

CSC 240

Computer Graphics

Sara Mathieson
Fall 2016
Smith College

Outline: 9/12

- Introductions
- What is computer graphics?
- Syllabus
- Images and pixel coloring
- Poll Everywhere and Lab 0

Introductions

To discuss with a partner:

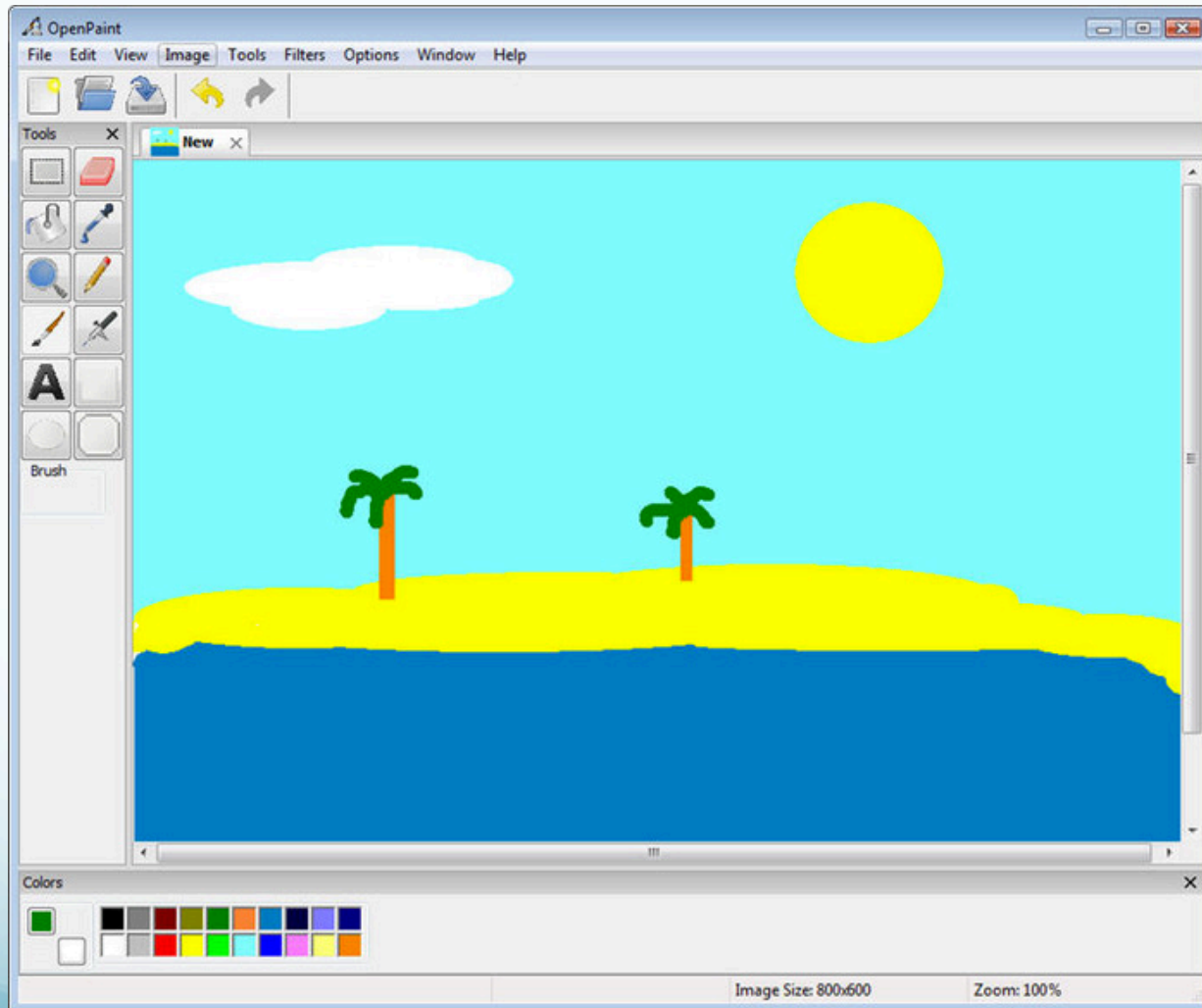
- 1) Why did you decide to take this class?
- 2) What are you hoping to gain from this class?
- 3) Any particular topics you would like to cover?

What is Computer Graphics?

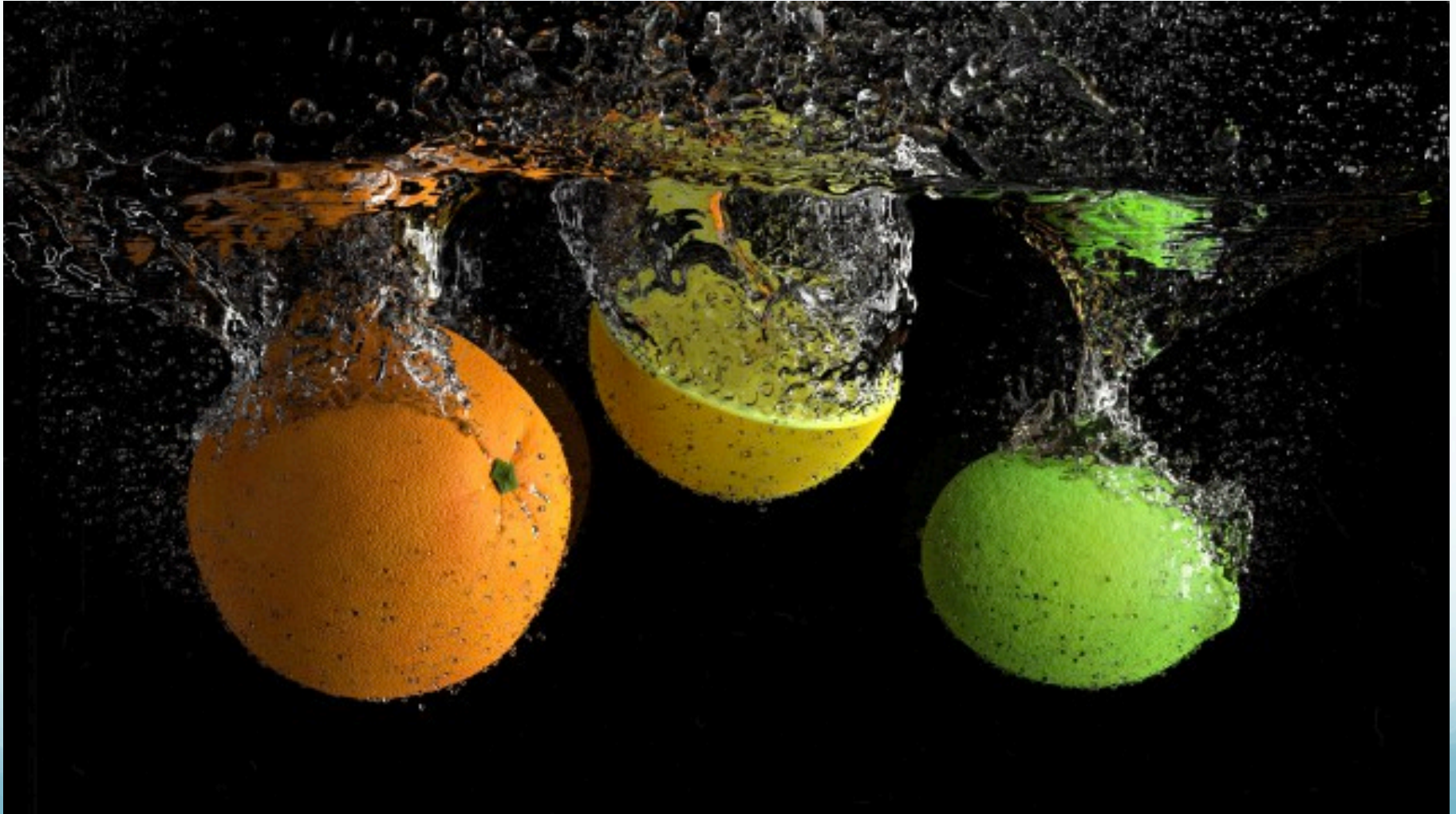
What is computer graphics?

- Creating images using a computer
- Manipulating images
- Modeling and simulation
- Animation and game design
- User-interface design

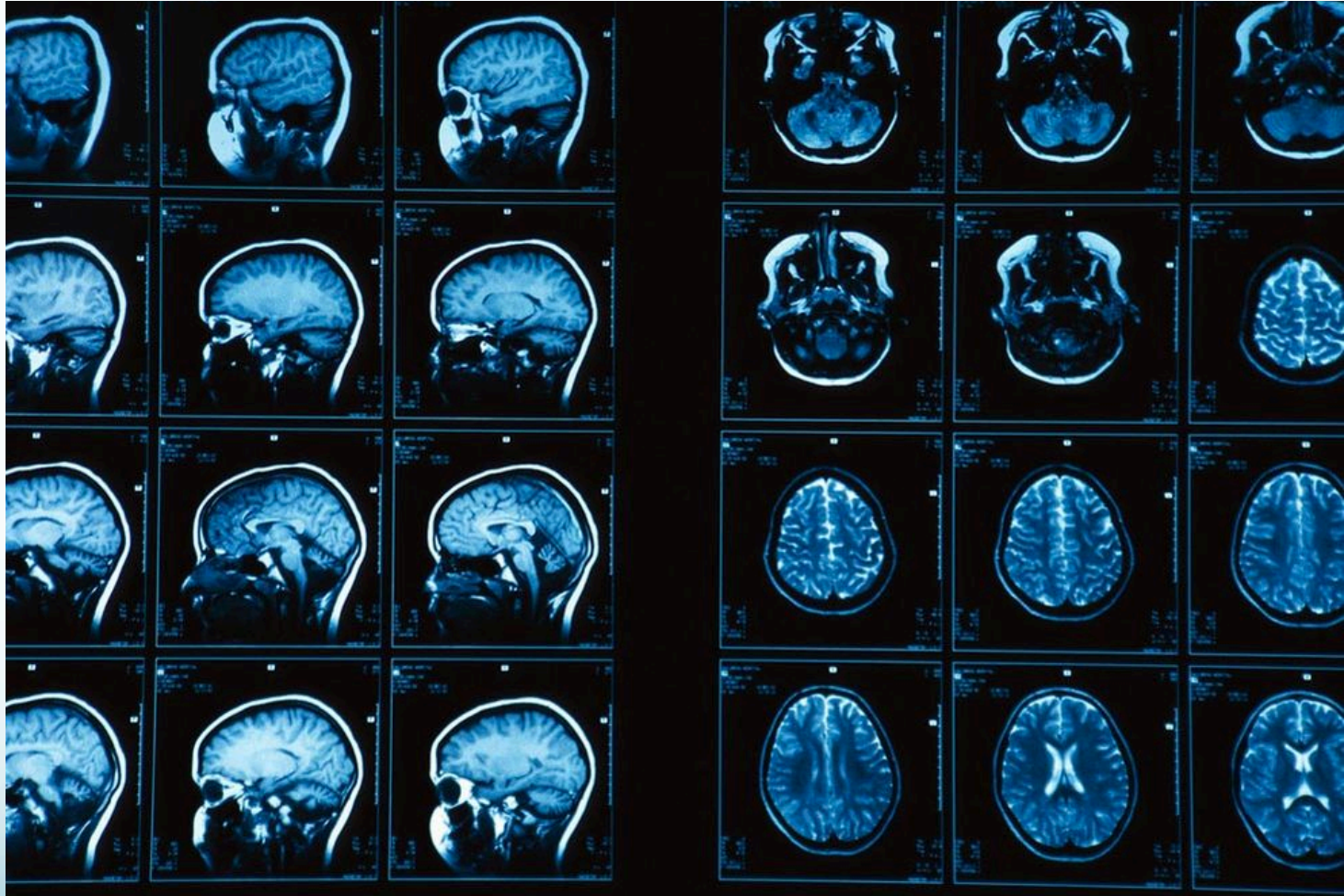
Creating images



Creating images

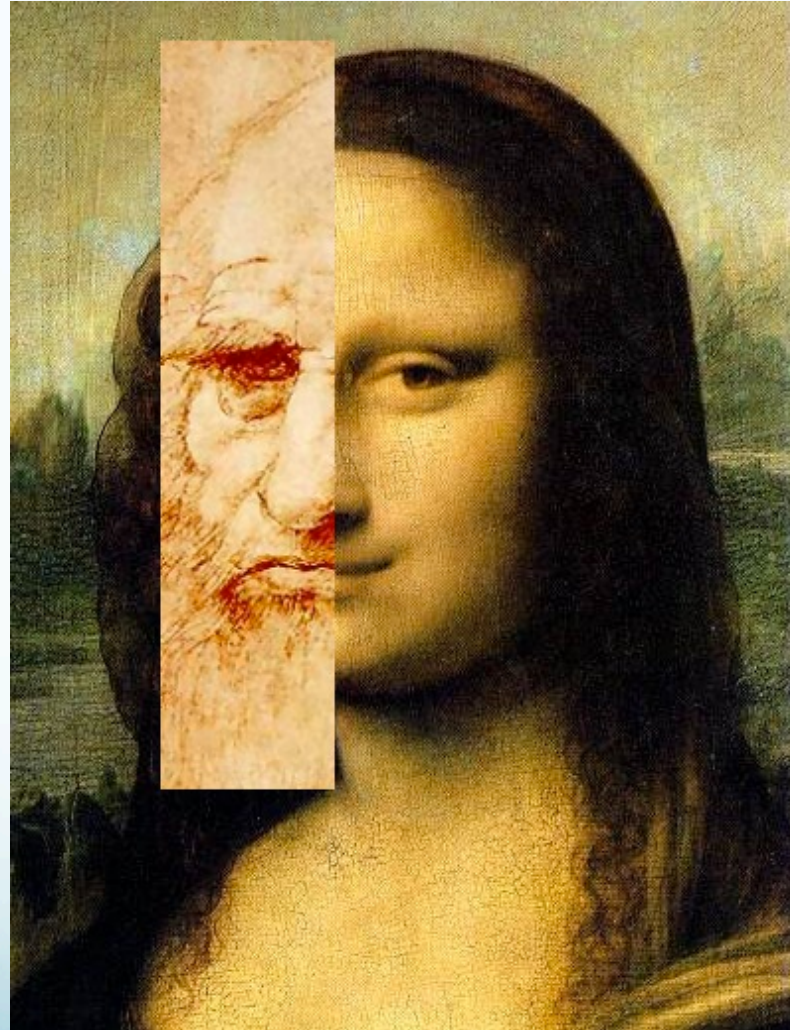


Creating images



Brain MRI scan, by Ken Glaser/Corbis, National Geographic

Manipulating images



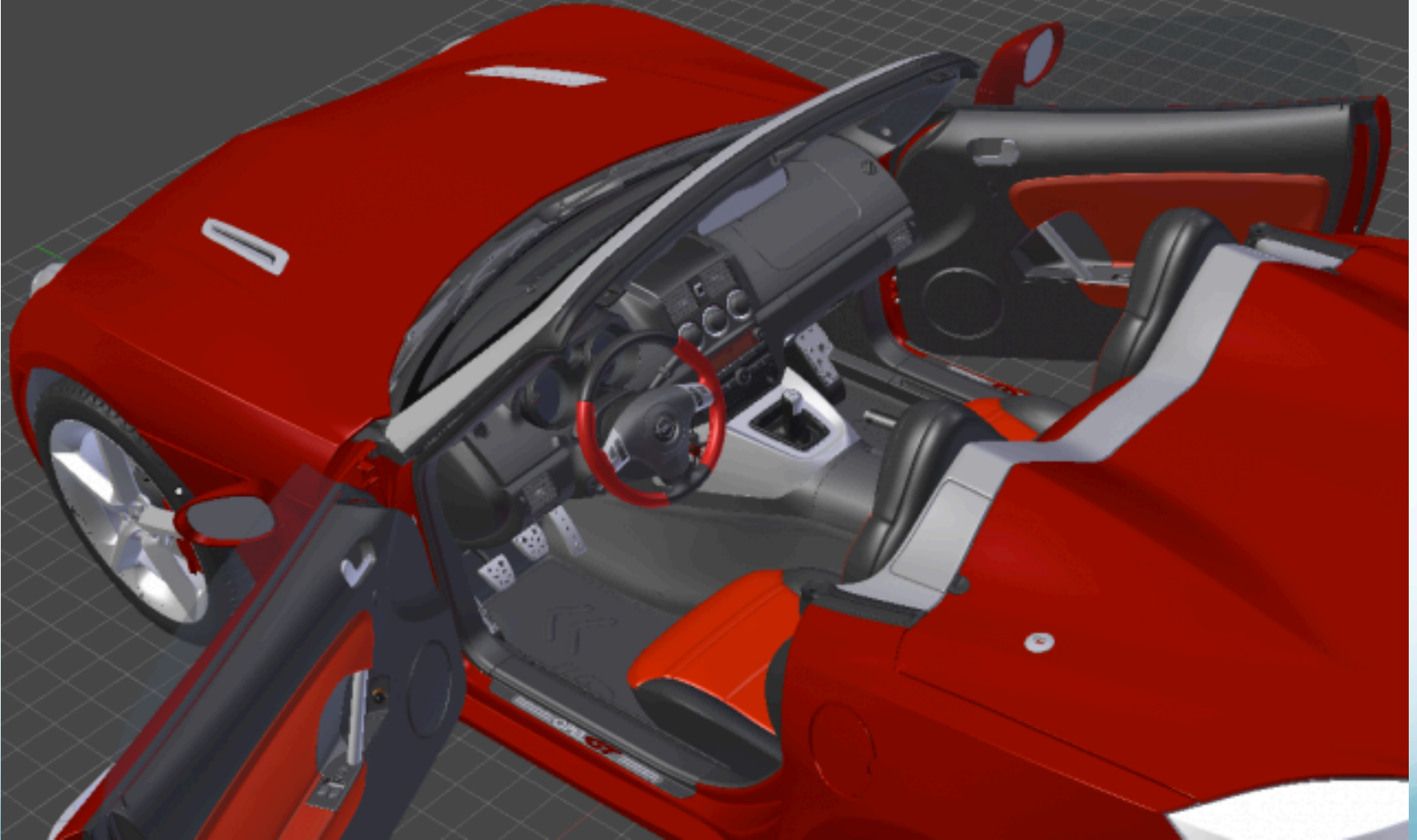
"DaVinci MonaLisa1b" by David R. Tribble

Manipulating images

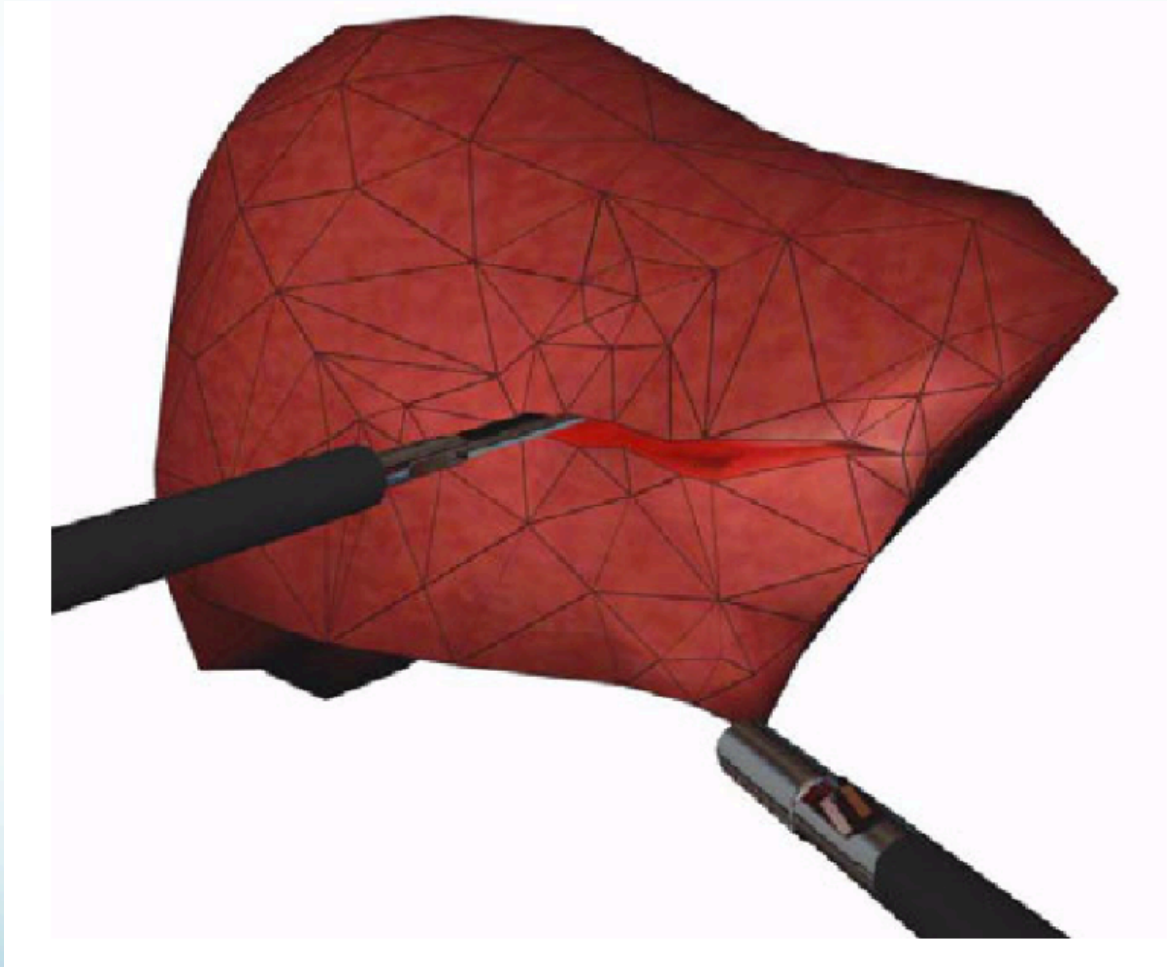


Confluence © George Grie @ neosurrealismart.com

Modeling and simulation

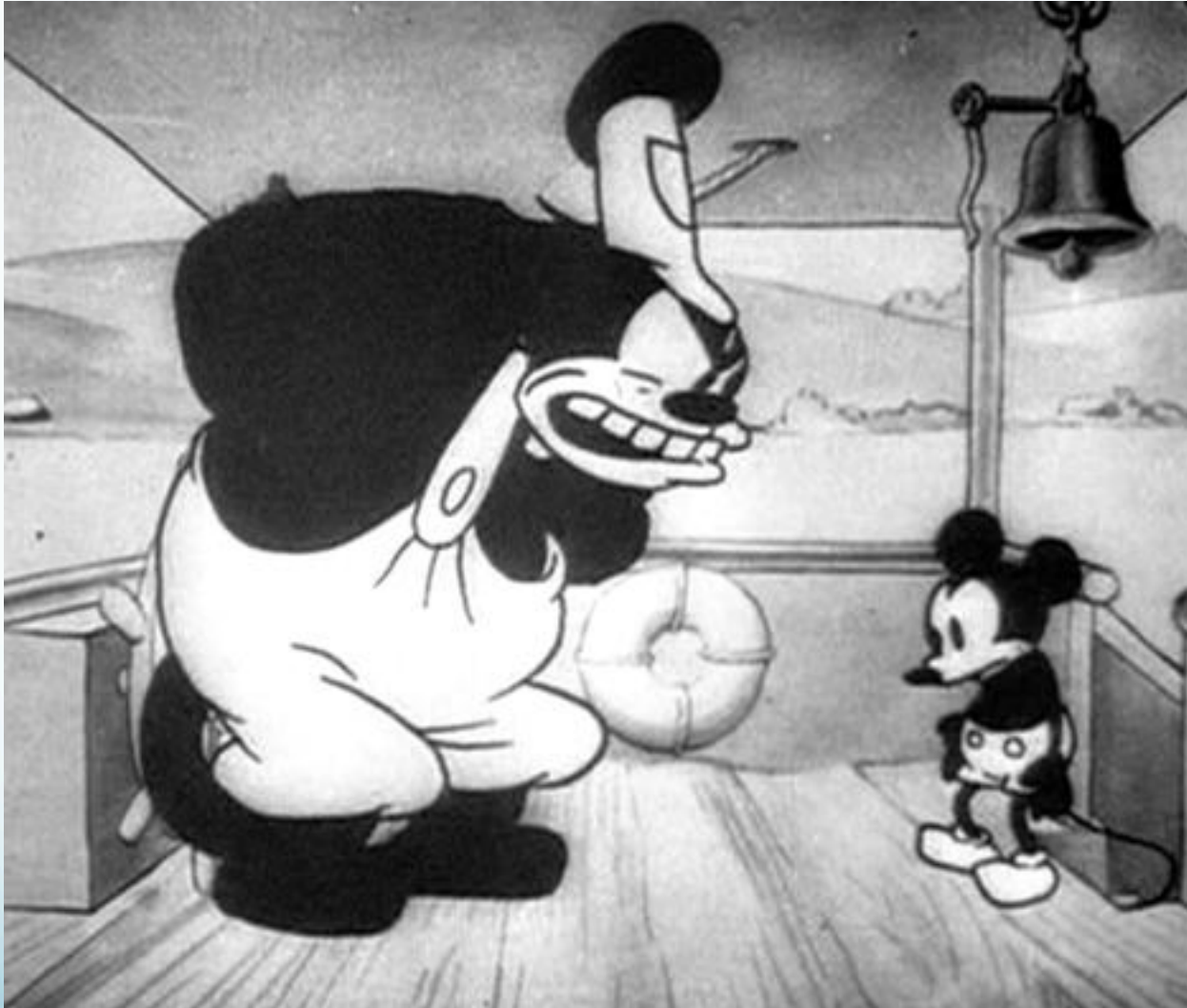


Modeling and simulation



Adaptive tissue modeling, Vidal *et al*, 2006

Animation



“Steamboat Willie”, Disney and Ub Iwerks, 1928

Animation



“Monsters Inc”, Disney/Pixar, 2001

Animation



Elsa: 400,000 strands of hair

“Frozen”, Disney, 2013

Animation



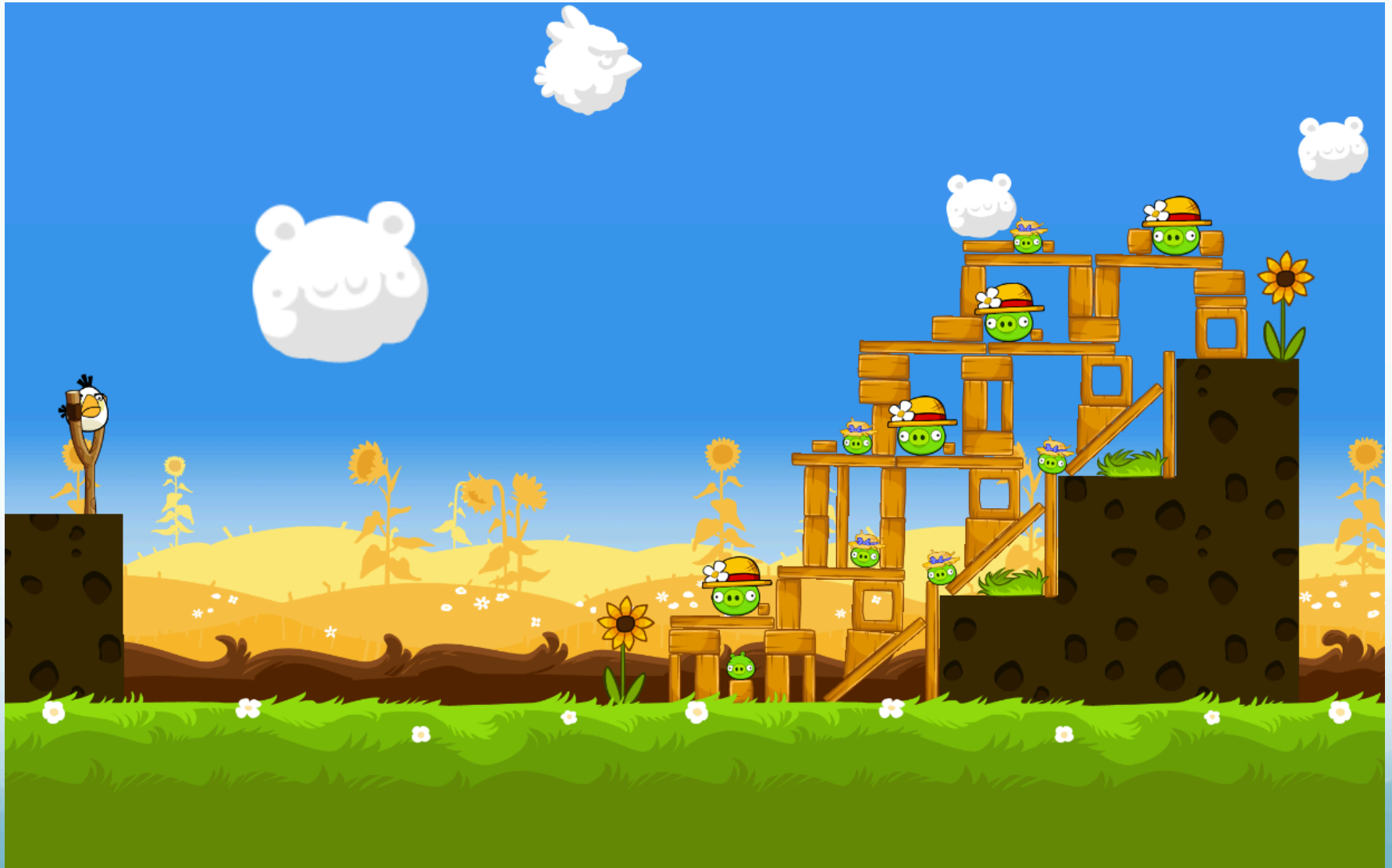
Giraffe: 9 million strands of hair

“Zootopia”, Disney, 2016

Game design



Game design



Game design



Pokémon Go, Niantic, 2016

User-interface design



DONATE GLOVES \$1



DONATE MASKS \$5



DONATE GOGGLES \$10



DONATE BOOTS \$25



DONATE APRONS \$50



DONATE SPRAYERS \$100



DONATE SUITS \$250



DONATE HOODS \$500



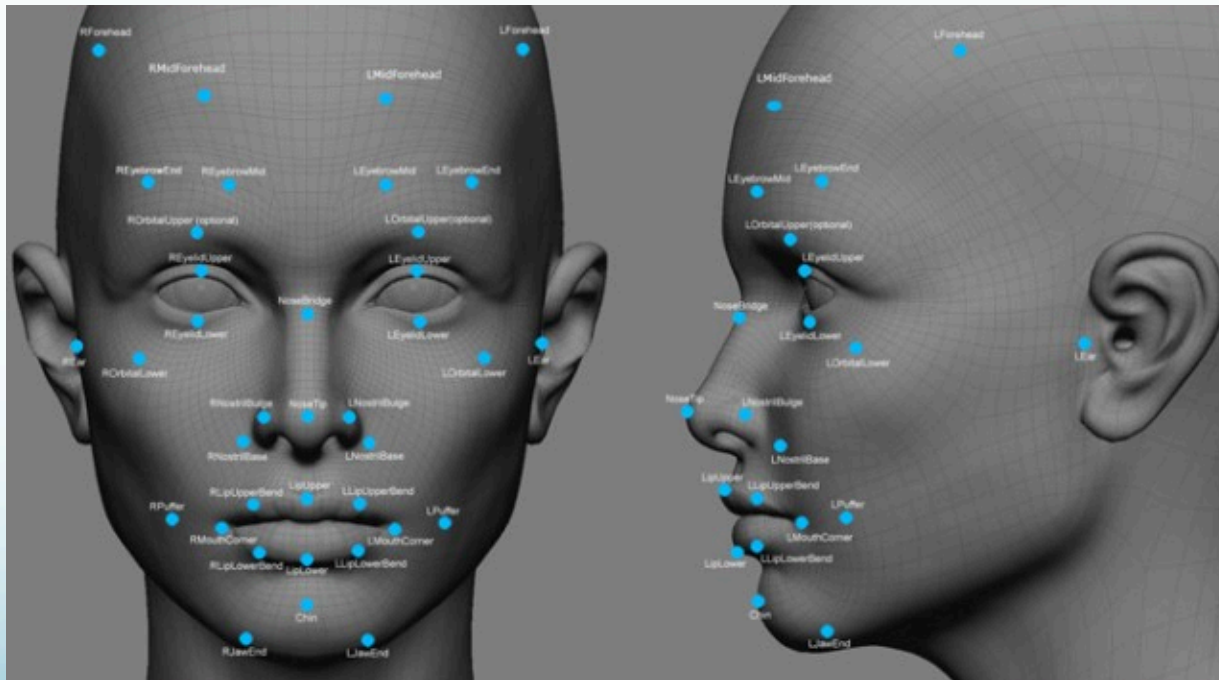
DONATE A DOCTOR \$2500



Doctors of the World,
morethanacostume.com

What is computer vision? (not this class!)

- Understanding [natural] images
- Examples: google books, image tagging, self-driving cars



Computer vision



Jeremy Hsu, IEEE Spectrum

Syllabus

Course staff

- **TAs:** Riley Mancuso and Farida Sabry

http://cs.smith.edu/classwiki/index.php/Computer_Science_TA_hours

Sunday 7:30 - 9:30 PM	Ford 241	Farida
Monday 7:30 - 9:30 PM	Ford 241	Riley
Tuesday 7:30 - 9:30 PM	Ford 241	Farida

- **Grader:** Nishit Parekh

Prerequisites

- **CSC 111**: Introduction to Computer Science
- **Math 111**: Calculus 1

Course Goals

- Understand algorithms and math behind graphics
- Build programming skills
- Enable artistic expression
- Resources for pursuing computer graphics further

Assignment Notes

- Mix of programming and pencil-and-paper exercises
- Weekly (usually due Tuesday nights)
- In-class labs not turned in, but count toward participation
- Email me if you do not have a laptop computer

Assignment Notes

- WebGL (i.e. OpenGL in java script/html) and Blender
- Submitted through Moodle
- 4 credit course = 12 hours/week

3 in class, 9 outside class

<http://cs.smith.edu/~ssheehan/fall16/csc240/home.html>

Username: csc240, Password: fall16

Topics (tentative)

- Graphics pipeline and pixel coloring
- Lines, 2D shapes, and fill algorithms
- Transformations
- Splines and Bezier curves
- Perspective
- 3D modeling
- Lighting, shading, and reflectance
- Texture mapping
- Ray tracing
- 3D printing
- Animation

Textbook

- Free, online, I will post sections on the calendar
- **Introduction to Computer Graphics** by David J. Eck

<http://math.hws.edu/graphicsbook/>

Online discussion

- Piazza
 - Class discussion
 - Homework help
 - Clarifications
 - Announcements

<https://piazza.com/smith/fall2016/csc240/home>

Poll for office hours!

Assessment

- Homeworks: 50%
- Midterm exam: 15% (Oct 26, tentative)
- Final project: 10%
- Self-scheduled final exam: 15%
- Participation: 10%
 - In-class labs
 - Poll Everywhere
 - Asking/answering questions in class
 - Piazza

Honor code

- Collaboration encouraged!
- Please cite:
 - student collaborators
 - online resources, especially any code
 - books
- For most assignments: individual original code, **produced and understood** by you
- Occasionally pair-programming assignments

Honor code

"Smith College expects all students to be honest and committed to the principles of academic and intellectual integrity in their preparation and submission of course work and examinations. All submitted work of any kind must be the original work of the student who must cite all the sources used in its preparation."

Course Policies

- 1) **Email**: use Piazza for all questions that might be relevant to others in the class

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- 1) **Email**: use Piazza for all questions that might be relevant to others in the class
- 2) **Sending code**: do NOT email or post long blocks of code on Piazza
- 3) **Late work**: no late work, one assignment dropped
Exceptions: accommodations letters, notice from Dean or Health Services

Course Policies

4) **Individual meetings**: limited; as I can accommodate in my schedule

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- 5) **Attendance**: two missed classes without affecting your participation grade

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- 5) **Attendance**: two missed classes without affecting your participation grade
- 6) **Electronic devices**: fine in class as long as directed towards class material
- 7) **Random partners**: frequently throughout the semester

Resources

- Piazza
- Office hours (instructor and TAs)
- Fellow students
- Spinelli Center for Quantitative Learning
 - Extra credit toward **participation** for attending workshops
- Accommodations (turn letters in early!)

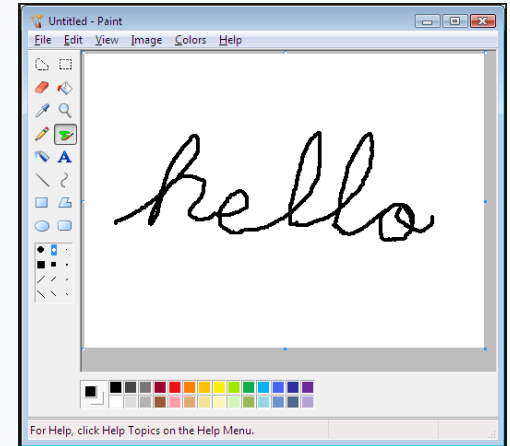
What does CSC 240 fulfill?

- Minor in Computer Science: Digital Arts
- Arts & Technology minor
- Distribution requirement for the Computer Science major (Programming, Theory)

What is a digital image?

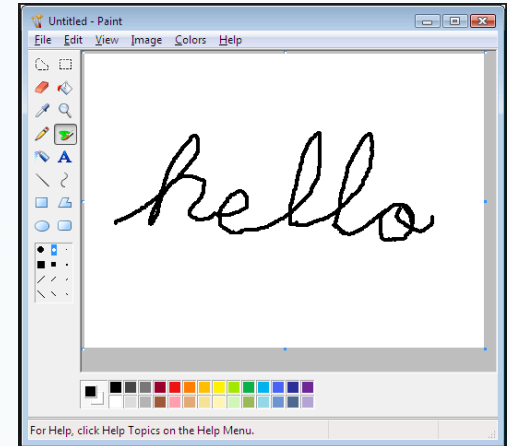
Raster Graphics vs. Vector Graphics

- **Raster graphics:** pixel by pixel
 - Used in **painting** programs
 - Microsoft paint, Adobe photoshop



Raster Graphics vs. Vector Graphics

- **Raster graphics:** pixel by pixel
 - Used in **painting** programs
 - Microsoft paint, Adobe photoshop
- **Vector graphics:** defined by shapes
 - Used in **drawing** programs
 - Line from A to B, Circle at C with radius r, etc
 - Inkscape, Adobe illustrator



INKSCAPE
Draw Freely.

Inkscape is a professional vector graphics editor for Windows, Mac OS X and Linux. It's free and open source.

Raster Graphics vs. Vector Graphics

- **Example:** tree in front of a house
- **Question:** if you erase the tree, is the entire house still there?



Raster Graphics vs. Vector Graphics

- **Example:** tree in front of a house
- **Question:** if you erase the tree, is the entire house still there?



- **Answer:**
 - vector graphics: yes!
 - raster graphics: no 😞

Raster Graphics vs. Vector Graphics

- Pros and Cons?

Raster Graphics vs. Vector Graphics

- Pros and Cons?
- Could a photo ever be a vector graphic?

Raster Graphics vs. Vector Graphics

- Pros and Cons?
- Could a photo ever be a vector graphic?
- **Raster graphics:** can't rescale (image gets "pixilated"), more fine control, portable format

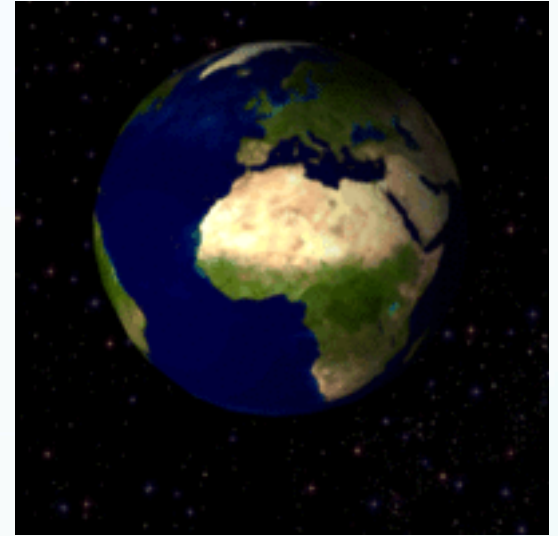
Raster Graphics vs. Vector Graphics

- Pros and Cons?
- Could a photo ever be a vector graphic?
- **Raster graphics**: can't rescale (image gets "pixilated"), more fine control, portable format
- **Vector graphics**: scale arbitrarily, less space to store, easier to interpret

Raster Graphics vs. Vector Graphics

File Formats

- Raster-based
- **GIF** (Graphics Interchange Format)
 - Limited colors, but supports animation.
 - Lossless compression.



Raster Graphics vs. Vector Graphics



File Formats

- Raster-based
- **GIF** (Graphics Interchange Format)
Limited colors, but supports animation.
Lossless compression.
- **PNG** (Portable Network Graphics)
Replacement for GIF, also lossless compression.



Raster Graphics vs. Vector Graphics

File Formats

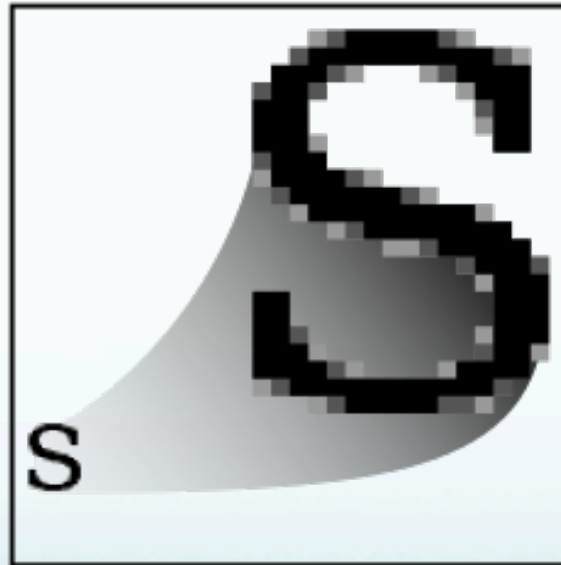
- Raster-based
- **GIF** (Graphics Interchange Format) 
Limited colors, but supports animation.
Lossless compression.
- **PNG** (Portable Network Graphics)
Replacement for GIF, also lossless compression.
- **JPEG** (Joint Photographic Experts Group) 
Designed with space/quality tradeoff in mind.
Best for photos.



Raster Graphics vs. Vector Graphics

File Formats

- Vector-based
 - SVG (Scalable Vector Graphics)



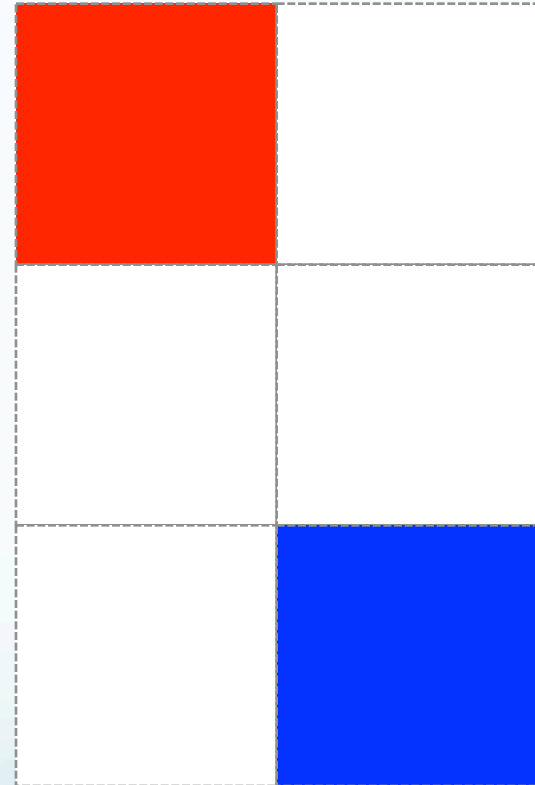
Raster
.jpeg .gif .png



Vector
.svg

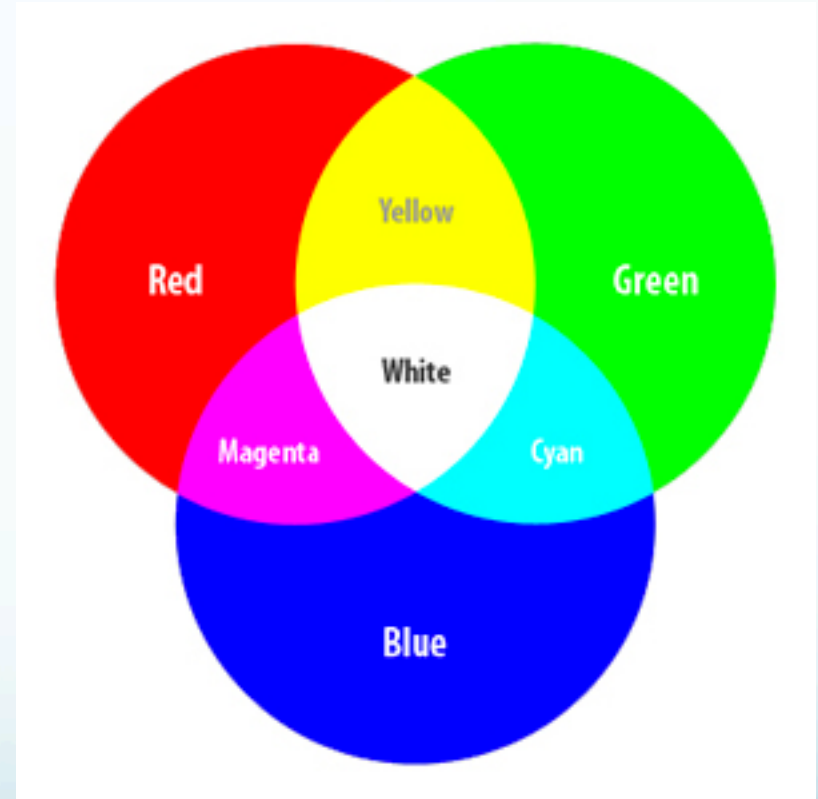
Simple image format

PPM: Portable Pixel Map



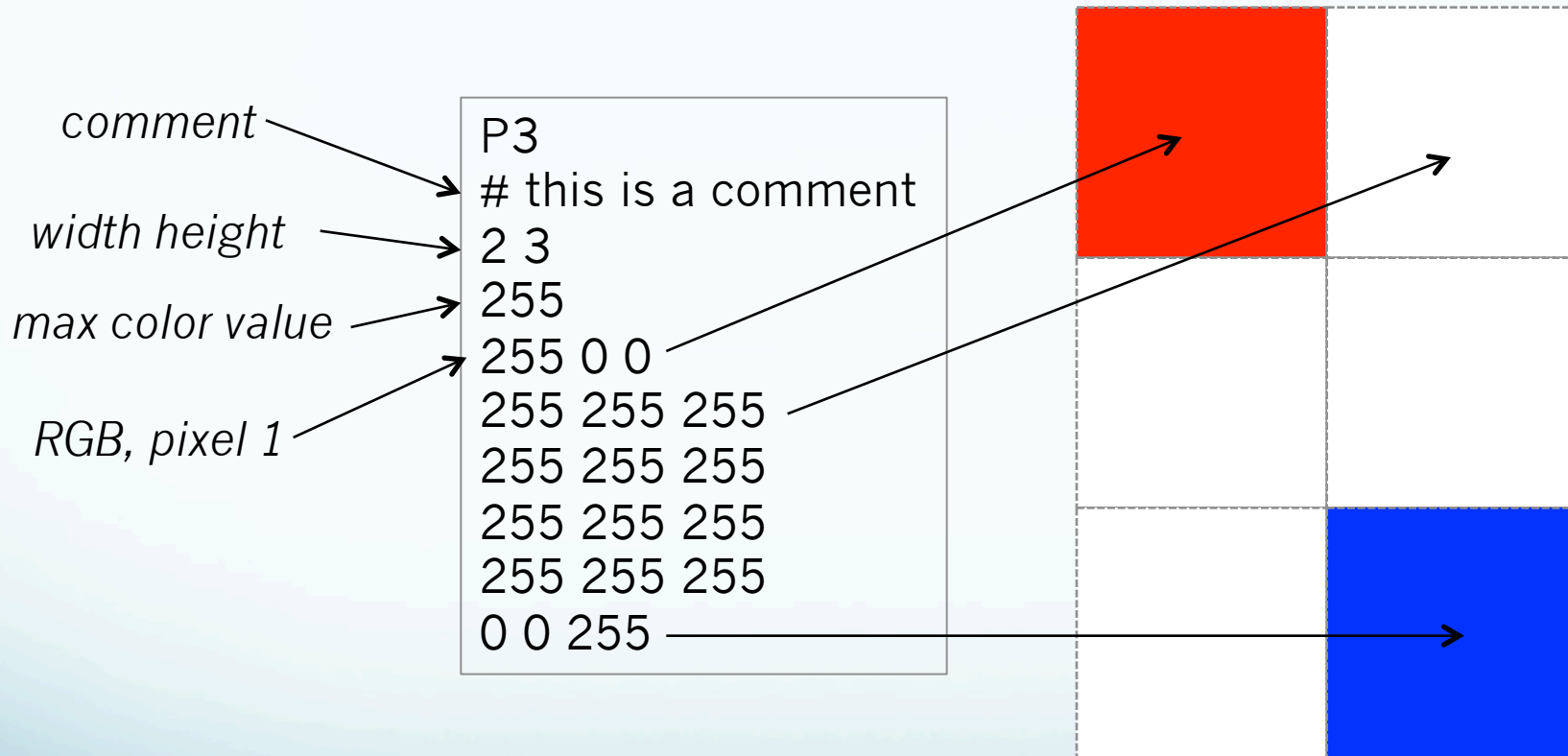
Pixel coloring

- Red
- Green
- Blue
- “RGB”, each 0-255

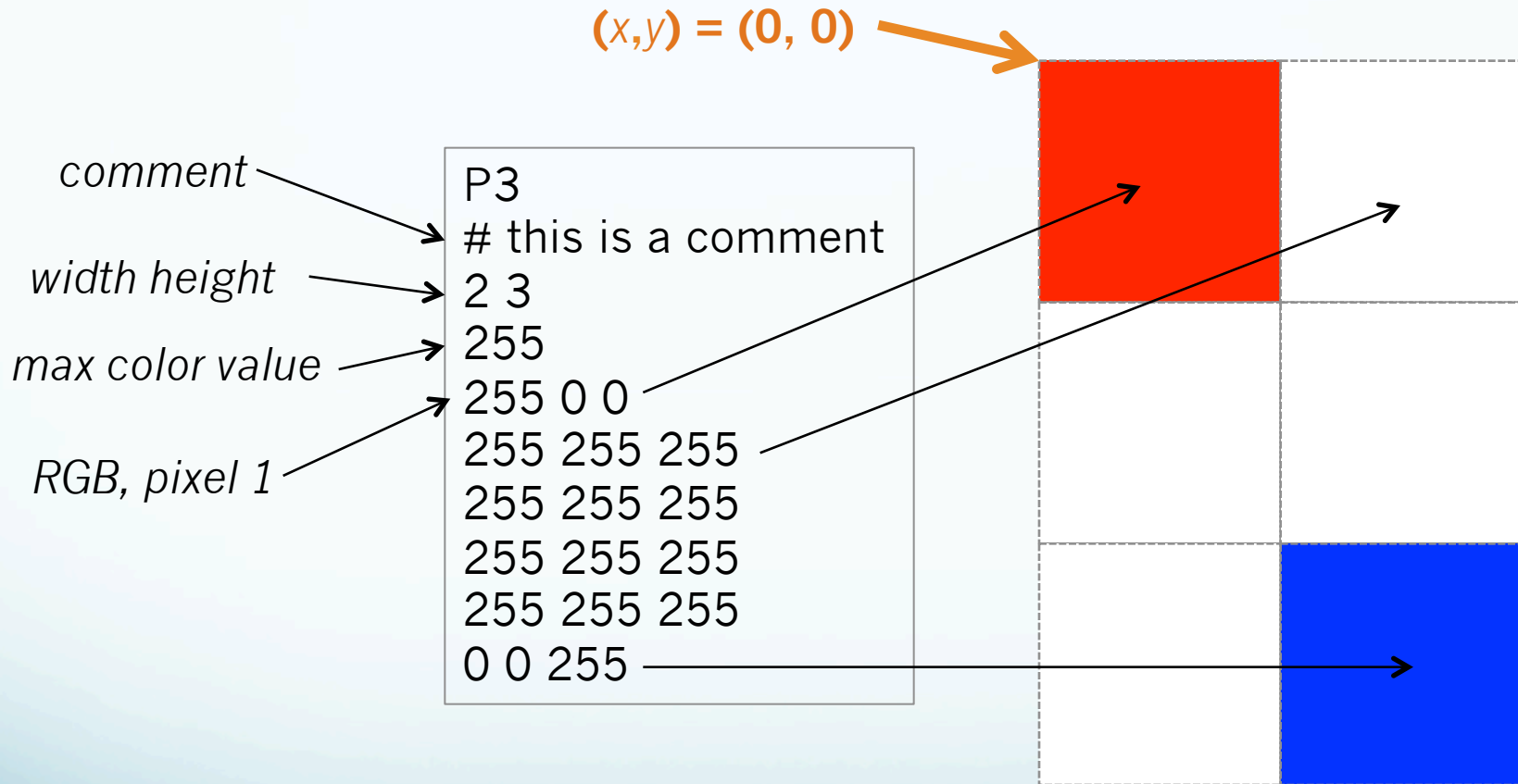


www.colorcodehex.com

Simple image format



Simple image format



Poll Everywhere + Lab 0

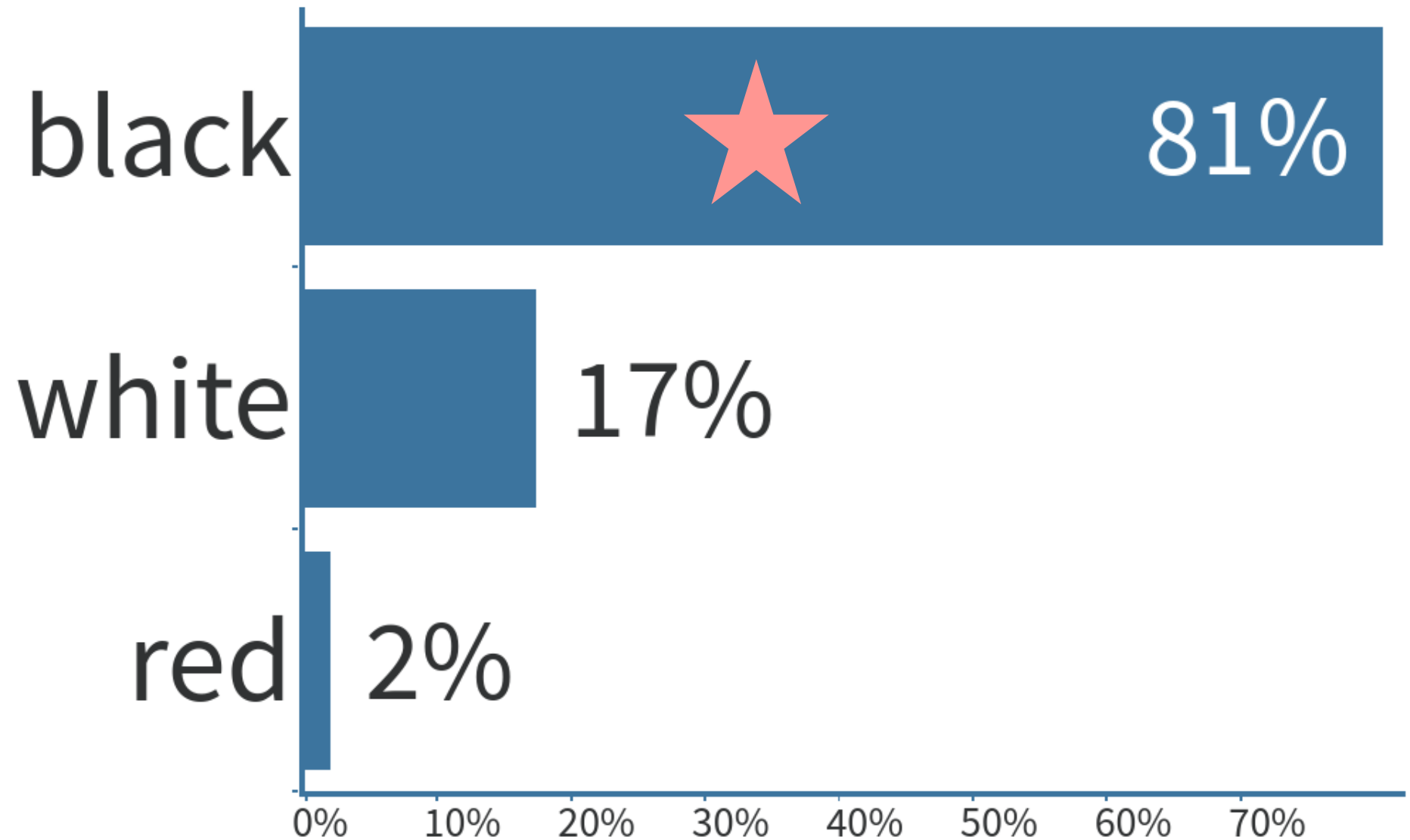
What color is represented by the RGB values (0,0,0)?



When poll is active, respond at **PollEv.com/saramathieso692**



Text **SARAMATHIESO692** to **22333** once to join



What RGB value corresponds to pure blue?



When poll is active, respond at **PollEv.com/saramathieso692**



Text **SARAMATHIESO692** to **22333** once to join

(255,255,0)

6%

(0,0,255)



94%

(127,127,255)

0%

20%

40%

60%

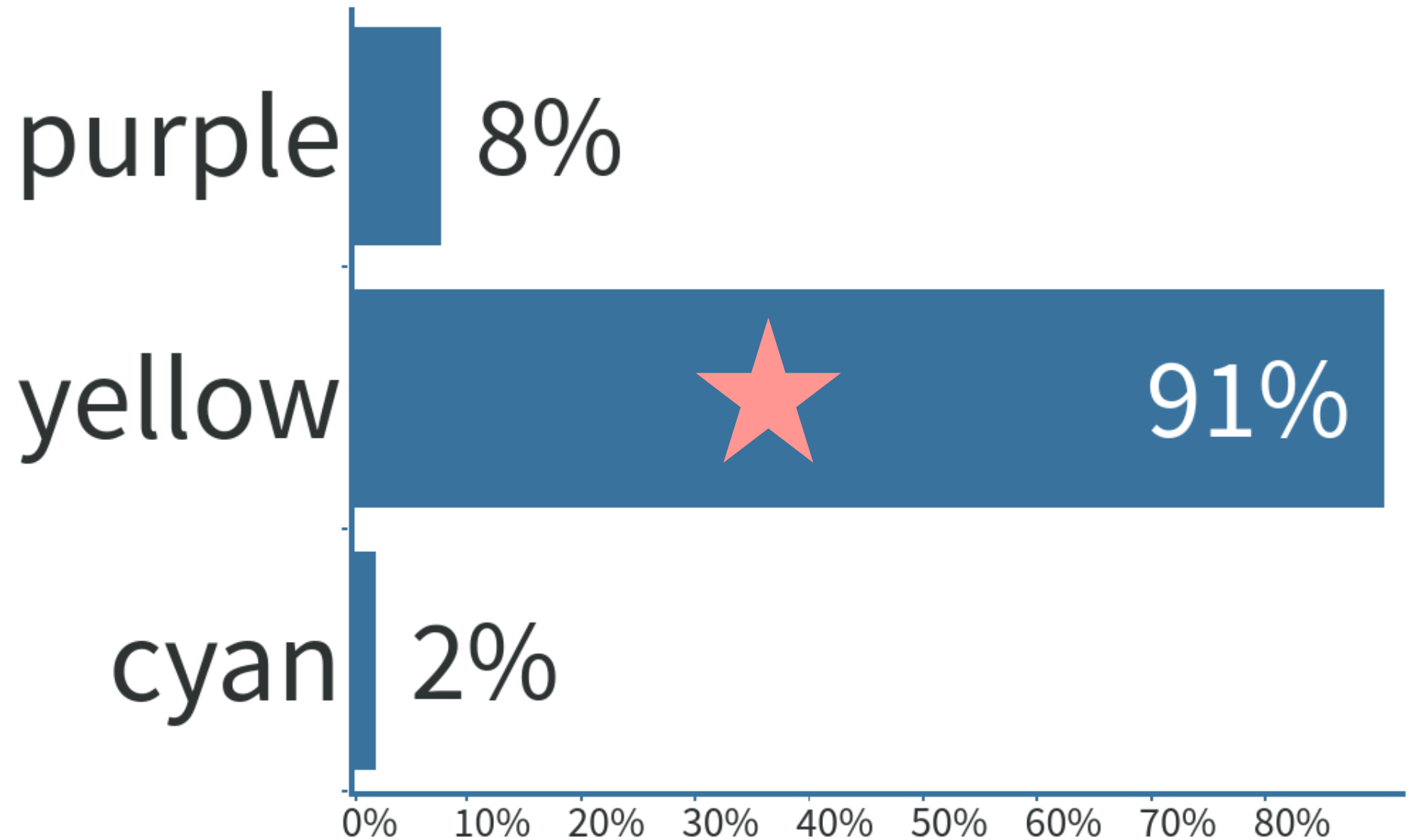
What color is represented by (255,255,0)?



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Say I have a window that is 600x800 pixels. What are the (x,y) coordinates of the center of the window?



When poll is active, respond at **PollEv.com/saramathieso692**



Text **SARAMATHIESO692** to **22333** once to join

(300,400)



94%

(-300,-400)

6%

(0,0)

0%

15%

30%

45%

60%

75%

Please turn in your
notecards!