

# Matrix Pix

Jessica Herzog



# Matrix Pix

Jessica Herzog

More than any other subject, students name math as the course they find most difficult in school.

# Matrix Pix

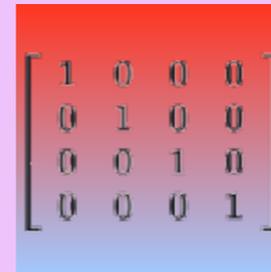
Jessica Herzog



By connecting math concepts to something the students are already interested in, they're able to create mental models that ground the math in intuitive, visual understanding.

# Matrix Pix

Jessica Herzog

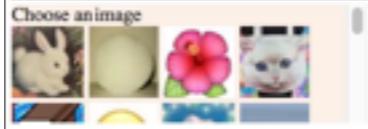


My thesis is a web resource that introduces middle schoolers (ages 11-13) to the math behind an image, using convolution matrices to create customizable image filters.

# Matrix Pix

Story mode  
 Play mode

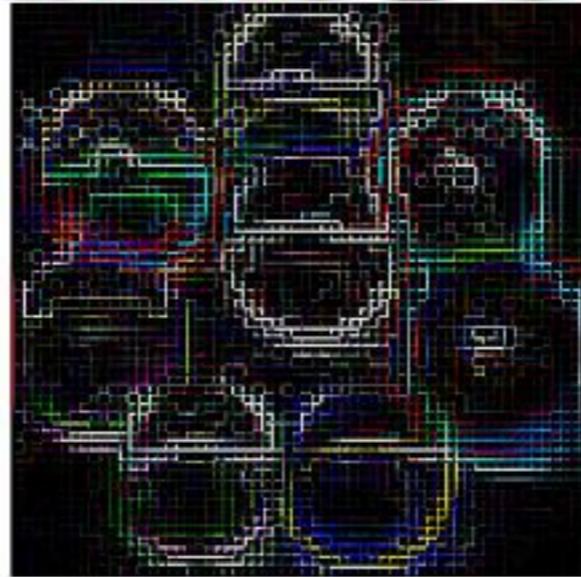
	0	0	0	
	0	1	0	
	0	0	0	



Actions	Recipes
Reset	

Print out

*Minnie Pie*



0,9,0  
9,-36,9  
0,9,0

Research

Research

spacial  symbolic

How do you bridge the symbolic and the spatial.  
there are many examples of this scenario in the world. for example,

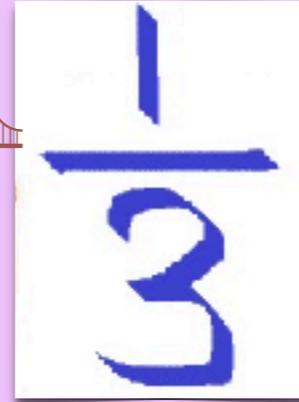


Research

outside of  
school



school



How is this also this?

How do you explain that.

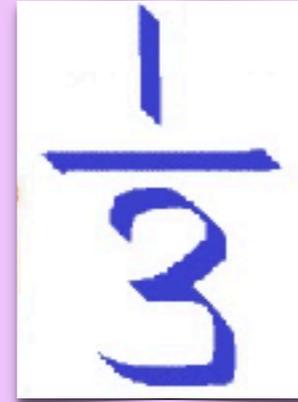
how to express an idea that has not one but TWO true, yet parallel forms?

Research

outside of  
school

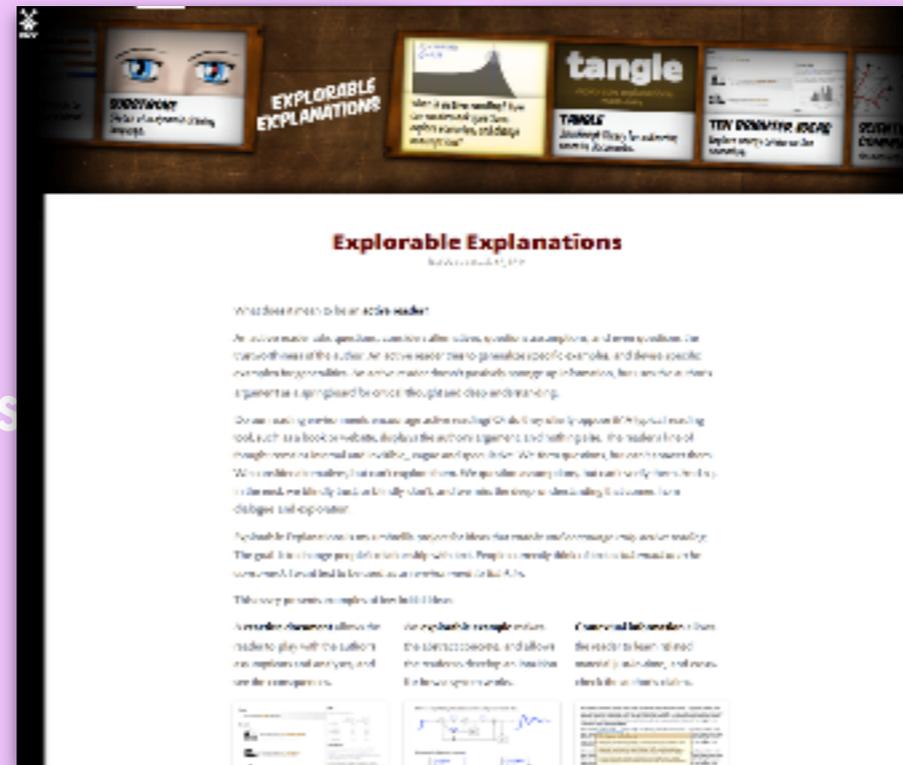


school

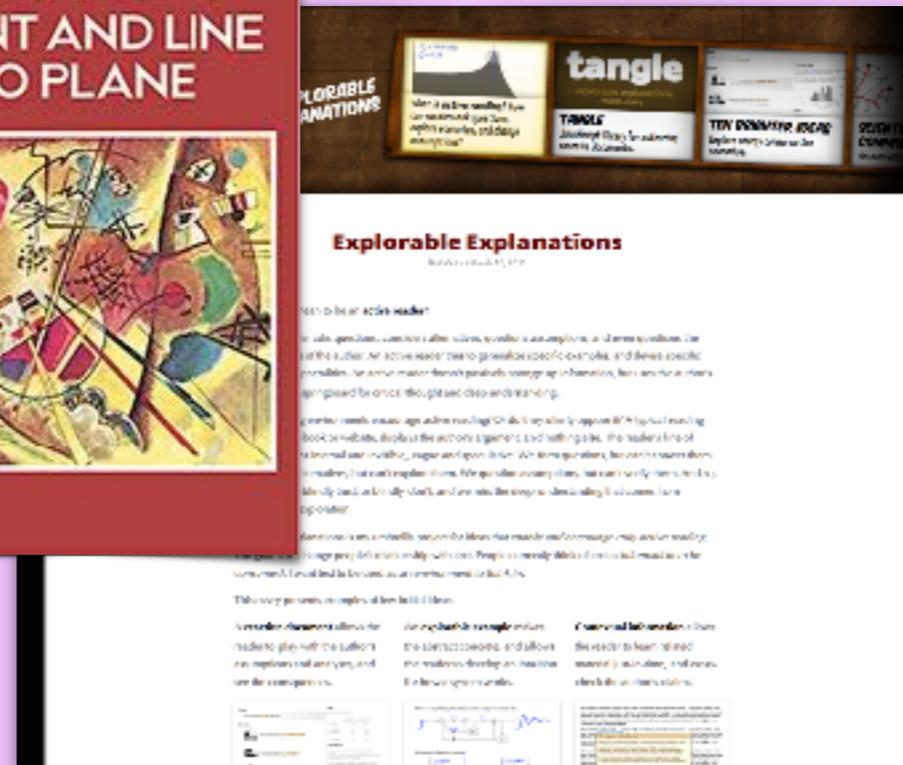
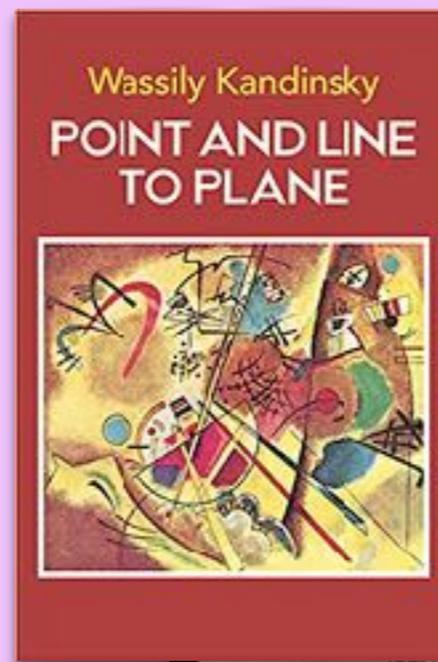


One way is to just provide both forms and the rest is on you to make the connection. But i wondered if there were more sophisticated ways to achieve this connection... took a look at what others had to say.

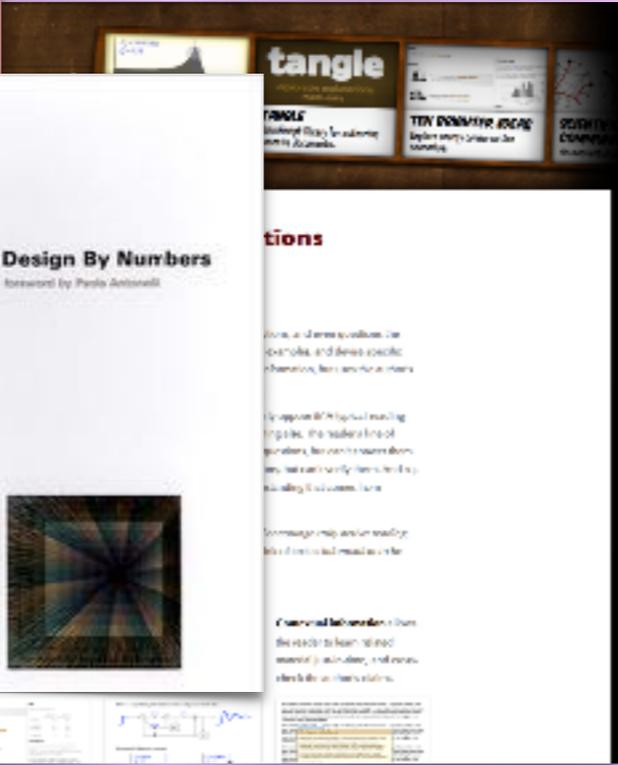
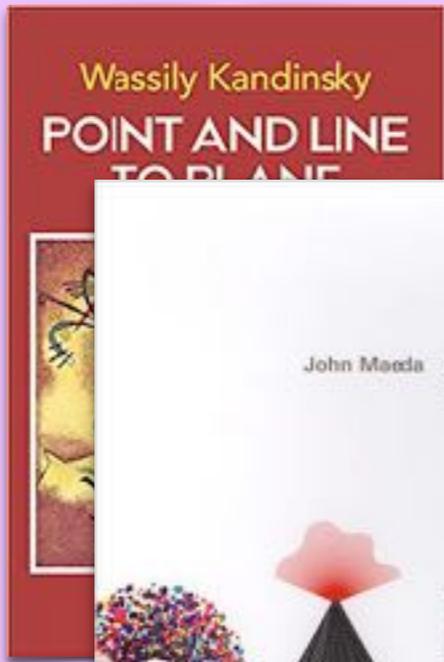
Res

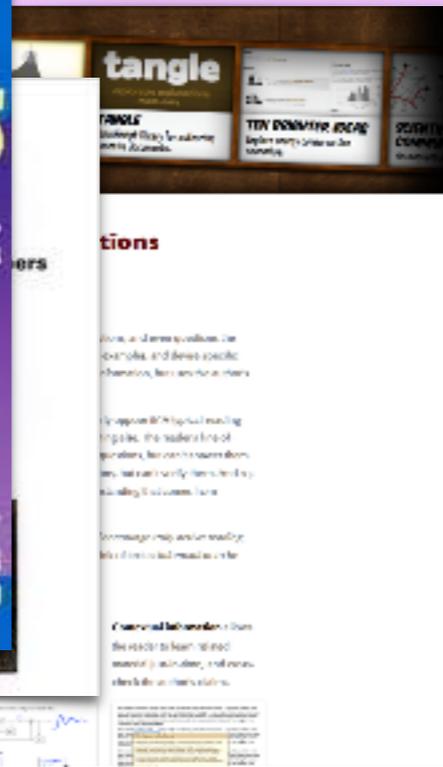
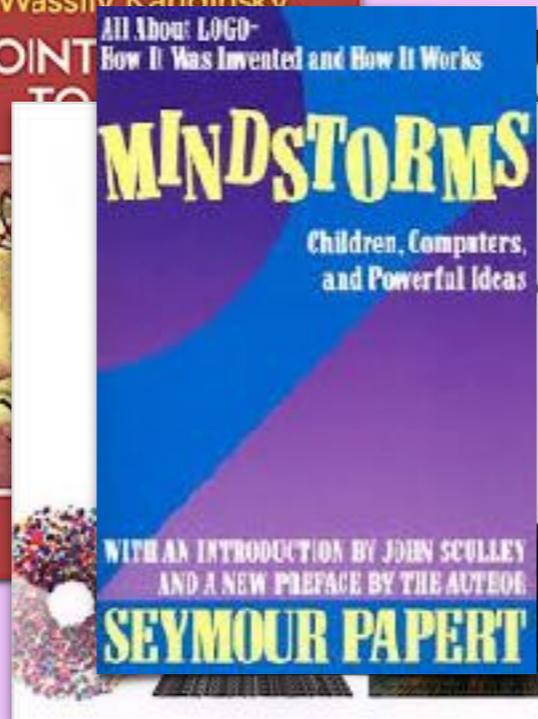
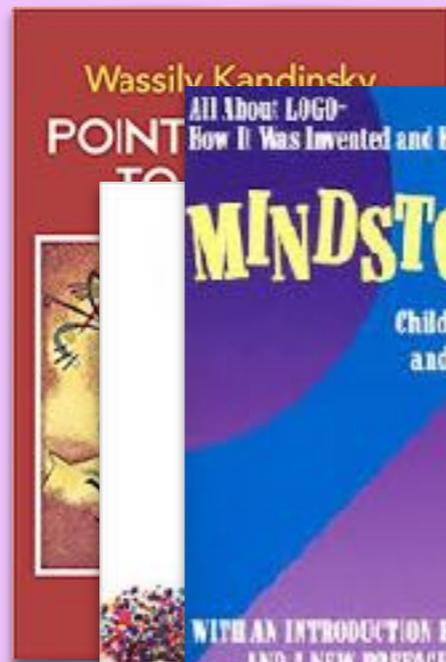


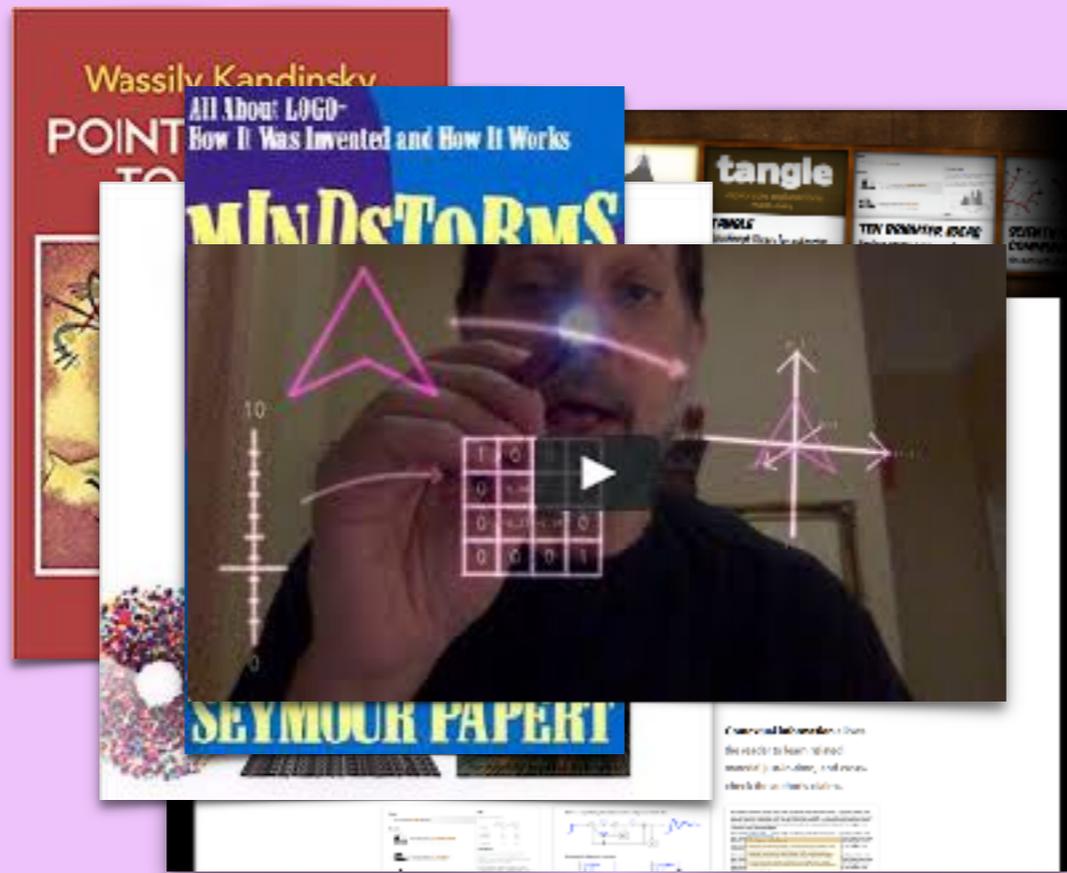
And i realized



= As you may imagine, this leaves room for infinite creative possibilities.











## Epistemological Pluralism and the Revaluation of the Concrete

Sherry Turkle and Seymour Papert\*

### EPISTEMOLOGICAL PLURALISM

The concrete that fuel the discussion of concrete and computers are here served by talking about more than women and more than computers. Women's access to science and engineering has historically been blocked by prejudice and discrimination. There are still too many women of color who are excluded, not by rules that keep women out, but by ways of thinking that make them excluded to begin with. One goal of this is that equal access to even the most basic elements of computer science is an epistemological problem, because the ability of multiple ways of knowing and thinking.

With this intention we find ourselves at the meeting point of three epistemological challenges to the hegemony of the abstract, formal, and logical in the privileged domain of scientific thought. The first of these challenges comes from within feminist scholarship. First, the canonical style, abstract and rule-driven, is associated with power and elitism, and with the social construction of science and objectivity as male.<sup>1</sup>

\*A earlier version of this paper appeared in *ACM SIGCSE Bulletin on Computer Science Education*, Volume 19(2), Fall, 1988.

<sup>1</sup> Similar reflections include Silver (1985) and Harding and Franklin (1985). An excellent book exploring many of the issues related with the issue of gender is Eisenberg (1988).

In this paper we draw and build on the work of Seymour Papert, Carl Gilly, and David Foray. Gilly, Gilly, with her emphasis on social structure, 1988 talks out of this in a discussion of institutional approaches to educational technology. The book argues that too often the activities of schools are not their own, but are imposed from above. In response, social and contextual learning helps to make the point. In addition, Gilly's cultural relationships to educational technology is analogous to our own culture's relationship to Papert's work. We appreciate Gilly because her work addresses, in our view, the importance of relationships with objects in the development of educational systems. Gilly, Gilly and Gilly in a somewhat different way as to highlight the different dimensions of what we call the "cultural" approach to education. See Gilly (1987), Gilly (1983, 1985).





An Interesting Chapter for PART III

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Epistemological Pluralism



$$z = z(2 - \frac{z}{15})$$

$$y = 1 + 1.2y - |x| \sqrt{\frac{2y-z}{15}}$$

$$x^2 + y^2 + z^2 = 15^2$$



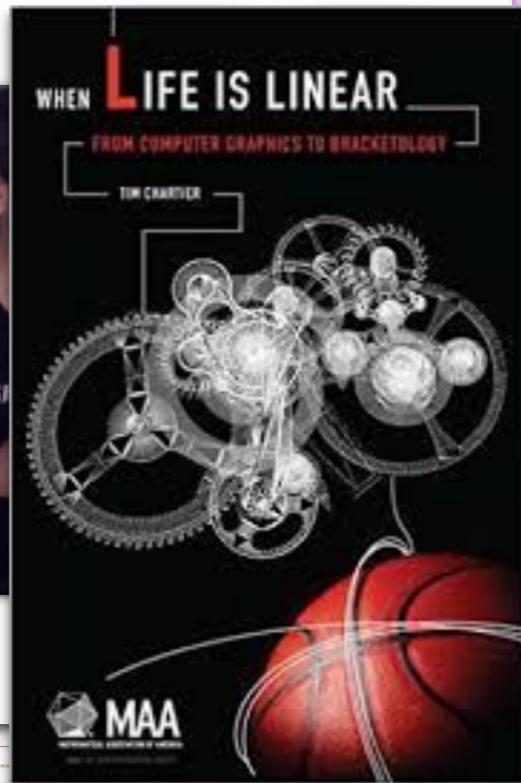
Garrett Keilberg is assigned to our next video, introducing to Dugan's work. We introduce Keilberg because her work addresses, in some ways, the importance of interdisciplinary work to the development of mathematical physics. Using Gillies and Keller as a starting point allows us to highlight two different dimensions of what we shall call the "math-physics interface." See Gillies (1987, p. 103, 106).

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An Diving Chapter for PART III



1974 revision of *Peirce's Theory of Signs*  
https://doi.org/10.1017/9781017018013.ch011

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*Peirce's Theory of Signs*  
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### Peirce's Theory of Signs

https://plato.stanford.edu/entries/peirce-theory-of-signs/

Peirce's Sign Theory, or Semiotic, is an account of signification, representation, reference and meaning. Although sign theories have a long history, Peirce's accounts are distinctive and innovative for their breadth and complexity, and for capturing the importance of interpretation to signification. For Peirce, developing a hermeneutic theory of signs was a central philosophical and intellectual project. The importance of semiotics to Peirce is wide ranging. As he himself said: "[...] he has never been more power to study anything—mathematics, ethics, metaphysics, gravitation, thermodynamics, optics, chemistry, comparative anatomy, astronomy, psychology, genetics, economics, the history of science, whitt, men and women, wine, meteorology, except as a study of semiotics" (S 1977, 15–16). Peirce also traced sign theory as central to his work on logic, as the medium for inquiry and the source of scientific discovery, and even as one possible means for 'proving' his pragmatism. Its importance to Peirce's philosophy, then, cannot be overstated.

Across the course of his intellectual life Peirce continually returned to and developed his ideas about signs and semiotics and these are three broadly definable accounts: a *semiotic Early Account* from the 1890s; a *semiotic and relatively non-Bertrian Account* developed through the 1890s and 1900s and presented in 1903; and his *quasi-Bertrian, modeling, and incomplete final account* developed between 1906 and 1913. The following entry examines these three accounts, and traces the changes that led Peirce to develop earlier accounts and generate new, more complex, signtheories. However, despite these changes, Peirce's ideas on the basic structure of signs and signification remain largely uniform throughout his developments. Consequently, it is useful to begin with an account of the basic structure of signs according to Peirce.



numbers



pixels



image processing.

This area of research serves as a great intro to advanced mathematical ideas, often building upon basic concepts - as math tends to do. And (image processing) is becoming more prevalent in daily life as more digital images enter our methods of communication and expression.



Target Audience

11-13 year olds

$$\begin{bmatrix} 1 & 2 & 3 \\ 0 & 1 & -2 \\ 1 & 2 & 5 \end{bmatrix}$$



Target Audience

context: The Common Core State Standards Initiative pushed matrices to the High School math curriculum two years ago.  
- so its seen on the advanced side for middle schoolers

$$\begin{bmatrix} 1 & 2 & 3 \\ 0 & 1 & -2 \\ 1 & 2 & 5 \end{bmatrix}$$



Target Audience



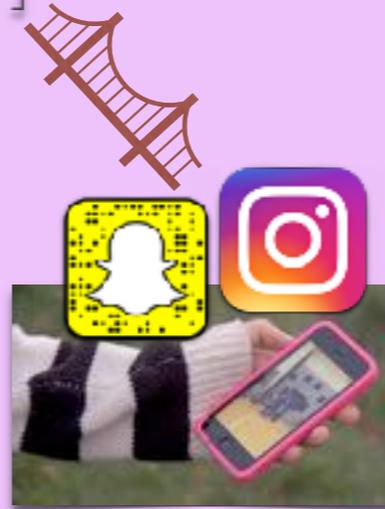
NORC at the University of Chicago. "New survey: Snapchat and Instagram are most popular social media platforms among American teens: Black teens are the most active on social media and messaging apps." ScienceDaily. [www.sciencedaily.com/releases/2017/04/170421113306.htm](http://www.sciencedaily.com/releases/2017/04/170421113306.htm) (accessed March 12, 2018).

digital natives / (13 and up) favor social media platforms and are now most likely to use Instagram and Snapchat.

Target Audience

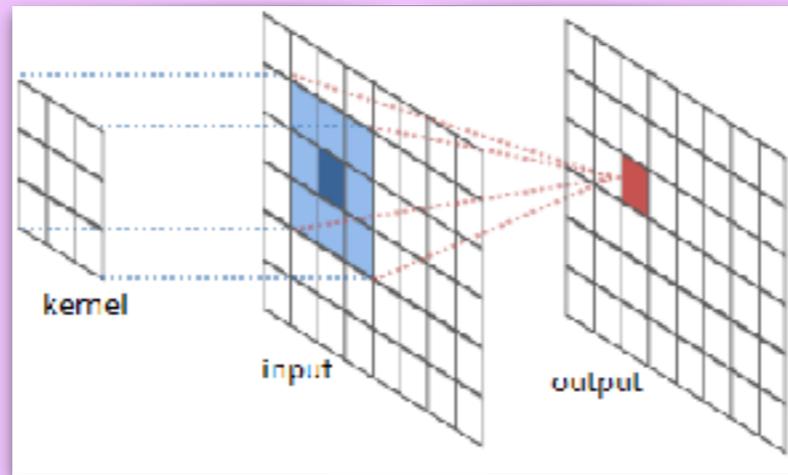


$$\begin{bmatrix} 1 & 2 & 3 \\ 0 & 1 & -2 \\ 1 & 2 & 5 \end{bmatrix}$$



NORC at the University of Chicago. "New survey: Snapchat and Instagram are most popular social media platforms among American teens: Black teens are the most active on social media and messaging apps." ScienceDaily. [www.sciencedaily.com/releases/2017/04/170421113306.htm](http://www.sciencedaily.com/releases/2017/04/170421113306.htm) (accessed March 12, 2018).

the thing that secretly bridges these two things (matrices and social media platforms) is that they both play well with images. Specifically, image filters. lets see how its been done:



start with a 3x3 matrix (kernel) of integers (neg or pos),  
multiply it with values of 9 corresponding pixels from an image  
the middle pixel receives the average sum or product of these 9 pixels as its new value  
apply the 3x3 matrix so every pixel receives a new value

# Precedents

How have convolution matrices been illustrated before?

Lets look at two pre-existing web resources



LiveSlide Site

[http://immersivemath.com/ila/ch06\\_matrices/ch06.html](http://immersivemath.com/ila/ch06_matrices/ch06.html)

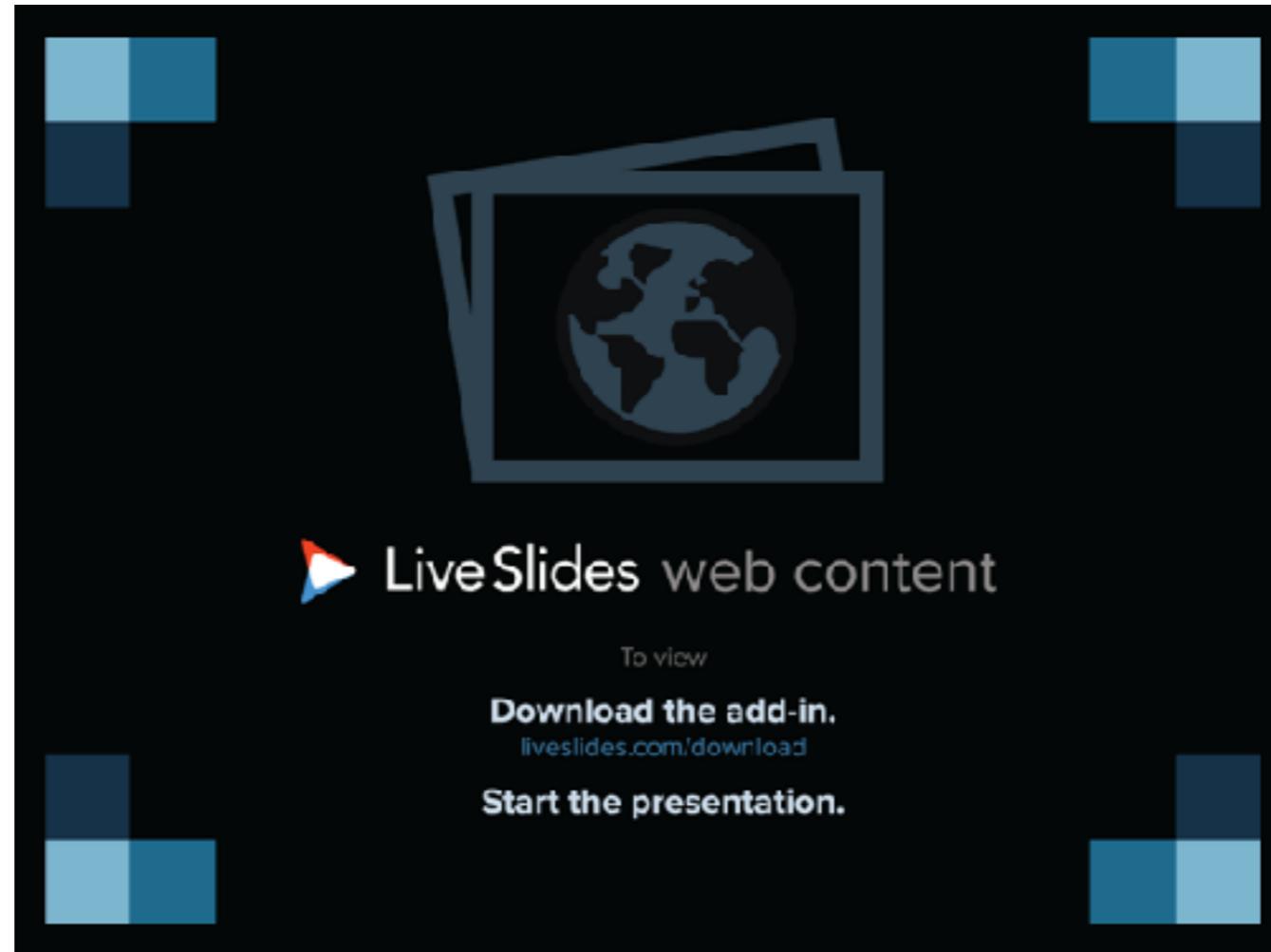
online textbook - lots of text

advanced level, college

notice 'Interactive Illustration' - youtube explanation + demo

**Takeaway** (just looking at the Interactive Illustration):

Simple concept shouldn't need this much explaining



LiveSlide Site

<http://setosa.io/ev/image-kernels/>

data viz feel

sleek, straightforward graphics

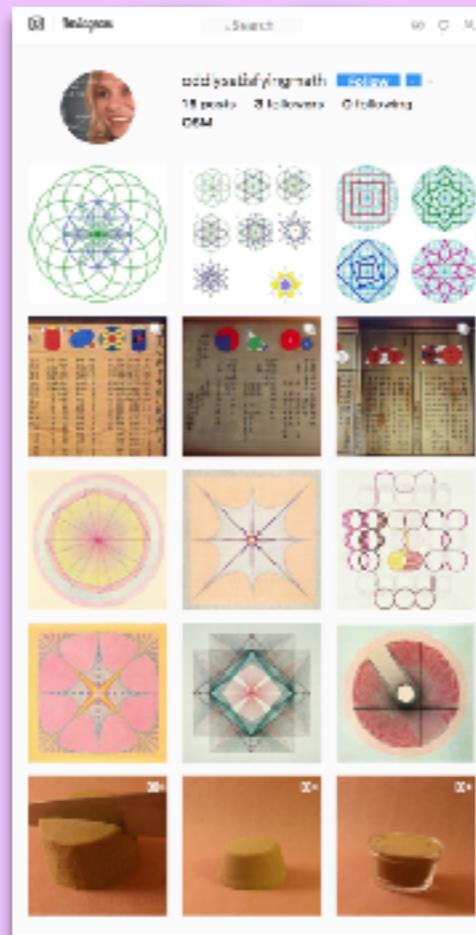
imgs grayscale :(

**Takeaway:**

Great for quickly getting idea, not fun to explore.

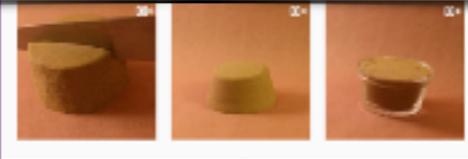
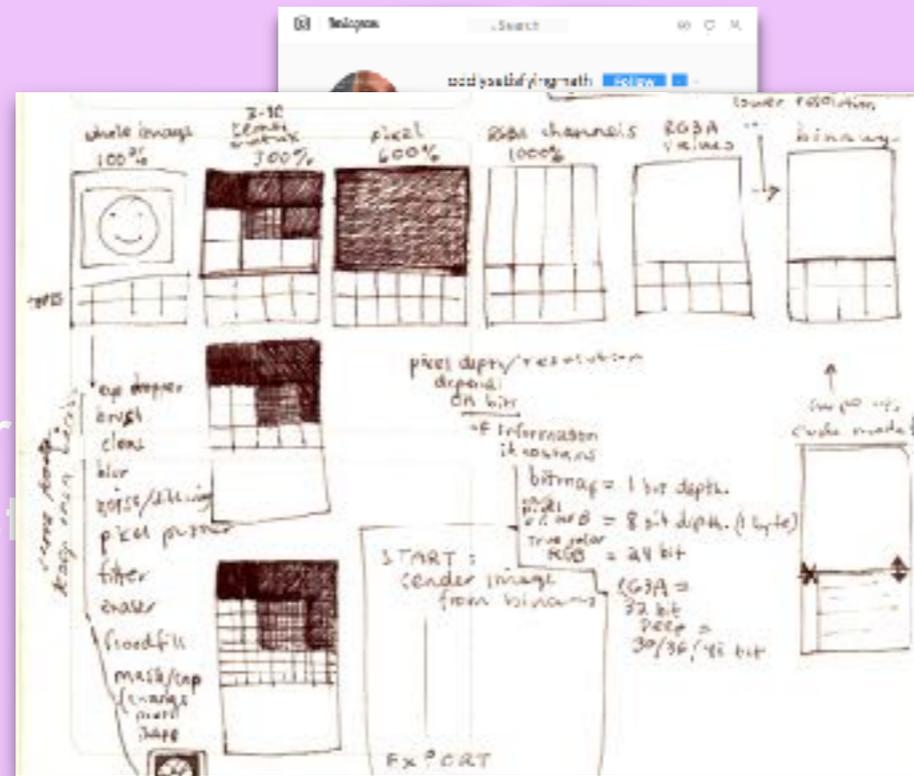
Iterations  
Testing

# Iterations Testing



challenge to find more visual examples of math

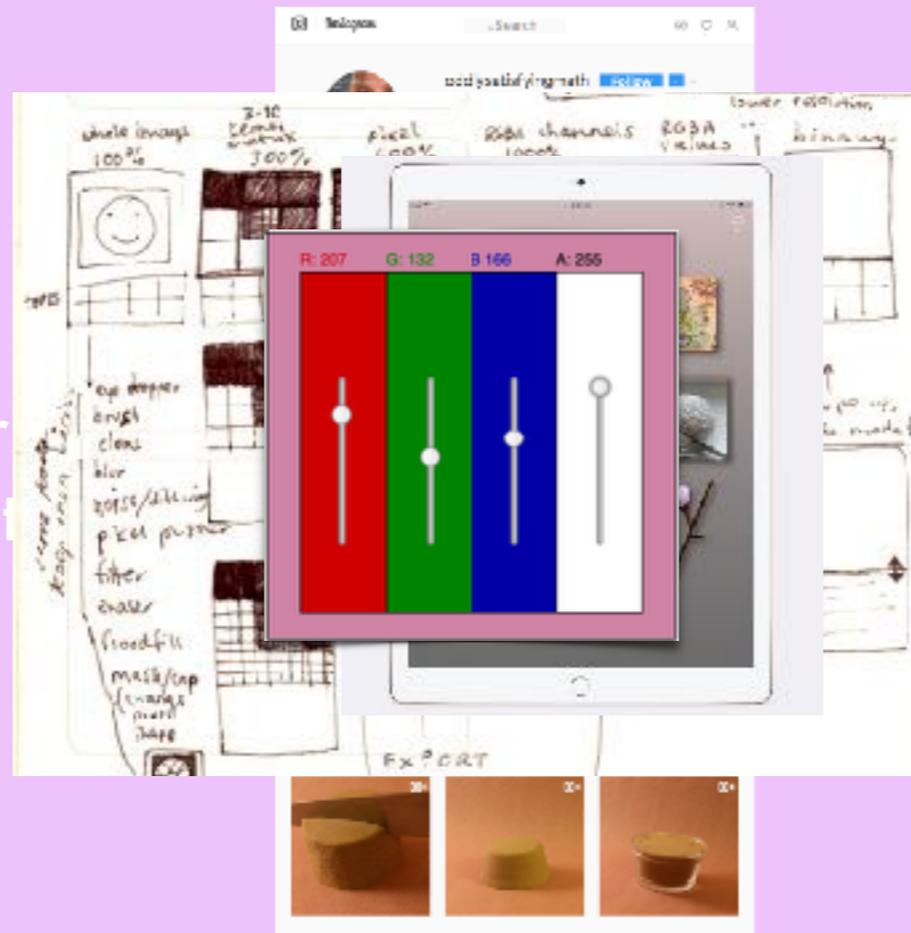
Iter  
Test



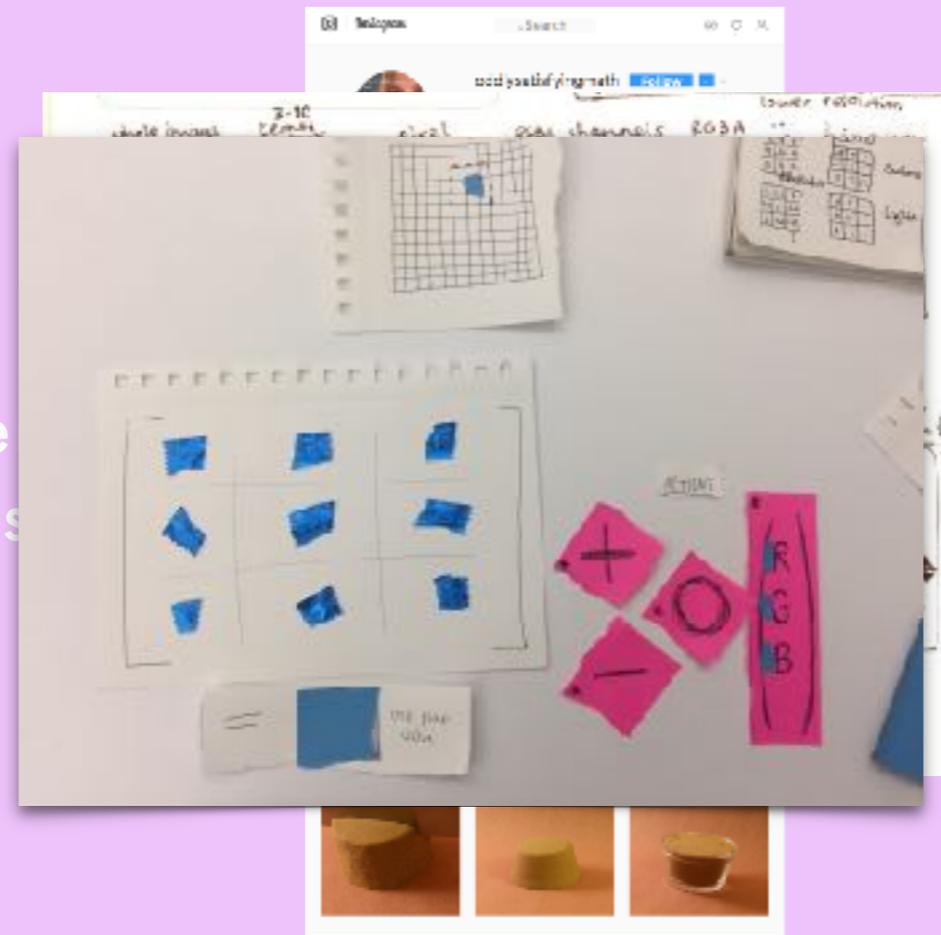
Iter  
Test



Iter  
Test



Iterative  
Testing



# Mama's Pix

Story mode  
Play mode



0	2	-3
9	9	-7
-5	-7	-6



Actions

- Mouse cursor icon
- Eraser icon
- +5
- 5
- Undo/Redo icon
- Zoom icon
- Print icon

Recipes

- Recipe 1: 2x2 grid
- Recipe 2: 3x3 grid
- Recipe 3: 4x4 grid
- Recipe 4: 5x5 grid
- Recipe 5: 6x6 grid
- Recipe 6: 7x7 grid
- Recipe 7: 8x8 grid
- Recipe 8: 9x9 grid



# Why use web / tech in general?

Lenhart, Amanda, Pew Research Center, April 2015, "Teen, Social Media and Technology Overview 2015"

- Accessibility: although IG and snapchat feel popular, studies show that lower-income kids use it less
- Better suited for complexity  
(dynamic changes and feedback)

# Production Calendar

Mar 13th  
now

April 15th

May 5th  
show

<b>bugs:</b>	—————→		
many	<b>cont'd user testing:</b>		
	LCCS		
<b>develop story</b>		<b>as self-explanatory as possible</b>	
<b>mode</b>	—————→	<b>printer setup</b>	
<b>zoom feature</b>		<b>links to additional resources</b>	

Pr

[jherz.org/matrixPix](http://jherz.org/matrixPix)