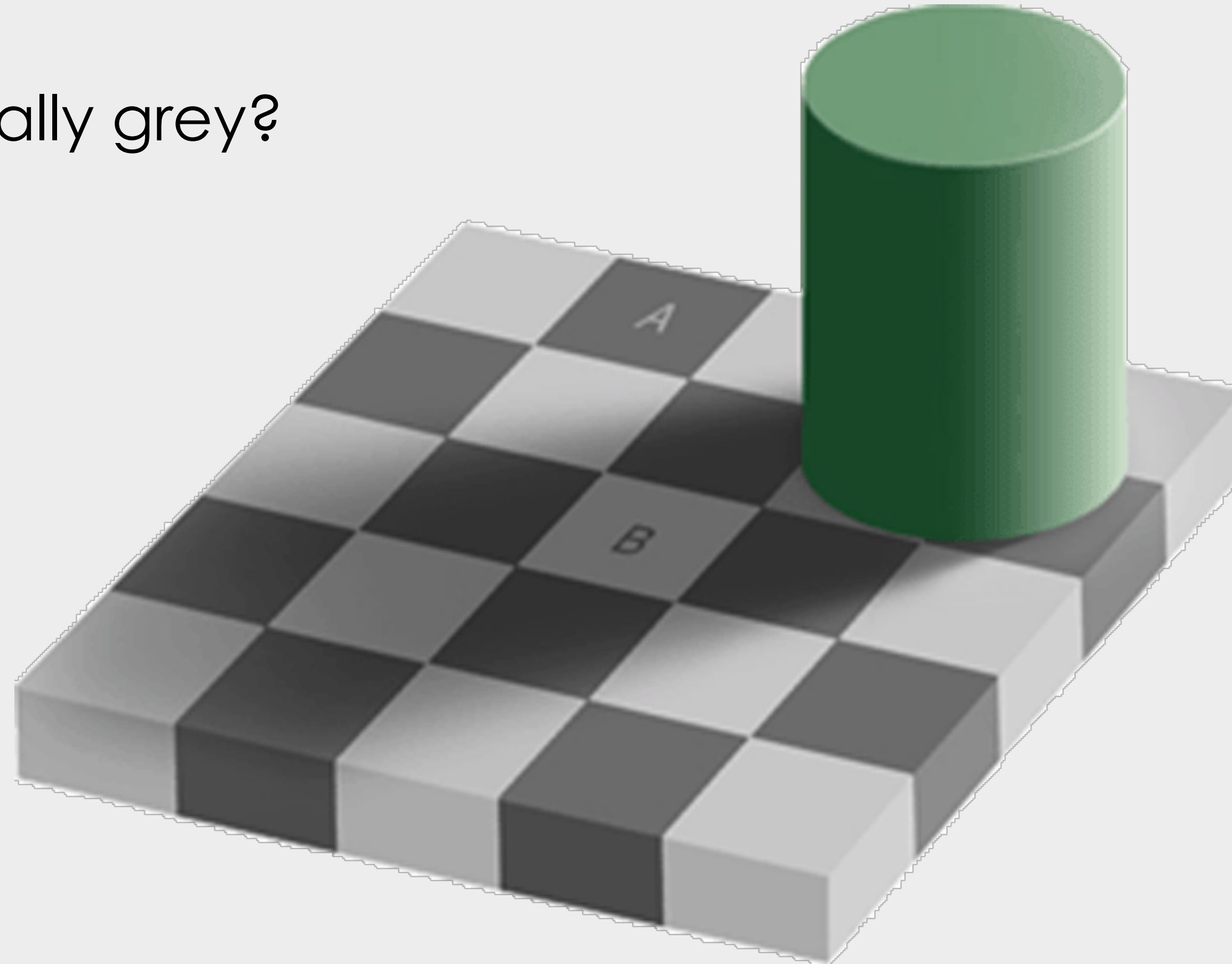


intensity perception depends strongly on neighborhood.



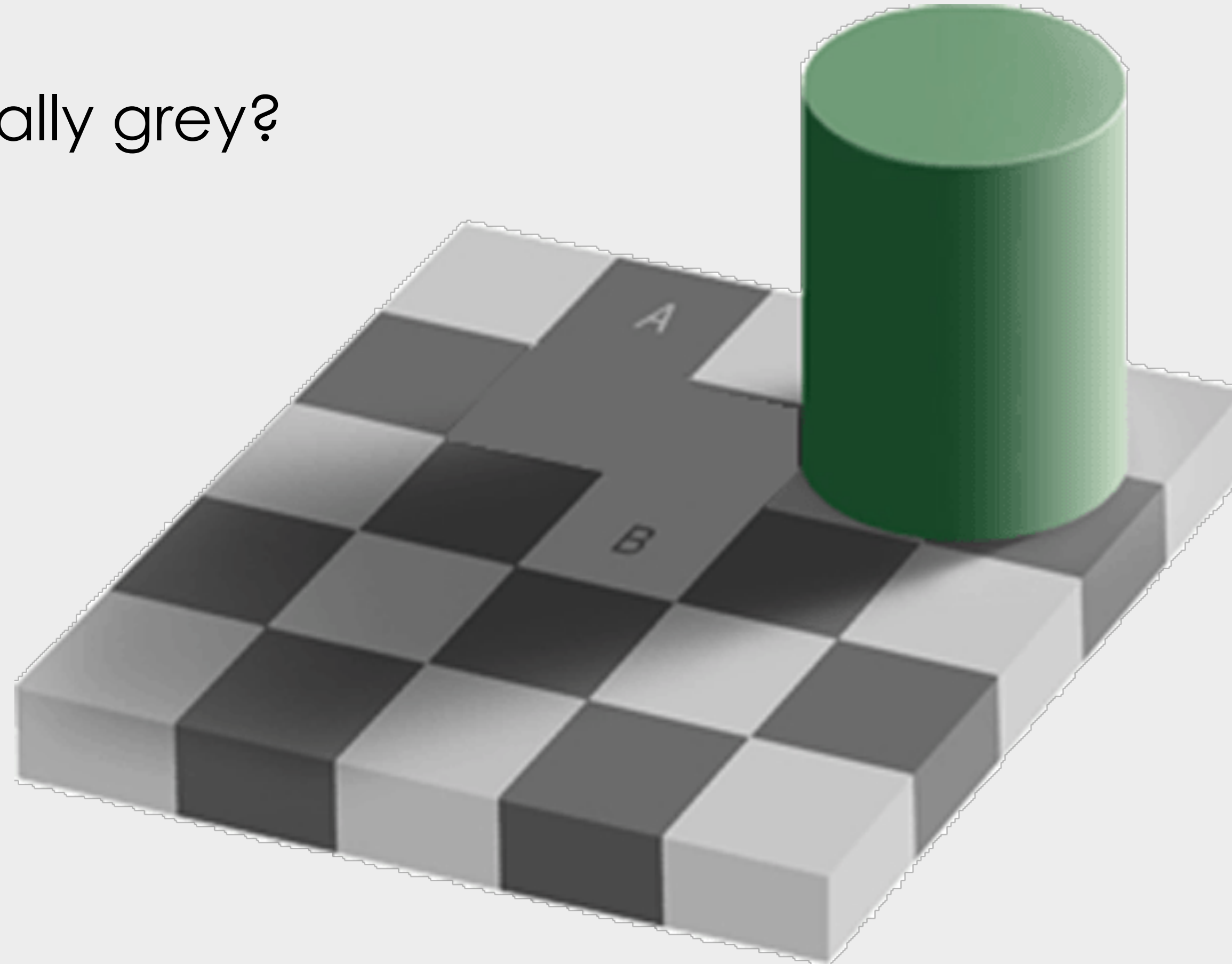
Why should you analyze images with computers?

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



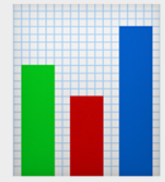
Why should you analyze images with computers?

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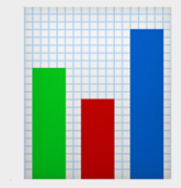
intensity perception depends strongly on neighborhood.





Why should still use your brain?





Why should still use your brain?

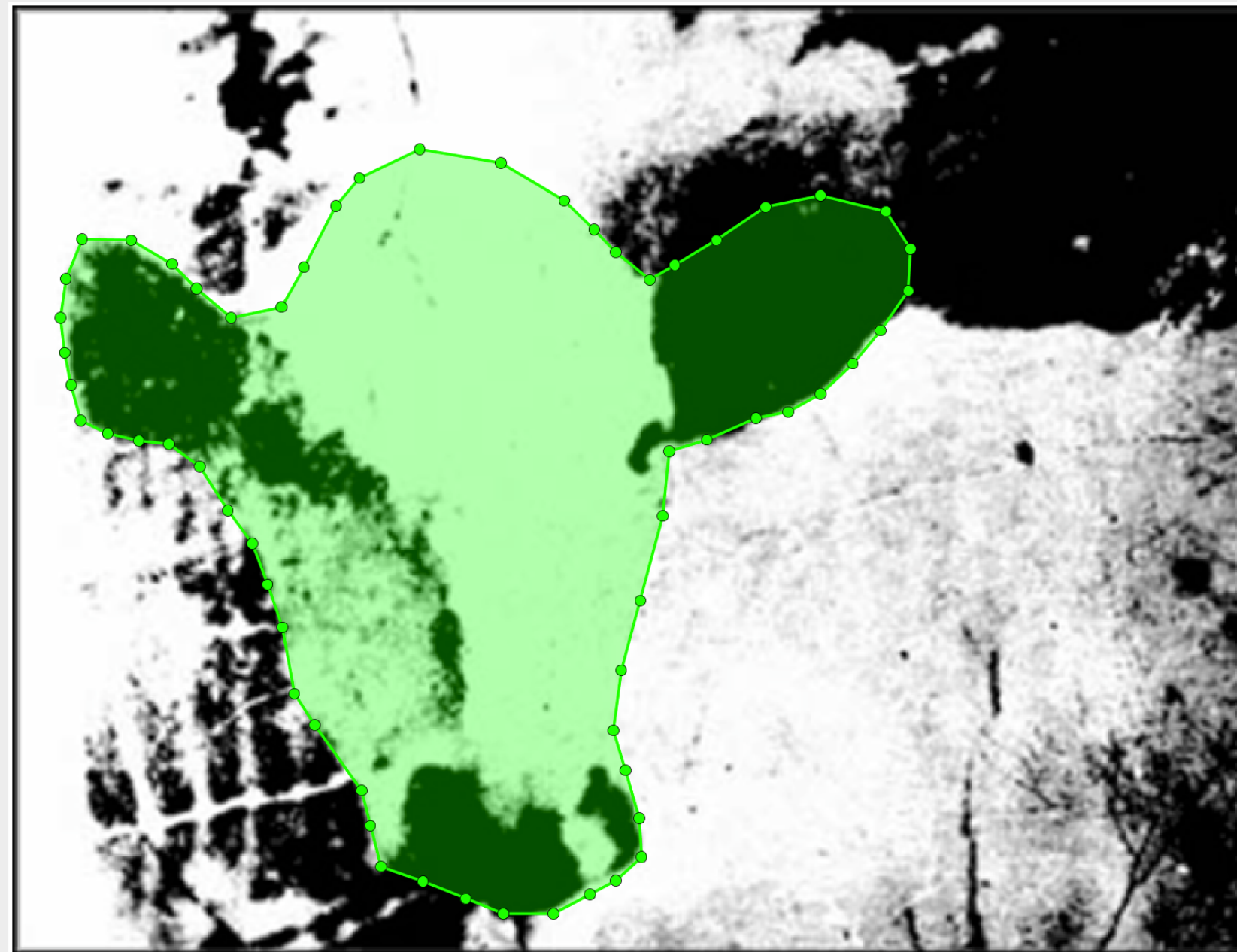
What do you see?





Why should still use your brain?

What do you see?



It's a cow!

<http://www.brainbashers.com>





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!

<http://www.brainbashers.com>

