

July 2, 2018

Data Authoring Environments

An Overview

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Dubberly Design Office

Introduction

This presentation captures over 200 examples of computer software and hardware interfaces for authoring data and programs from the 1960s through the present day.

It is presented in eight sections. Additionally, some of the frequently occurring design patterns are cataloged in the last section.

- | | |
|---------------------|------------------------------------|
| 1 Origins | 5 IDE (Environments & Experiments) |
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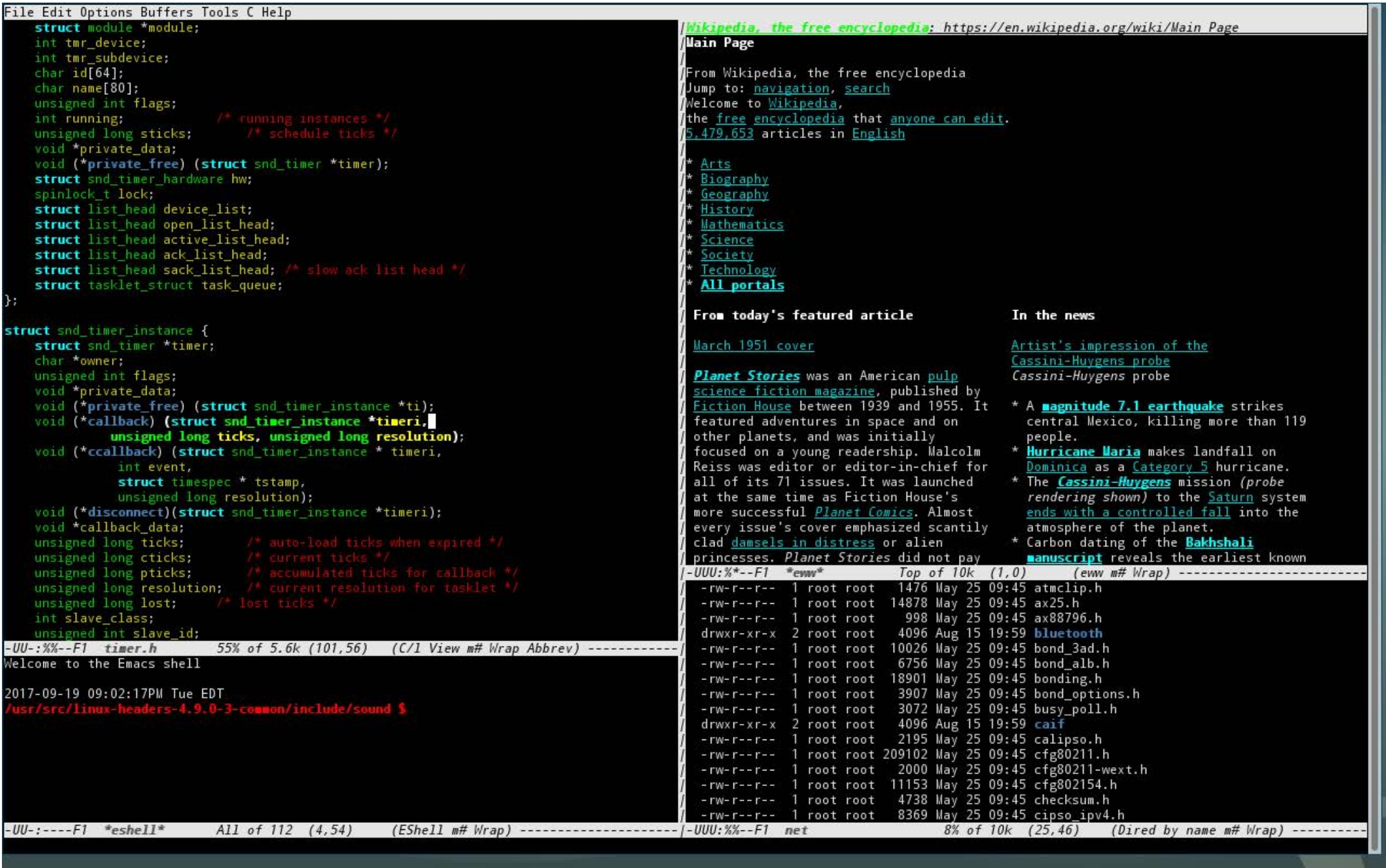
Origins

Starting with “Strings”

Text Editors

```
+8 +16 +24 +32 +40 +48 +56 +64 +72 +80
!
'x,.n
13
14 The principlce difference between line editors and display editors
15 is that display editors provide instant feedback to user commands,
16 whereas line editors require sometimes lengthy input before any
17 effects are seen. The advantage of instant feedback, of course,
18 is that if a mistake is made, it can be corrected immediately,
19 before more damage is done. Editing in 'ed' requires more strategy
20 and forethought; but if you are up to the task, it can be quite
21 efficient.
14s/p
```

Ken Thompson



David A. Moon and Guy L. Steele Jr.


```
// These two lines are required to initialize Express in Cloud Code.
var express = require('express');
var app = express();

// Global app configuration section
app.set('views', 'cloud/views'); // Specify the folder to find templates
app.set('view engine', 'ejs');    // Set the template engine
app.use(express.bodyParser());     // Middleware for reading request body

// This is an example of hooking up a request handler with a specific request
// path and HTTP verb using the Express routing API.
app.get('/hello', function(req, res) {
  res.render('hello', { message: 'Congrats, you just set up your app!' });
});

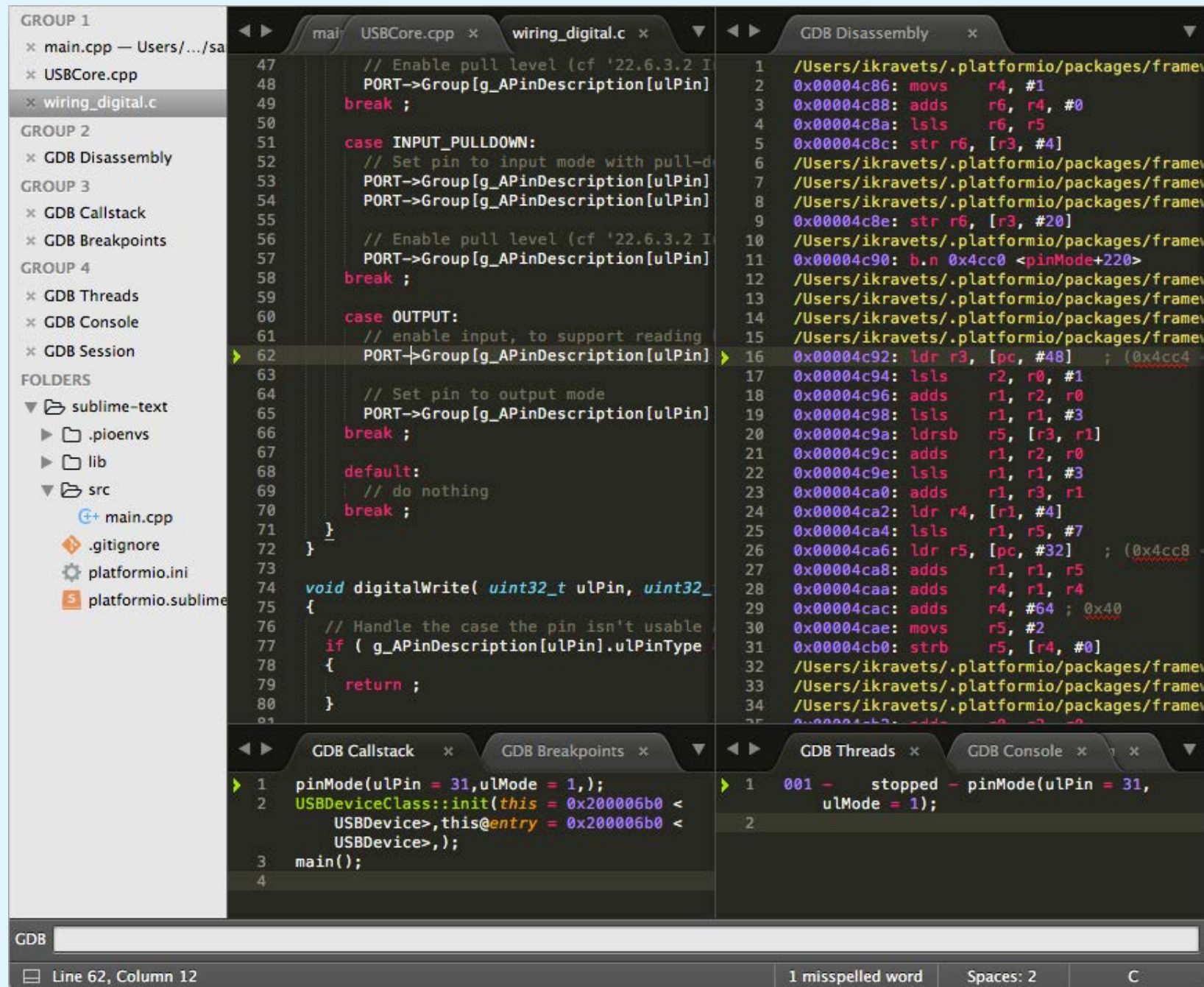
// // Example reading from the request query string of an HTTP get request.
// app.get('/test', function(req, res) {
//   // GET http://example.parseapp.com/test?message=hello
//   res.send(req.query.message);
// });

// // Example reading from the request body of an HTTP post request.
// app.post('/test', function(req, res) {
//   // POST http://example.parseapp.com/test (with request body "message=hello")
//   res.send(req.body.message);
// });

// Attach the Express app to Cloud Code.
app.listen();
~
~
~
~
~
~
~
~
'require' was used before it was defined.
```

Sublime Text

2008-Today



Jon Skinner, Will Bond

Atom

2014-Today

Project

real-time

.git

lib

buffer-binding.js

editor-binding.js

guest-portal-binding.js

join-portal-dialog.js

normalize-uri.js

real-time-package.js

node_modules

script

styles

test

.gitignore

.travis.yml

index.js

package-lock.json

package.json

README.md

JS real-time-package.js

1

2

3

4

5

6

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10

11

12

13

14

```
const {CompositeDisposable} = require('atom')
const {allowUnsafeNewFunction} = require('loophole')

let Client
allowUnsafeNewFunction(() => { Client =

const BufferBinding = require('./buffer-binding')
const EditorBinding = require('./editor-binding')

module.exports =
class RealTimePackage {
  constructor (options) {
    cons
```

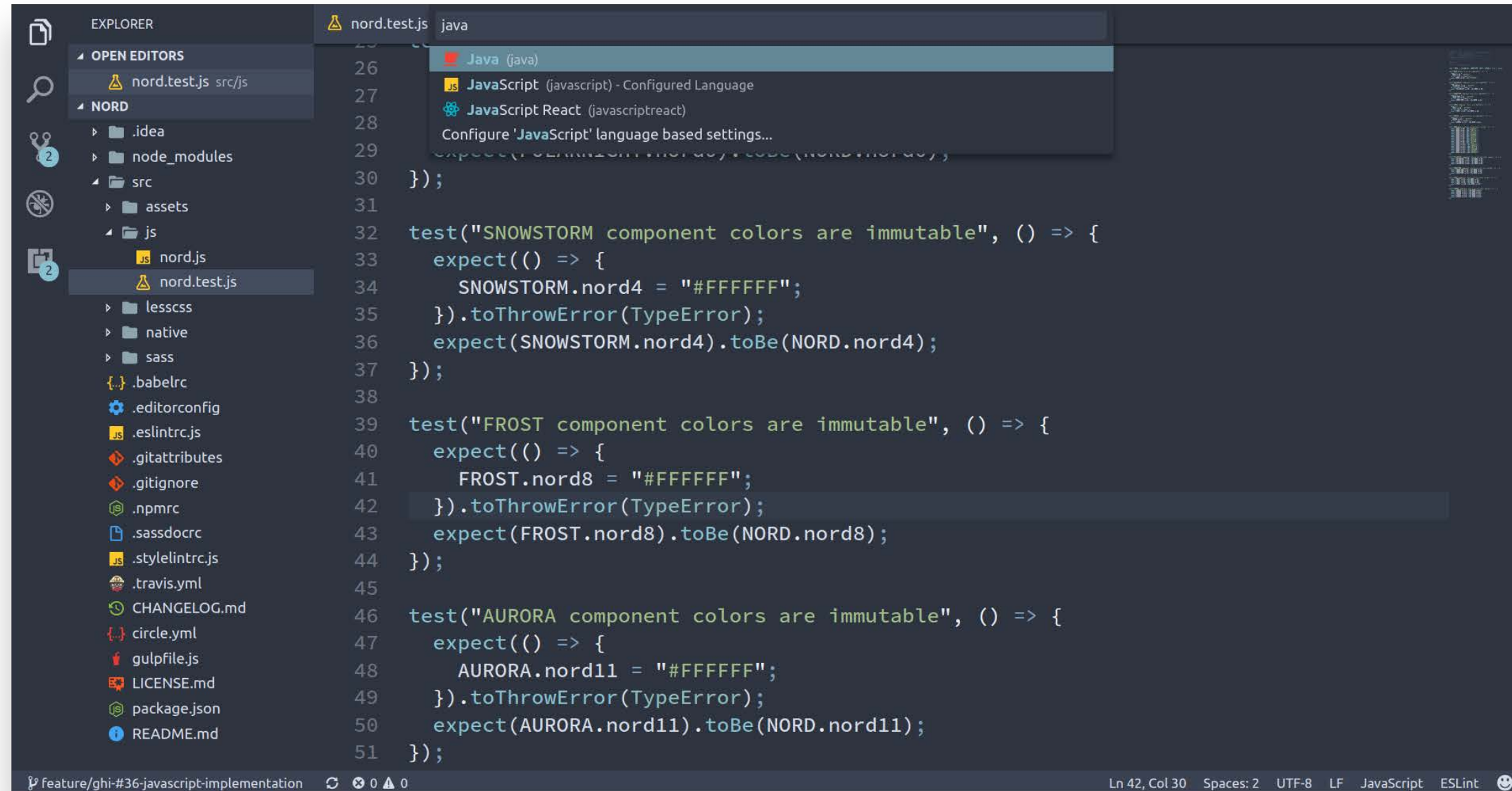
lib/real-time-package.js

JavaScript

GitHub

Visual Studio Code

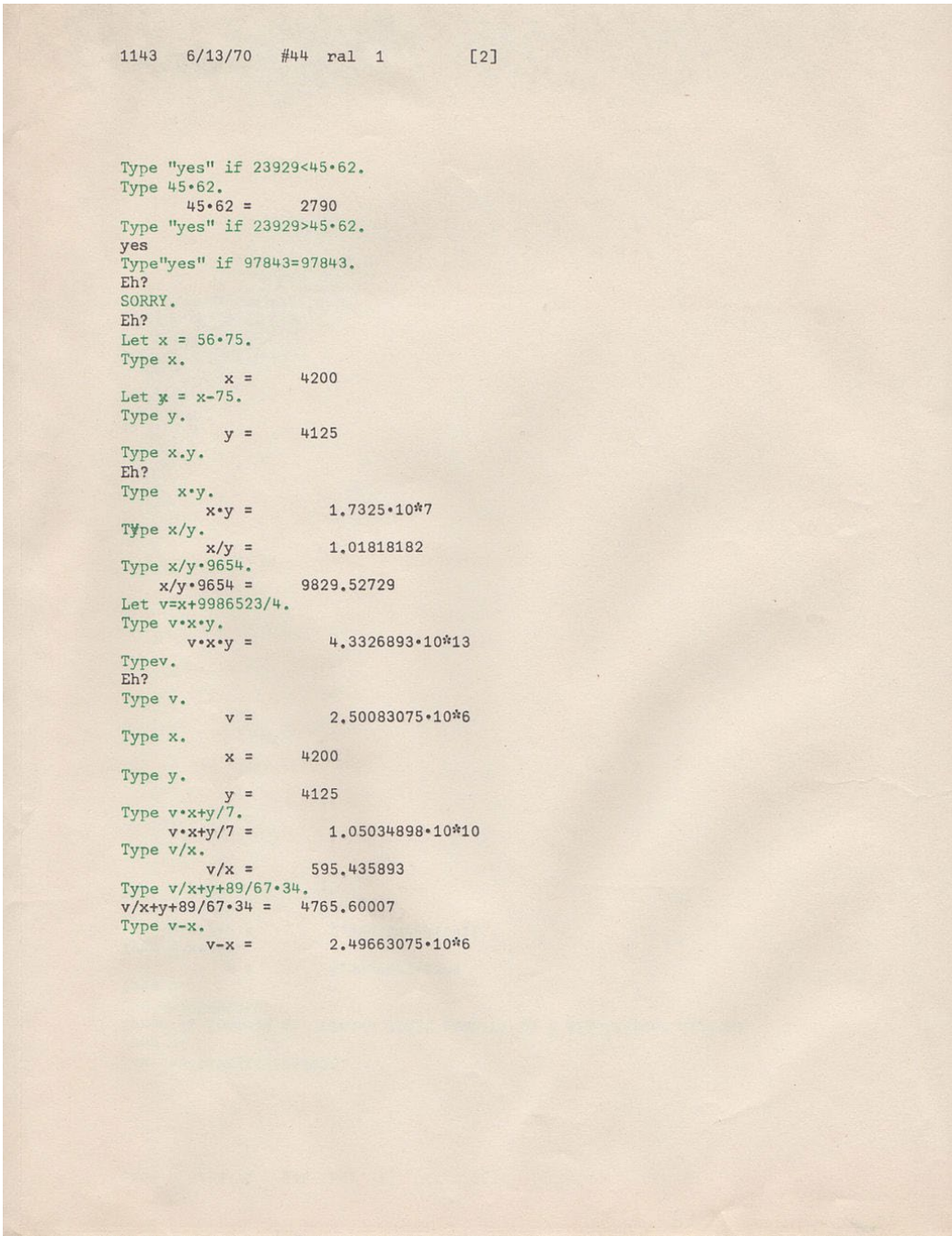
2015-Today



Microsoft

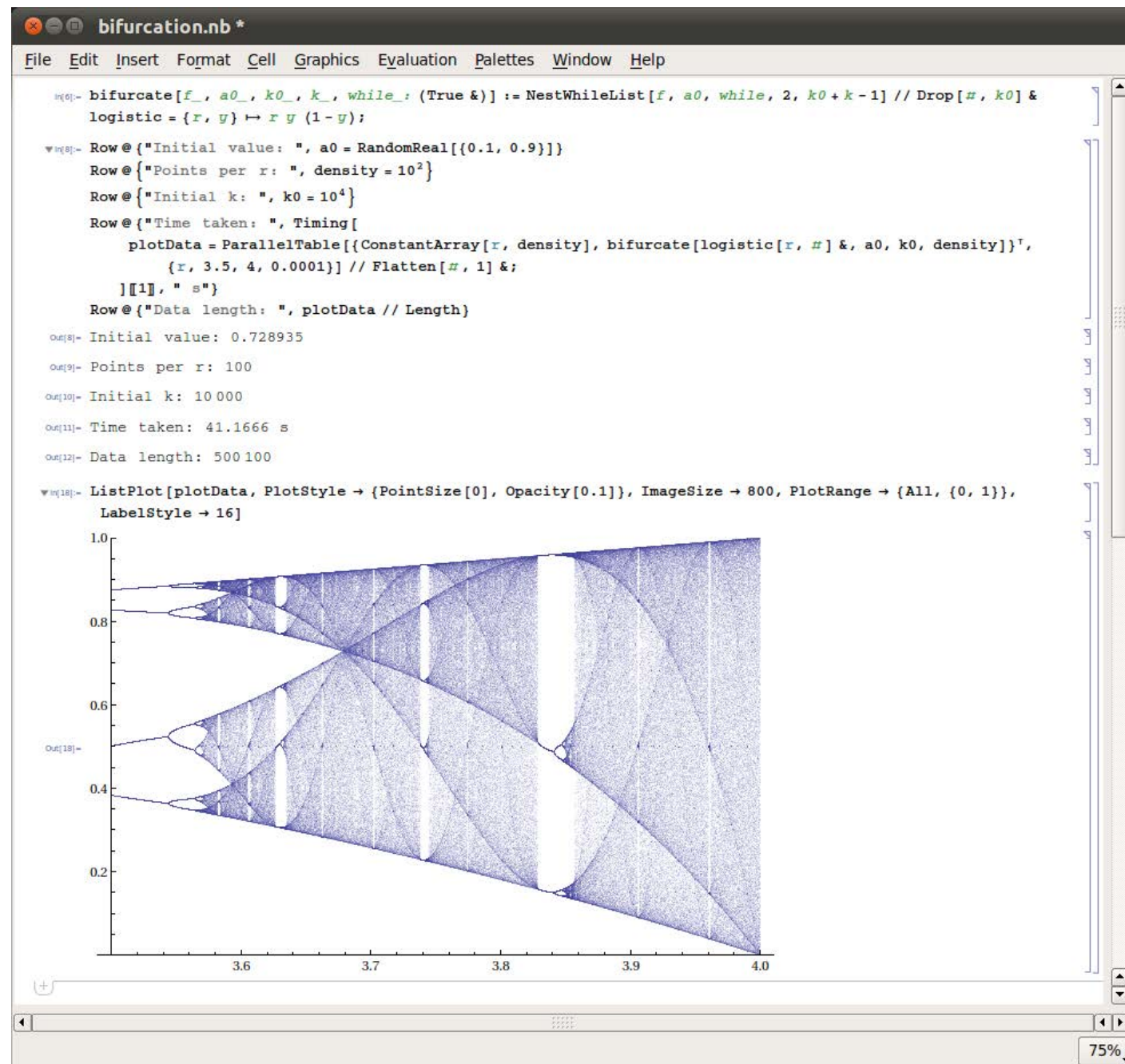
Notebooks

Query & Response Environments

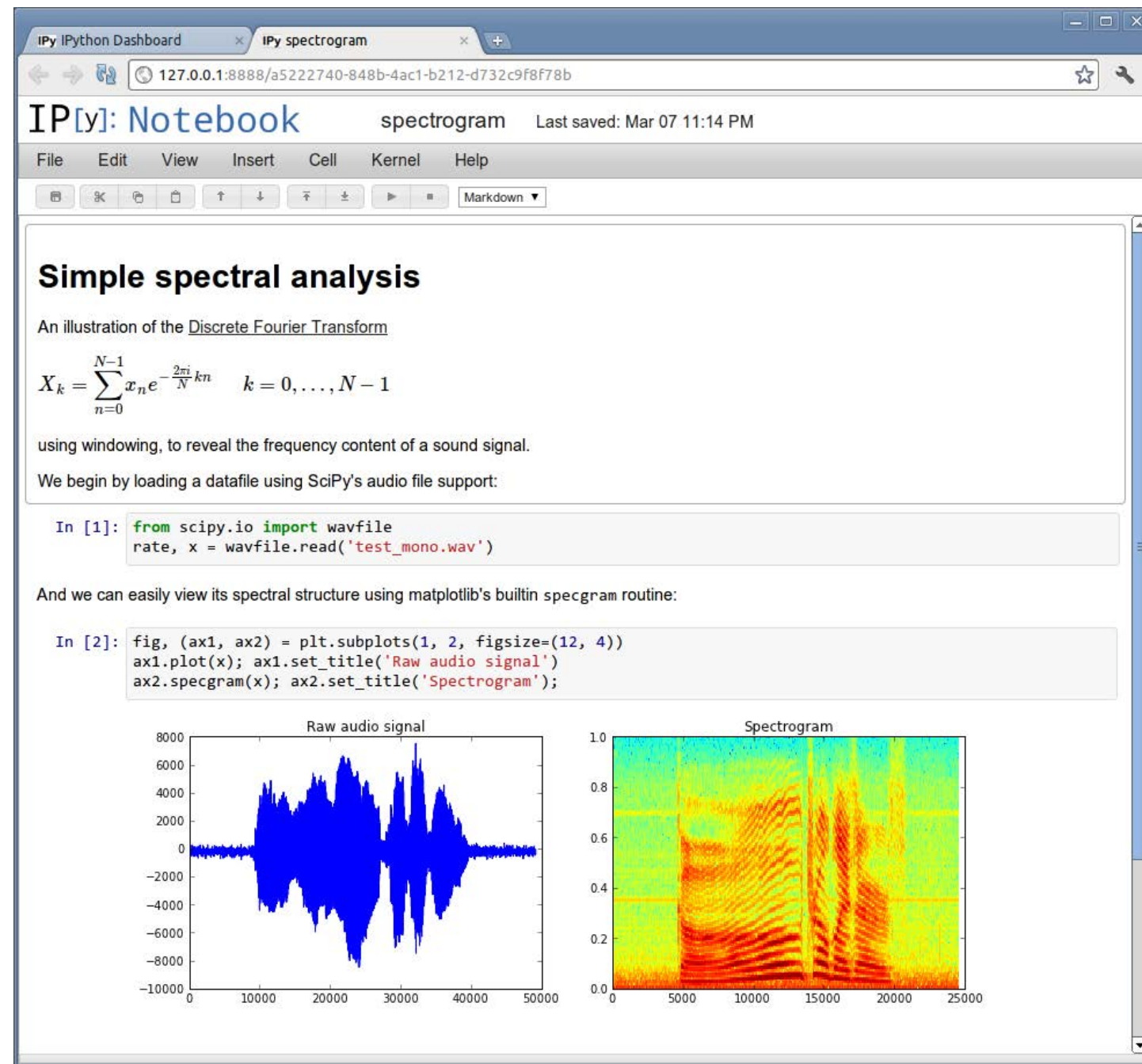


Mathematica

1988-Today

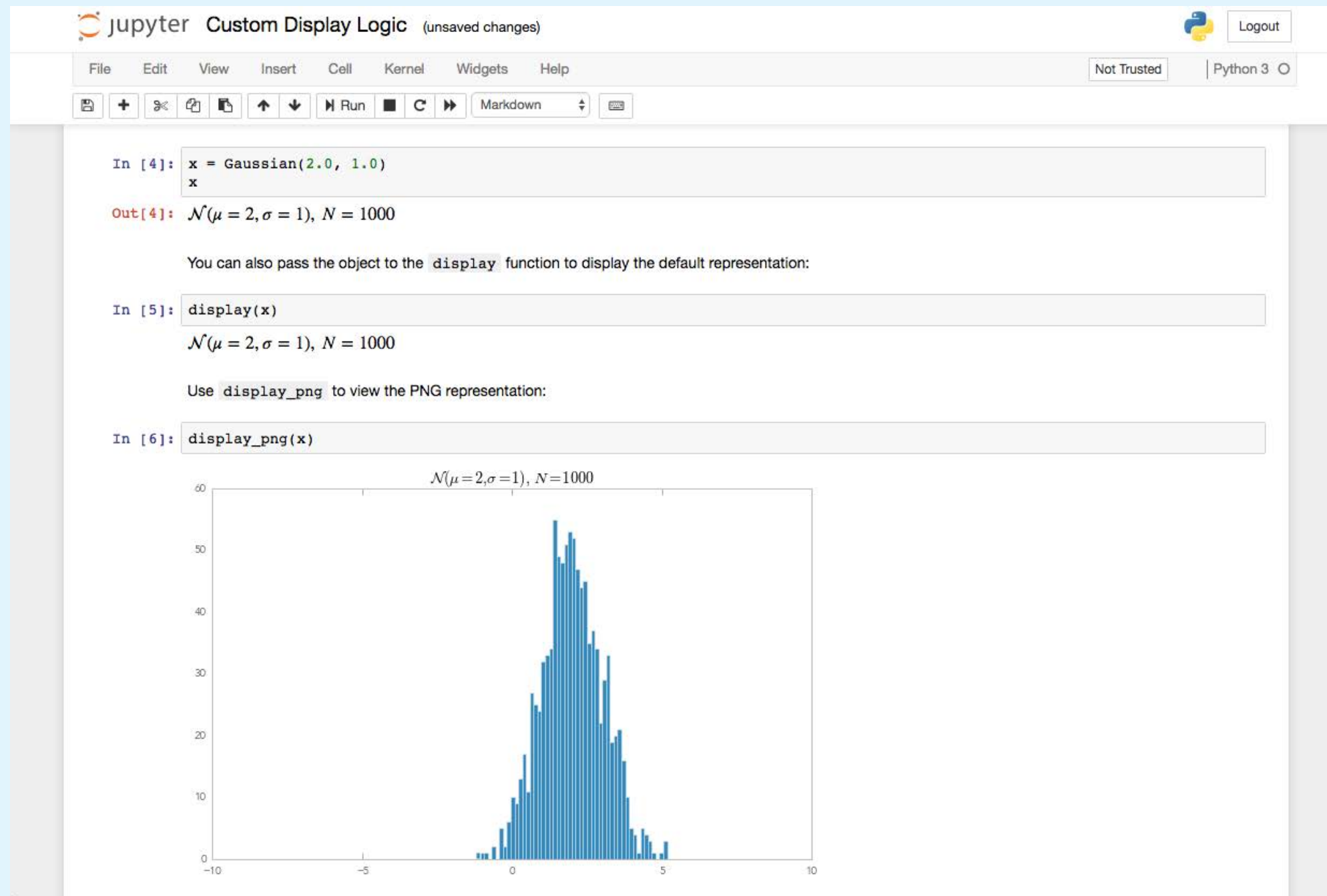


Stephen Wolfram



Jupyter

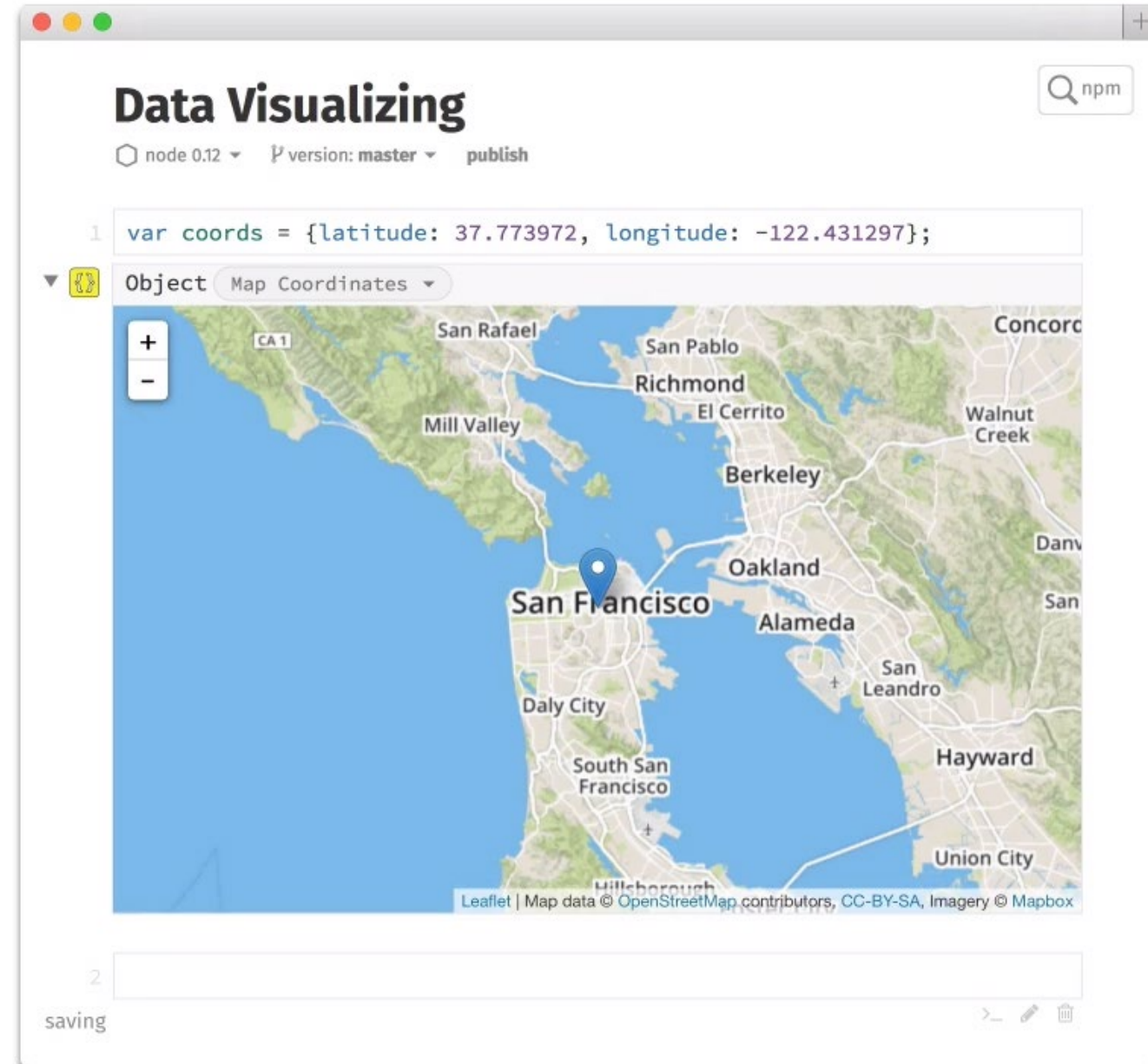
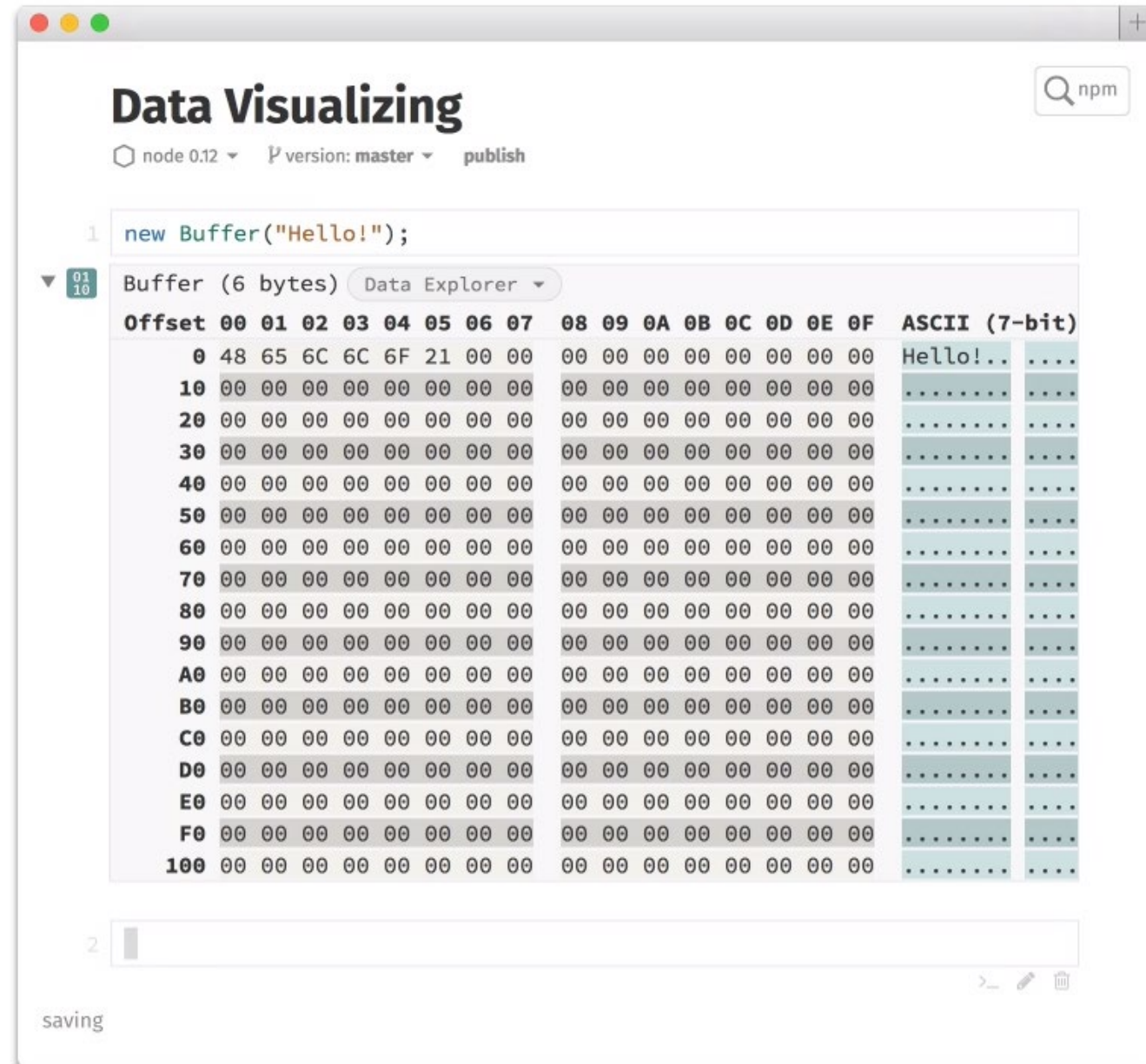
2014-Today



Fernando Pérez and Others

Tonic/RunKit

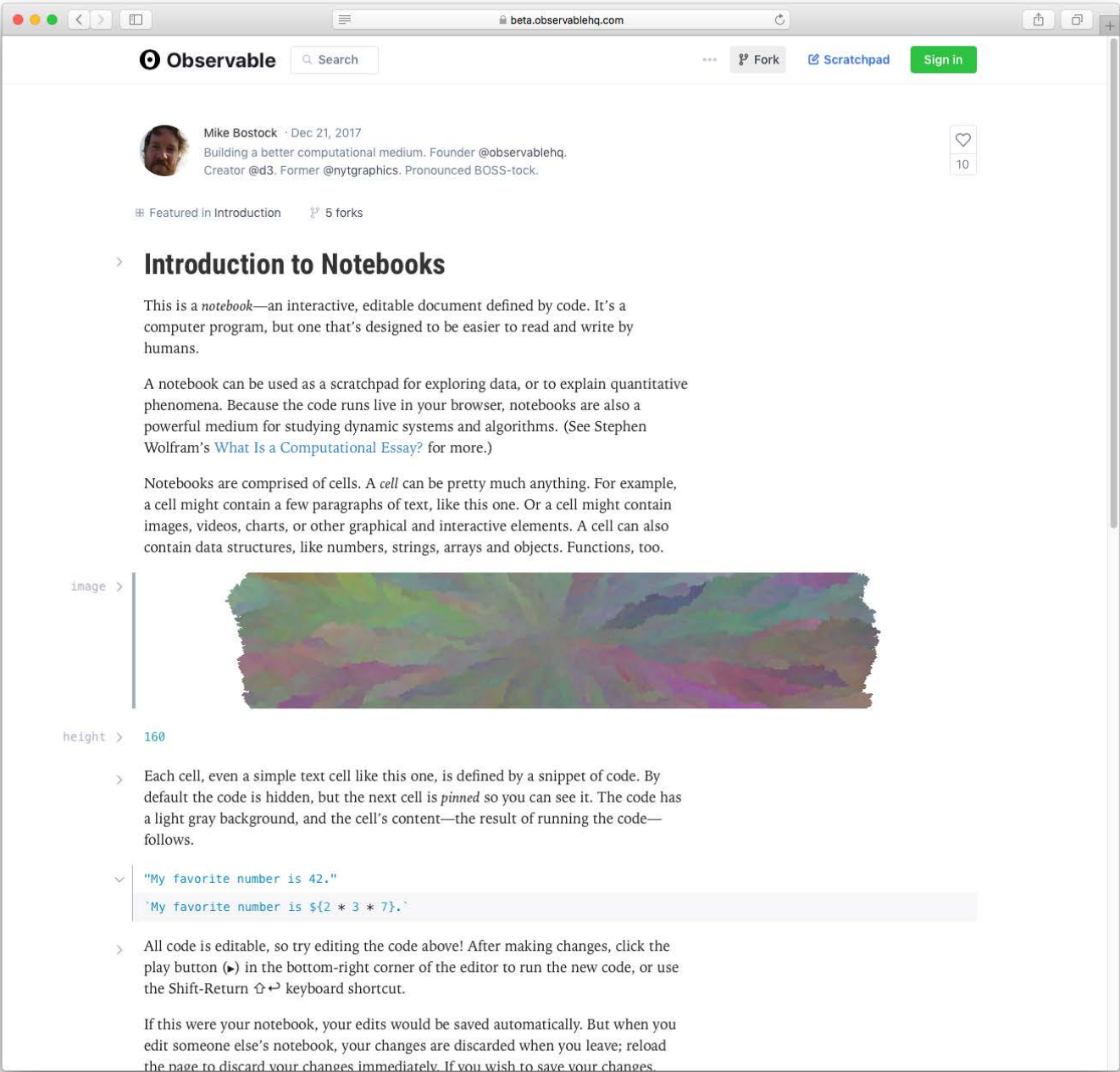
2015-Today



Francisco Tolmasky

Observable

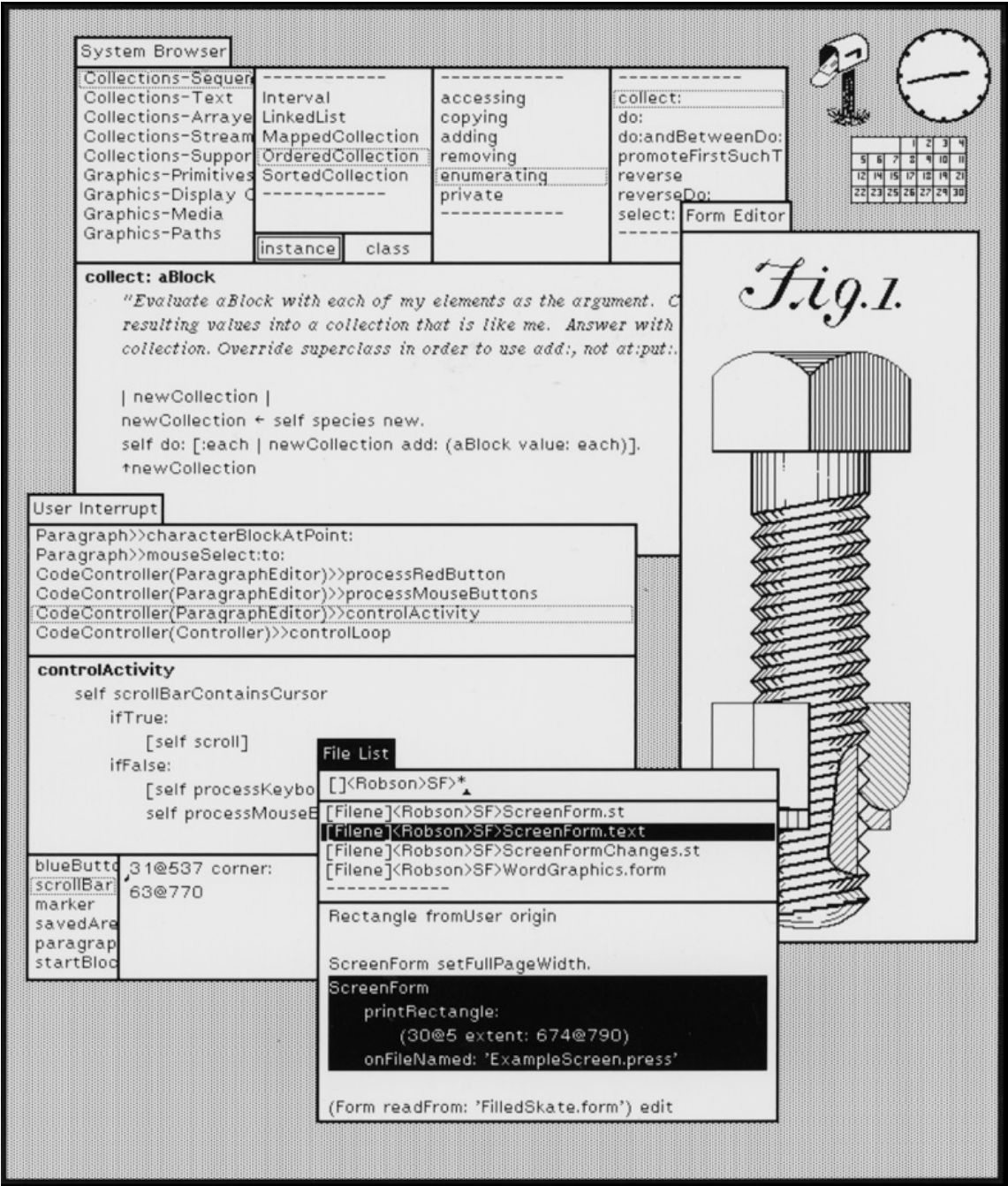
2018-Today



Mike Bostock, Tom MacWright, Jeremy Ashkenas for Observable, Inc.

Card-Stack / Kit-of-Parts

‘Construction Sets’



Alan Kay, Dan Ingalls, Adele Goldberg, Ted Kaehler, Diana Merry, Scott Wallace, Peter Deutsch at XEROX PARC

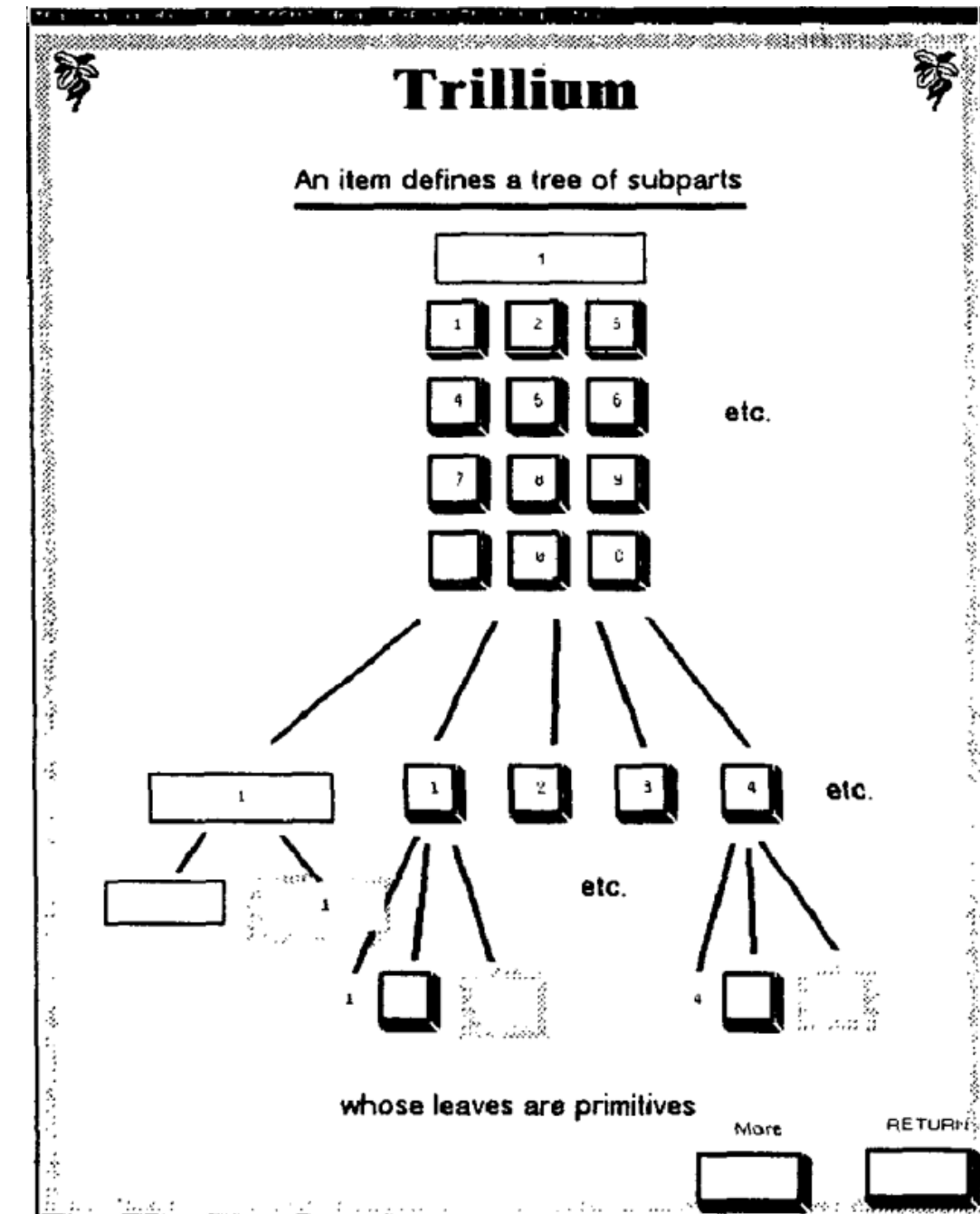
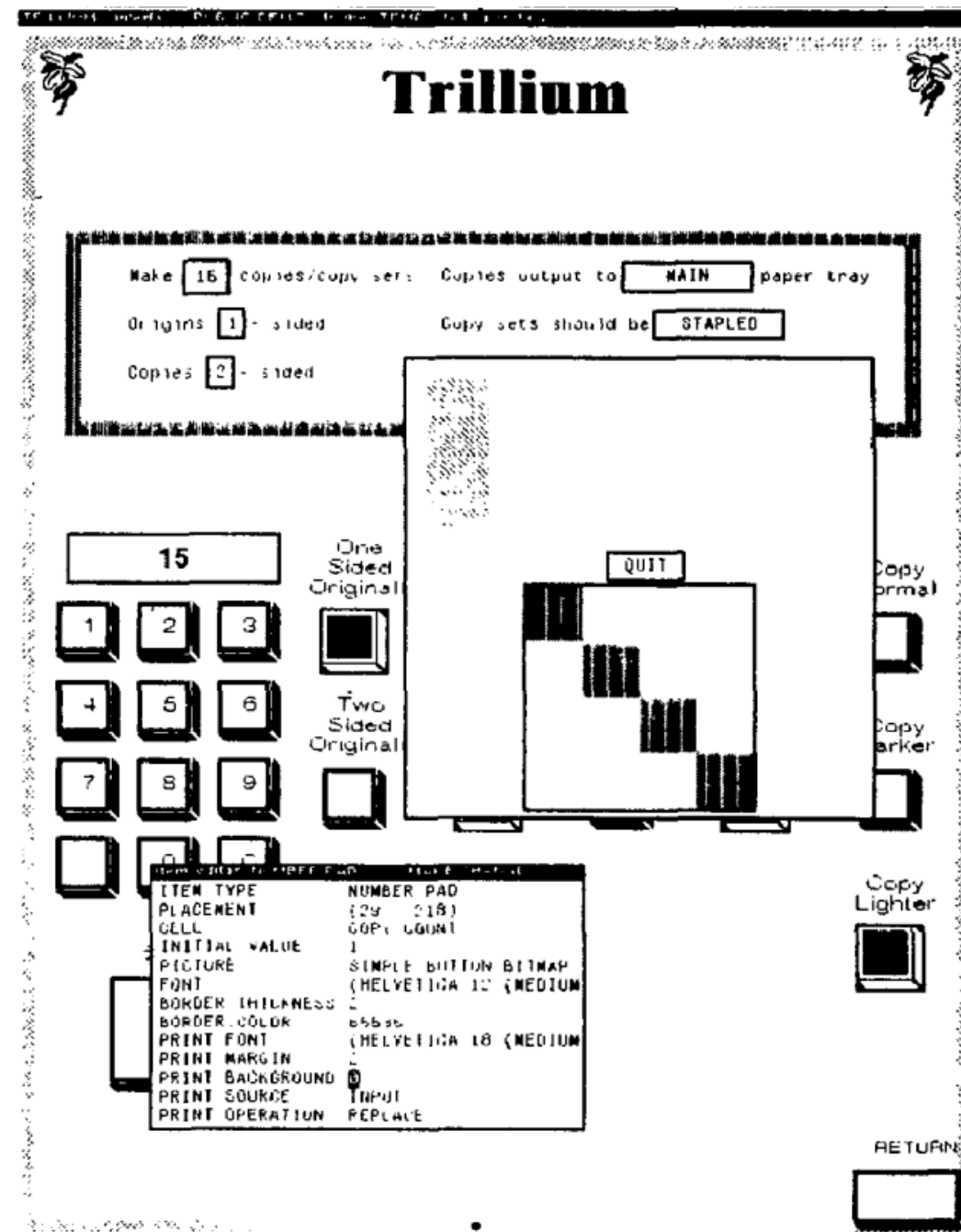
ThingLab Browser

Anchor BitImage ConstantLengthL Ex2 Ex4 LineSegment	picture structure values	constrain merge move edit prefer require	LineSegment MidPointLine Node Plus Point Printer Rectangle
--	--------------------------------	---	--

Object Point QTheorem Quadrilateral Rectangle TextThing Triangle	structure prototype's picture prototype's values as save file subclass template	insert delete constrain merge move edit text	GeometricObject Line MidPointLine Point Quadrilateral Rectangle Triangle
--	---	---	--

Trillium

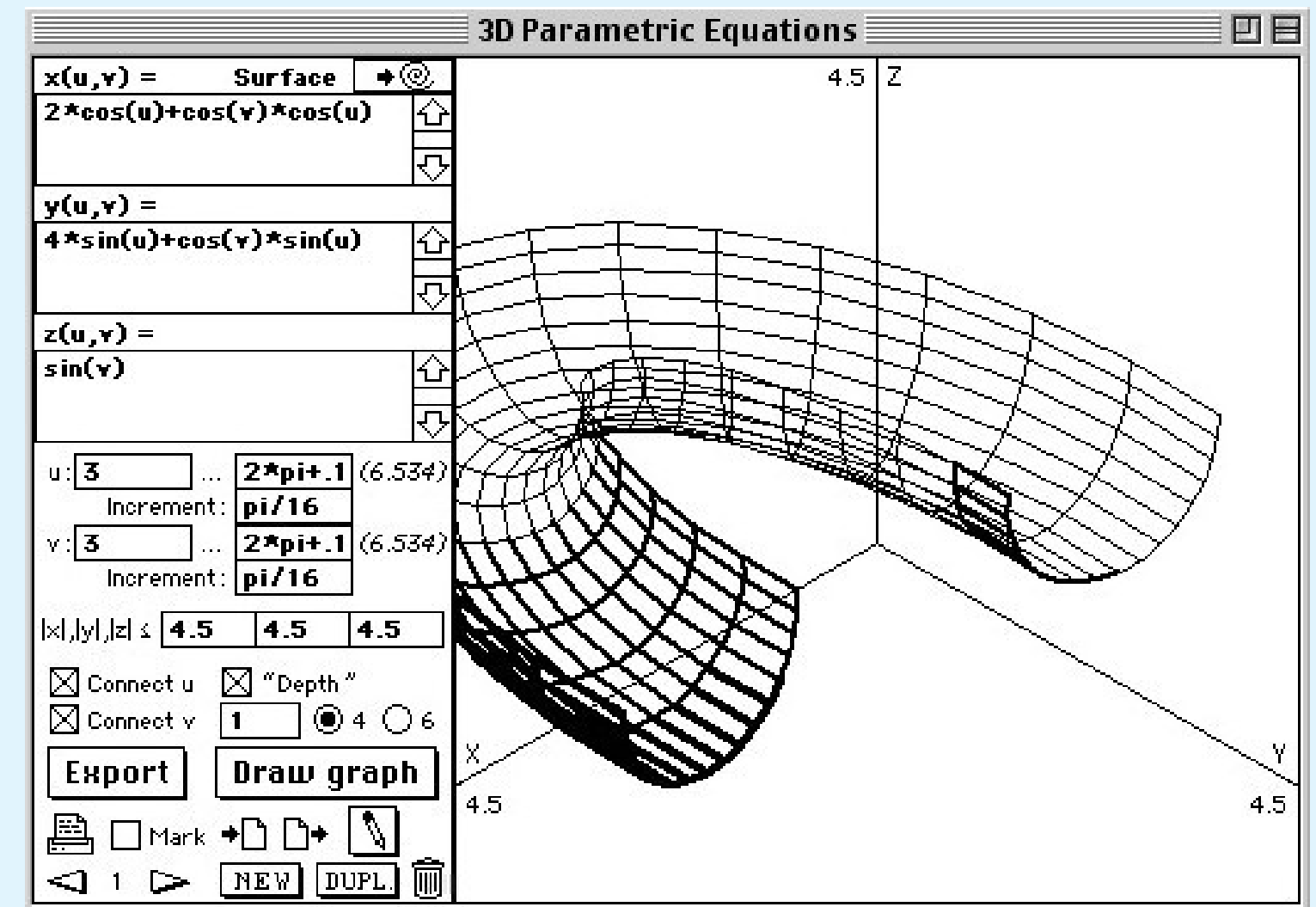
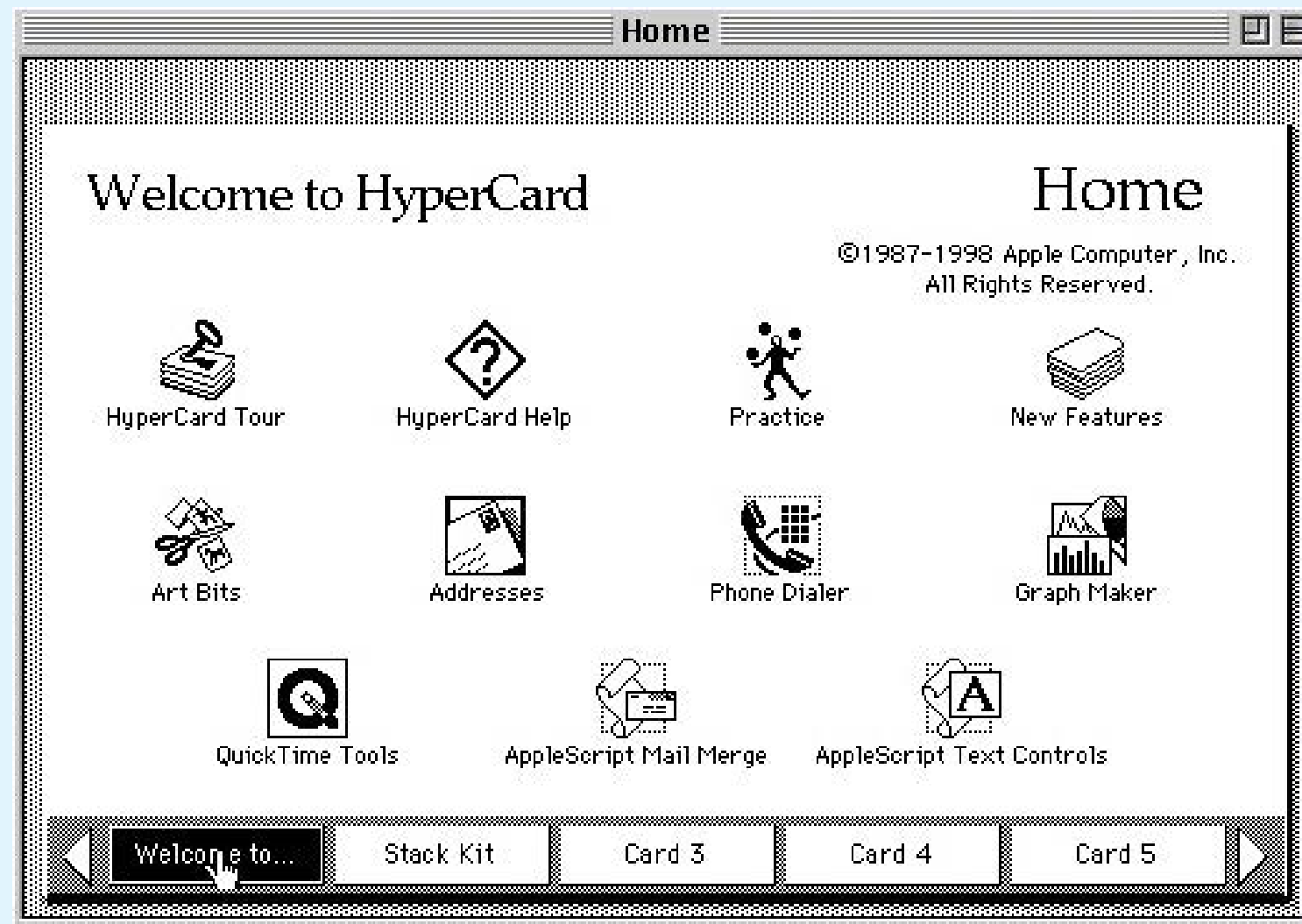
1986



Austin Henderson at Xerox PARC

Hypercard

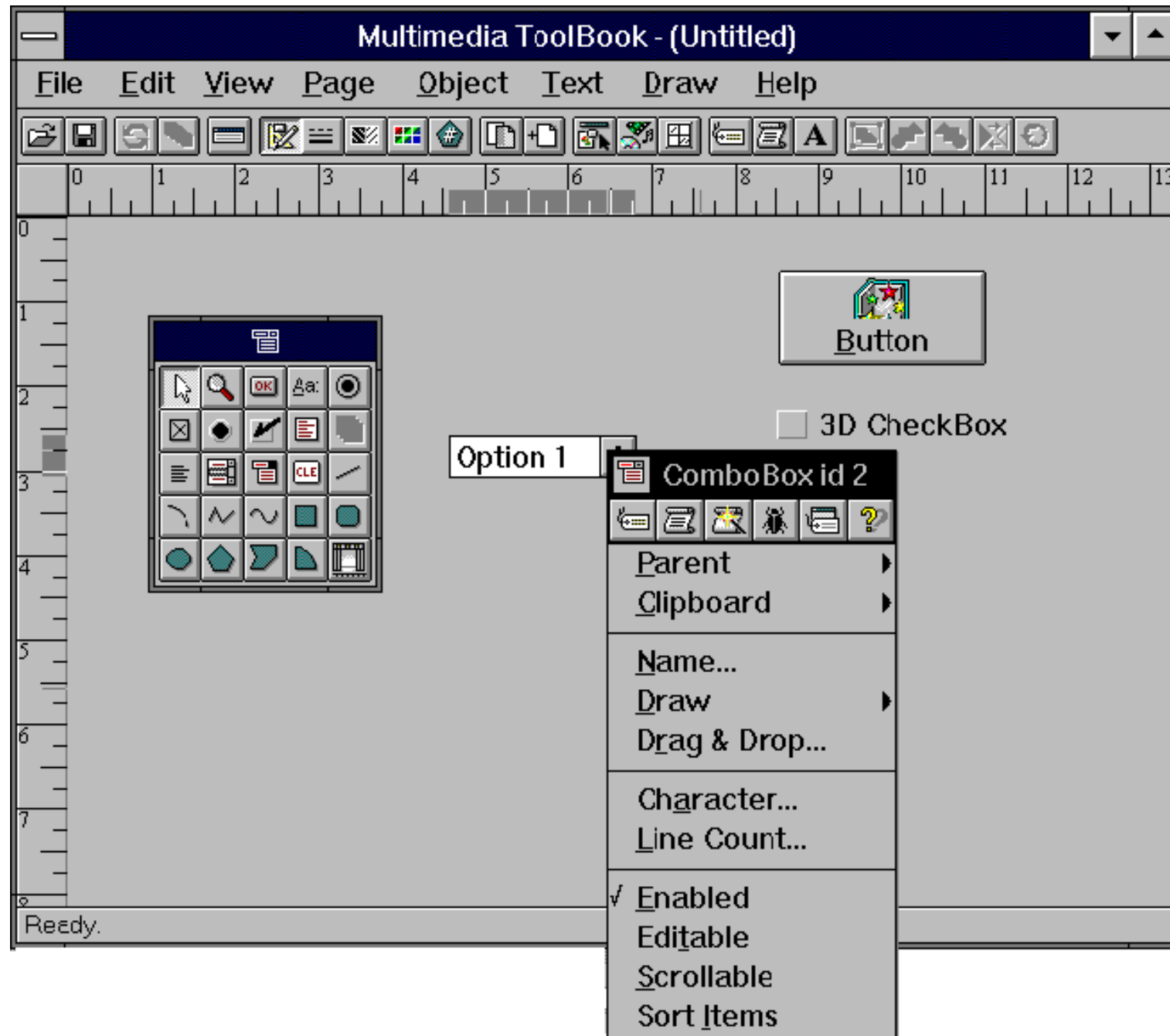
1987-1998



Bill Atkinson for Apple

ToolBook

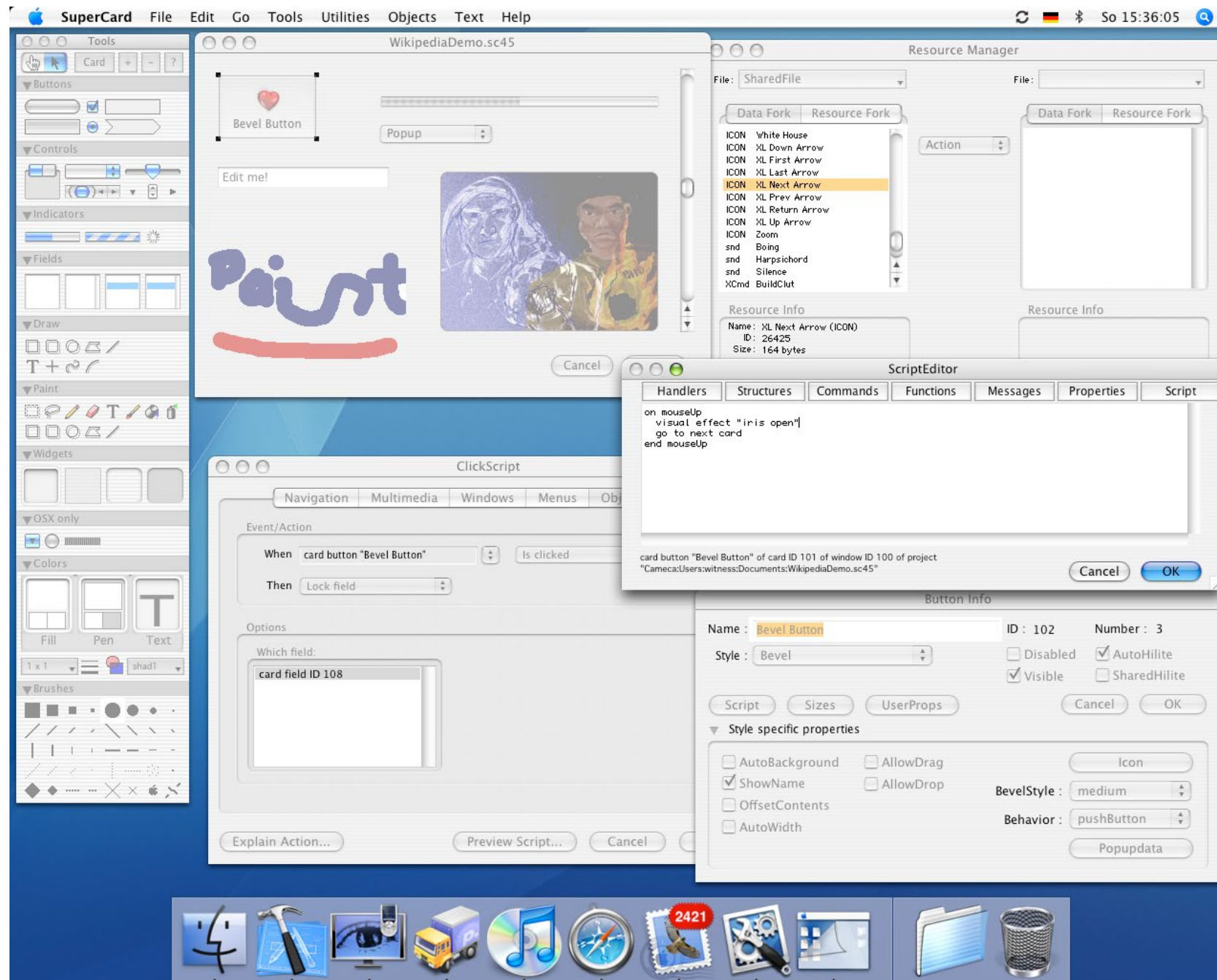
1990-2012



Asymetrix (Later SumTotal Systems)

SuperCard

1989-2012



Bill Appleton for Silicon Beach Software (Later Aldus Corporation, Allegiant Technologies, Incwell DMG, now Solutions Etcetera)

'Bureaucracy Processing'

From Static Documents To Living Environments

WordStar

1978-1999

```
H:INTRO  PAGE 1 LINE 9 COL 11      INSERT ON
      <<<      M A I N  M E N U      >>>
--Cursor Movement--  | -Delete- |  -Miscellaneous- |  -Other Menus-
^S char left ^D char right | ^G char | ^I Tab  ^B Reform | (from Main only)
^A word left ^F word right | DEL chr lf | ^V INSERT ON/OFF | ^J Help ^K Block
^E line up ^X line down | ^T word rt | ^L Find/Replce again | ^Q Quick ^P Print
      --Scrolling-- | ^Y line | RETURN End paragraph | ^O Onscreen
^Z line down ^W line up | | ^N Insert a RETURN |
^C screen up ^R screen down | | ^U Stop a command |
      !----!----!----!----!----!----!----!----!----!----!-----R

1. Introducing WordStar

WordStar is highly flexible and very visible. Watch the
screens as you give commands, and information in various
parts of the screen will guide you. You won't see all the
information all the time, but it will be there when you need
it.

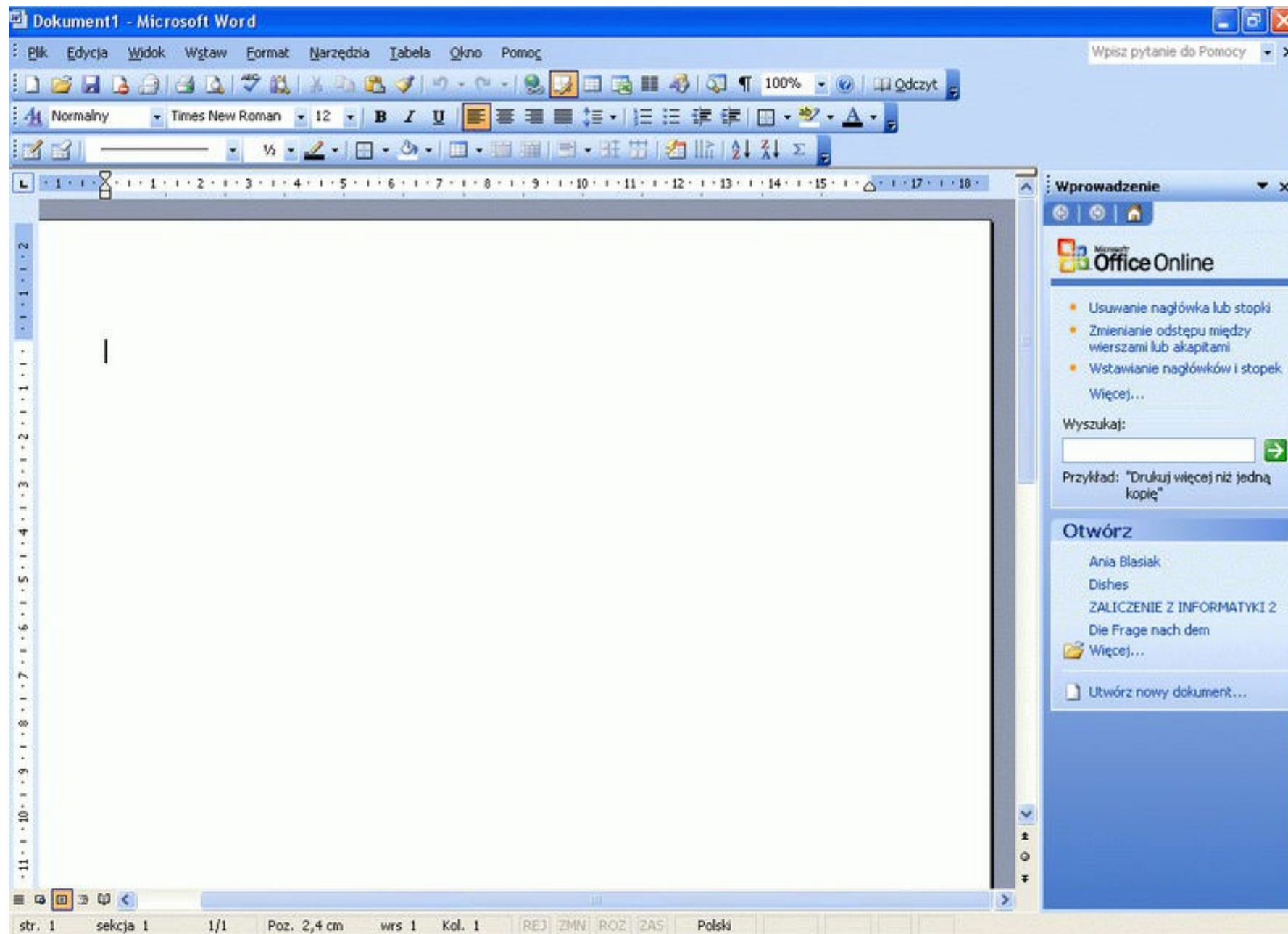
WHERE YOU ARE

The seven WordStar menus are your greatest aids. They are
like signposts at the top of your screen, showing you where
you are.
1HELP 2INDENT 3SET LM 4SET RM 5UNDLIN 6BLDFCE 7BEGBLK 8ENDBLK 9BEGFIL 10ENDFIL
```

Rob Barnaby

Word

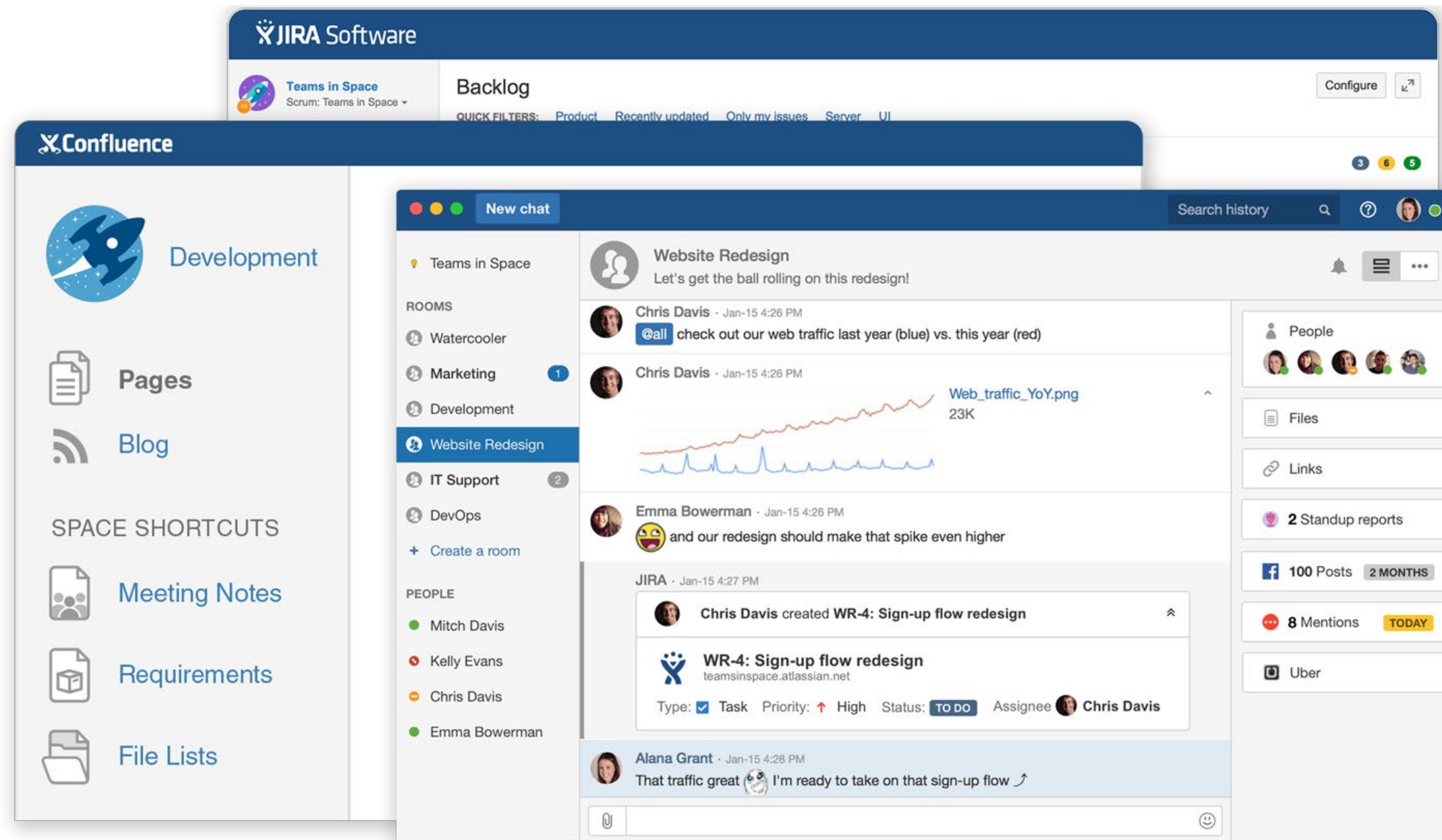
1983-Today



Microsoft

Atlassian (Suite)

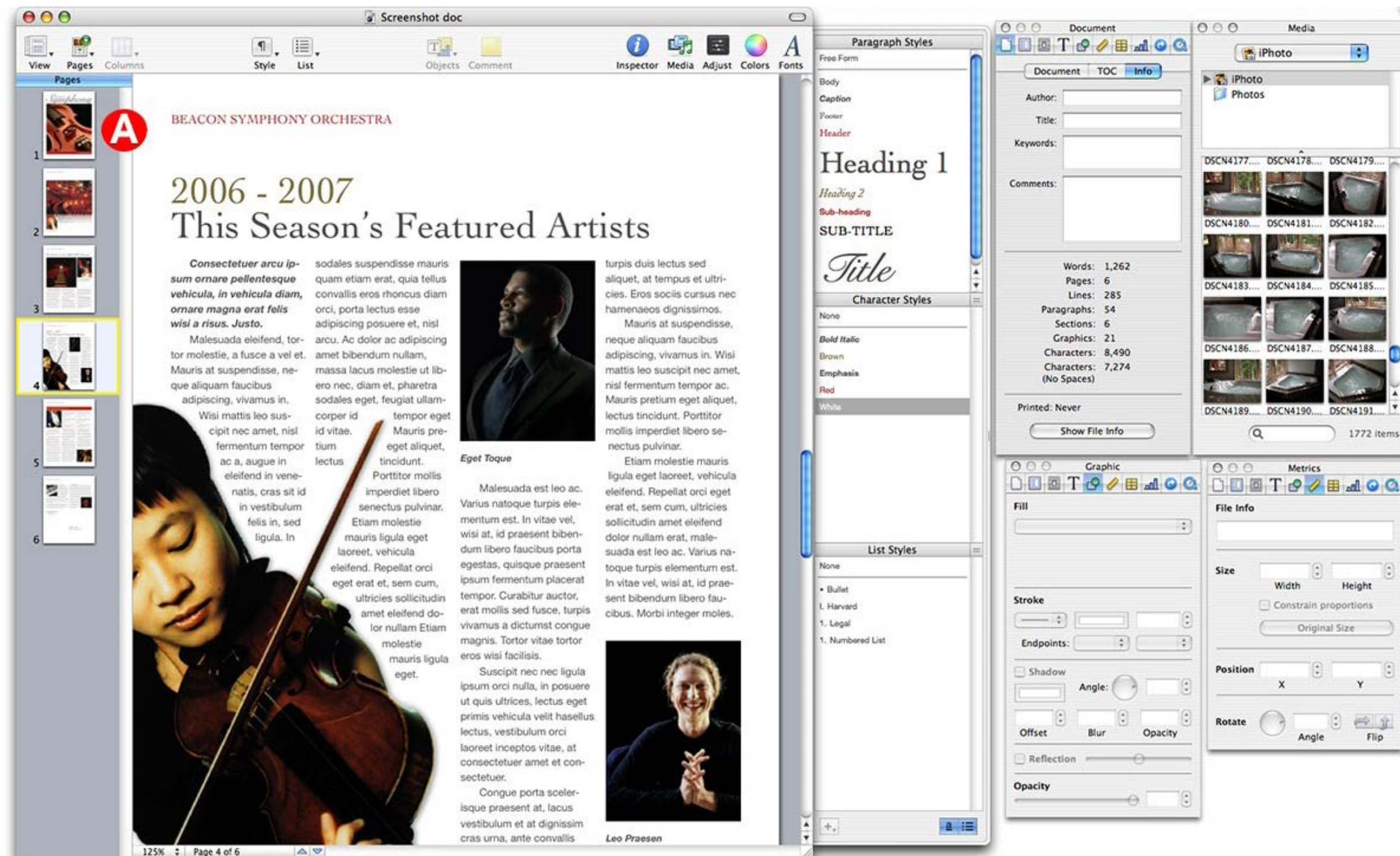
2002-Today



Mike Cannon-Brookes and Scott Farquhar

Pages

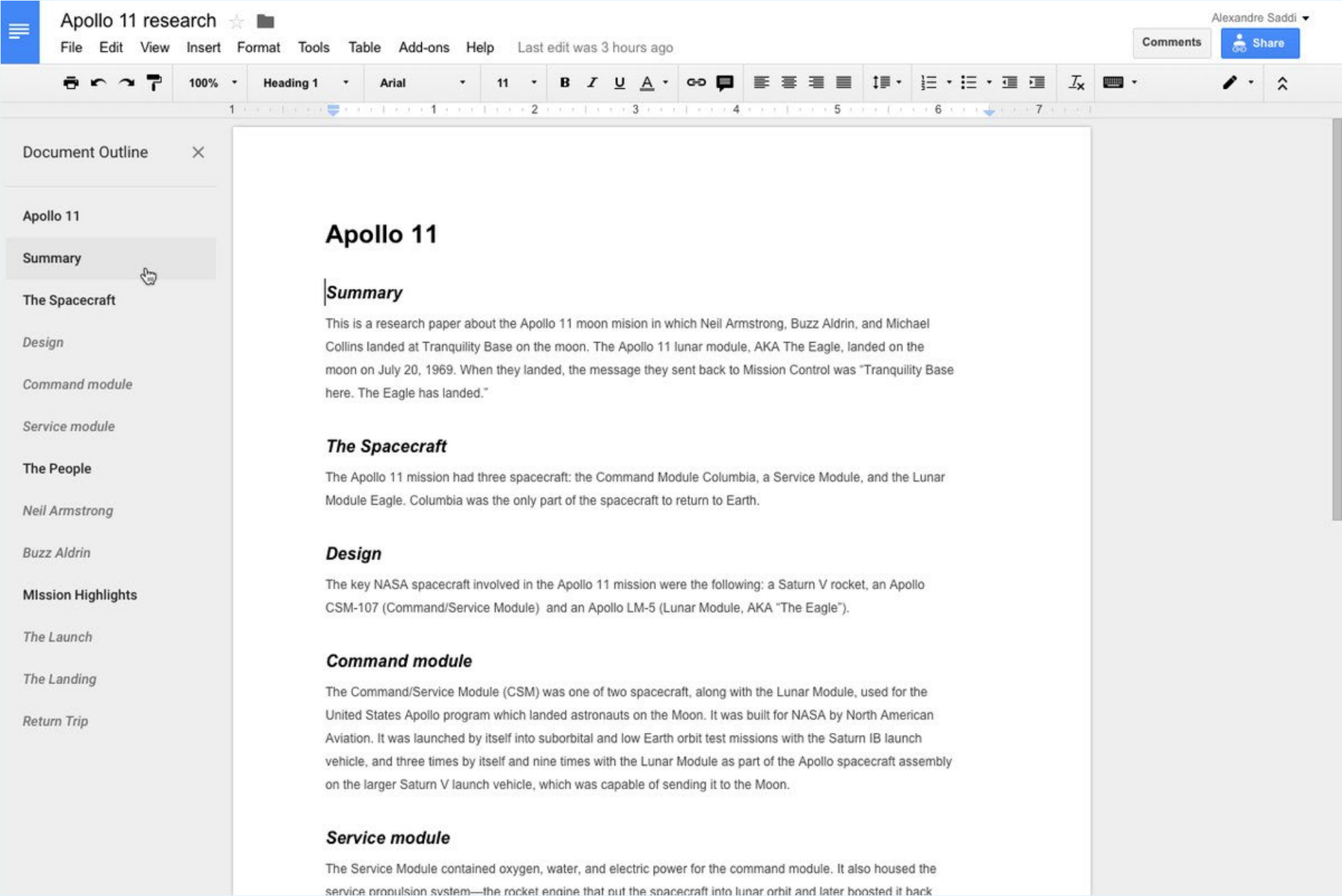
2005-Today

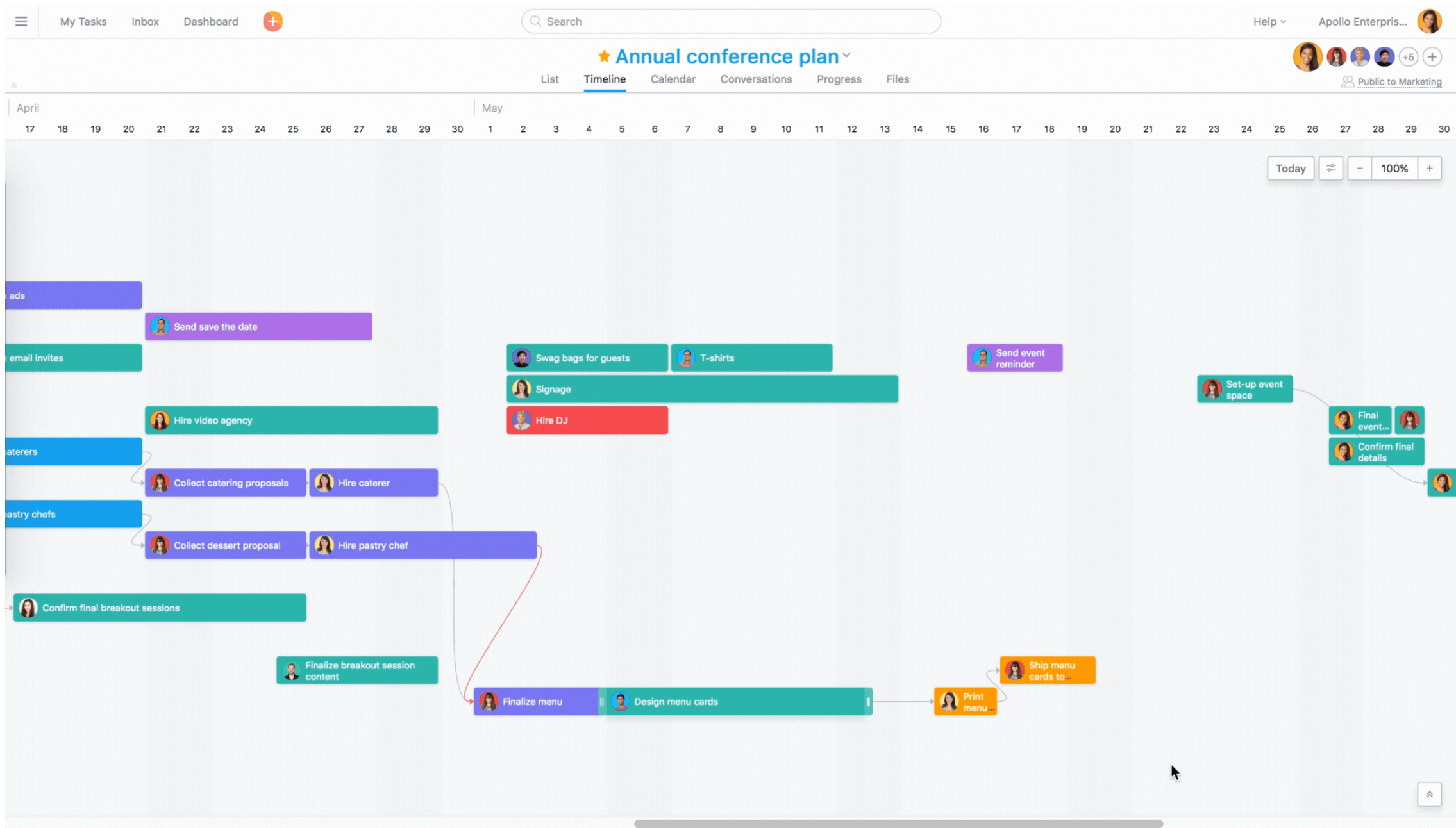


Apple

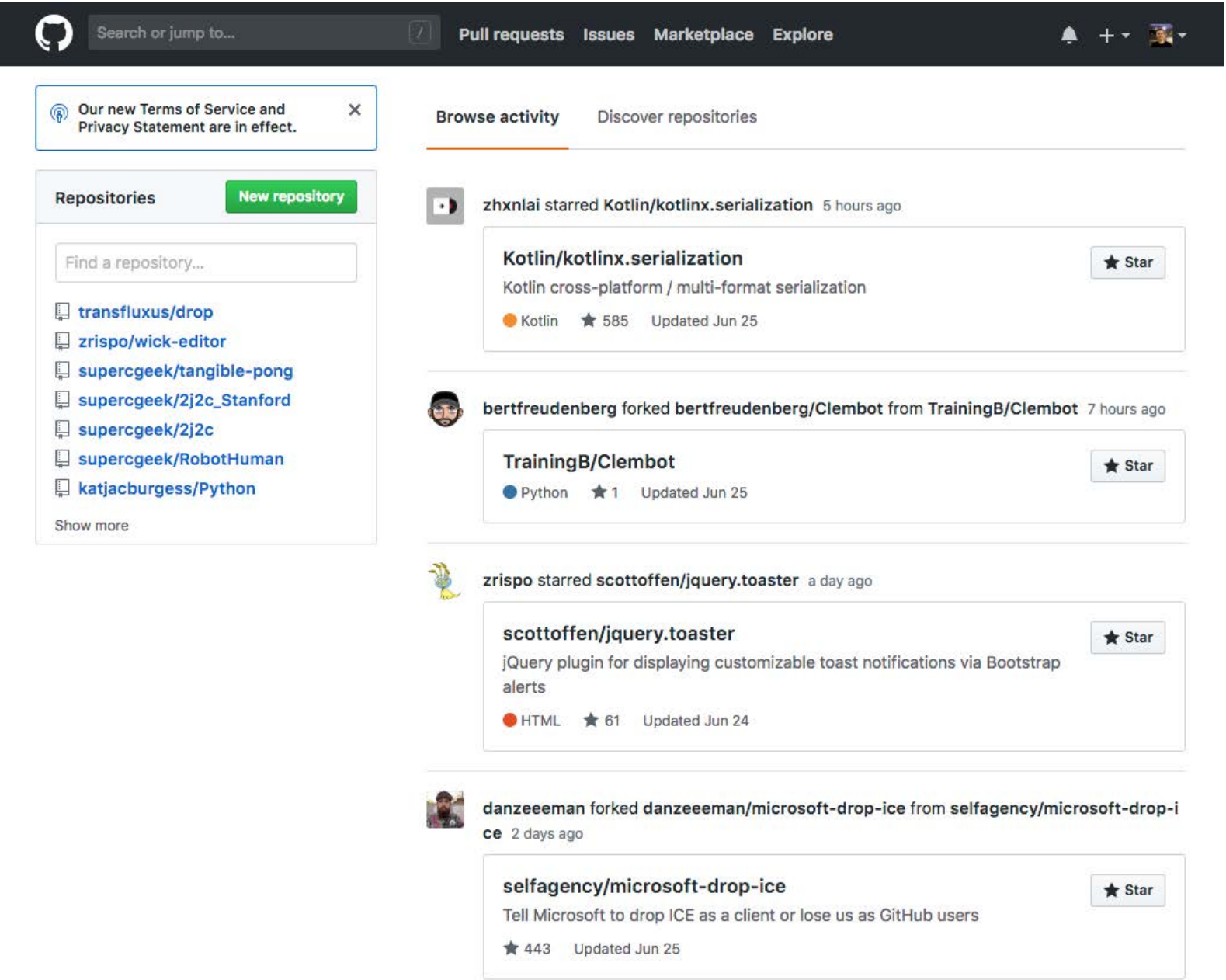
Docs

2006-Today





Dustin Moskovitz and Justin Rosenstein



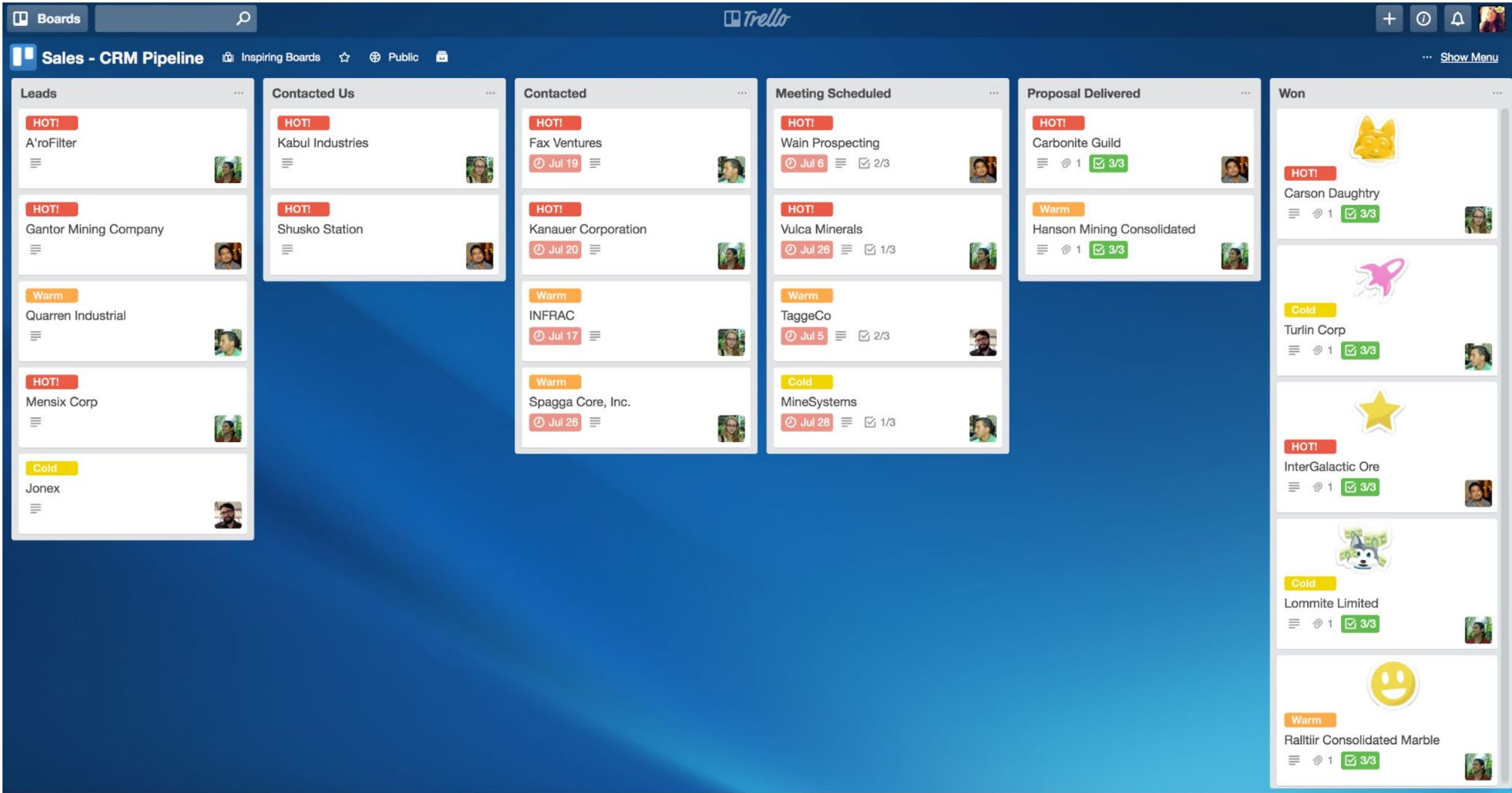
Tom Preston-Werner for GitHub Inc (Now Microsoft)

Wave

2009-2011



Google



Joel Spolsky at Fog Creek (Later Atlassian)

Tasks & Issues

Share Updates Favorite ...

Tasks & Issues

Board by Status

PropertiesGroup by StatusFilterSortSearch...New Item

No Status1...+Next Up2...+In Progress2...+Completed1

Button blue hover color

Important

Mike ShaferBrian Park

+ Add an Item

Fix keyboard shortcuts

BugImportant

Brian Park

+ Add an Item

Desktop push notifications

AndroidQA

Shawn Sanchez

+ Add an Item

Offline mode polish

iOSQA

Leslie Jensen

+ Add an Item

Add avatars

Polish

Leslie Jensen

+ Add an Item

Rename archive to trash

Polish

Shawn Sanchez

+ Add an Item

Bits to Atoms

Computation meets Business & Industry

Spreadsheets

Functional Programming – with a visual interface – became the PC's first 'Killer App'

VisiCalc

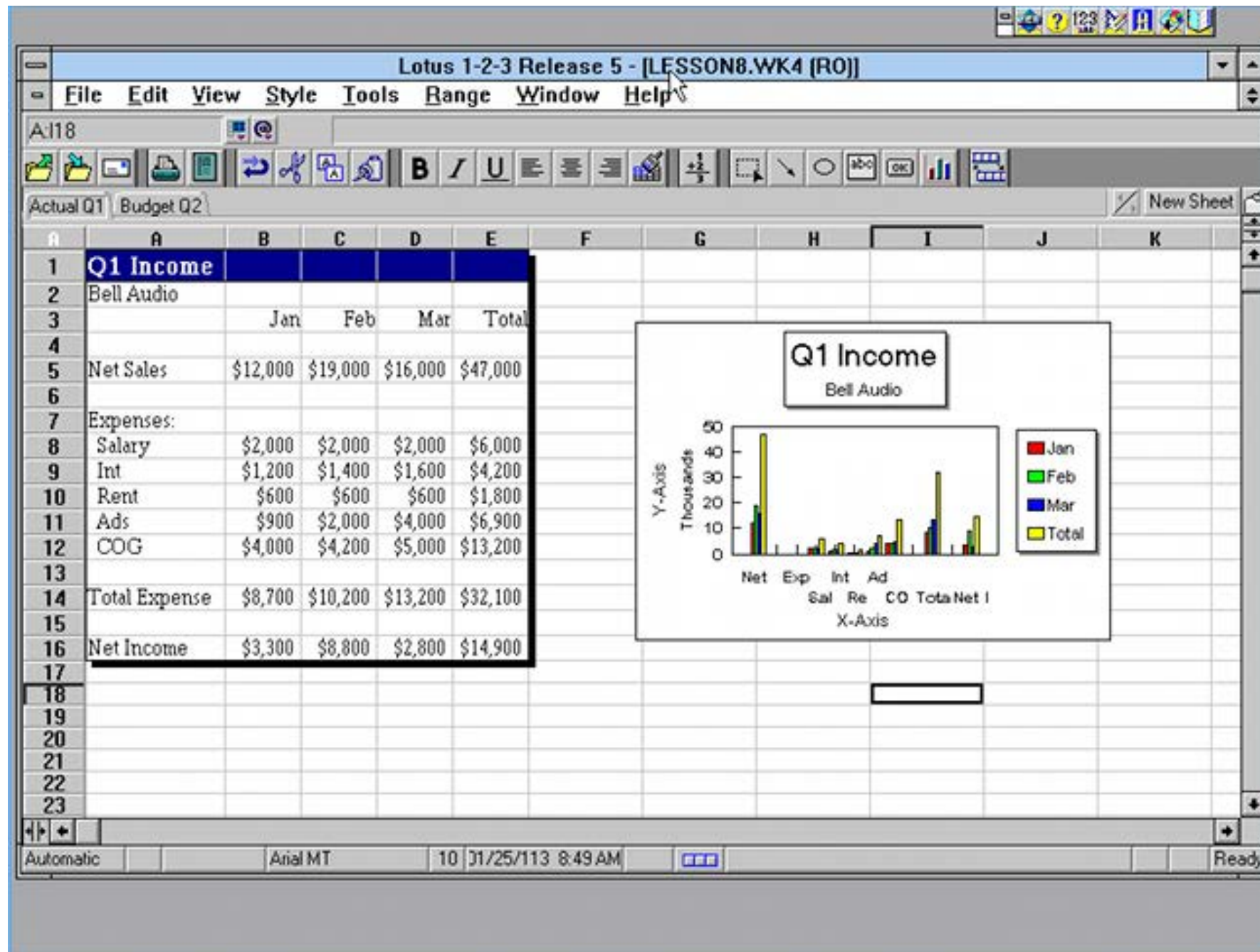
1979-1983

C11 (L) TOTAL				C1
				25
	A	B	C	D
	ITEM	NO.	UNIT	COST
	----	----	----	----
	MUCK RAKE	43	12.95	556.00
	BUNZ CUT	15	6.75	101.25
	TOE TONER	25	4.95	124.80
	EYE SNUFF	2	4.95	9.90
			SUBTOTAL	13155.50
		9.75% TAX		1282.66
			TOTAL	14438.16

Software Arts

1-2-3

1983-2002



Lotus Software

Excel

1987-Today

Microsoft Excel - pairs.xls

File Edit View Insert Format Tools Data Window Help

75%

A1 = ^No.

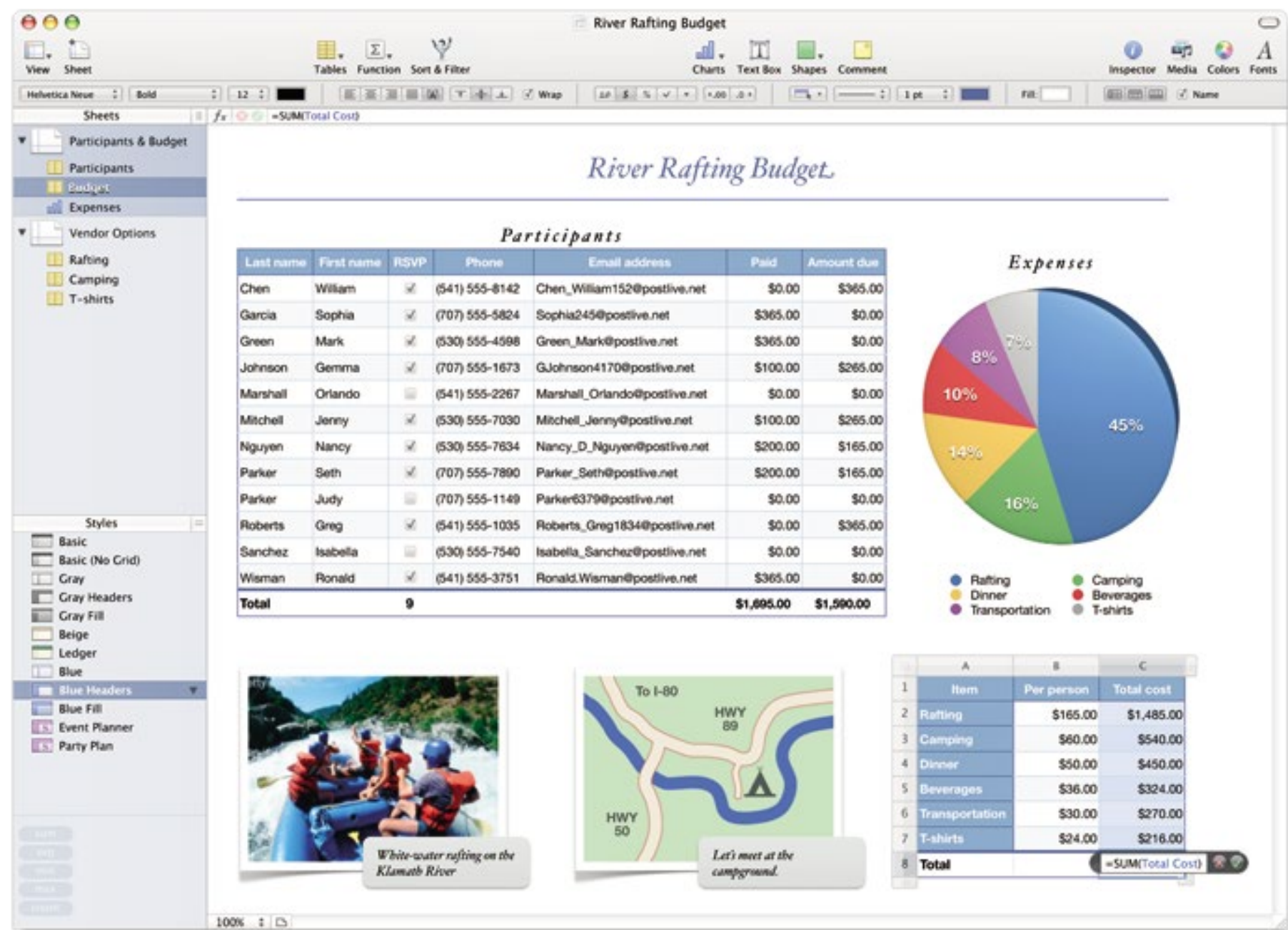
	A	B	C	D	E	F	G	H	I	J	K
1	No.	Date	Ball 1	Ball 2	Ball 3	Ball 4	Ball 5	Ball 6			Update Pair Stats
2	1st	19-Nov-94	3	5	14	22	30	44			
3	2nd	26-Nov-94	6	12	15	16	31	44			
4	3rd	3-Dec-94	11	17	21	29	30	40			
5	4th	10-Dec-94	26	35	38	43	47	49			
6	5th	17-Dec-94	3	5	9	13	14	38			
7	6th	24-Dec-94	2	3	27	29	39	44			
8	7th	31-Dec-94	9	17	32	36	42	44			
9	8th	7-Jan-95	2	5	21	22	25	32			
10	9th	14-Jan-95	7	17	23	32	38	42			
11	10th	21-Jan-95	6	16	20	30	31	47			
12	11th	28-Jan-95	4	16	25	26	31	43			
13	12th	4-Feb-95	1	7	37	38	42	46			
14	13th	11-Feb-95	15	18	29	35	38	48			
15	14th	18-Feb-95	16	19	21	29	36	45			
16	15th	25-Feb-95	5	8	10	18	21	22			

Ready

Microsoft

Numbers

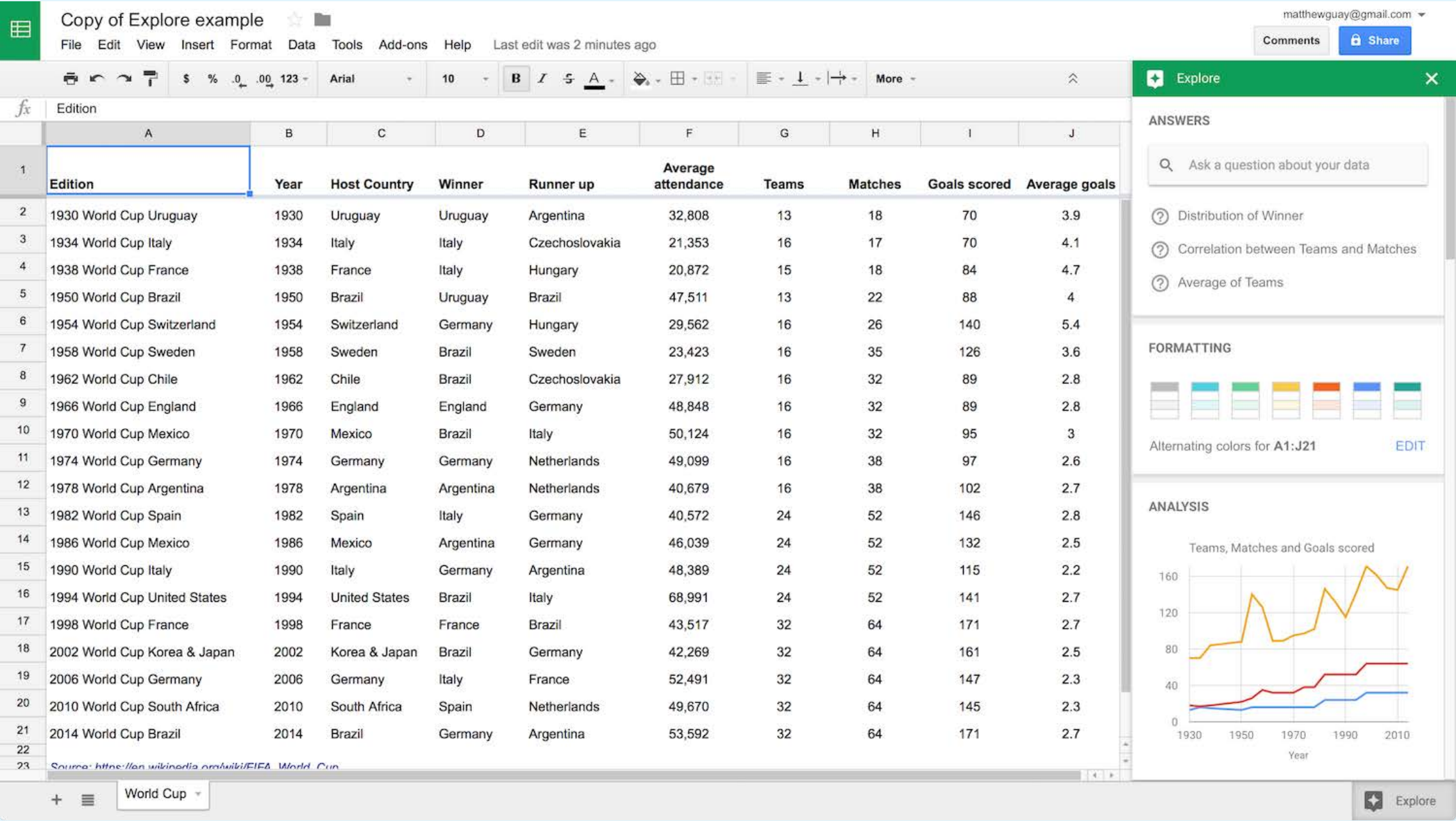
2005-Today



Apple

Sheets

2006-Today

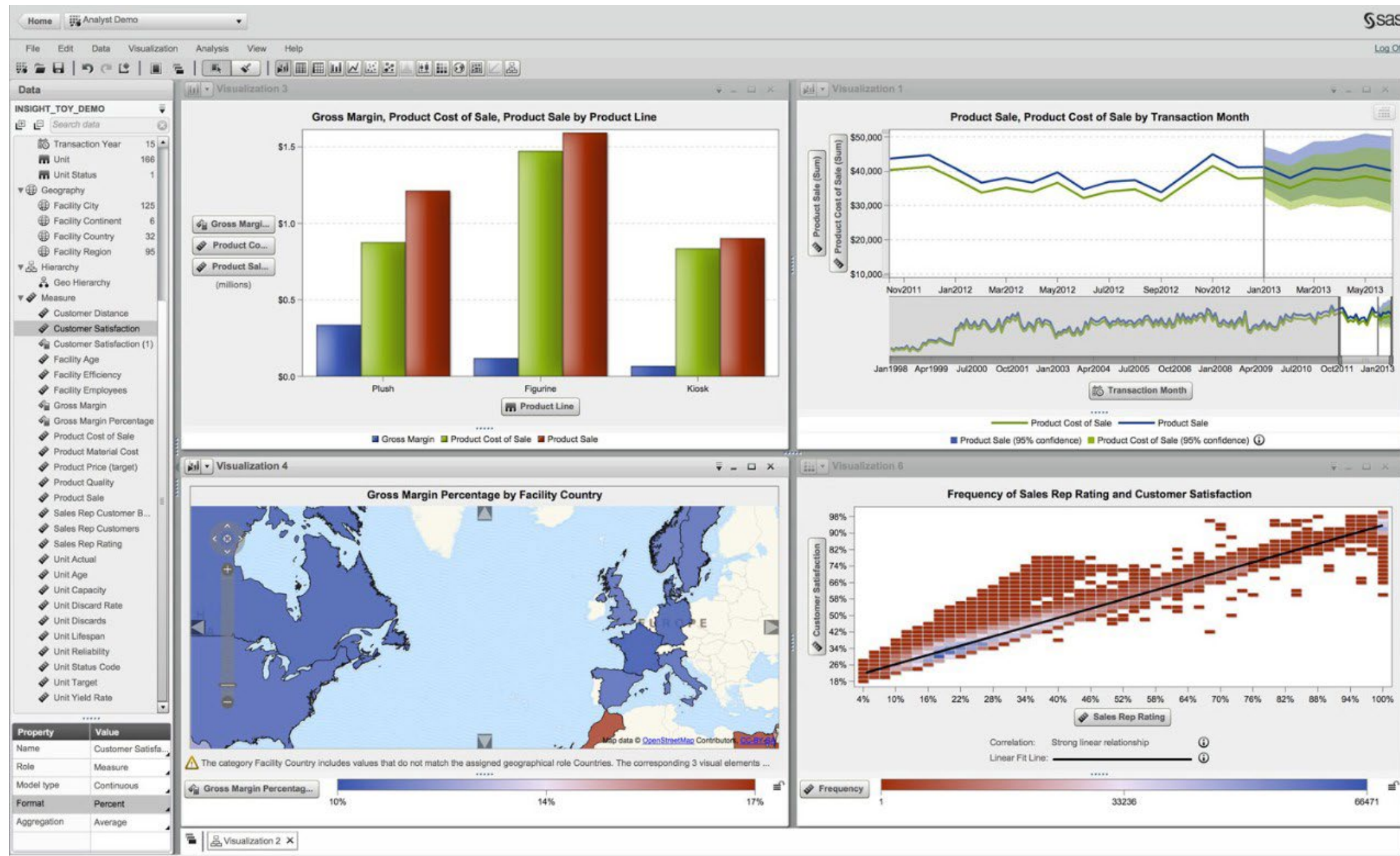


Data Analysis

From Simple Languages to
Expansive Environments and
Hosted Compute Platforms

SAS

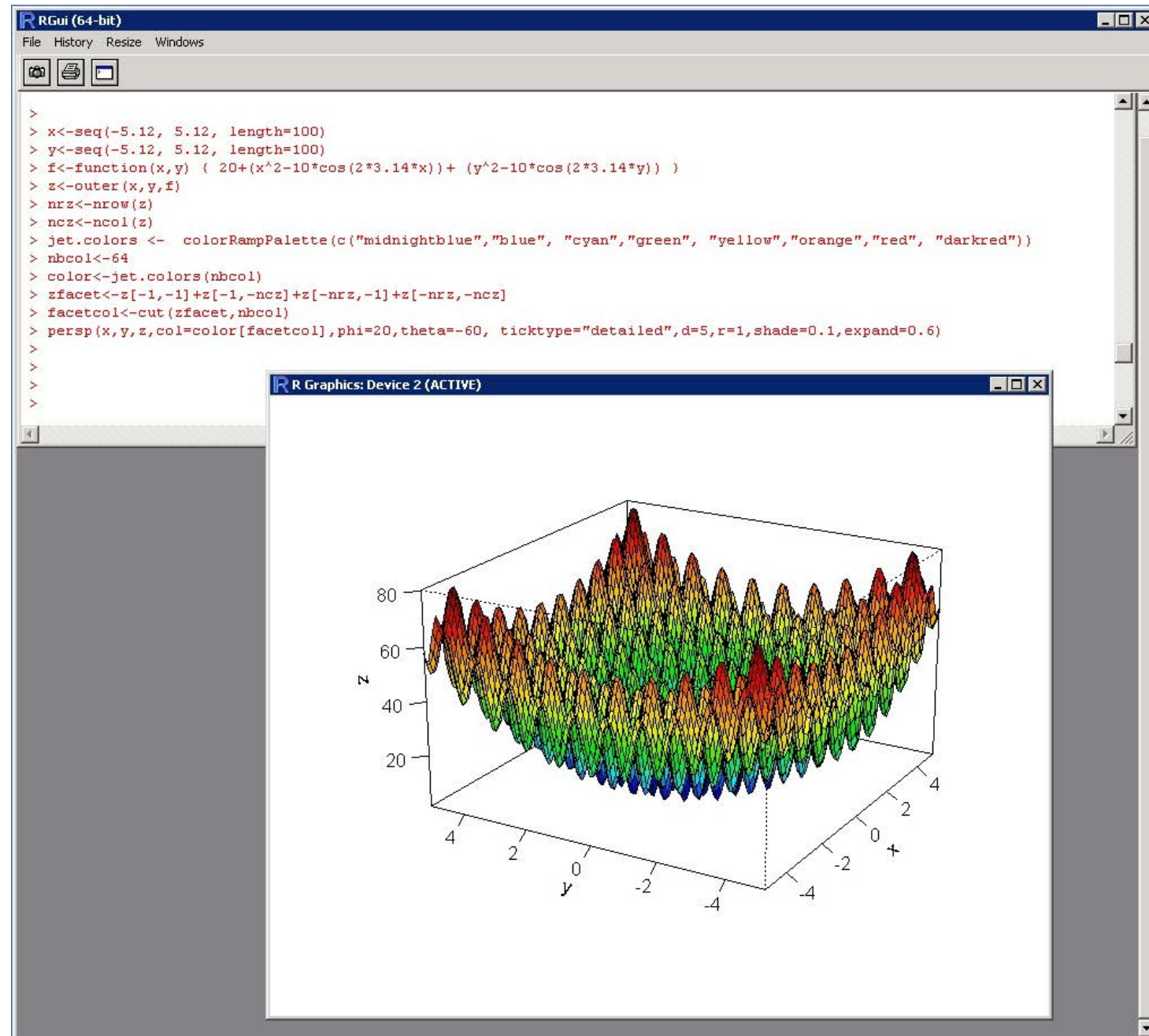
1976-2013



SAS Institute

R

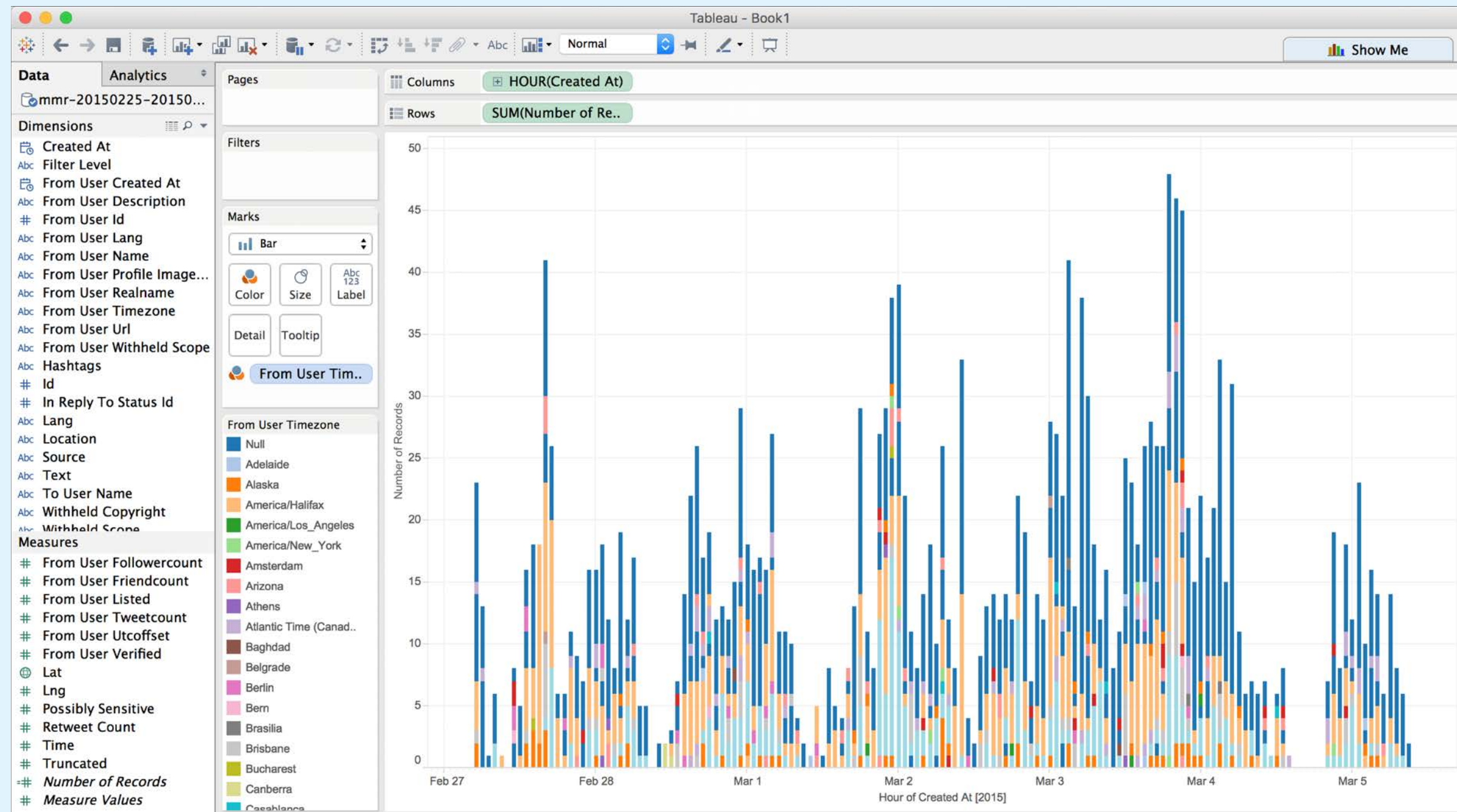
1993-Today



Ross Ihaka and Robert Gentleman (Now the R Core Team)

Tableau

2003-Today



Pat Hanrahan, Christian Chabot, Chris Stolte for Tableau Software

RapidMiner

2006-Today

The screenshot displays the RapidMiner software interface with a workflow titled "Main Process". The workflow consists of the following steps:

- Retrieve**: Connects to a data source.
- Normalization**: Normalizes the data.
- MissingValue...**: Handles missing values.
- LibSVM**: The core machine learning model.
- Nominal2Bino...**: Converts nominal attributes to binary.
- Nominal2Num...**: Converts nominal attributes to numeric.

The right-hand pane shows the **Parameters** for the **LibSVM (Support Vector Machine (LibSVM))** operator:

- svm type: C-SVC
- kernel type: rbf
- gamma: 22644346174132
- C: 85795883818439
- epsilon: 0.0010
- ☐ calculate confidences

A warning message indicates "4 hidden expert parameters".

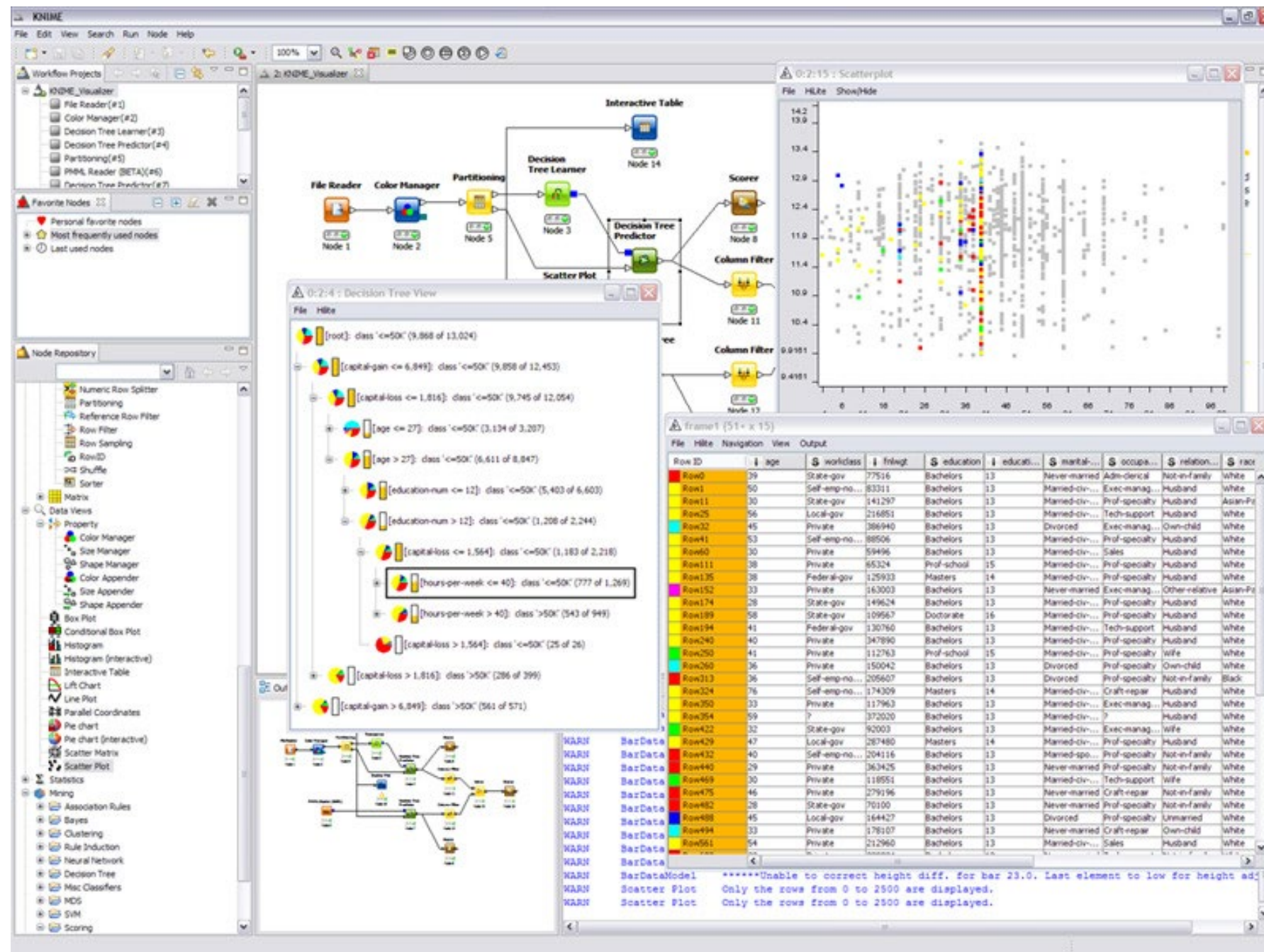
The bottom pane shows the **Problems** section with the message: "2 potential problems".

Message	Fixes	Location
Attribute filter does not match any attributes.	Select all attributes.	Nominal2Binomin...
Attribute filter does not match any attributes.	Select all attributes.	Nominal2Numeric...

RapidMiner

Knime

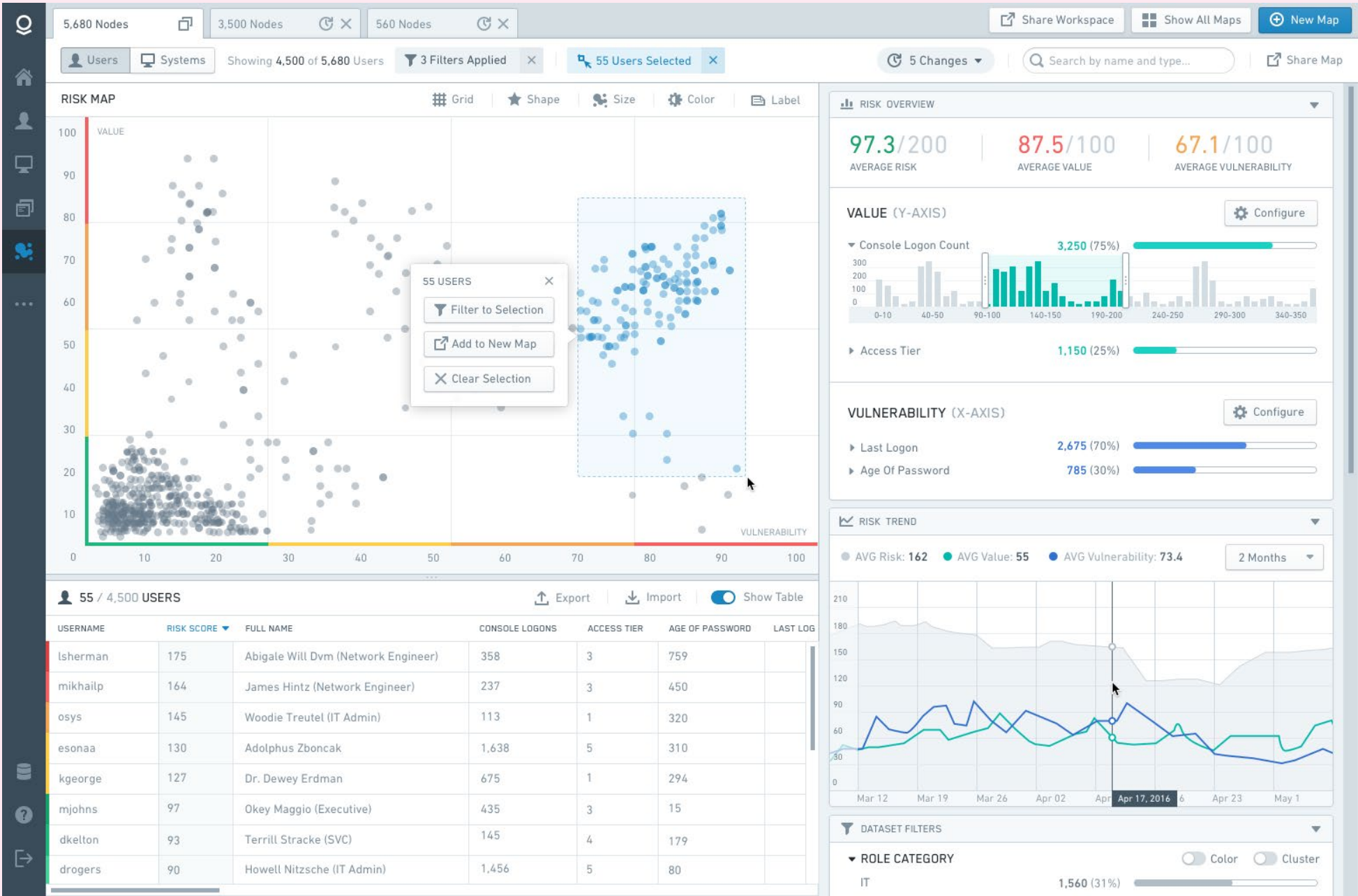
2006-Today



KNIME.com AG

Foundry

-Foundry

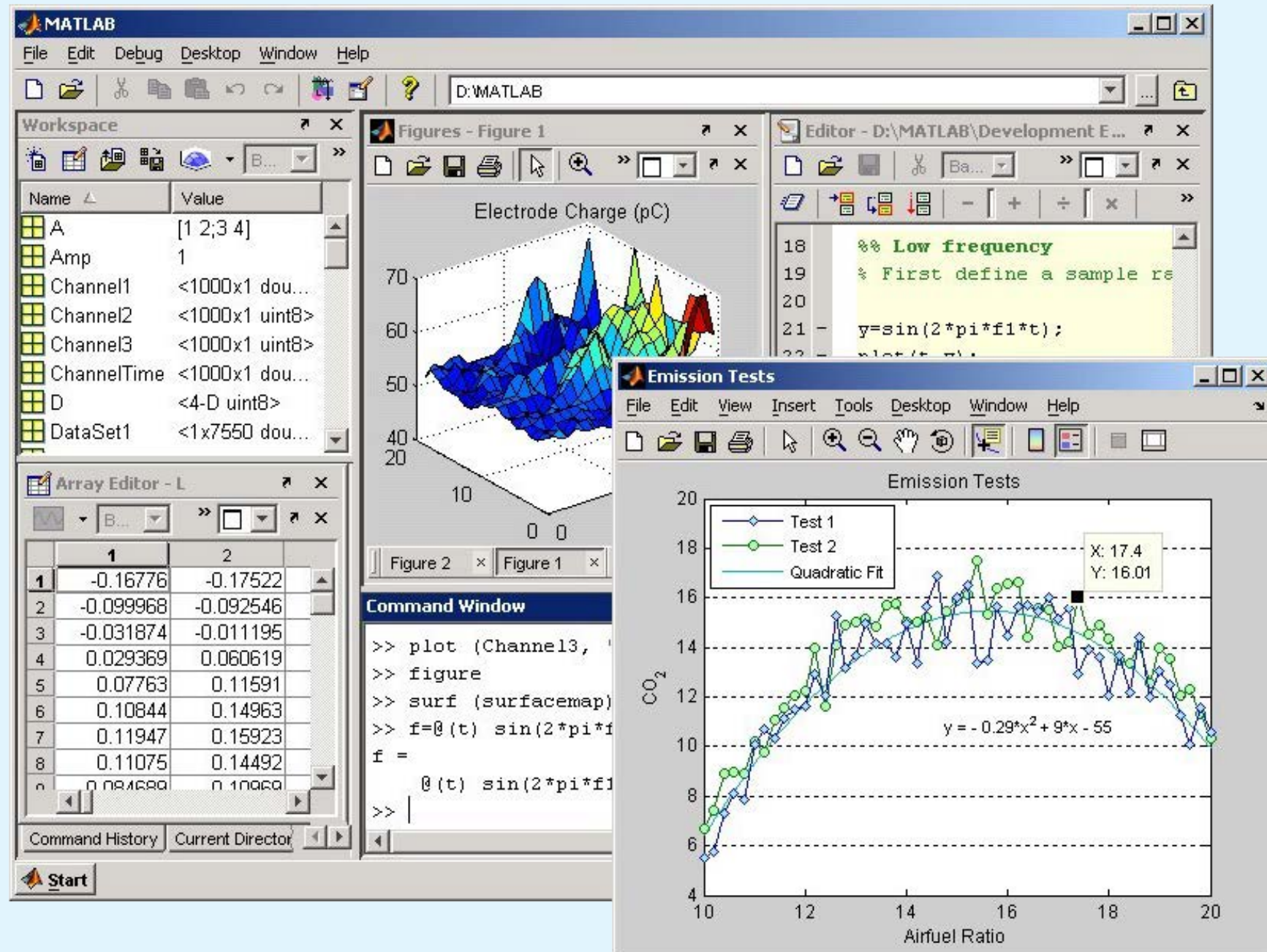


Palantir

Simulation

MATLAB

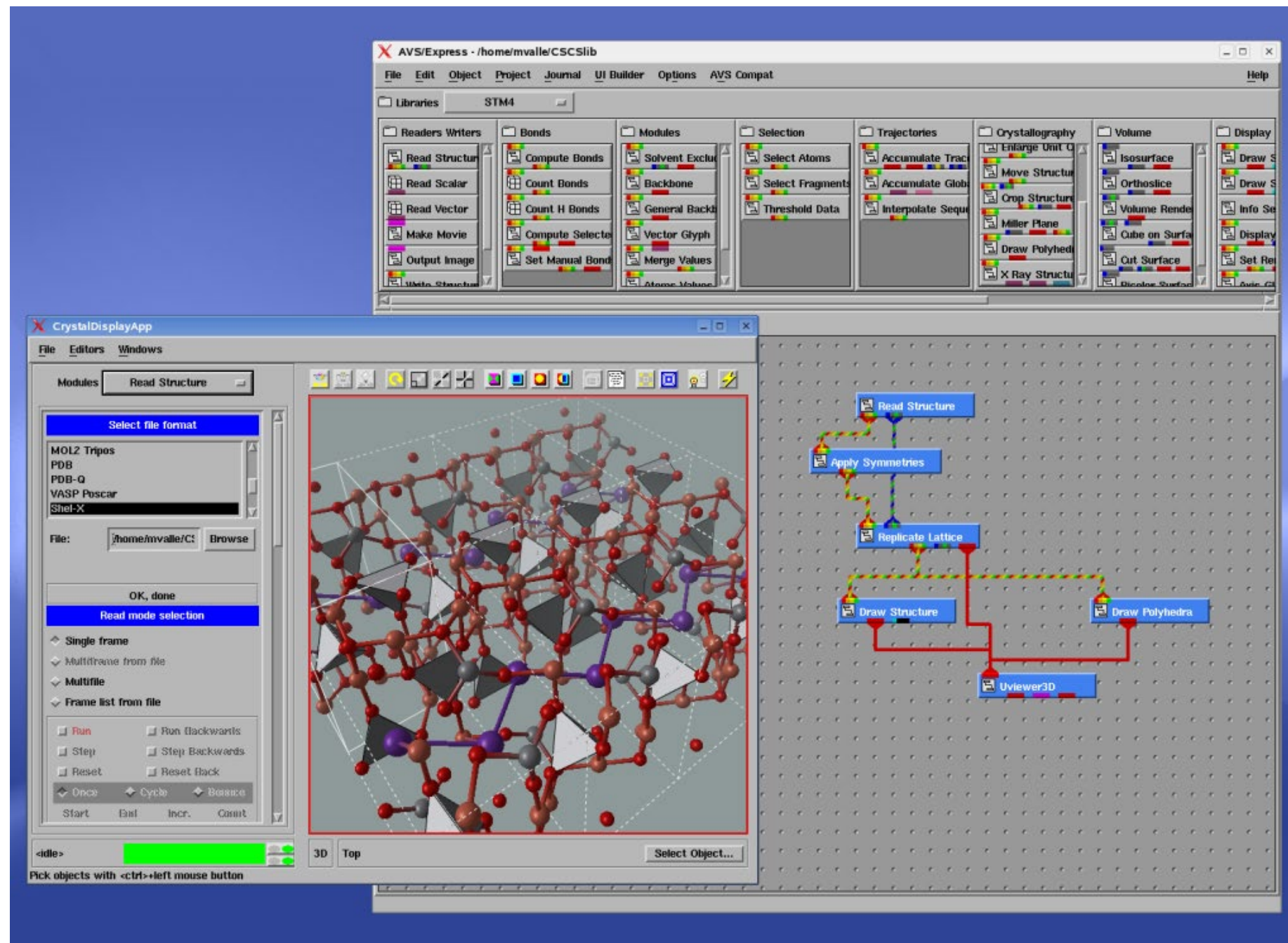
1984-Today



Cleve Moler, Steve Bangert and Jack Little for MathWorks

AVS Express

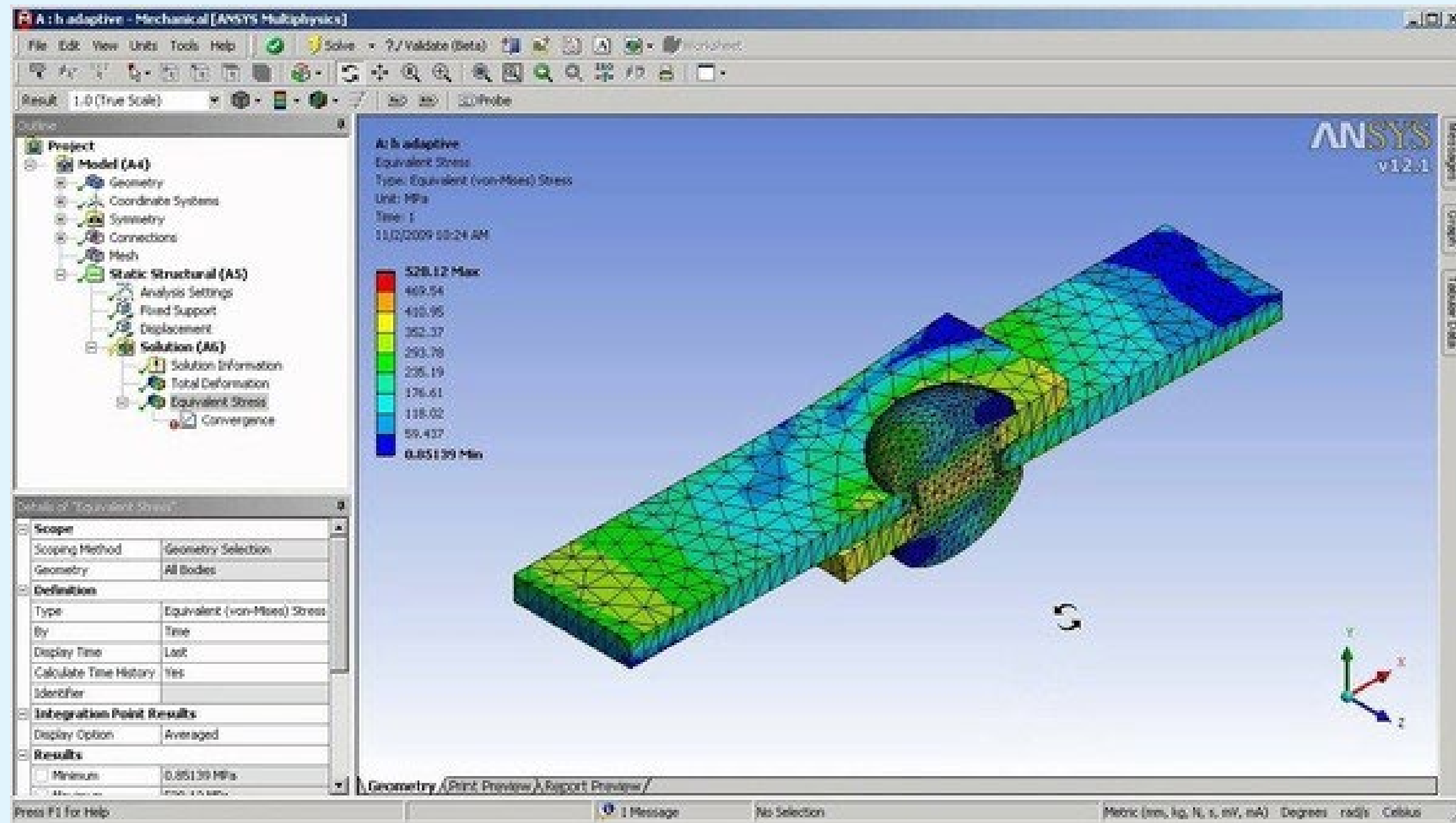
1991-Today



Advanced Visual Systems Inc

Ansys

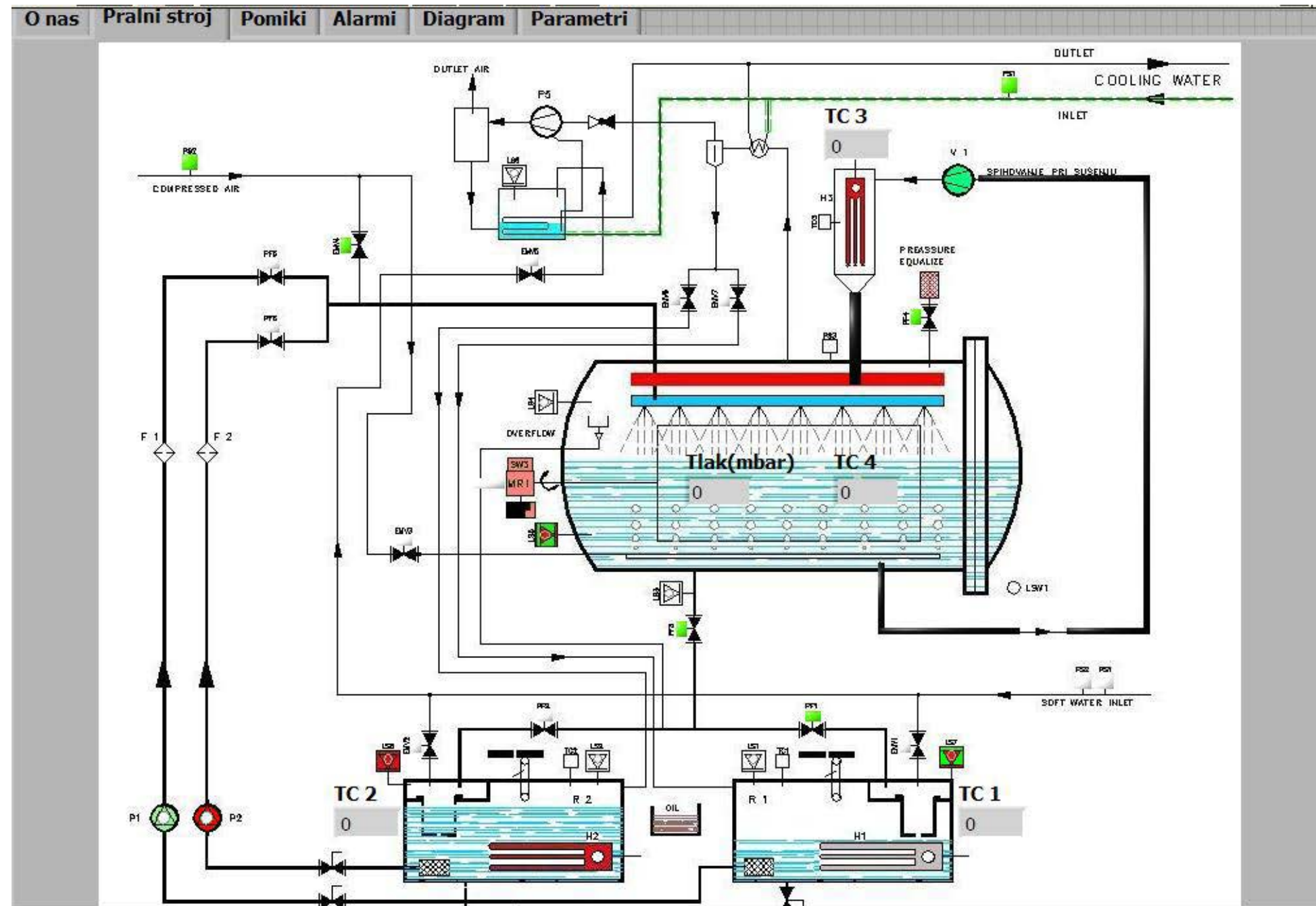
1970-Today



ANSYS Inc

LabView

1986-Today

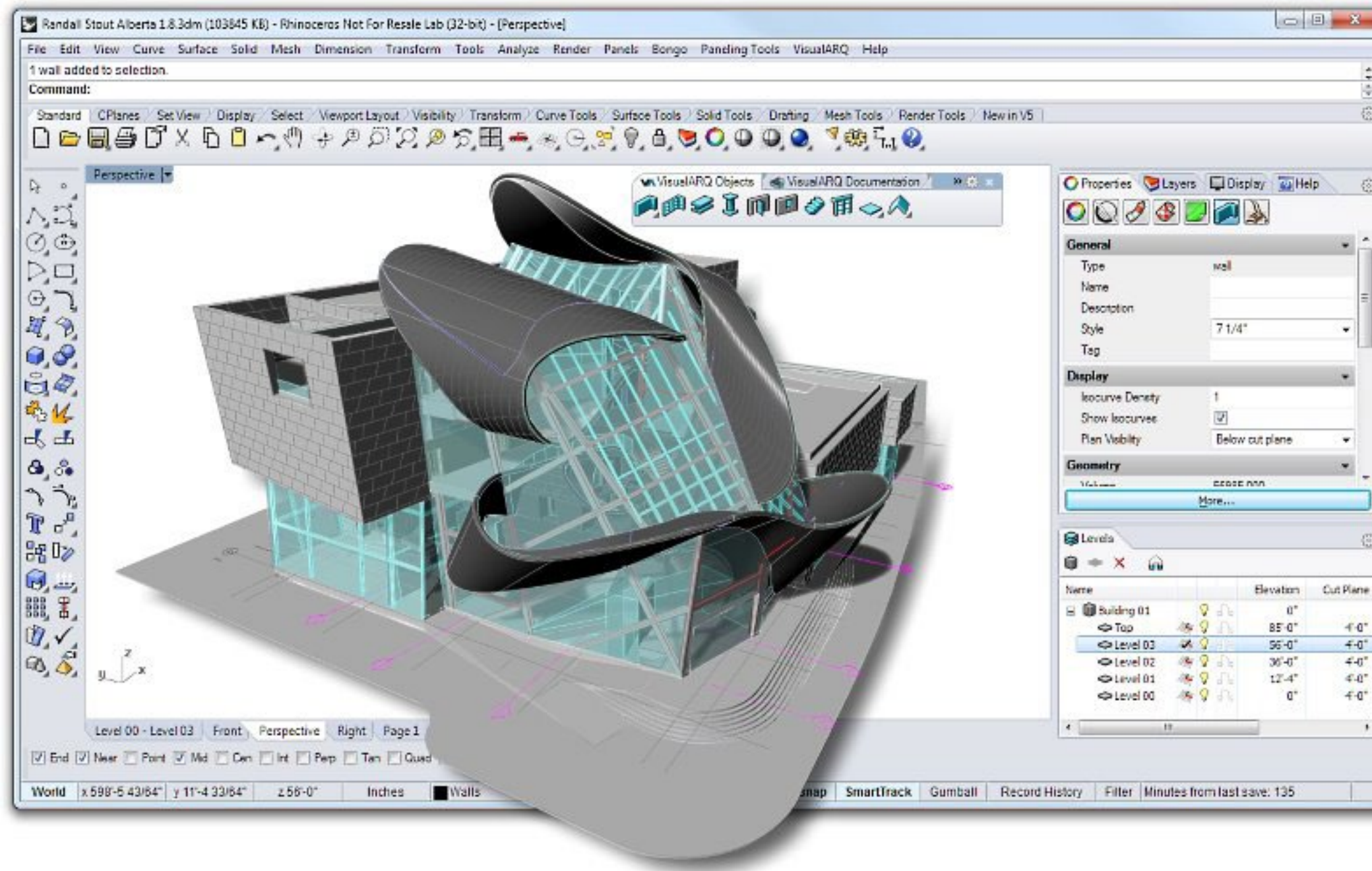


National Instruments

3D (Solid Geometry) Modeling

Rhino

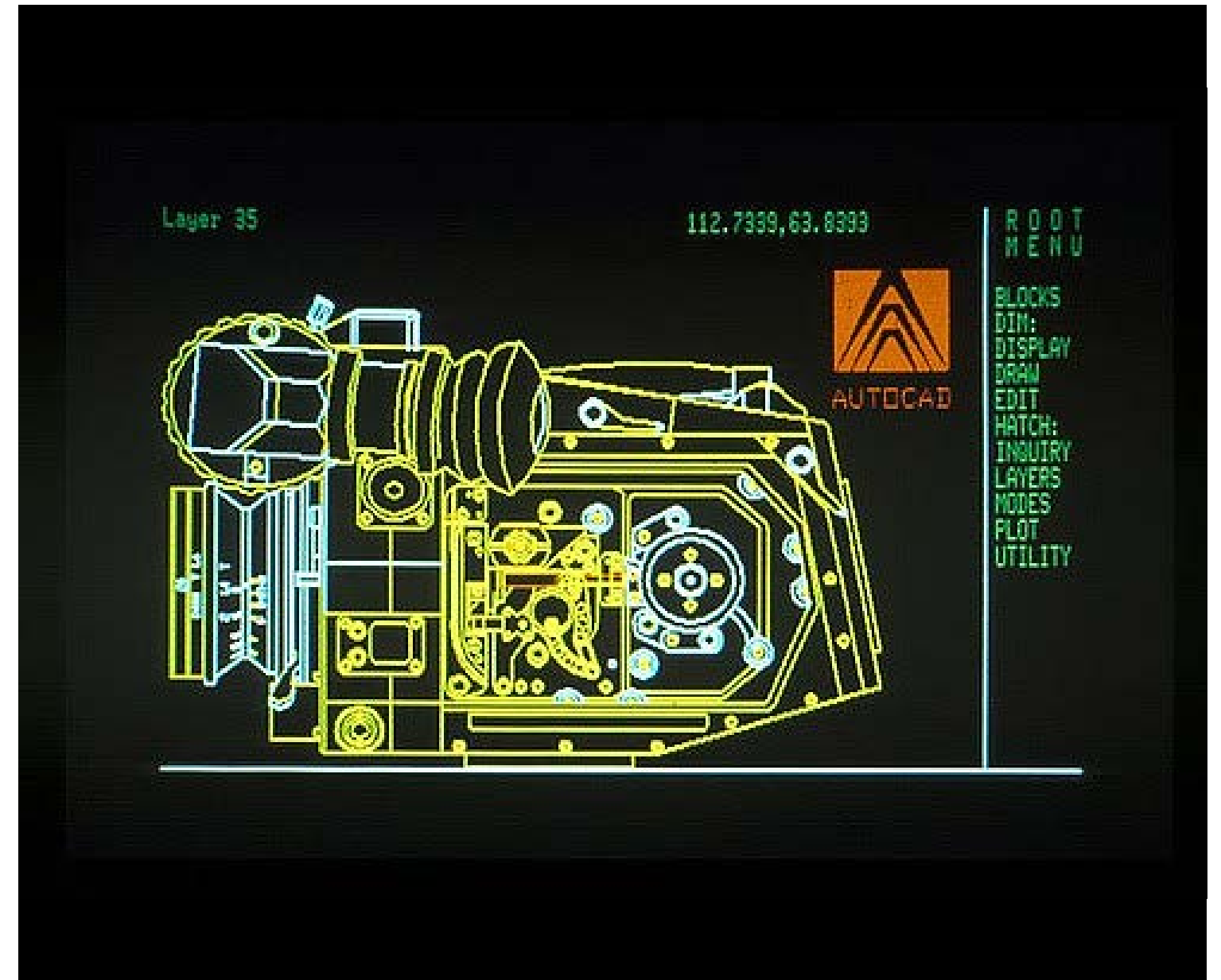
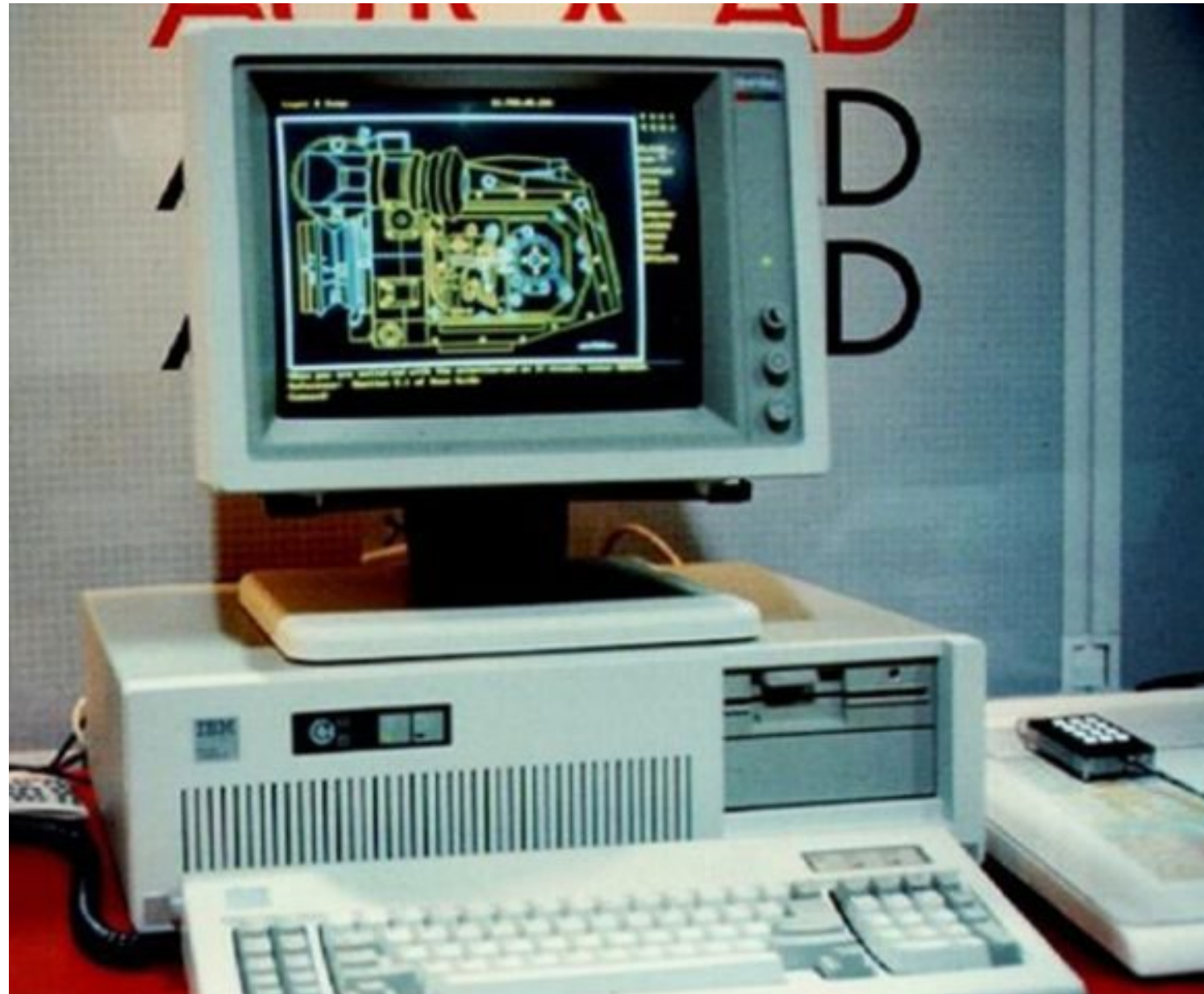
1980-Today



Robert McNeel & Associates

AutoCAD

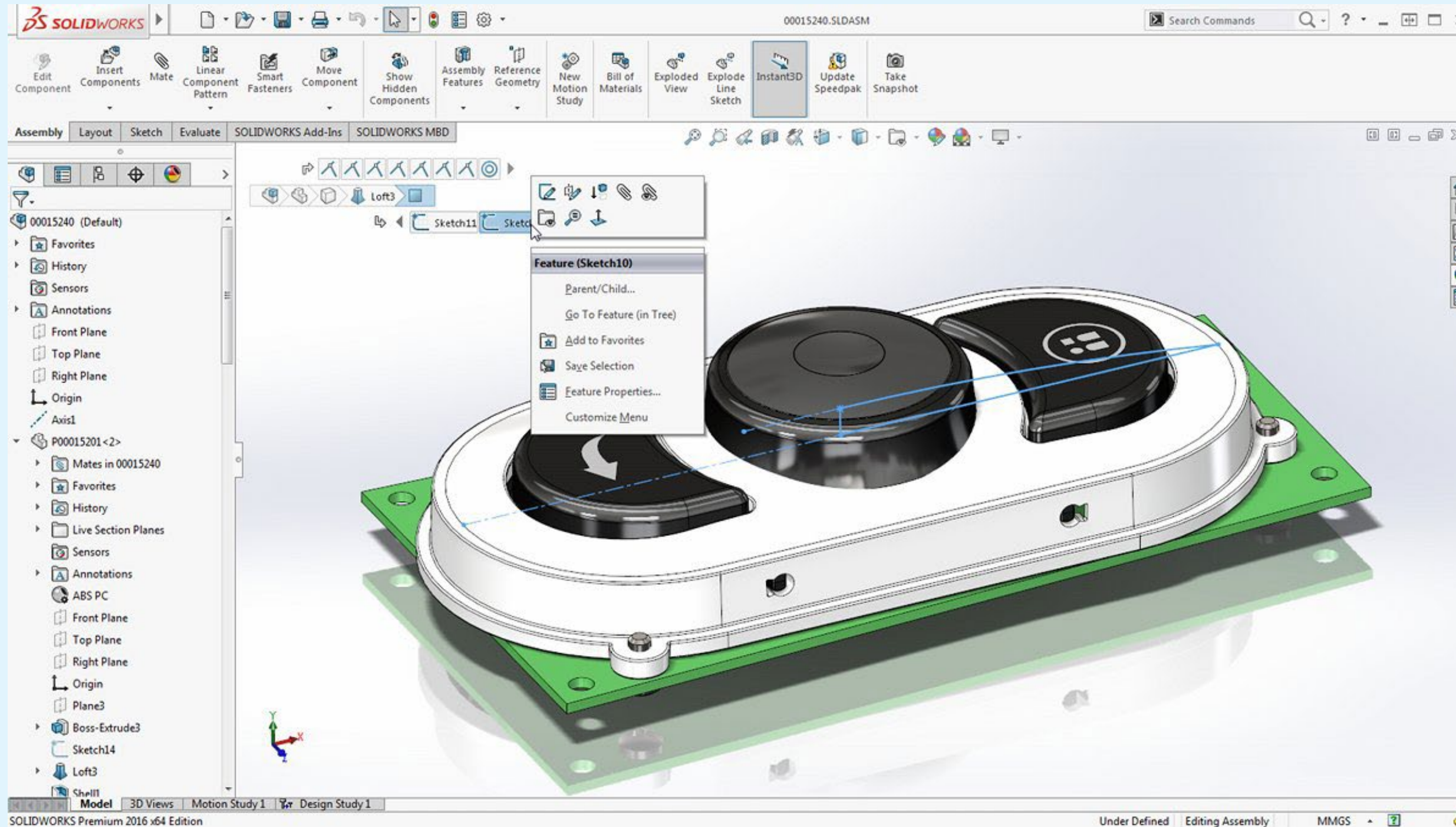
1982-Today



AutoDesk

SolidWorks

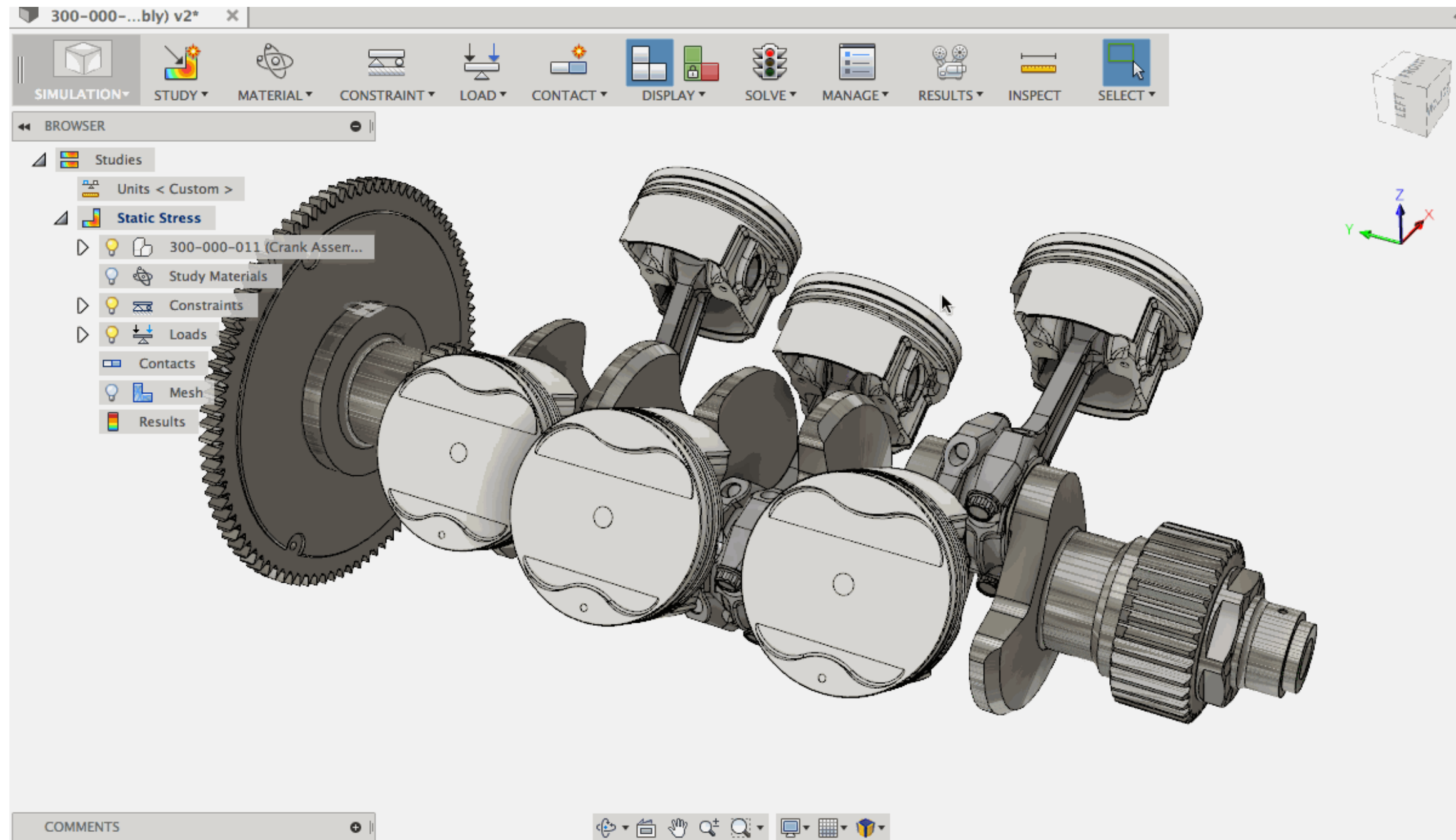
1995-Today



Dassault Systèmes

Fusion 360

2013-Today



Autodesk

Design Machine

Creative Tools for Everyone

Graphics

Direct-Manipulation + Computer Graphics

Sketchpad

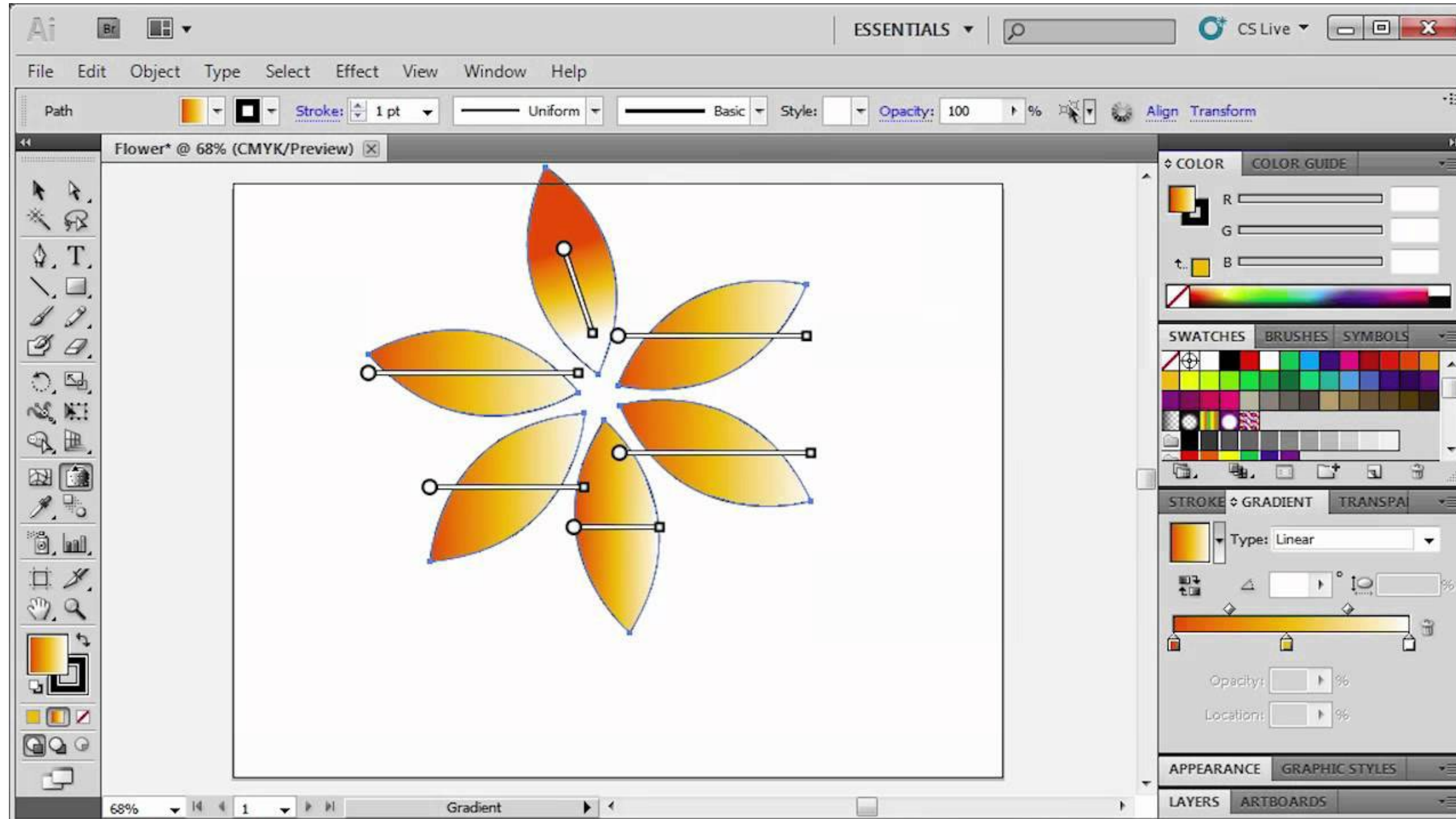
1963



Ivan Sutherland

Illustrator

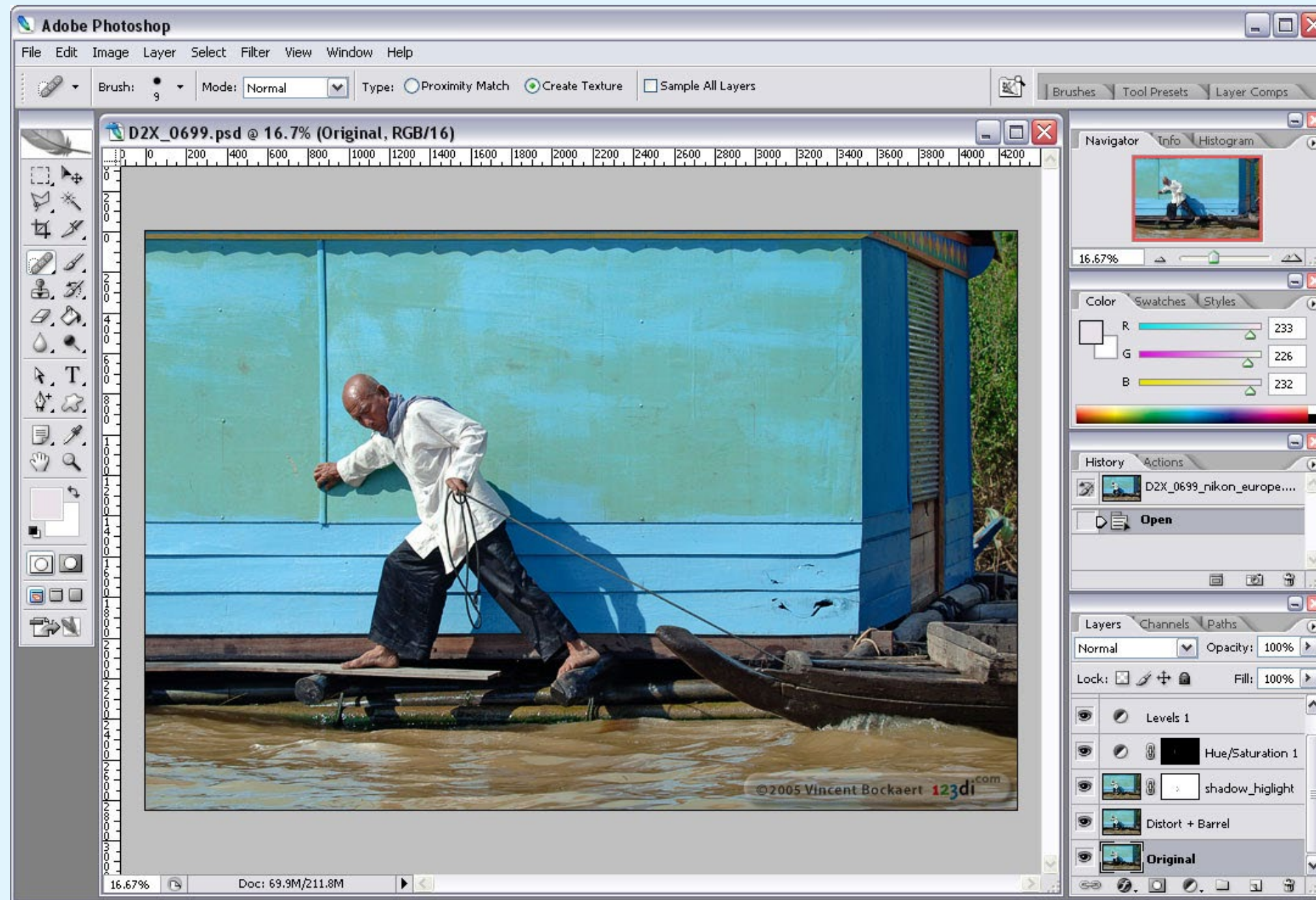
1987-Today



Adobe Systems

Photoshop

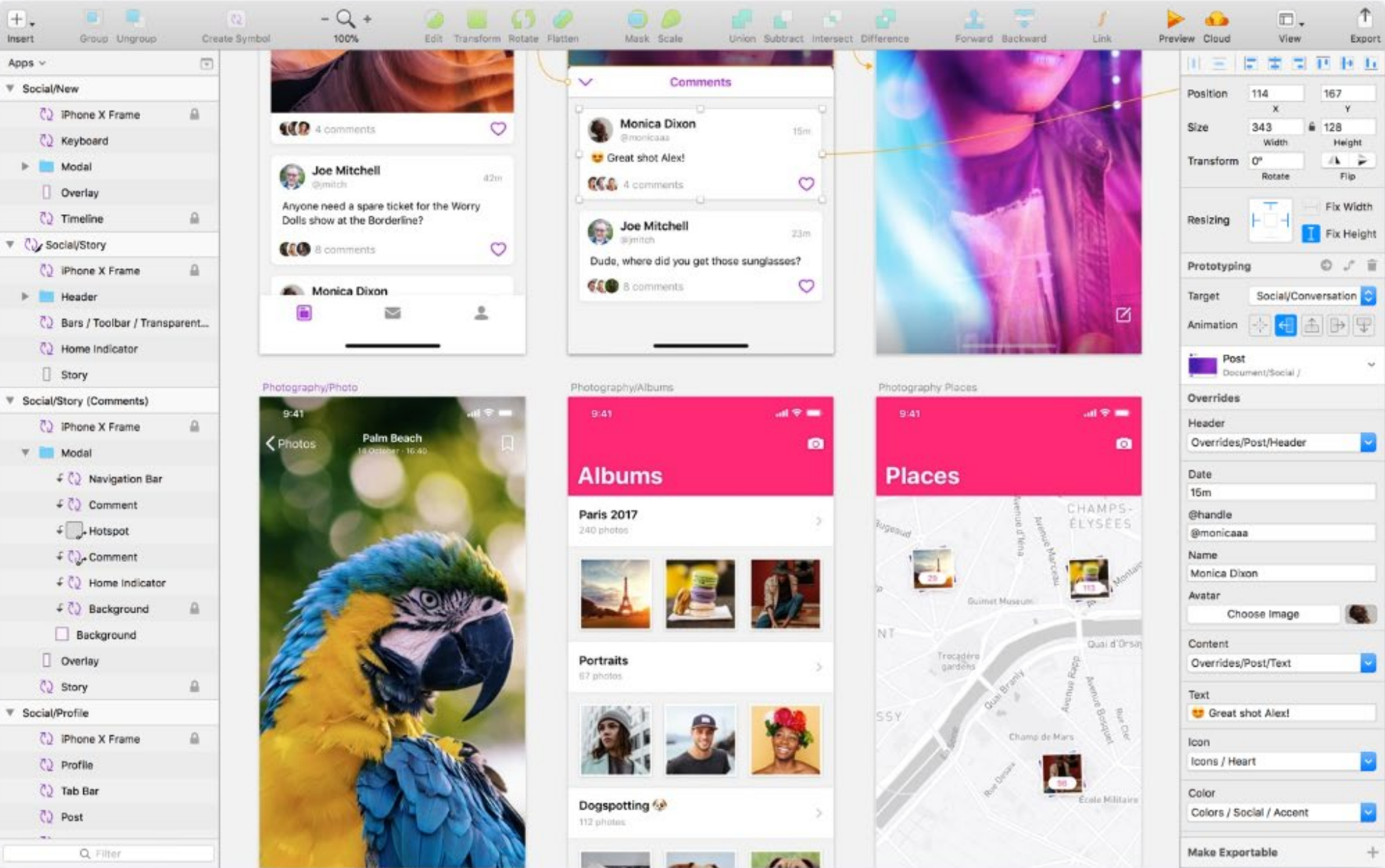
1990-Today



Adobe Systems

Sketch

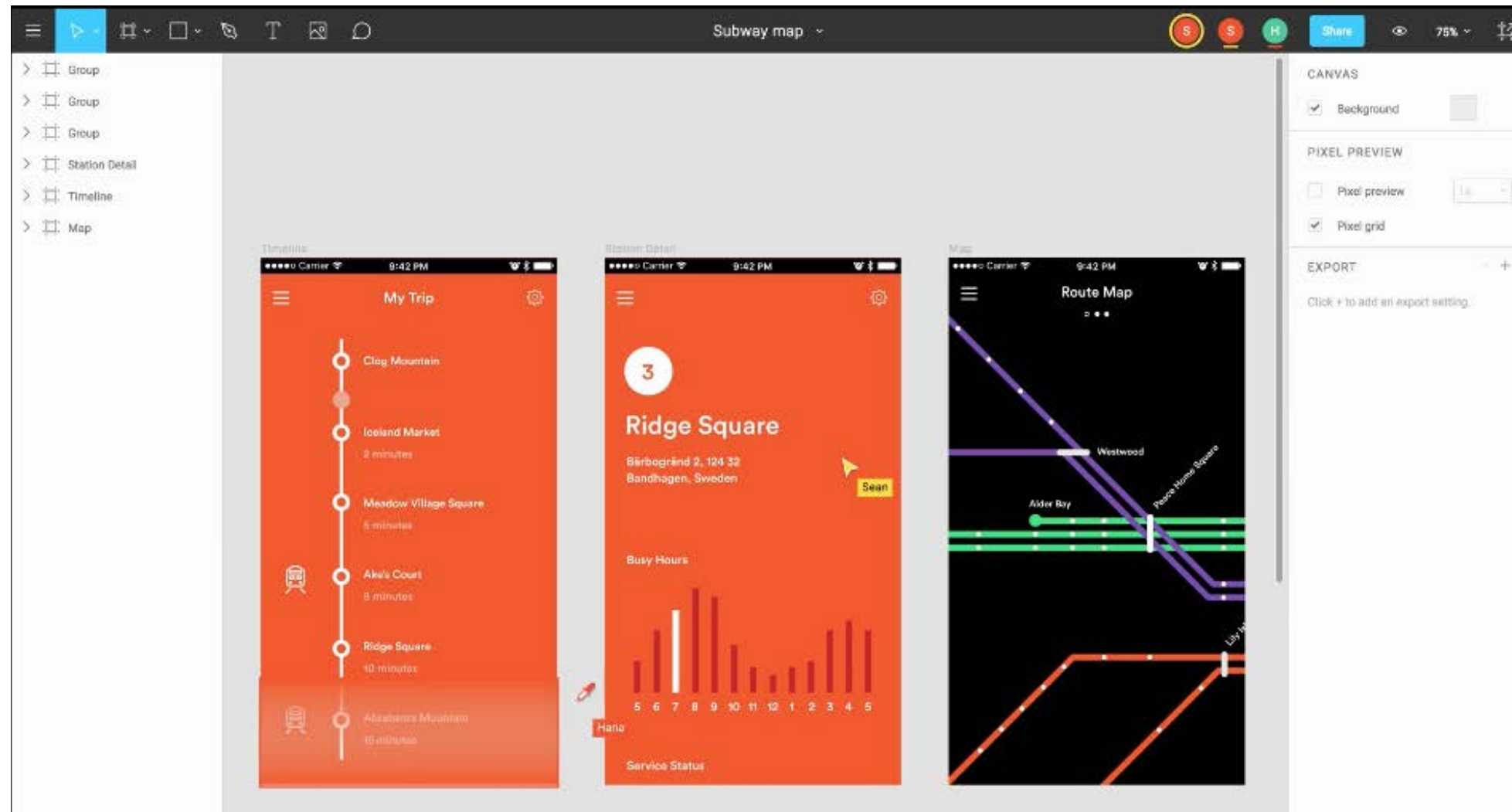
2010-Today



Bohemian Coding

Figma

2016-Today



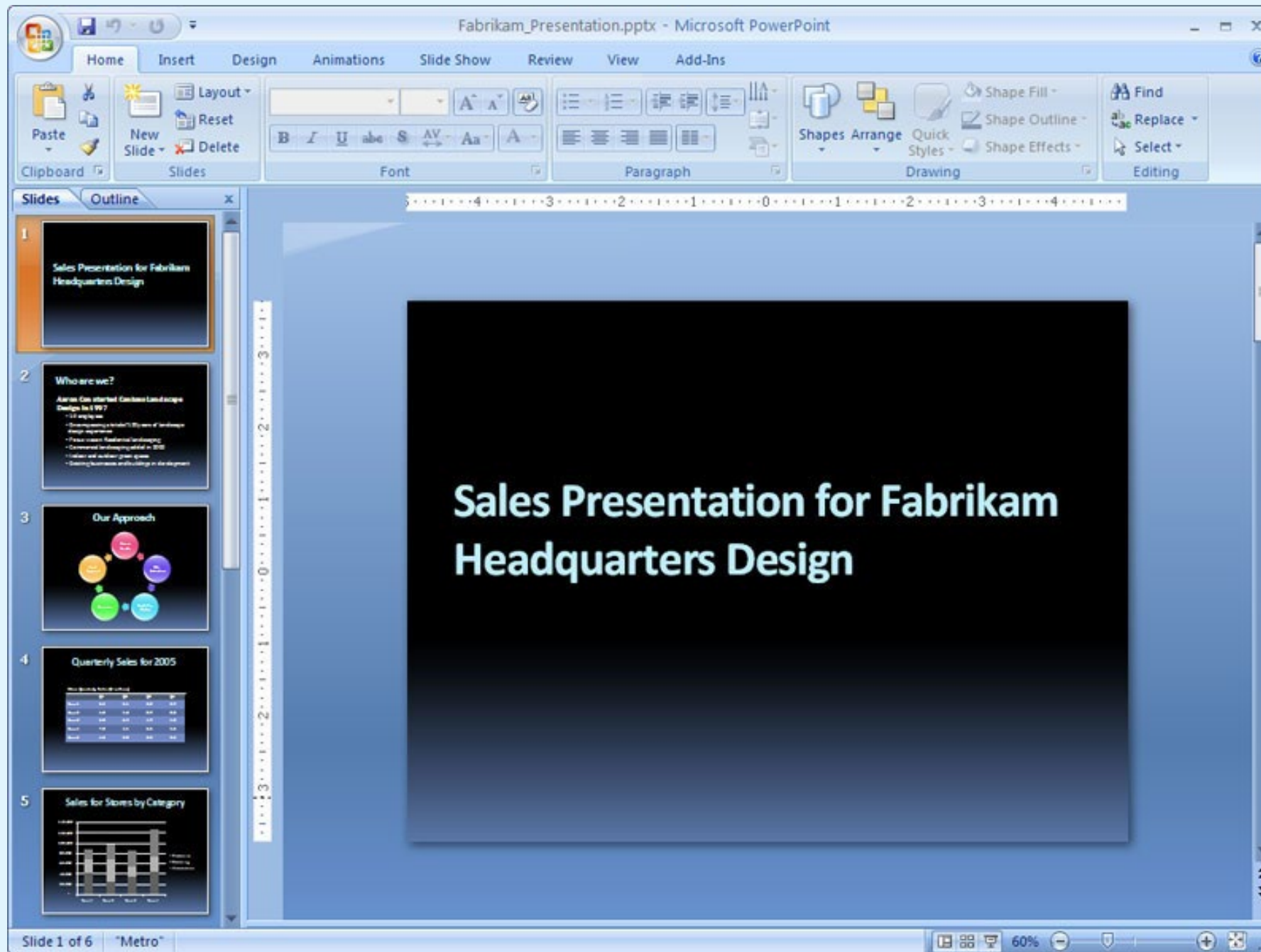
Figma

Presentation

From Outline to Slides to Demo

Powerpoint

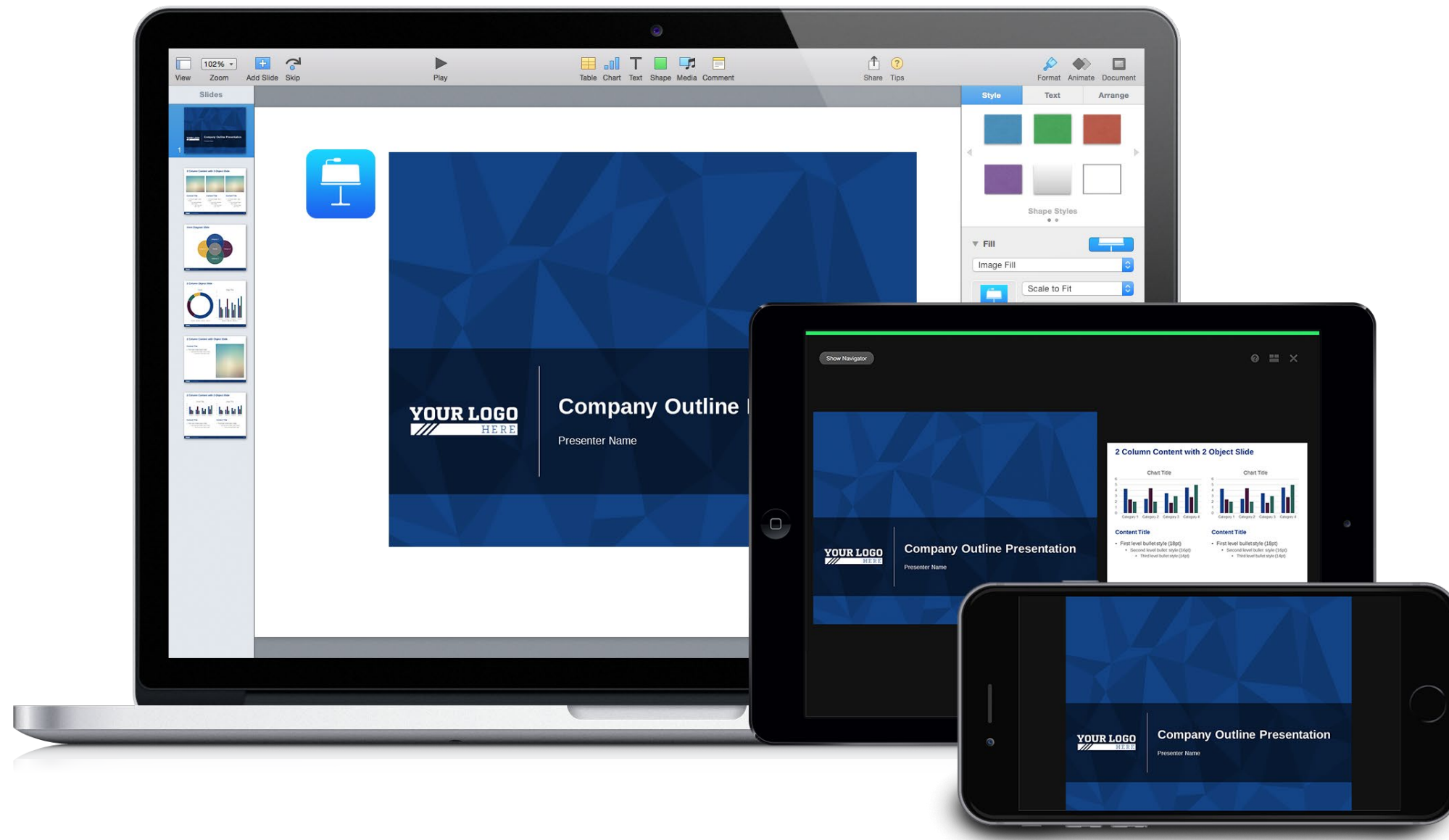
1987-Today



Microsoft

Keynote

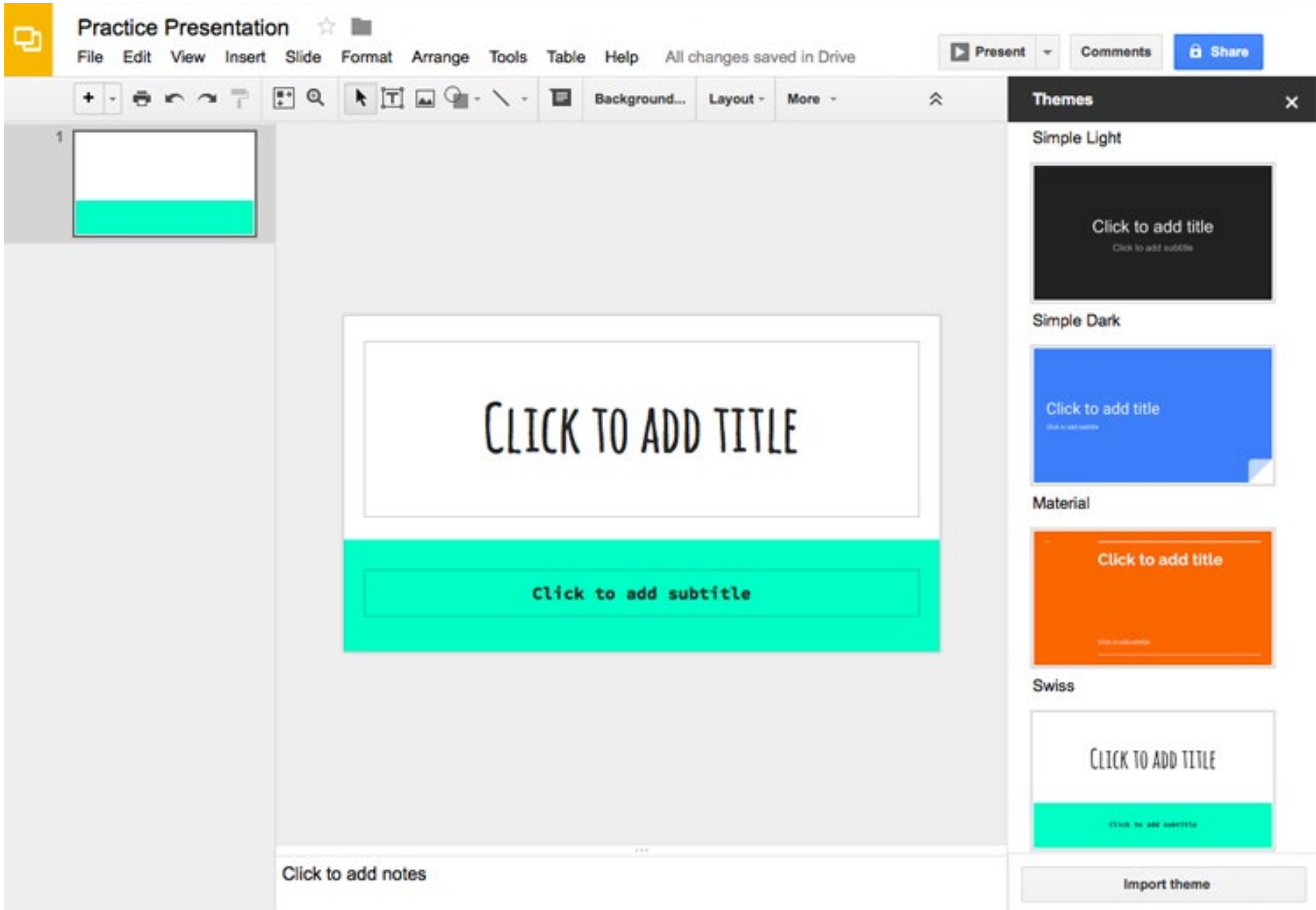
2003-Today



Apple

Slides

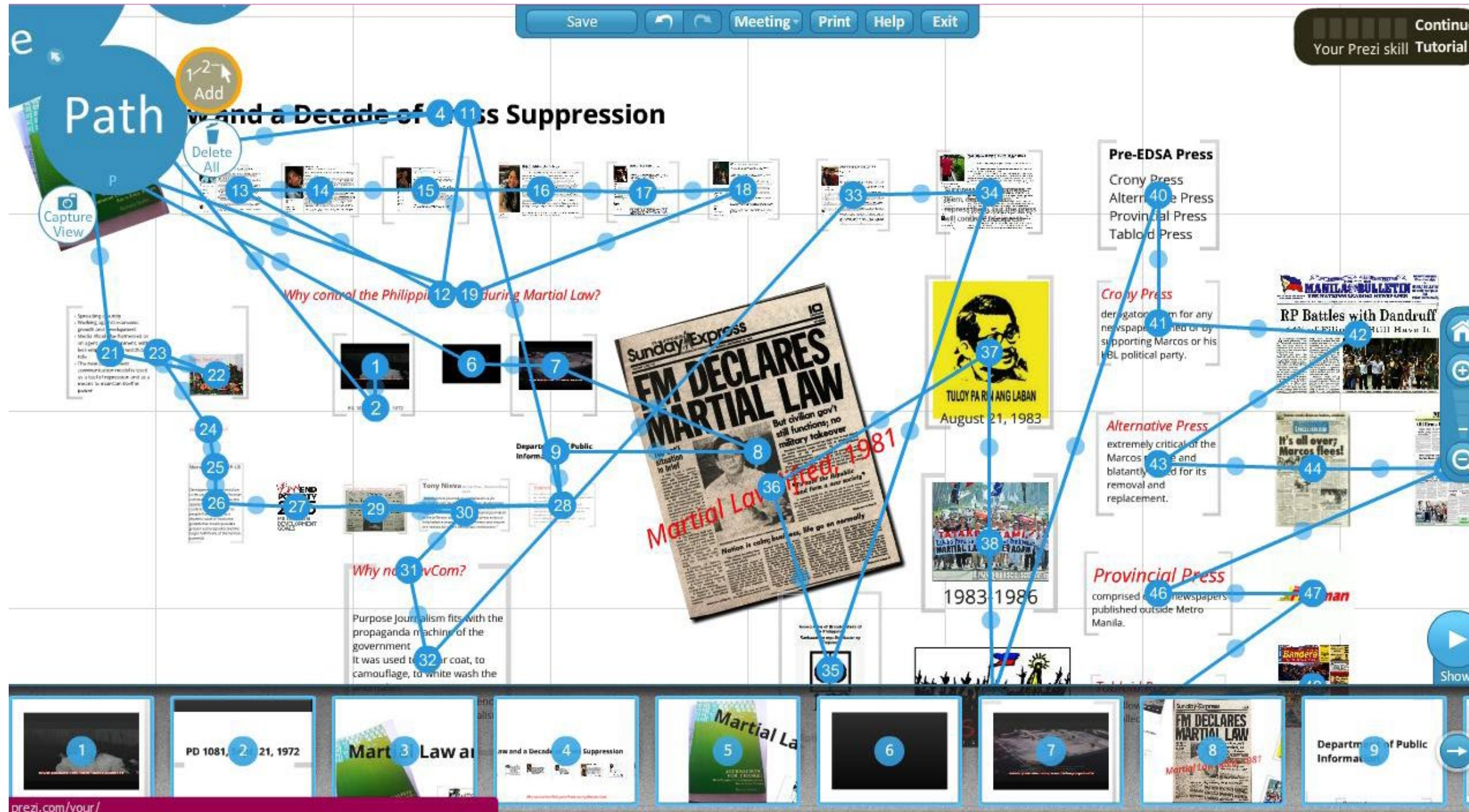
2006-Today



Google

Prezi

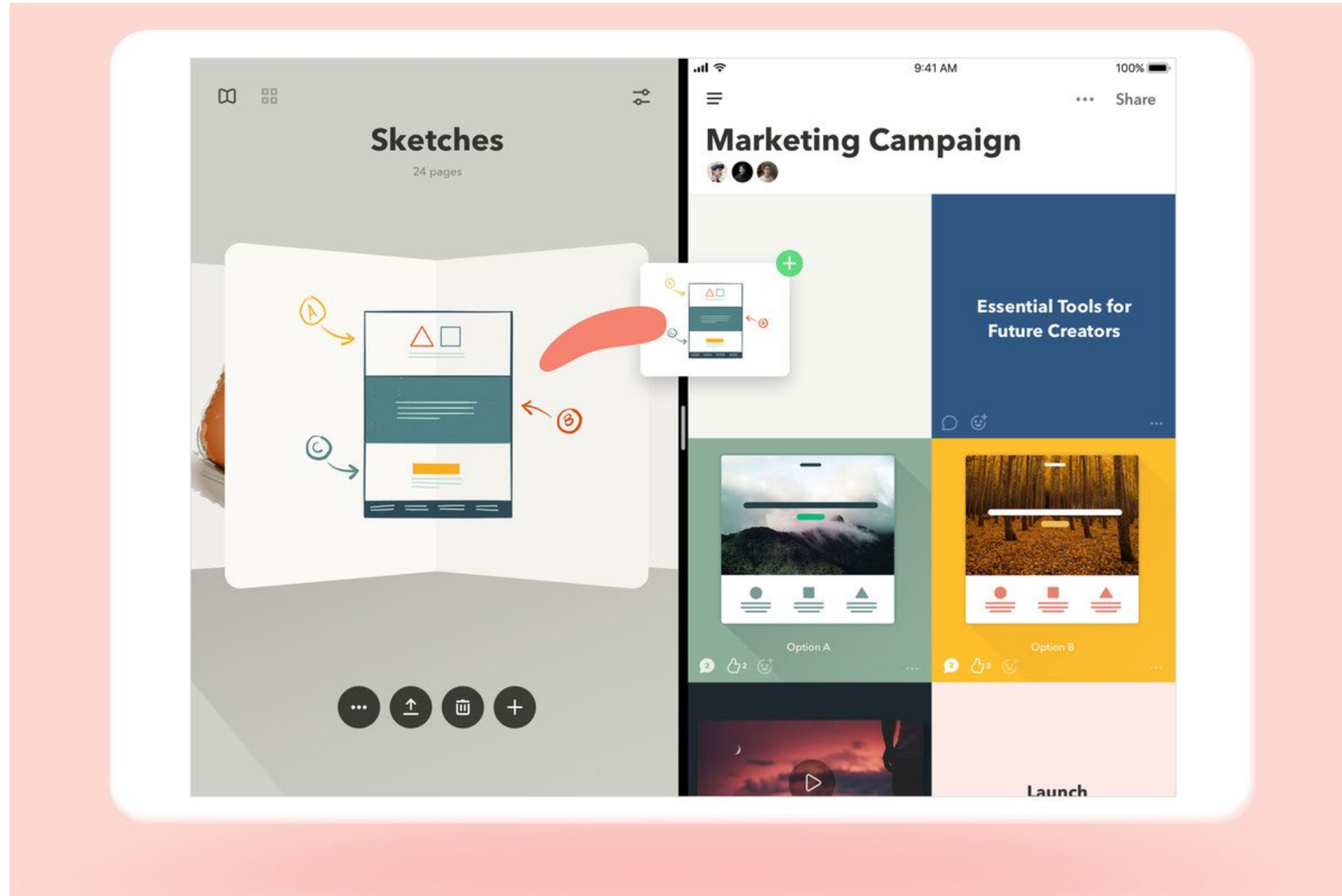
2009-Today



Adam Somlai-Fischer, Peter Halacsy and Peter Arvai

Paste

2017-Today

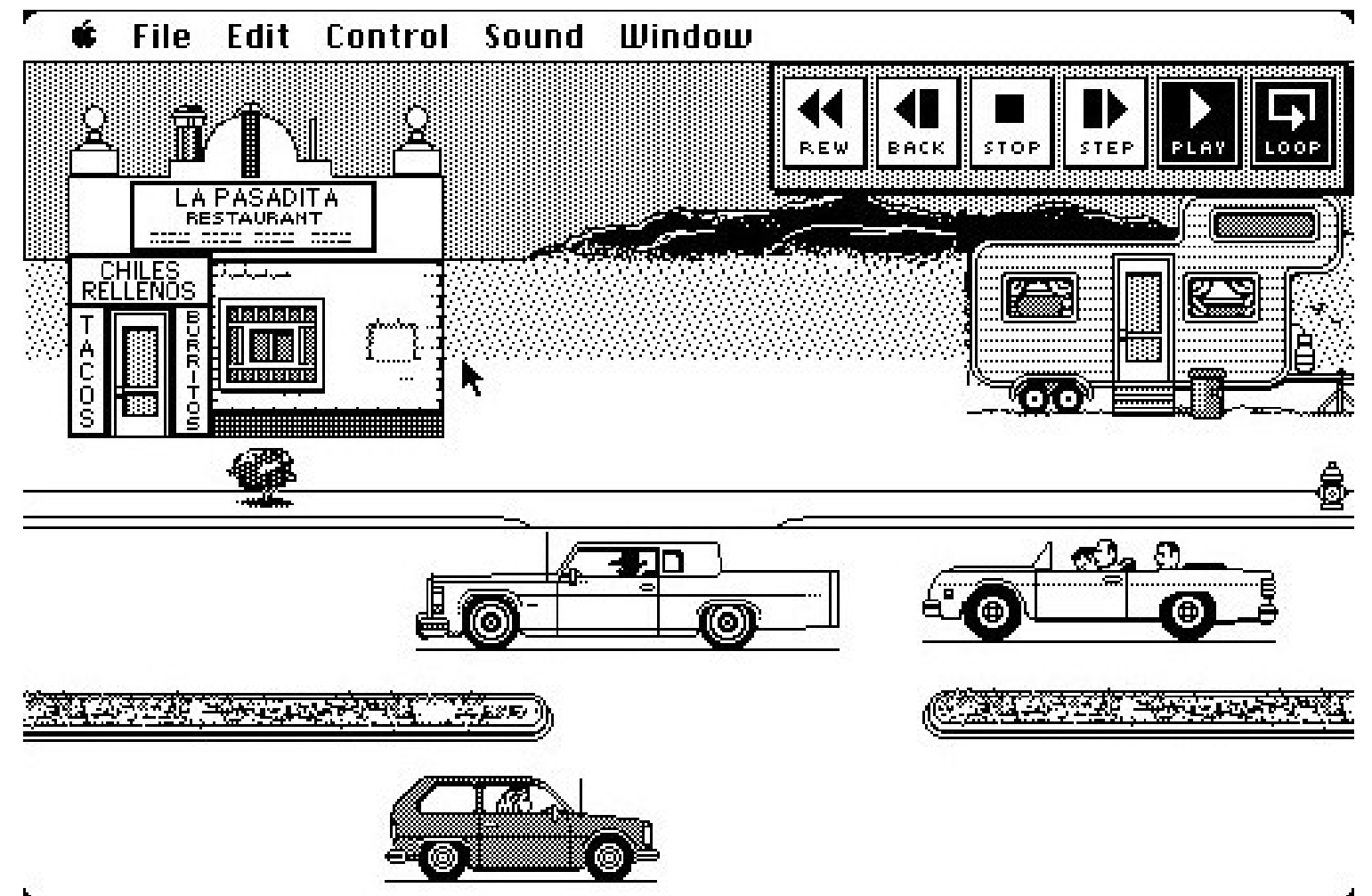
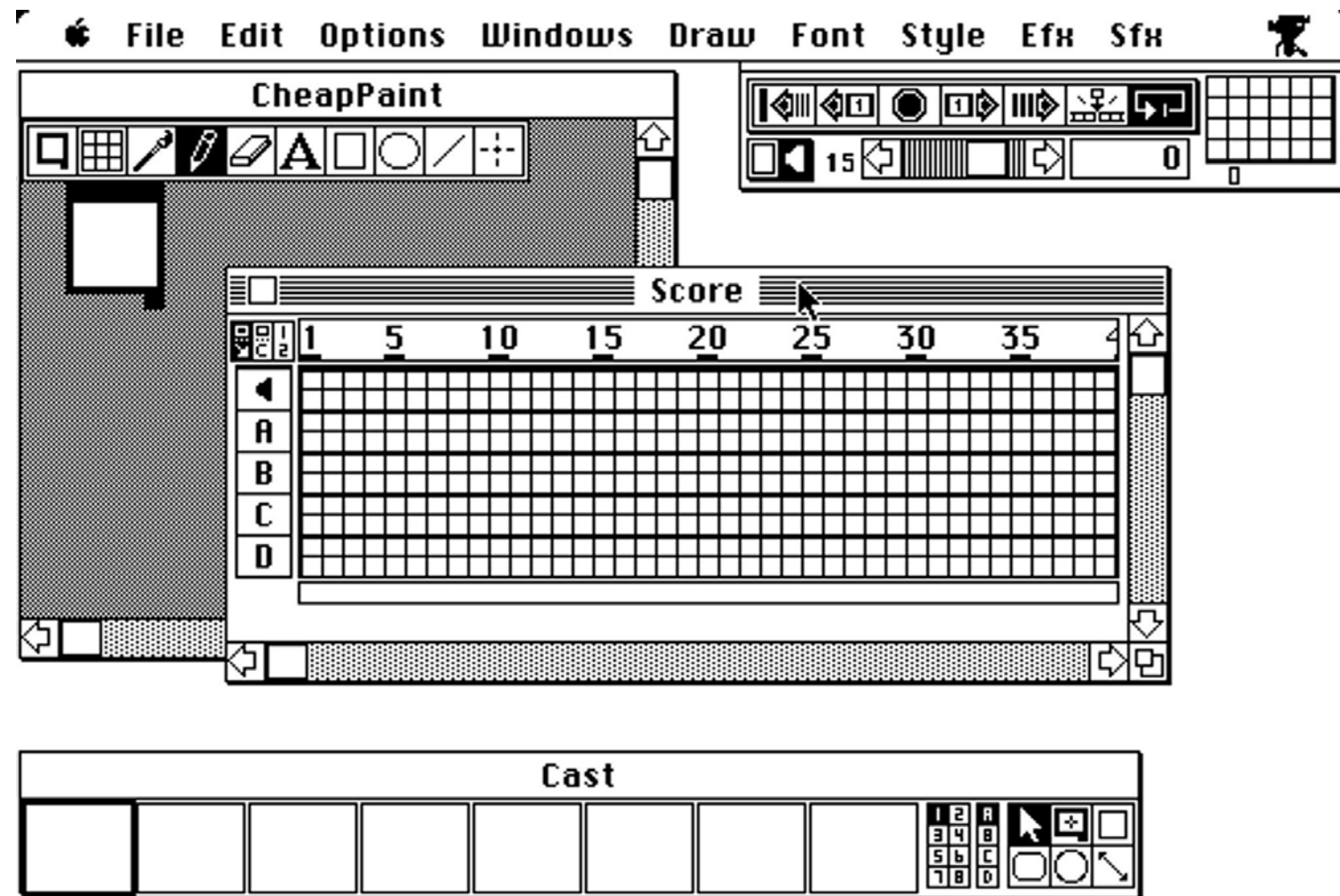


FiftyThree

Timeline-Based Applications

VideoWorks

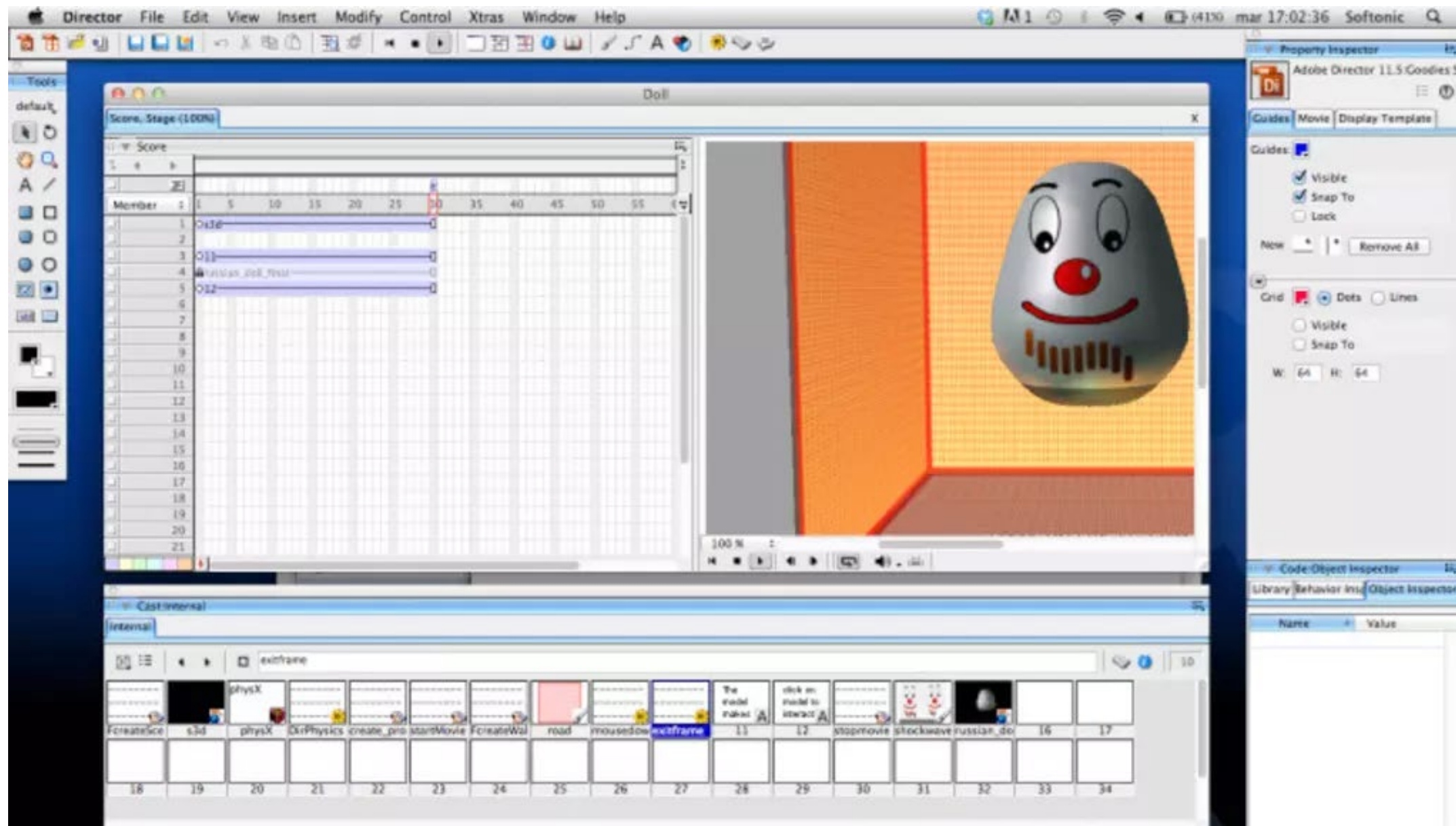
1985-1987



Marc Canter, Jay Fenton and Mark Pierce and Dan Sadowski for MacroMind

Director

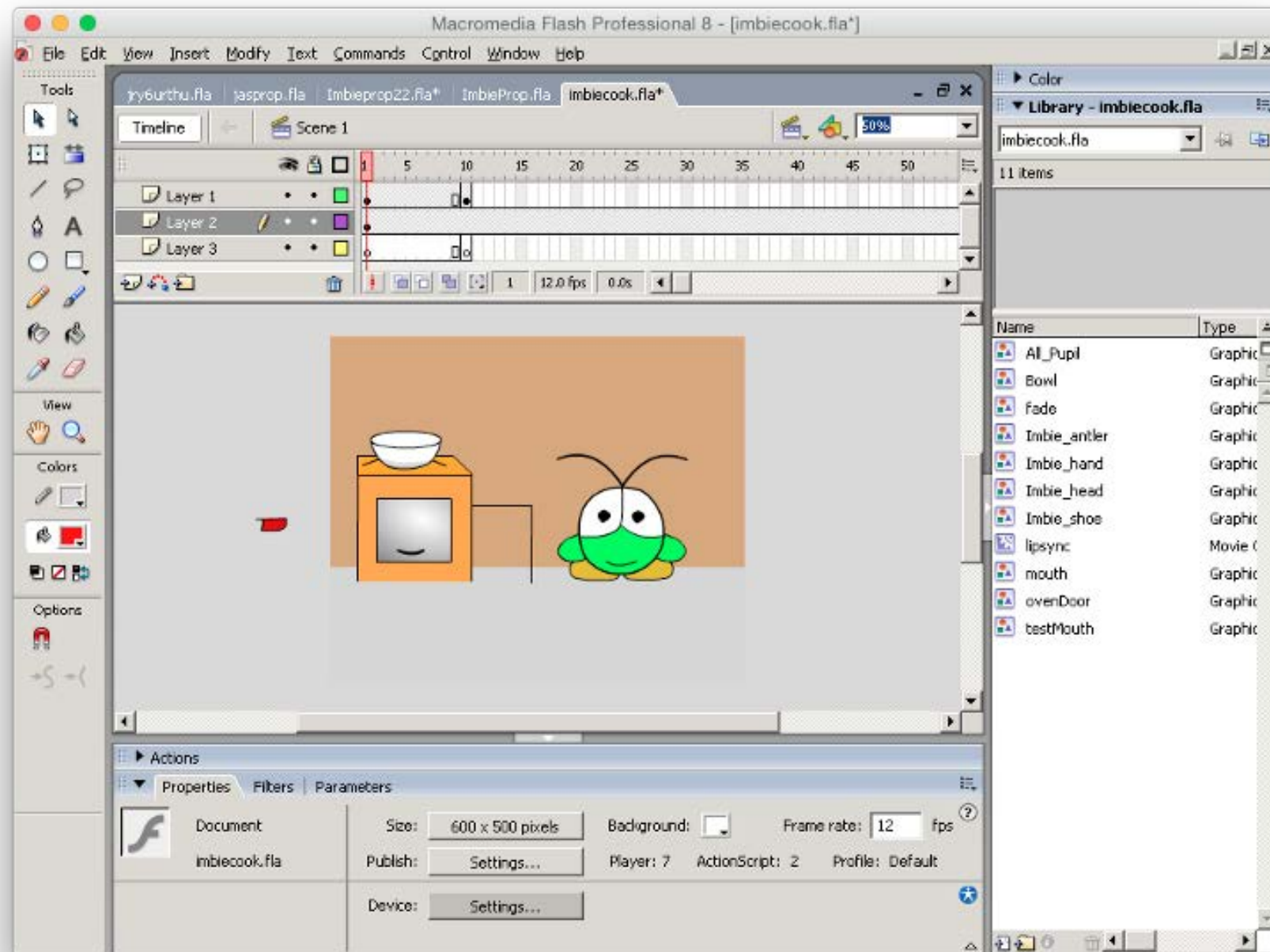
1988-2013



MacroMedia (Later Adobe)

Flash

1996-2016



Adobe

iMovie

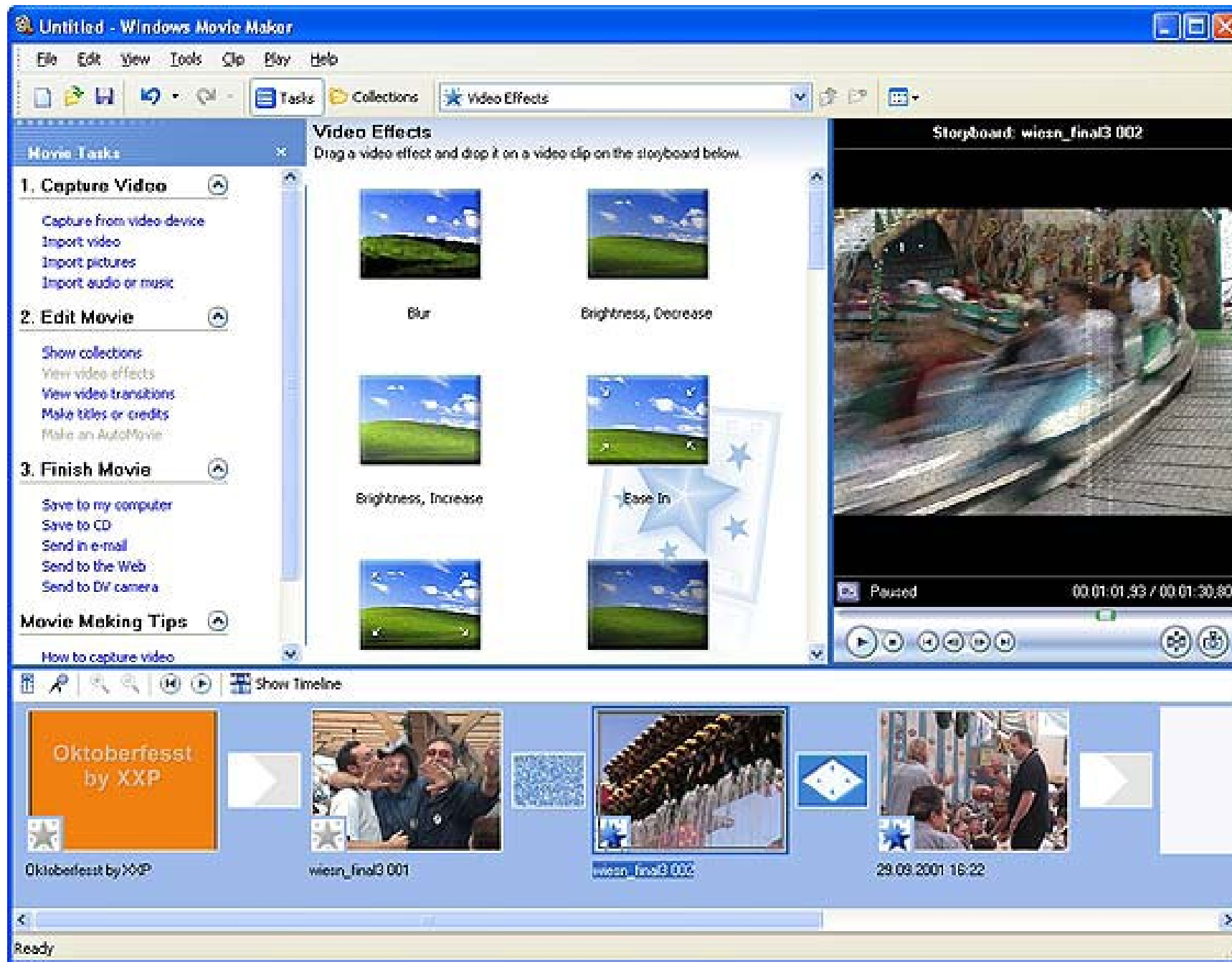
1999-Today



Apple

Windows Movie Maker

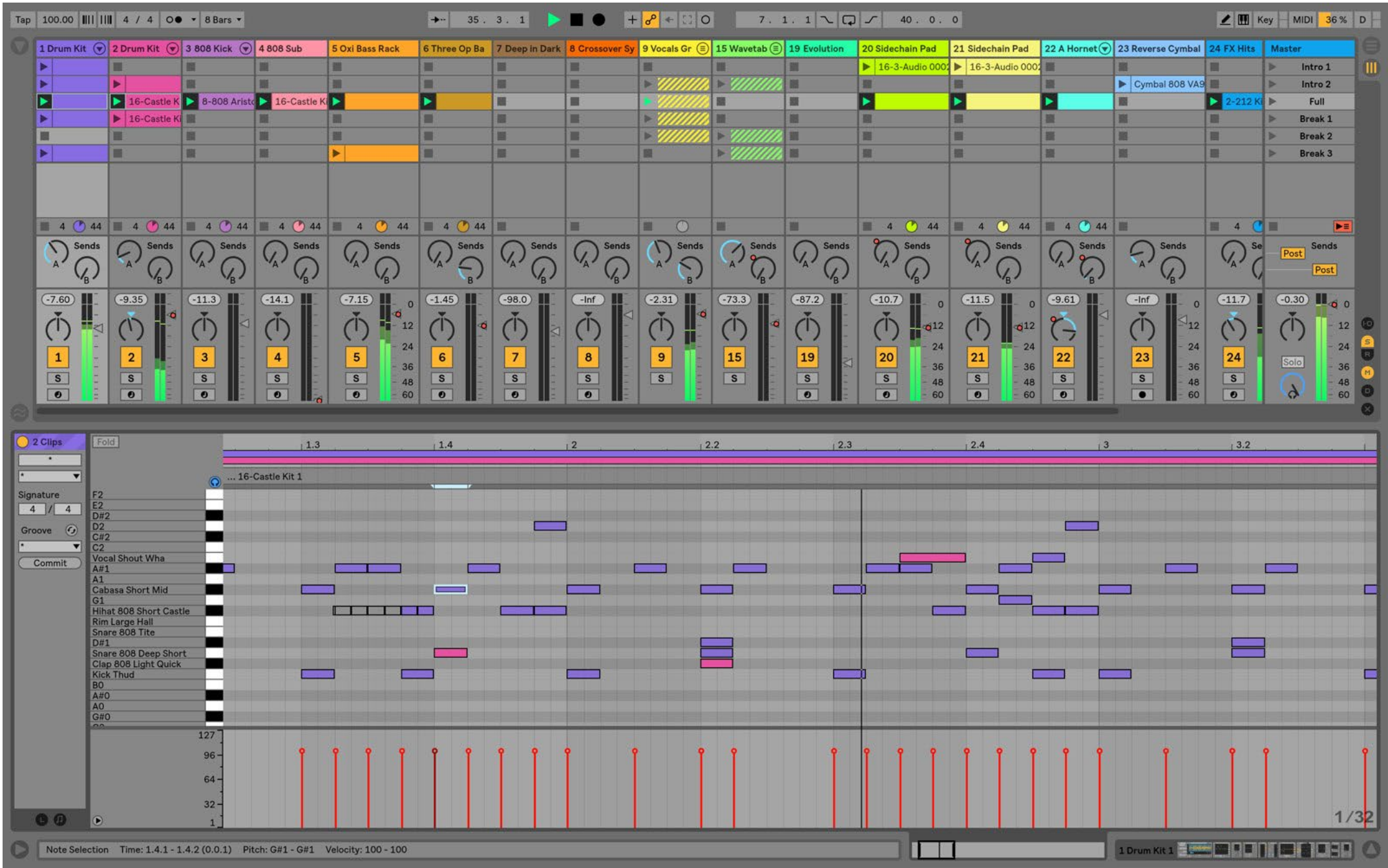
2000-2012



Microsoft

Ableton Live

2001-Today



Ableton

GarageBand

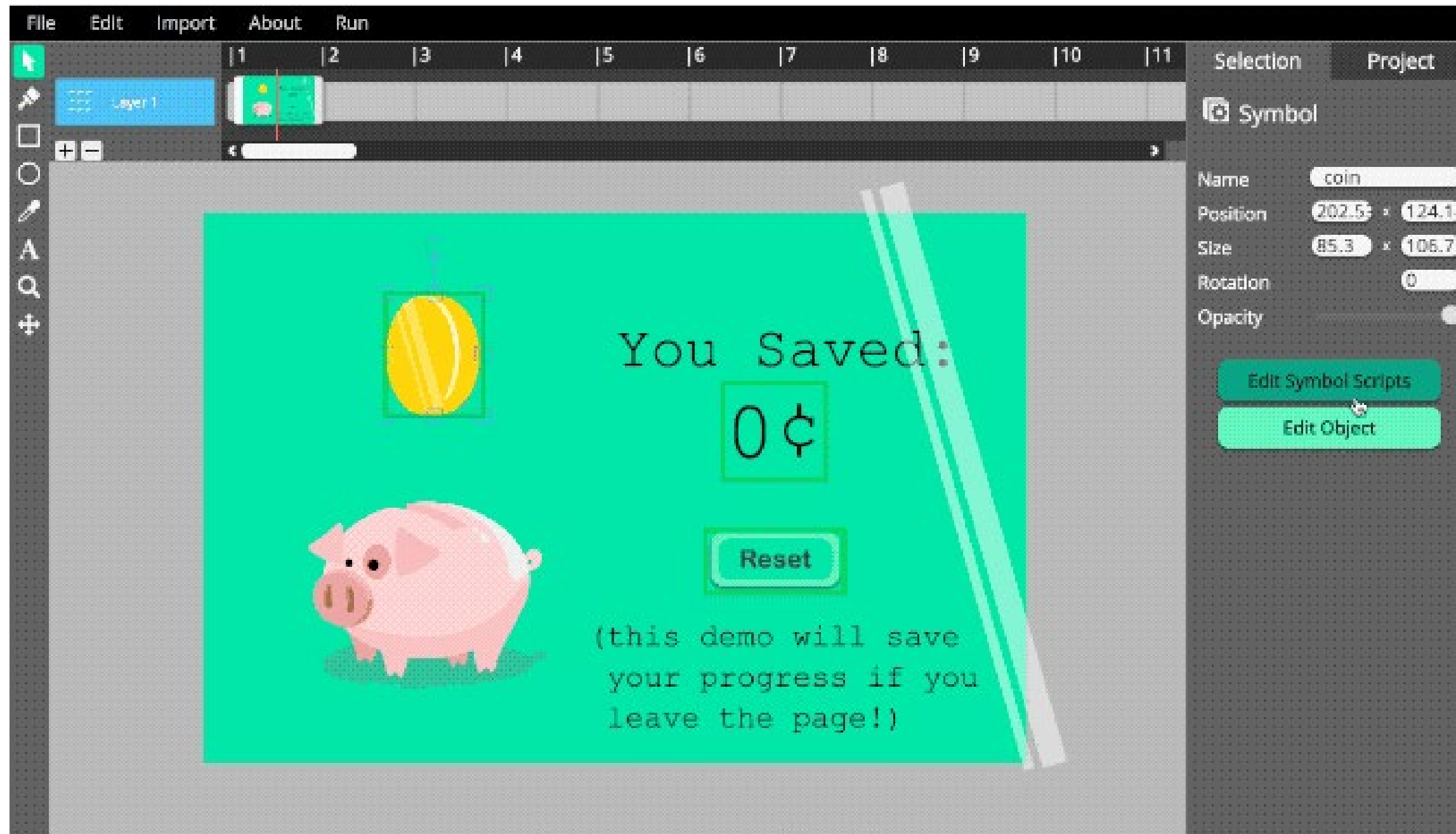
2004-Today



Apple

Wick Editor

2017-Today



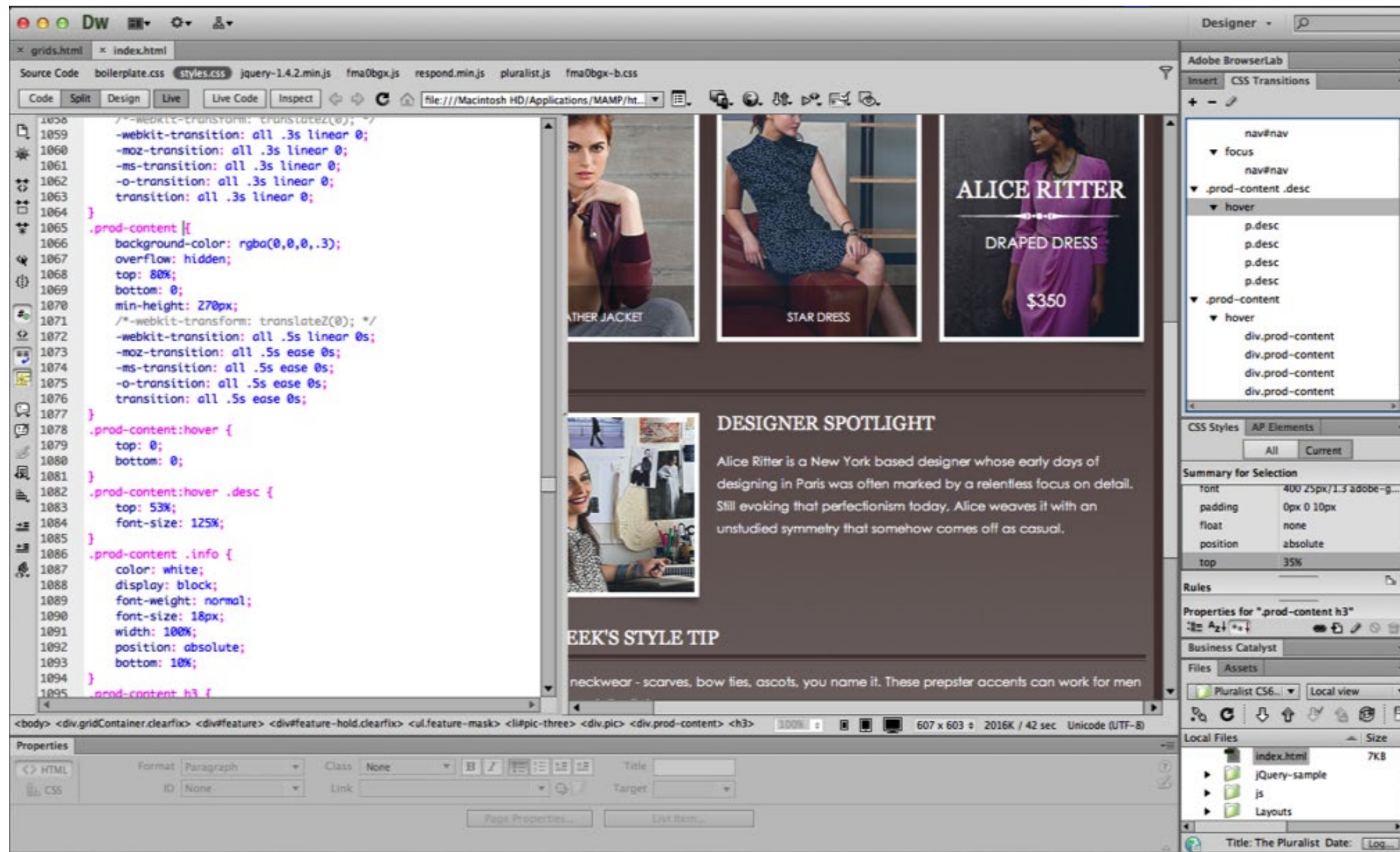
Luca Damasco and Zach Rispoli at the Frank-Ratchye STUDIO for Creative Inquiry at Carnegie Mellon University

World Wide Web

Design & Development Environments

Dreamweaver

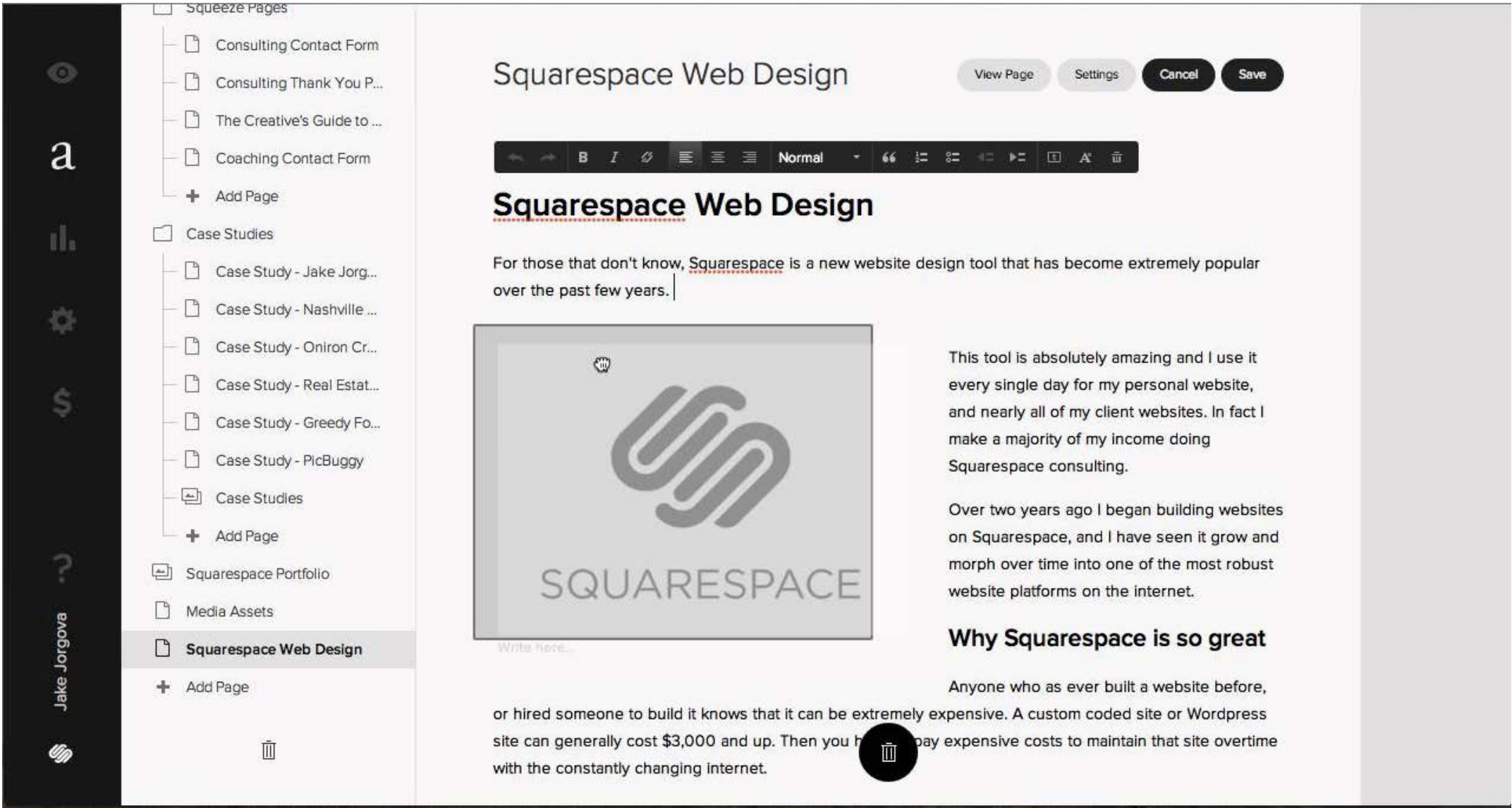
1997-Today



Macromedia (Later Adobe)

Squarespace

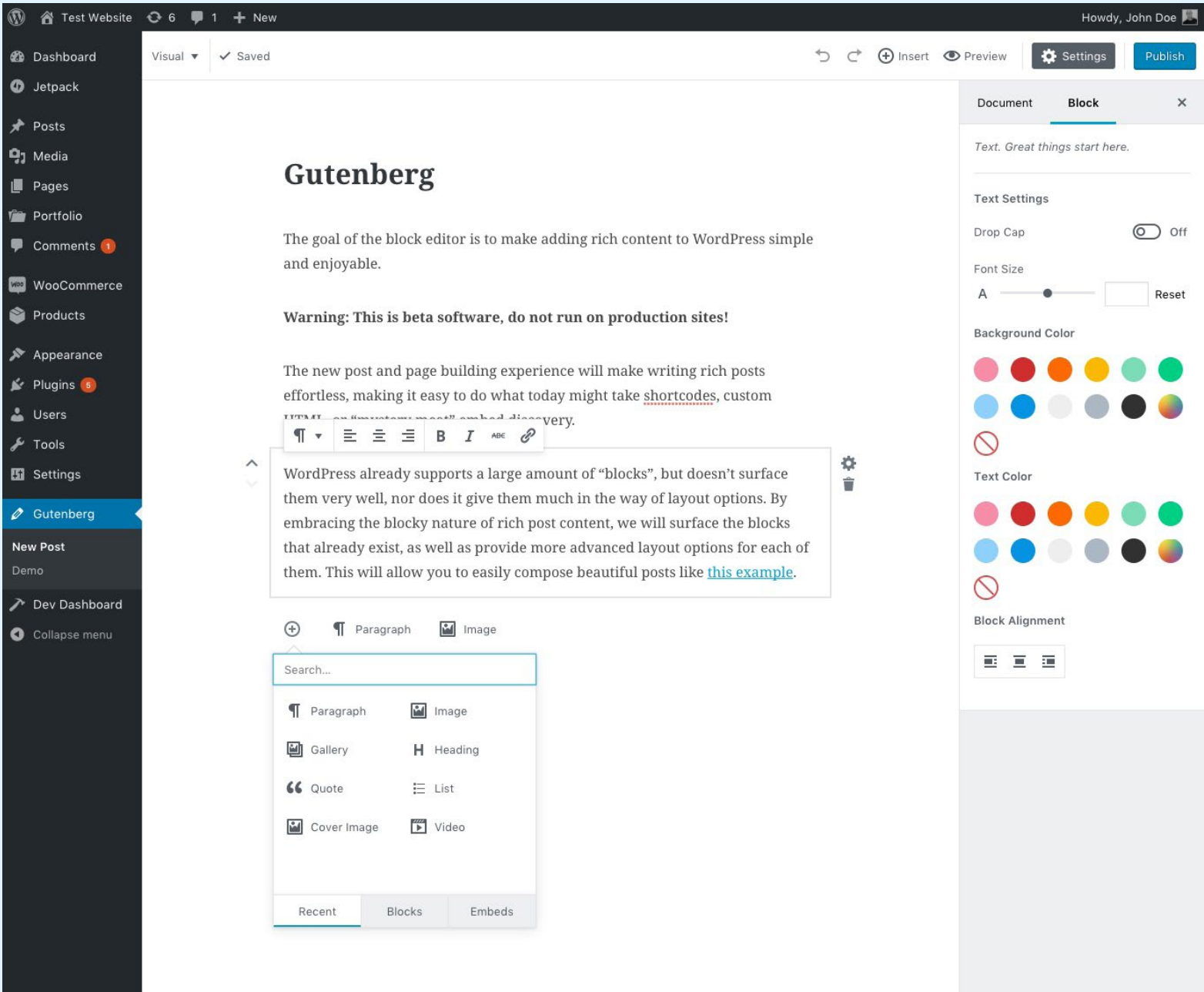
2003-Today



Anthony Casalena and Others

Wordpress

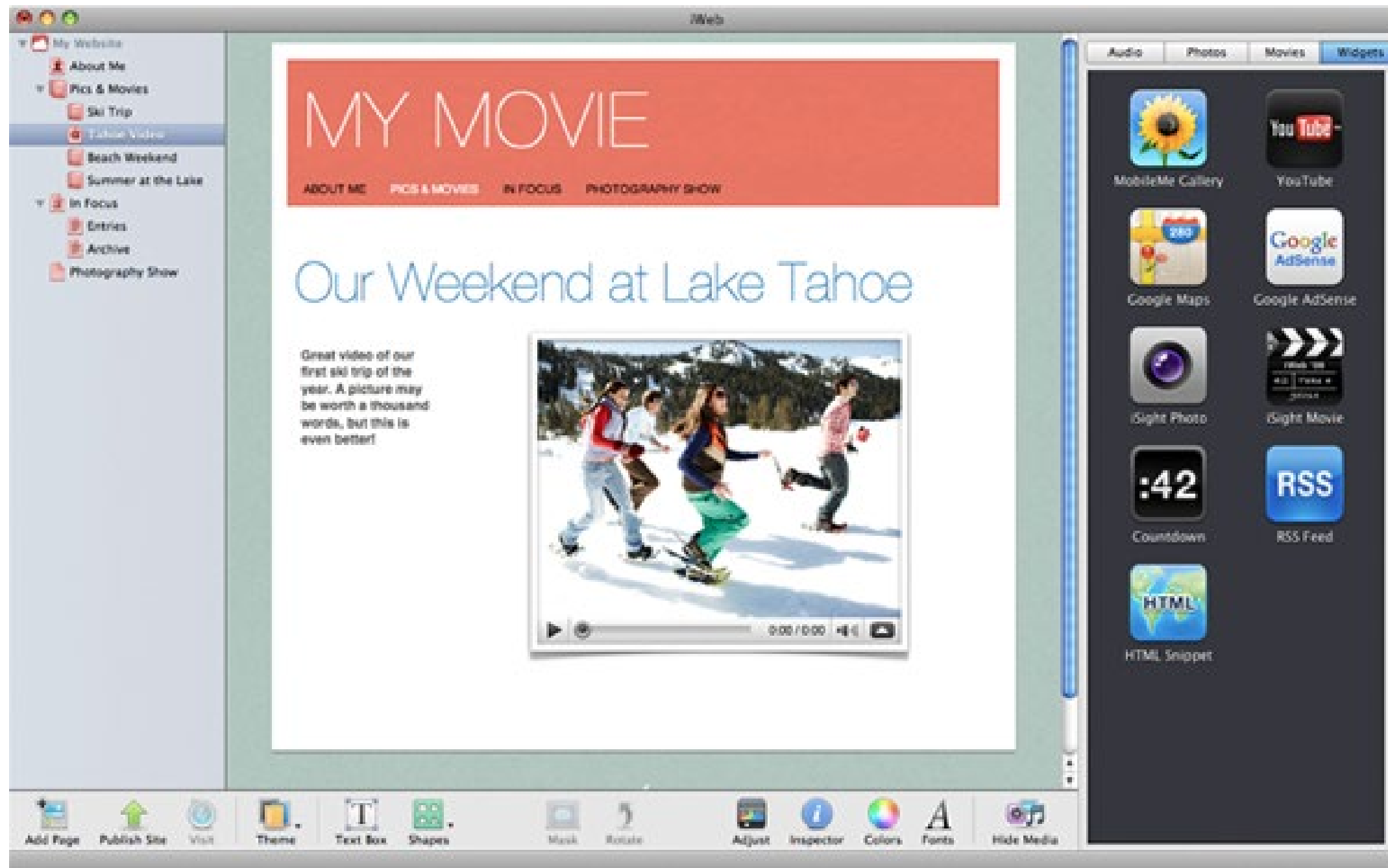
2005-Today



Automatic

iWeb

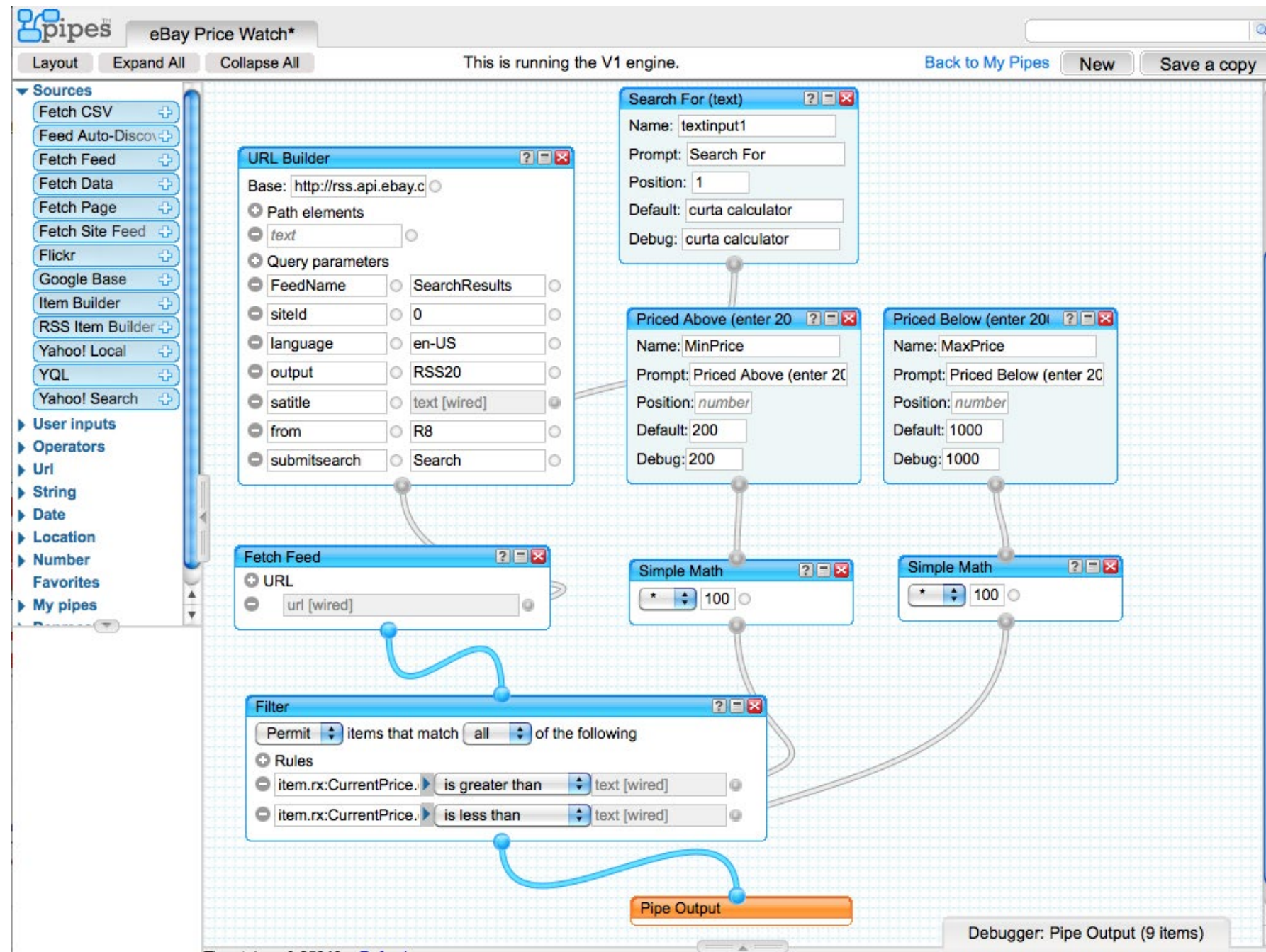
2006-2011



Apple

Yahoo! Pipes

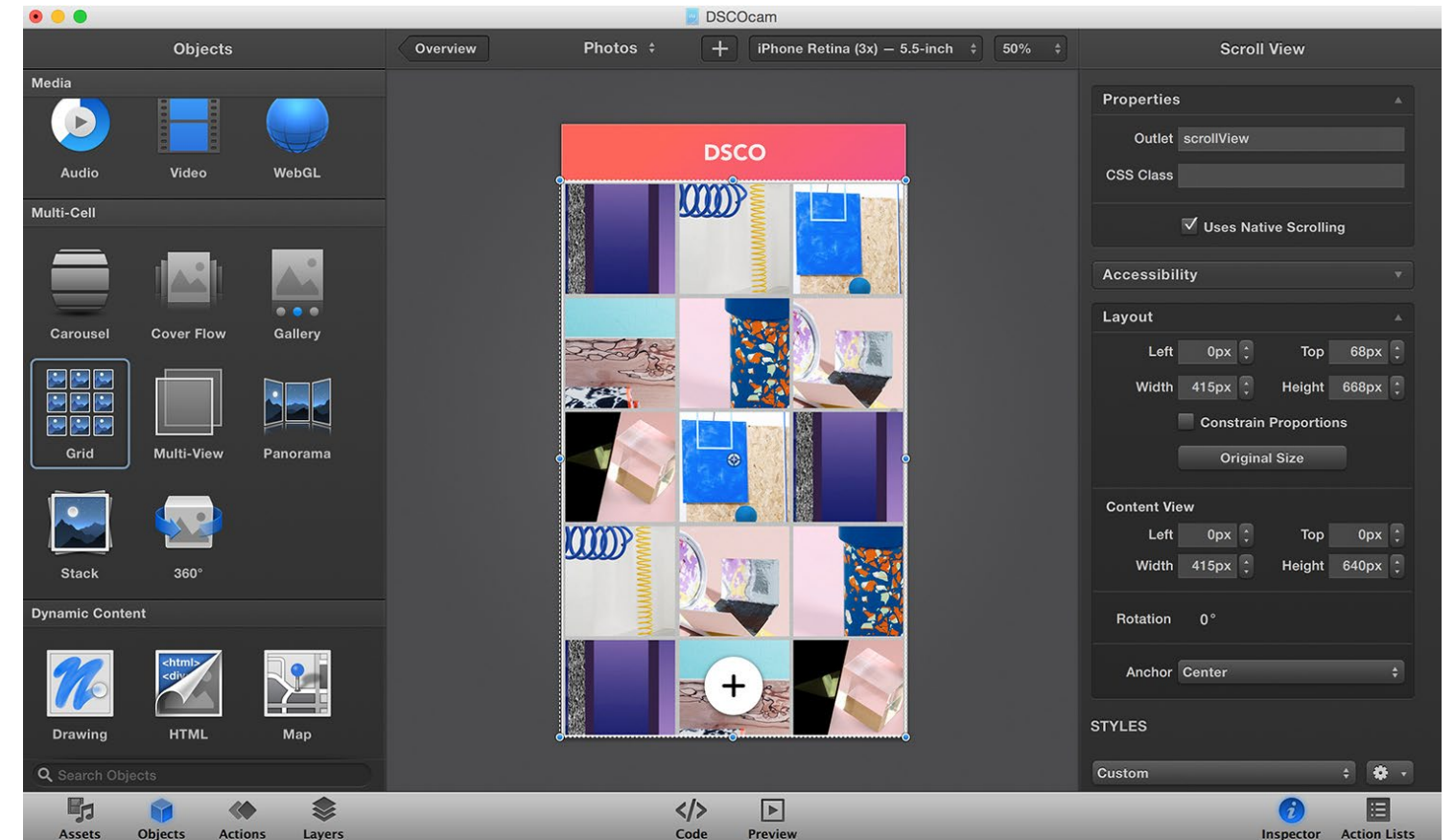
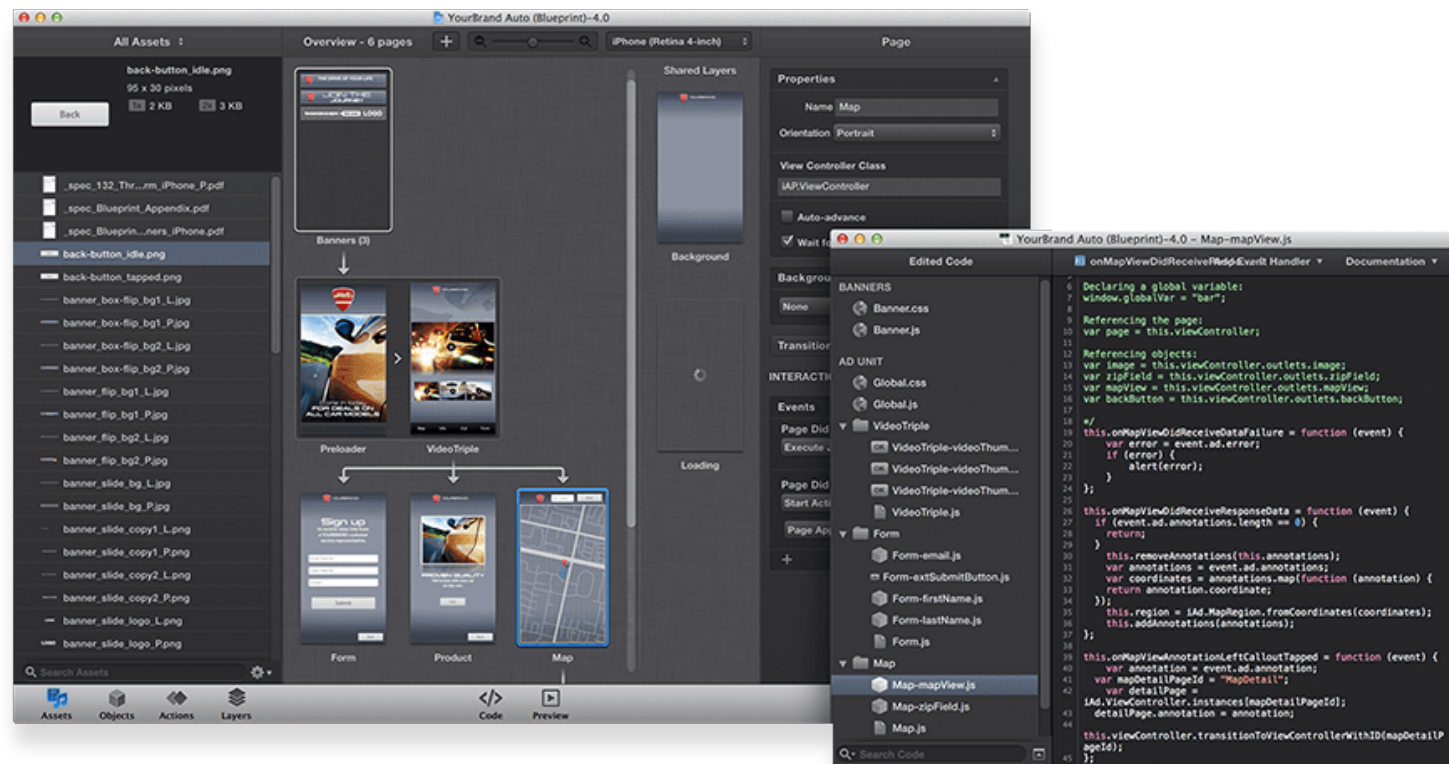
2007-2015



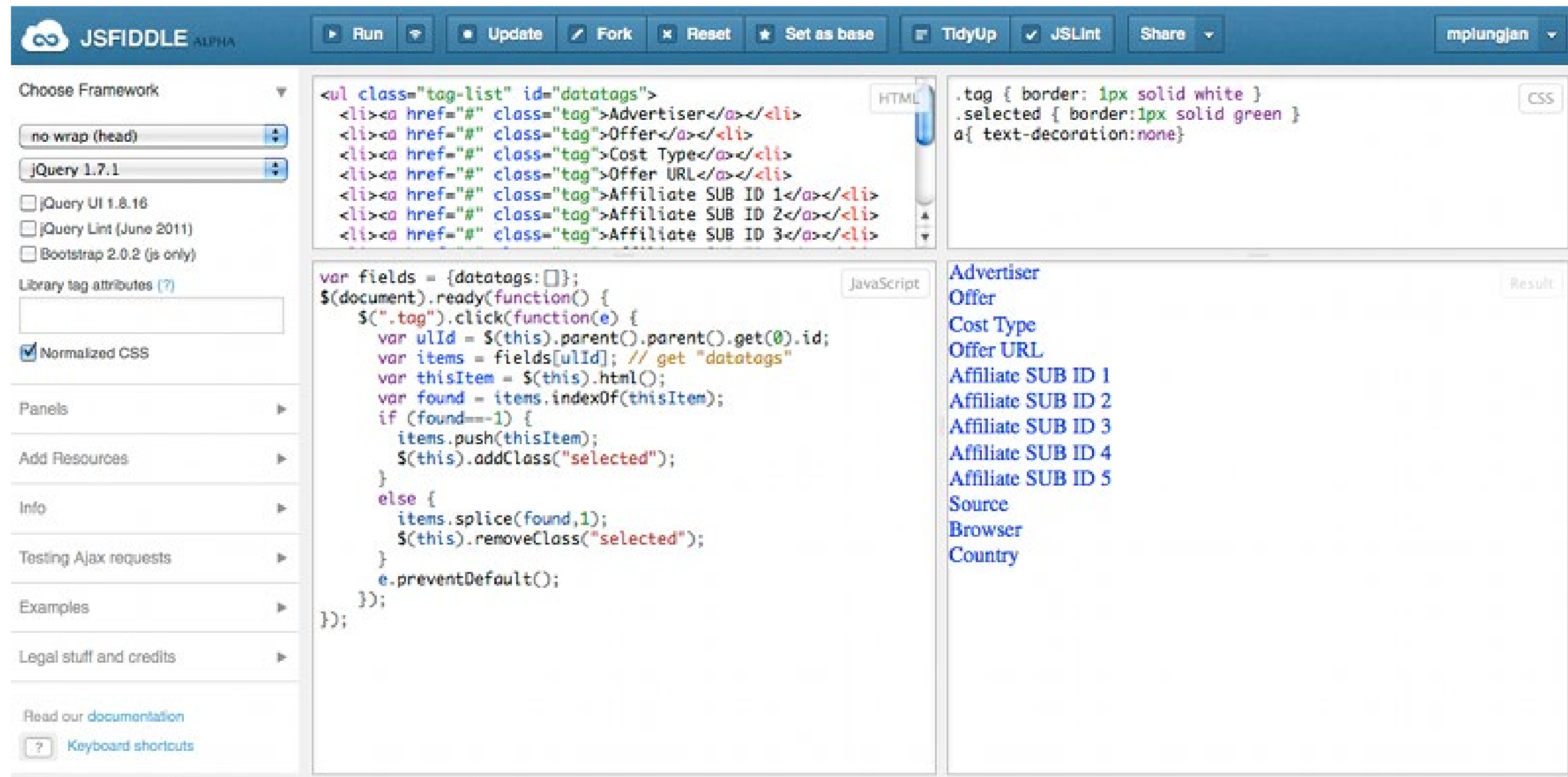
Pasha Sadri, Ed Ho, Jonathan Trevor, Kevin Cheng, Ido Green and Daniel Raffel at Yahoo!

iAd Producer

2010-2016

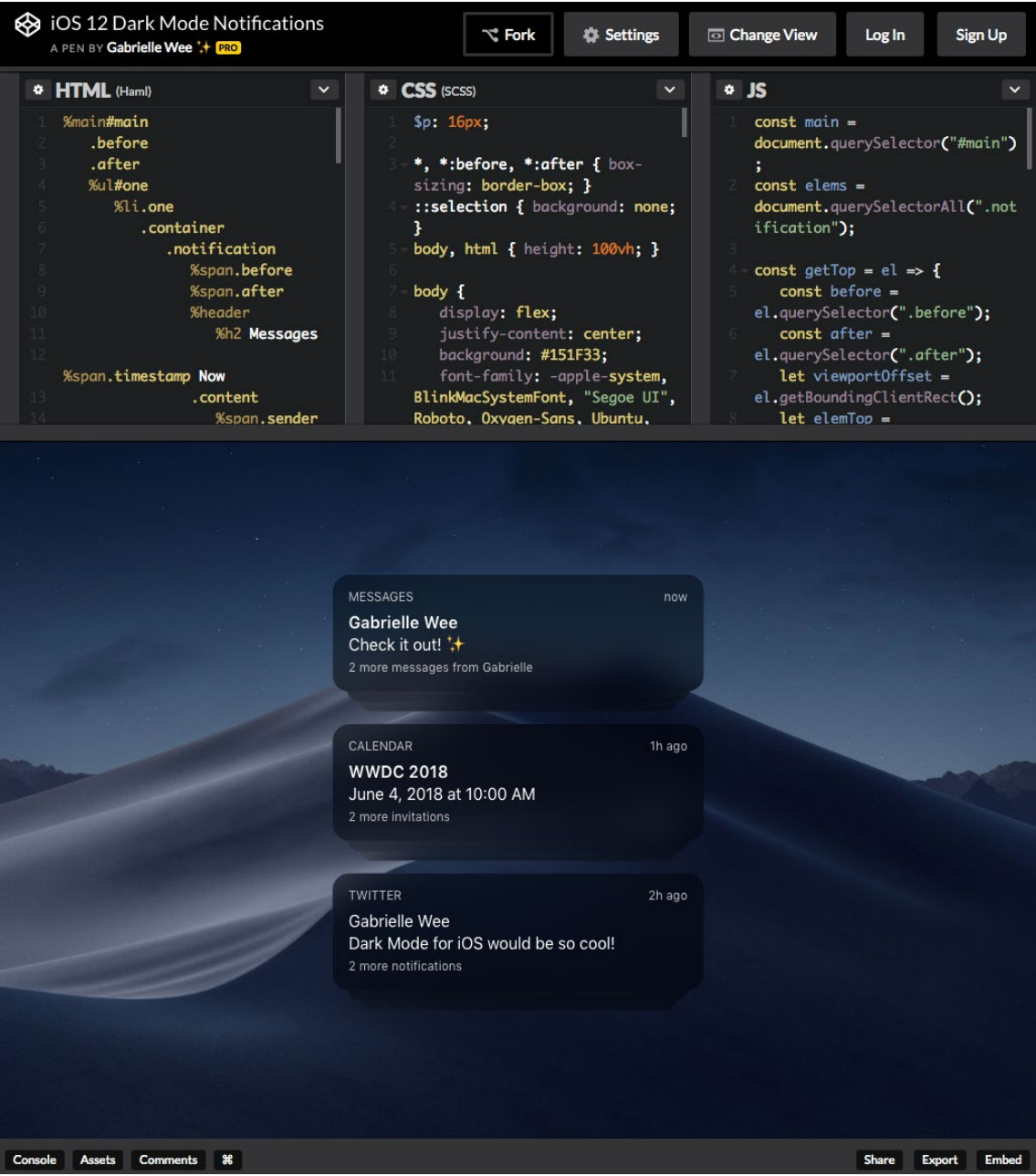


Apple



CodePen

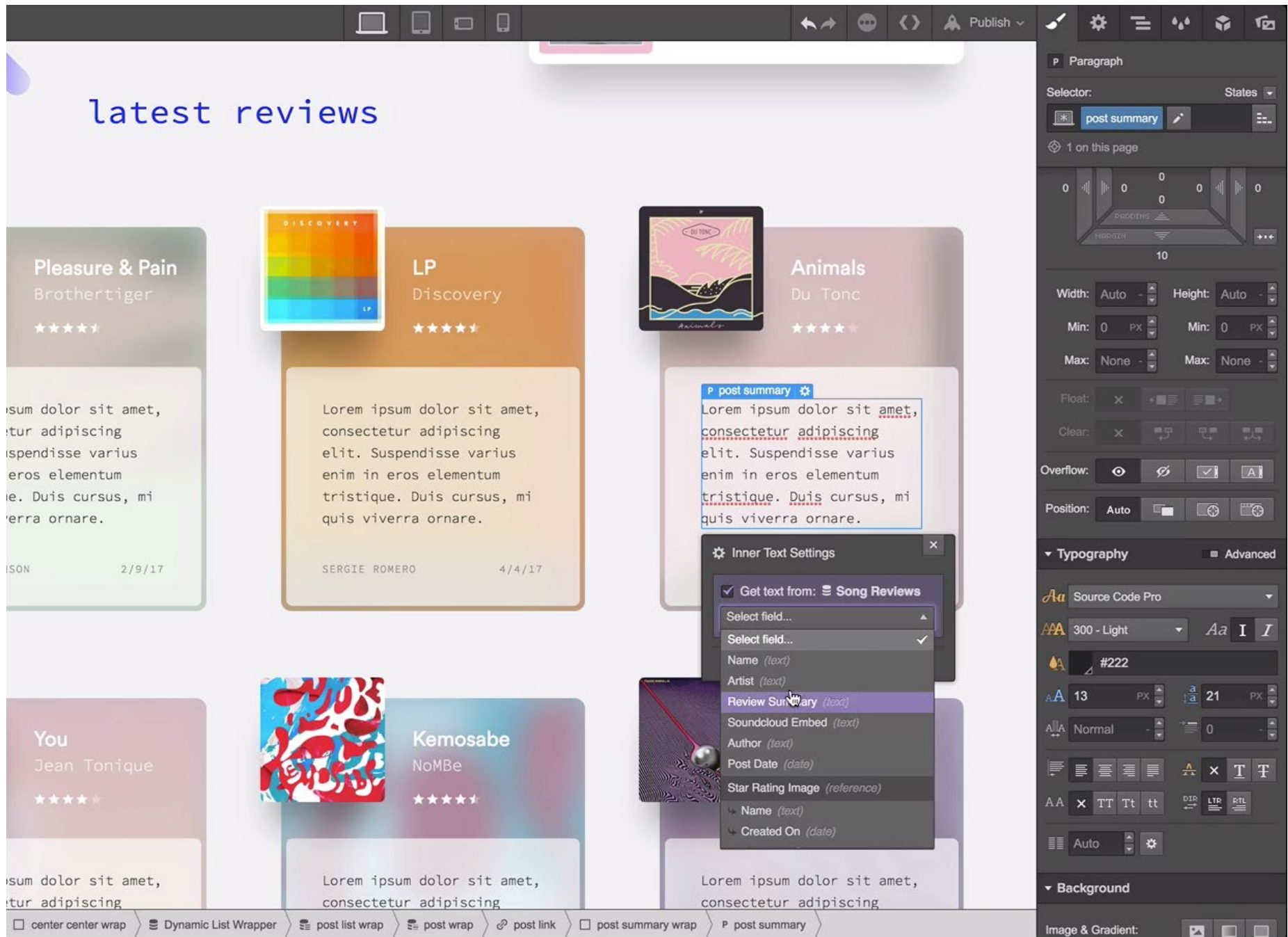
2012-Today



Tim Sabat, Alex Vazquez, Chris Coyier

Webflow

2013-Today

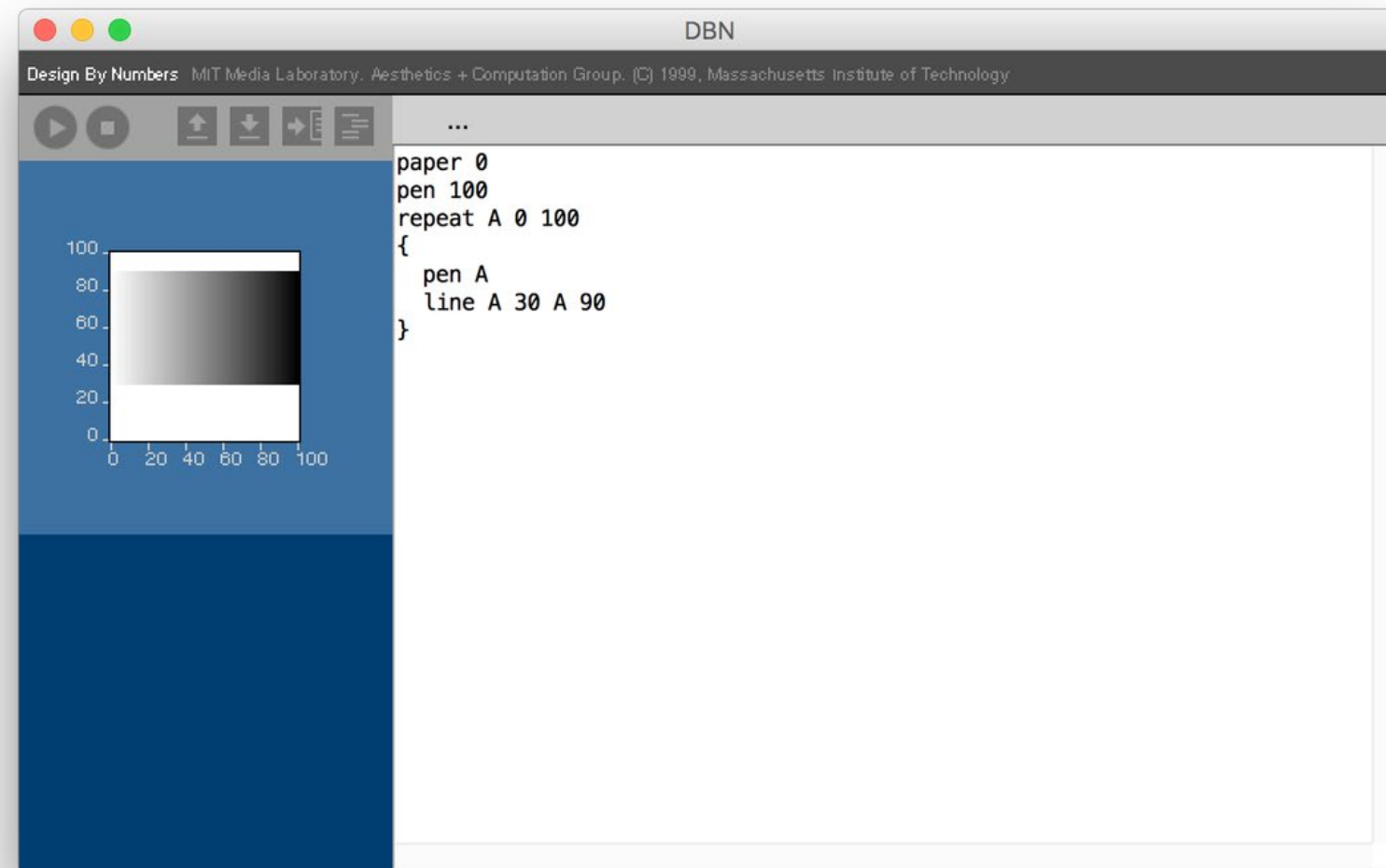


Vlad Magdalin and Sergie Magdalin

‘Creative Coding’ Toolkits

Design by Numbers

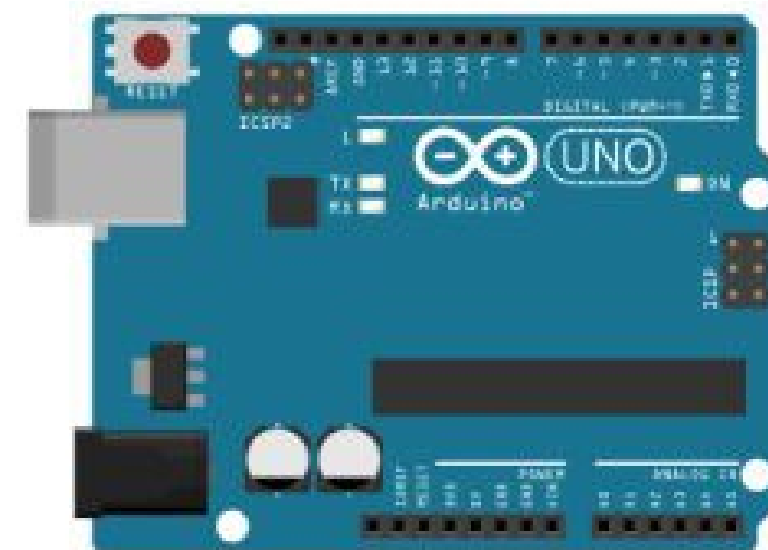
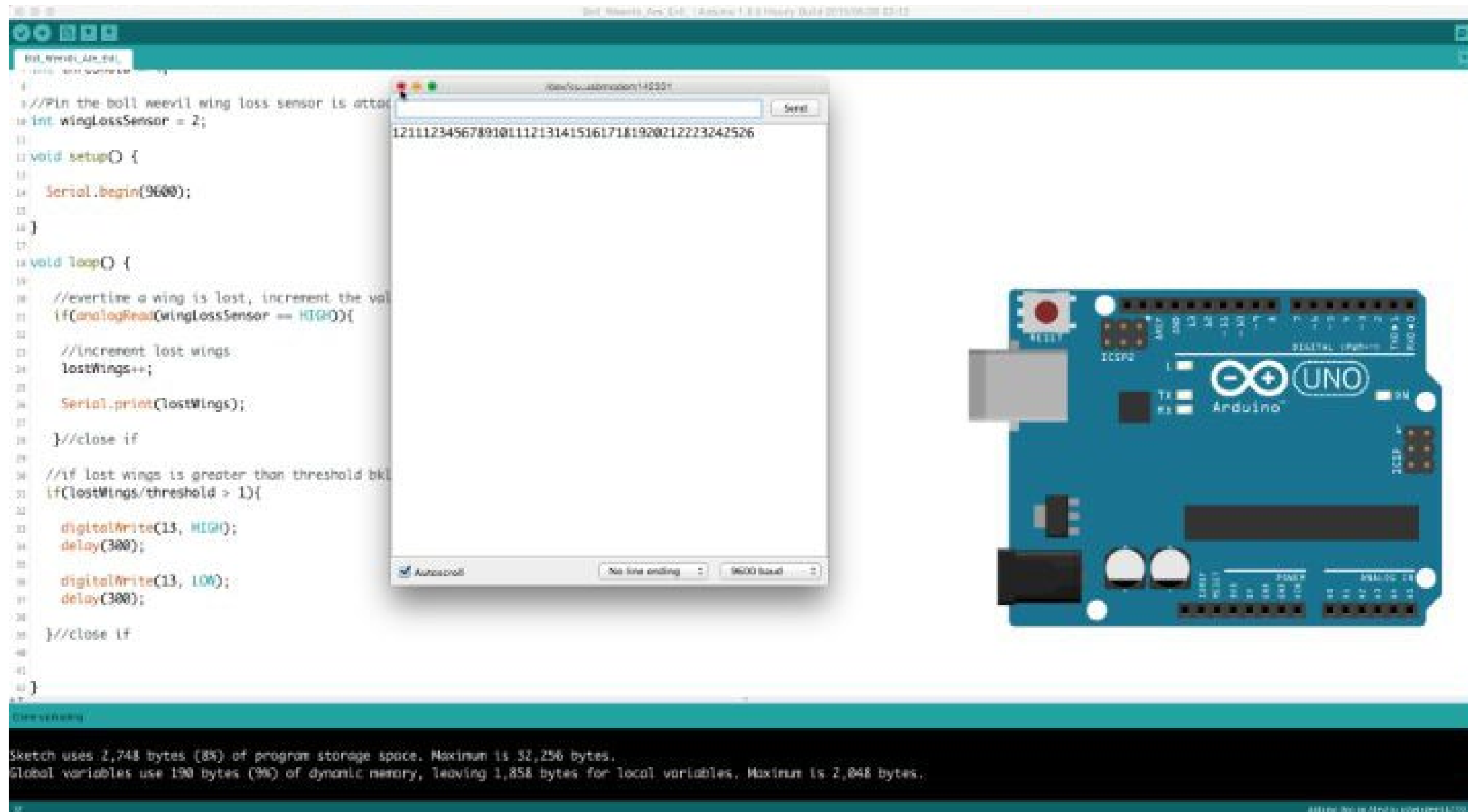
1999-2003



John Maeda at the MIT Media Lab (Aesthetics and Computation Group)

Arduino

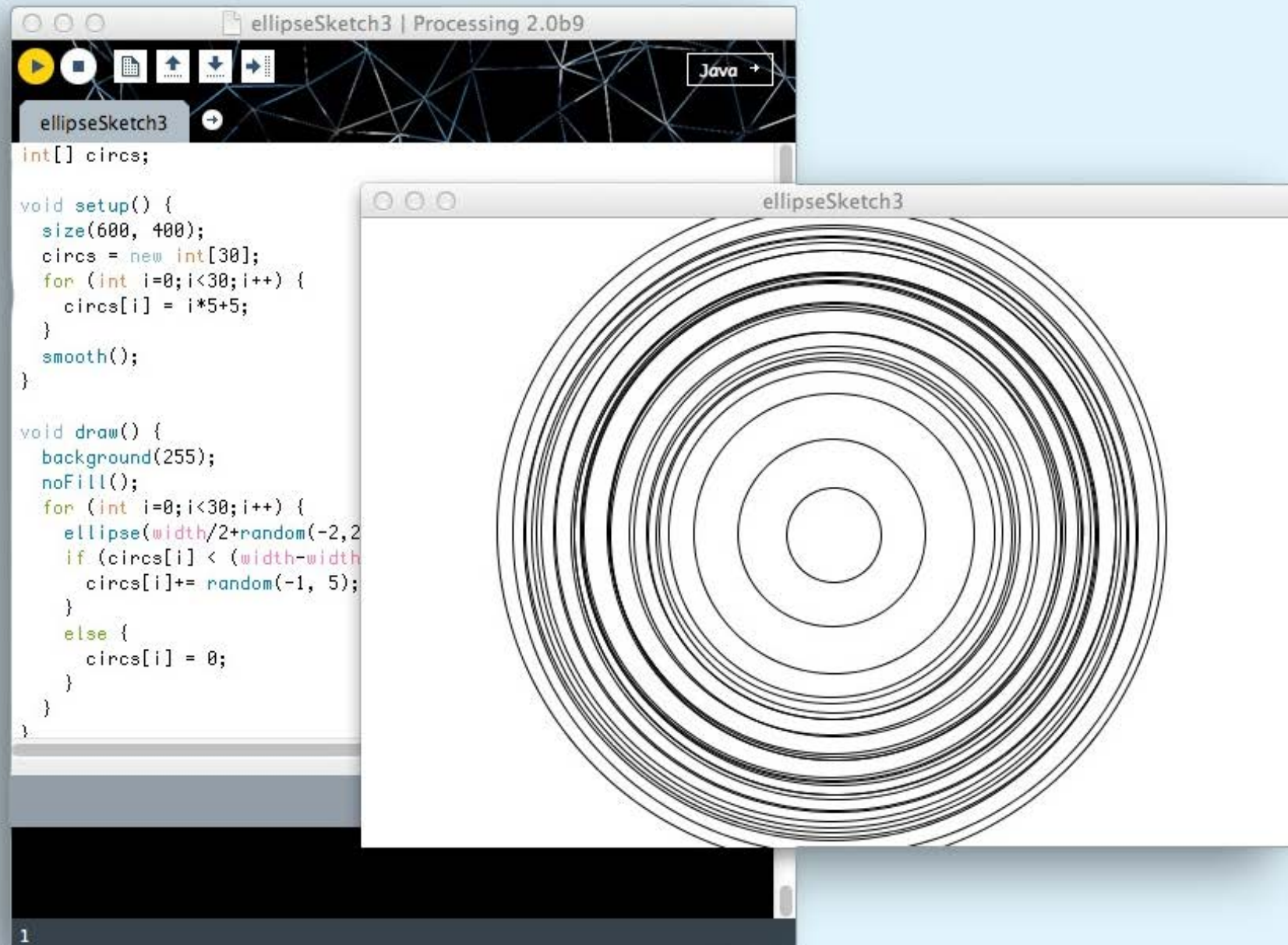
2003-Today



Massimo Banzi, David Cuartielles, Tom Igoe, Gianluca Martino, and David Mellis at Interaction Design Institute Ivrea

Processing

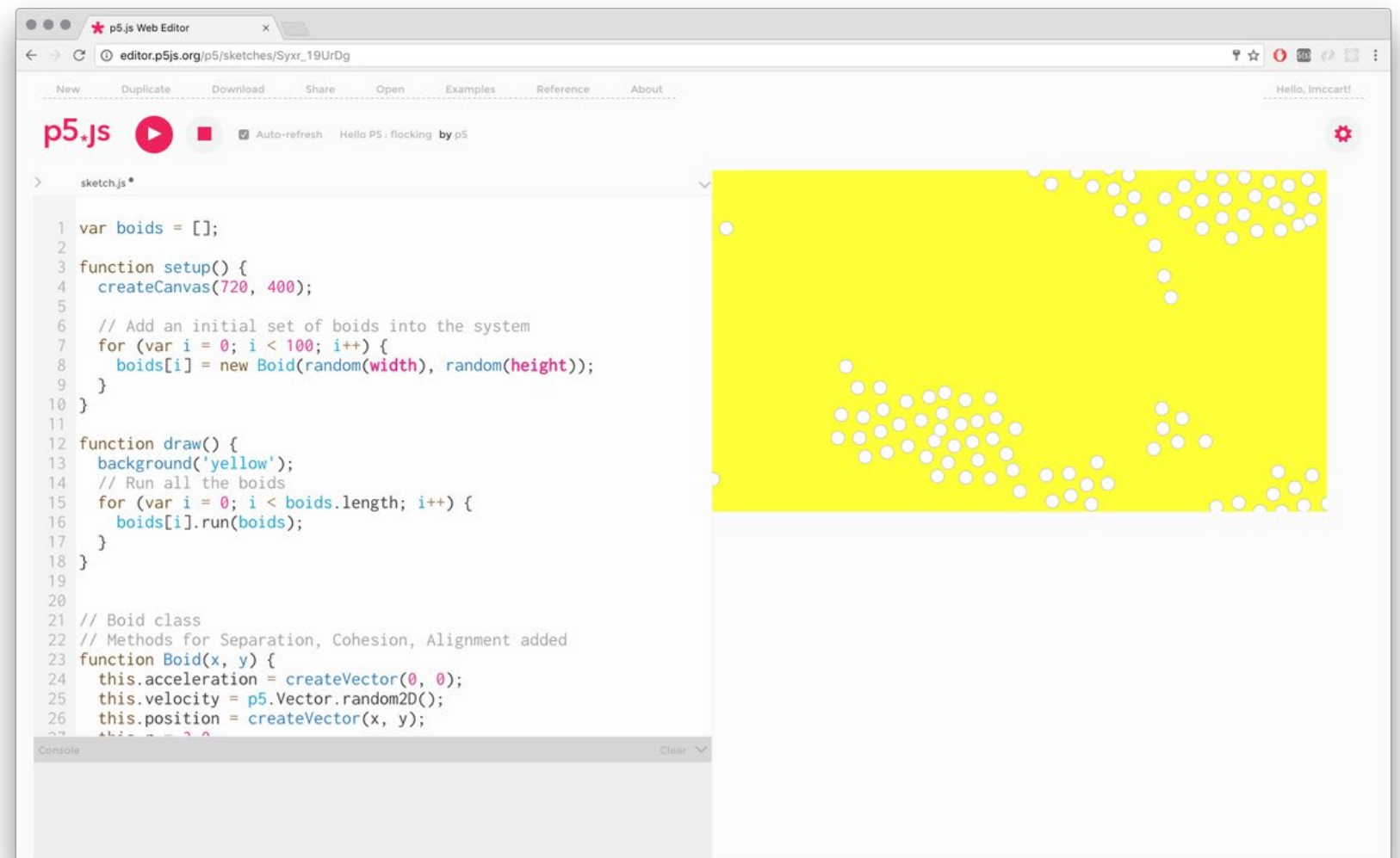
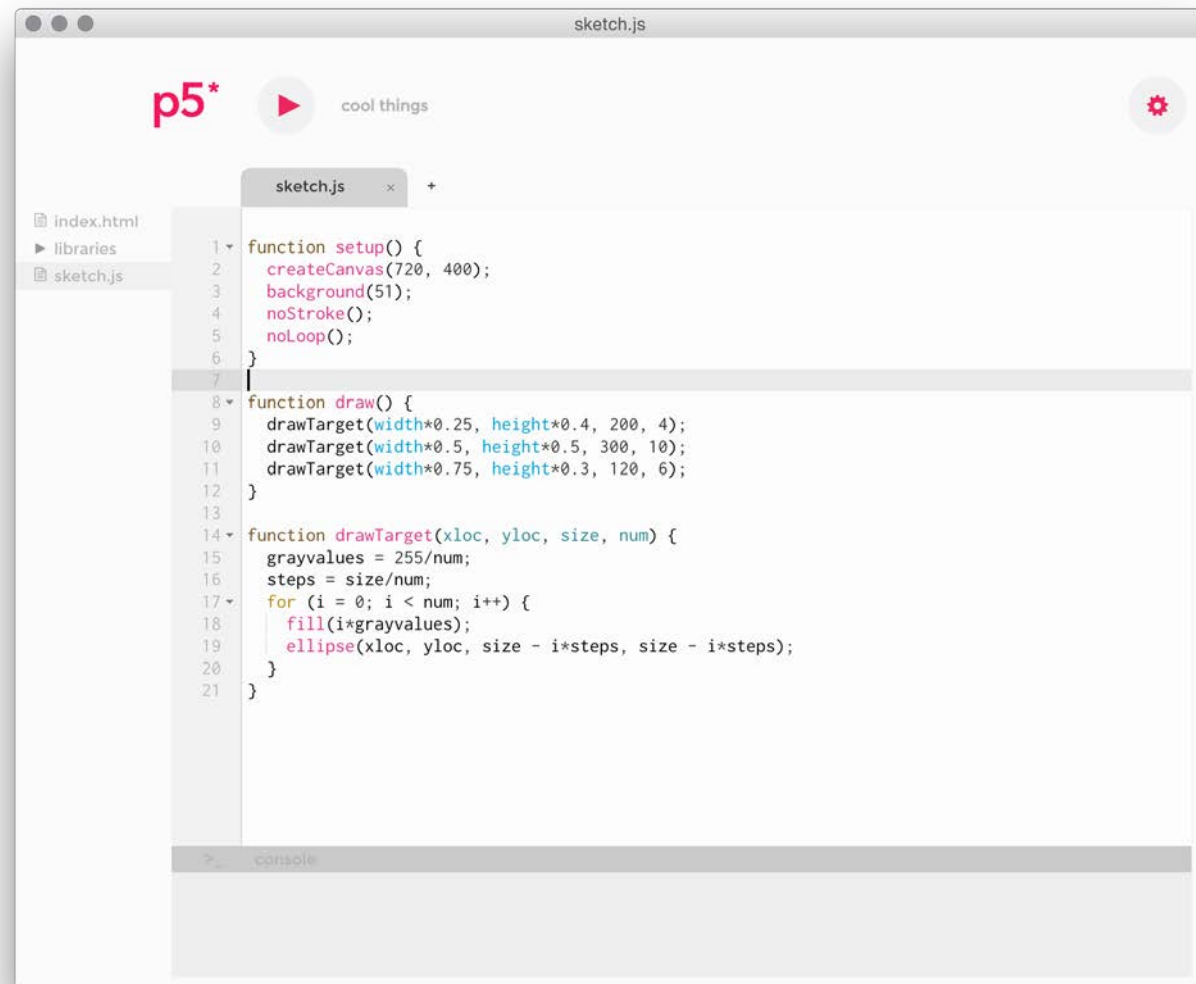
2001-Today



Casey Reas and Ben Fry at the MIT Media Lab (Now Processing Foundation)

p5.js

2014-Today



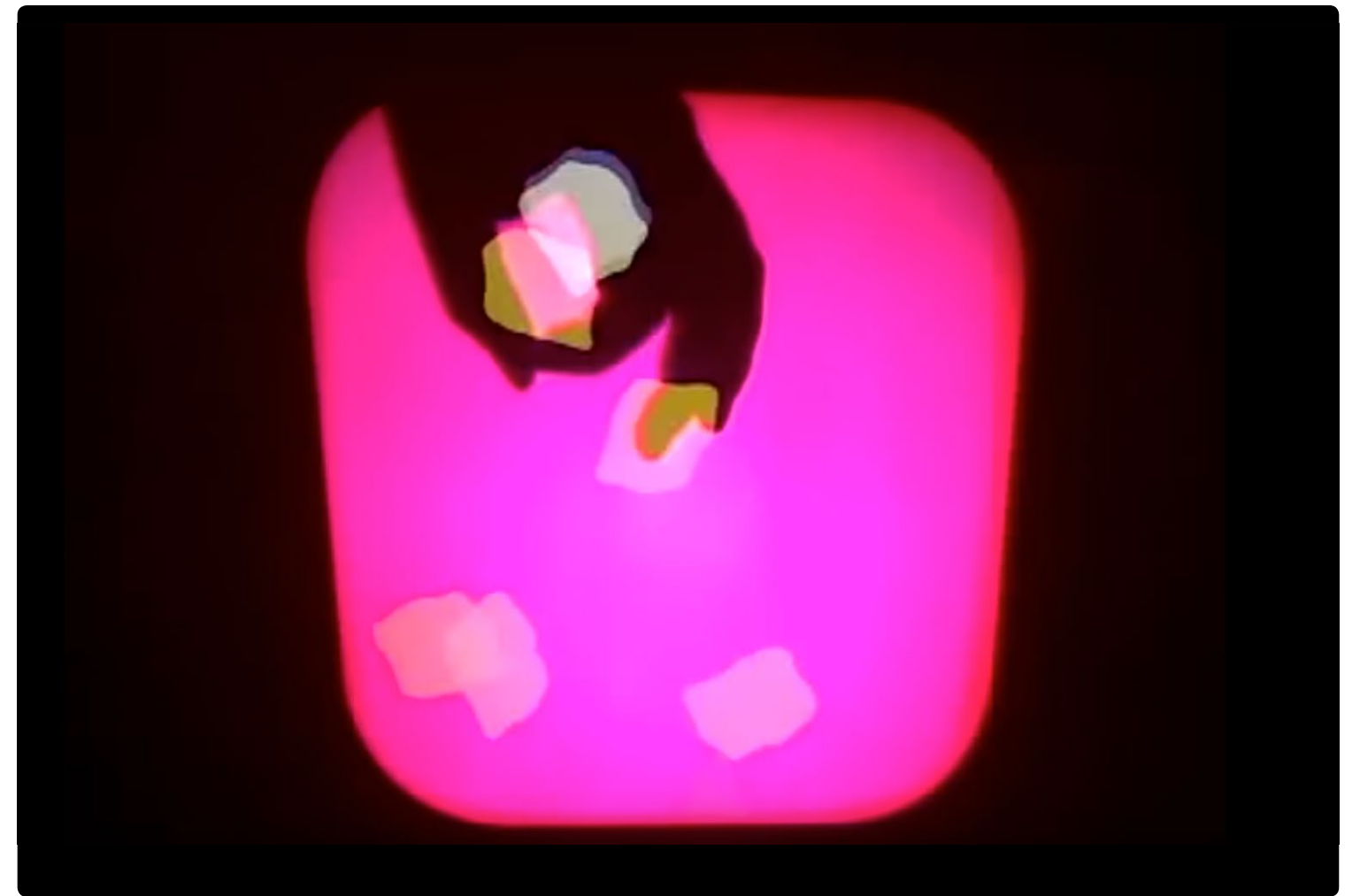
Lauren McCarthy at MIT (Now at UCLA, Dept. of Design Media Arts)

Digital Drawing

Painterly Approaches + Computational Methods

The Manual Input Workstation

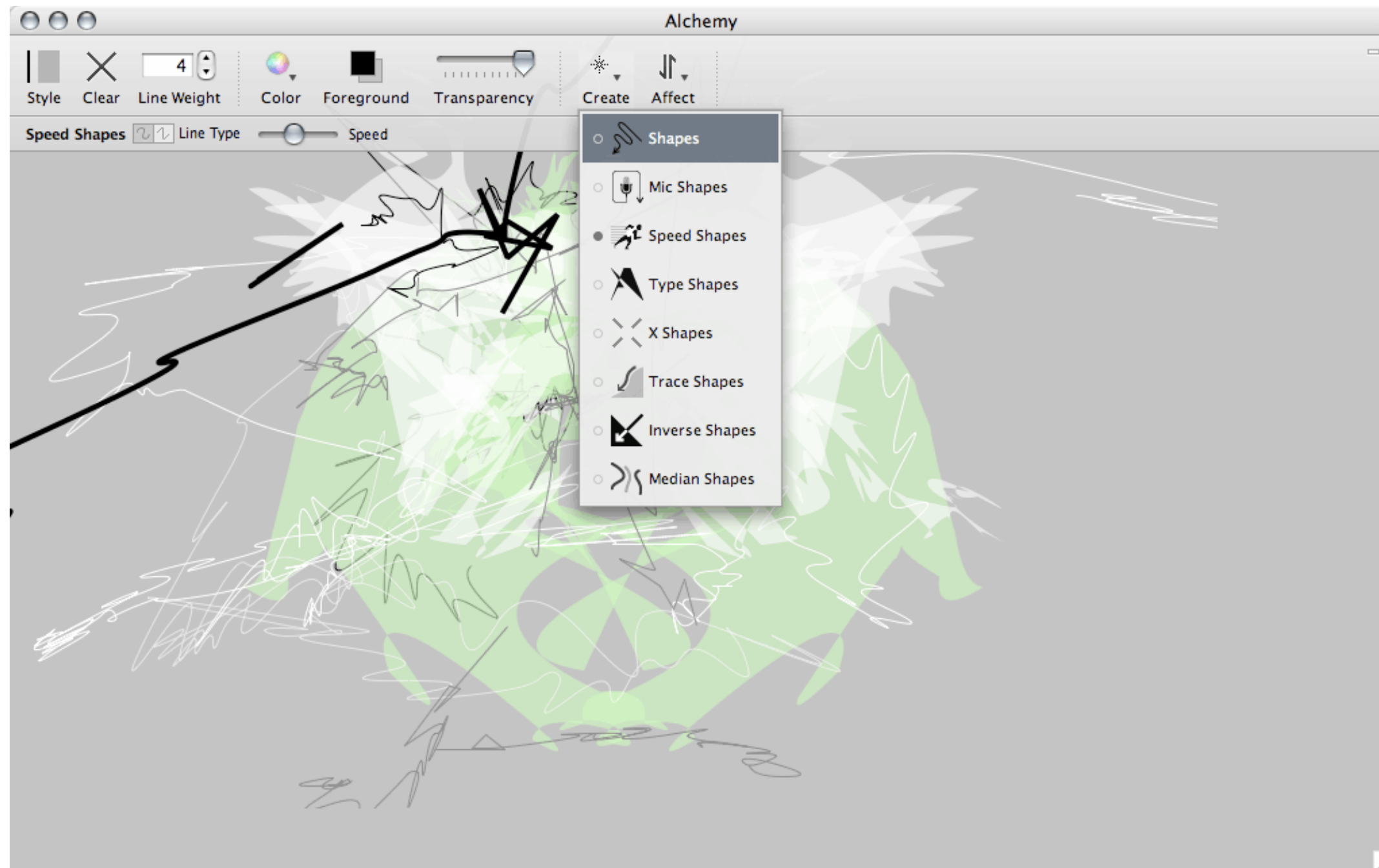
2004



Golan Levin and Zachary Lieberman

Alchemy

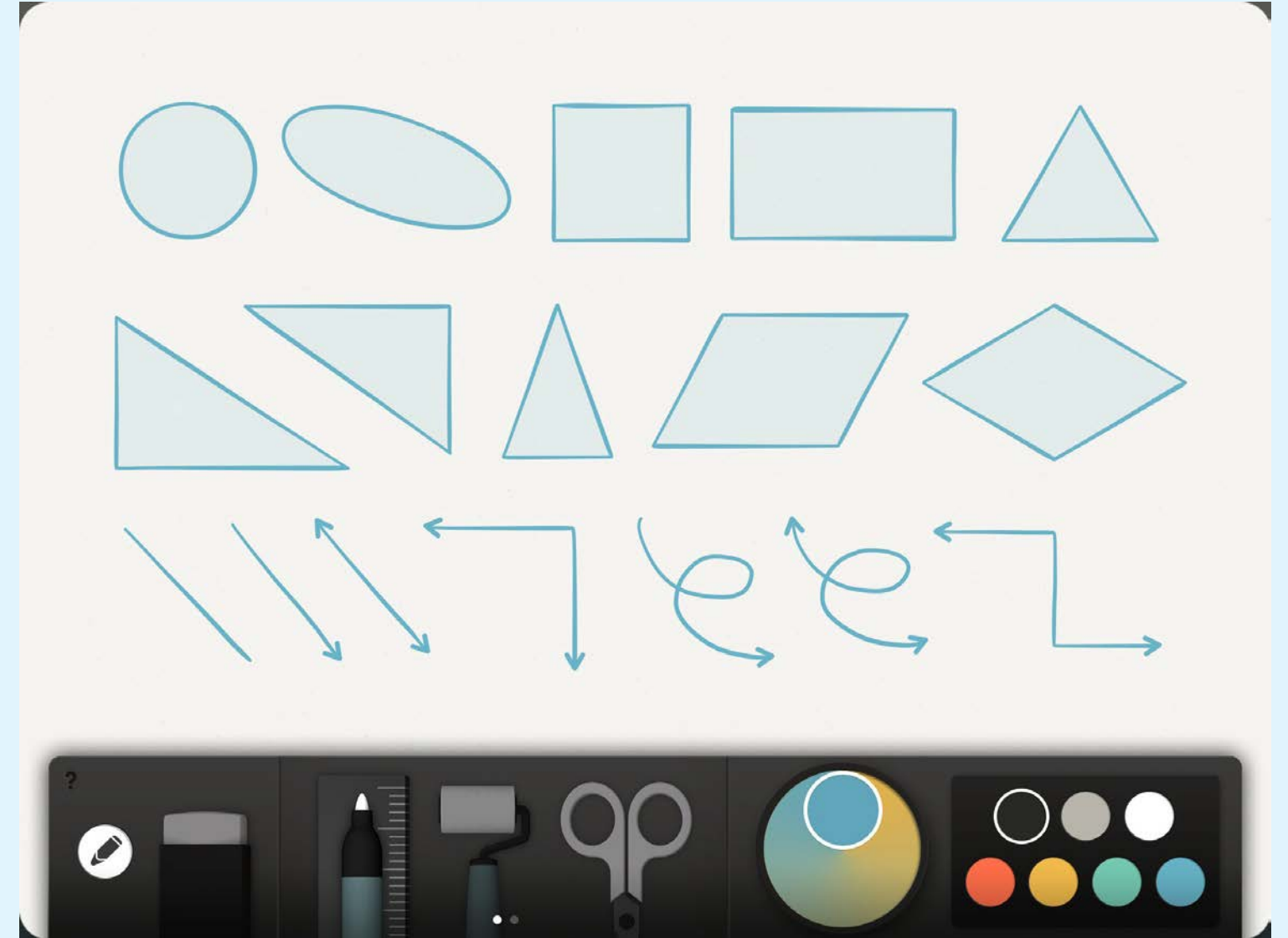
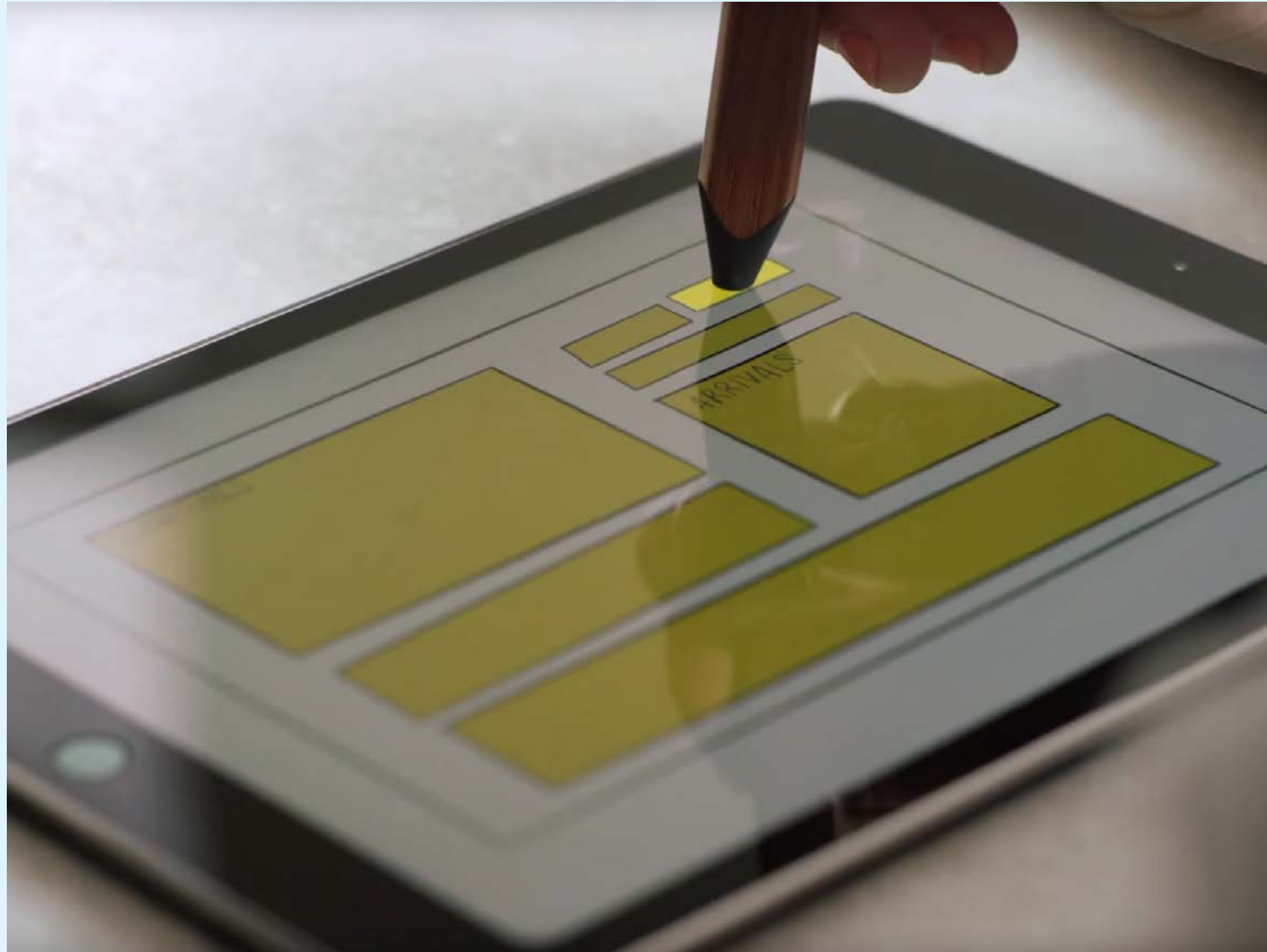
2008-



Karl D.D. Willis and Jacob Hina

Paper

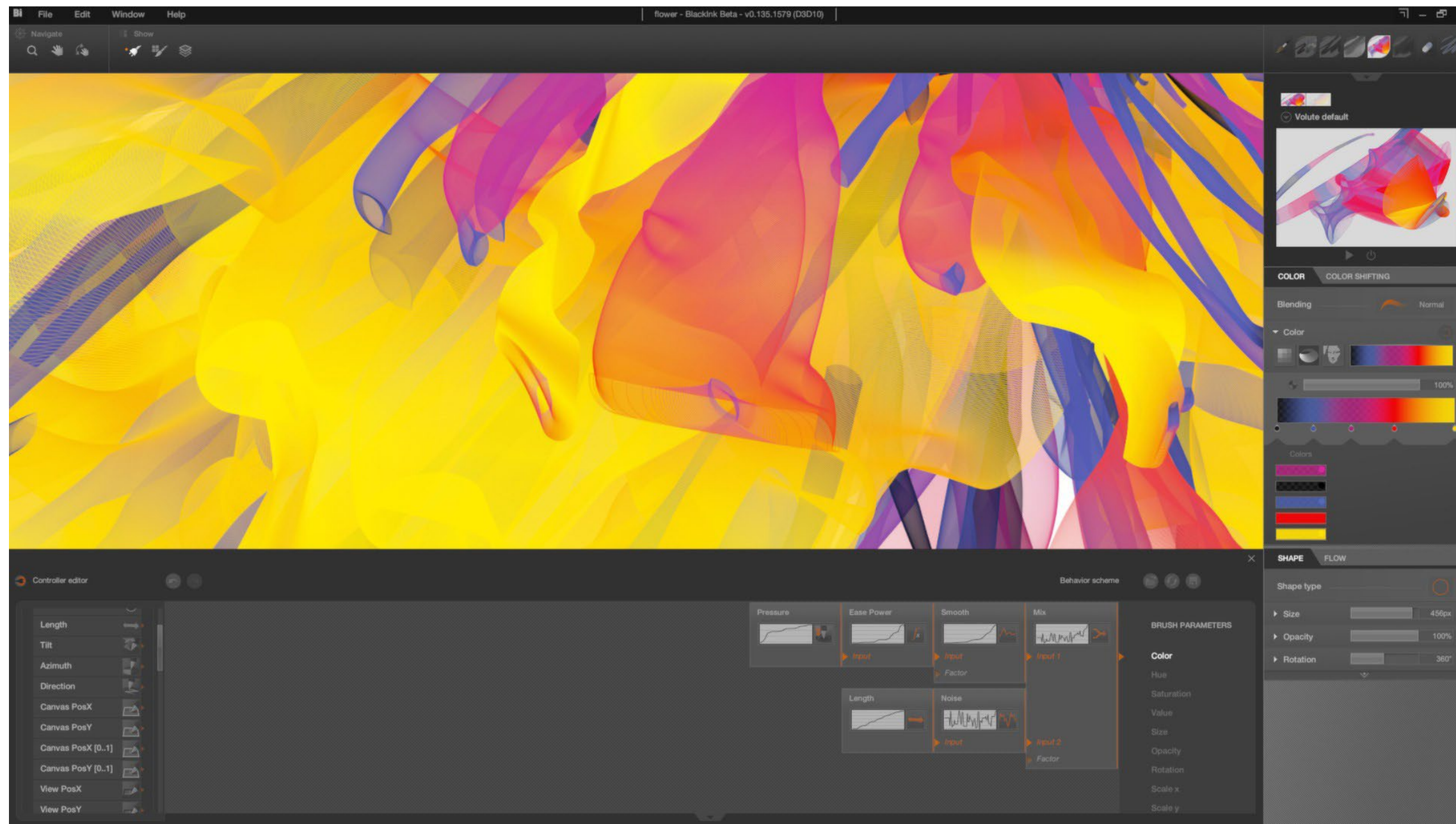
2011-Today



Georg Petschnigg, Andrew S. Allen, Julian Walker and Jonathan Harris for FiftyThree

BlackInk

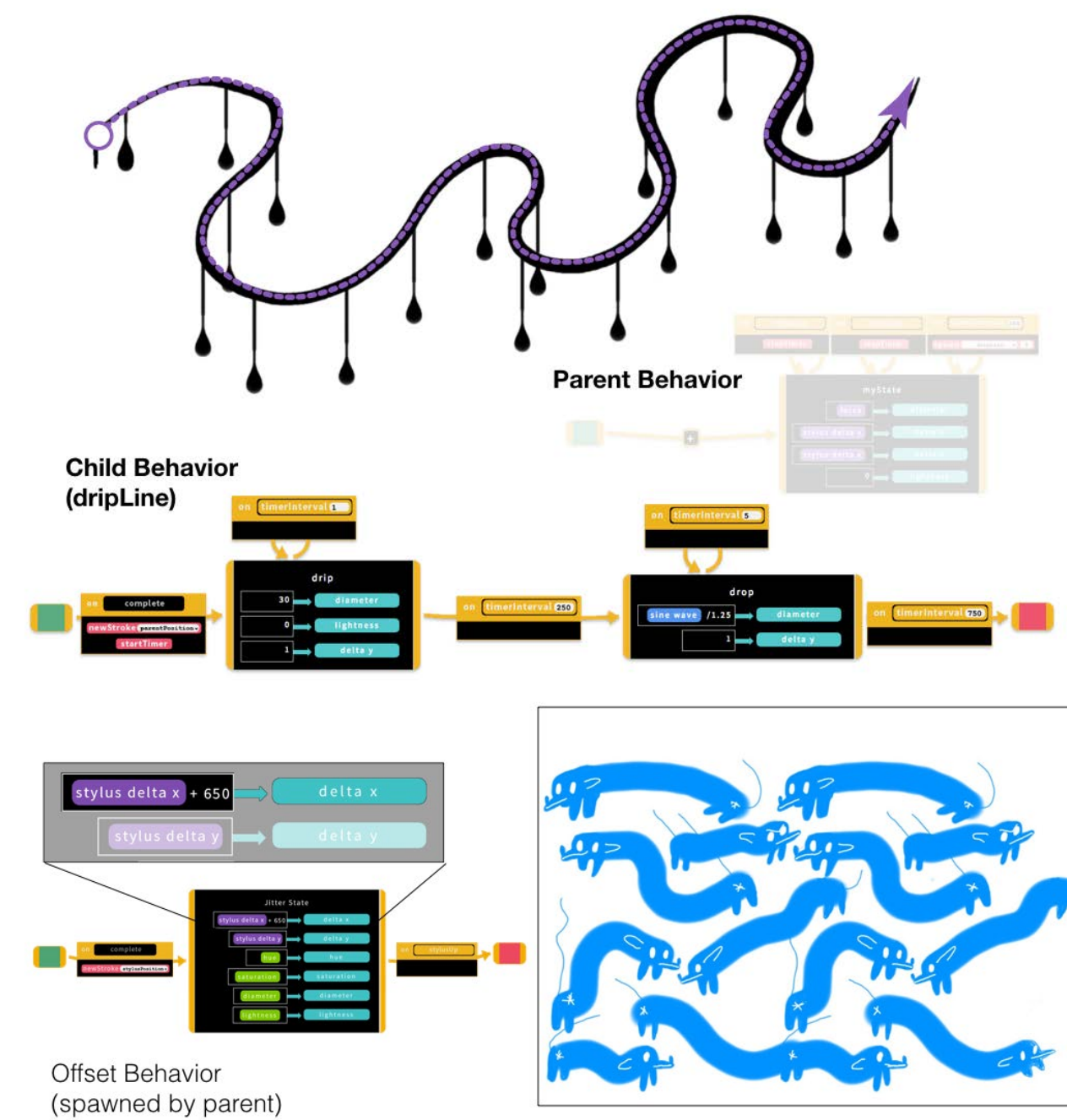
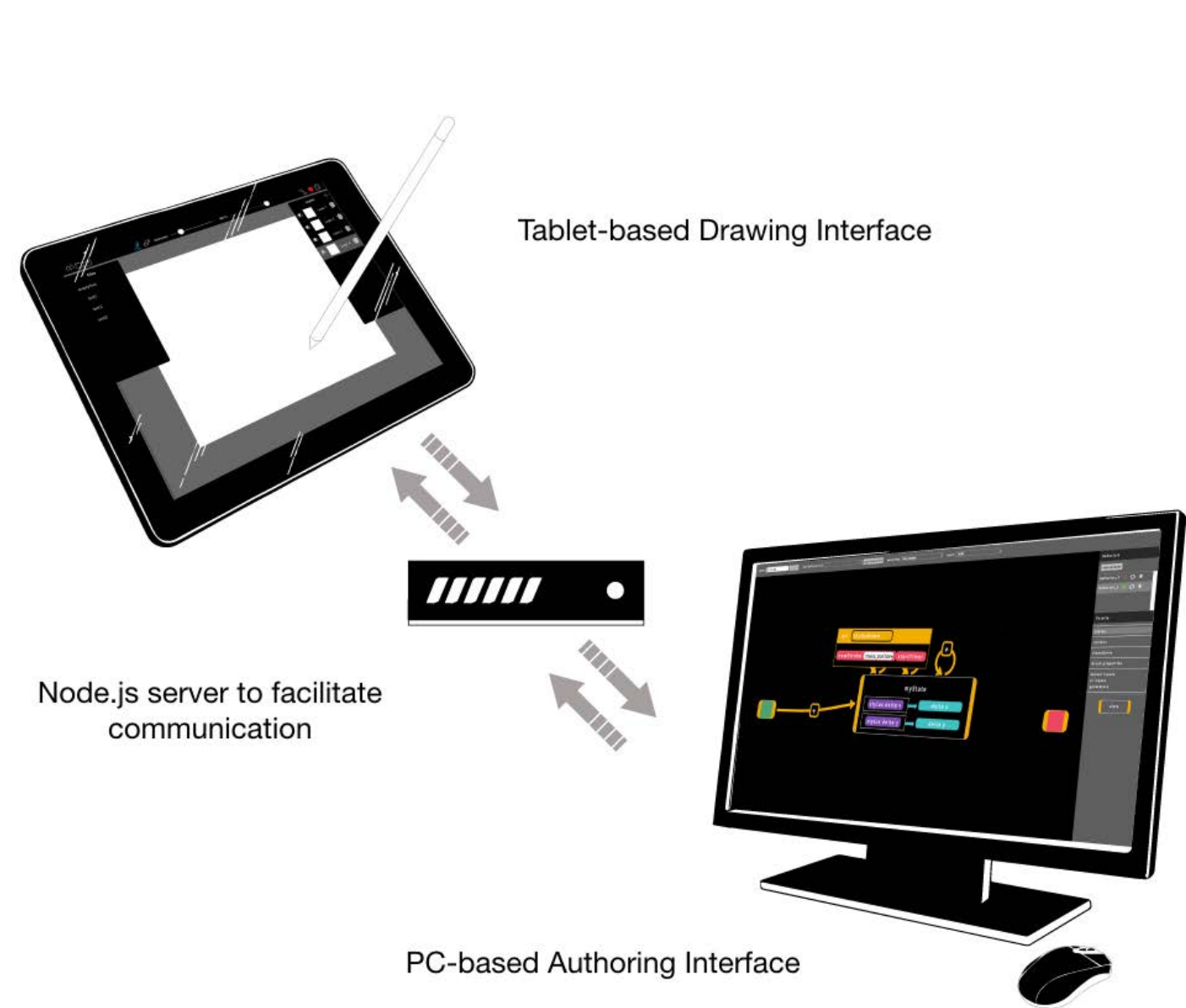
2013-Today



Bleank

Dynamic Brushes

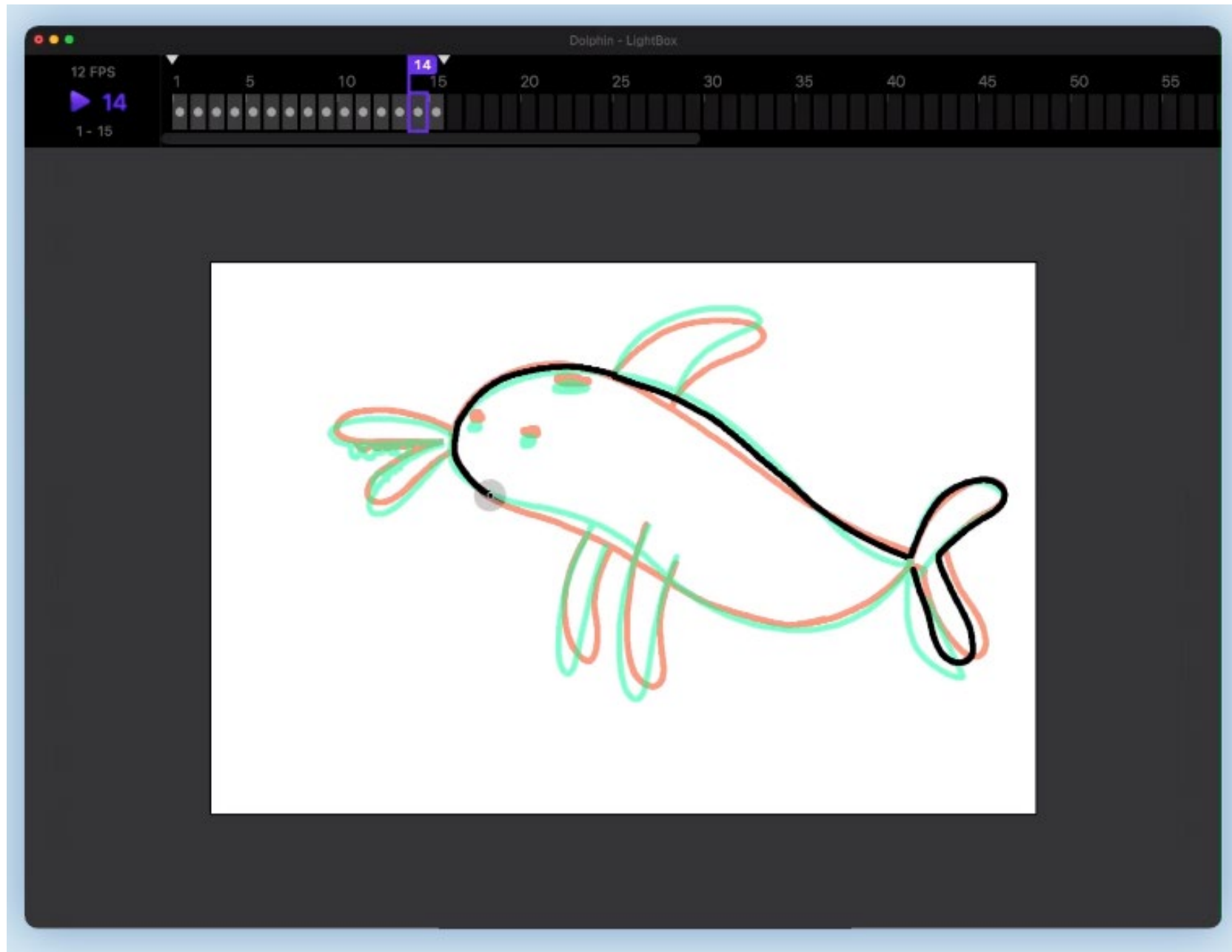
2017



Jennifer Jacobs

Lightbox

2018-Today



Pasquale D'Silva, Jacob Bijani and Wojtek Witkowski

Visual Interfaces

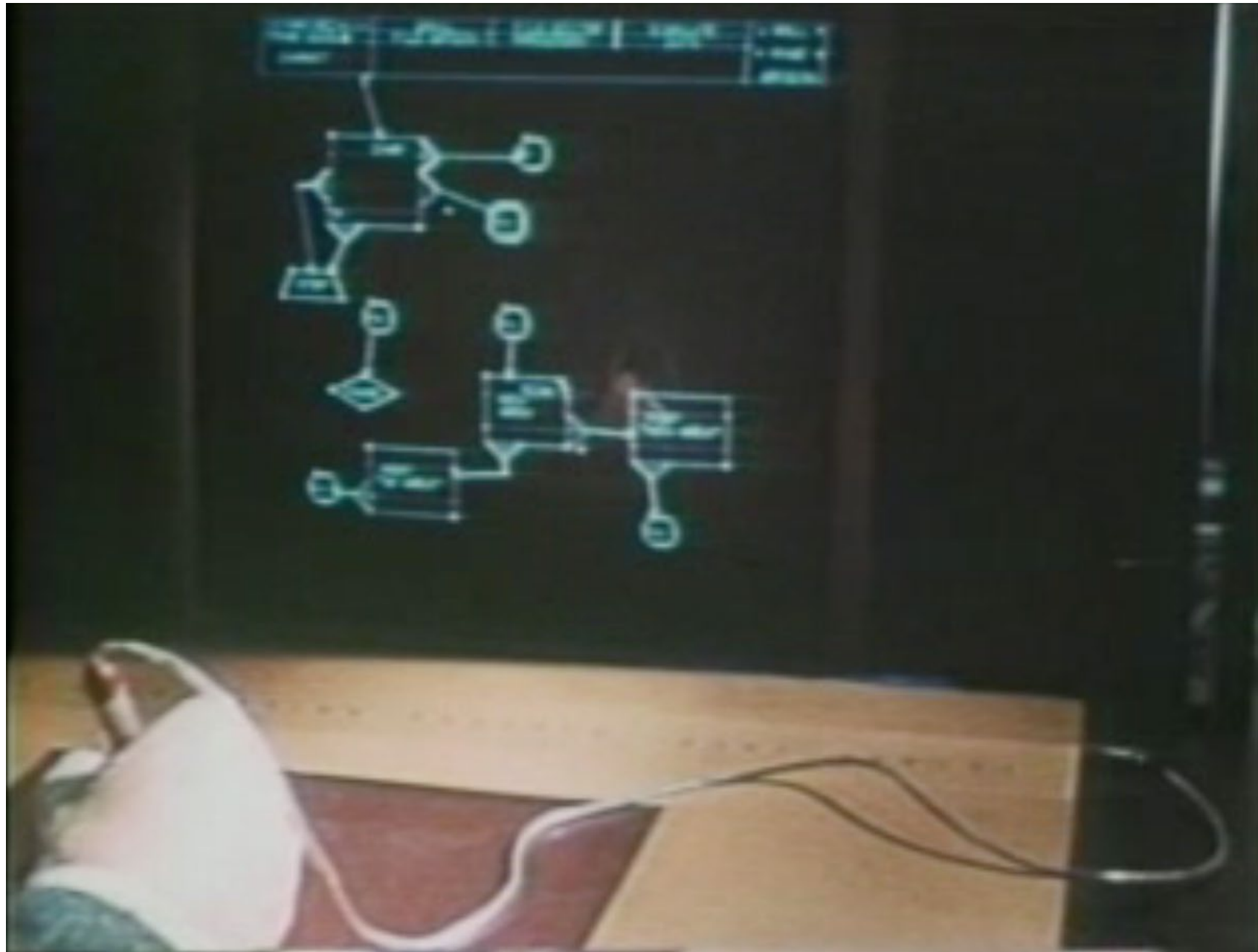
Across the (Design-Development) Divide

Node-Based (Graph)

Environments afford the
Visual Authoring of Programs

GRail

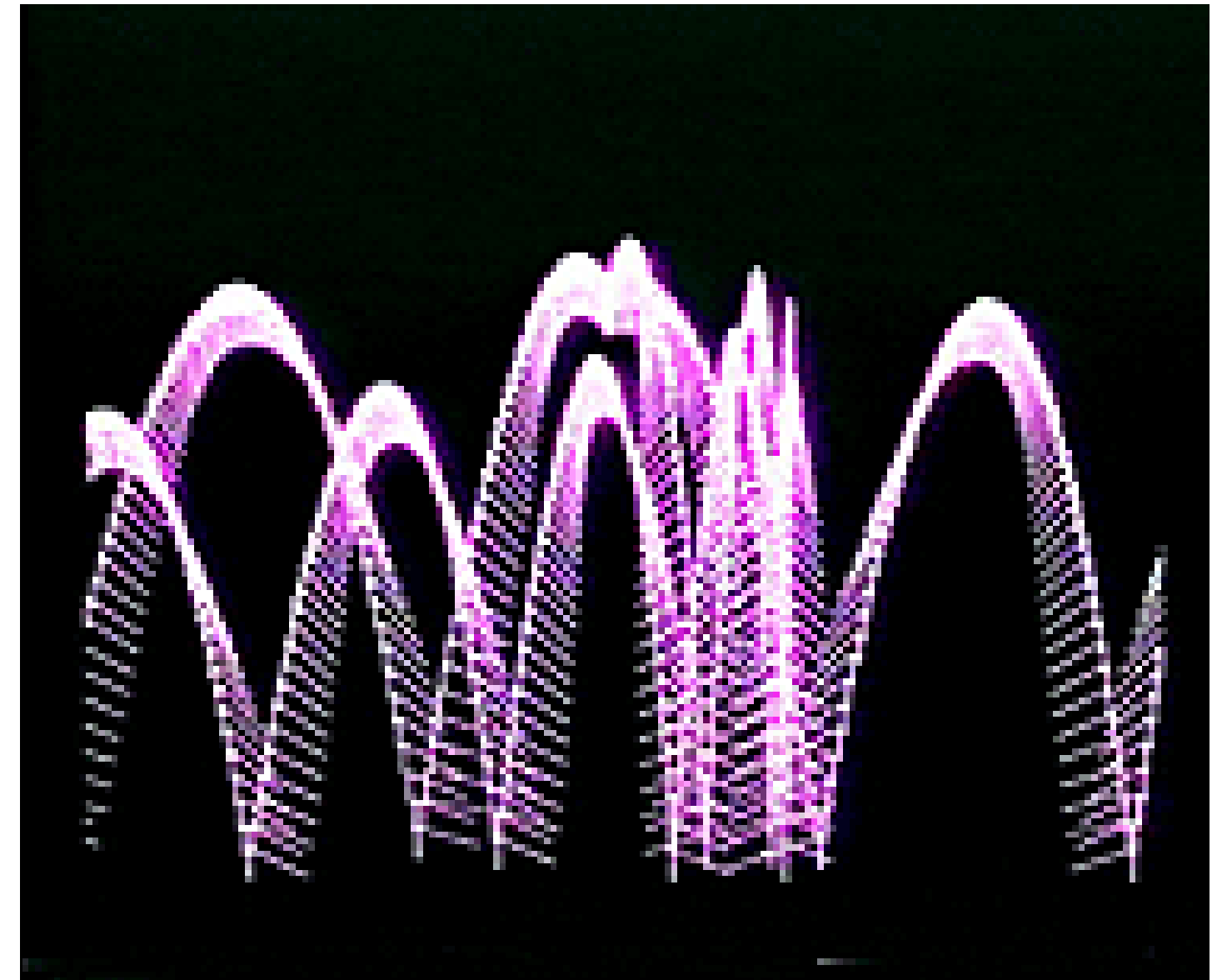
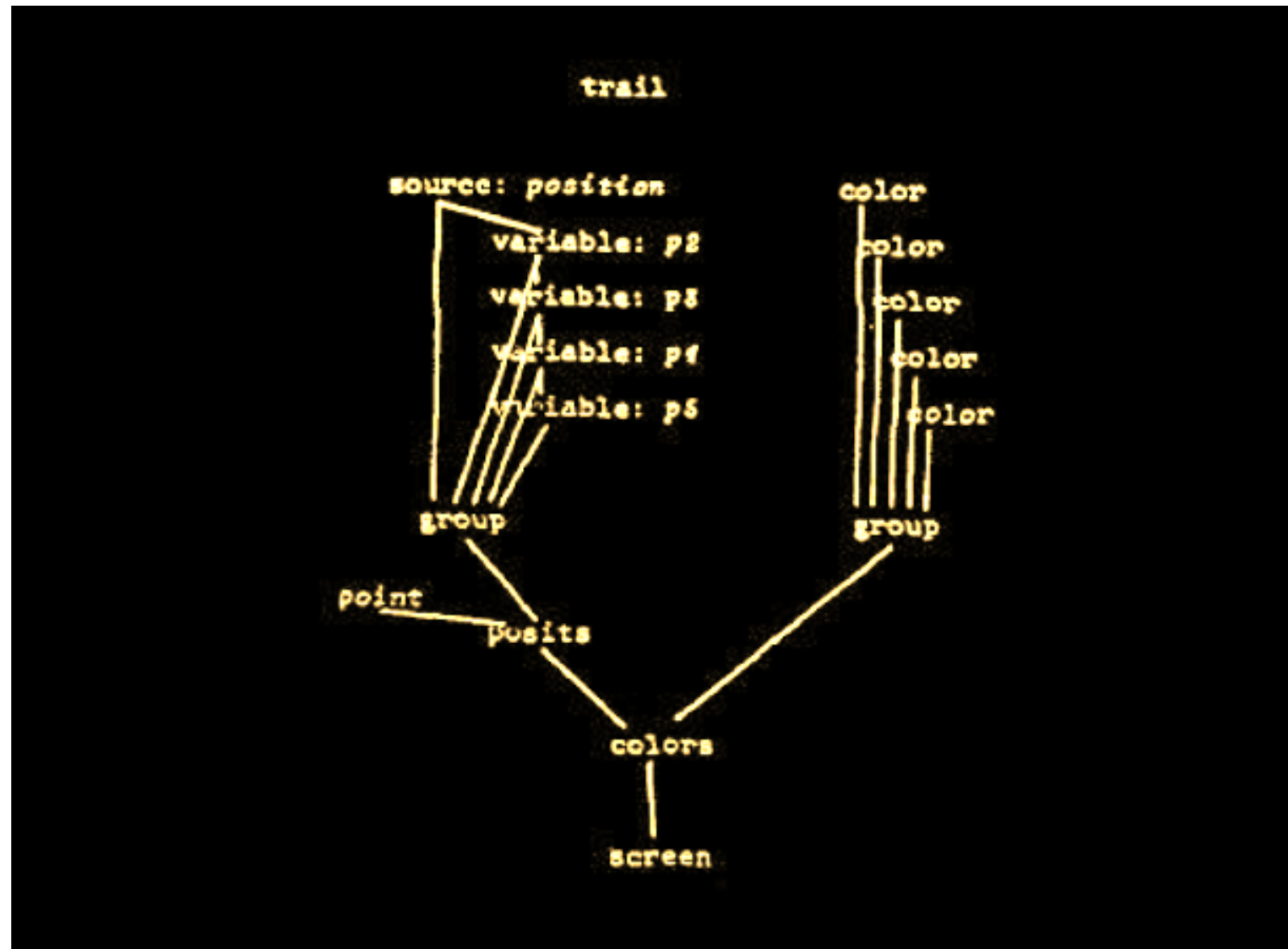
1968



RAND Corporation

EOM (Graphical Simulation System)

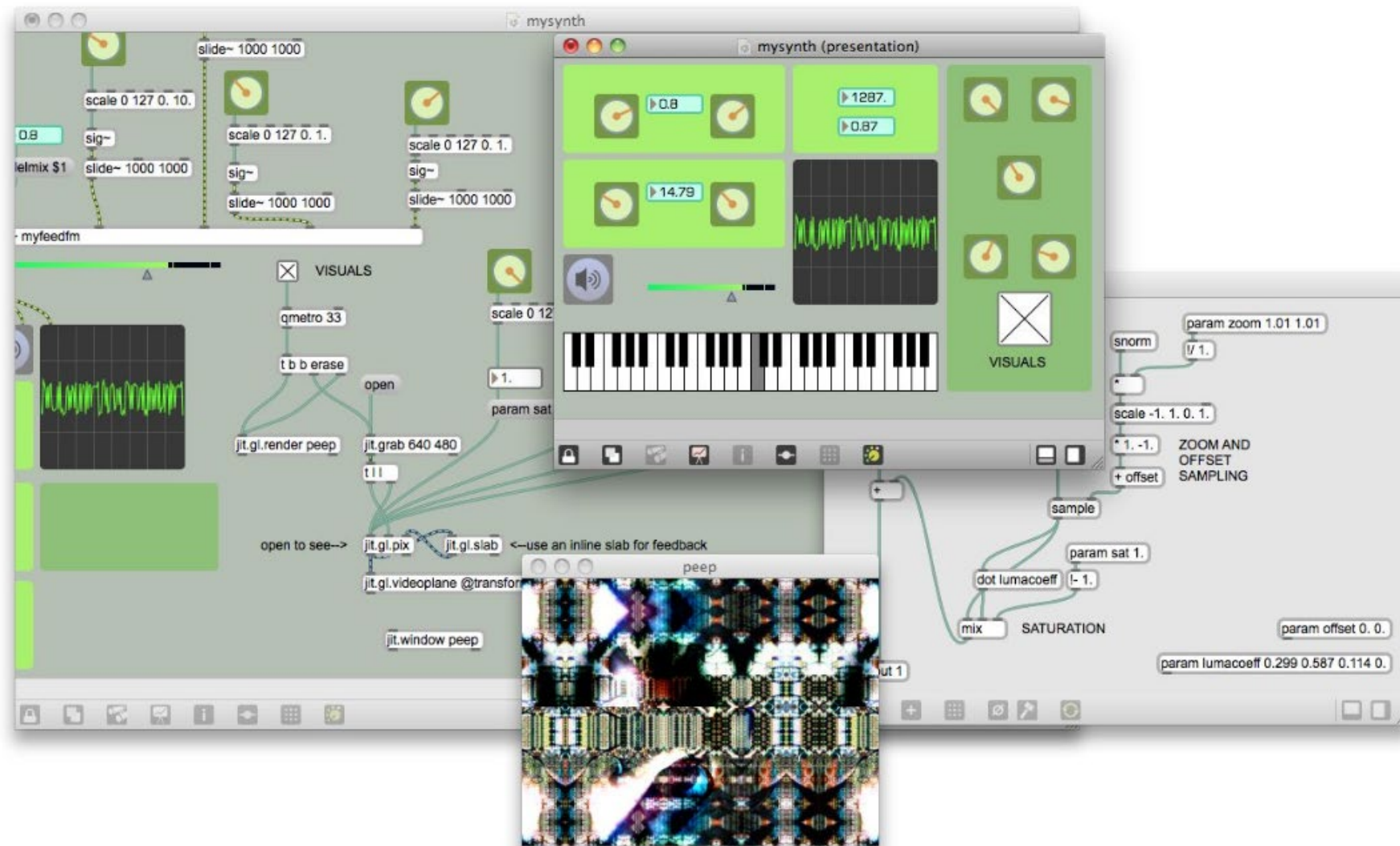
1976-1977



Paul Pangaro, Seth Steinberg, Jim Davis, and Ben McCann at the MIT Architecture Machine Group

MaxMSP

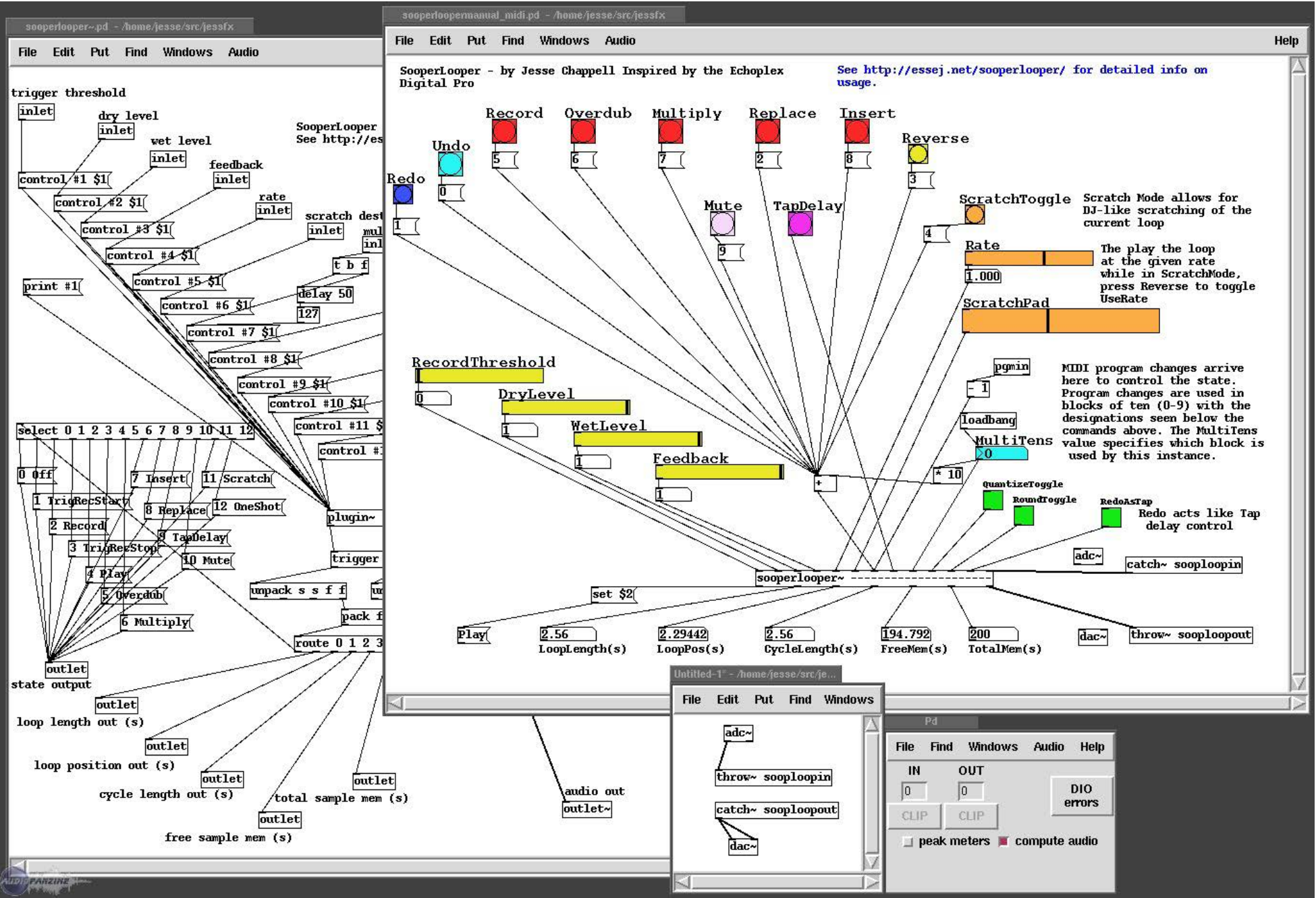
1990-Today



Miller Puckette at IRCAM (Now Cycling '74)

Pure Data

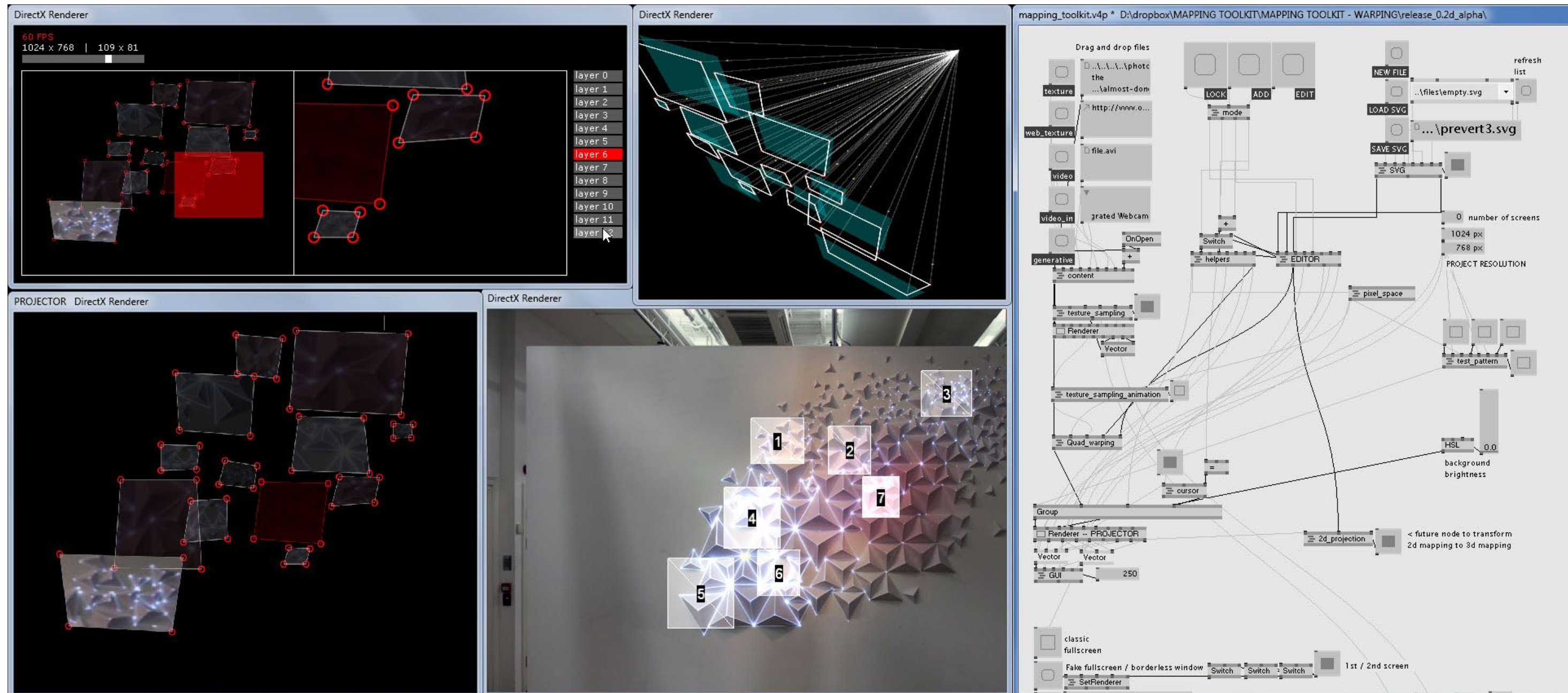
1996-Today



Miller Puckette

VVVV

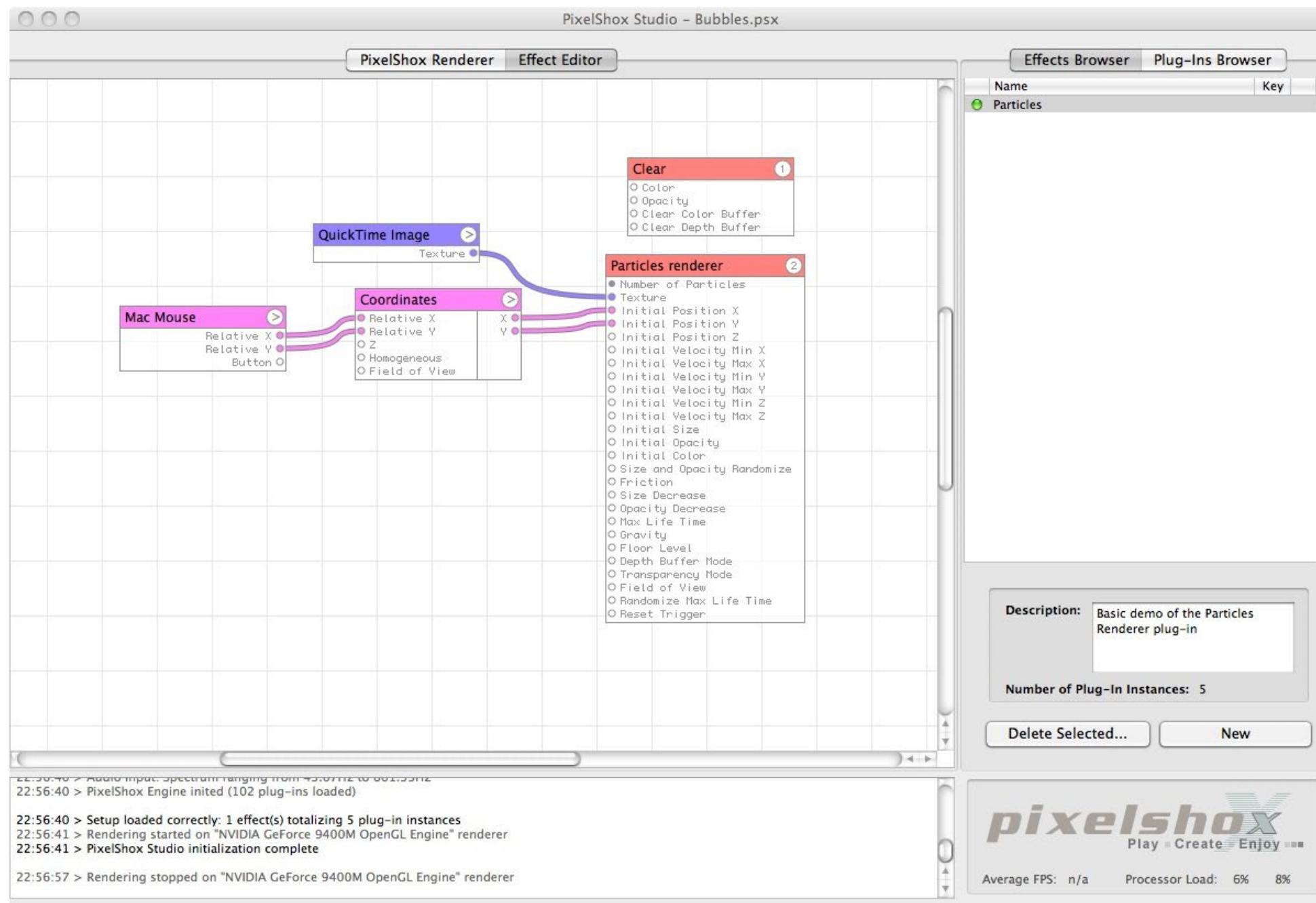
1998-Today



Joreg, Max Wolf, Sebastian Gregor, Sebastian Oschatz for 'vvvv Group'

PixelShox Studio

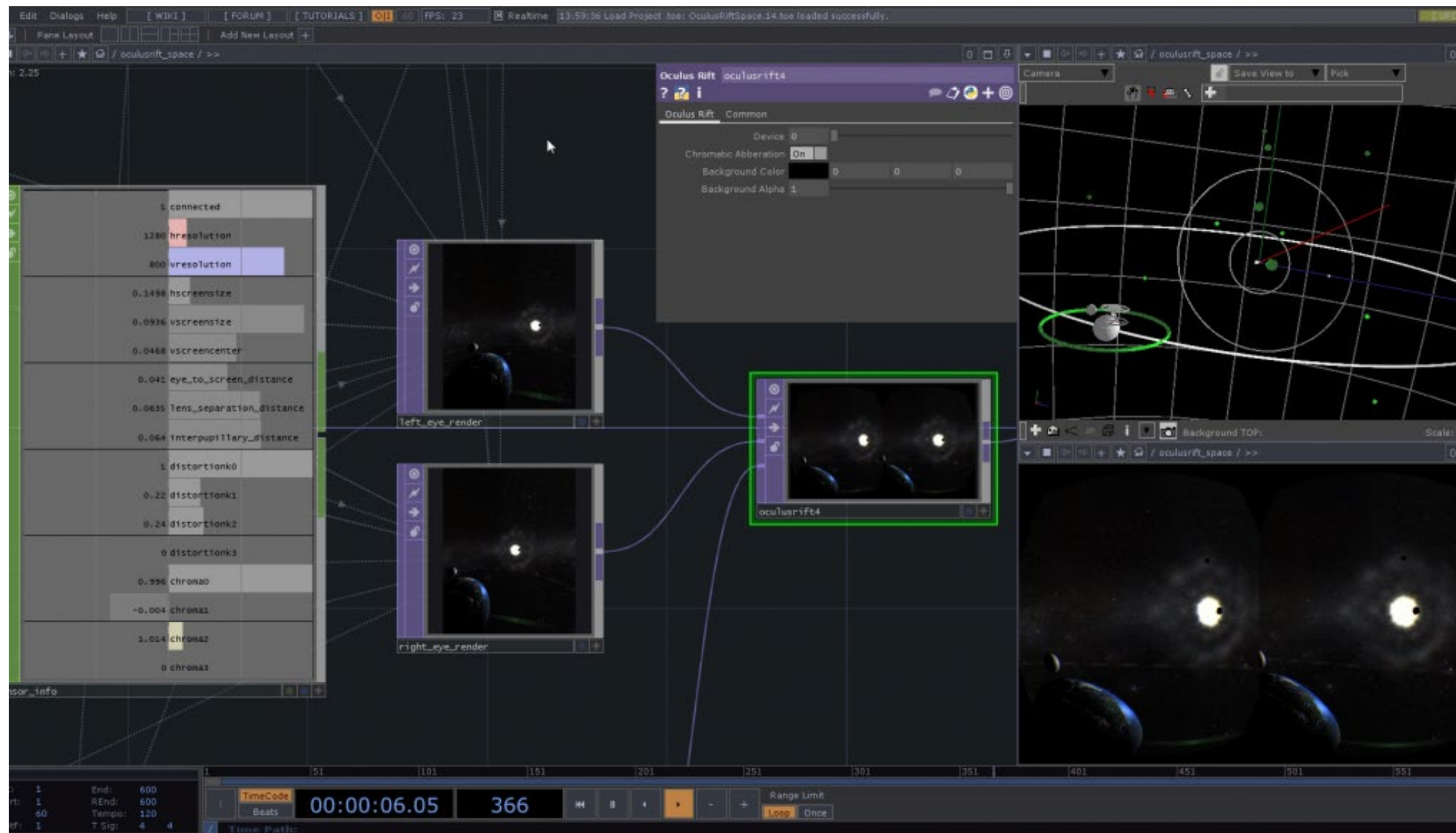
2002-2003



Pierre-Olivier Latour for PixelShox (Acquired by Apple)

TouchDesigner

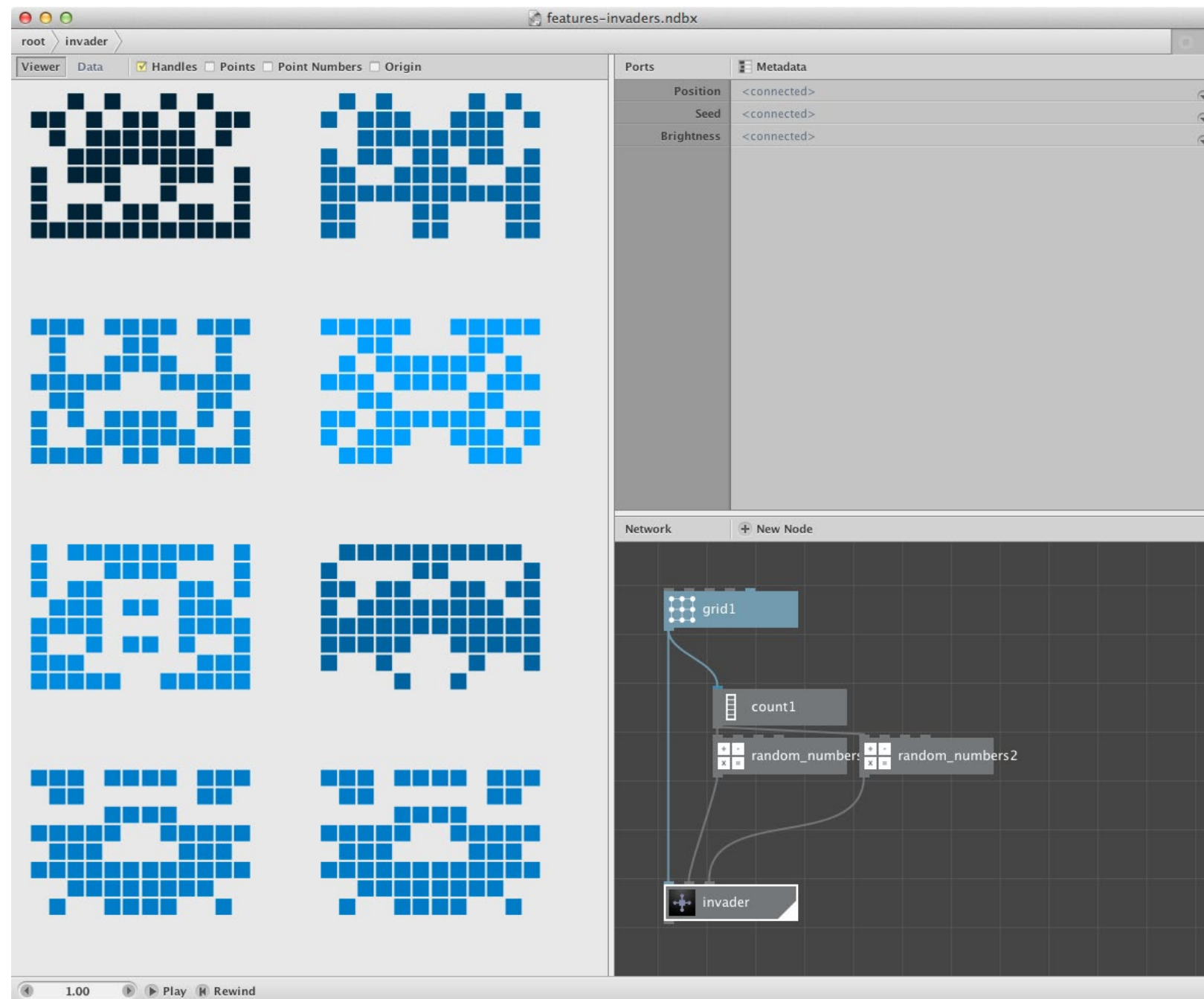
2000-Today



Greg Hermanovic, Rob Bairos, and Jarrett Smith for Derivative Inc

NodeBox

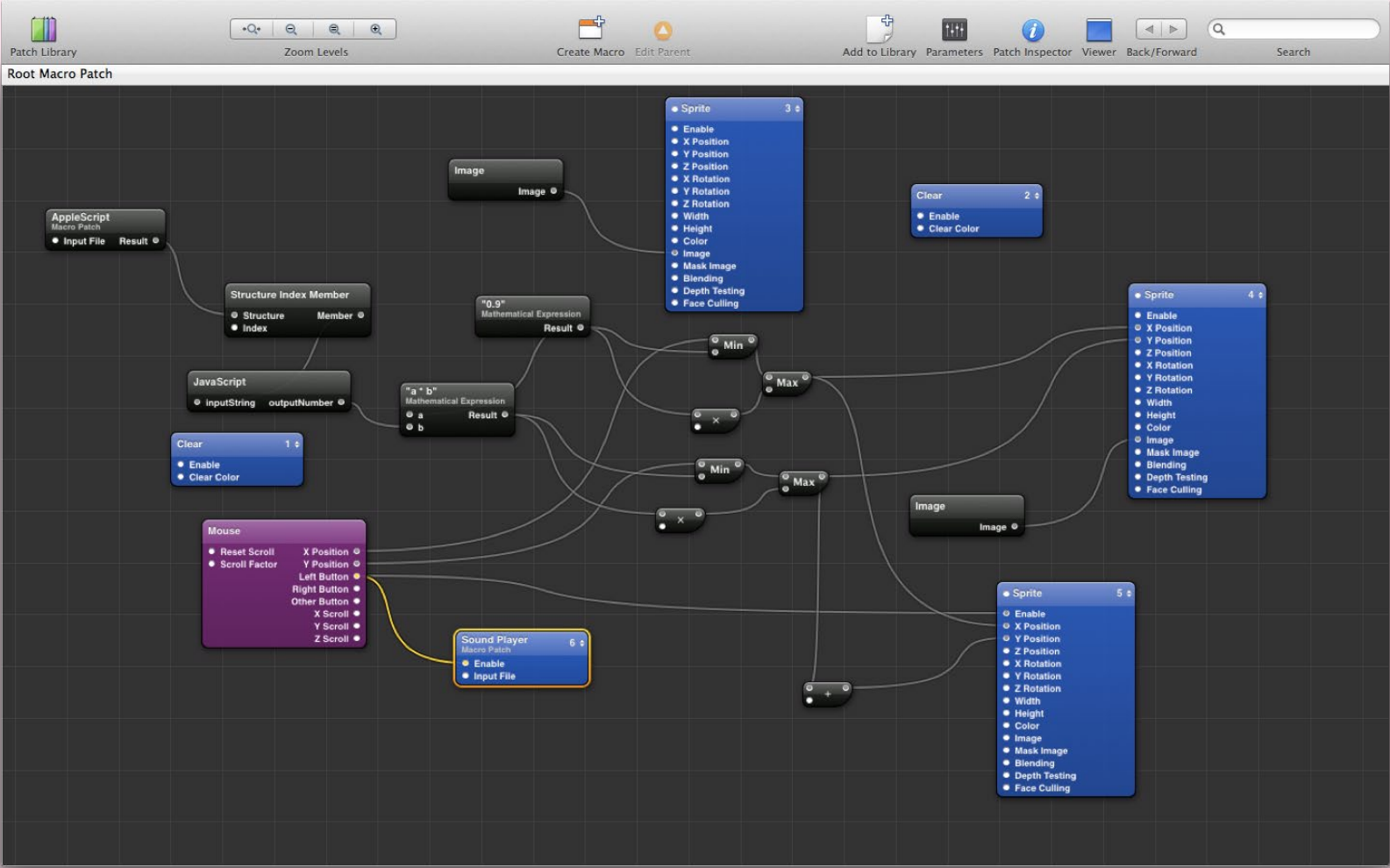
2004-Today



Experimental Media Research Group at Sint Lucas School of Arts of the Karel de Grote-Hogeschool

Quartz Composer

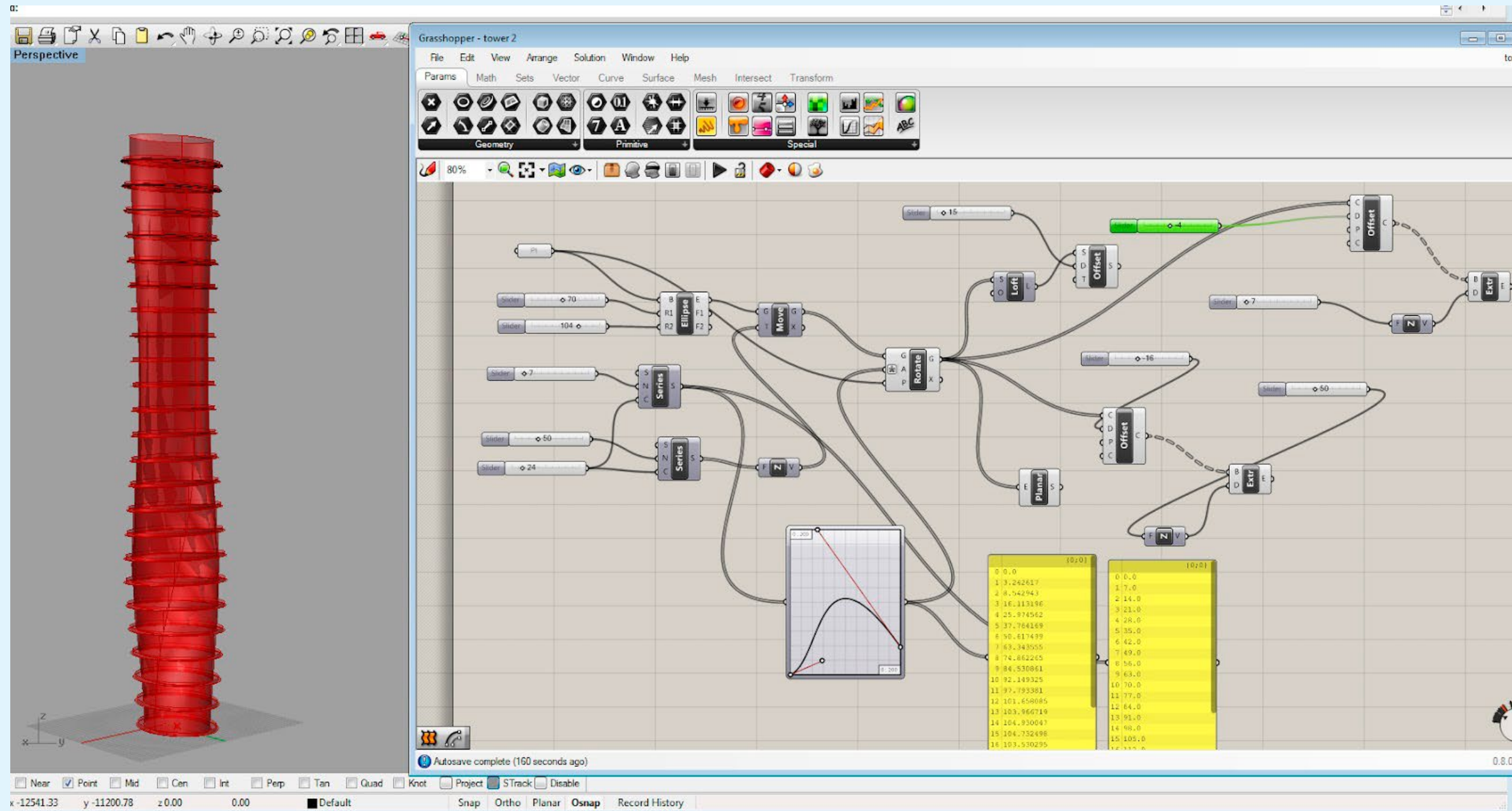
2005-2016



Apple

Grasshopper for Rhino

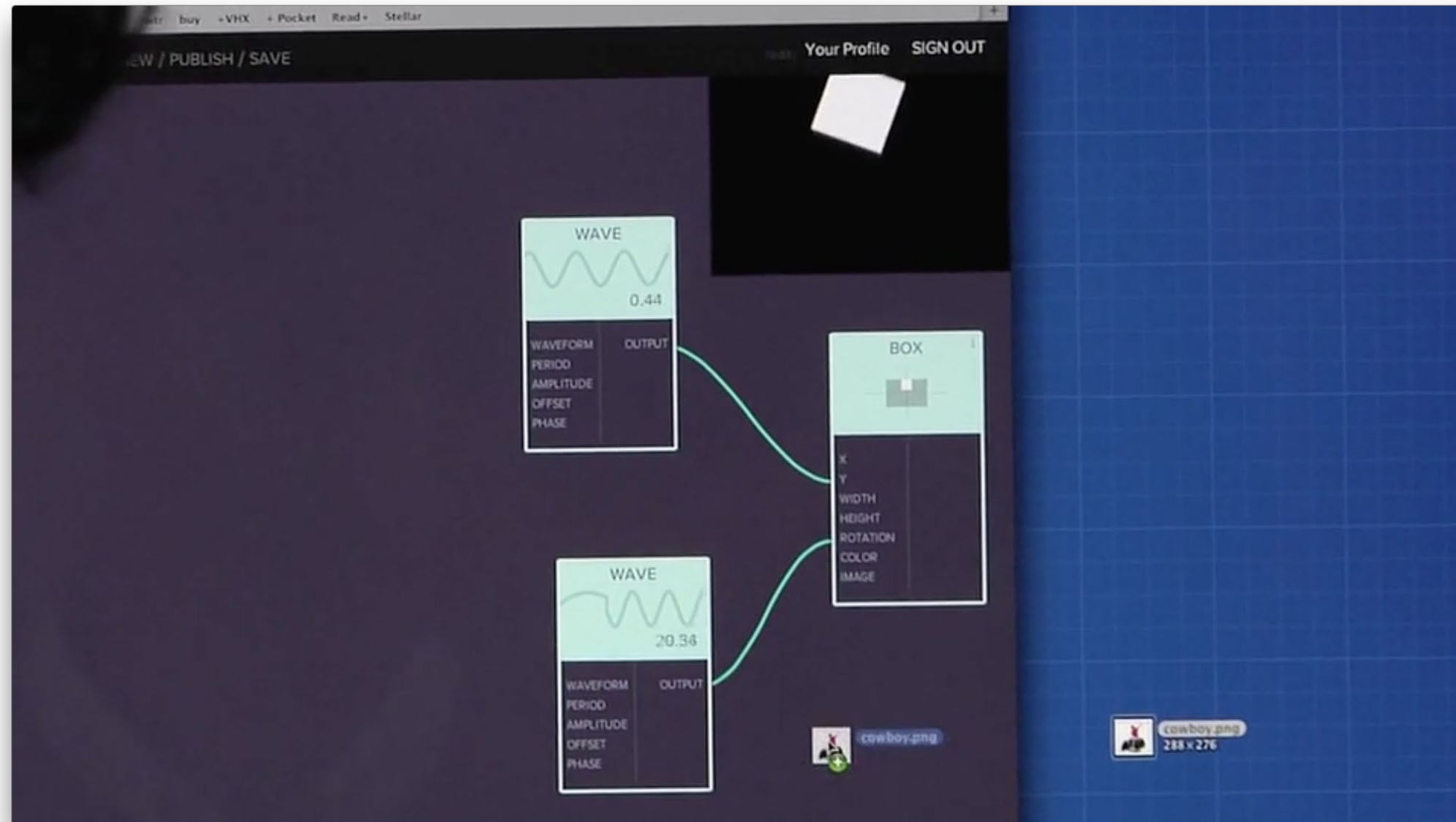
2007-Today



Robert McNeel and David Rutton

Moonbase

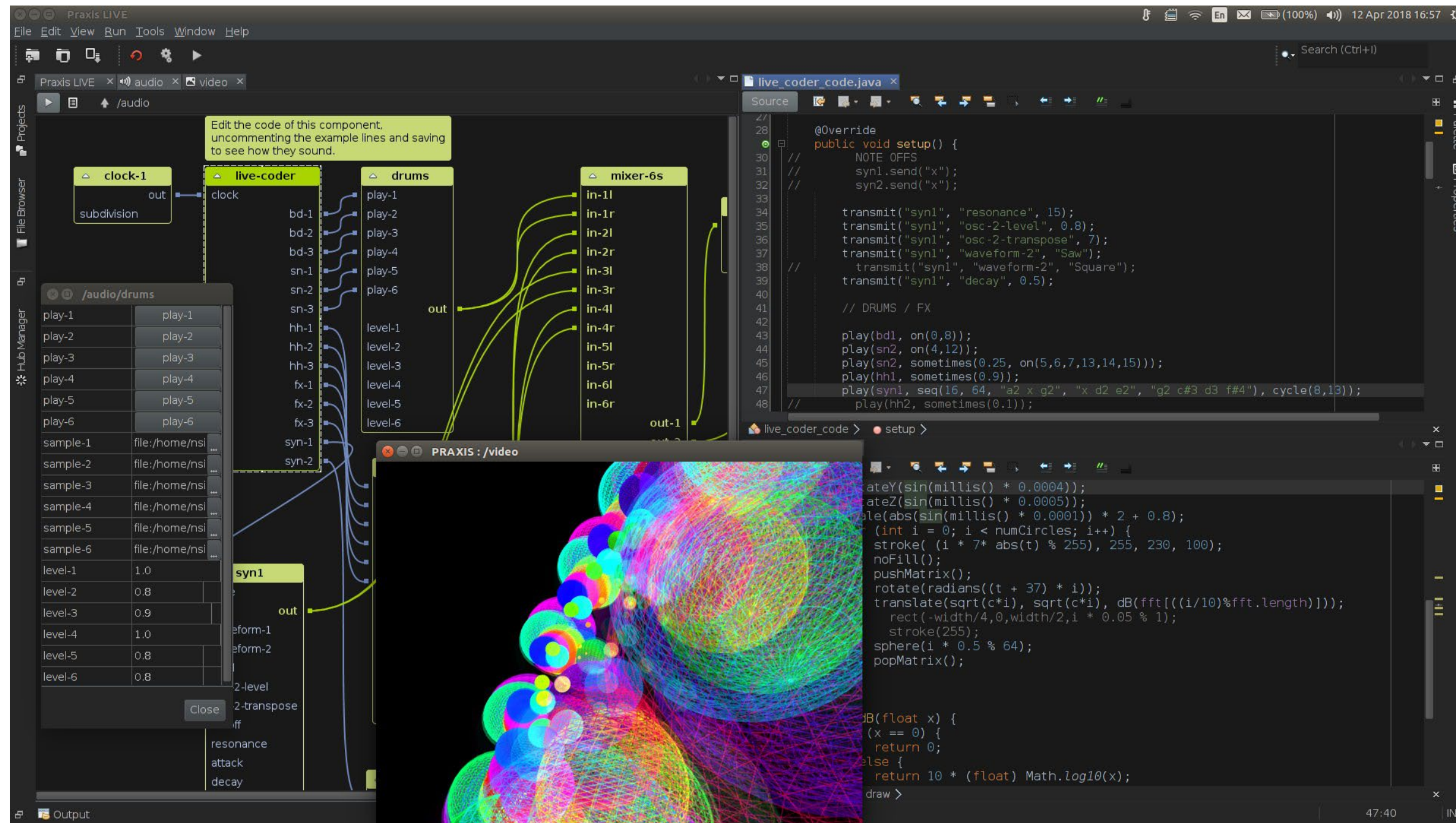
2012



William Cotton and Pasquale D'Silva

Praxis Live

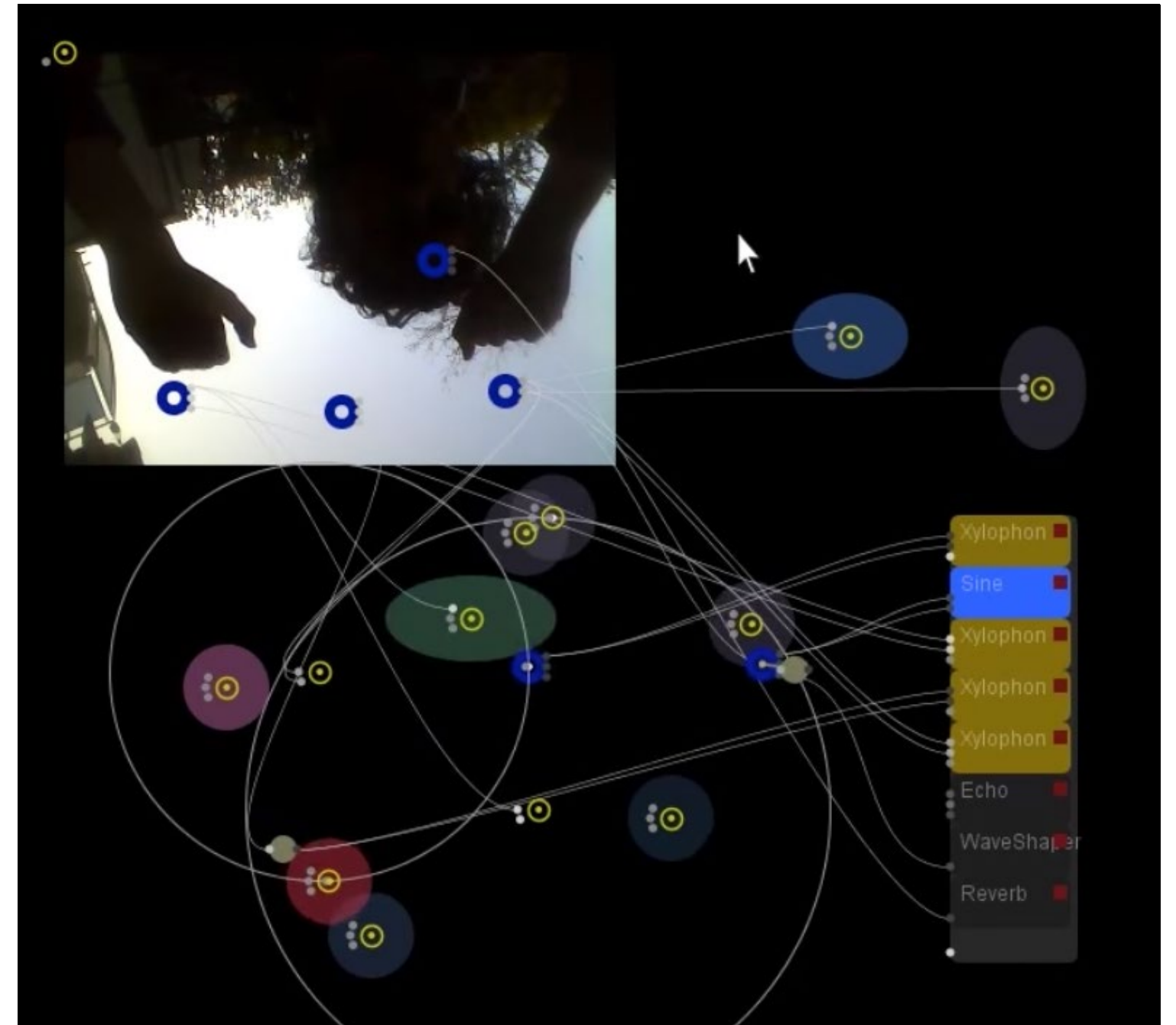
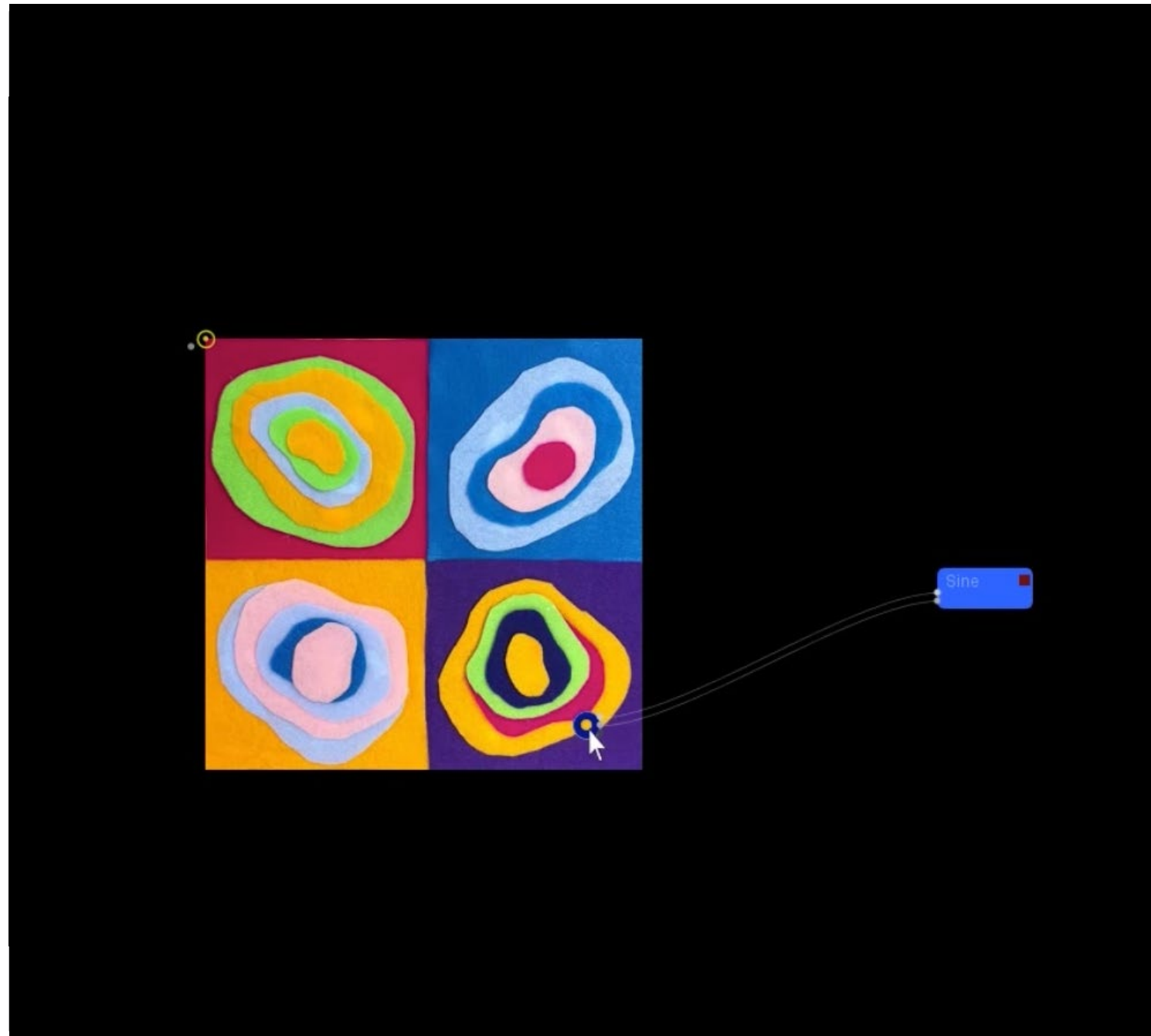
2012-Today



Neil C Smith

Loligo

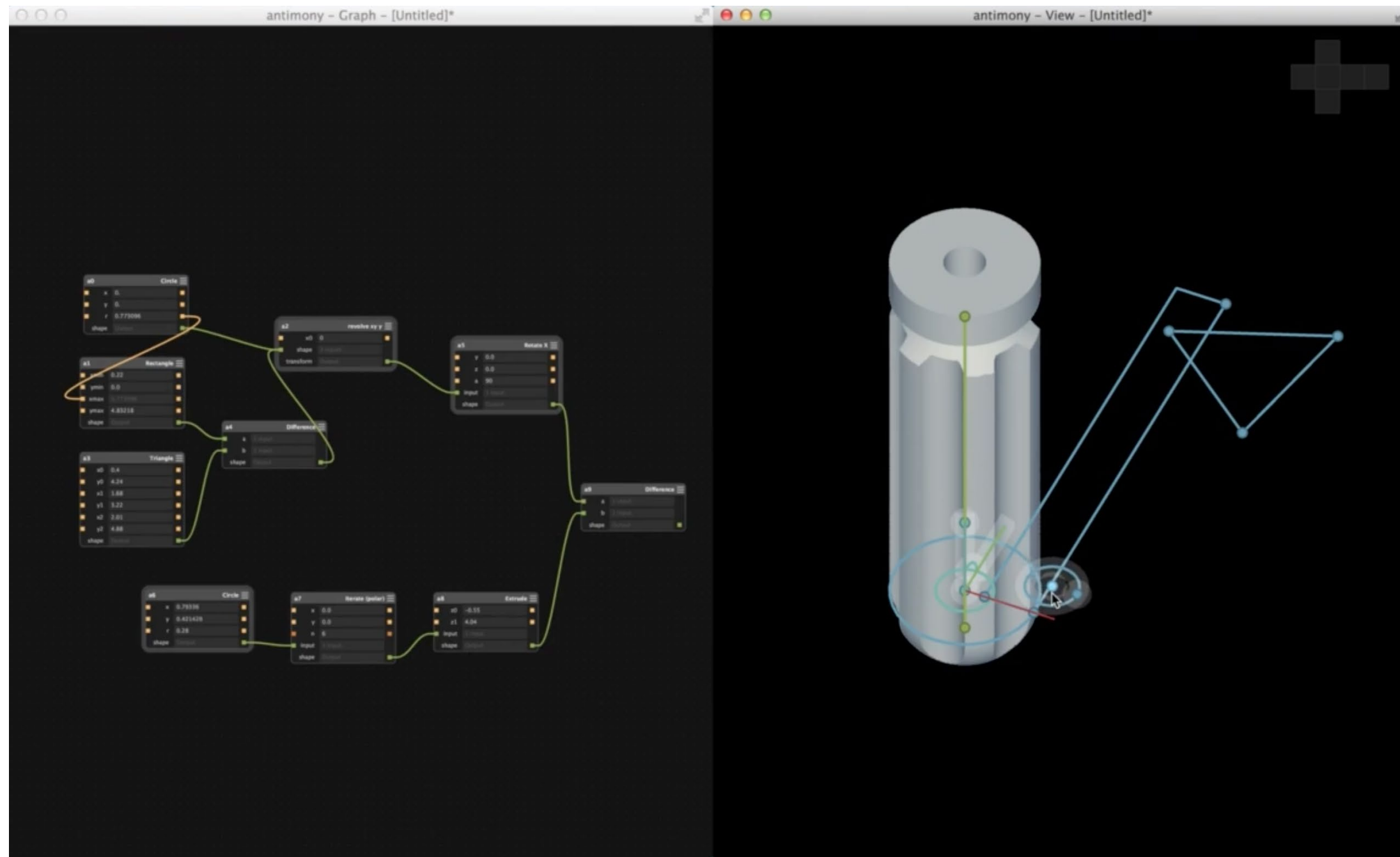
2014



Vanja Cuk

Antimony

2015



Matt Keeter

Interaction Prototyping

Empower designers to Build
'Working-Prototypes'

Net Lab Toolkit (NTK)

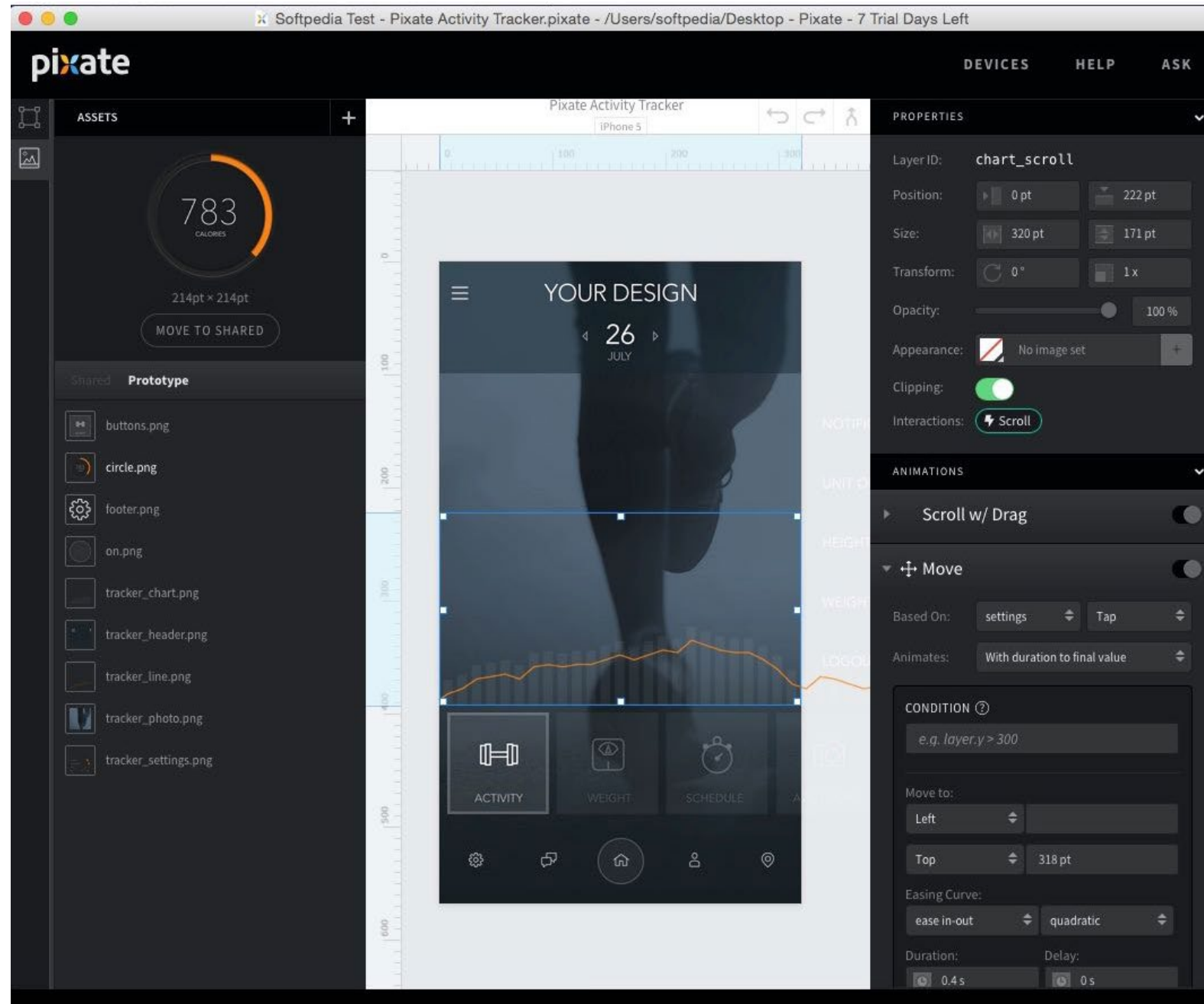
2003-Today

The screenshot displays the Net Lab Toolkit (NTK) software interface. On the left is a vertical toolbar with buttons: Edit ON, Save, Import, Export, Clear, Show/Hide Widgets, and Full Screen. The main workspace shows a visual programming workflow with four widgets: AnalogIn, IfThen, AnalogOut, and CloudOut. The AnalogIn widget is connected to the first IfThen widget, which is connected to the AnalogOut widget. The second IfThen widget is connected to the CloudOut widget. The CloudOut widget has a 'Send in: 10s' label. On the right is a panel titled 'Add Widgets' with categories: I/O, NETWORK, UI, GENERATOR, LOGIC, and MEDIA. The I/O category is expanded, showing AnalogIn, AnalogOut, DigitalIn, DigitalOut, and Servo. In the center of the interface is a photograph of a hand holding a red potentiometer connected to a blue Arduino Uno board.

Philip van Allen at ArtCenter College of Design

Pixate

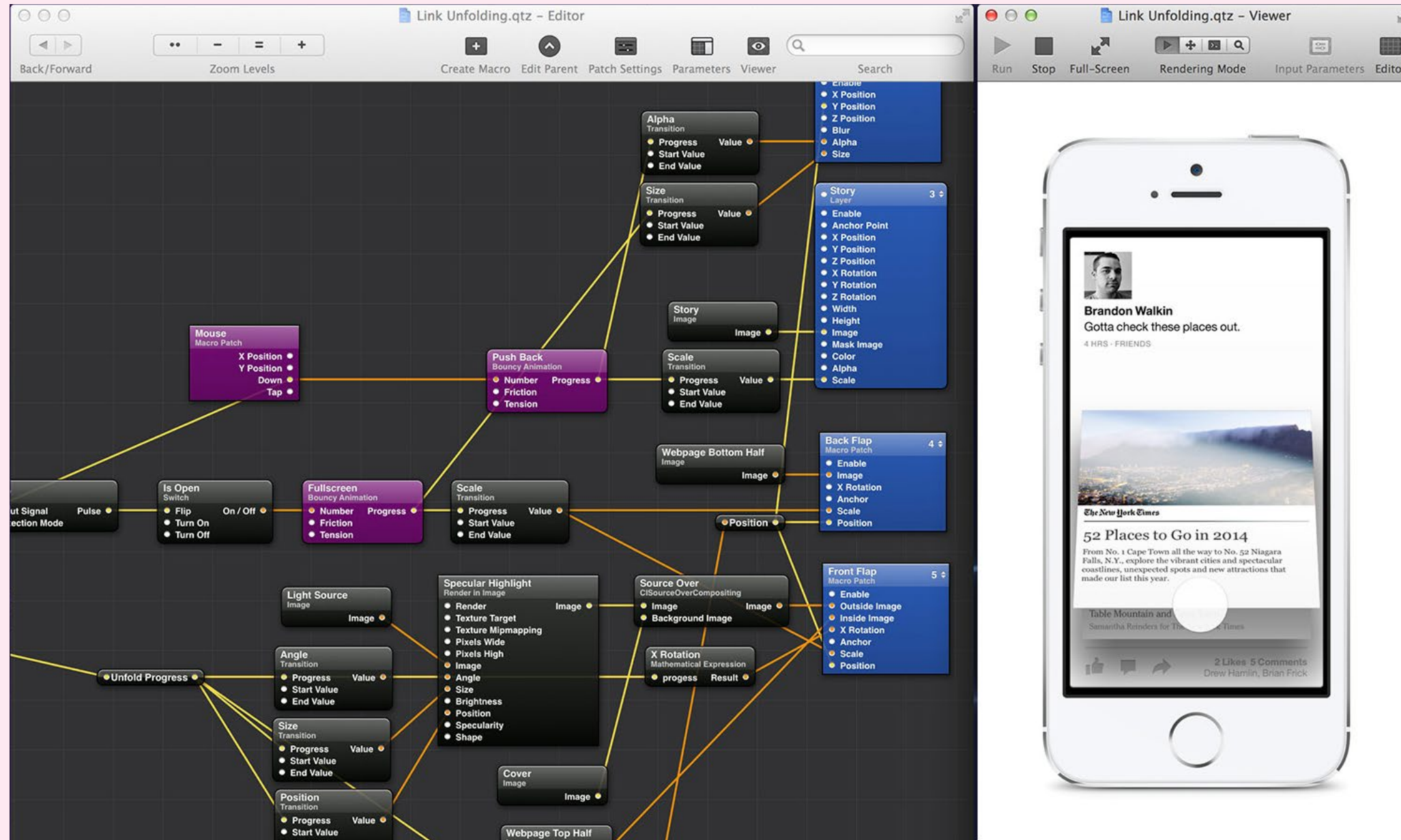
2012-2016



Kevin Lindsey and Paul Colton for Pixate (Acquired by Google)

Origami for Quartz Composer

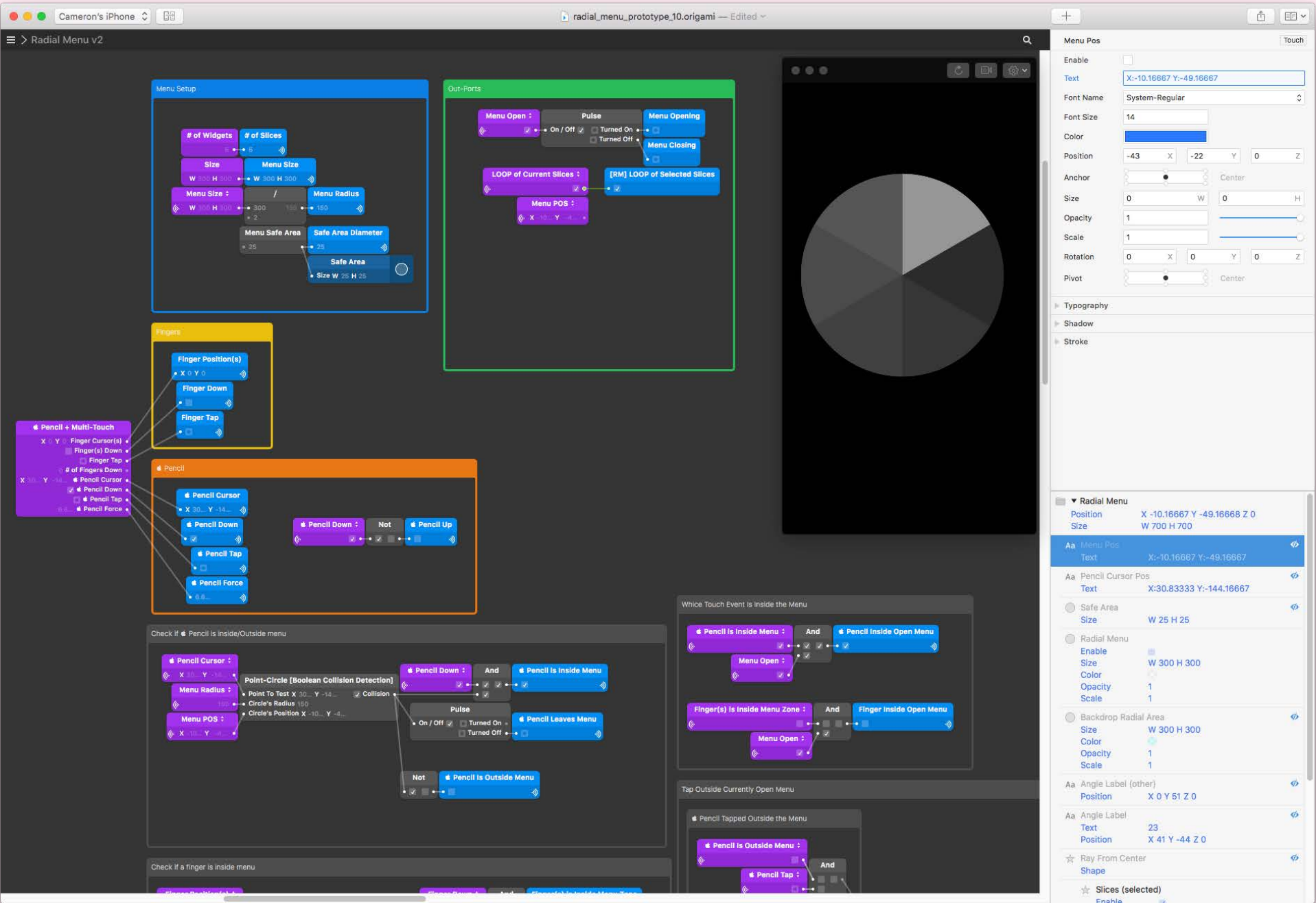
2013-2016



Facebook

Origami Studio

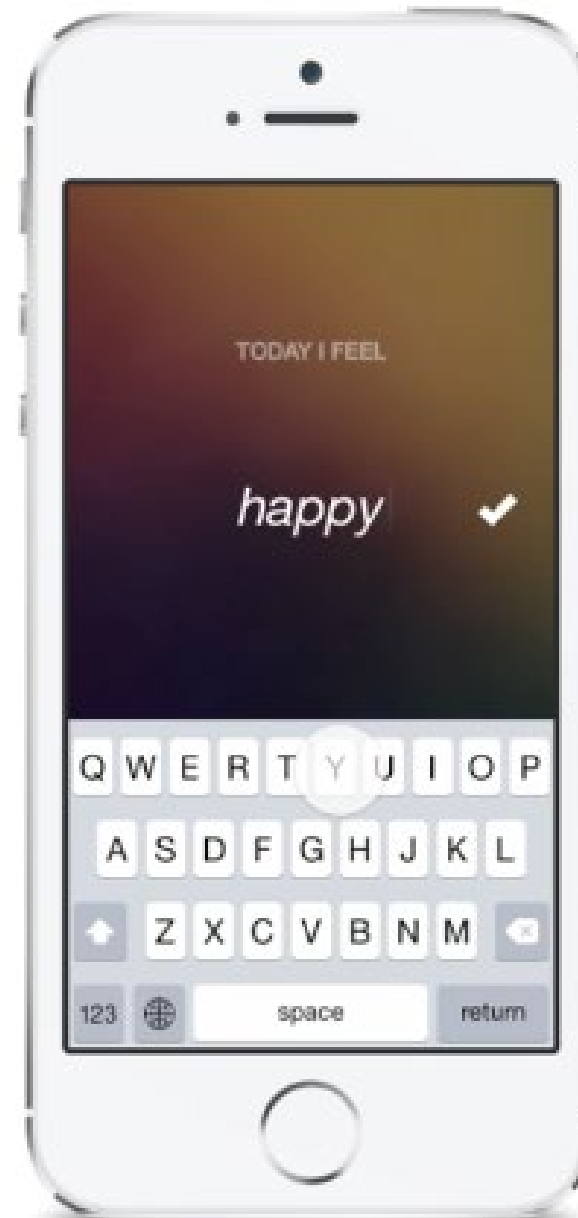
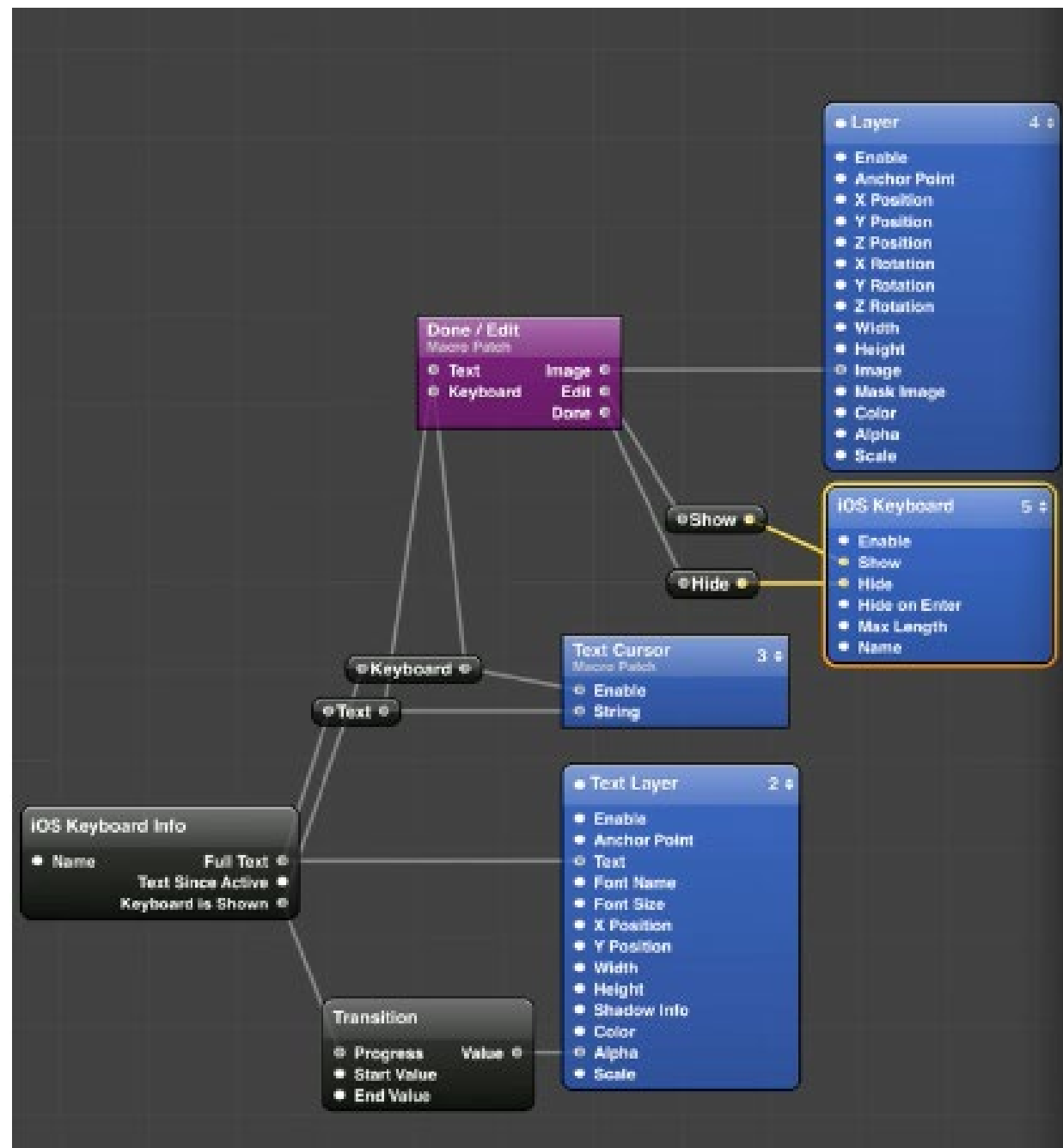
2016-Today



Facebook

Avocado for Quartz Composer

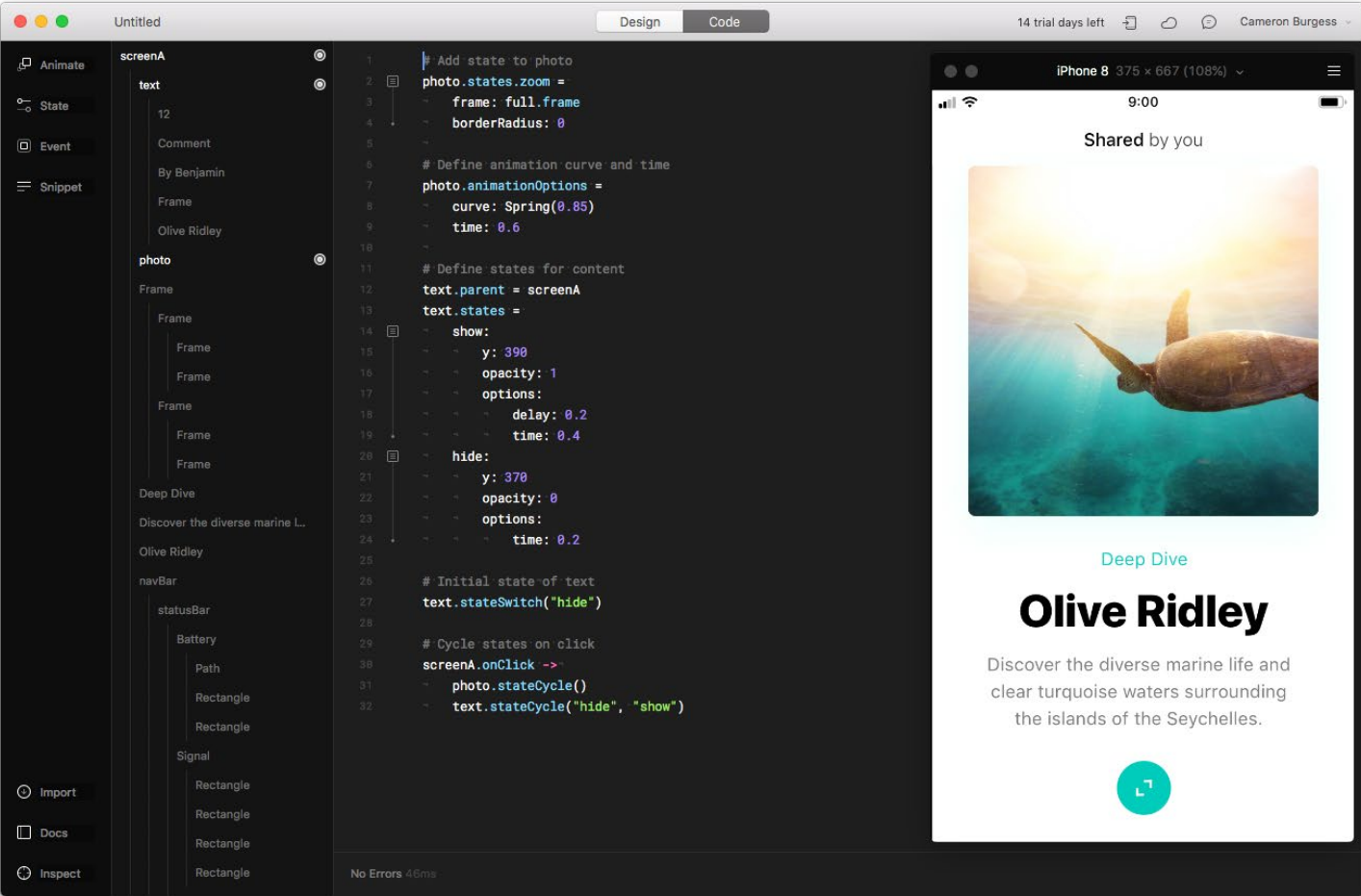
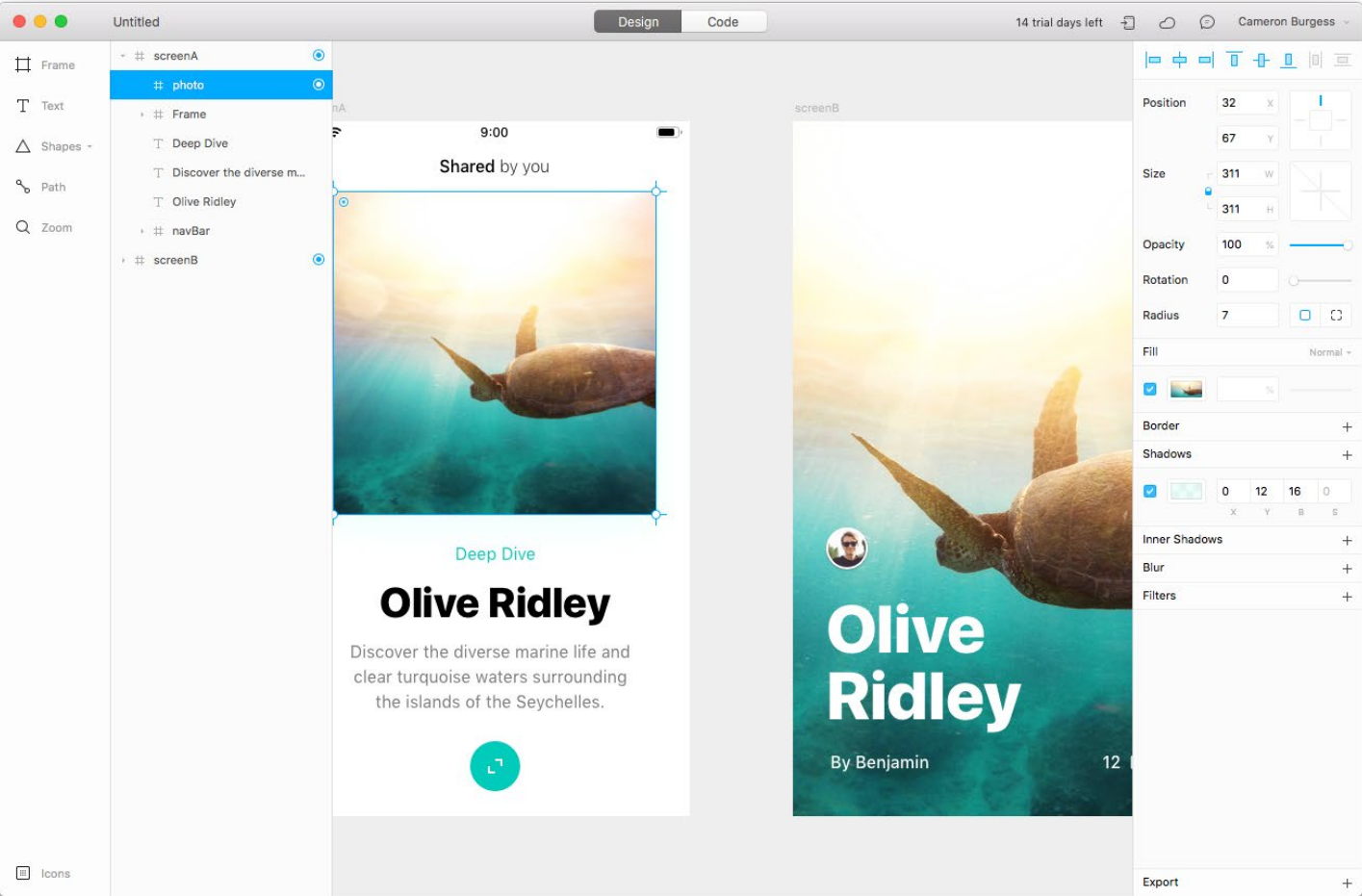
2014



Marco Triverio at IDEO LABS

Framer Studio

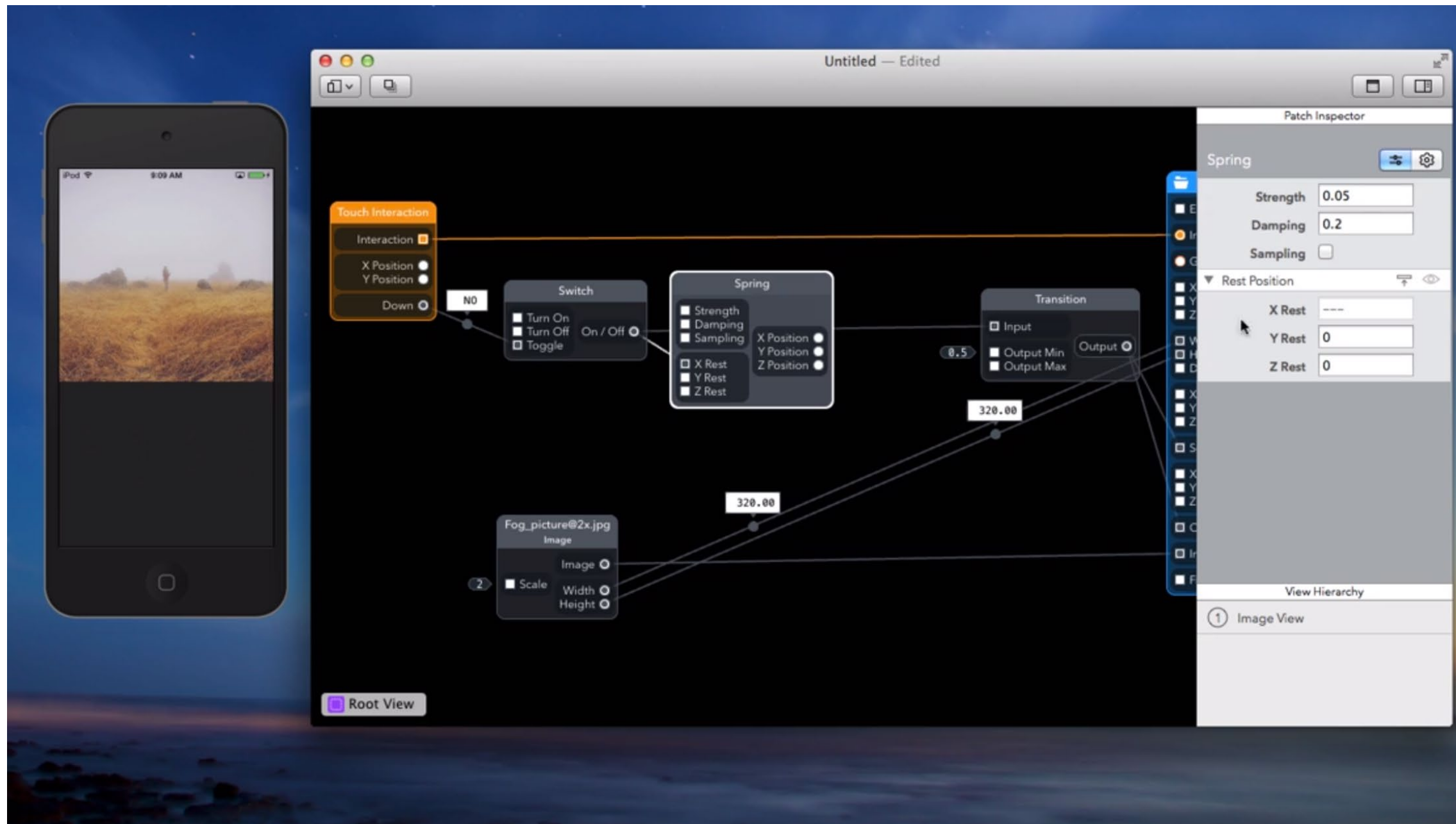
2013-Today



Koen Bok and Jorn van Dijk for Framer

Form

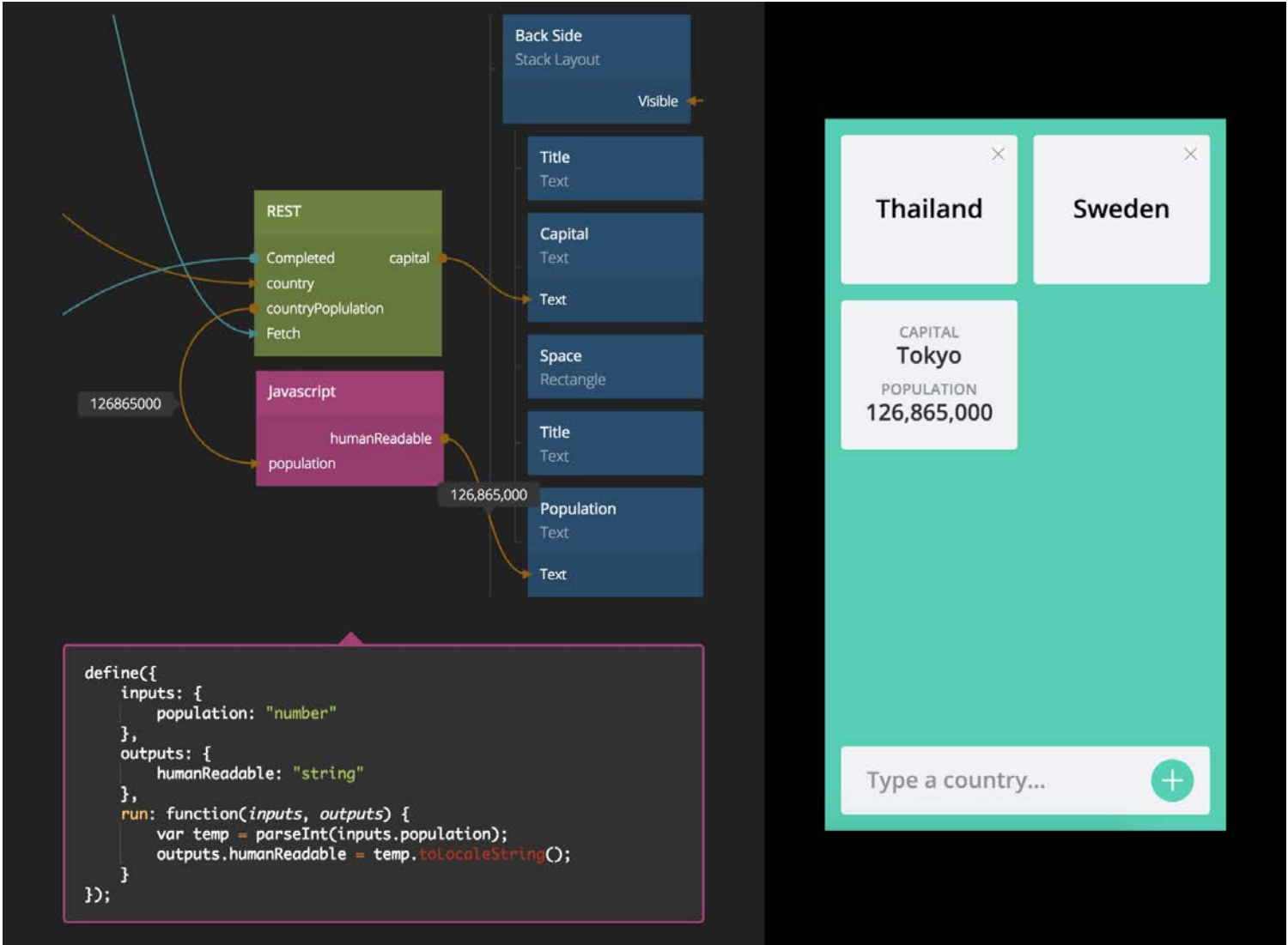
2012-2014



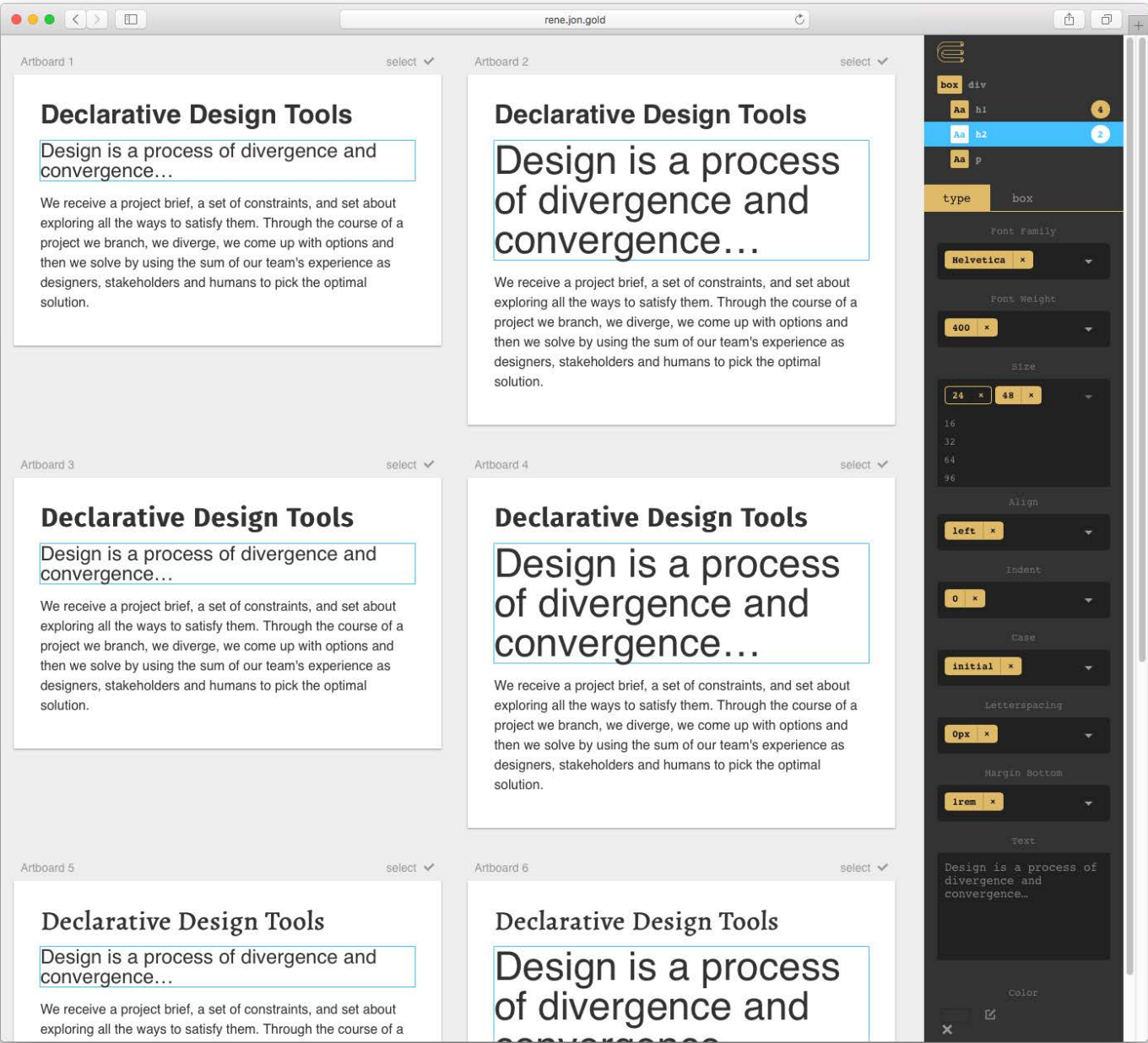
Max Weisel for RelativeWave (Acquired by Google)

Noodl

2014-Today

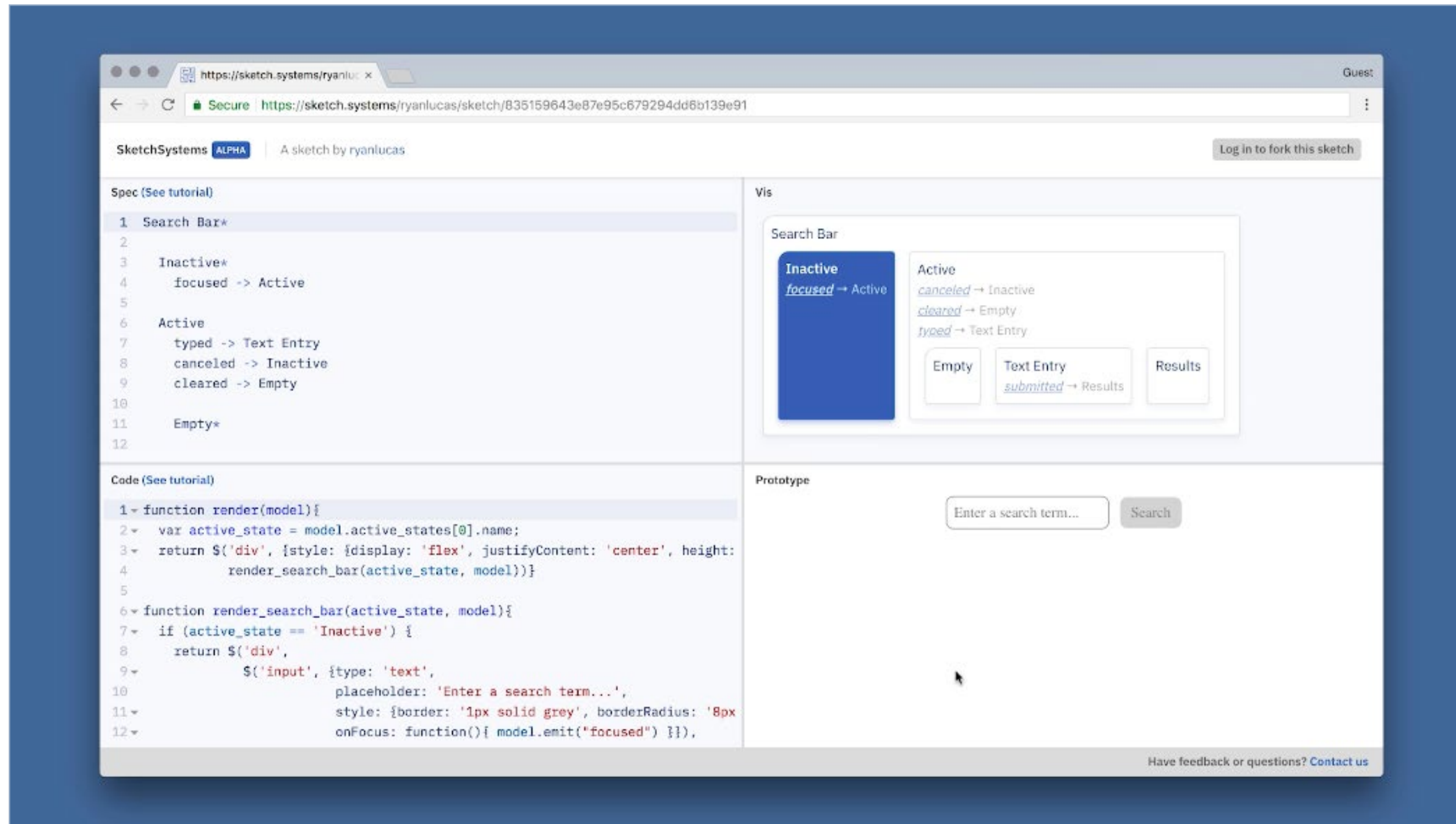


Topp Design



Sketch.systems

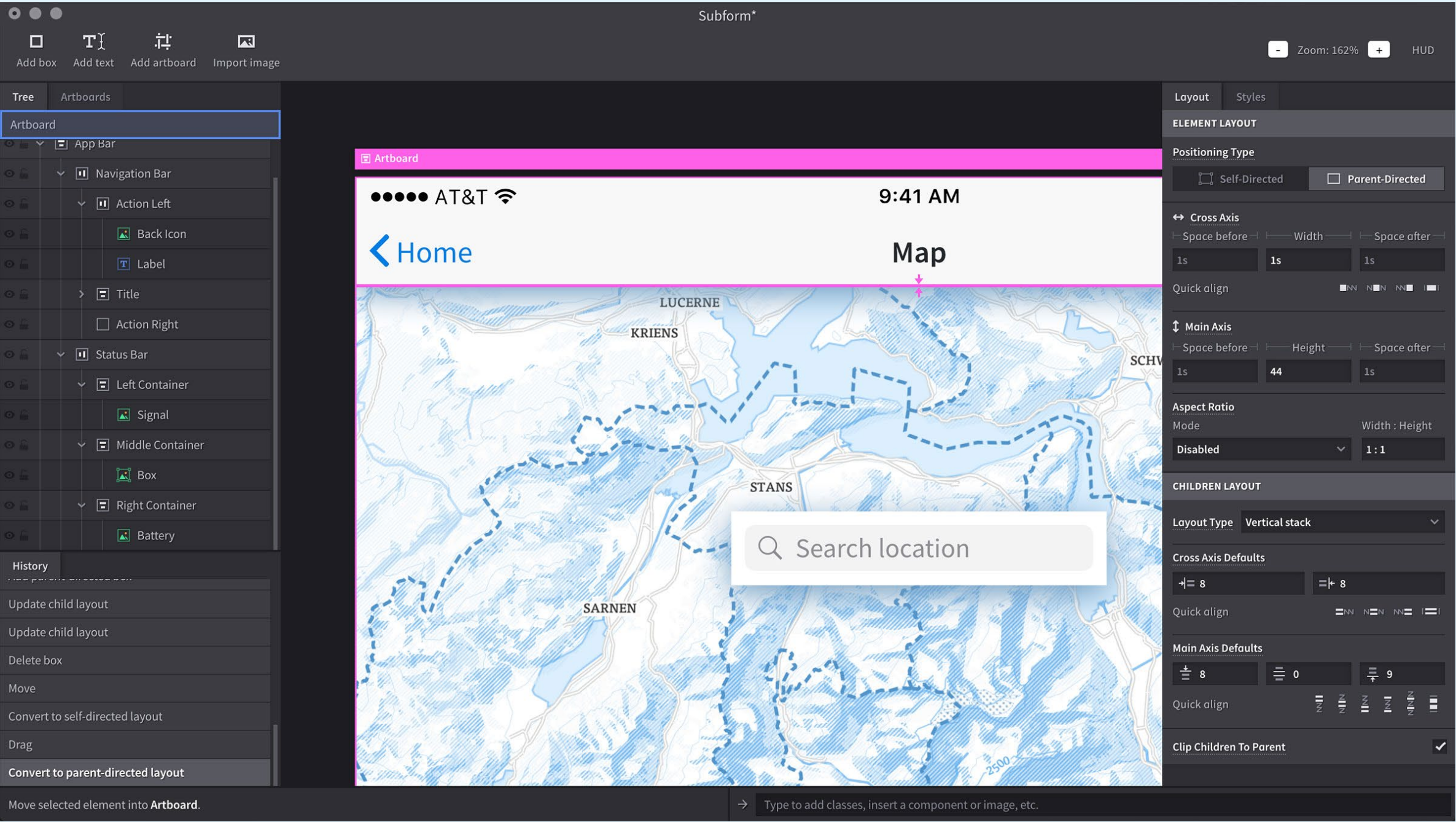
2018-Today



Kevin Lynagh and Ryan Lucas for General Reactives L.L.C.

Subform

2018



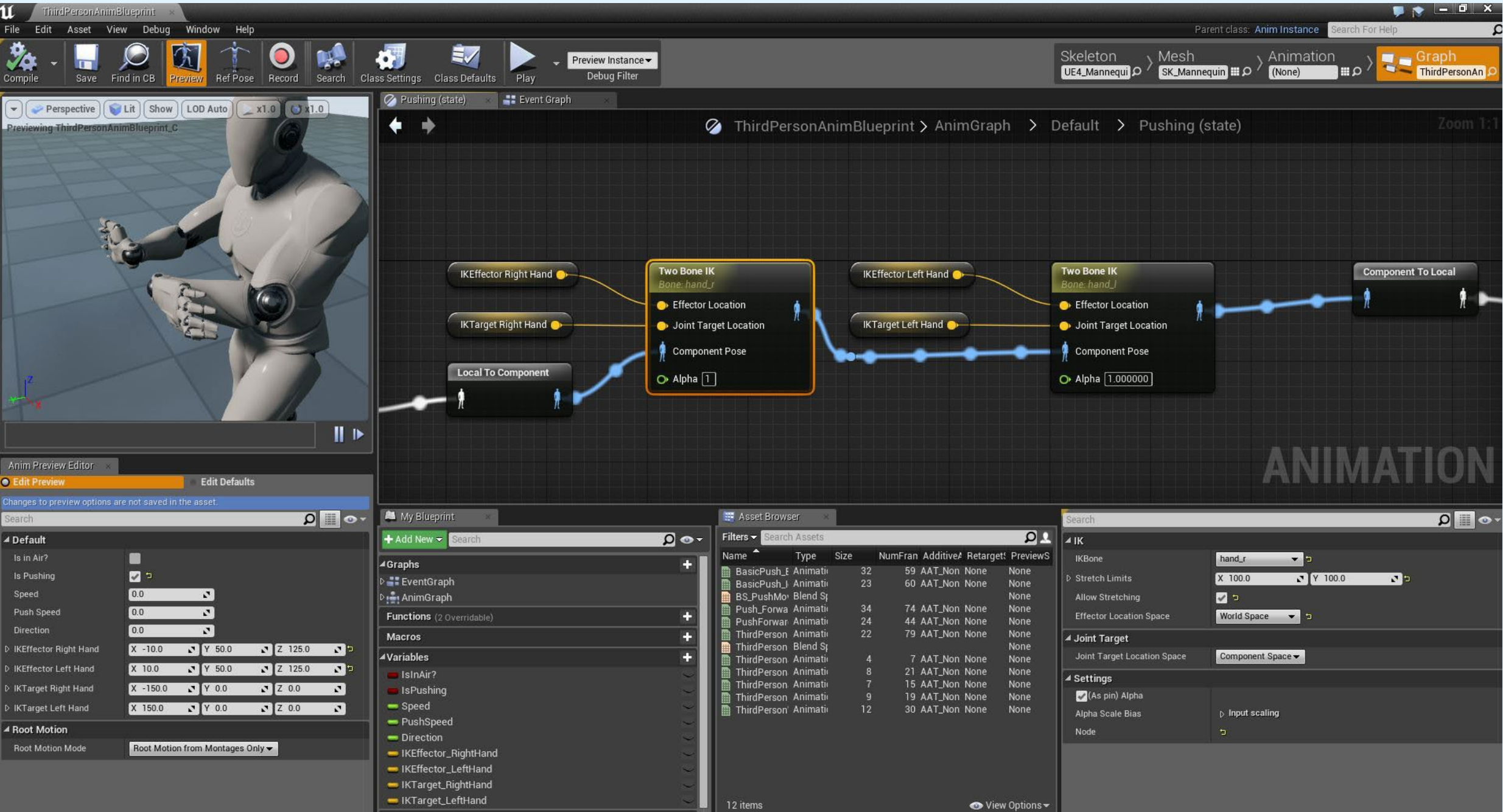
Kevin Lynagh and Ryan Lucas for General Reactives L.L.C.

Prototyping & Development Tools

Enable more people to build
'Working & Distributable' artifacts

Blueprints in Unreal Engine

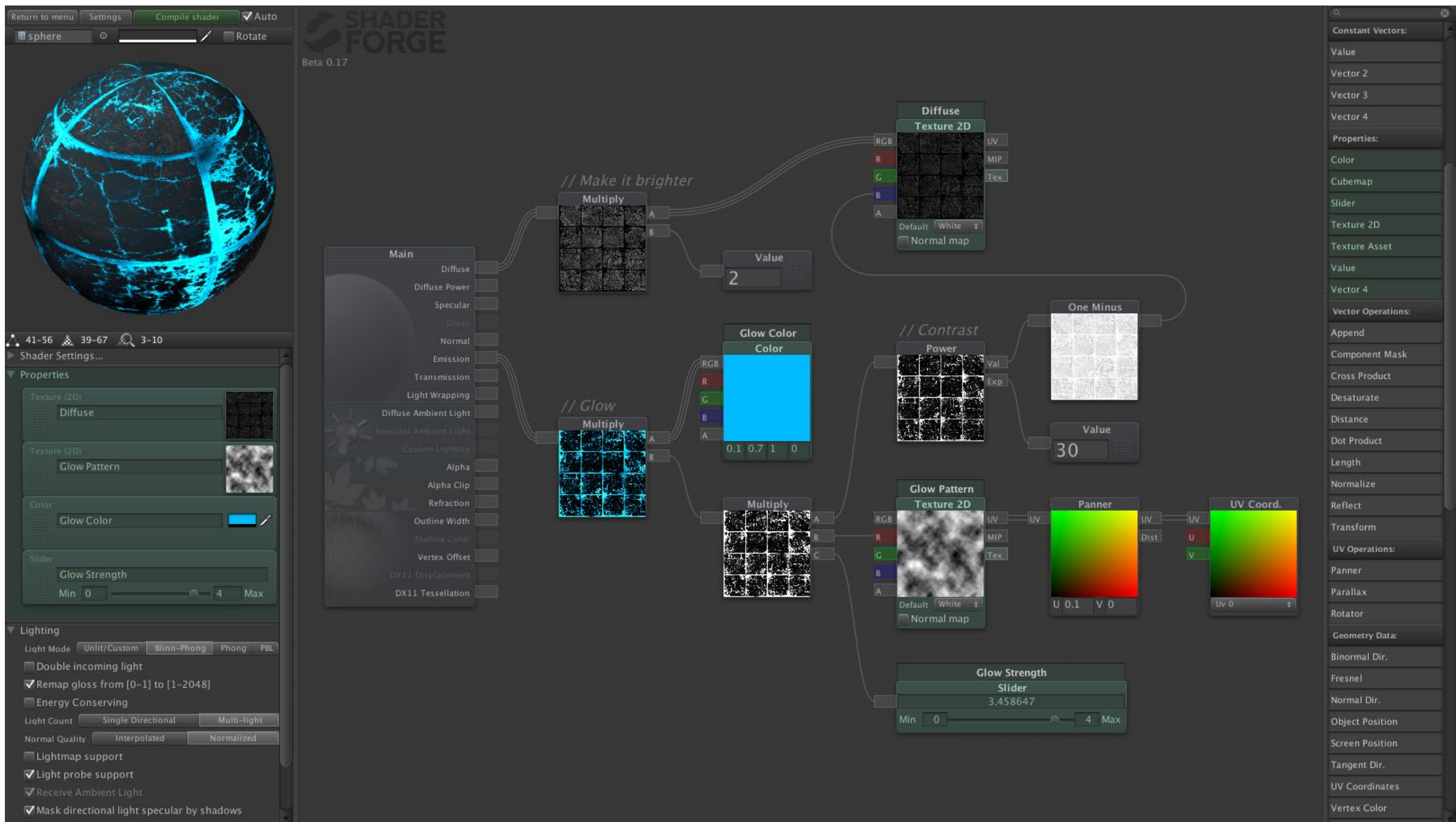
2012-Today



Epic Games

ShaderForge for Unity

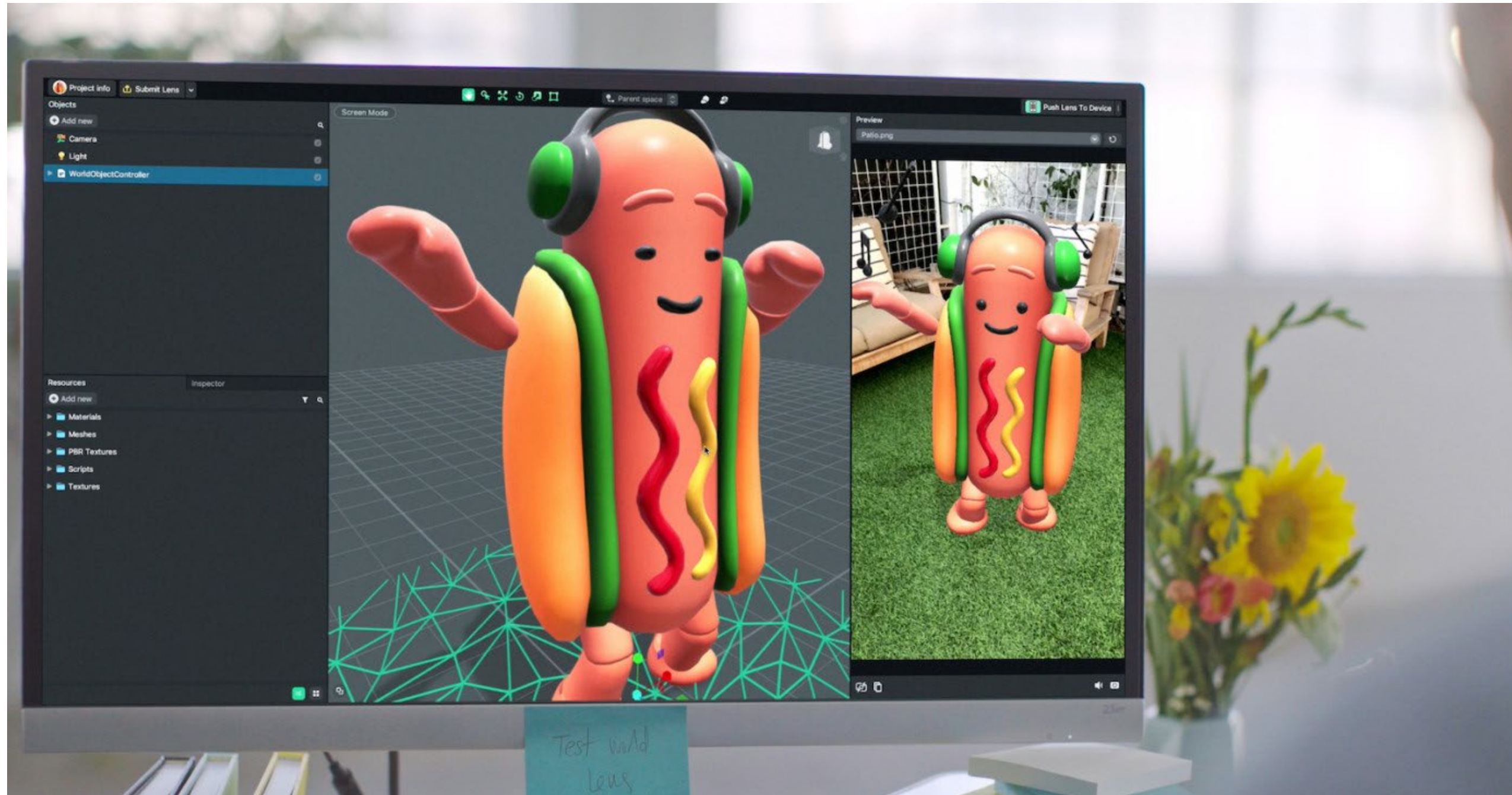
2013-2018



Freya Holmér

Lens Studio

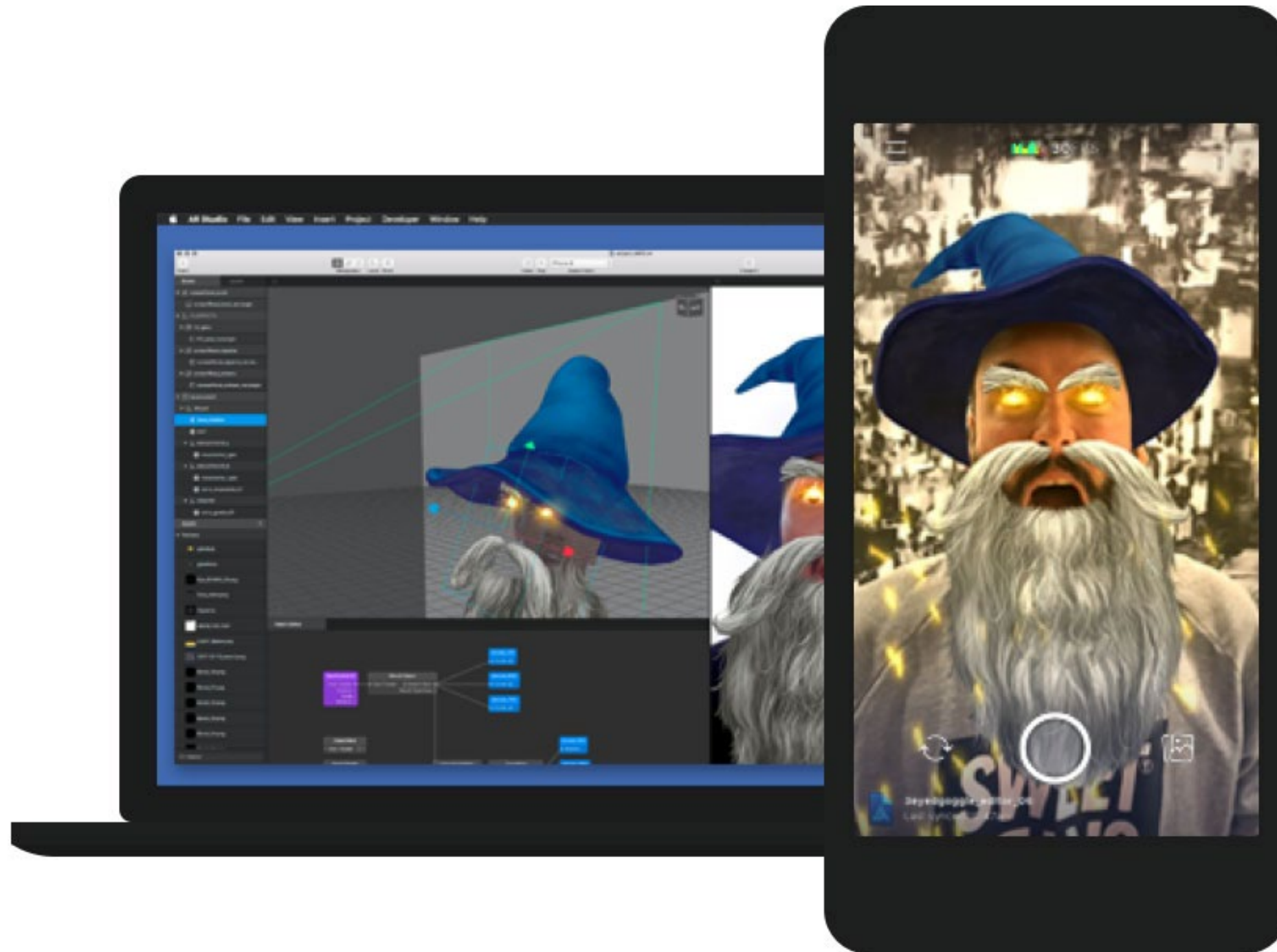
2017-Today



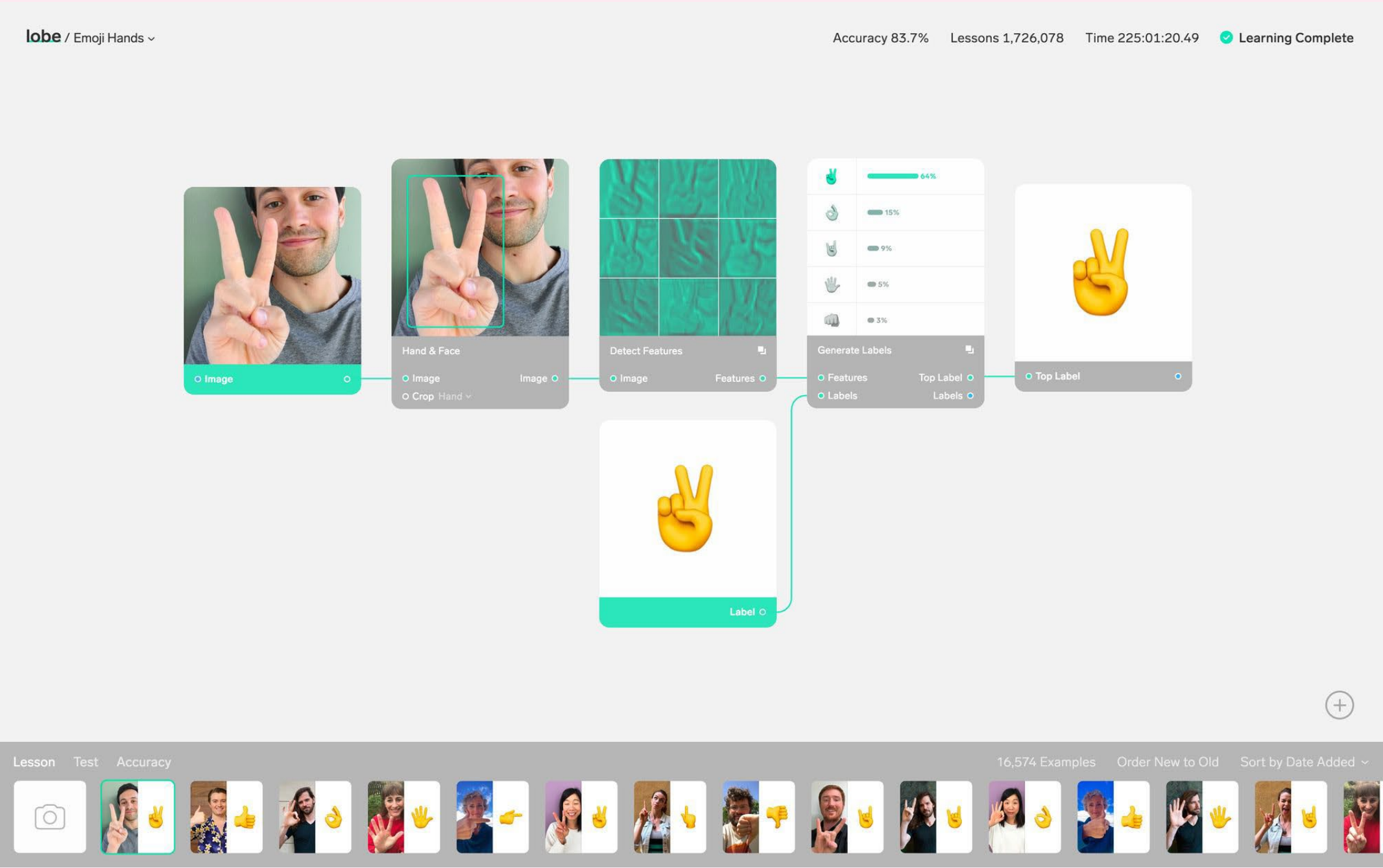
Snap Inc

AR Studio

2017-Today



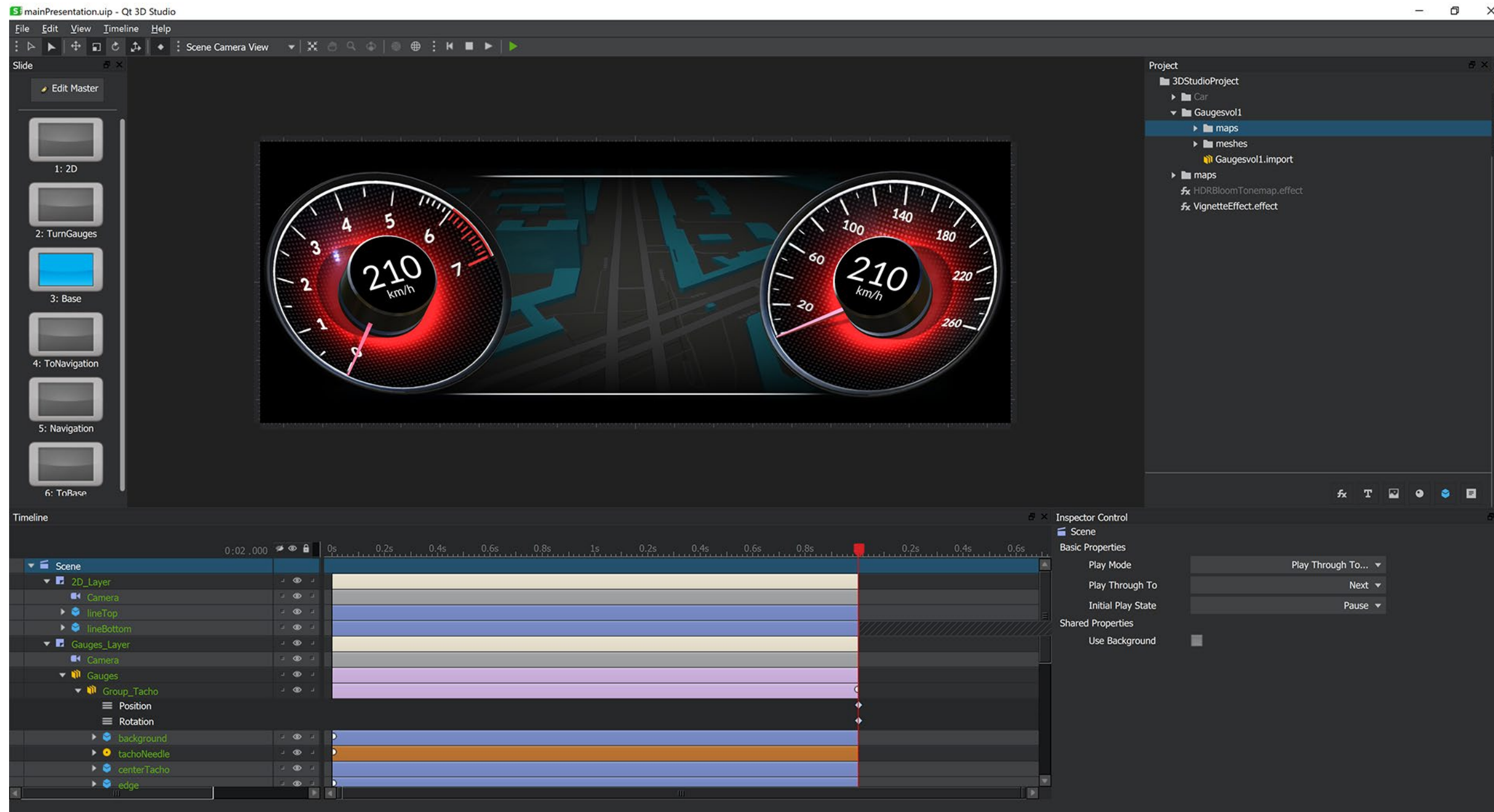
Facebook



Mike Matas, Adam Menges and Markus Beissinger for Lobe Artificial Intelligence Inc

Qt 3D Studio

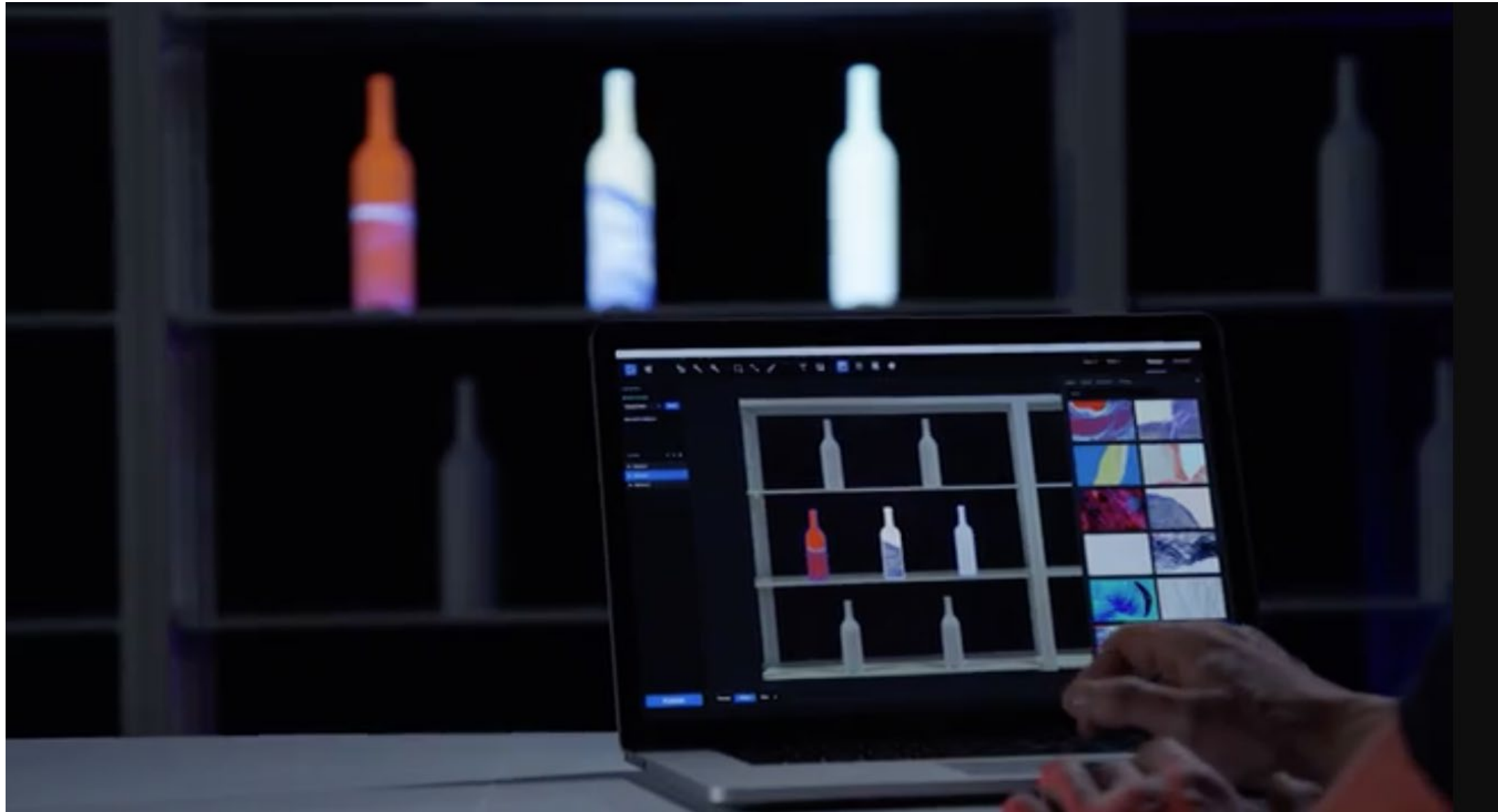
2017-Today



The Qt Company

Lightform

2018-Today



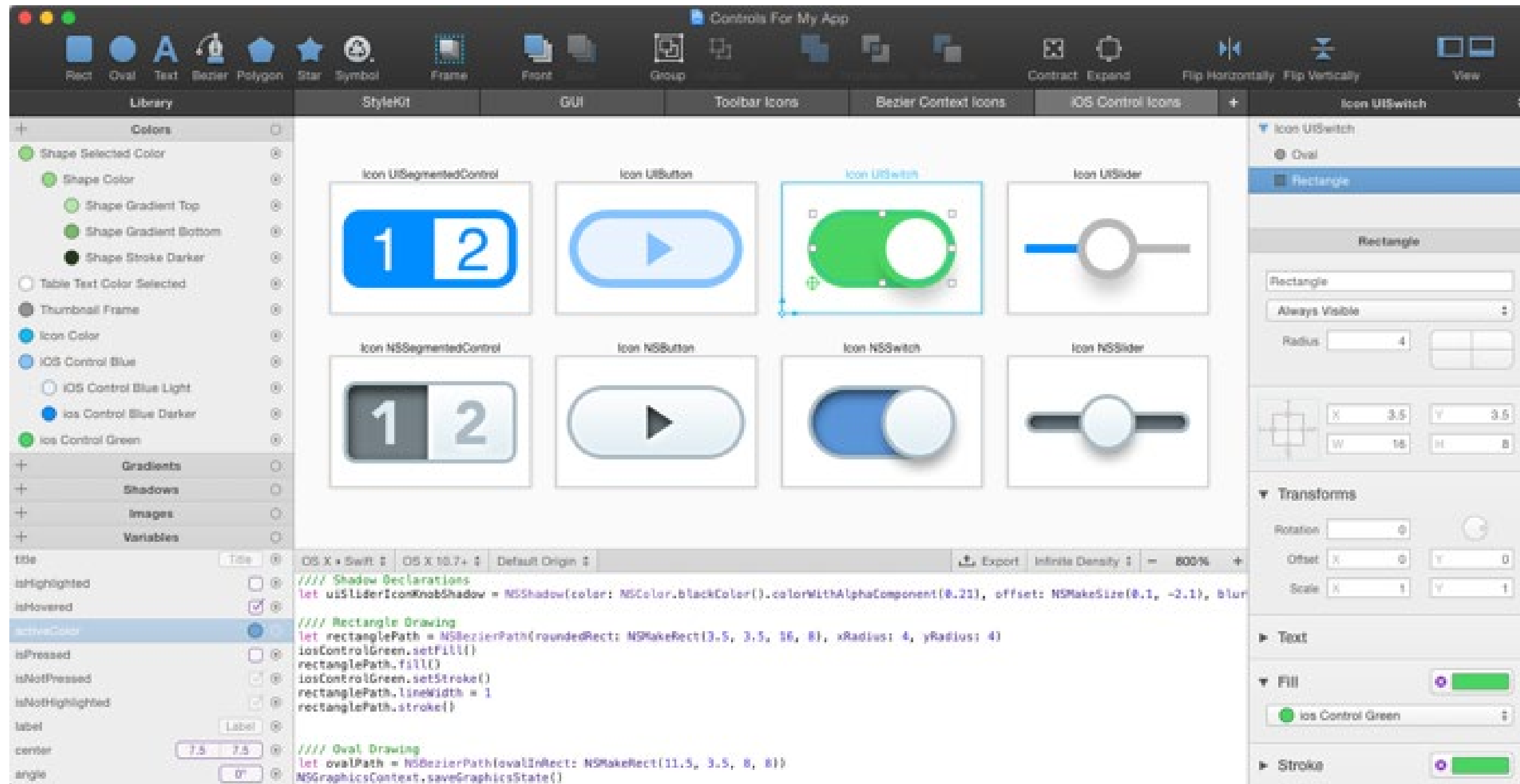
Brett Jones, Kevin Karsch and Rajinder Sodhi

Design-Development Toolchain Integration

Has decreased the distance
between Design & Engineering

Paint Code

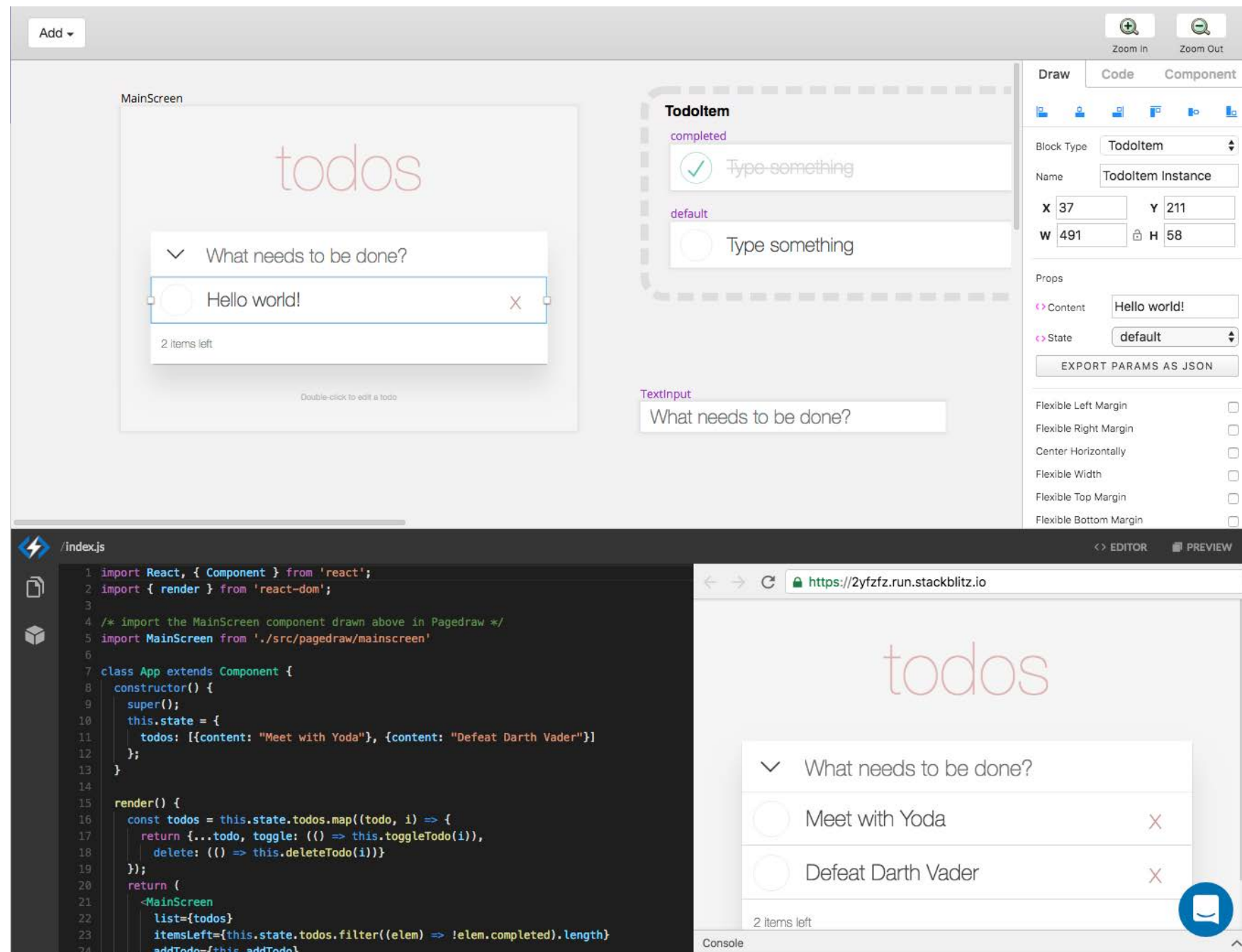
2012-Today



Peter Krajcik, Mike Antonic, Matt Dunik and Martin Kiss for PixelCut

PageDraw

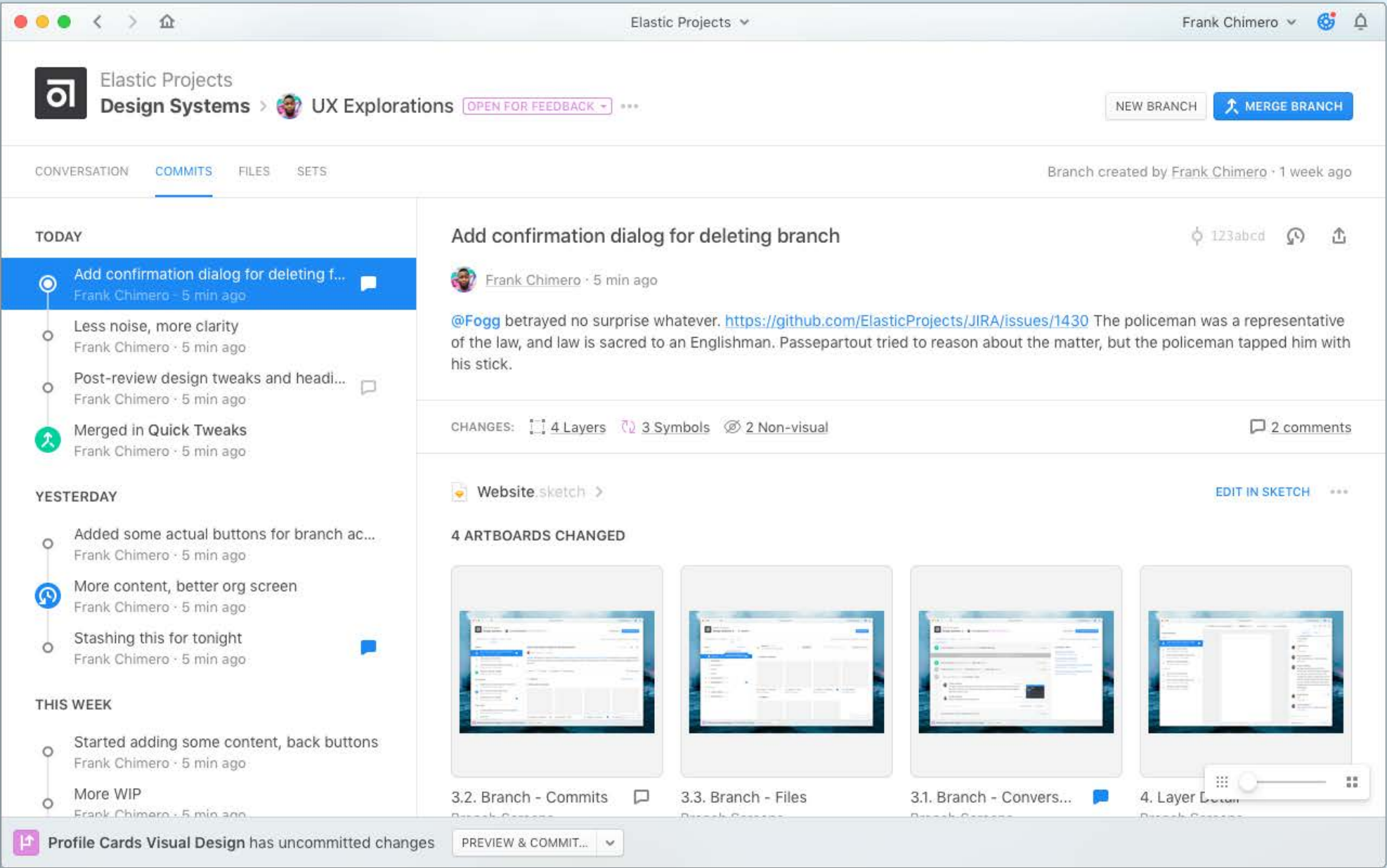
2016-Today



Jared Pochtar

Abstract

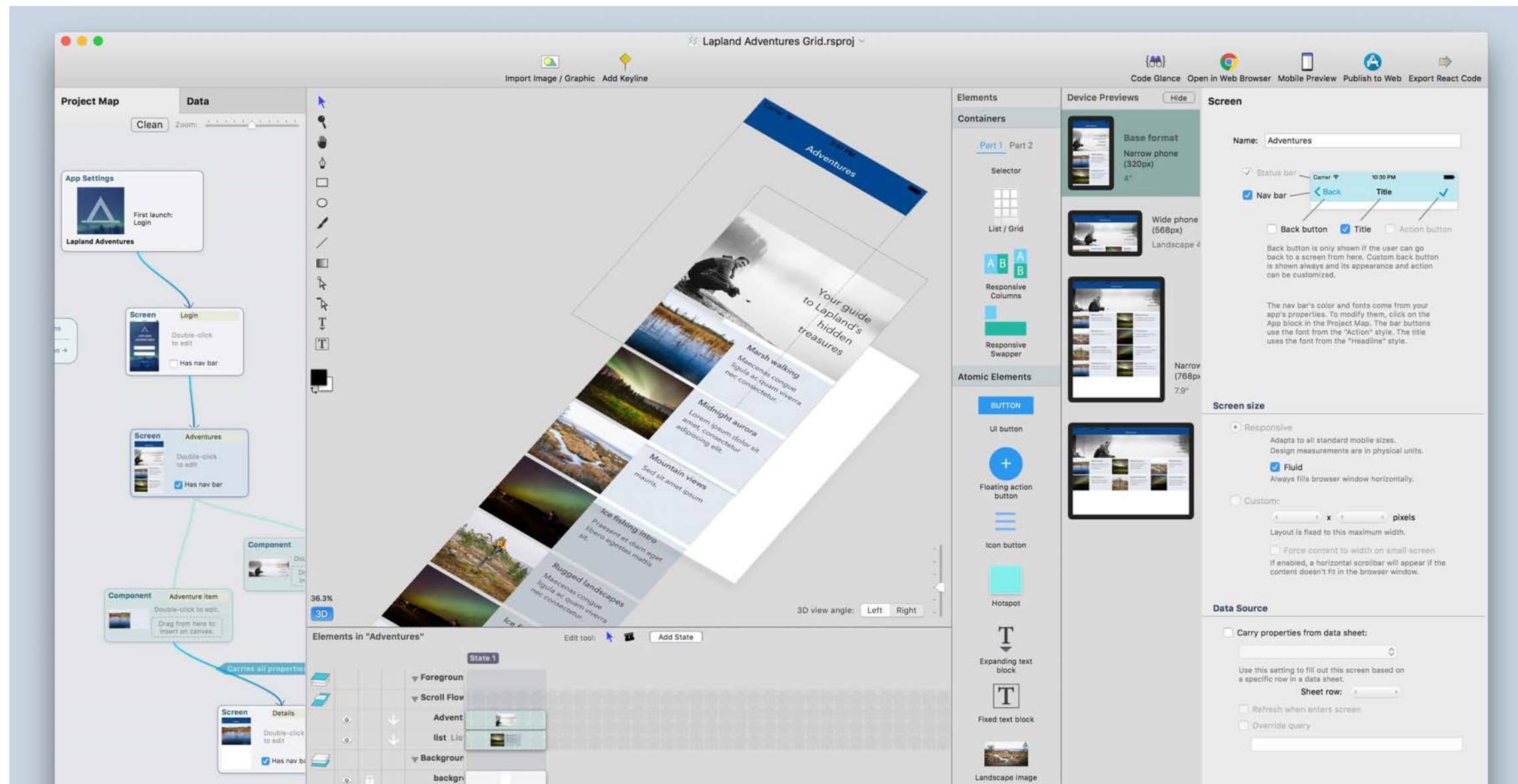
2016-Today



Elastic Projects

React Studio

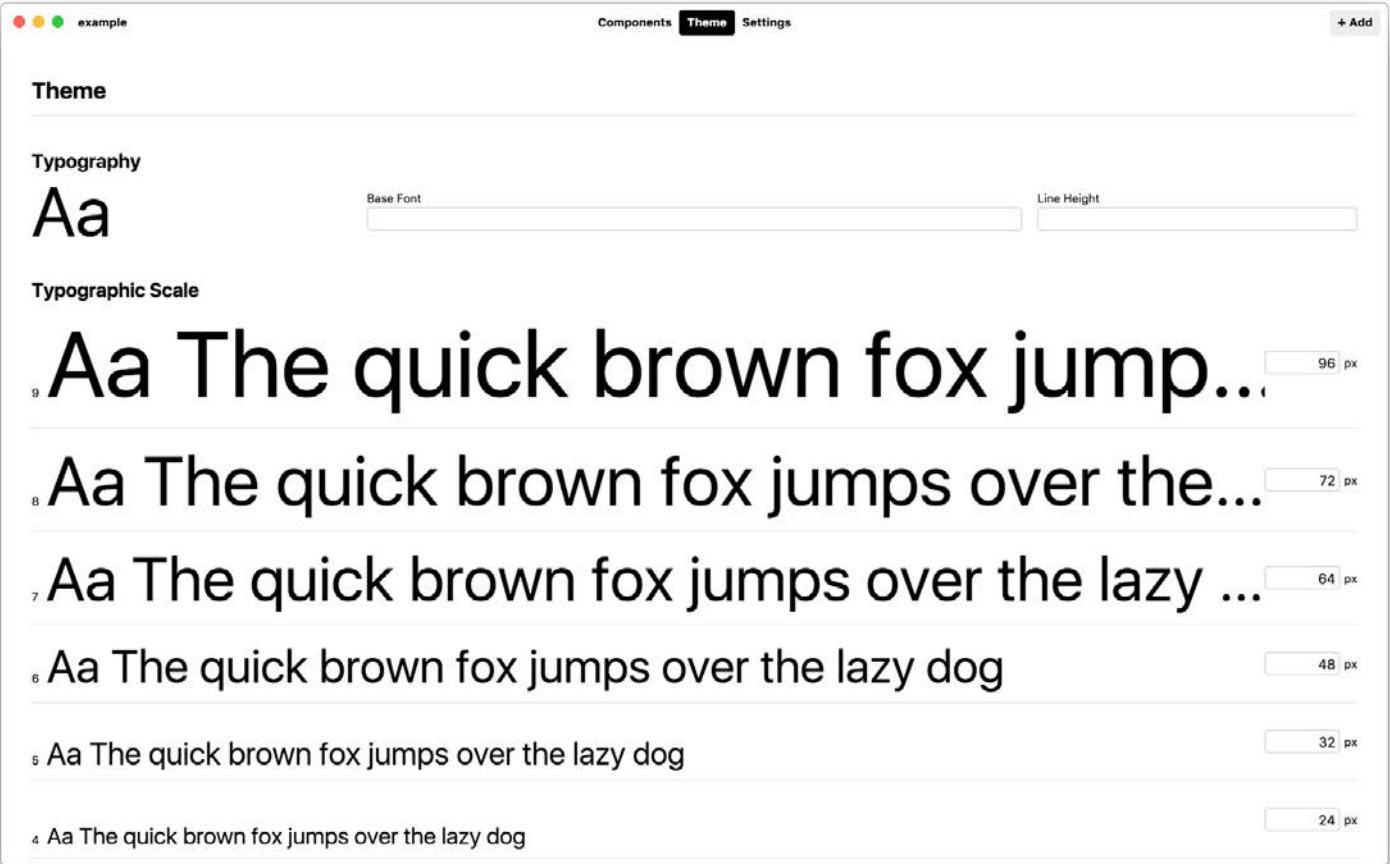
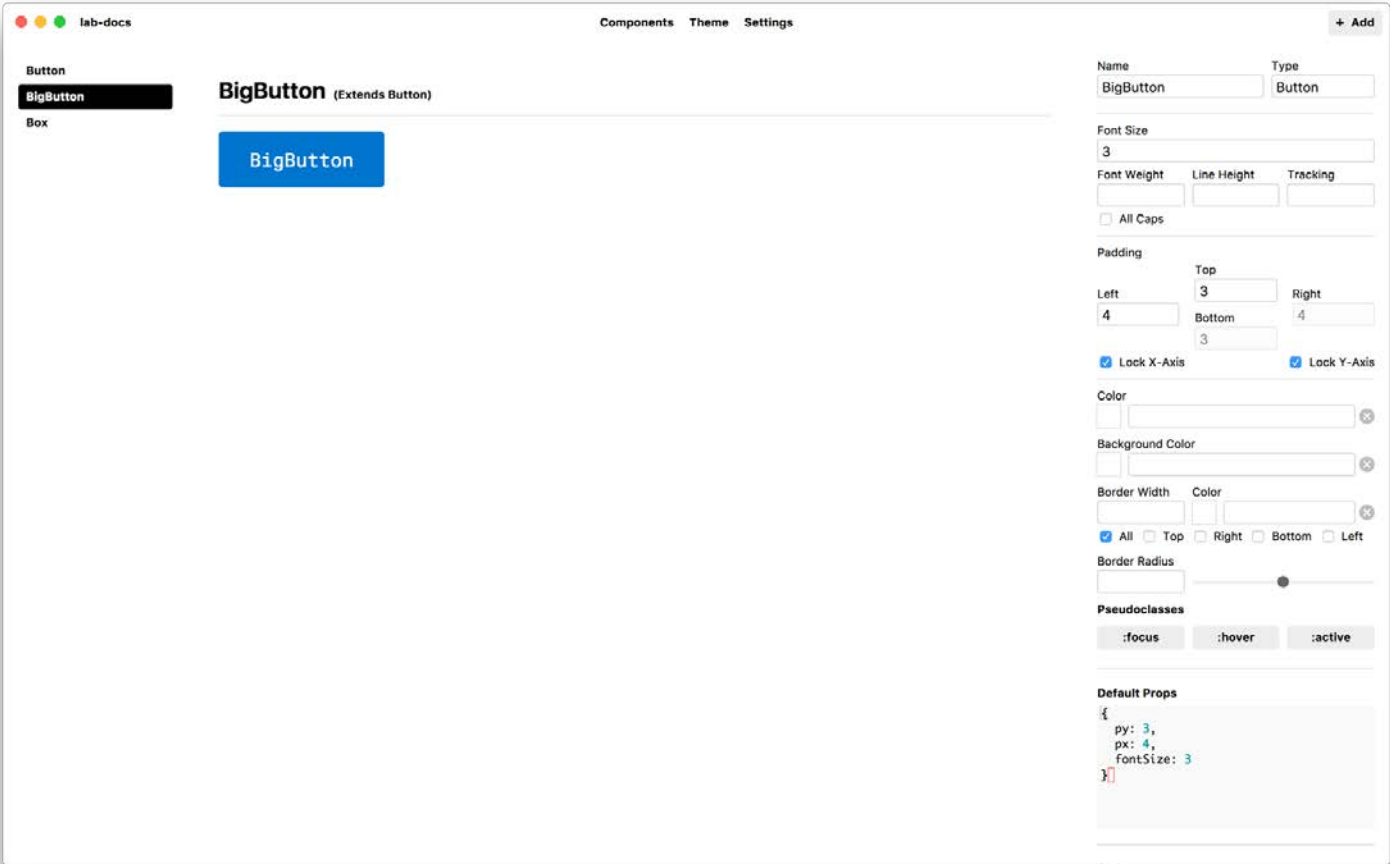
2017-Today

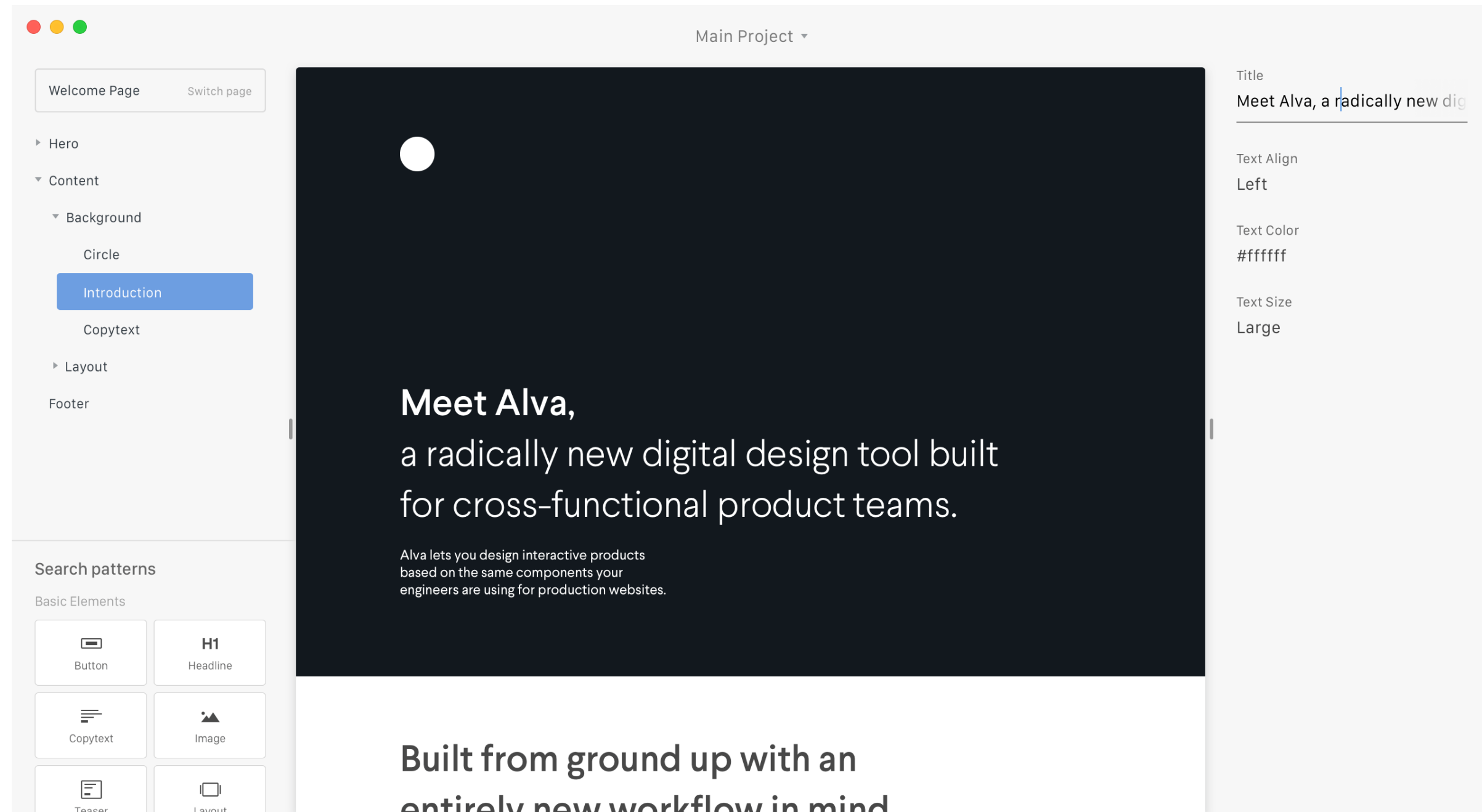


Neonto Ltd

Compositor Lab

2017-Today





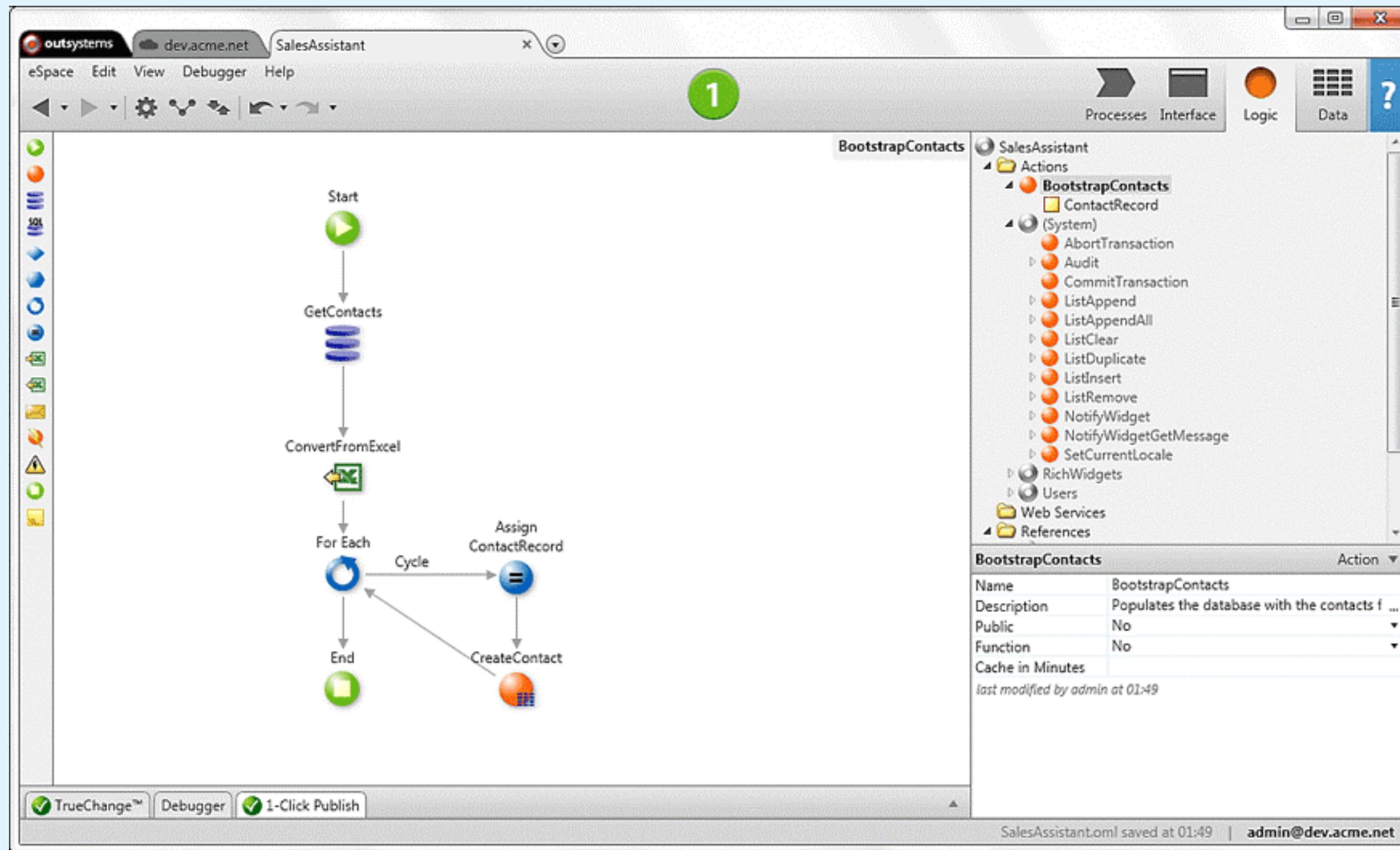
SinnerSchrader Deutschland GmbH (Part of Accenture Interactive)

‘Low Code’ Environments

Enable the Development of Apps
using modular Building-Blocks

OutSystems Platform

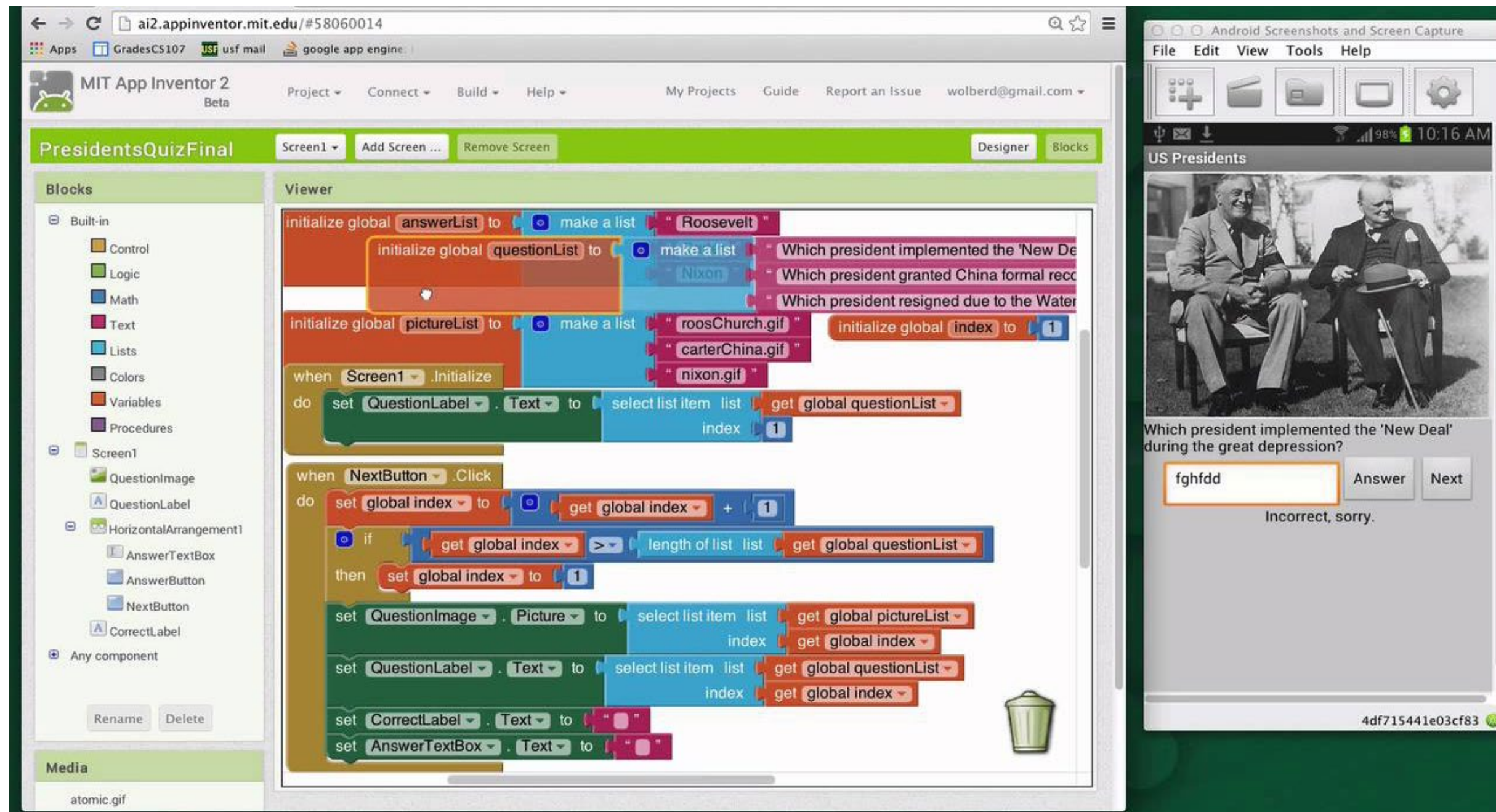
2001-Today



OutSystems Inc

App Inventor for Android

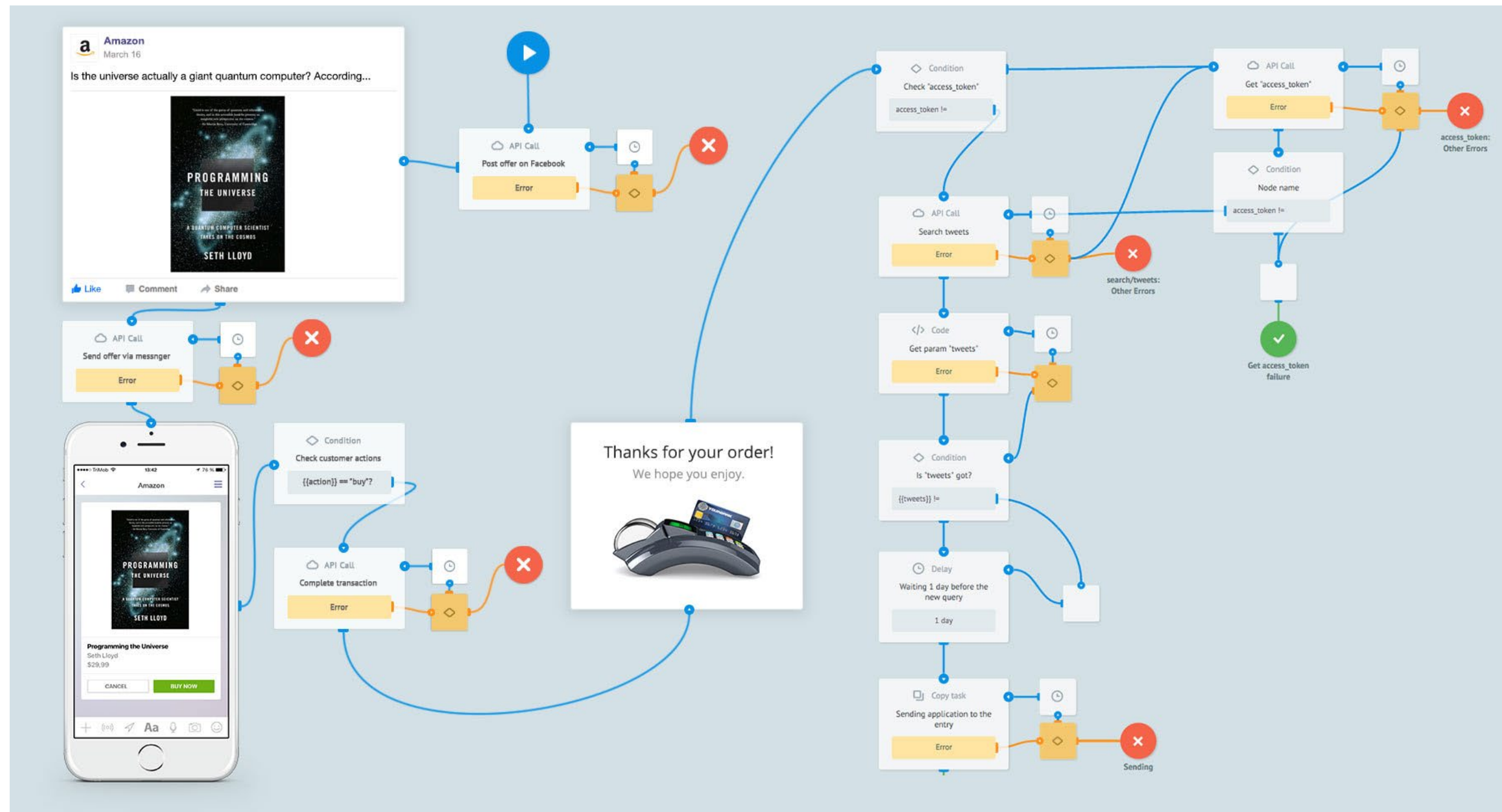
2010-Today



Google and MIT Computer Science and Artificial Intelligence Lab

Corezoid Process Modeler

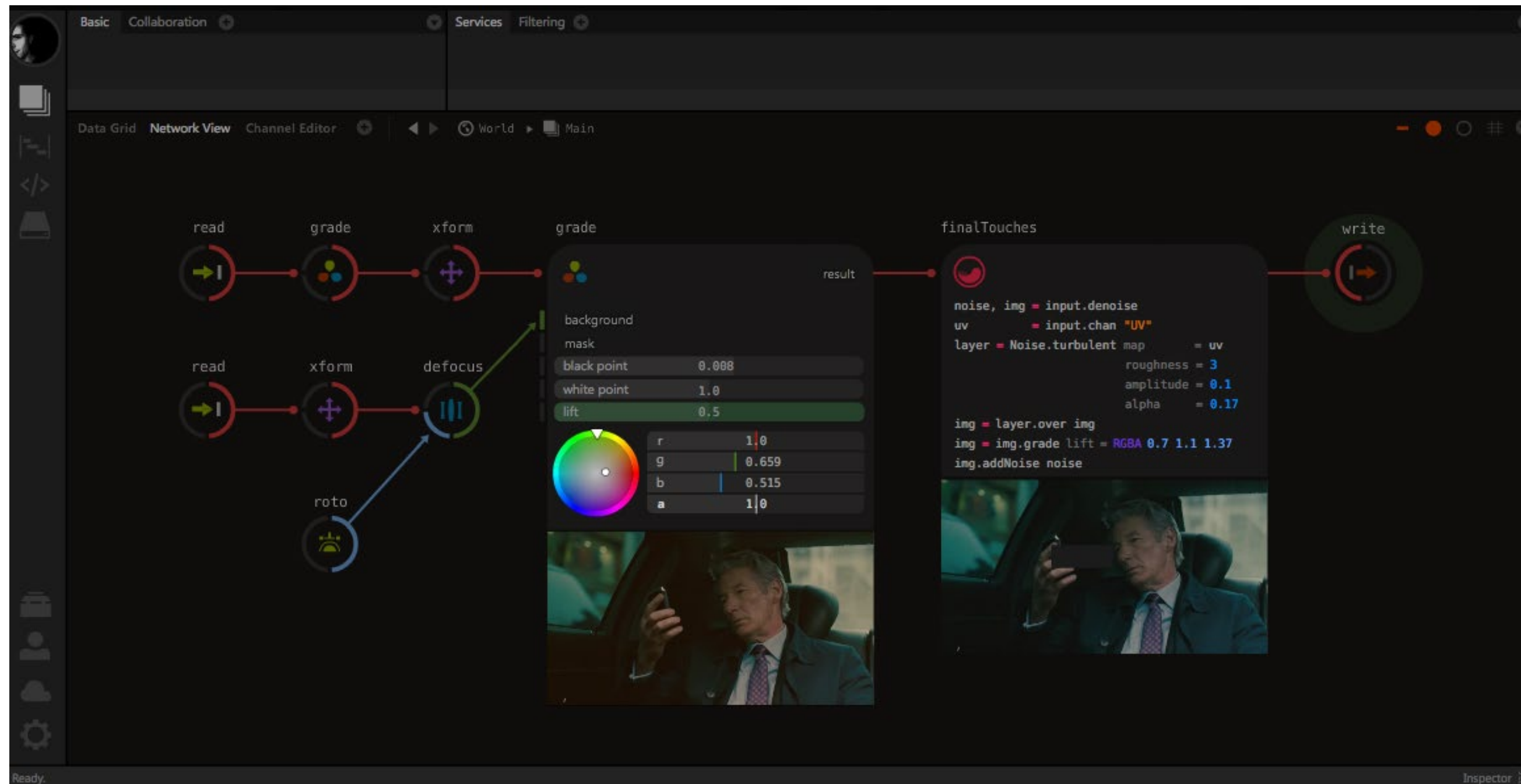
2013-Today



Corezoid.com Middleware Inc

Luna Studio

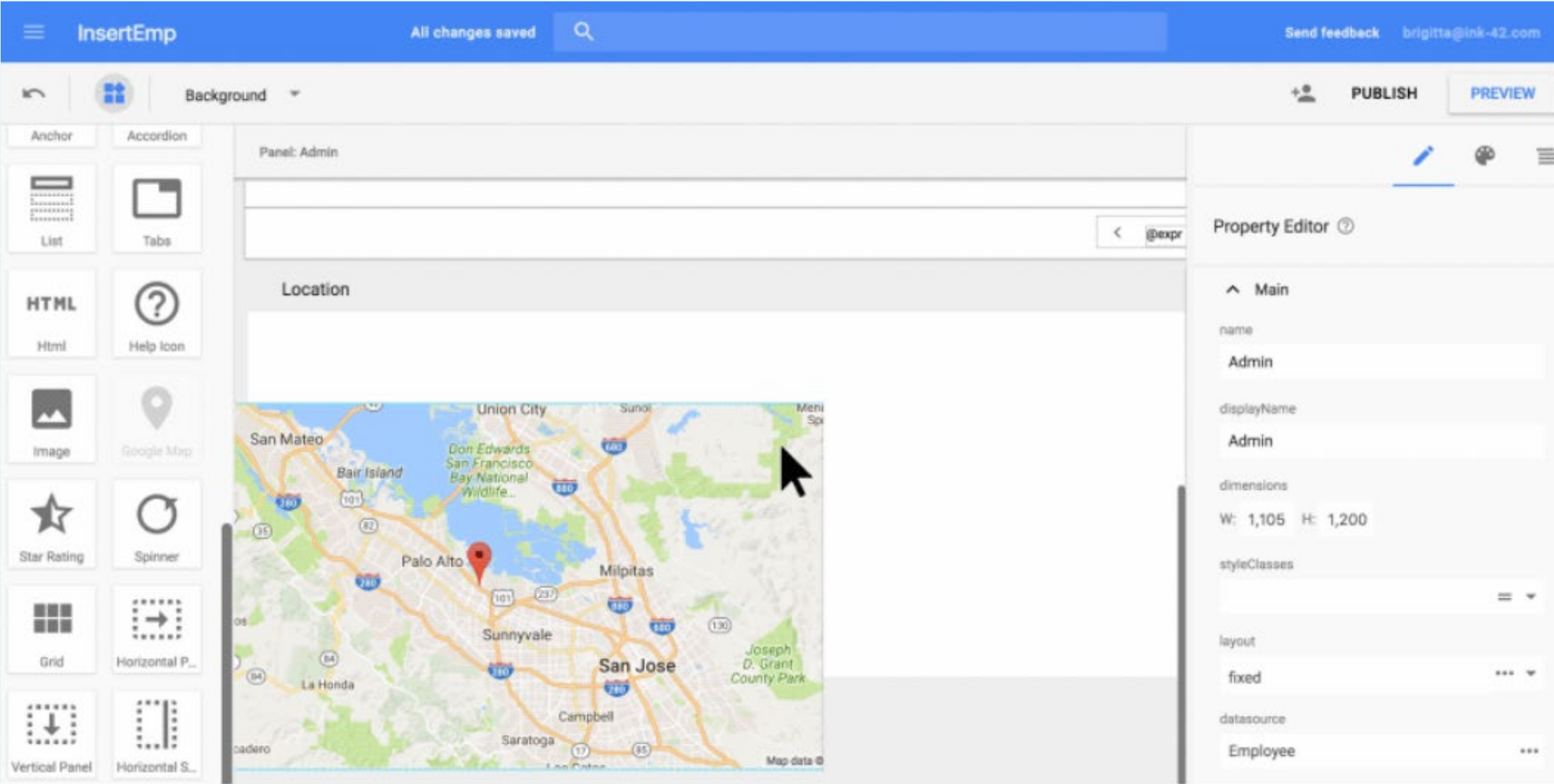
2017-Today



Wojciech Daniłó, Marcin Kostrzewa

AppMaker

2018-Today



The screenshot displays the Google App Maker interface for an application named 'InsertEmp'. The top navigation bar is blue and includes a menu icon, the app name 'InsertEmp', a status 'All changes saved', a search bar, and links for 'Send feedback' and 'brigitte@ink-42.com'. Below the navigation bar, there's a toolbar with icons for 'Background', 'Publish', and 'Preview'. The main workspace is divided into three sections: a left sidebar with a grid of widgets (List, Tabs, HTML, Help icon, Image, Google Map, Star Rating, Spinner, Grid, Horizontal Panel, Vertical Panel, Horizontal Split), a central canvas showing a map of the San Jose area with a red pin and a black cursor, and a right sidebar titled 'Property Editor'. The Property Editor shows settings for the selected 'Main' widget, including 'name' (Admin), 'displayName' (Admin), 'dimensions' (W: 1,105 H: 1,200), 'styleClasses' (empty), 'layout' (fixed), and 'datasource' (Employee).

- Build integrated, tailor-made solutions for every need: App Maker lets you build a range of applications customized to meet the needs of your organization and connects to a wide range of data sources and APIs. This unique flexibility starts with built-in support

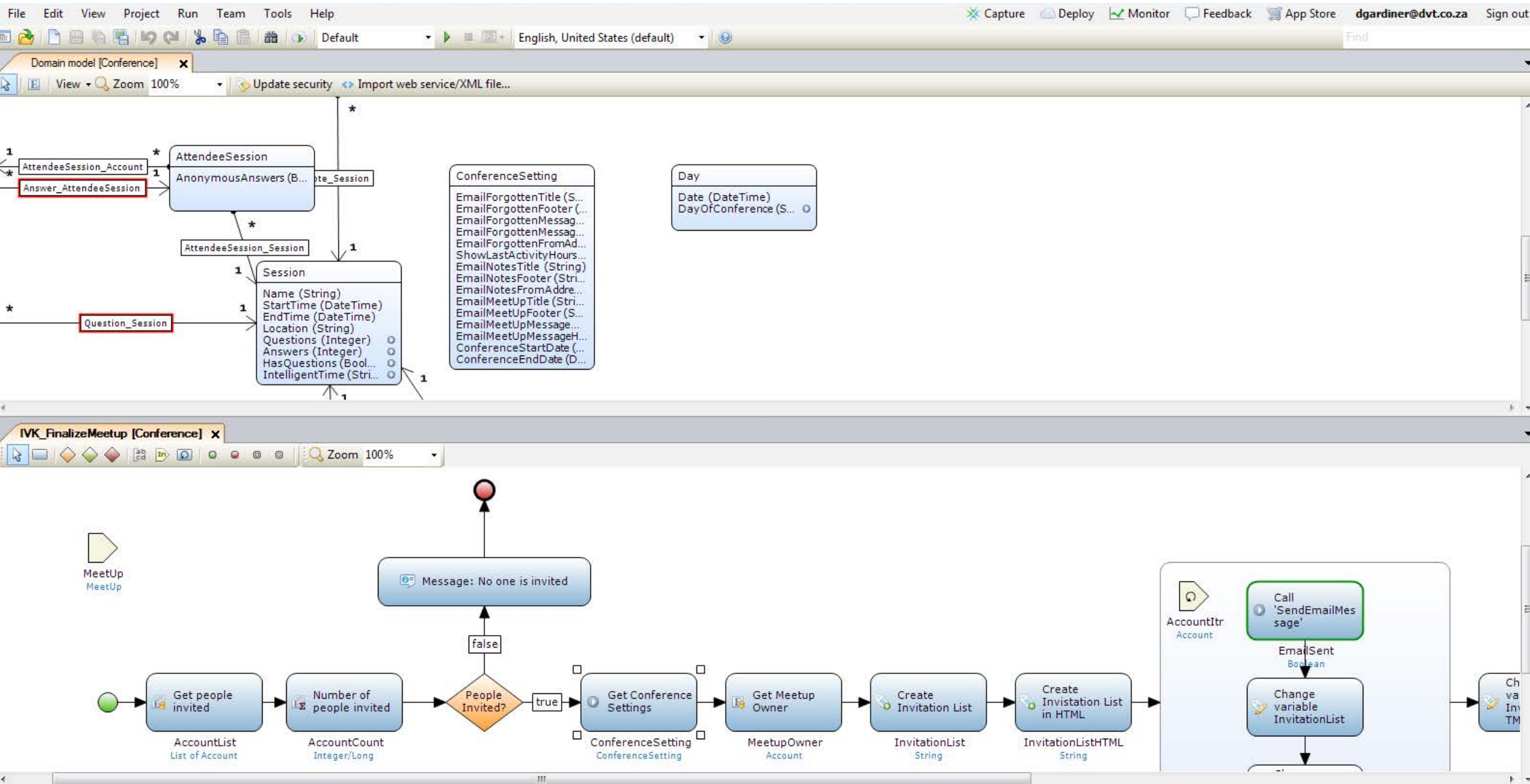
Google

Dynamic Modeling Tools

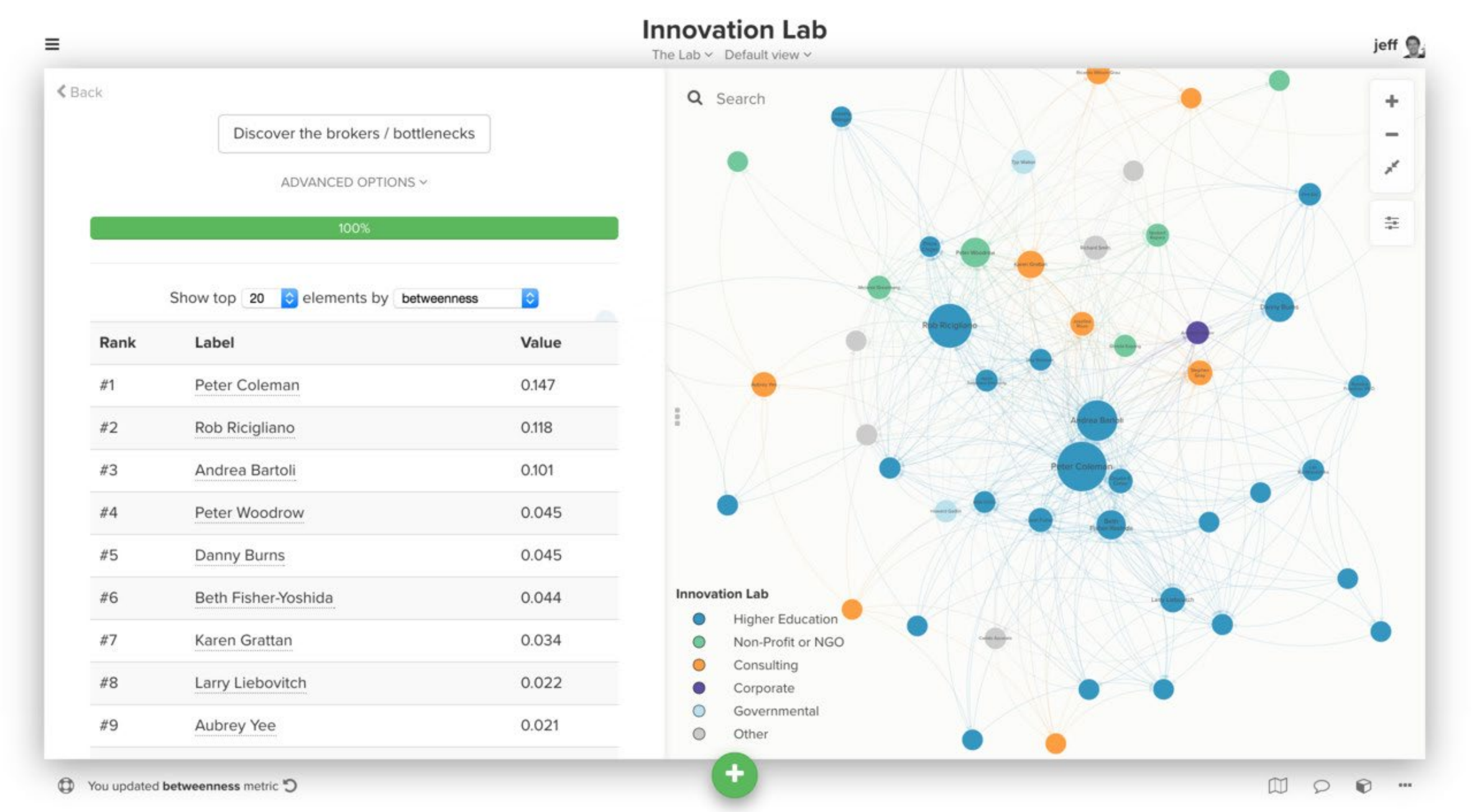
Support System Visualizing

Mendix Business Modeler

2005-Today



Mendix



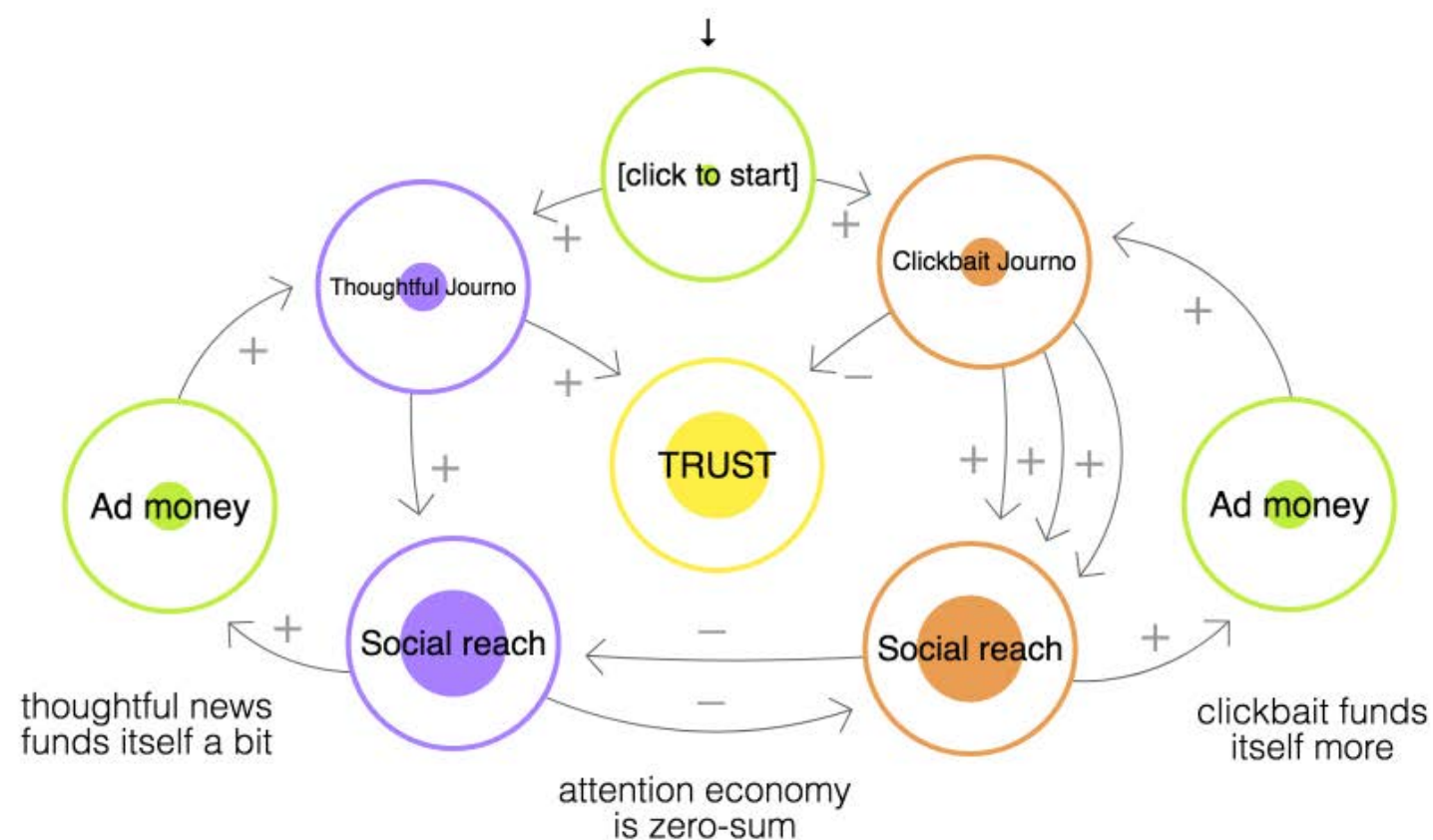
Jeff and Ryan Mohr for Kumu Inc

Loopy

2017

Both thoughtful & clickbait journalism is supported by a positive feedback loop of ad money. But there's two differences: 1) thoughtful journo increases trust, clickbait hurts it. 2) clickbait gets more social reach... and this effect compounds.

result: ad-based journalism WILL skew towards clickbait, and WILL destroy trust.
THE MEDIUM (of advertising) IS THE MESSAGE.



Nicky Case

IDE: Environments & Experiments

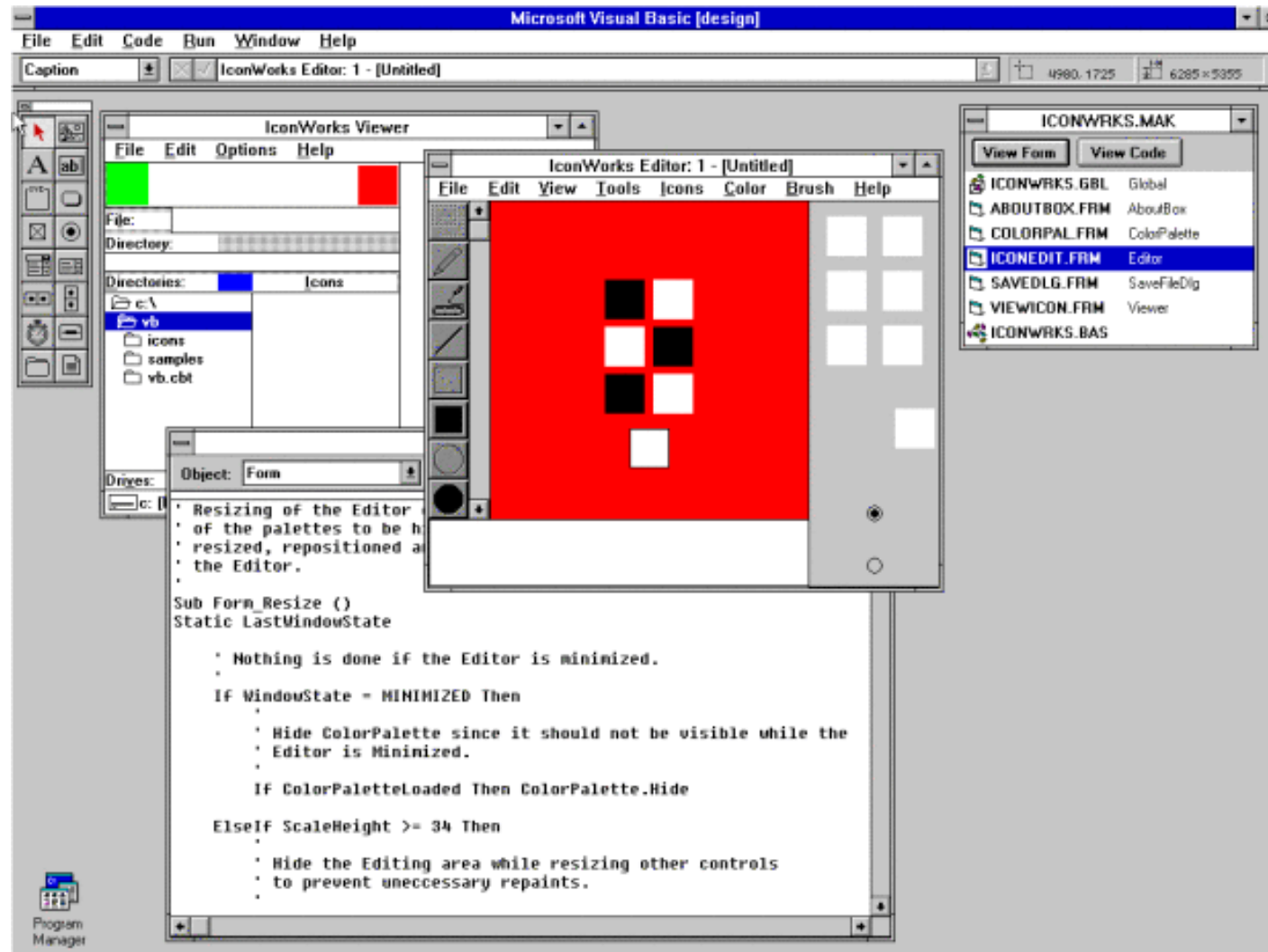
What Is & What's Next

Traditional IDEs

Integrated Development Environments

Visual Basic

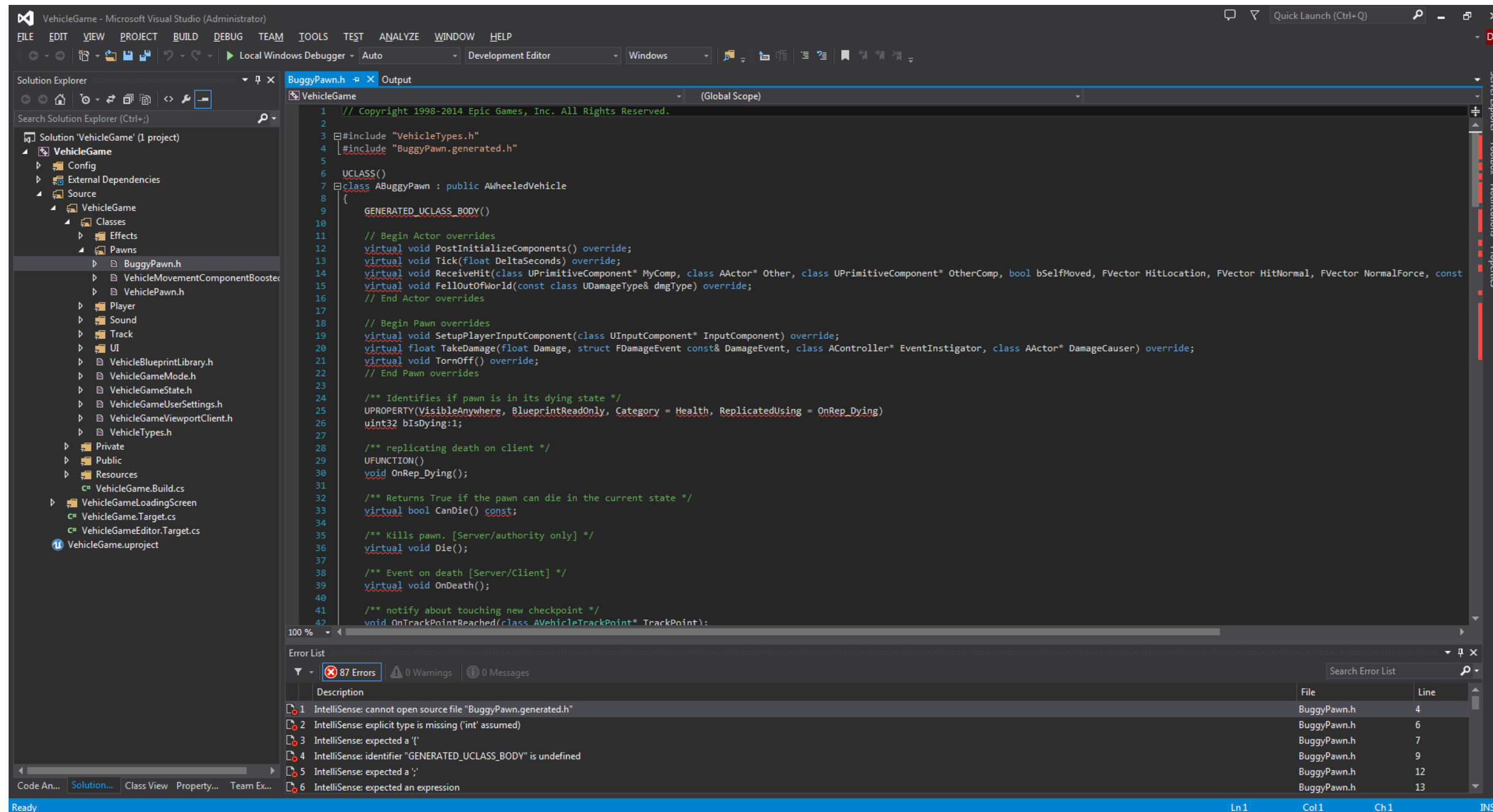
1991-1998



Cooper Software for Microsoft

Visual Studio

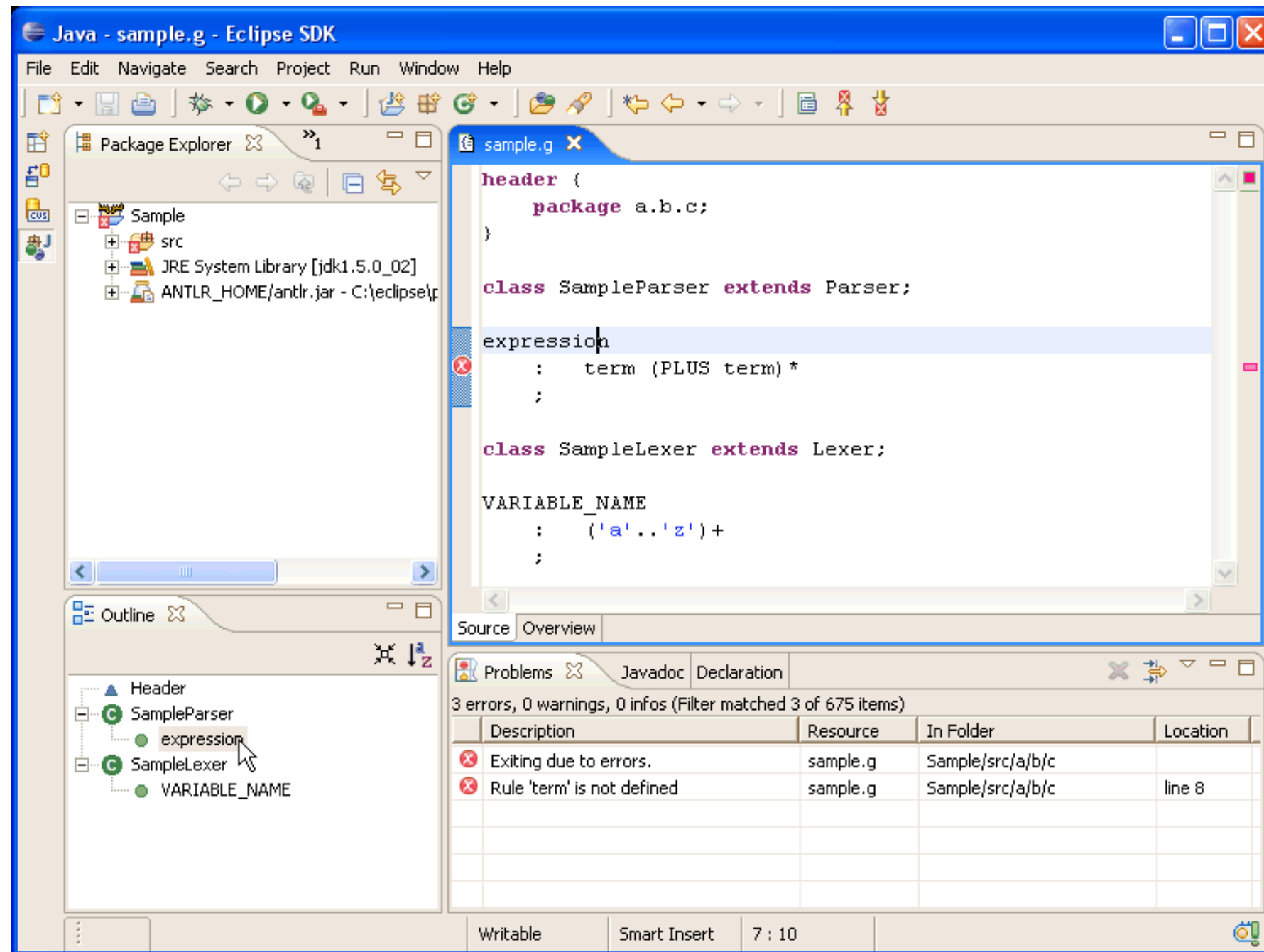
1997-Today



Microsoft

Eclipse

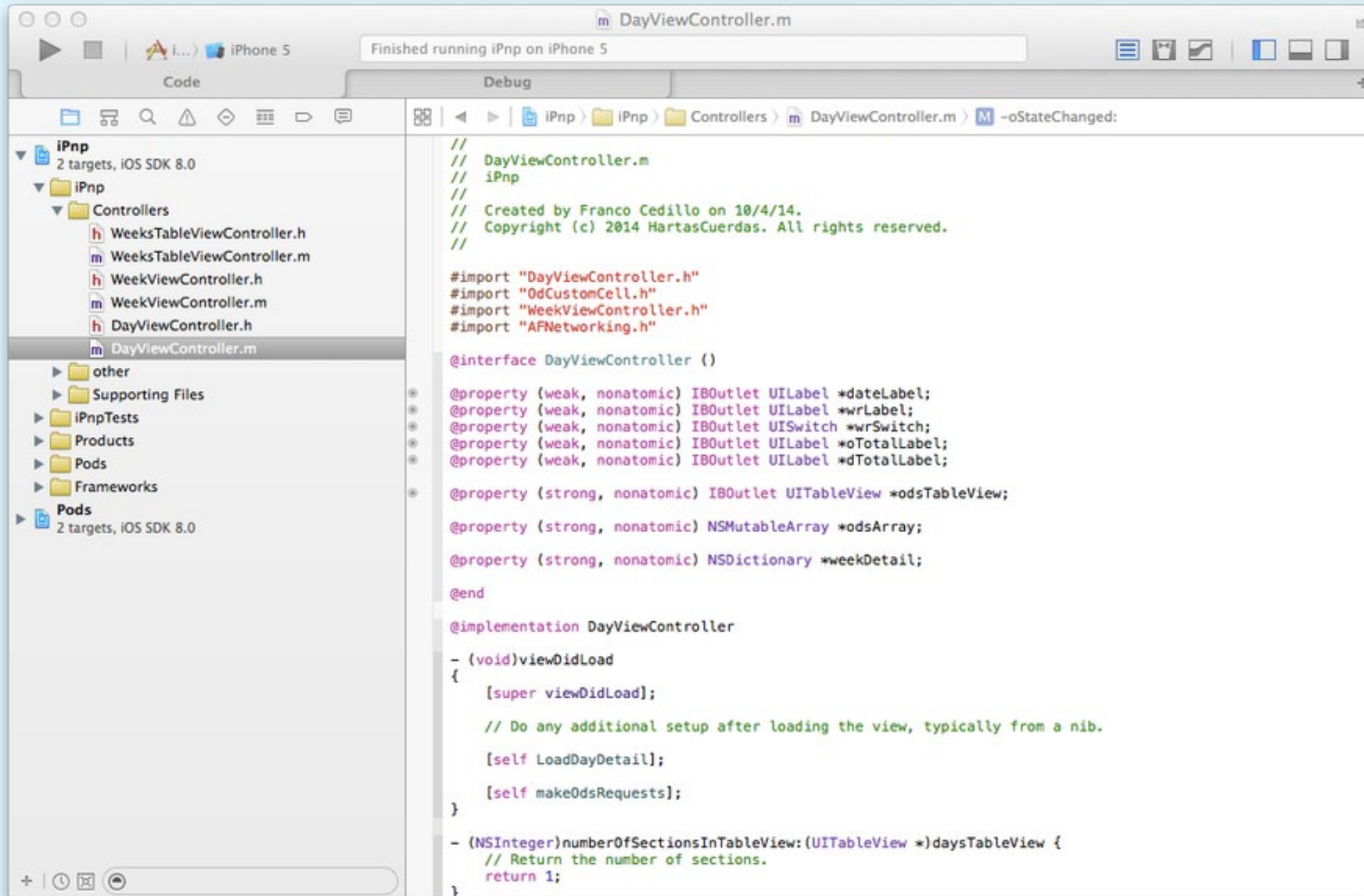
2001-Today



Eclipse Foundation

Xcode

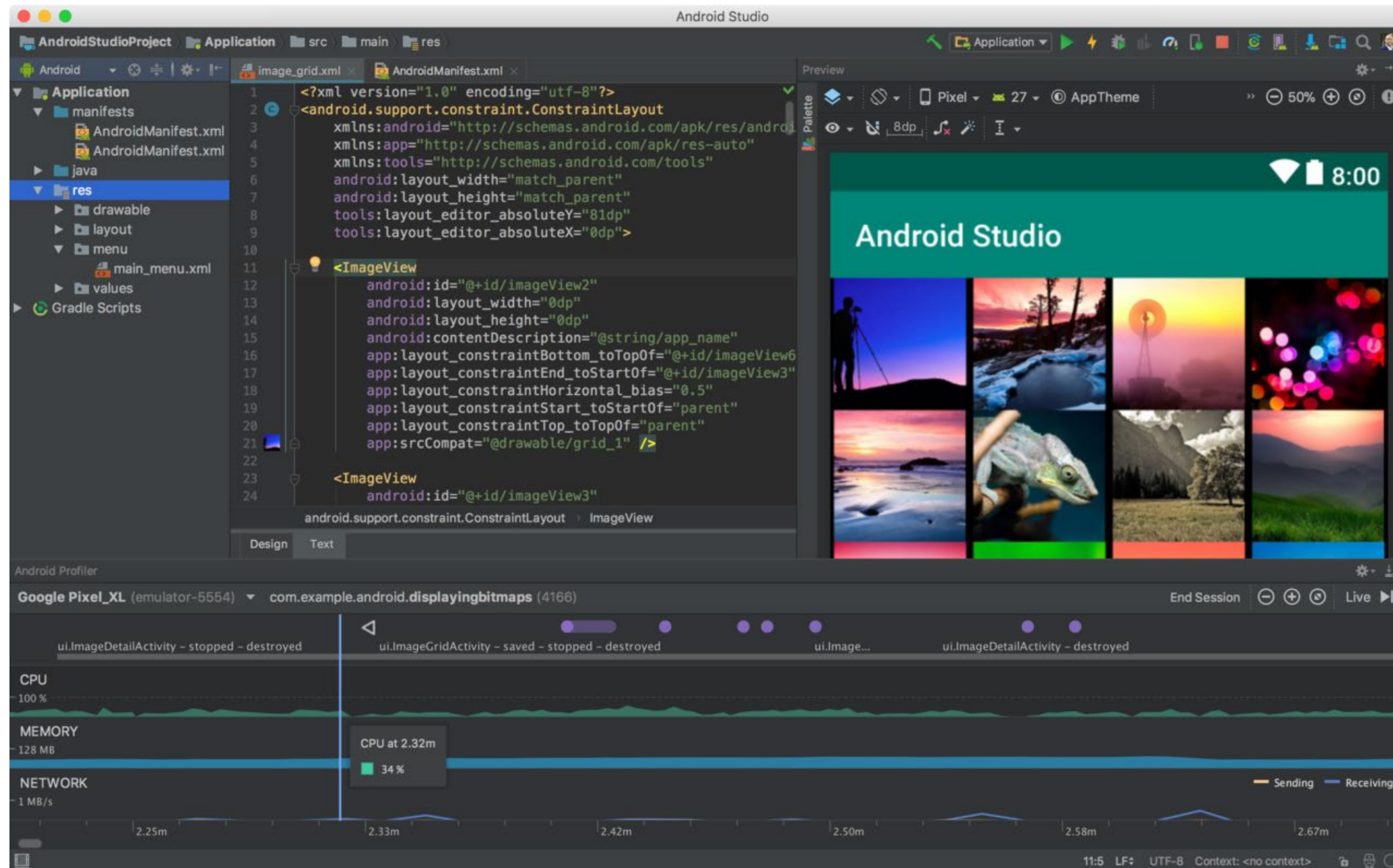
2003-Today



Apple

Android Studio

2013-Today



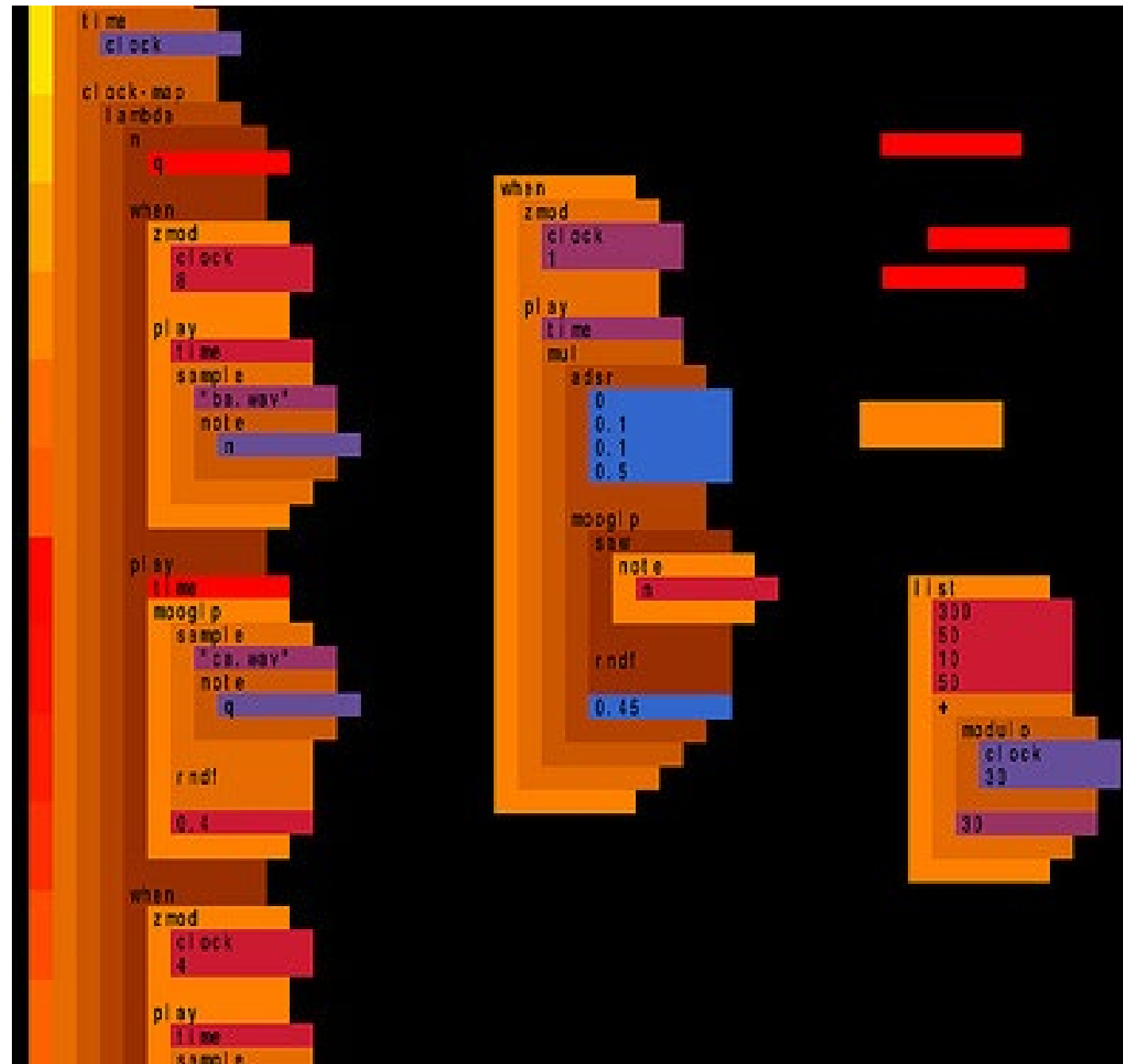
Google

Structure Editing

At Nested Levels of Abstraction

Scheme Bricks

2008



Dave Griffiths

Code Bubbles for Eclipse

2010

The screenshot displays the Eclipse IDE with the Code Bubbles plugin. The main window is titled "Code Bubbles" and contains several panels:

- Thread Viewer:** A panel on the left showing a list of threads. The selected thread is "edu.brown.cs.bubbles.bddt.BddtThreadView\$TableUpdater.run(...)".
- Bubbles List:** A panel on the right showing a list of bubbles. The selected bubble is "edu.brown.cs.bubbles.bddt.BddtThreadView\$TableUpdater.run(...)".
- Thread Model:** A panel in the center showing the thread model used by the viewer. It includes a description: "The thread model used by the viewer is a direct view on the bump_threads structure." and a list of methods: "getValueAt(int r, int c)", "getRowCount()", "paintComponent(Graphics g)", "getActualThread(int)", and "BddtThreadView(Bdd...)".
- Source Code:** A panel on the left showing the source code of the selected bubble. It includes the following code:

```
@Override public void run() {
    BumpThread bt;
    switch (run_event.getEventType()) {
        case THREAD_ADD :
            bt = run_event.getThread();
            if (bt != null) {
                thread_set.add(bt);
                synchronized (bump_threads) {
                    bump_threads.clear();
                    bump_threads.addAll(thread_set);
                }
            }
            break;
        case THREAD_REMOVE :
            bt = run_event.getThread();
            if (bt != null) {
                thread_set.remove(bt);
                synchronized (bump_threads) {
                    bump_threads.remove(bt);
                }
            }
            break;
        case THREAD_CHANGE :
            //TODO: Update thread
            break;
    }
    threads_model.fireTableDataChanged();
}
```
- Annotations:** A panel on the right showing annotations for the selected bubble. It includes the following code:

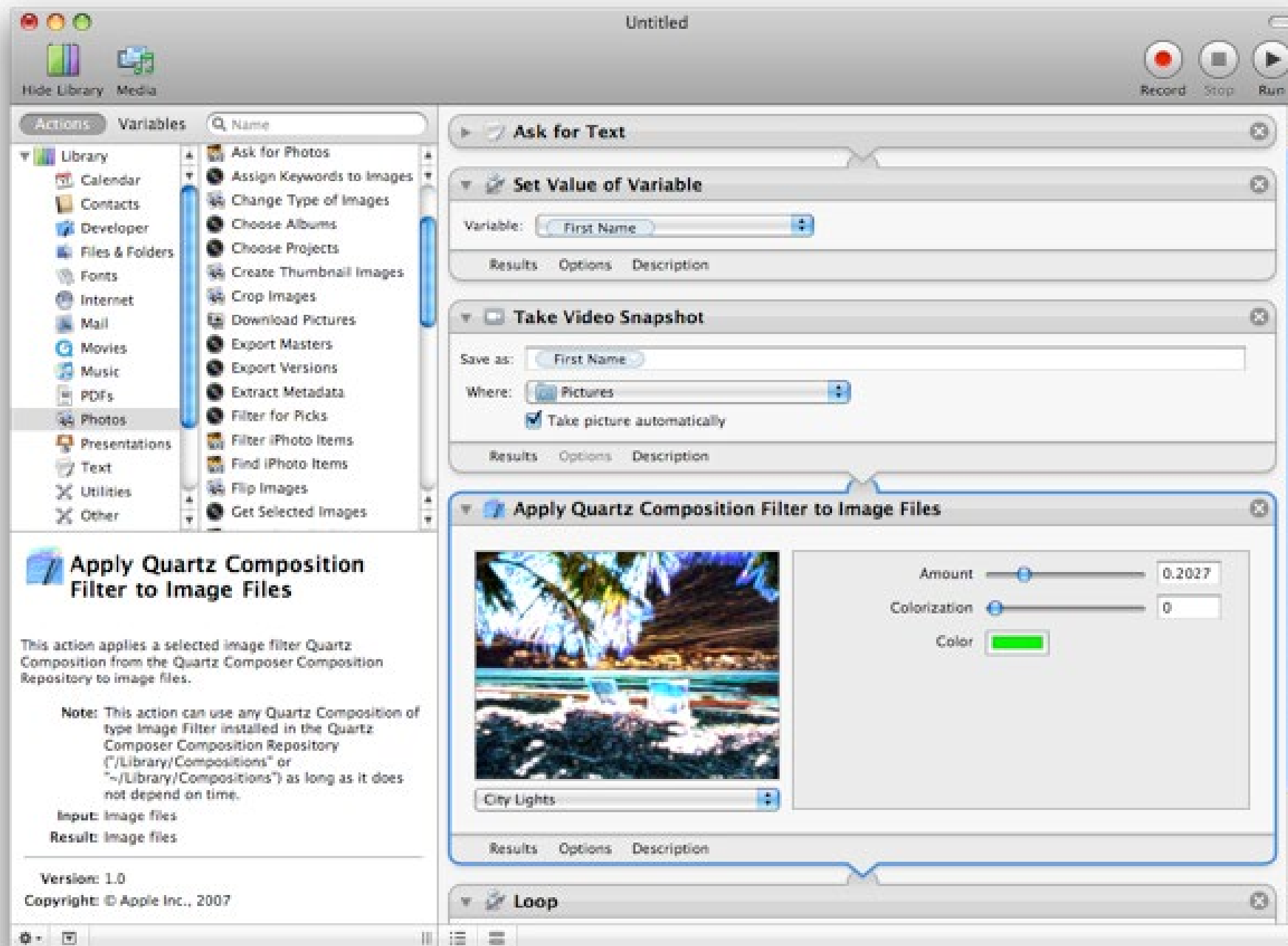
```
@Override public int getRowCount() {
    return bump_threads.size();
}
```
- Method Signature:** A panel on the right showing the method signature for the selected bubble: "java.util.List.size()".
- Class Hierarchy:** A panel on the right showing the class hierarchy for the selected bubble. It includes the following classes: "edu.brown.cs.bubbles.bddt.BddtThreadView", "edu.brown.cs.bubbles.bump.BumpRunManager", and "java.util.List".

Work Flow

Step-based Programming

Automator

2005-Today



Apple

IFTTT

2010-Today



Alexander Tibbets, Linden Tibbets

WorkFlow

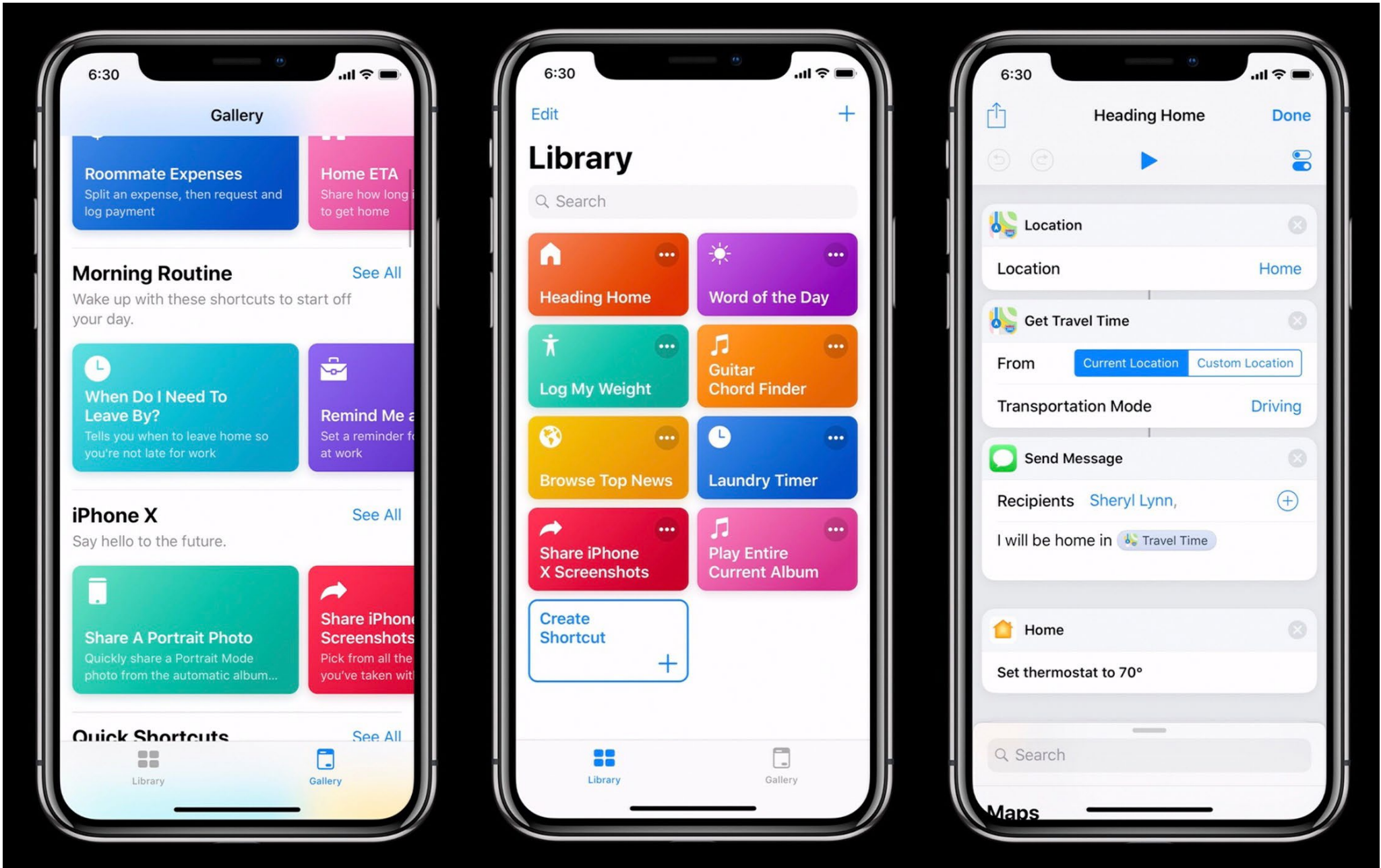
2014-



Ari Weinstein, Conrad Kramer, Ayaka Nonaka and Nick Frey for DeskConnect, Inc (Acquired by Apple)

Siri Shortcuts

2018



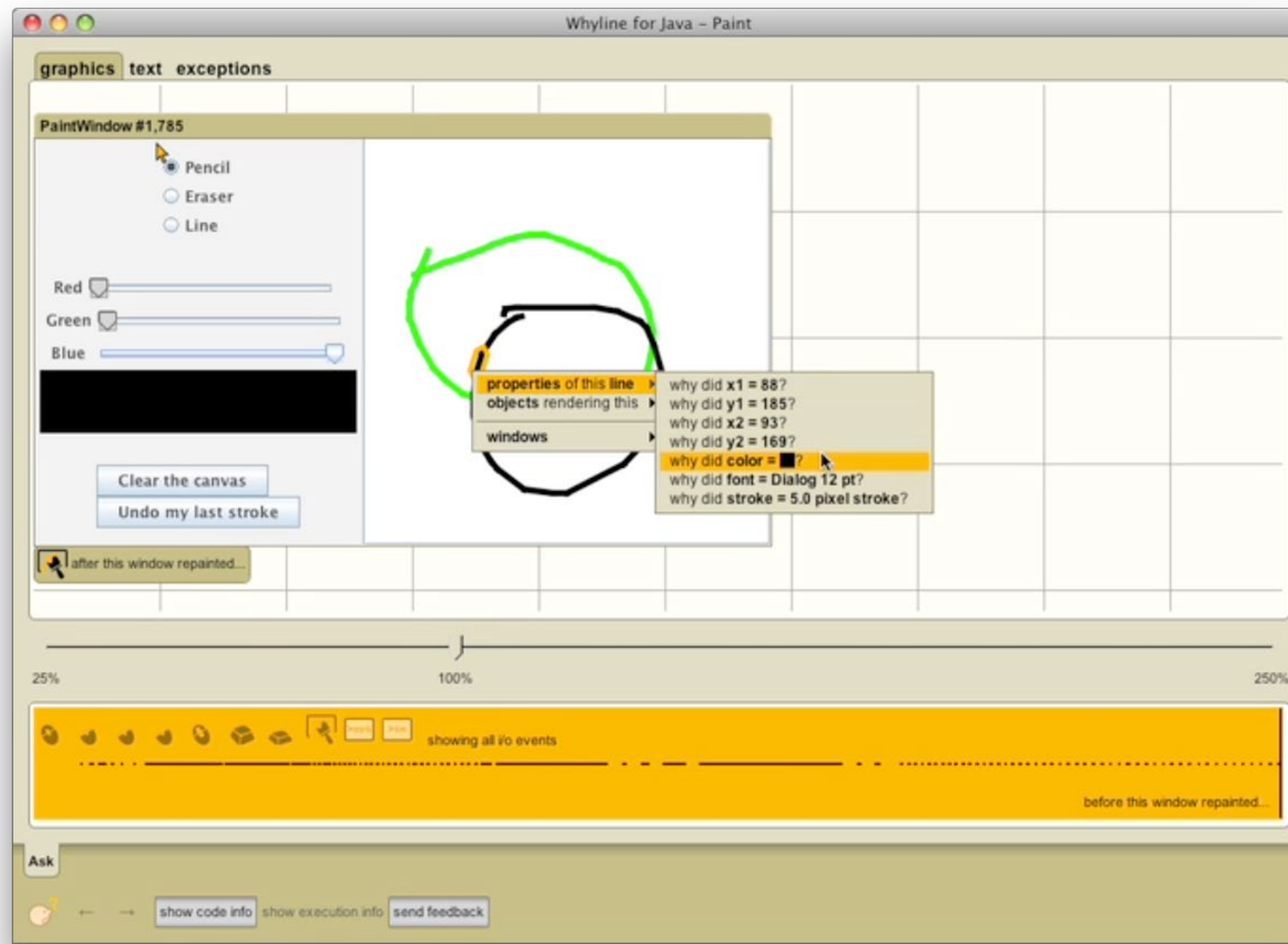
Apple

Visible State Editors

Introduce Transparency to
Traditional Programming

Whyline

2008



Andrew Ko at Carnegie Mellon University (HCI Institute)

Learnable Programming (Essay)

2012

step 24

```
var i = 0;
while (i < 20) {
  var scaleFactor = 1 + (20 - i)/20;
  resetMatrix();
  scale(scaleFactor);
  rotate(i * 6);
  fill(i * 30, i * 18, 0);
  triangle(0,0, 100,-20, 95,40);
  i += 1;
}
```

0

t t t t t t t

2 1.95 1.9 1.85 1.8 1.75 1.7 1.65

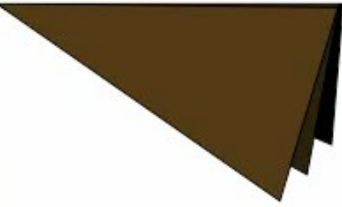
• • • • • • •

2 1.95 1.9 1.85 1.8 1.75 1.7 1.6


⌂ ⌂ ⌂ ⌂ ⌂ ⌂ ⌂

• • • • • • •

1 3 4 5 6 7



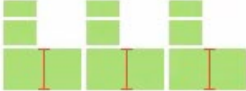
```
fill(0,0,0);
drawRect(80,80, 40,25);
drawRect(60,20, 80,40);
drawLine(20,20, 180,160);
drawTriangle(80,60, 80,20, 140,60);
drawRect(60,20, 80,40);
drawEllipse(100,40, 80,40);
drawBezier(60,20, 180,20, 140,60, 60,60);
drawText("Hello!", 60,40);
```



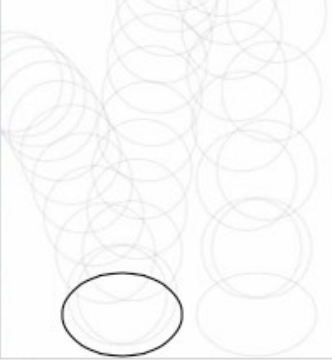
```
fill(161, 219, 114);
for (var x = 40; x < 150; x += 50) {
  rect(x, 33, 20, 10);
  rect(x, 45, 20, 15);
  rect(x, 62, 47, 25);
}
```

height of the rectangle

25



```
var x = 0, y = 50, dy = 0;
function draw () {
  x += 3;
  y += dy;
  if (y > 185) {
    dy = -dy;
    ellipse(x, 190, 36, 25);
  }
  else {
    dy = dy * 1.07 + 3;
    ellipse(x, y, 30, 30);
  }
}
```



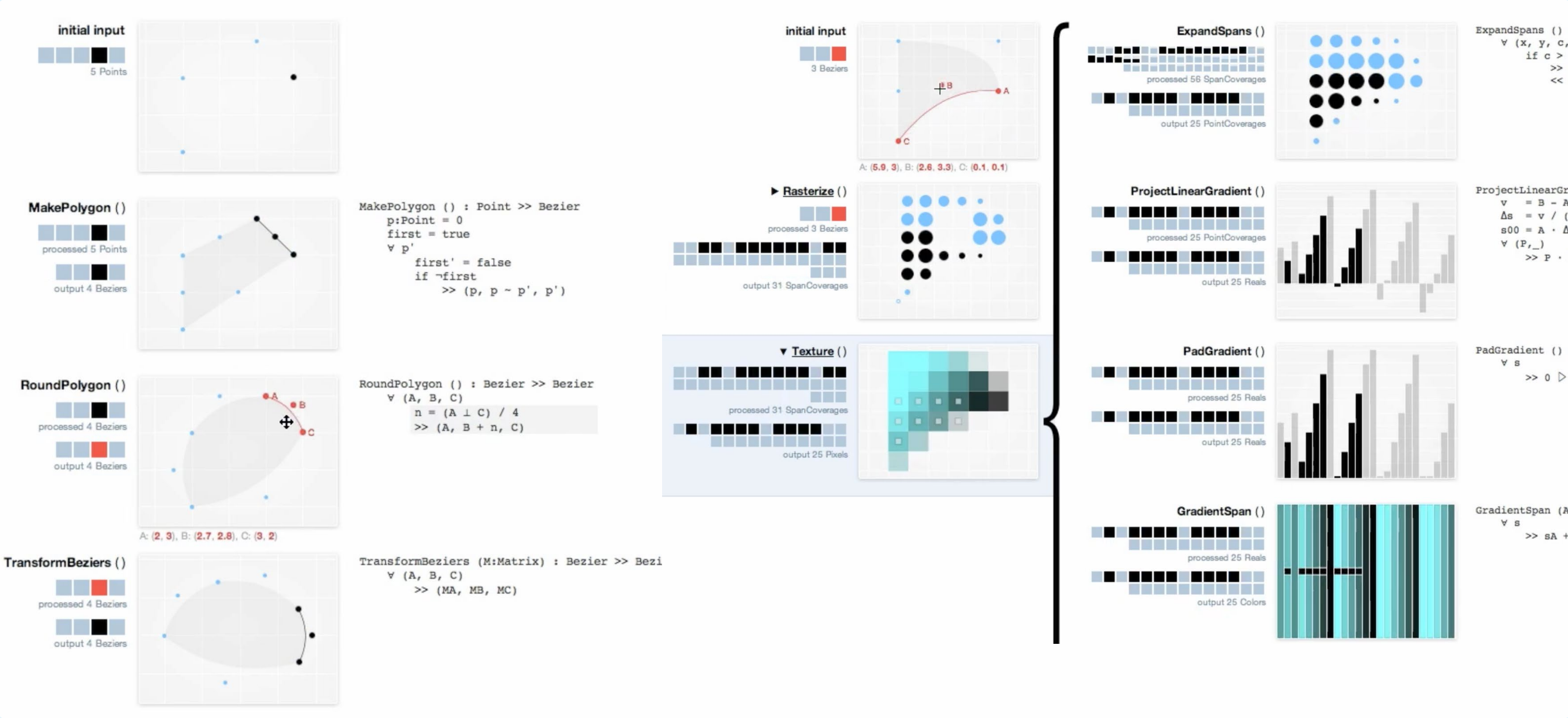
frame 10

*

id

Bret Victor

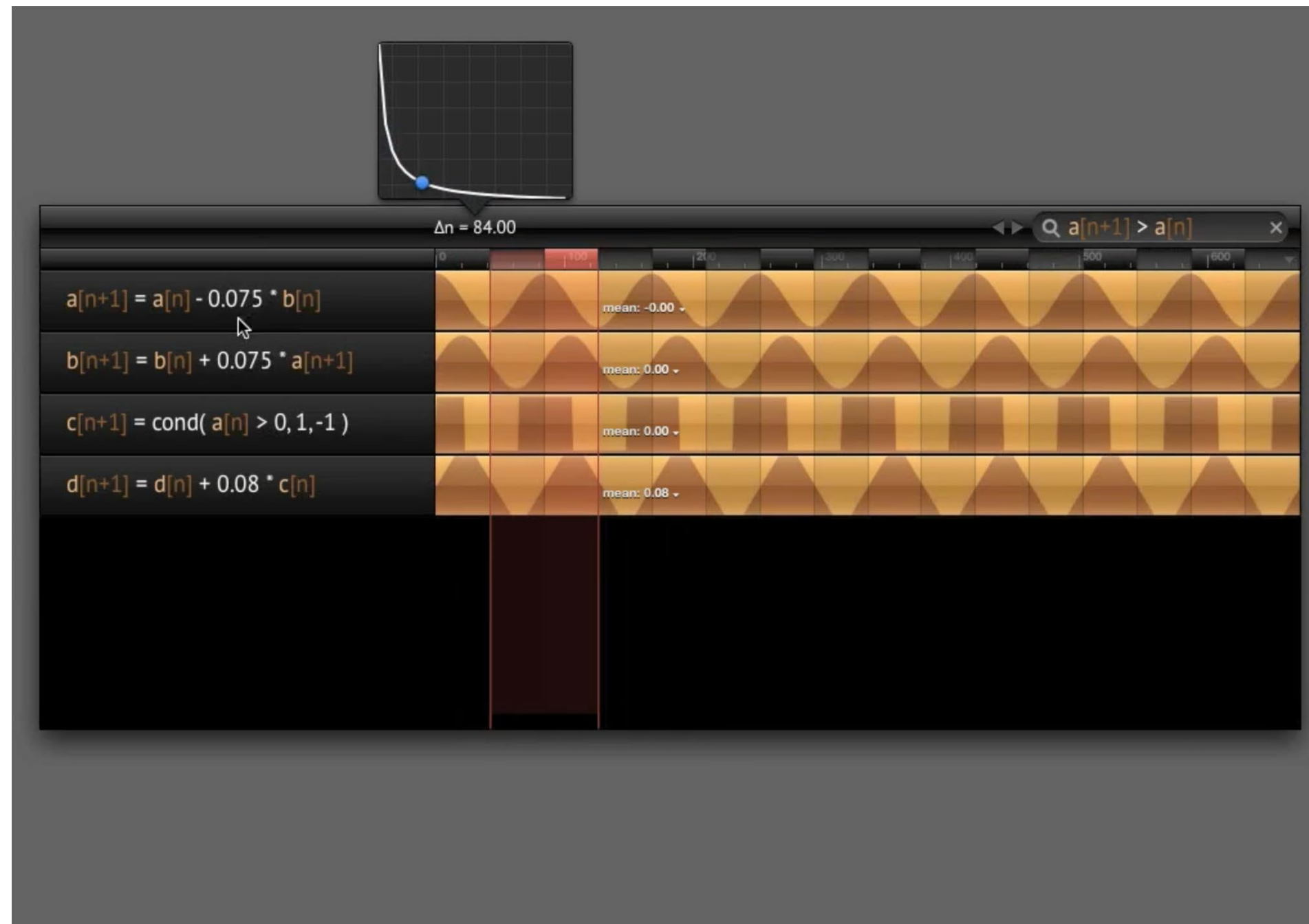
Media for Thinking The Unthinkable (Nile Demo) 2013



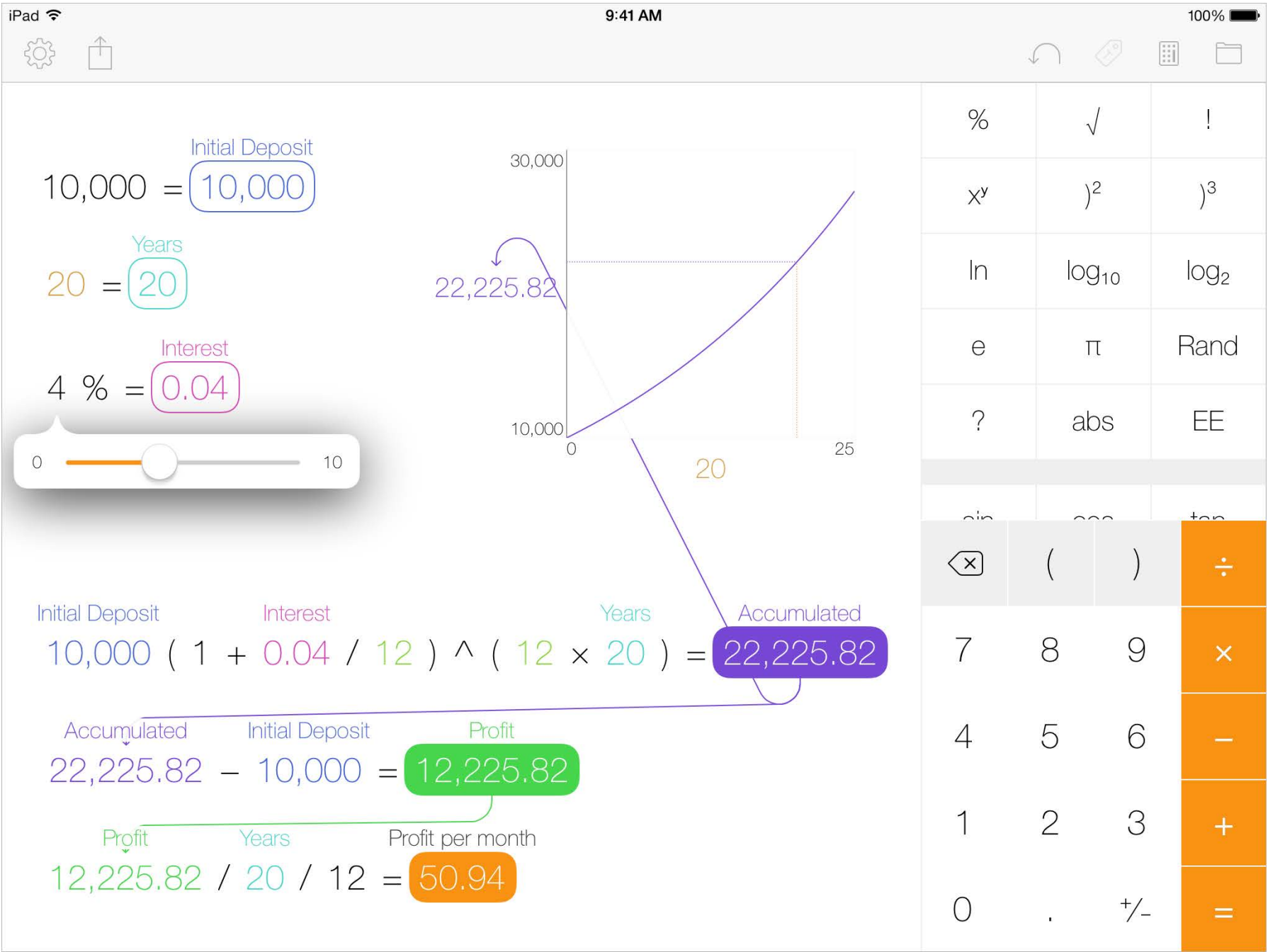
Bret Victor

Media for Thinking The Unthinkable (MSP)

2013



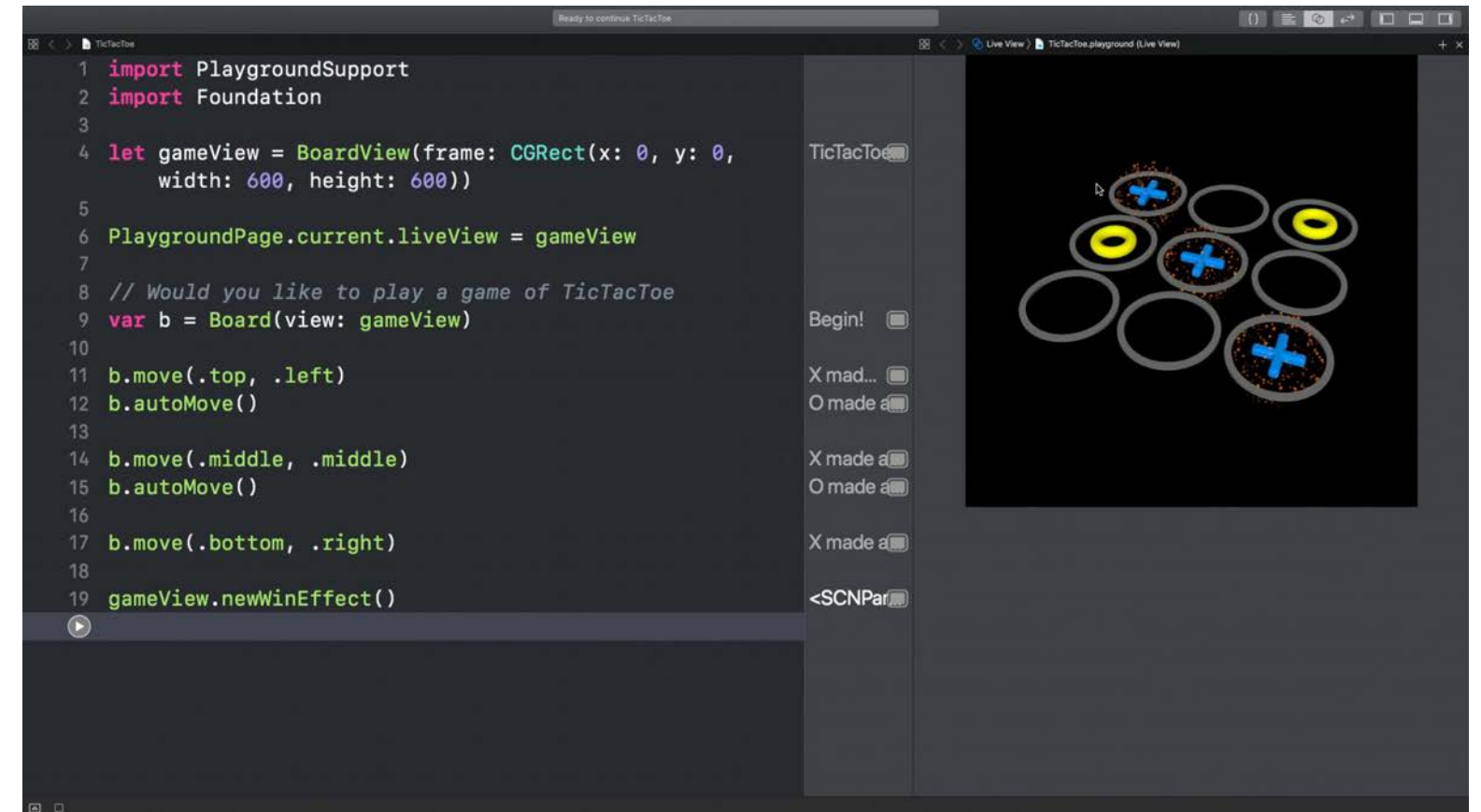
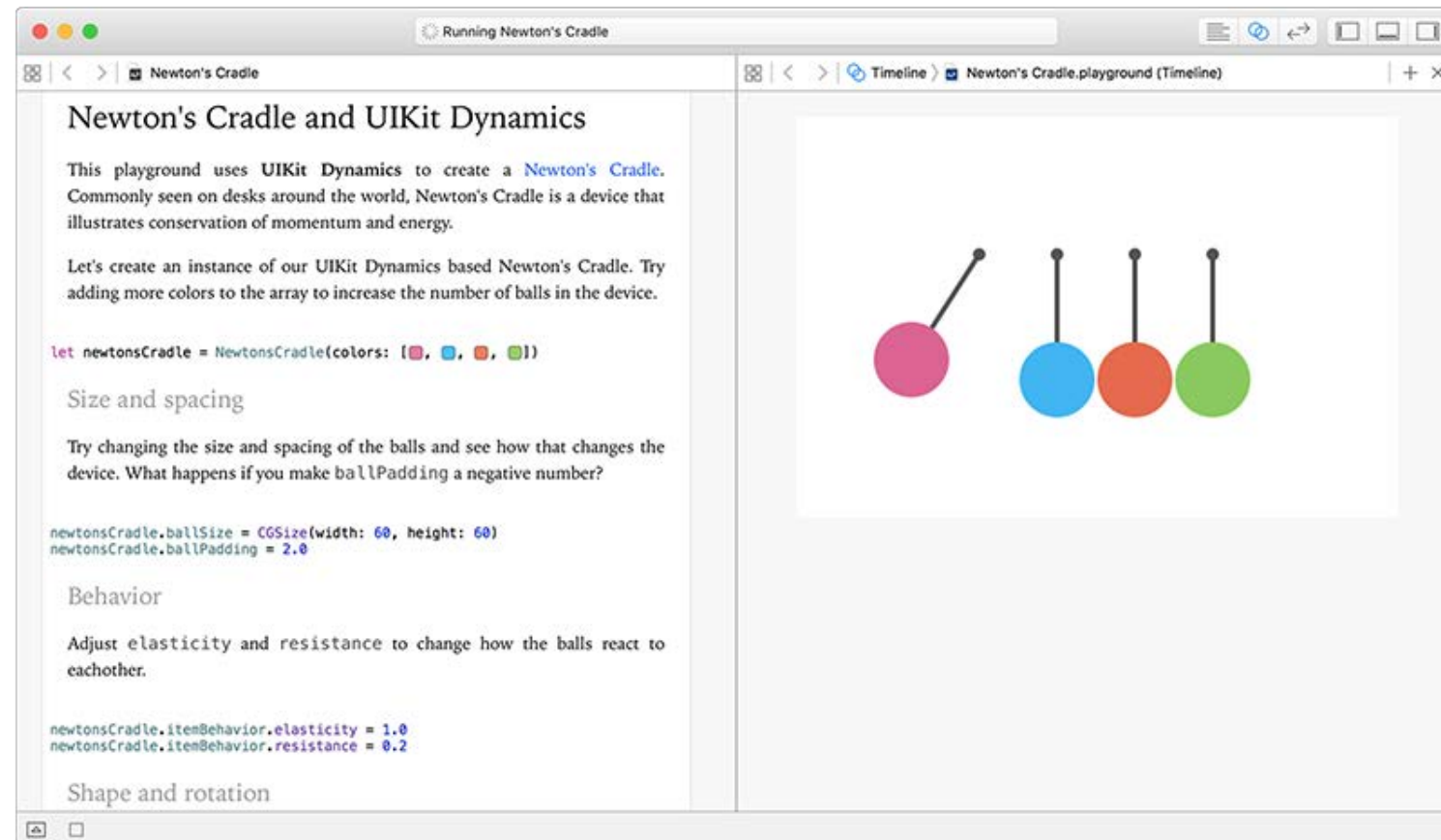
Bret Victor



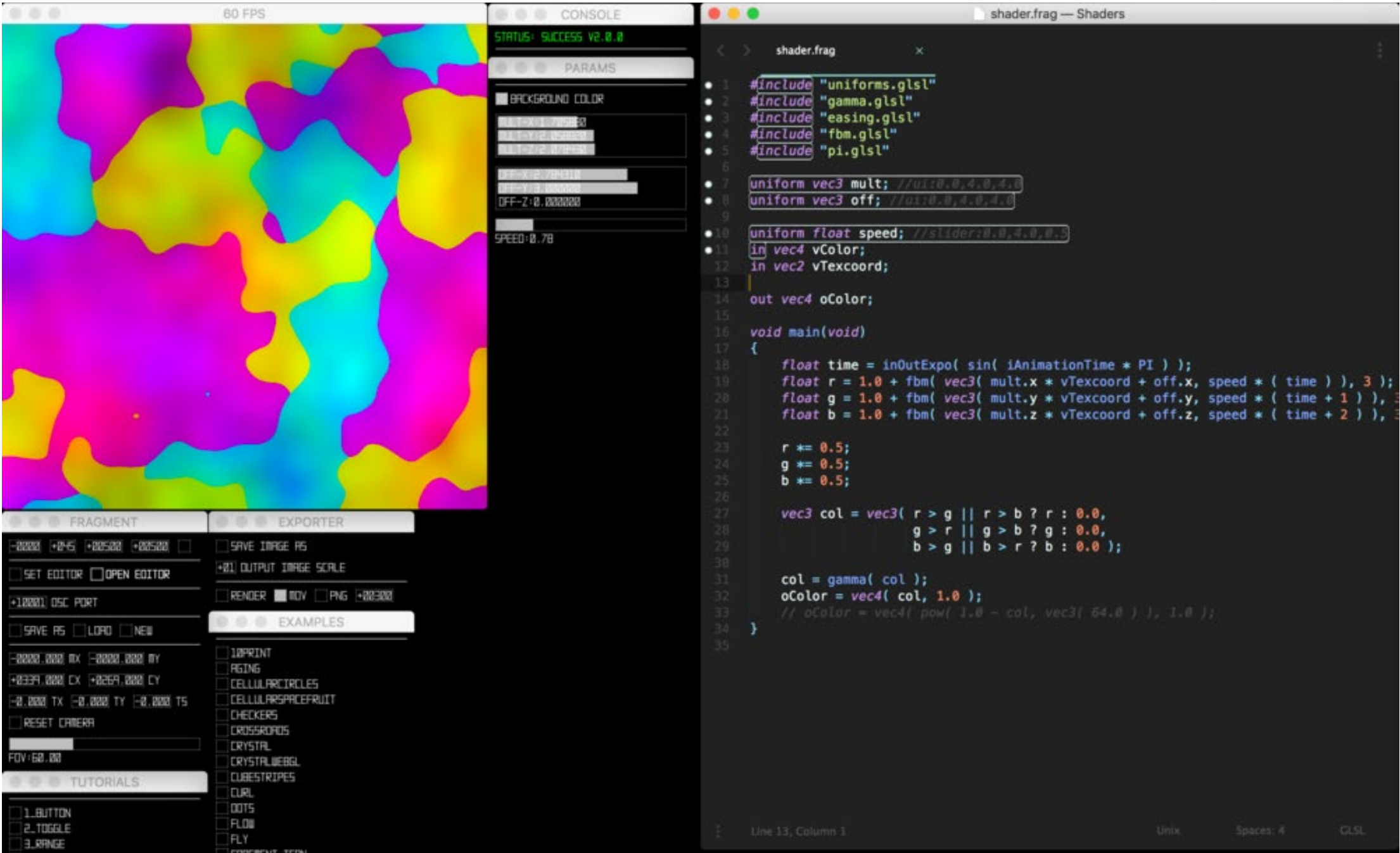
Andreas Karlsson for Tydlig Software AB

Xcode Playgrounds

2015-Today

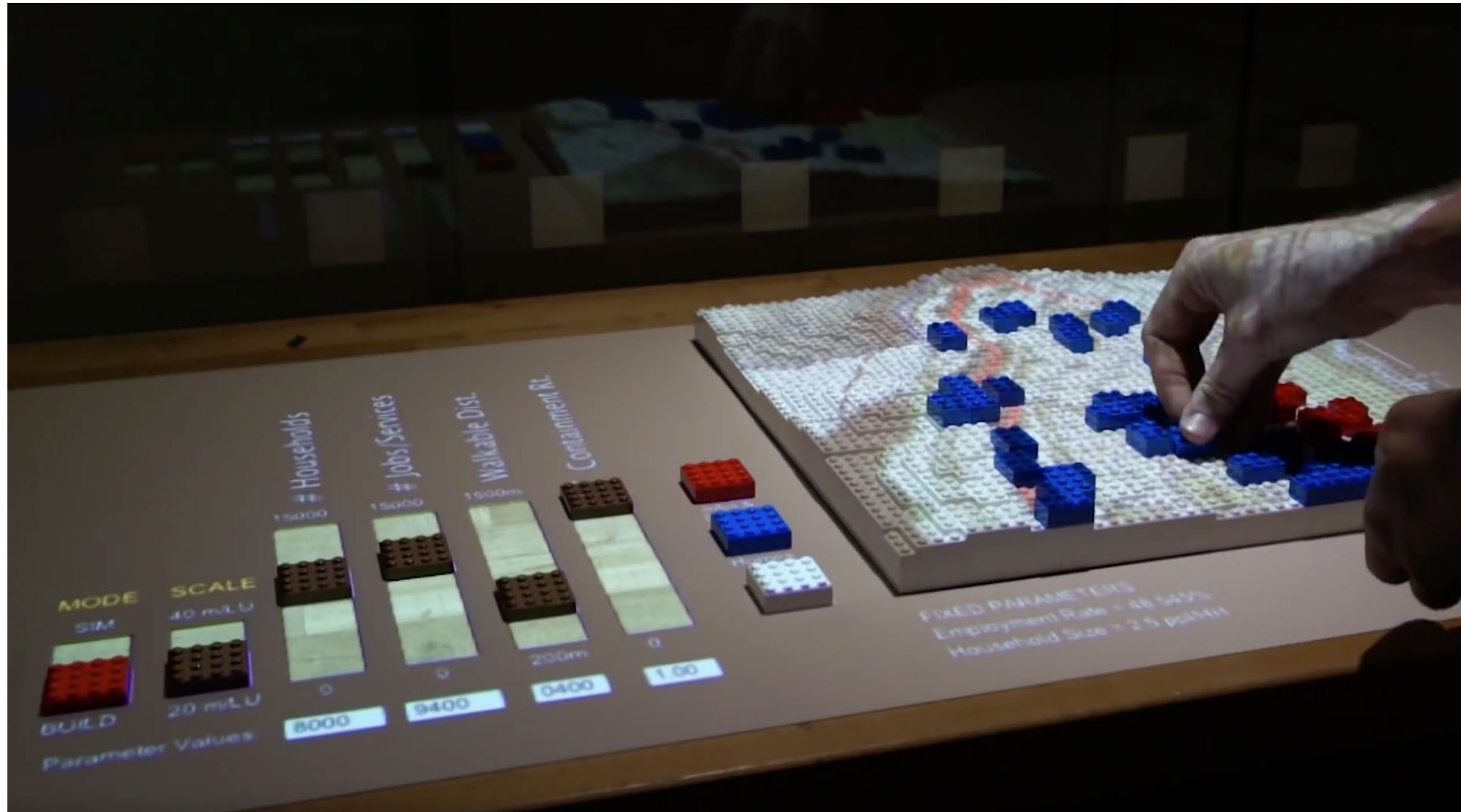


Apple



CityScope

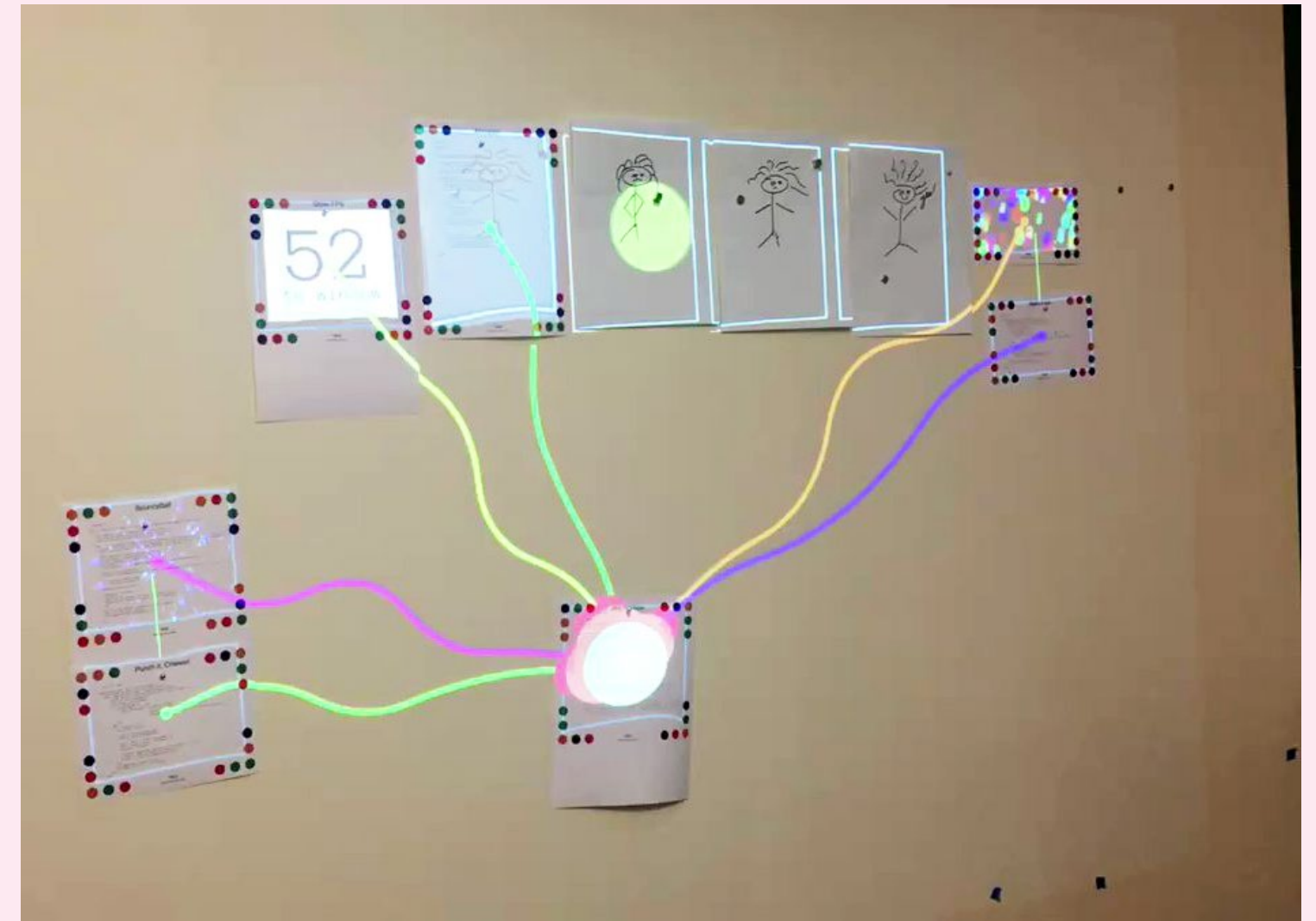
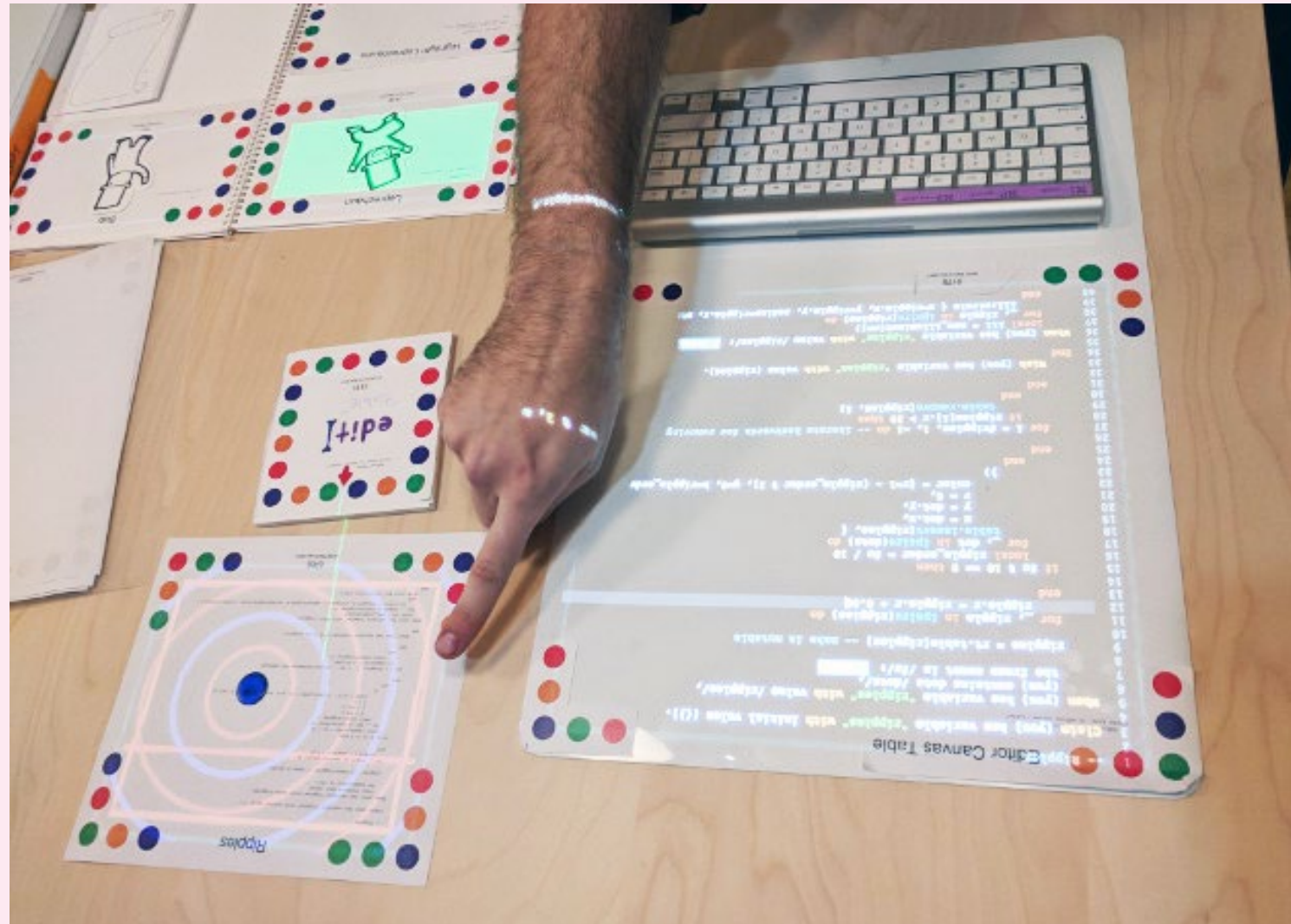
2015



Ira Winder and Joshua Fabian at the MIT Media Lab (Changing Places Group)

Dynamicland

2017-Today



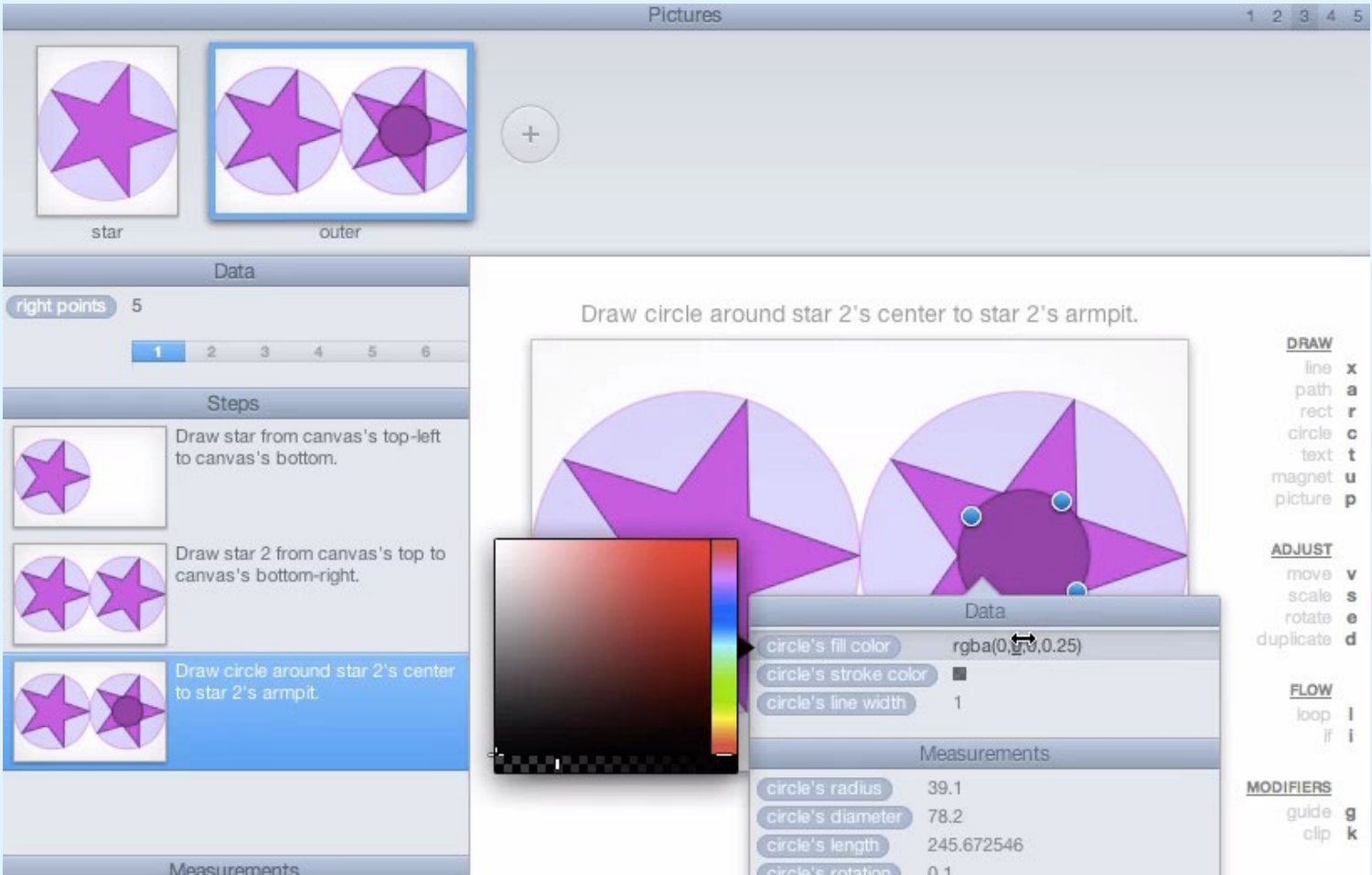
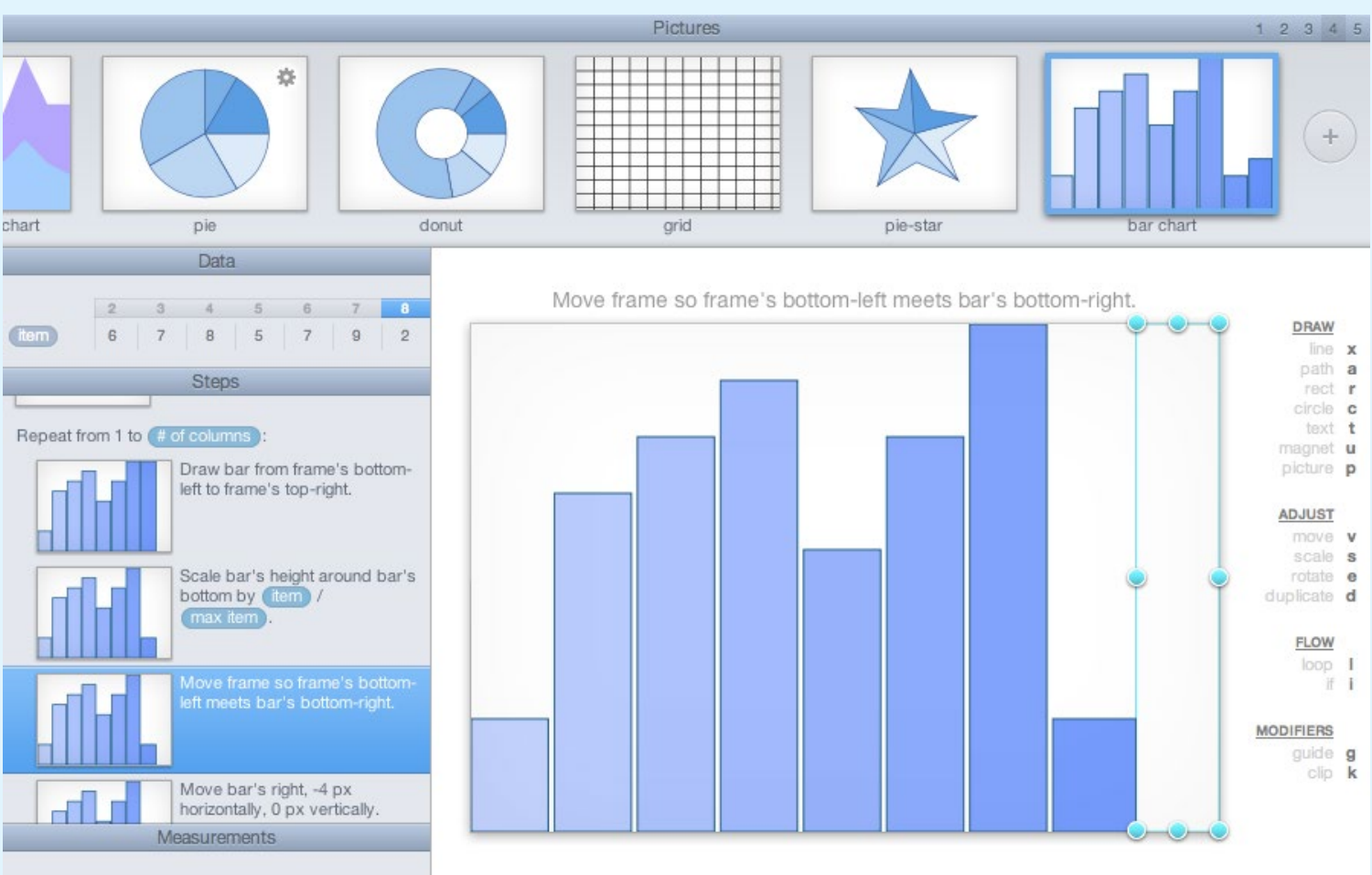
Bret Victor and Others at Y Combinator Research's Human Advancement Research Community

Dynamic Diagram Experiments

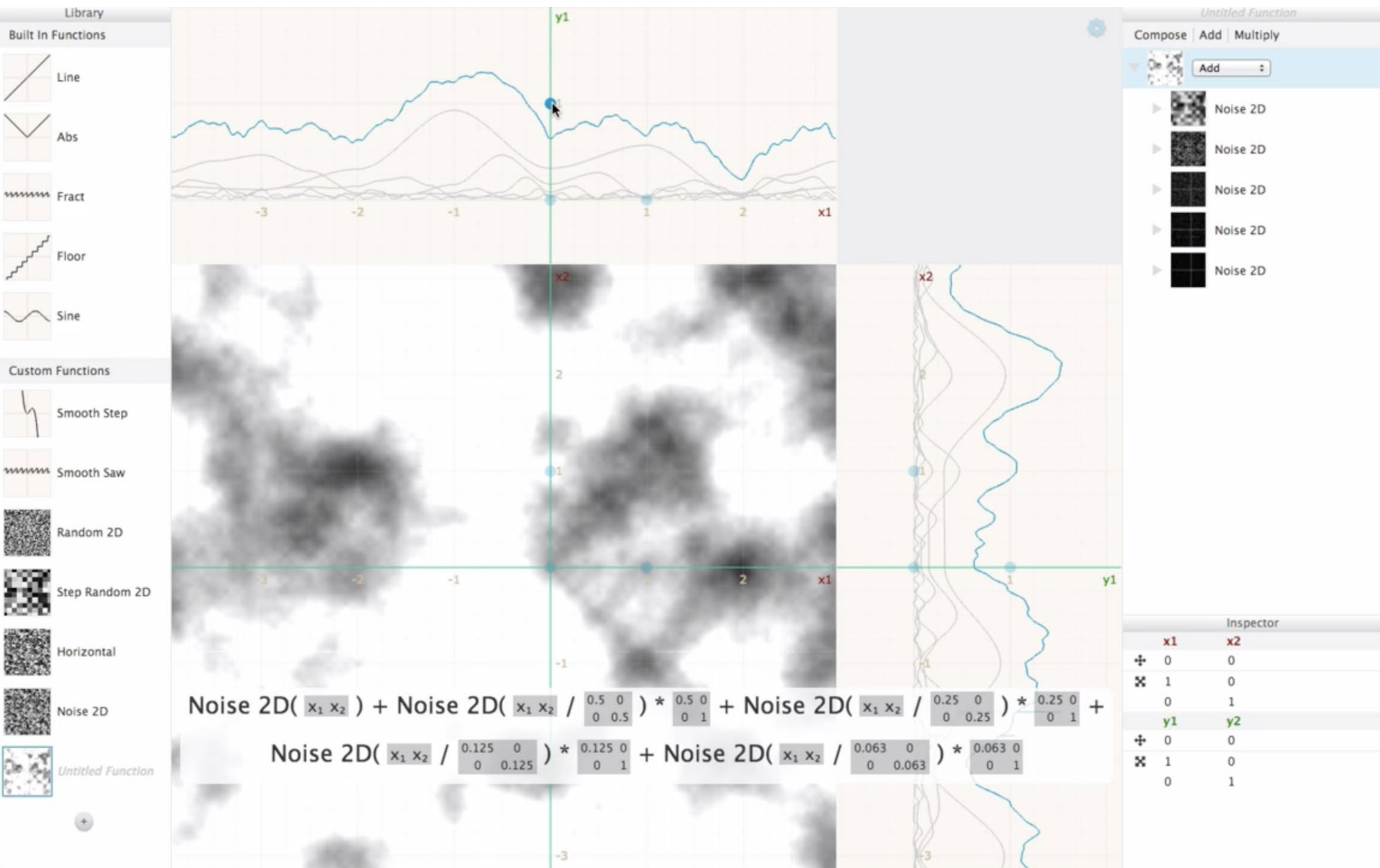
Direct-Manipulation +
Symbolic Relationships

Drawing Dynamic Visualizations

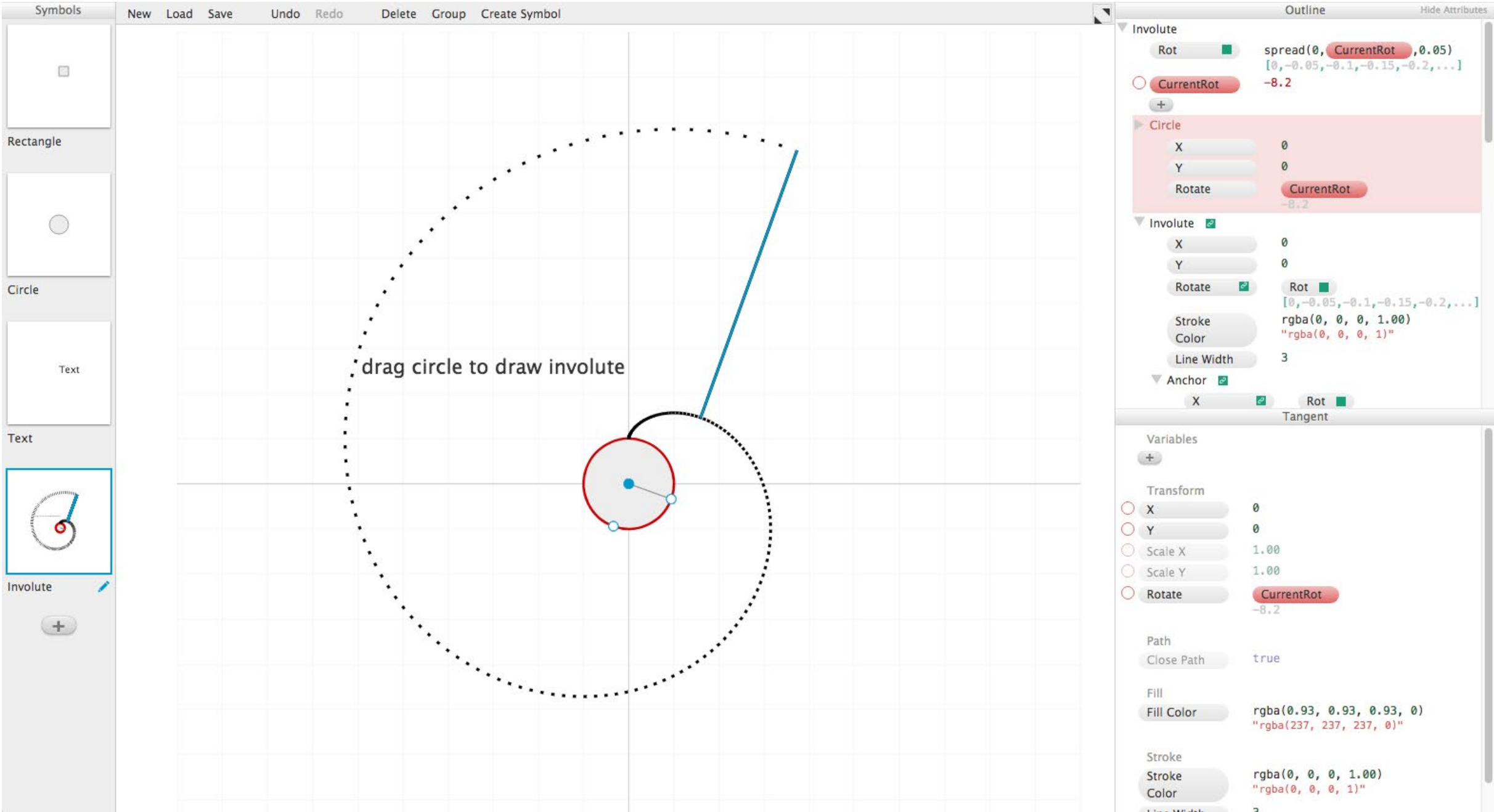
2013



Bret Victor



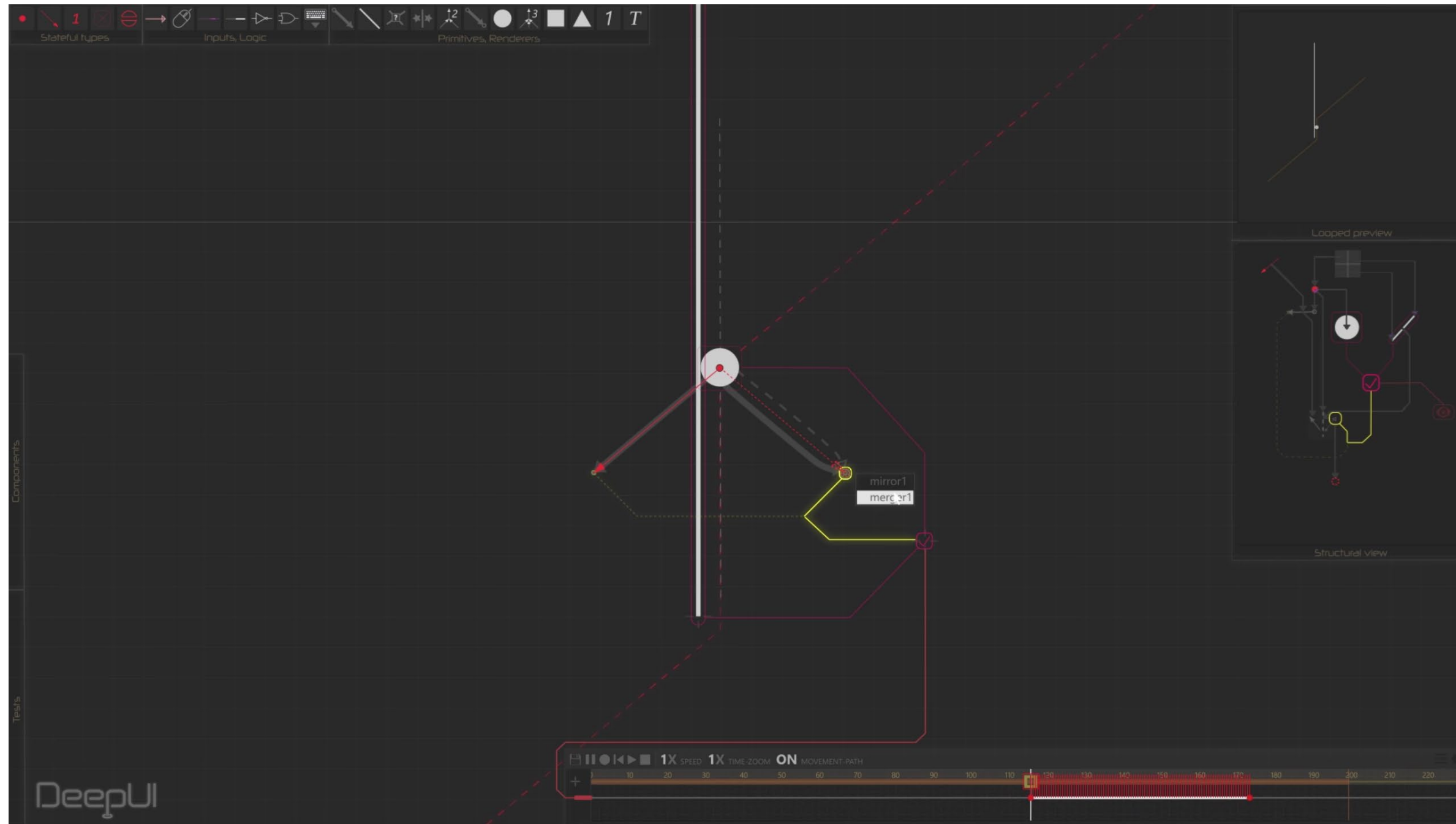
Toby Schachman for Communication Design Group at SAP



Toby Schachman for Communication Design Group at SAP

DeepUI

2017



Arnold Lagler

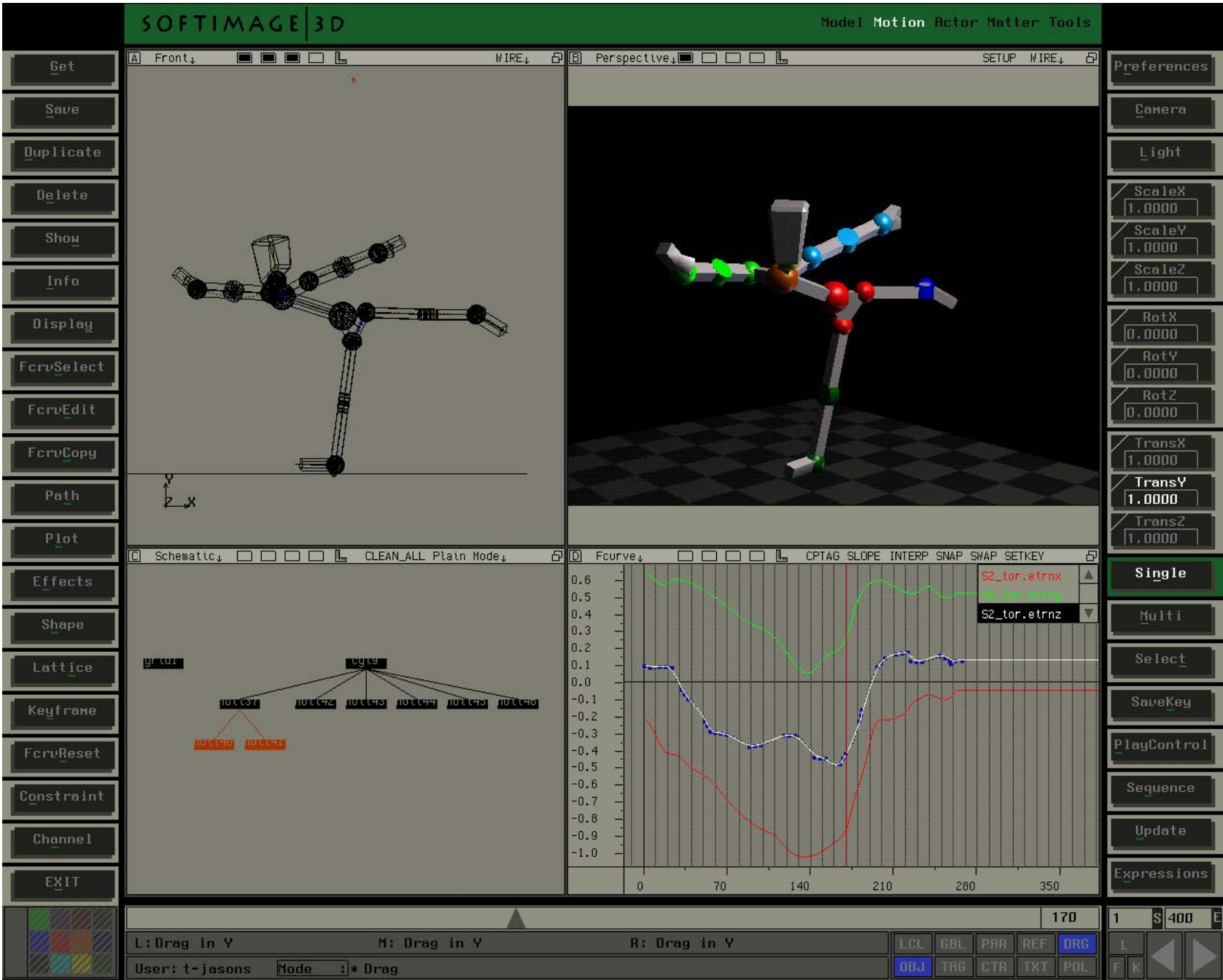
Learning From/Within Cyberspace

How Game-Tech is enabling the Next Wave

3D (Mesh/NURBs) Creation Suites

Softimage 3D

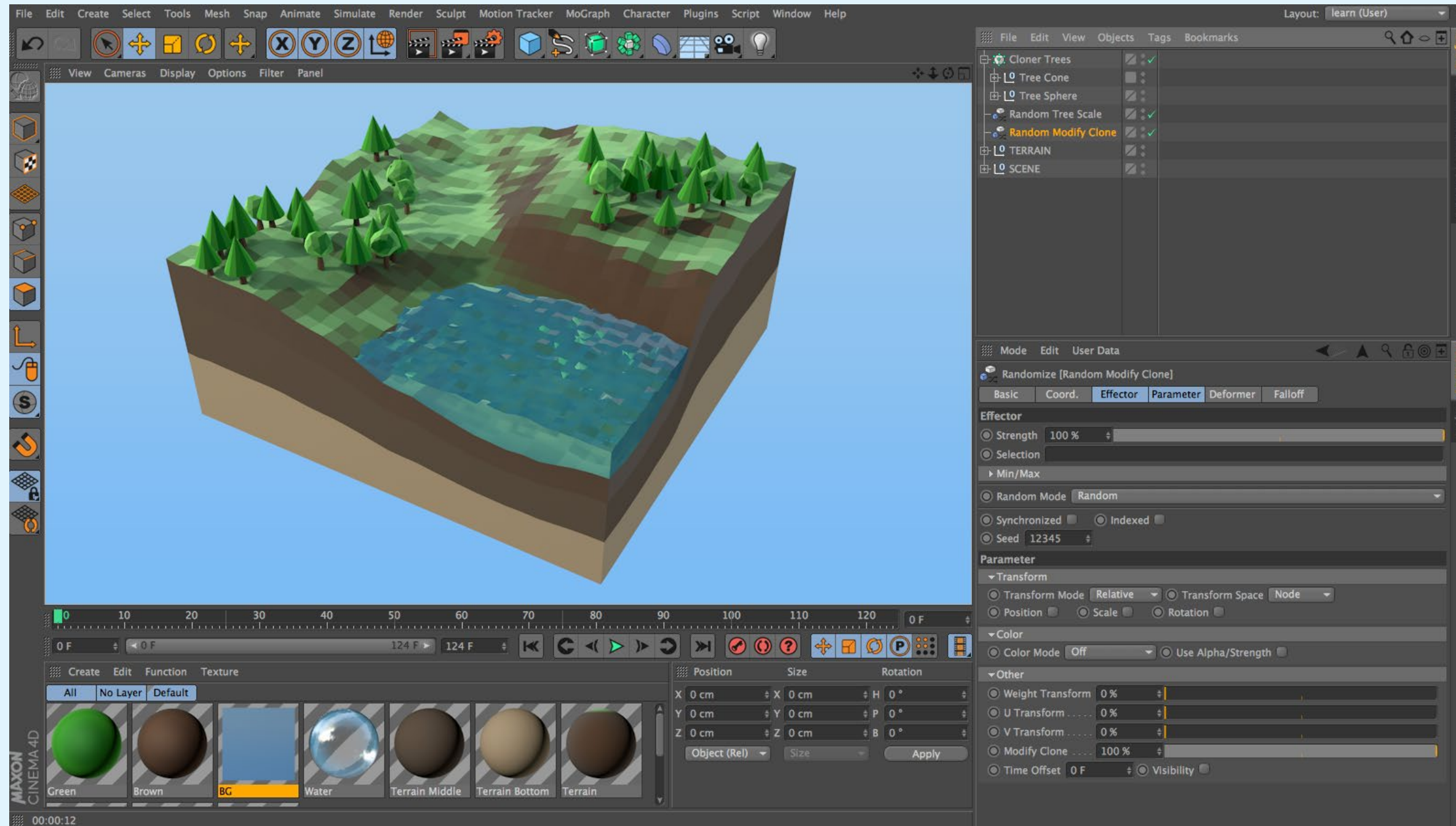
1988-2001



Softimage, Co.

Cinema 4D

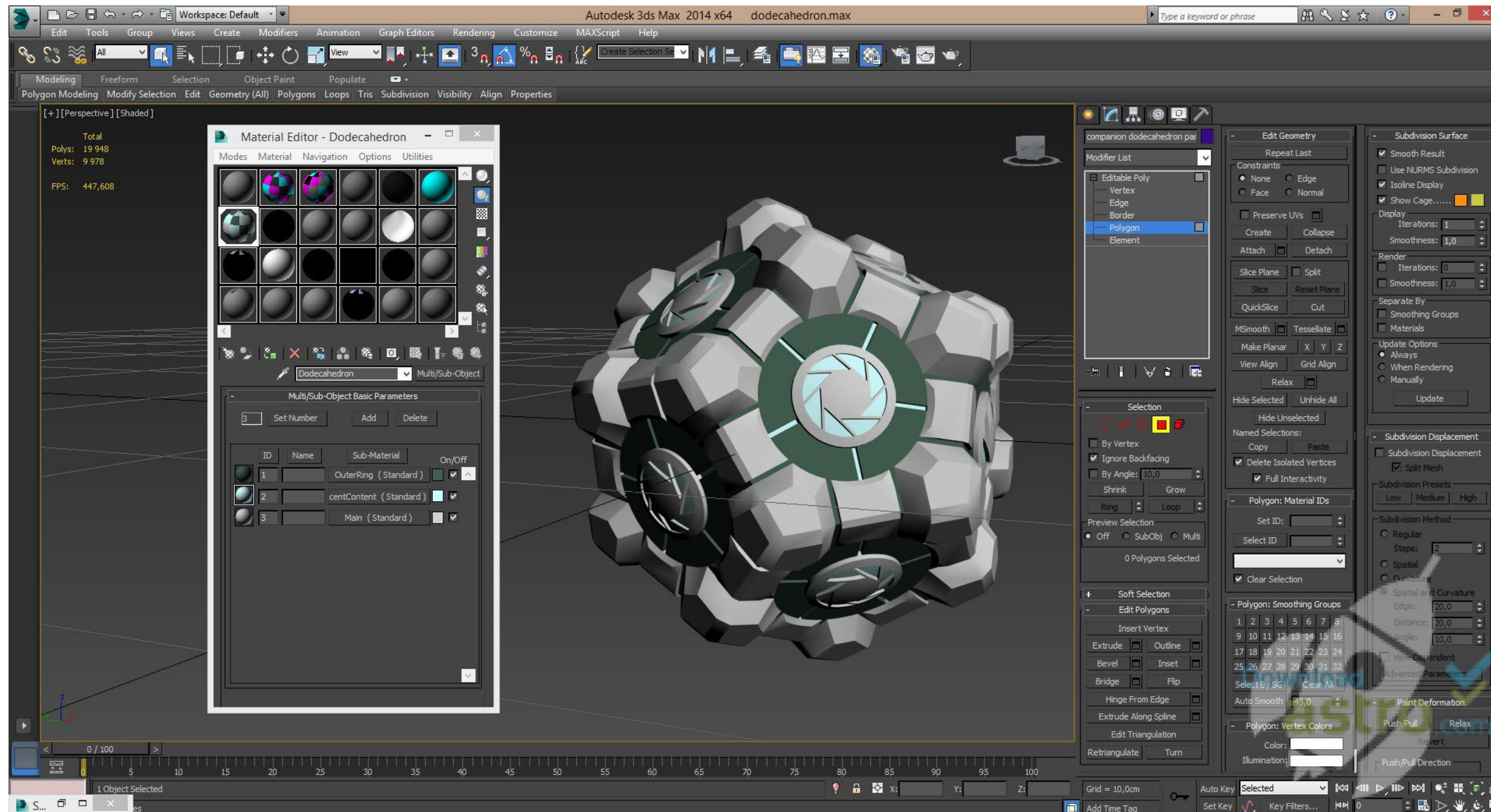
1990-2001



MAXON Computer GmbH

3DS Max

1996-Today



Autodesk

Shake

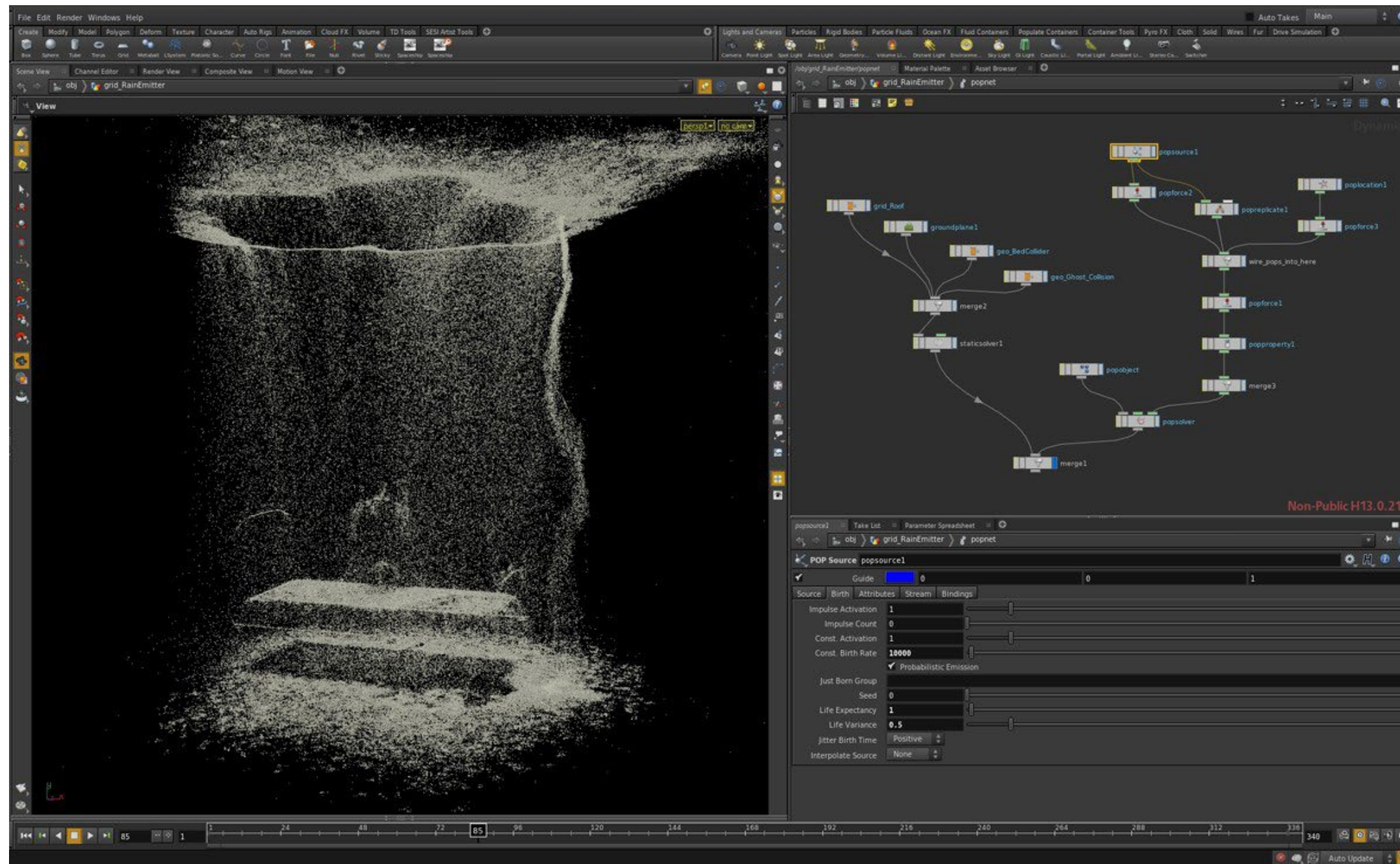
1997-2008



Arnaud Hervas and Allen Edwards for Nothing Real L.L.C. (Later Apple)

Houdini

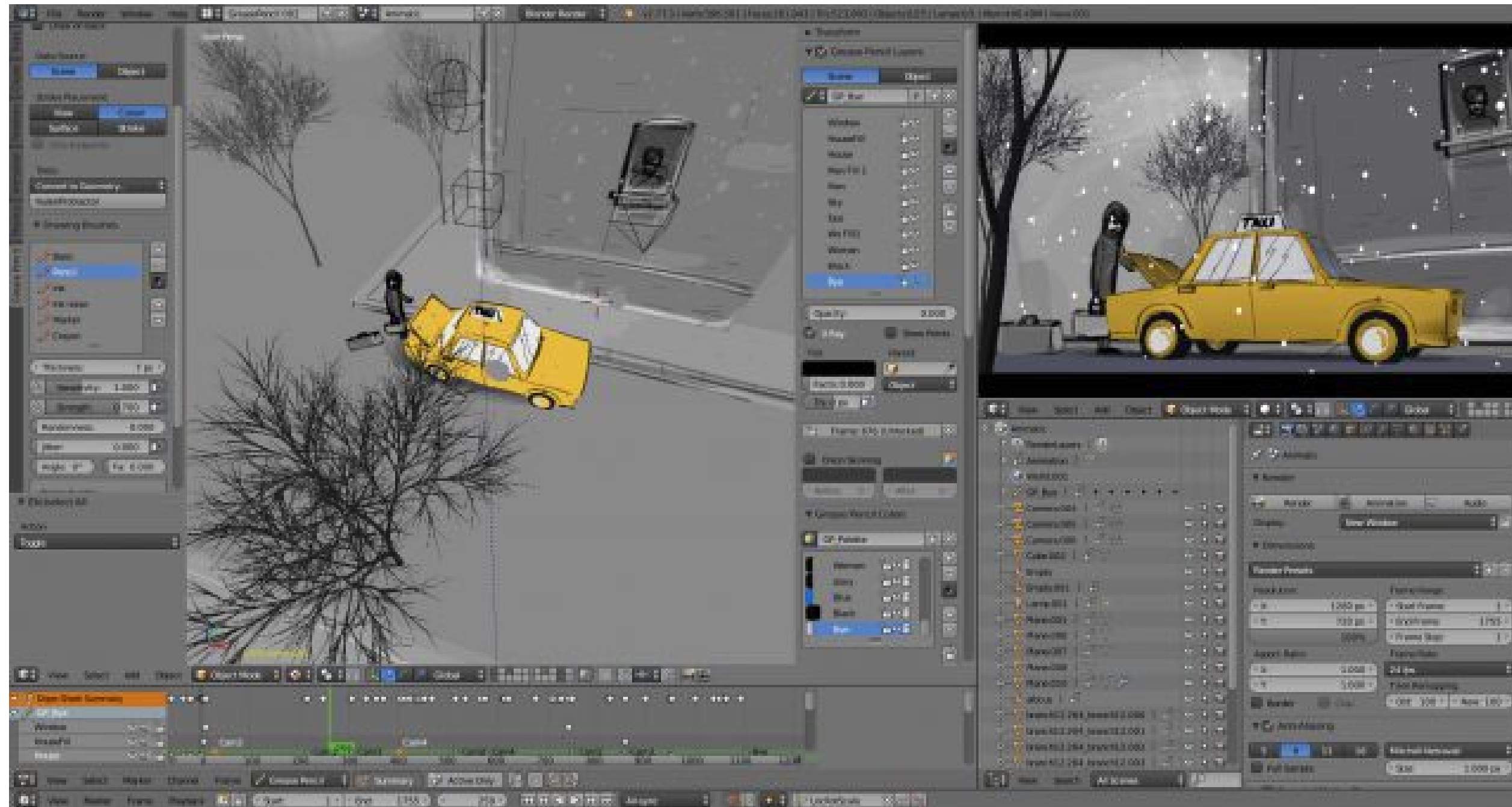
1996-Today



Side Effects Software Inc

Blender

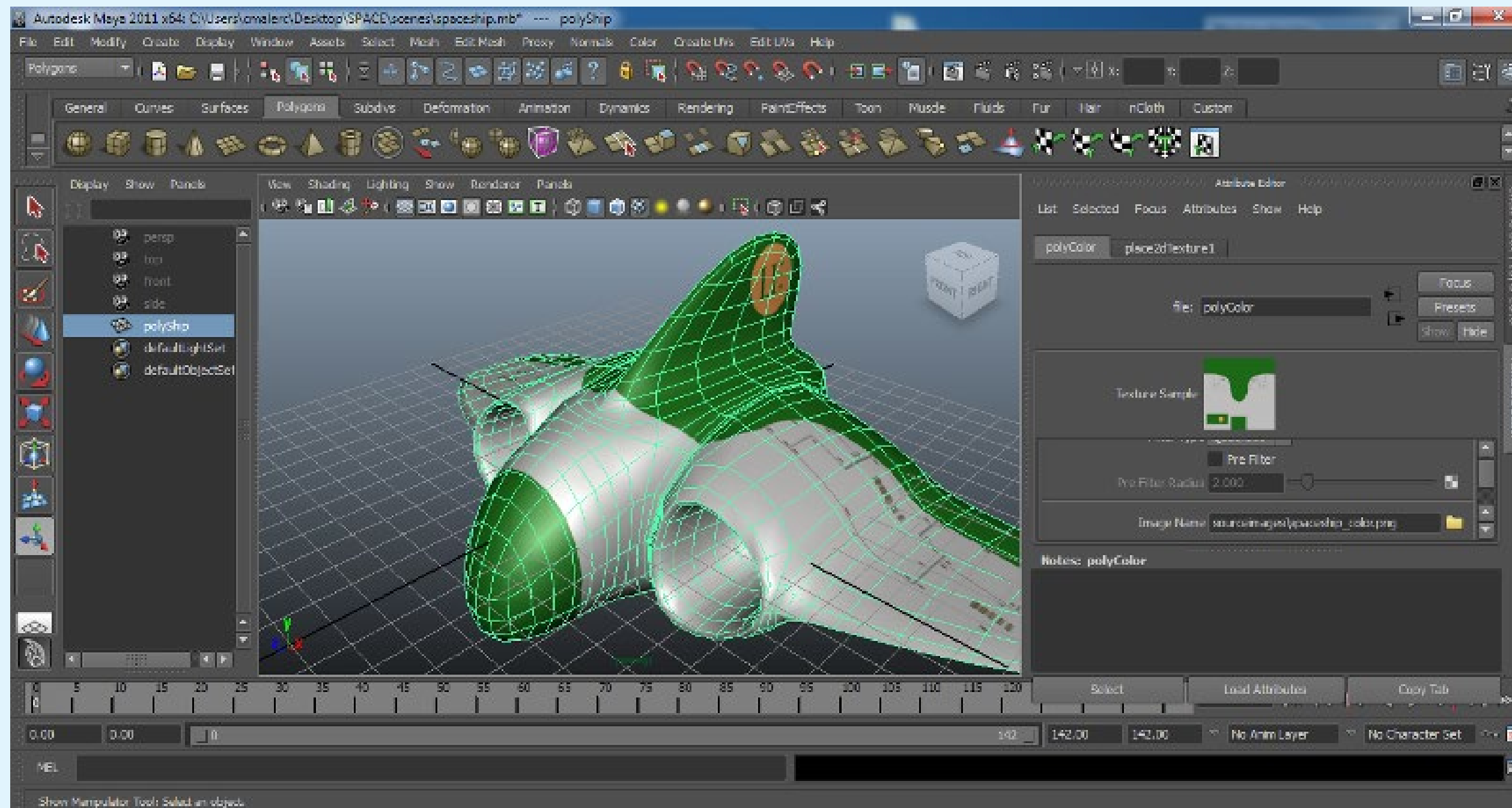
1998-Today



Blender Foundation

Maya

1998-Today



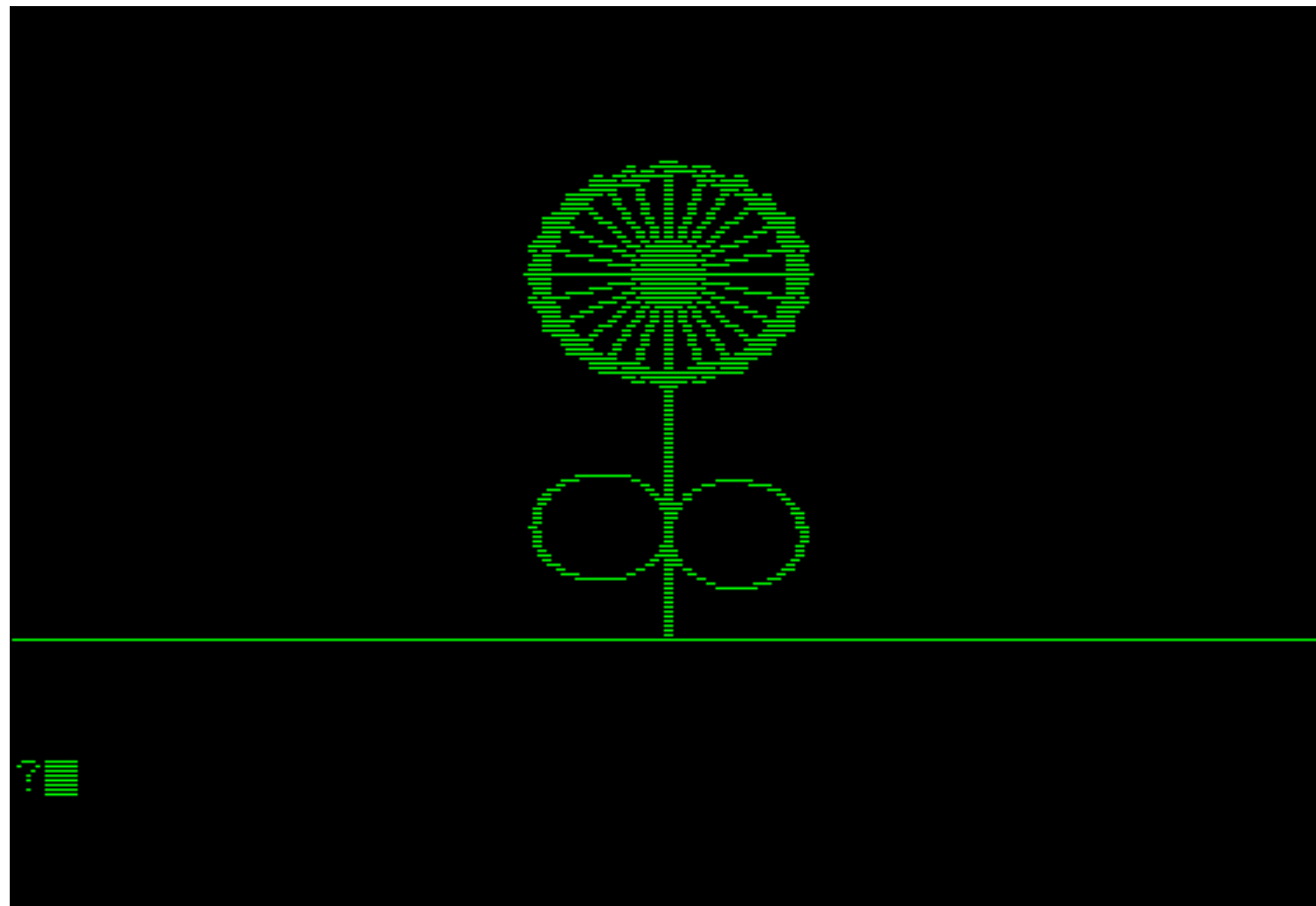
Alias Systems Corporation (Later Autodesk)

Learnable Programming

Offers a 'Gentle Introduction'

LOGO

1967-



```
TO BOAST
  PRINT "WHO'S THE GREATEST?"
  REQUEST = MR. SYD LEXIA THEN PRINT!
  COURSE! STOP
  TRY AGAIN
END

TO CHAT
  PRINT "WHAT'S YOUR NAME?"
  REQUEST
  TYPE "FELLOW REQUEST"
  PRINT "SOMETHING YOU LIKED"
  IF "I'M GLAD YOU LIKED" REQUEST
END

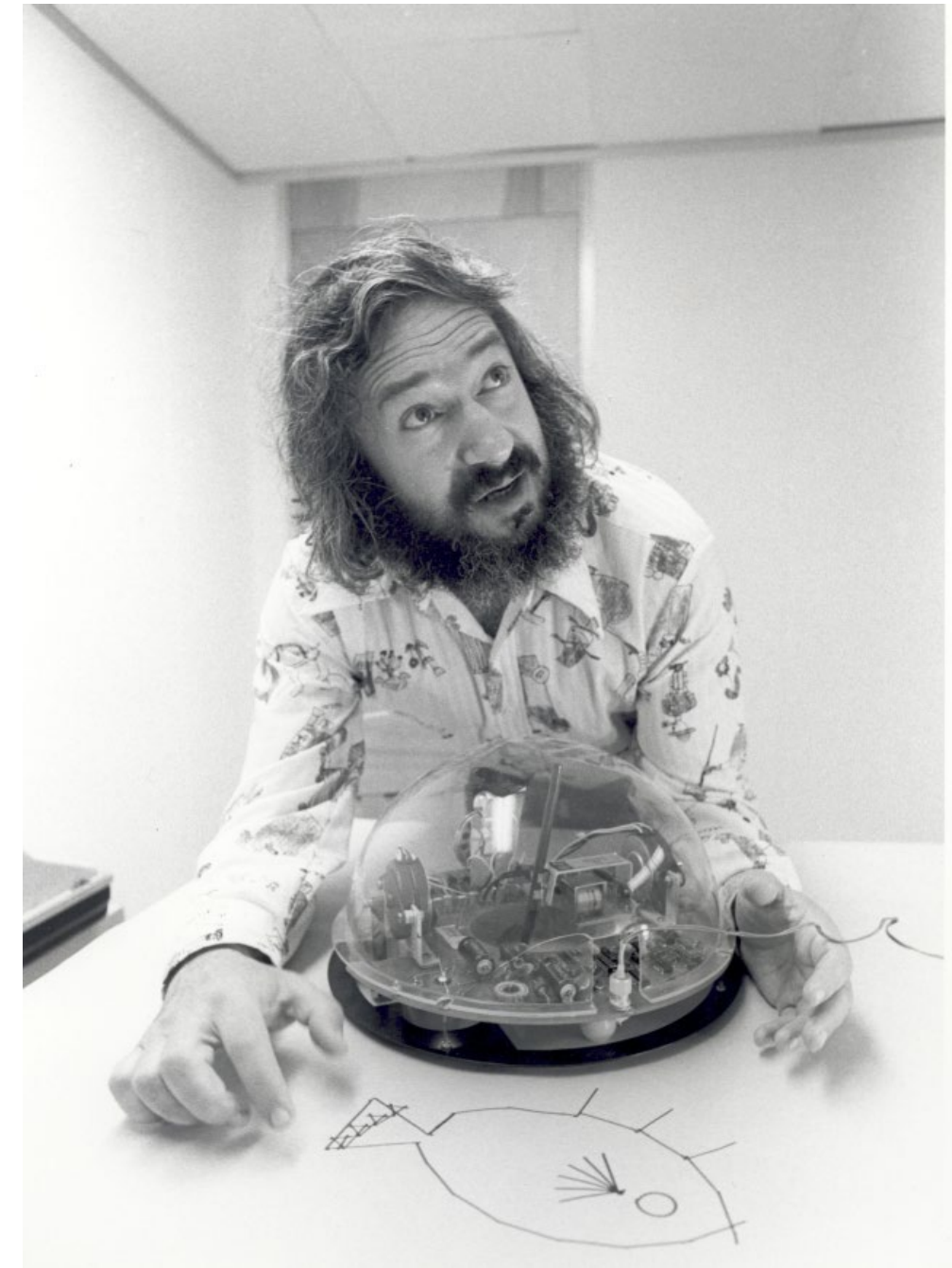
TO TIME
  PRINT "EXCUSE ME, WHAT TIME IS IT?"
  MAKE "TIME REQUEST
  (PRINT "TIME "I'M LATE!")
  PRINT "SEE YOU LATER."
END

EDUC CARLE TO DEFINE CARLE TO ABORT
```

Wally Feurzeig, Seymour Papert, Cynthia Solomon at MIT

Turtle

1969



Seymour Papert and Others at the MIT Logo Lab

```
File Edit View Search Run Basic Menu Bar Help
colors.bas
SUB rainbow(x,y, c, radius)
'Draws a circular rainbow. Our rainbow is a circle with thickness,
'where color is defined by the angle (determined using arctangent).
'In order to draw a thick circle, we simply draw a box and ignore
'those pixels that are not part of the arc. The selection is done
'by measuring the distance from the origin. Only pixels that fall
'within the certain range are accepted.
minr = radius * 0.6
minr2 = minr*minr ' minimum radius ^ 2
maxr2 = radius*radius ' maximum radius ^ 2
pi! = 3.14159!
xradius = radius*4/3 ' aspect ratio correction
FOR py=-radius TO radius
  py2 = py*py
  FOR px=-xradius TO xradius
    pxr! = px*3/4
    r = pxr!*pxr! + py2
    IF r >= minr2 AND r <= maxr2 THEN
      ' angle! = ATAN2(py, px) -- only QBASIC does not have ATAN2.
      IF px = 0 THEN angle! = SGN(py) * pi! * 0.5 ELSE angle! = ATN(py / pxr)
      IF px < 0 THEN angle! = angle! + pi!
      IF py < 0 THEN angle! = angle! + pi! + pi!
      ' Convert angle into a color and place the pixel.
      cc! = angle! * 12 / pi! + 6
      cc = INT(cc! + RND) ' Quantize with random dithering
      PSET(x+px, y+py), c + (cc + 24) MOD 24
    END IF
  NEXT px
NEXT py
END SUB

SUB Speak(x,y, e$, f$) STATIC
IF f=0 THEN f = FREEFILE: OPEN "VOX" AS f
IOCTL f, e$ + "~" + f$ + "$"
'Speak text. This is something I added to my copy of DOSBox.
'Feel free to comment out those two lines if it does not work for you.
IF y>=200 THEN EXIT SUB
END SUB
END SUB

QBASIC masquerade mode engaged. 158 lines | 13:21:24 | *00154:001
```



LEGO Mindstorms RCX

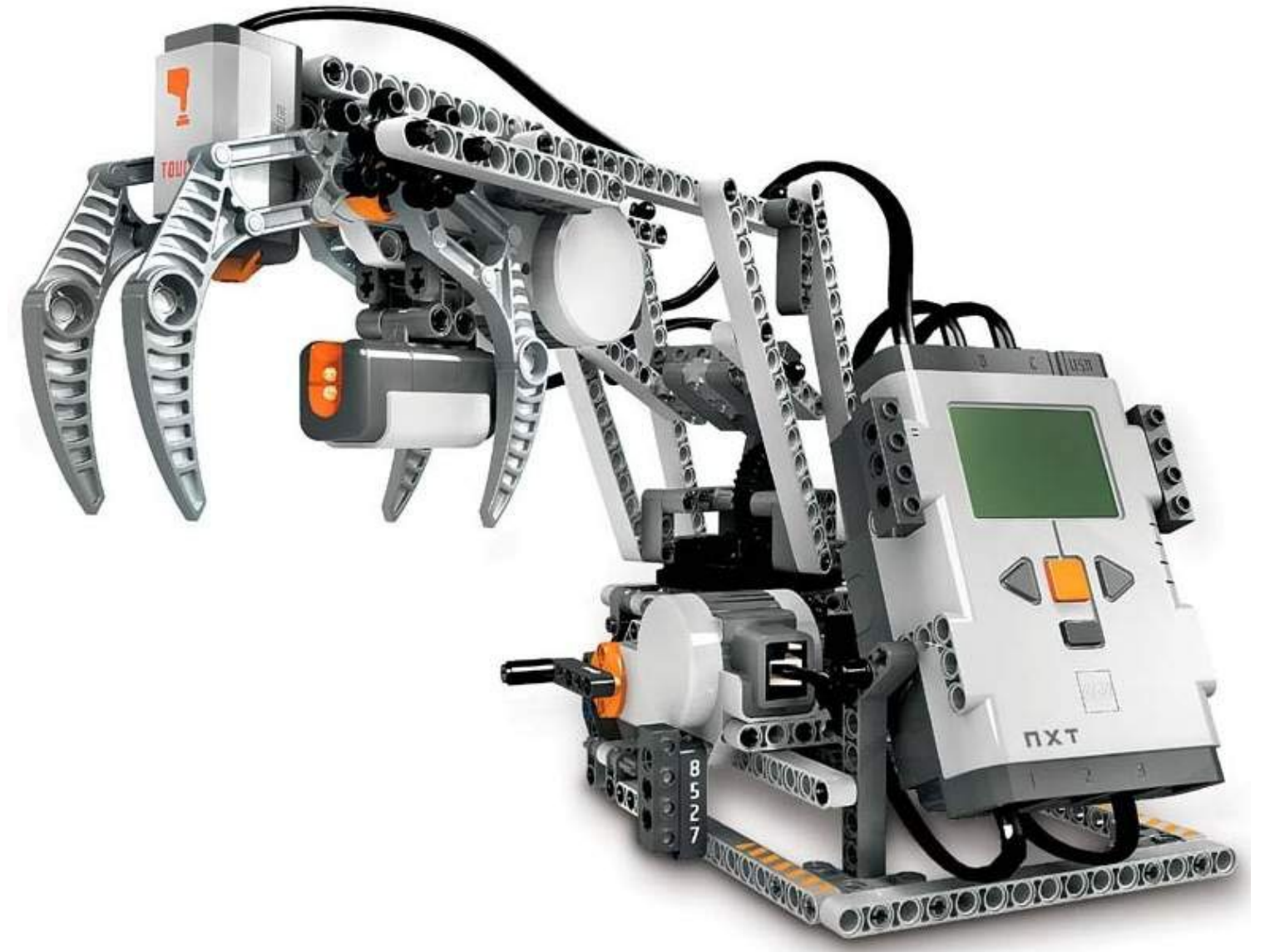
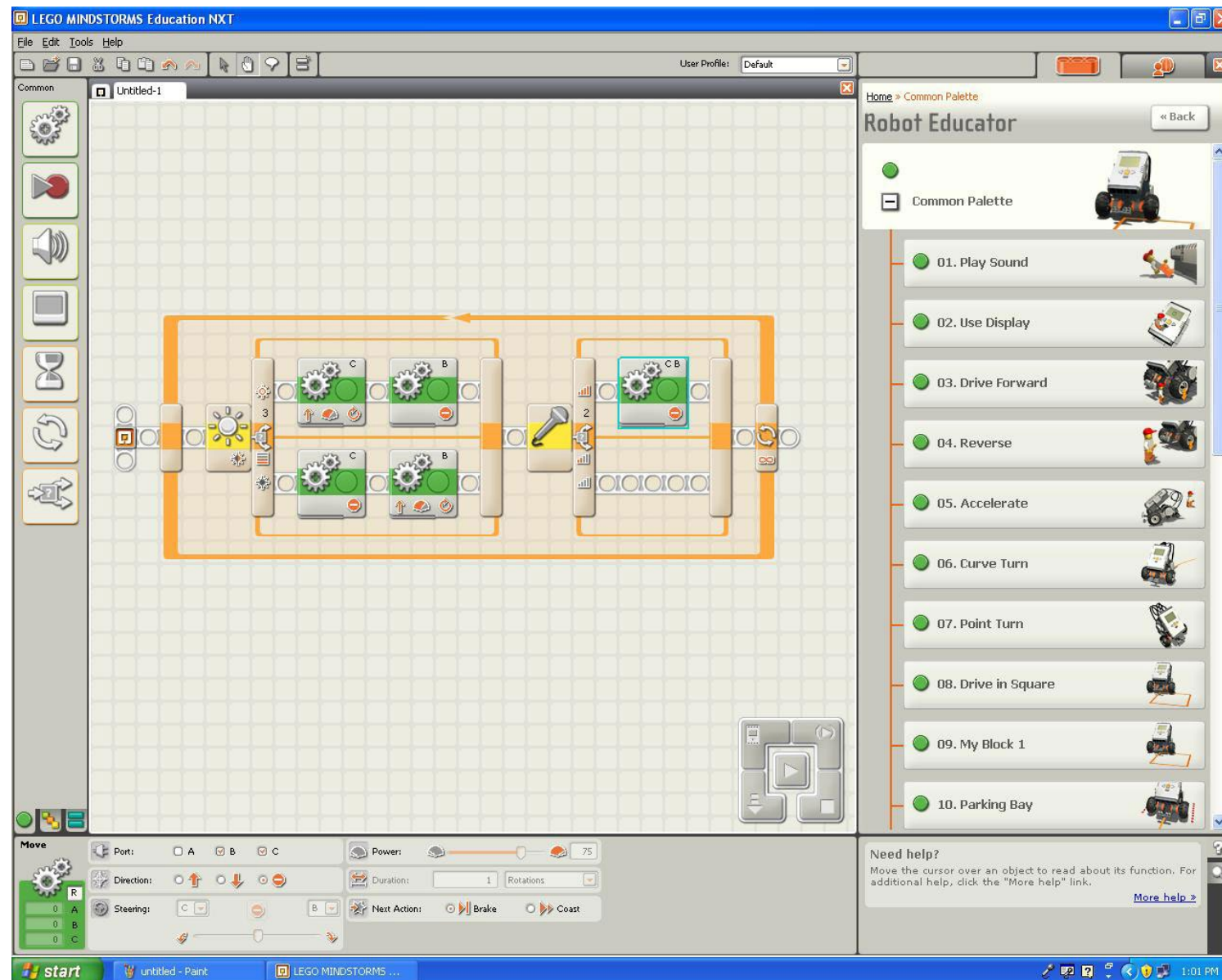
1998-2006



LEGO in Partnership with the MIT Media Lab (Lifelong Learning Group)

LEGO Mindstorms NXT

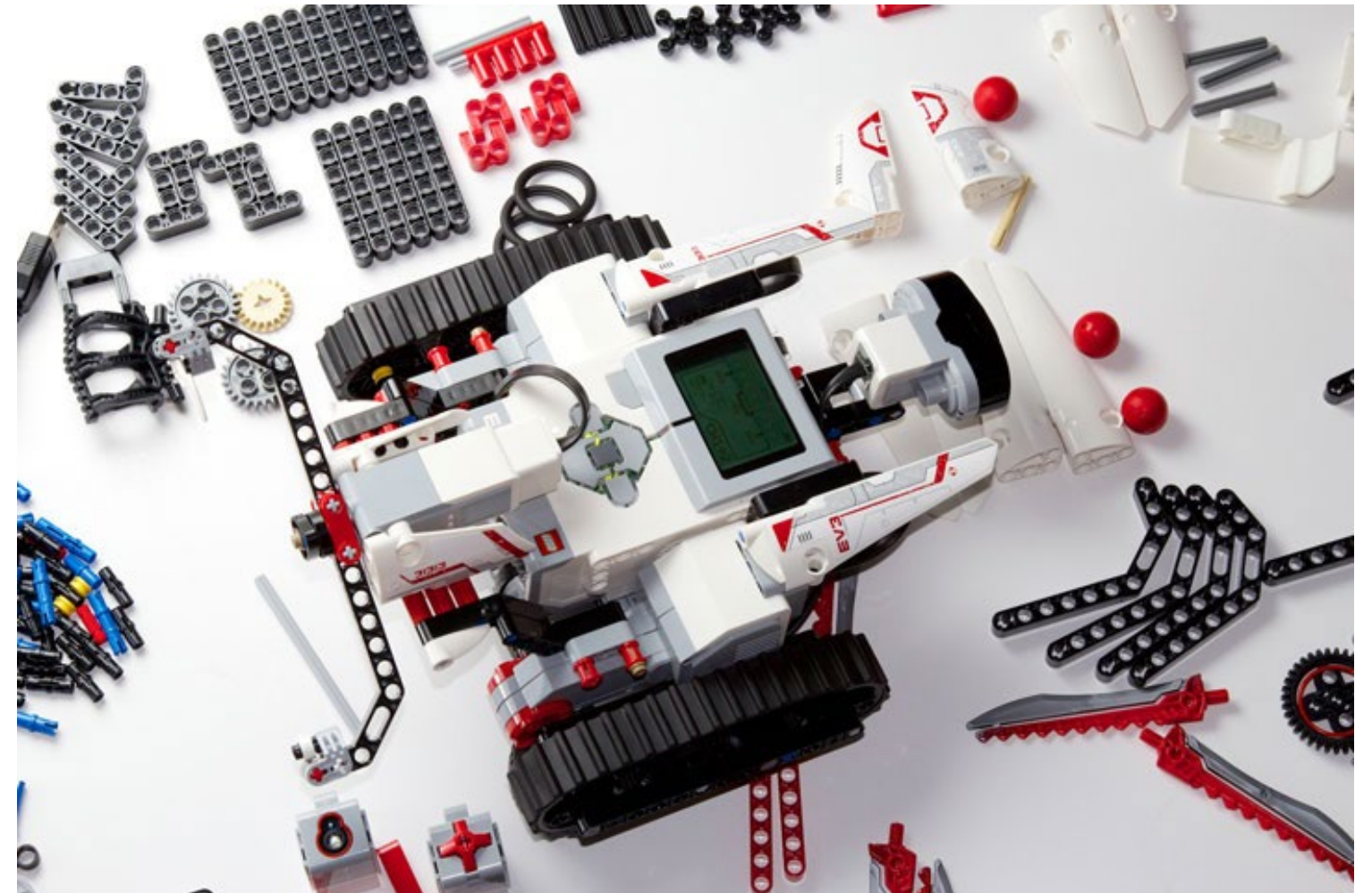
2006-2013



LEGO in Partnership with the MIT Media Lab (Lifelong Learning Group)

LEGO Mindstorms EV3

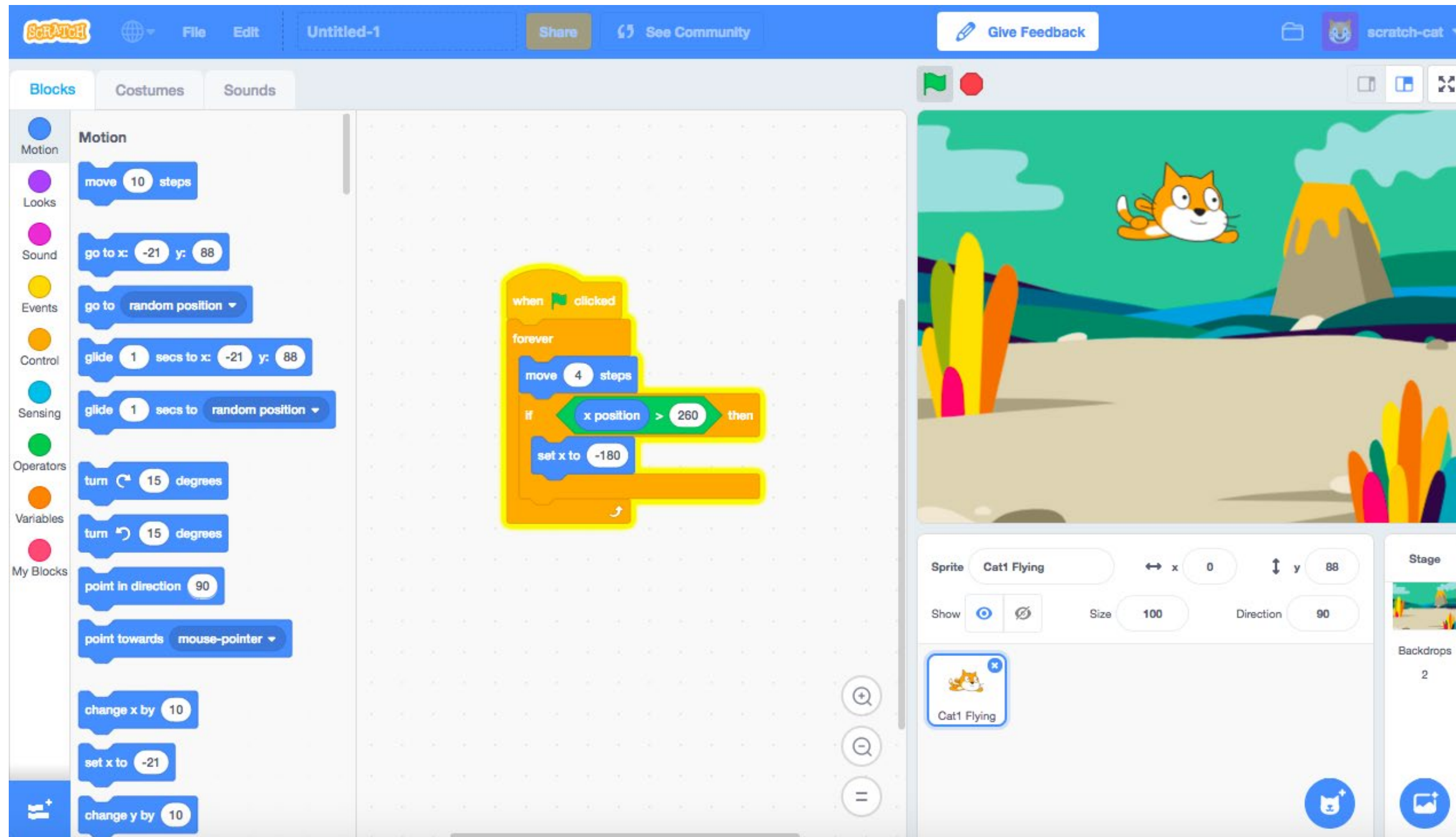
2013-Today



LEGO in Partnership with the MIT Media Lab (Lifelong Learning Group)

Scratch

2002-Today



Mitchel Resnick and others at the MIT Media Lab (Lifelong Kindergarten Group)

littleBits

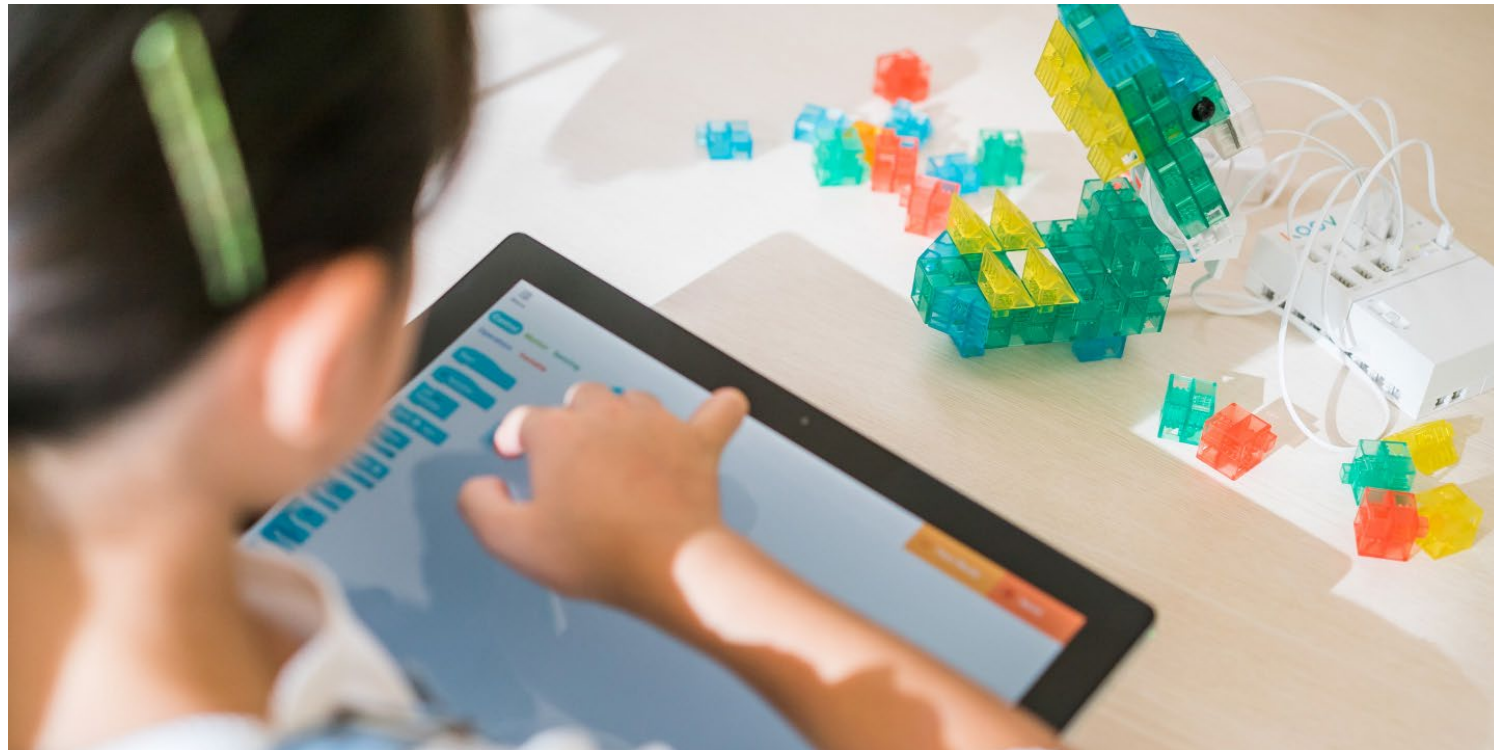
2011-Today



Ayah Bdeir at the MIT Media Lab (Now littleBits Electronics Inc)

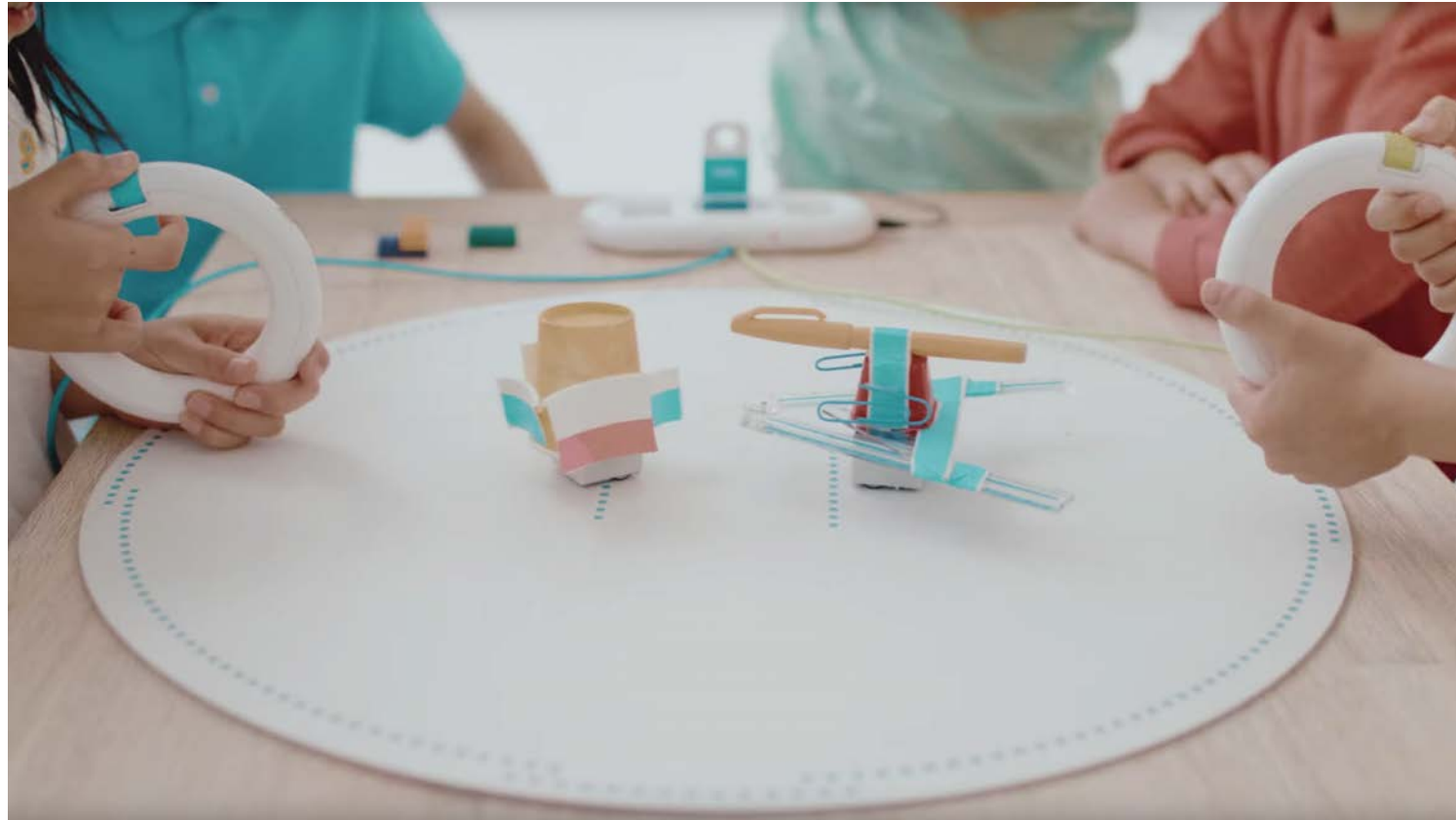
Koov

2017-Today

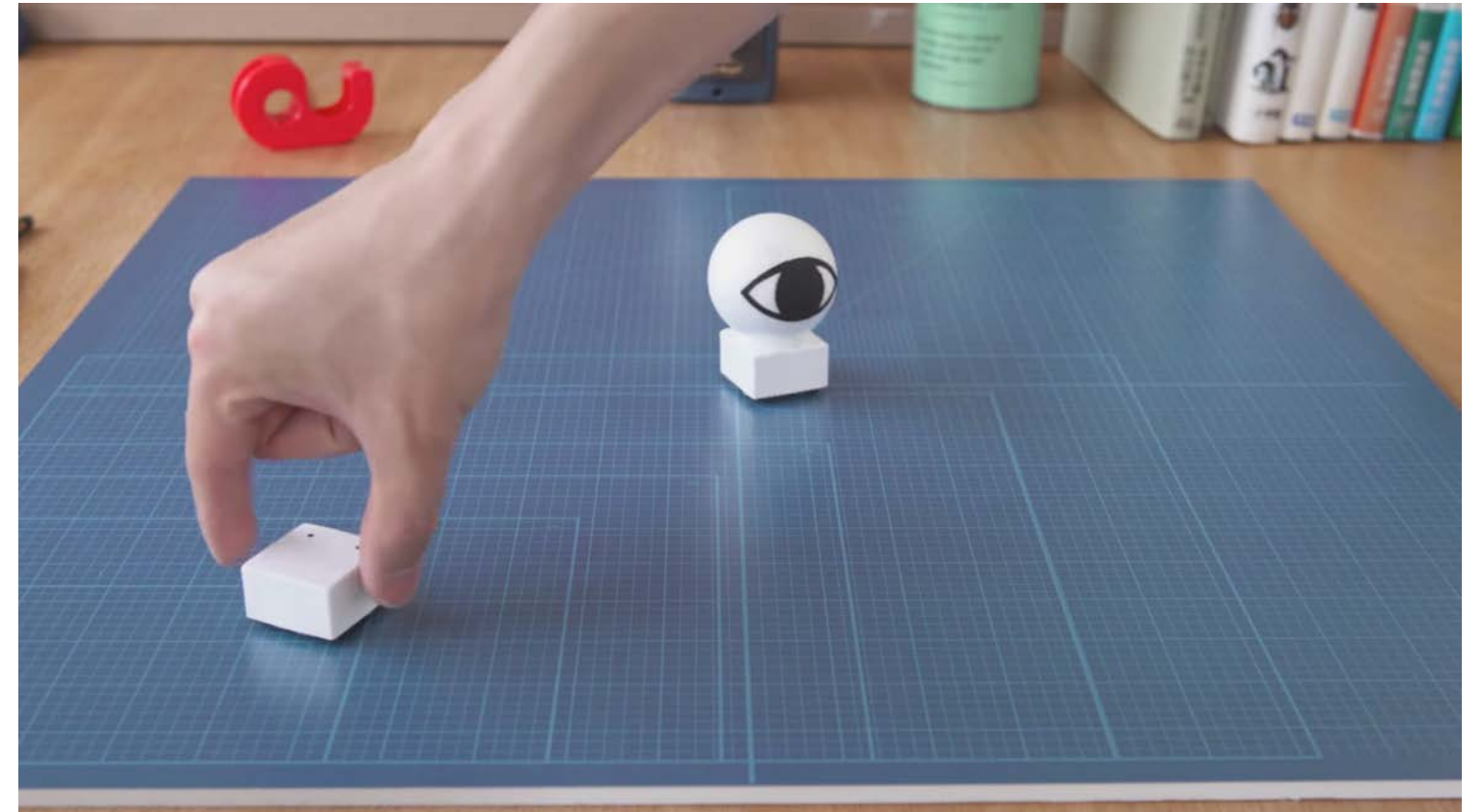


Sony

Toio



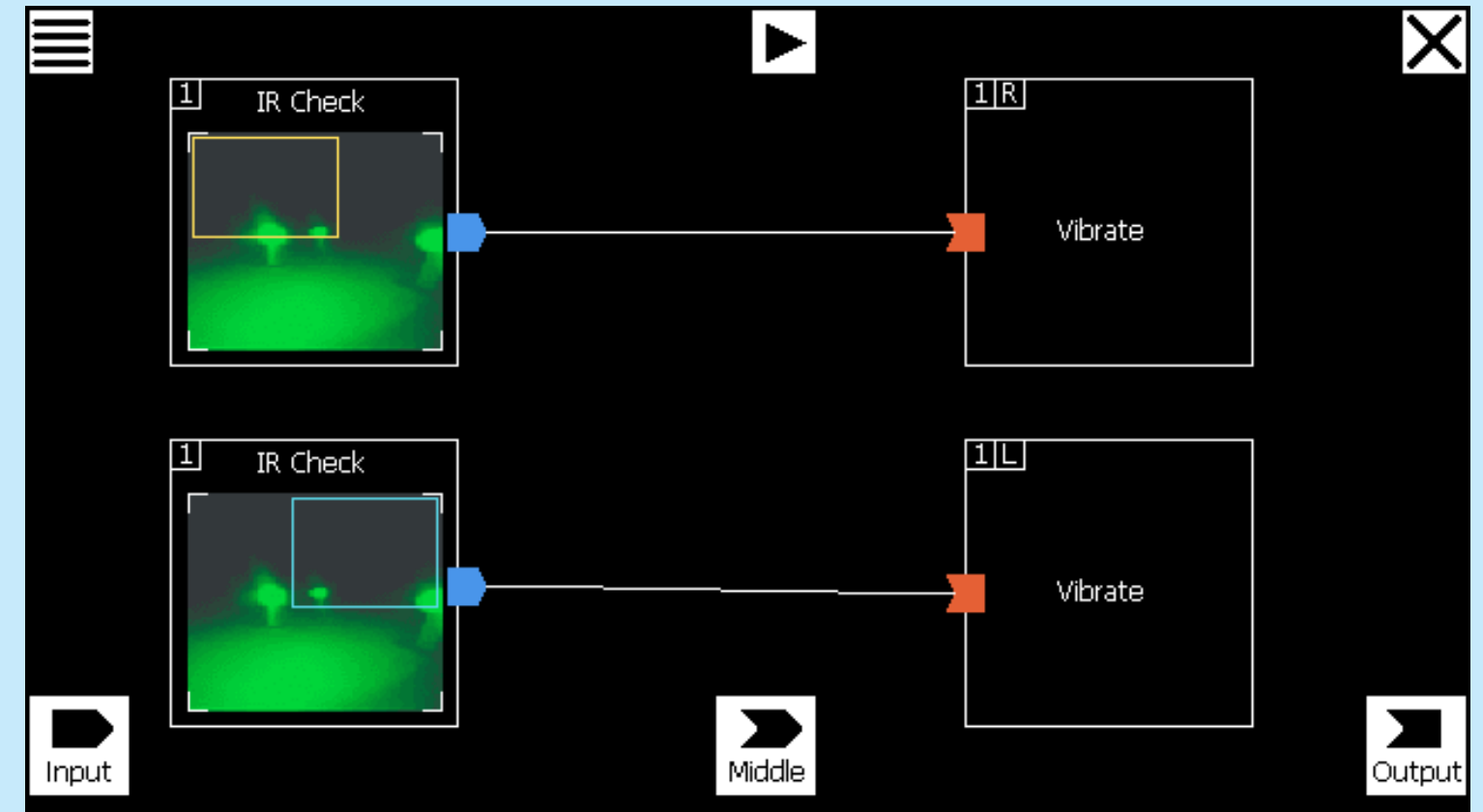
2017-Today



Sony

Joy-Con Garage

2018-Today



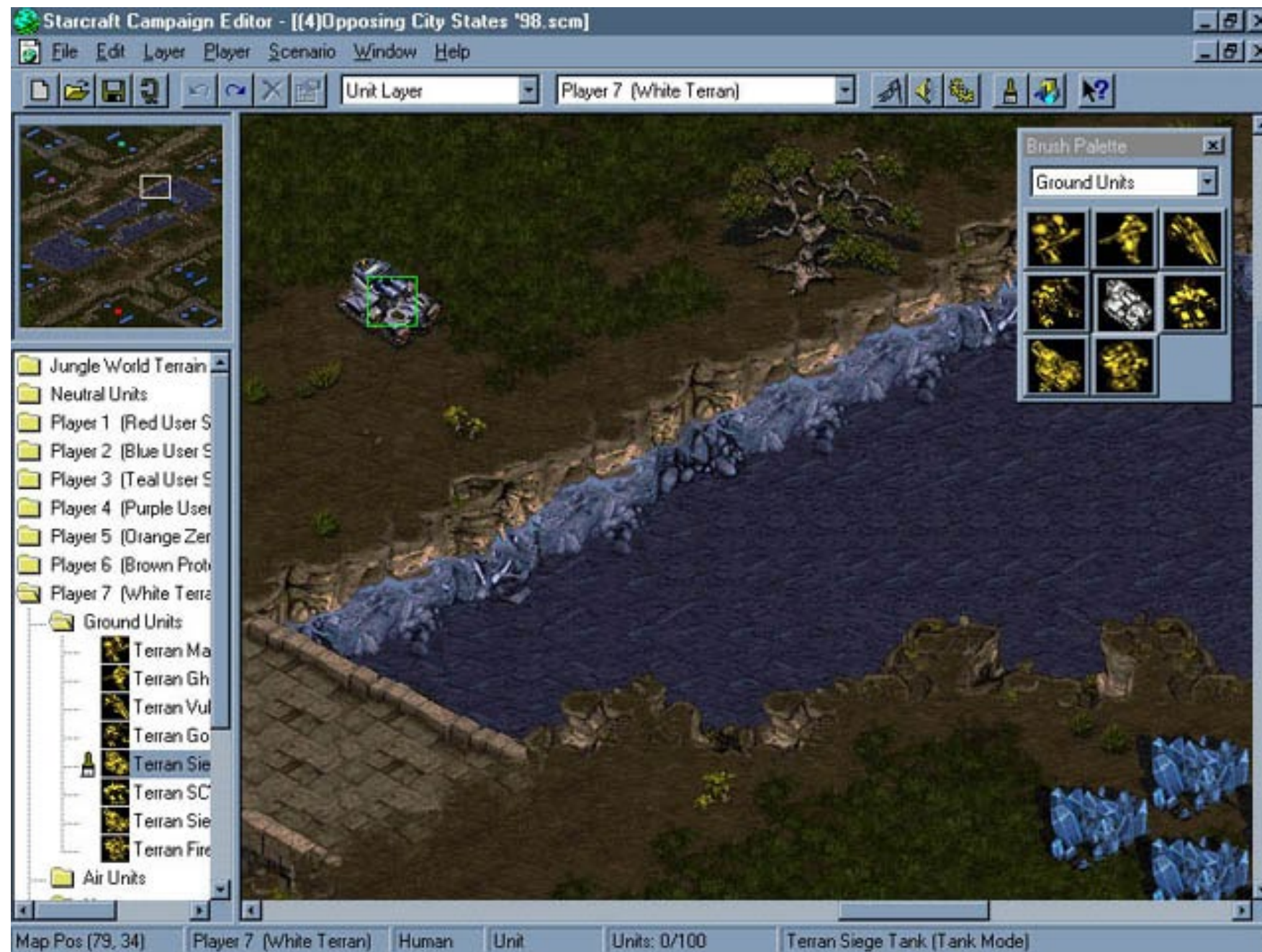
Nintendo

Game Authoring

From video games to VR/AR/MR

StarEdit

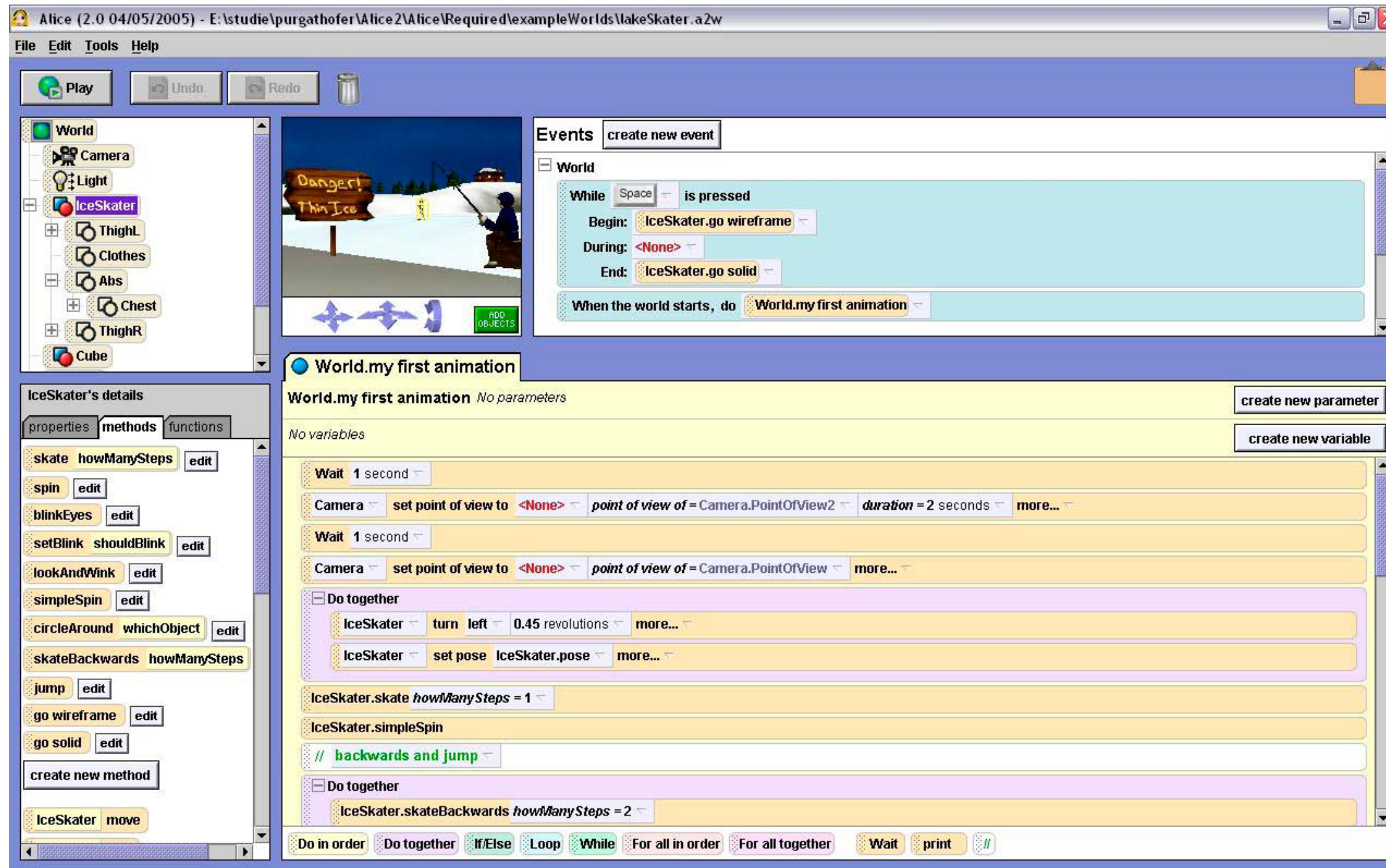
1998



Blizzard Entertainment

Alice

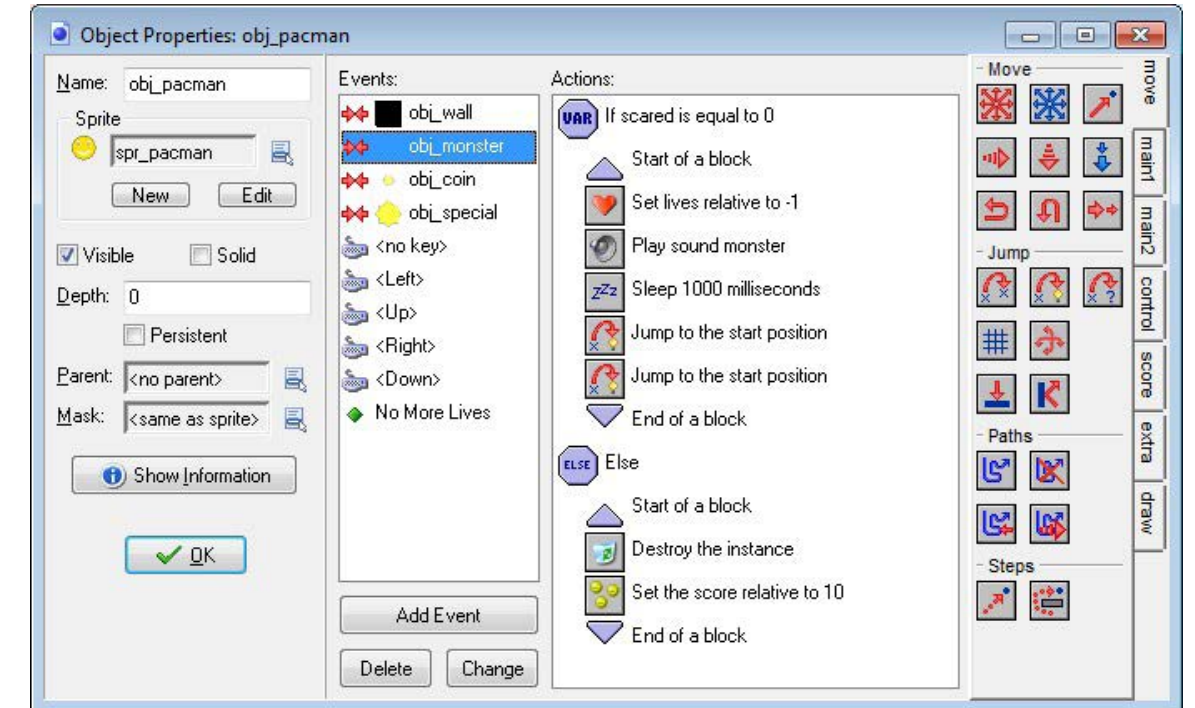
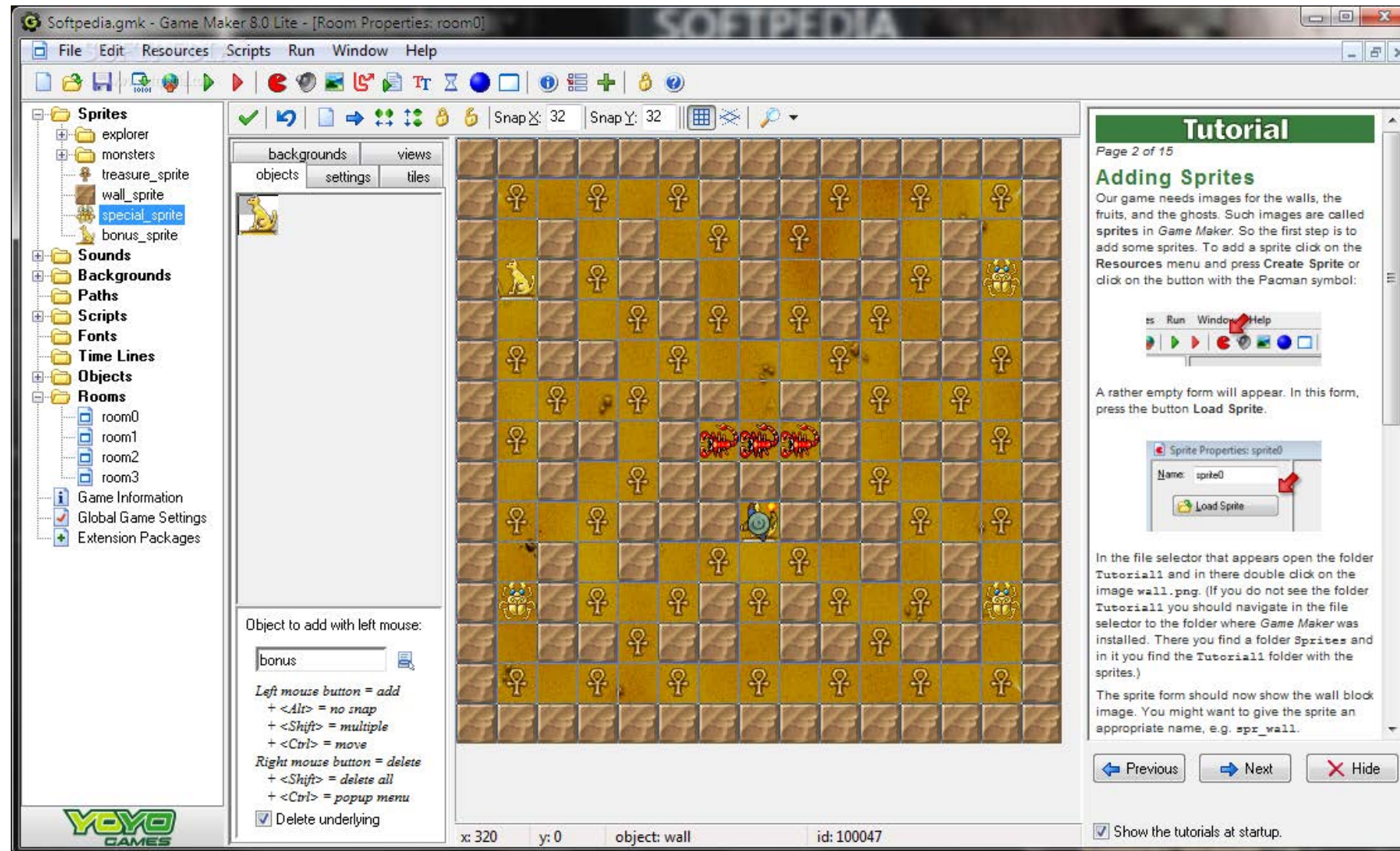
1998-Today



Randy Pausch and Others at Carnegie Mellon University

GameMaker

1999-Today



Mark Overmars

Unreal Engine

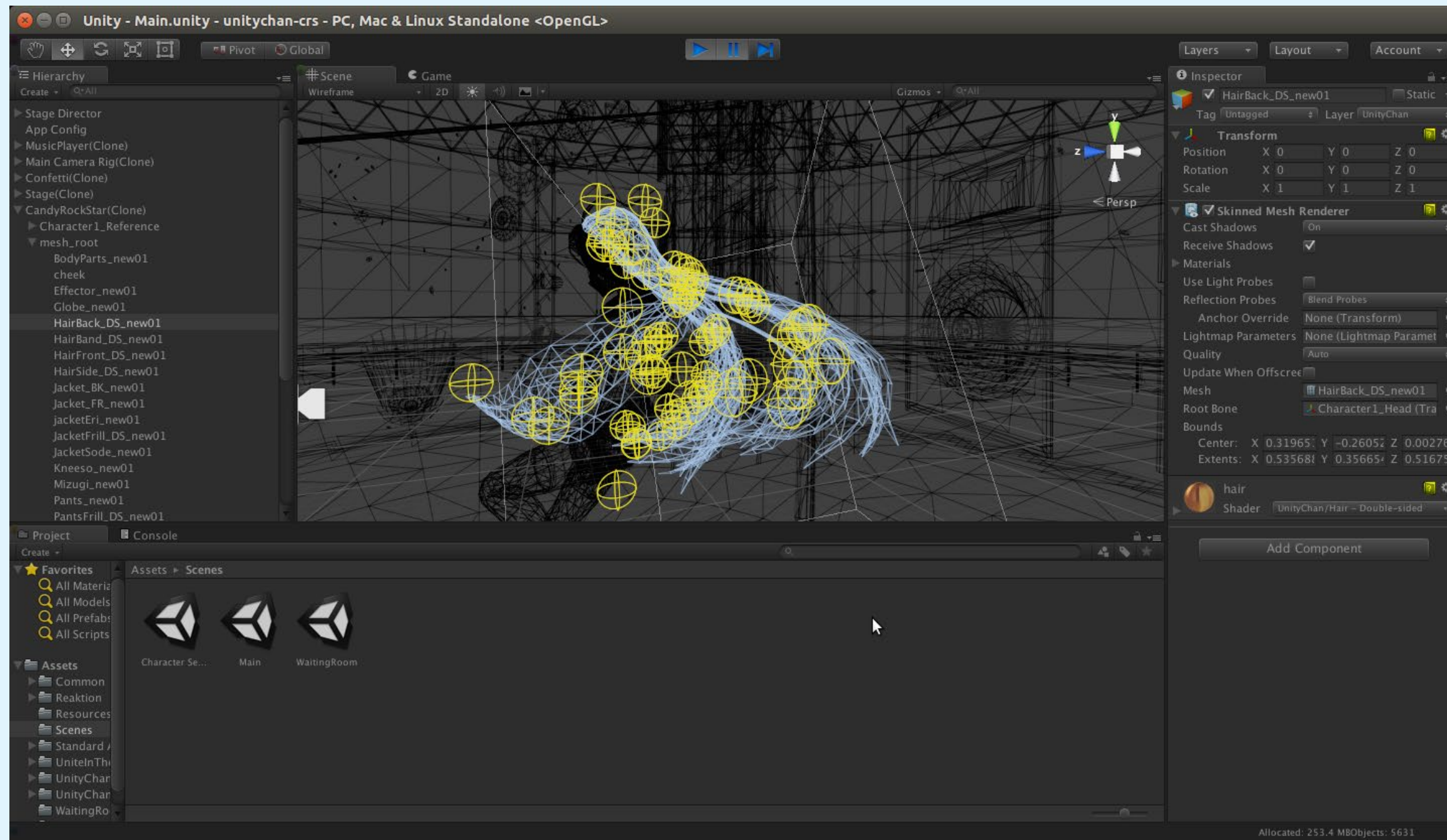
1998-Today



Epic Games

Unity

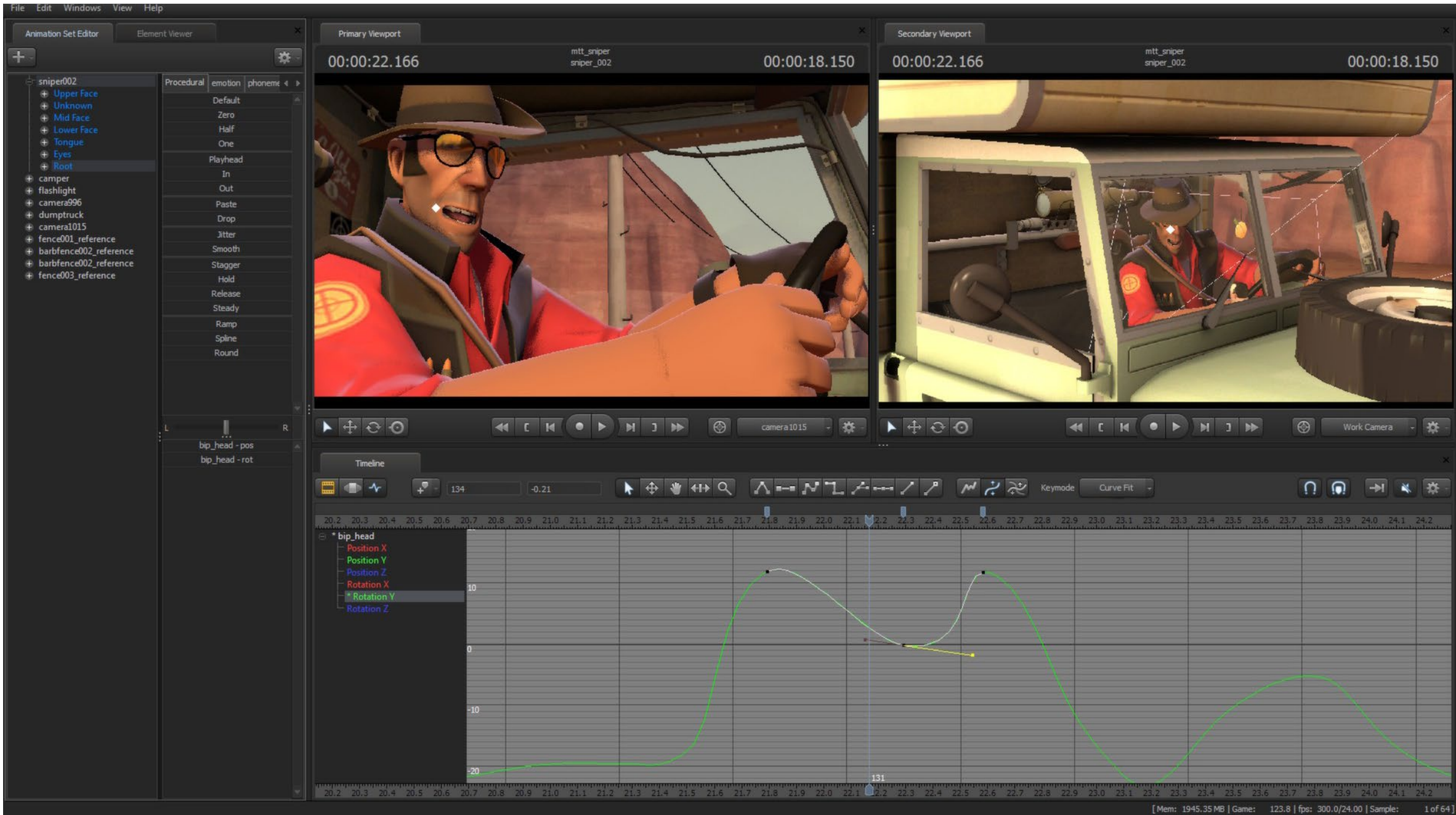
2005-Today



Unity Technologies

Source Filmmaker

2012-Today



Valve Corporation

Pocket Chip for PICO-8

2016-2018



Next Thing Co

Games with Authoring

Decisions have Confined Effects
on the Player Experience

Sims (Series)

2000-Today



Electronic Arts and Others

Second Life

2003-Today



Linden Lab

Spore

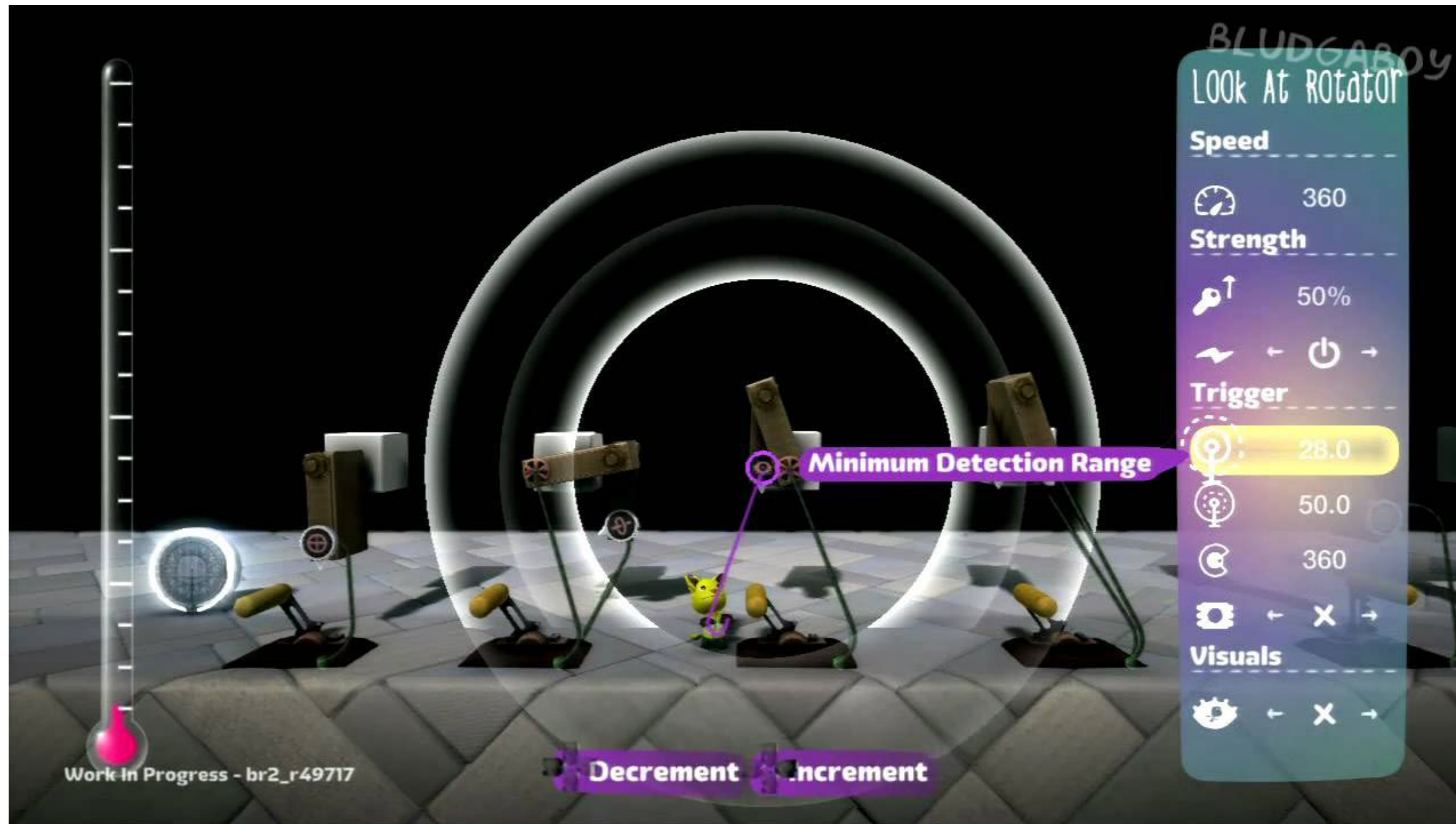
2008



Maxis

Little Big Planet (Series)

2008-2014



Media Molecule and Sumo Digital

ModNation Racers

2010



United Front Games and SIE San Diego Studio

Grand Theft Auto V

2013



Rockstar Games

Games as Authoring

Decisions & Their Side-Effects Are the
Whole Player Experience

The Incredible Machine (Series)

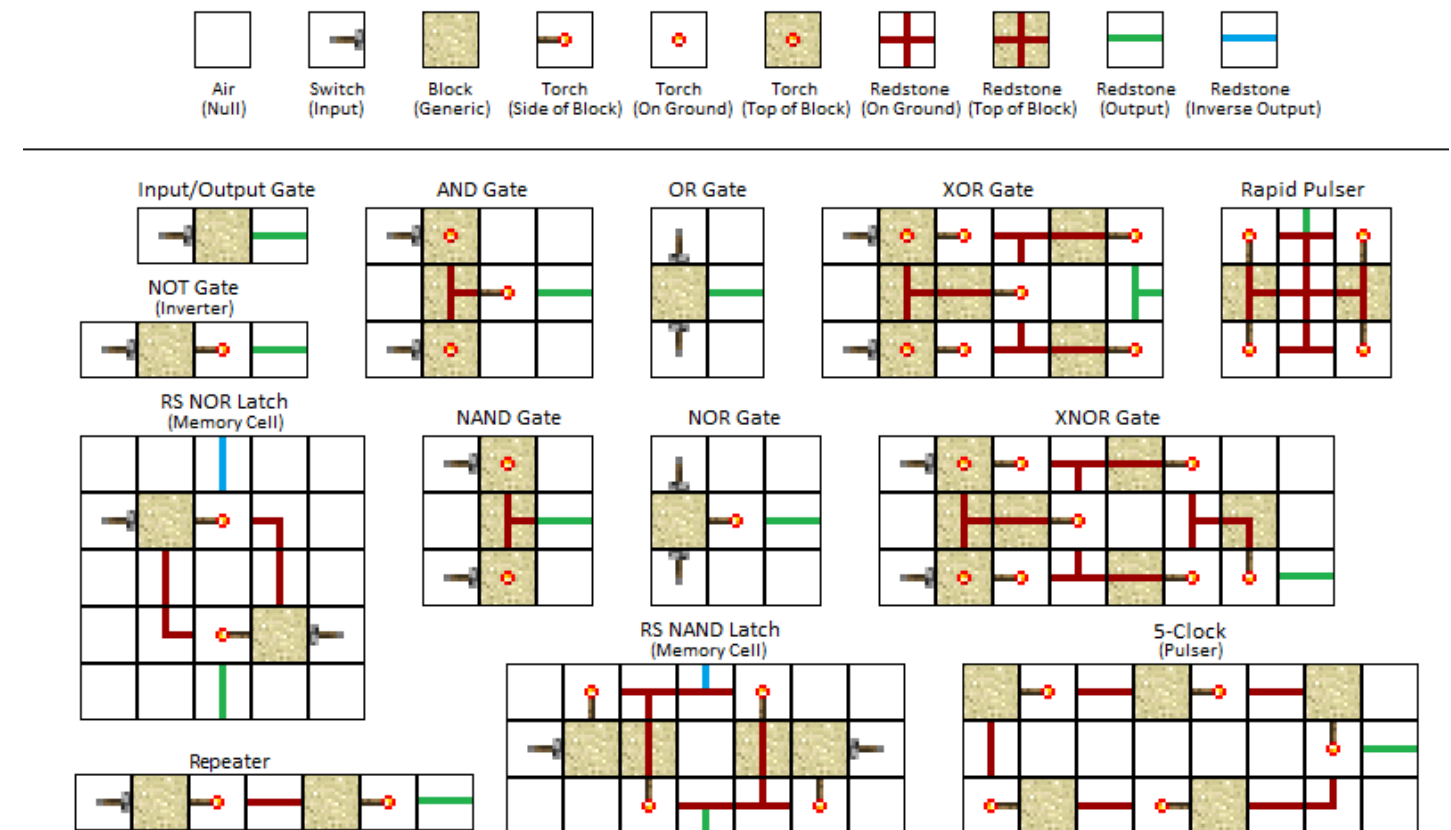
1993-2011



Jeff Tunnell Productions (Later PushButton Labs, Playdom, Disney Interactive)

Minecraft

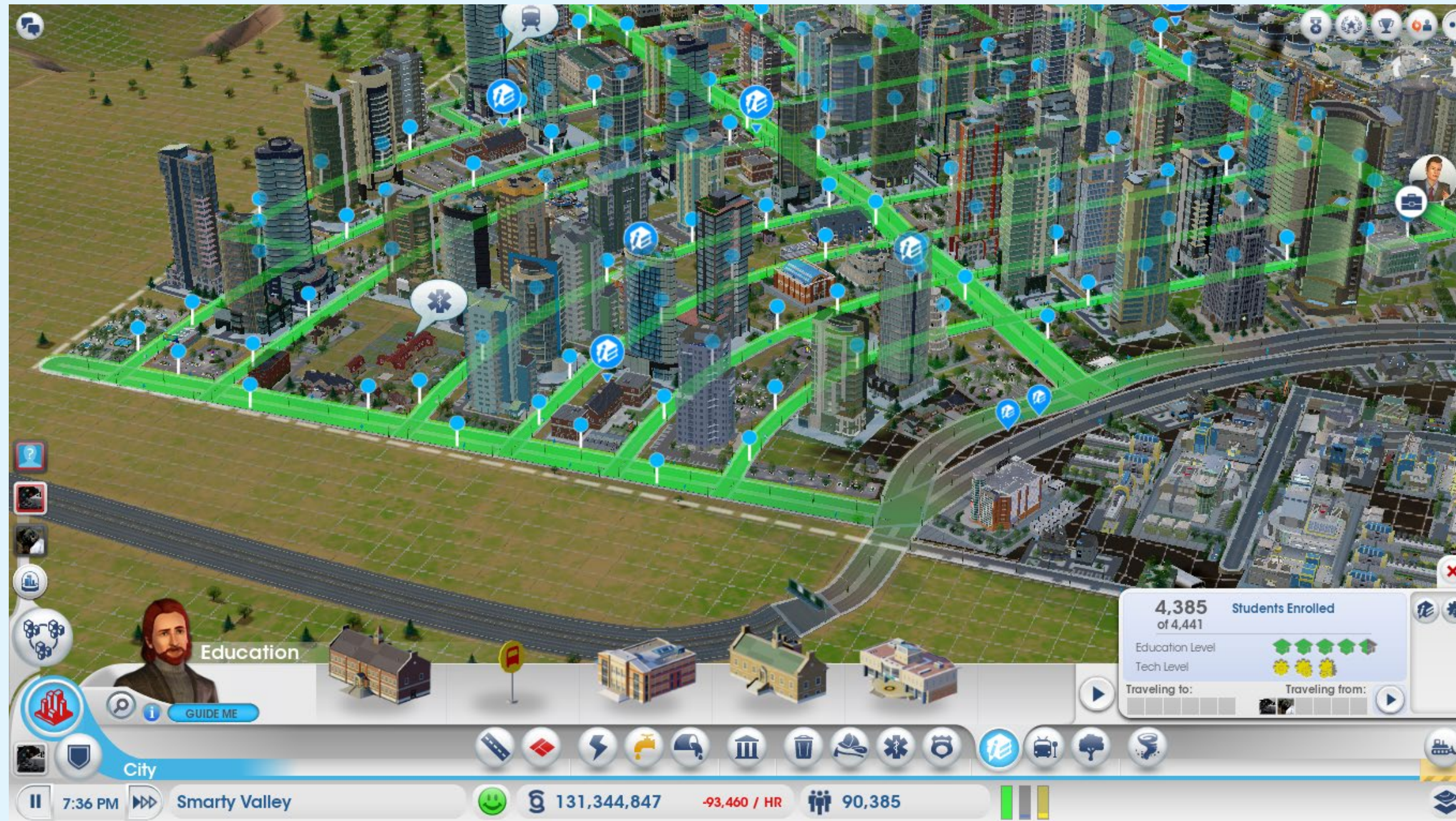
2009-Today



Markus Persson, Jens Bergensten at Mojang

SimCity (Series)

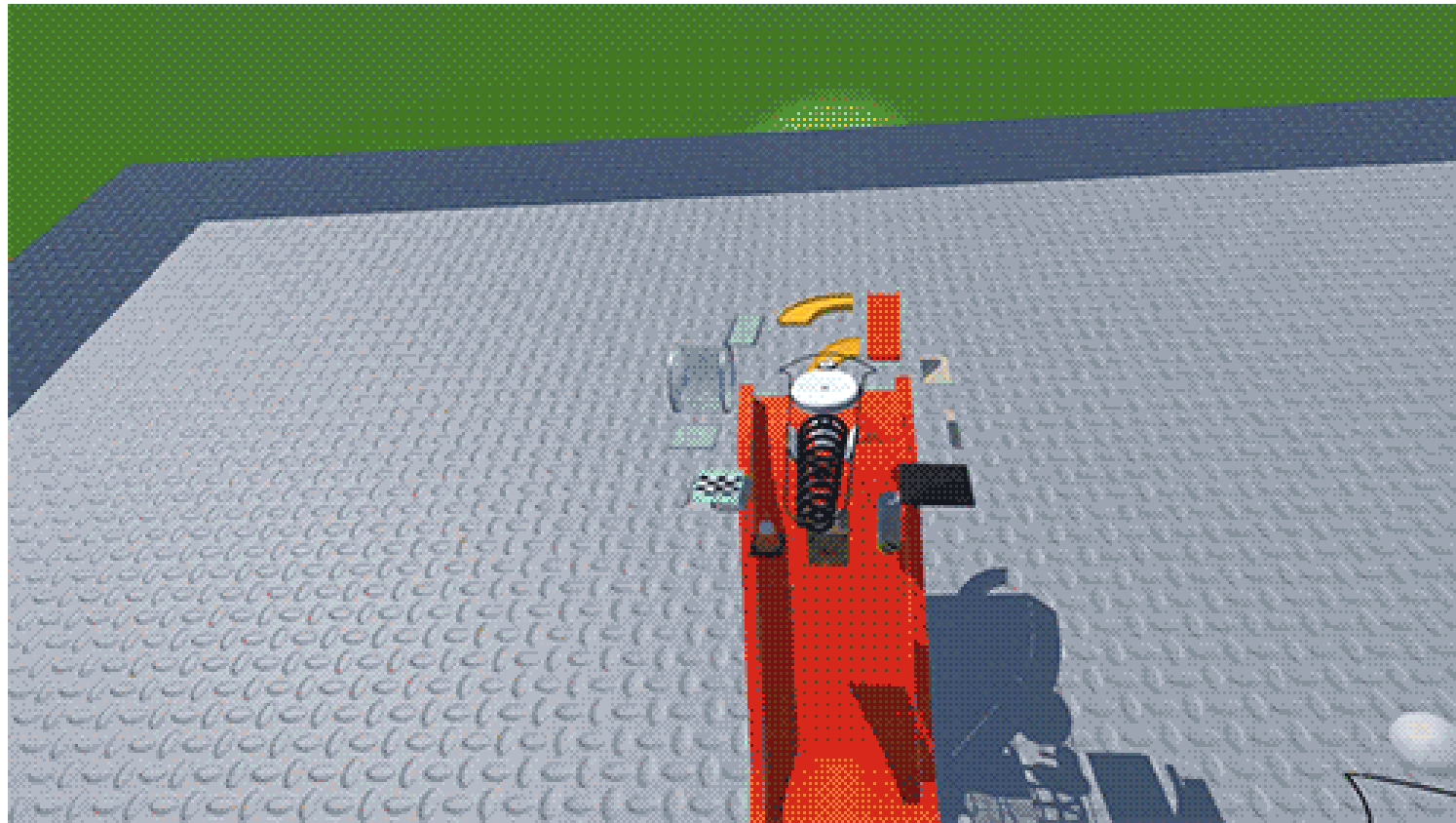
1989-2014



Various

Tiny Wheels

2017



Robbie Tilton

Dreams

2018



Media Molecule

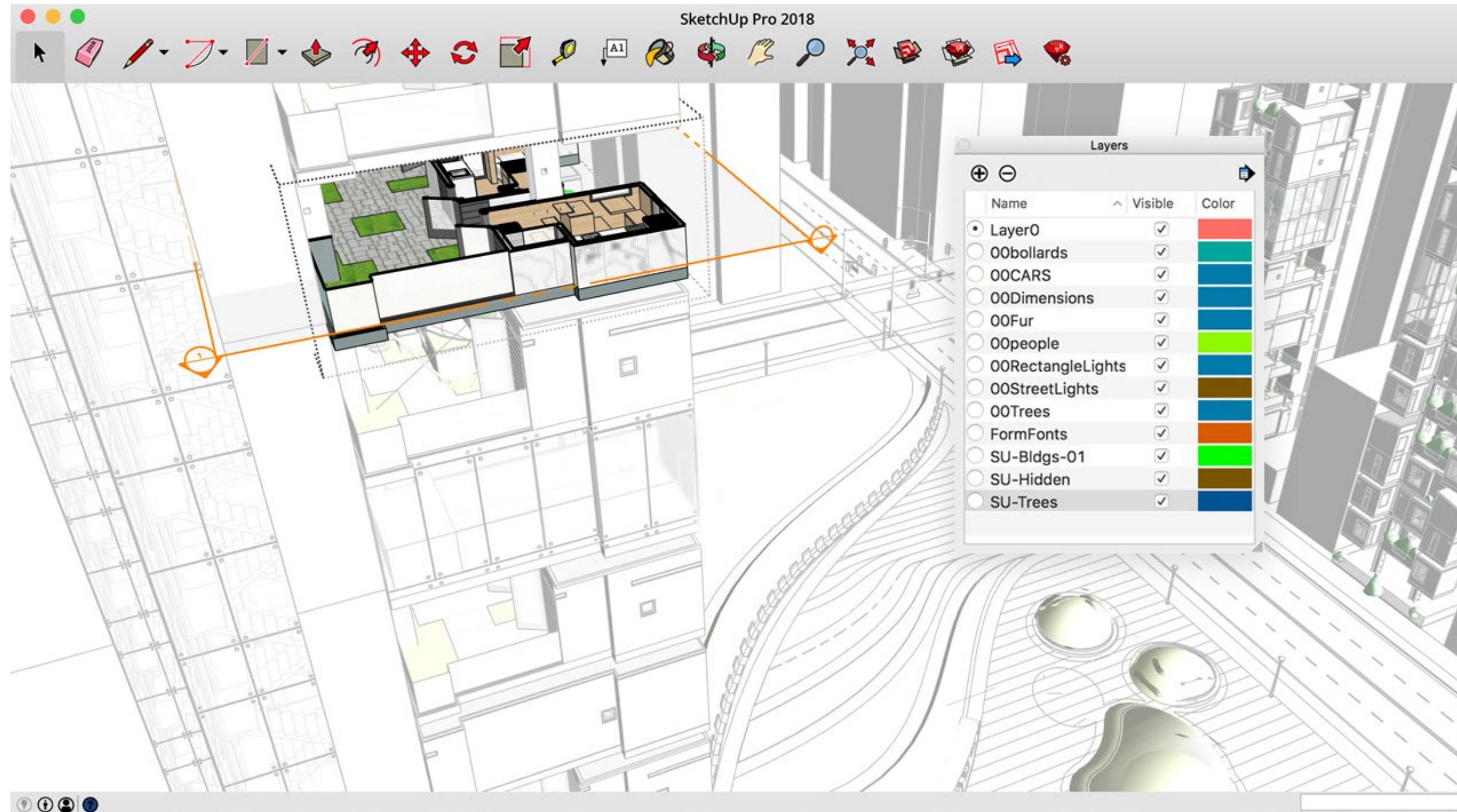
Remaking Reality

Measure, Simulate, Predict & Act

Reality Design

SketchUp

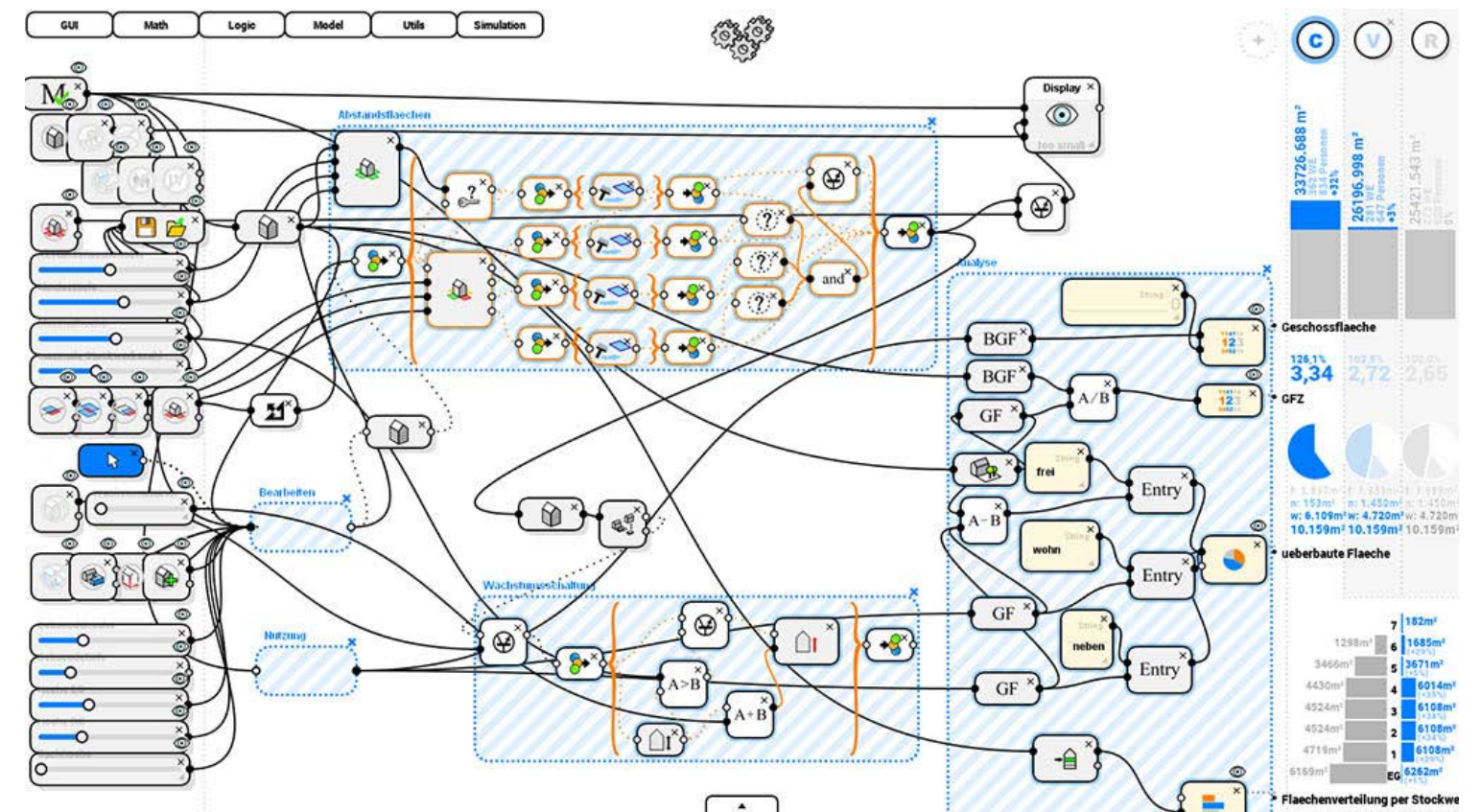
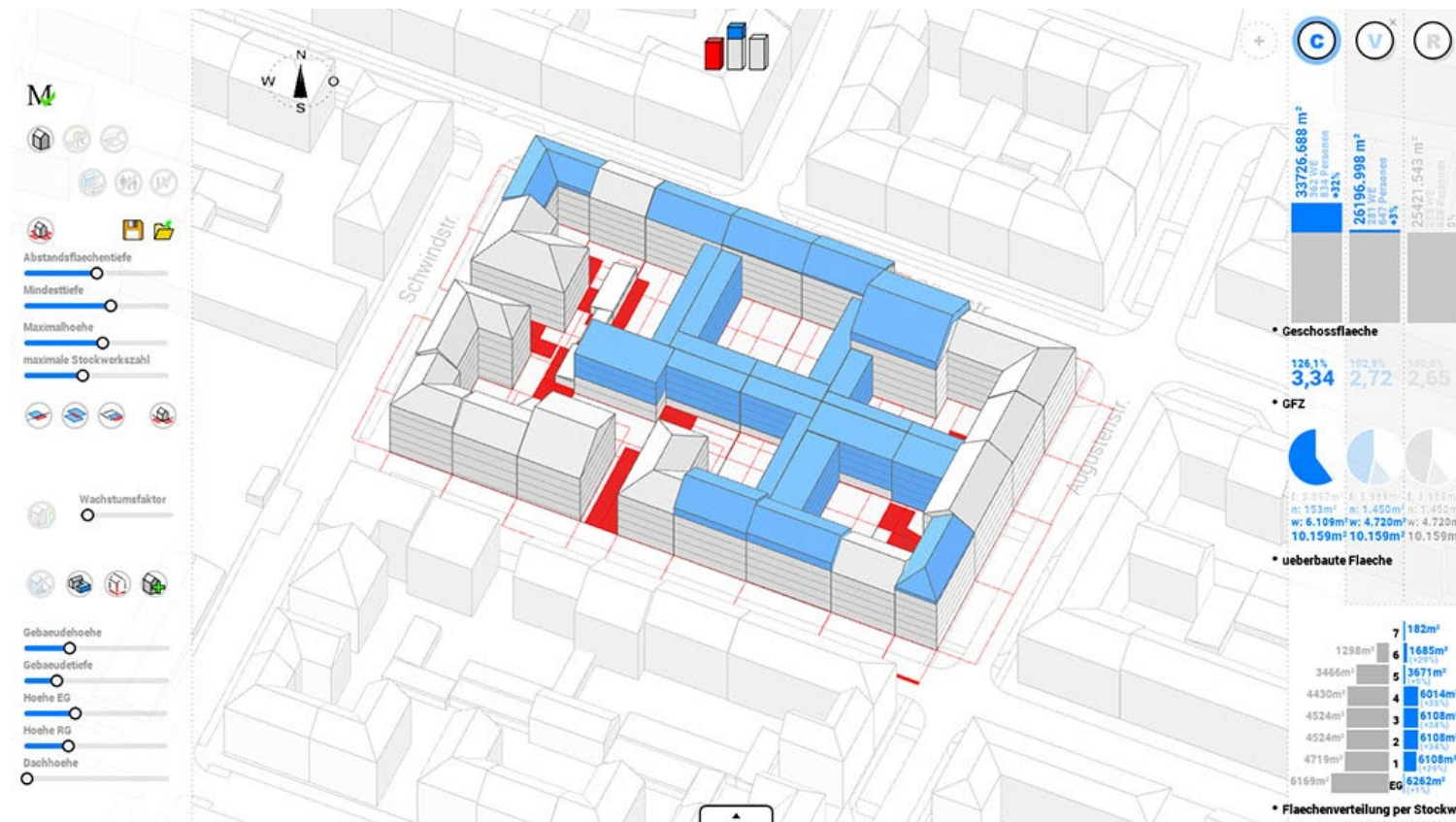
2000-Today



Brad Schell and Joe Esch for @Last Software (Later Google, Trimble Inc)

Urban Strategy Playground (Suite)

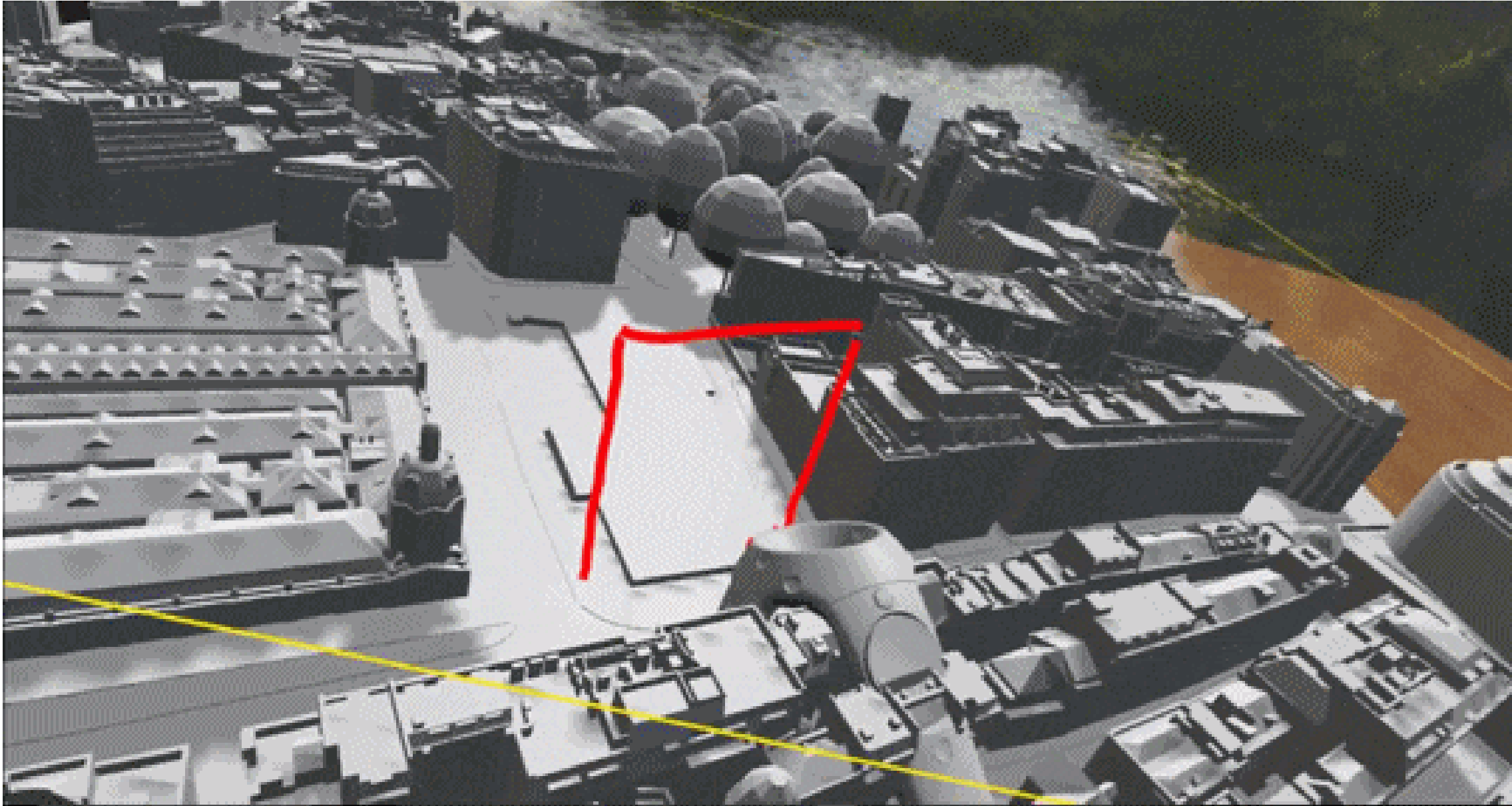
2013-Today



USP Research Group in the Department of Architektur at Technische Universität München

DesignSpace

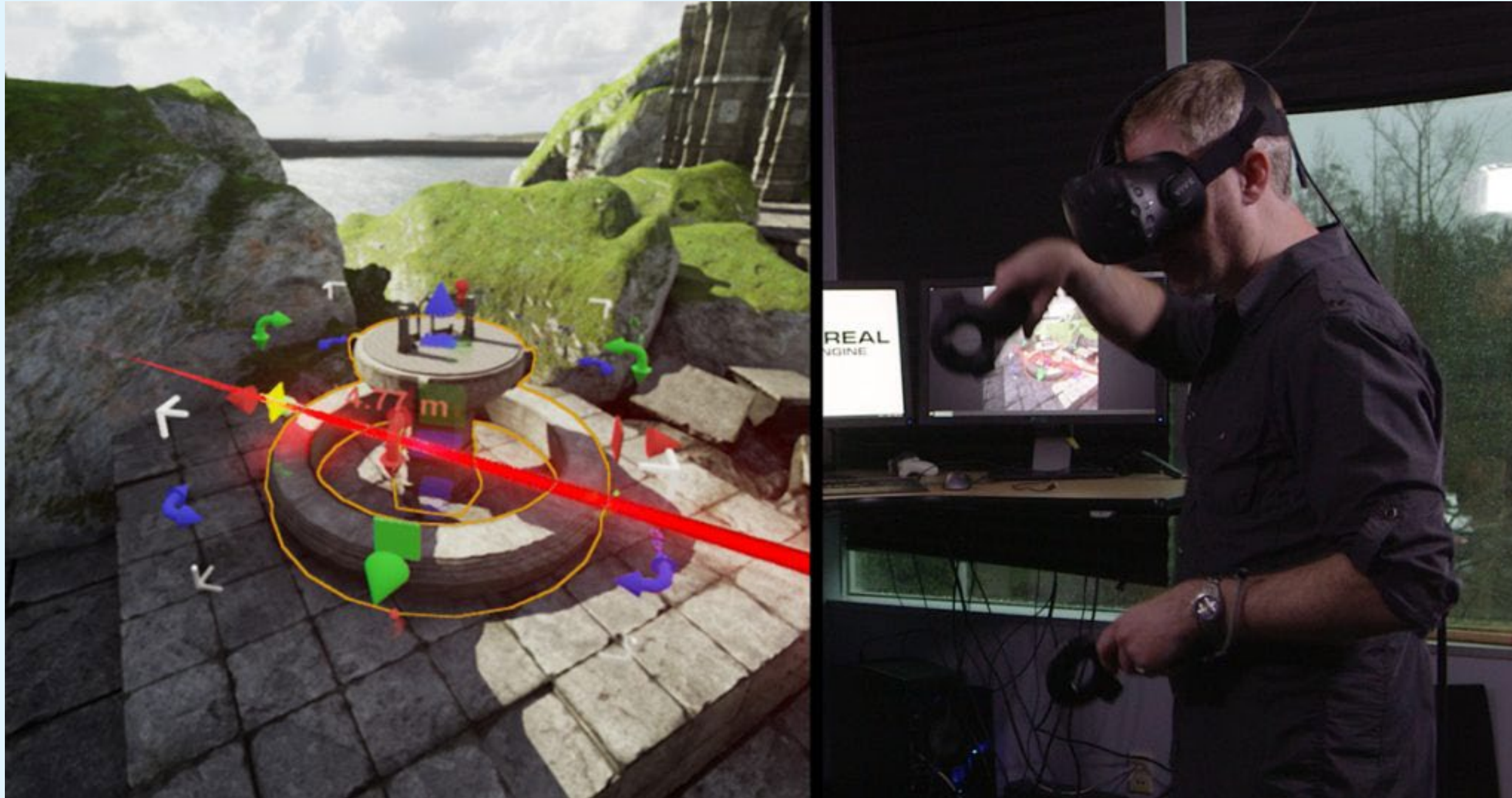
2016



Thomas Van Bouwe

VR Editor for Unreal Engine

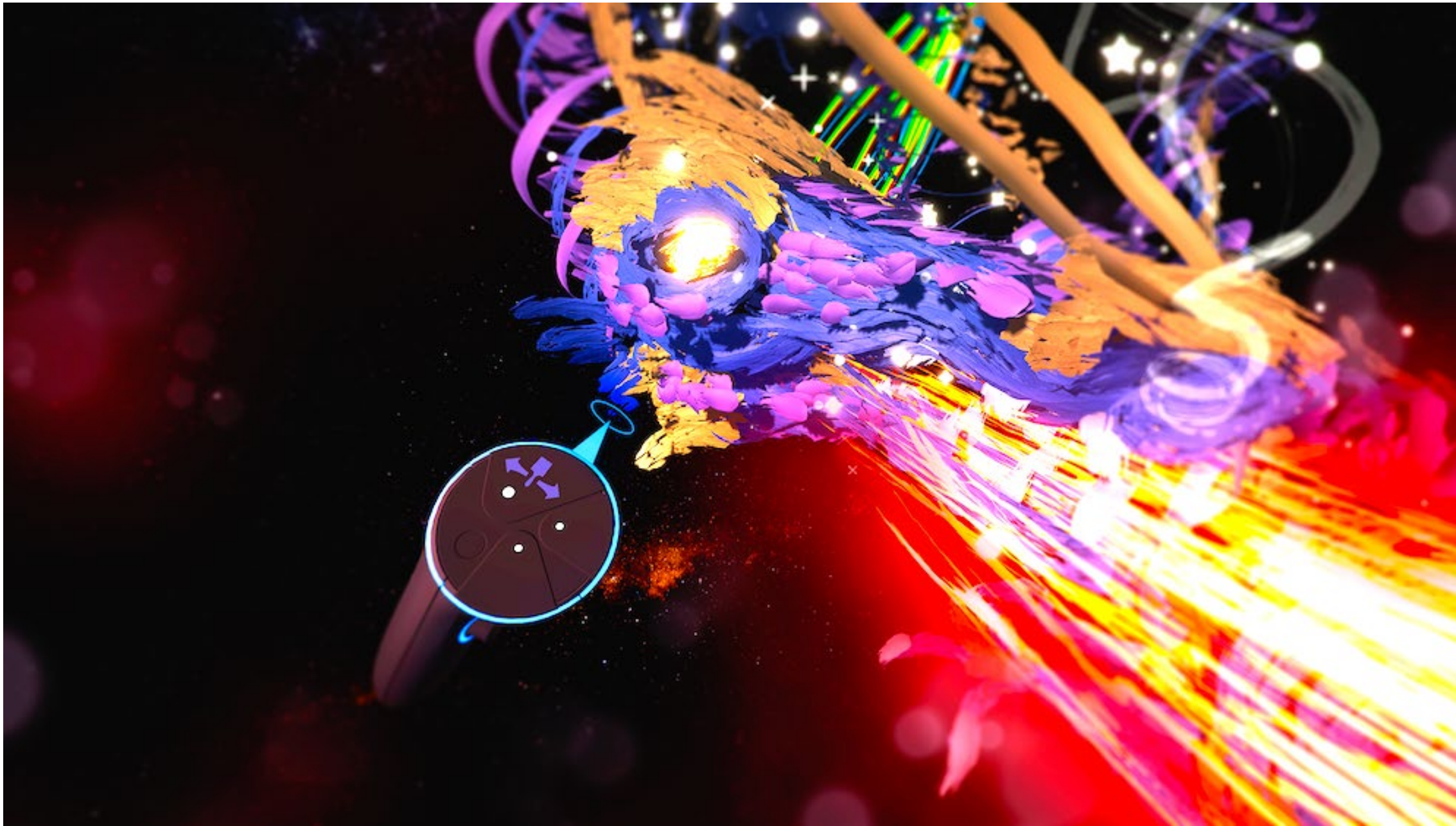
2016-Today



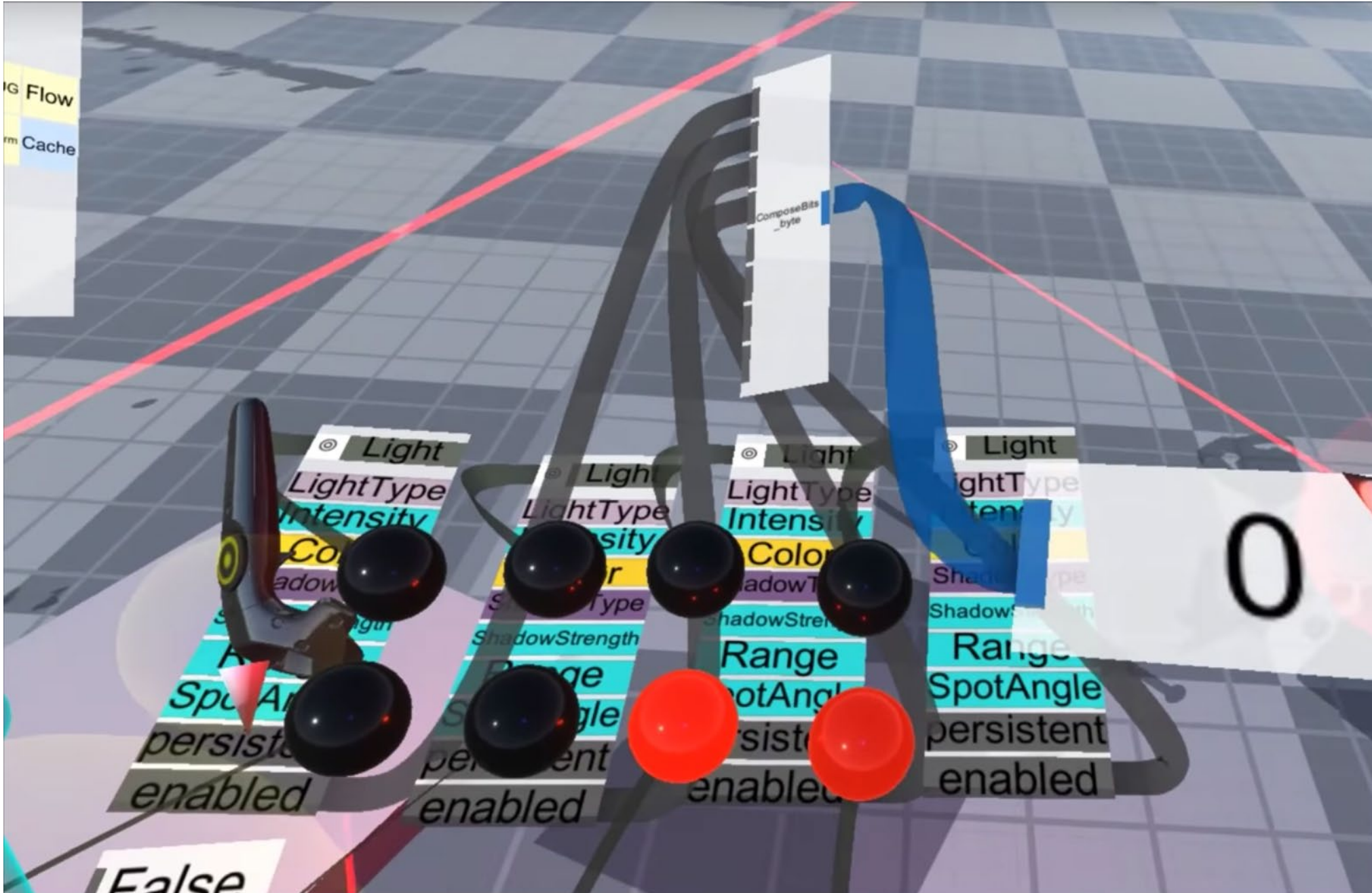
Epic Games

TiltBrush

2016-Today

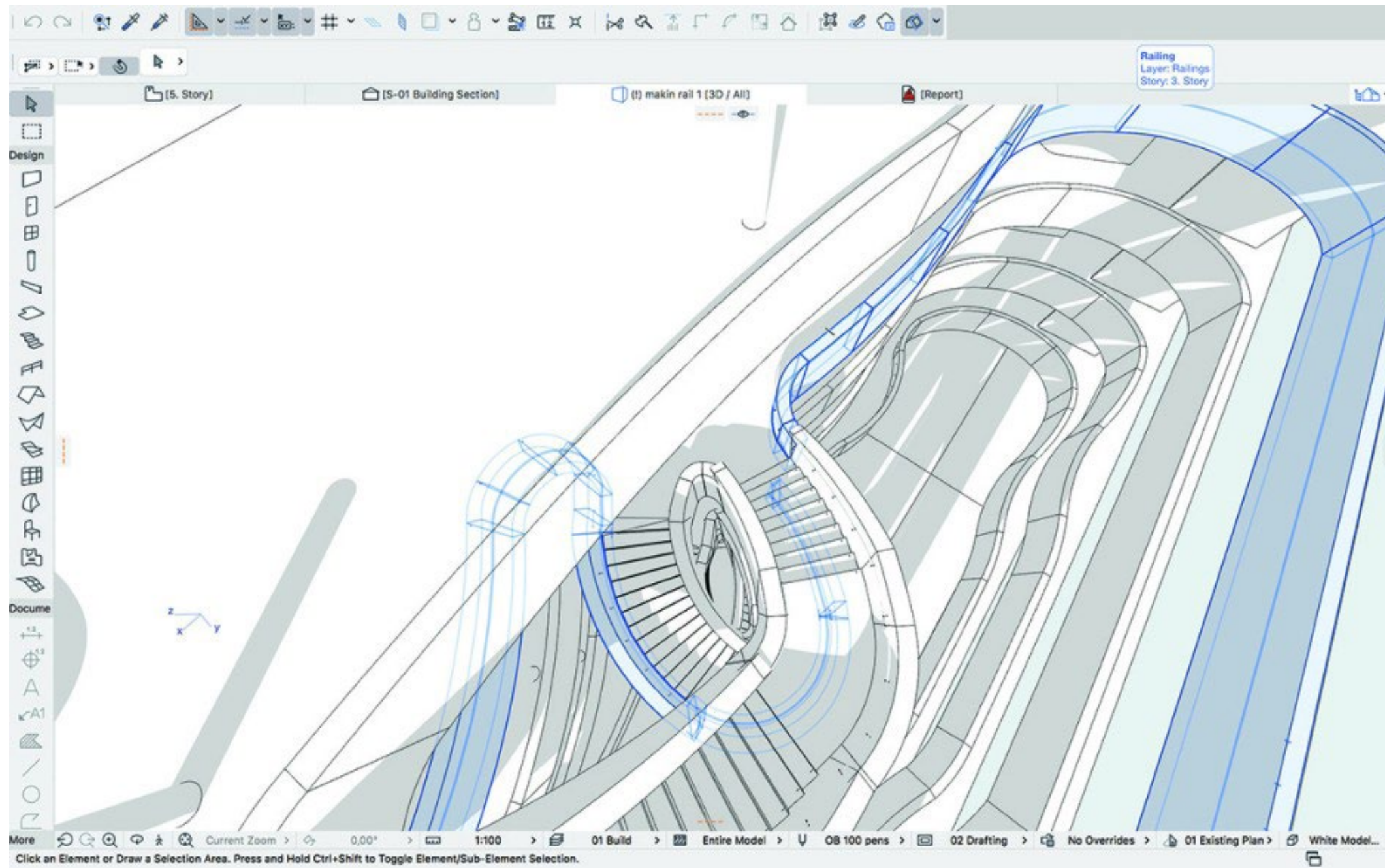


Google



ArchiCAD (Predictive Design)

2018-Today



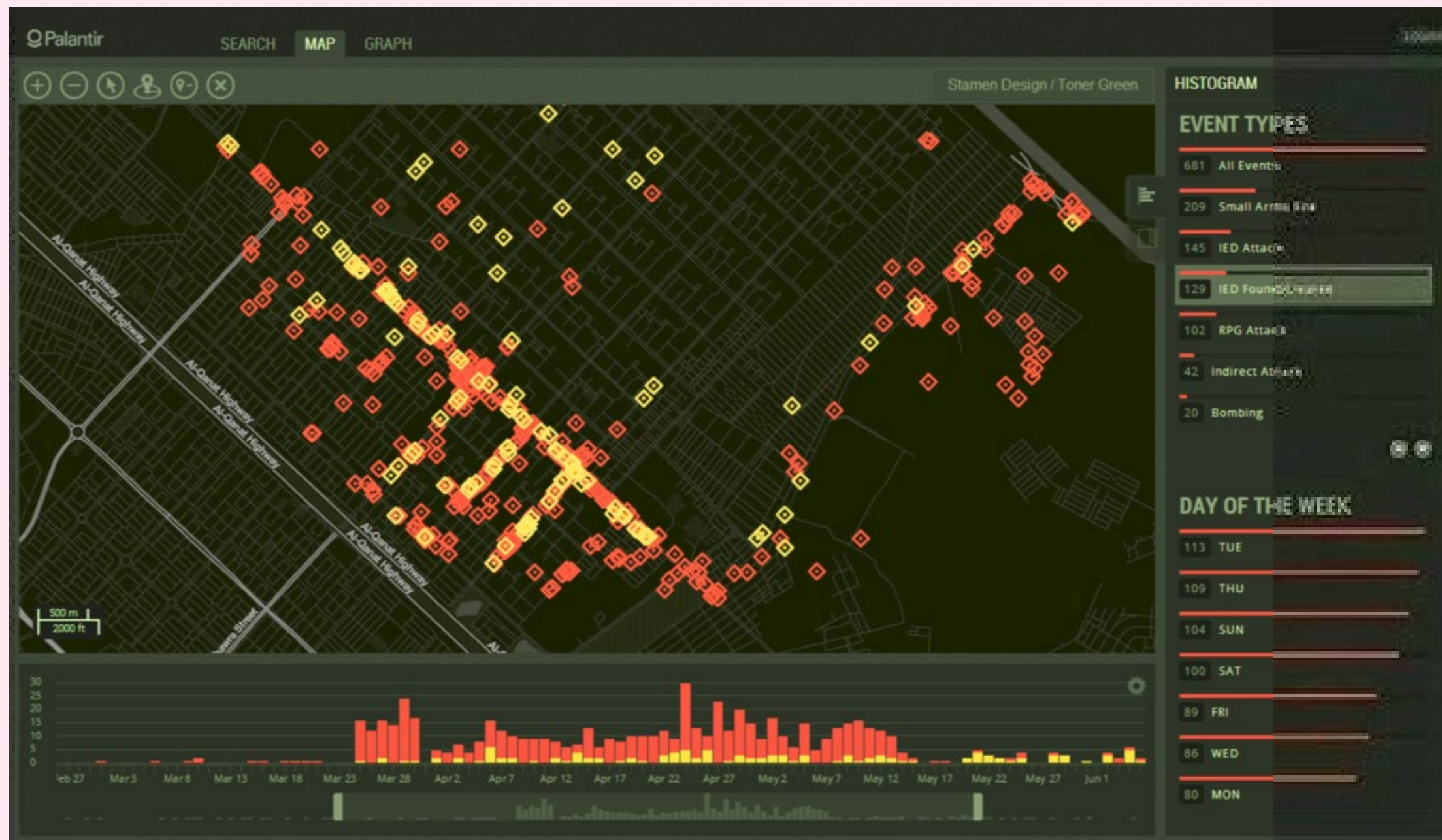
Graphisoft SE (Part of the Nemetschek Group)

Local Simulation

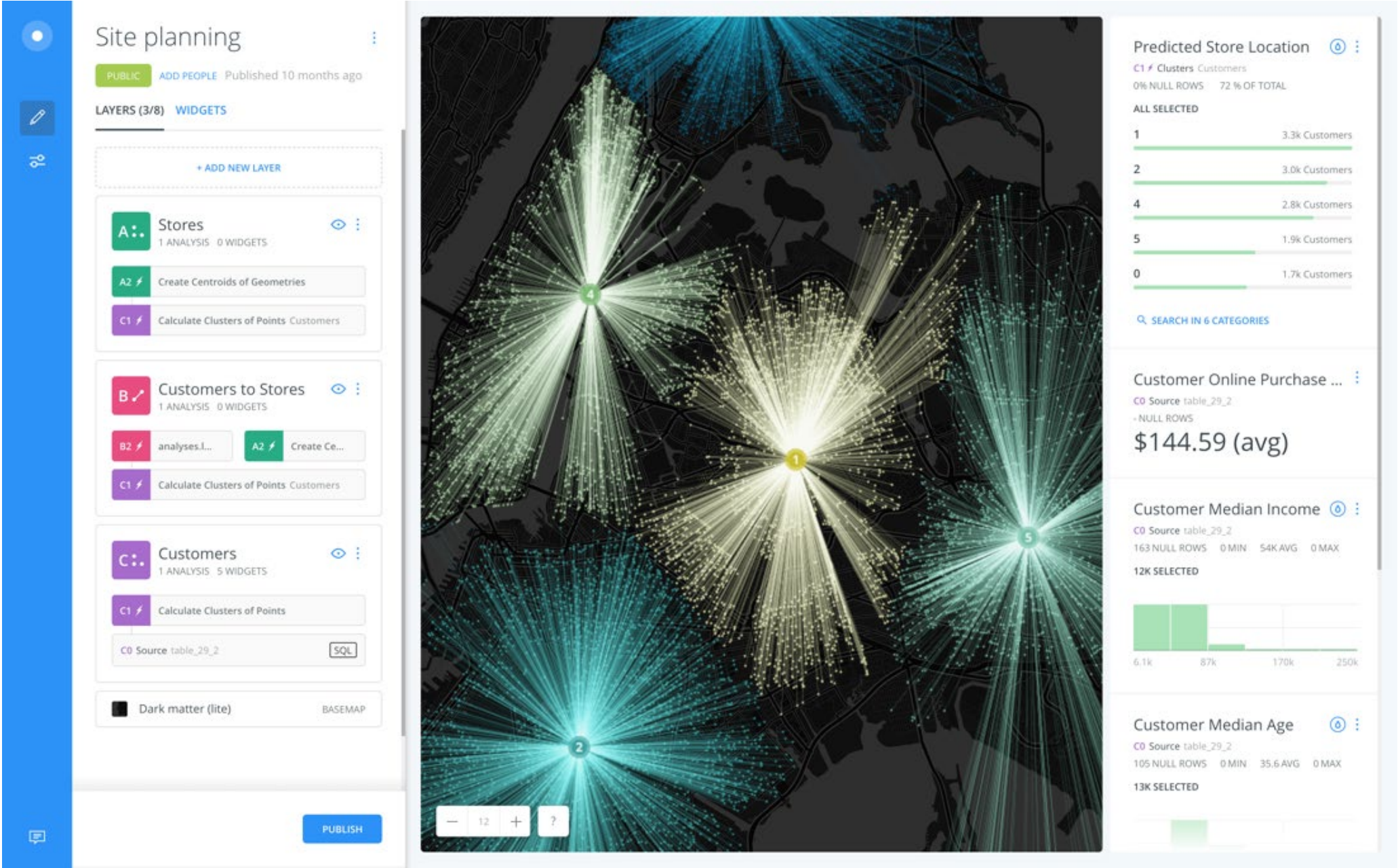
(i.e. Urban, Regional, etc)

Gotham

2004-Today



Palantir



MARK43 Computer Aided Dispatch

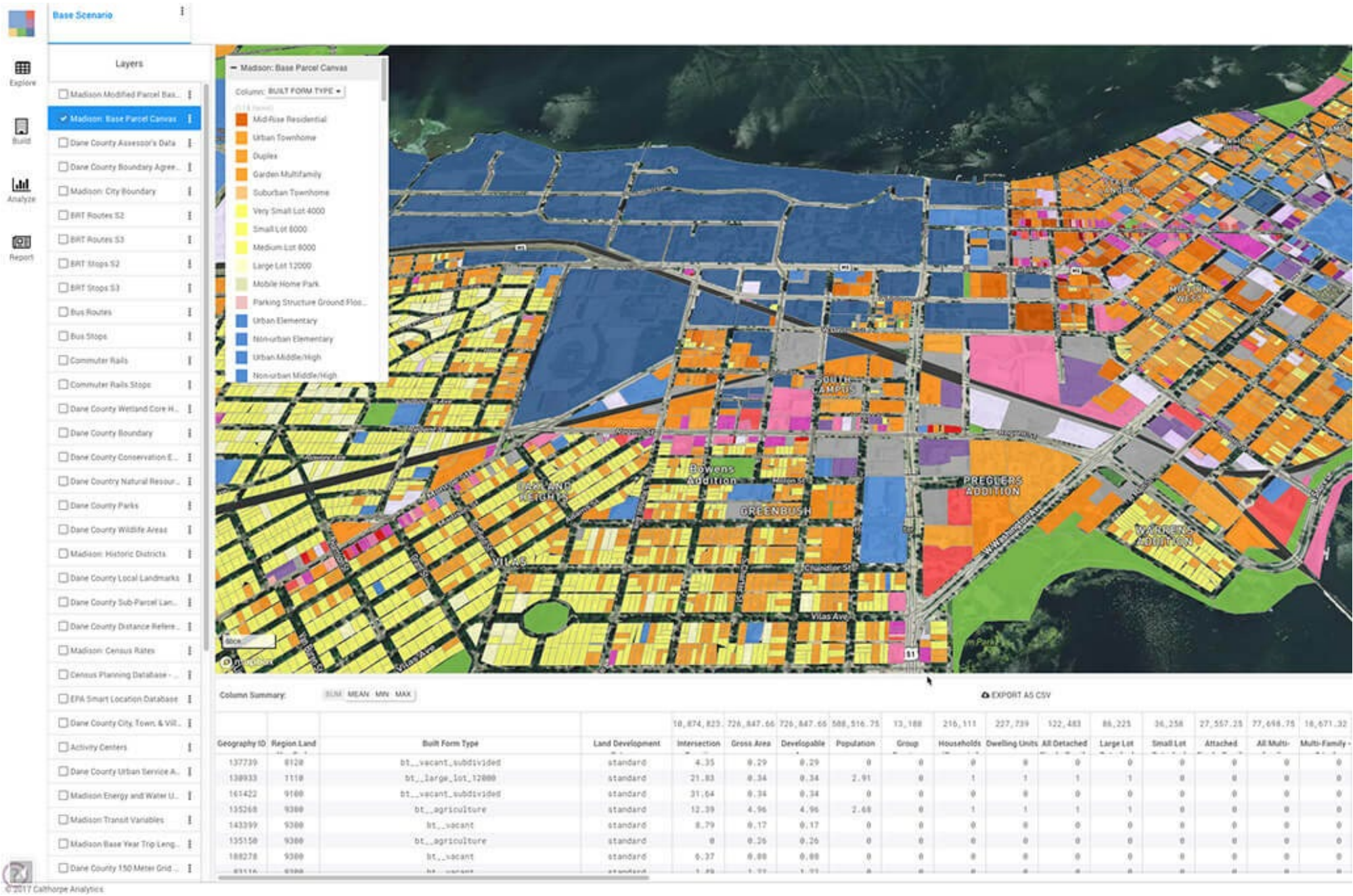
2012-Today



Mark43 Inc

UrbanFootprint

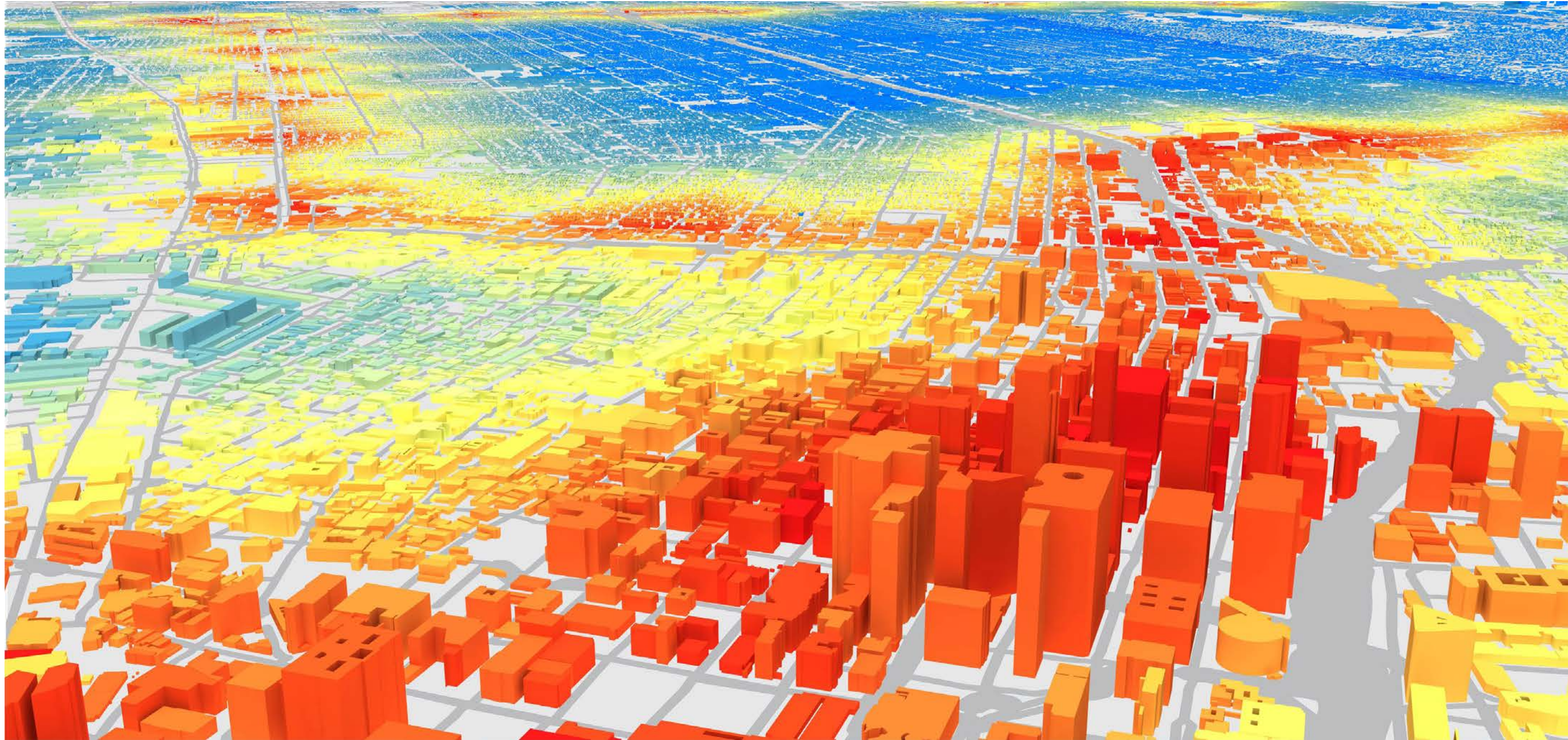
2014-Today



Joe Distefano, Peter Calthorpe for Calthorpe Analytics

Urban Network Analysis Toolbox

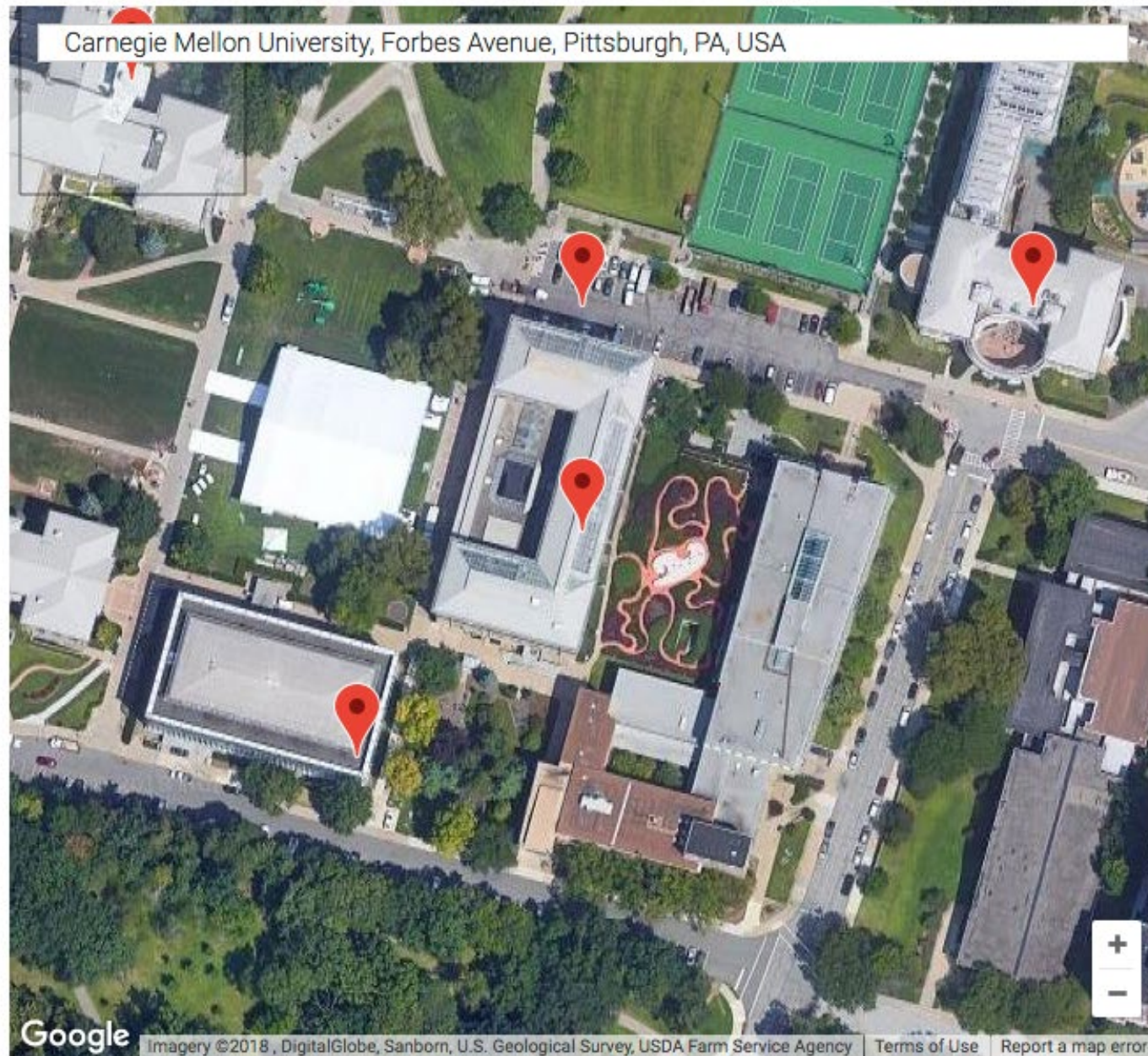
2015-Today



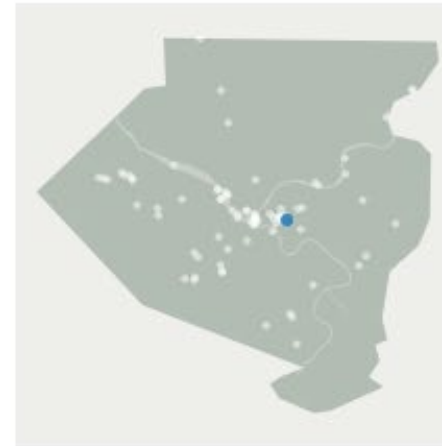
City Form Lab at the Harvard University Graduate School of Design

TerraPattern

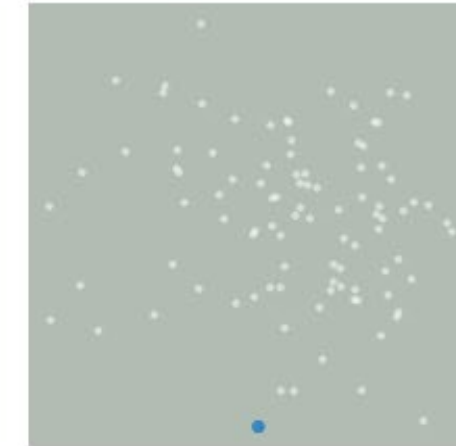
2016



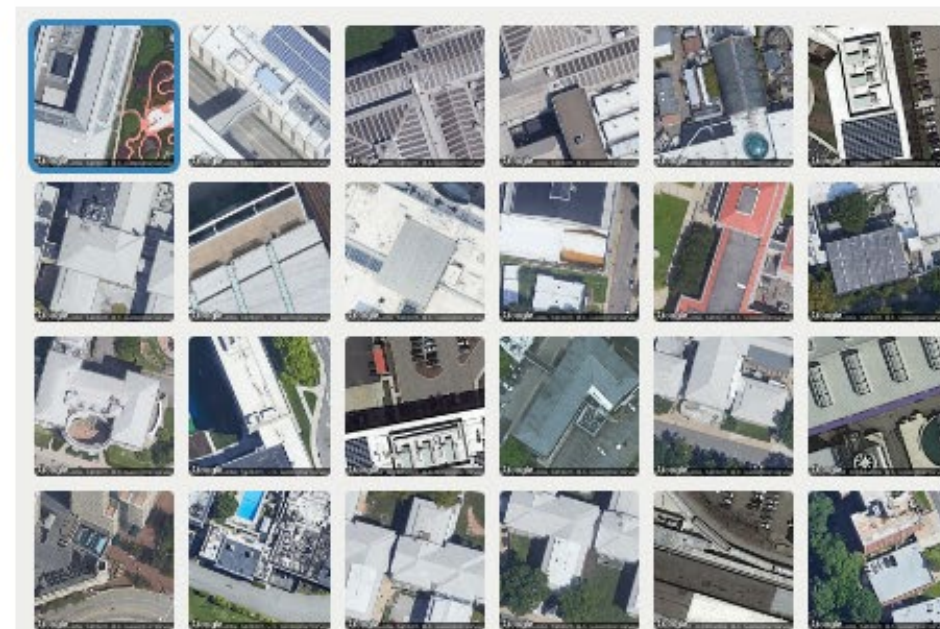
Geographical Plot



Similarity Plot



Search Results



Golan Levin, David Newbury, Kyle McDonald, Irene Alvarado, Aman Tiwari and Manzil Zaheer
at the Frank-Ratchye STUDIO for Creative Inquiry at Carnegie Mellon University

Hololens App: Forest Fire Fighting

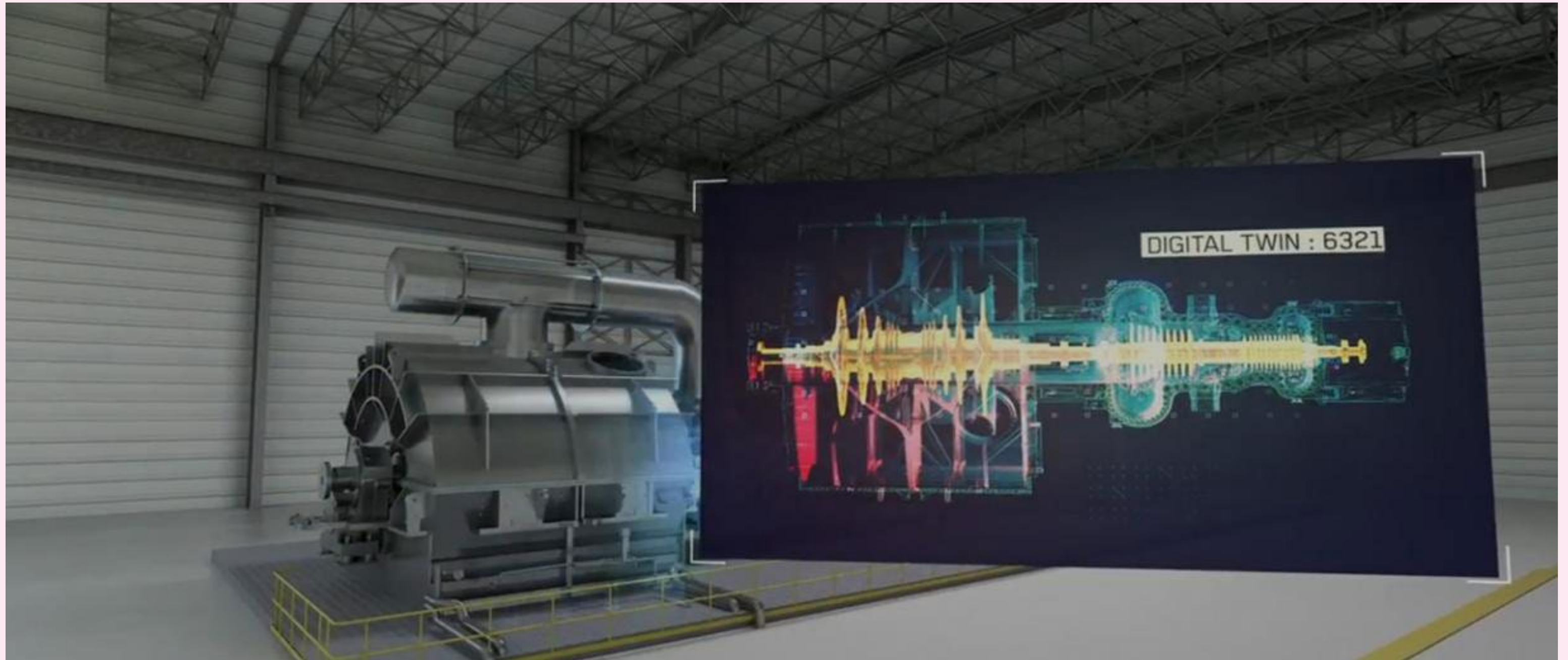
2016



Boeing

GE Predix (Digital Twin)

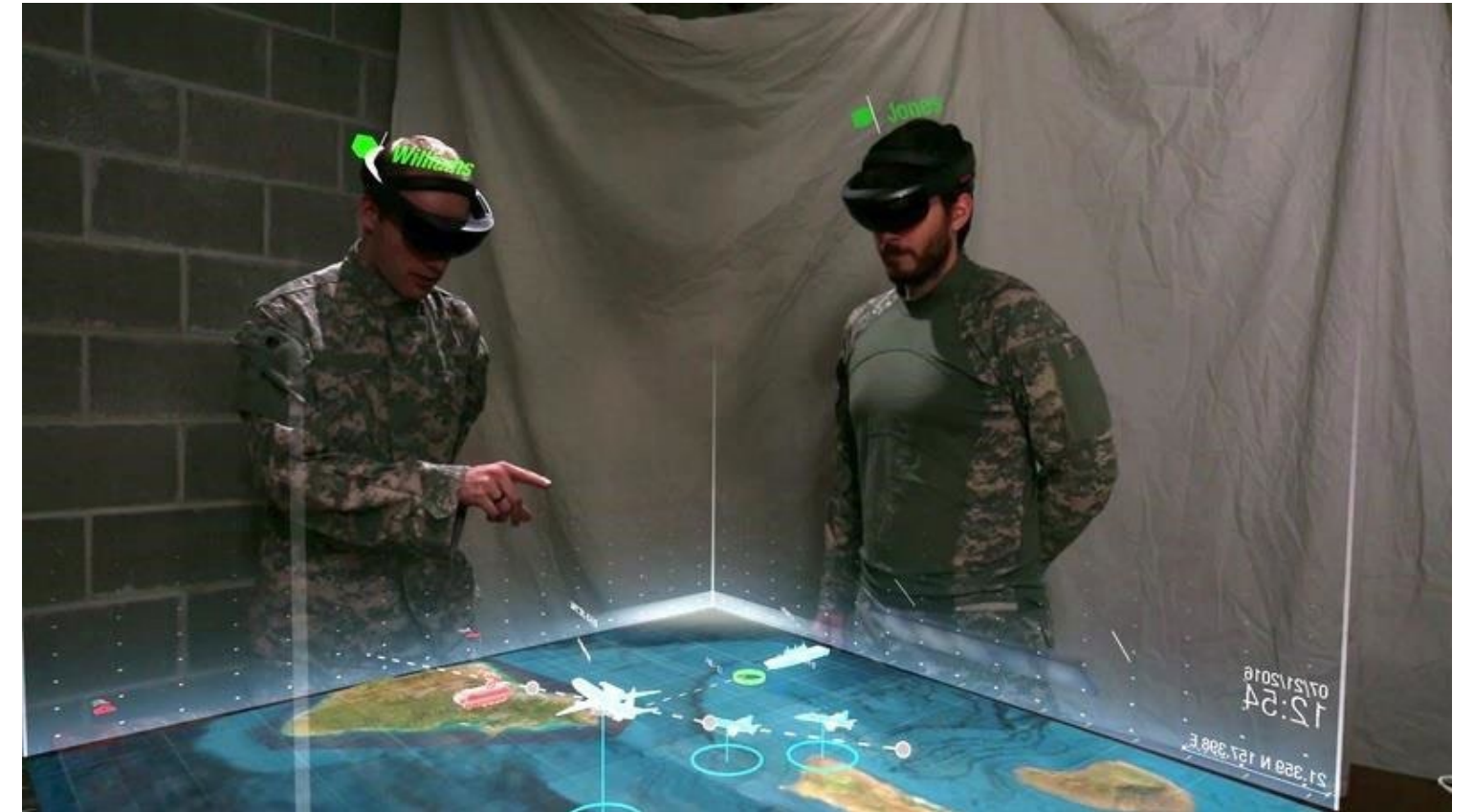
2016-Today



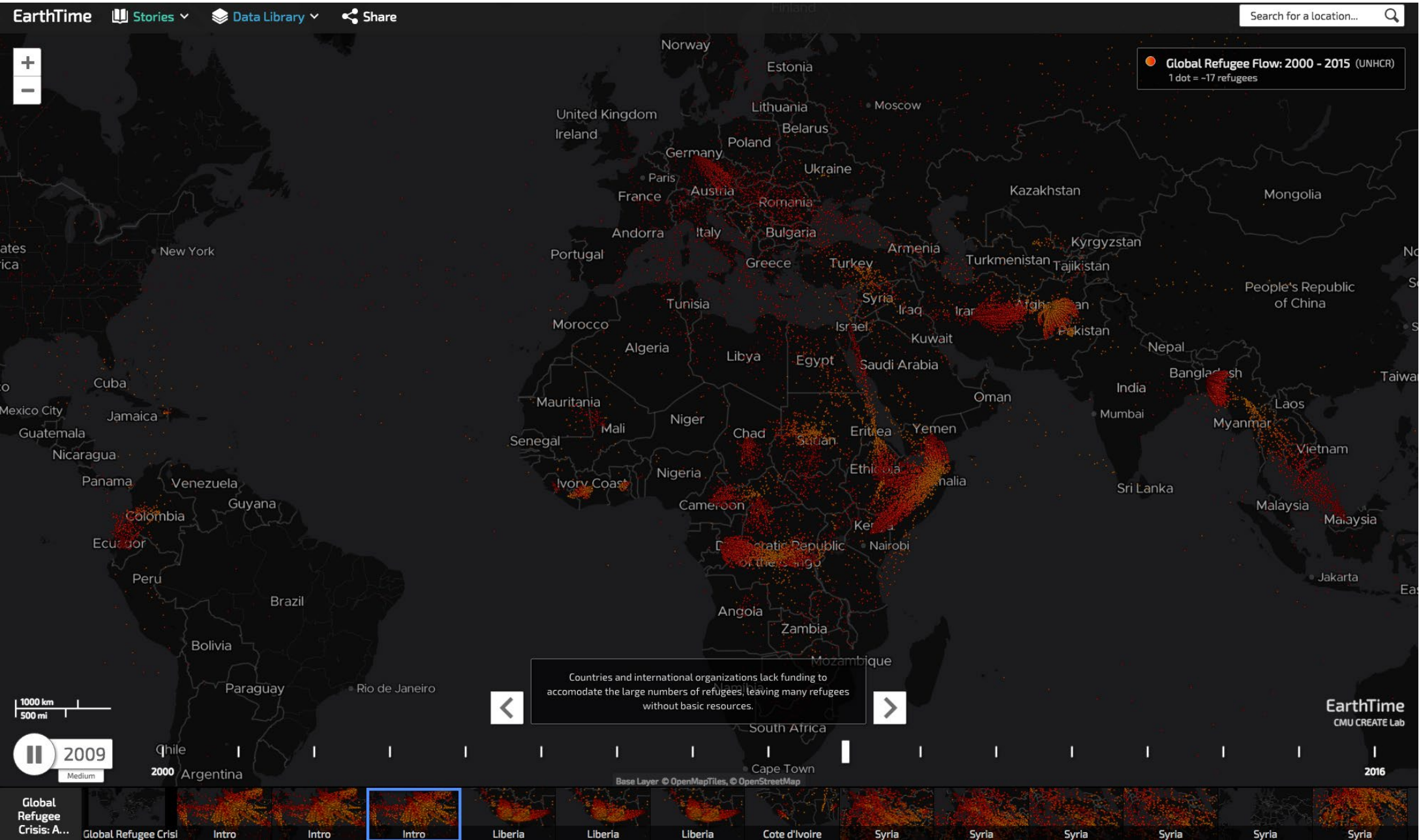
General Electric and ANSYS

Hololens App: Air Force Asset Planning

2017



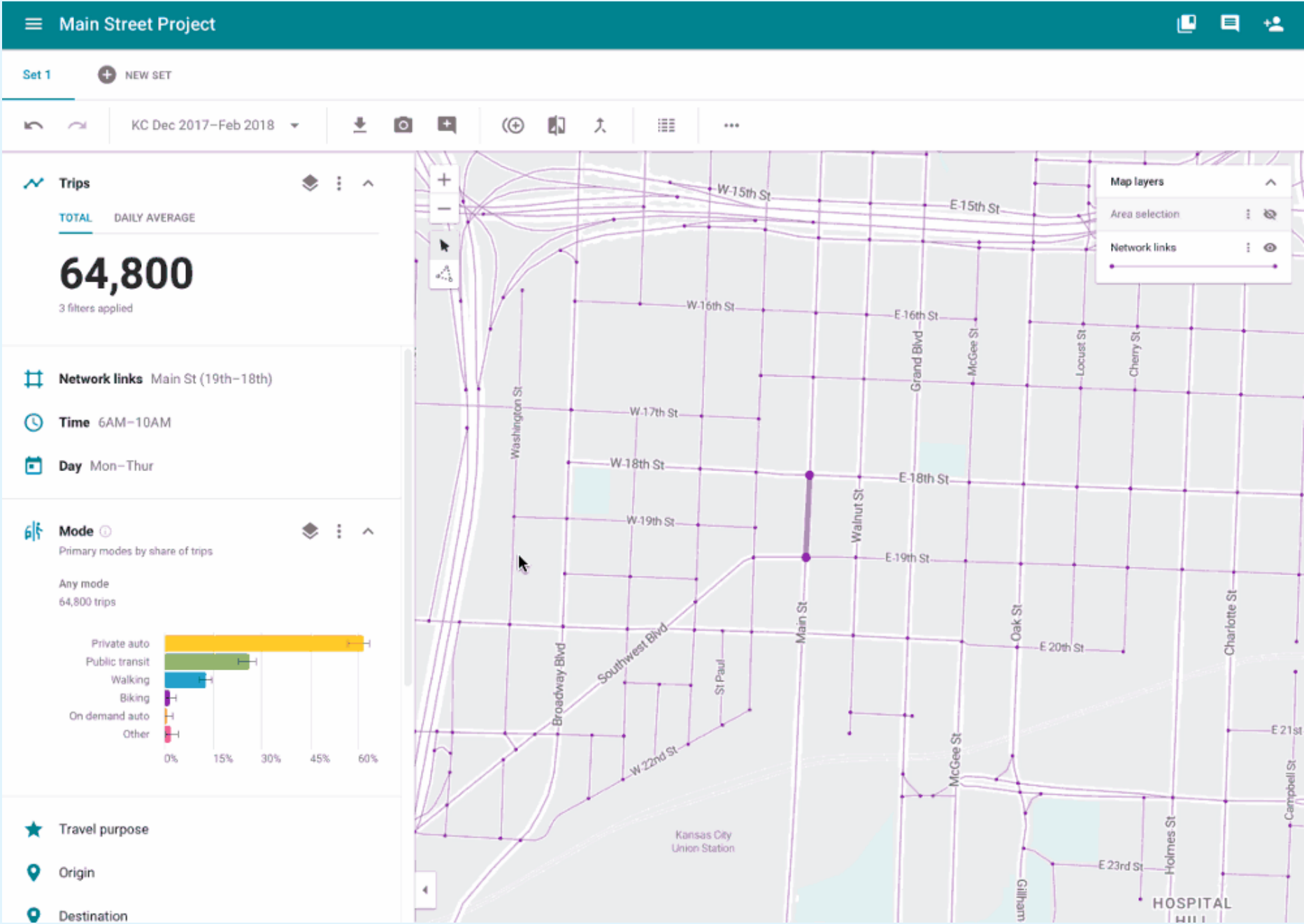
Royal Australian Air Force



CREATE (Community Robotics, Education and Technology Empowerment) Lab at Carnegie Mellon University

Replica

2018-Today



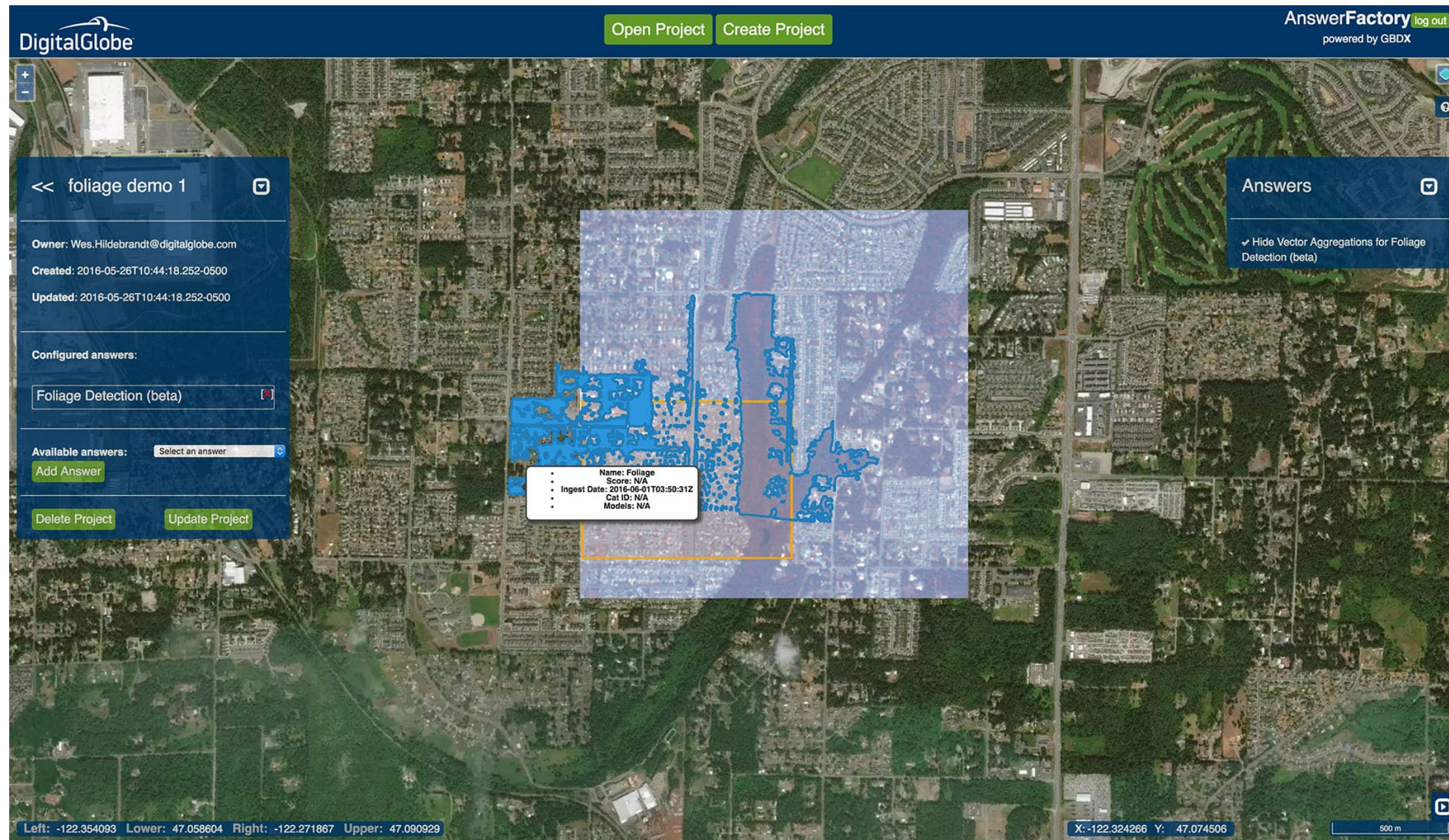
Sidewalk Labs (Part of Alphabet)

Global View

‘Macrosopes’

DigitalGlobe AnswerFactory

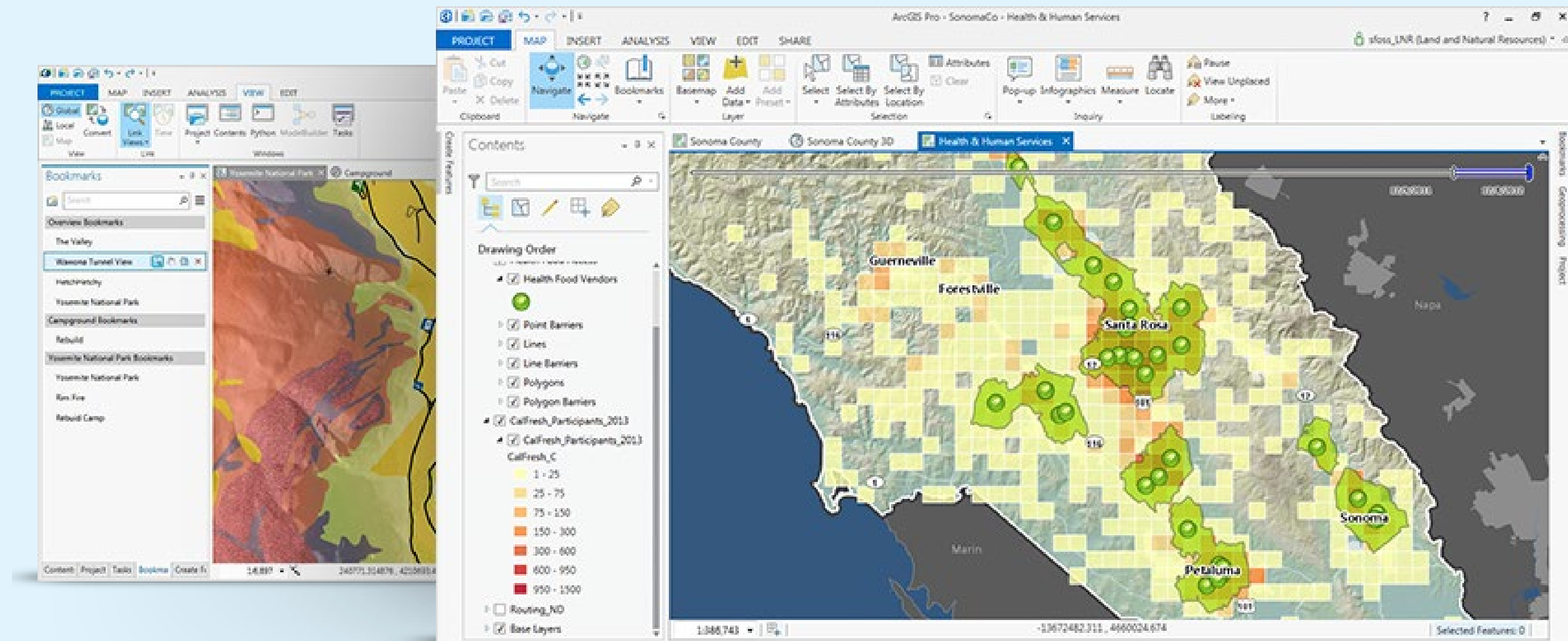
1992-Today



DigitalGlobe (Part of MAXAR)

ArcGIS

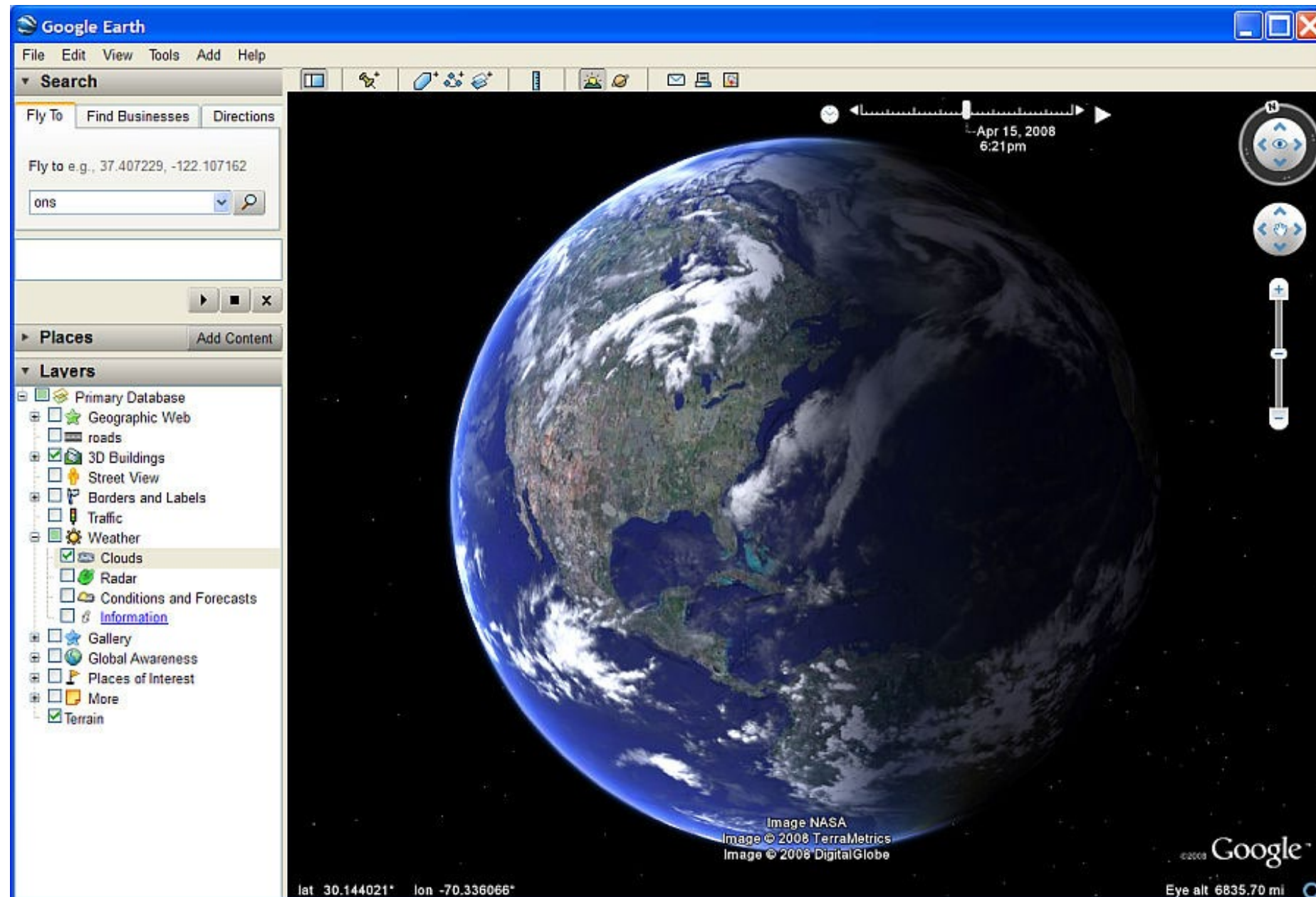
1999-Today



Esri

Google Earth

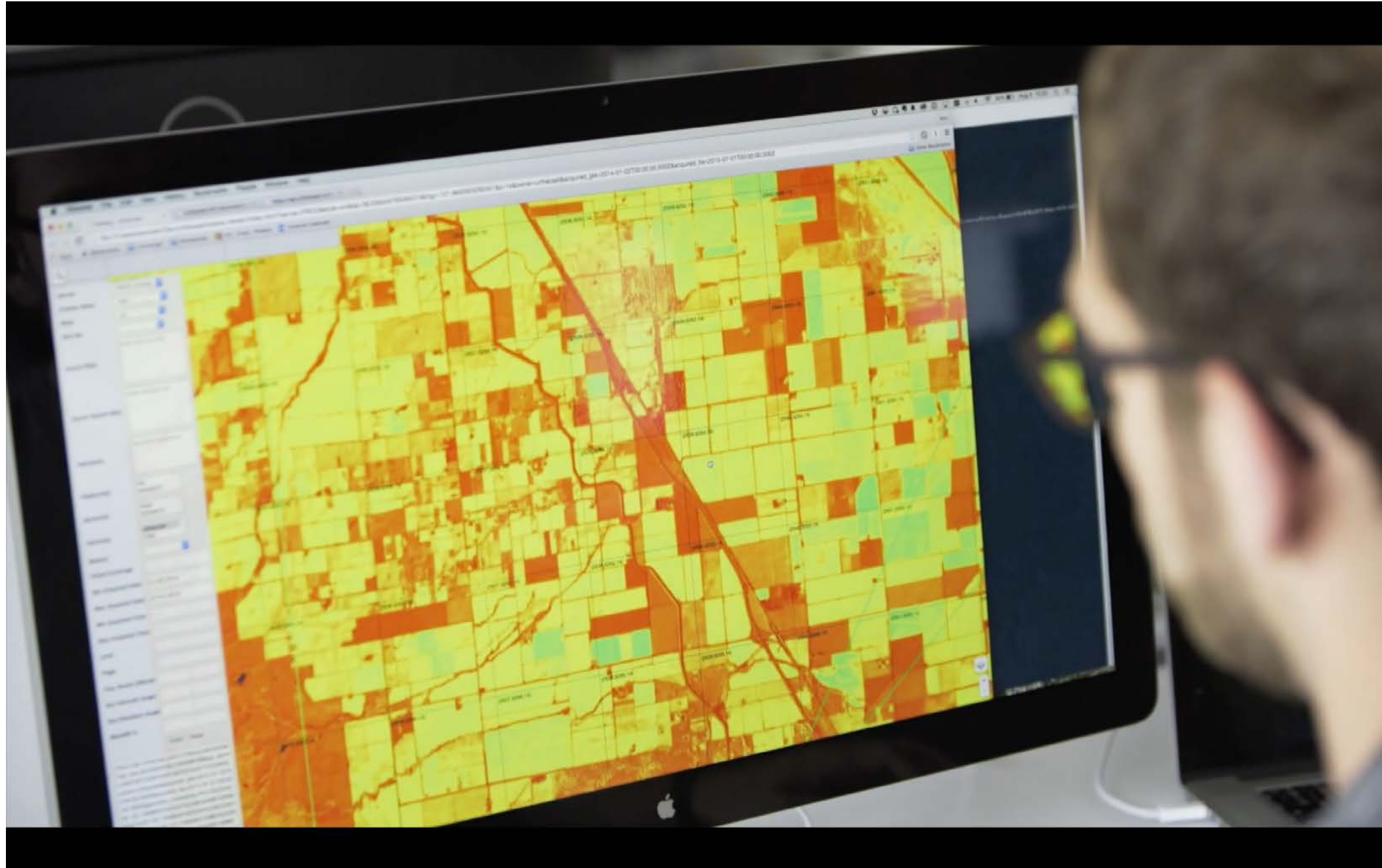
2001-Today



Intrinsic Graphics (Later Keyhole Inc, Google)

UrtheCast

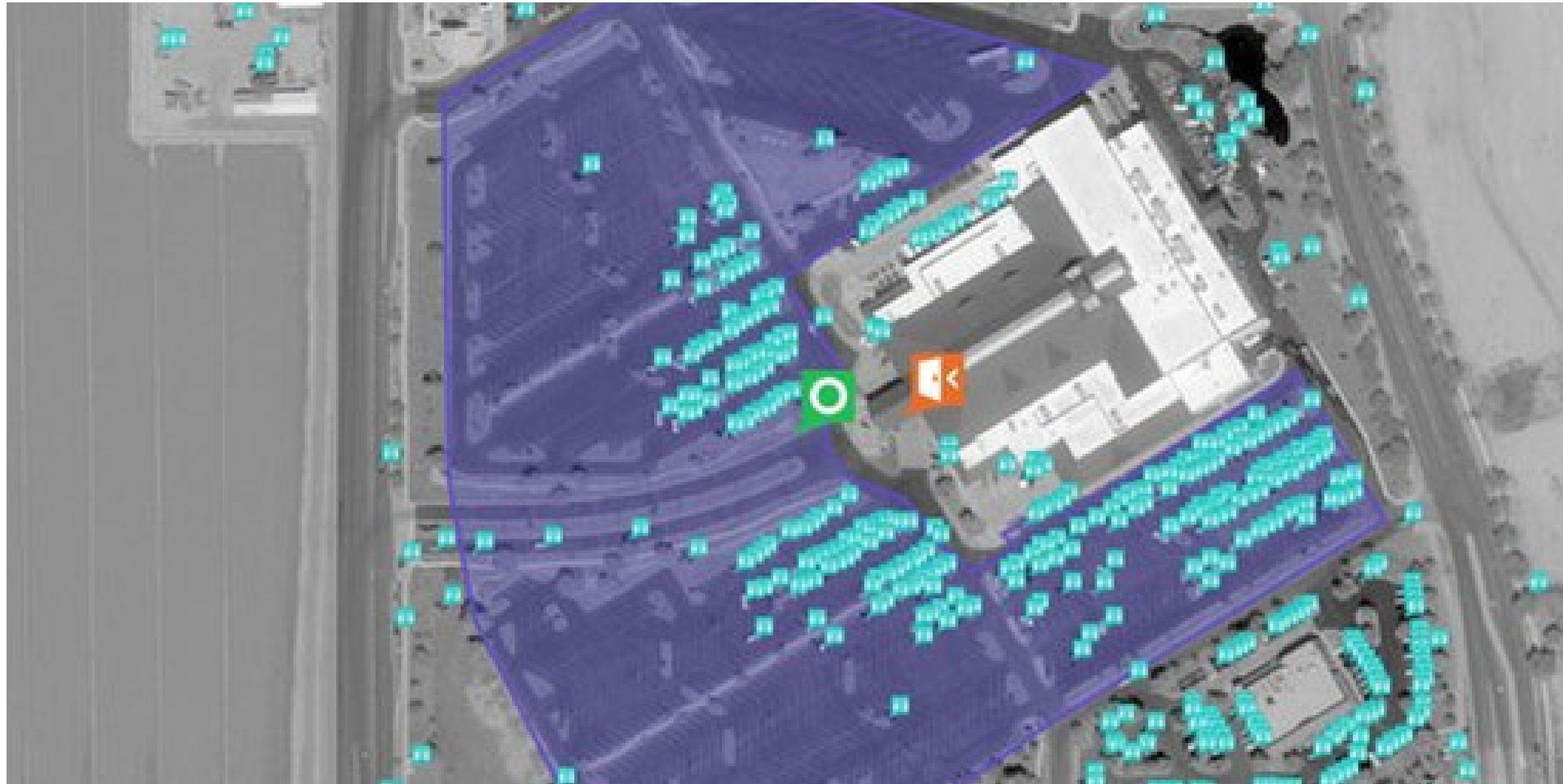
2004-Today



UrtheCast Corp

Orbital Insight

2013-Today

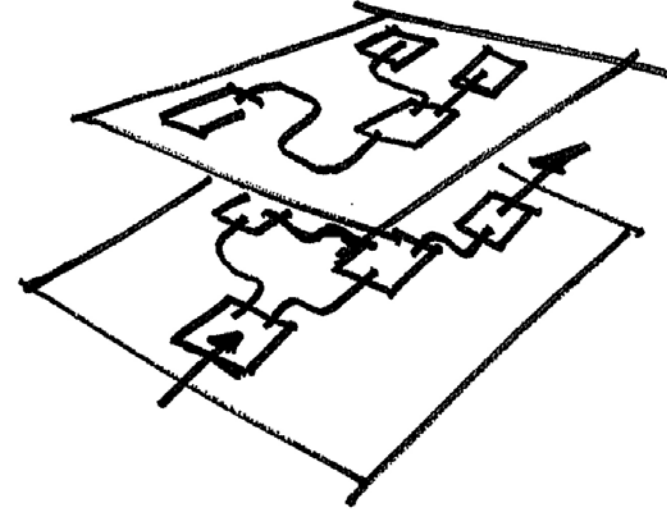
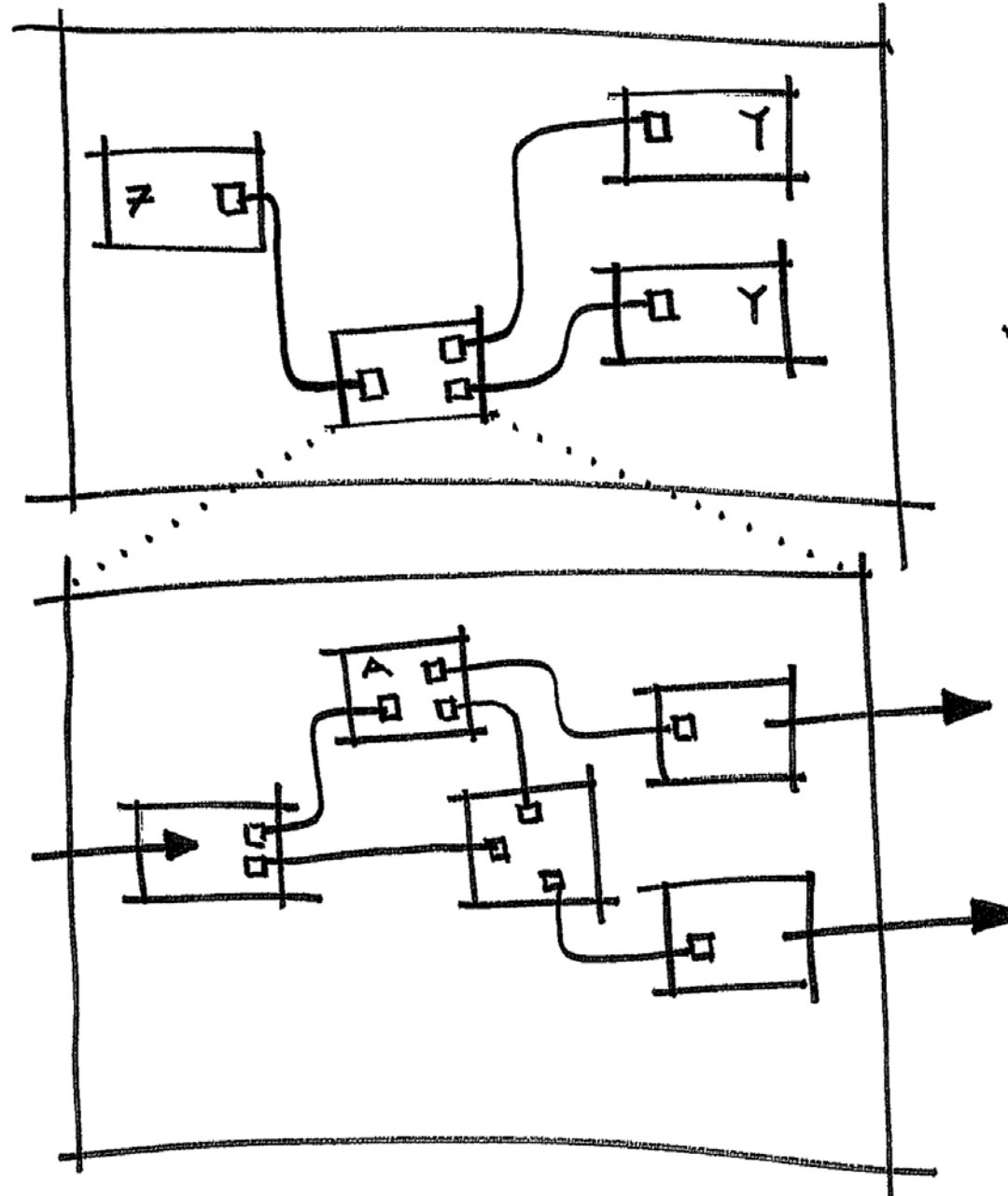


Orbital Insight Inc

Design Patterns

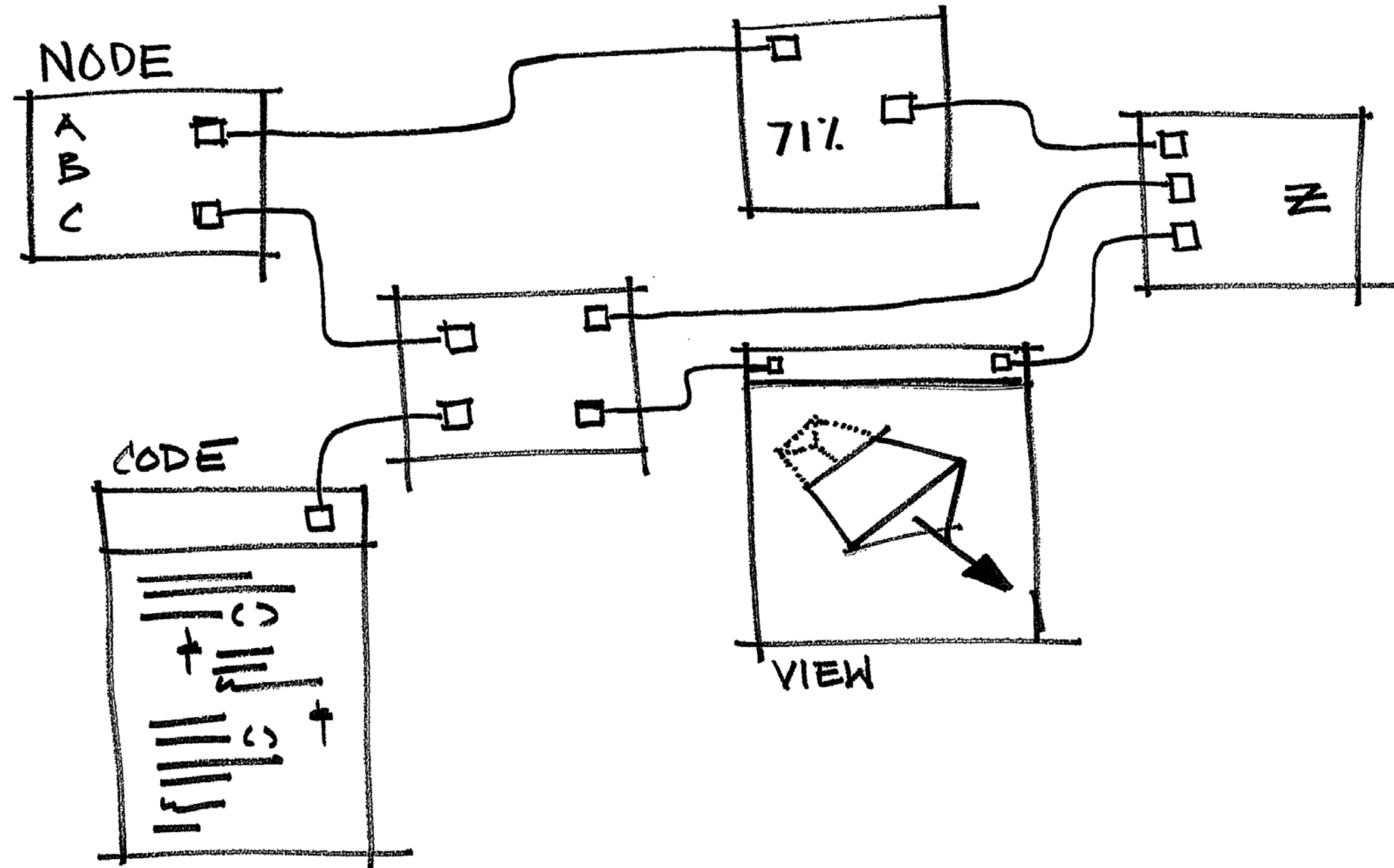
Preliminary Sketches

NESTED STRUCTURE



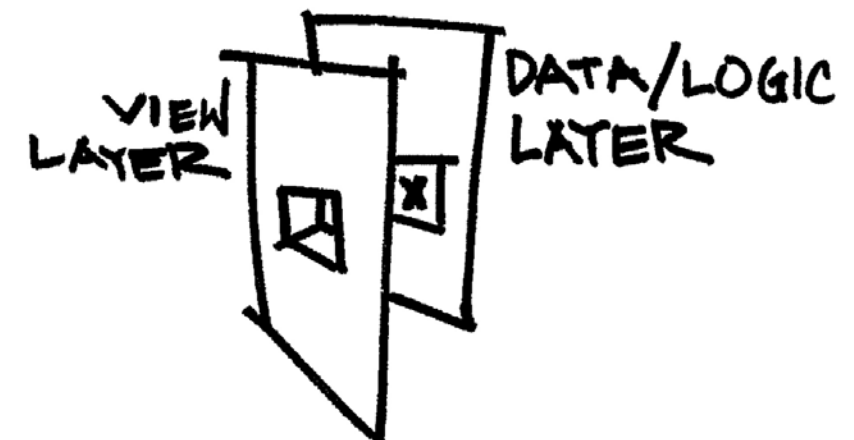
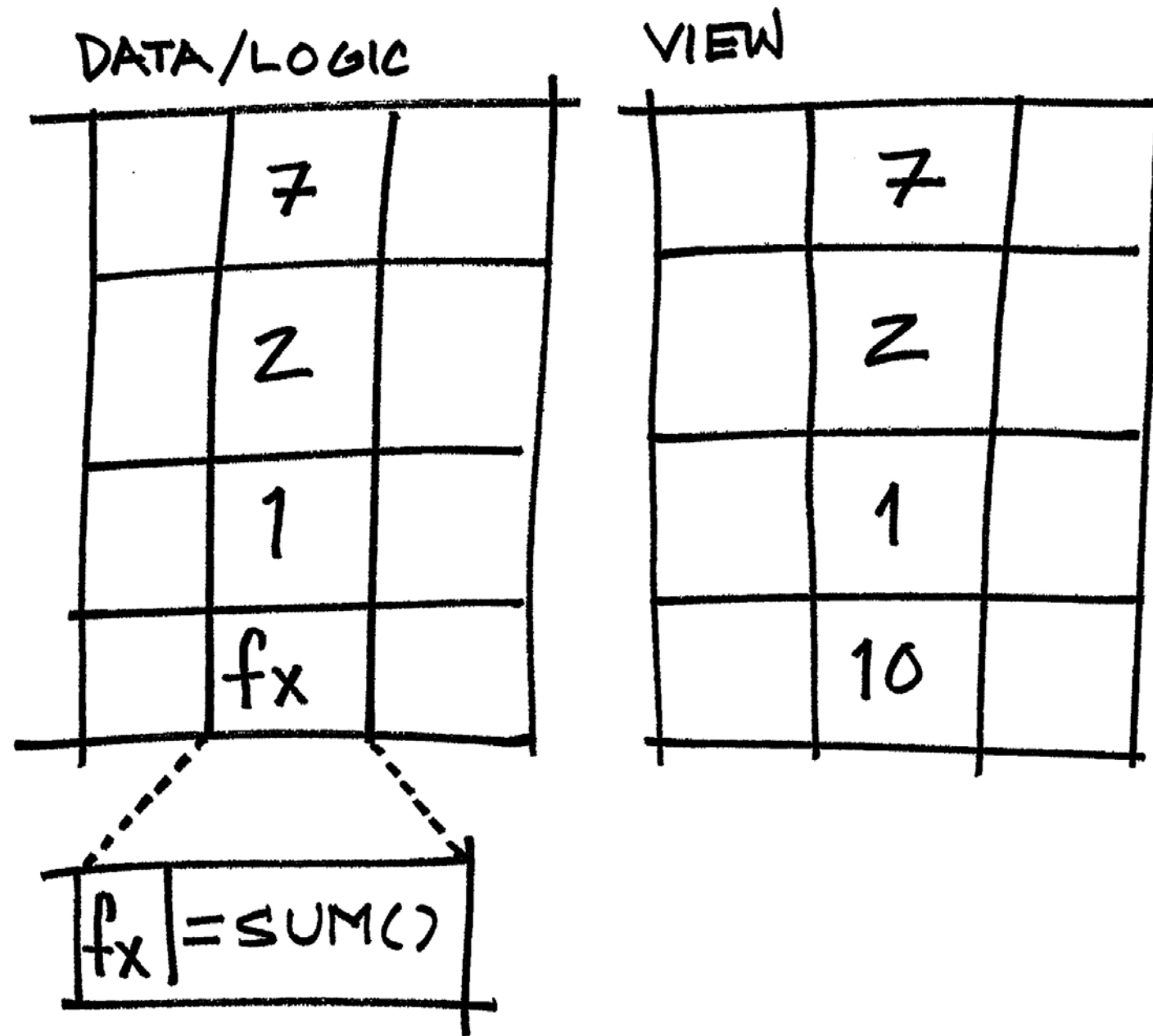
4.3.6, 4.1.6, 1.3.4

GRAPH (NODE-LINK) ENVIRONMENT



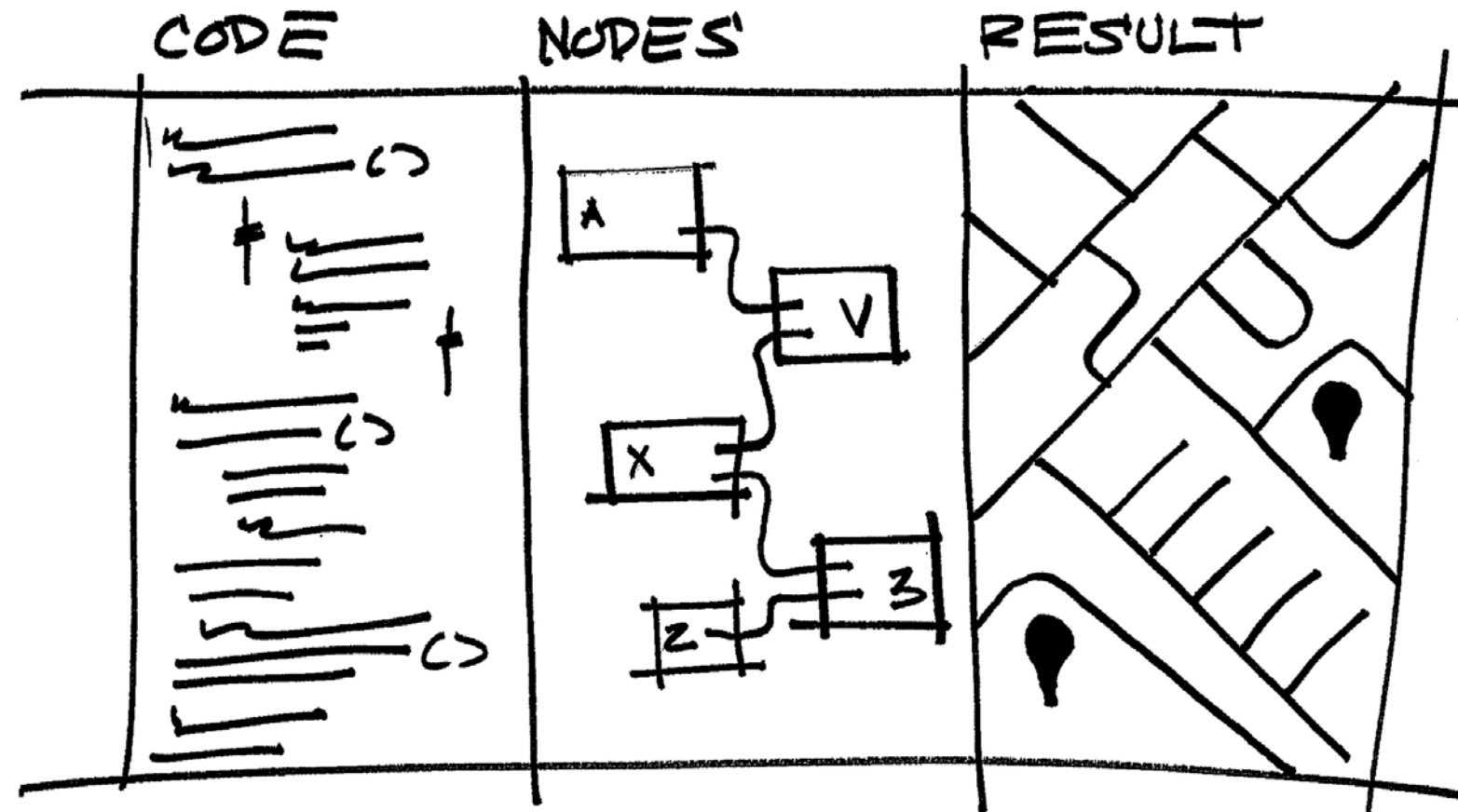
4.1.8, 4.3.1, 4.1.1

KEYHOLE MODEL



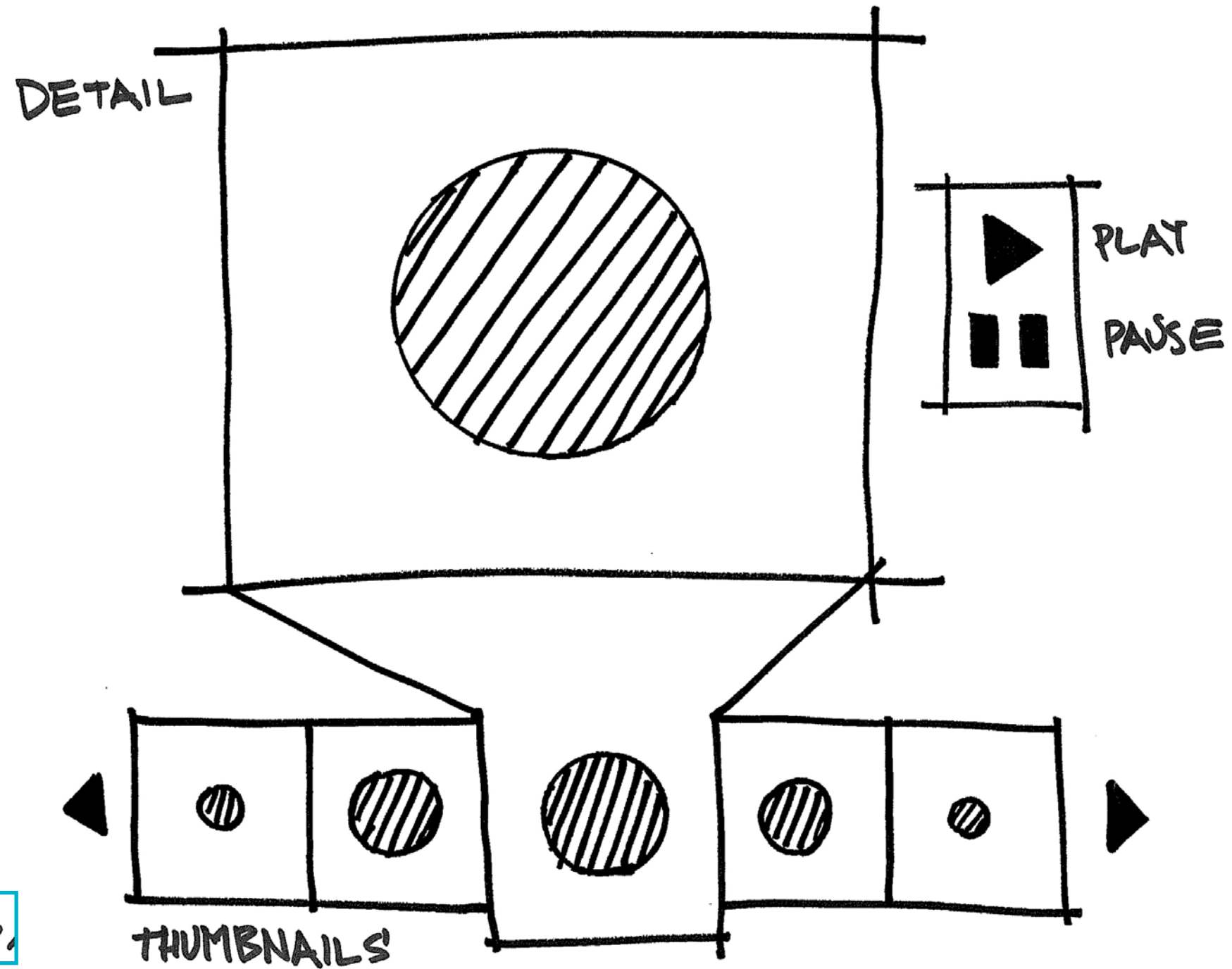
2.1.3, 2.2.3, 2.4.3

MULTIPLE VIEWS



5.4.9, 5.4.3, 4.3.2, 7.2.1

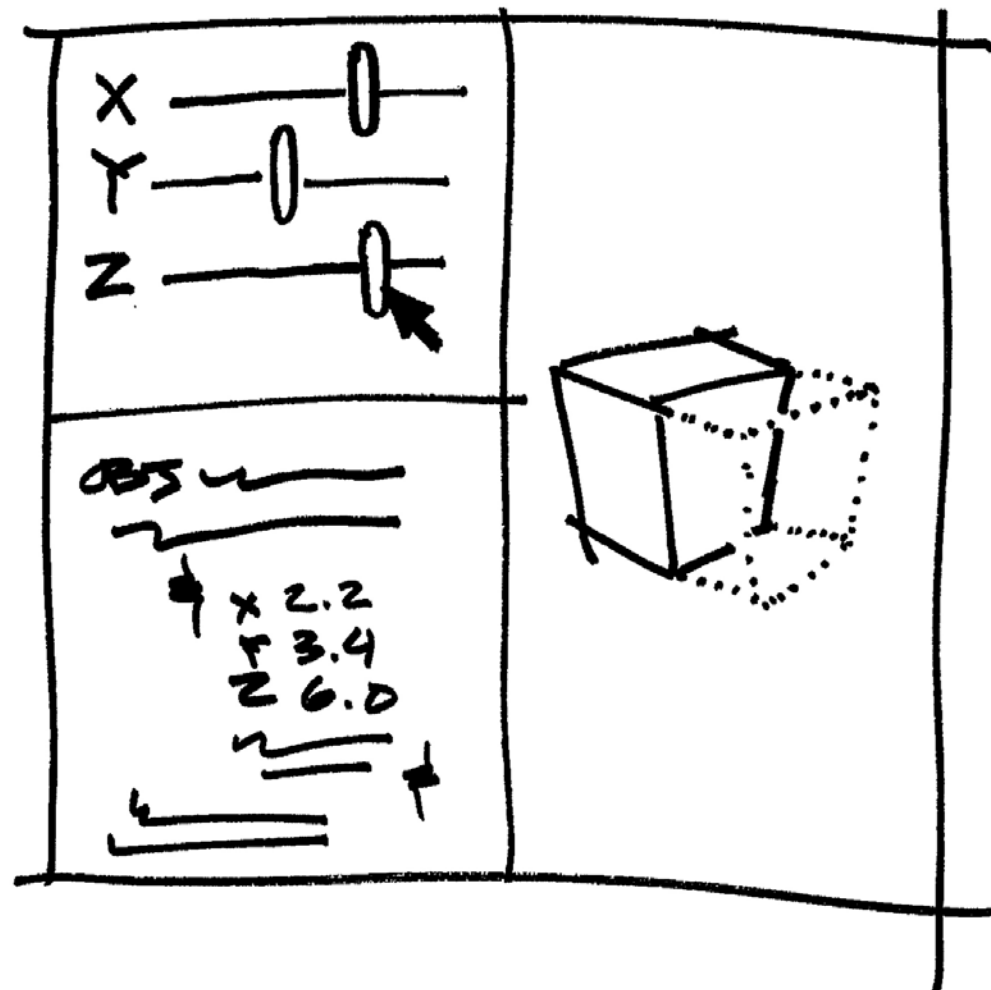
TIMELINE-BASED



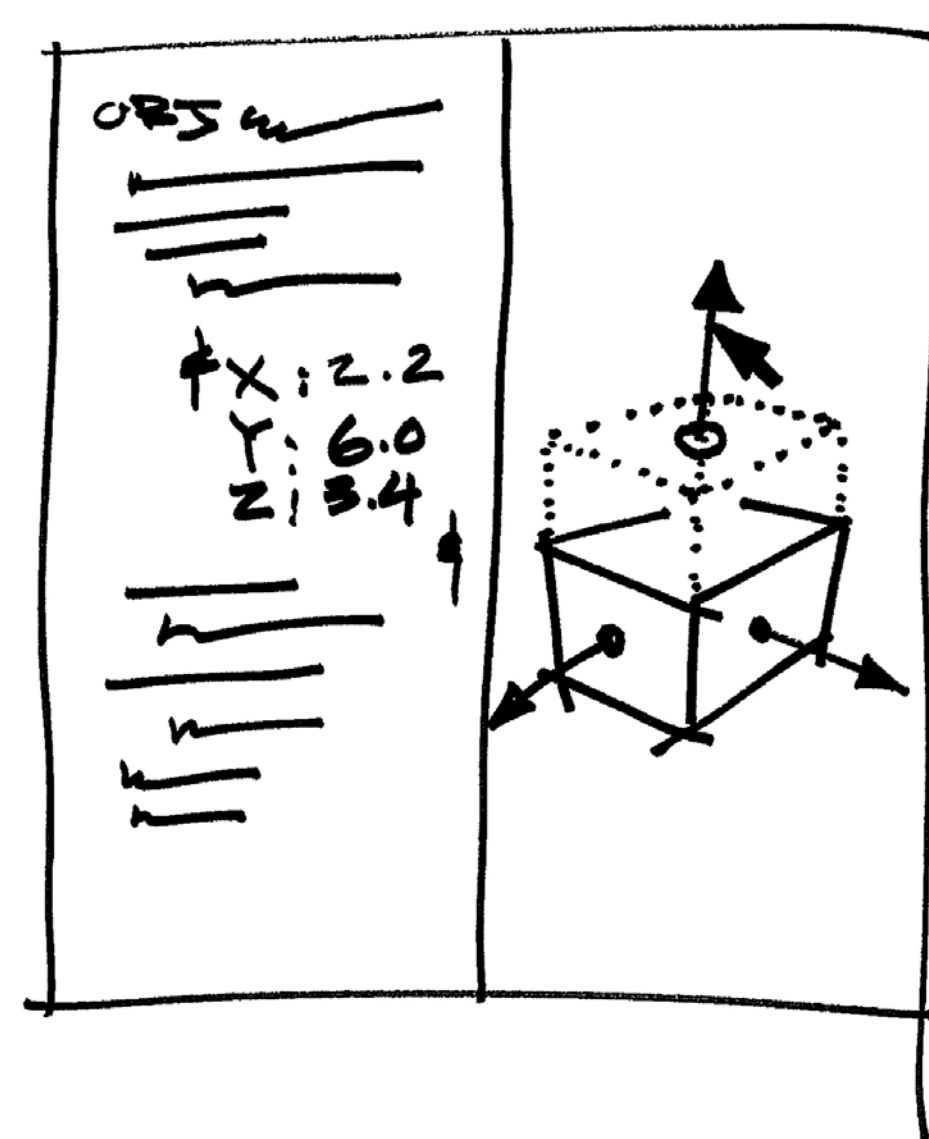
3.3.3, 6.3.6,
6.1.7

LIVE COMPILE

LIVE "FIDDLE"



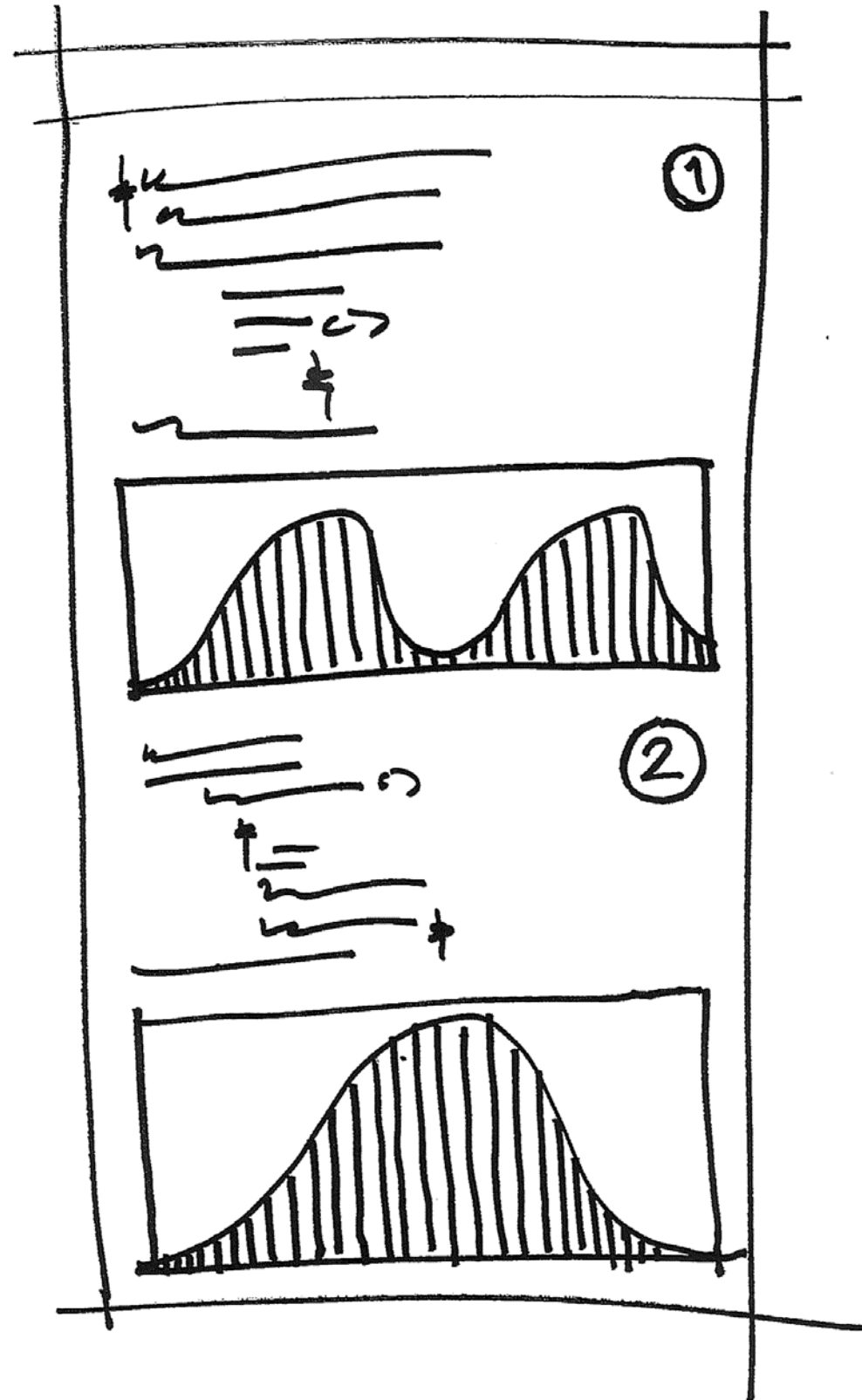
EDITABLE RESULT



4.1.9, 5.4.7, 4.2.4

QUERY & RESPONSE

1.2.4, 1.2.1, 1.2.6



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