

# Healing Structures: Weaving Technology into Medical Education

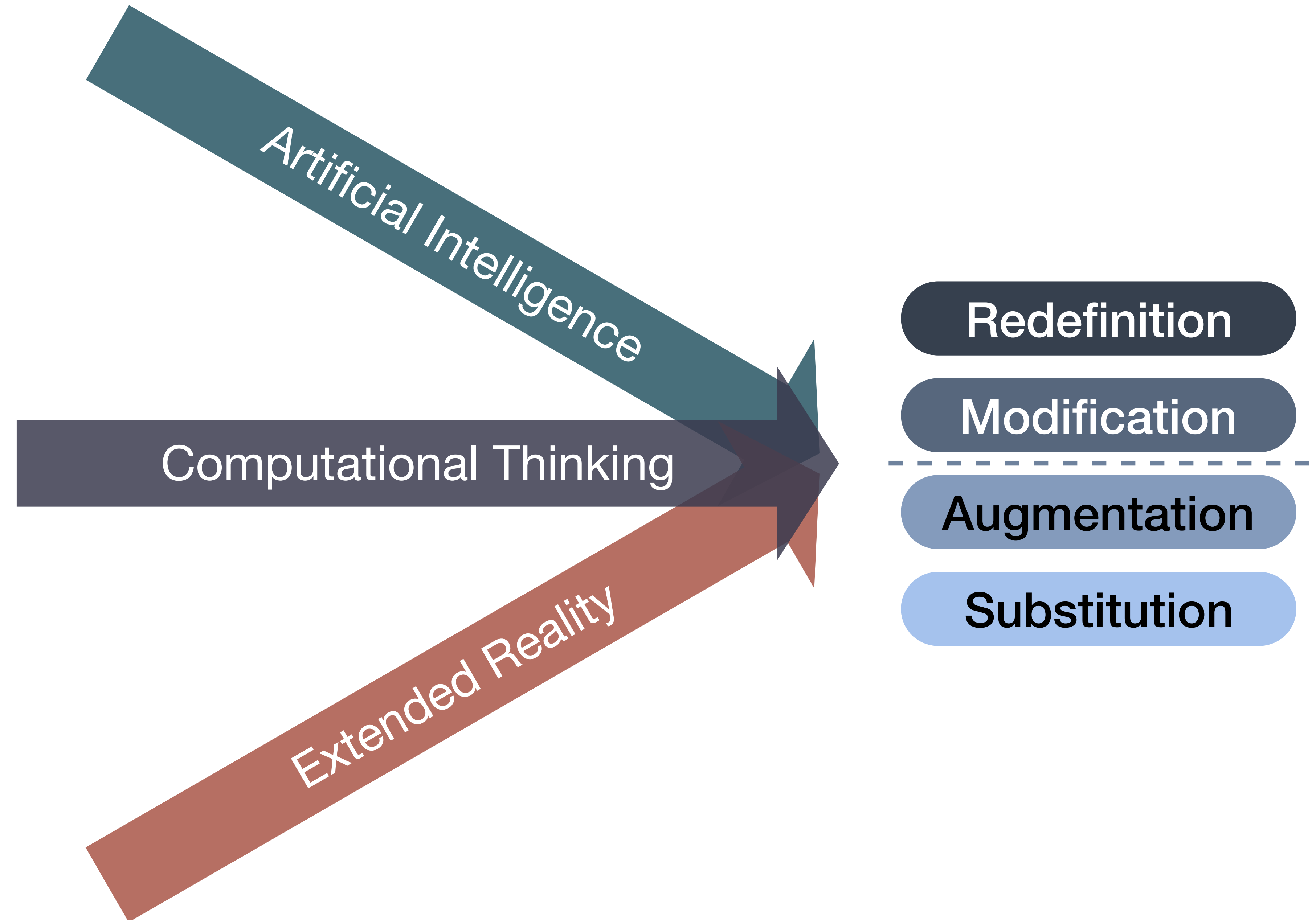
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Ruben R. Puentedura, Ph.D.

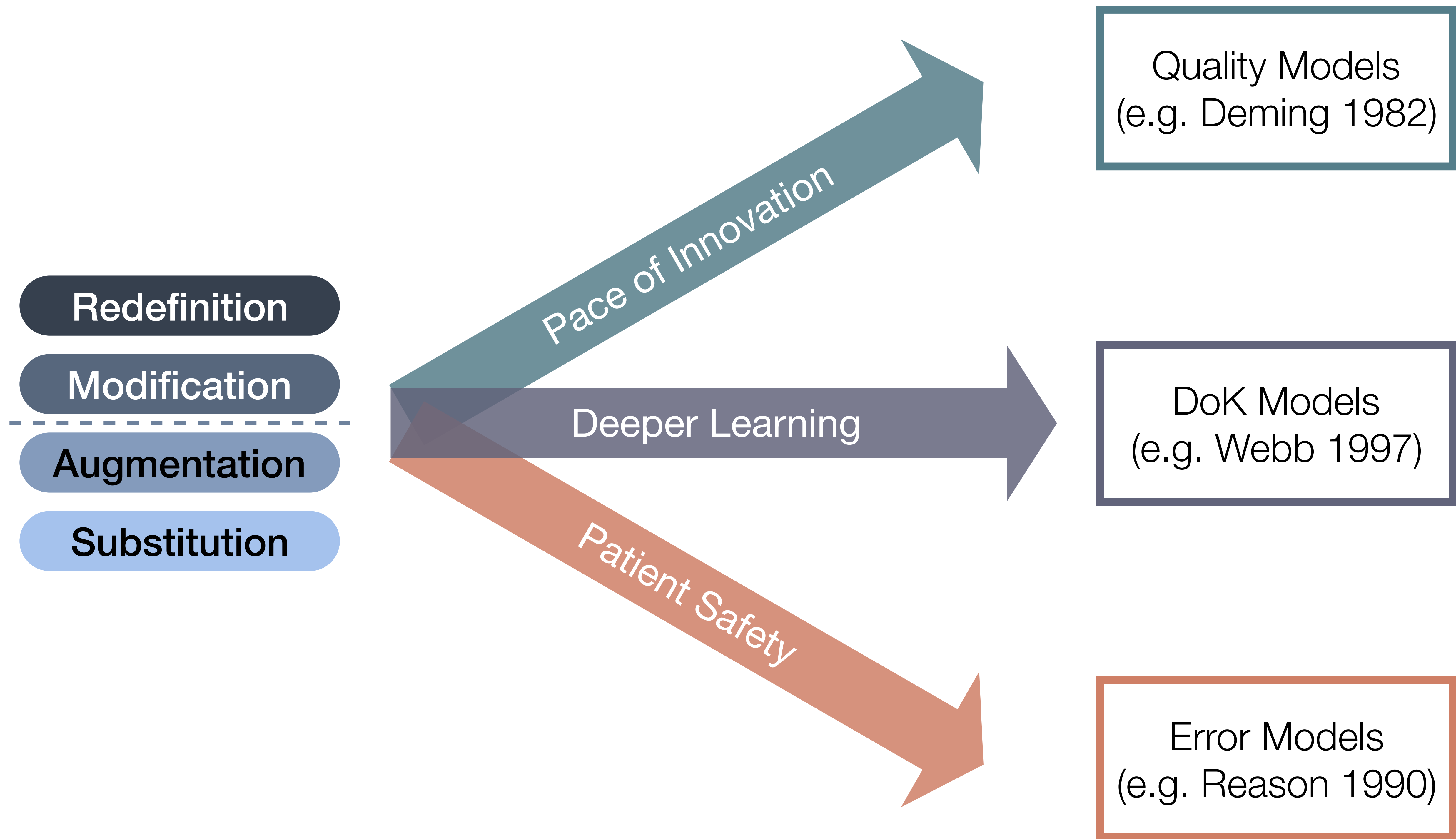
Taxonomy of AI  
(e.g. Russell &  
Norvig 2011)

Dimensions of CT  
(e.g. Brennan &  
Resnick 2012)

Taxonomy of XR  
(e.g. Milgram &  
Kishino 1994)

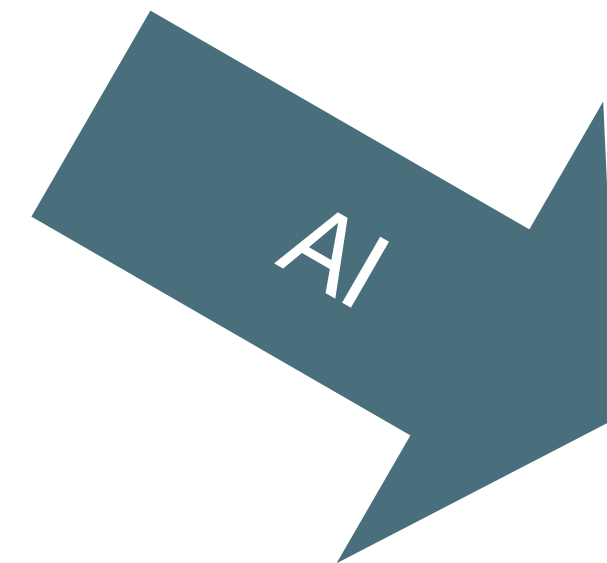






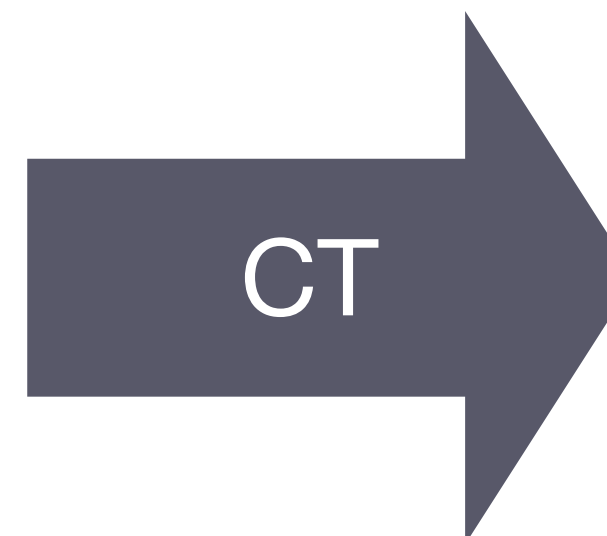
Taxonomy of AI  
(e.g. Russell &  
Norvig 2011)

Quality Models  
(e.g. Deming 1982)



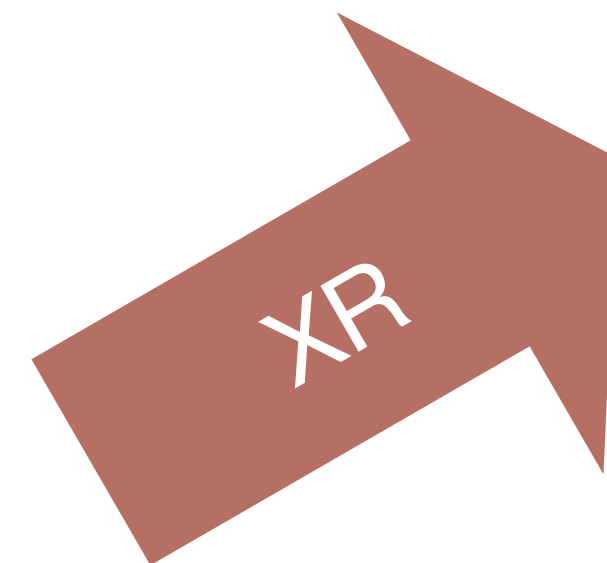
Dimensions of CT  
(e.g. Brennan &  
Resnick 2012)

DoK Models  
(e.g. Webb 1997)



Taxonomy of XR  
(e.g. Milgram &  
Kishino 1994)

Error Models  
(e.g. Reason 1990)



Redefinition

Modification

Augmentation

Substitution

*Transformation*

## **Redefinition**

*Tech allows for the creation of new tasks,  
previously inconceivable*

## **Modification**

*Tech allows for significant task redesign*

---

## **Augmentation**

*Tech acts as a direct tool substitute,  
with functional improvement*

## **Substitution**

*Tech acts as a direct tool substitute,  
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*Enhancement*

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John E. Hall PhD

directions to interdigitate with the myosin filaments. The Z disk, which is composed of filamentous proteins different from the actin and myosin filaments, passes crosswise across the myofibril and also crosswise from myofibril to myofibril, attaching the myofibrils to one another all the way across the muscle fiber. Therefore, the entire muscle fiber has light and dark bands, as do the individual myofibrils. These bands give skeletal and cardiac muscle their striated appearance.

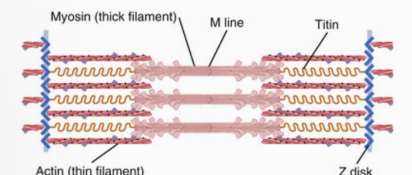
**The protein lies between the myofibrils, the actin filaments, and the myosin filaments. It is a springy protein that changes length as the sarcomere contracts and relaxes.**

**Titin Filaments:** The side-by-side relationship between the myosin and actin filaments is maintained by a large number of filamentous molecules of a protein called **titin** (Figure 6-3). Each titin molecule has a molecular weight of about 3 million, which makes it one of the largest protein molecules in the body. Also, because it is filamentous, it is very *springy*. These springy titin molecules act as a framework that holds the myosin and actin filaments in place so that the contractile machinery of the sarcomere will work. One end of the titin molecule is elastic and is attached to the Z disk, acting as a spring and changing length as the sarcomere contracts and relaxes. The other part of the titin molecule tethers it to the myosin thick filament.

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Guyton and Hall Textbook...Medical Physiology E-Book

The titin molecule also appears to act as a template for initial formation of portions of the contractile filaments of the sarcomere, especially the myosin filaments.



**FIGURE 6-3 Organization of proteins in a sarcomere.** Each titin molecule extends from the Z disk to the M line. Part of the titin molecule is closely associated with the myosin thick filament, whereas the rest of the molecule is springy and changes length as the sarcomere contracts and relaxes.

**Sarcoplasm is the Intracellular Fluid between Myofibrils.** The many myofibrils of each muscle fiber are suspended side by side in the muscle fiber. **The spaces between the myofibrils are filled with intracellular fluid called sarcoplasm, containing large quantities of potassium, magnesium, and phosphate, plus multiple protein enzymes.** Also present are tremendous numbers of mitochondria that lie parallel to the myofibrils. These mitochondria supply the contracting myofibrils with large amounts of energy in the form of adenosine triphosphate (ATP) formed by the mitochondria.

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in some of cancer cells. Kinesin-1 has been considered as a target of anti-cancer therapy. Several small molecules were recognized as potent inhibitors of Eg5. Interestingly the inhibitors bind to the common pocket in Eg5 motor domain. STLC is one of the well-known potent inhibitor of Eg5. The crystallographic structure of Eg5-STLC complex revealed that STLC binds to the pocket composed of  $\alpha 2$ ,  $\alpha 3$  helix and loop L5. The inhibitory mechanism of STLC has been well studied. Photochromic molecules such as azobenzene and spiropyran derivatives, which change their structures and properties reversibly by light irradiation, are expected to be applicable to photo-switches of biomimetic machines. Previously we have demonstrated that STLC analogues composed of azobenzenes (ACTAB) or spiropyran (SP-APA) inhibit Eg5 ATPase activity and motor activity photo-reversibly upon UV and visible light irradiations. Moreover, HeLa cell division was photo-regulated with ACTAB. In this study, we have tried to study the optimum conditions to regulate the function of Eg5 with the photochromic inhibitors we have synthesized. In the results, pH and ionic strength dependent effect of the inhibitors on the ATPase activity and Eg5 driven microtubule gliding. At pH 6.8, SP-APA showed significant efficiency to control ATPase and motor activities as an inhibitor that has a photo-switching system.

**2108-Pos Board B428**  
**Tight Coupling between the Heat Dissipation and Molecular Motor's Transport Properties in Nonequilibrium Steady State**  
Wonsuk Hwang, Changhong Hyeon, Computational Sciences, Korea Institute for Advanced Study, Seoul, Korea, Republic of.  
We report a theoretical analysis showing tight coupling between velocity  $V$ , diffusion coefficient  $D$ , and the heat dissipation of kinesin-1 motor protein which is reminiscent of the recent surprising observation of enhanced diffusivity of exothermic enzyme in solution by its own catalytic turnover (Riedel et al., Nature, 2015). From the quantification of  $V$ ,  $D$ , and heat dissipation in terms of rate constants using periodic one-dimensional hopping model, we found: (i)  $D$  increases in the form of 3rd order polynomial of  $V$  when  $V$  is augmented by the increase of ATP concentration; (ii) the increase of diffusivity with the heat production is a natural outcome of systems in non-equilibrium steady states; (iii) the energetic cost for determining the position of a kinesin-1 with a given precision is close to lower bound.

**Cytoskeletal Assemblies and Dynamics**


**2109-Pos Board B429**  
**From Ribosome to Sarcomere - Titin Dynamics in Striated Muscle Cells**  
Michael Gotthardt<sup>1</sup>, Franziska Rudolph<sup>1</sup>, Judith Huettemeister<sup>1</sup>, Katharina da Silva Lopes<sup>1</sup>, Lily Yu<sup>2</sup>, Nora Bergmann<sup>1</sup>, Claudia Fink<sup>1</sup>, Eva Wagner<sup>1</sup>, Stephan Lehmann<sup>1</sup>, Carol Gregorio<sup>3</sup>,  
<sup>1</sup>Max Delbrück Center for Molecular Medicine, Berlin, Germany, <sup>2</sup>University of Arizona, Tucson, AZ, USA, <sup>3</sup>Goettingen University, Goettingen, Germany.

**Engineering X**  
Nisha Mohd Rafiq<sup>1</sup>, Zi Zhao Liu<sup>1</sup>, TingTing Jiang<sup>1</sup>, Cheng-han Yu<sup>1</sup>, Paul Matsudaira<sup>2</sup>, Gareth Jones<sup>3</sup>, Alexander Bershadsky<sup>1</sup>,  
<sup>1</sup>Mechanobiology Institute, Singapore, Singapore, <sup>2</sup>King's College London, London, United Kingdom, <sup>3</sup>University of Cambridge, Cambridge, United Kingdom.  
Podosomes represent a special class of integrin-mediated cell-matrix adhesions formed by migrating and matrix degrading cells. Here, we demonstrated that in macrophage-like THP1 cells and in fibroblasts stimulated to produce podosomes, down-regulation of ARF1 by siRNA, and by pharmacological inhibitors led to striking podosome elimination. Treatments that induced podosome formation increased the level of GTP-bound ARF1. Furthermore, siRNA knockdown of the ARF1-GEF ARNO also resulted in dramatic podosome inhibition. ARNO was found to co-localize with the adhesive rings of podosomes while ARF1 was localized to vesicular structures transiently contacting podosome rings. Inhibition of ARF1 led to an increase in RhoA-GTP levels and triggered assembly of myosin-IIA filaments in THP1 cells that resemble sarcomere-like organization typically observed in fibroblasts, whilst the suppression of myosin-IIA rescued podosome formation despite ARF1 inhibition. Finally, expression of constitutively active ARF1 in fibroblasts induced formation of putative podosome precursors: actin-rich puncta that coincided with matrix degradation sites and containing proteins of the podosome core but not of the adhesive ring. We conclude that ARNO-ARF1 regulates formation of podosomes by inhibition of Rho/myosin II and promotion of actin core assembly.

**2111-Pos Board B431**  
**Local Pulses of RhoA Activation Assemble Polarized Network Architectures for Efficient Actomyosin Contractility**  
François B. Robin<sup>1</sup>, Jonathan M. Michaux<sup>2</sup>, Edwin M. Munro<sup>2</sup>,  
<sup>1</sup>Developmental Biology Department, Institute for Biology Paris-Seine, Paris, France, <sup>2</sup>Molecular Genetics and Cell Biology, University of Chicago, Chicago, IL, USA.  
Spatiotemporal patterning of actomyosin contractility plays a key role in cell and tissue morphogenesis during early development. In embryonic cells, actomyosin arrays are highly dynamic structures that remodel on a time scale of 10s of seconds, through a combination of local actomyosin turnover and rapid spatial redistribution of filaments and motors caused by myosin activity or actin polymerization. Because of these dynamic and active properties, contractility is complex and intrinsically self-organizing.  
We used the *C. elegans* early embryo to understand how cells pattern force generation through local modulation of self-organized contractility, focusing on pulsed contractility in the *C. elegans* embryo.  
We combined two-color fluorescence imaging, live single-molecule imaging, particle tracking, image analysis, and numerical modeling to tease apart the mechanisms of pulse initiation and termination. Our results demonstrate that the mechanical component (advection) played little role in pulse initiation or termination, and that the process was mostly governed by Actin and Myosin turnover. In our system, autocatalytic RhoA activation/recruitment is responsible for pulse initiation, while the delayed recruitment of a RhoA inactivator

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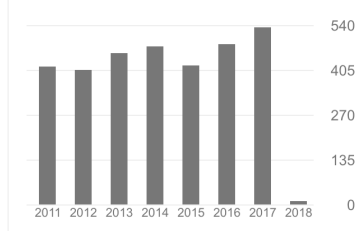


**Michael Gotthardt**  
Professor of Molecular Cardiology, Max Delbrück Center for Molecular Medicine  
Verified email at mdc-berlin.de - Homepage  
Systems Medicine RNA Sarcomere Cell Biology


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Co-authors




Joachim Herz  
UT Southwestern



John M. Shelton  
Senior Research Scientist, UT S...



Gary R. Lewin  
Max Delbrück Center for Molecu...



Marie-Louise Bang  
National Research Council Italy/...

TITLE	CITED BY	YEAR
Reeler/Disabled-like disruption of neuronal migration in knockout mice lacking the VLDL receptor and ApoE receptor 2 M Trommsdorff, M Gotthardt, T Hiesberger, J Shelton, W Stockinger, ... Cell 97 (6): 689-701	1179	1999
LRP: role in vascular wall integrity and protection from atherosclerosis P Boucher, M Gotthardt, WP Li, RGW Anderson, J Herz Science 300 (6617): 329-332	546	2003
Neuronal sorting protein-related receptor sortA/LR11 regulates processing of the amyloid precursor protein OM Andersen, J Reiche, V Schmidt, M Gotthardt, R Spoelgen, J Behlke, ... Proceedings of the National Academy of Sciences of the United States of ...	520	2005
The complete gene sequence of titin, expression of an unusual 700-kDa titin isoform, and its interaction with obscurin identify a novel Z-line to I-band linking system ML Bang, T Centner, F Fornoff, AJ Geach, M Gotthardt, M McNabb, ... Circulation research 89 (11): 1065-1072	484	2001
Interactions of the low density lipoprotein receptor gene family with cytosolic adaptor and scaffold proteins suggest diverse biological functions in cellular communica... M Gotthardt, M Trommsdorff, MF Nevitt, J Shelton, JA Richardson, ... Journal of Biological Chemistry 279 (53): 25616-25624	472	2000
Inducible inactivation of hepatic LRP gene by cre-mediated	438	1998



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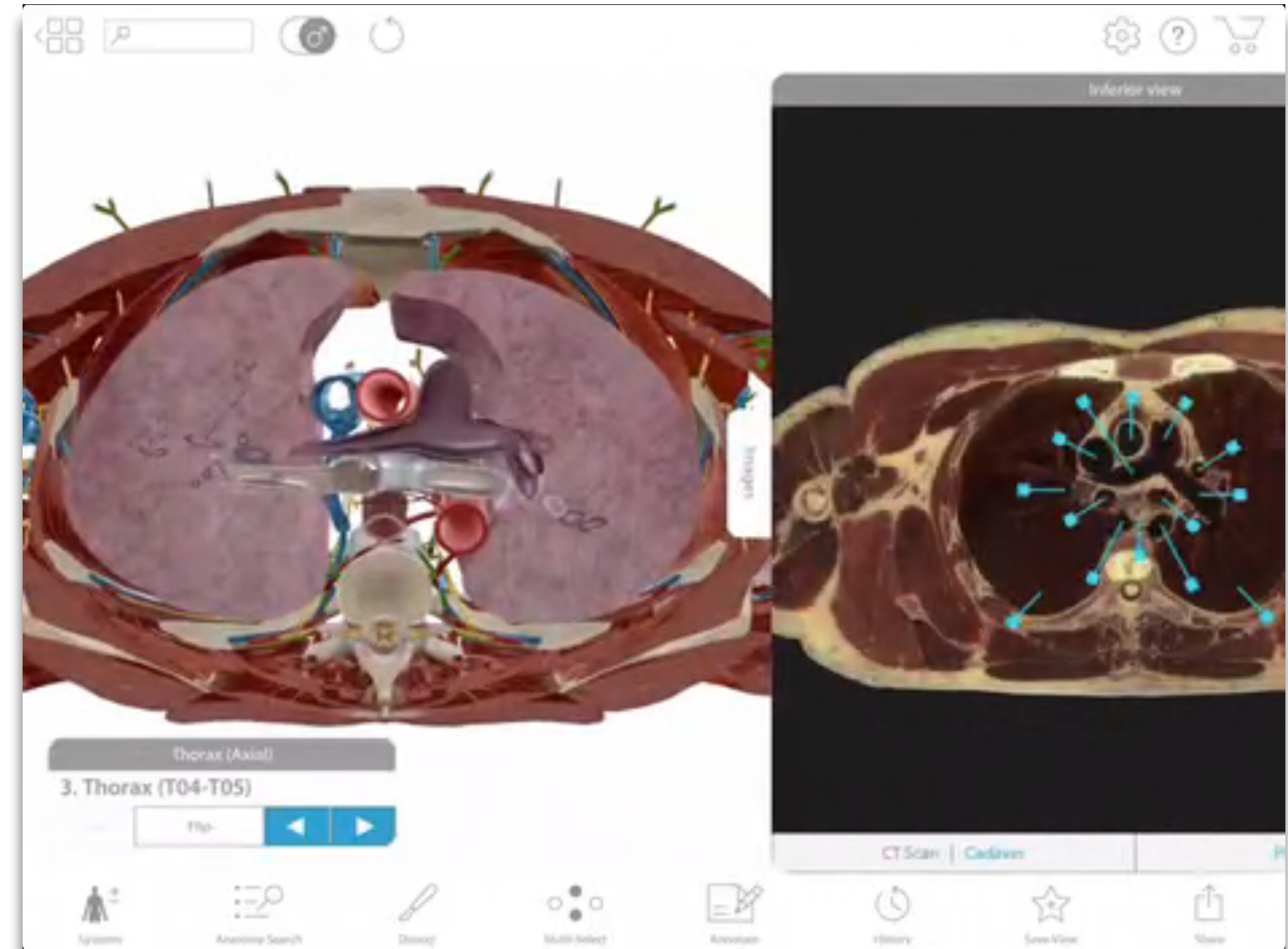
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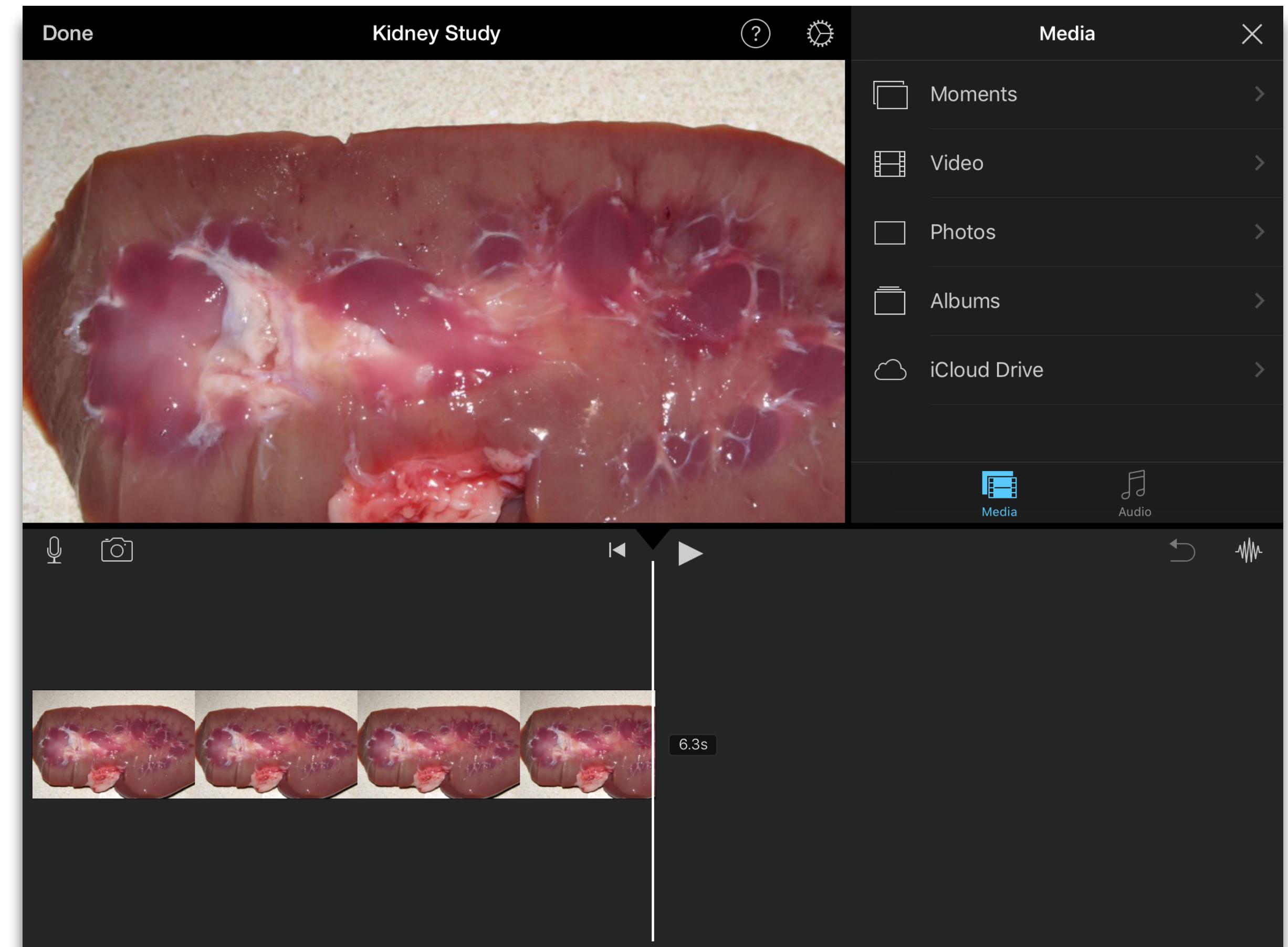
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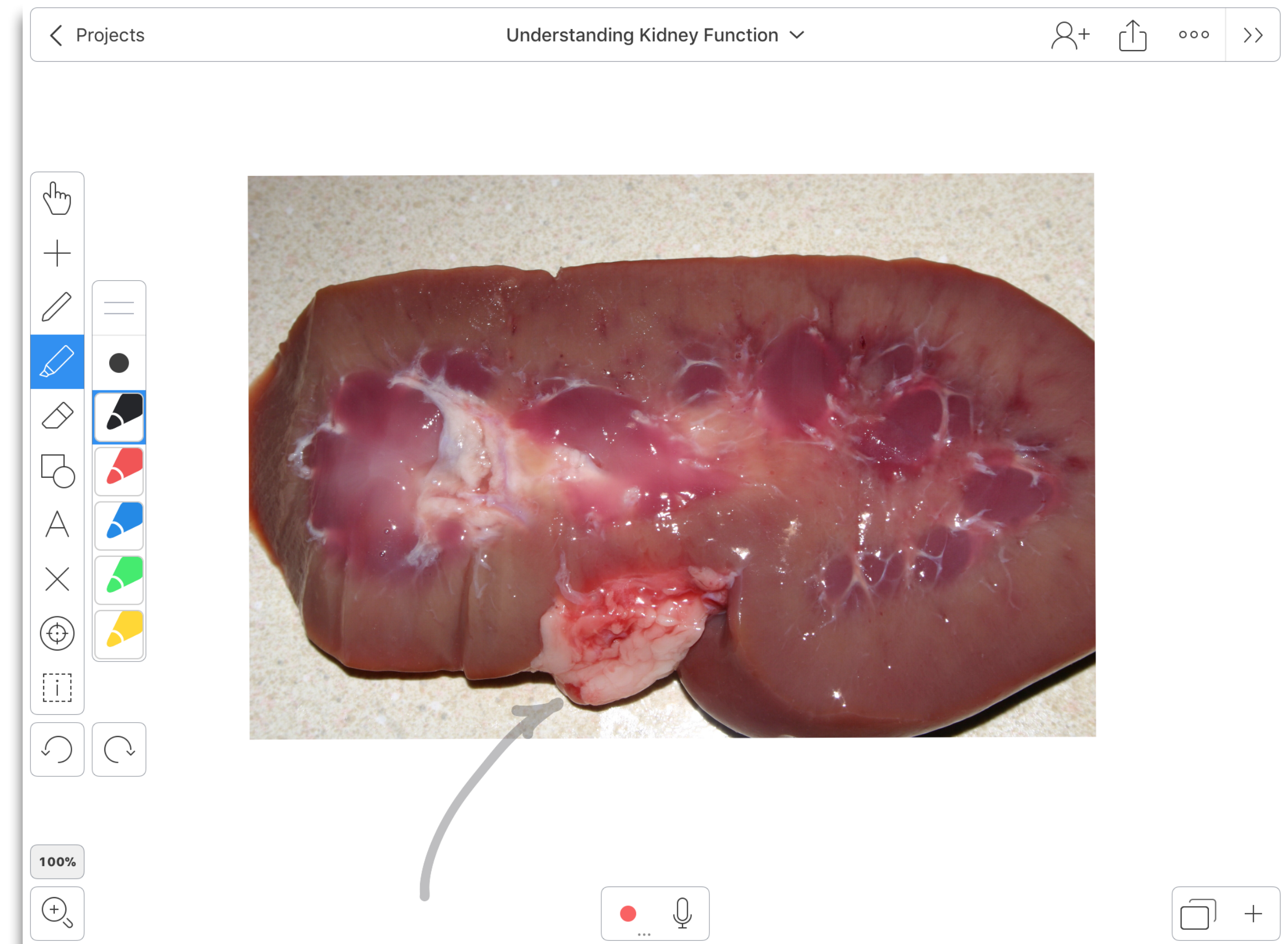
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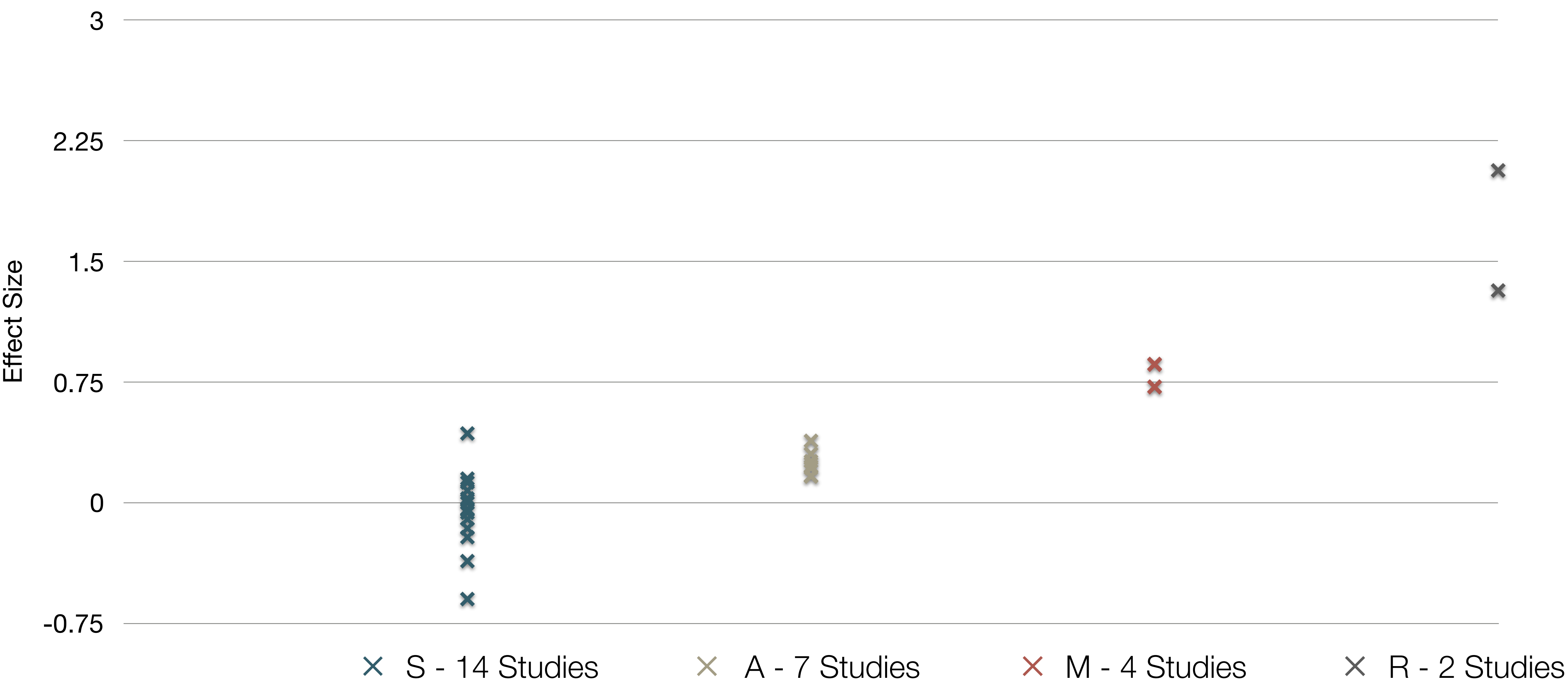
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# SAMR and the Use of Tablets in Education





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The screenshot shows the MIT OpenCourseWare website interface. At the top, there's a navigation bar with the MIT OpenCourseWare logo, a rating of five stars, and buttons for 'Save', 'My items', 'Comment', 'Evaluate', 'Tags', and 'Share'. A 'Log In' button is also present. Below the navigation bar, there's a dark header with the MIT OpenCourseWare logo and the text 'MASSACHUSETTS INSTITUTE OF TECHNOLOGY'. To the right of the header, there's a 'Subscribe to the OCW Newsletter' button and social media icons for Facebook, Twitter, YouTube, and WordPress. Below the header, there's a navigation bar with a home icon, 'FIND COURSES', 'For Educators', 'Give Now', and 'About'. A search bar is also present. The main content area is titled 'Principles of Pharmacology' and includes a breadcrumb trail: 'Home » Courses » Health Sciences and Technology » Principles of Pharmacology'. On the left, there's a sidebar with links to 'COURSE HOME', 'SYLLABUS', 'CALENDAR', 'READINGS', 'LECTURE NOTES', 'ASSIGNMENTS', 'EXAMS', 'STUDY MATERIALS', and 'DOWNLOAD COURSE MATERIALS'. The main content area features a large image of chemistry glassware, a list of instructors (Dr. Carl Rosow, Dr. David Standaert, Prof. Gary Strichartz), the MIT Course Number (HST.151), and the term 'As Taught In' (Spring 2005). The level is listed as 'Graduate'. There's a 'CITE THIS COURSE' button. Below the image, there's a caption: 'Chemotherapy drugs in vials and an IV bottle. (Photo by Bill Branson. Courtesy of National Cancer Institute Visuals Online.)'. A 'Course Features' section lists links for 'Selected lecture notes', 'Assignments: problem sets with solutions', 'Assignments: presentations with examples', 'Assignments: written (no examples)', and 'Exams and solutions'. A 'Course Description' section is also visible.

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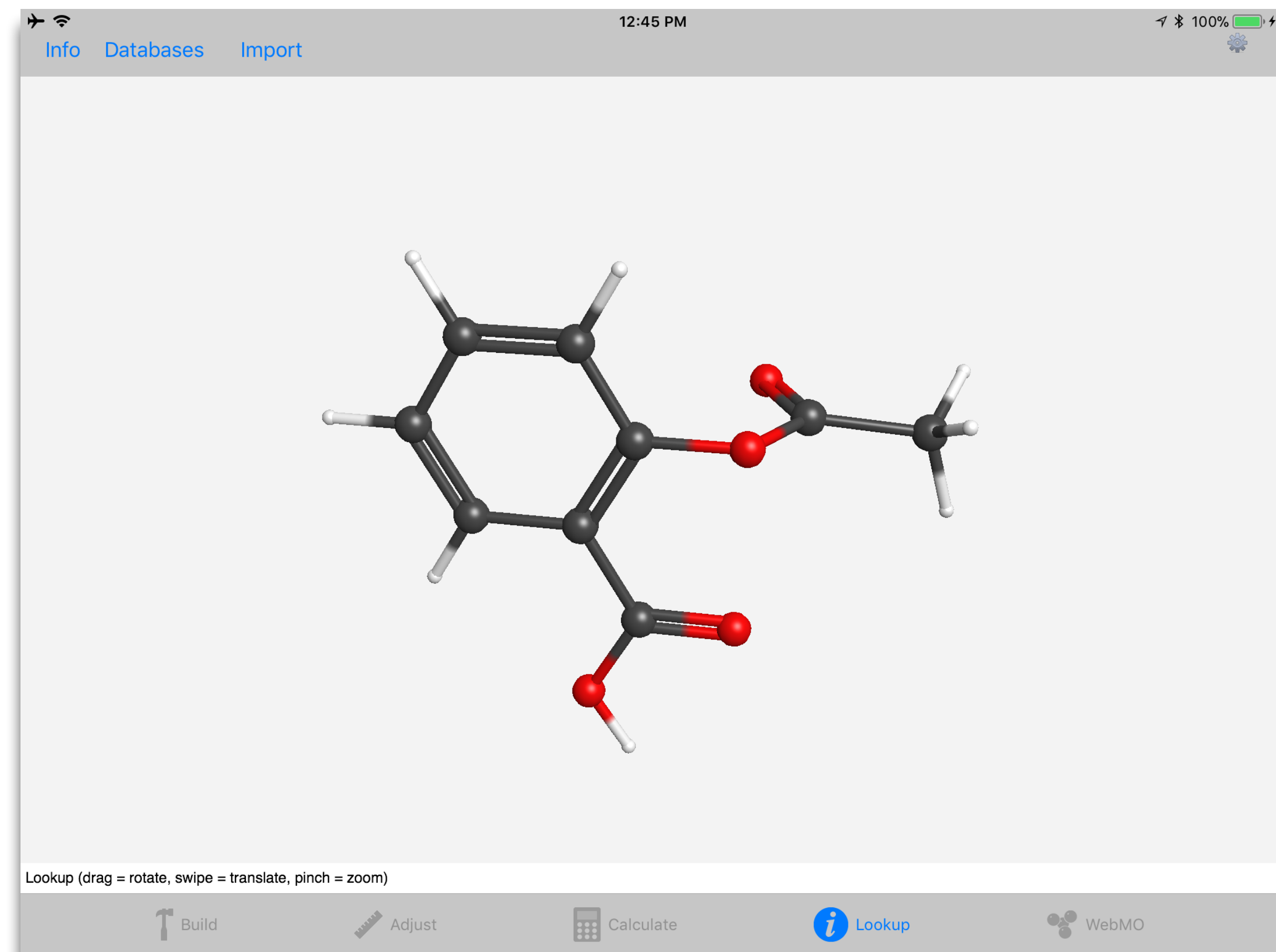
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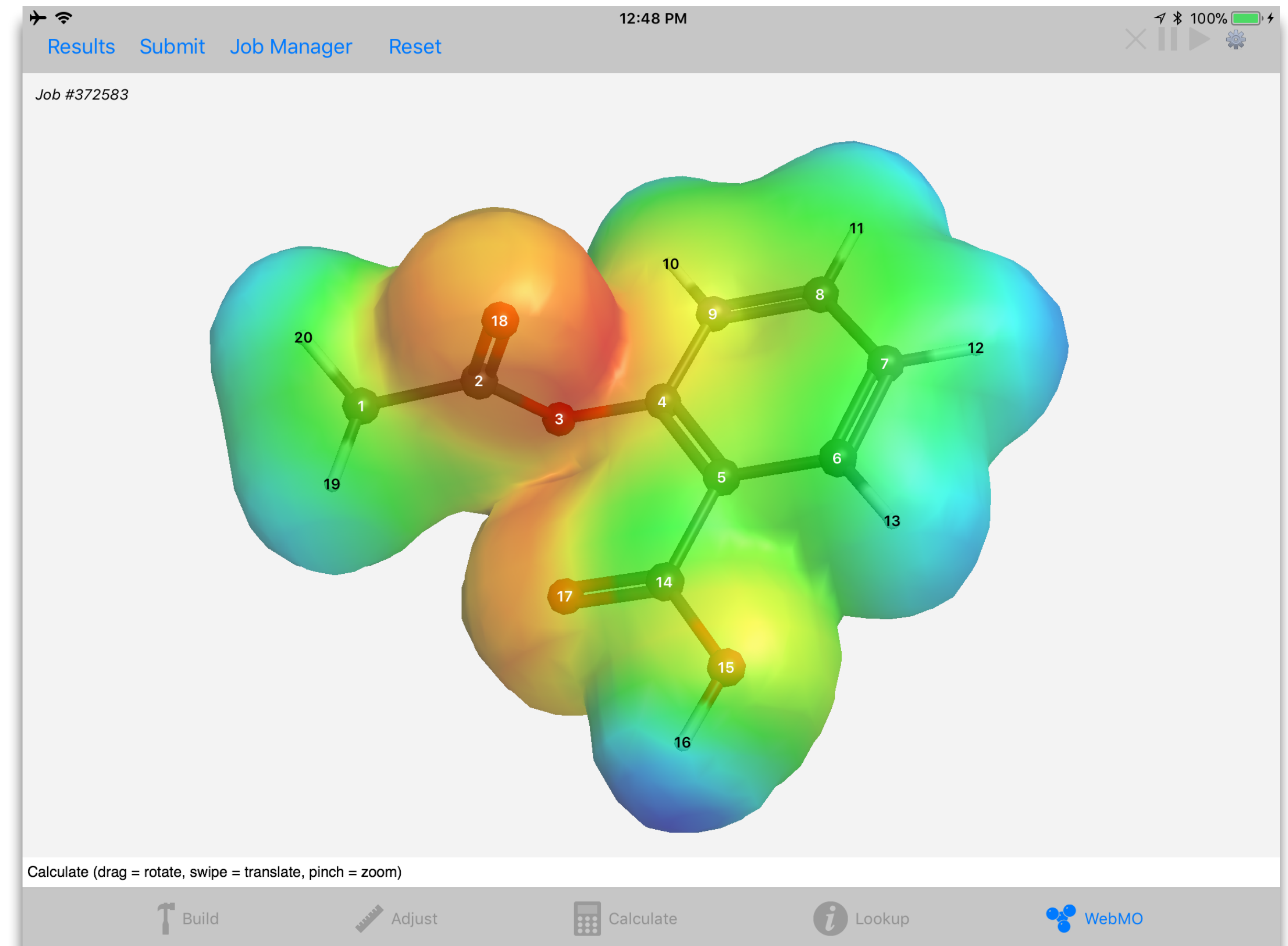
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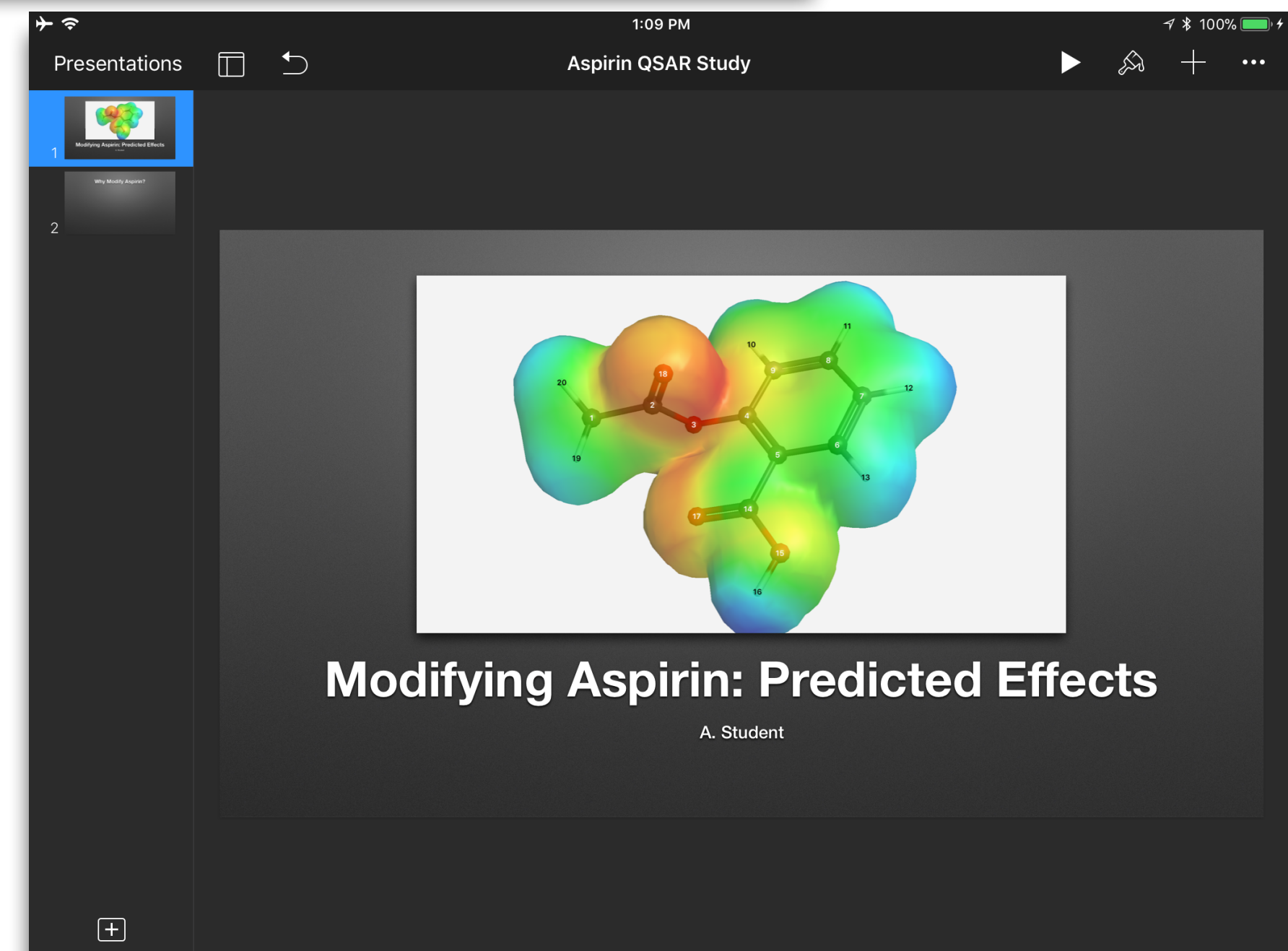
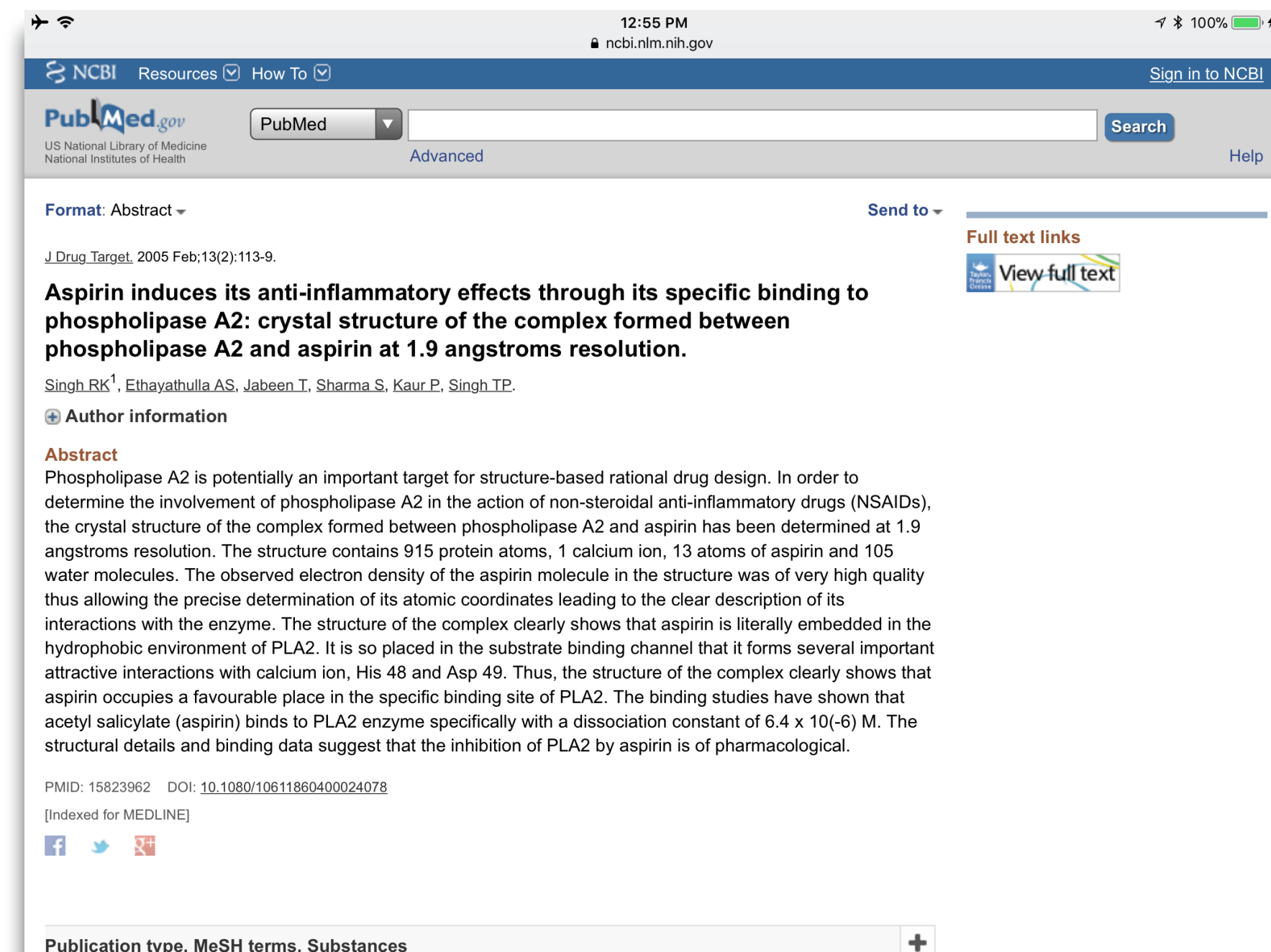
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Social	Mobility	Visualization	Storytelling	Gaming
200,000 years	70,000 years	40,000 years	17,000 years	8,000 years
				



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Discussions



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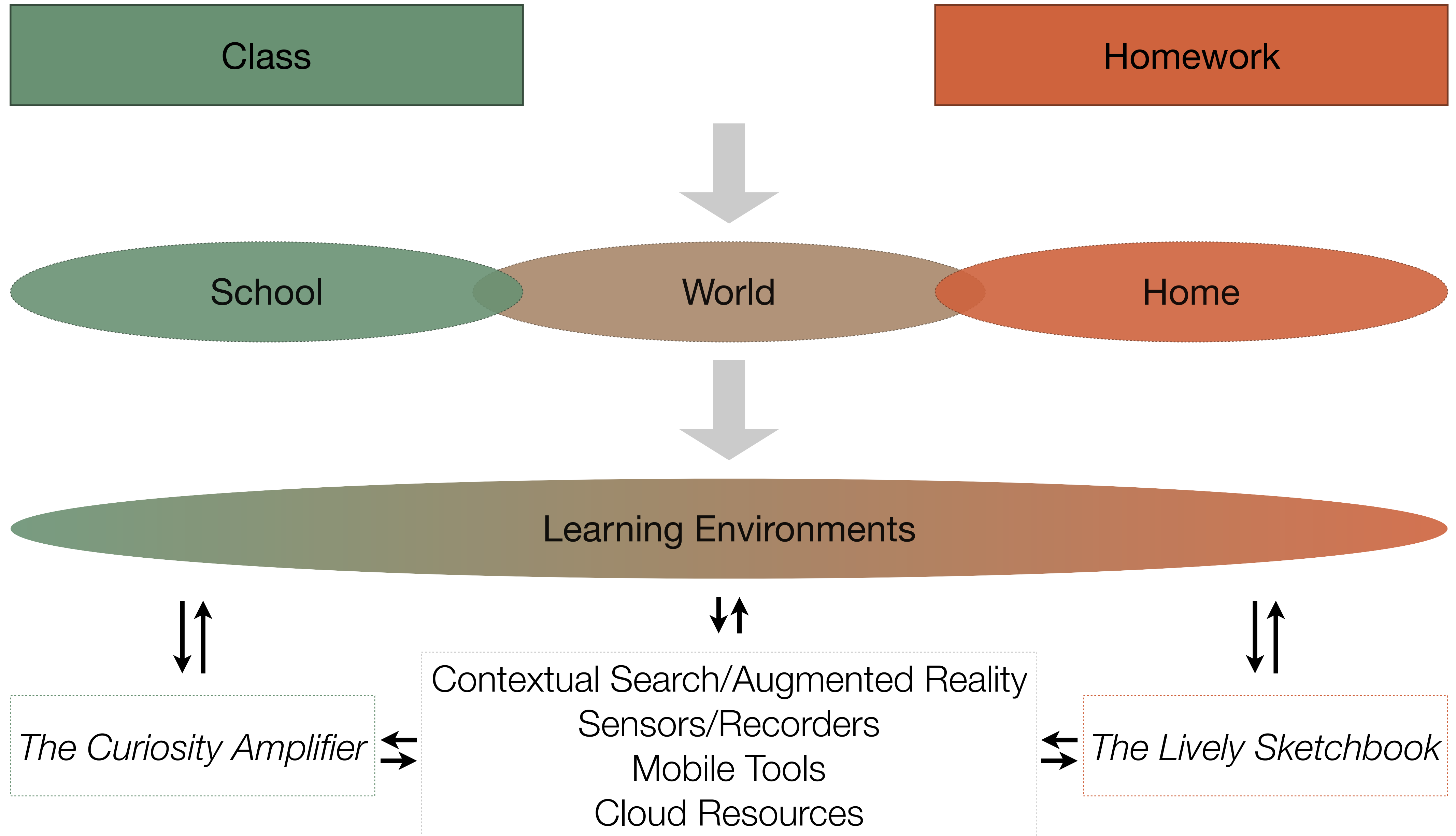


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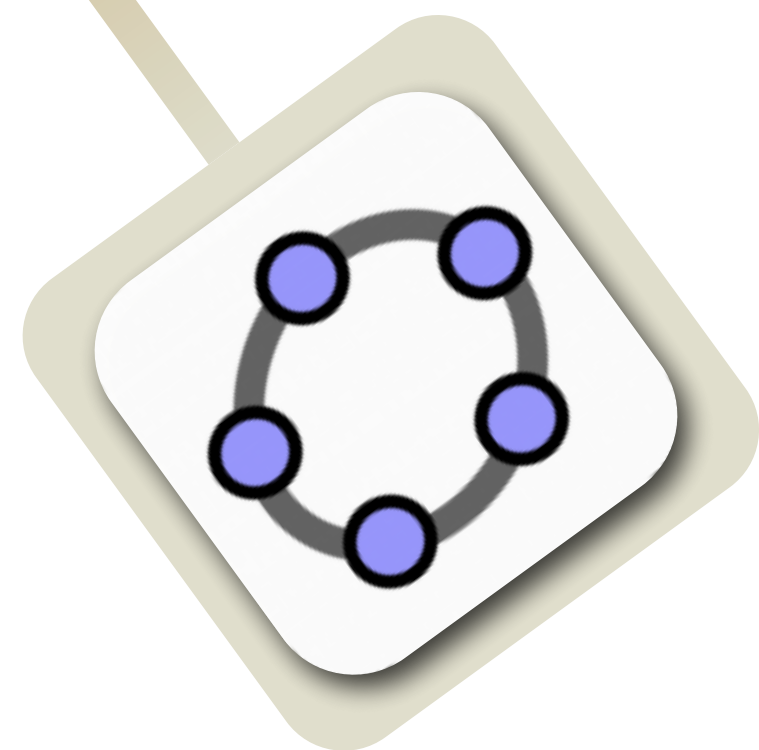
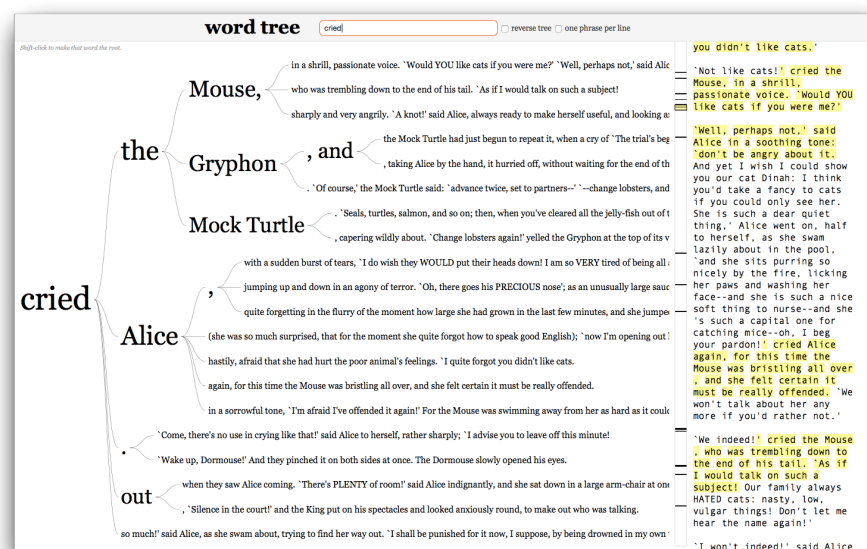
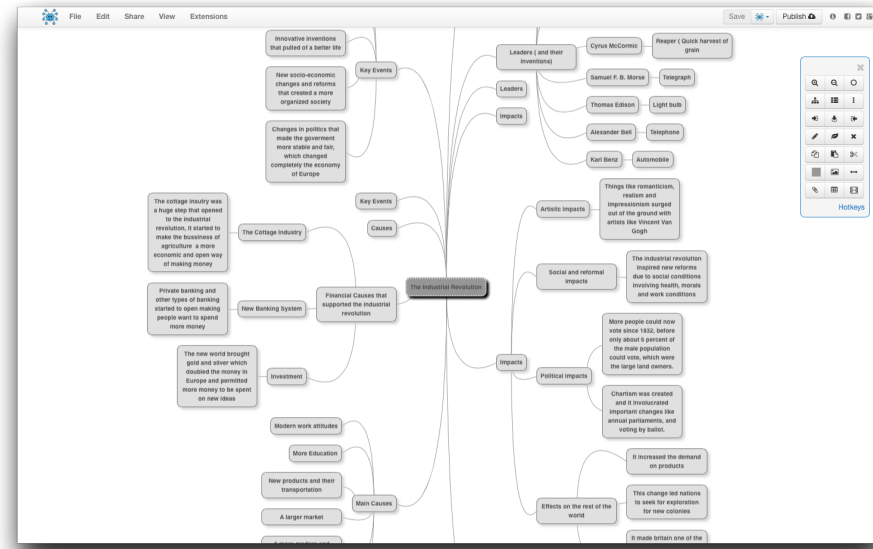
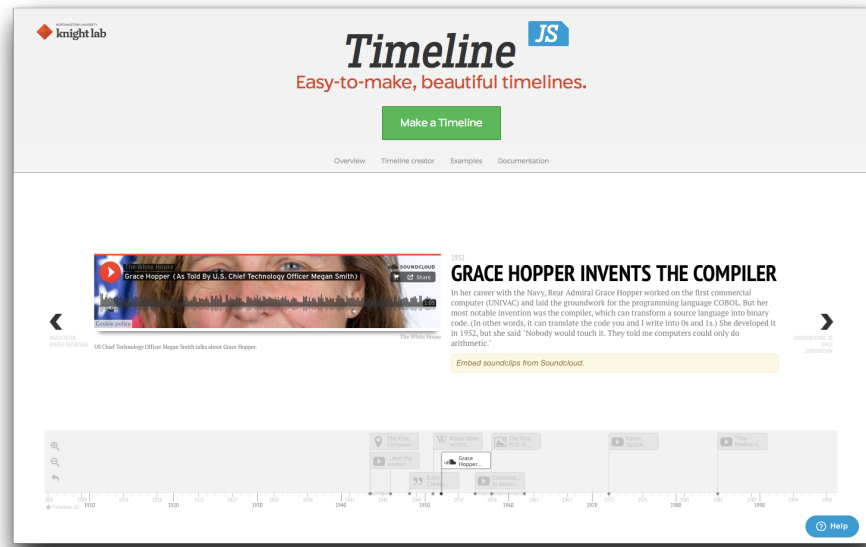
Telepresence



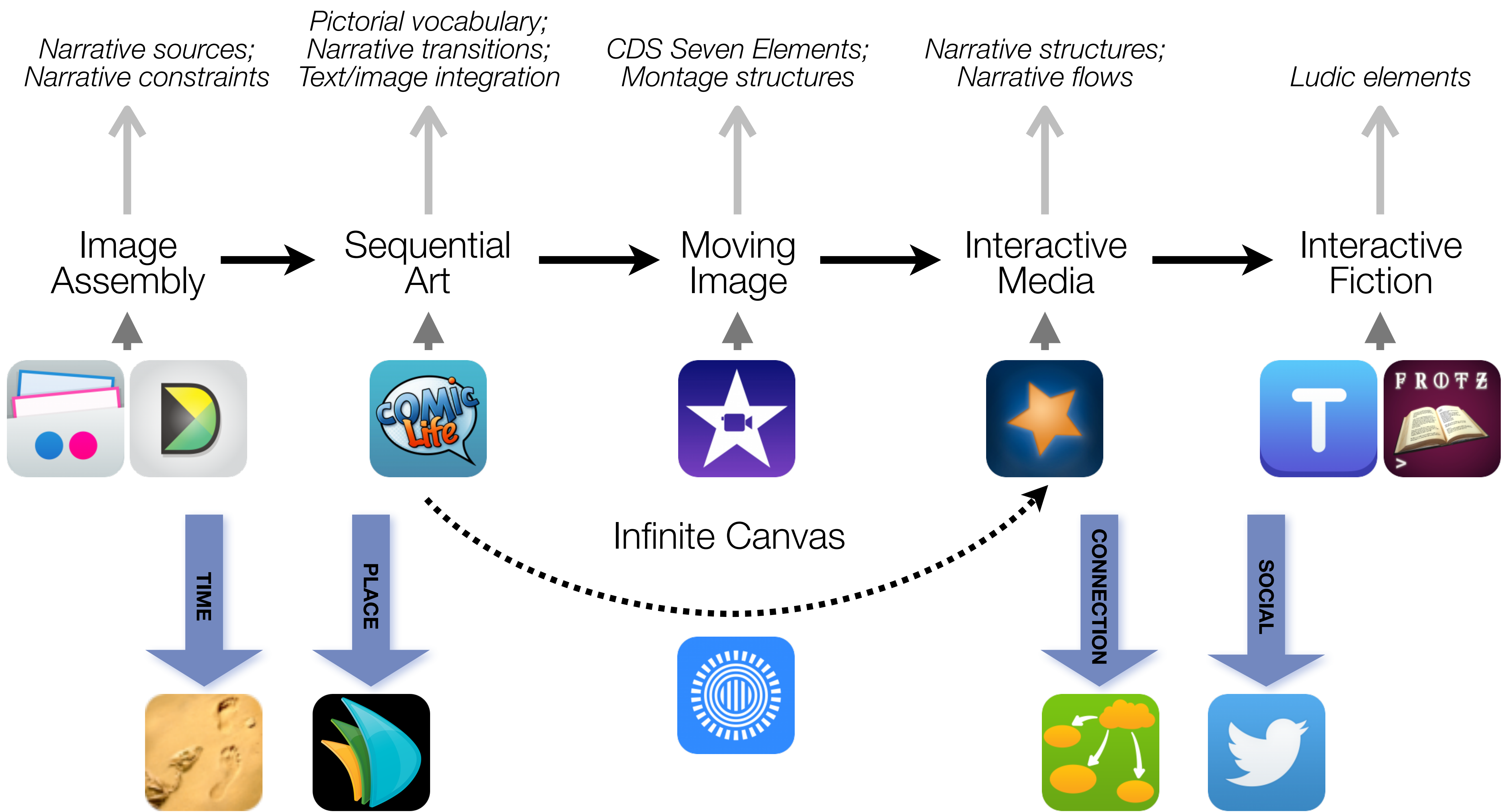
File Sharing



# Visualization







## Formal Definition of **Game** (Salen & Zimmerman)

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“A game is a system in which players engage in an artificial conflict, defined by rules, that results in a quantifiable outcome.”

## The EdTech Quintet – Associated Practices

Social	Communication, Collaboration, Sharing
Mobility	Anytime, Anyplace Learning and Creation
Visualization	Making Abstract Concepts Tangible
Storytelling	Knowledge Integration and Transmission
Gaming	Feedback Loops and Formative Assessment

Social  
Mobility

Localization

Visualization  
AI + XR

Analysis

Social  
Storytelling

Communication

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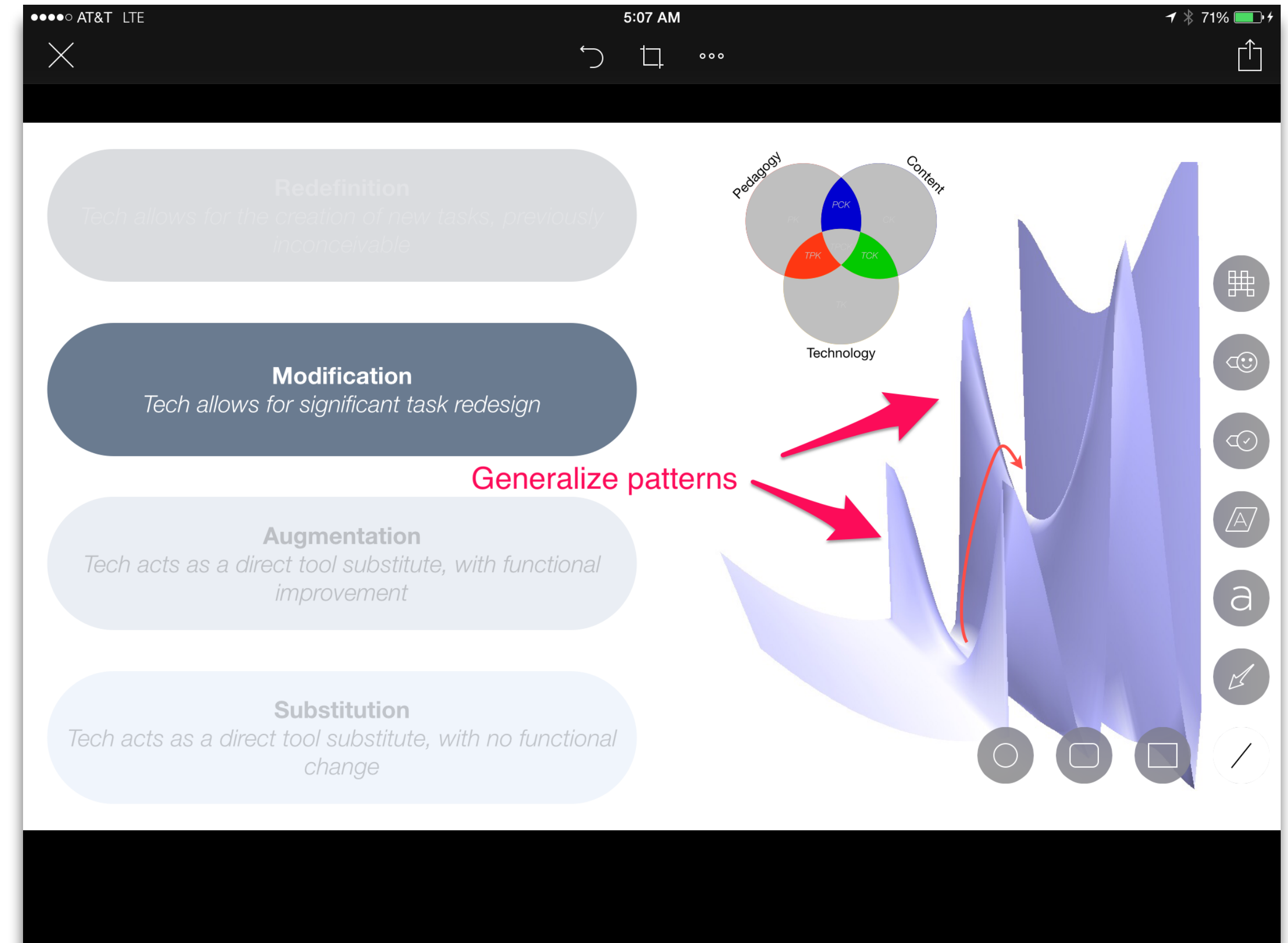
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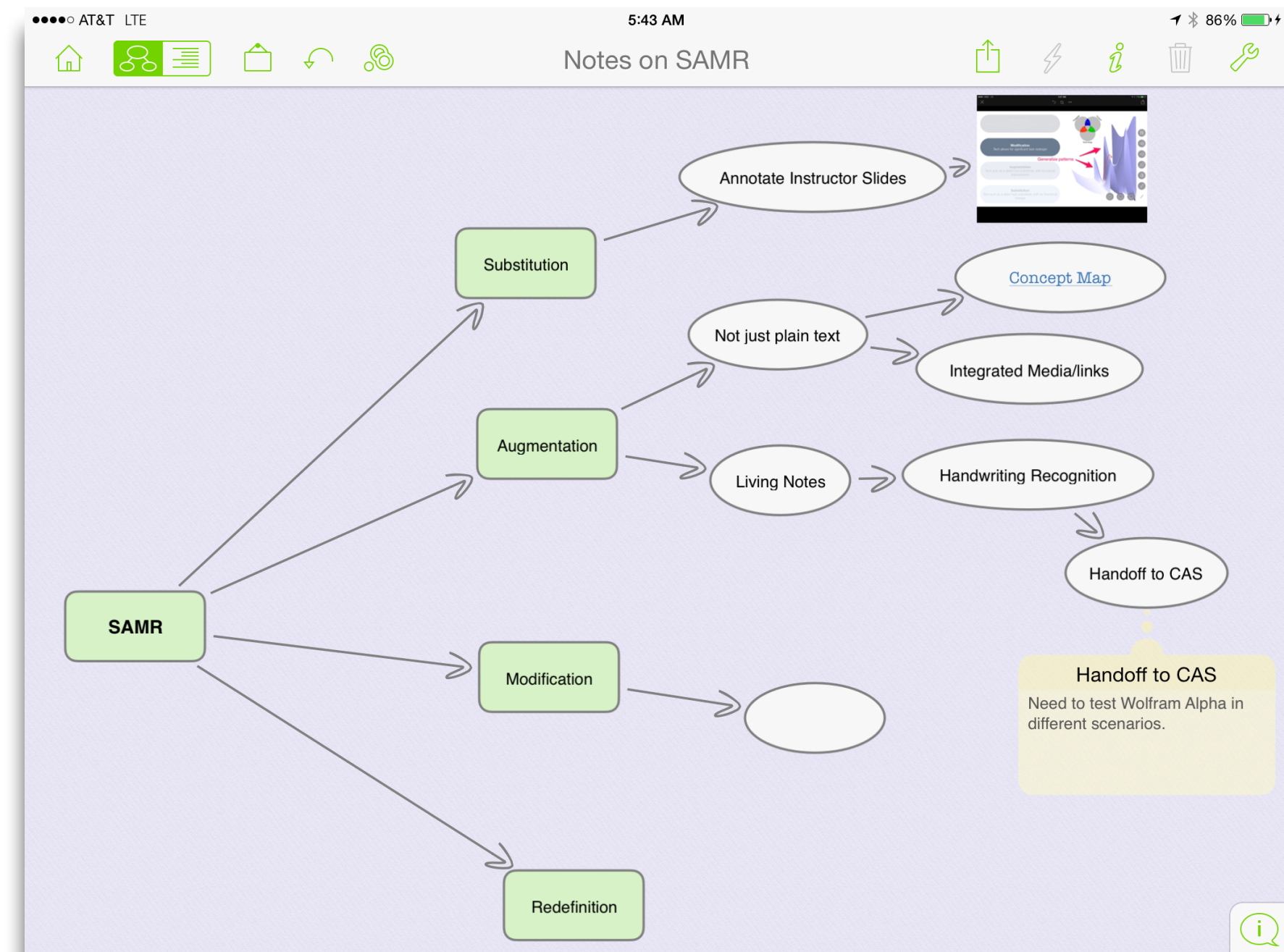
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**Thoughts on SAMR**  
Jun 20, 2014, 5:45 AM

Substitution: the valley where we were  
Augmentation: the next valley over - could see, not reach

Google Scholar search results for "concept maps":

- Book:** Learning, creating, and using knowledge: Concept maps as facilitative tools in schools and corporations. J. Novak. 2010. books.google.com
- Journal Article:** The theory underlying concept maps and how to construct them. J.D. Novak, A.J. Cañas. Florida Institute for Human and Machine Cognition, 2008. - vcu.edu
- Journal Article:** Clarify with Concept Maps. J. Novak - Science Teacher, 1991 - ERIC
- Journal Article:** Problems and issues in the use of concept maps in science assessment. stanford.edu (PDF)

Concept Maps - Google Scholar



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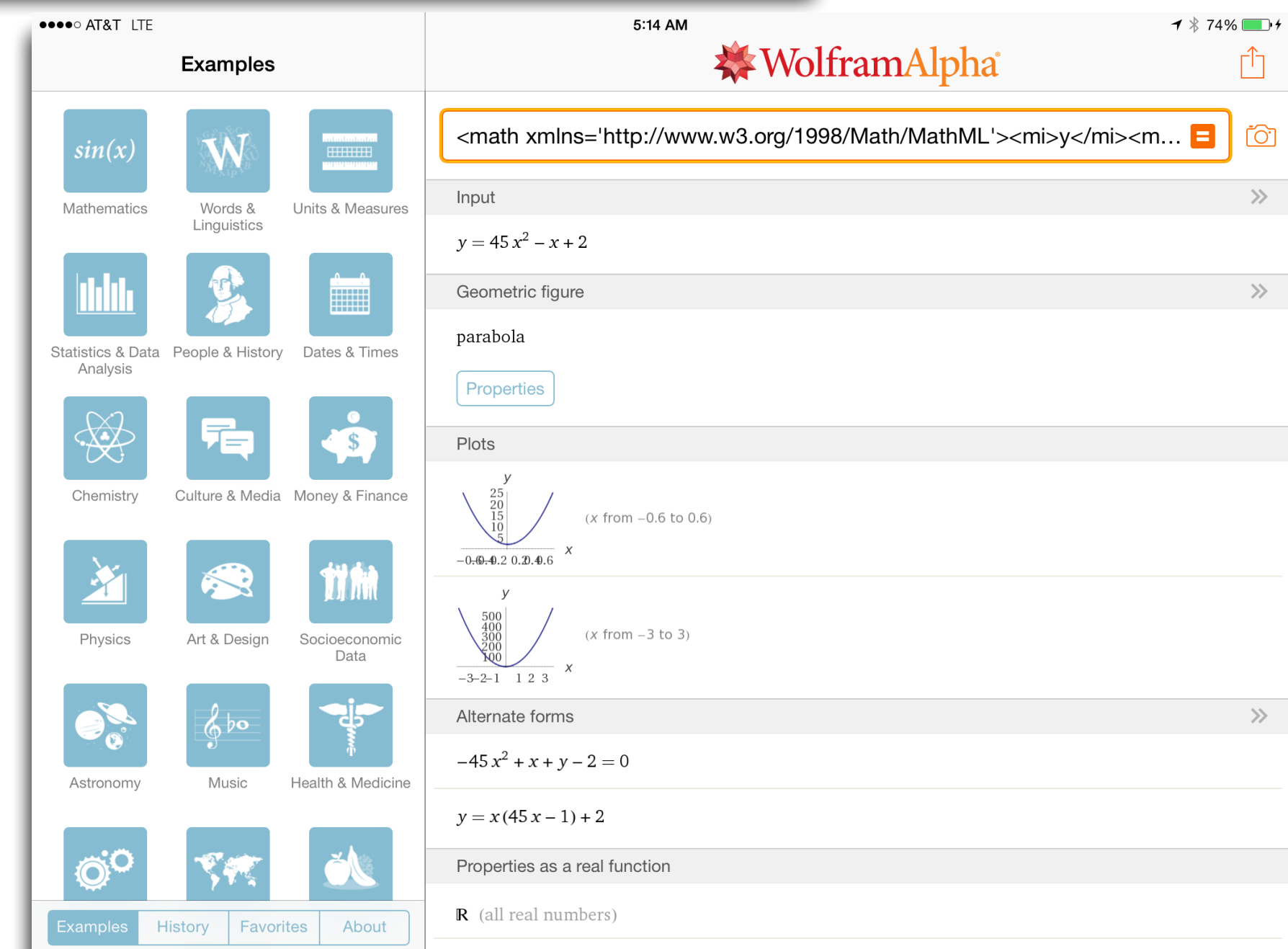
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$$y = 45x^2 - x + 2$$





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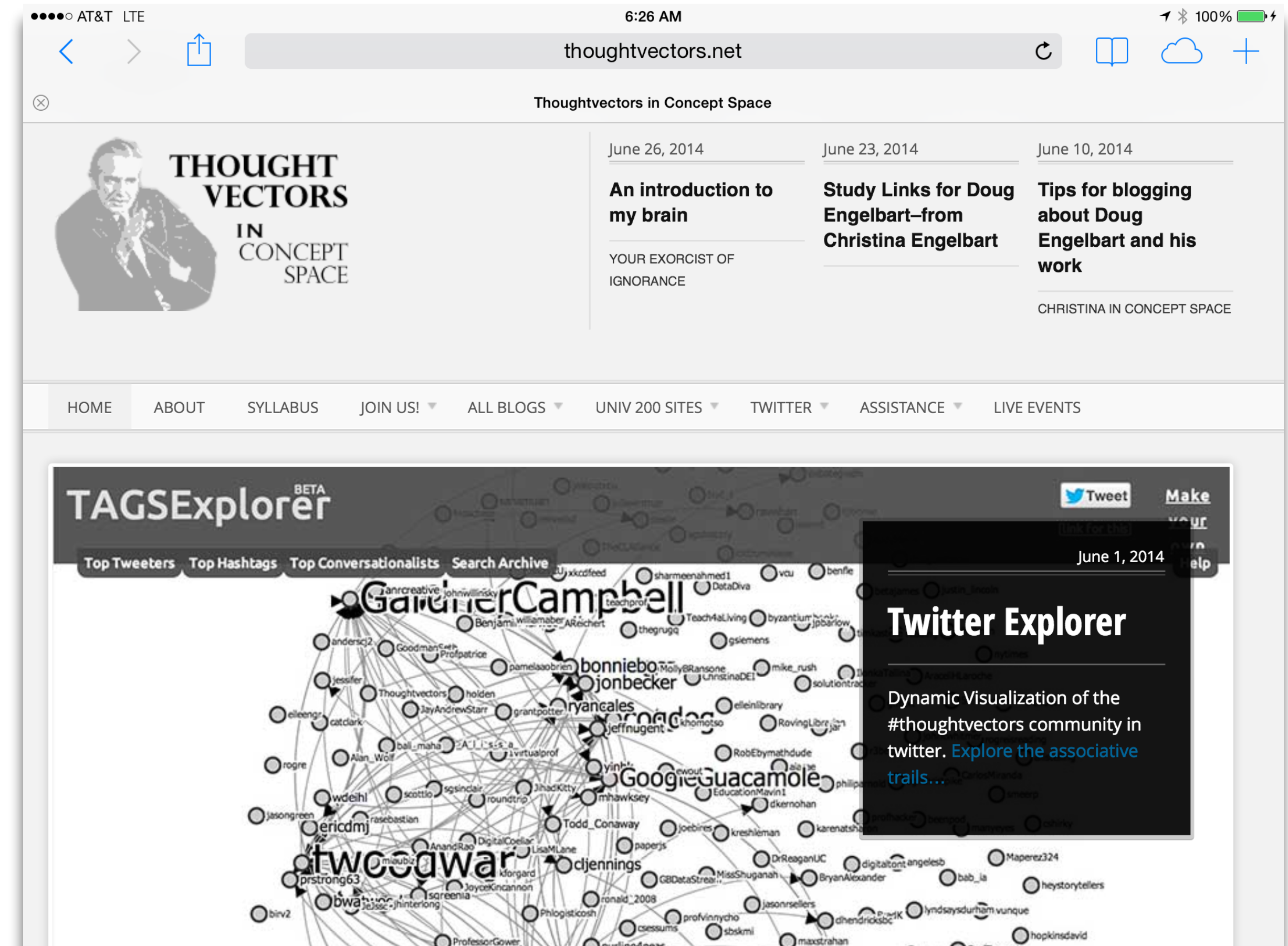
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Context I

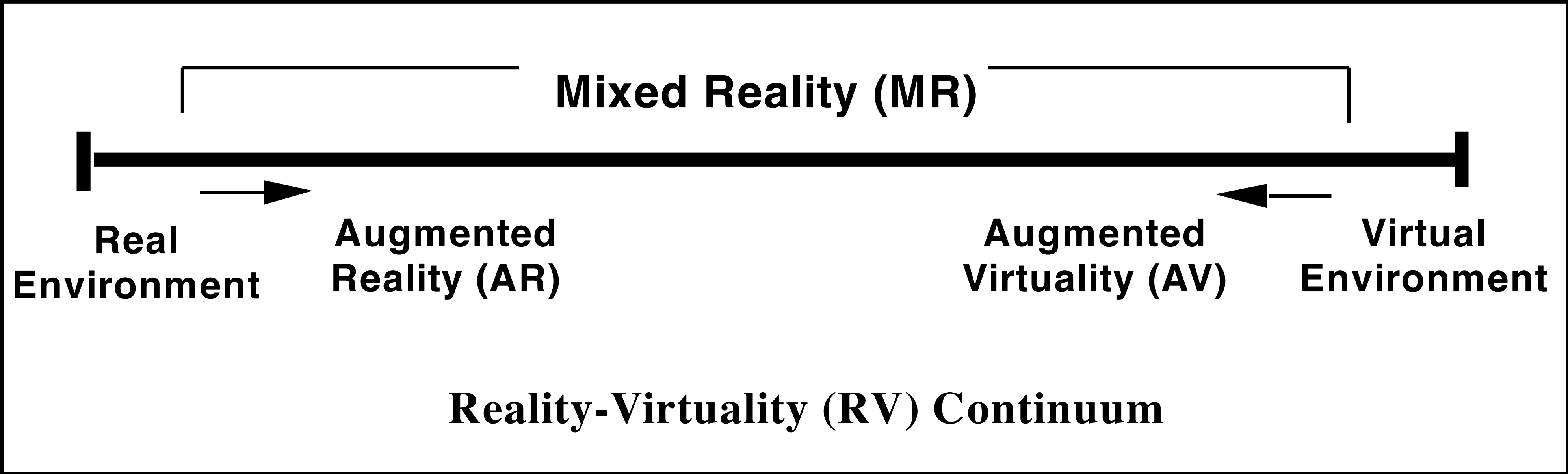
# Dimensions of Computational Thinking

Computational Concepts	Computational Practices	Computational Perspectives
Sequences	Being Incremental and Iterative	Expressing
Loops	Testing and Debugging	Connecting
Events	Reusing and Remixing	Questioning
Parallelism	Abstracting and Modularizing	
Conditionals		
Operators		
Data		

# Computational Thinking in Math and Science

Data Practices	Modeling & Simulation Practices	Computational Problem Solving Practices	System Thinking Practices
Collecting Data	Using Computational Models to Understand a Concept	Preparing Problems for Computational Solutions	Investigating a Complex System as a Whole
Creating Data	Using Computational Models to Find and Test Solutions	Programming	Understanding the Relationships within a System
Manipulating Data	Assessing Computational Models	Choosing Effective Computational Tools	Thinking in Levels
Analyzing Data	Designing Computational Models	Assessing Different Approaches/ Solutions to a Problem	Communicating Information about a System
Visualizing Data	Constructing Computational Models	Developing Modular Computational Solutions	Defining Systems and Managing Complexity
		Creating Computational Abstractions	
		Troubleshooting and Debugging	

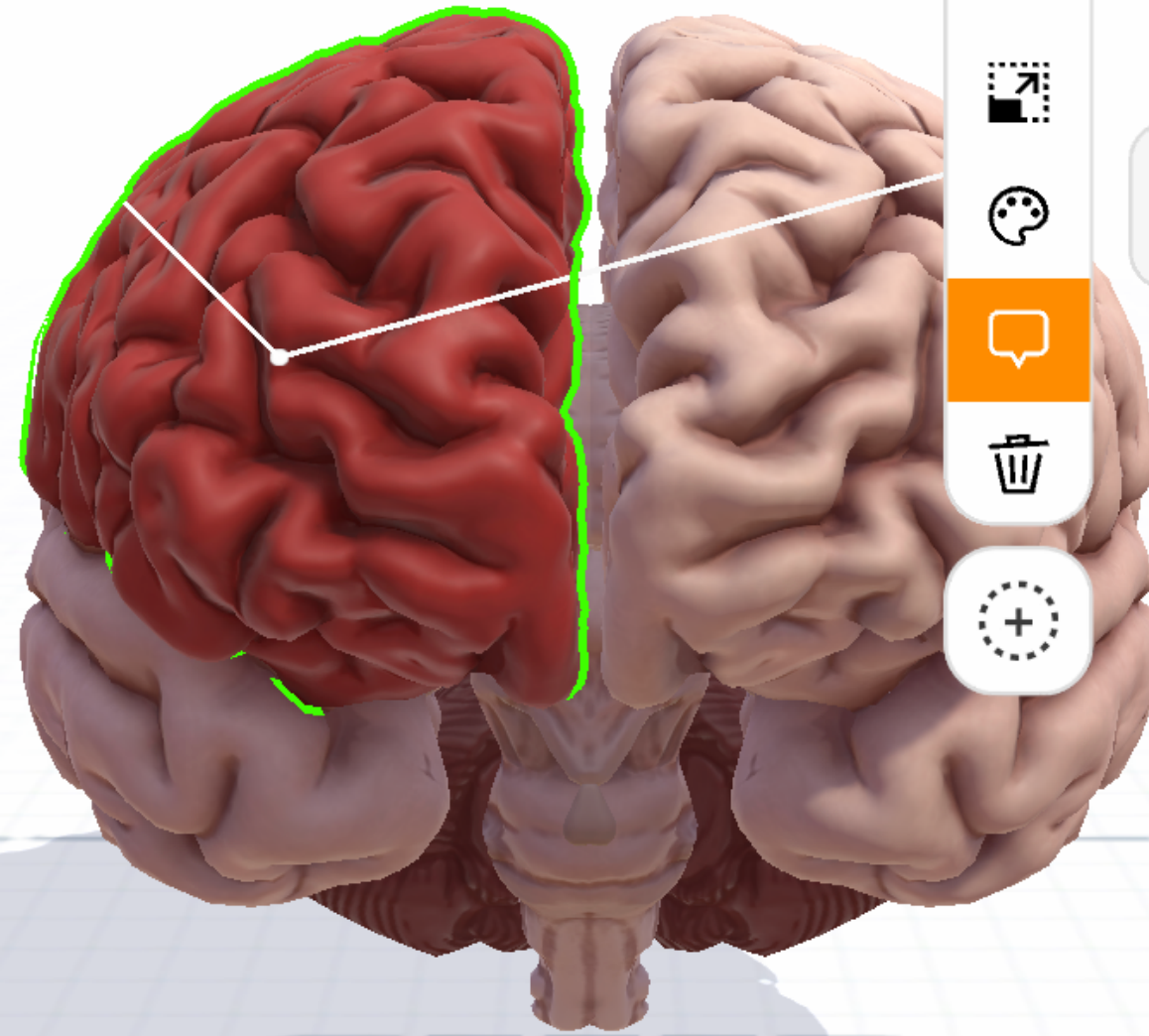
# Defining XR







Frontal Lobe



Frontal Lobe

☐ Always show

Tap here to add instructions for this step...

1 METRE



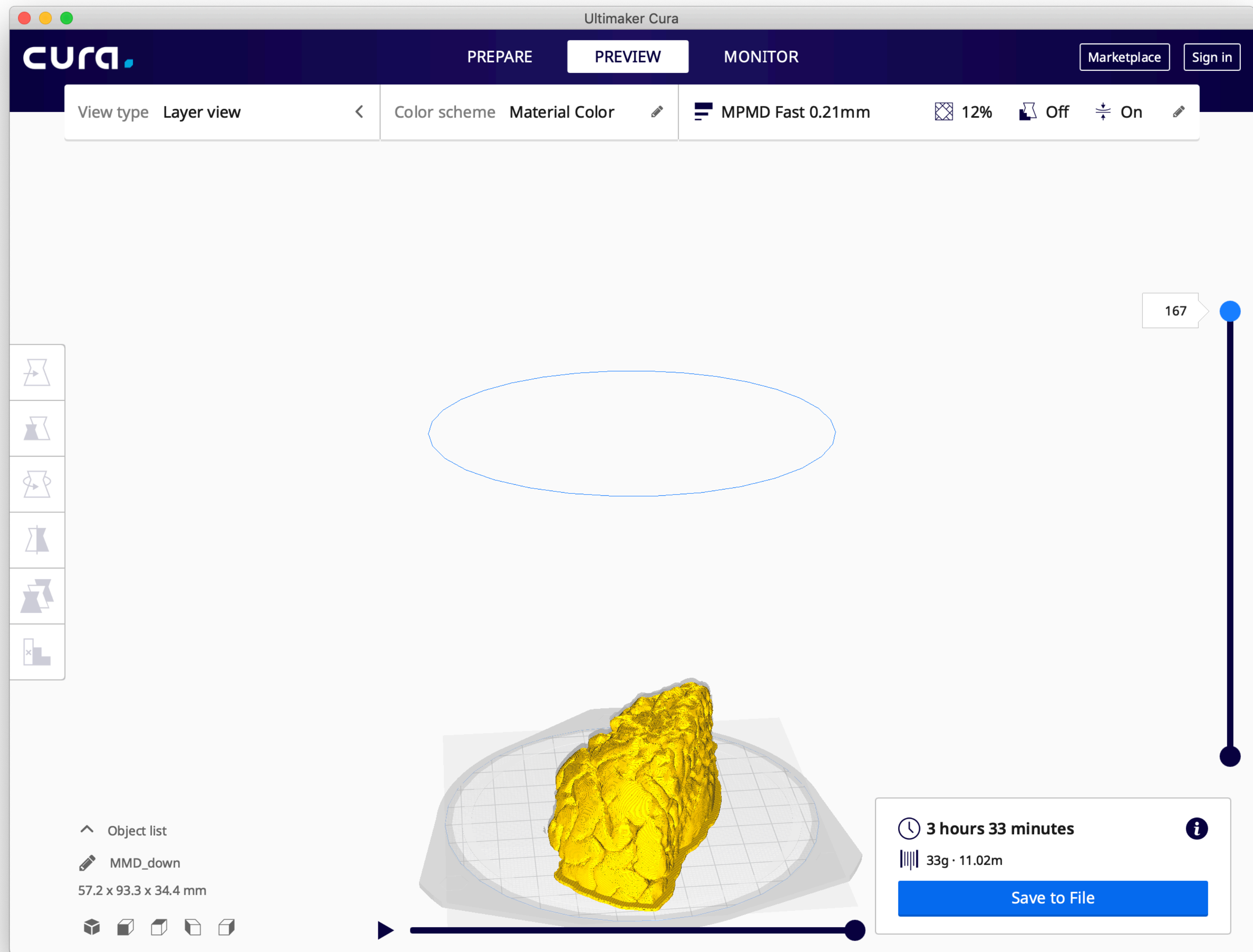


Frontal Lobe

2 of 2









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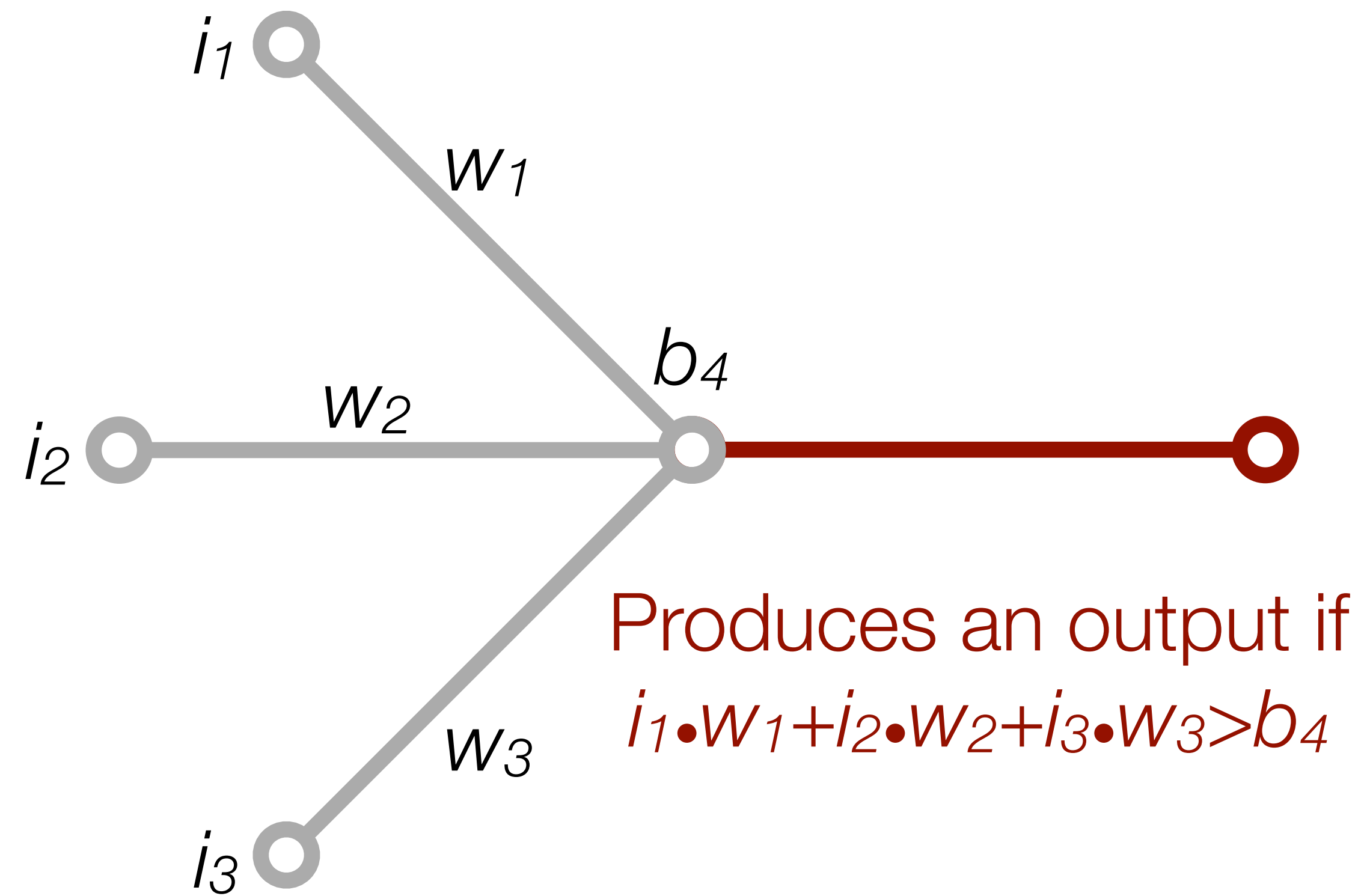
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Nozzle	Bed	Speed
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Pause	Cancel	



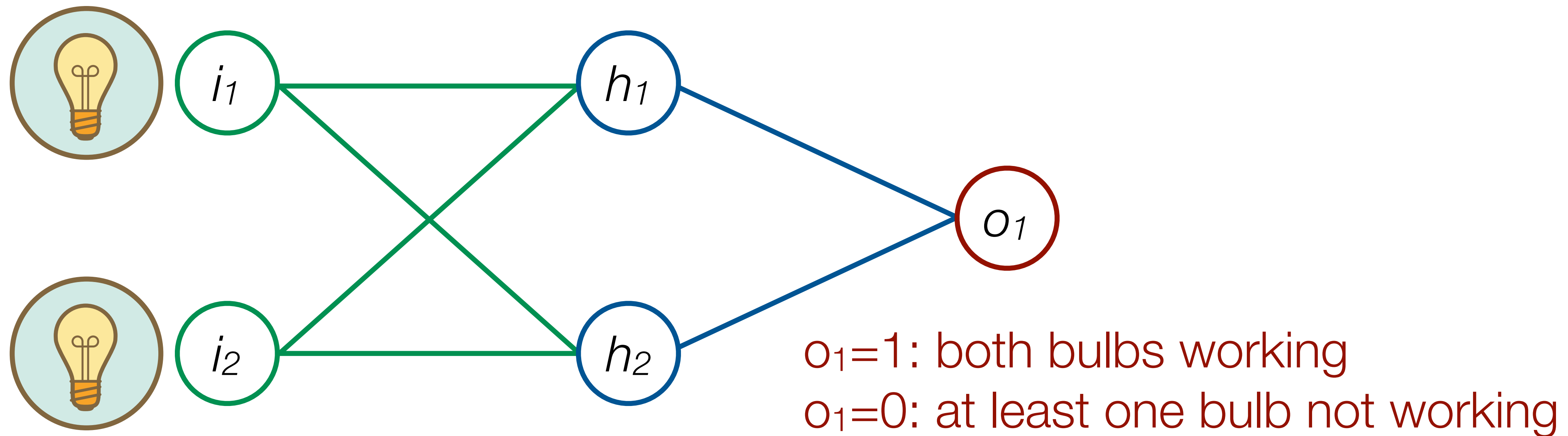
# Simple McCulloch–Pitts/Perceptron Model

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# A Simple Example: A Light Bulb Tester

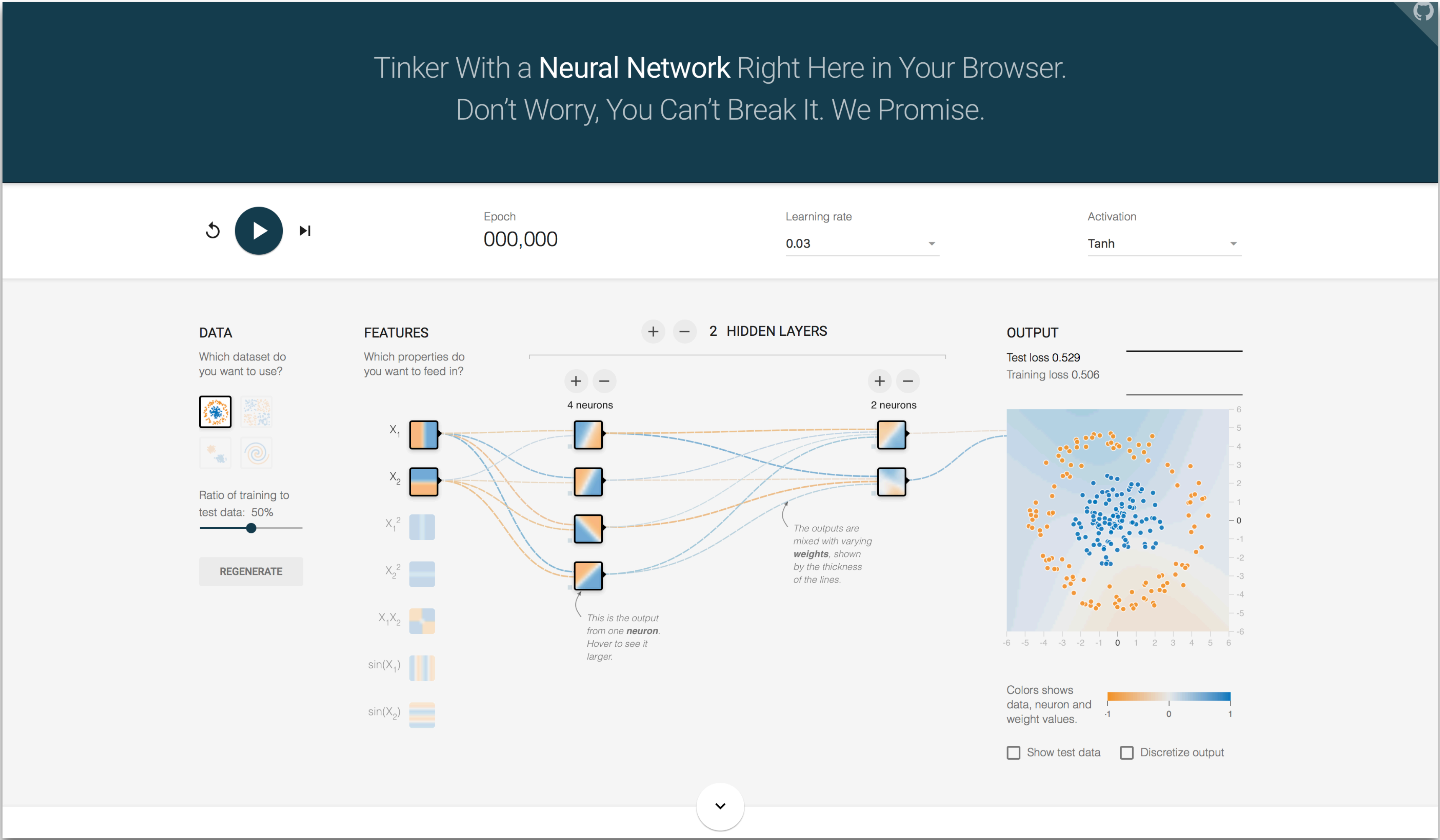
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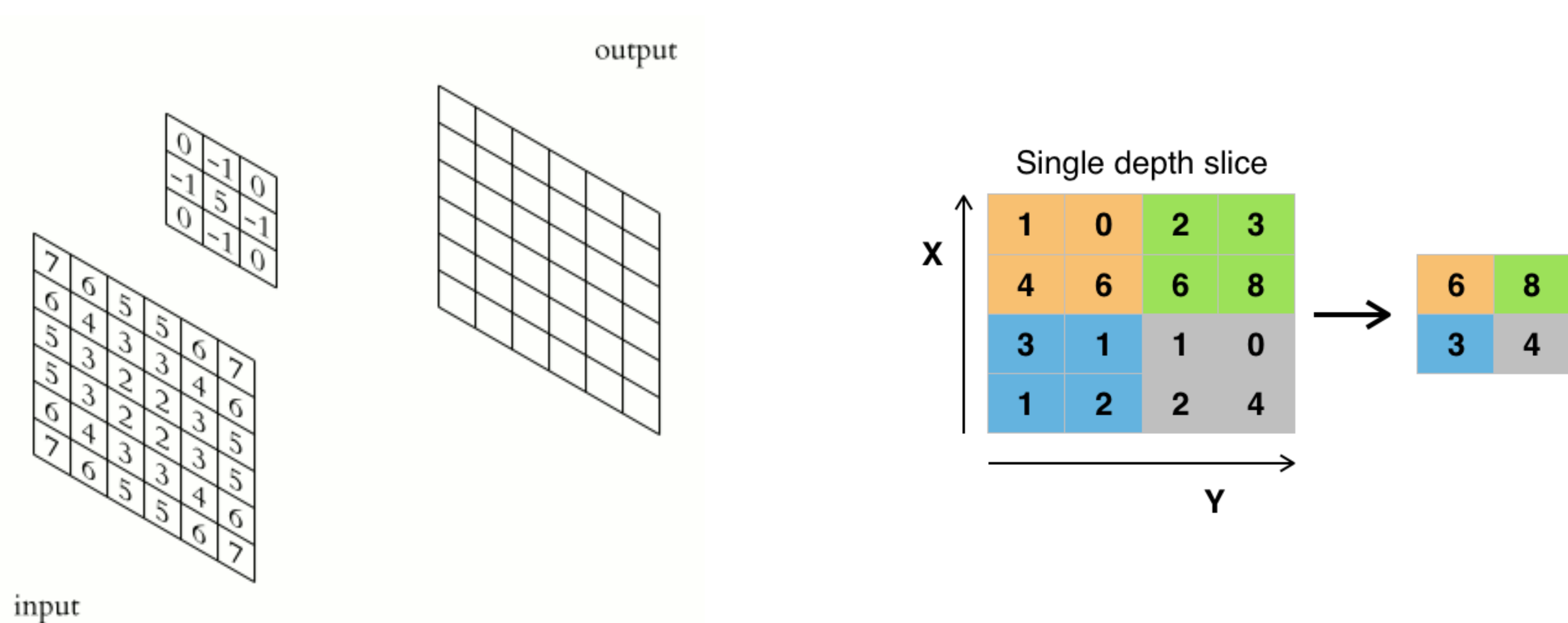


# A Neural Network Playground:

<http://tinyurl.com/mlti17nndemo>



# Convolution and Pooling Layers





# AI in Medical Education -Basic Exercises

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- Bots
- Recommendation Systems
- Regression and Clustering
- Image Classification
- Object Detection
- Sequence Classification

# Turi Create



Check out our talks at [WWDC 2019](#) and at [WWDC 2018](#)!

Turi Create simplifies the development of custom machine learning models. You don't have to be a machine learning expert to add recommendations, object detection, image classification, image similarity or activity classification to your app.

- **Easy-to-use:** Focus on tasks instead of algorithms
- **Visual:** Built-in, streaming visualizations to explore your data
- **Flexible:** Supports text, images, audio, video and sensor data
- **Fast and Scalable:** Work with large datasets on a single machine
- **Ready To Deploy:** Export models to Core ML for use in iOS, macOS, watchOS, and tvOS apps

With Turi Create, you can accomplish many common ML tasks:

ML Task	Description
<a href="#">Recommender</a>	Personalize choices for users
<a href="#">Image Classification</a>	Label images
<a href="#">Drawing Classification</a>	Recognize Pencil/Touch Drawings and Gestures
<a href="#">Sound Classification</a>	Classify sounds
<a href="#">Object Detection</a>	Recognize objects within images
<a href="#">One Shot Object Detection</a>	Recognize 2D objects within images using a single example
<a href="#">Style Transfer</a>	Stylize images
<a href="#">Activity Classification</a>	Detect an activity using sensors
<a href="#">Image Similarity</a>	Find similar images
<a href="#">Classifiers</a>	Predict a label
<a href="#">Regression</a>	Predict numeric values
<a href="#">Clustering</a>	Group similar datapoints together
<a href="#">Text Classifier</a>	Analyze sentiment of messages



## Redefinition

*Tech allows for the creation of new tasks, previously inconceivable*

## Modification

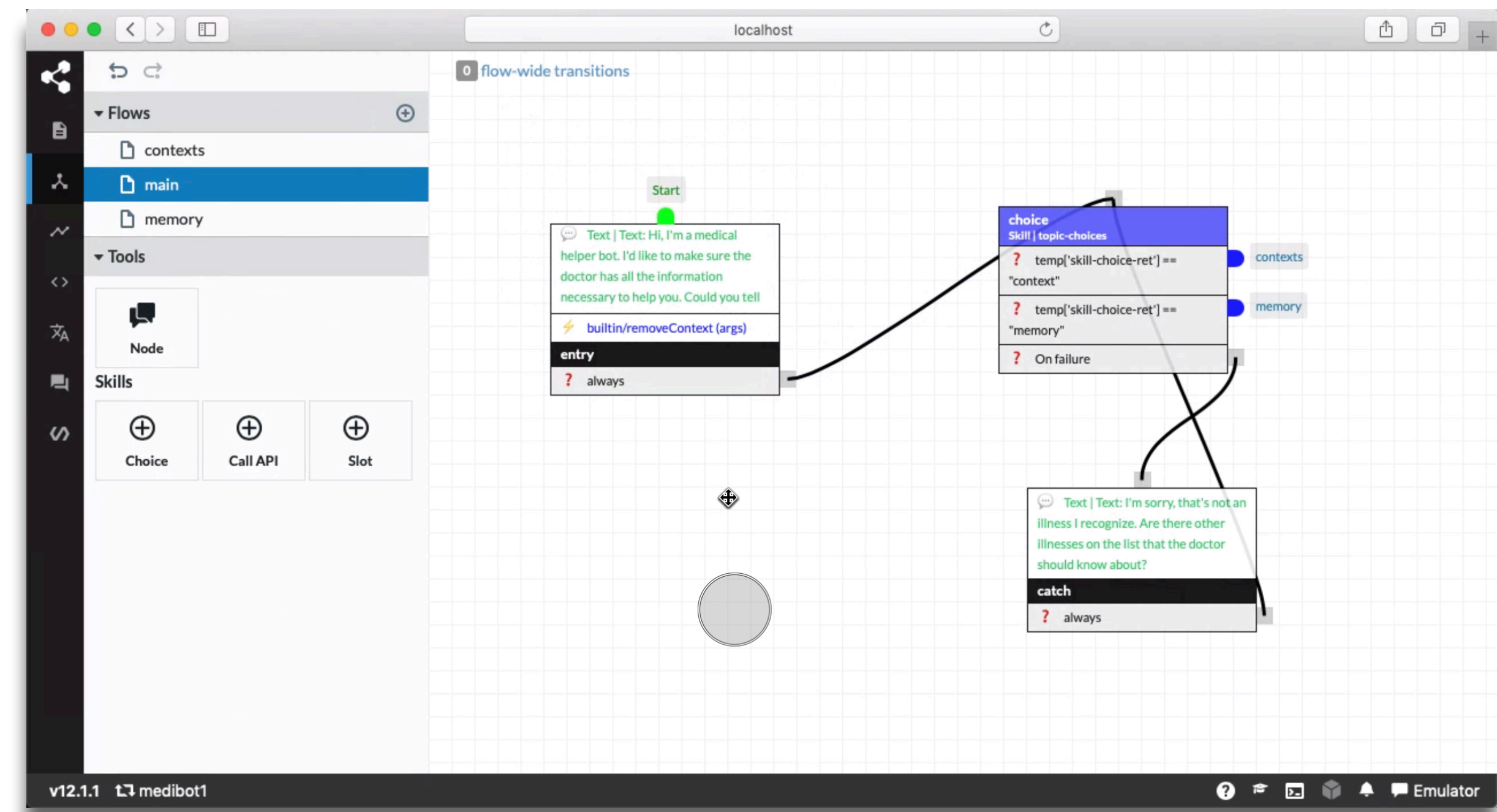
*Tech allows for significant task redesign*

## Augmentation

*Tech acts as a direct tool substitute, with functional improvement*

## Substitution

*Tech acts as a direct tool substitute, with no functional change*



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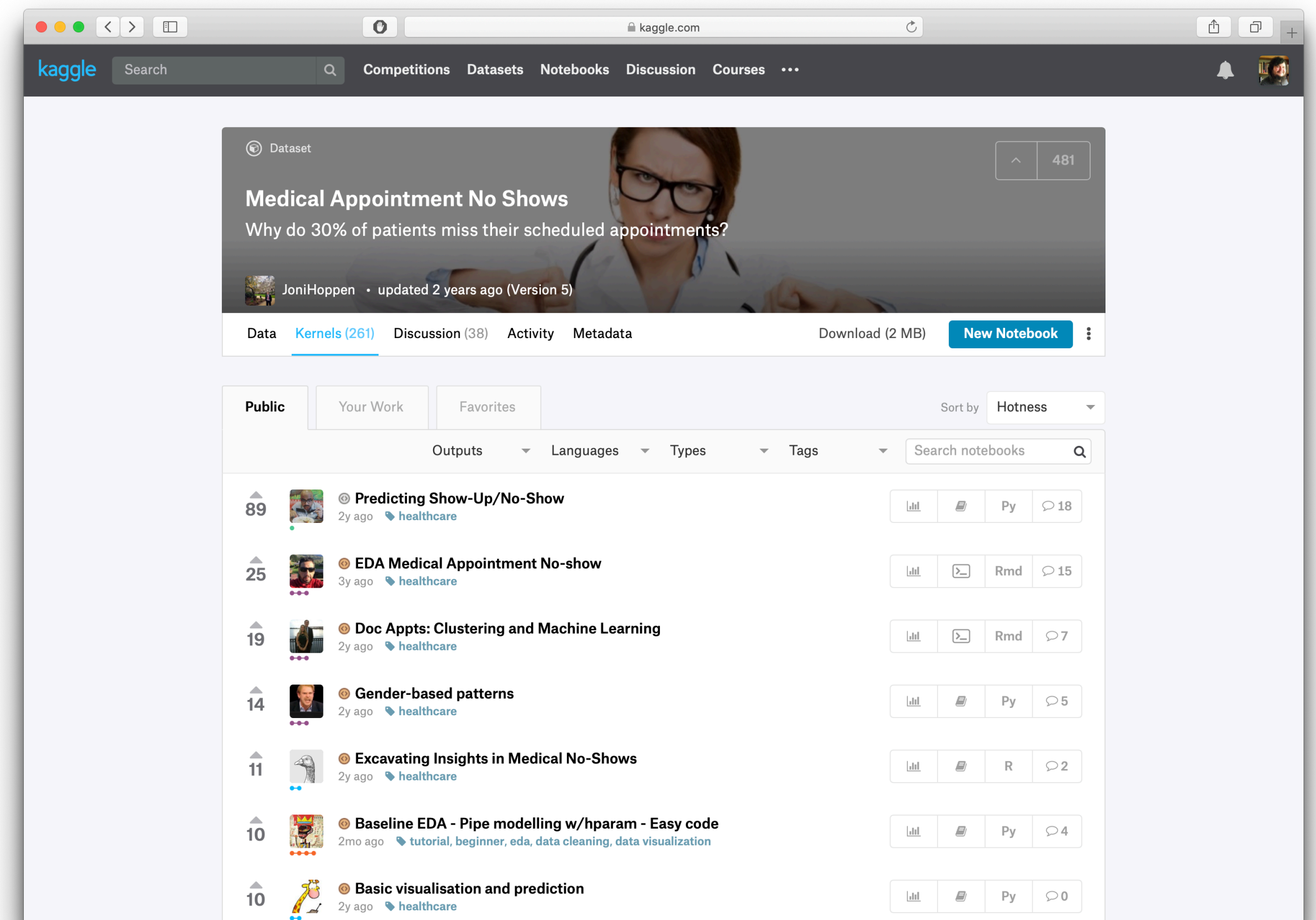
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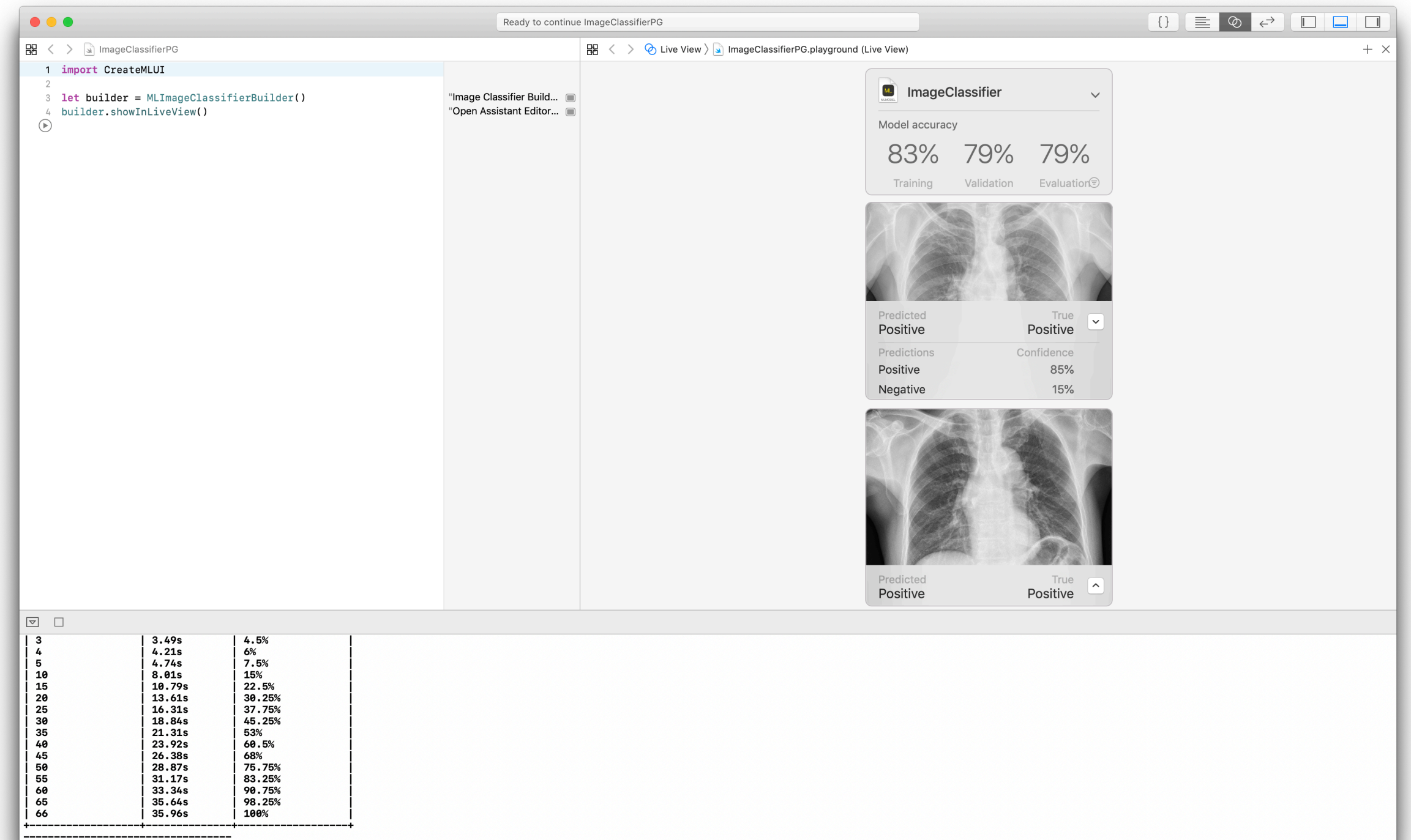
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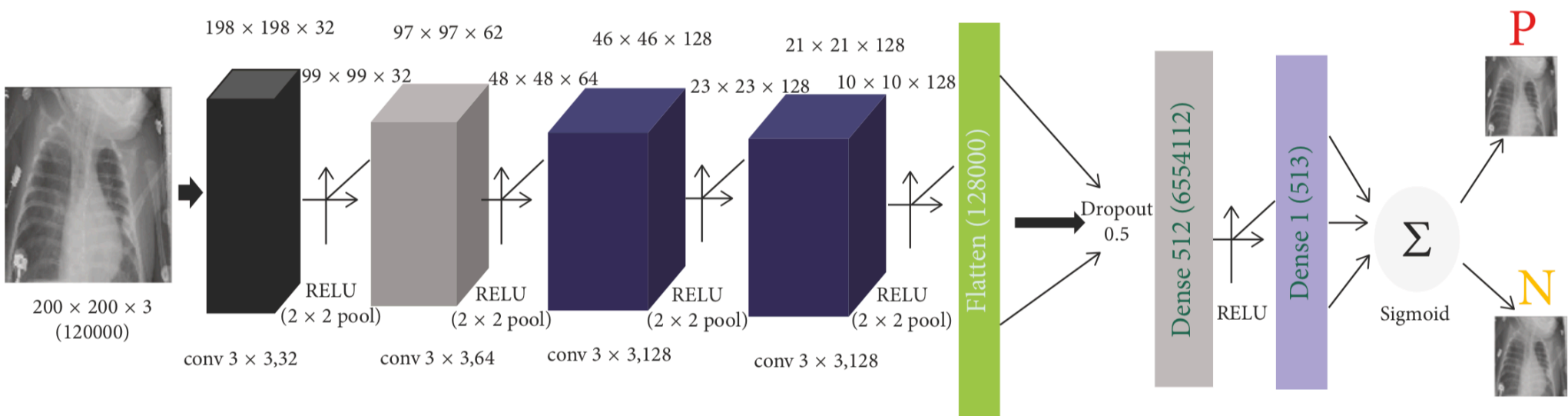


FIGURE 3: The proposed architecture.

TABLE 2: The output of the proposed network architecture.

Layer (type)	Output shape	Turtles
conv2d_9 (conv2D)	(None, 198, 198, 32)	896
max_Pooling2d_9 (MaxPooling2)	(None, 99, 99, 32)	0
conv2d_10 (conv2D)	(None, 97, 97, 64)	18496
max_Pooling2d_10 (MaxPooling2)	(None, 48, 48, 64)	0
conv2d_11 (conv2D)	(None, 46, 46, 128)	73856
max_Pooling2d_11 (MaxPooling2)	(None, 23, 23, 128)	0
conv2d_12 (conv2D)	(None, 21, 21, 128)	147584
max_Pooling2d_12 (MaxPooling2)	(None, 10, 10, 128)	0
flatten_3 (Flatten)	(None, 12800)	0
dropout_3 (Dropout)	(None, 12800)	0
dense_5 (Dense)	(None, 512)	6554112
dense_6 (Dense)	(None, 1)	513



# Choosing the First SAMR Ladder Project: Three Options

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- **Your Passion:**

- If you had to pick one topic from your class that best exemplifies why you became fascinated with this aspect of medicine, what would it be?

- **Barriers to Your Students' Progress:**

- Is there a topic in your class that a significant number of students get stuck on, and fail to progress beyond?

- **What Students Will Do In the Future:**

- Which topic from your class would, if deeply understood, best serve the interests of your students as future physicians?

In this exercise you will design a SAMR ladder to transform a unit of instruction; the complete exercise should take about 1 hour.

- Please break up into teams of 3-5 participants.
- Your team should take 10 minutes to select the topic that you will use as the basis for your ladder. You should select the topic according to one of these criteria:
  - Your Passion:  
If you had to pick one topic from your class that best exemplifies why you became fascinated with this aspect of medicine, what would it be?
  - Barriers to Your Students' Progress:  
Is there a topic in your class that a significant number of students get stuck on, and fail to progress beyond?
  - What Students Will Do In the Future:  
Which topic from your class would, if deeply understood, best serve the interests of your students as future physicians?
- You should make sure that the topic is not too broad or too narrow - for instance, trying to transform the entire Physiology curriculum would be too ambitious for this exercise, but focusing solely on teaching the structure of myosin would be too narrow.
- Having chosen a topic, you should design a SAMR ladder to transform how it is taught today. Plan to spend about 20 minutes identifying key pedagogical goals and creating a "rough" version of the ladder, followed by 20 minutes refining and revising the ladder to put it into final form, including the tools you plan to use and reasonably detailed descriptions of the activities planned.
- In the final 10 minutes of this exercise, transcribe a description of your ladder, making sure that the writeup is understandable by someone who has not participated in your discussions, and is detailed enough that they could implement your ladder with a minimum of additional work needed.



# Determining SAMR Level: Questions and Transitions

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- **Substitution:**
  - What is gained by replacing the older technology with the new technology?
- **Substitution to Augmentation:**
  - Has an improvement been added to the task process that could not be accomplished with the older technology at a fundamental level?
  - How does this feature contribute to the design?
- **Augmentation to Modification:**
  - How is the original task being modified?
  - Does this modification fundamentally depend upon the new technology?
  - How does this modification contribute to the design?
- **Modification to Redefinition:**
  - What is the new task?
  - Is any portion of the original task retained?
  - How is the new task uniquely made possible by the new technology?
  - How does it contribute to the design?

# S to A: The Value of Shared Practices

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- Augmented Note Taking and Annotation
- Visualization Methods:
  - 5 Primary Domains: Space, Time, Networks, Text, Number
- Simple Blogging
- Simple Digital Storytelling Video
- Flipped Classroom:
  - Materials Creation
  - Peer Discussion/Instruction Methods
- Simple Interactive Fiction
- LMS Practices



# Black and Wiliam: Defining Formative Assessment

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“Practice in a classroom is formative to the extent that evidence about student achievement is elicited, interpreted, and used by teachers, learners, or their peers, to make decisions about the next steps in instruction that are likely to be better, or better founded, than the decisions they would have taken in the absence of the evidence that was elicited.”

# Wiliam: A Framework for Formative Assessment

---

	Where the learner is going	Where the learner is right now	How to get there
Teacher	1 Clarifying learning intentions and criteria for success	2 Engineering effective classroom discussions and other learning tasks that elicit evidence of student understanding	3 Providing feedback that moves learners forward
Peer	Understanding and sharing learning intentions and criteria for success	4 Activating students as instructional resources for one another	
Learner	Understanding learning intentions and criteria for success	5 Activating students as the owners of their own learning	



Context II

## **Redefinition**

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## **Modification**

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## **Extended Thinking**

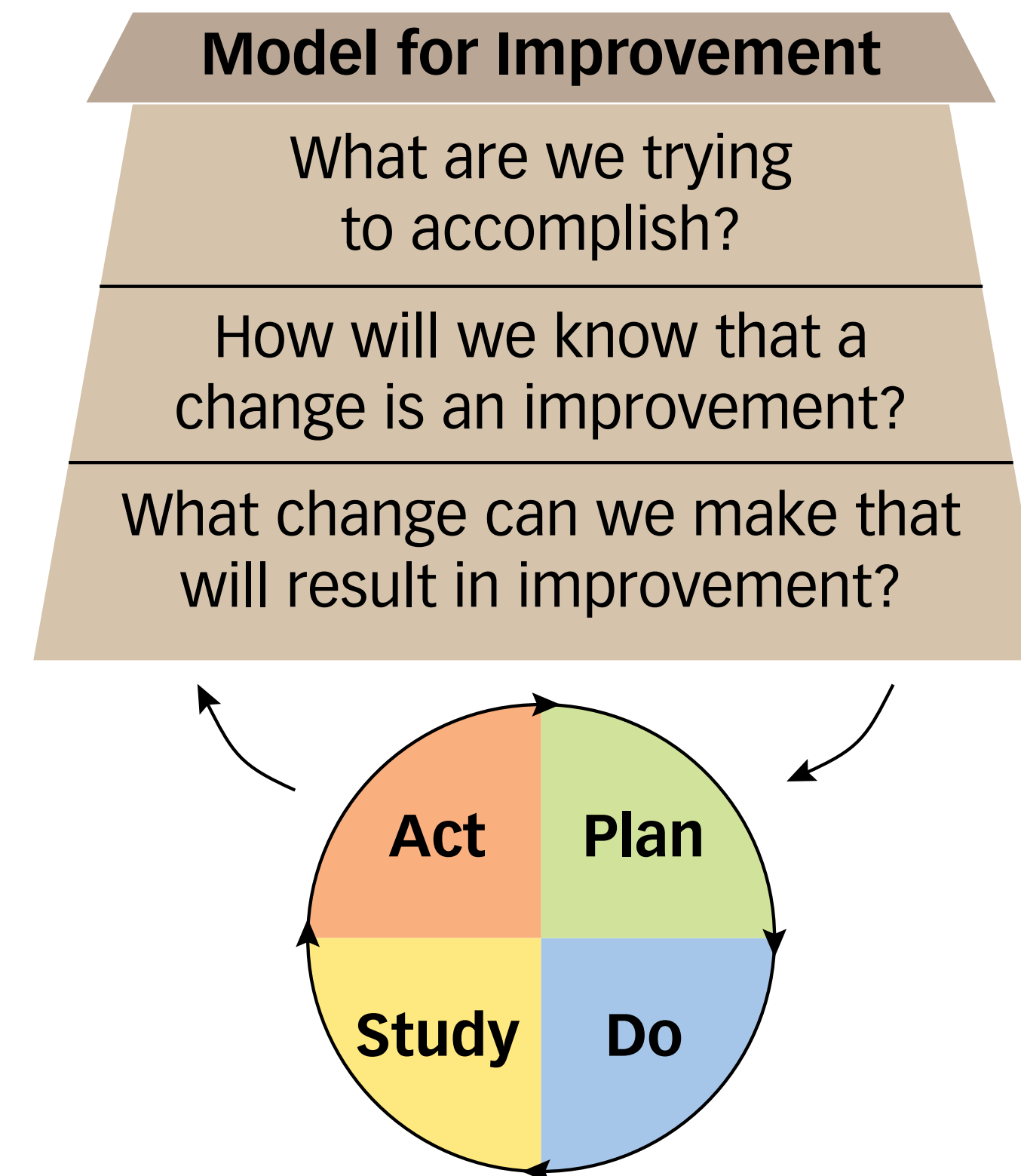
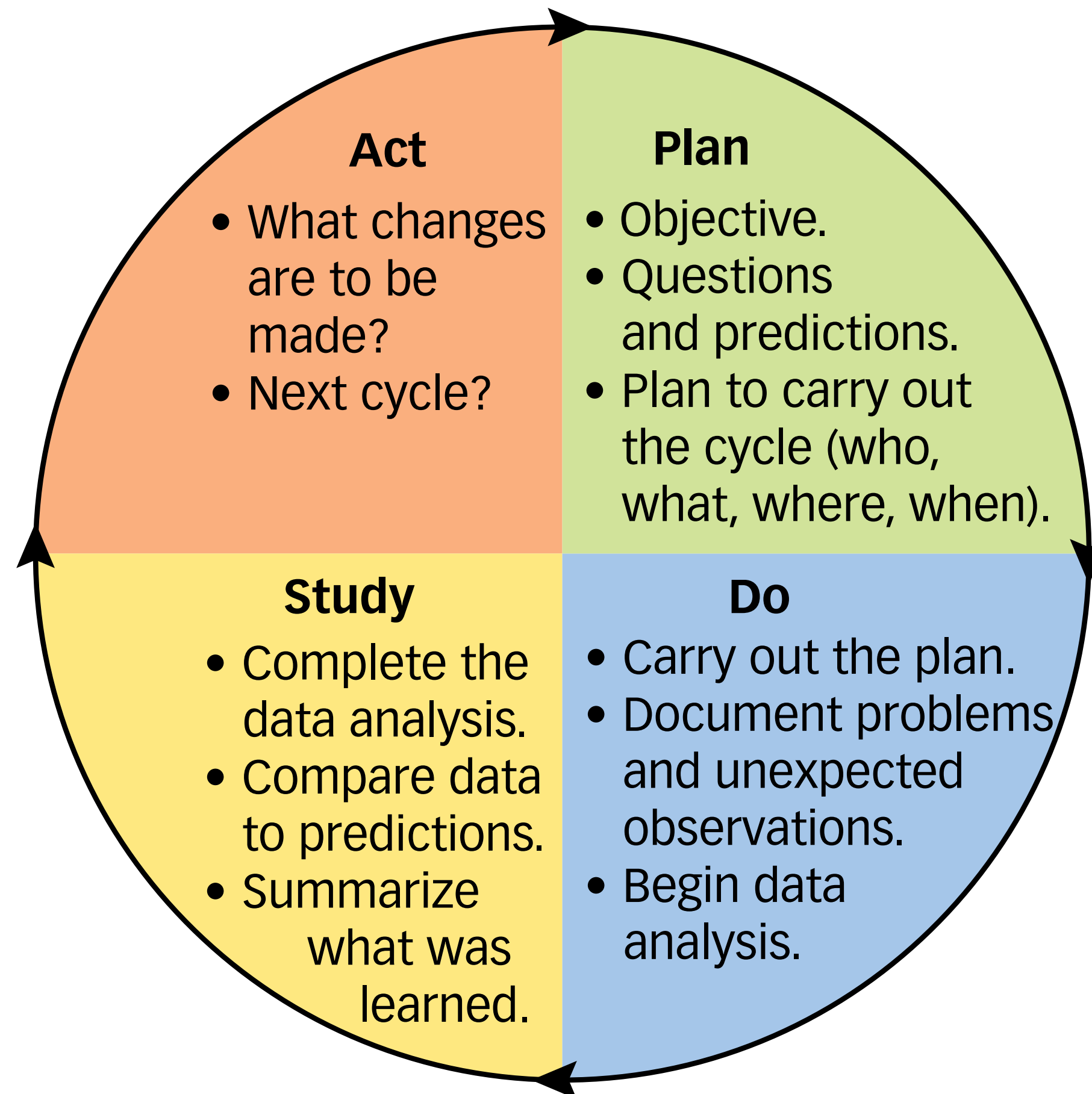
## **Strategic Thinking**

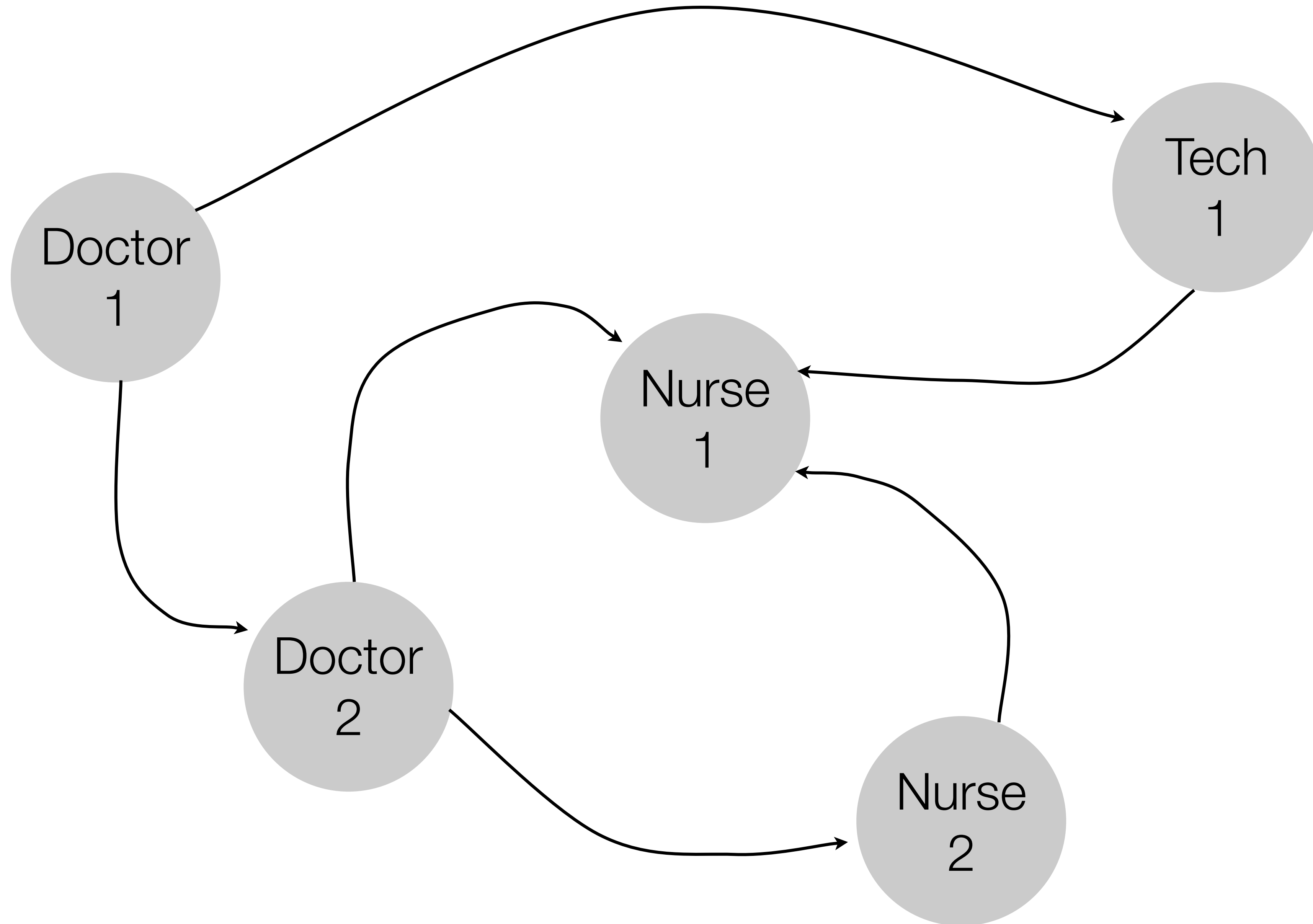
## **Skills and Concepts**

## **Recall and Reproduction**



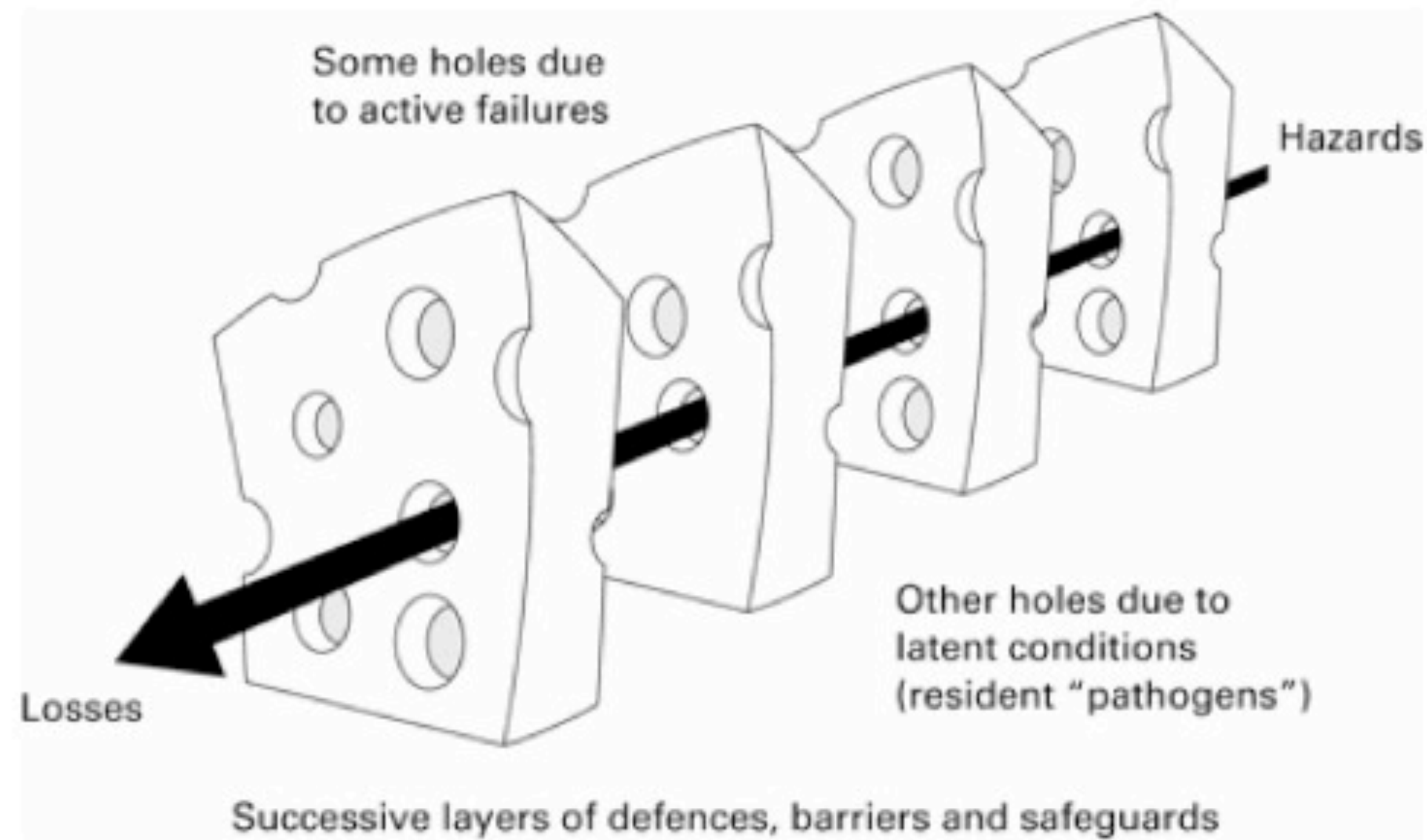
# Deming's PDSA Cycle





# Reason's Swiss Cheese Model

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## Anticoagulants and Communication



Why is this so complicated? I just want a piece of tissue!  
I forget how many people "touch " the patient... to get this stuff done.

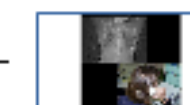
Frank Monroe, M.D.

Expectation   Disappointment   Understanding   Communication   Appreciation



   1 Mrs. Barlow

   2 Janet Reed, R.N.



Drag zoom slider to enlarge image



# Hippasus

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Twitter: @rubenrp

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