

# Image Processing

Girls Who Build

# Fathom

[fathom.info](https://fathom.info)



processing.org

What do you think of when you  
hear **image processing**?

Image processing is **analyzing** and **manipulating** an image through code.

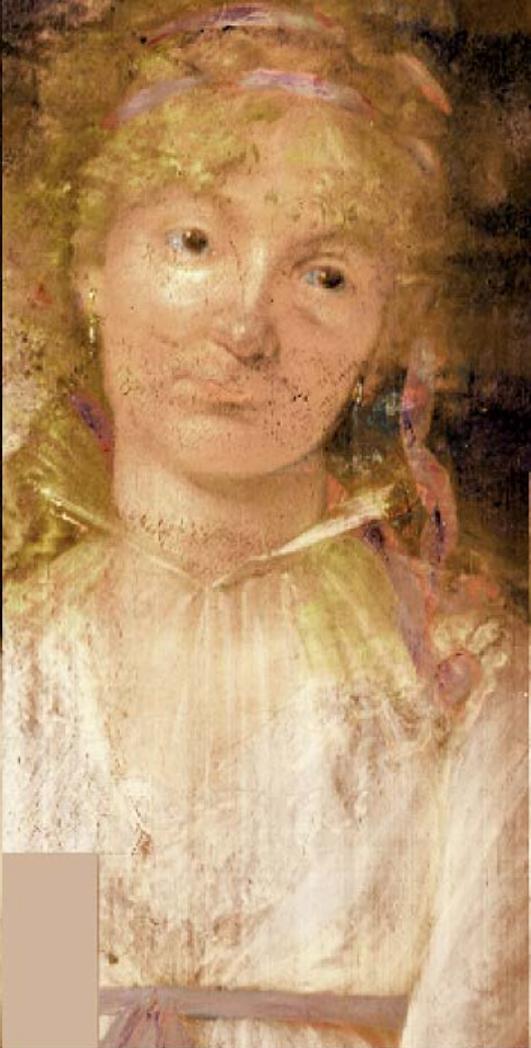
Using math + computer science, we can analyze, enhance and distort images for all kinds of uses.







Surface

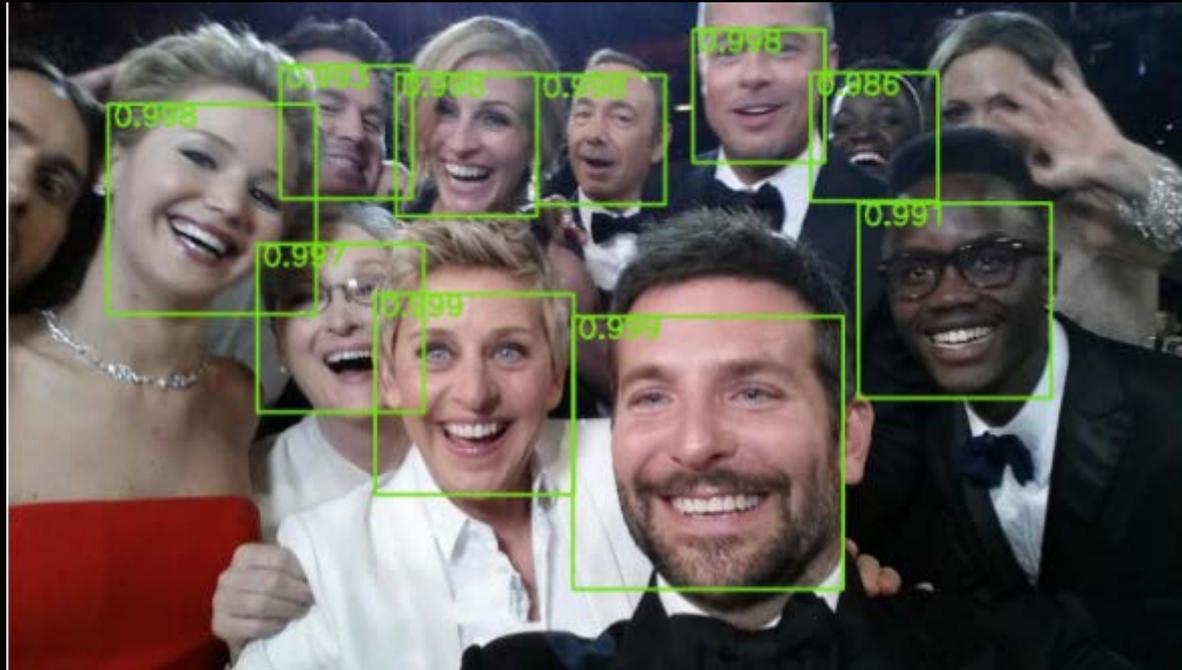


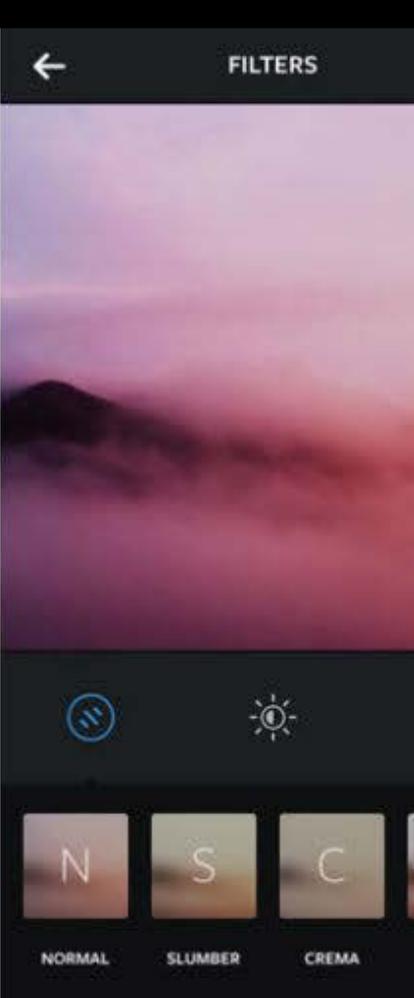
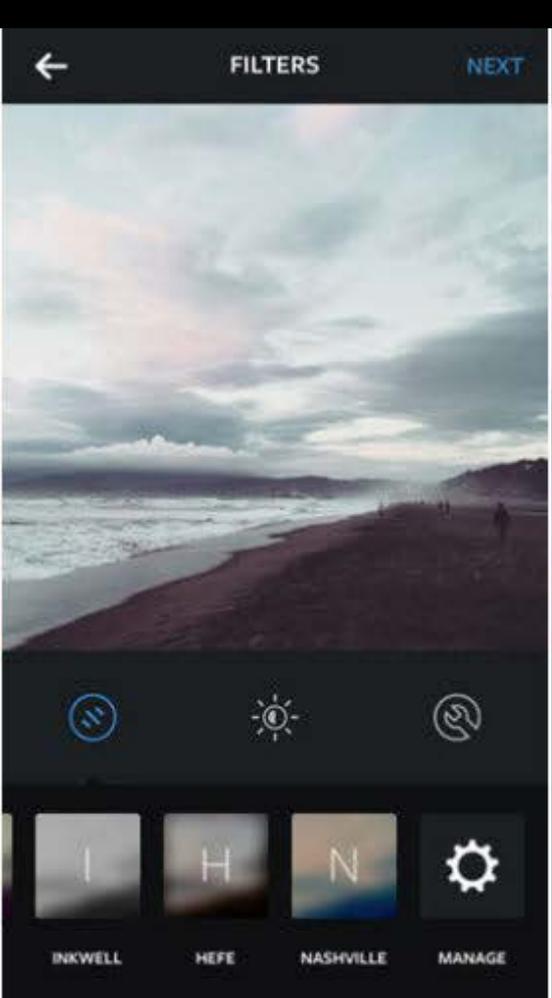
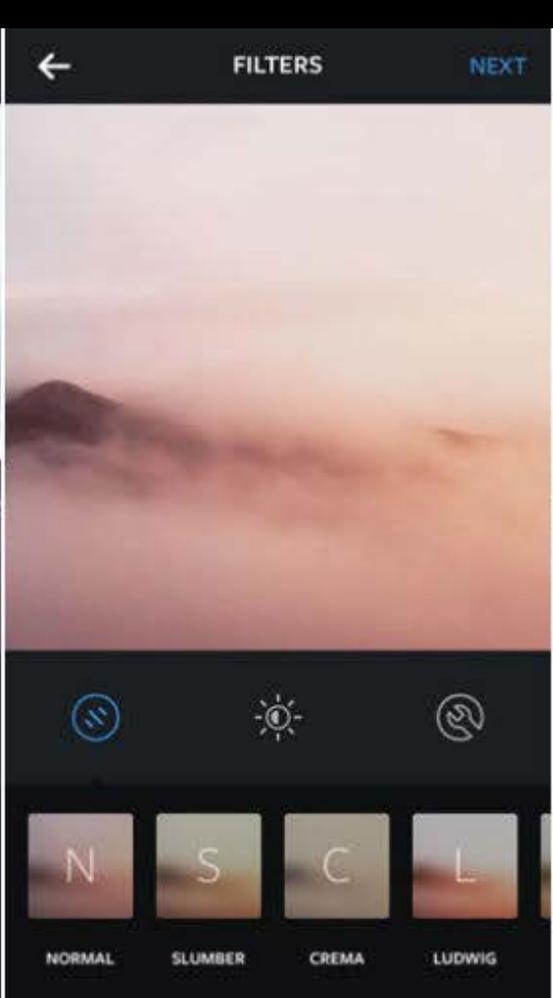
Reconstructed

© IP4AI Image Processing for Art Investigation. All rights reserved. This content is excluded from our Creative Commons license. For more information, see <http://ocw.mit.edu/help/faq-fair-use/>

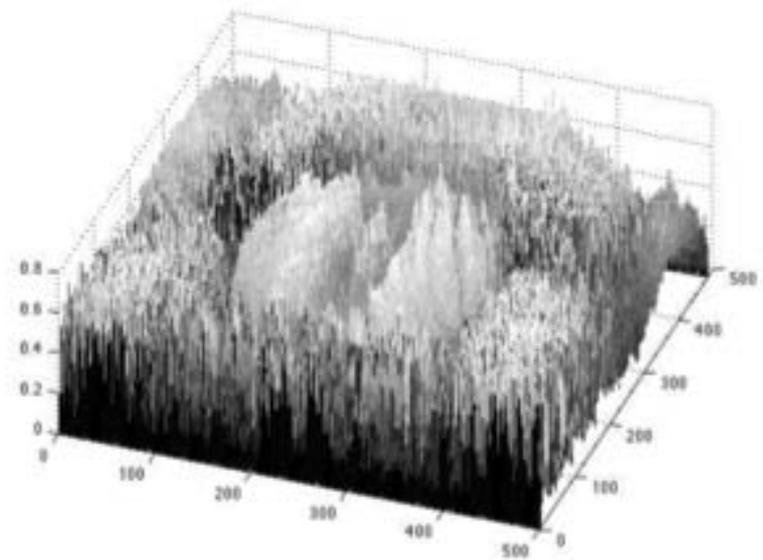
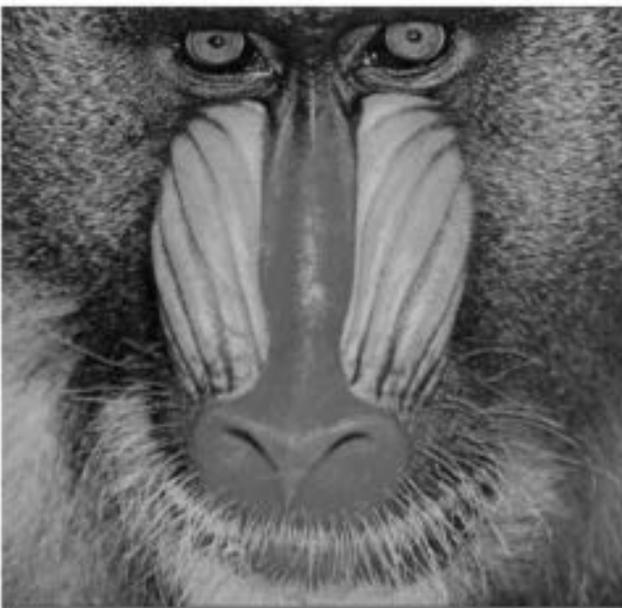


[Image](#) via NASA (X-ray:  
NASA/CXC/SAO/J.DePasquale; IR:  
NASA/JPL-Caltech; Optical:  
NASA/STScI). CC BY-NC.





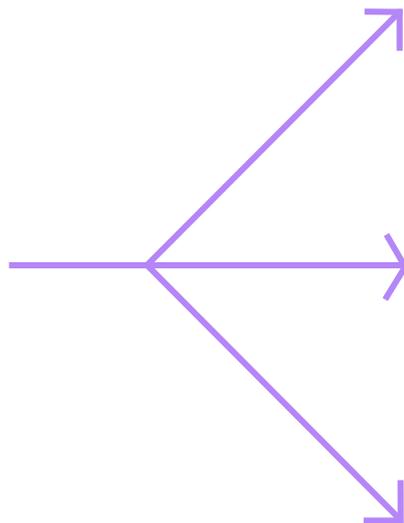
Color on the computer



© source unknown. All rights reserved. This content is excluded from our Creative Commons license. For more information, see <http://ocw.mit.edu/help/faq-fair-use/>



A color image can be represented as a percentage of the red, green and blue “intensities” combined.



30% red



60% green



10% blue

A color image can also be represented as a set of **hue**, **value**, and **saturation** (HSB) values.



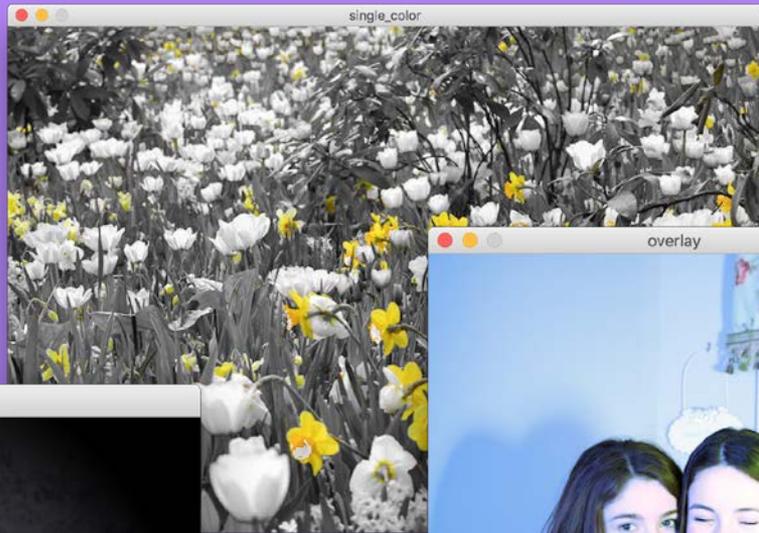
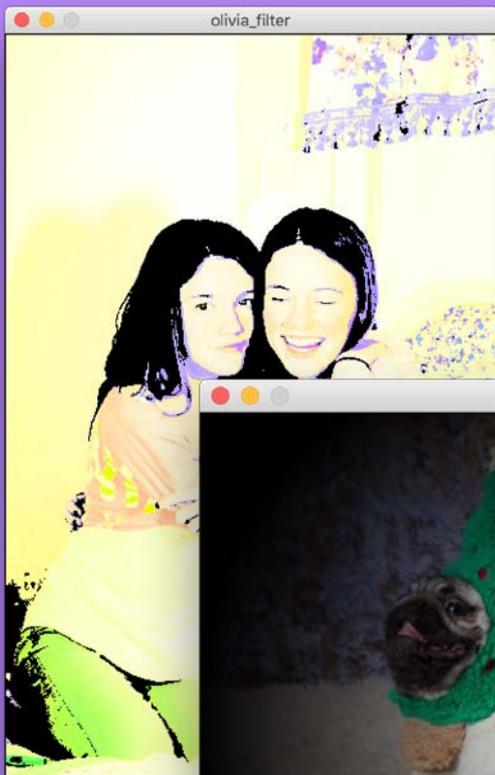
Shift across hue, but not saturation or value

Let's make filters of our own!



$$+ \text{[Sine Wave]} =$$





Blend mode	Formula
<b>Darken</b>	$\min(\text{Target}, \text{Blend})$
<b>Multiply</b>	$\text{Target} * \text{Blend}$
<b>Color Burn</b>	$1 - (1 - \text{Target}) / \text{Blend}$
<b>Linear Burn</b>	$\text{Target} + \text{Blend} - 1$
<b>Lighten</b>	$\max(\text{Target}, \text{Blend})$
<b>Screen</b>	$1 - (1 - \text{Target}) * (1 - \text{Blend})$
<b>Color Dodge</b>	$\text{Target} / (1 - \text{Blend})$
<b>Linear Dodge</b>	$\text{Target} + \text{Blend}$
<b>Overlay</b>	$(\text{Target} > 0.5) * (1 - (1 - 2 * (\text{Target} - 0.5)) * (1 - \text{Blend})) + (\text{Target} \leq 0.5) * ((2 * \text{Target}) * \text{Blend})$

Blend mode	Formula
<b>Soft Light</b>	$(\text{Blend} > 0.5) * (1 - (1 - \text{Target}) * (1 - (\text{Blend} - 0.5))) + (\text{Blend} \leq 0.5) * (\text{Target} * (\text{Blend} + 0.5))$
<b>Hard Light</b>	$(\text{Blend} > 0.5) * (1 - (1 - \text{Target}) * (1 - 2 * (\text{Blend} - 0.5))) + (\text{Blend} \leq 0.5) * (\text{Target} * (2 * \text{Blend}))$
<b>Vivid Light</b>	$(\text{Blend} > 0.5) * (1 - (1 - \text{Target}) / (2 * (\text{Blend} - 0.5))) + (\text{Blend} \leq 0.5) * (\text{Target} / (1 - 2 * \text{Blend}))$
<b>Linear Light</b>	$(\text{Blend} > 0.5) * (\text{Target} + 2 * (\text{Blend} - 0.5)) + (\text{Blend} \leq 0.5) * (\text{Target} + 2 * \text{Blend} - 1)$
<b>Pin Light</b>	$(\text{Blend} > 0.5) * (\max(\text{Target}, 2 * (\text{Blend} - 0.5))) + (\text{Blend} \leq 0.5) * (\min(\text{Target}, 2 * \text{Blend}))$
<b>Difference</b>	$ \text{Target} - \text{Blend} $
<b>Exclusion</b>	$0.5 - 2 * (\text{Target} - 0.5) * (\text{Blend} - 0.5)$

Resource: Girls Who Build Cameras

Kristen Railey, Bob Schulein, Olivia Glennon, Leslie Watkins, Alex Lorman, Carol Carveth, Sara James

The following may not correspond to a particular course on MIT OpenCourseWare, but has been provided by the author as an individual learning resource.

For information about citing these materials or our Terms of Use, visit: <https://ocw.mit.edu/terms>.