

Welcome to the

Bo BiAC

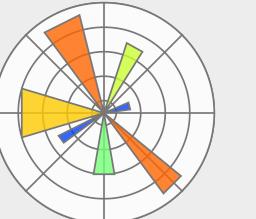
Boston Bioimage Analysis Course | 2025



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



Time: 9:00 am - 6:30 pm



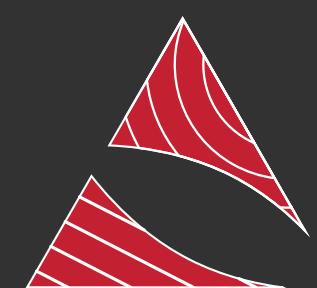
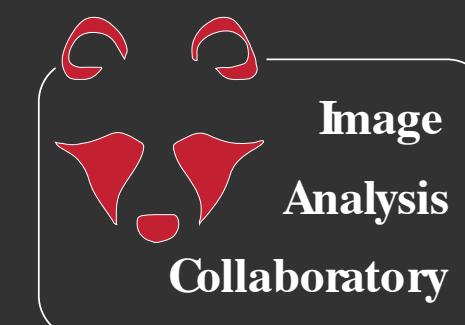
location: Gordon Hall - Harvard Medical School



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



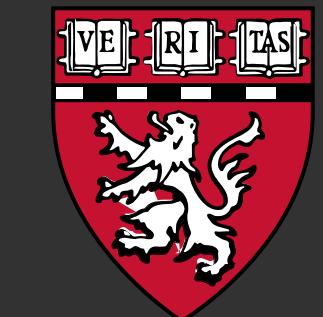
course material: hms-iac.github.io/bobiac



C I T E
Core for Imaging Technology & Education



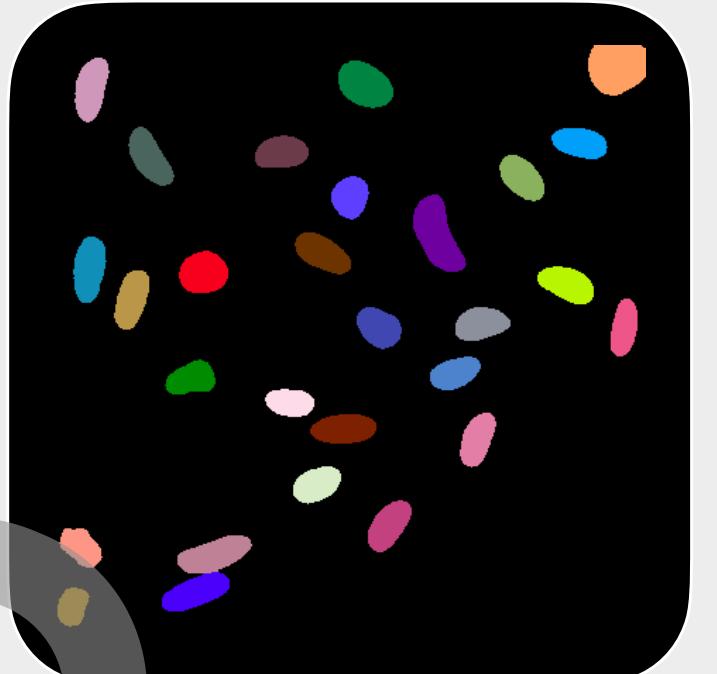
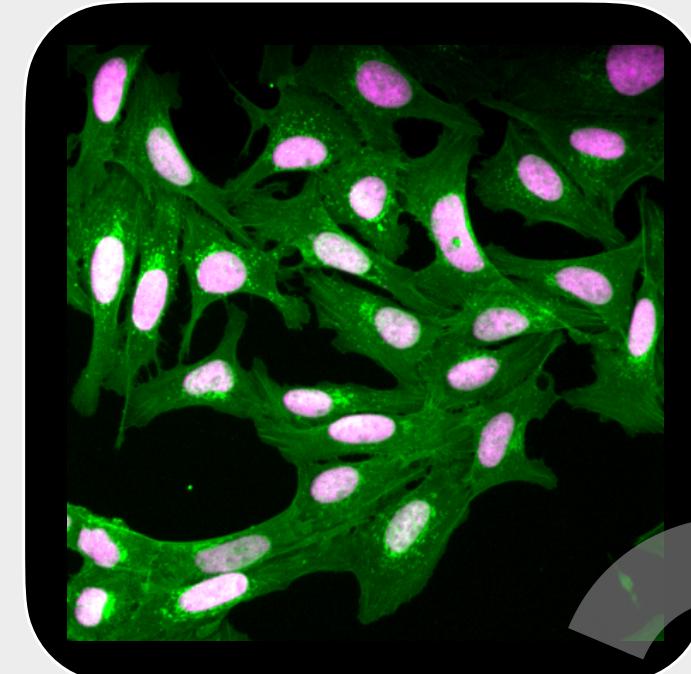
BioImaging
North America



HARVARD
MEDICAL SCHOOL

IAC: iac.hms.harvard.edu

CITE: cite.hms.harvard.edu





The BoBiAC Team



IAC: iac.hms.harvard.edu



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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:

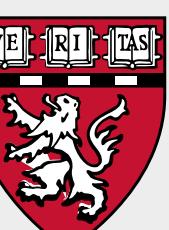
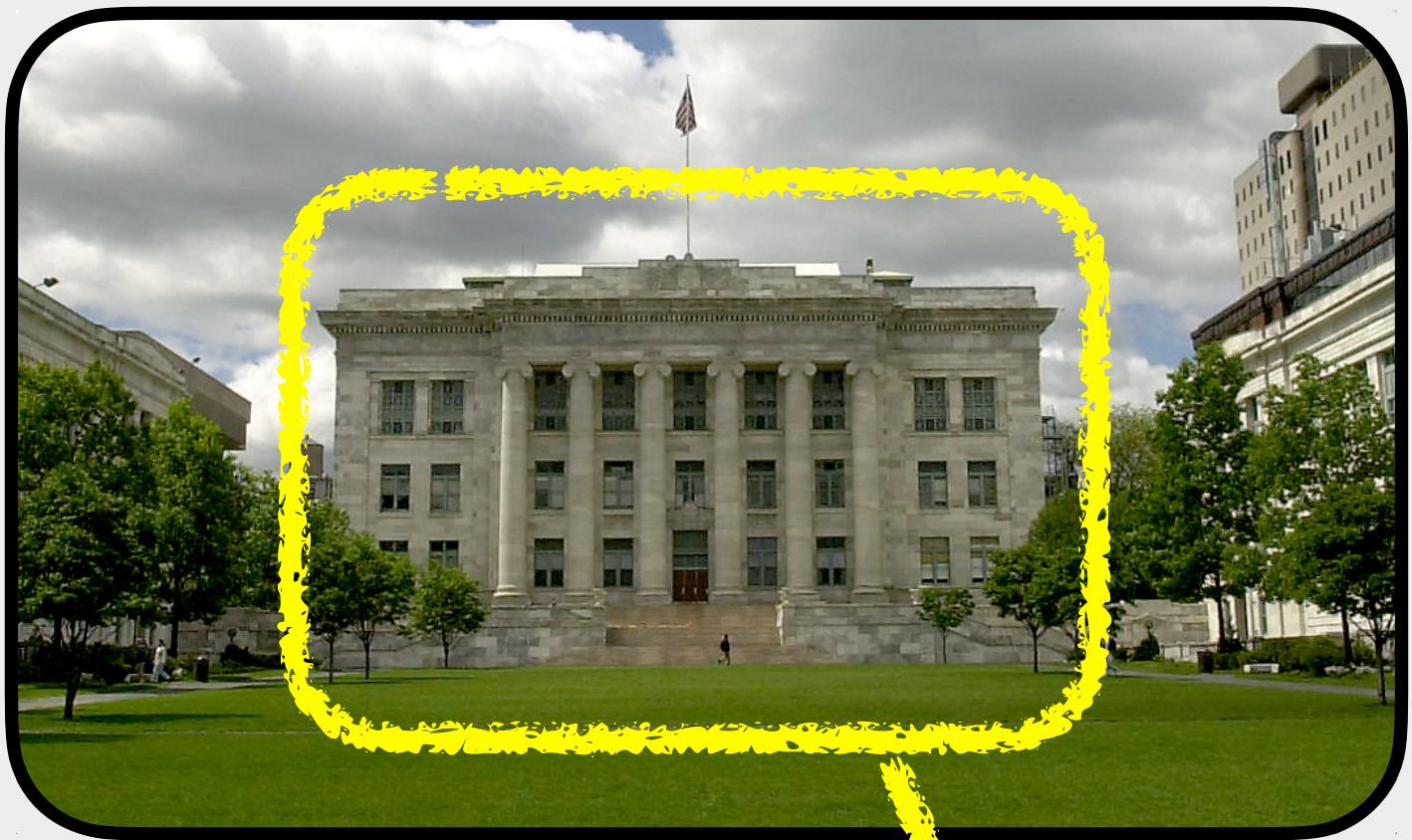
- bagels 🥯, coffee, tea & snacks @ 9:00 am

pizza 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.





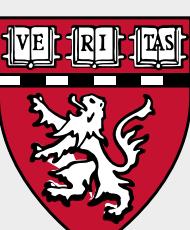
Schedule



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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	Coffee Break	Coffee Break	Coffee Break	Coffee Break	Coffee Break	
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		Lunch	Lunch	Lunch	Lunch	Lunch	
12:00pm - 12:30pm		Lunch	Lunch	Lunch	Lunch	Lunch	
12:30pm - 1:00pm	Getting Started with Python	Student Presentations (5x5min)	Student Presentations (5x5min)	Student Presentations (5x5min)	Student Group Work	Colocalization	
1:00pm - 1:30pm		Student Presentations (5x5min)	Student Presentations (5x5min)	Student Presentations (5x5min)			
1:30pm - 2:00pm		Python for Bioimage Analysis	Segmentation (Machine Learning)	Measurements and Quantification			
2:00pm - 2:30pm				Student Group Work	Colocalization		
2:30pm - 3:00pm	The Python Basics	Segmentation (Classic)	Object Classification (llastik)			Measurements and Quantification	
3:00pm - 3:30pm				Student Group Results Presentation	Colocalization		
3:30pm - 4:00pm							
4:00pm - 4:30pm	The Python Basics	Segmentation (Classic)	Object Classification (llastik)	Measurements and Quantification	Reproducibility & Image Ethics	Feedback & Wrap-Up	
4:30pm - 5:00pm							
5:00pm - 5:30pm					Results Discussion		
5:30pm - 6:00pm					Coffee Break		
6:00pm - 6:30pm	The Python Basics	Segmentation (Classic)	Object Classification (llastik)	Measurements and Quantification	Social Dinner	Feedback & Wrap-Up	
6:30pm - 7:30pm				Optional: Office Hour		Optional: Office Hour	
7:30pm - 8:30pm	Optional: Office Hour	Optional: Office Hour	Optional: Office Hour				
8:30pm - 9:30pm							





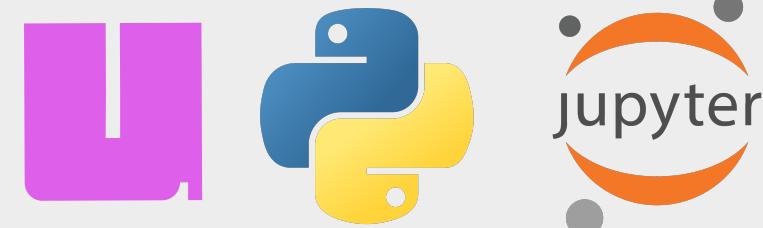
Course Topics I



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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

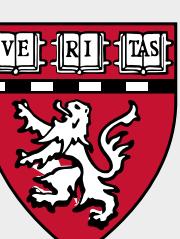


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Learning Python for Bioimage Processing & Analysis



- ▶ **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?



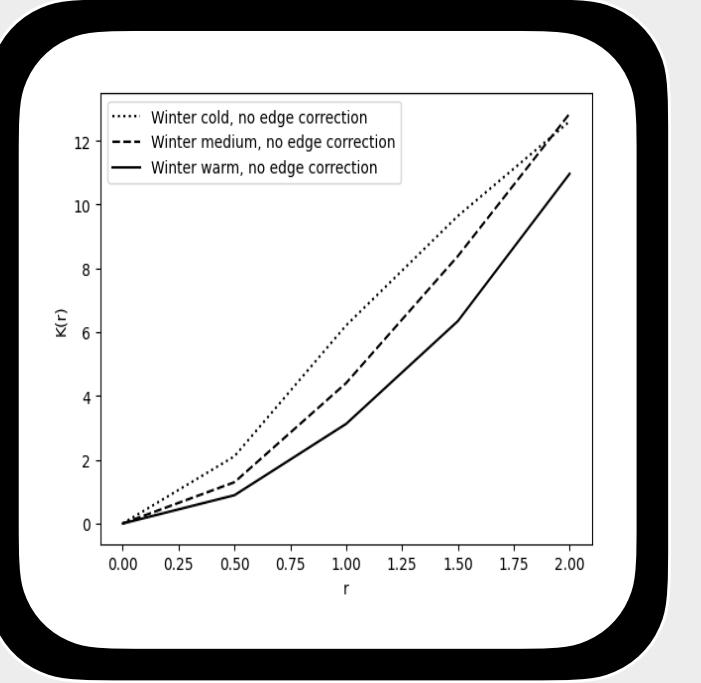
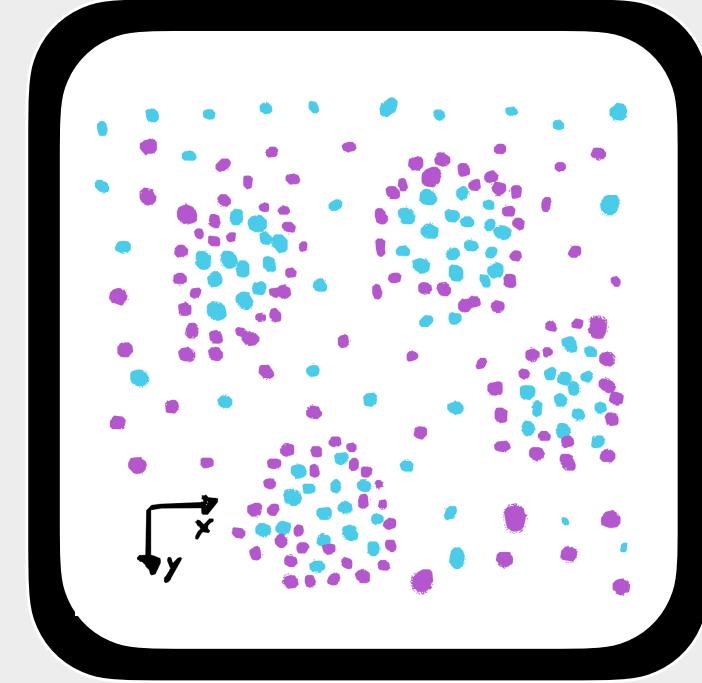
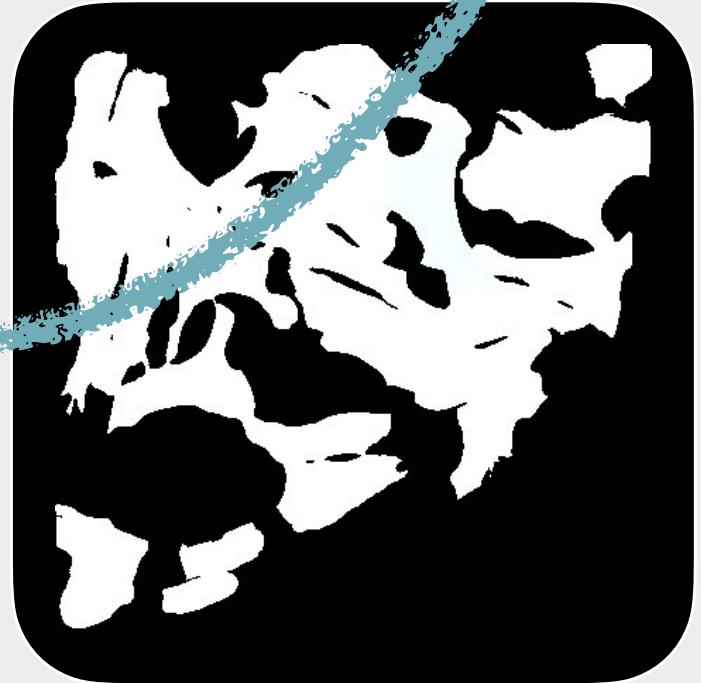
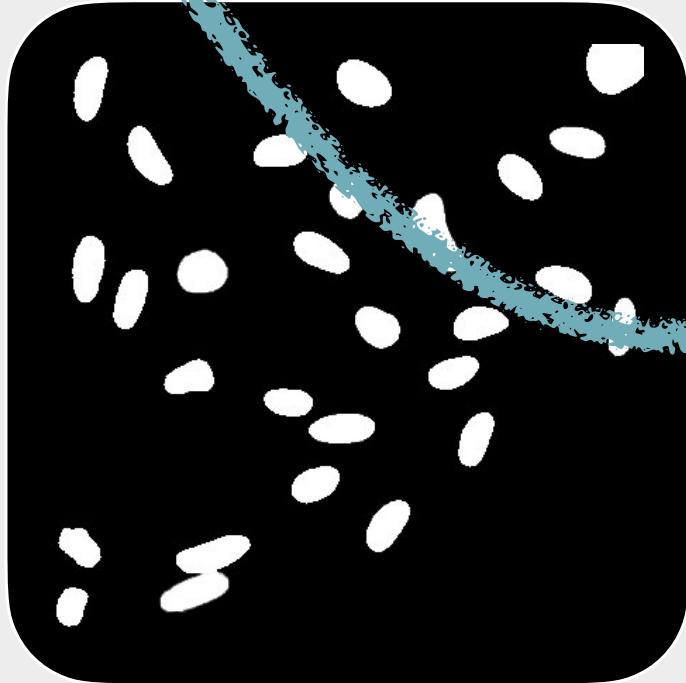
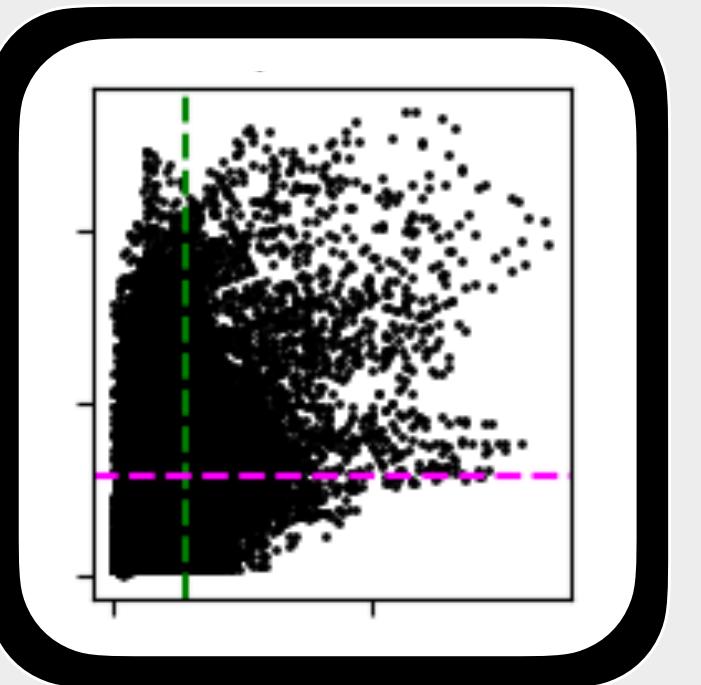
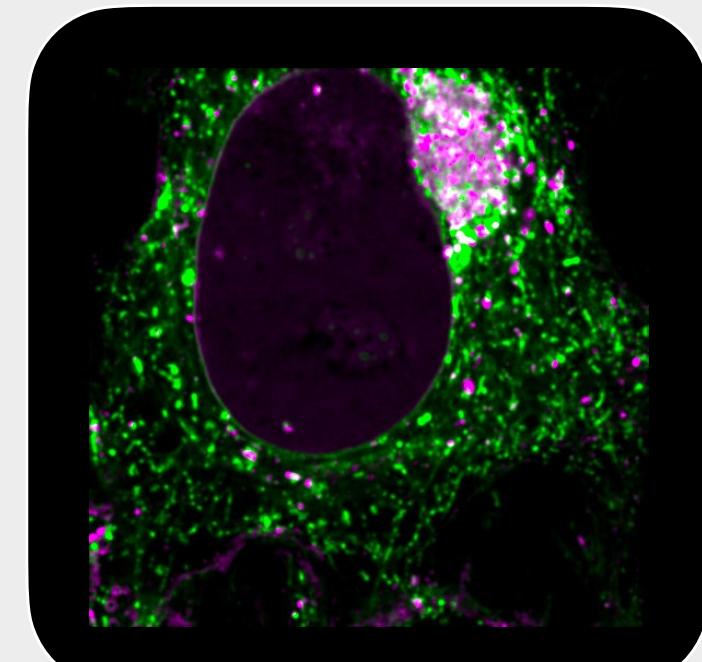
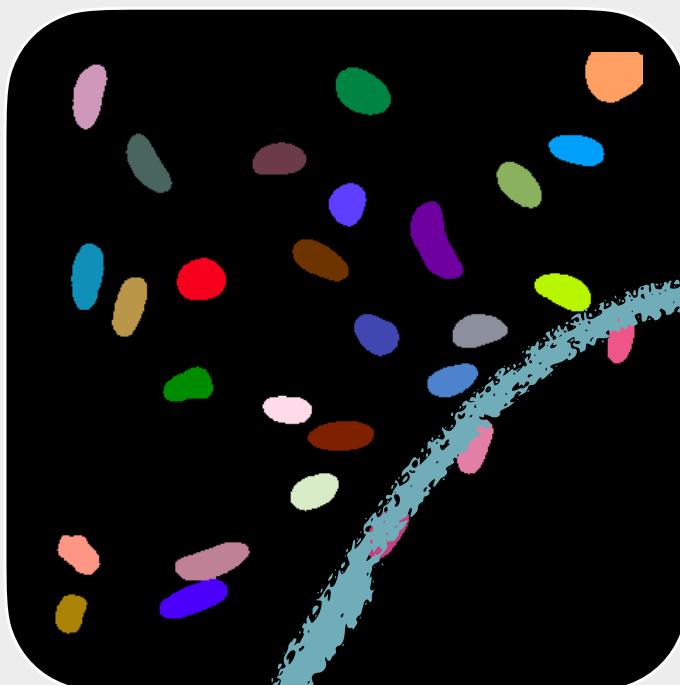
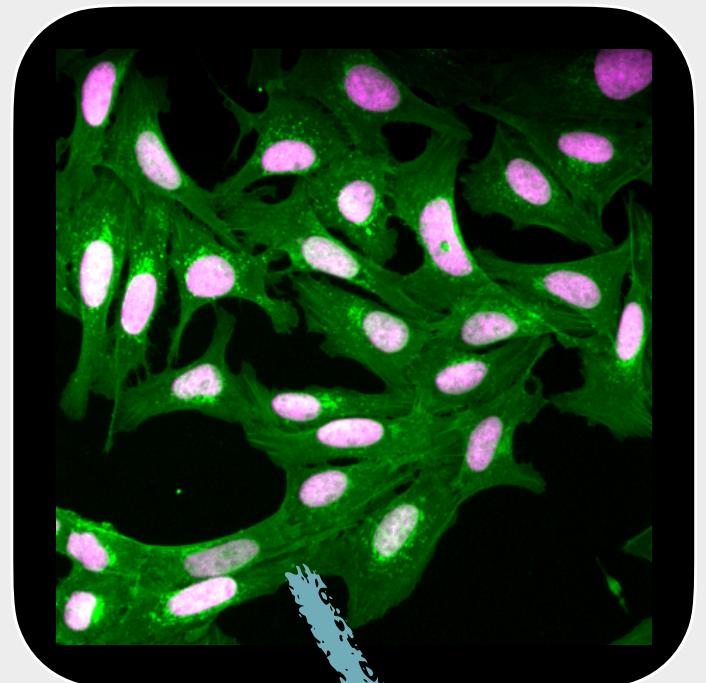


Course Topics II



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Learning Python for Bioimage Processing & Analysis



segmentation, classification, quantification

colocalization

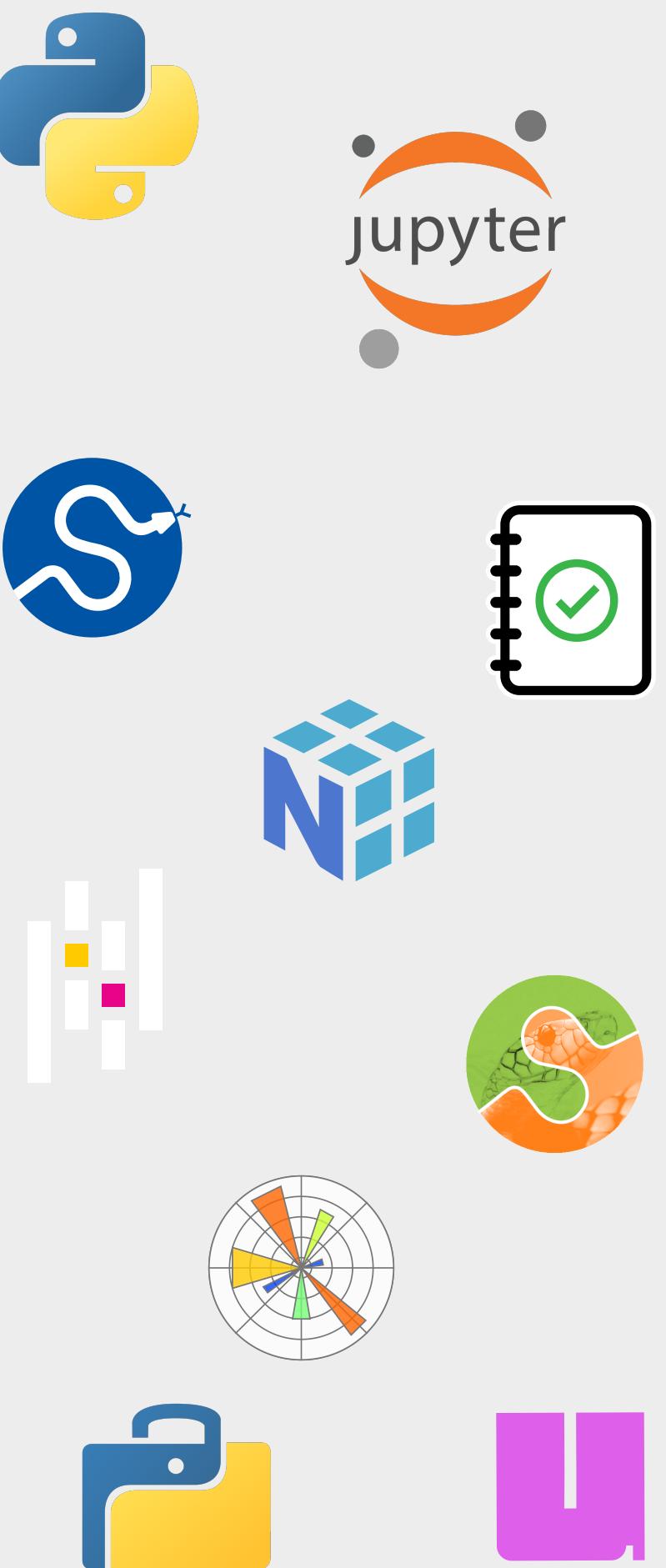




Learning Objectives

► Become a Python & Bioimage Analysis Expert!

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Learning Objectives

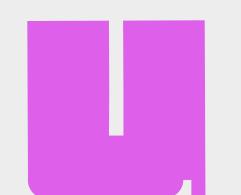
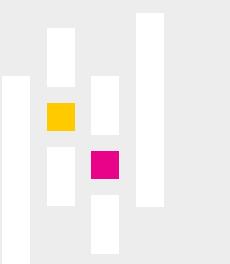
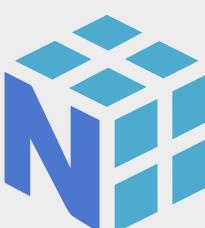
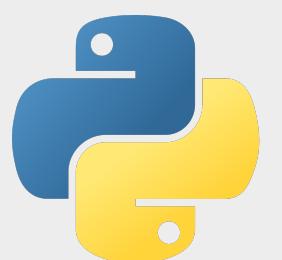


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► **Become a Python & Bioimage Analysis Expert!**

- 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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The screenshot shows the homepage of the BoBiAC Jupyter Book. At the top left is the BoBiAC logo with the text "Boston Bioimage Analysis Course | 2025". To its right are the logos for Image Analysis Collaboratory, CITE, and Harvard Medical School. The main title "Bo BiAC" is prominently displayed in large letters. Below the title is the subtitle "Boston Bioimage Analysis Course | 2025". A green header bar contains the text "Welcome to the BoBiAC Book #". Below this, a section titled "Lecture Slides" explains that all lecture slides are available for download as PDFs, and provides instructions on how to do so.

Bo BiAC
Boston Bioimage Analysis Course | 2025

Image Analysis Collaboratory CITE HARVARD MEDICAL SCHOOL

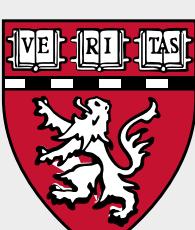
Welcome to the BoBiAC Book #

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.



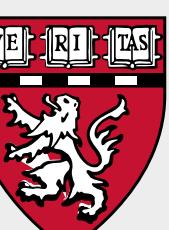
hms-iac.github.io/bobiac



? 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/Python if we have AI/LLMs?

The prompt is the key!

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

Show All Commands ⌘ P

Go to File ⌘ P

Open Chat ⌘ I

Find in Files ⌘ F

Toggle Terminal ⌘ T

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 `'tifffile'`, `'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 modification to make sure it works.

- Before running, create a new environment in this folder using `'uv'` and Agent GPT-4.1

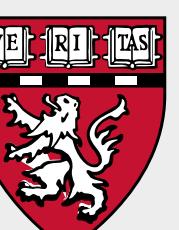
OUTLINE

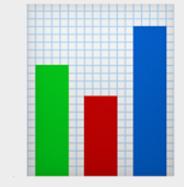
TIMELINE

×

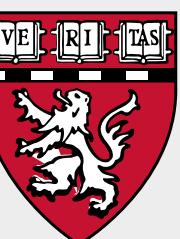
0 △ 0

∅ ⌘ ⌘ Go Live



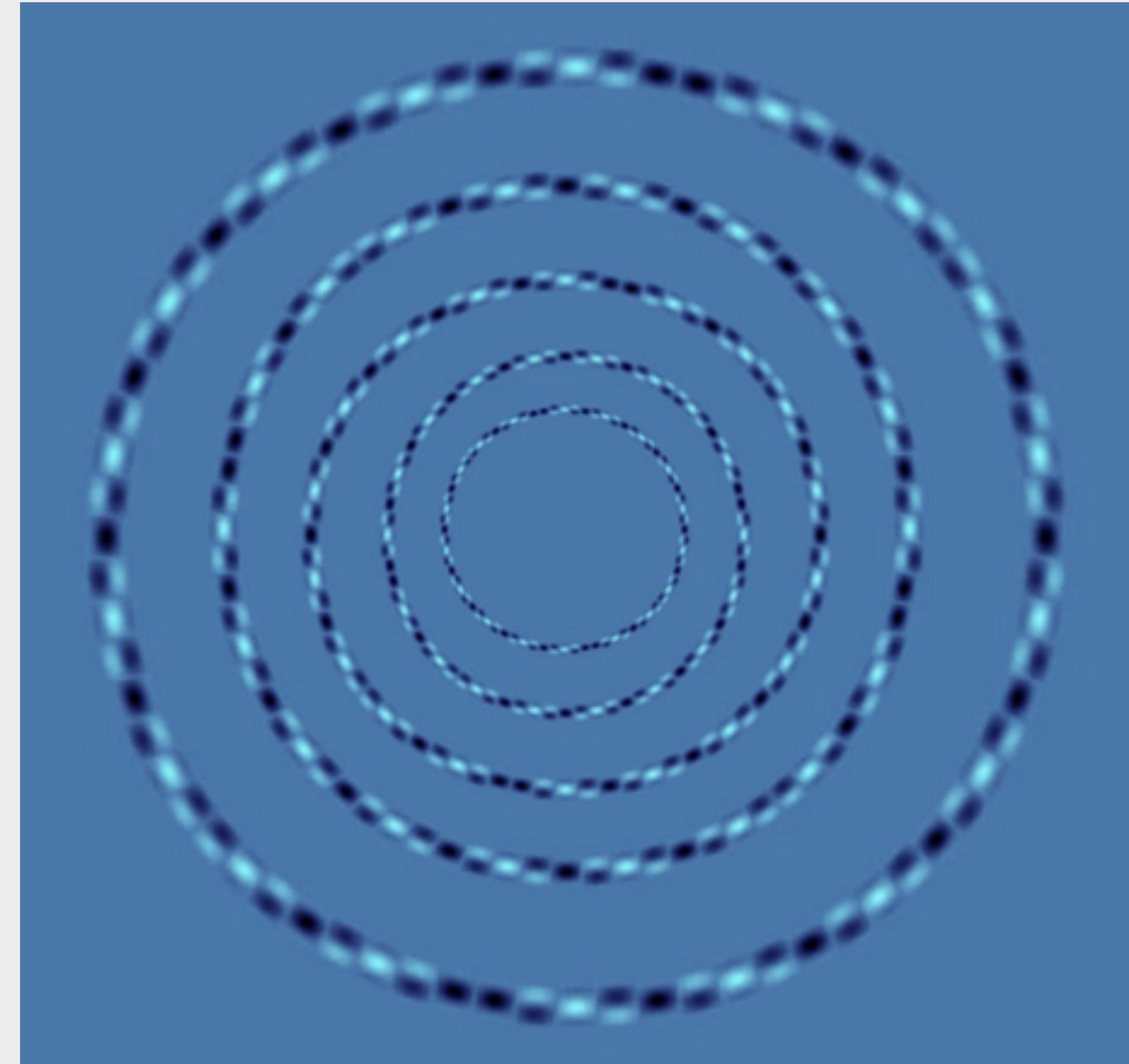


Why should you analyze images with computers?





Why should you analyze images with computers?



concentric?

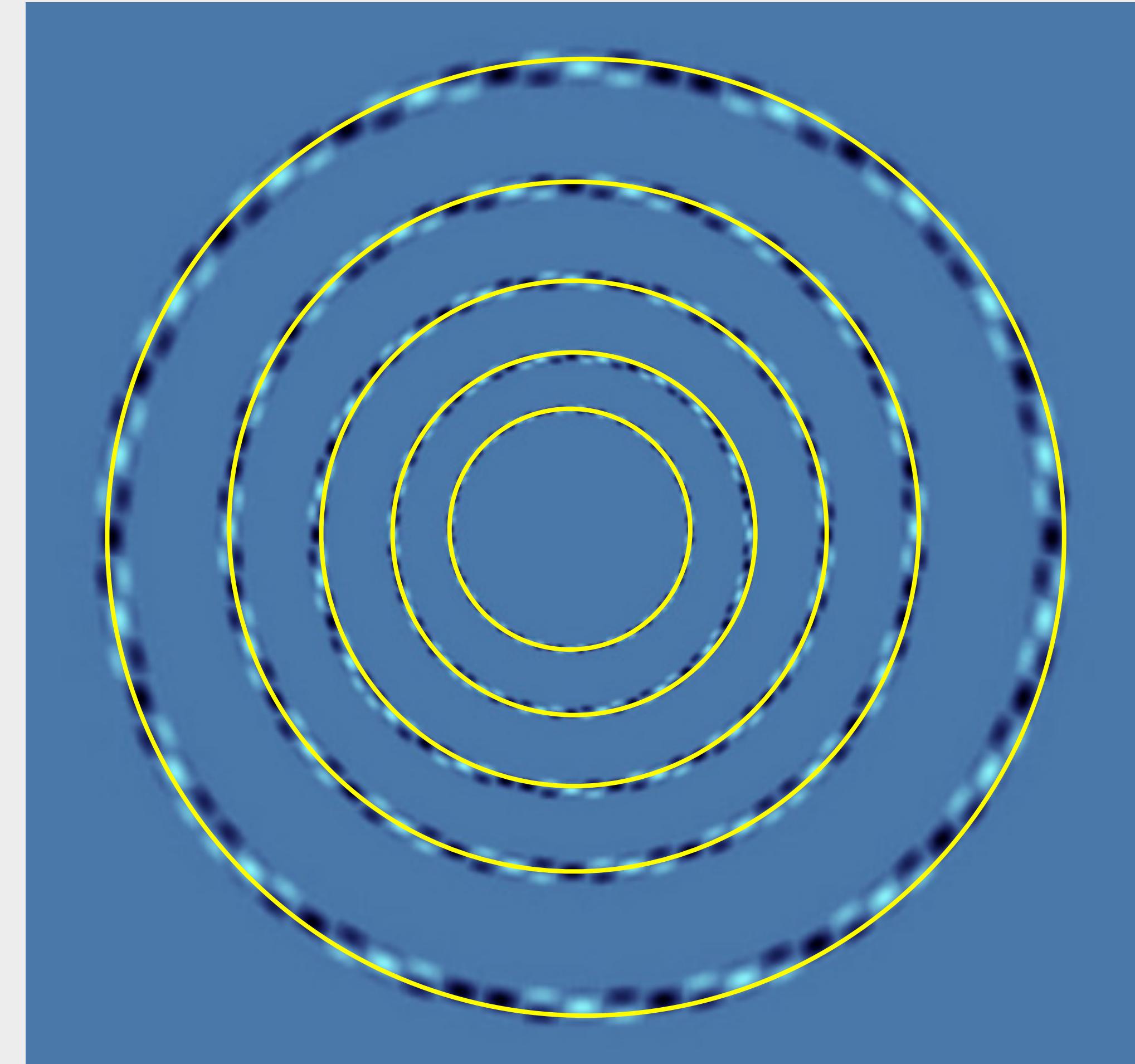


<https://www.moillusions.com/perfect-circles-optical-illusion>





Why should you analyze images with computers?



concentric?

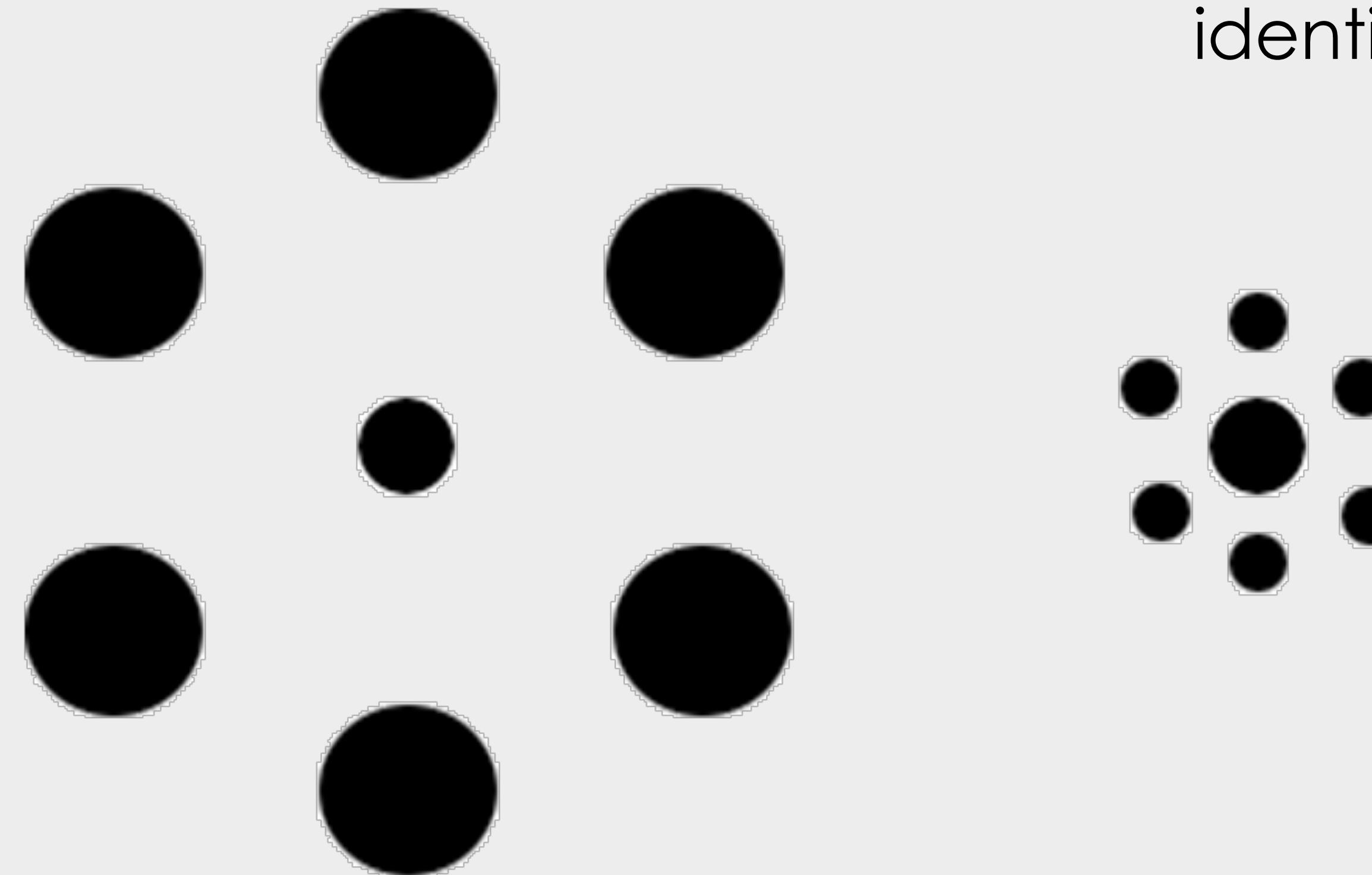
color perception and pattern recognition is individual, science less so.

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

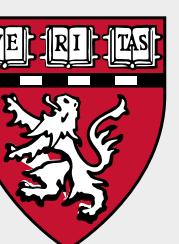




Why should you analyze images with computers?

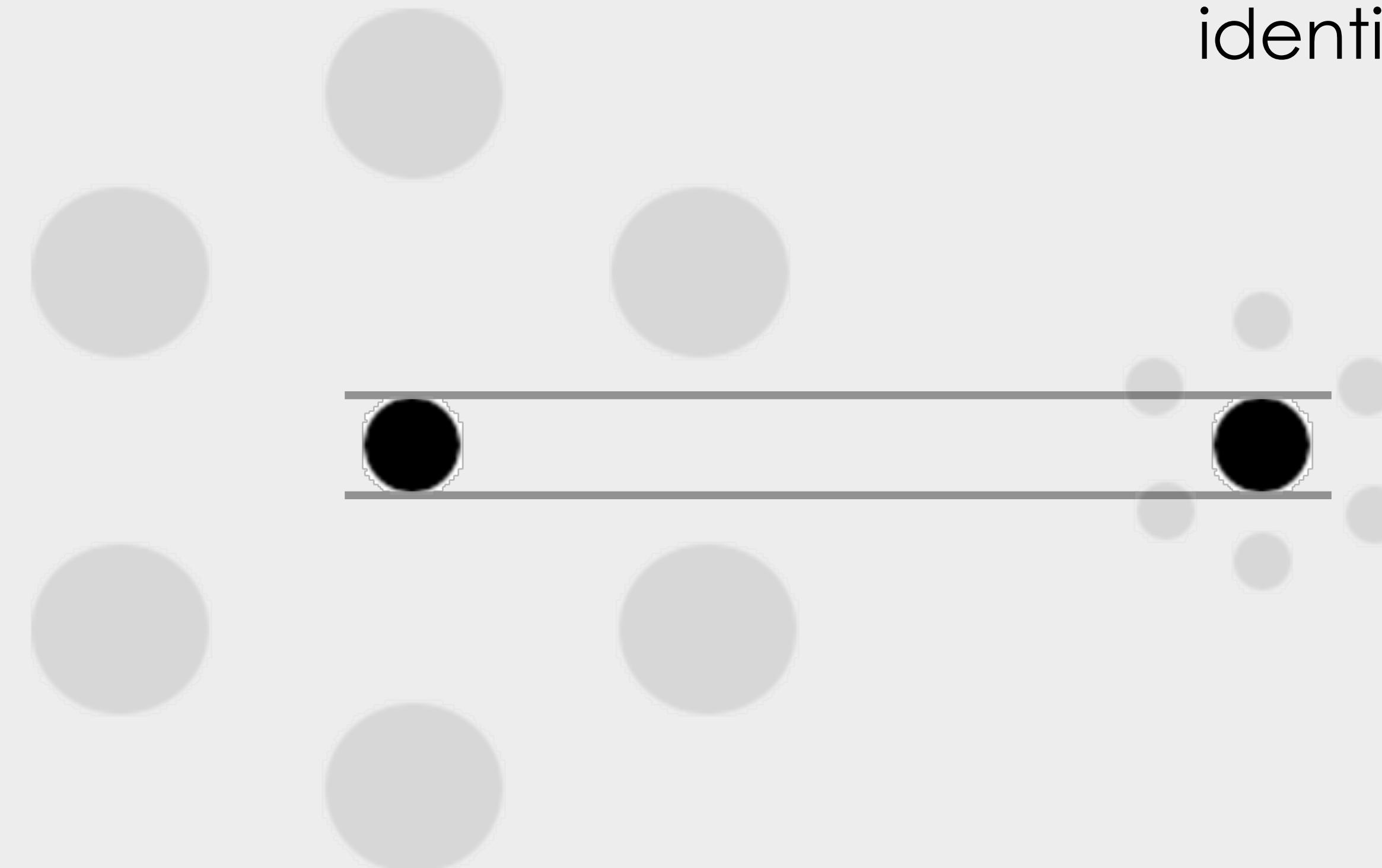


identical central discs?





Why should you analyze images with computers?



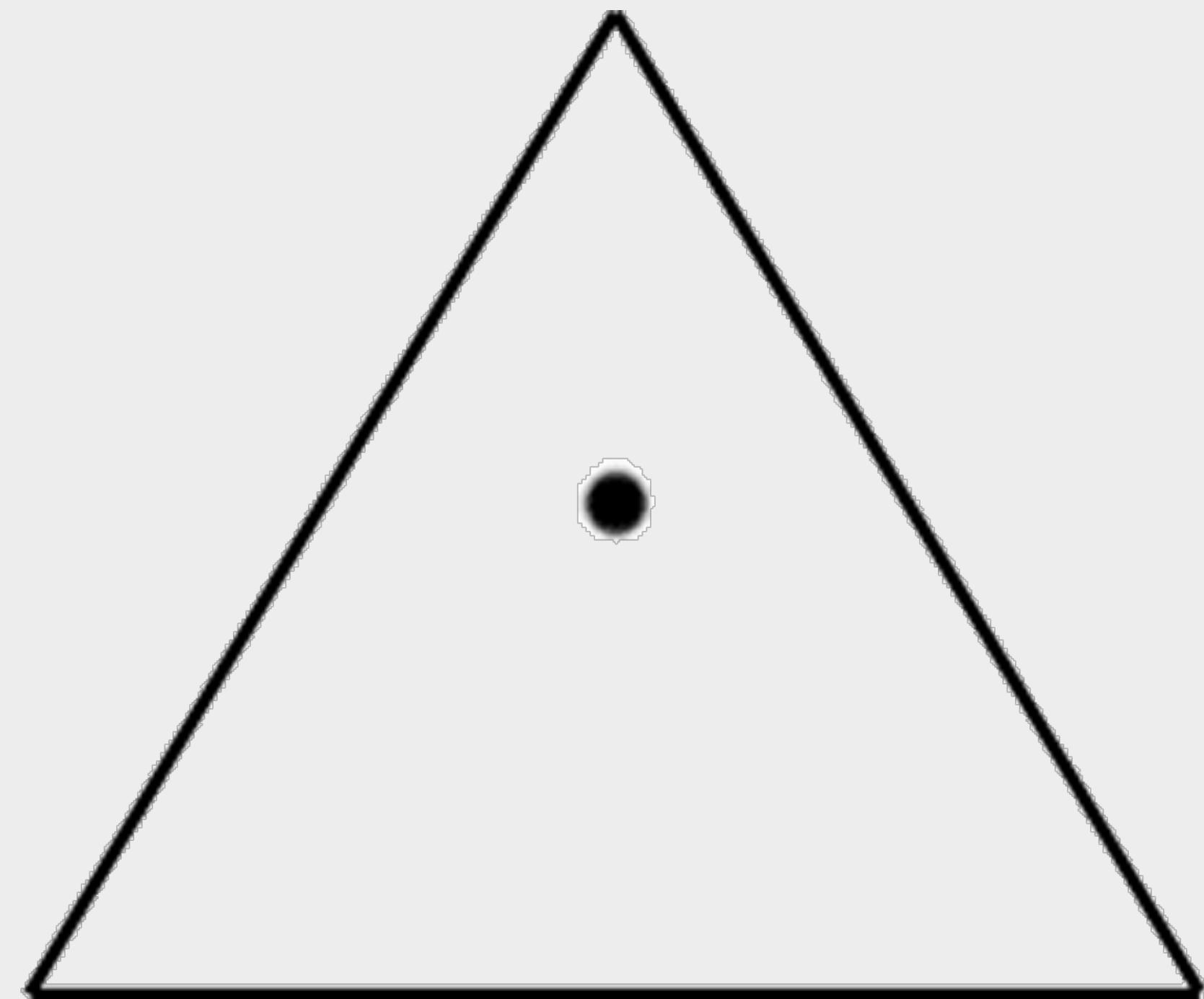
identical central discs?

our size estimate is strongly influenced by the local neighborhood.

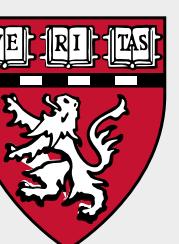




Why should you analyze images with computers?



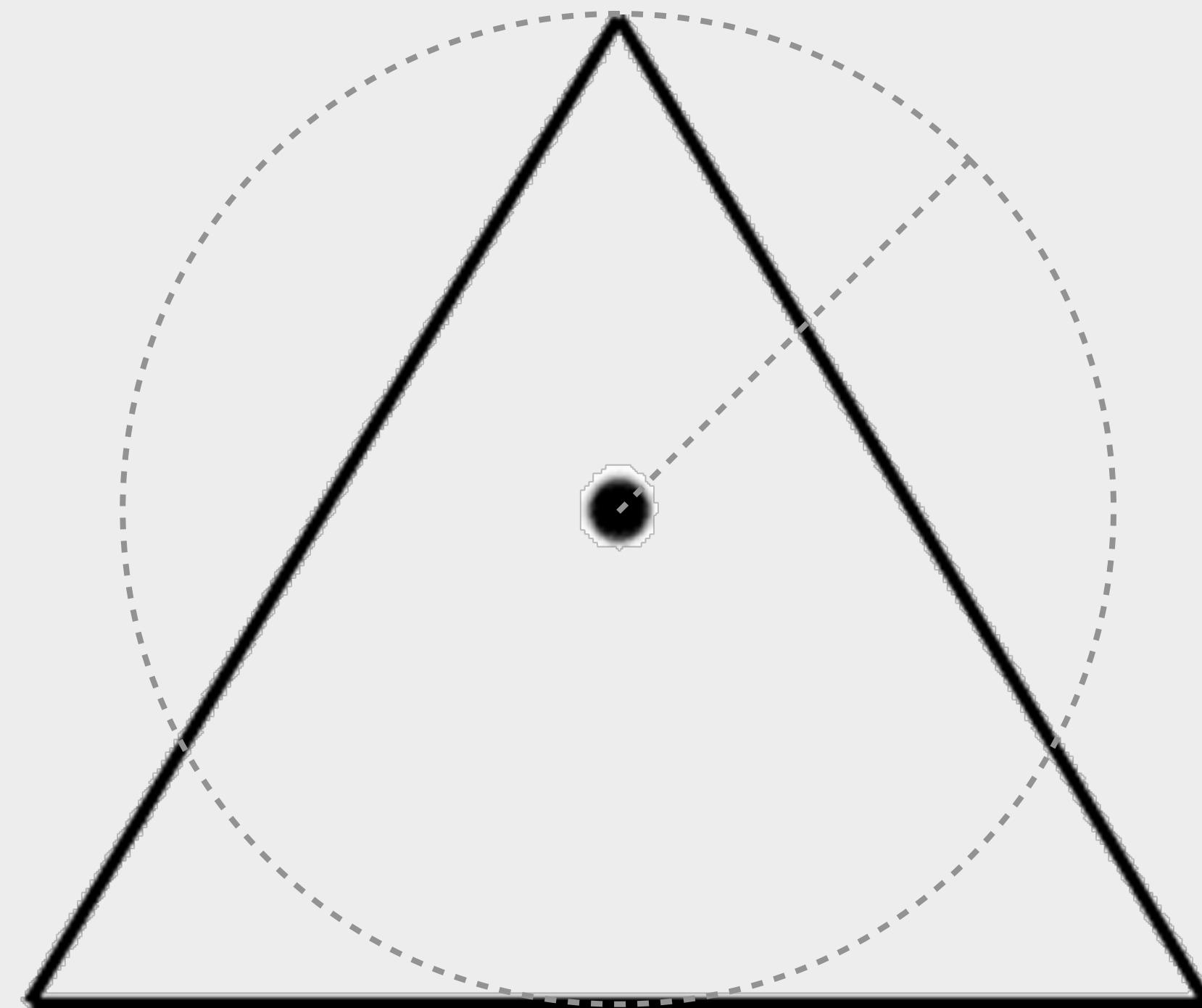
Is the dot half-way up?



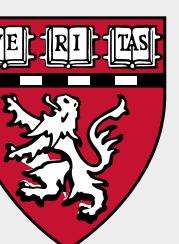


Why should you analyze images with computers?

Is the dot half-way up?



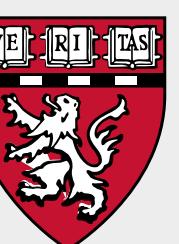
our sense of distance depends on neighborhood.





Why should you analyze images with computers?

are discs equally grey?





Why should you analyze images with computers?

are discs equally grey?



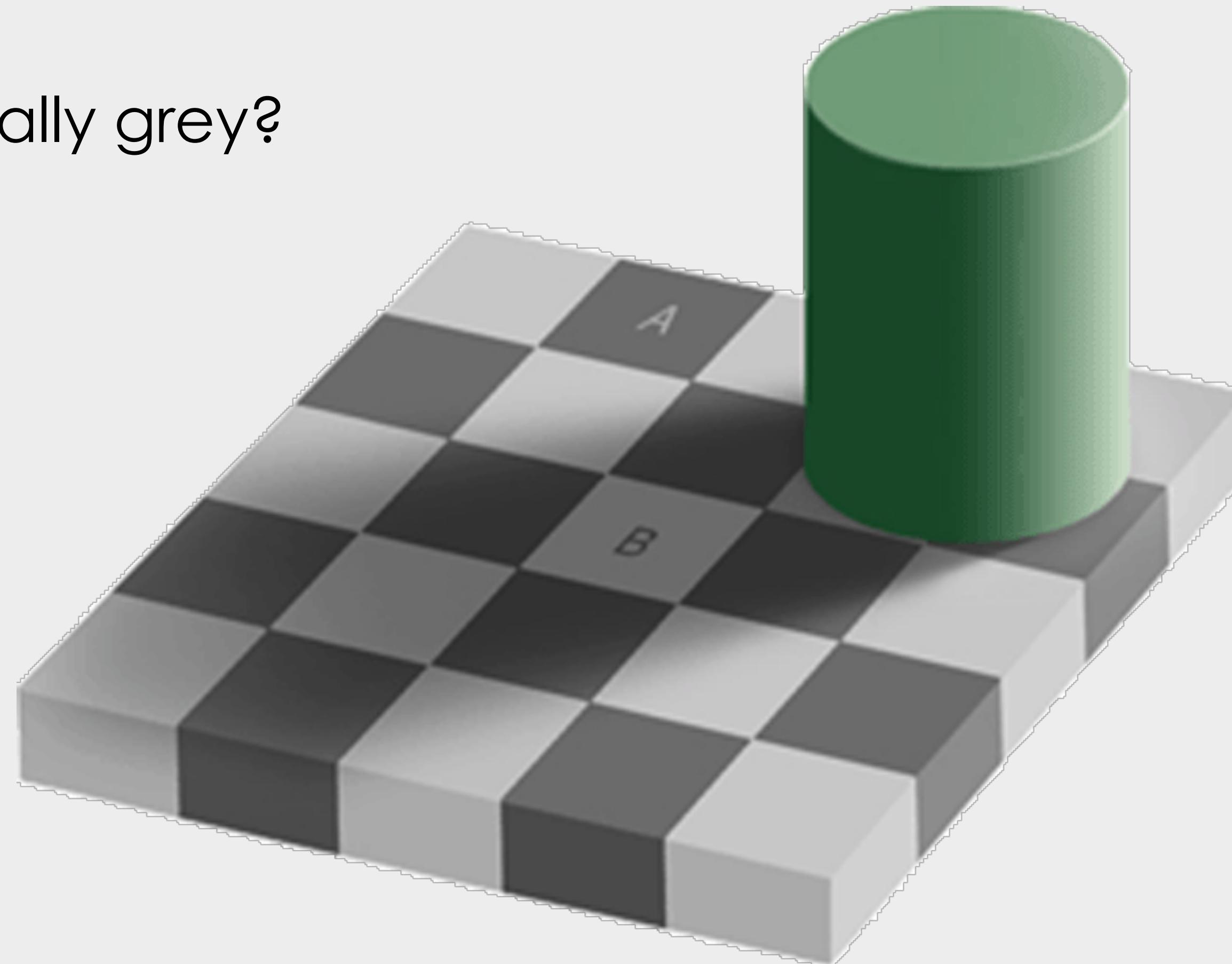
intensity perception depends strongly on neighborhood.





Why should you analyze images with computers?

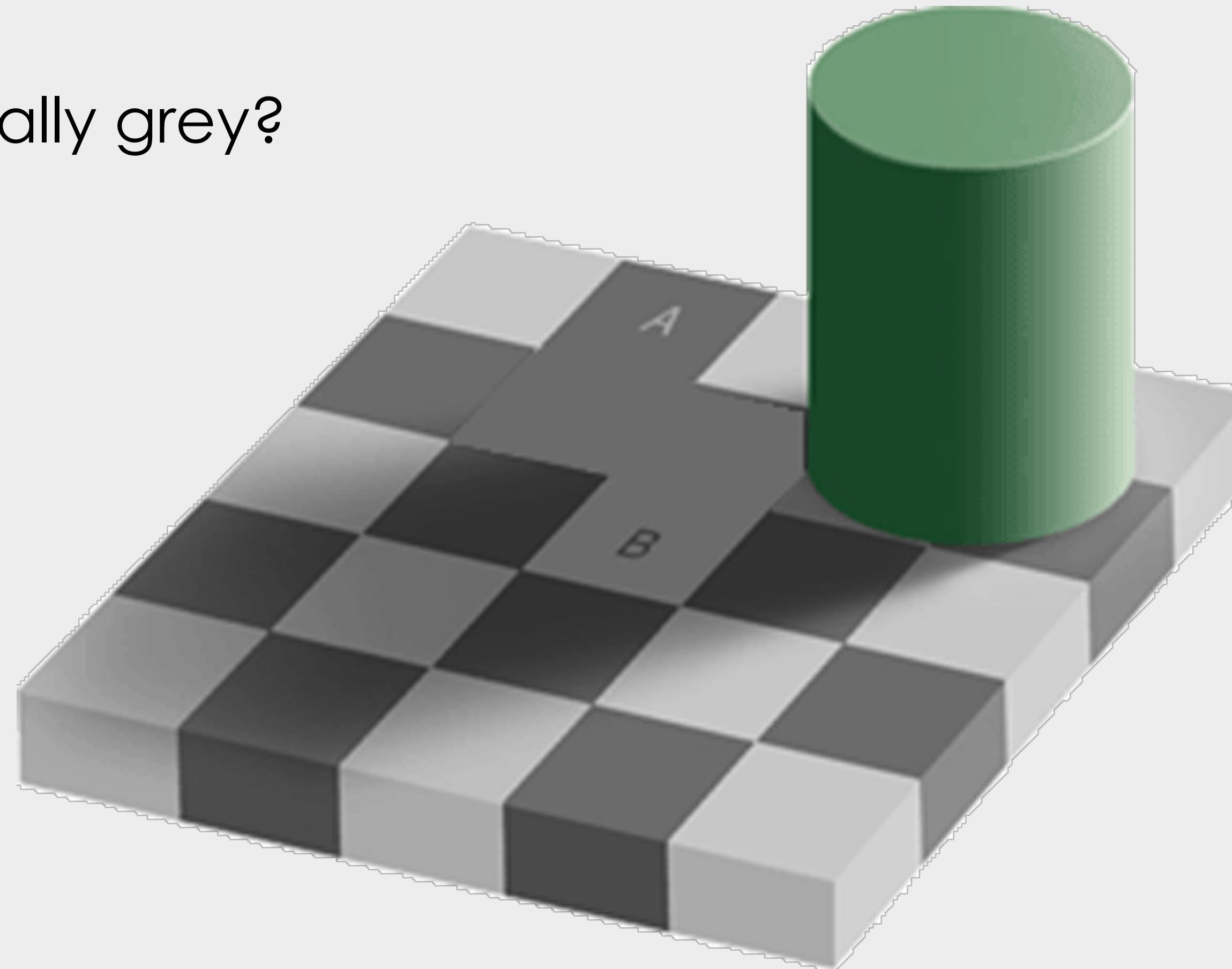
are **A** and **B** equally grey?





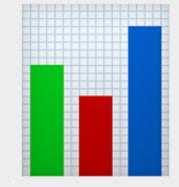
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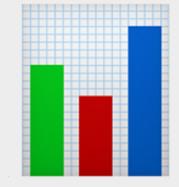
intensity perception depends strongly on neighborhood.





Why should still use your brain?





Why should still use your brain?



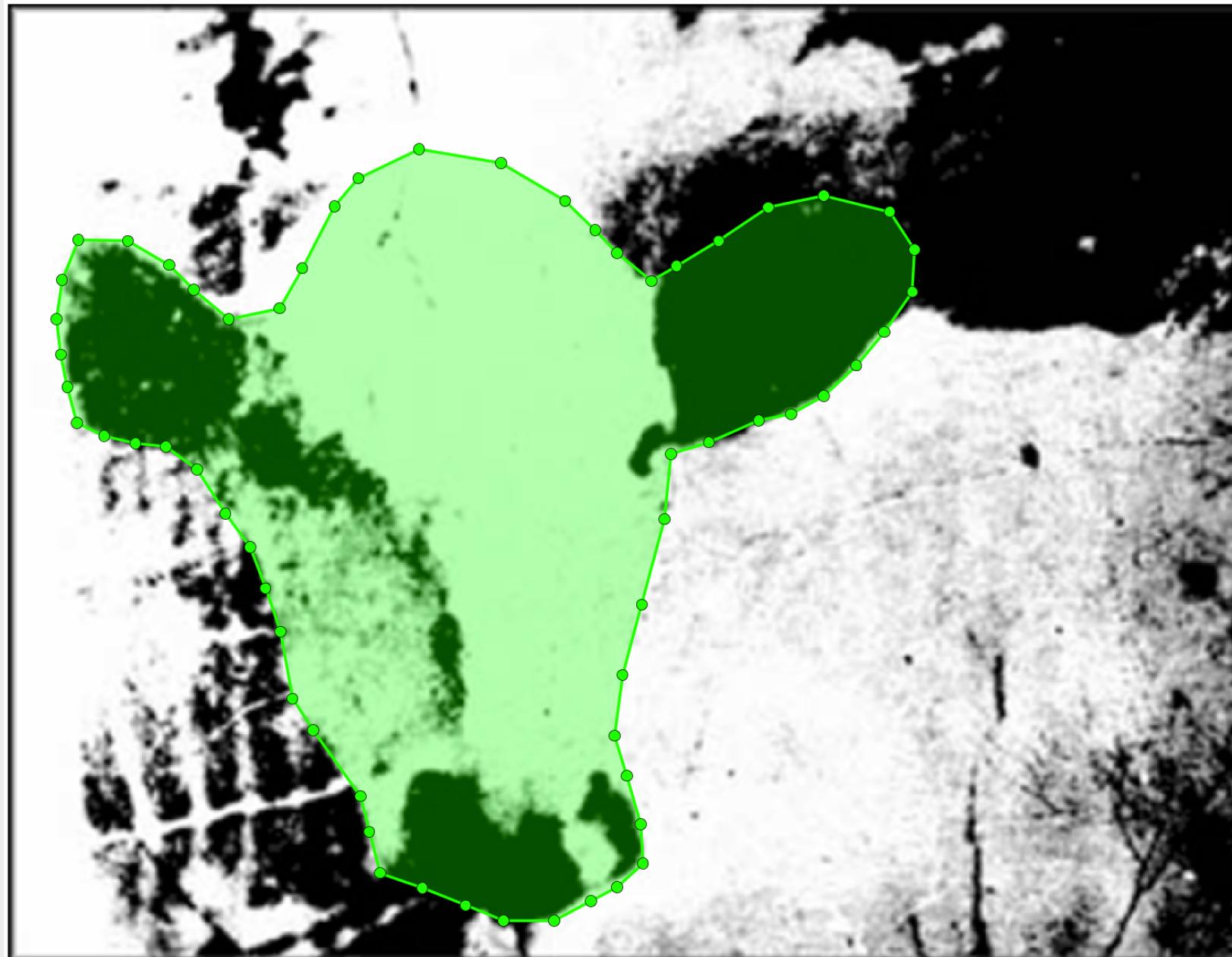
What do you see?





Why should still use your brain?

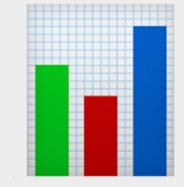
What do you see?



It's a cow!

<http://www.brainbashers.com>





Why should still use your brain?



What do you see?

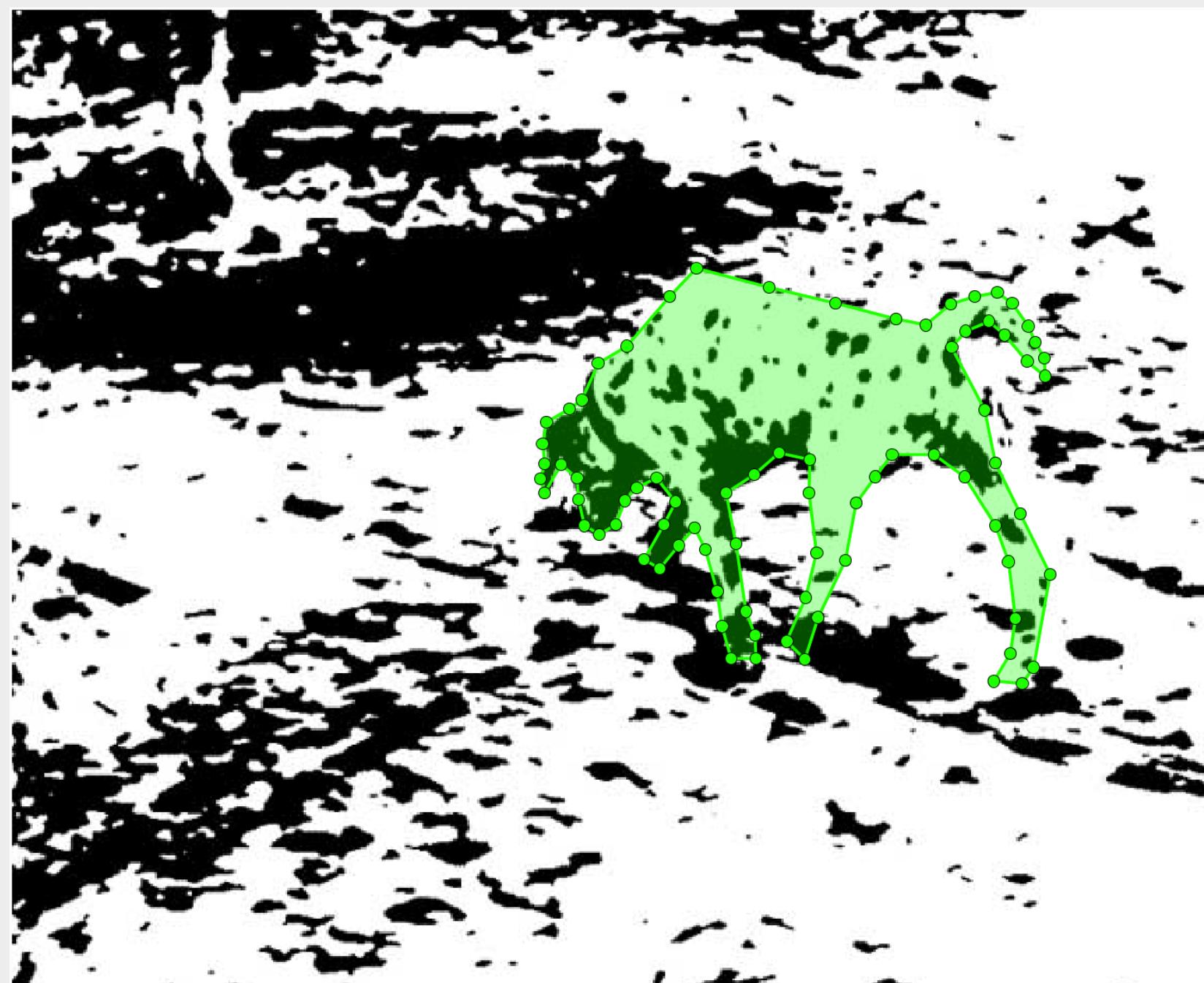




Why should still use your brain?



What do you see?



It's a Dalmatian dog!

<http://www.brainbashers.com>

