July 2, 2018

Data Authoring Environments
An Overview

Hugh Dubberly, Cameron Burgess
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.

Table of Contents

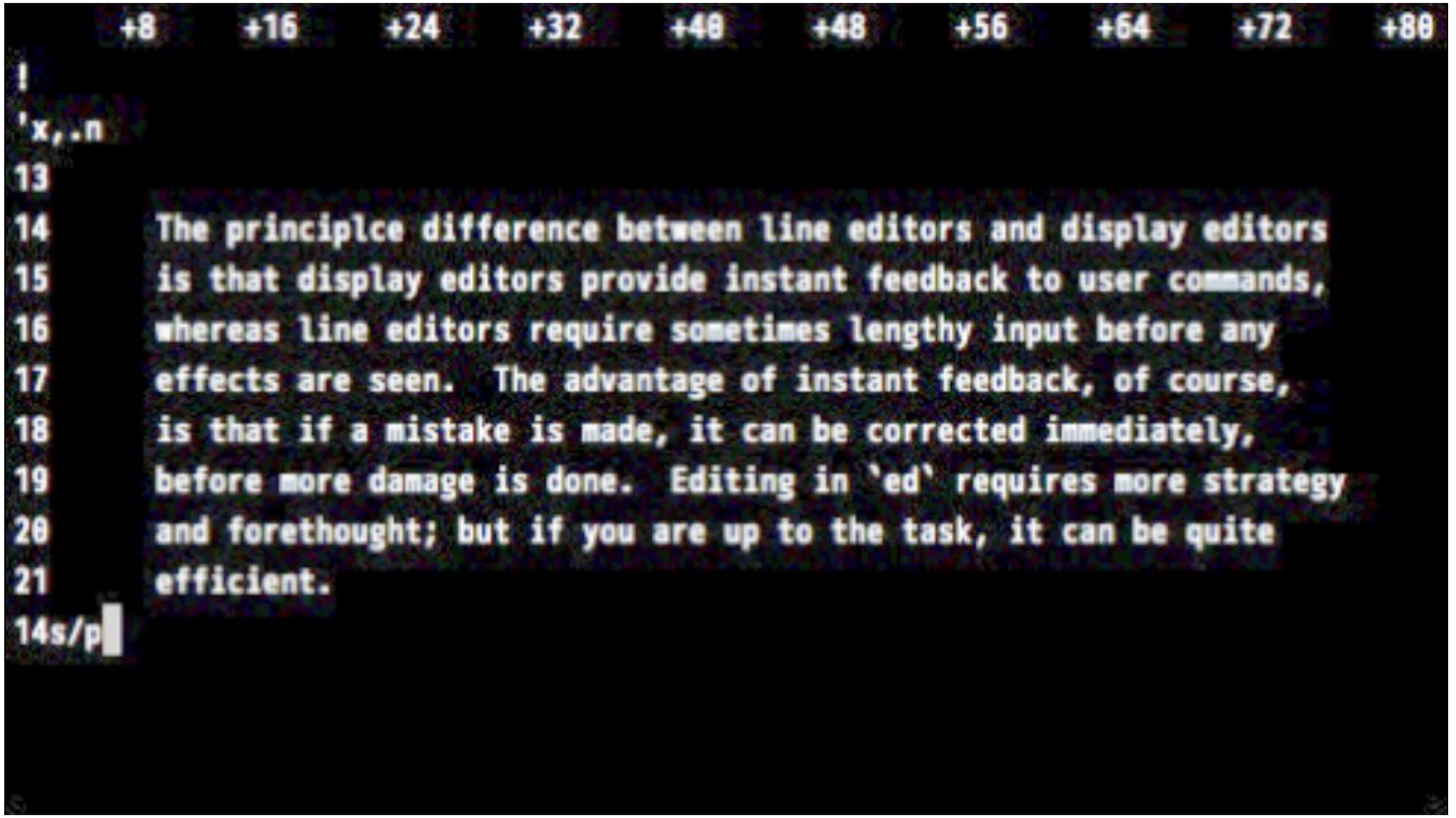
Origins

Starting with “Strings”

Text Editors

Ed

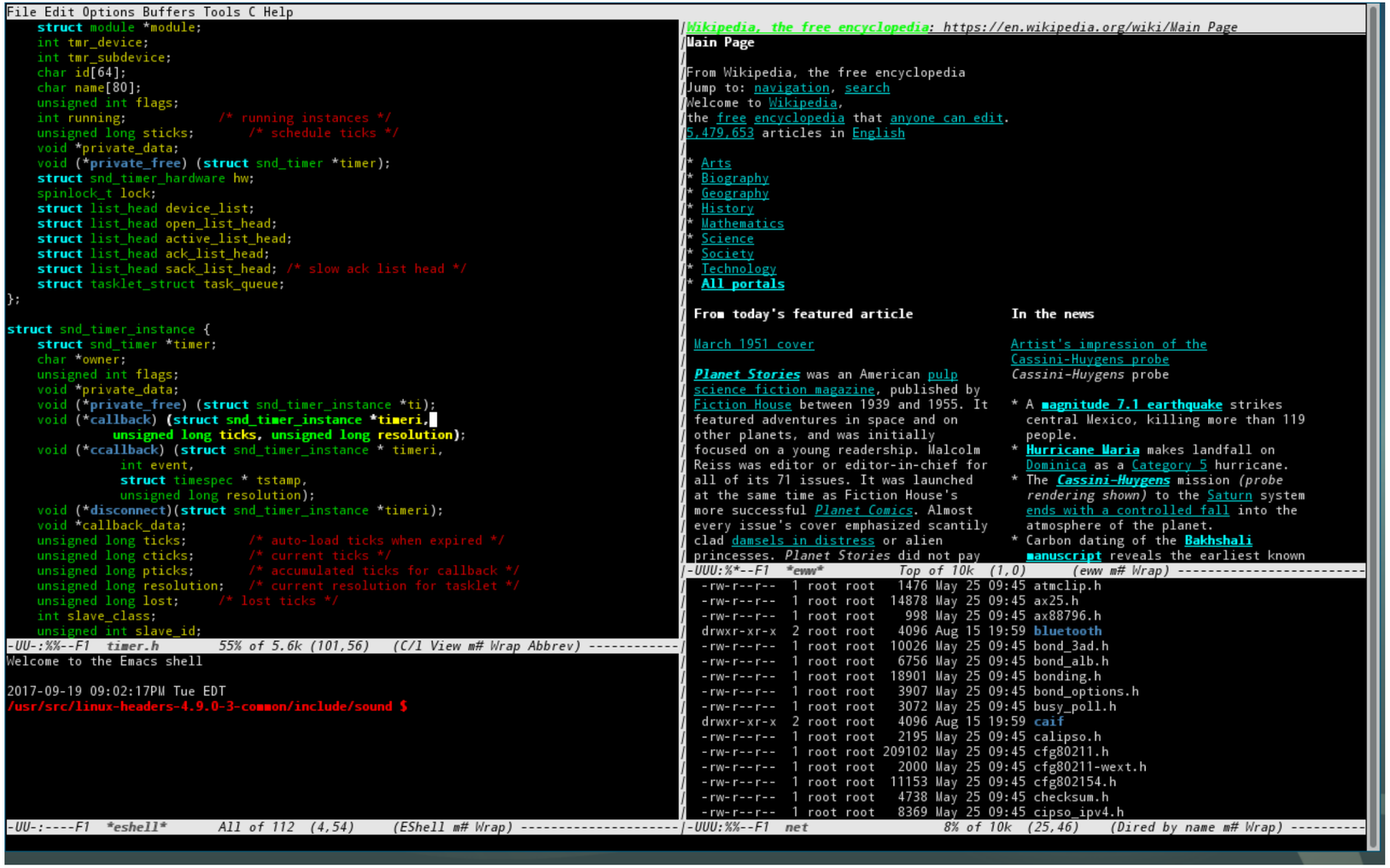
1971



Ken Thompson

Emacs

1976-Today



David A. Moon and Guy L. Steele Jr.

Vim

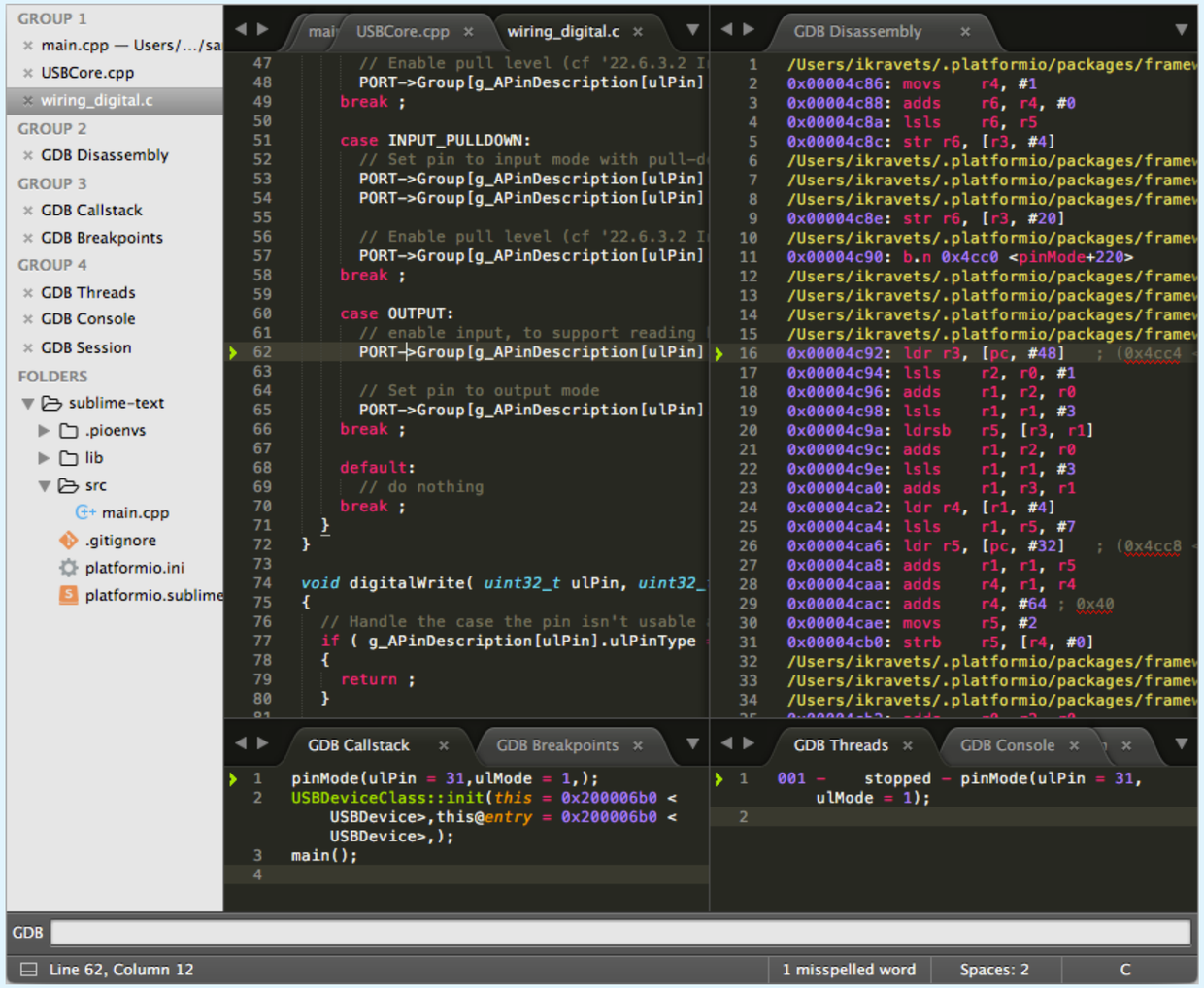
1991-Today

```
// 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.
```

Bram Moolenaar

Sublime Text

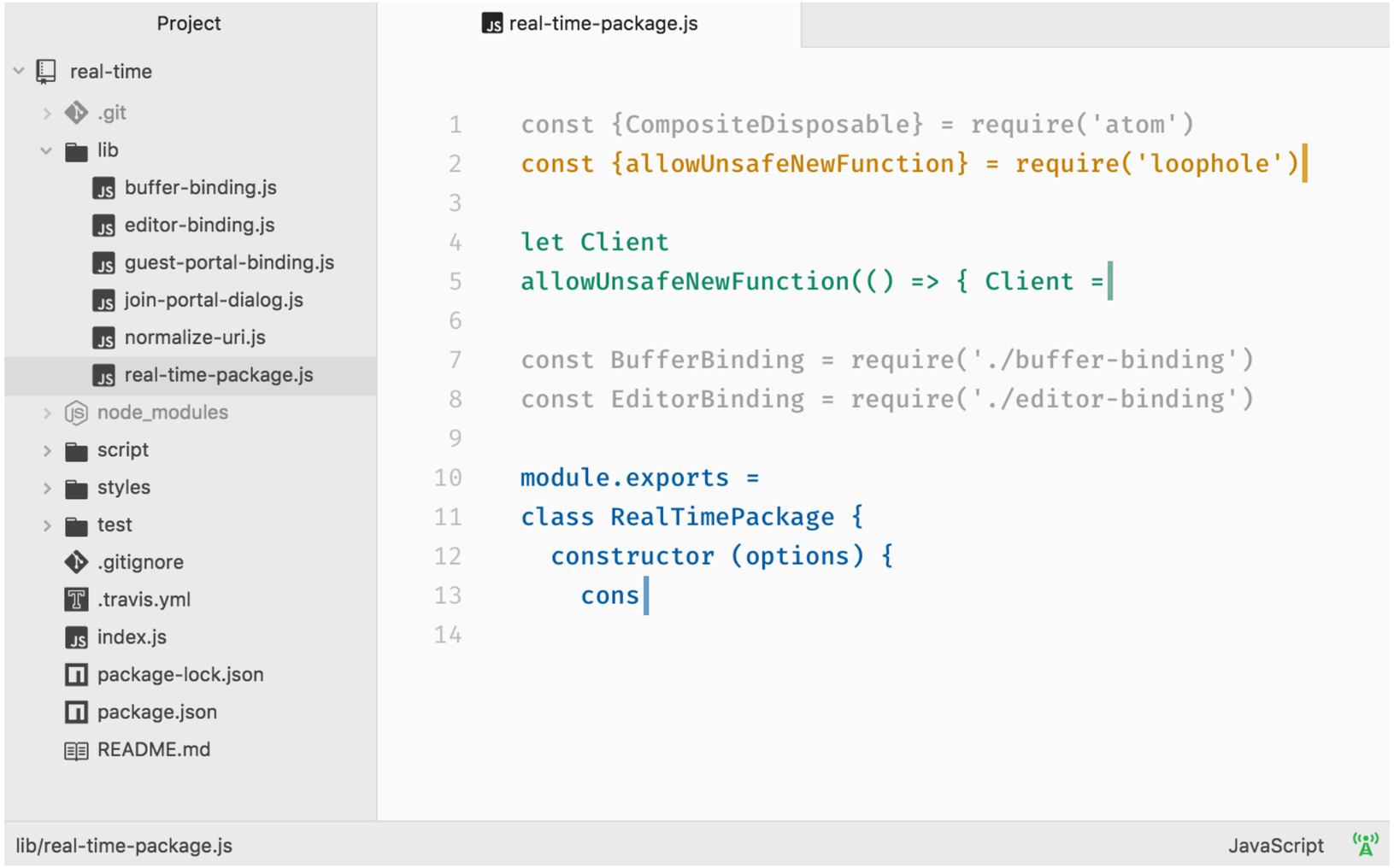
2008-Today



Jon Skinner, Will Bond

Atom

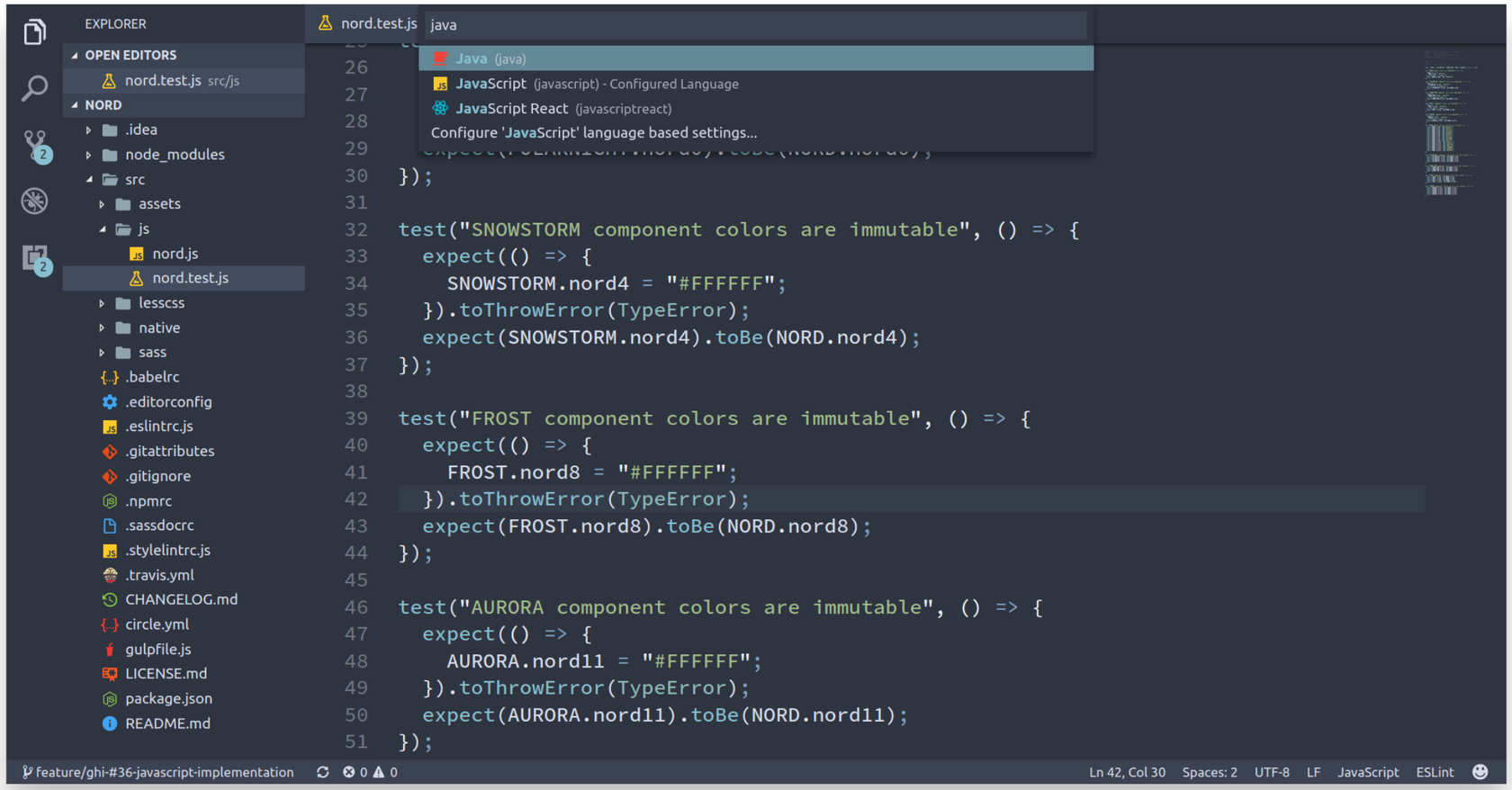
2014-Today



GitHub

Visual Studio Code

2015-Today



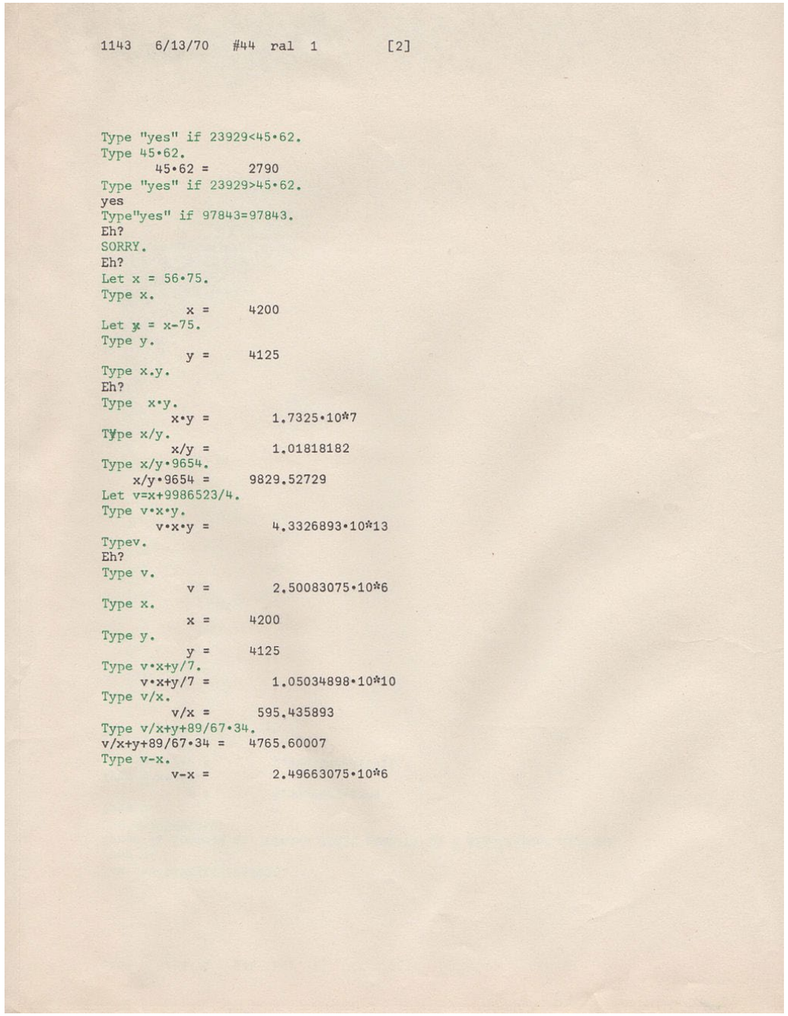
Microsoft

Notebooks

Query & Response Environments

JOSS

1966

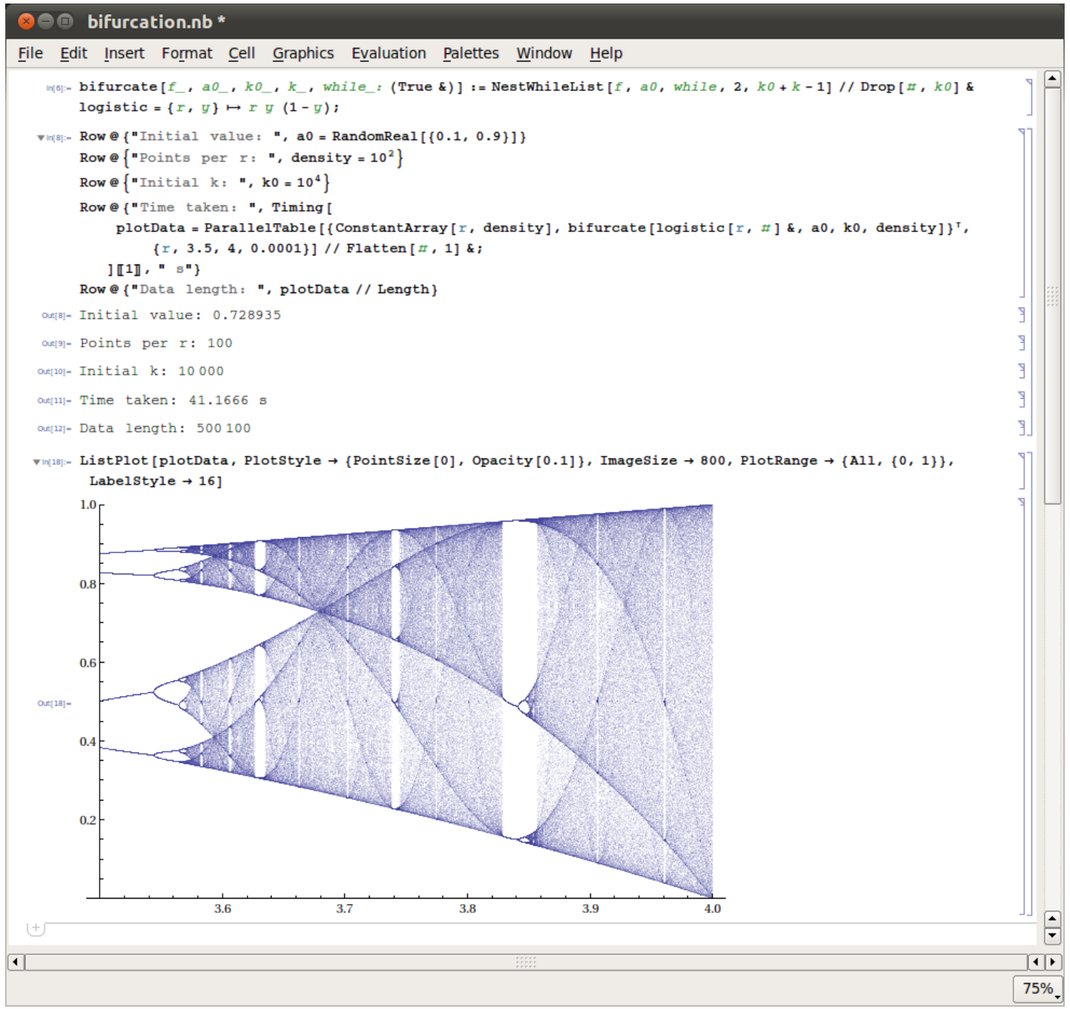


```
1143   6/13/70   #44  ral  1        [2]



Type "yes" if 23929<45•62.
Type 45•62.
      45•62 =     2790
Type "yes" if 23929>45•62.
yes
Type"yes" if 97843=97843.
Eh?
SORRY.
Eh?
Let x = 56•75.
Type x.
         x =     4200
Let x = x-75.
Type y.
         y =     4125
Type x.y.
Eh?
Type  x•y.
        x•y =        1.7325•10*7
Type x/y.
        x/y =        1.01818182
Type x/y•9654.
    x/y•9654 =     9829.52729
Let v=x+9986523/4.
Type v•x•y.
       v•x•y =        4.3326893•10*13
Typev.
Eh?
Type v.
         v =        2.50083075•10*6
Type x.
         x =     4200
Type y.
         y =     4125
Type v•x+y/7.
     v•x+y/7 =        1.05034898•10*10
Type v/x.
        v/x =      595.435893
Type v/x+y+89/67•34.
v/x+y+89/67•34 =   4765.60007
Type v-x.
        v-x =        2.49663075•10*6
```

RAND Corporation

Mathematica

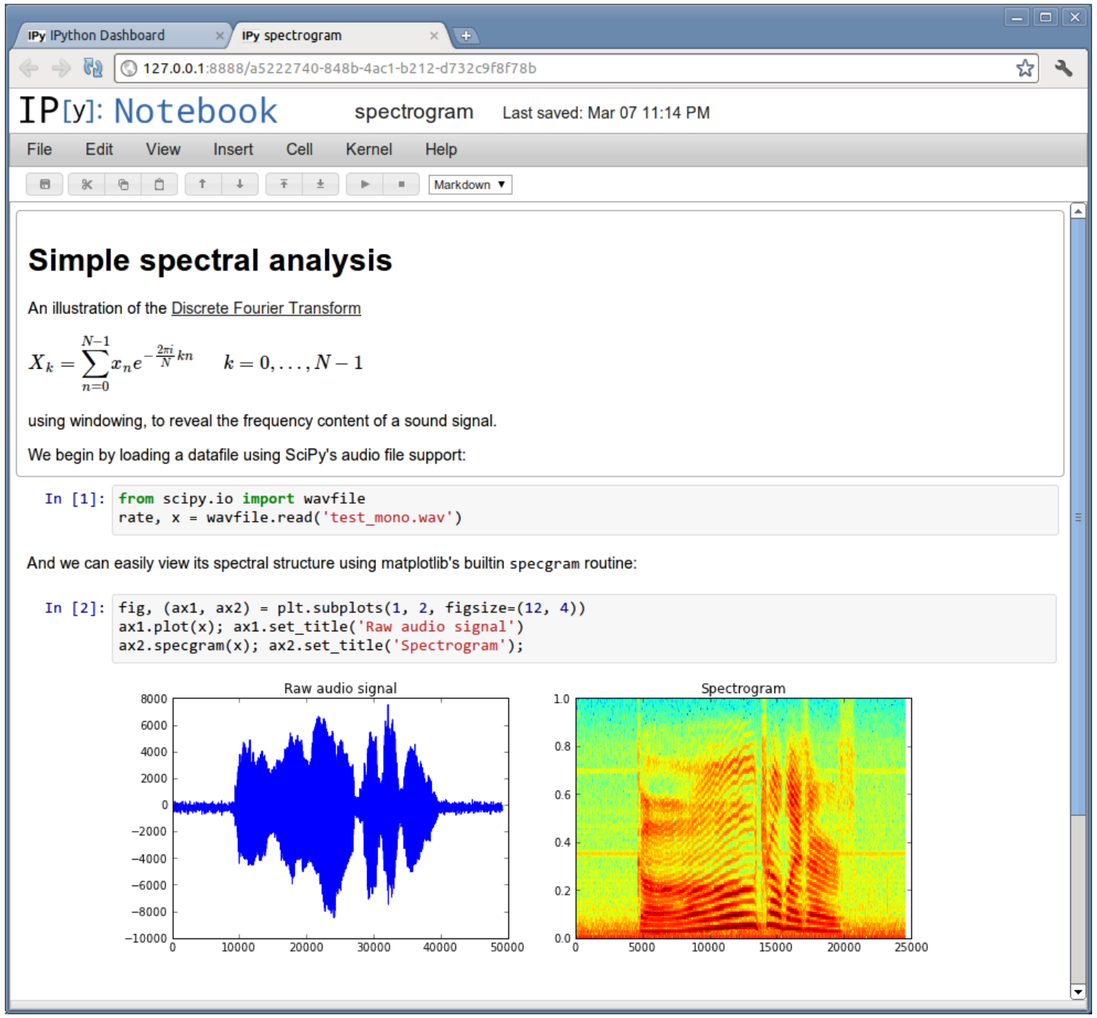
1988-Today



Stephen Wolfram

iPython

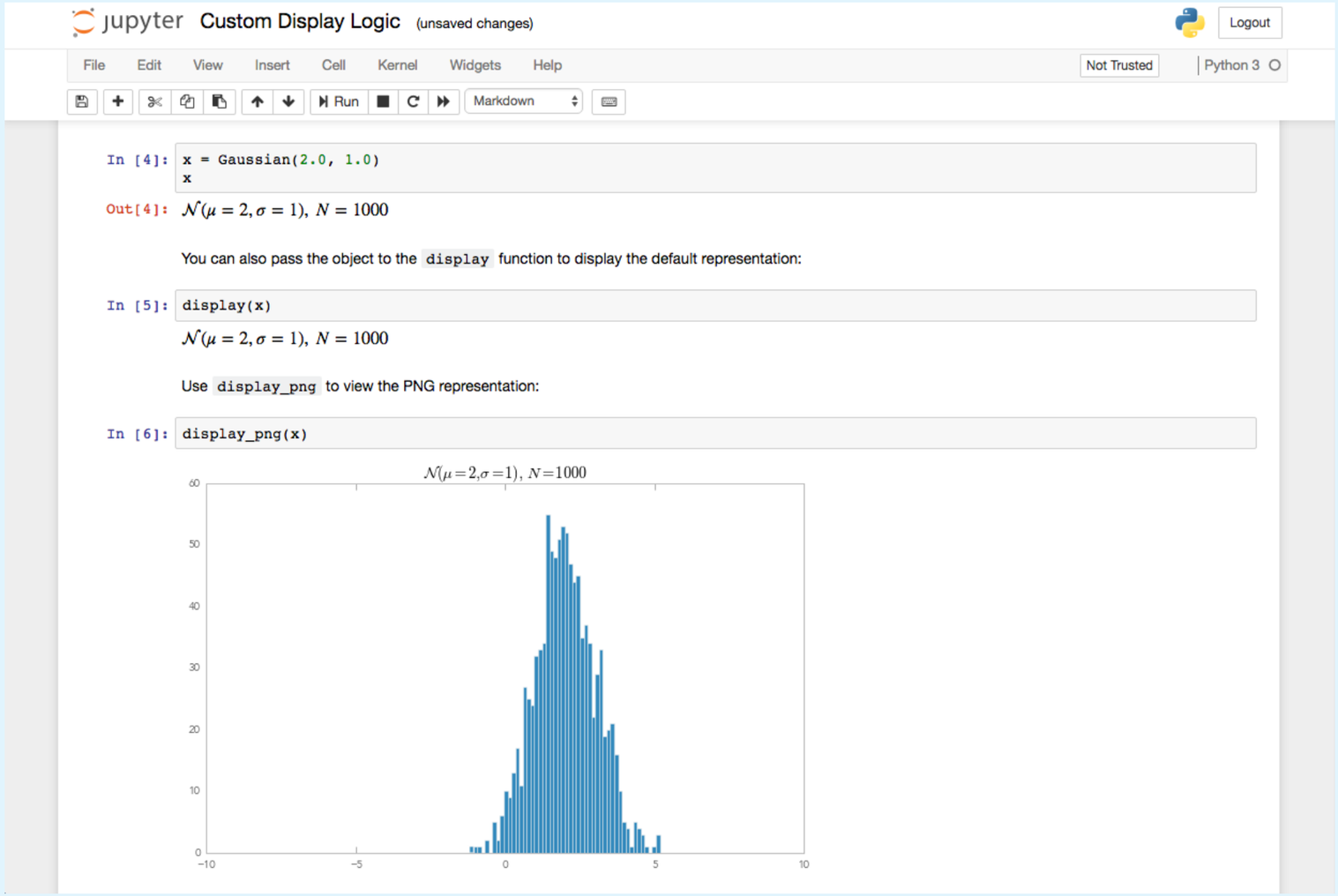
2001-2014



Fernando Pérez

Jupyter

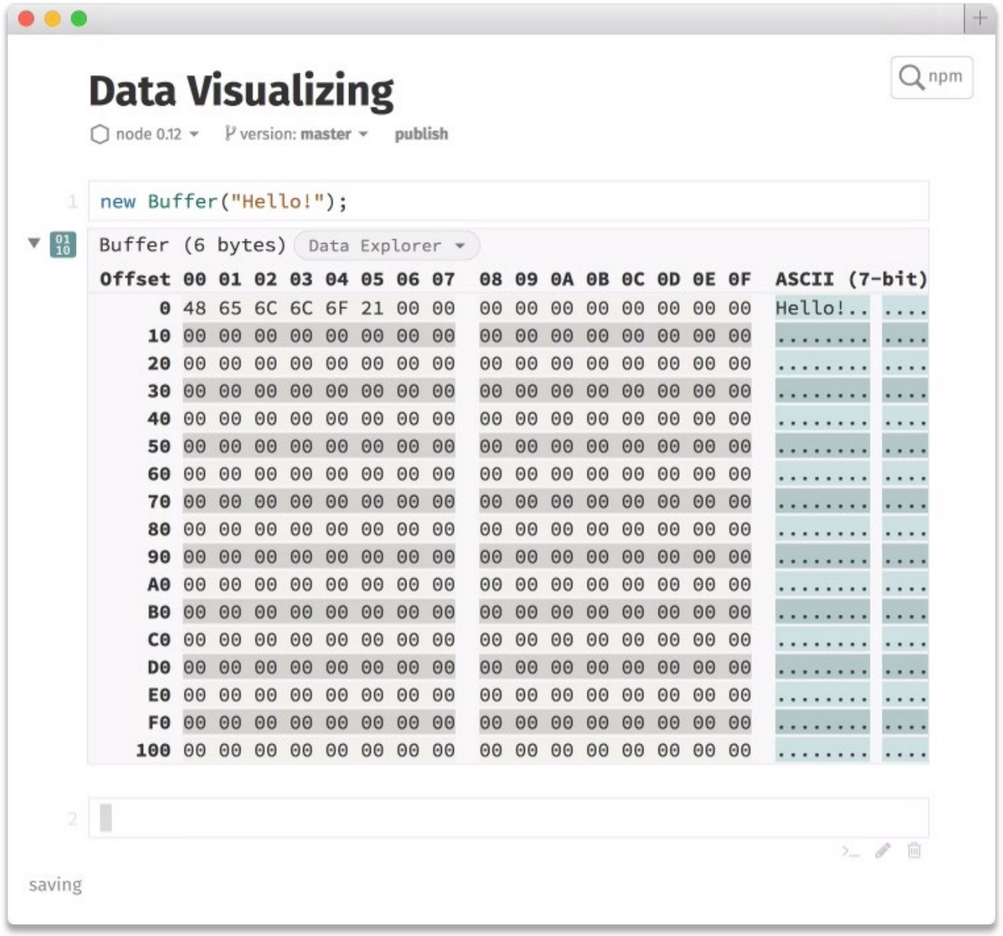
2014-Today

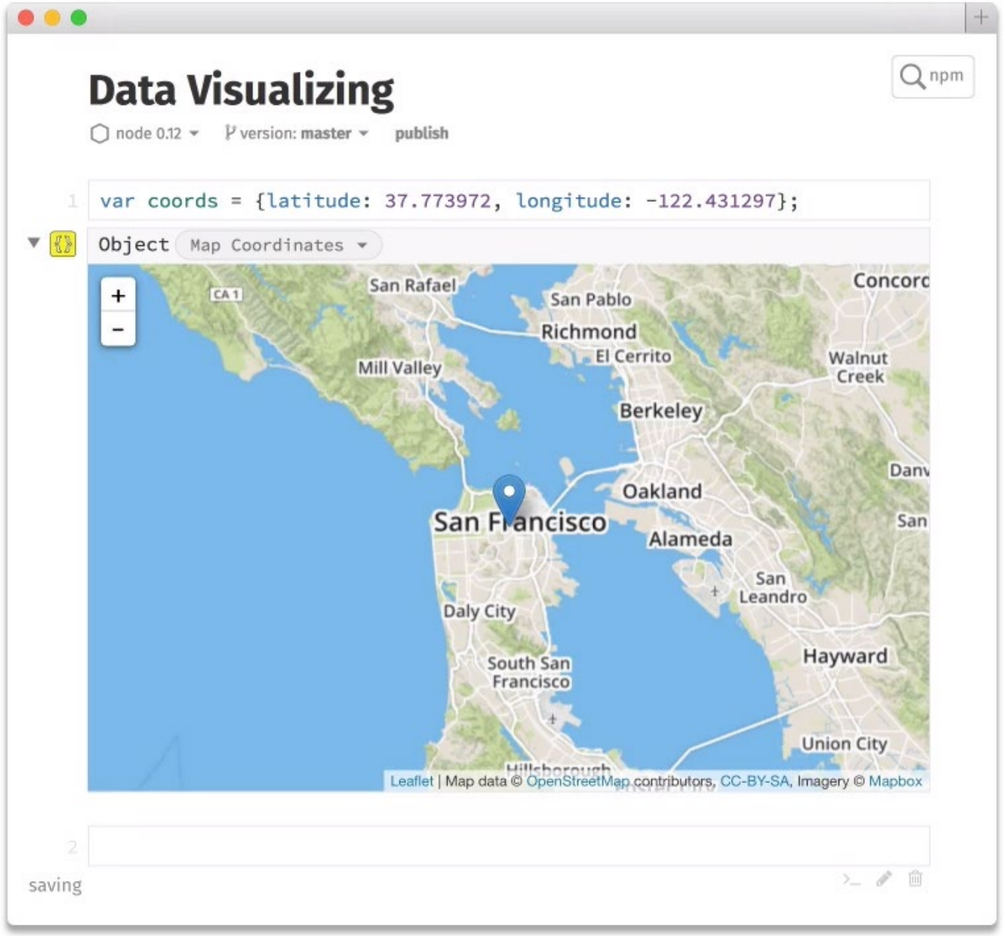


Fernando Pérez and Others

Tonic/RunKit

2015-Today

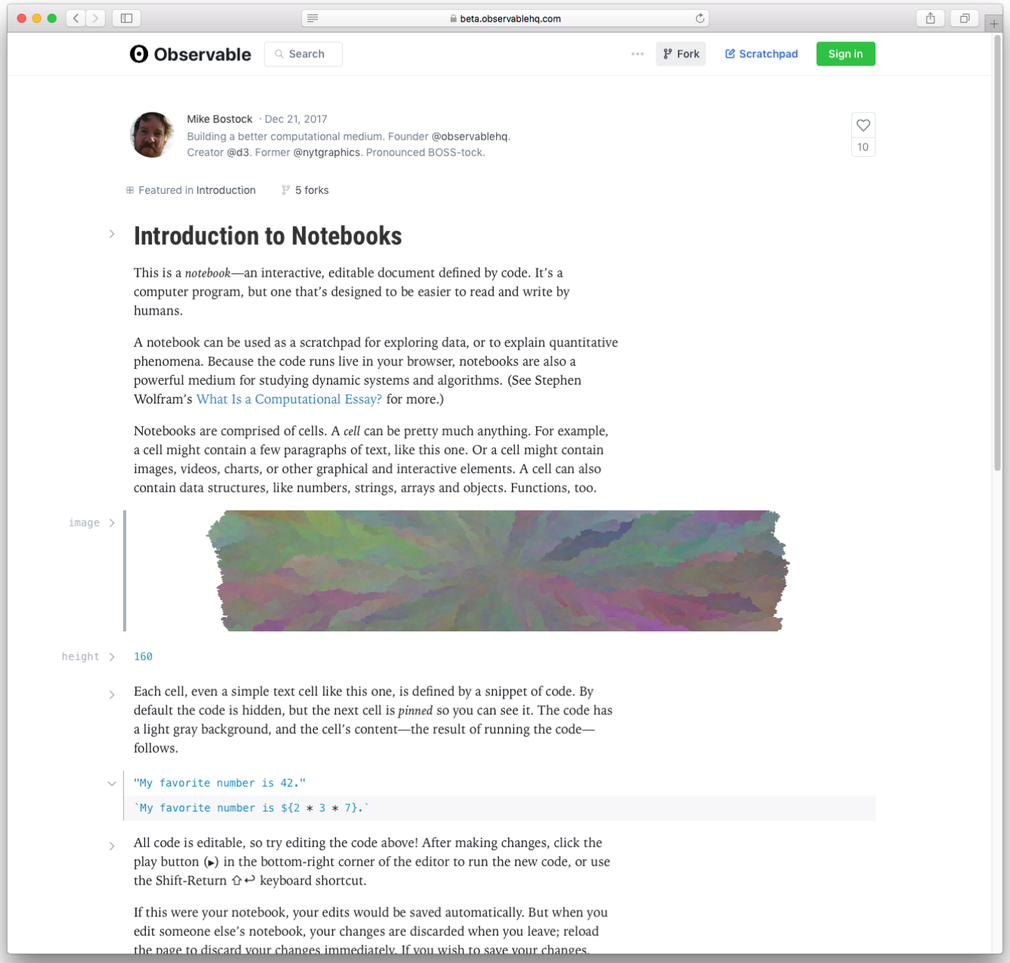




Francisco Tolmasky

Observable

2018-Today



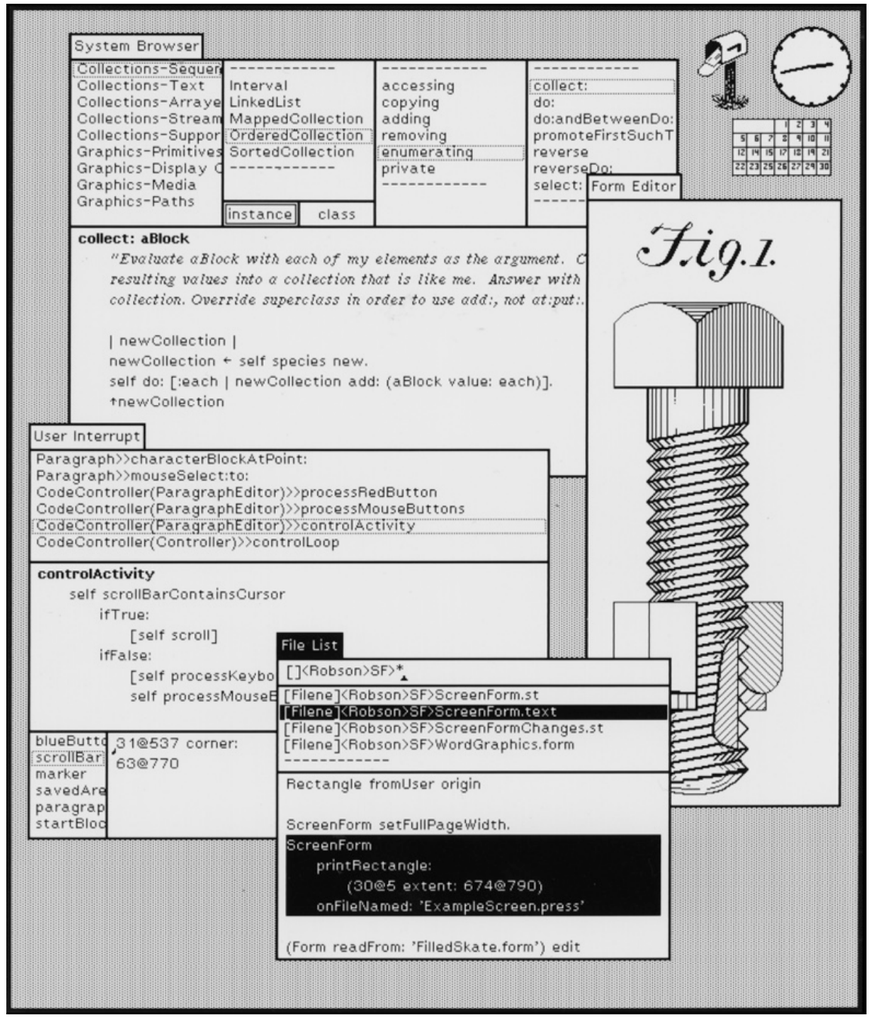
Mike Bostock, Tom MacWright, Jeremy Ashkenas for Observable, Inc.

Card-Stack / Kit-of-Parts

‘Construction Sets’

SmallTalk

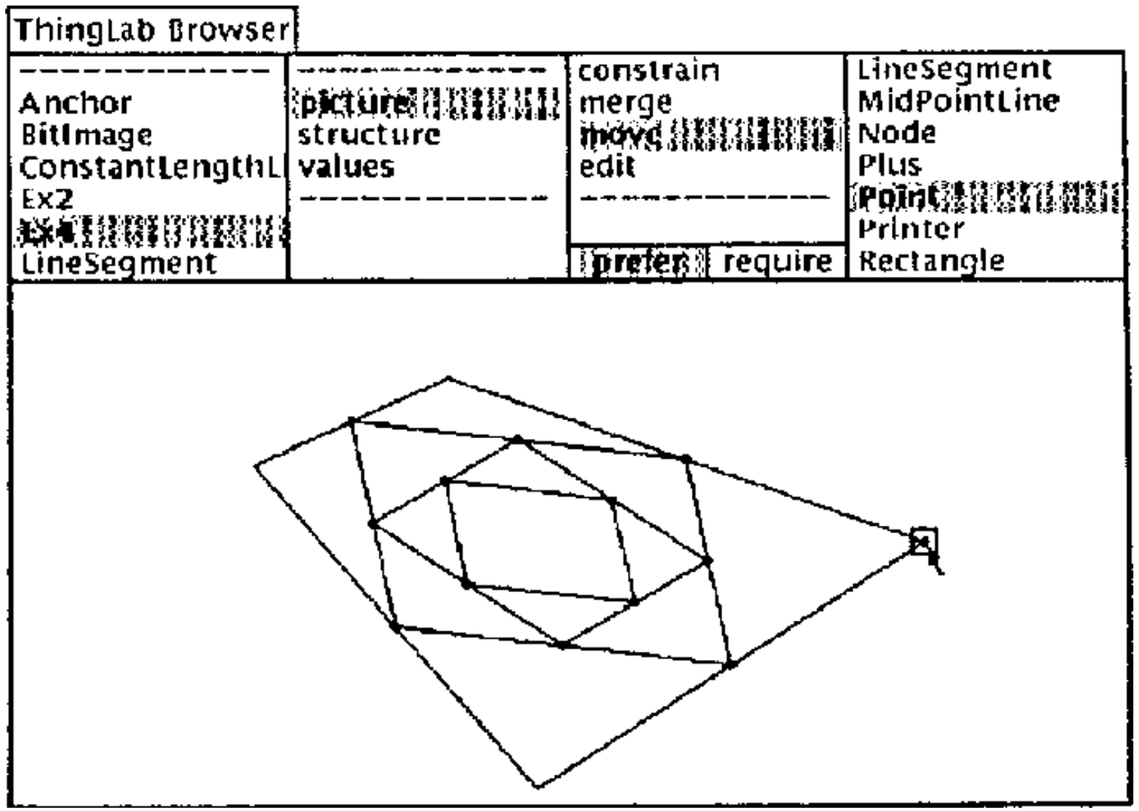
1972-1980

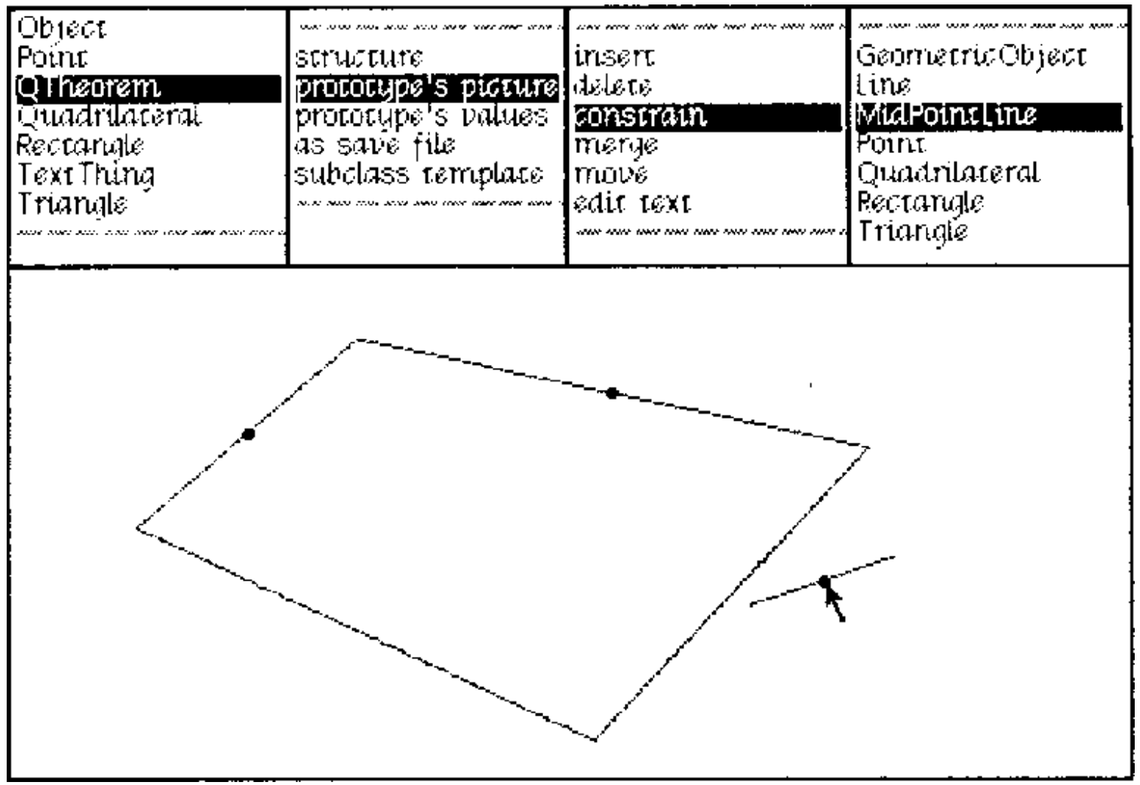


Alan Kay, Dan Ingalls, Adele Goldberg, Ted Kaehler, Diana Merry, Scott Wallace, Peter Deutsch at XEROX PARC

ThingLab

1977

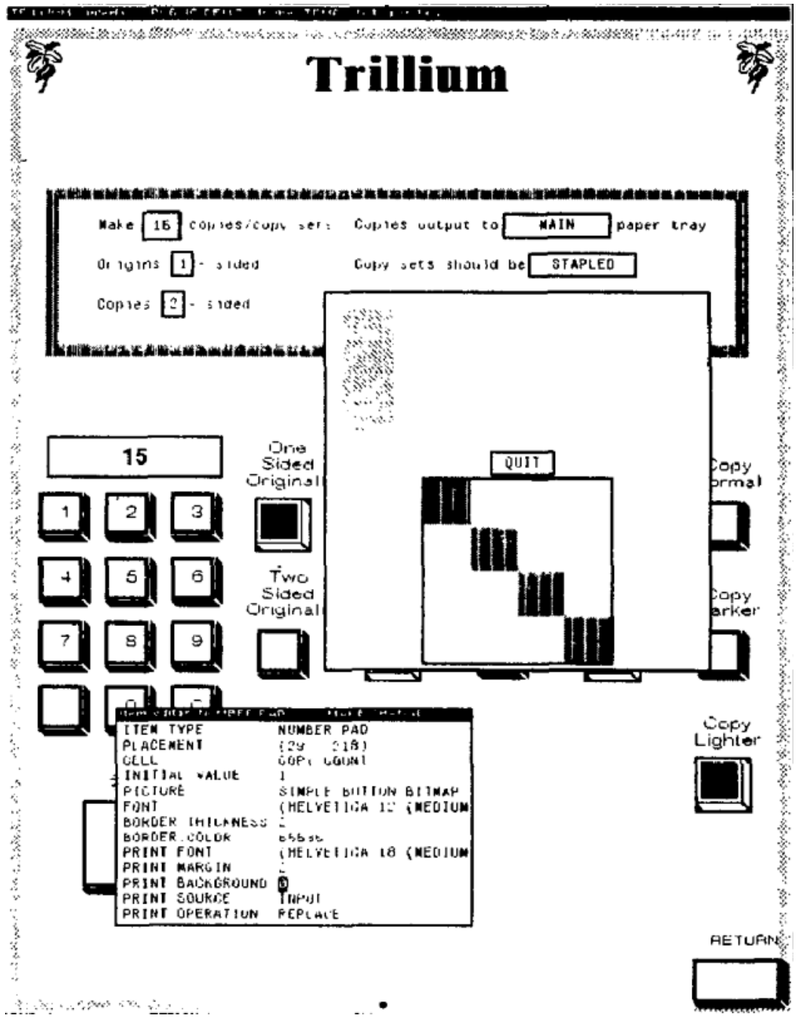


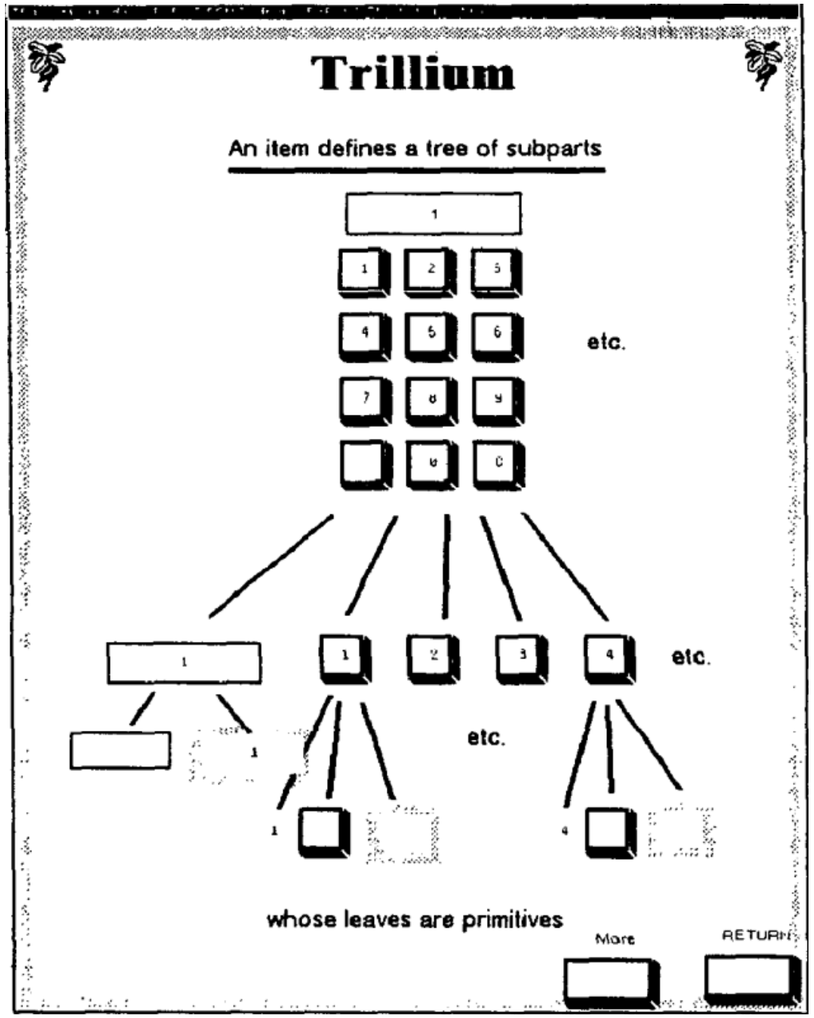


Alan Borning

Trillium

1986

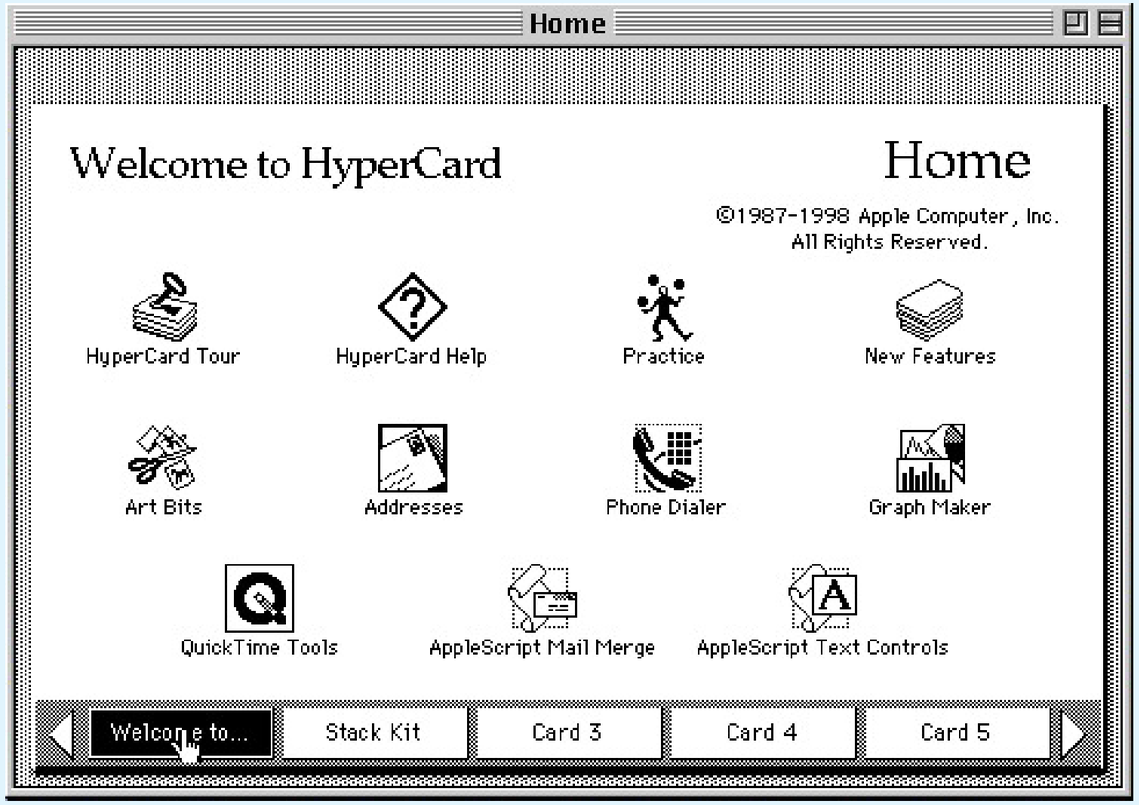


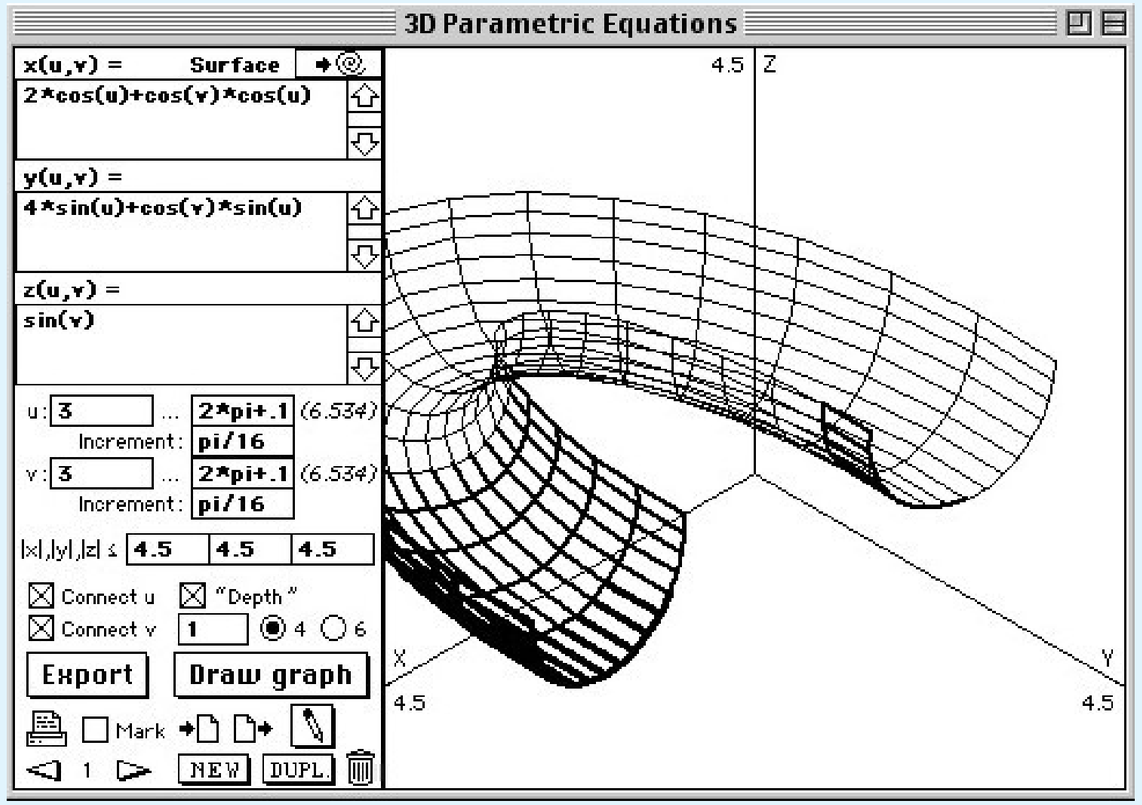


Austin Henderson at Xerox PARC

Hypercard

1987-1998

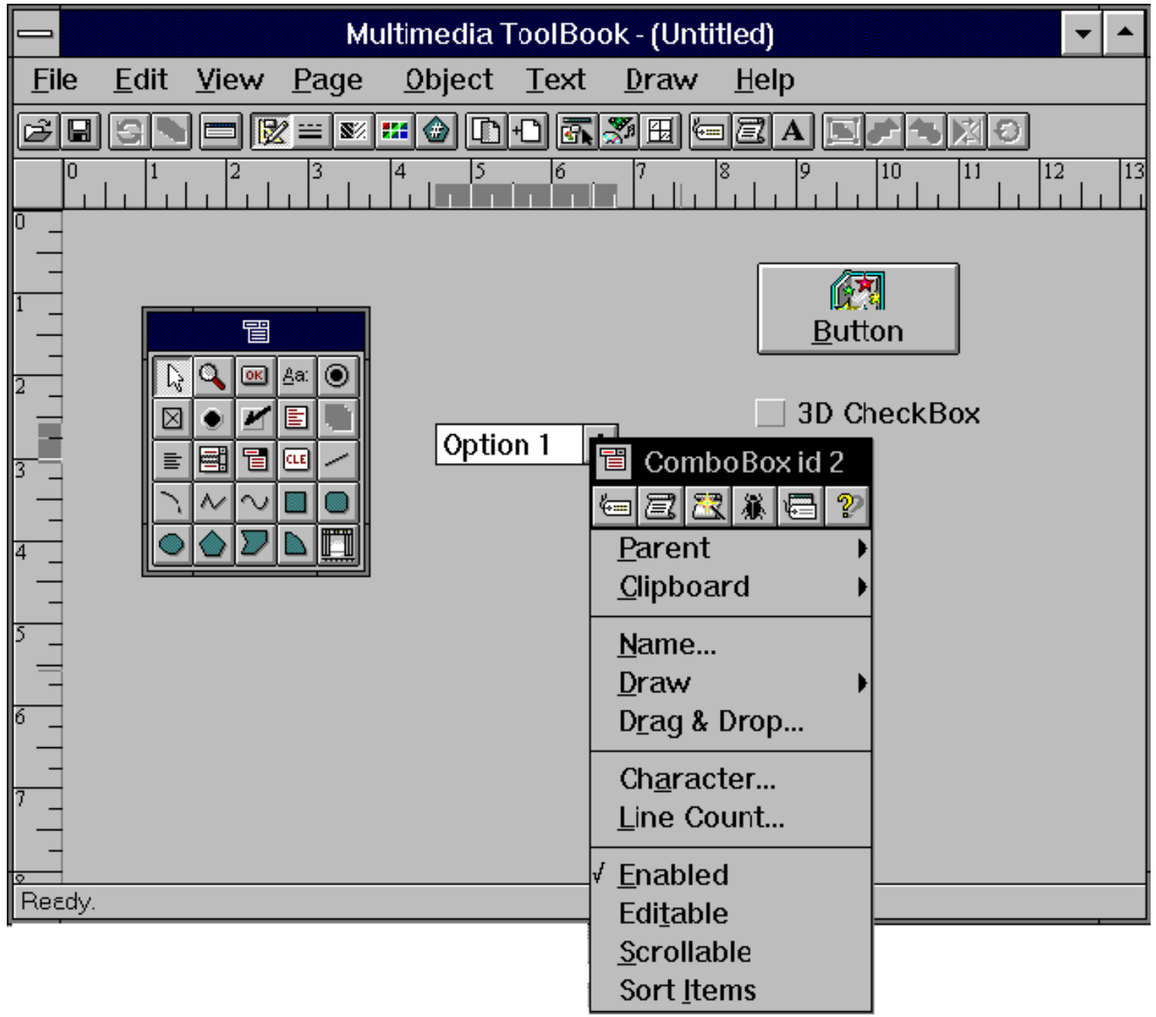




Bill Atkinson for Apple

ToolBook

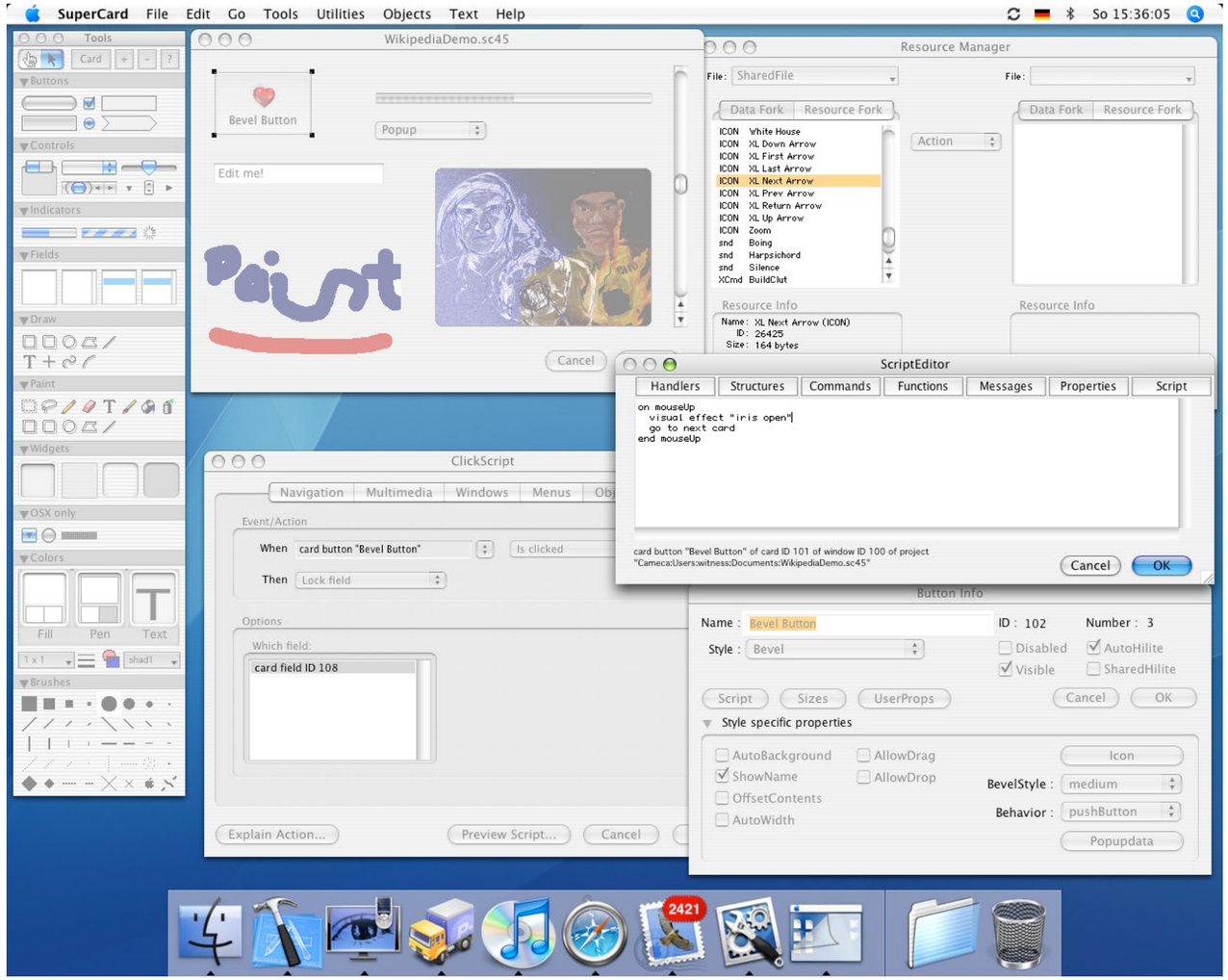
1990-2012



Asymetrix (Later SumTotal Systems)

SuperCard

1989-2012



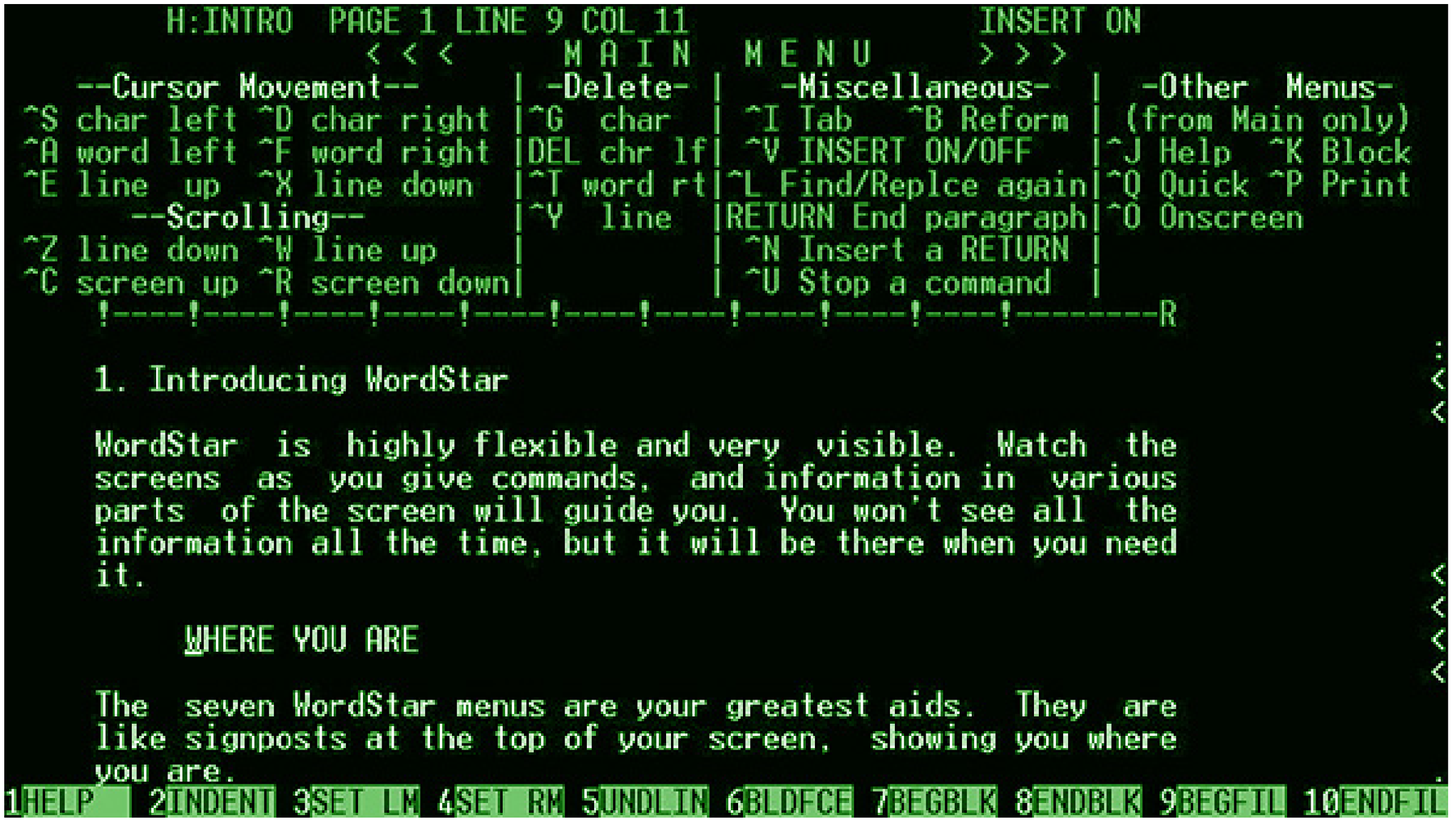
Bill Appleton for Silicon Beach Software (Later Aldus Corporation, Allegiant Technologies, Incwell DMG, now Solutions Etcetera)

‘Bureaucracy Processing’

From Static Documents To Living Environments

WordStar

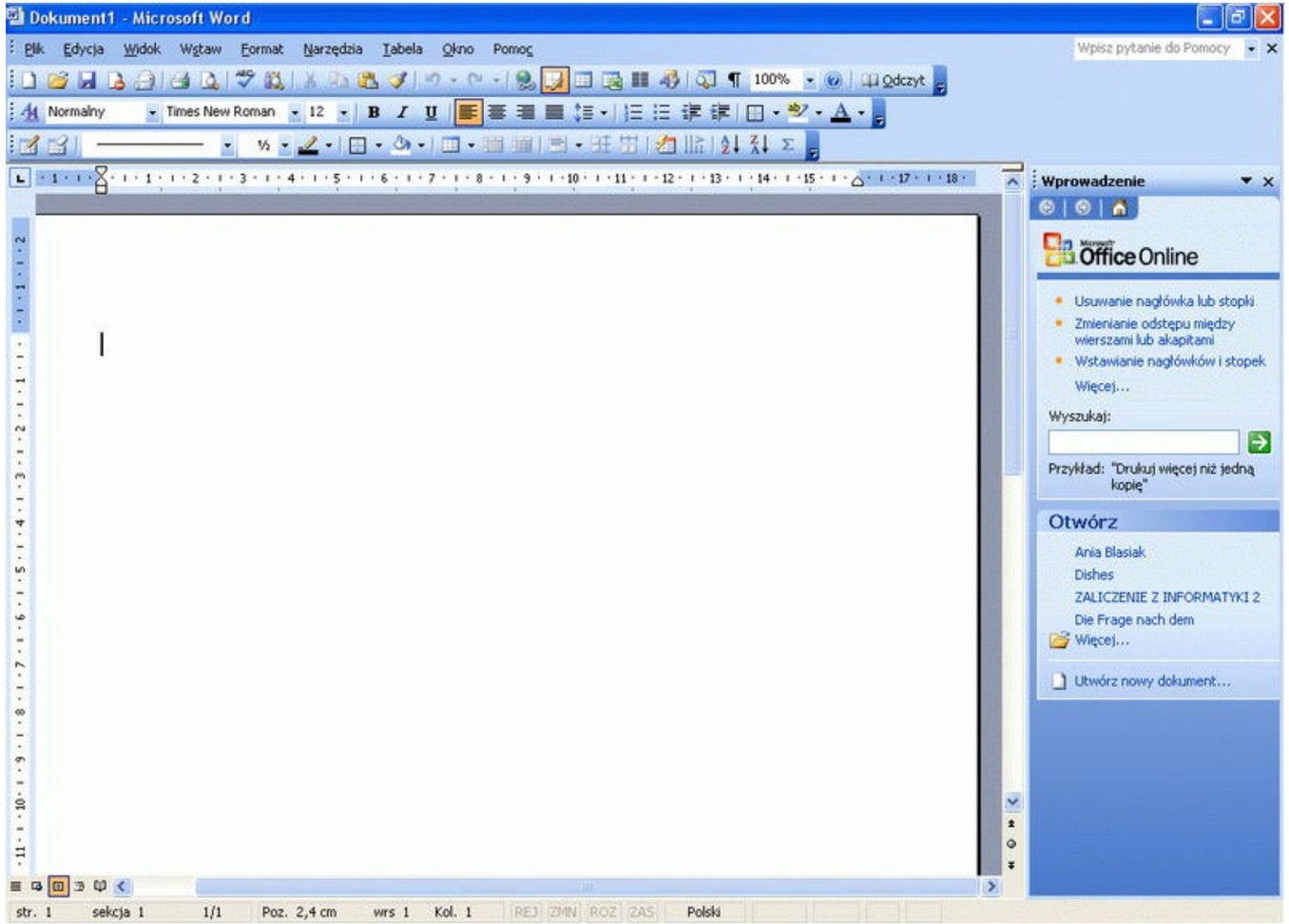
1978-1999



Rob Barnaby

Word

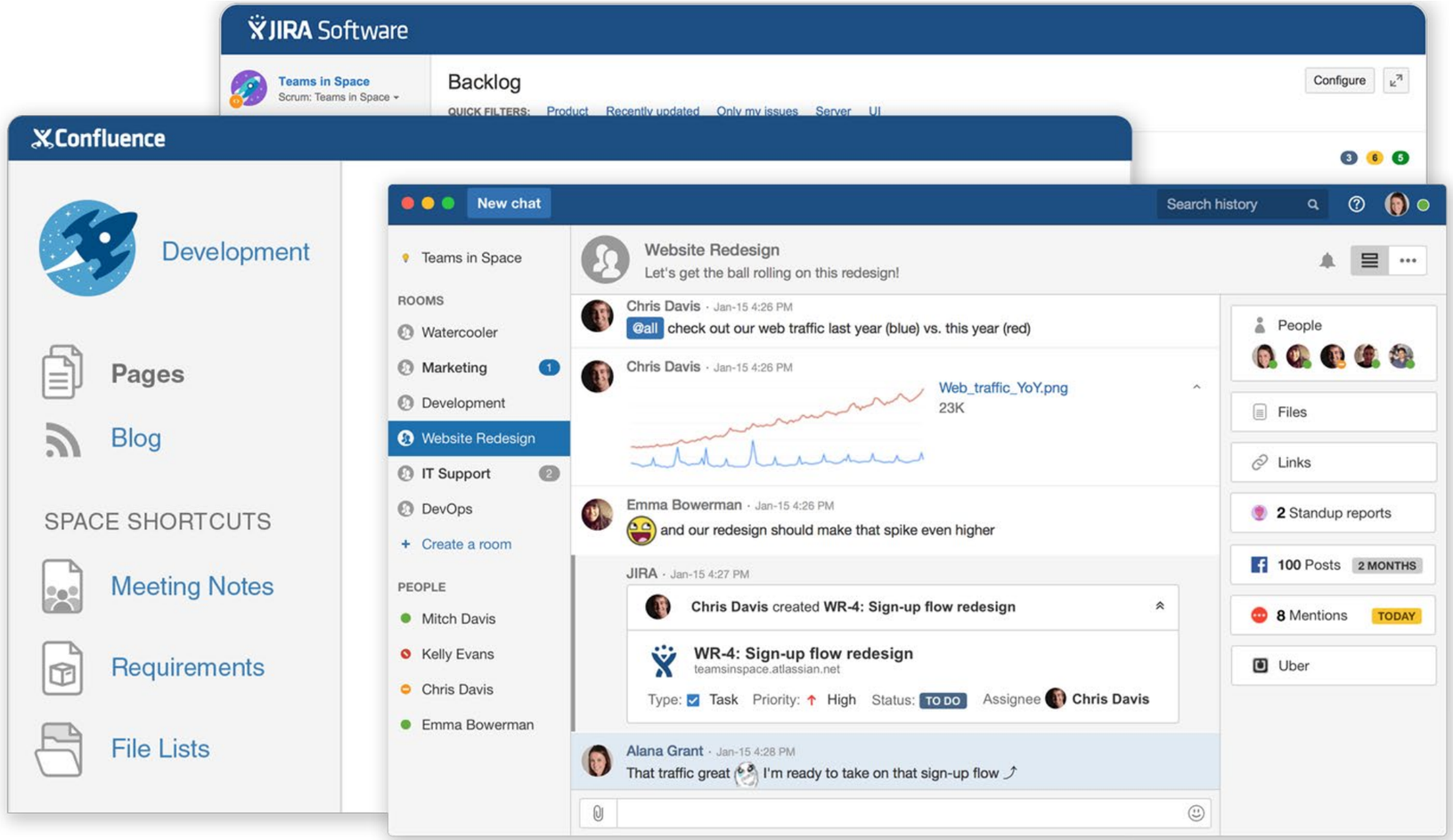
1983-Today



Microsoft

Atlassian (Suite)

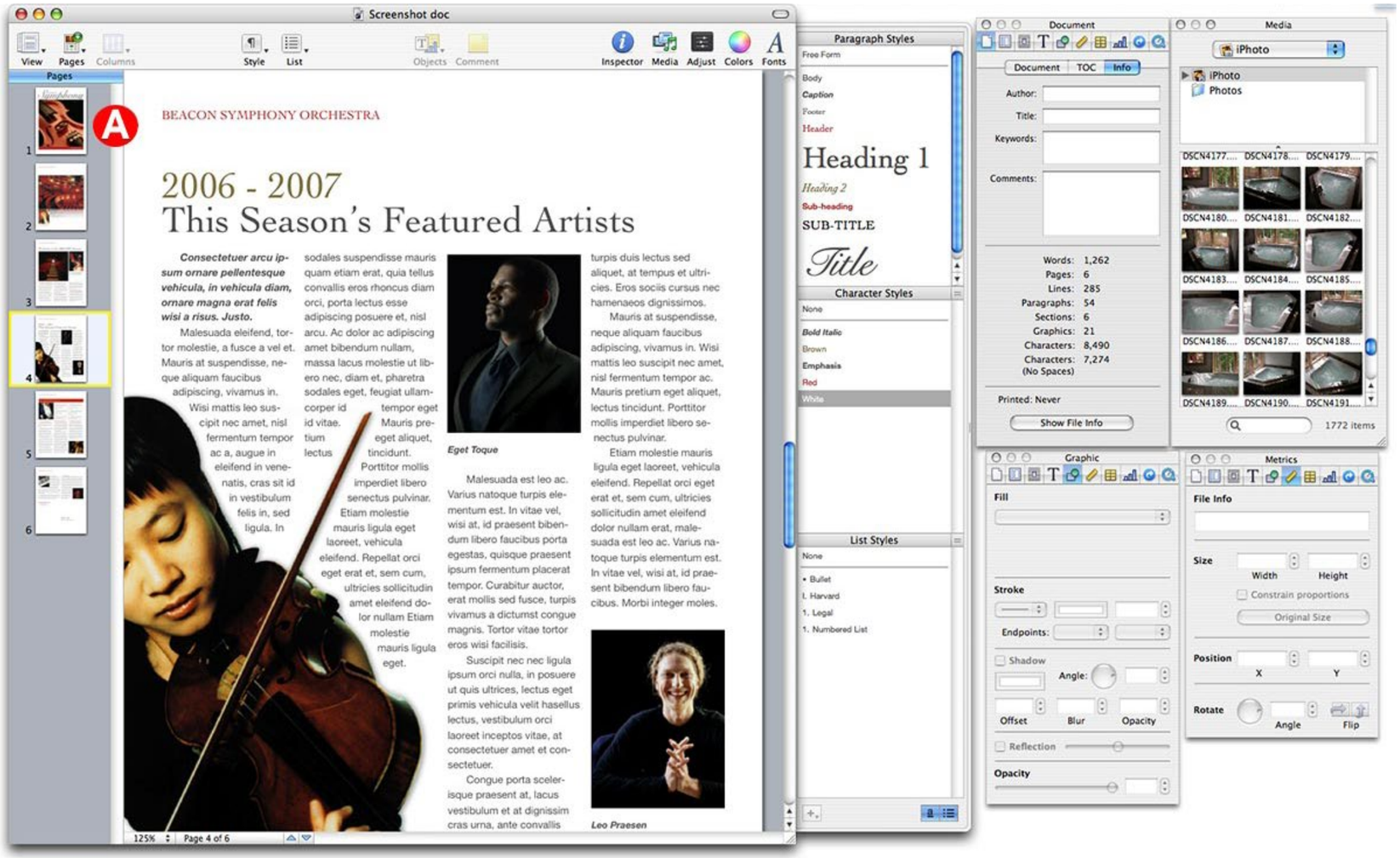
2002-Today



Mike Cannon-Brookes and Scott Farquhar

Pages

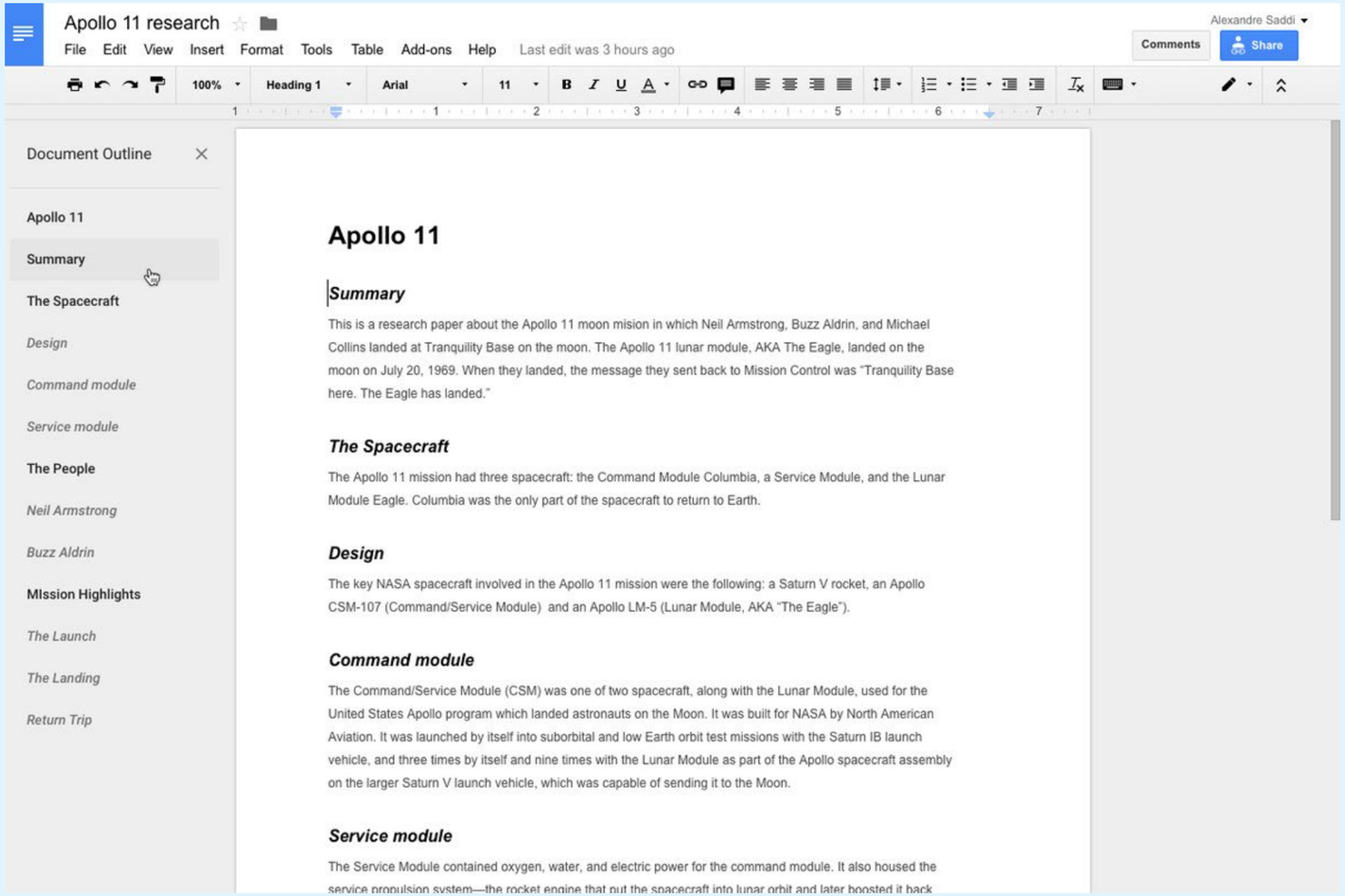
2005-Today



Apple

Docs

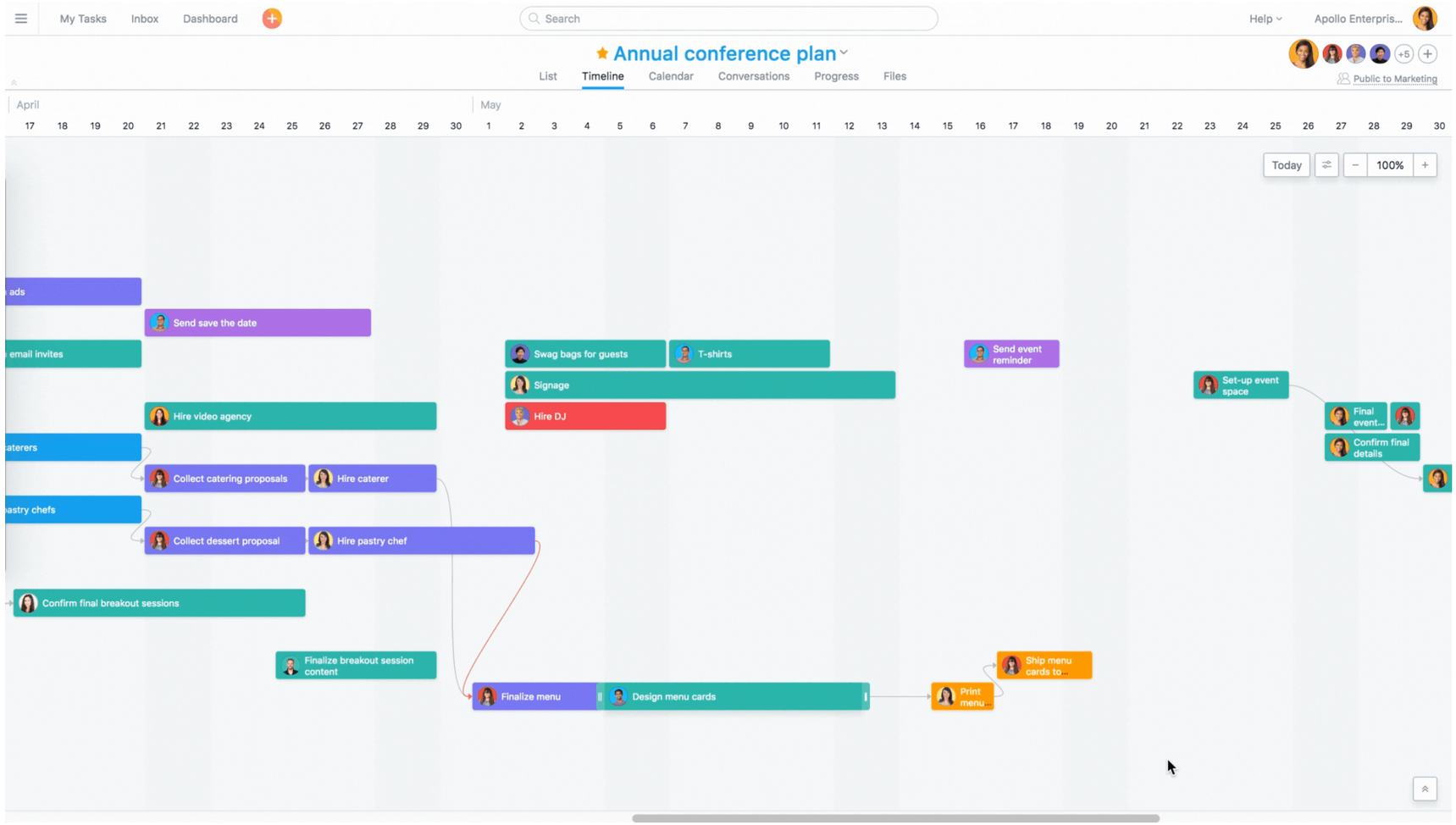
2006-Today



Google

Asana

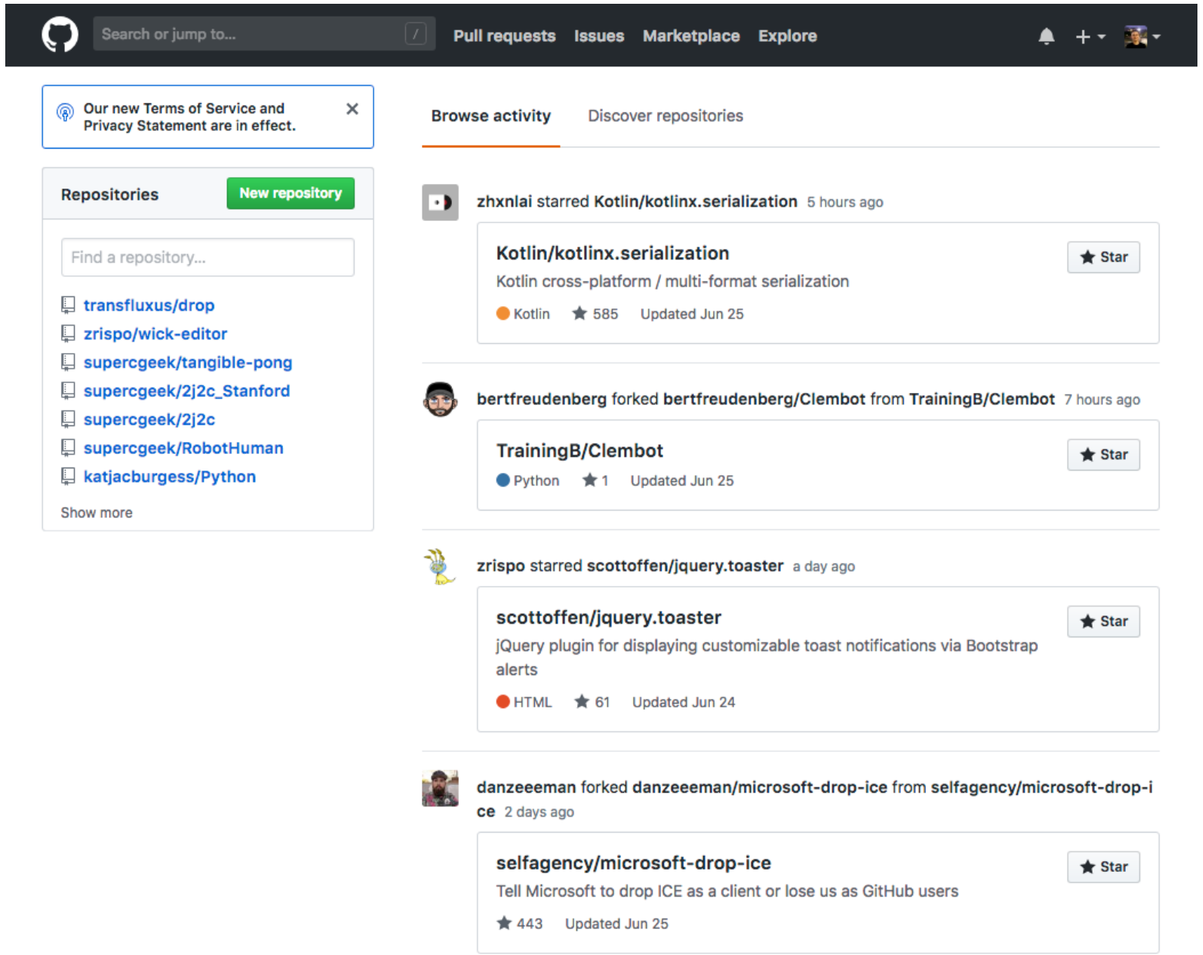
2008-Today



Dustin Moskovitz and Justin Rosenstein

GitHub

2008-Today



Tom Preston-Werner for GitHub Inc (Now Microsoft)

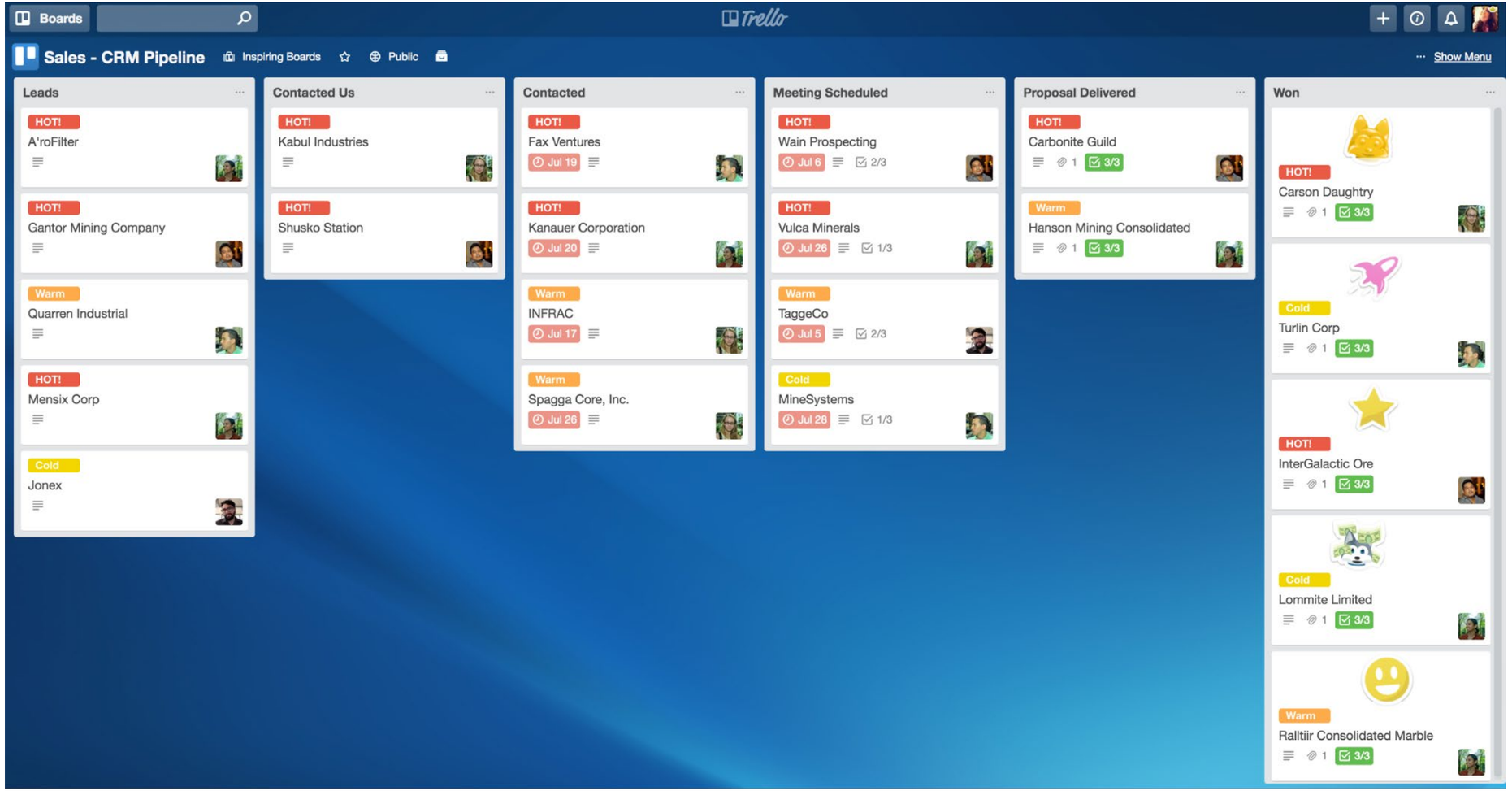
Wave

2009-2011

Google

Trello

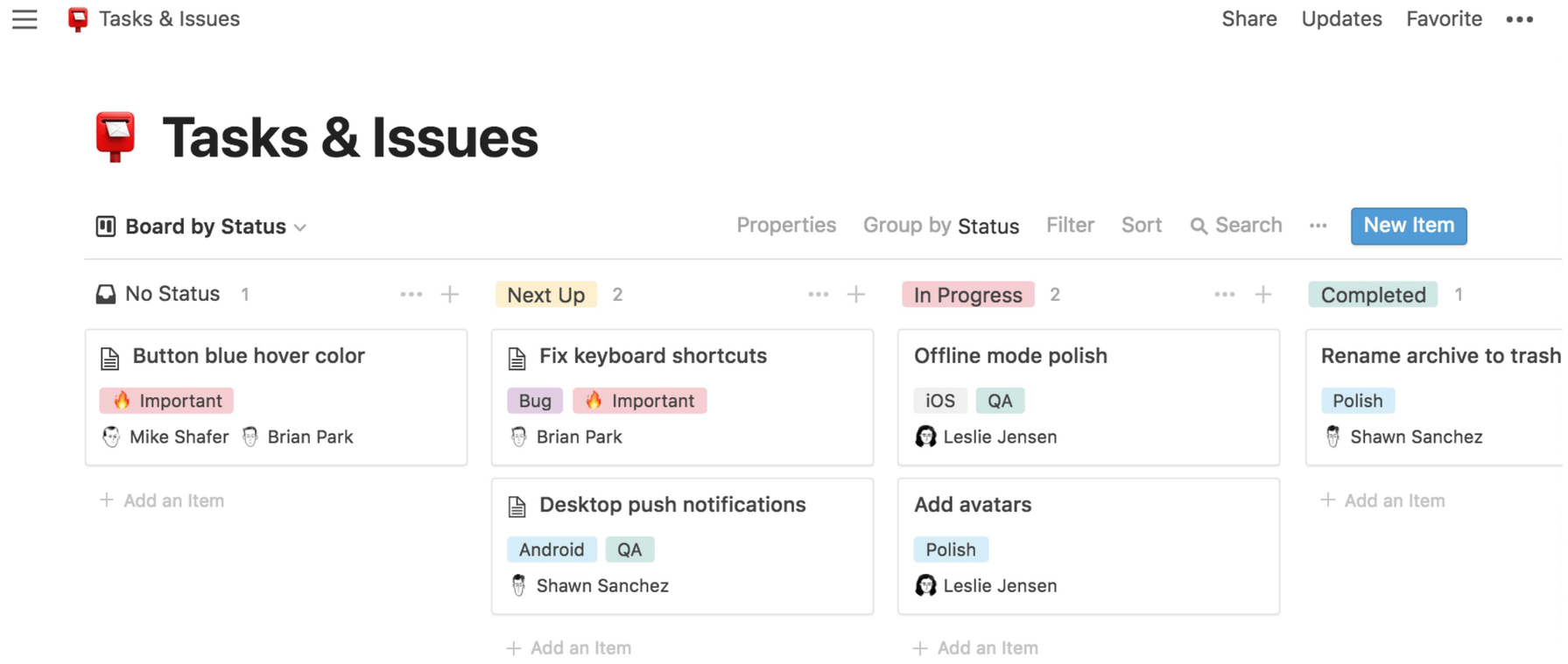
2011-Today



Joel Spolsky at Fog Creek (Later Atlassian)

Notion

2016-Today



Notion Labs Inc

Bits to Atoms

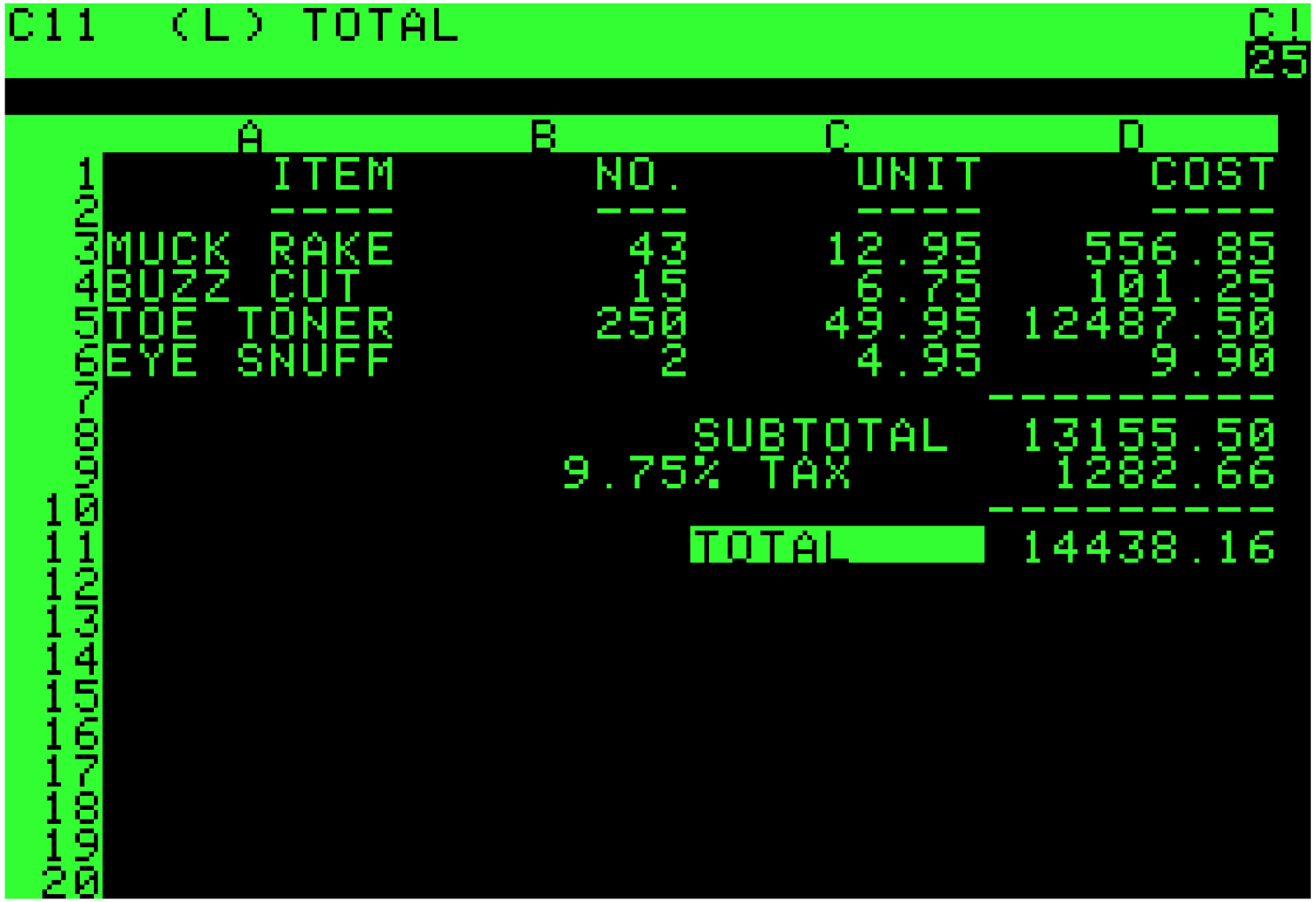
Computation meets Business & Industry

Spreadsheets

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

VisiCalc

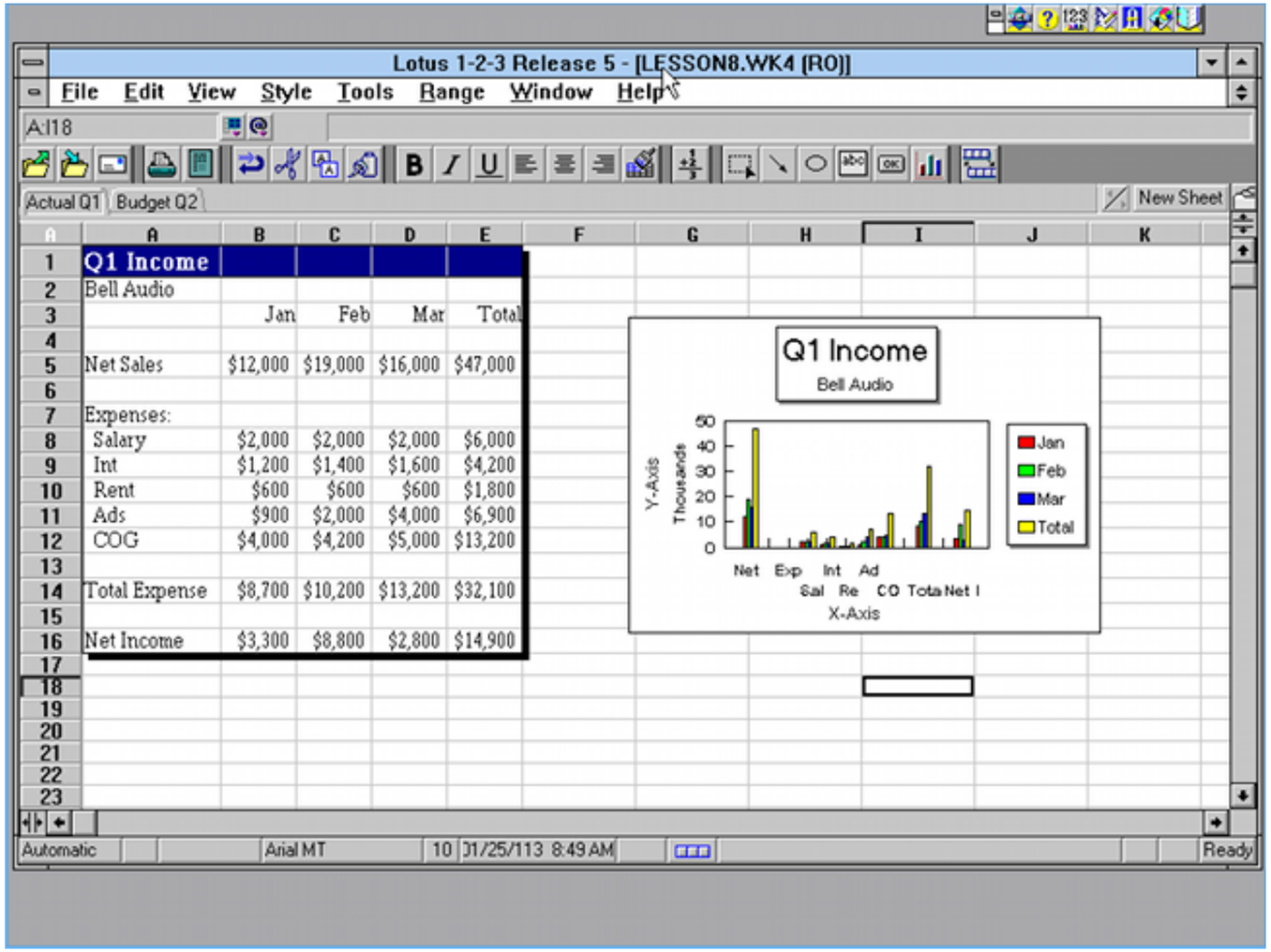
1979-1983



Software Arts

1-2-3

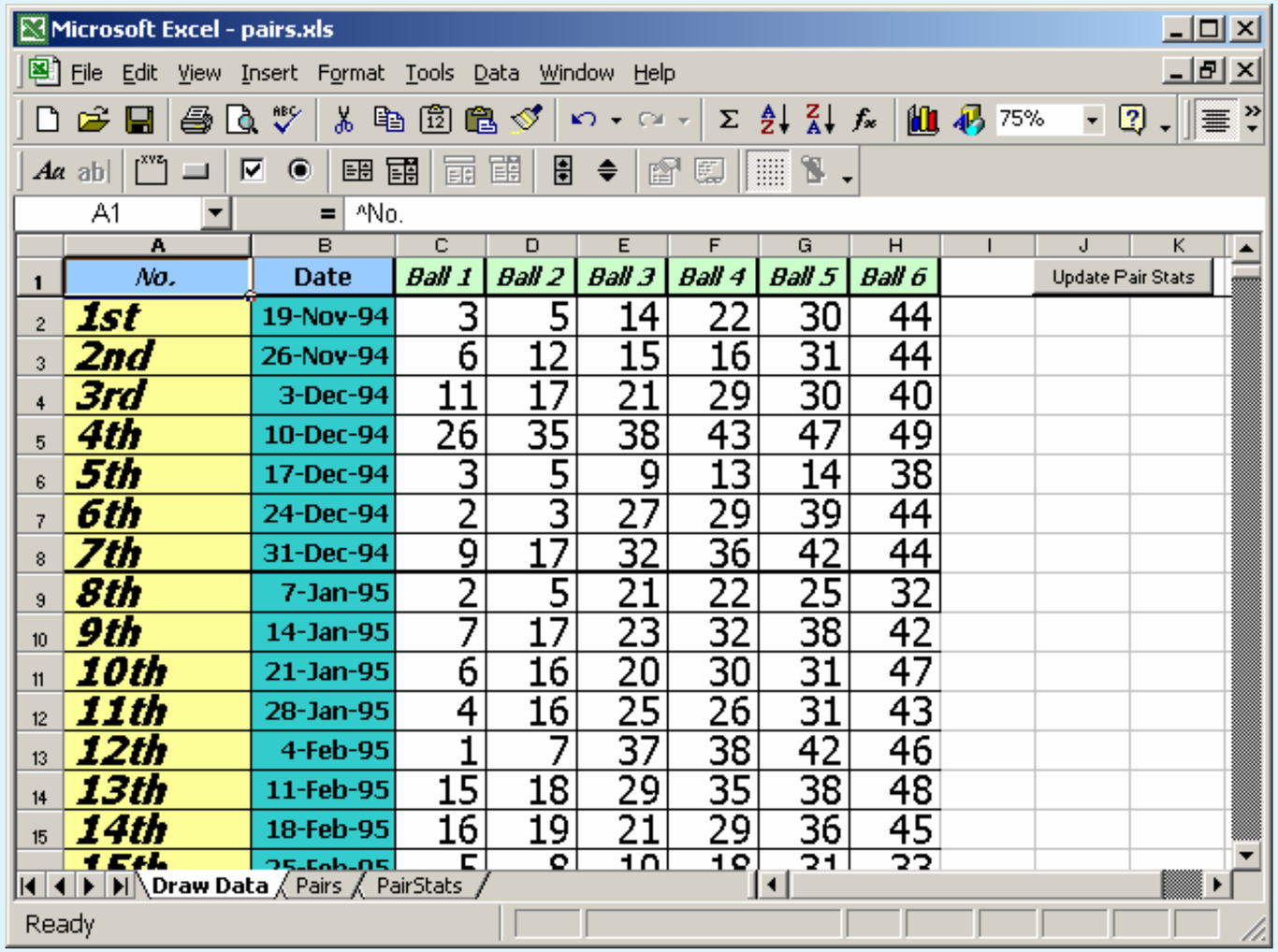
1983-2002



Lotus Software

Excel

1987-Today

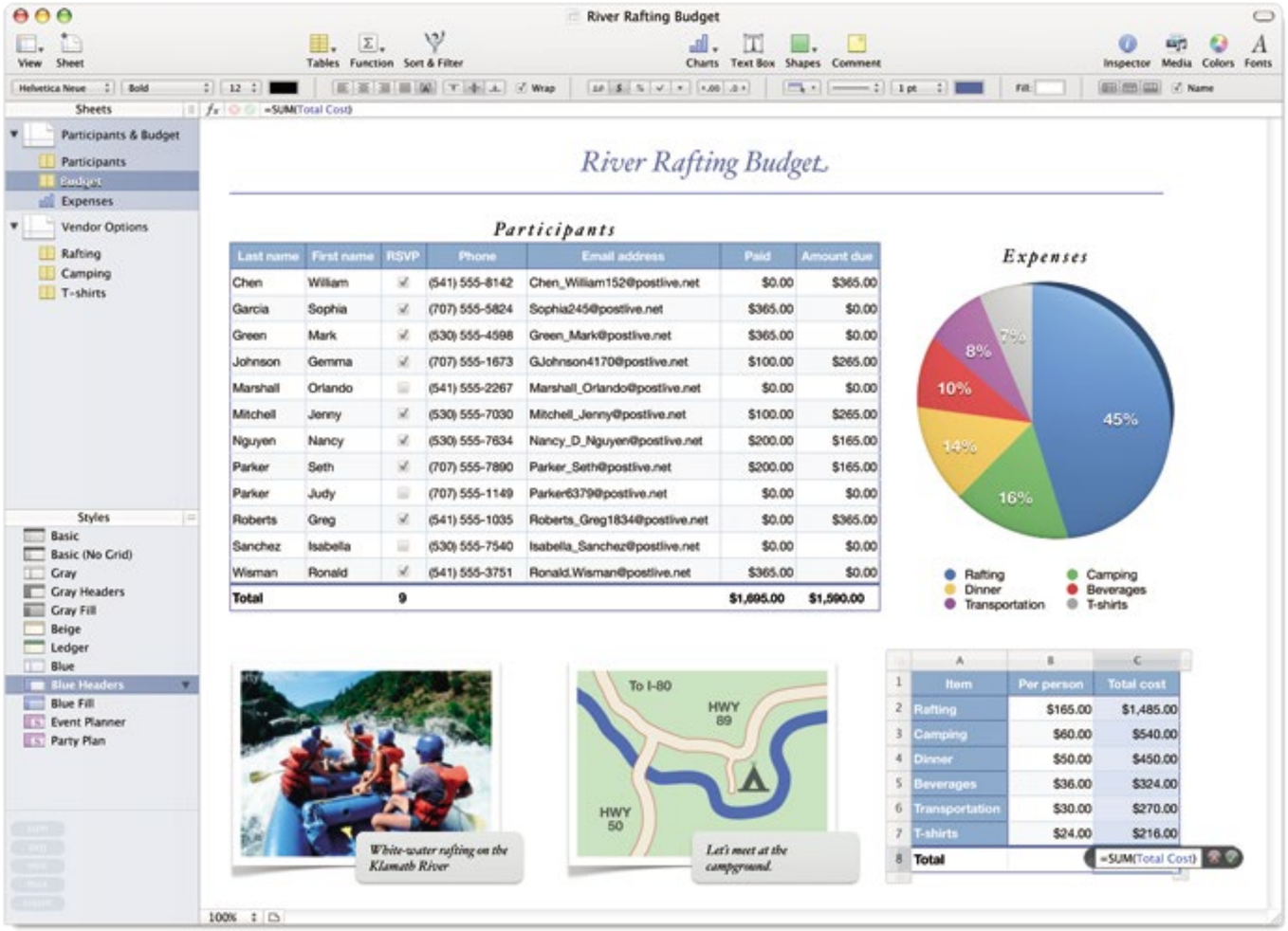


No.	Date	Ball 1	Ball 2	Ball 3	Ball 4	Ball 5	Ball 6
1st	19-Nov-94	3	5	14	22	30	44
2nd	26-Nov-94	6	12	15	16	31	44
3rd	3-Dec-94	11	17	21	29	30	40
4th	10-Dec-94	26	35	38	43	47	49
5th	17-Dec-94	3	5	9	13	14	38
6th	24-Dec-94	2	3	27	29	39	44
7th	31-Dec-94	9	17	32	36	42	44
8th	7-Jan-95	2	5	21	22	25	32
9th	14-Jan-95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

Microsoft

Numbers

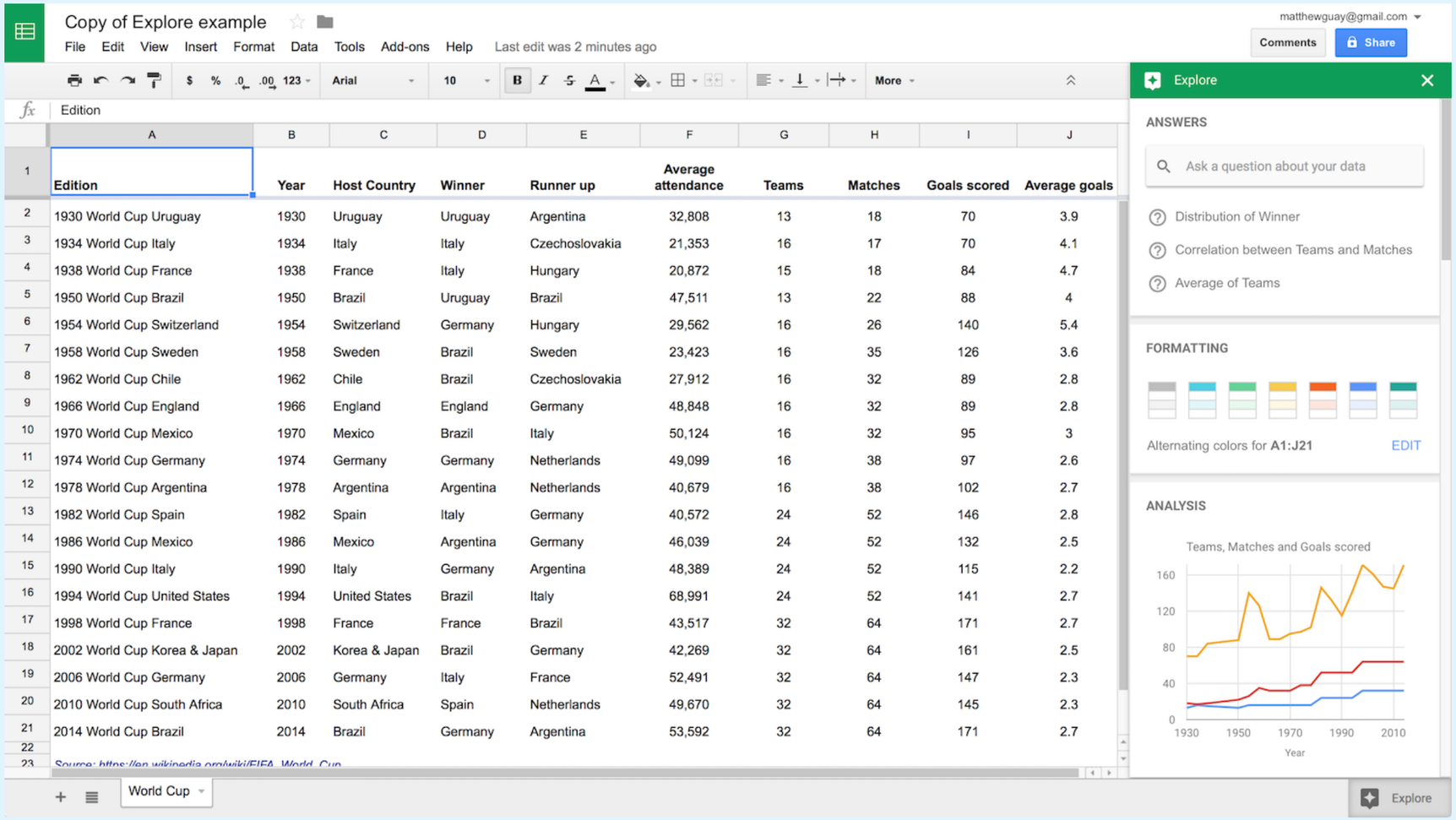
2005-Today



Apple

Sheets

2006-Today



	A	B	C	D	E	F	G	H	I	J
1	Edition	Year	Host Country	Winner	Runner up	Average attendance	Teams	Matches	Goals scored	Average goals
2	1930 World Cup Uruguay	1930	Uruguay	Uruguay	Argentina	32,808	13	18	70	3.9
3	1934 World Cup Italy	1934	Italy	Italy	Czechoslovakia	21,353	16	17	70	4.1
4	1938 World Cup France	1938	France	Italy	Hungary	20,872	15	18	84	4.7
5	1950 World Cup Brazil	1950	Brazil	Uruguay	Brazil	47,511	13	22	88	4
6	1954 World Cup Switzerland	1954	Switzerland	Germany	Hungary	29,562	16	26	140	5.4
7	1958 World Cup Sweden	1958	Sweden	Brazil	Sweden	23,423	16	35	126	3.6
8	1962 World Cup Chile	1962	Chile	Brazil	Czechoslovakia	27,912	16	32	89	2.8
9	1966 World Cup England	1966	England	England	Germany	48,848	16	32	89	2.8
10	1970 World Cup Mexico	1970	Mexico	Brazil	Italy	50,124	16	32	95	3
11	1974 World Cup Germany	1974	Germany	Germany	Netherlands	49,099	16	38	97	2.6
12	1978 World Cup Argentina	1978	Argentina	Argentina	Netherlands	40,679	16	38	102	2.7
13	1982 World Cup Spain	1982	Spain	Italy	Germany	40,572	24	52	146	2.8
14	1986 World Cup Mexico	1986	Mexico	Argentina	Germany	46,039	24	52	132	2.5
15	1990 World Cup Italy	1990	Italy	Germany	Argentina	48,389	24	52	115	2.2
16	1994 World Cup United States	1994	United States	Brazil	Italy	68,991	24	52	141	2.7
17	1998 World Cup France	1998	France	France	Brazil	43,517	32	64	171	2.7
18	2002 World Cup Korea & Japan	2002	Korea & Japan	Brazil	Germany	42,269	32	64	161	2.5
19	2006 World Cup Germany	2006	Germany	Italy	France	52,491	32	64	147	2.3
20	2010 World Cup South Africa	2010	South Africa	Spain	Netherlands	49,670	32	64	145	2.3
21	2014 World Cup Brazil	2014	Brazil	Germany	Argentina	53,592	32	64	171	2.7
22										
23	Source: https://en.wikipedia.org/wiki/FIFA_World_Cup									

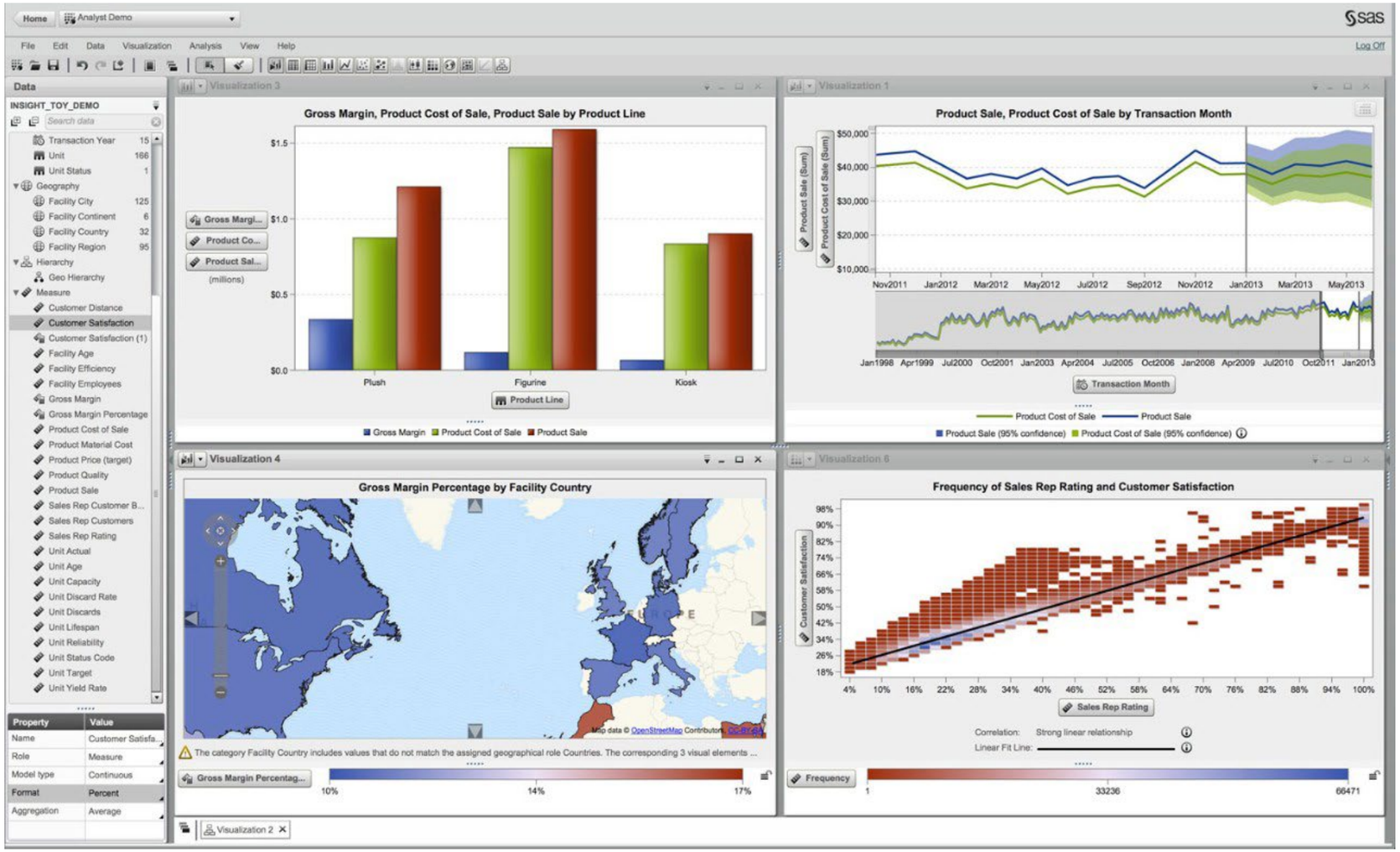
Google

Data Analysis

From Simple Languages to Expansive Environments and Hosted Compute Platforms

SAS

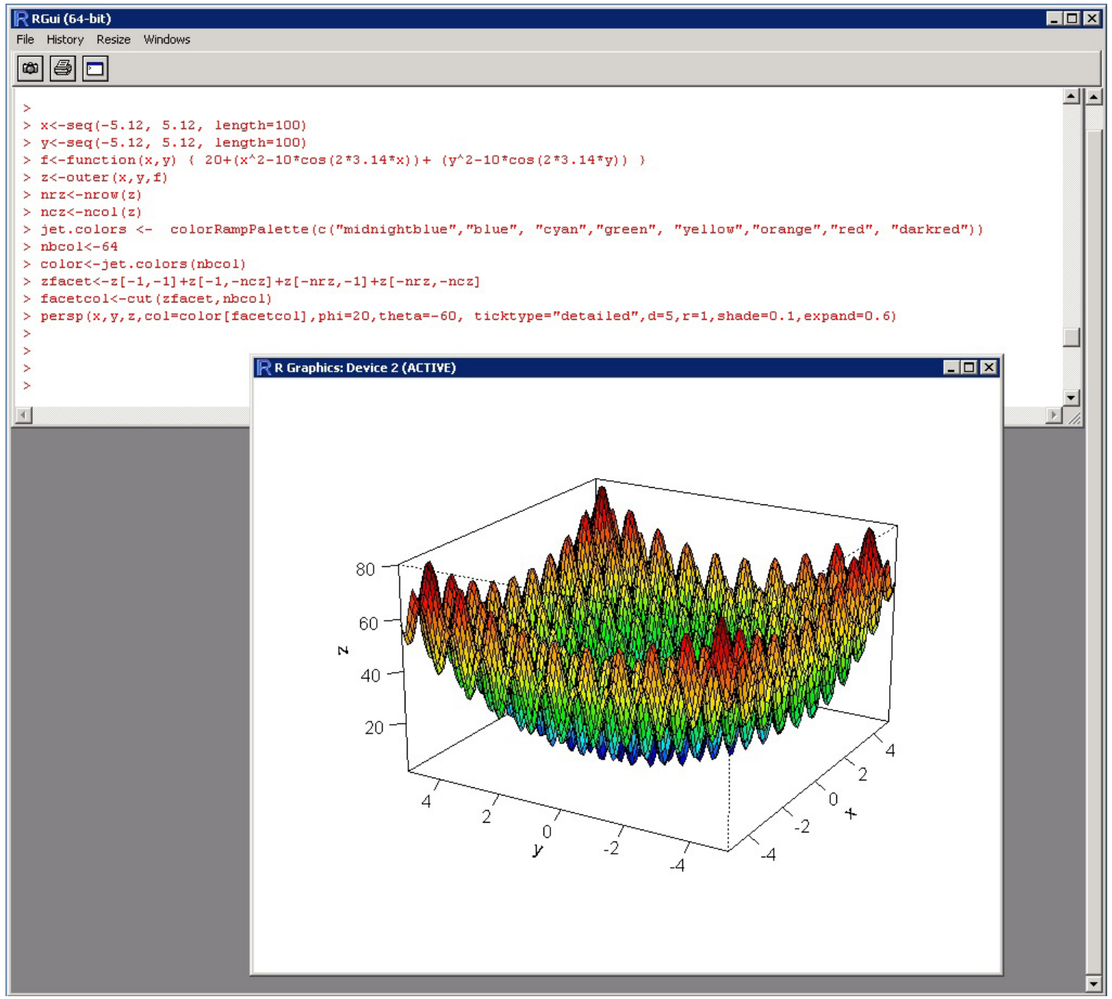
1976-2013



SAS Institute

R

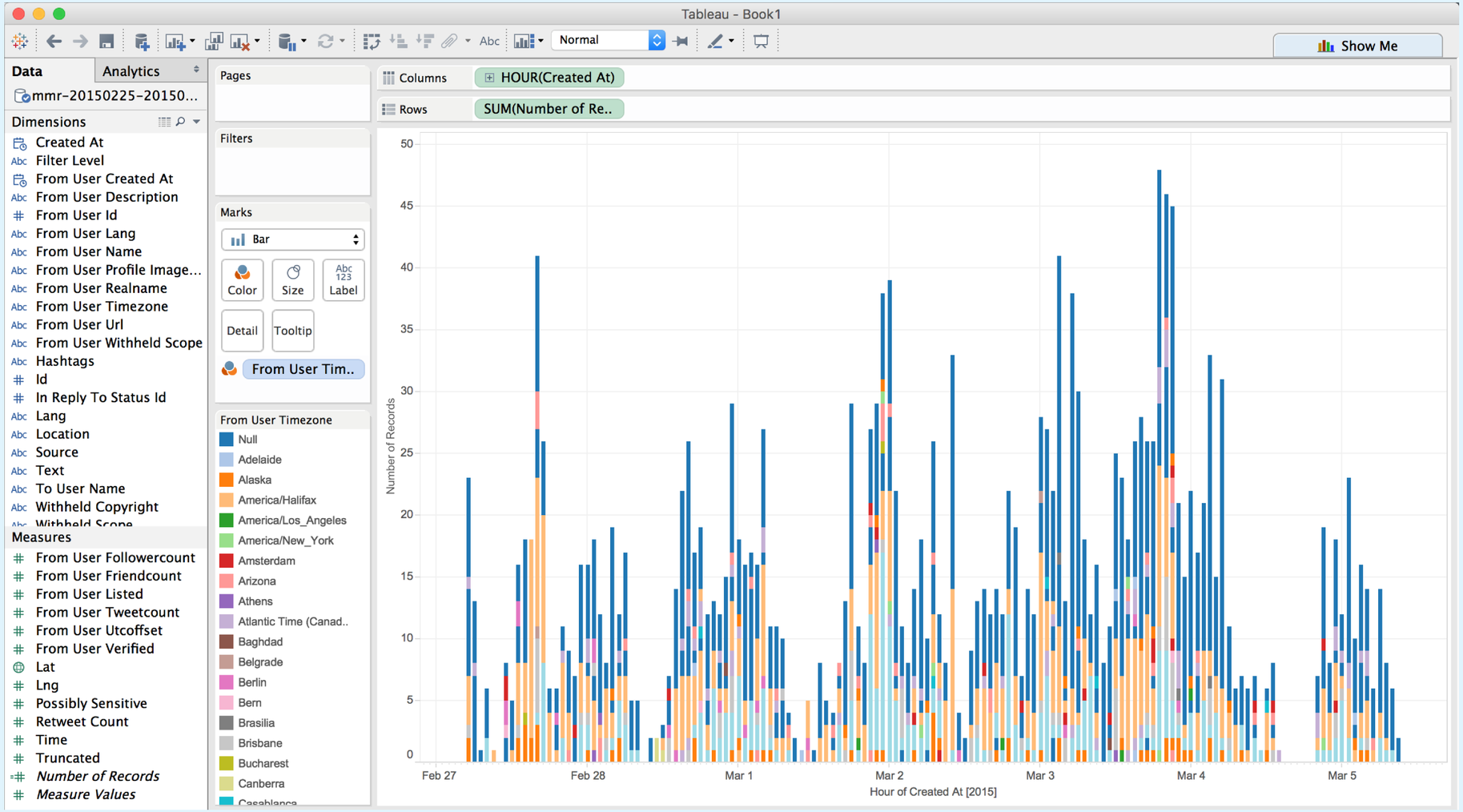
1993-Today



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

Tableau

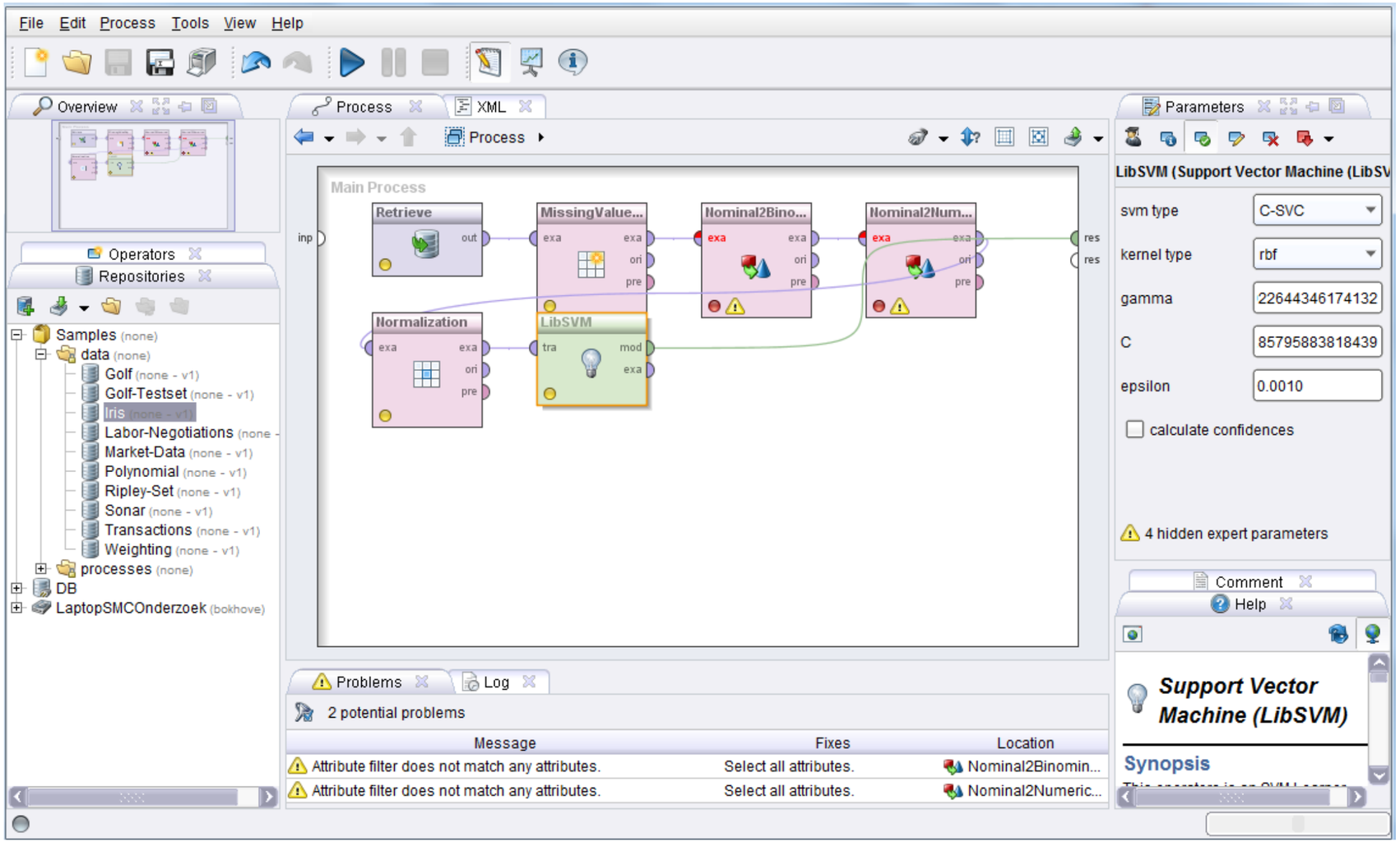
2003-Today



Pat Hanrahan, Christian Chabot, Chris Stolte for Tableau Software

RapidMiner

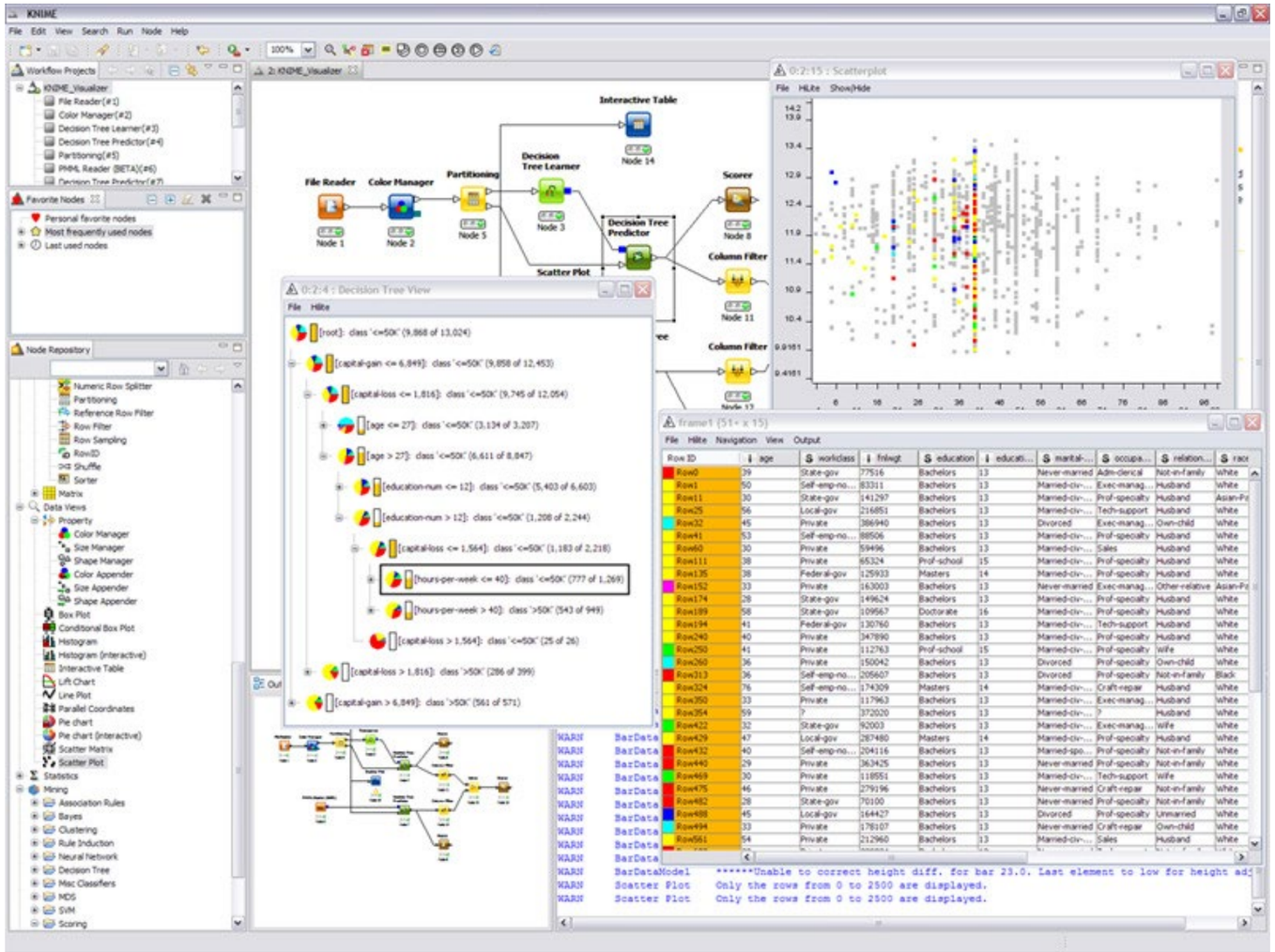
2006-Today



RapidMiner

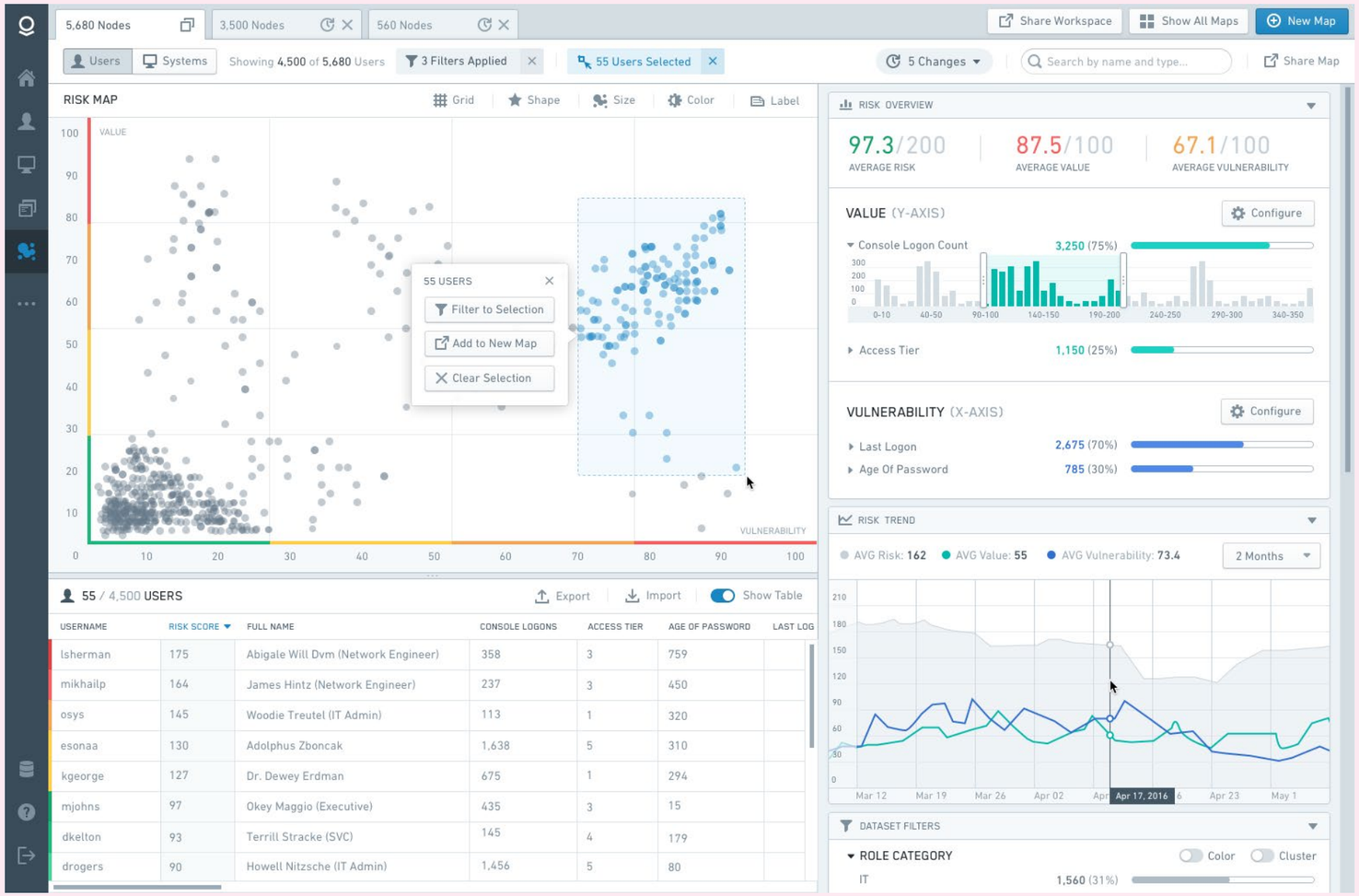
Knime

2006-Today



KNIME.com AG

Foundry -Foundry

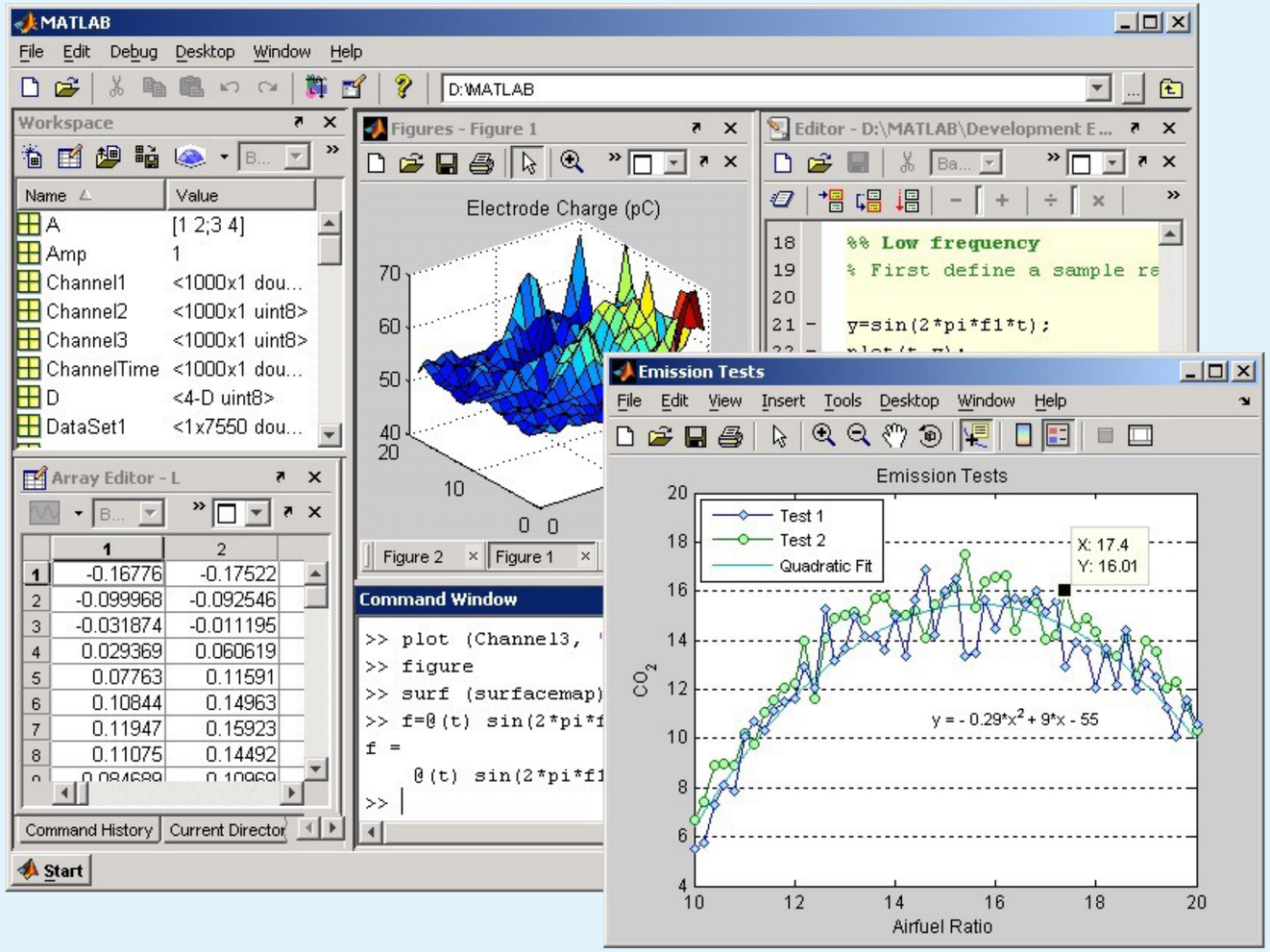


Palantir

Simulation

MATLAB

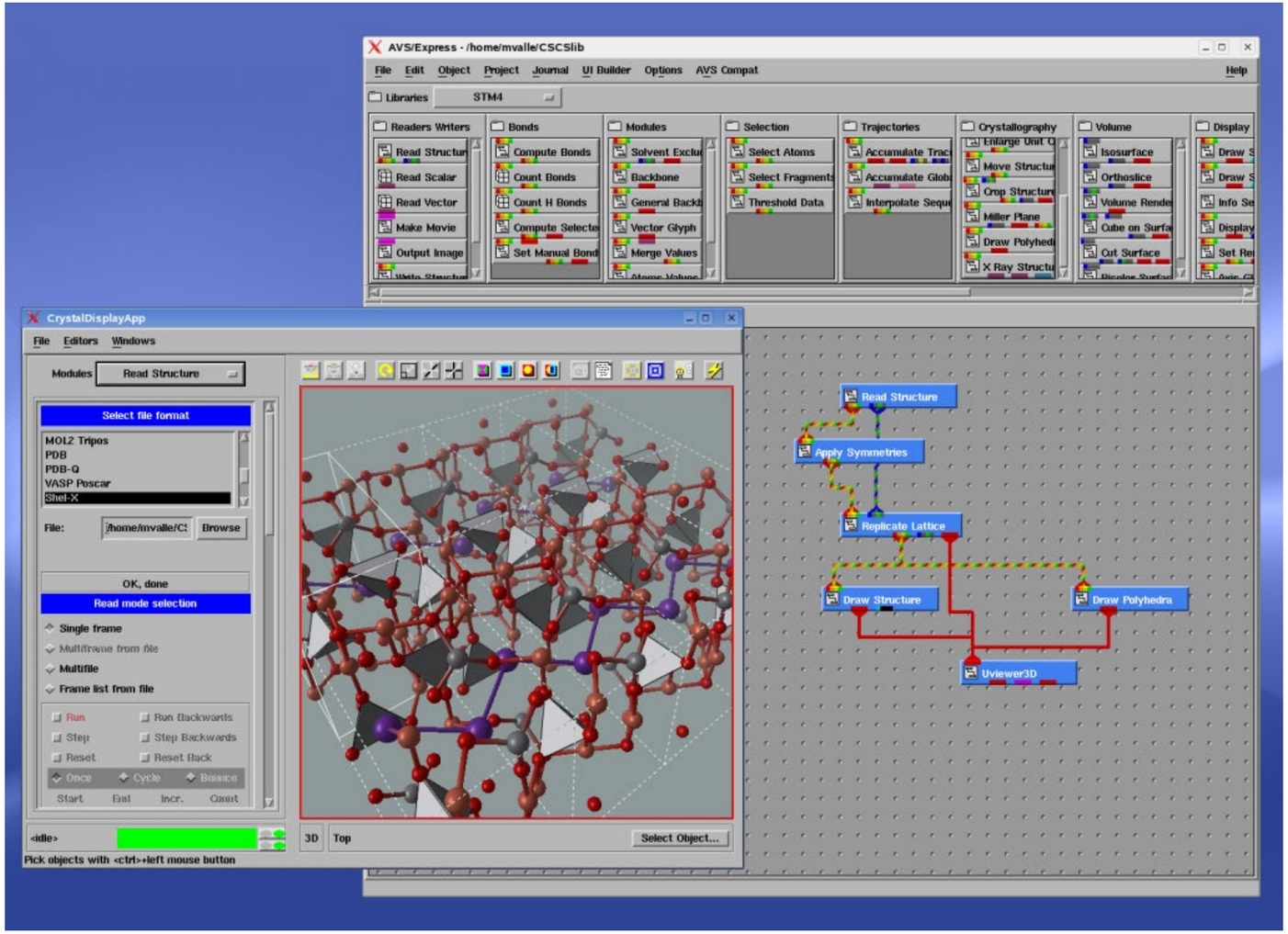
1984-Today



Cleve Moler, Steve Bangert and Jack Little for MathWorks

AVS Express

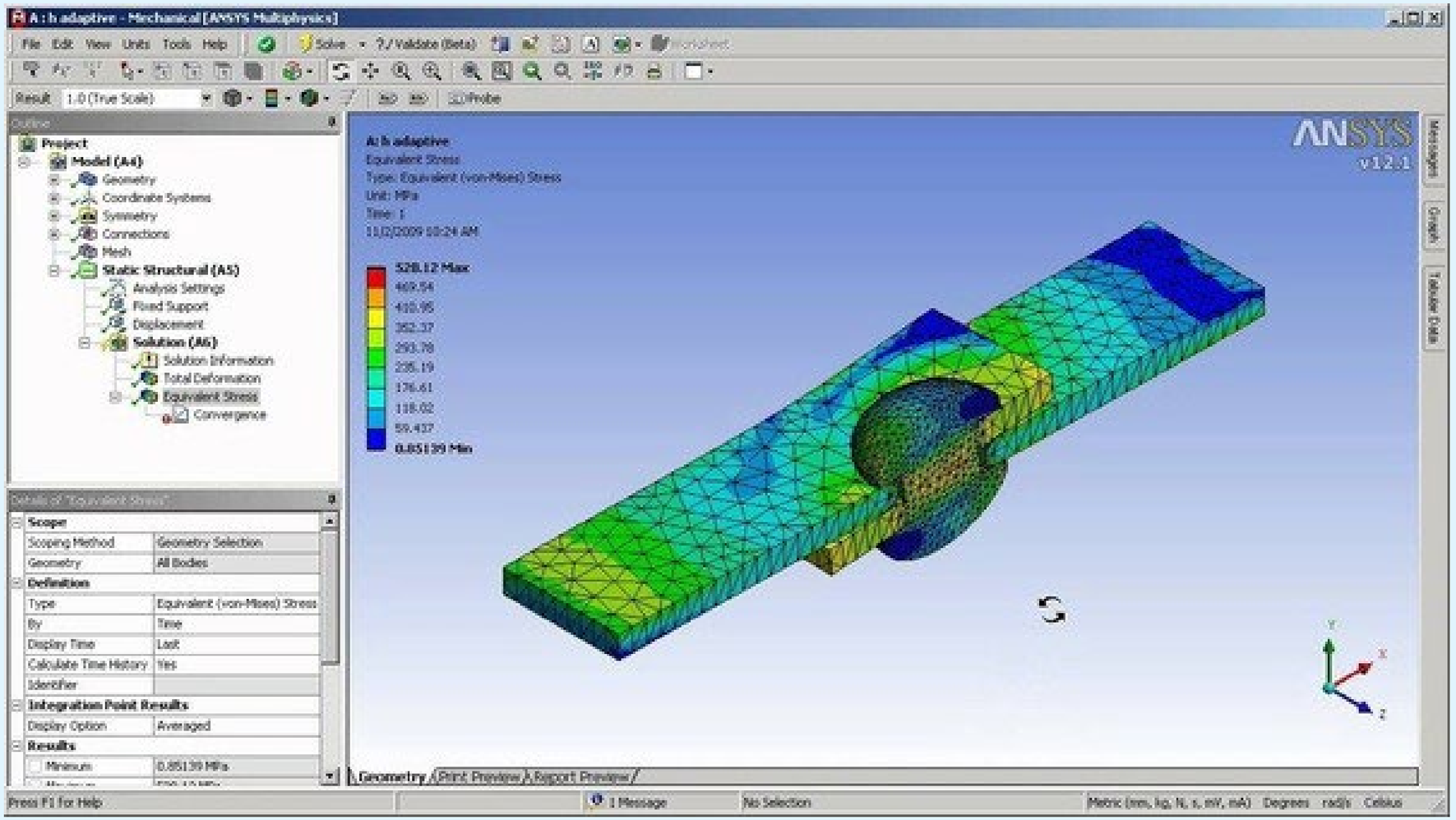
1991-Today



Advanced Visual Systems Inc

Ansys

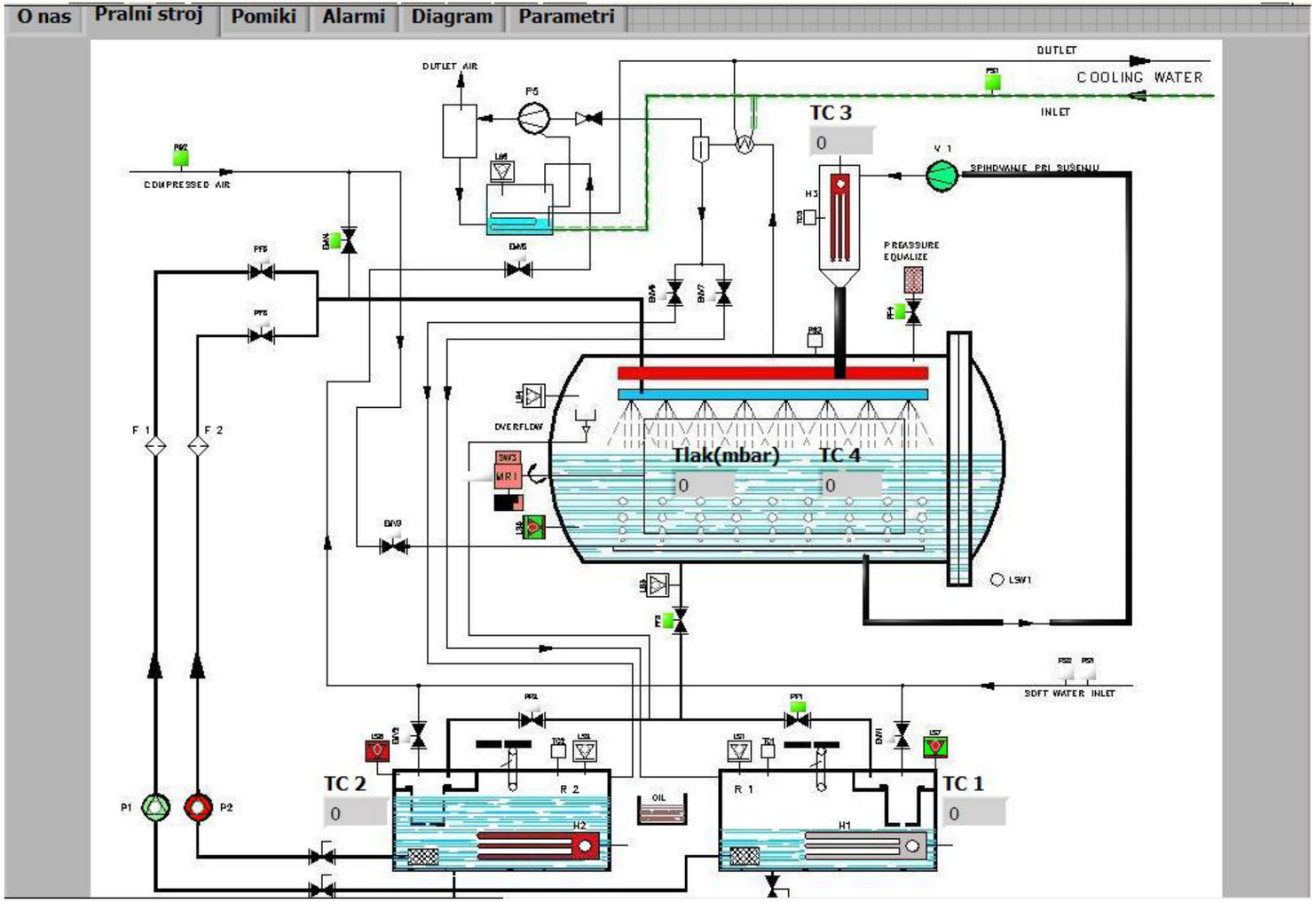
1970-Today



ANSYS Inc

LabView

1986-Today

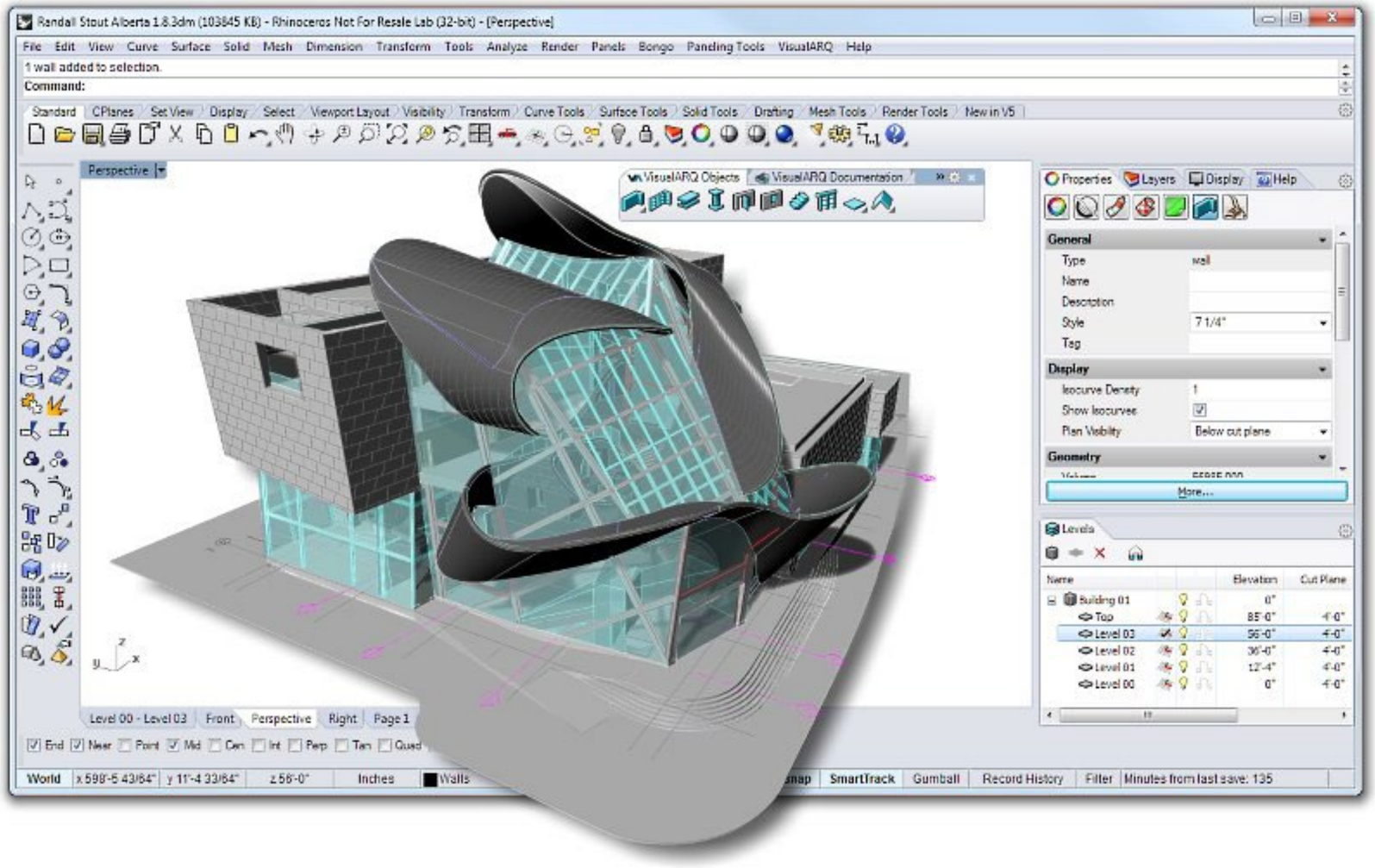


National Instruments

3D (Solid Geometry) Modeling

Rhino

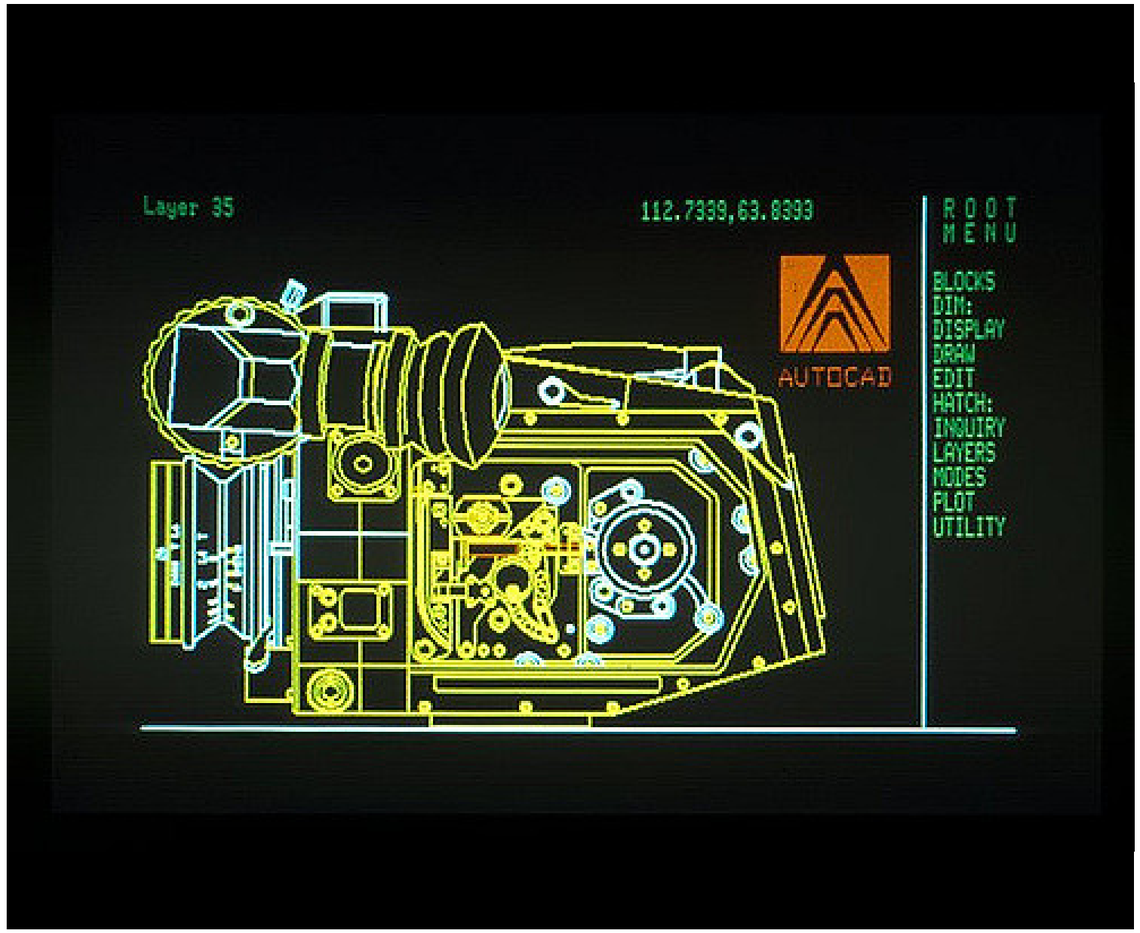
1980-Today



Robert McNeel & Associates

AutoCAD

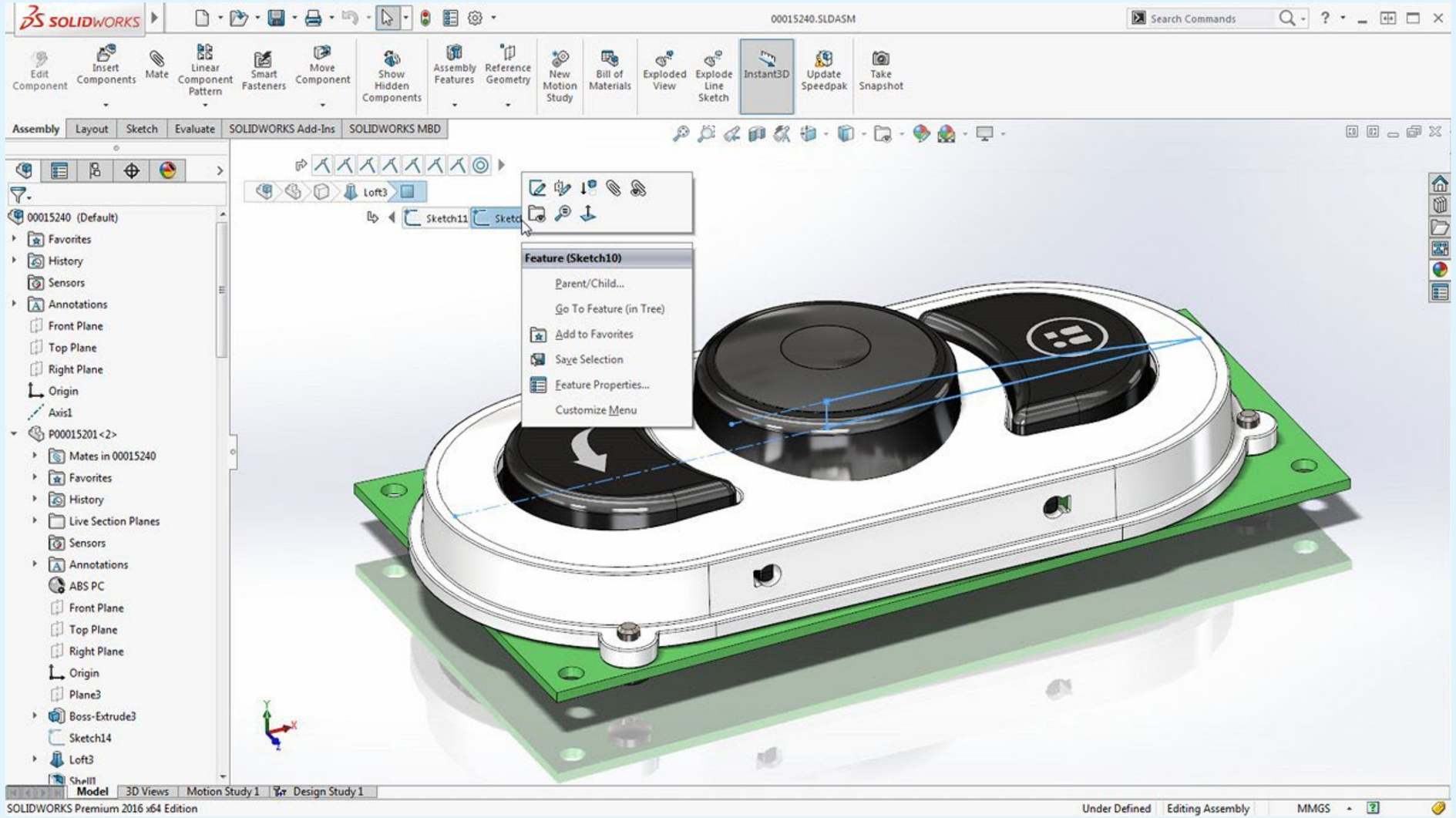
1982-Today



AutoDesk

SolidWorks

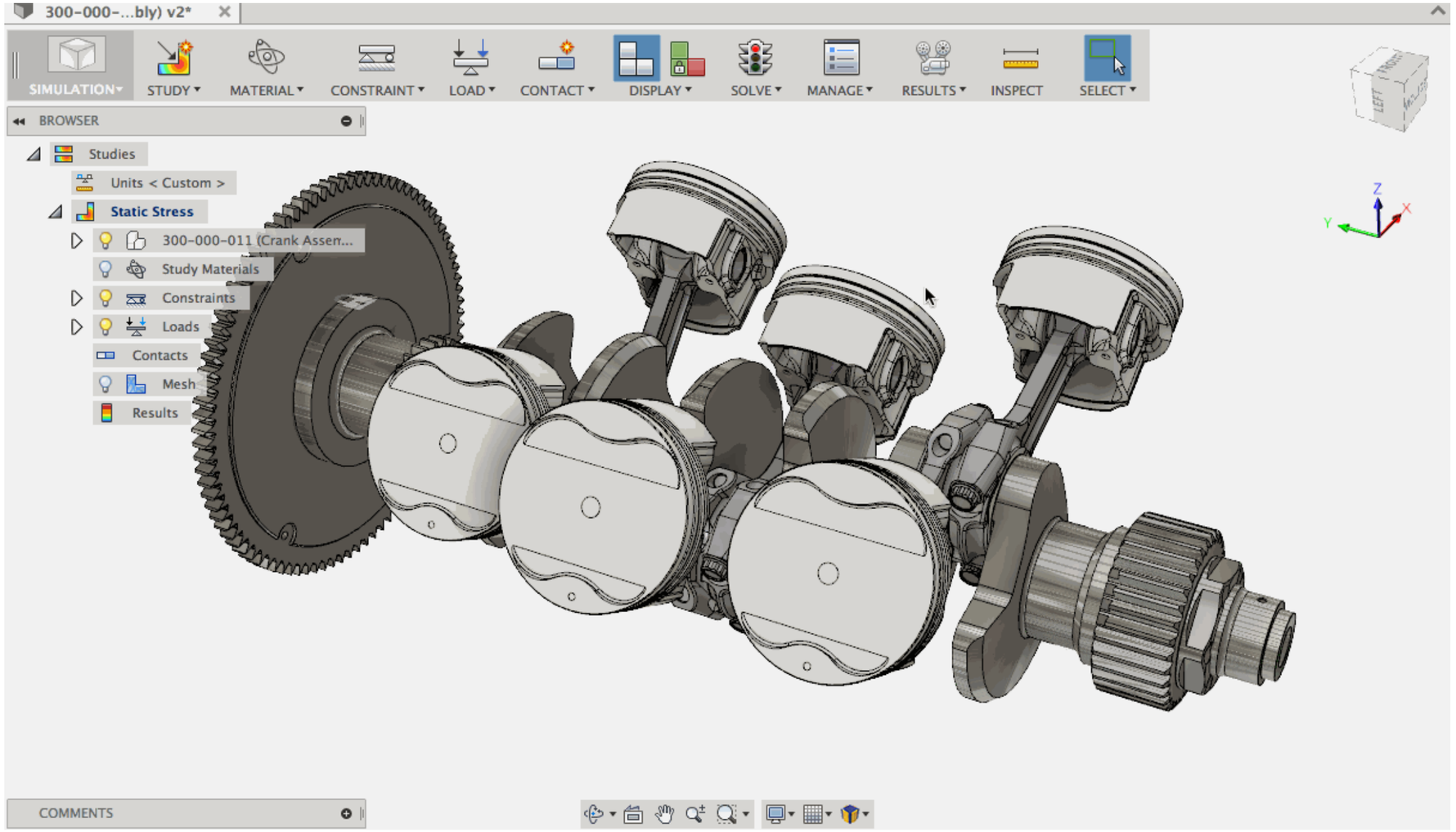
1995-Today



Dassault Systèmes

Fusion 360

2013-Today



Autodesk

Design Machine

Creative Tools for Everyone

Graphics

Direct-Manipulation + Computer Graphics

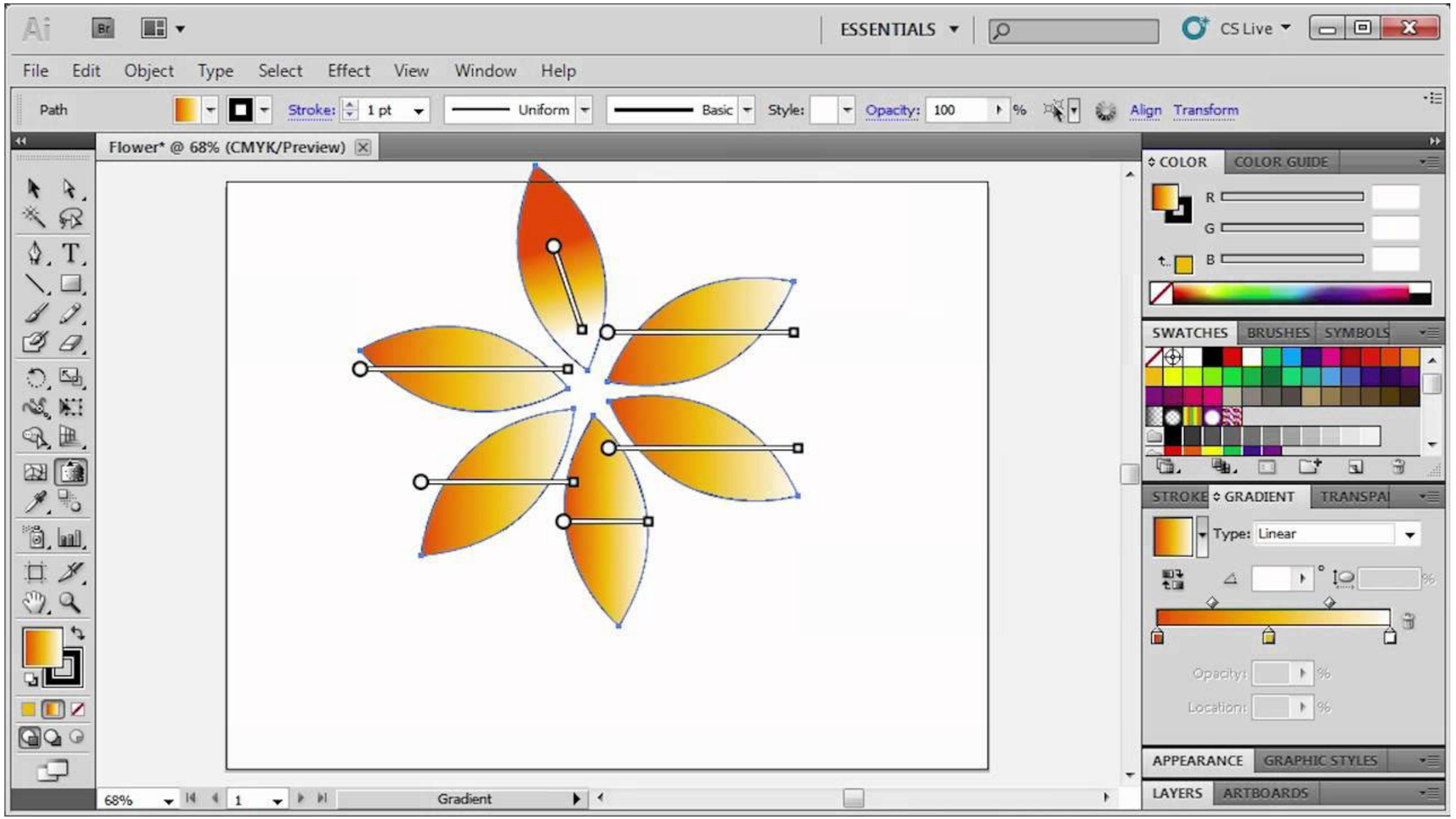
Sketchpad

1963

Ivan Sutherland

Illustrator

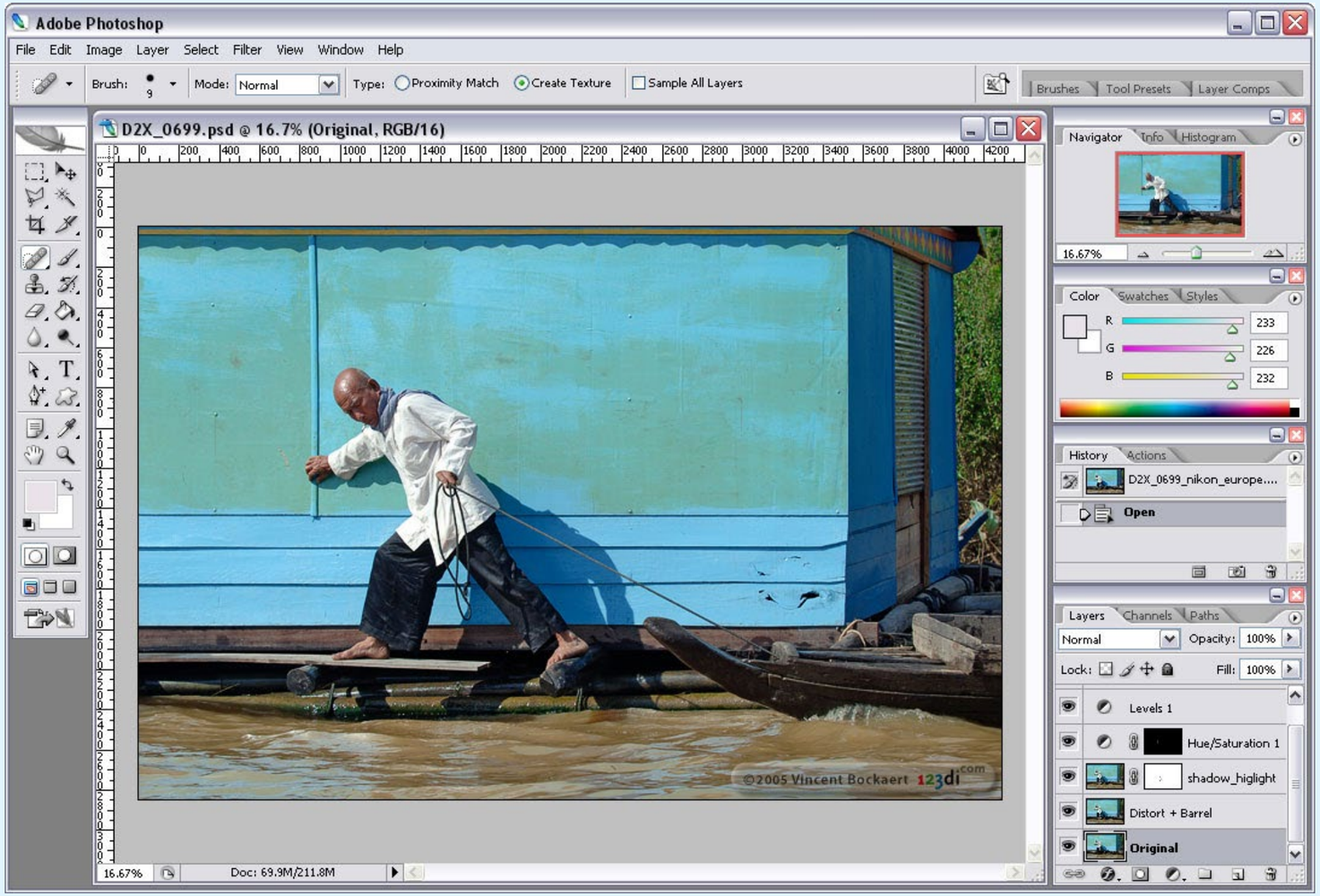
1987-Today



Adobe Systems

Photoshop

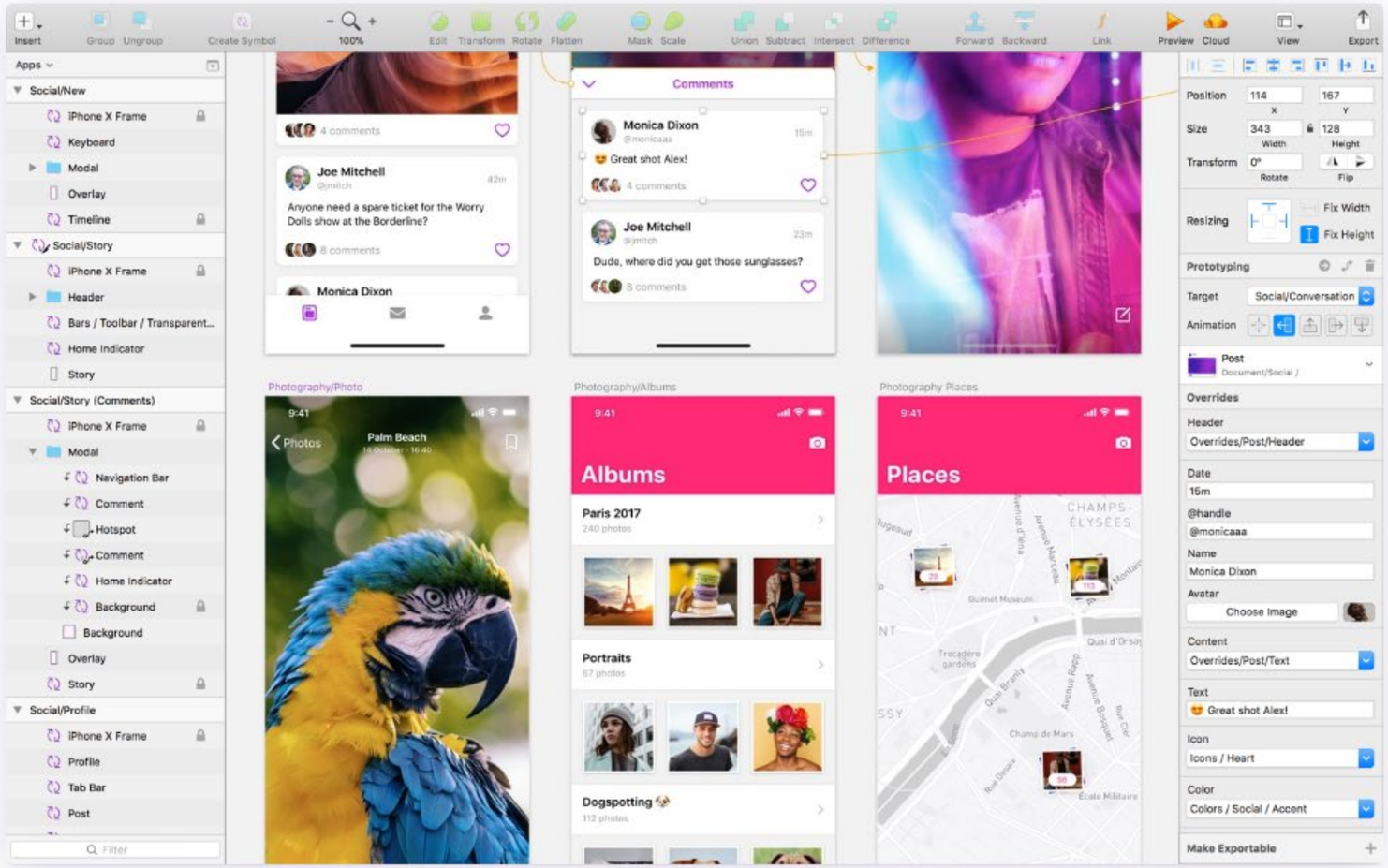
1990-Today



Adobe Systems

Sketch

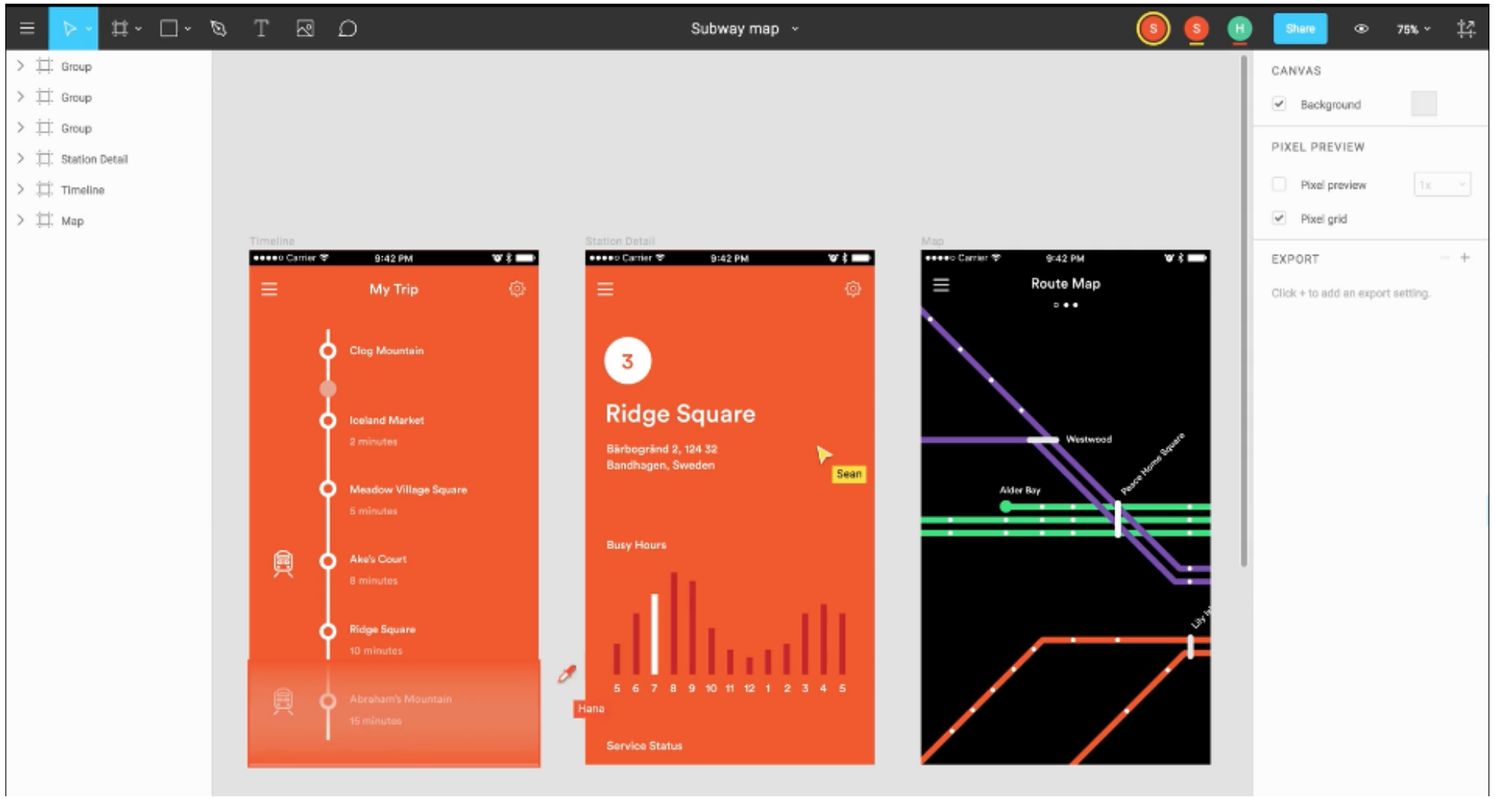
2010-Today



Bohemian Coding

Figma

2016-Today



Figma

Presentation

From Outline to Slides to Demo

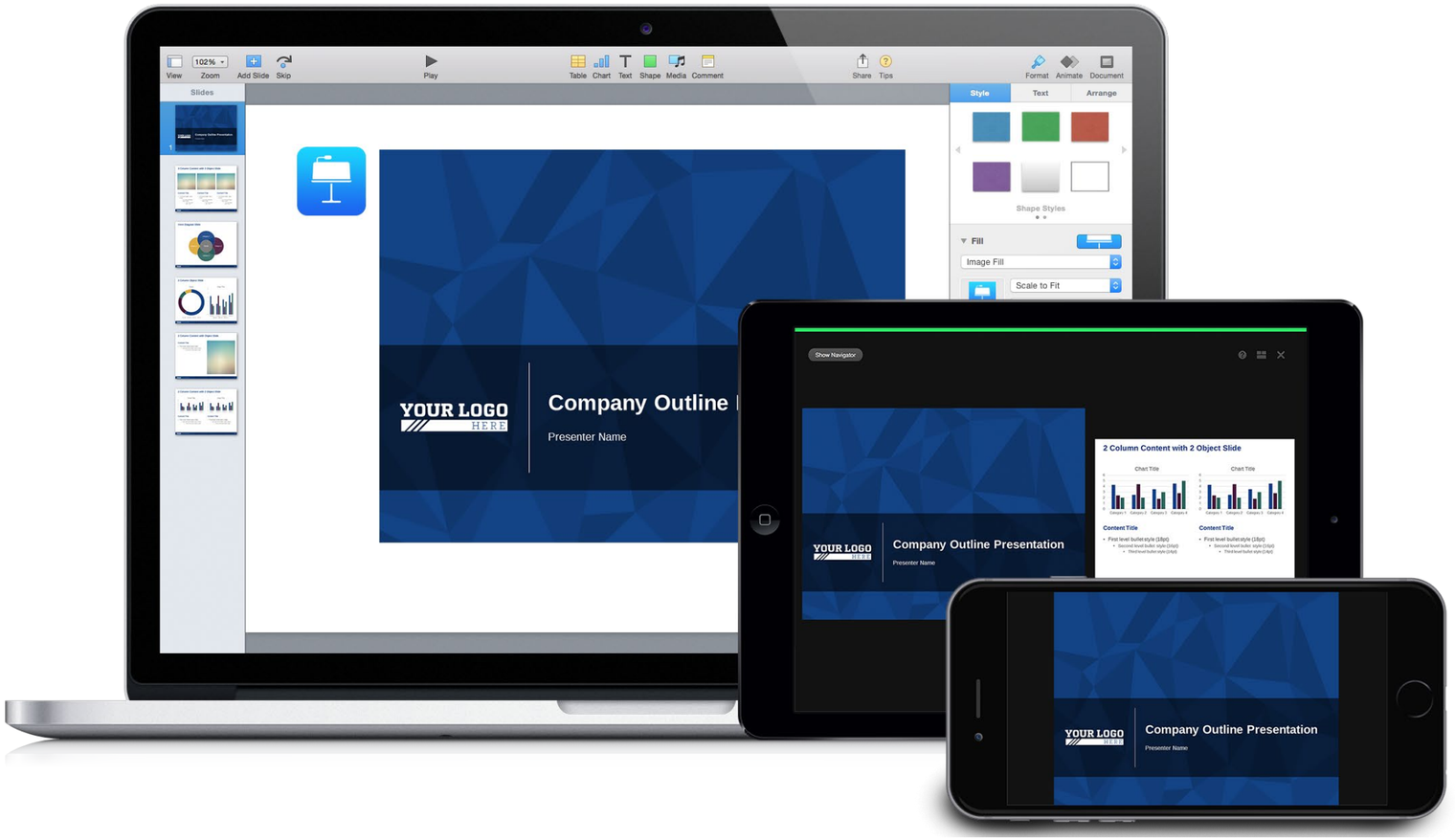
Powerpoint

1987-Today

Microsoft

Keynote

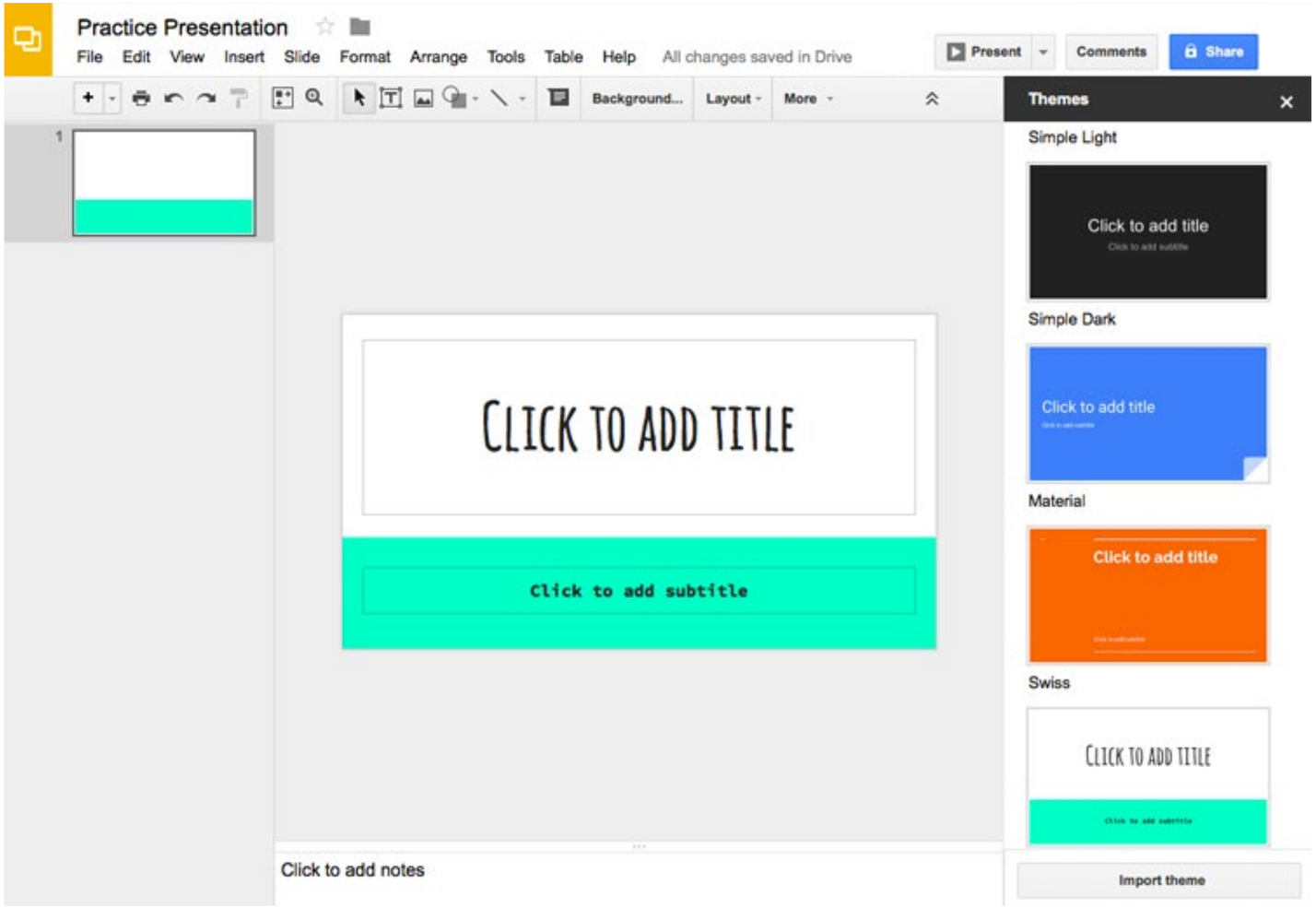
2003-Today



Apple

Slides

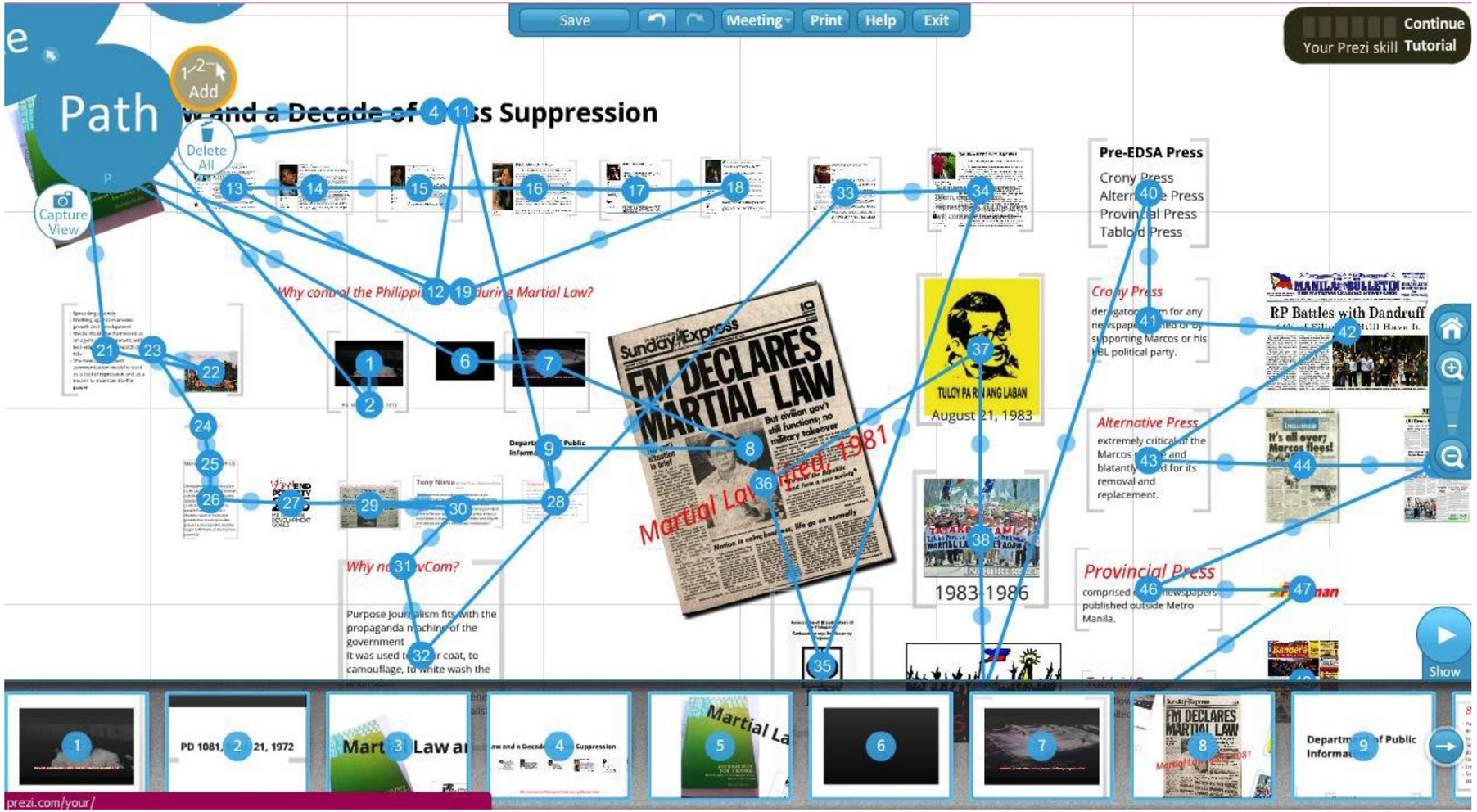
2006-Today



Google

Prezi

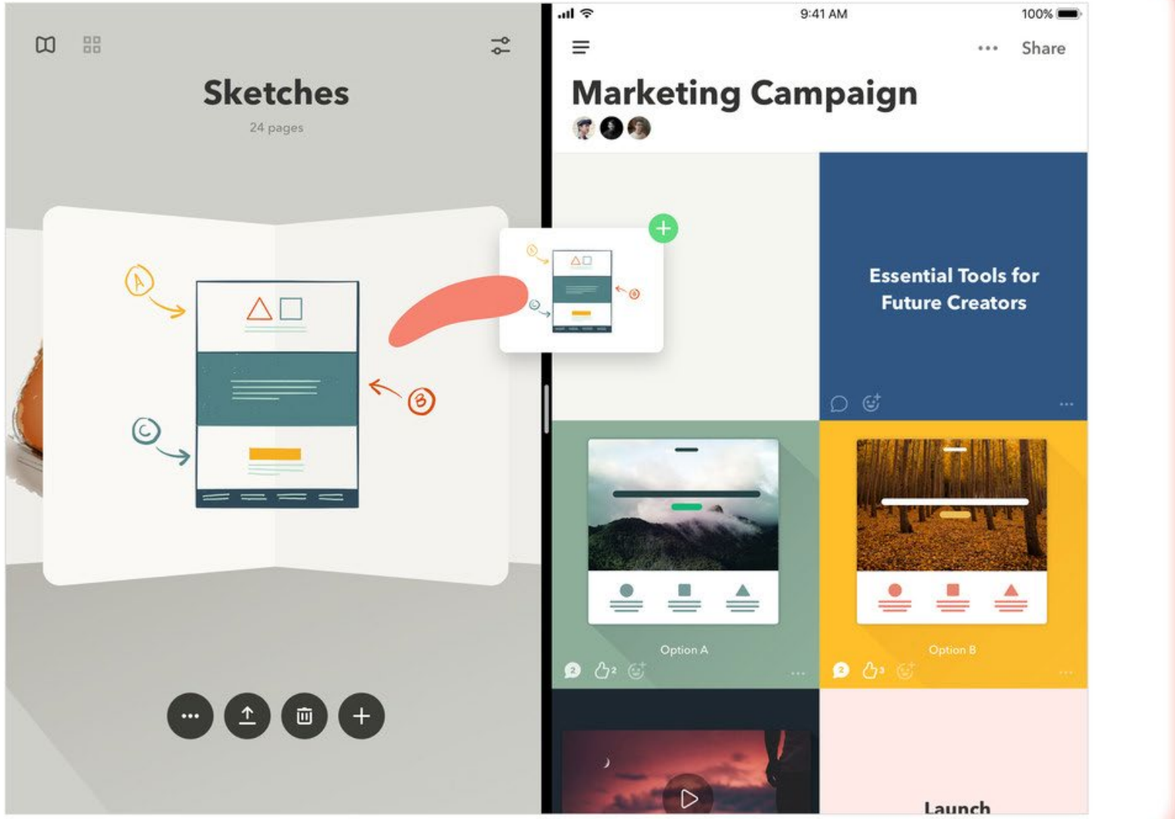
2009-Today



Adam Somlai-Fischer, Peter Halacsy and Peter Arvai

Paste

2017-Today

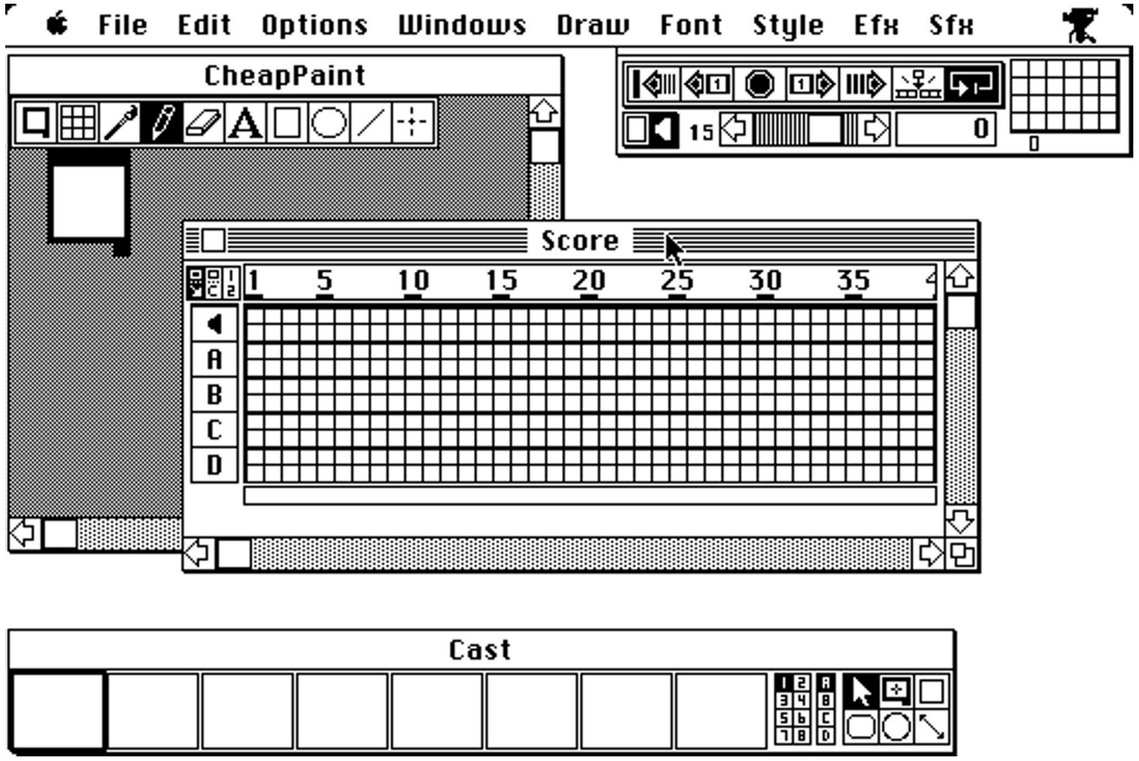


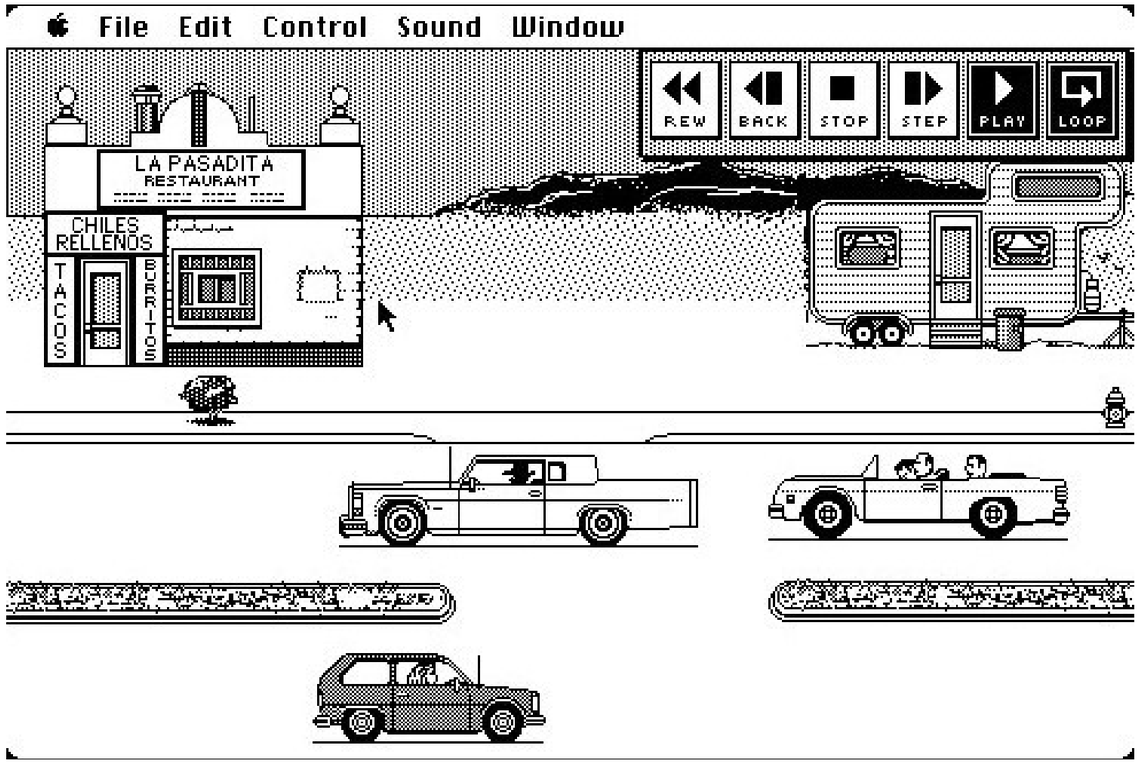
FiftyThree

Timeline-Based Applications

VideoWorks

1985-1987

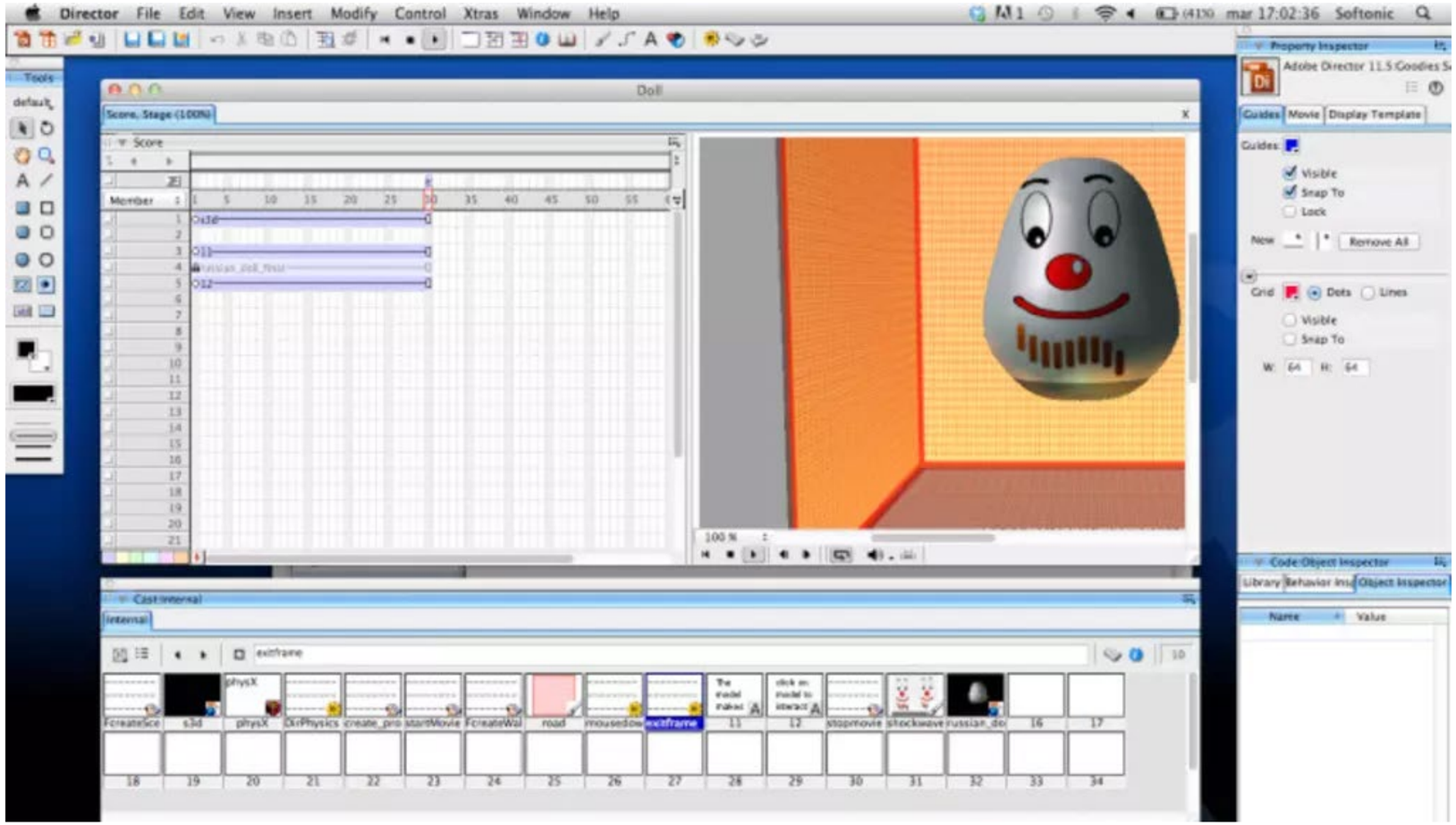




Marc Canter, Jay Fenton and Mark Pierce and Dan Sadowski for MacroMind

Director

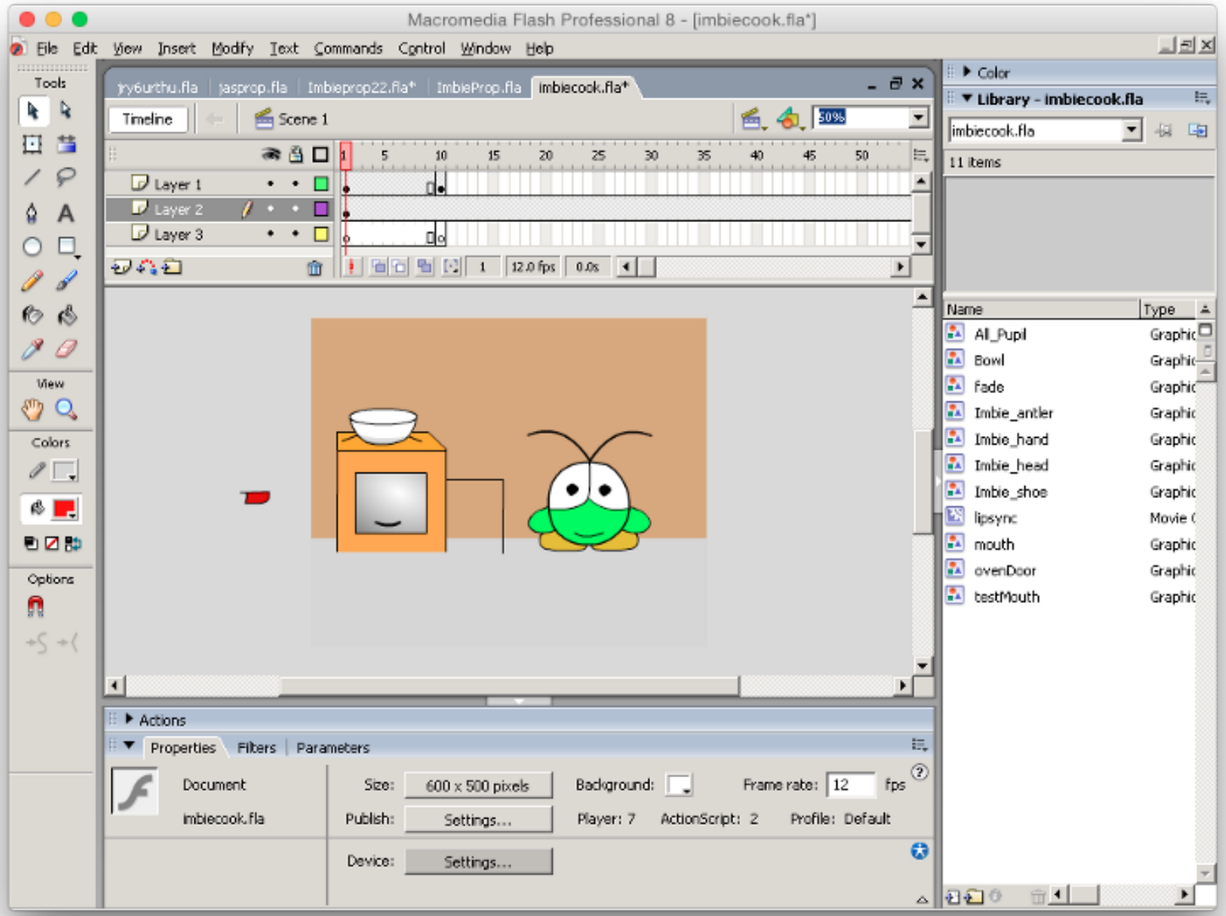
1988-2013



MacroMedia (Later Adobe)

Flash

1996-2016



Adobe

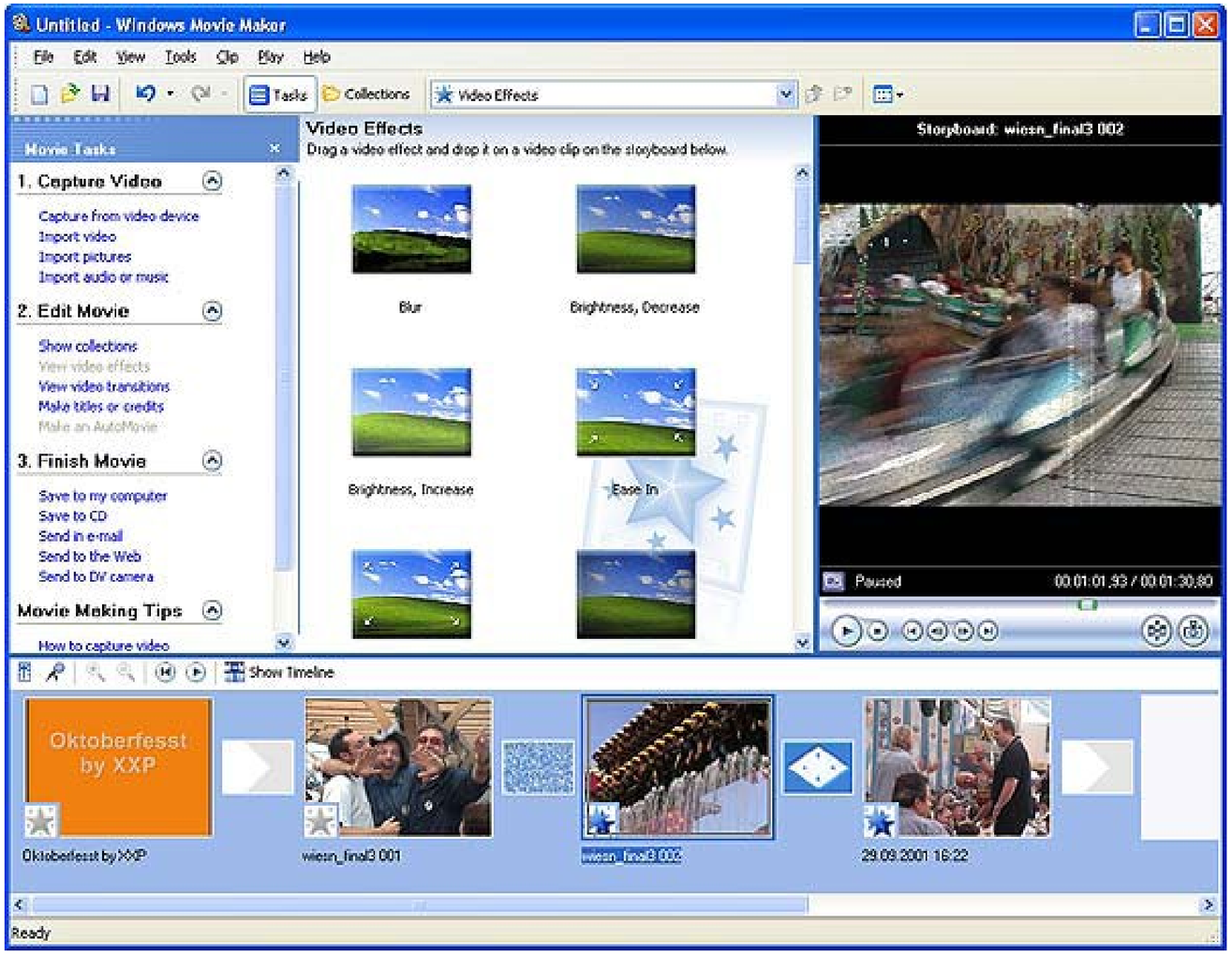
iMovie

1999-Today

Apple

Windows Movie Maker

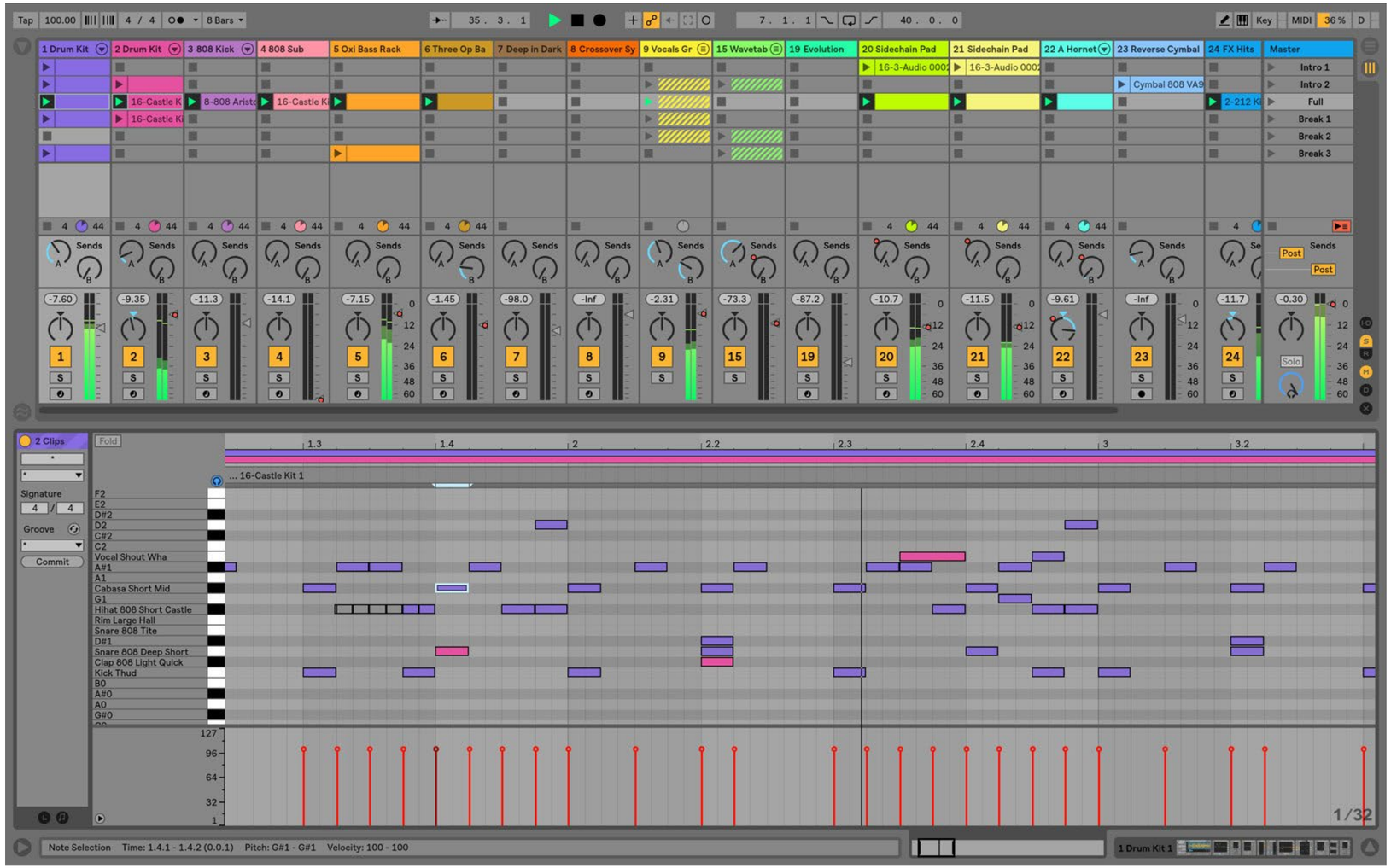
2000-2012



Microsoft

Ableton Live

2001-Today



Ableton

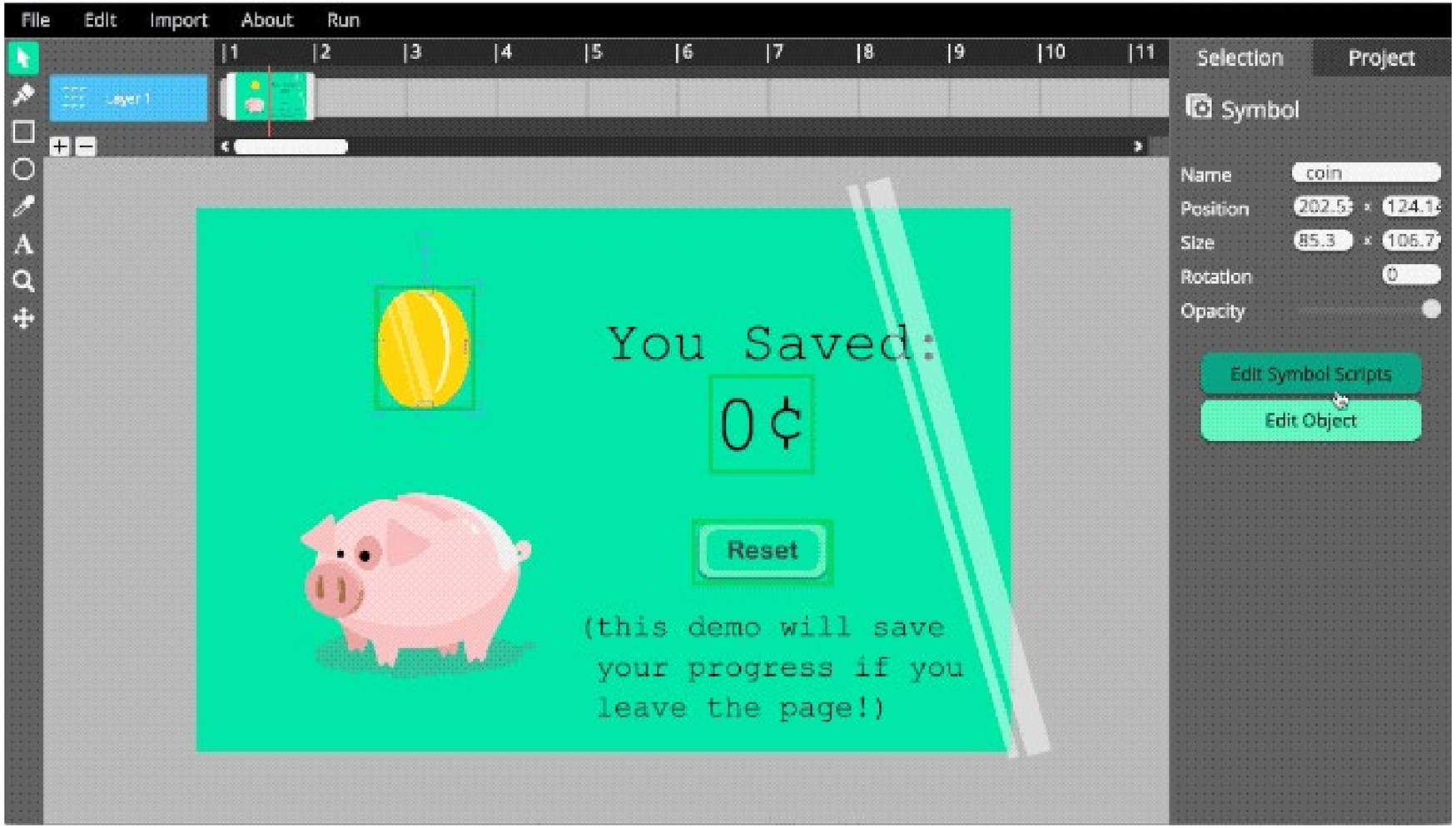
GarageBand

2004-Today

Apple

Wick Editor

2017-Today



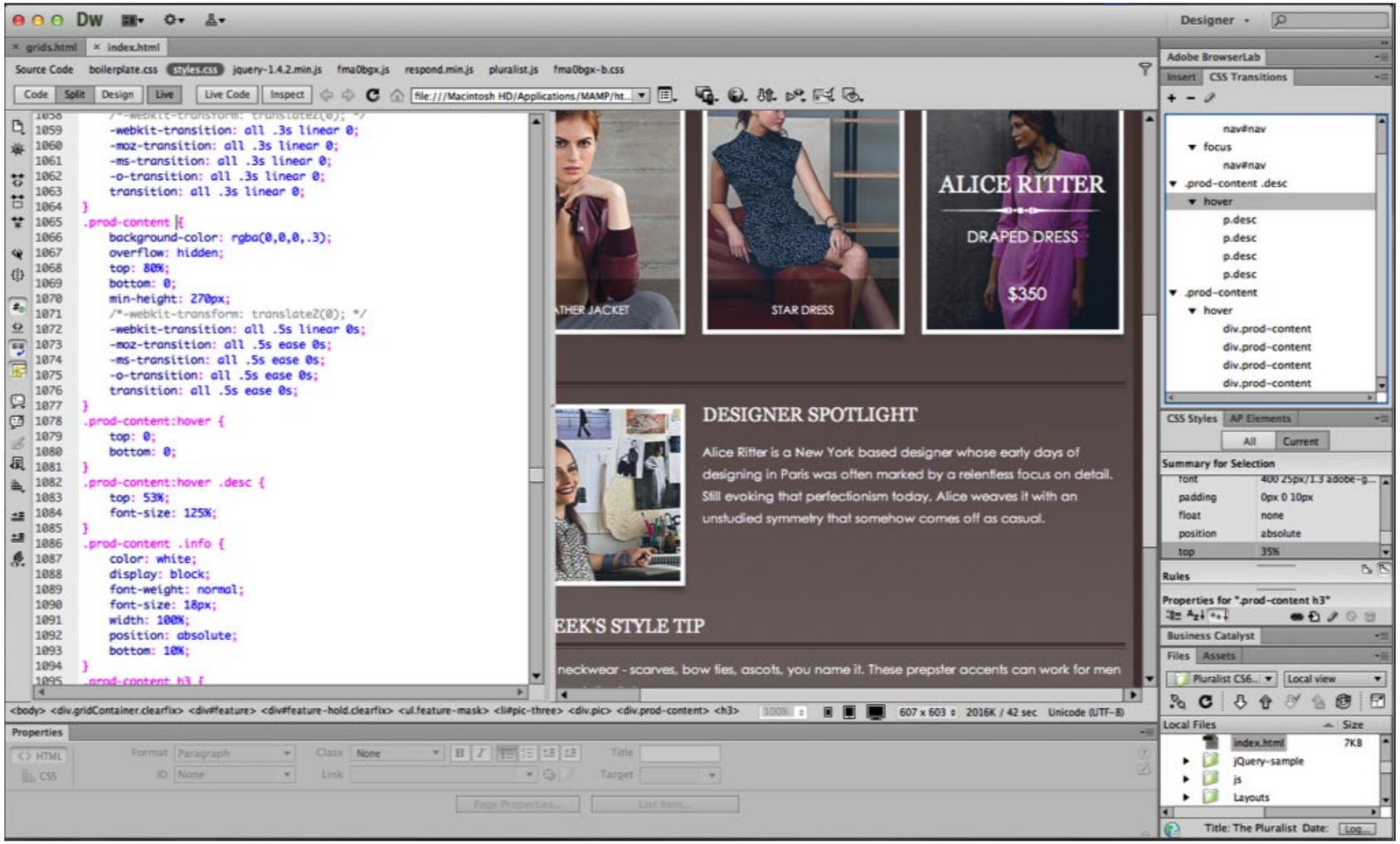
Luca Damasco and Zach Rispoli at the Frank-Ratchye STUDIO for Creative Inquiry at Carnegie Mellon University

World Wide Web

Design & Development Environments

Dreamweaver

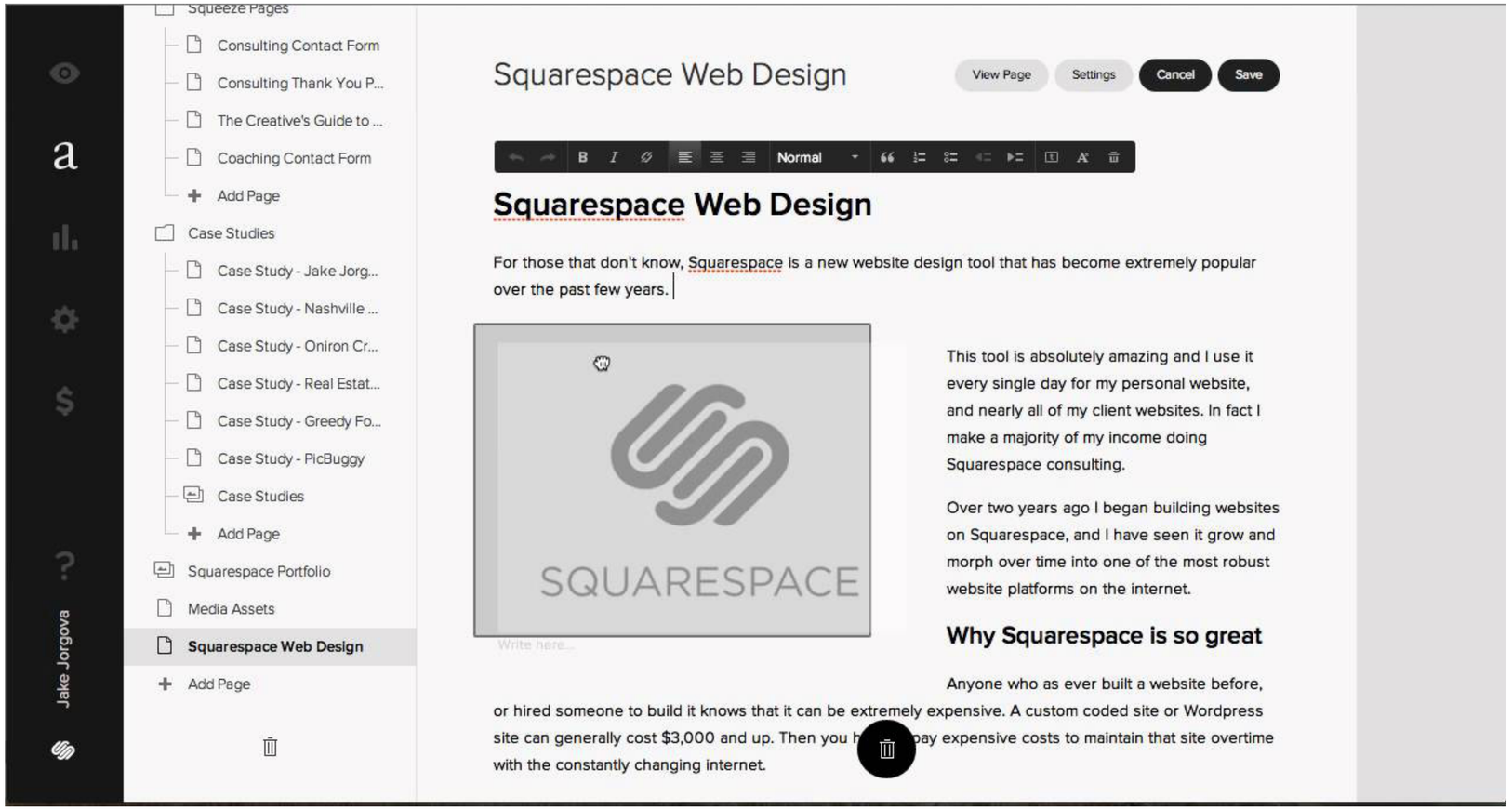
1997-Today



Macromedia (Later Adobe)

Squarespace

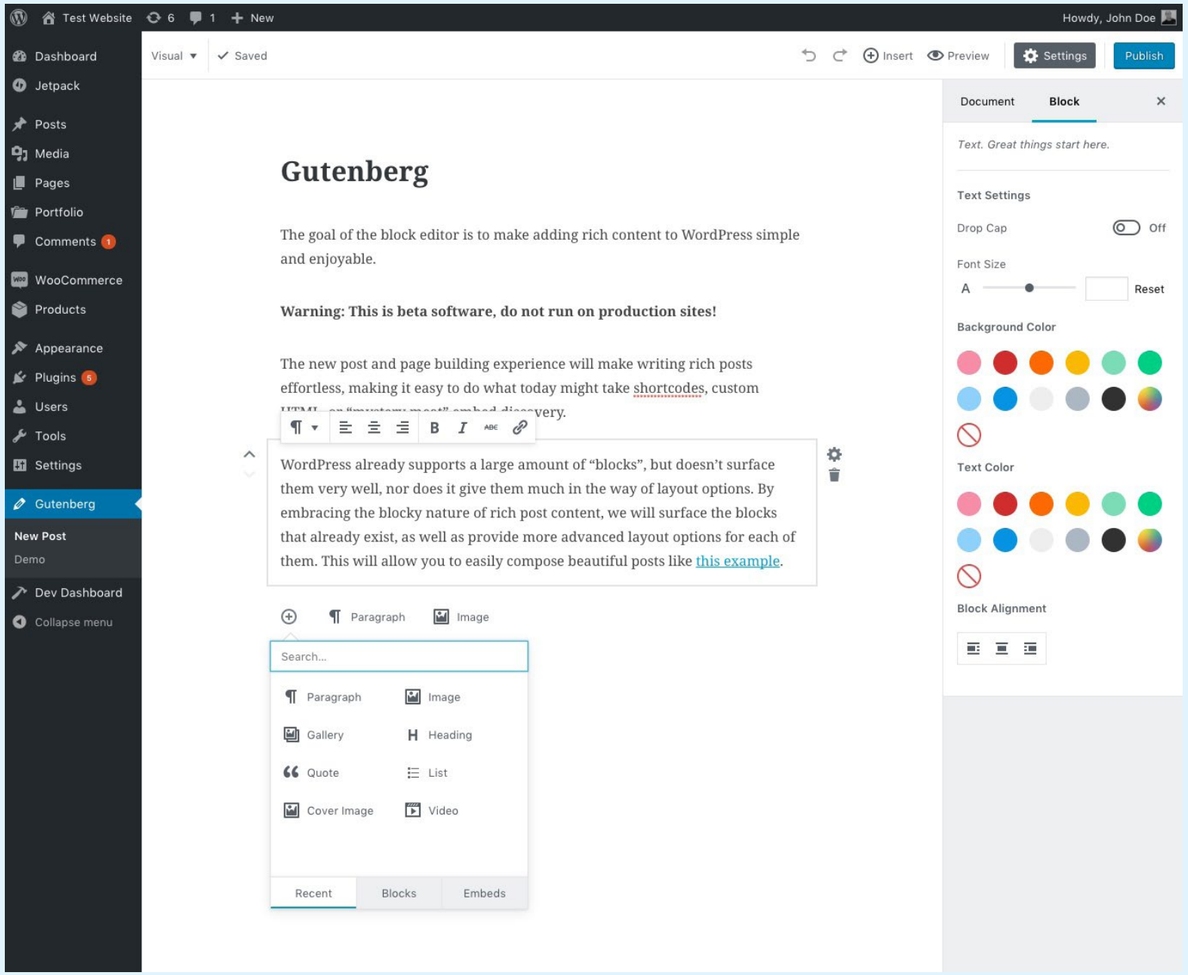
2003-Today



Anthony Casalena and Others

Wordpress

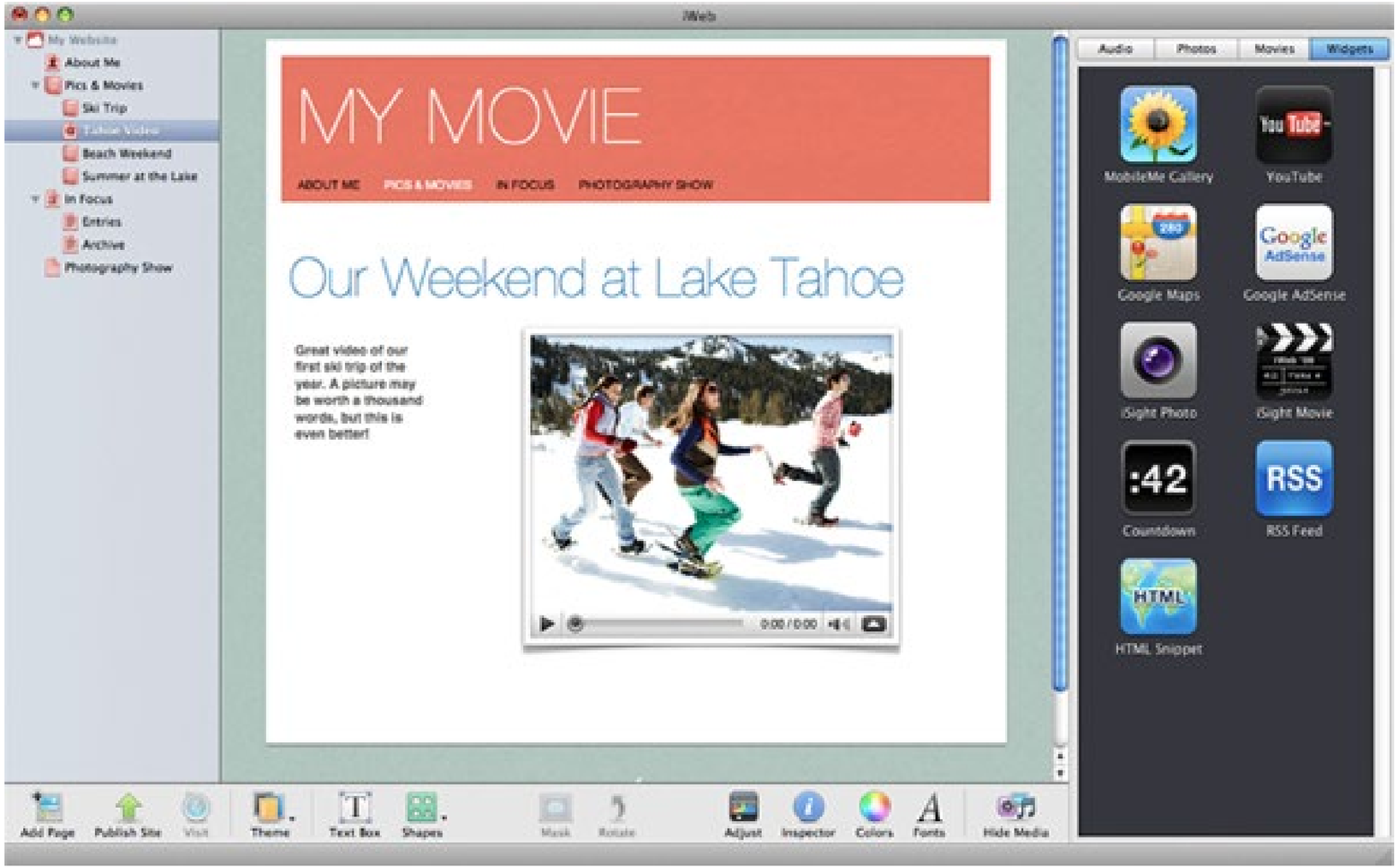
2005-Today



Automattic

iWeb

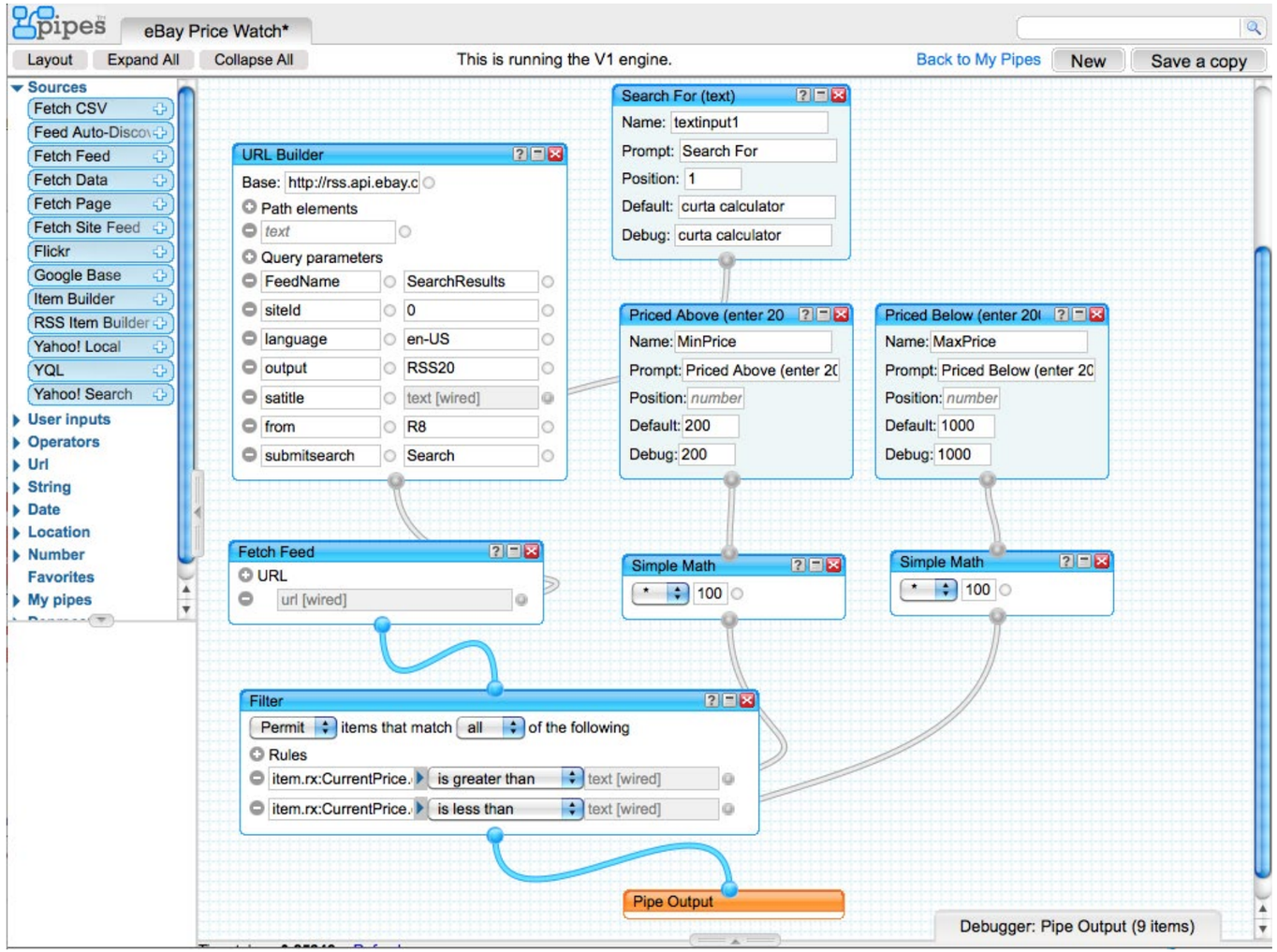
2006-2011



Apple

Yahoo! Pipes

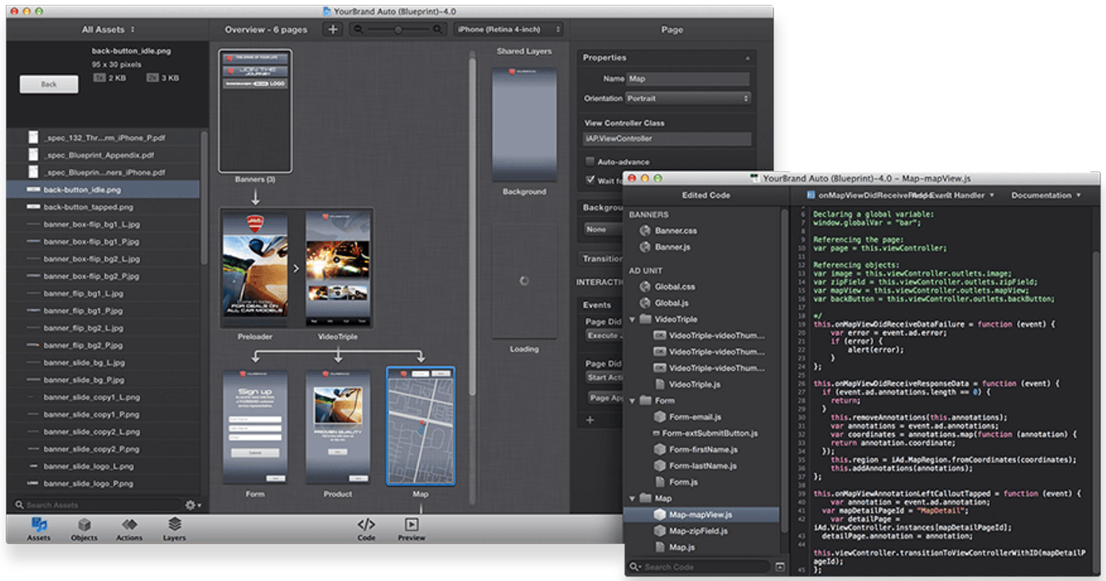
2007-2015

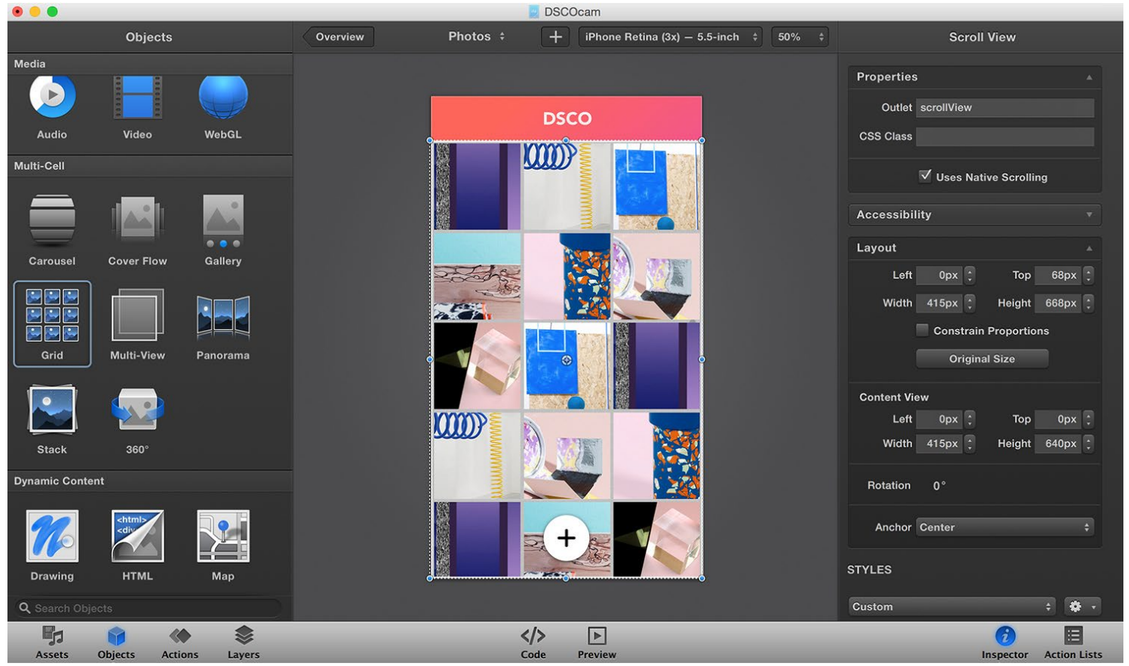


Pasha Sadri, Ed Ho, Jonathan Trevor, Kevin Cheng, Ido Green and Daniel Raffel at Yahoo!

iAd Producer

2010-2016

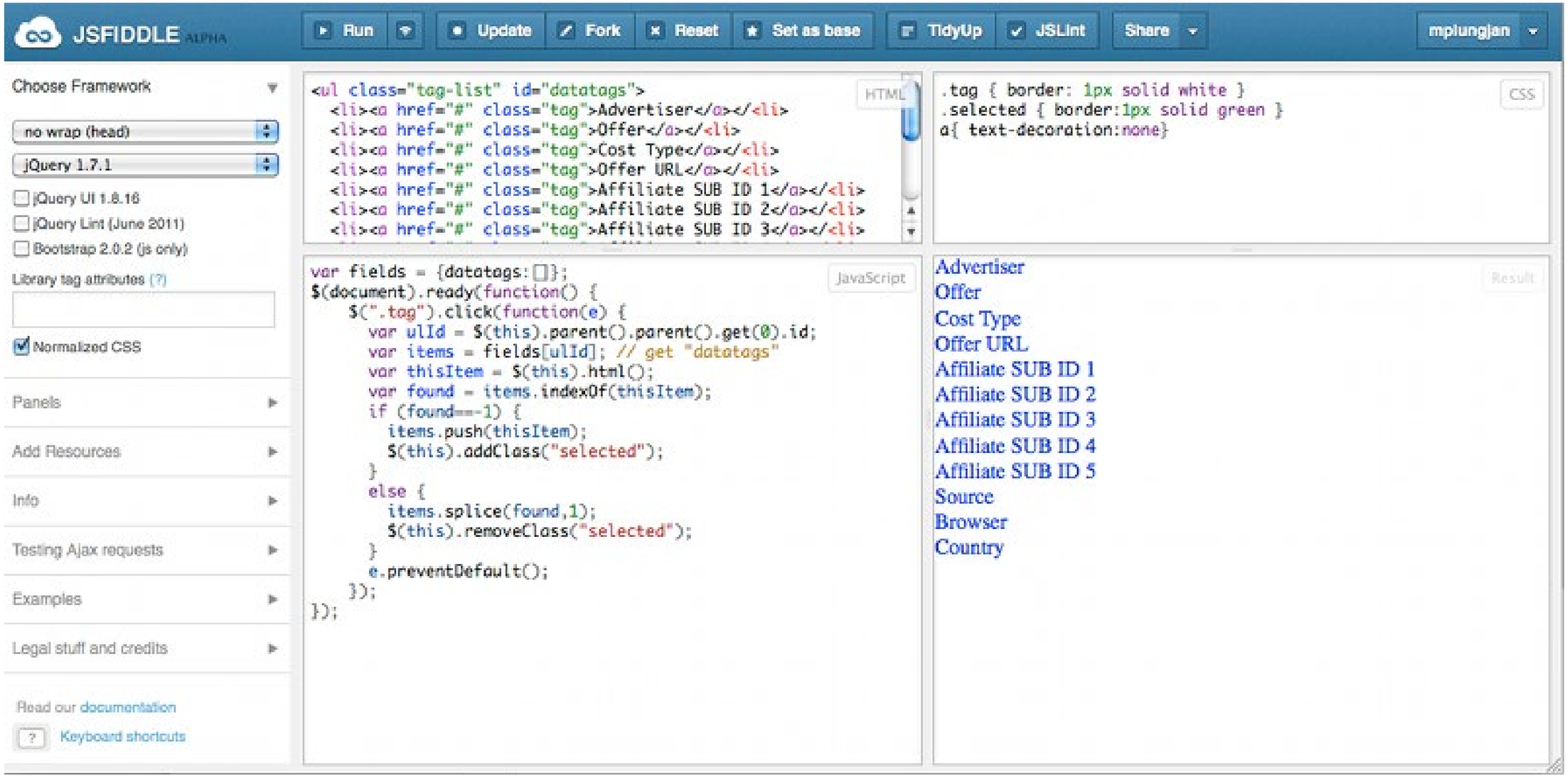




Apple

JSFiddle

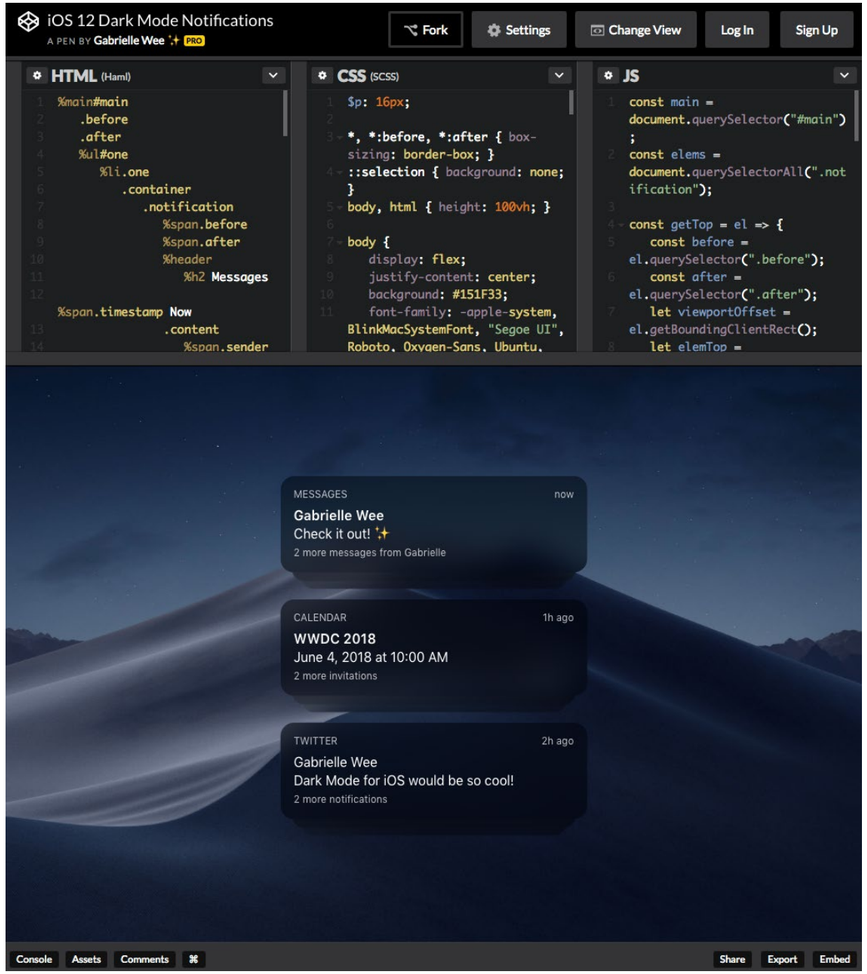
2010-Today



Oskar Krawczyk, Piotr Zalewa

CodePen

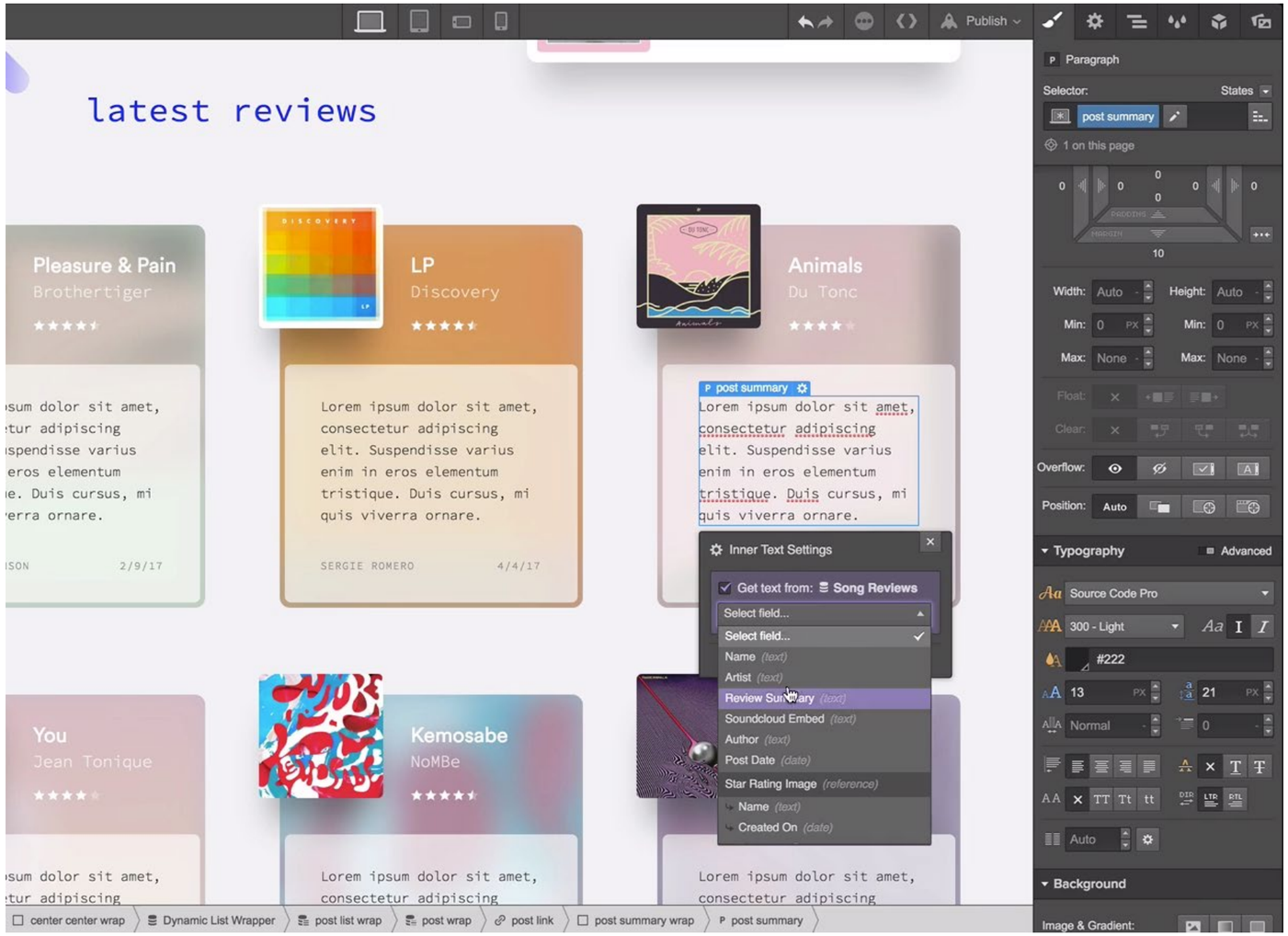
2012-Today



Tim Sabat, Alex Vazquez, Chris Coyier

Webflow

2013-Today

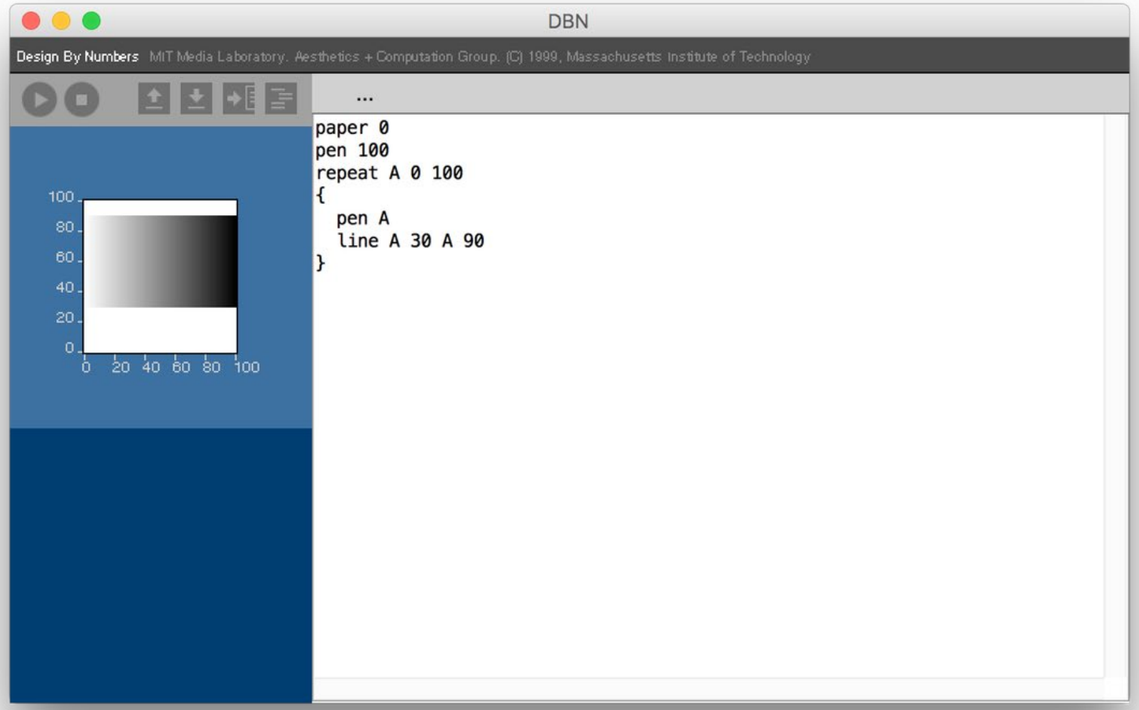


Vlad Magdalin and Sergie Magdalin

‘Creative Coding’ Toolkits

Design by Numbers

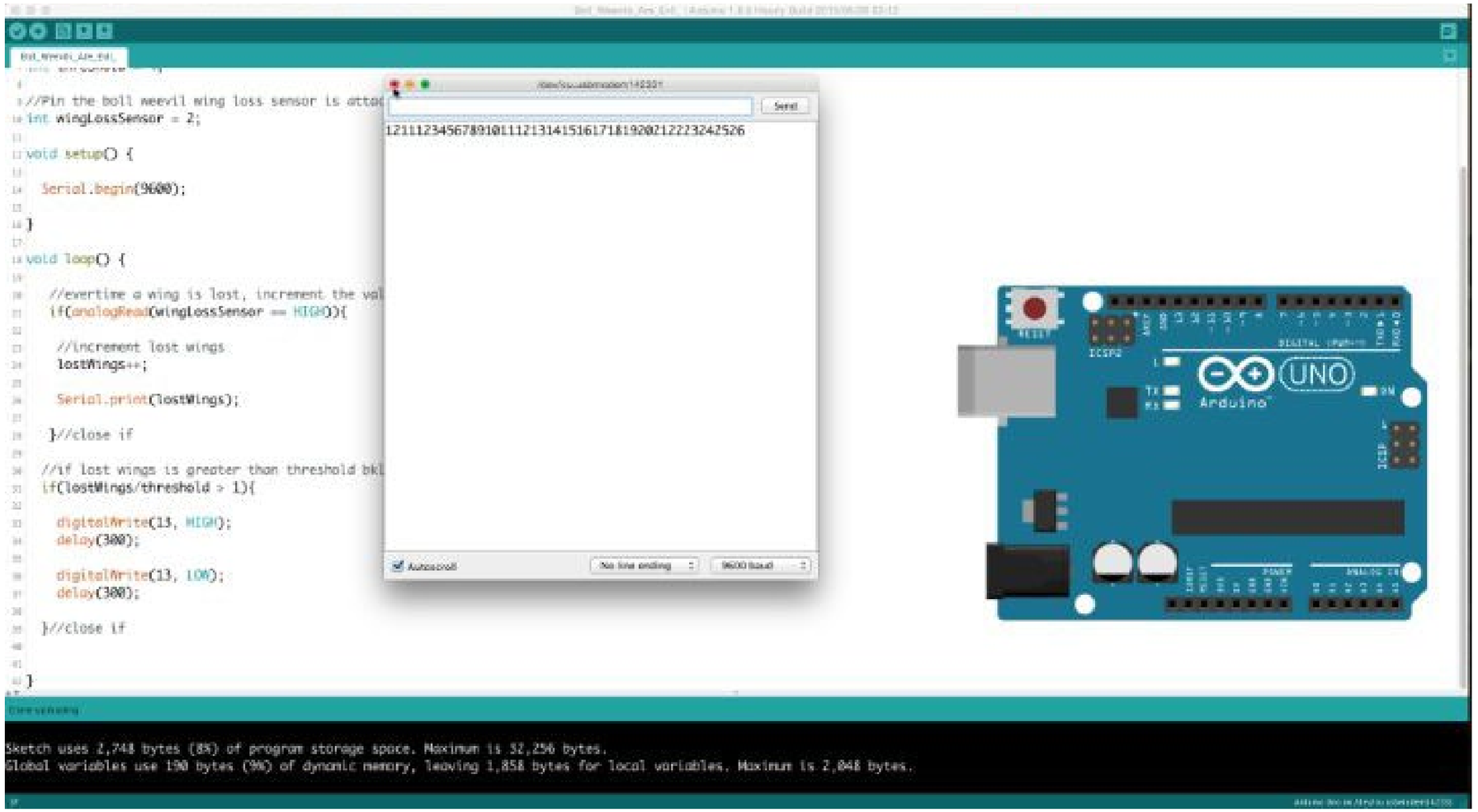
1999-2003



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

Arduino

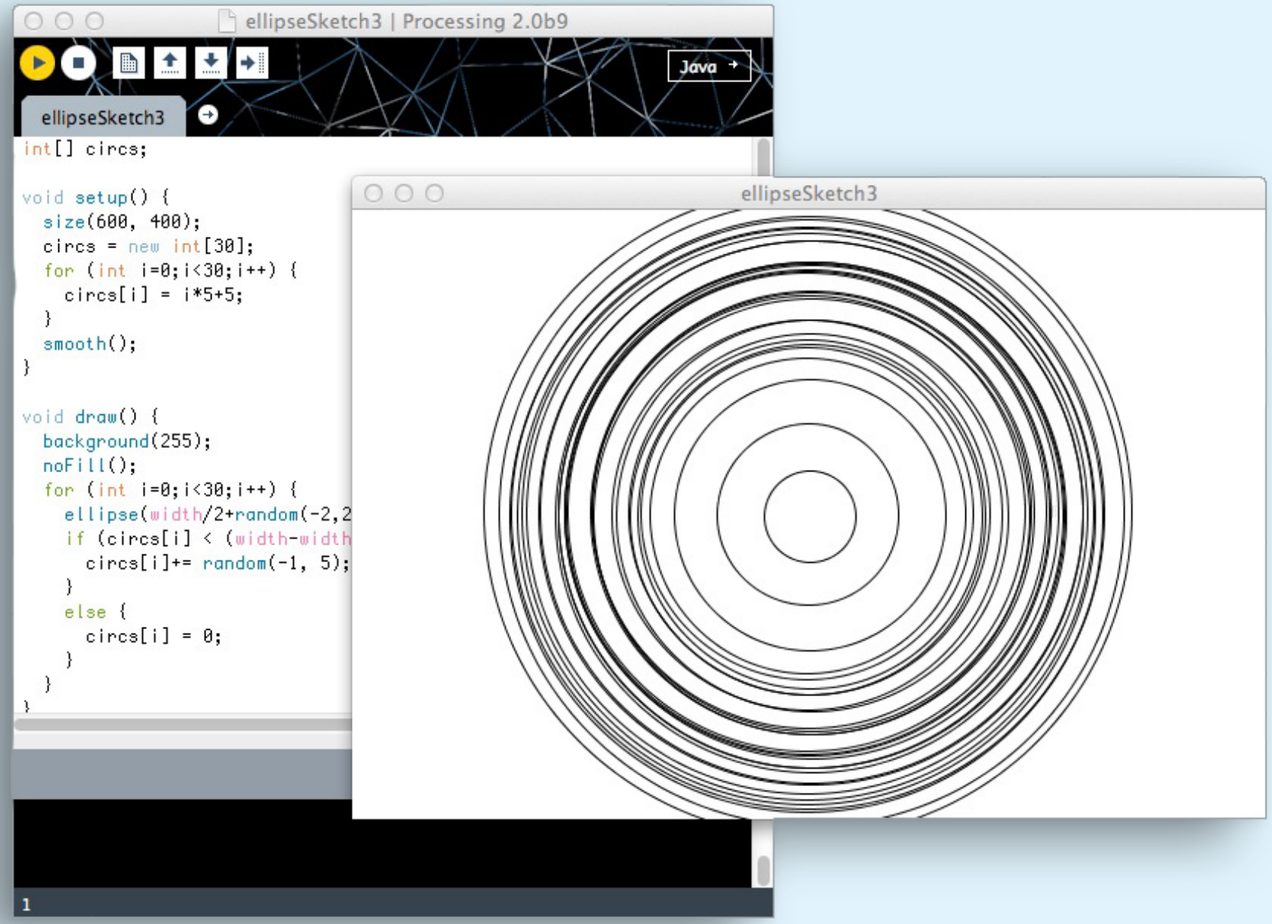
2003-Today



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

Processing

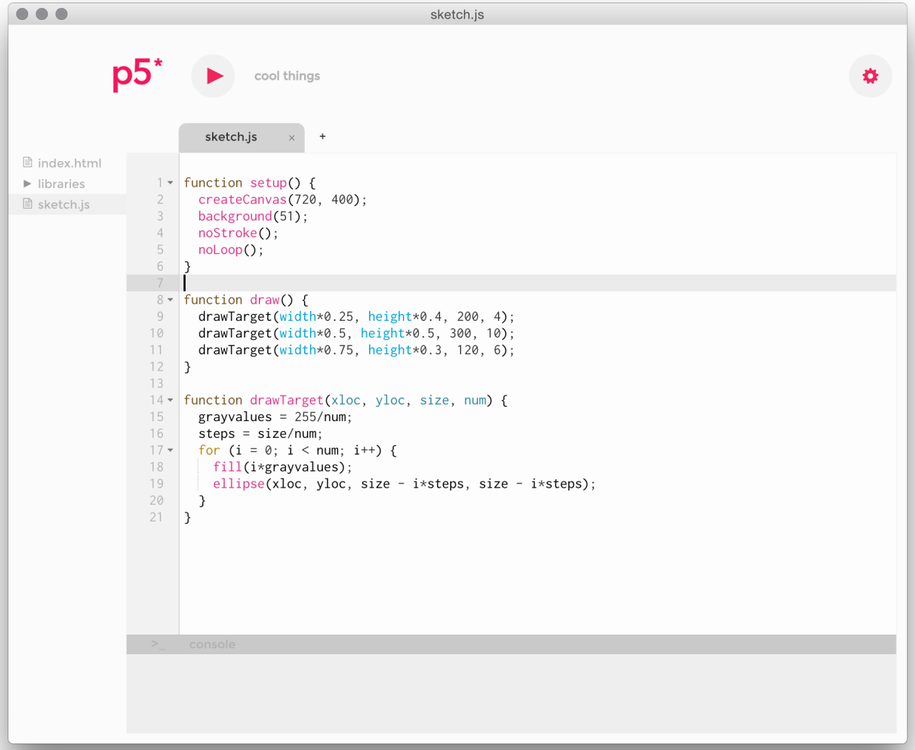
2001-Today

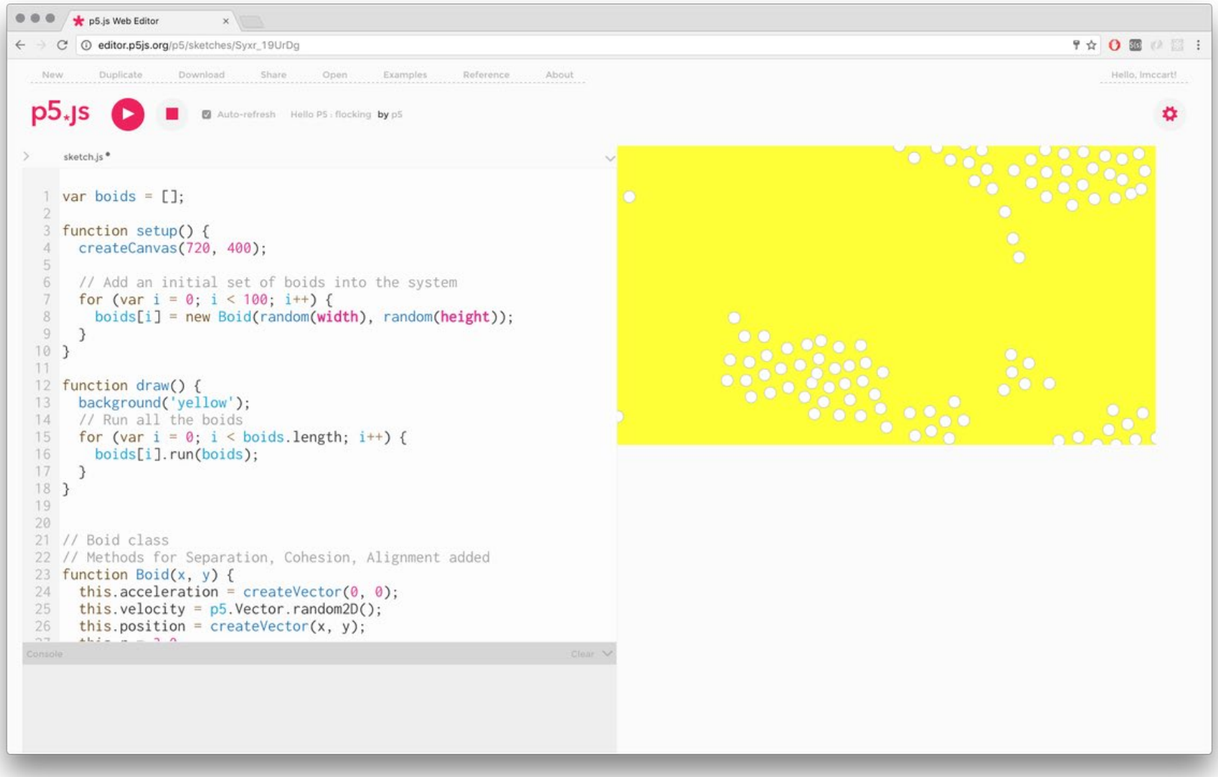


Casey Reas and Ben Fry at the MIT Media Lab (Now Processing Foundation)

p5.js

2014-Today





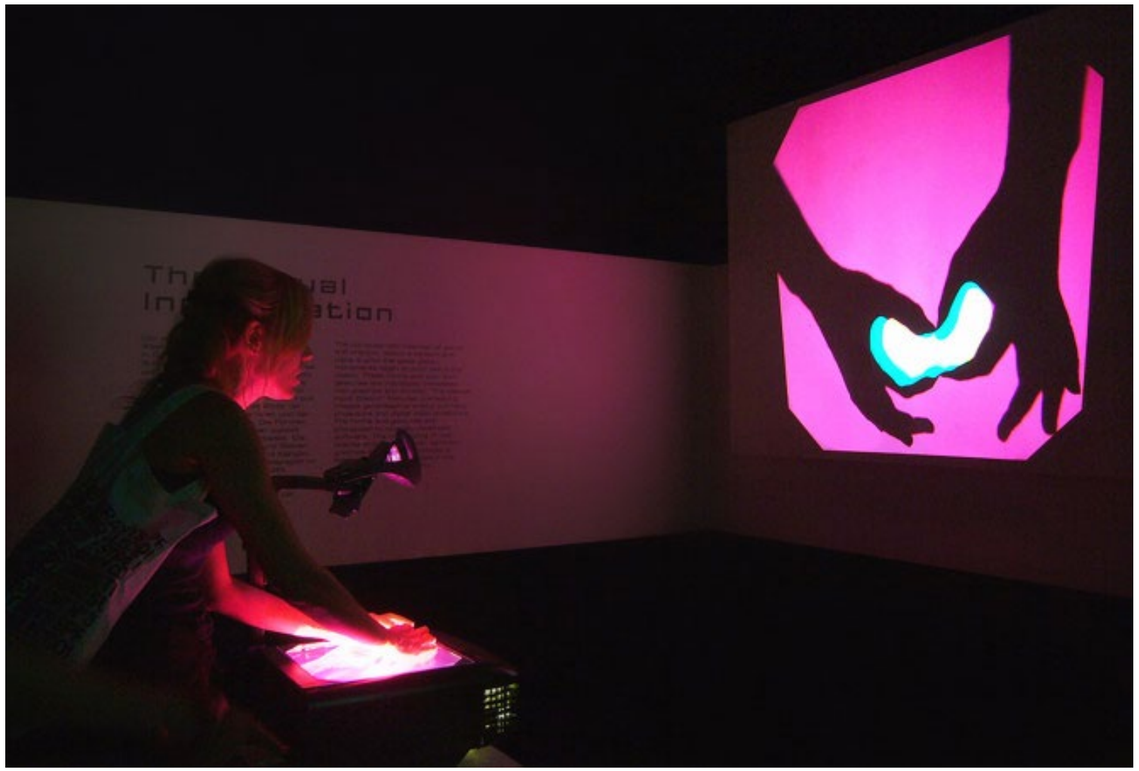
Lauren McCarthy at MIT (Now at UCLA, Dept. of Design Media Arts)

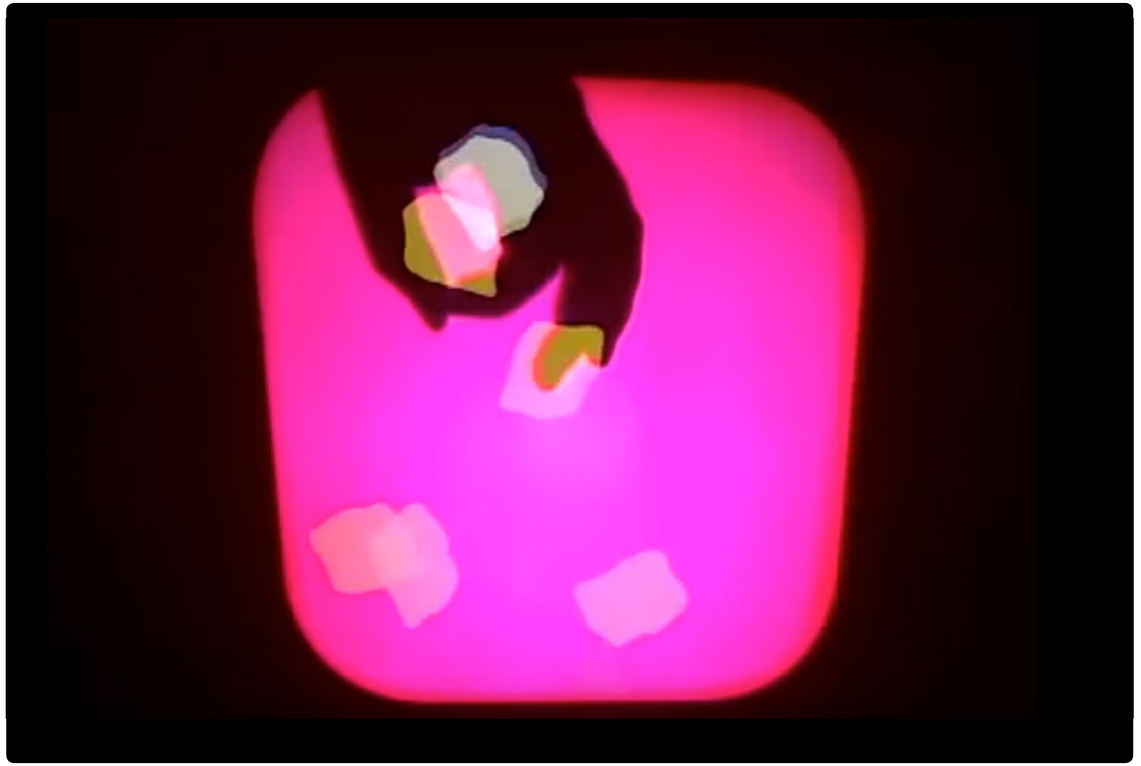
Digital Drawing

Painterly Approaches + Computational Methods

The Manual Input Workstation

2004

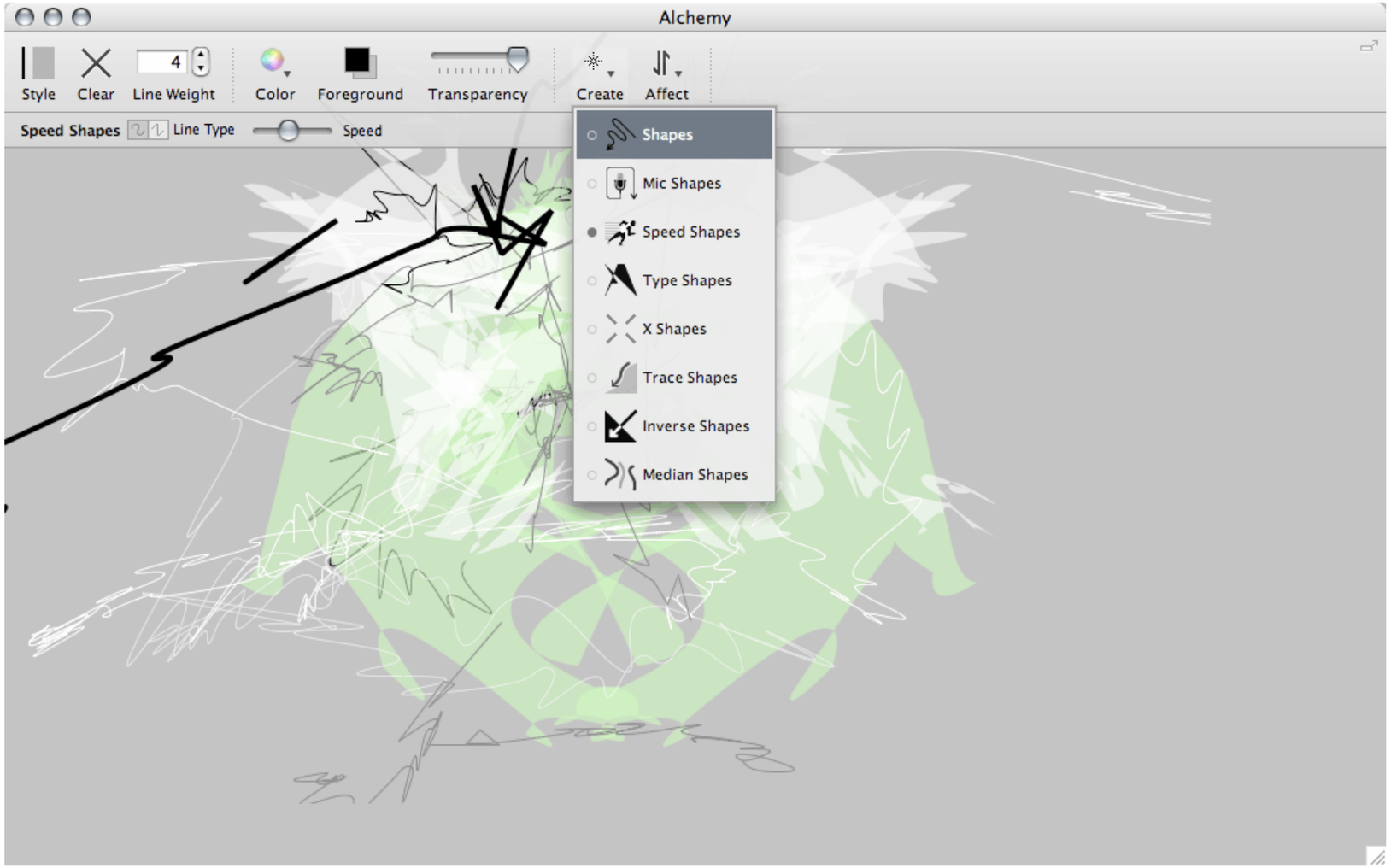




Golan Levin and Zachary Lieberman

Alchemy

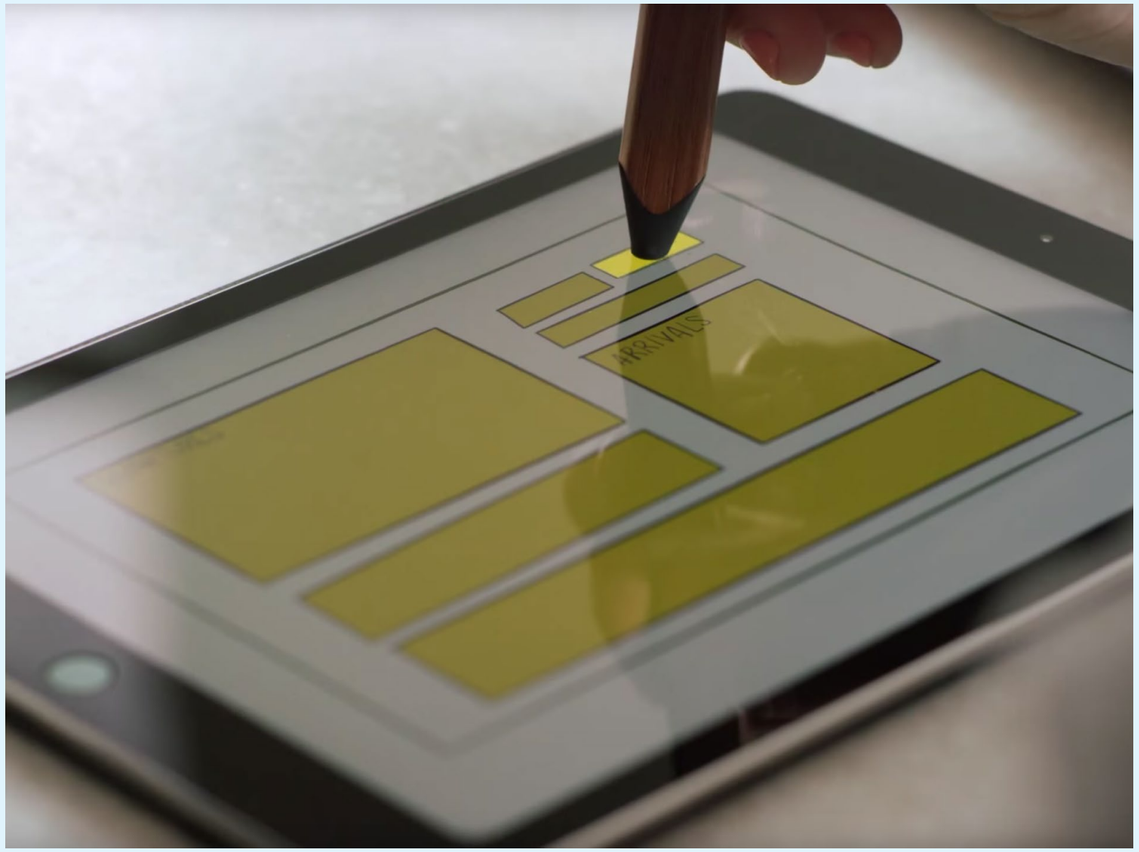
2008-

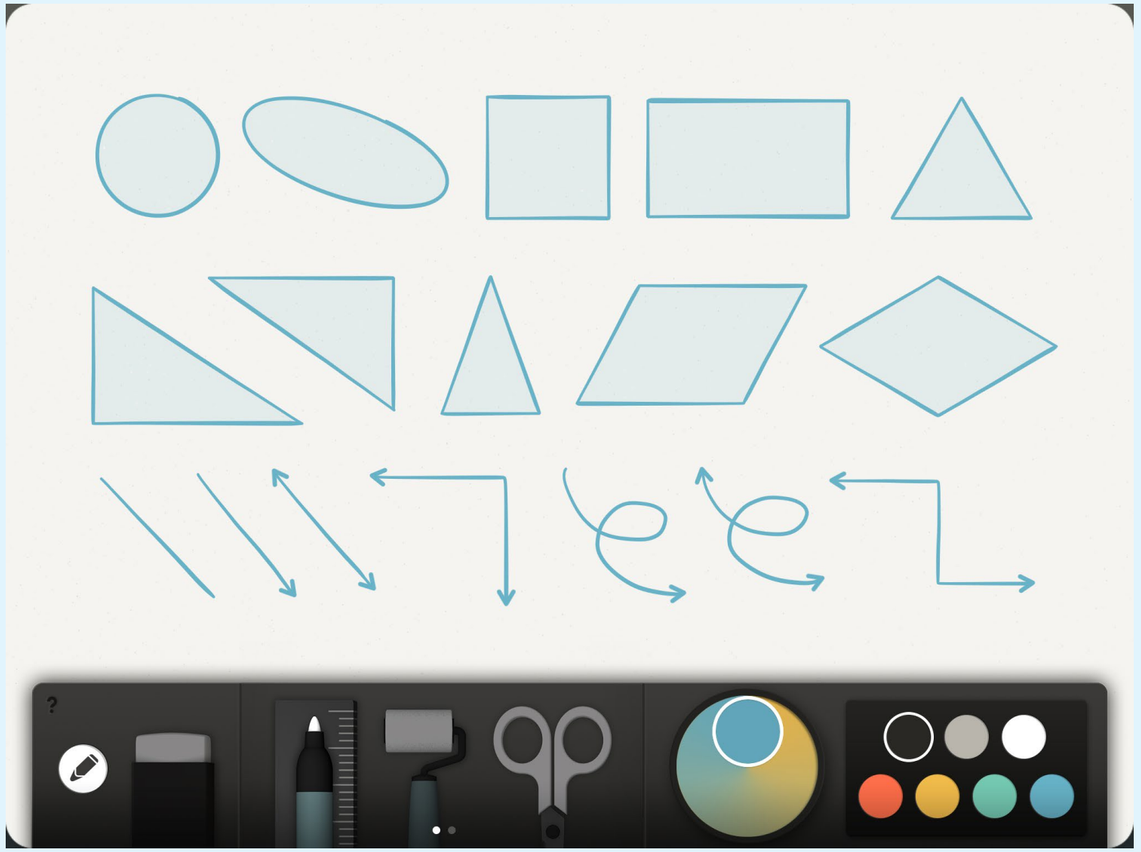


Karl D.D. Willis and Jacob Hina

Paper

2011-Today

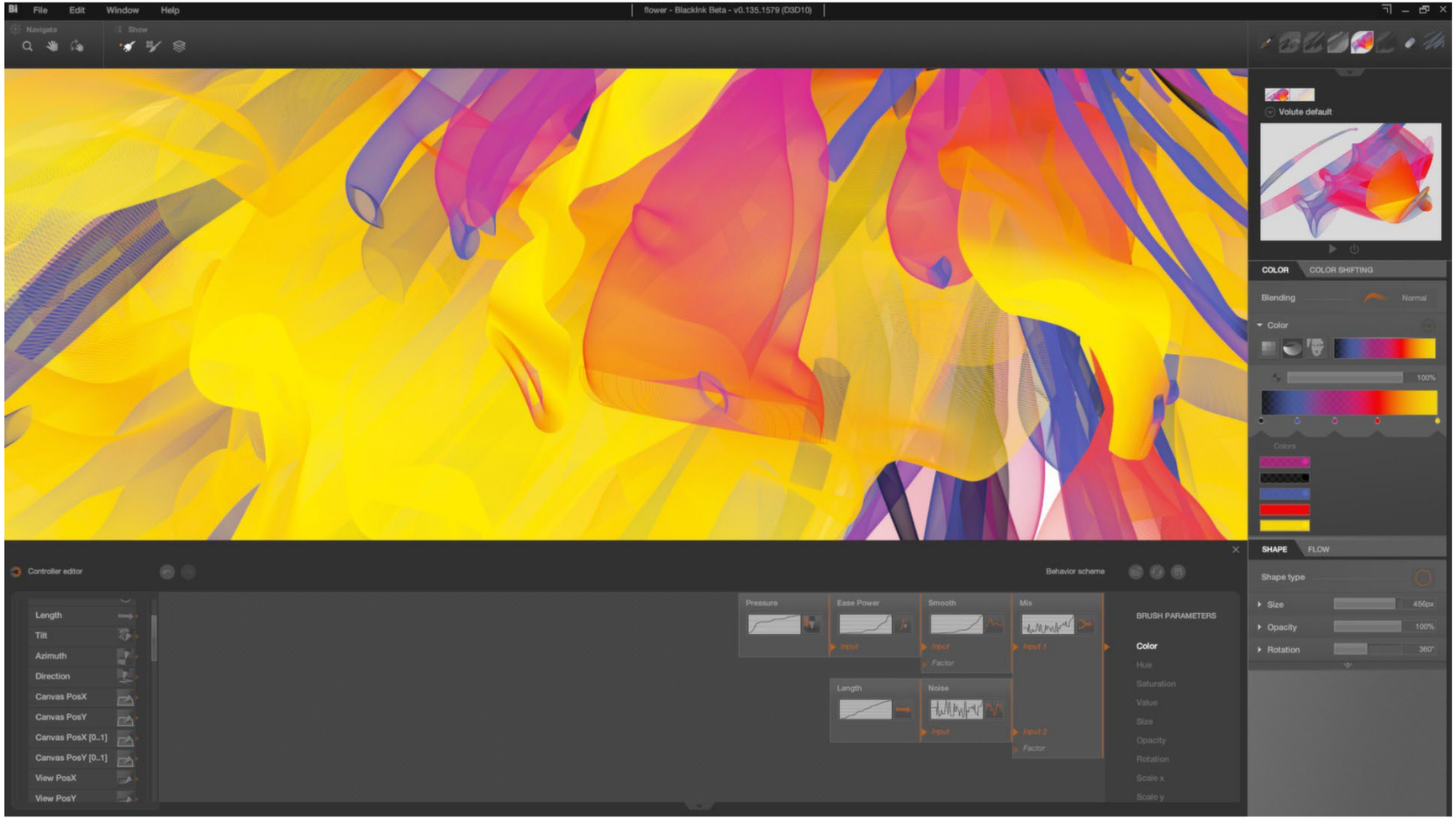




Georg Petschnigg, Andrew S. Allen, Julian Walker and Jonathan Harris for FiftyThree

BlackInk

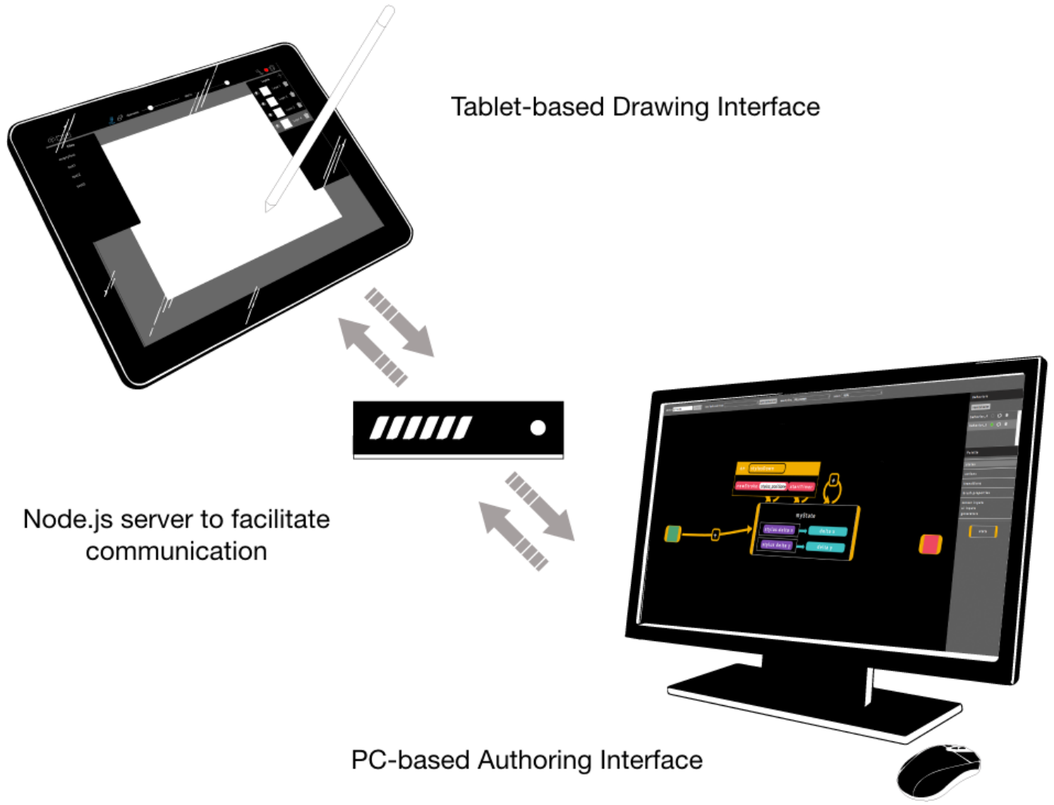
2013-Today

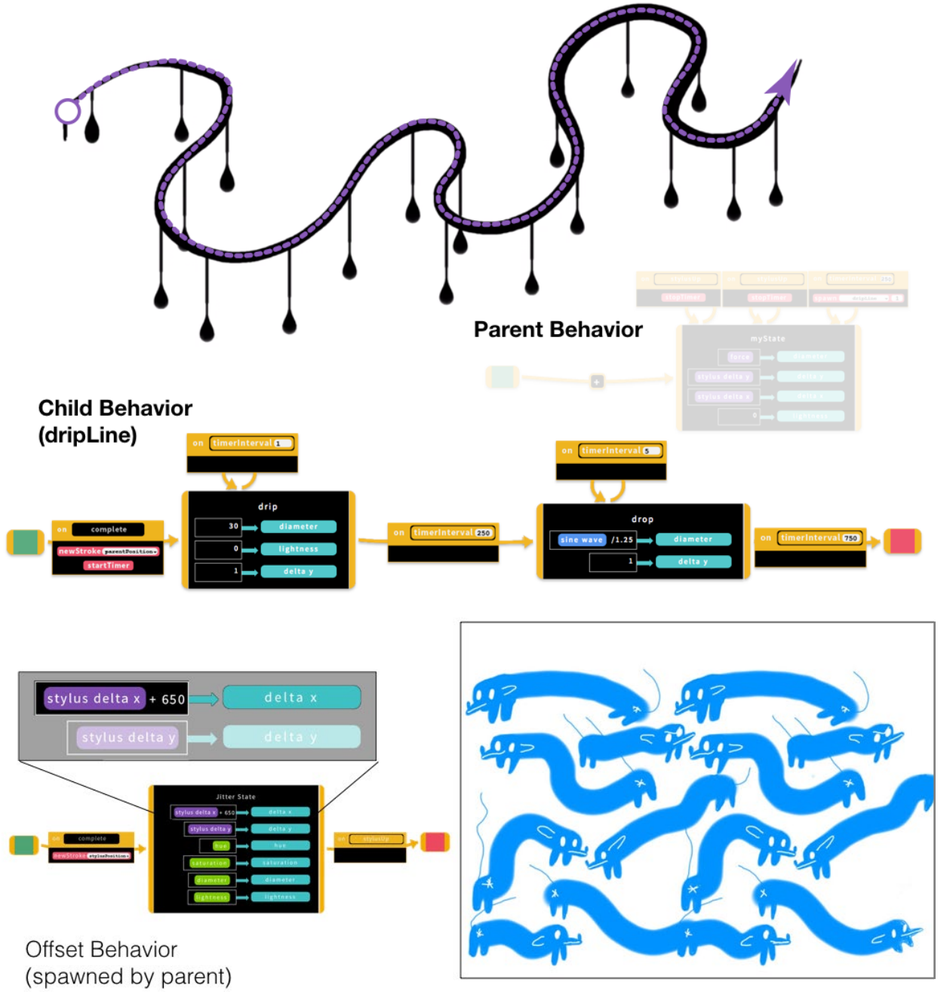


Bleank

Dynamic Brushes

2017

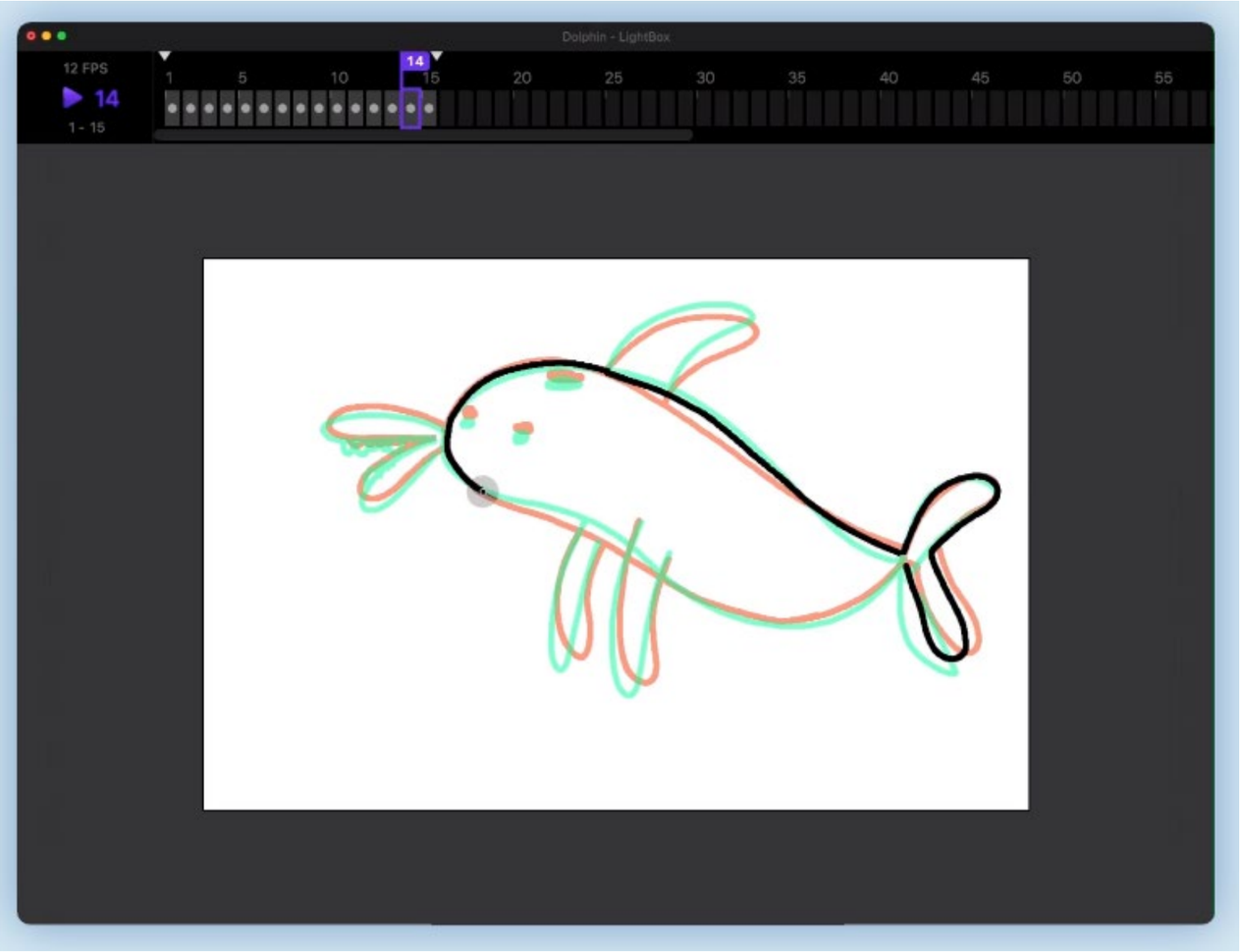




Jennifer Jacobs

Lightbox

2018-Today



Pasquale D'Silva, Jacob Bijani and Wojtek Witkowski

Visual Interfaces

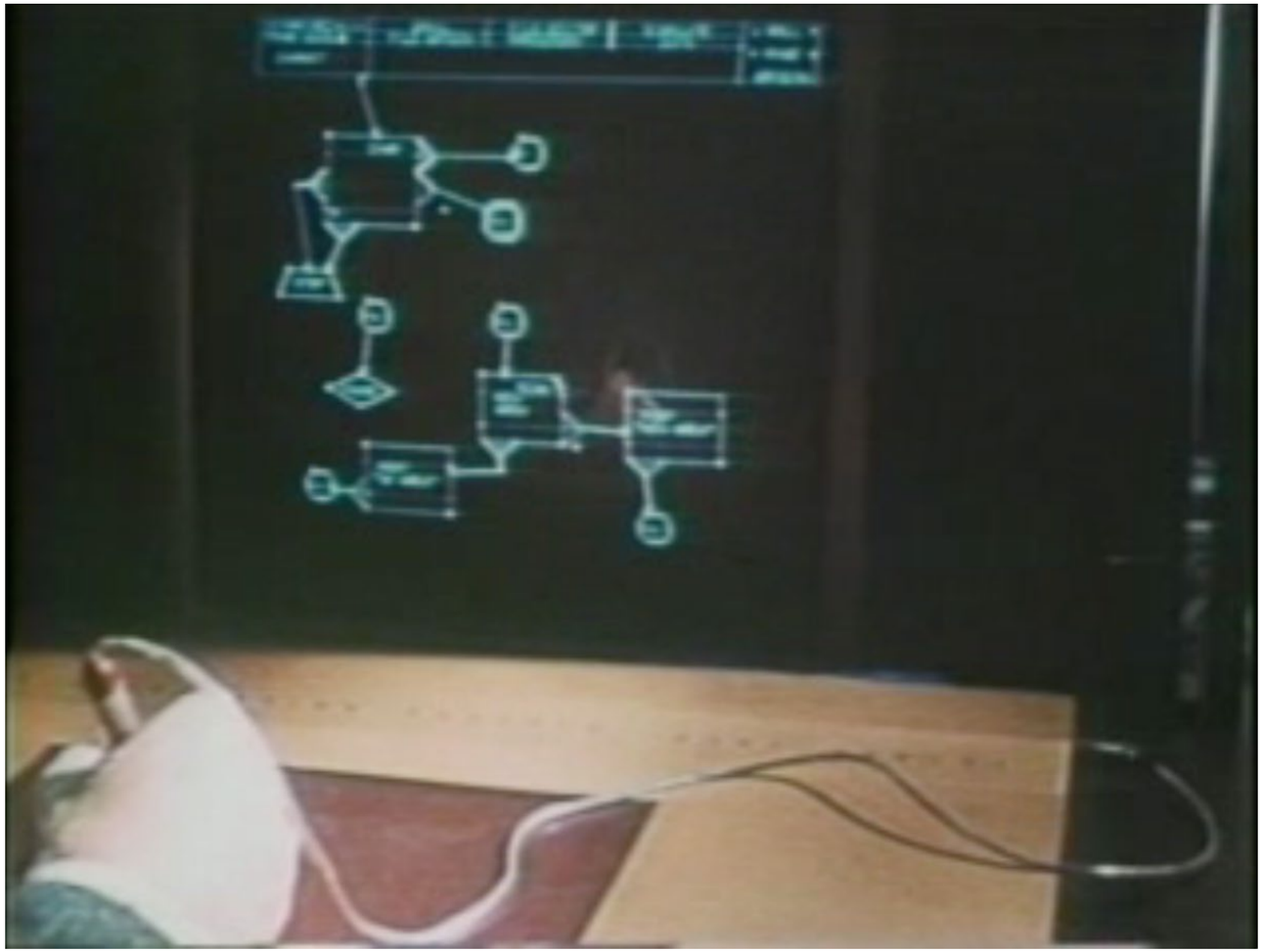
Across the (Design-Development) Divide

Node-Based (Graph)

Environments afford the Visual Authoring of Programs

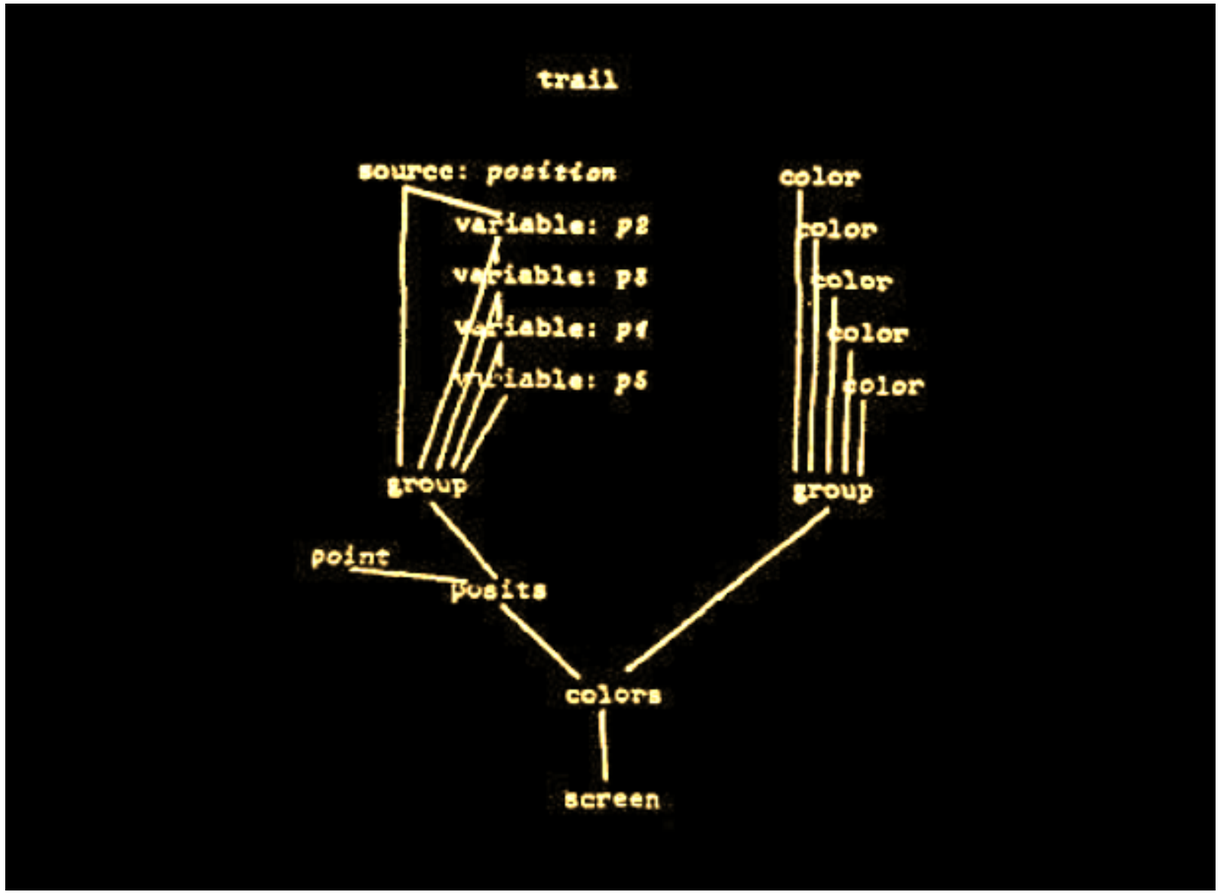
GRaIL

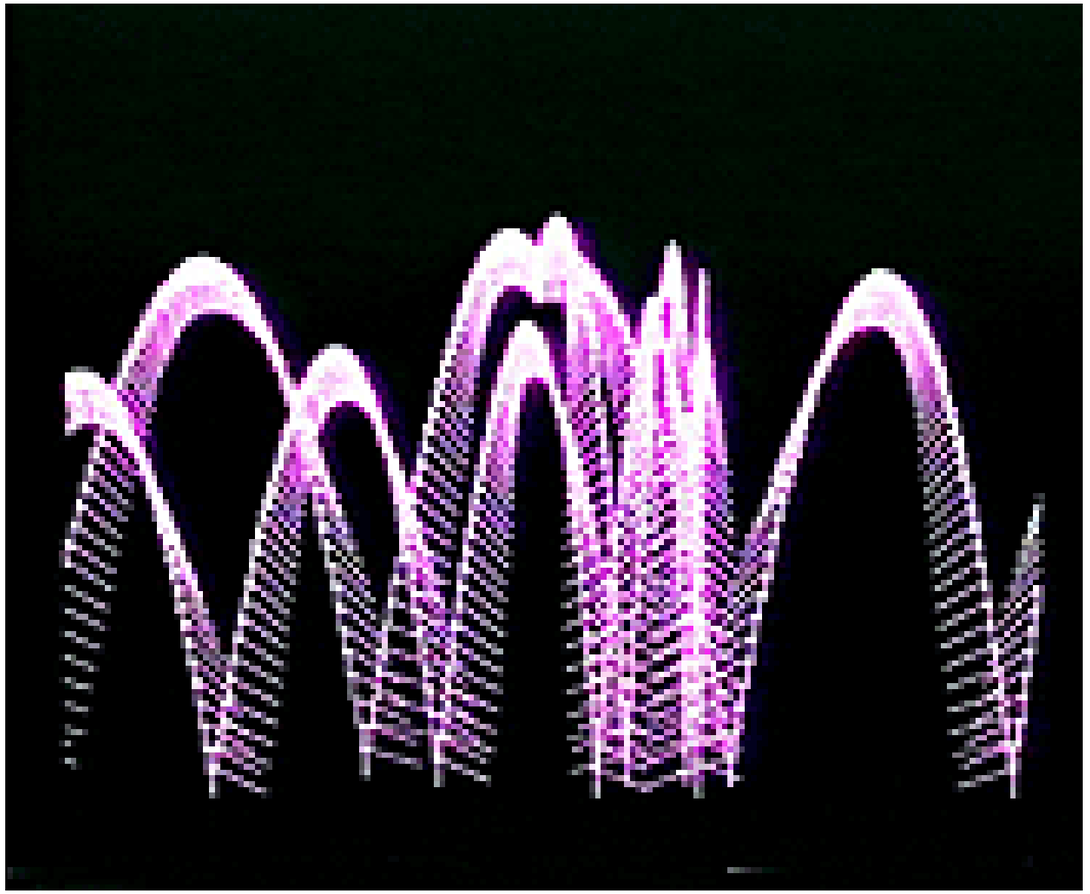
1968



RAND Corporation

EOM (Graphical Simulation System) 1976-1977

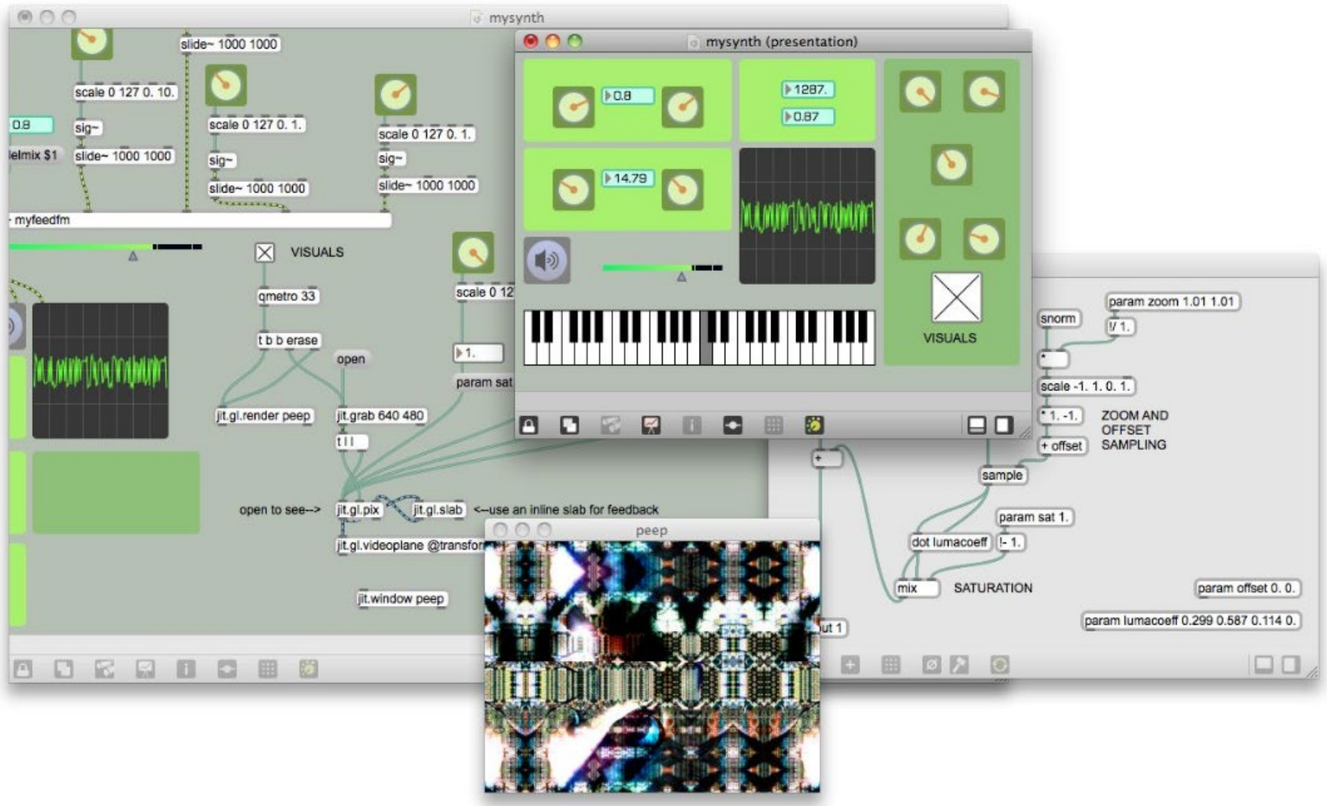




Paul Pangaro, Seth Steinberg, Jim Davis, and Ben McCann at the MIT Architecture Machine Group

MaxMSP

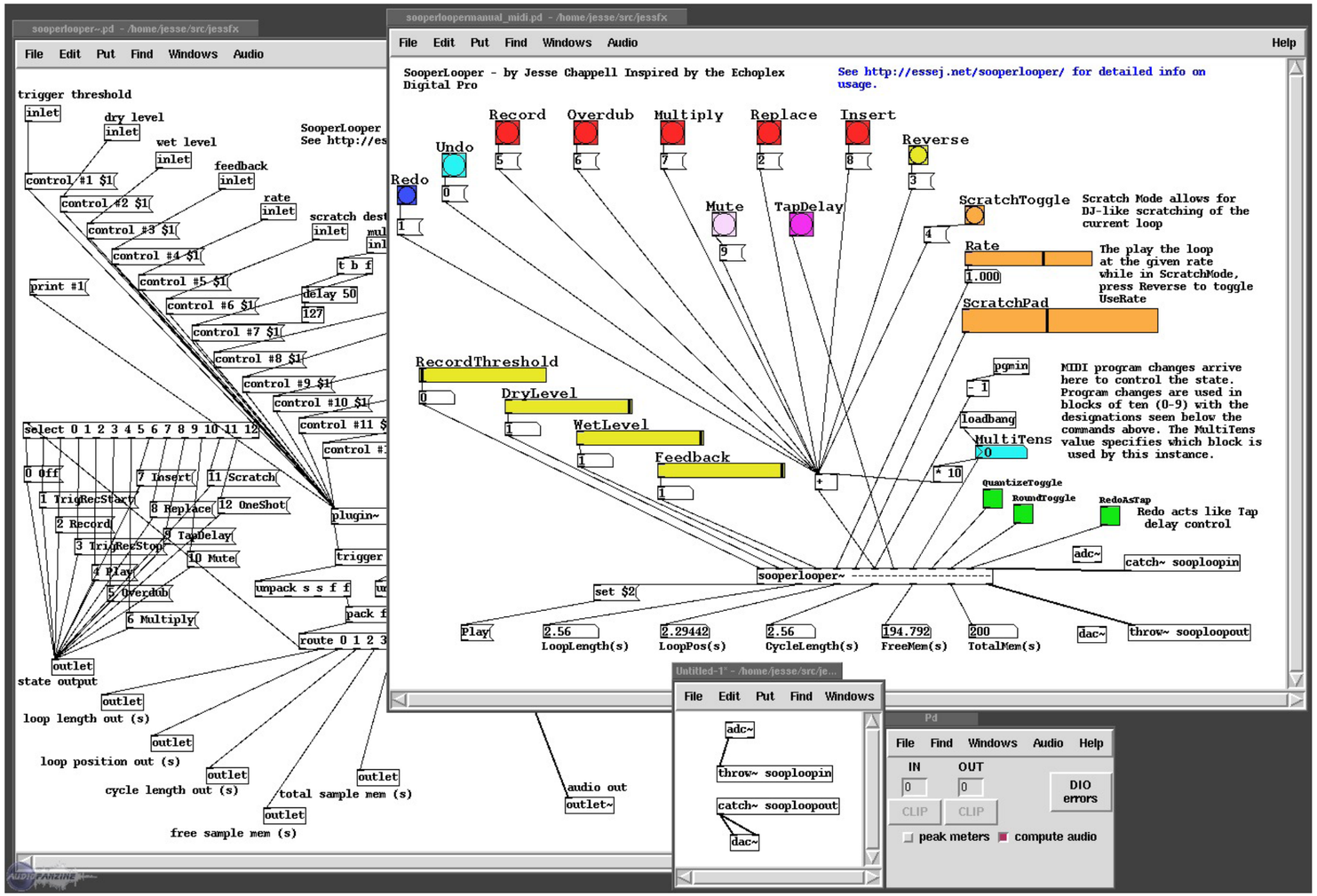
1990-Today



Miller Puckette at IRCAM (Now Cycling '74)

Pure Data

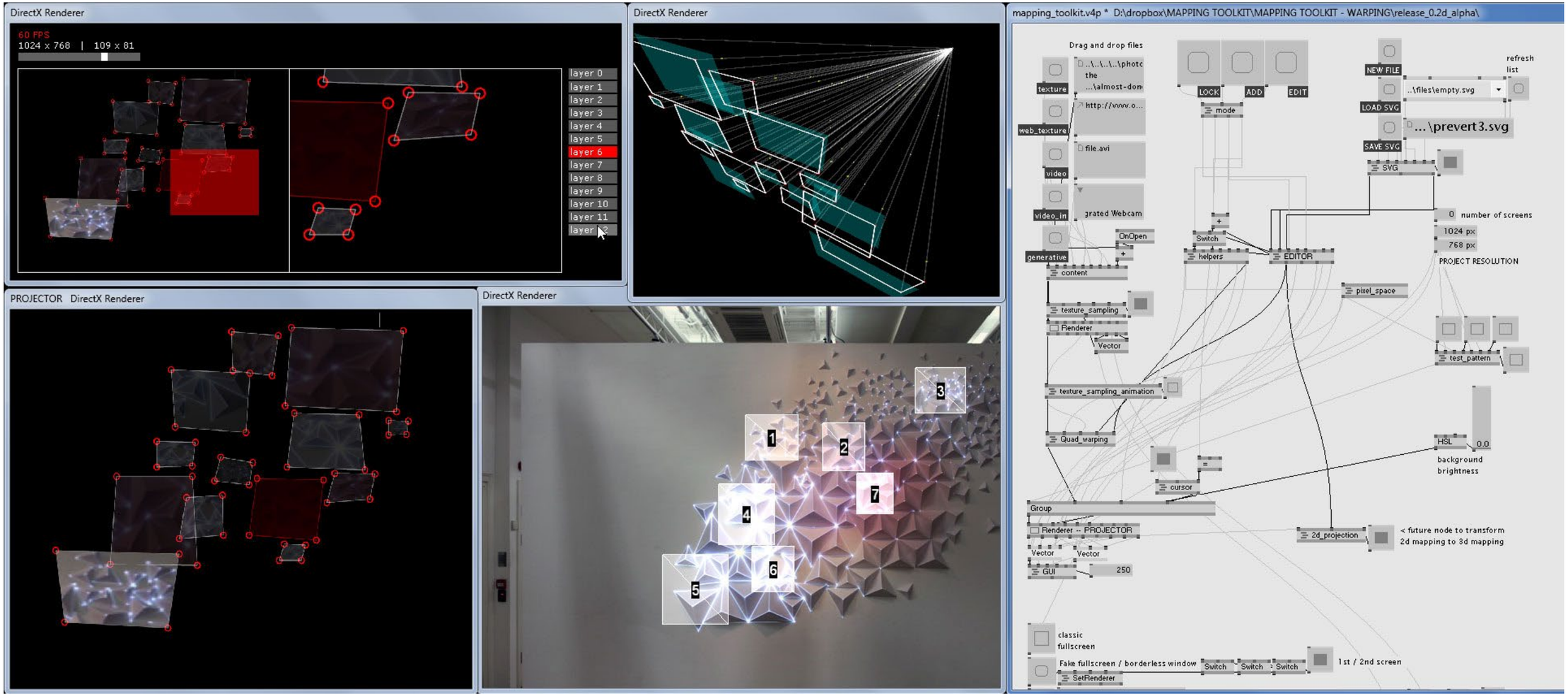
1996-Today



Miller Puckette

vvvv

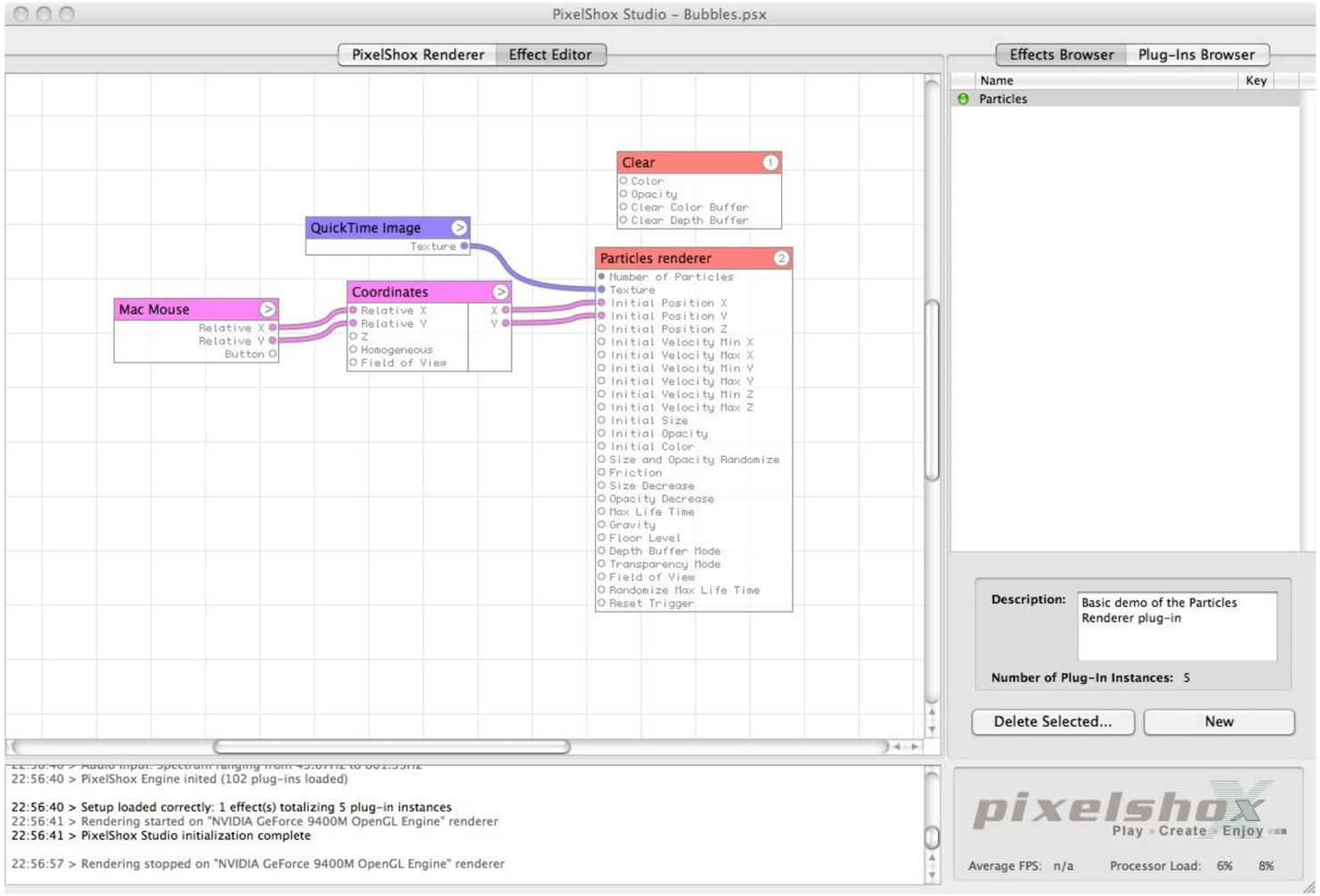
1998-Today



Joreg, Max Wolf, Sebastian Gregor, Sebastian Oschatz for ‘vvvv Group’

PixelShox Studio

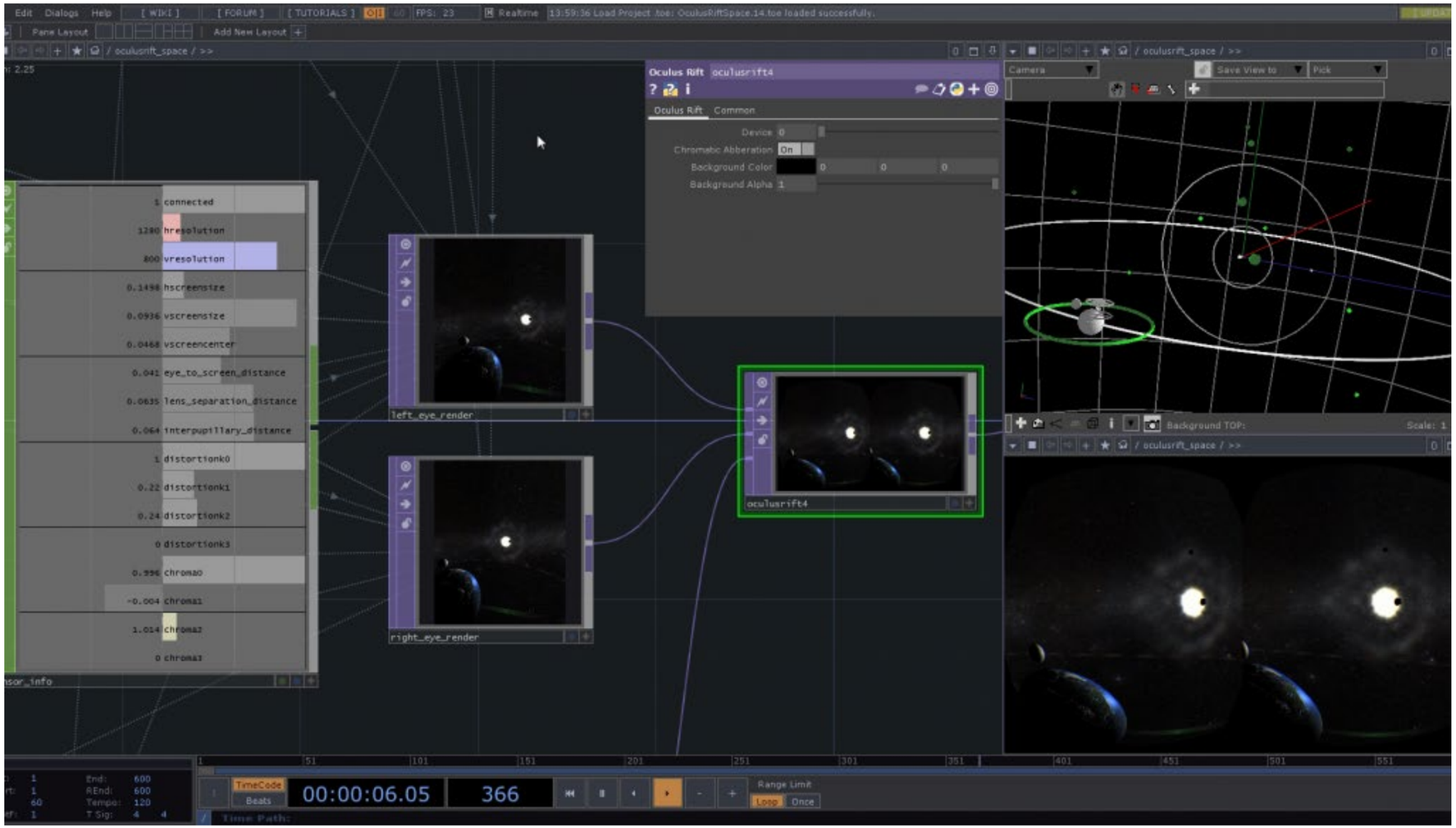
2002-2003



Pierre-Olivier Latour for PixelShox (Acquired by Apple)

TouchDesigner

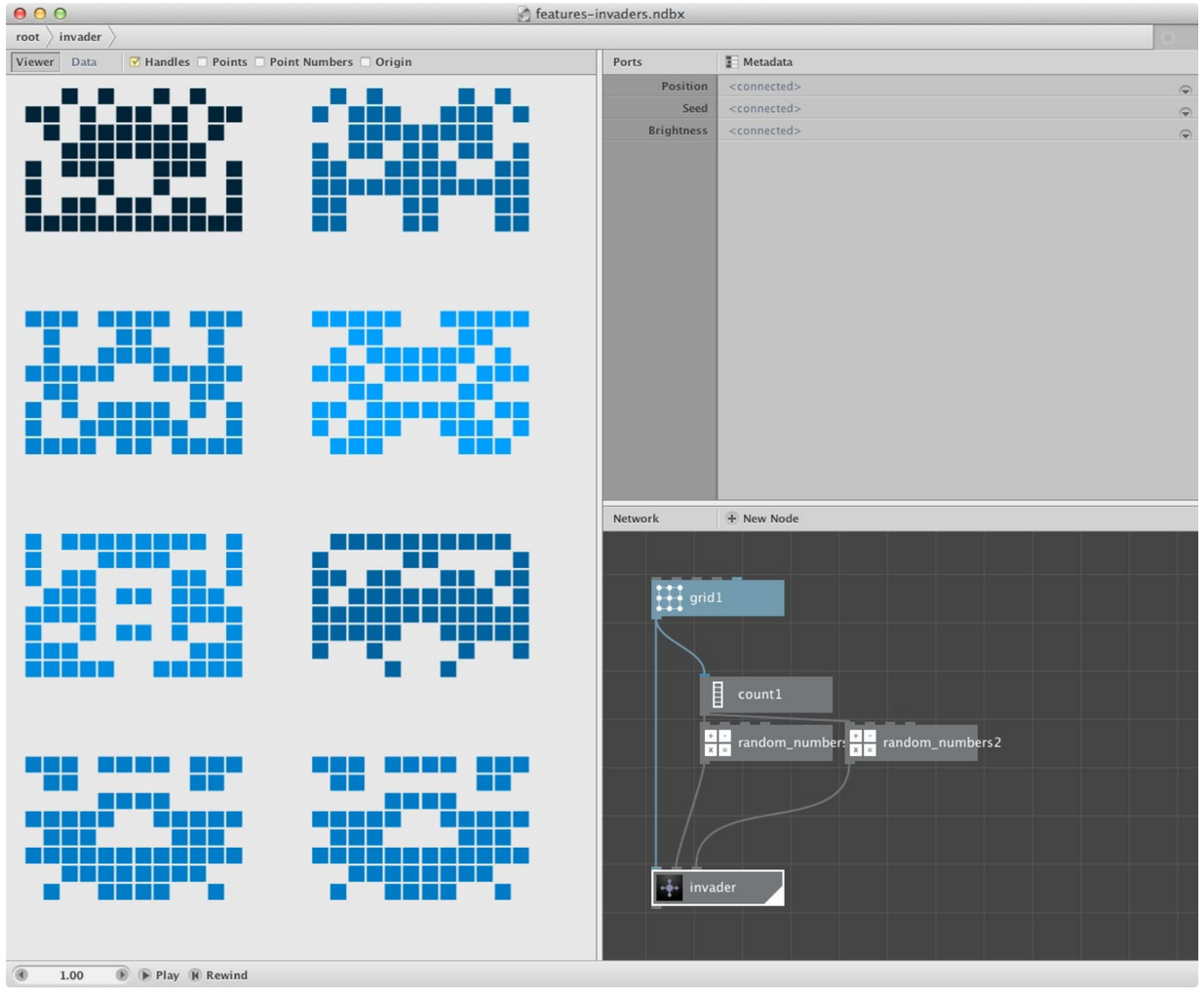
2000-Today



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

NodeBox

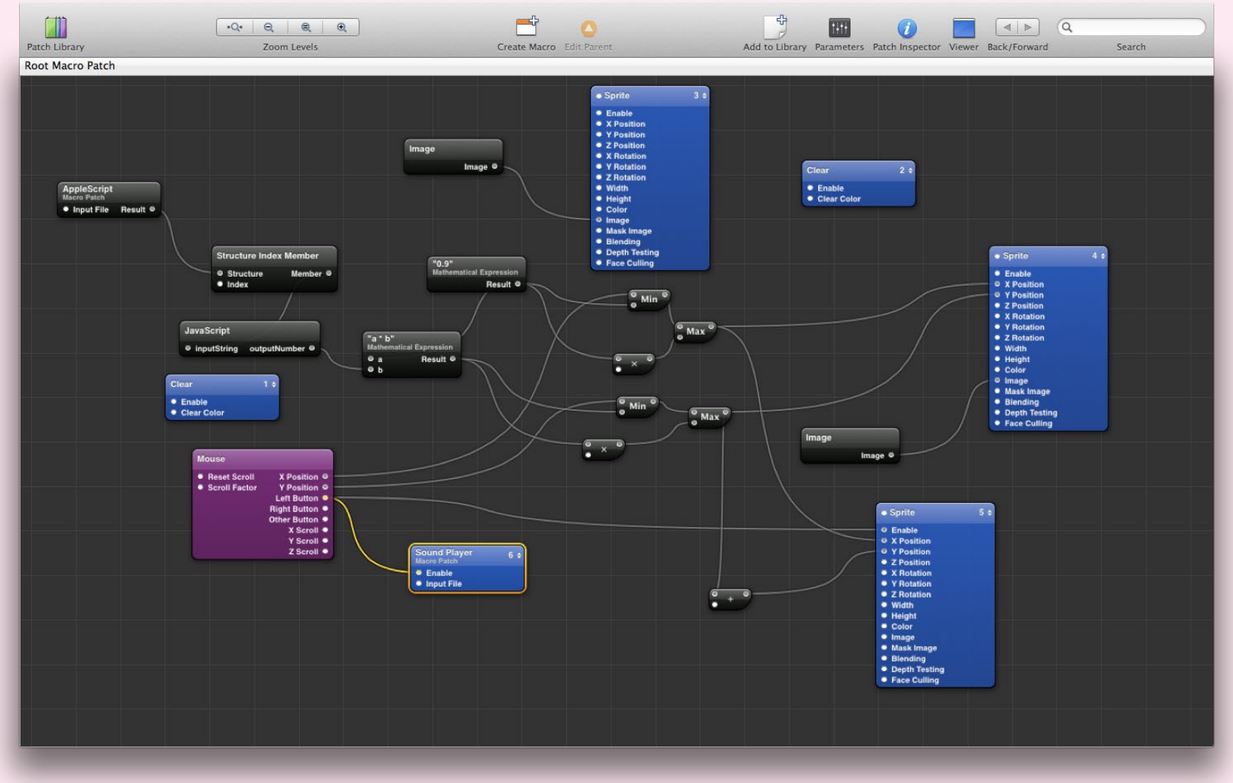
2004-Today



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

Quartz Composer

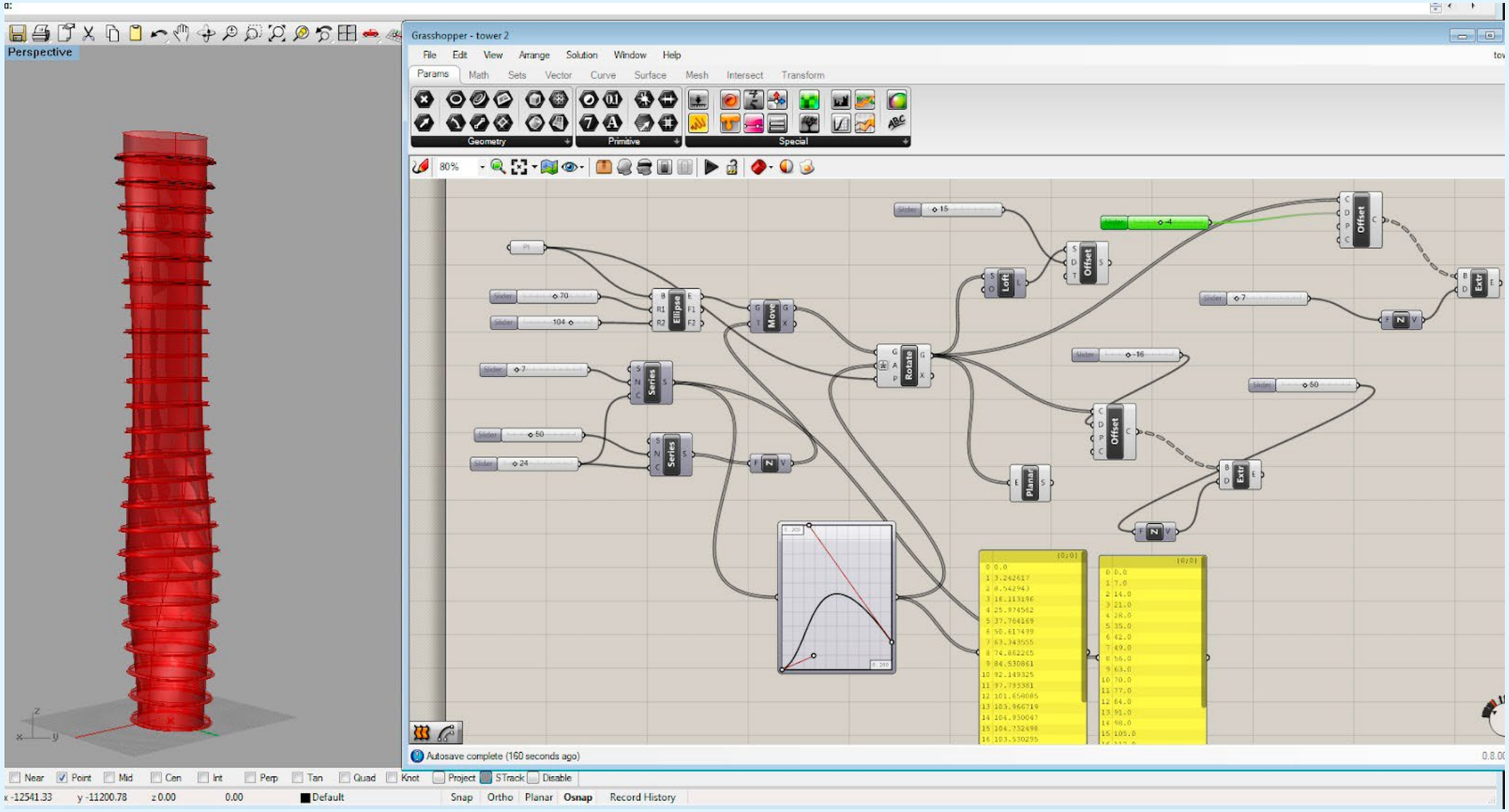
2005-2016



Apple

Grasshopper for Rhino

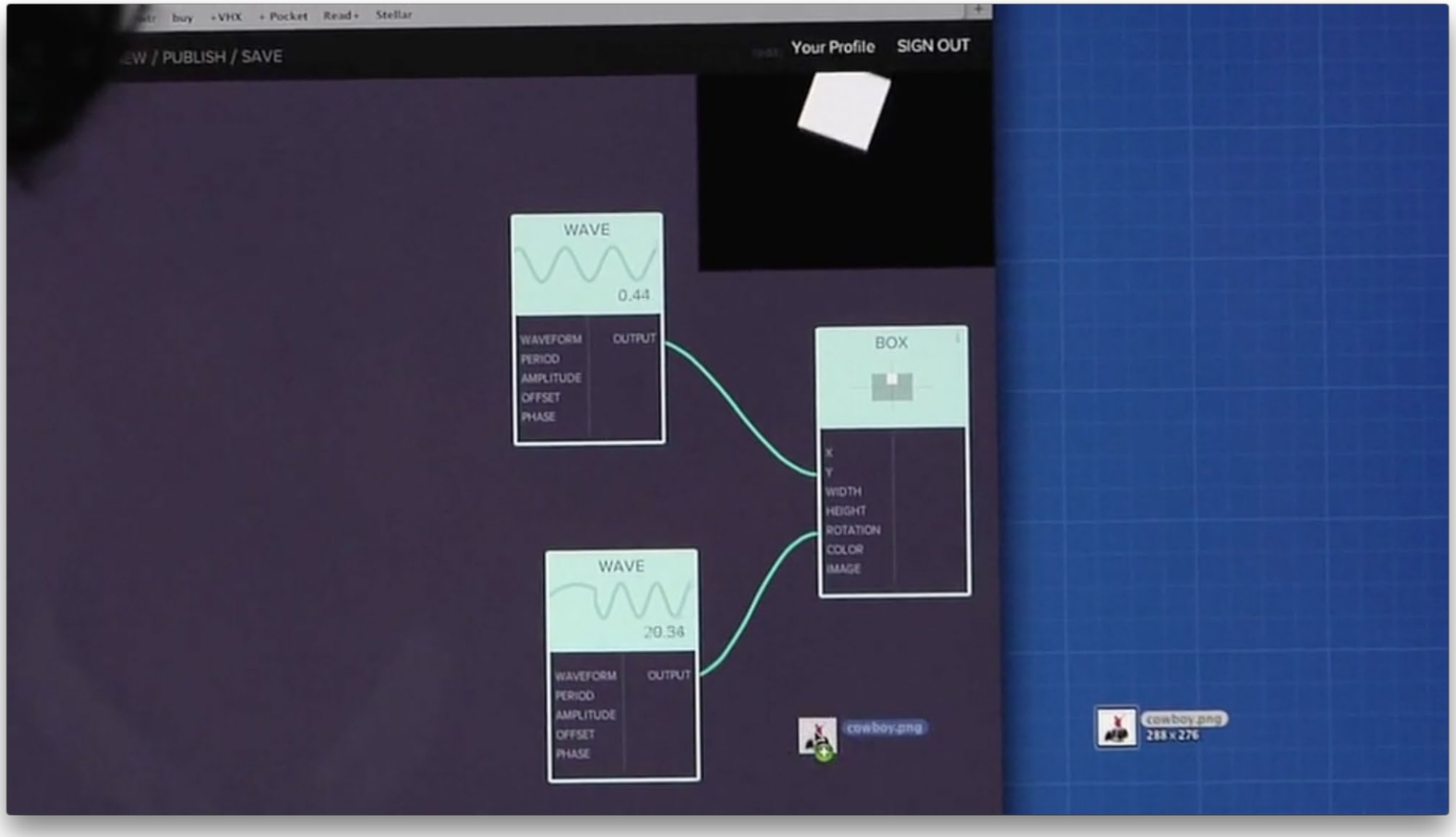
2007-Today



Robert McNeel and David Rutten

Moonbase

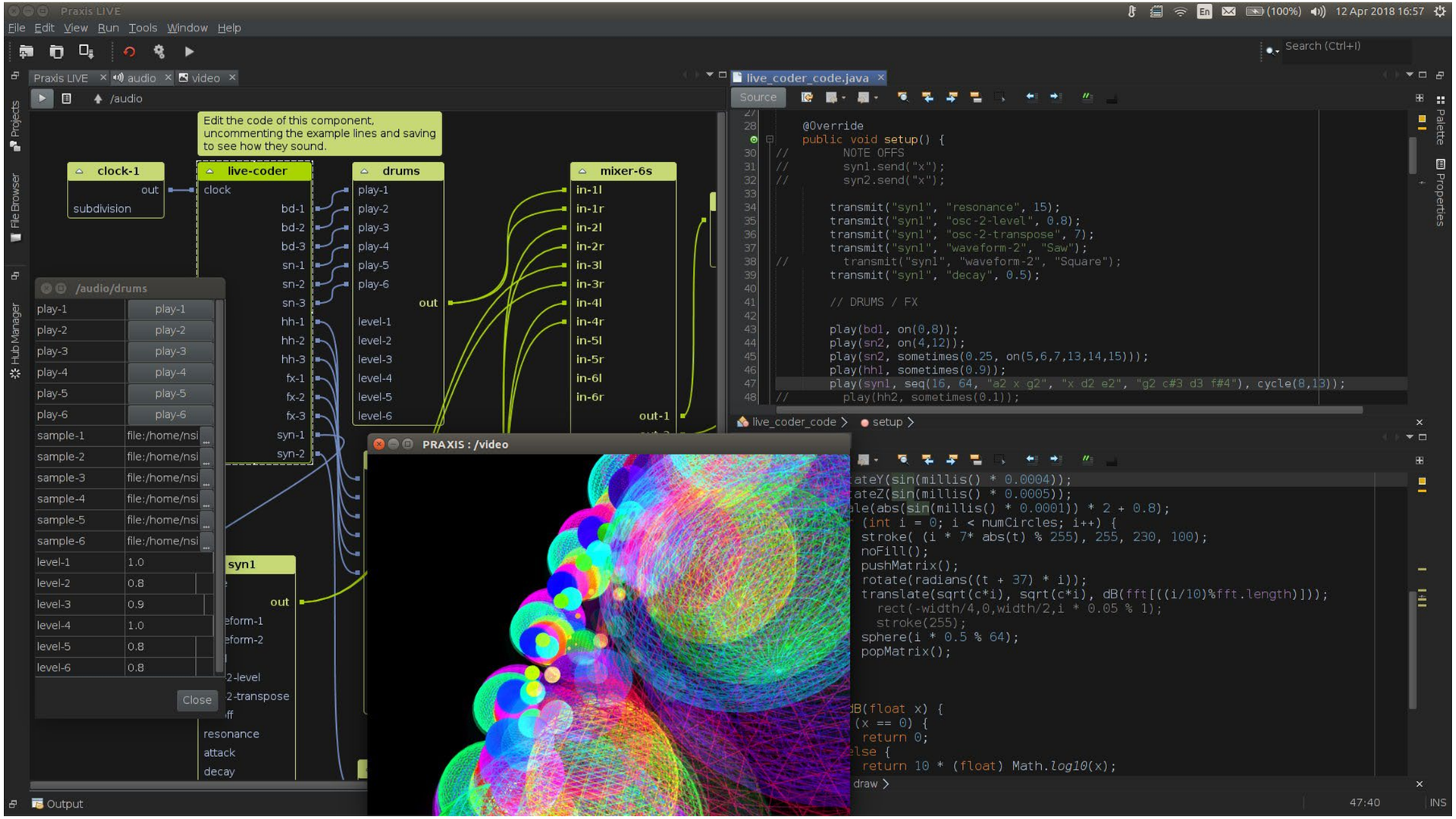
2012



William Cotton and Pasquale D'Silva

Praxis Live

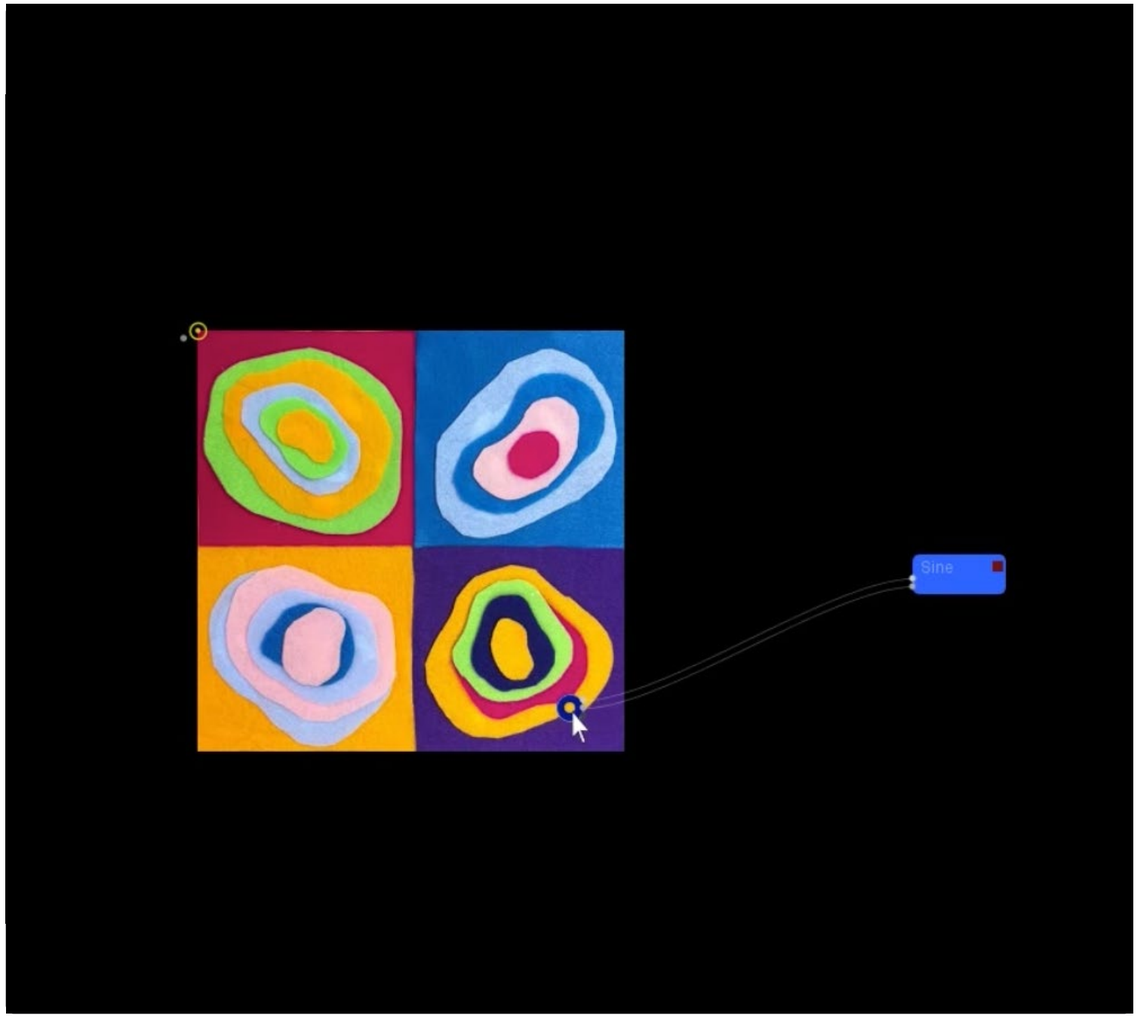
2012-Today

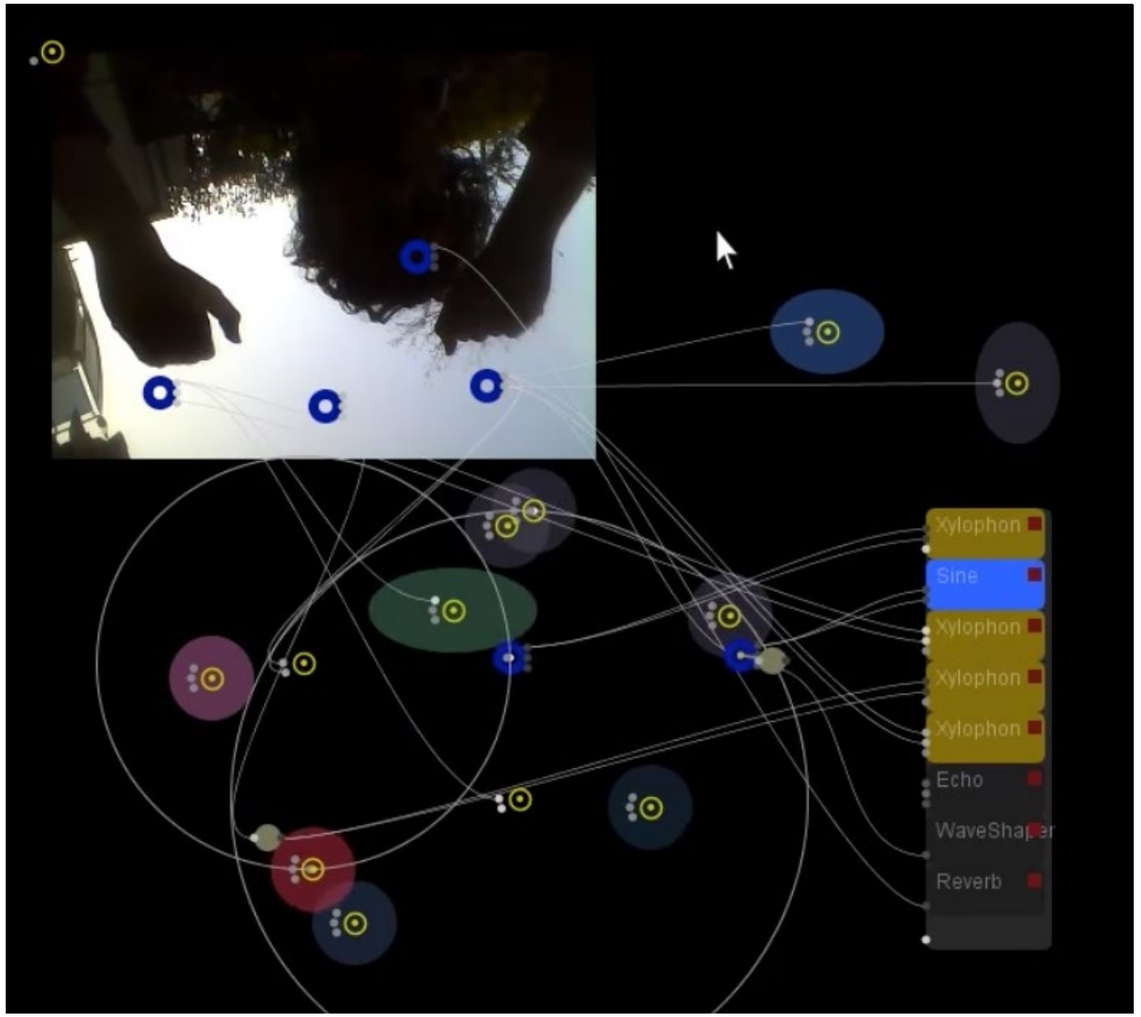


Neil C Smith

Loligo

2014

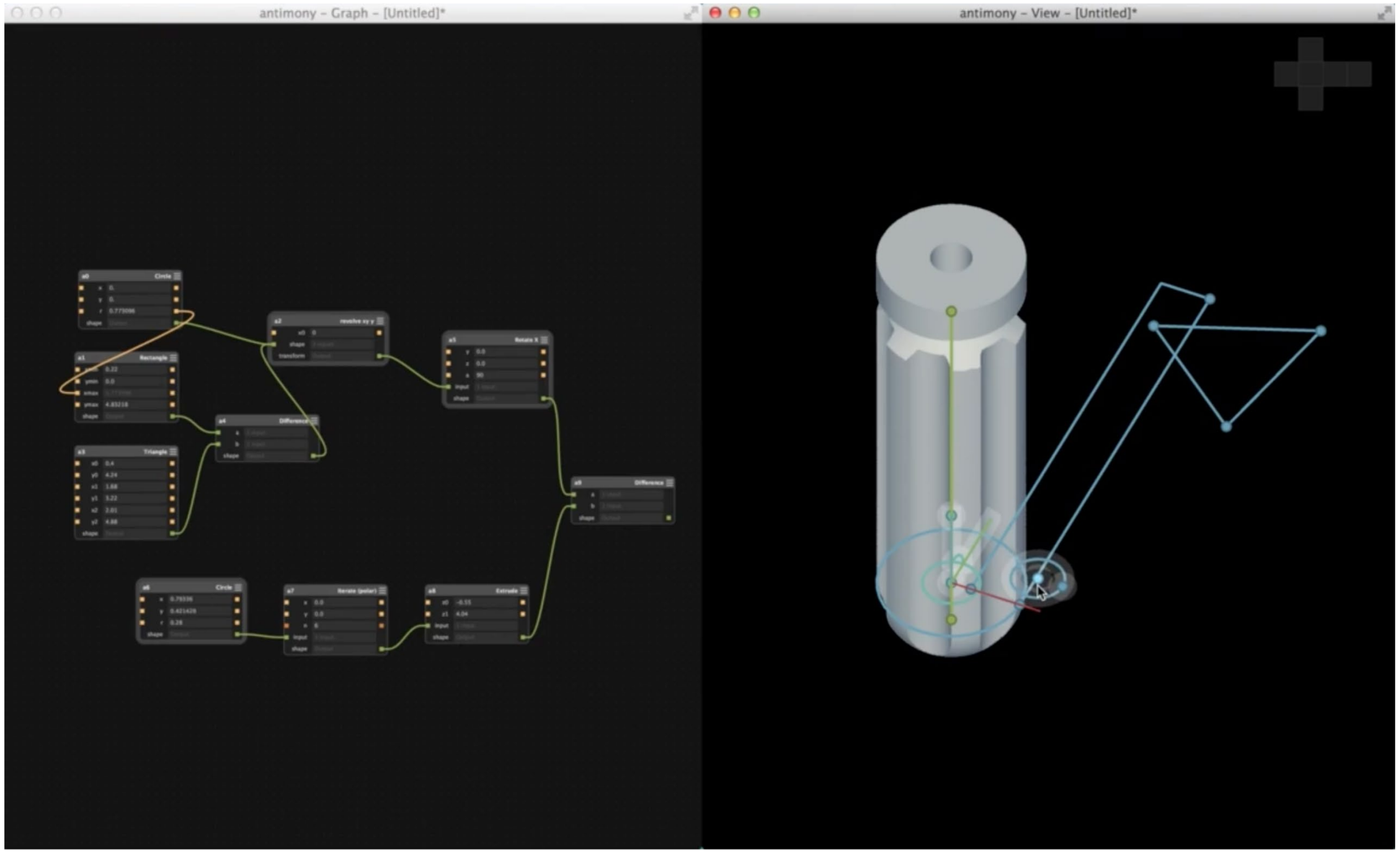




Vanja Cuk

Antimony

2015



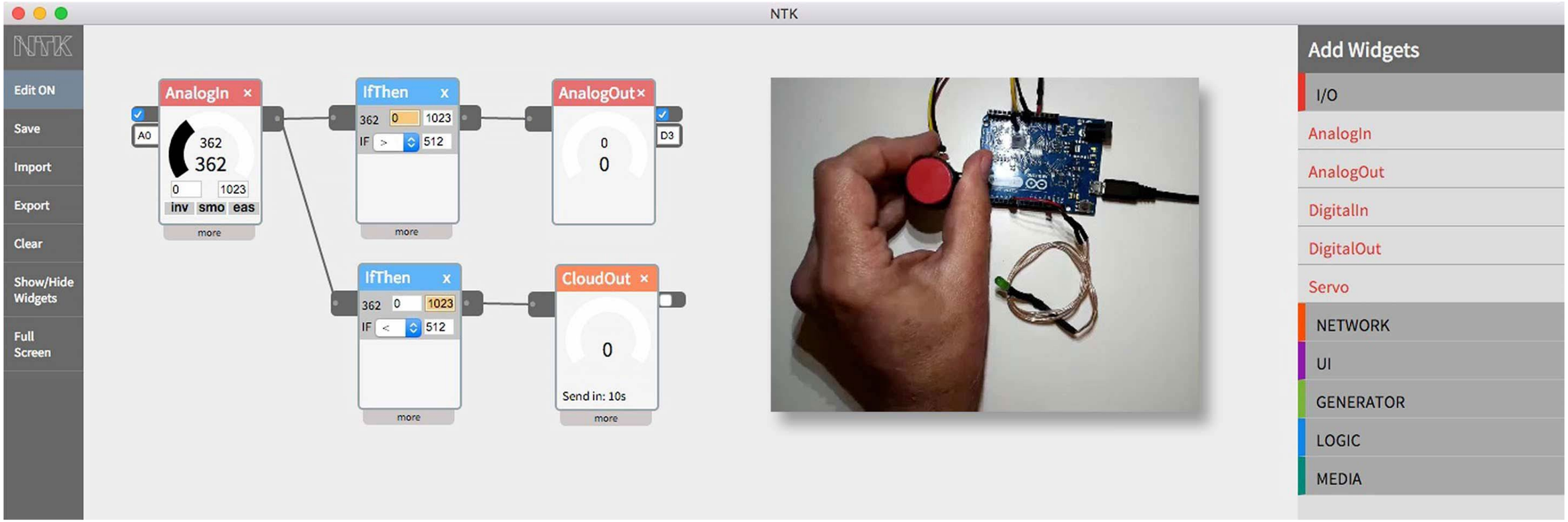
Matt Keeter

Interaction Prototyping

Empower designers to Build ‘Working-Prototypes’

Net Lab Toolkit (NTK)

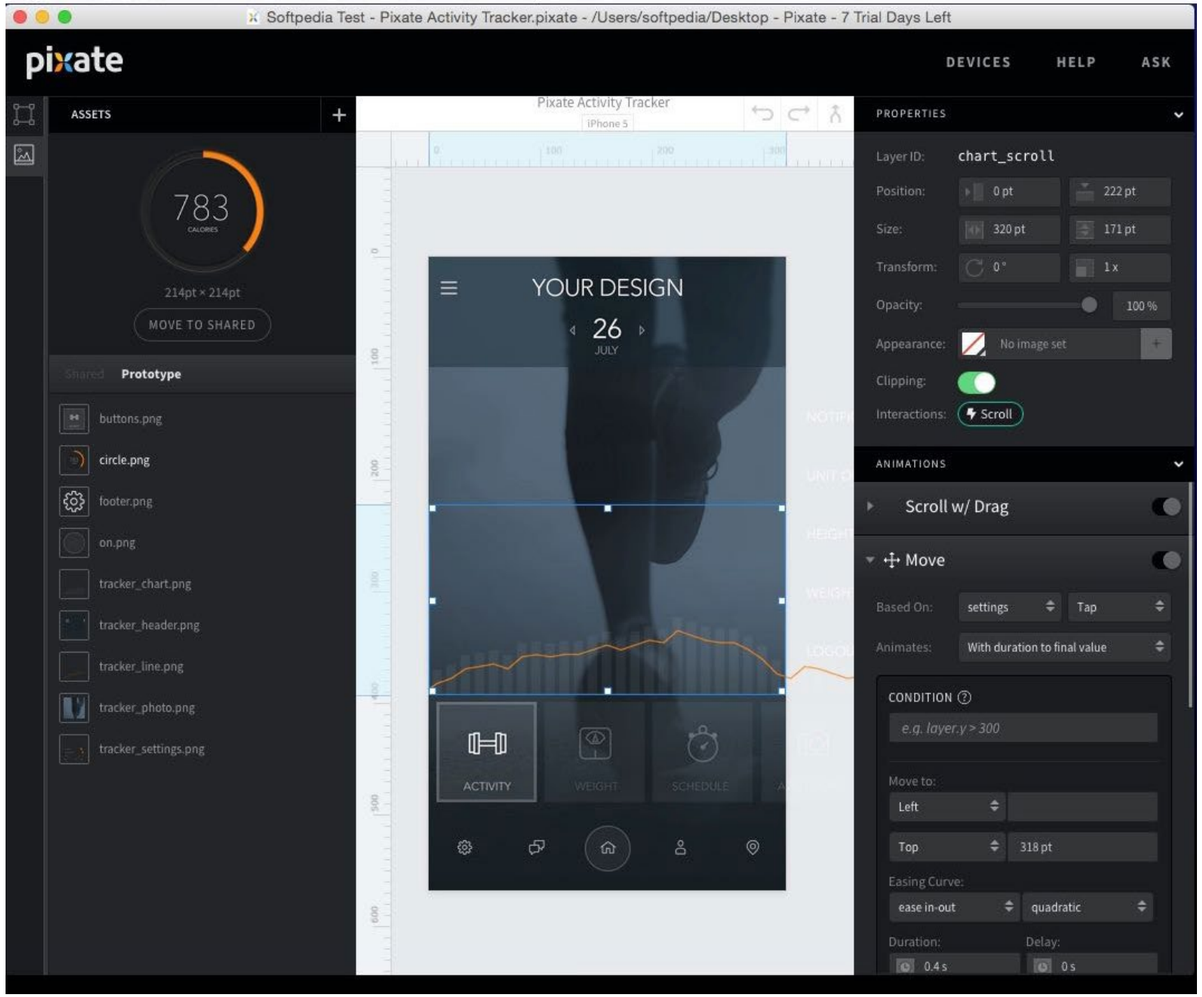
2003-Today



Philip van Allen at ArtCenter College of Design

Pixate

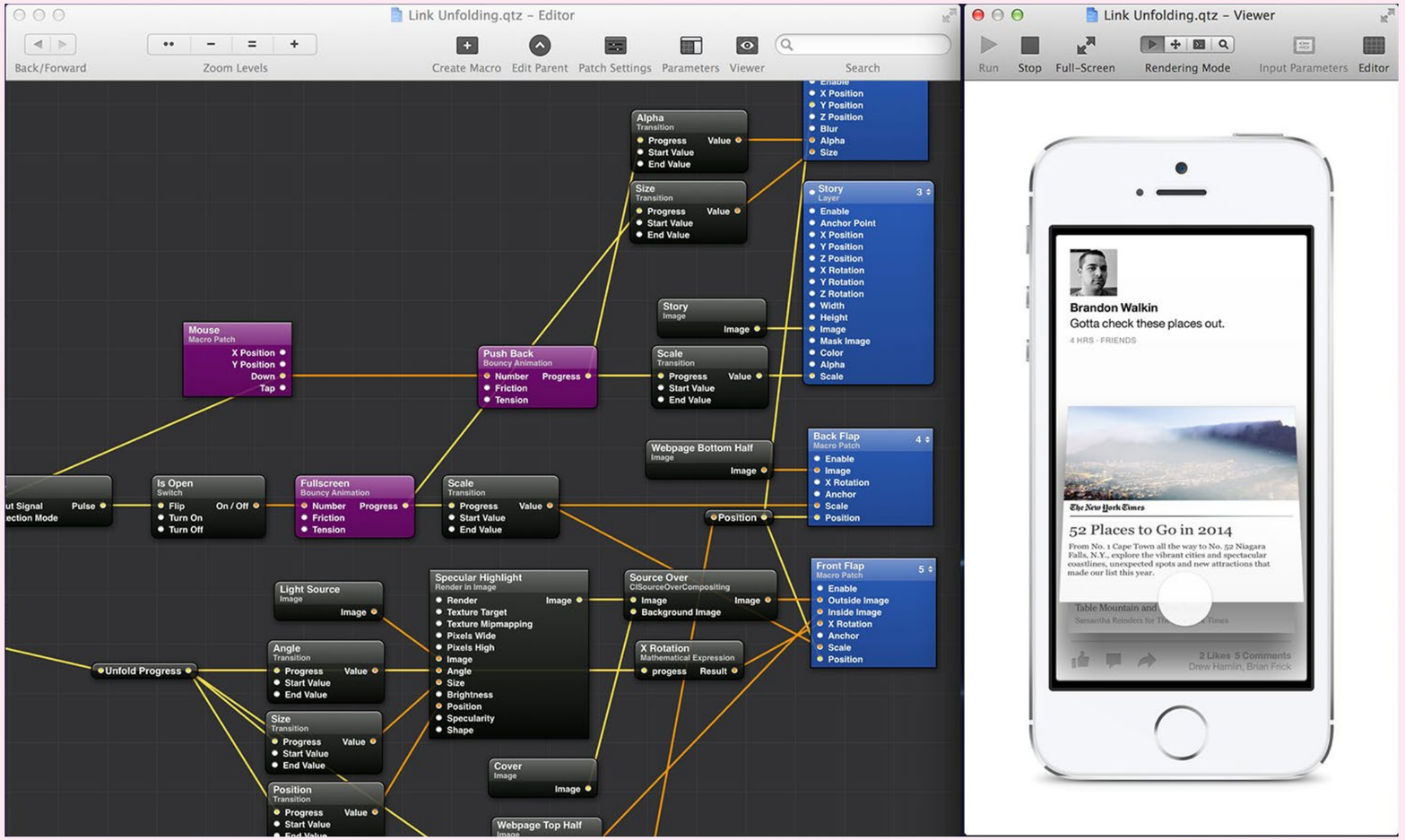
2012-2016



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

Origami for Quartz Composer

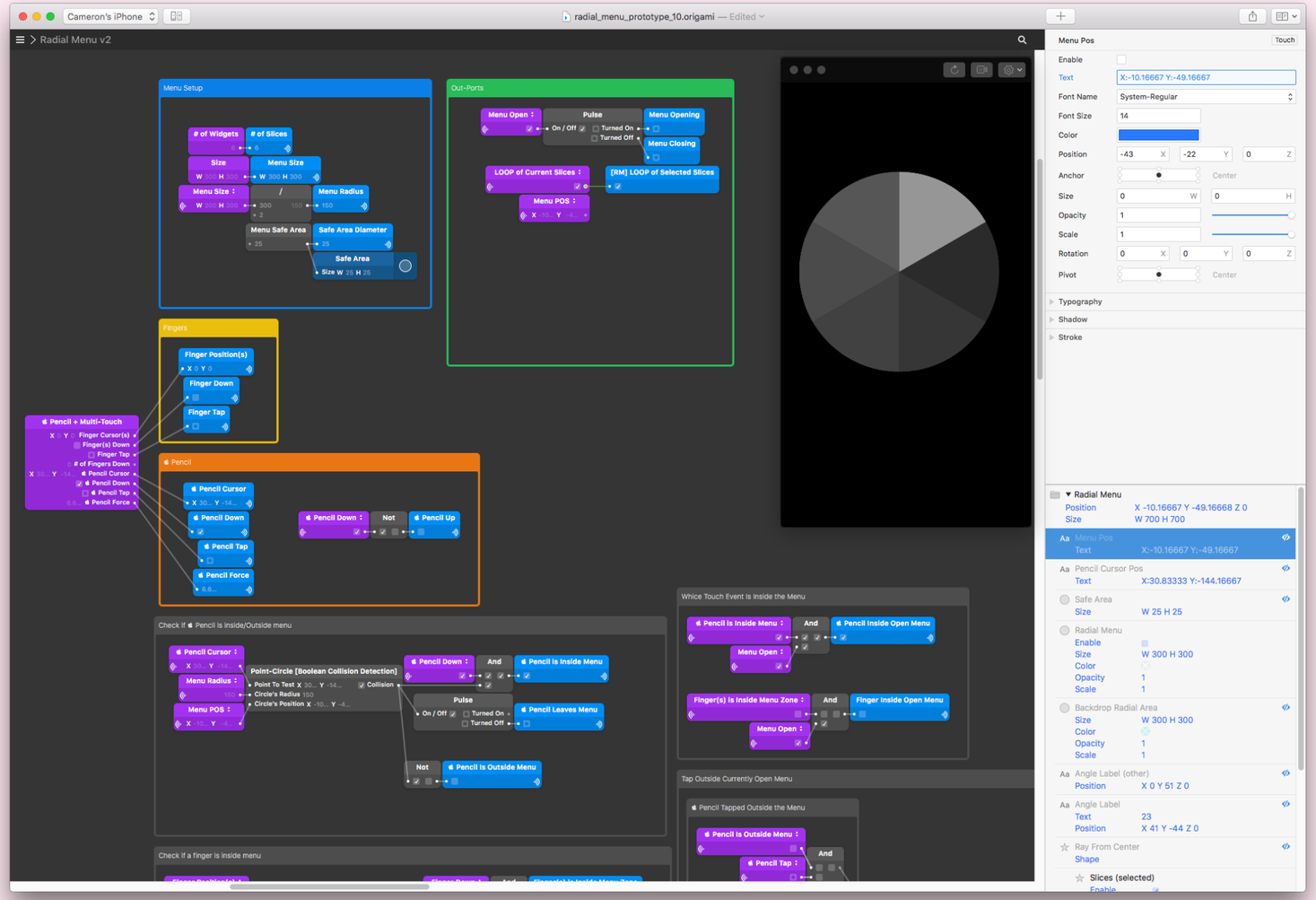
2013-2016



Facebook

Origami Studio

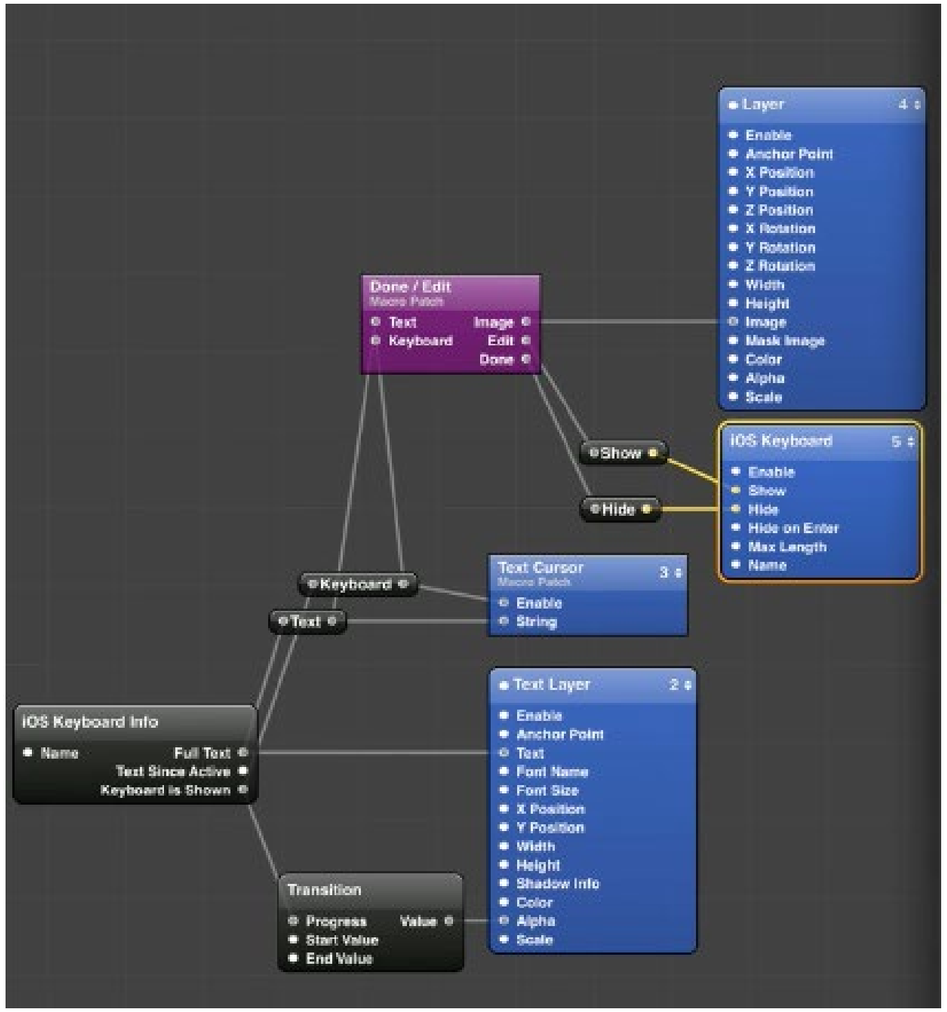
2016-Today



Facebook

Avocado for Quartz Composer

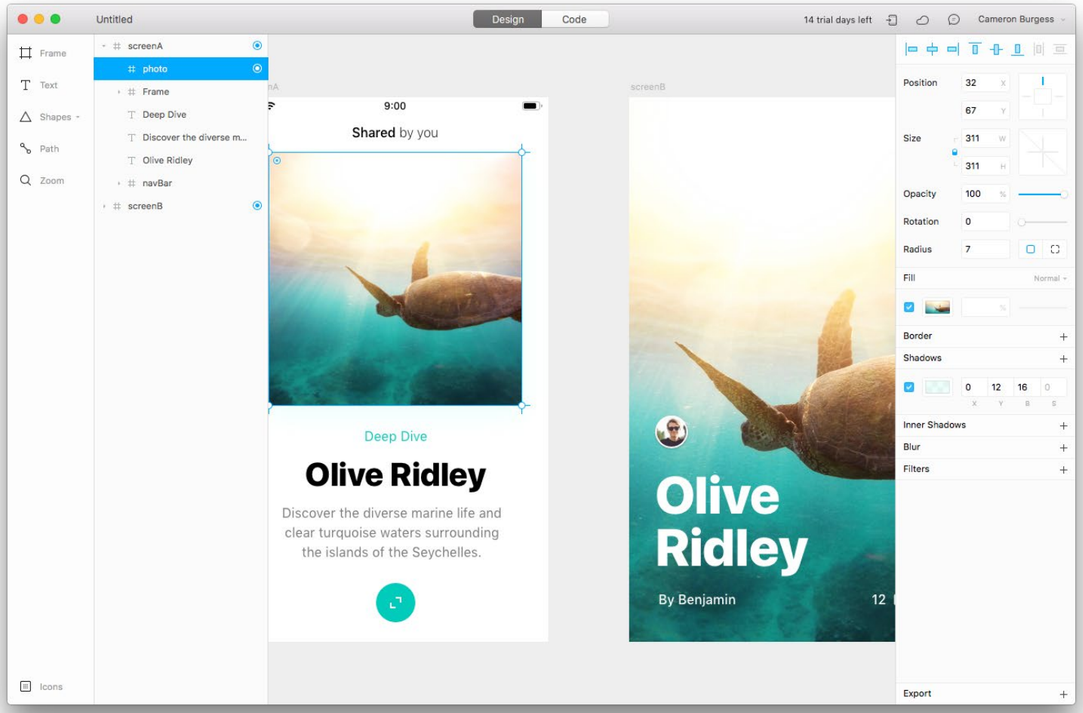
2014

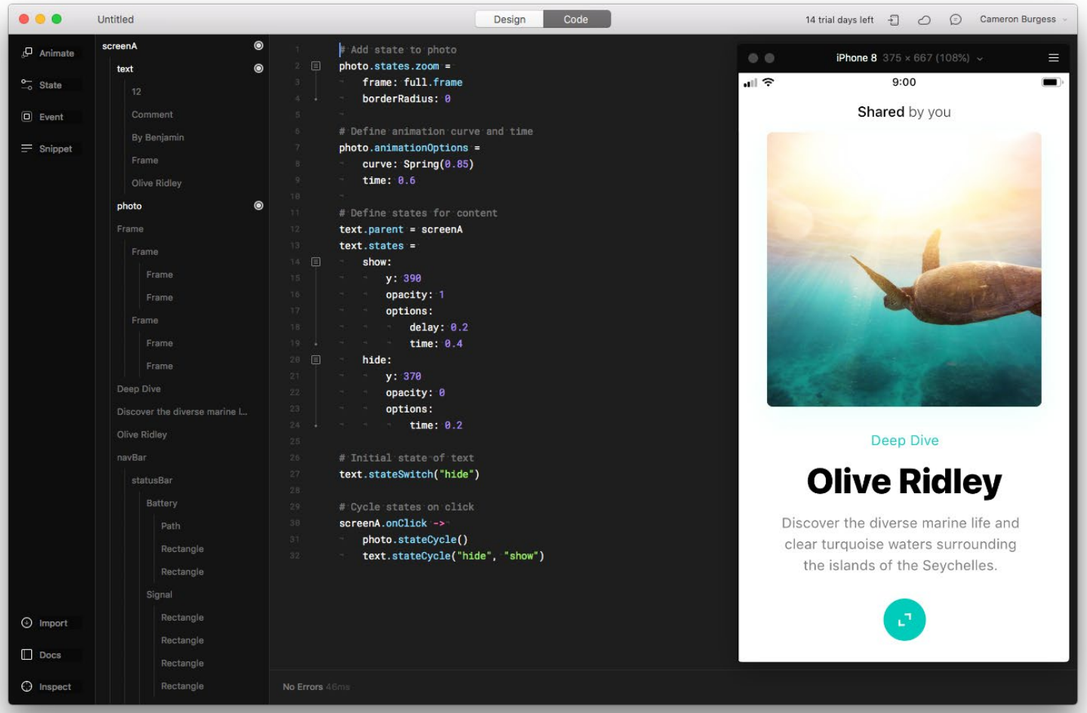


Marco Triverio at IDEO LABS

Framer Studio

2013-Today

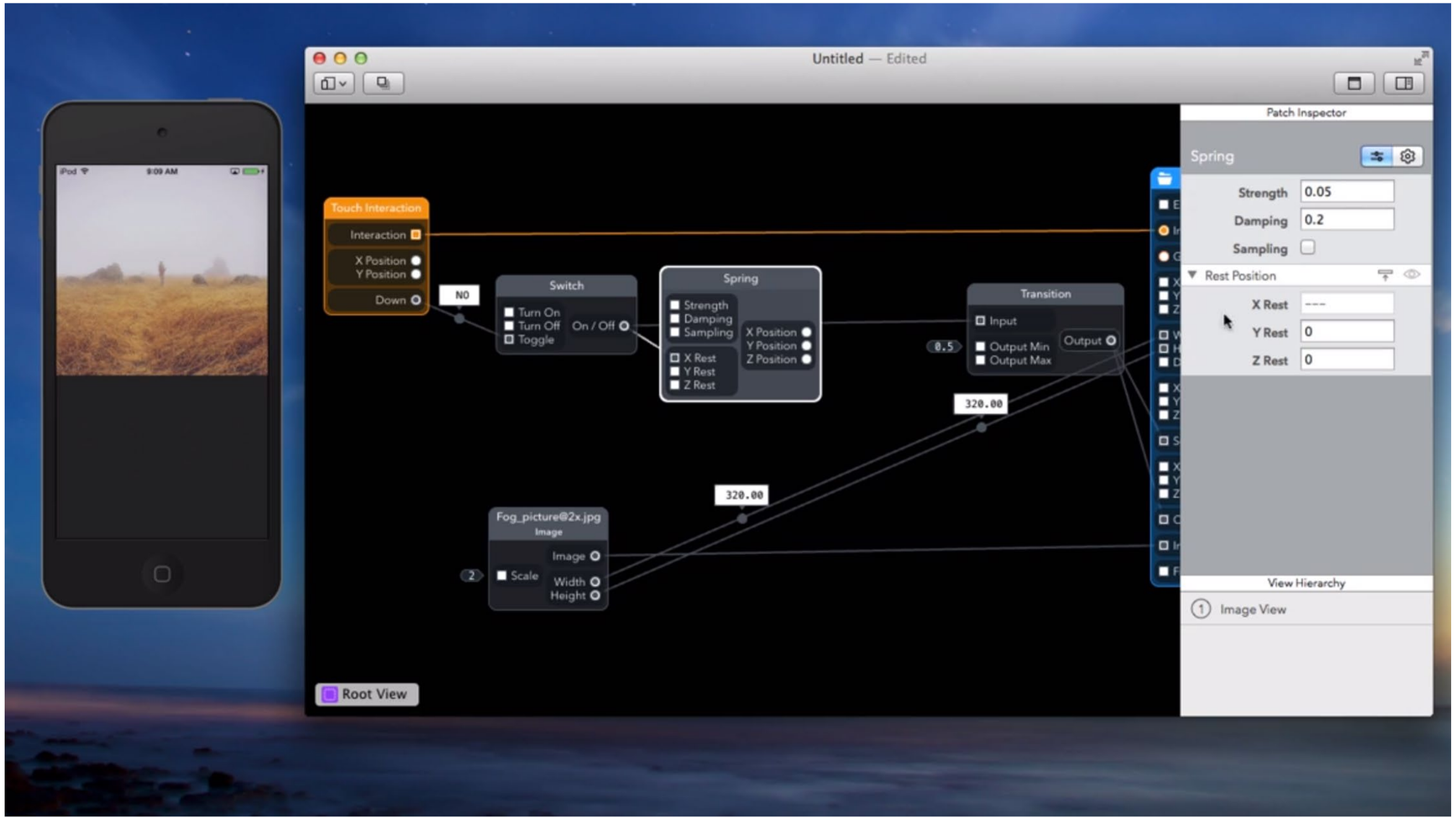




Koen Bok and Jorn van Dijk for Framer

Form

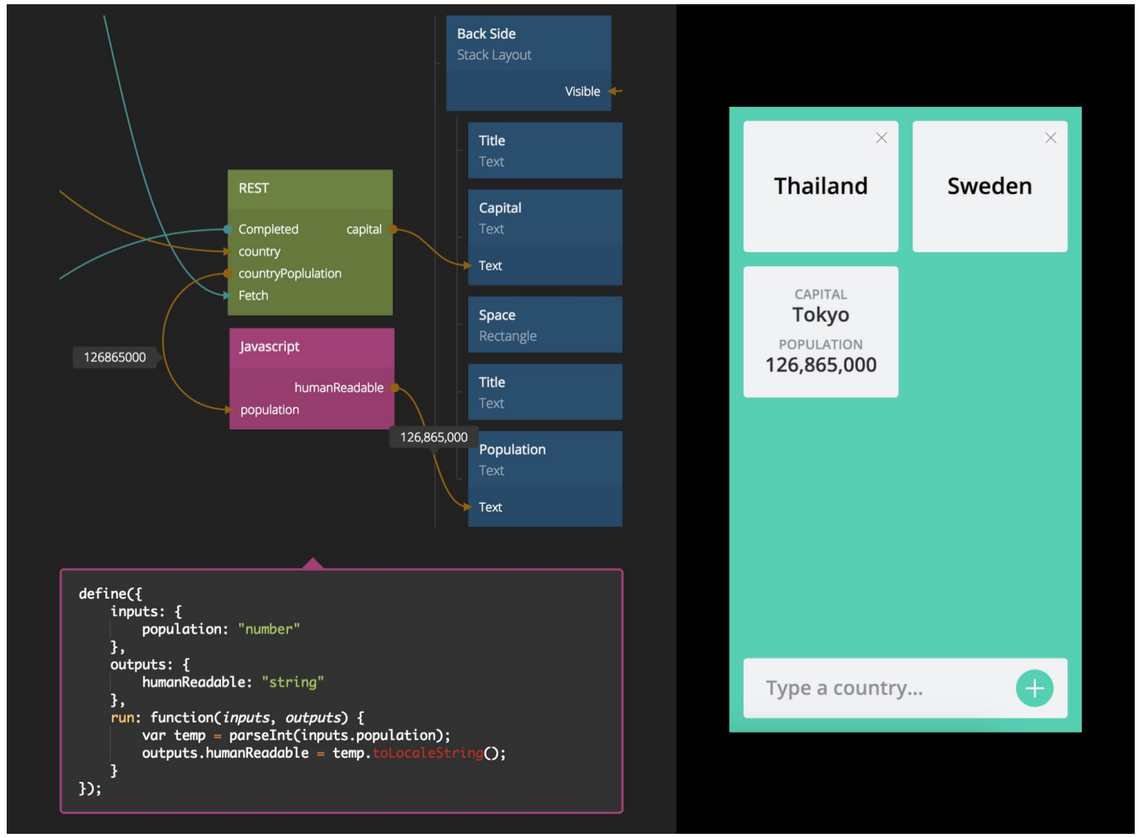
2012-2014



Max Weisel for RelativeWave (Acquired by Google)

Noodl

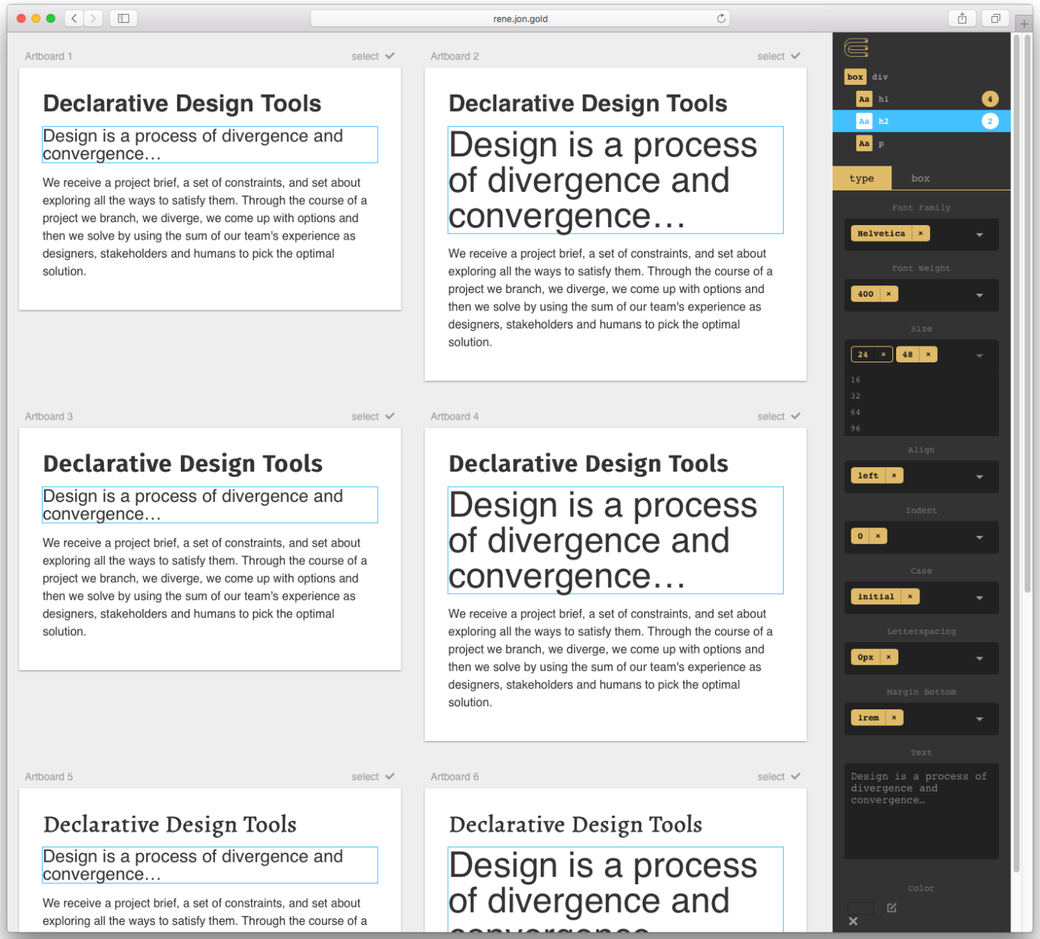
2014-Today



Topp Design

René

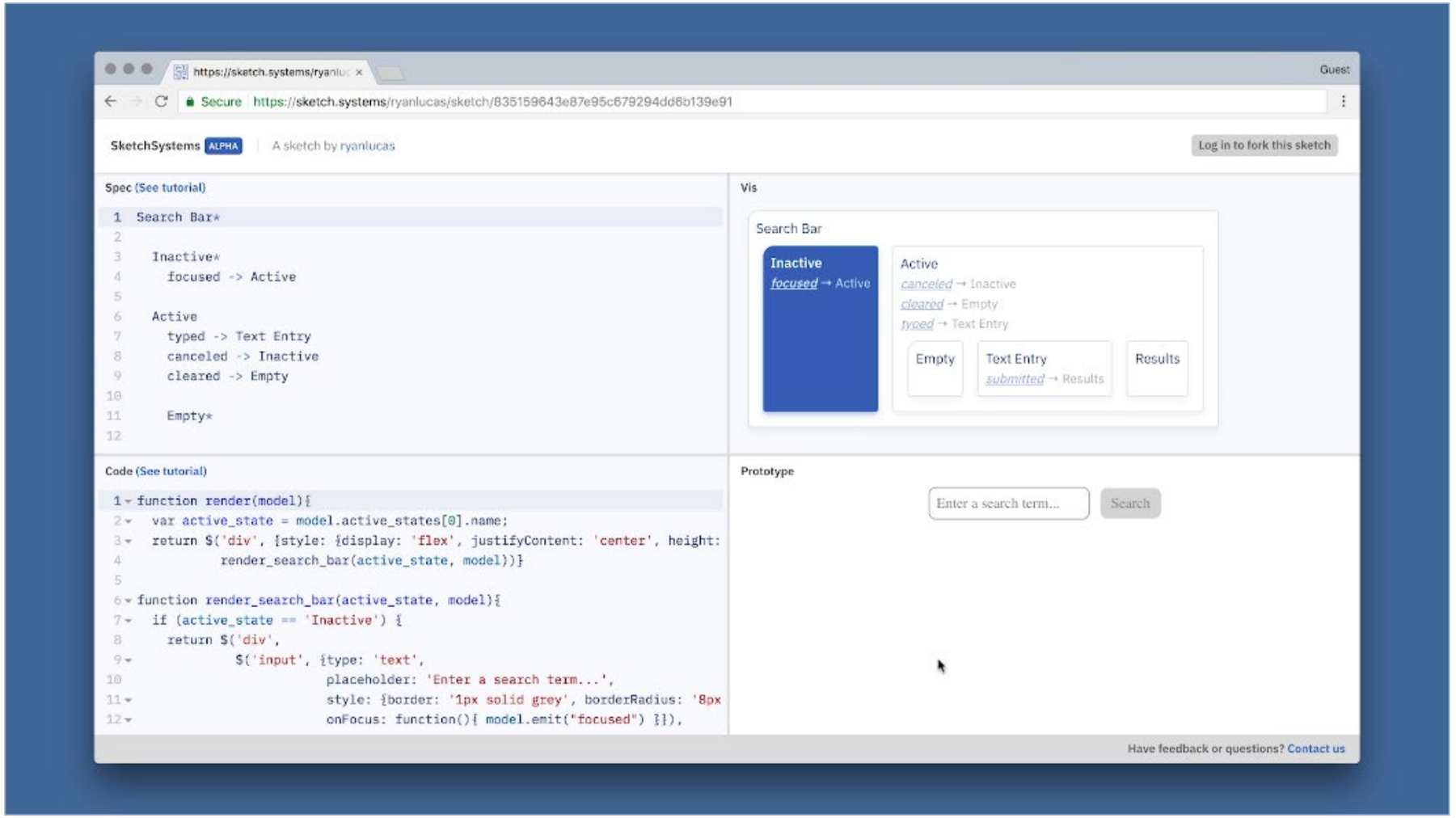
2016



Jon Gold

Sketch.systems

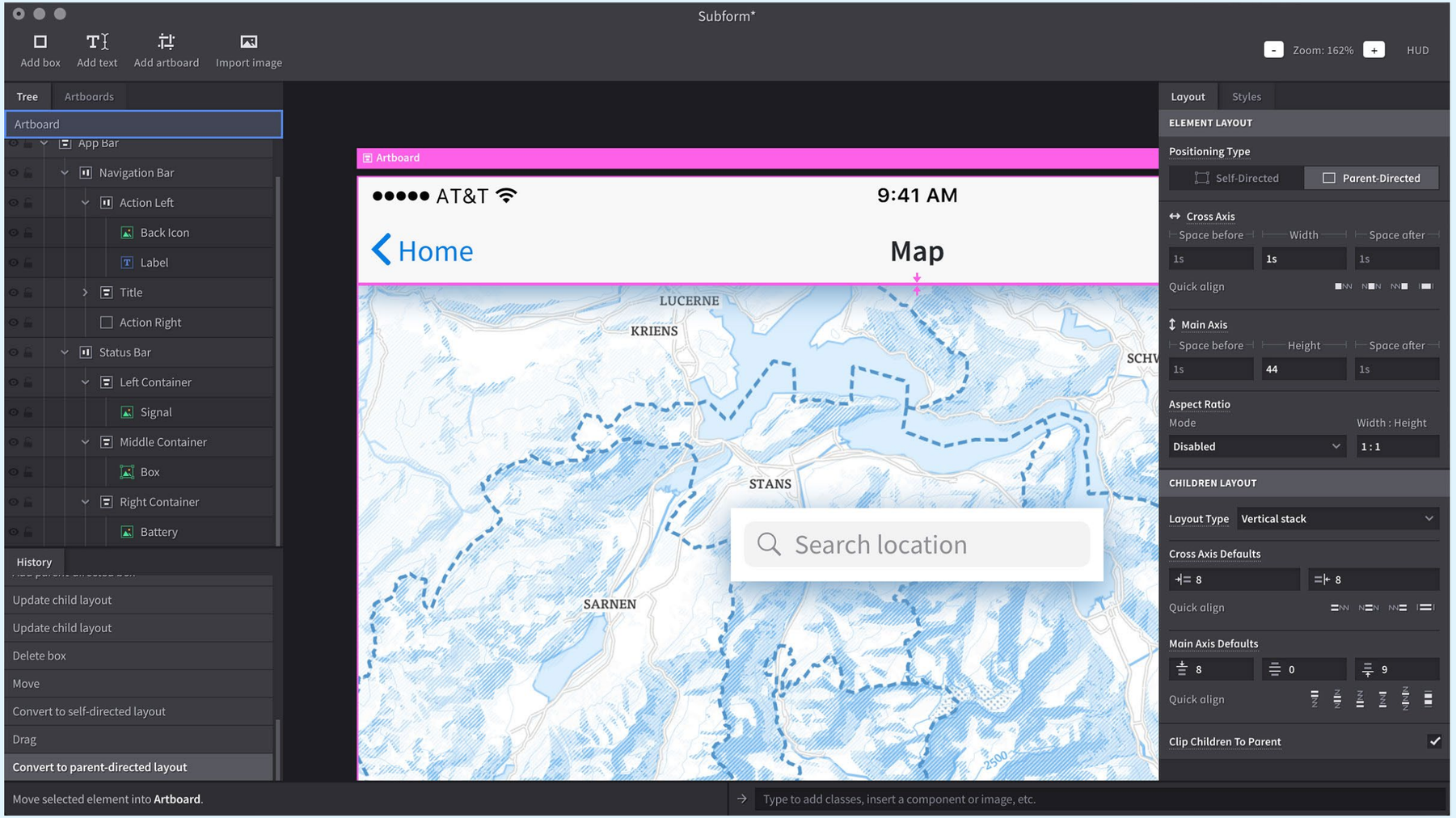
2018-Today



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

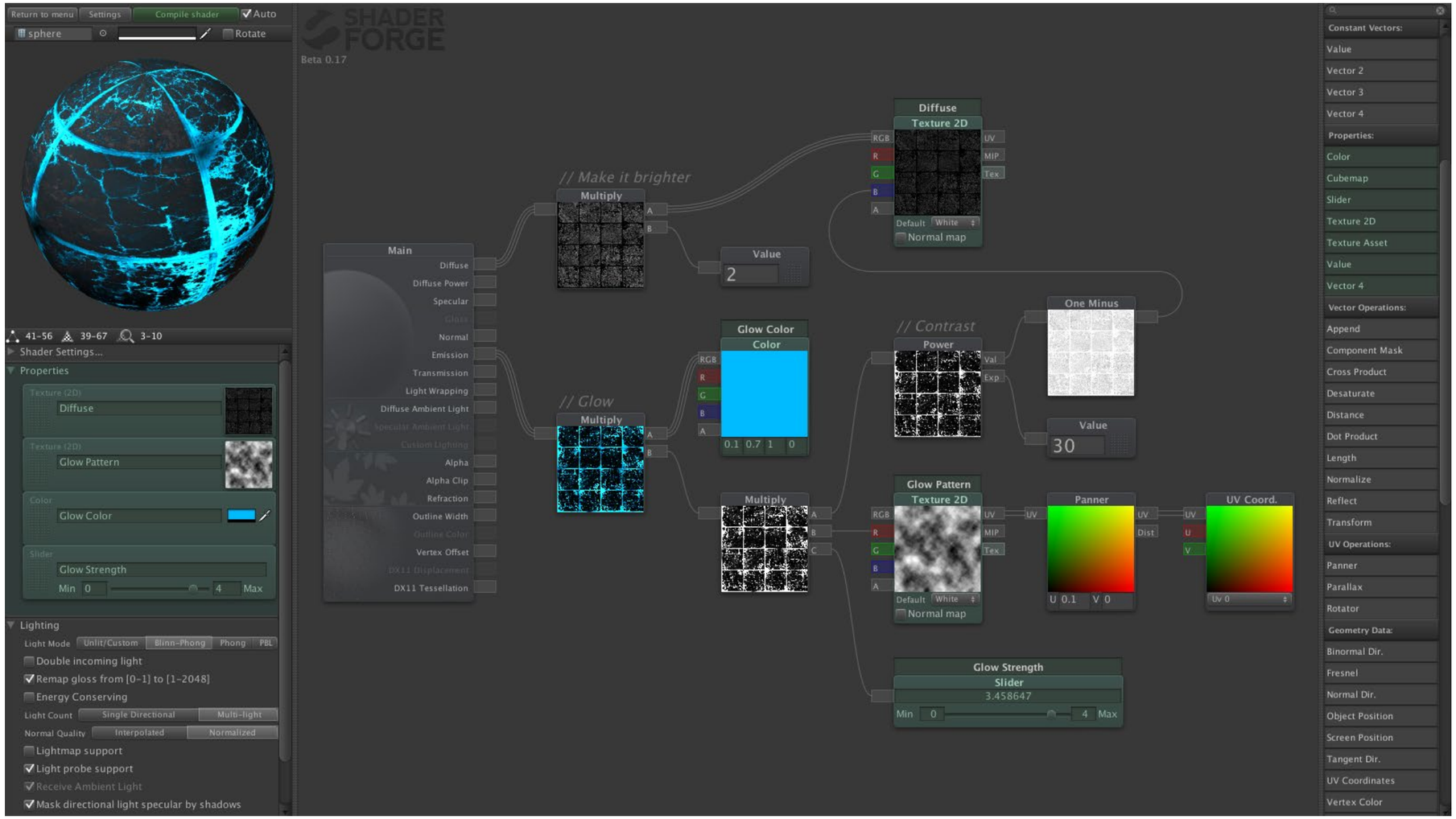
Blueprints in Unreal Engine

2012-Today

Epic Games

ShaderForge for Unity

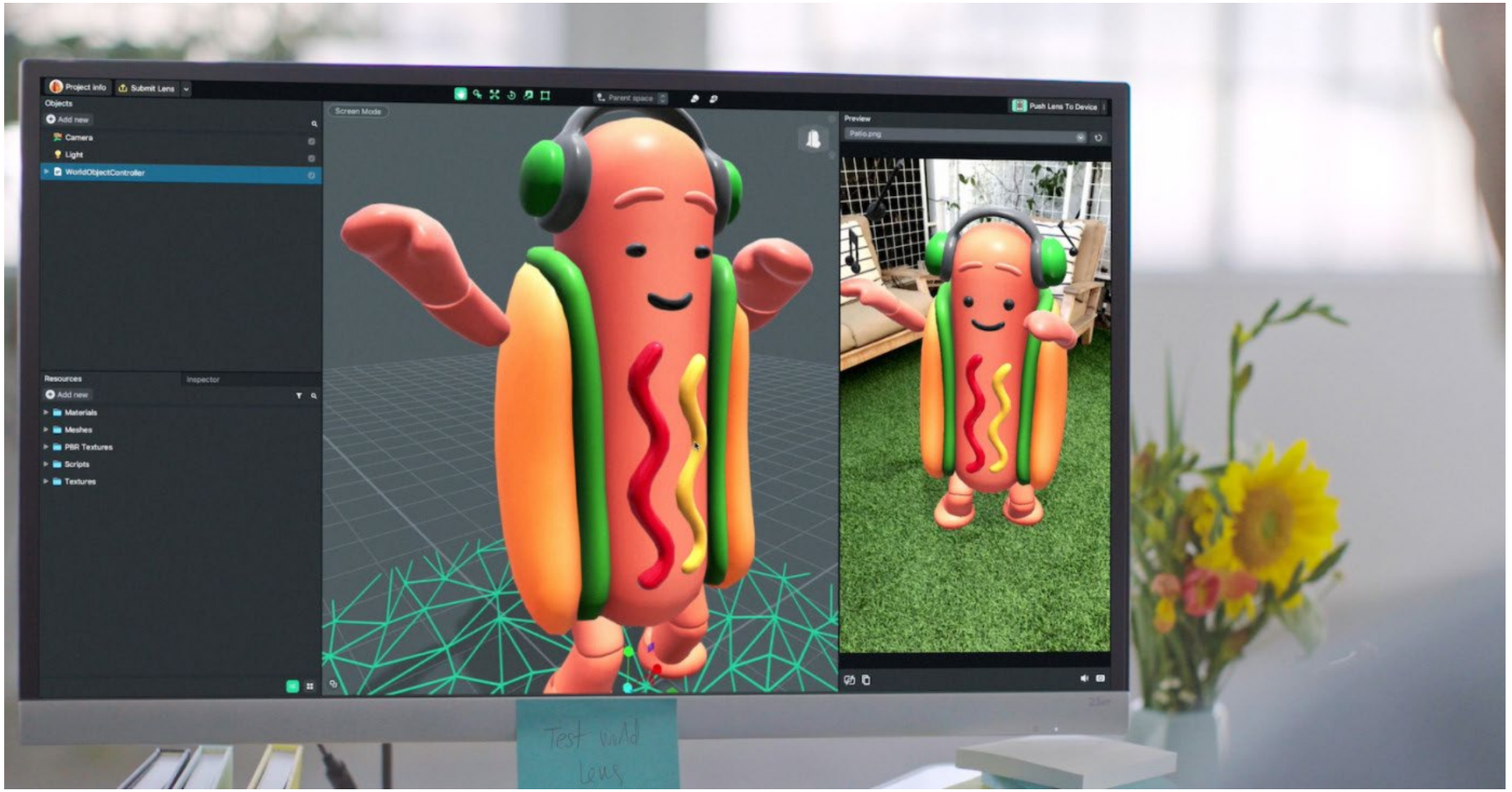
2013-2018



Freya Holmér

Lens Studio

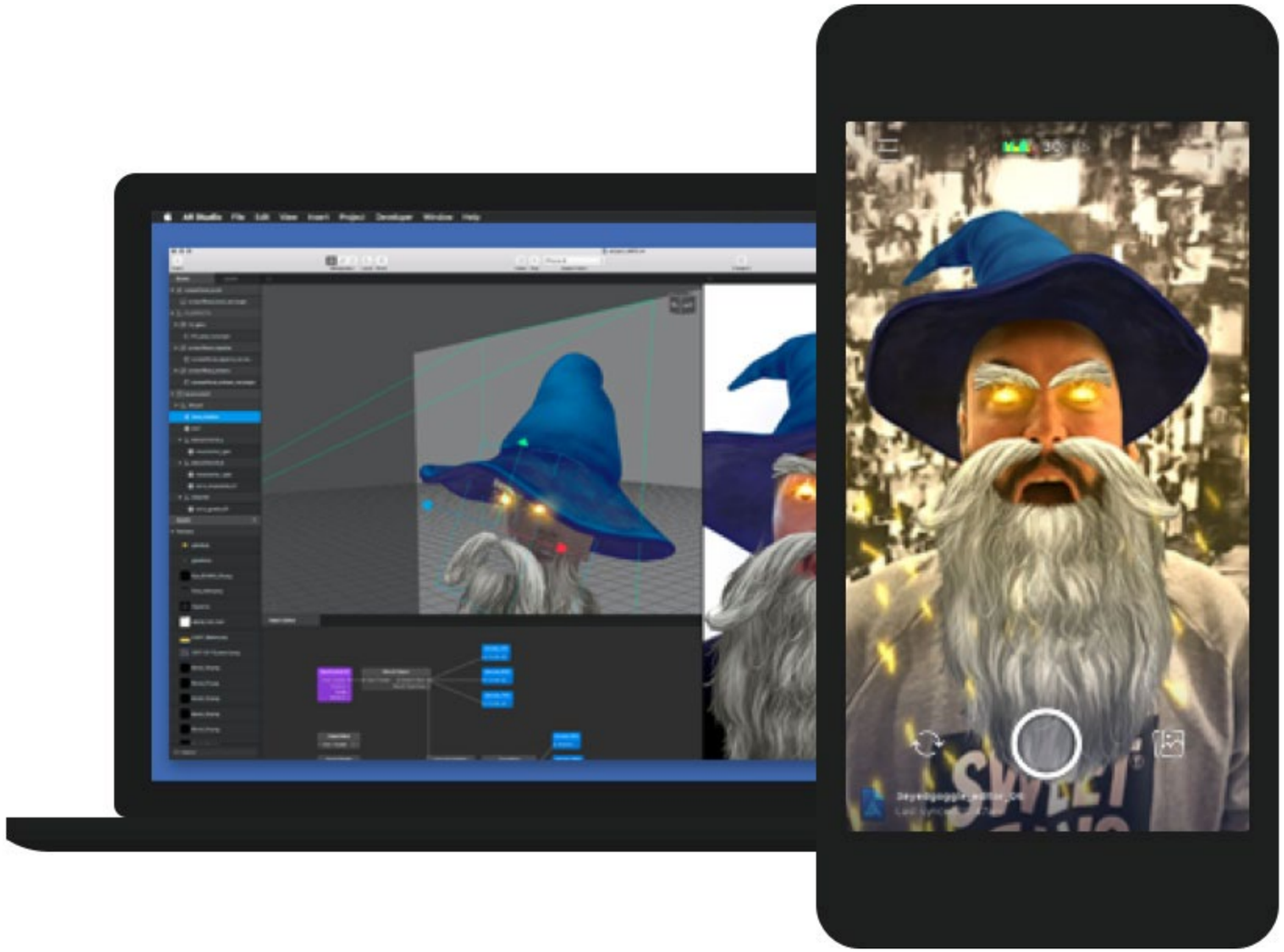
2017-Today



Snap Inc

AR Studio

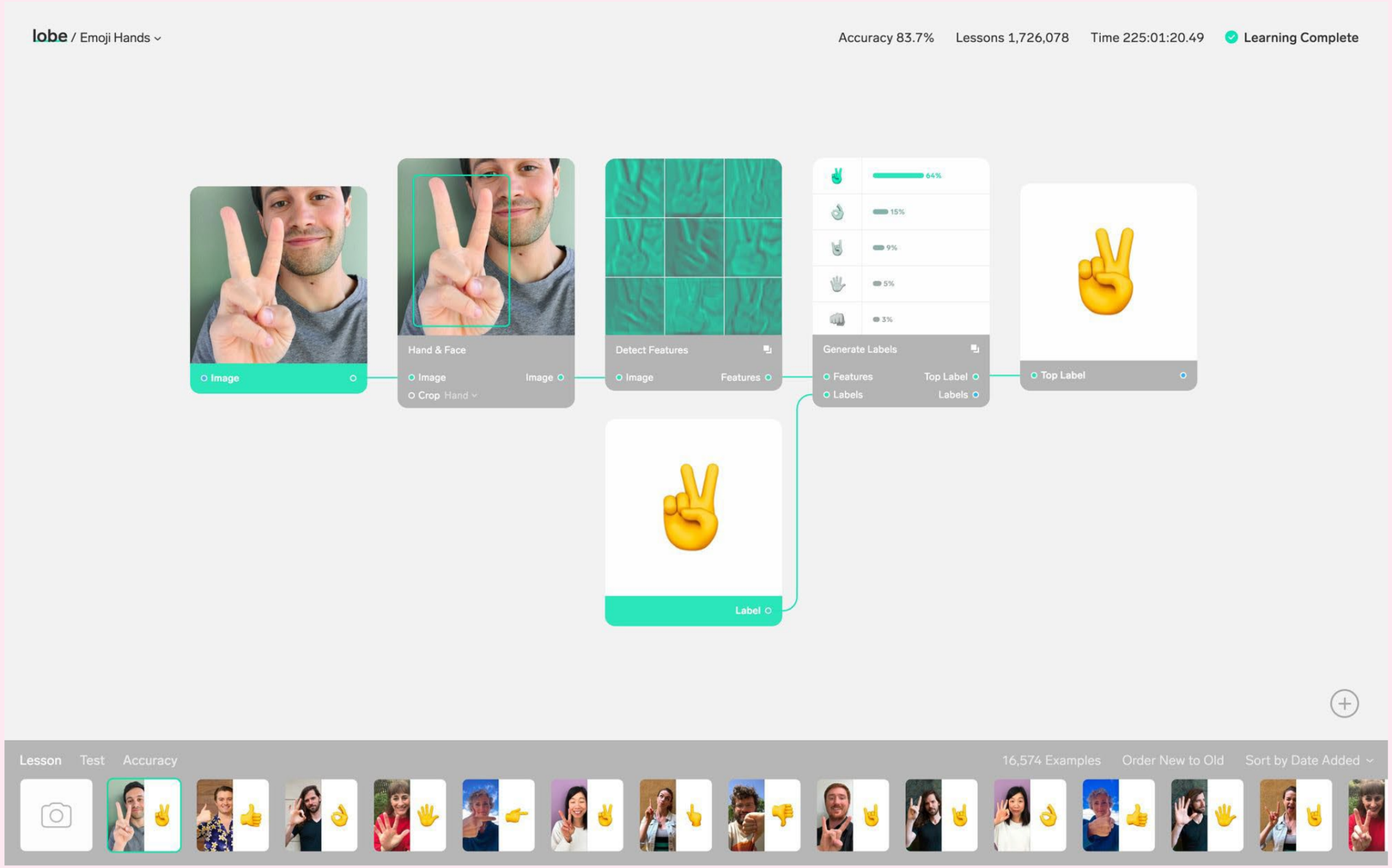
2017-Today



Facebook

Lobe AI

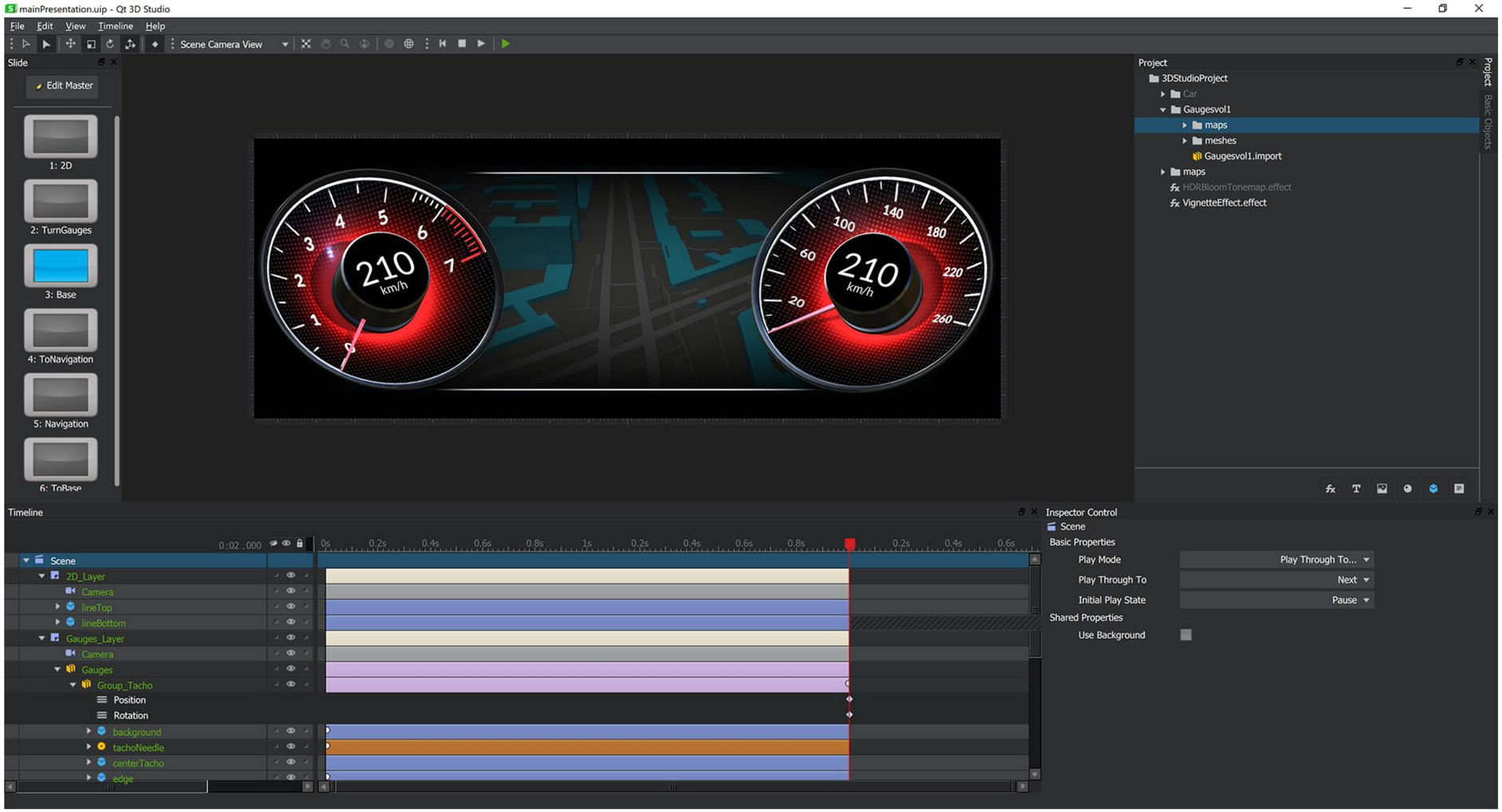
2018-Today



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

Qt 3D Studio

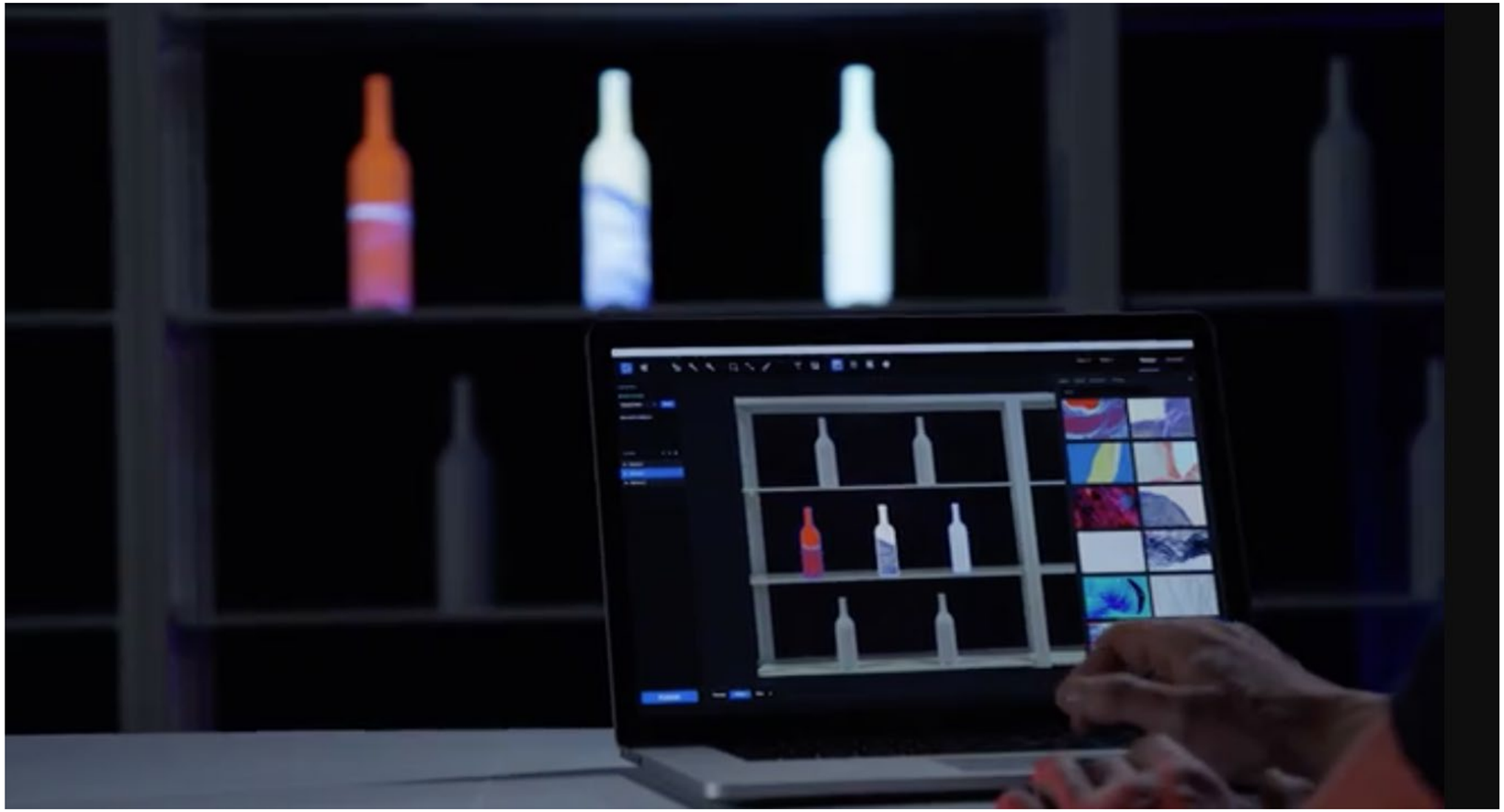
2017-Today



The Qt Company

Lightform

2018-Today



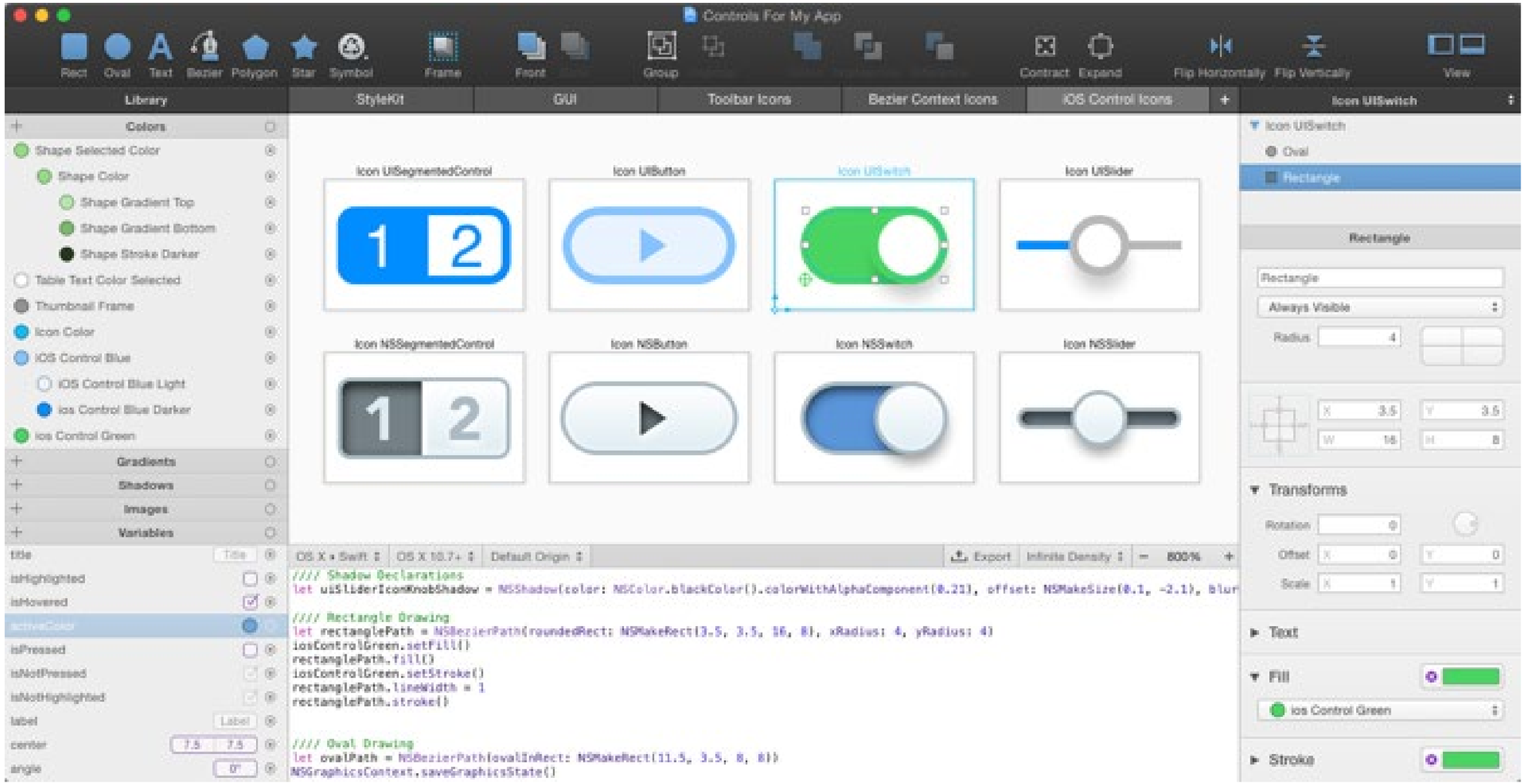
Brett Jones, Kevin Karsch and Rajinder Sodhi

Design-Development Toolchain Integration

Has decreased the distance between Design & Engineering

Paint Code

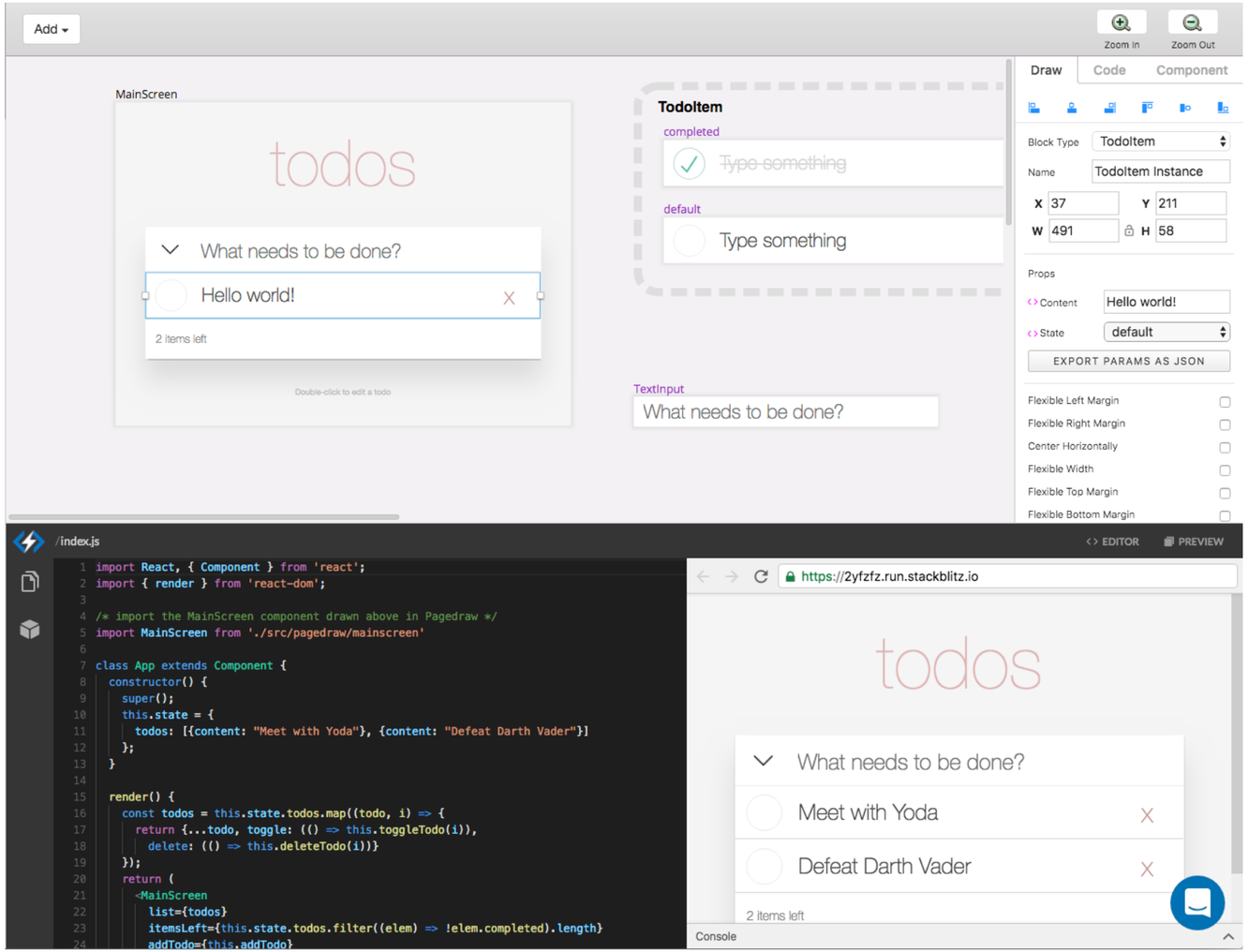
2012-Today



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

PageDraw

2016-Today

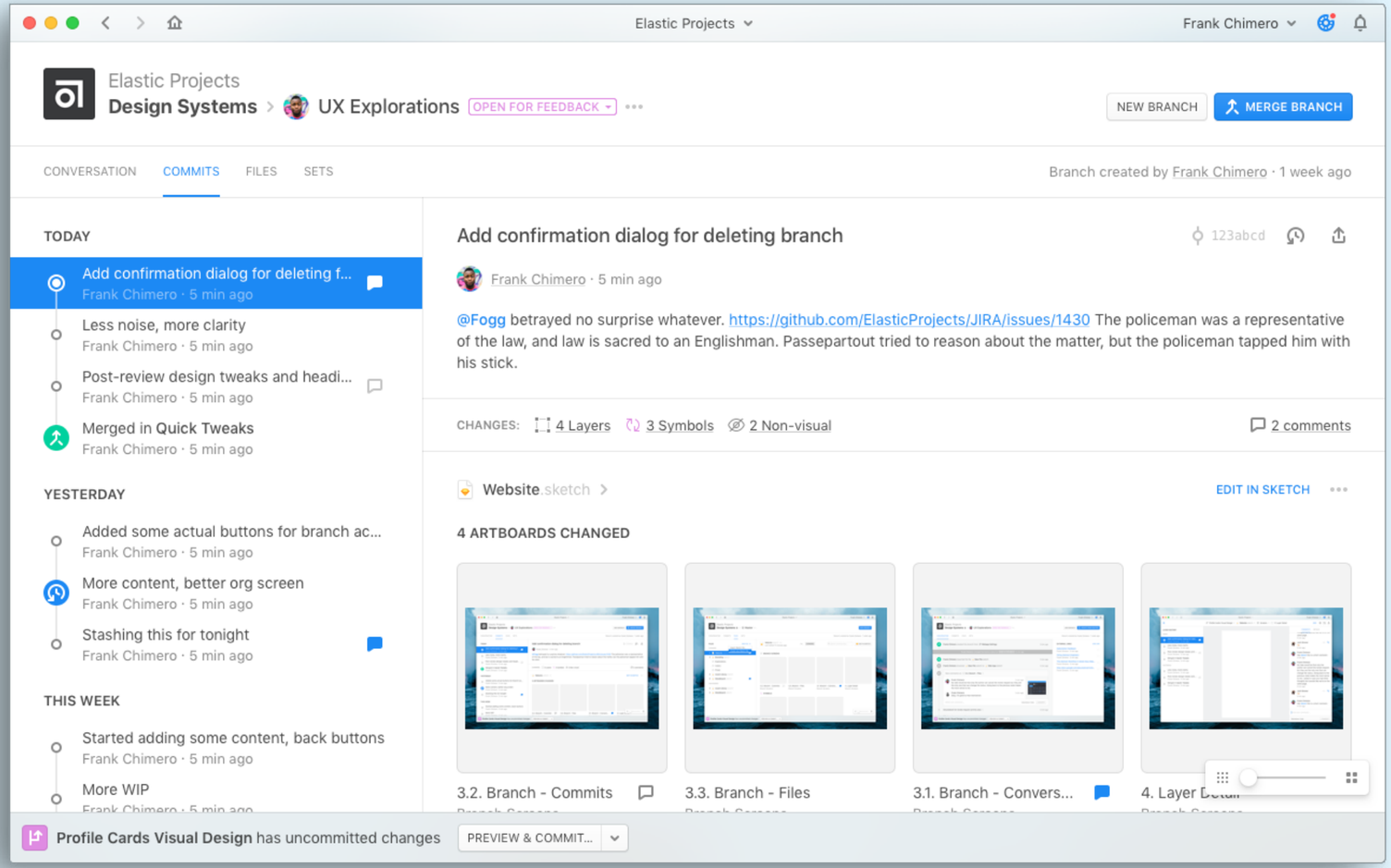



```
import React, { Component } from 'react';
import { render } from 'react-dom';

/* import the MainScreen component drawn above in Pagedraw */
import MainScreen from './src/pagedraw/mainscreen'

class App extends Component {
  constructor() {
    super();
    this.state = {
      todos: [{content: "Meet with Yoda"}, {content: "Defeat Darth Vader"}]
    };
  }

  render() {
    const todos = this.state.todos.map((todo, i) => {
      return {...todo, toggle: (() => this.toggleTodo(i)),
        delete: (() => this.deleteTodo(i))}
    });
    return (
      <MainScreen
        list={todos}
        itemsLeft={this.state.todos.filter((elem) => !elem.completed).length}
        addTodo={this.addTodo}
```

Jared Pochtar

Abstract

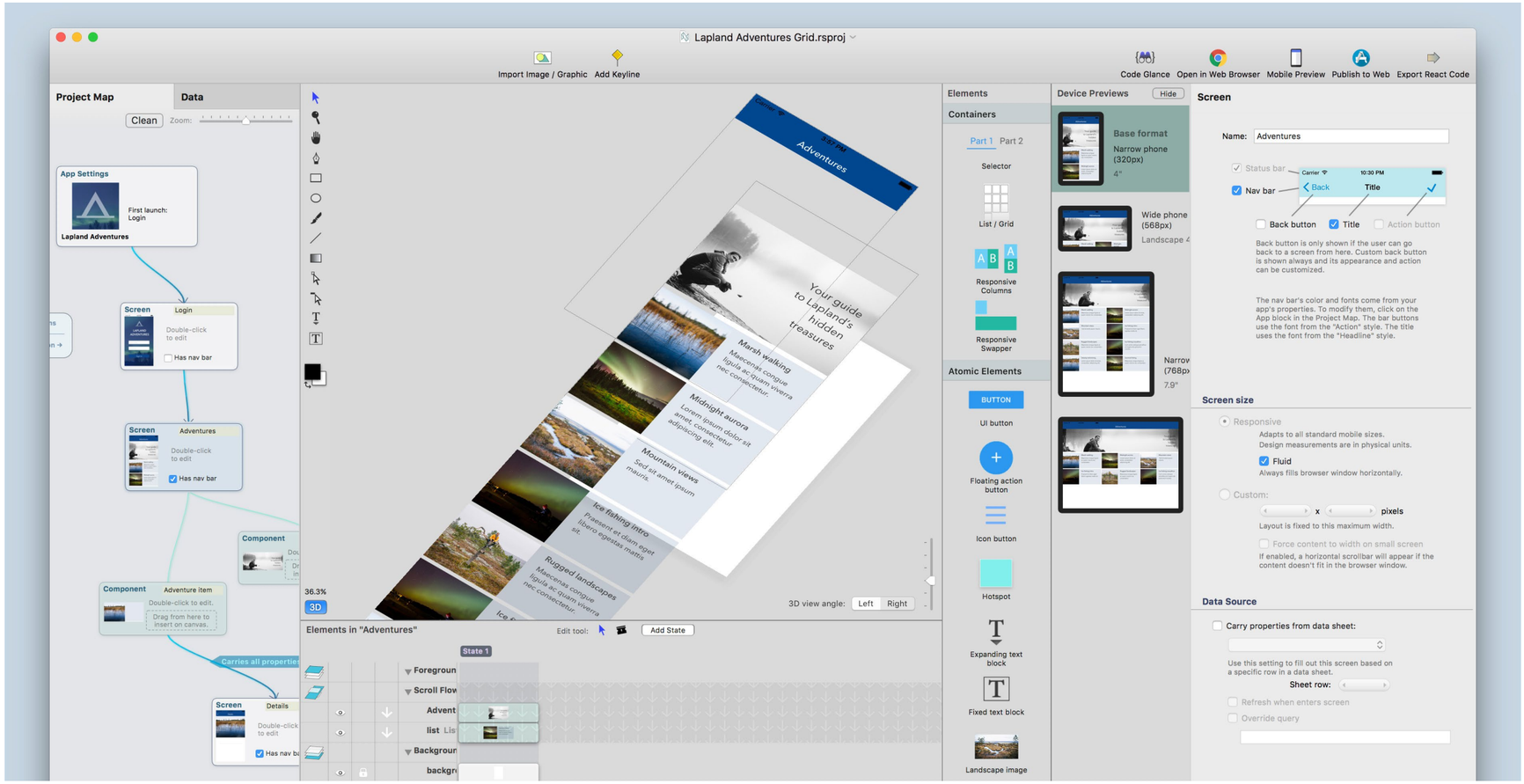
2016-Today



Elastic Projects

React Studio

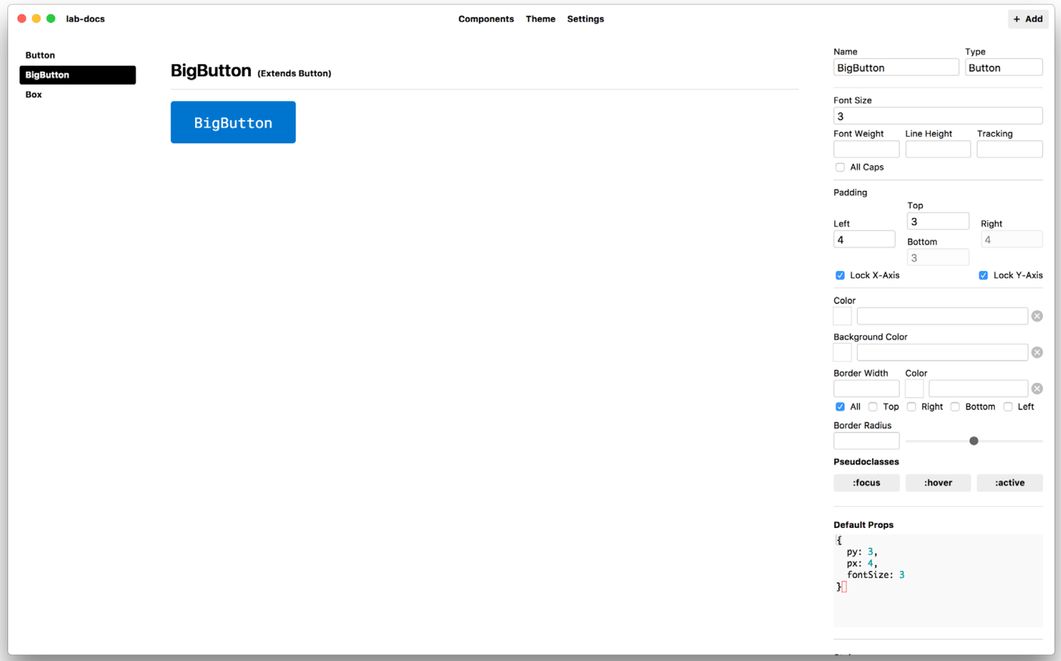
2017-Today

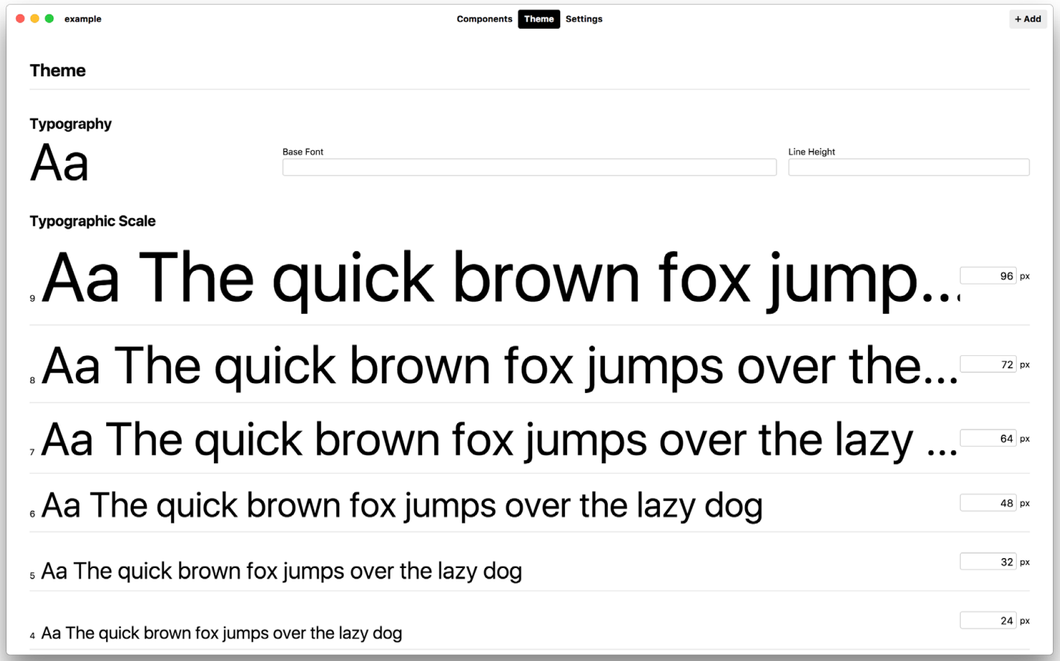


Neonto Ltd

Compositor Lab

2017-Today

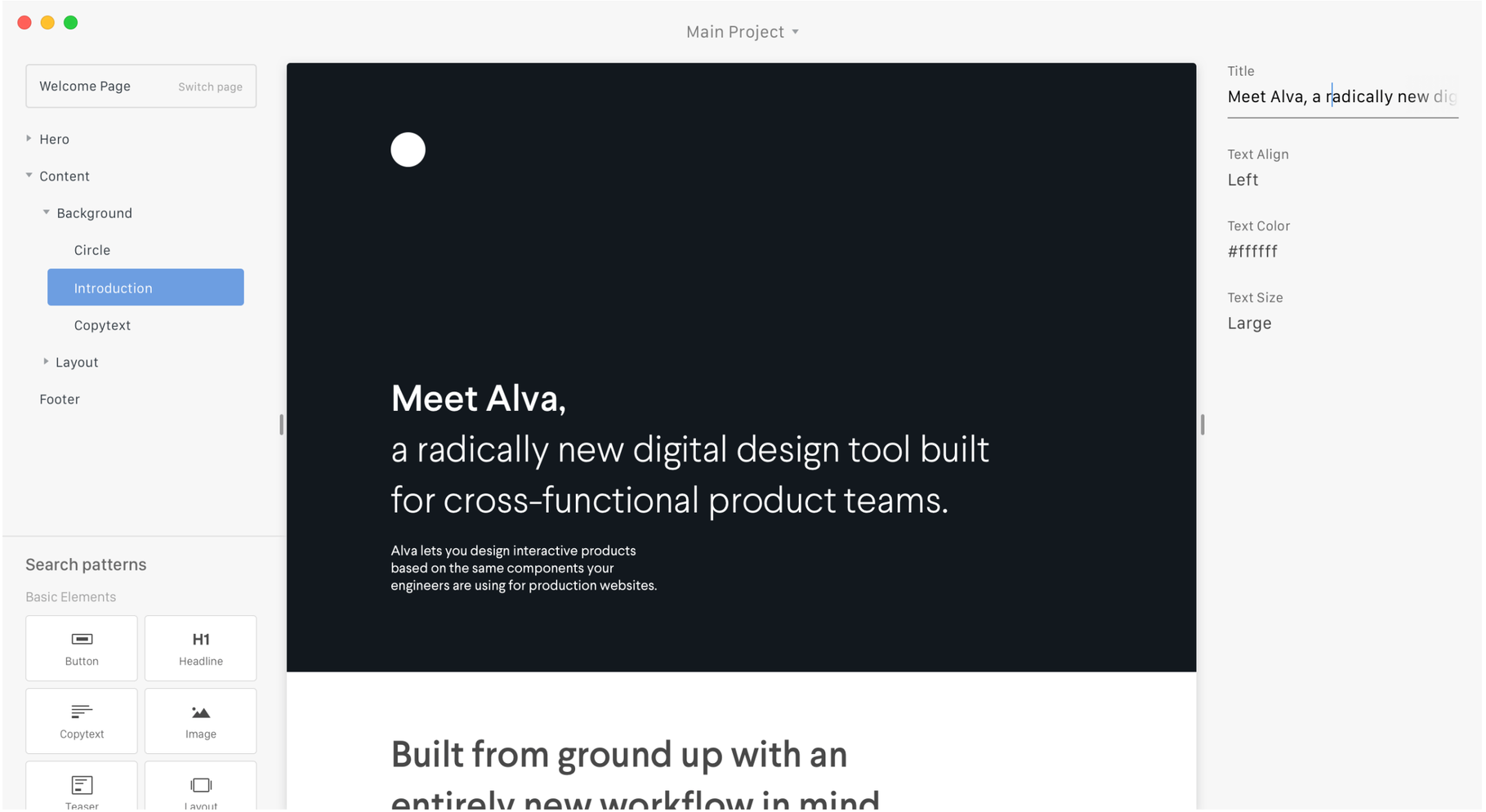




Compositor Inc

Alva

2017-Today



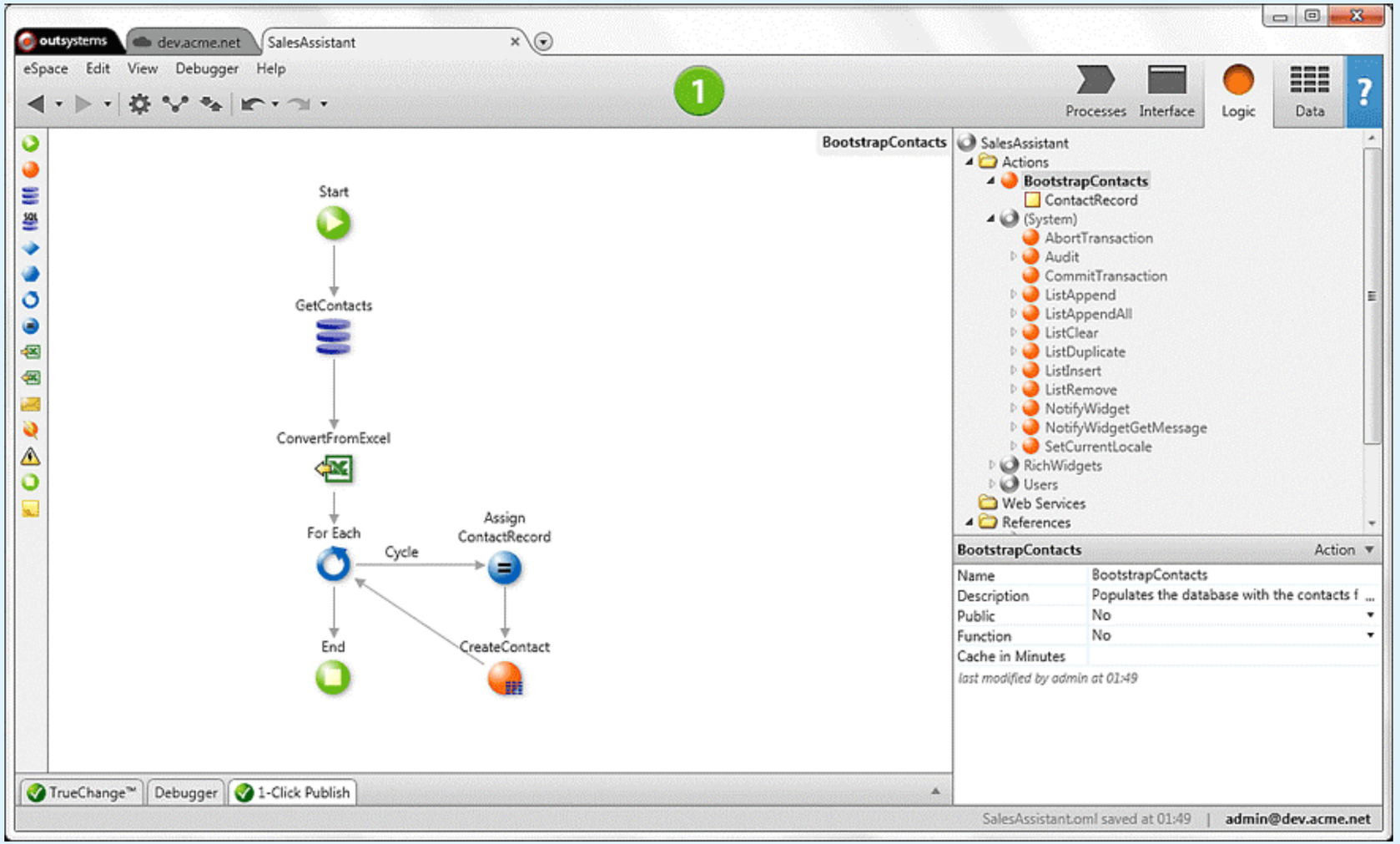
SinnerSchrader Deutschland GmbH (Part of Accenture Interactive)

‘Low Code’ Environments

Enable the Development of Apps using modular Building-Blocks

OutSystems Platform

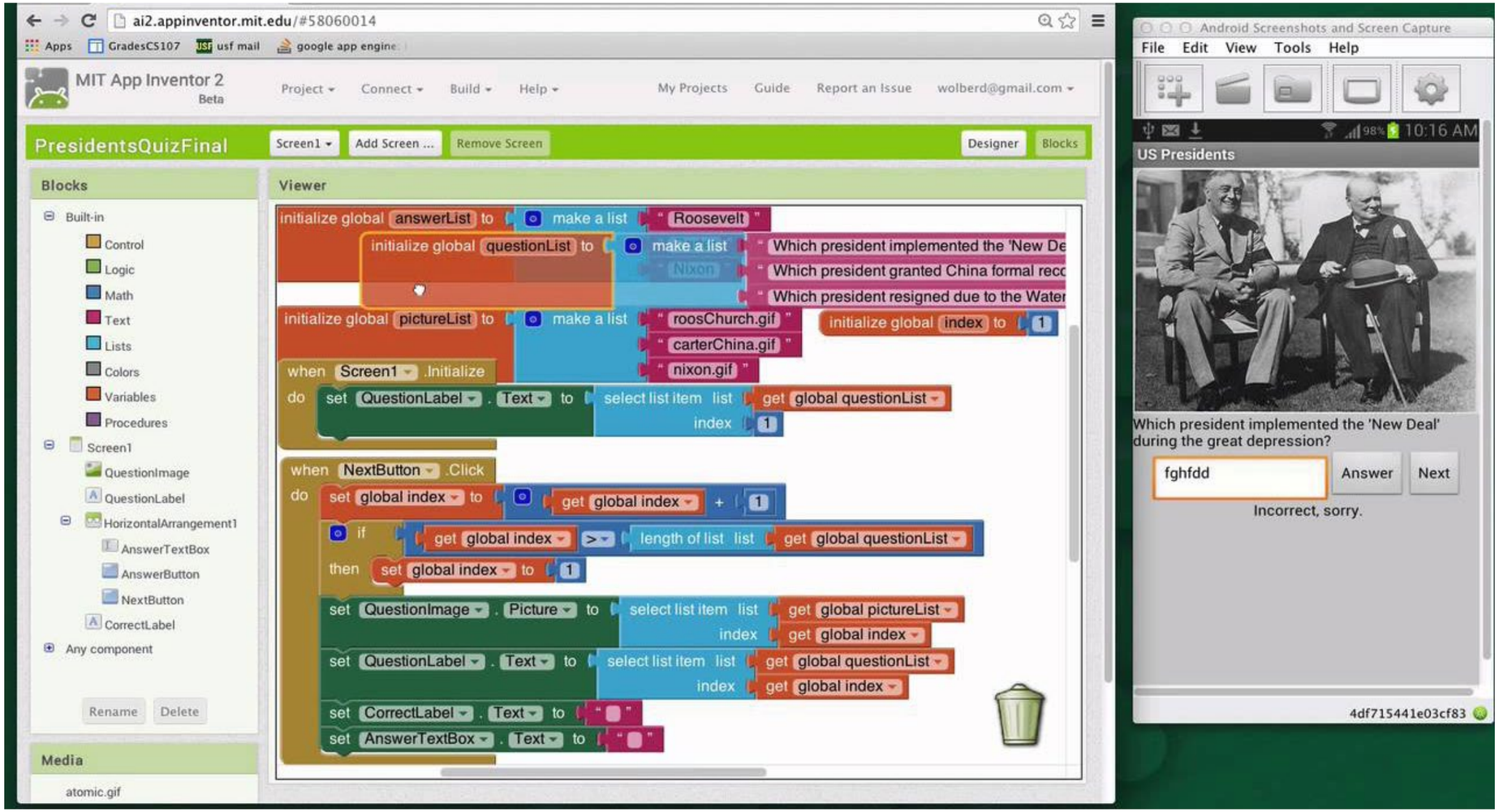
2001-Today



OutSystems Inc

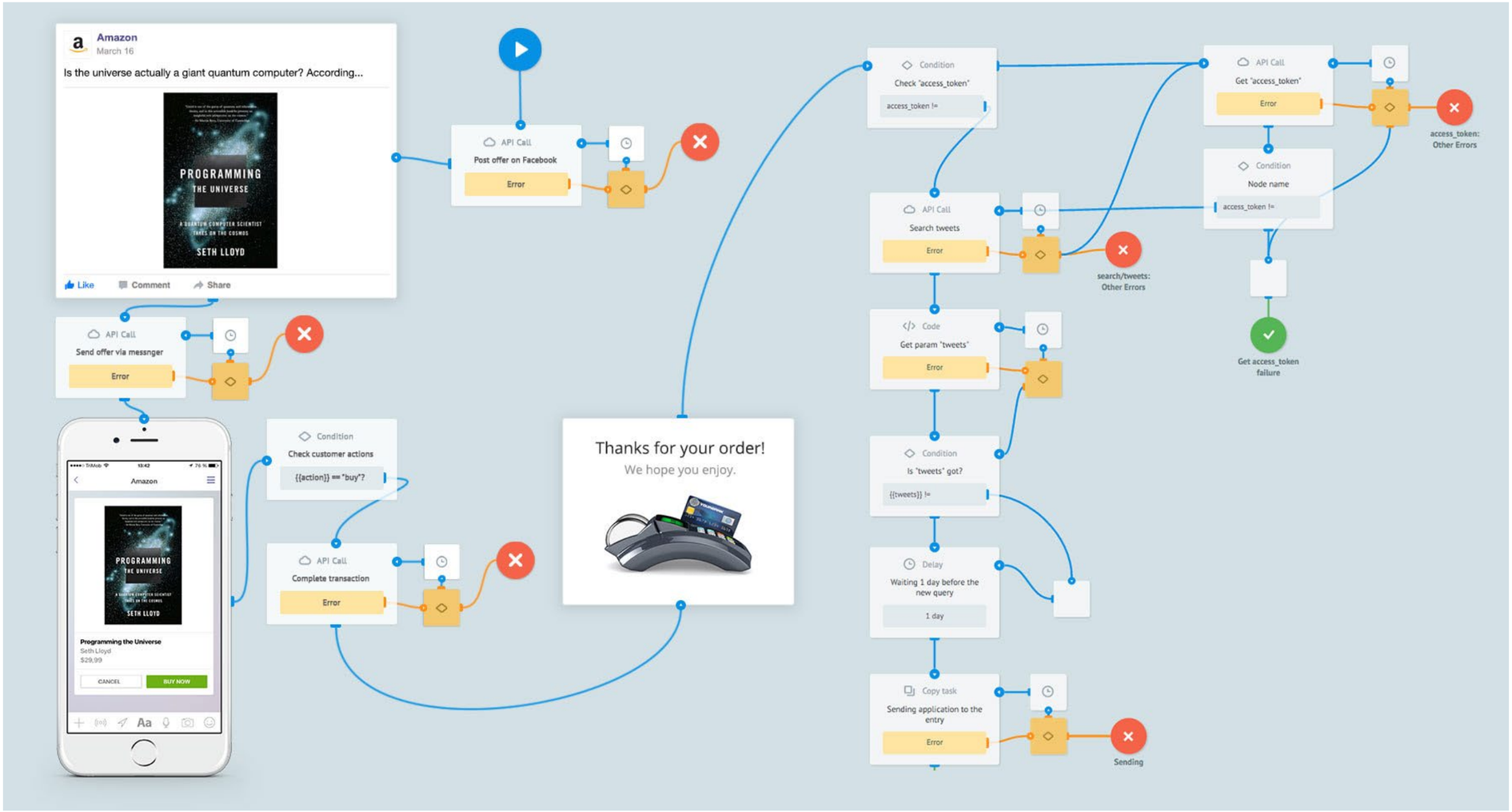
App Inventor for Android

2010-Today



Google and MIT Computer Science and Artificial Intelligence Lab

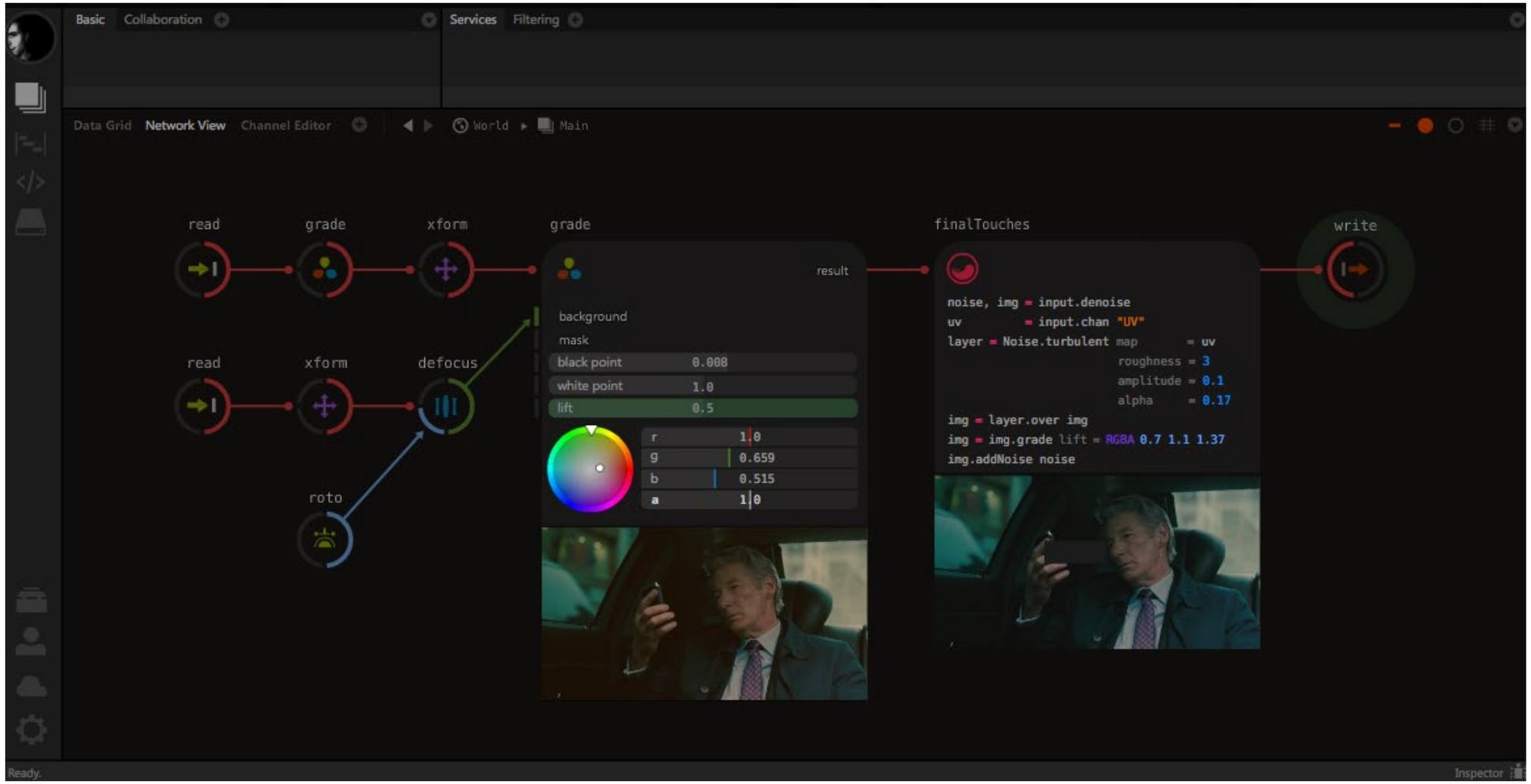
Corezoid Process Modeler 2013-Today



Corezoid.com Middleware Inc

Luna Studio

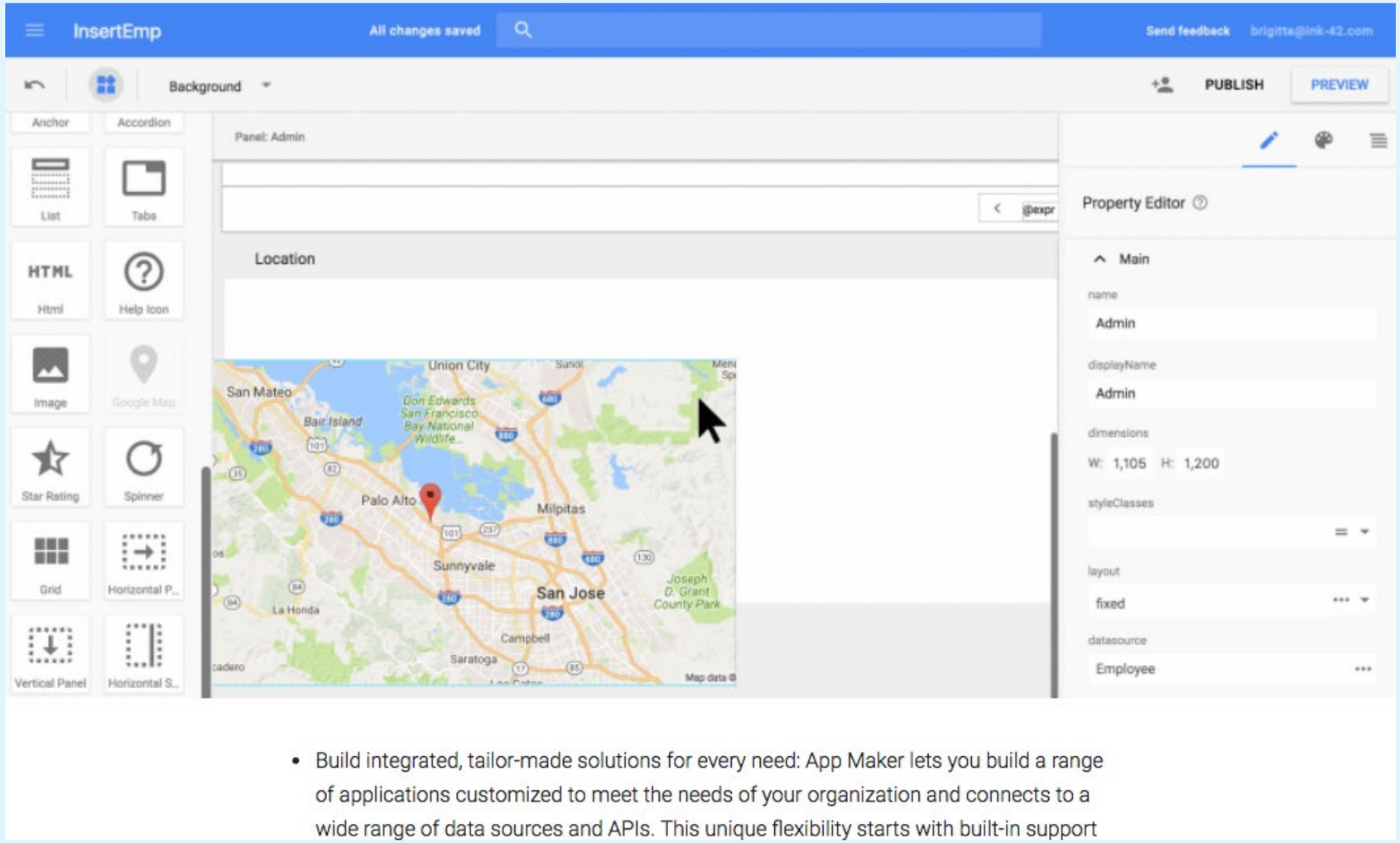
2017-Today



Wojciech Daniło, Marcin Kostrzewa

AppMaker

2018-Today



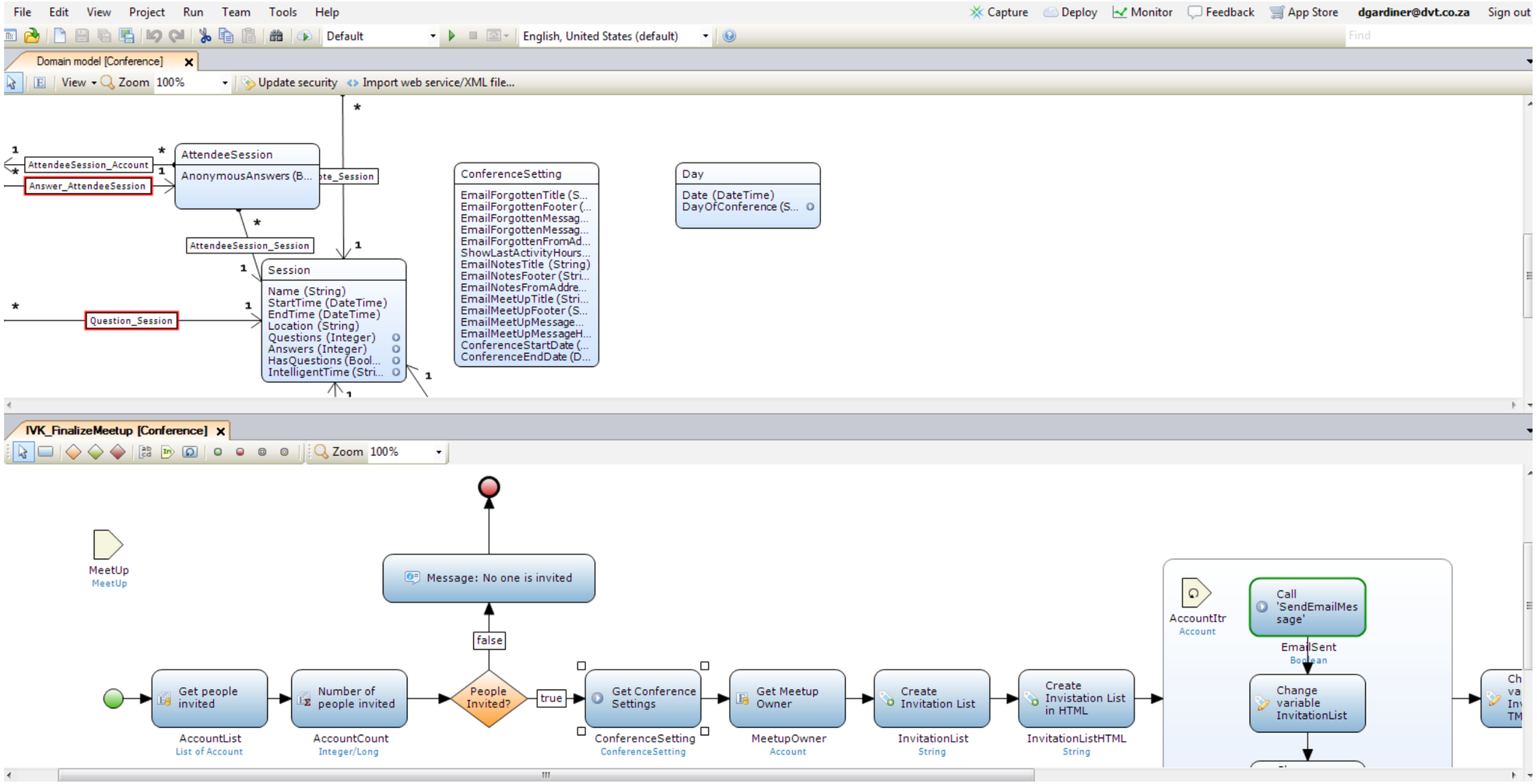
- Build integrated, tailor-made solutions for every need: App Maker lets you build a range of applications customized to meet the needs of your organization and connects to a wide range of data sources and APIs. This unique flexibility starts with built-in support

Google

Dynamic Modeling Tools

Support System Visualizing

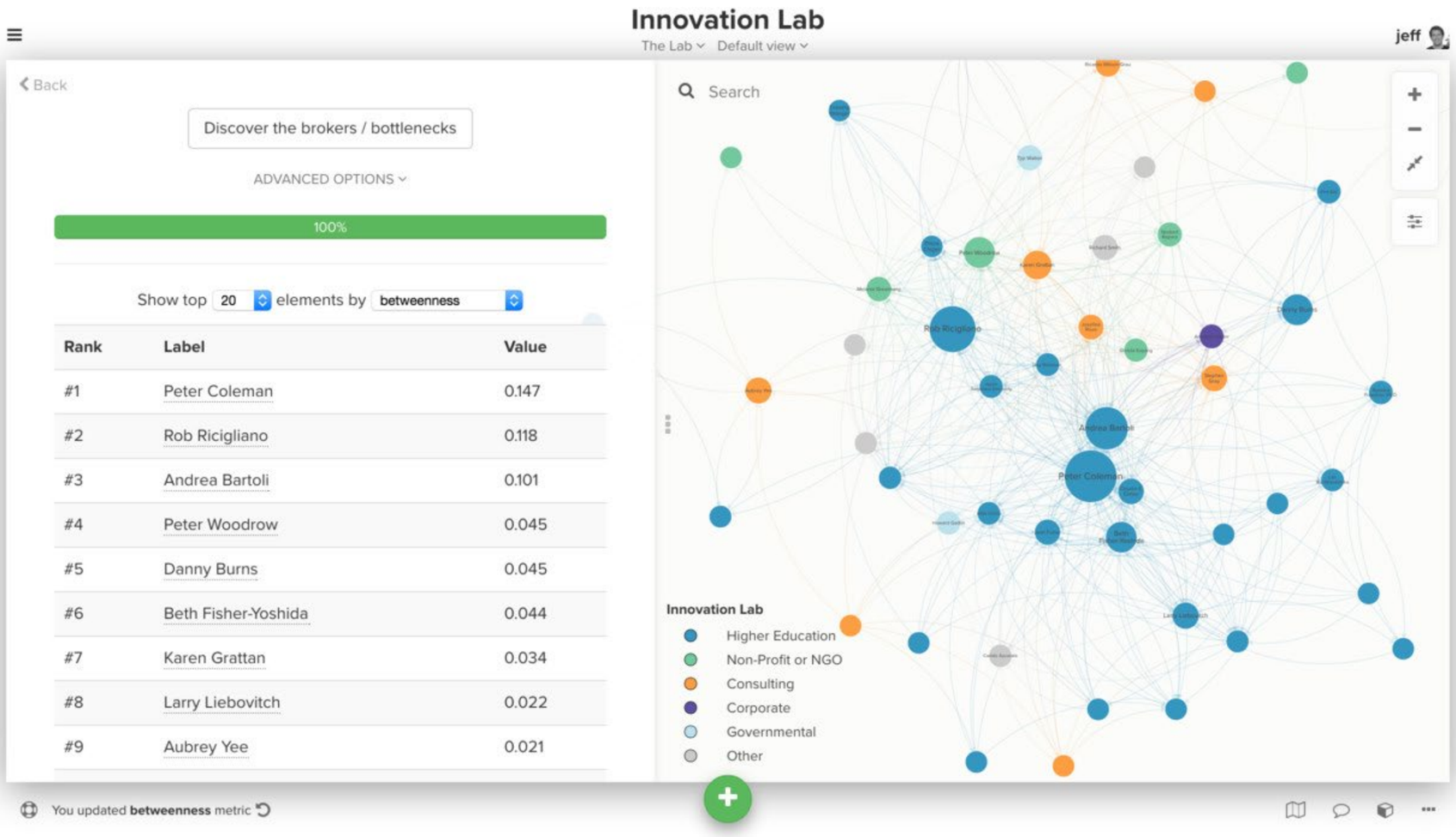
Mendix Business Modeler 2005-Today



Mendix

Kumu

2011-Today



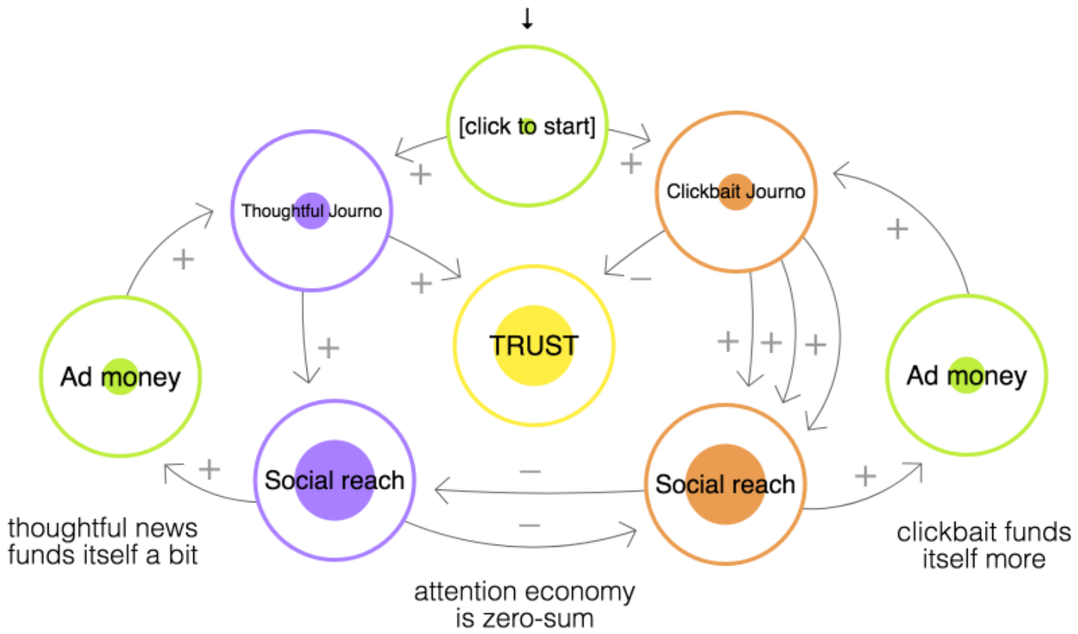
Jeff and Ryan Mohr for Kumu Inc

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.



Play

Nicky Case

IDE: Environments & Experiments

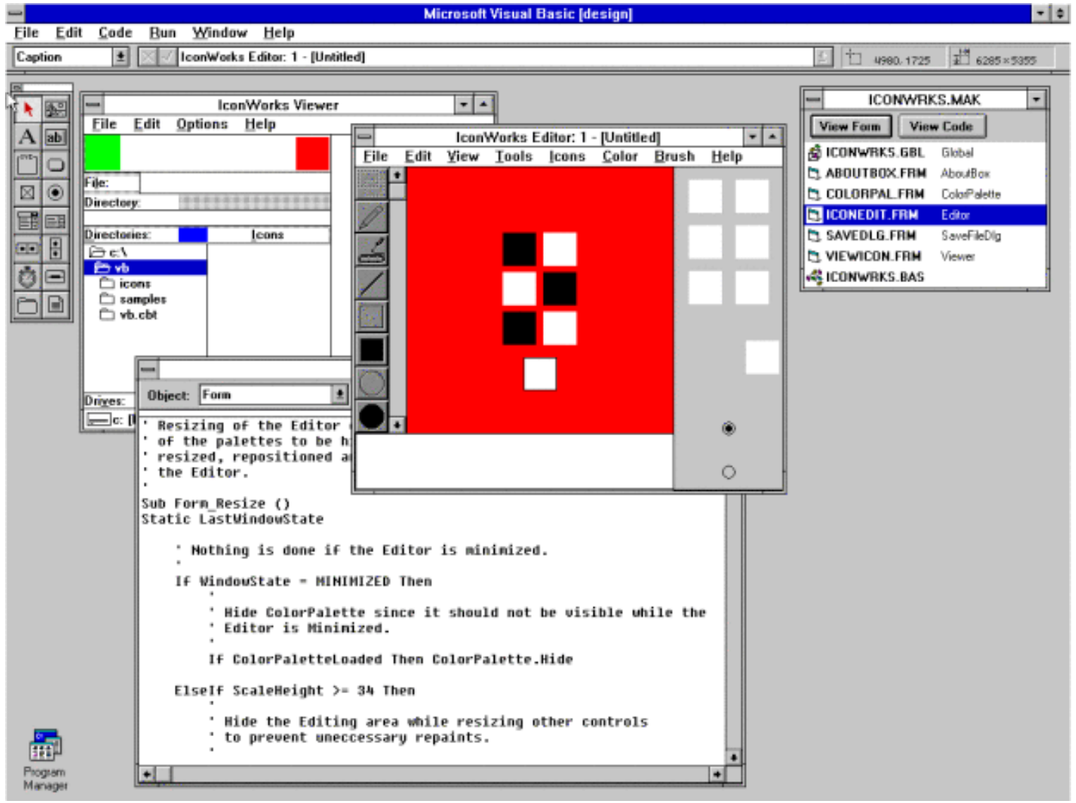
What Is & What's Next

Traditional IDEs

Integrated Development Environments

Visual Basic

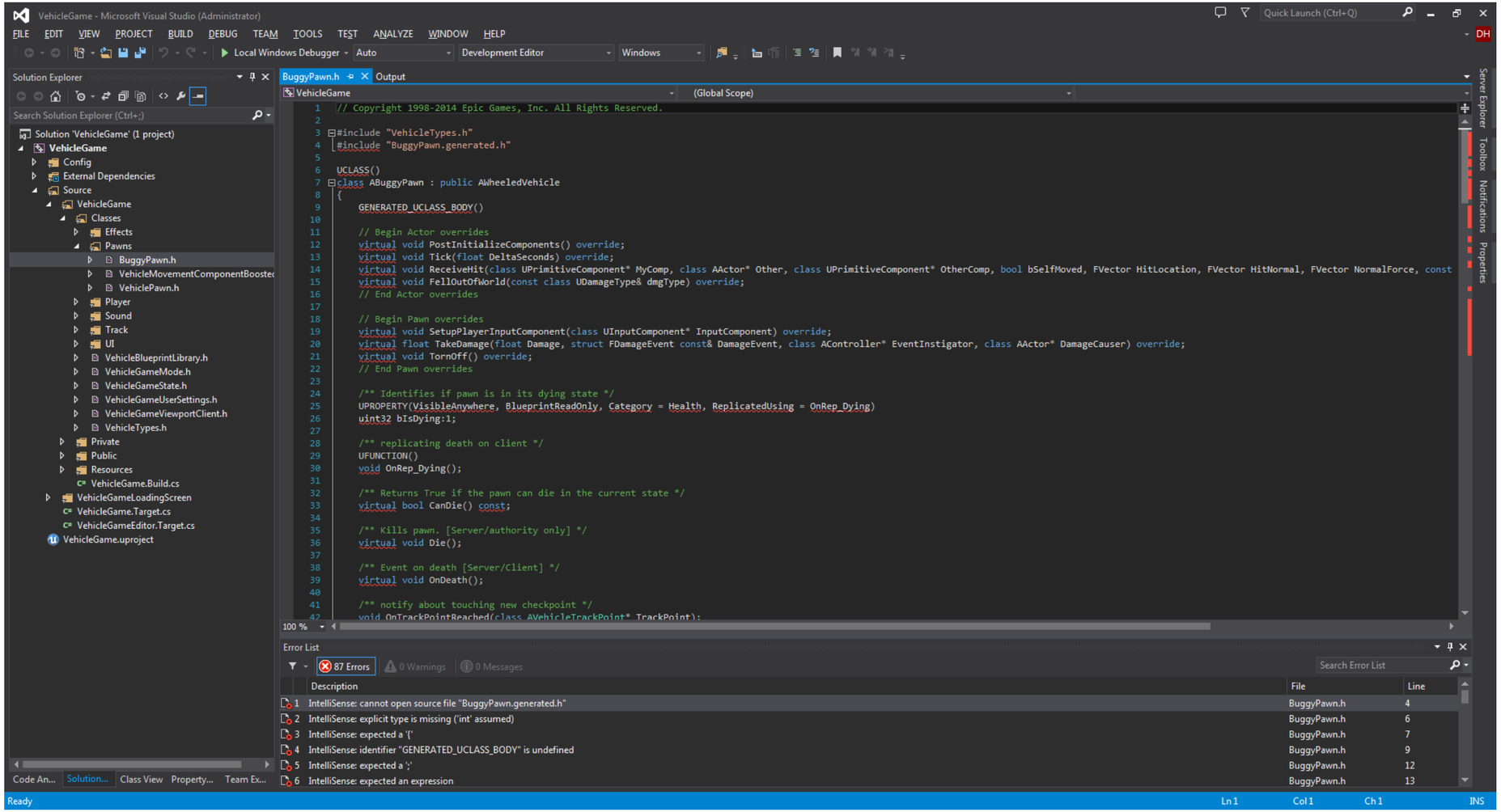
1991-1998



Cooper Software for Microsoft

Visual Studio

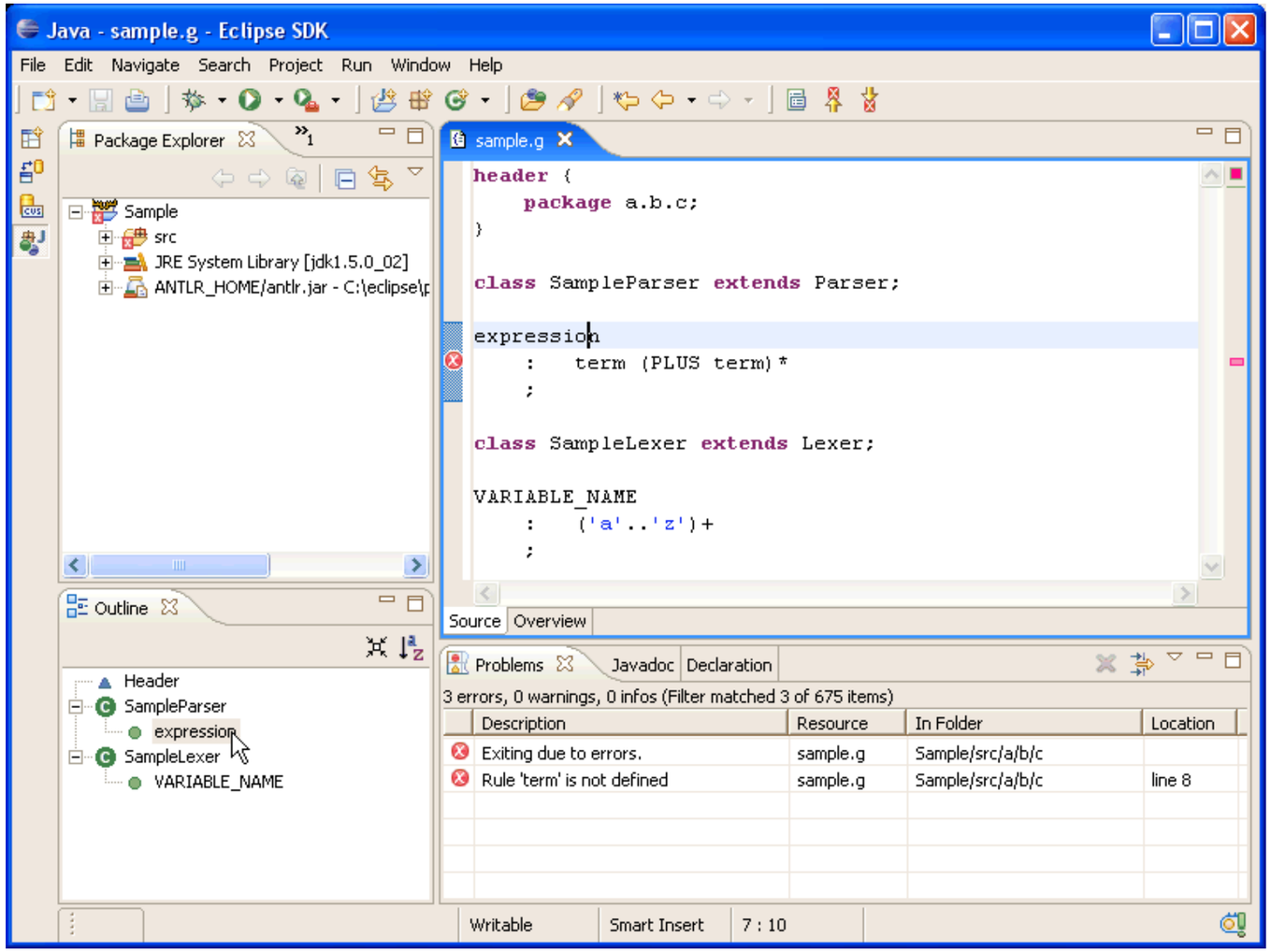
1997-Today



Microsoft

Eclipse

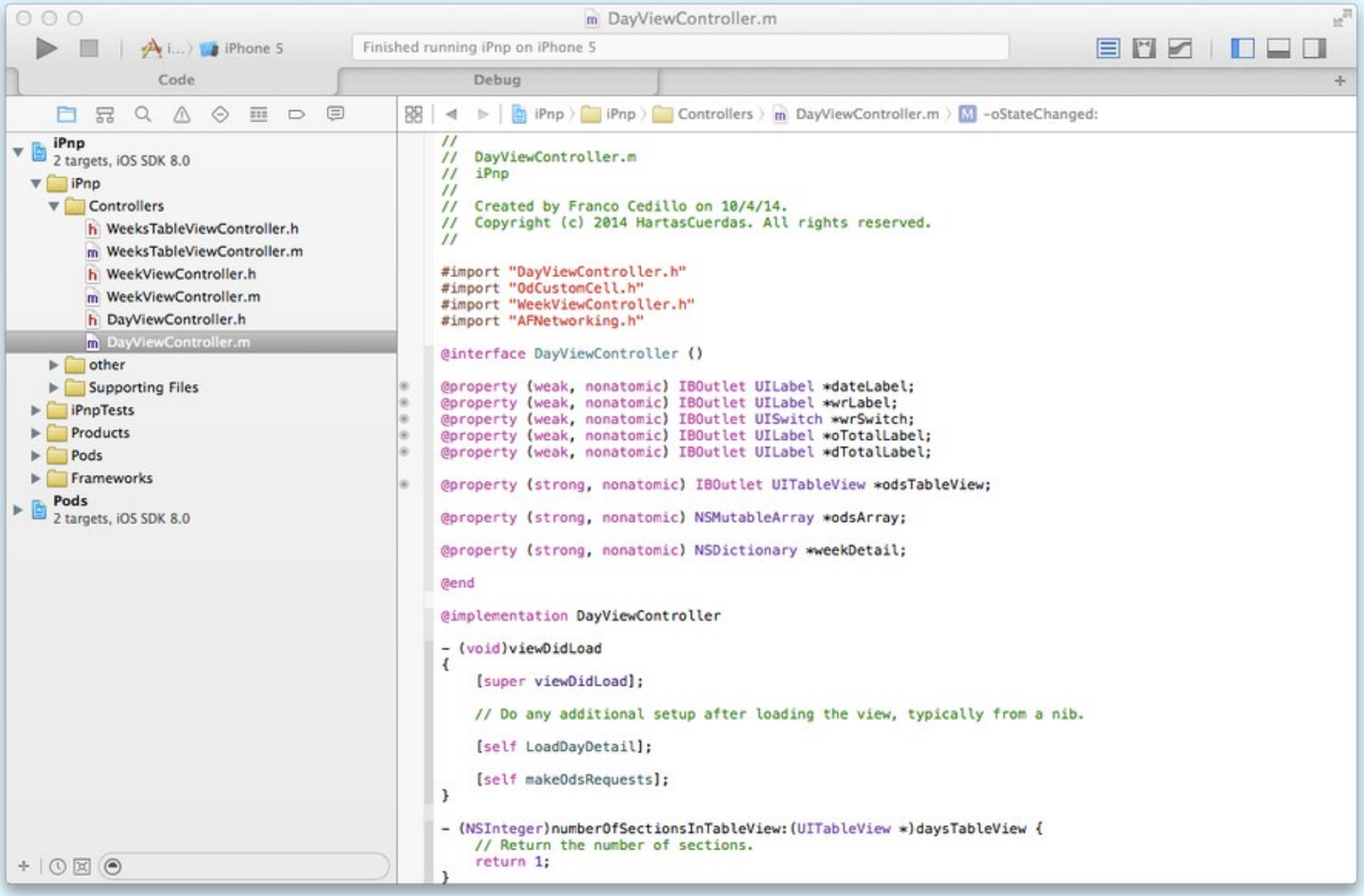
2001-Today



Eclipse Foundation

Xcode

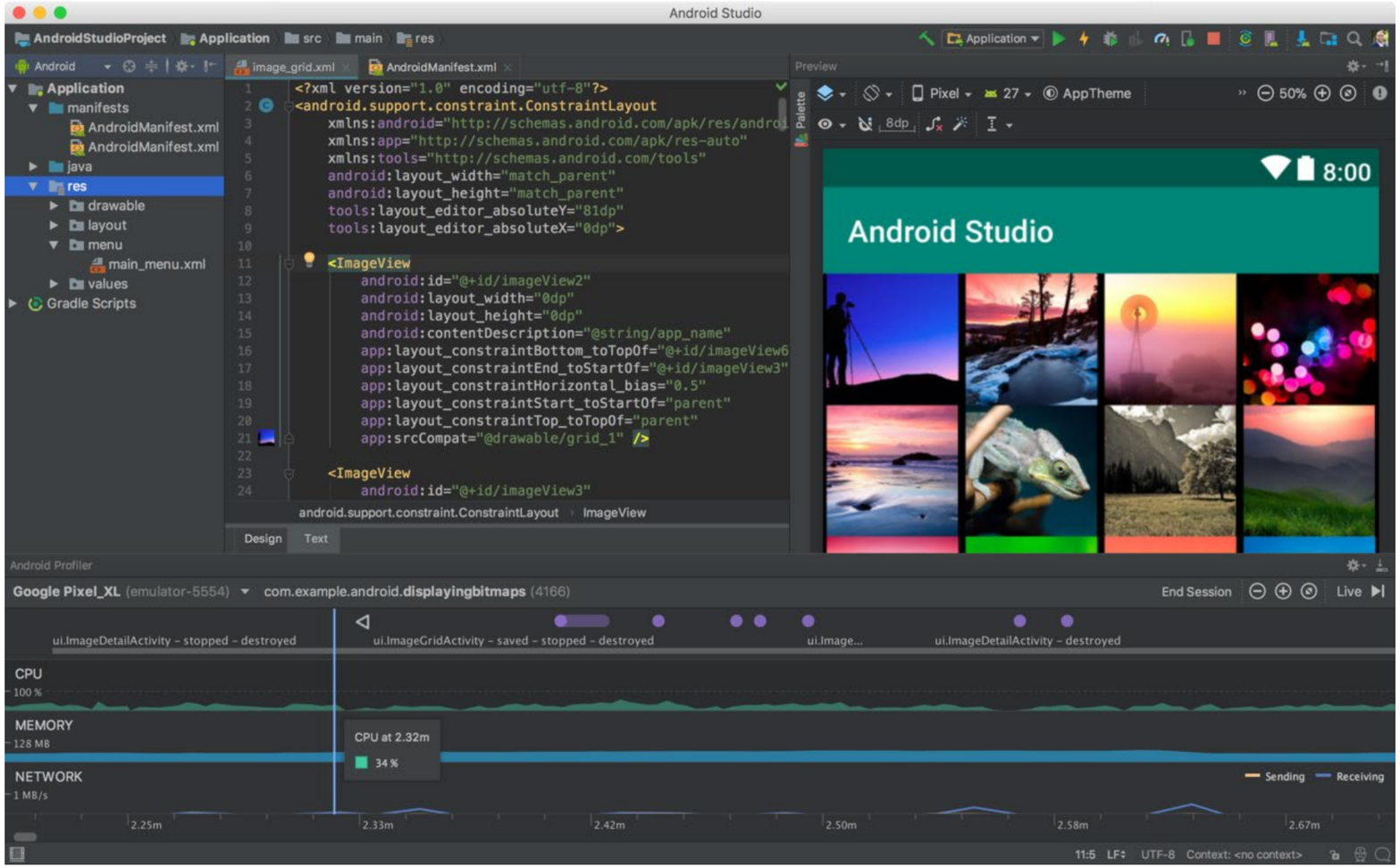
2003-Today



Apple

Android Studio

2013-Today



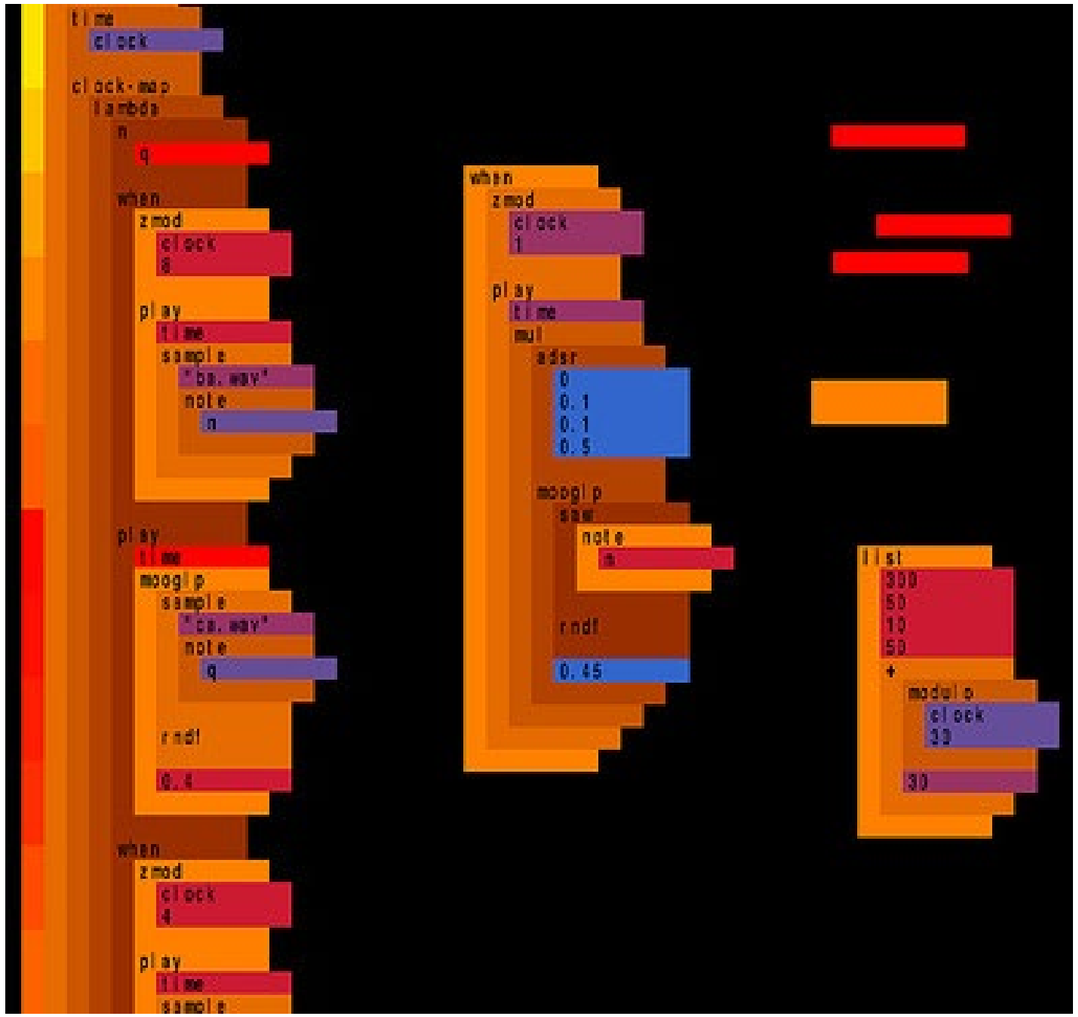
Google

Structure Editing

At Nested Levels of Abstration

Scheme Bricks

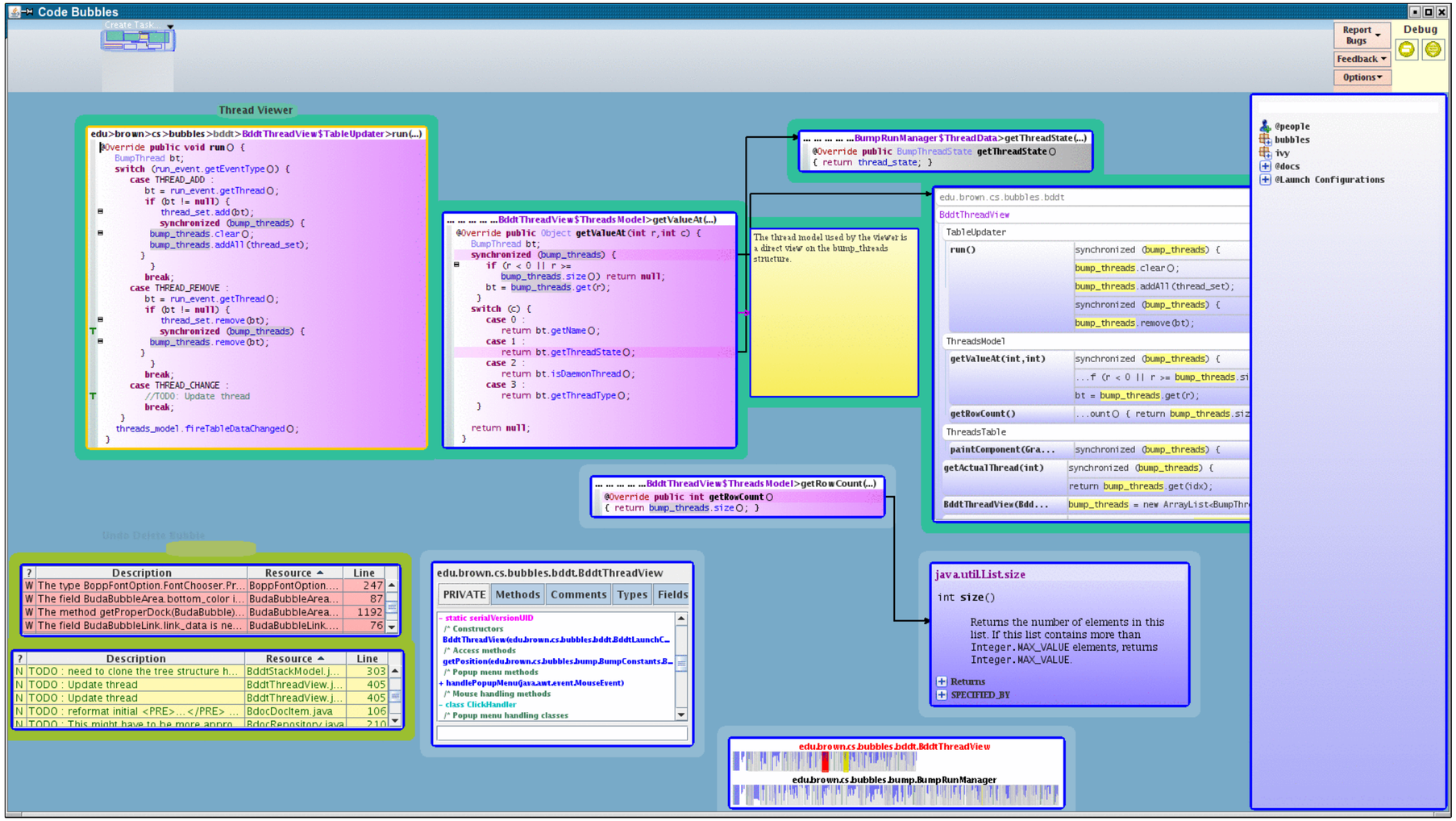
2008



Dave Griffiths

Code Bubbles for Eclipse

2010



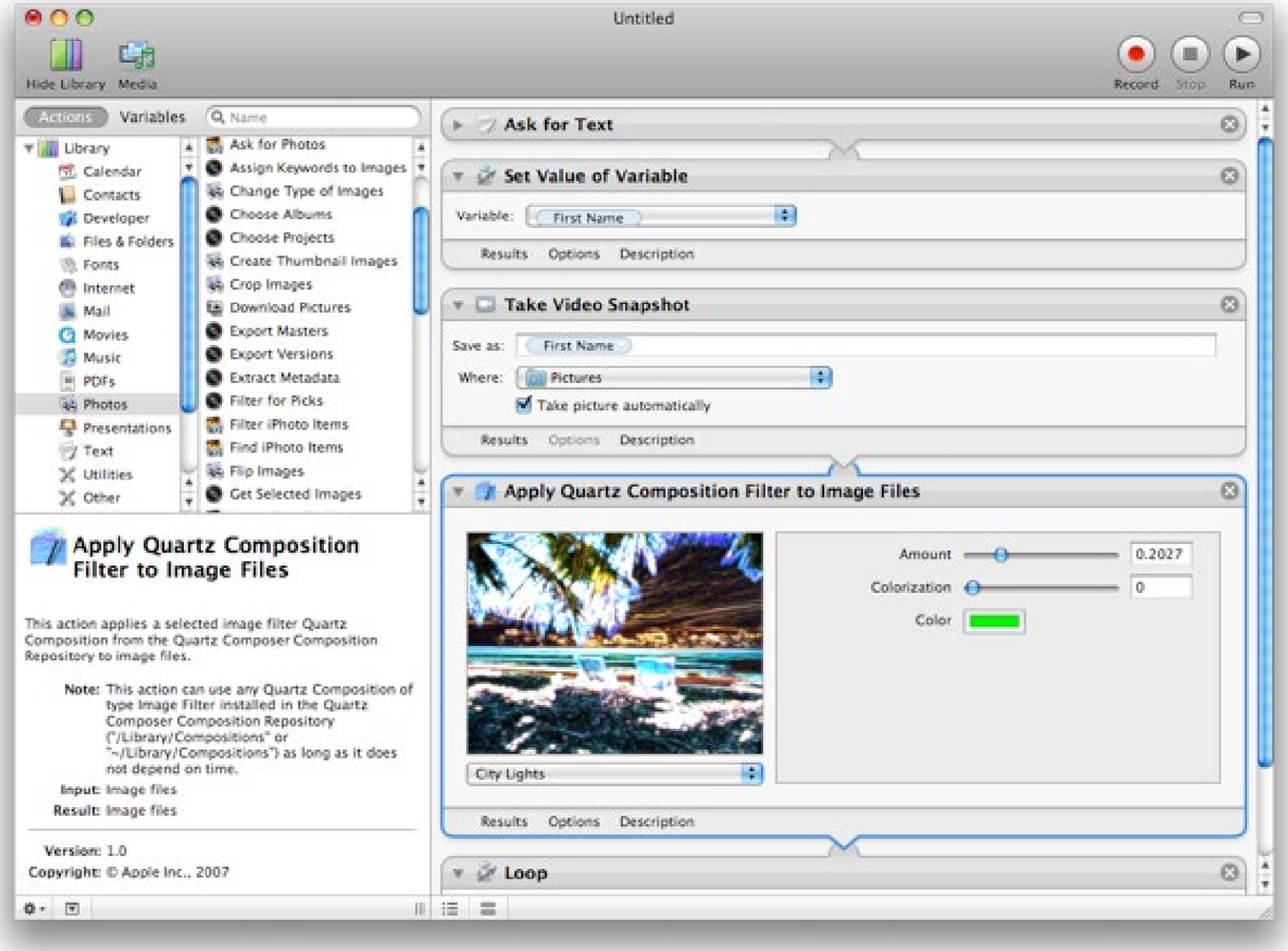
Computer Science at Brown University

Work Flow

Step-based Programming

Automator

2005-Today



Apple

IFTTT

2010-Today

Alexander Tibbets, Linden Tibbets

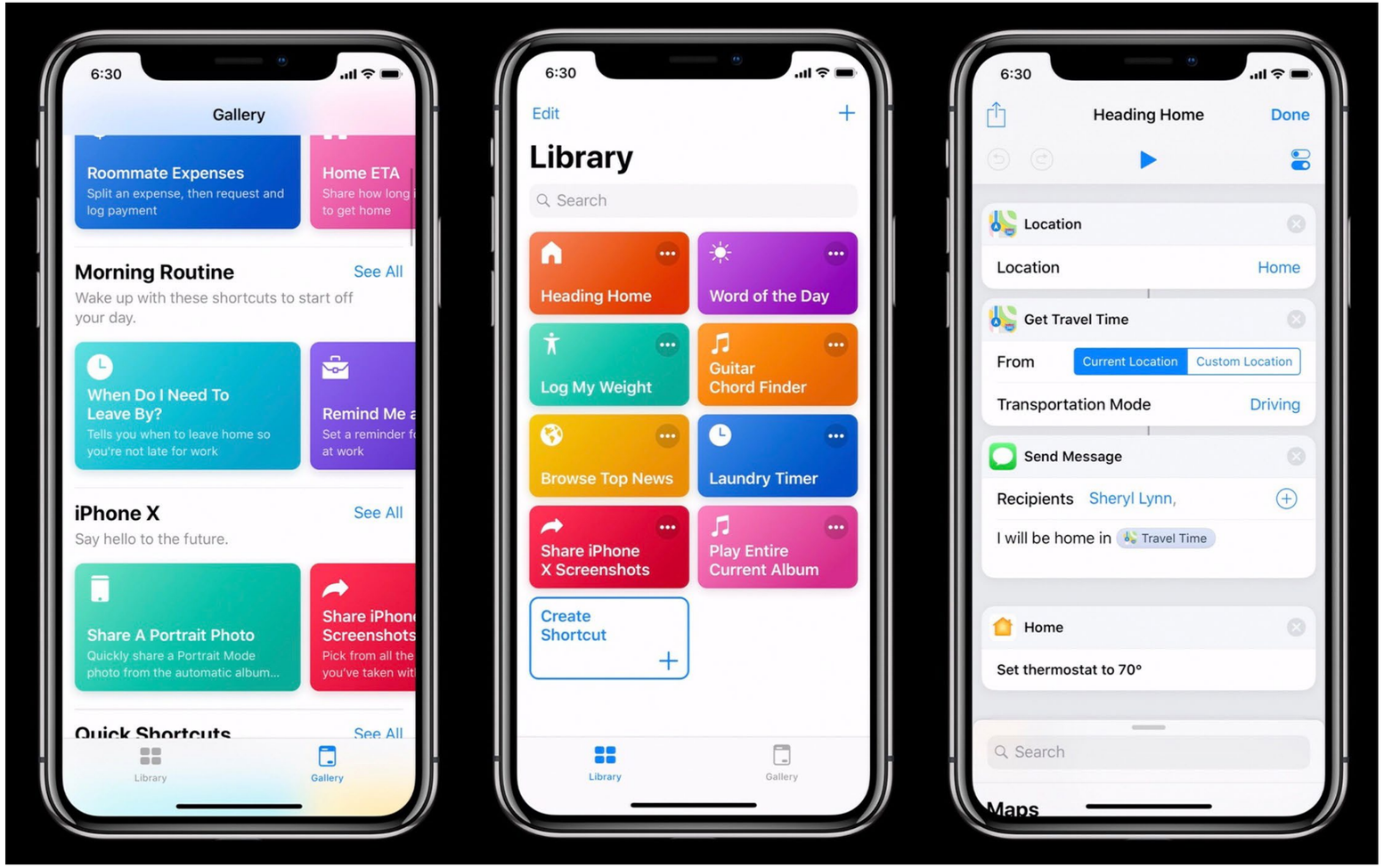
WorkFlow

2014-

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

Siri Shortcuts

2018



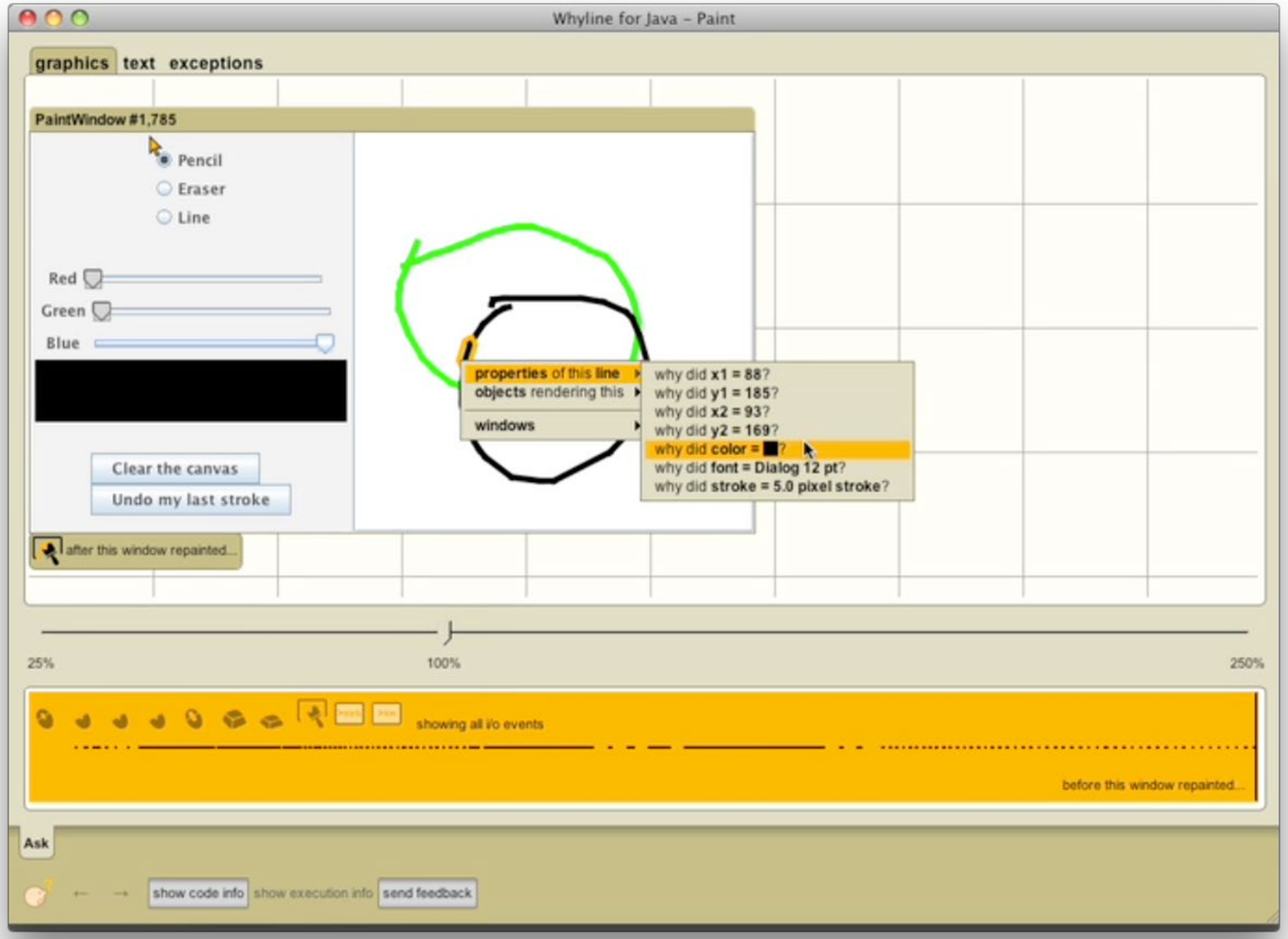
Apple

Visible State Editors

Introduce Transparency to Traditional Programming

Whyline

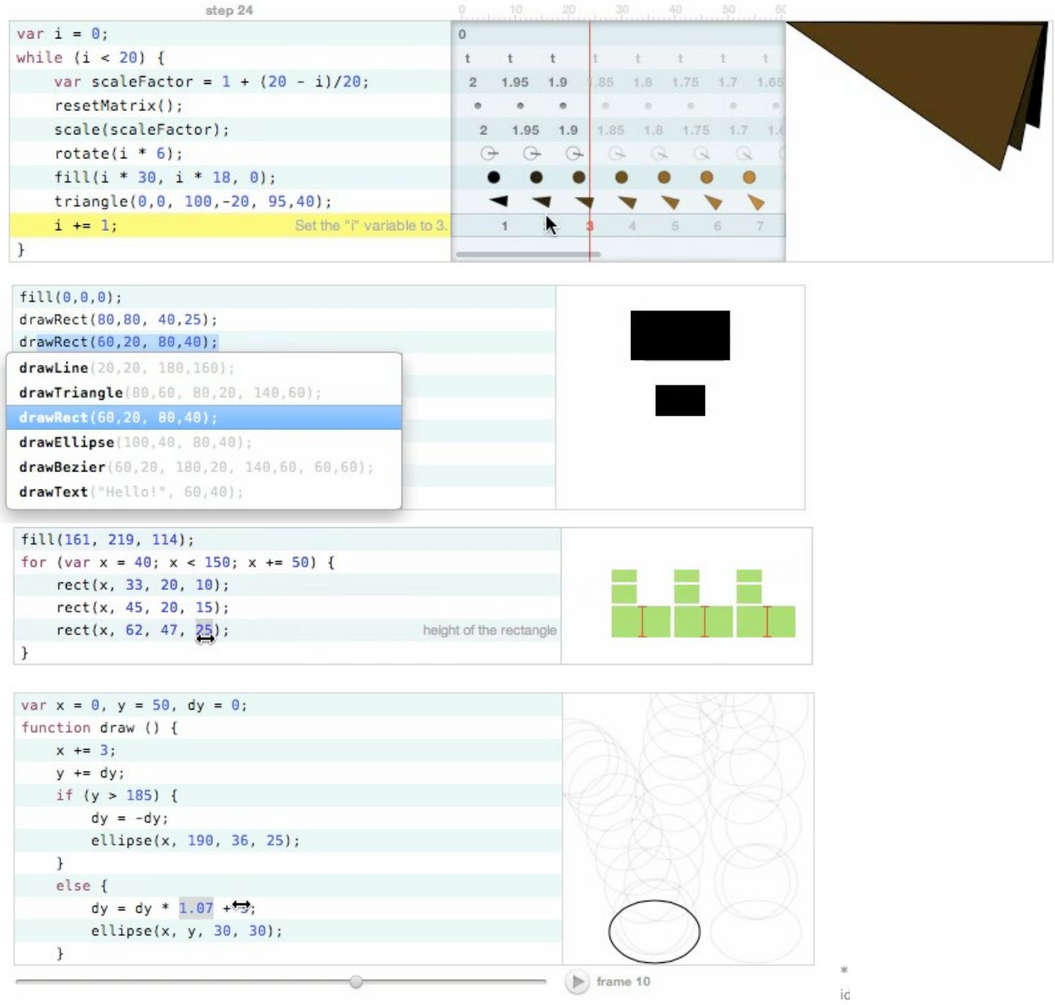
2008



Andrew Ko at Carnegie Mellon University (HCI Institute)

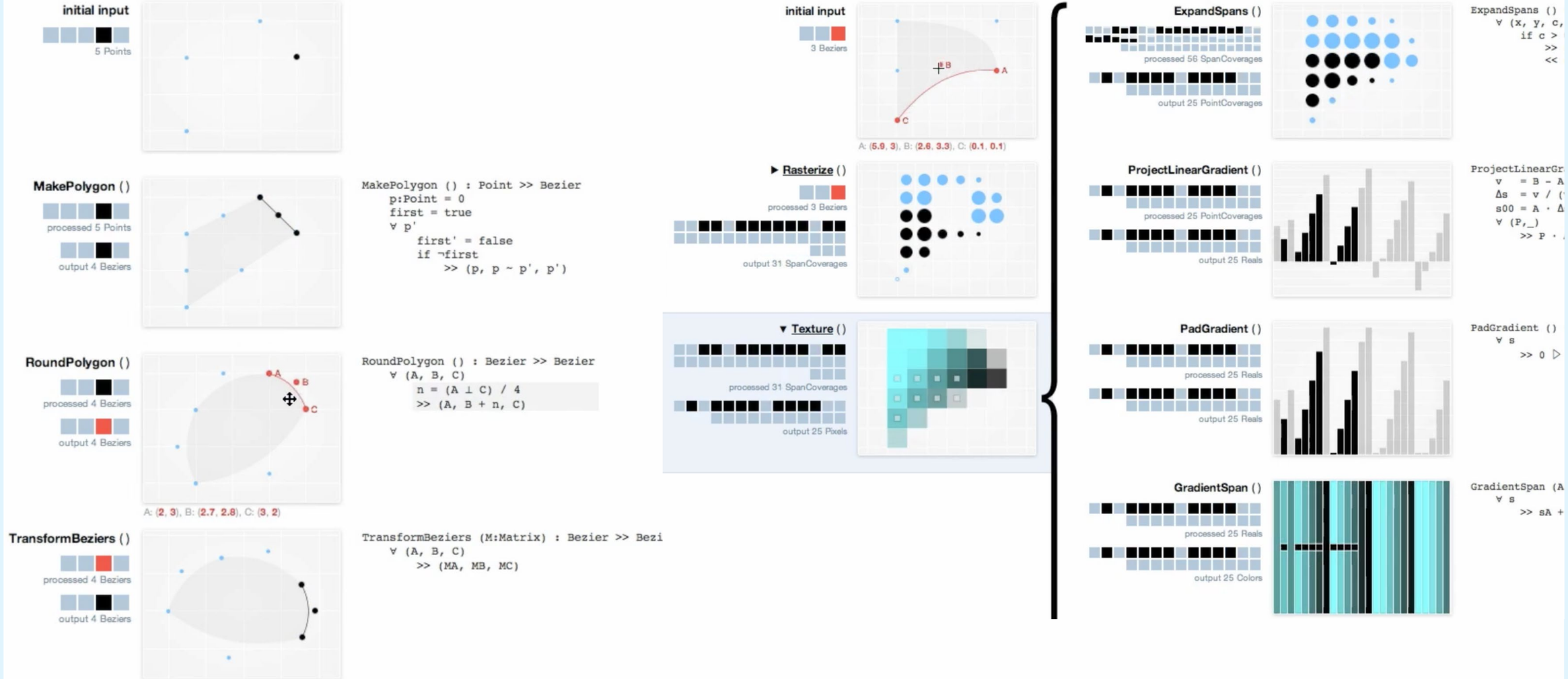
Learnable Programming (Essay)

2012



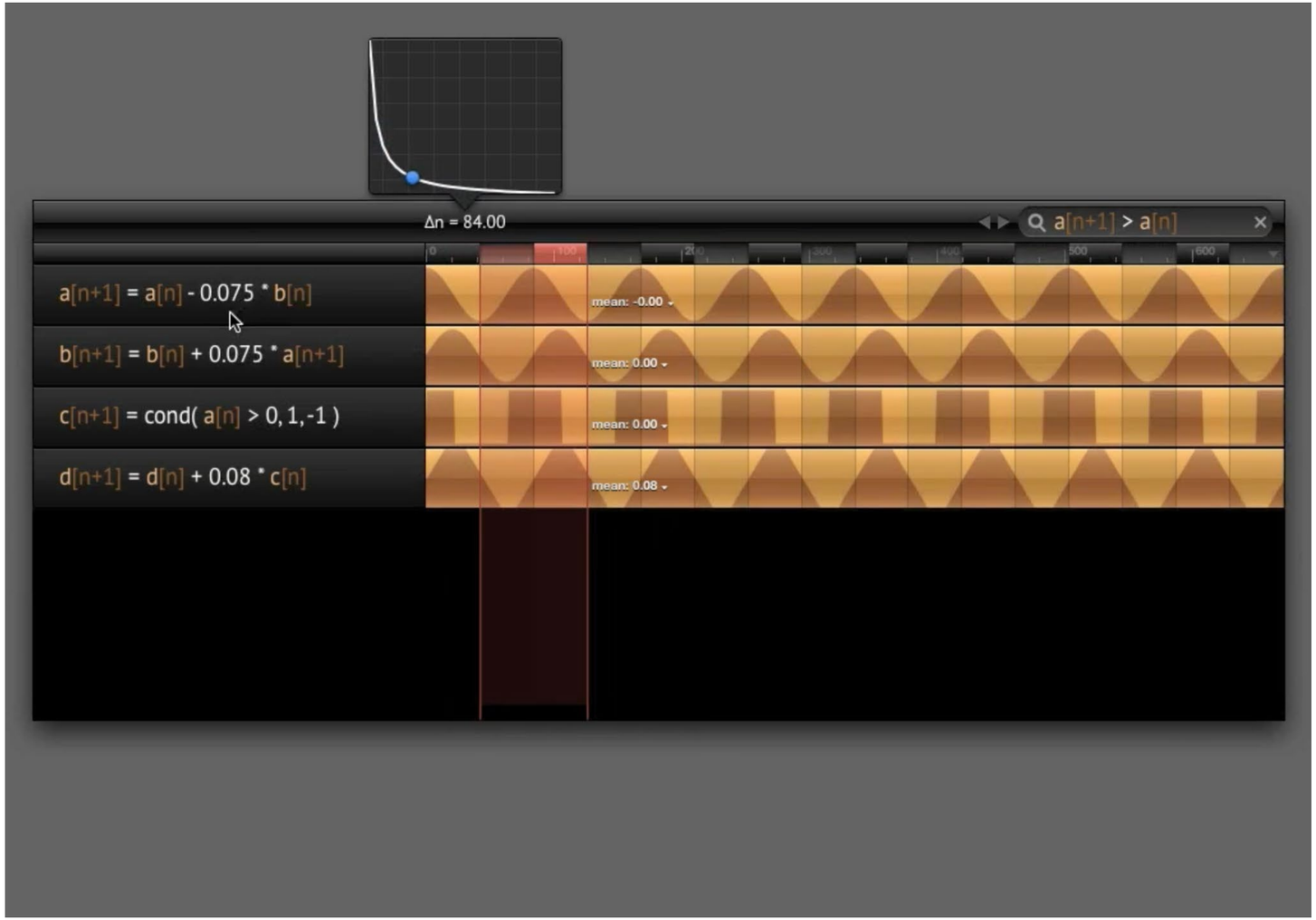
Bret Victor

Media for Thinking The Unthinkable (Nile Demo) 2013



Bret Victor

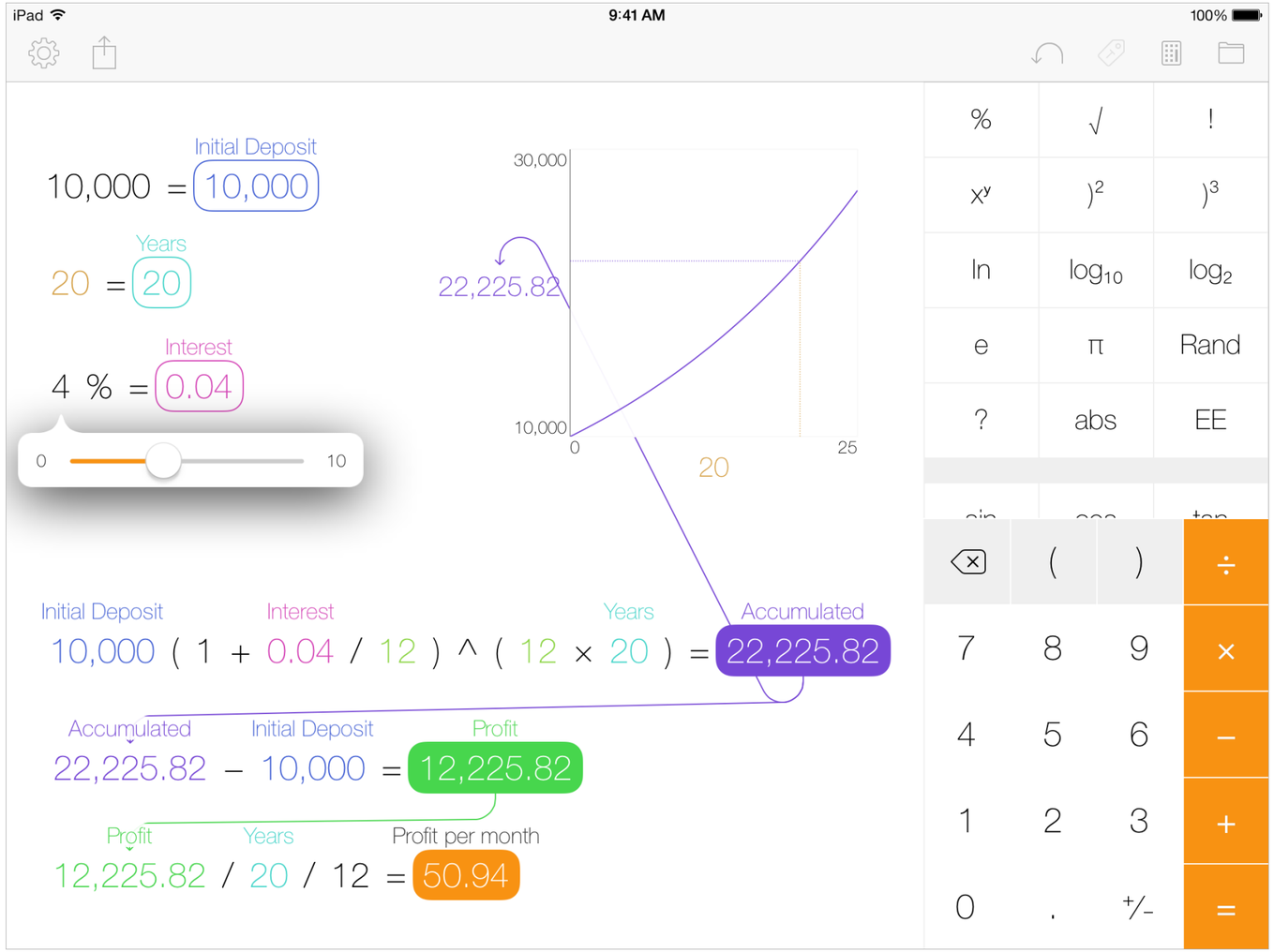
Media for Thinking The Unthinkable (MSP) 2013



Bret Victor

Tydlig

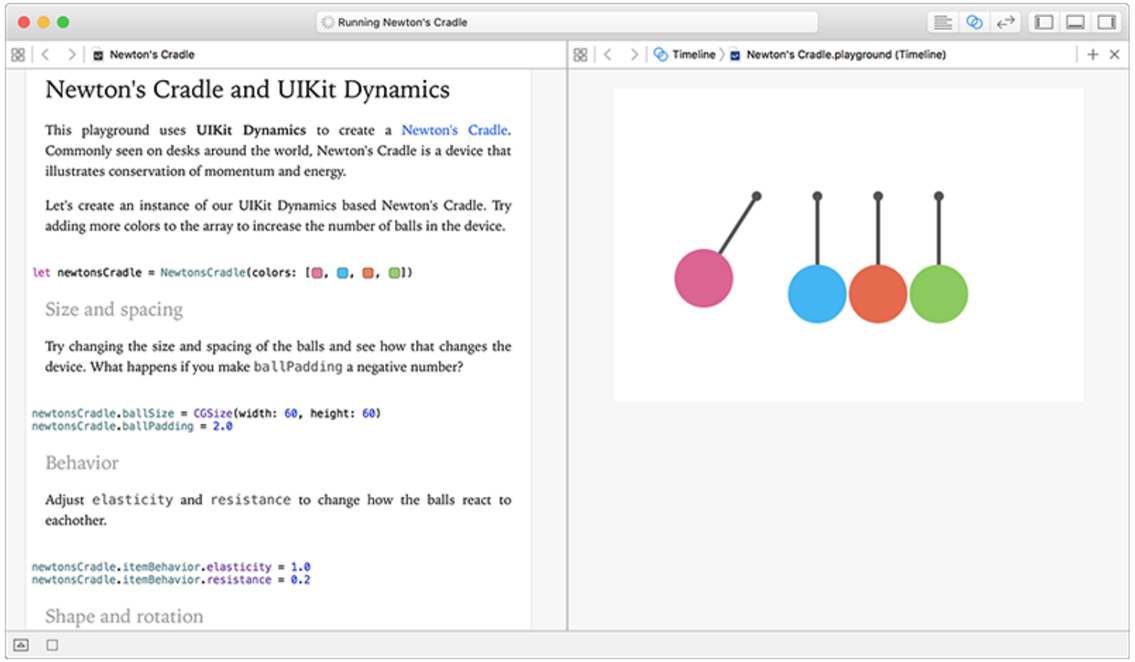
2013

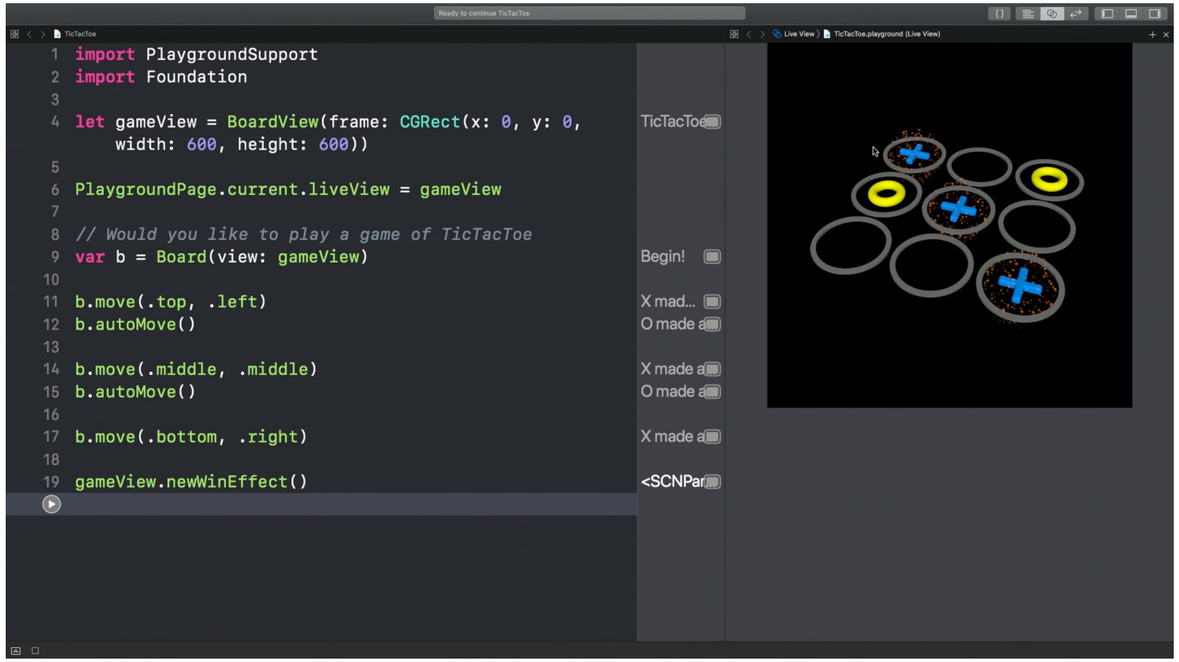


Andreas Karlsson for Tydlig Software AB

Xcode Playgrounds

2015-Today

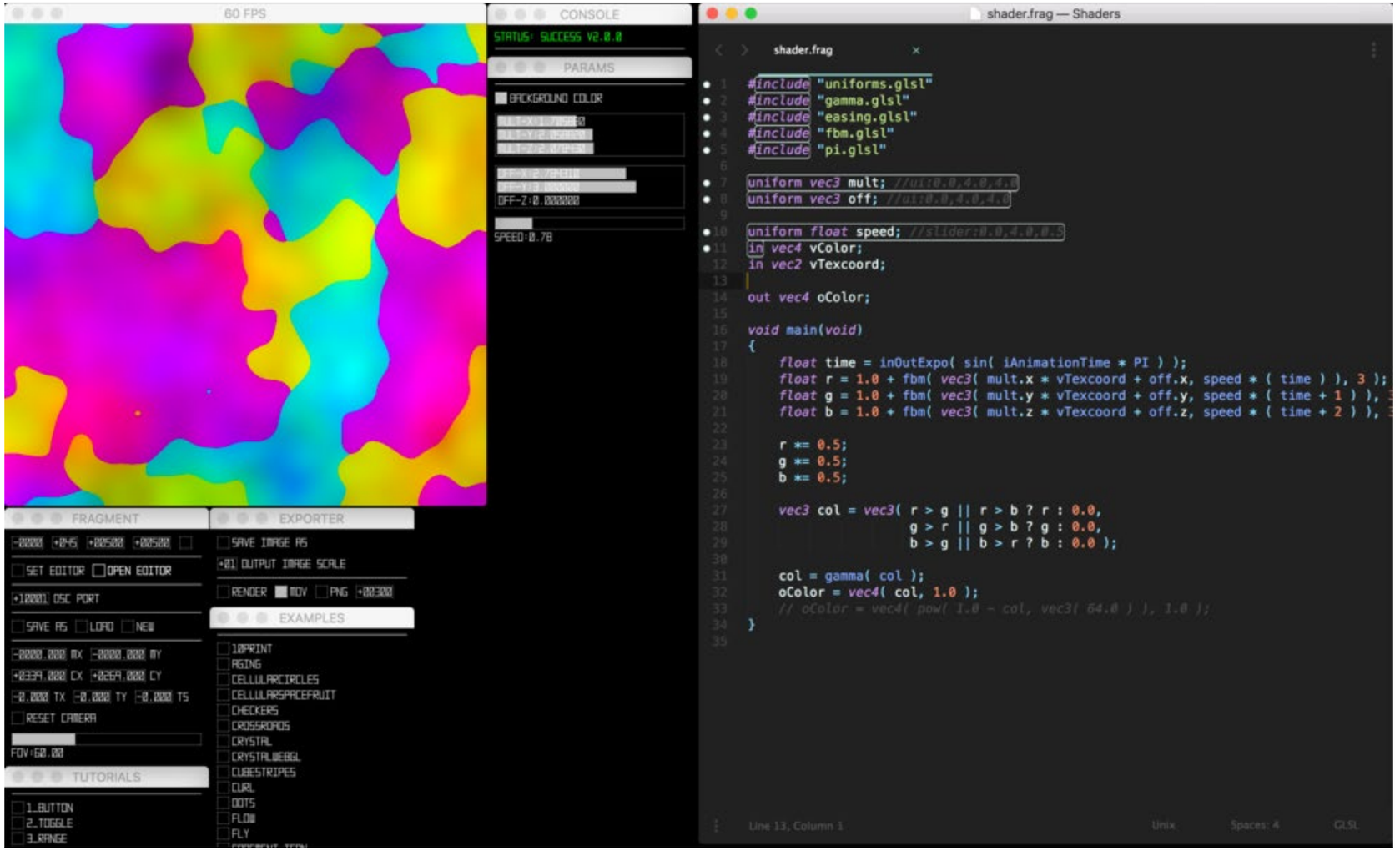




Apple

Fragment

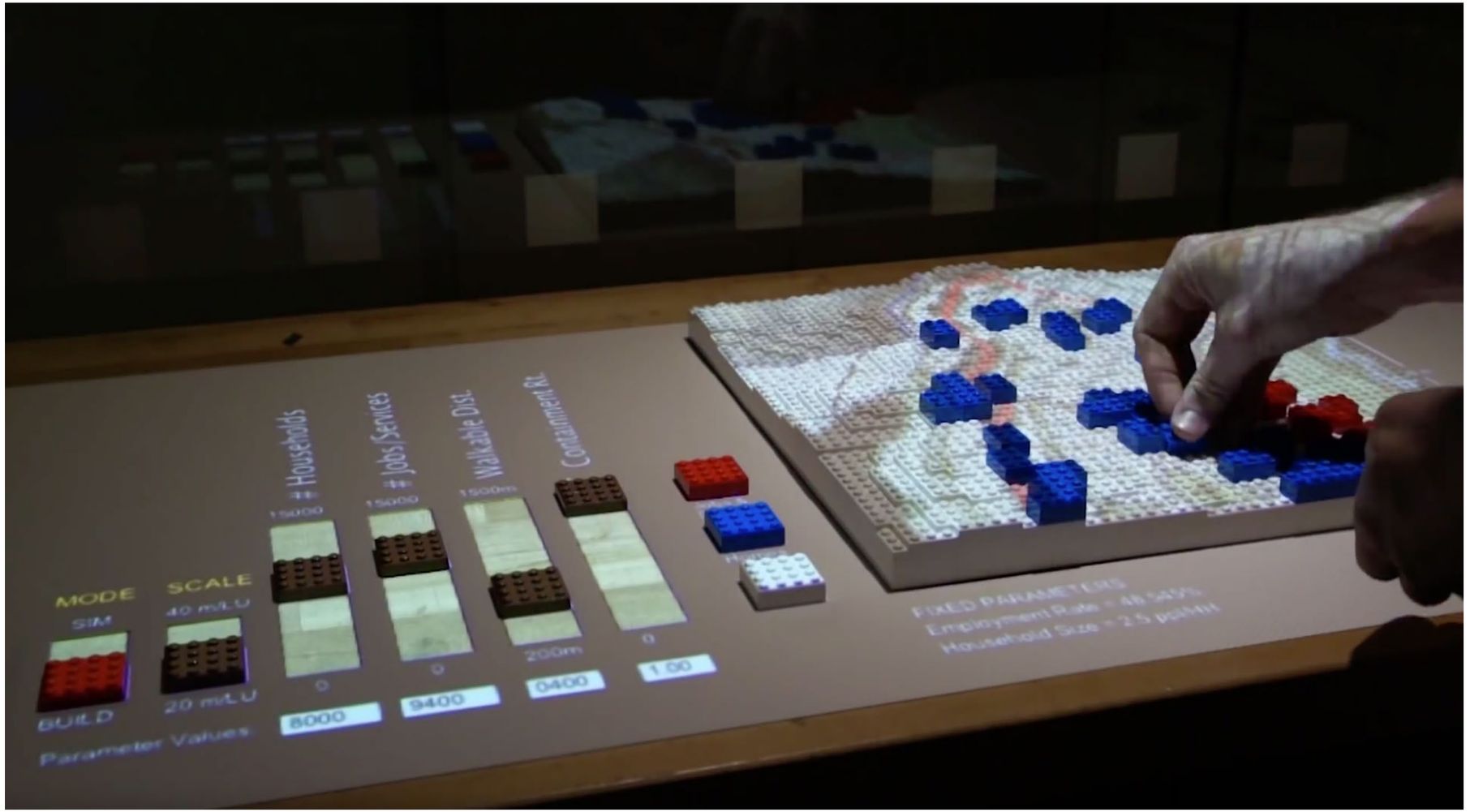
2017



Reza Ali

CityScope

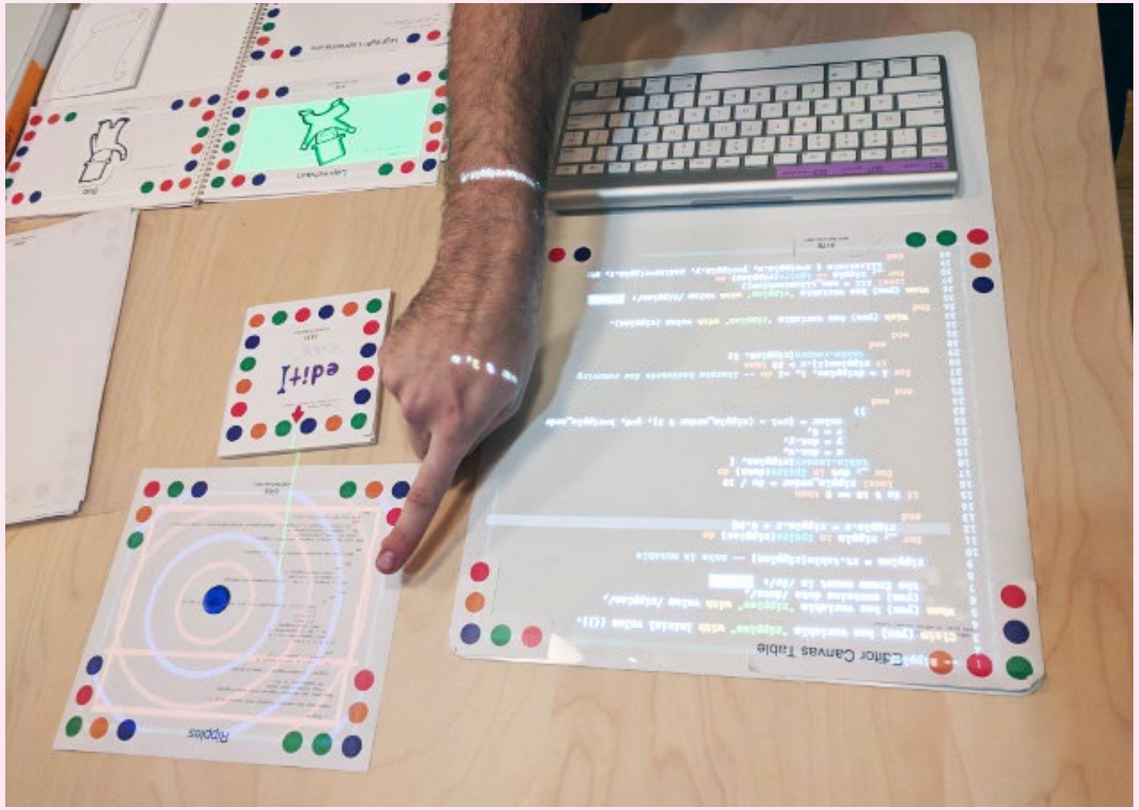
2015

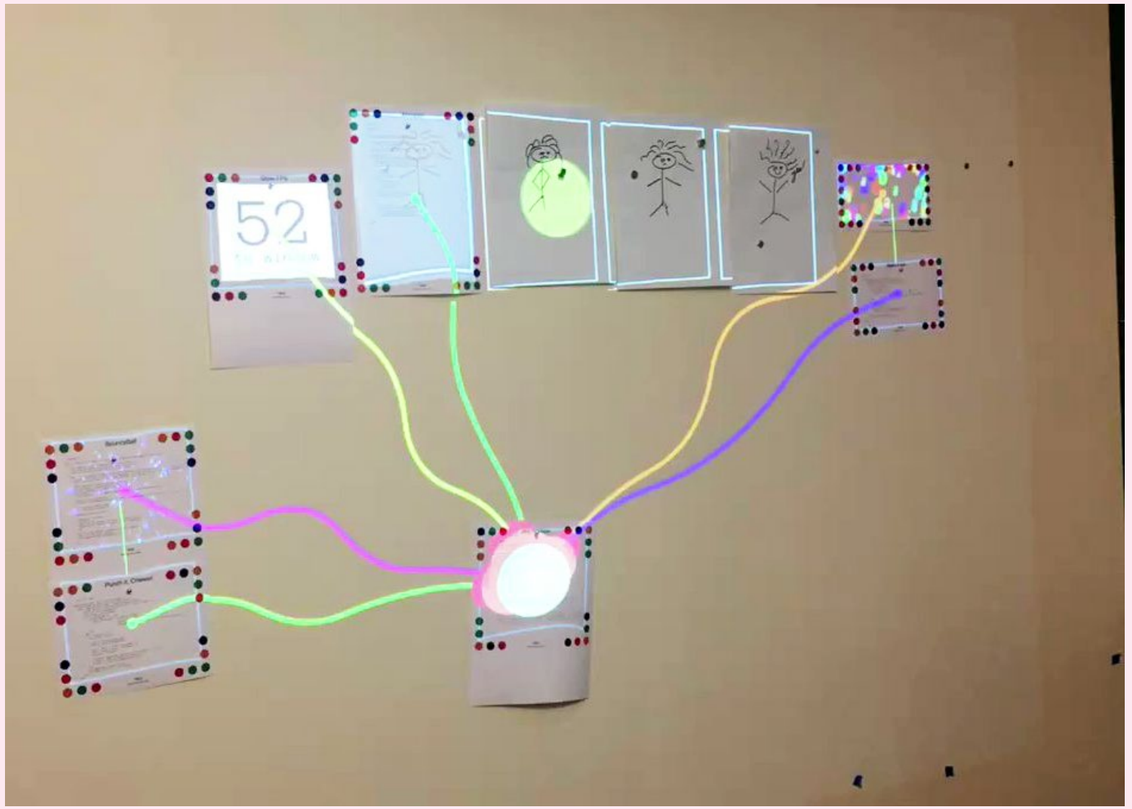


Ira Winder and Joshua Fabian at the MIT Media Lab (Changing Places Group)

Dynamicland

2017-Today





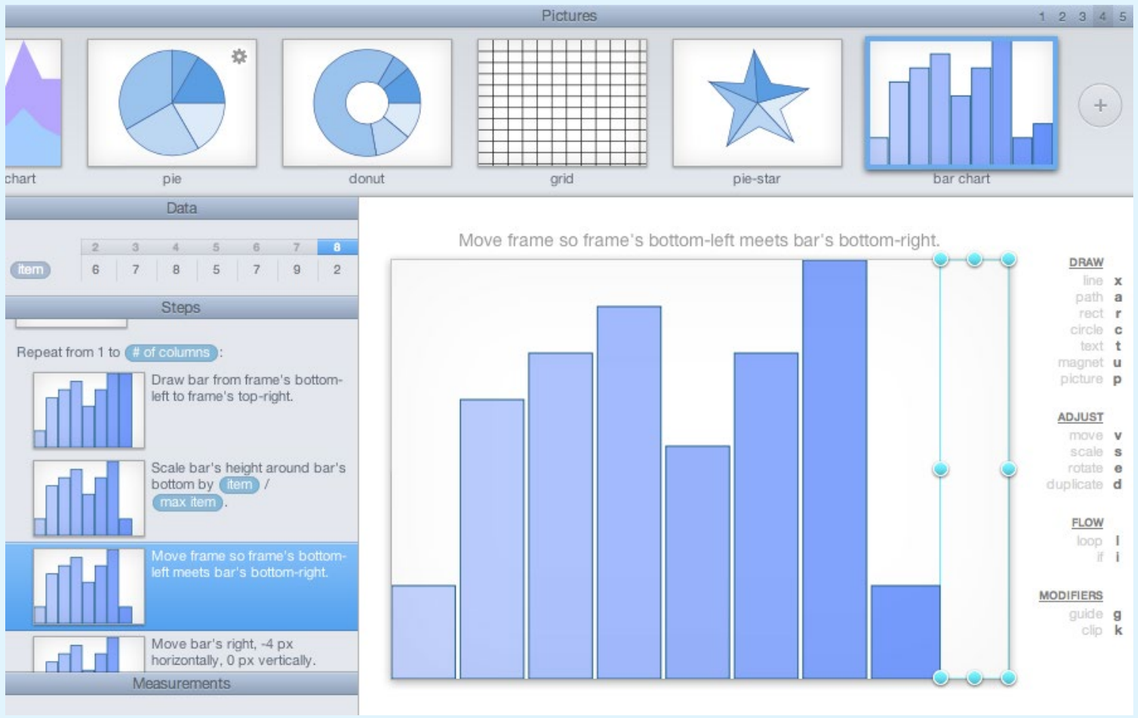
Bret Victor and Others at Y Combinator Research's Human Advancement Research Community

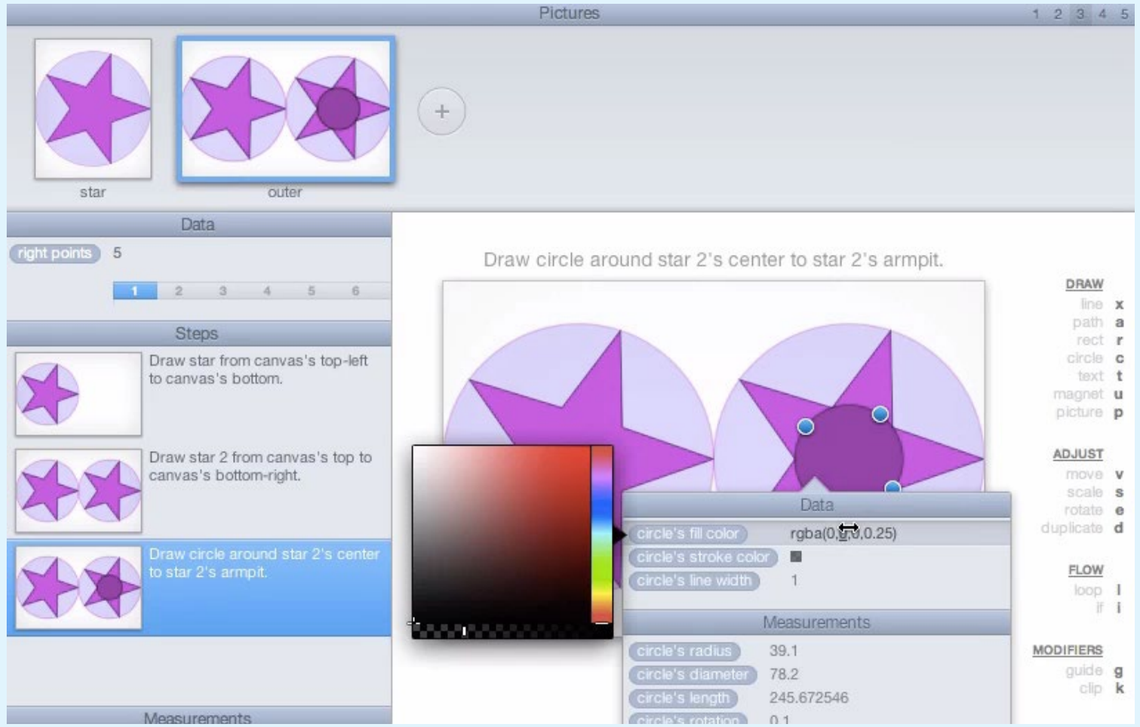
Dynamic Diagram Experiments

Direct-Manipulation + Symbolic Relationships

Drawing Dynamic Visualizations

2013

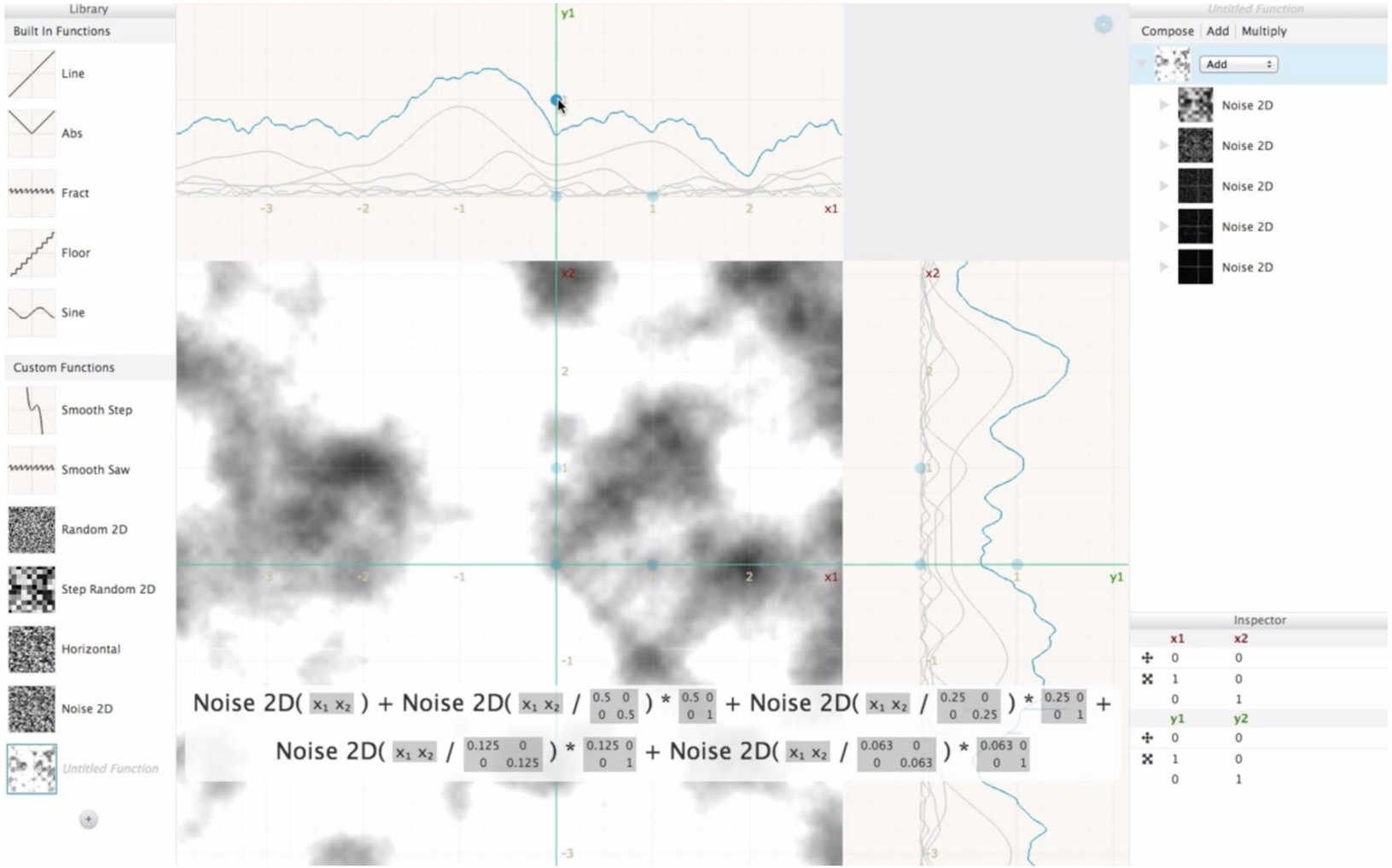




Bret Victor

ShaderShop

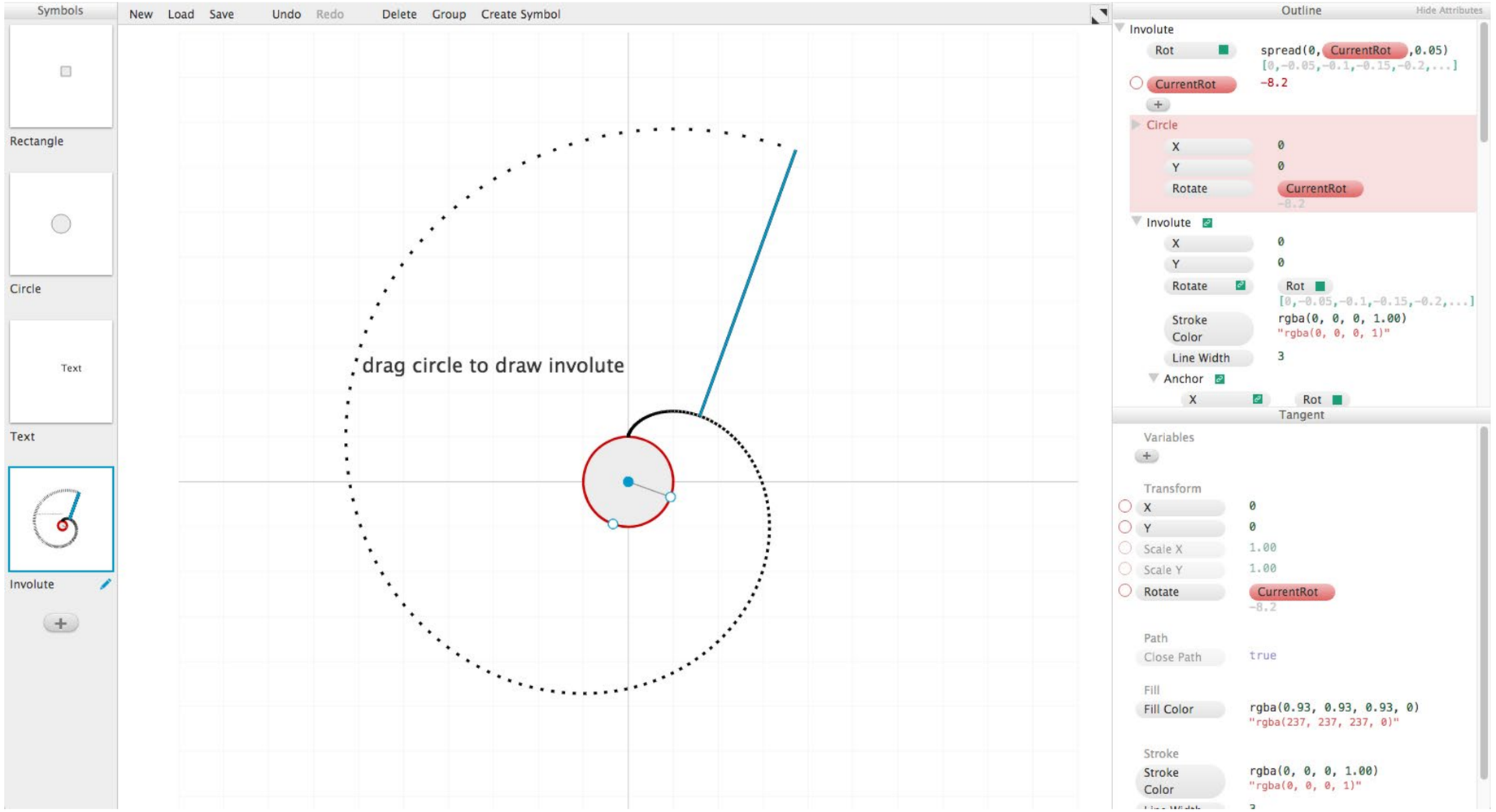
2014



Toby Schachman for Communication Design Group at SAP

Appaaratus

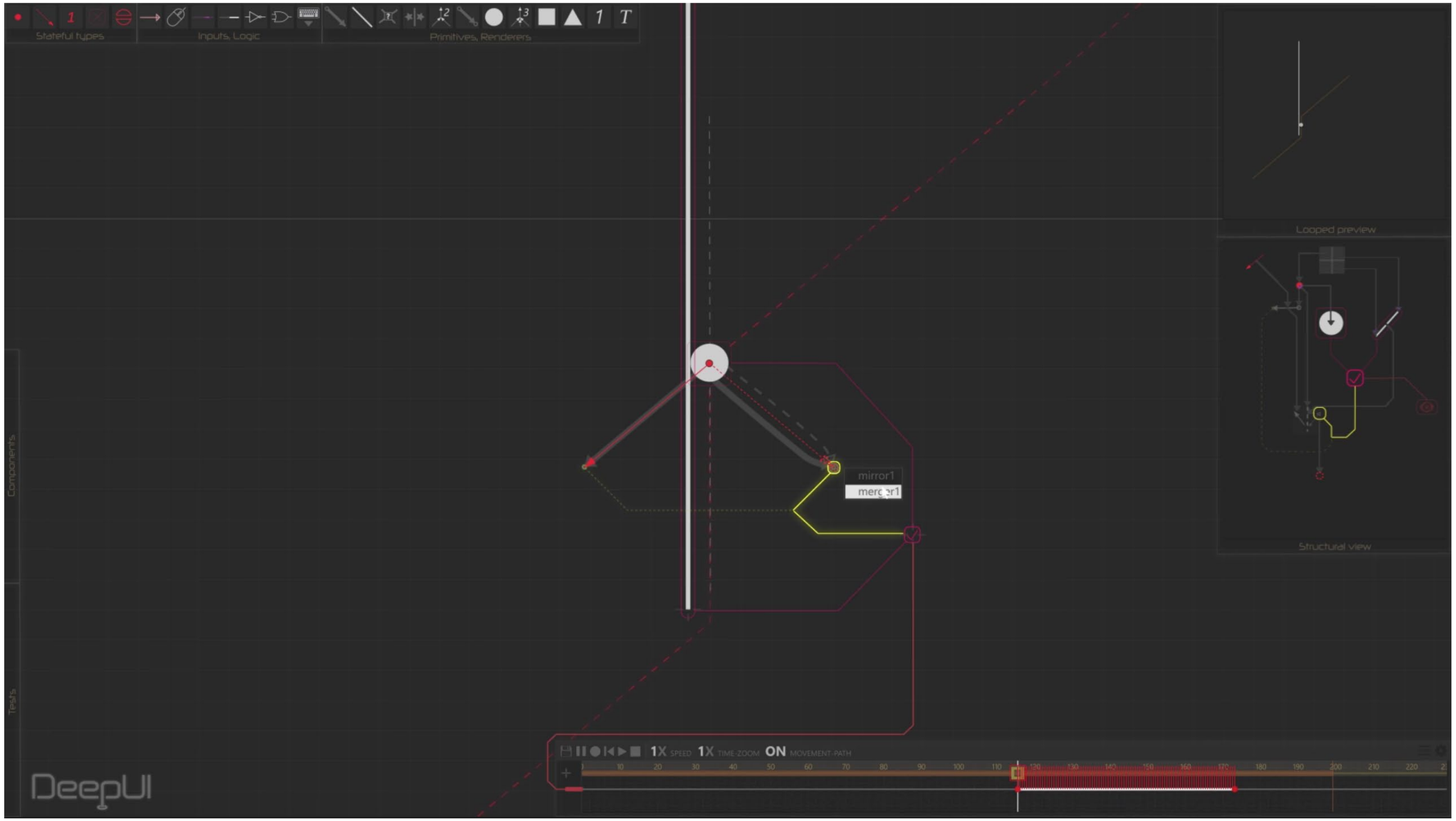
2015



Toby Schachman for Communication Design Group at SAP

DeepUI

2017



Arnold Lagler

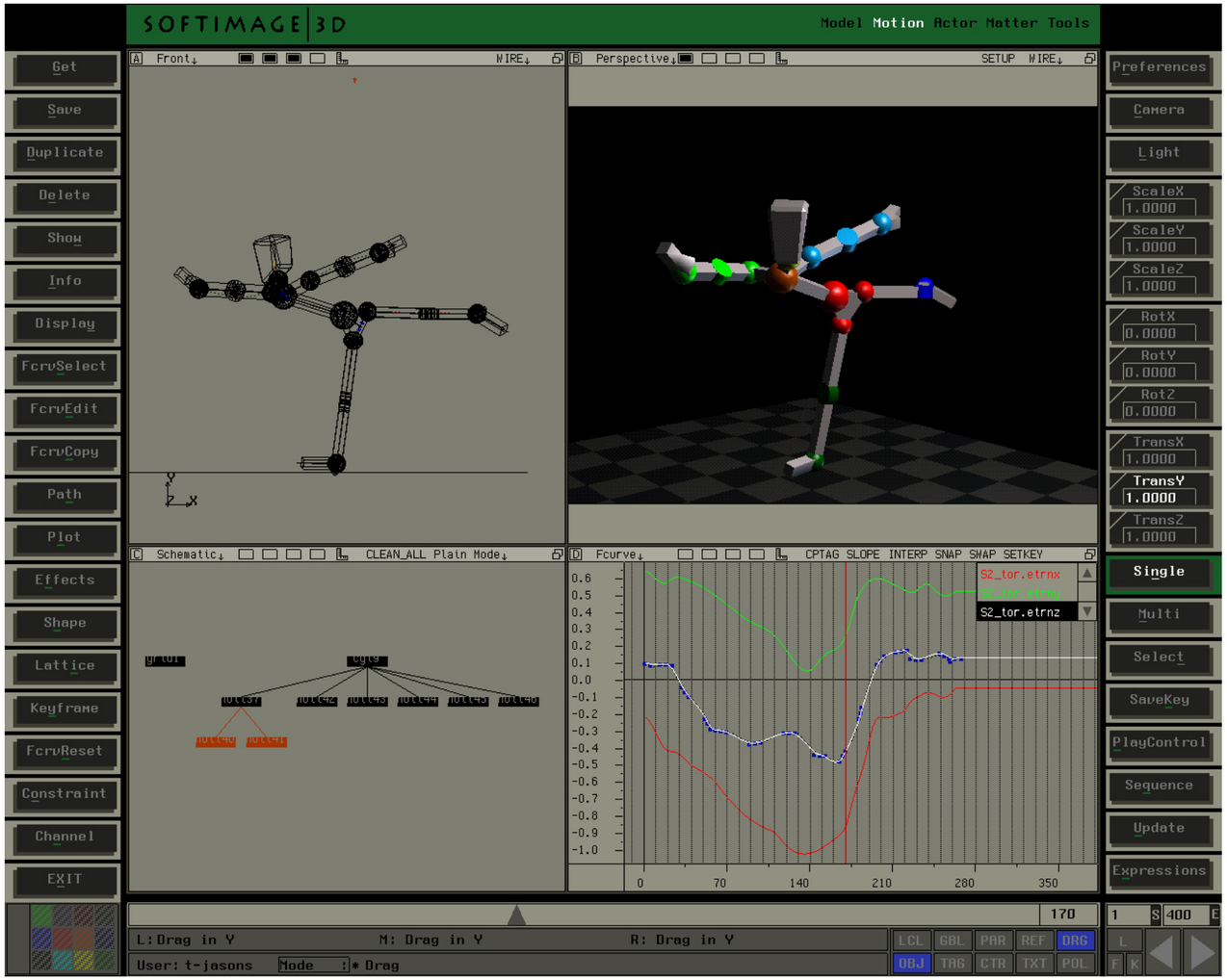
Learning From/Within Cyberspace

How Game-Tech is enabling the Next Wave

3D (Mesh/NURBs) Creation Suites

Softimage 3D

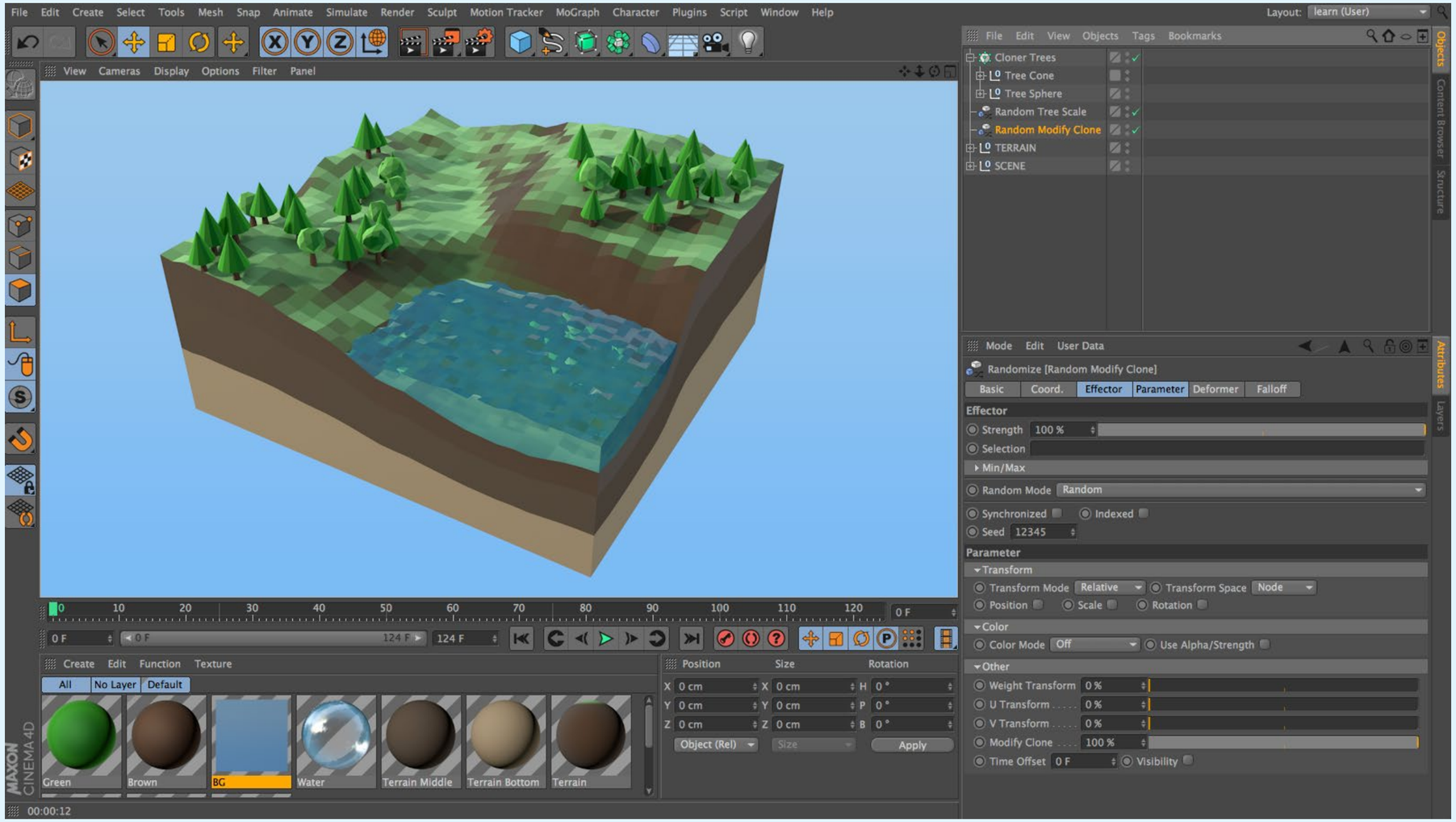
1988-2001



Softimage, Co.

Cinema 4D

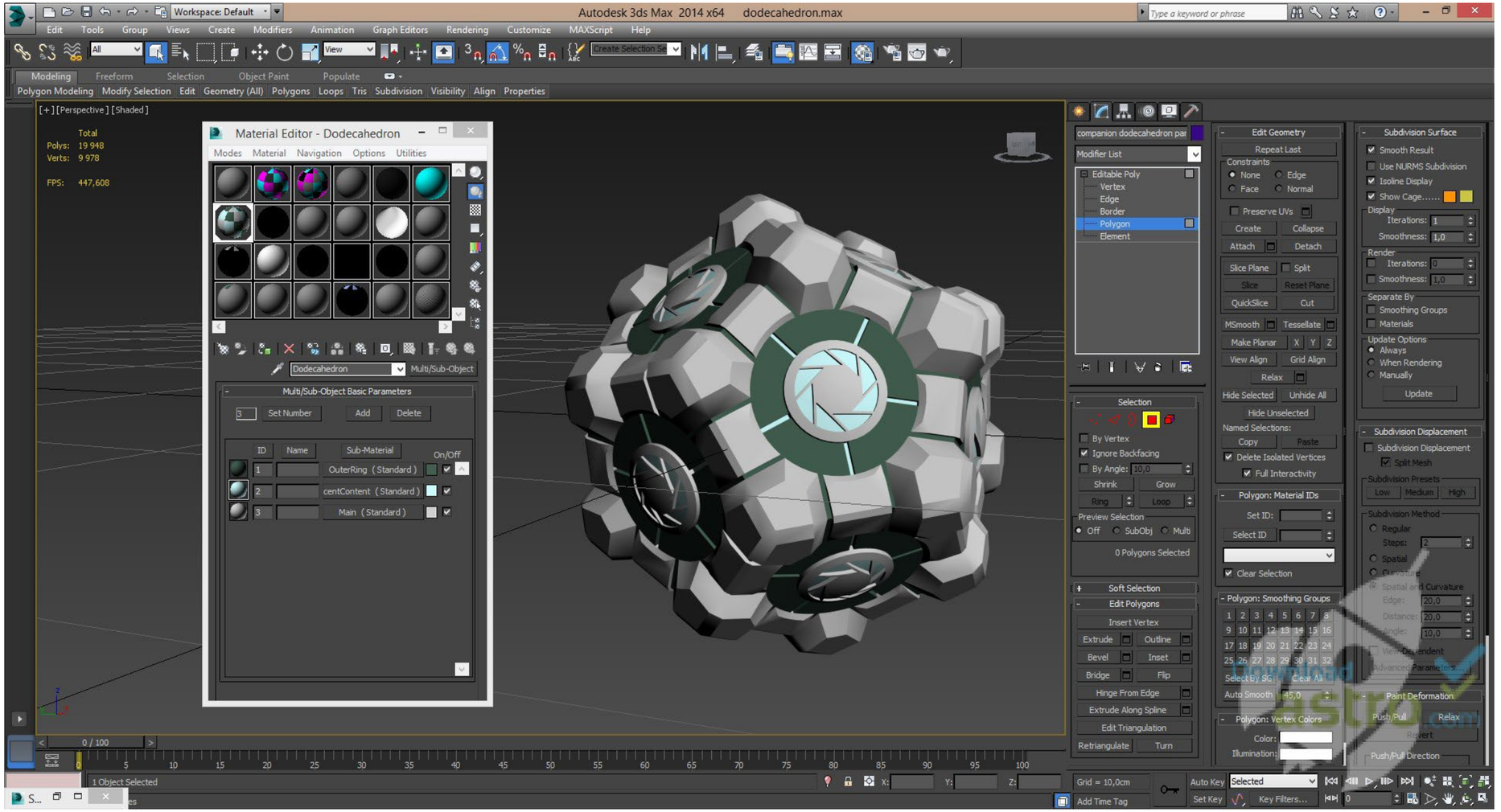
1990-2001



MAXON Computer GmbH

3DS Max

1996-Today



Autodesk

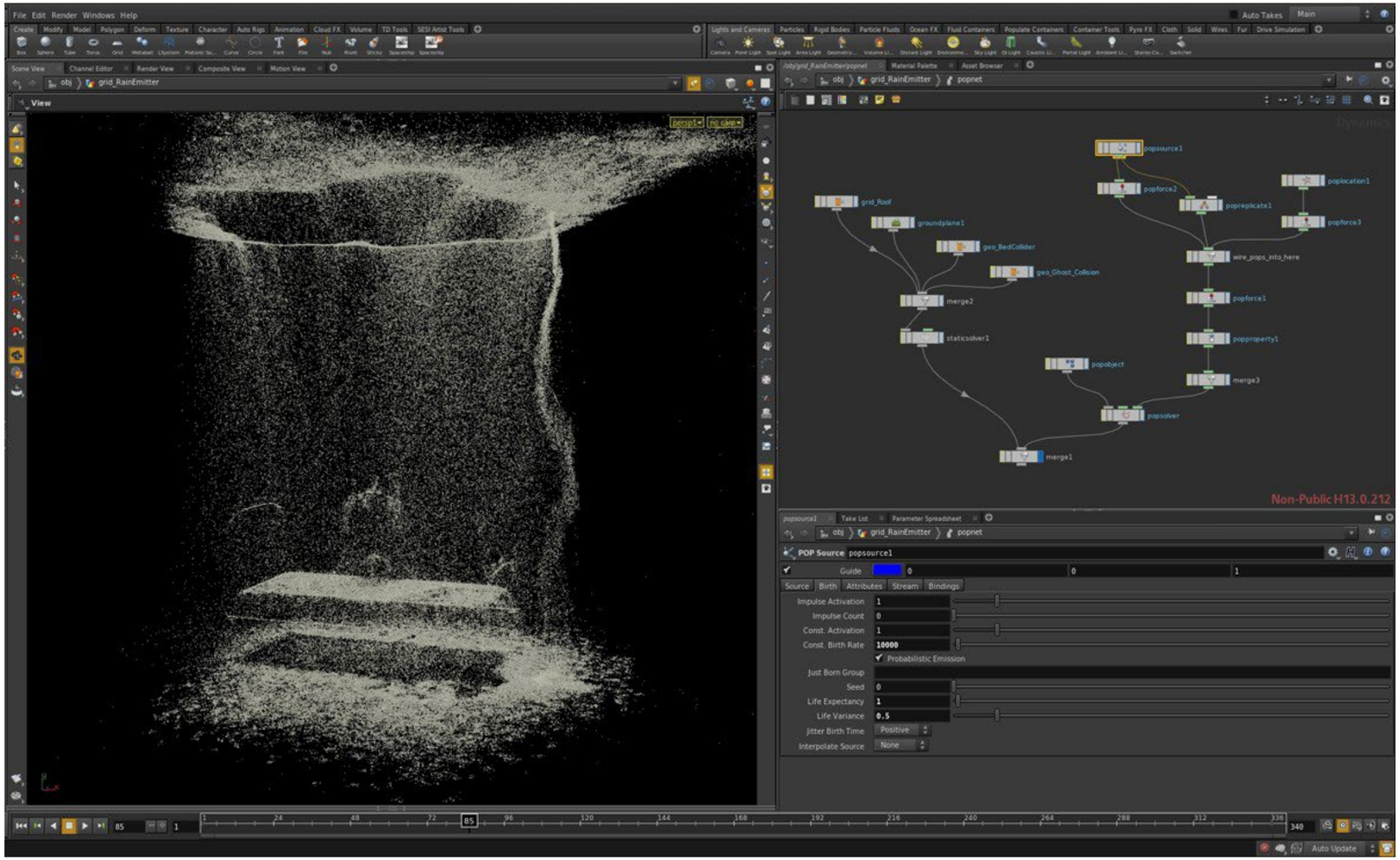
Shake

1997-2008

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

Houdini

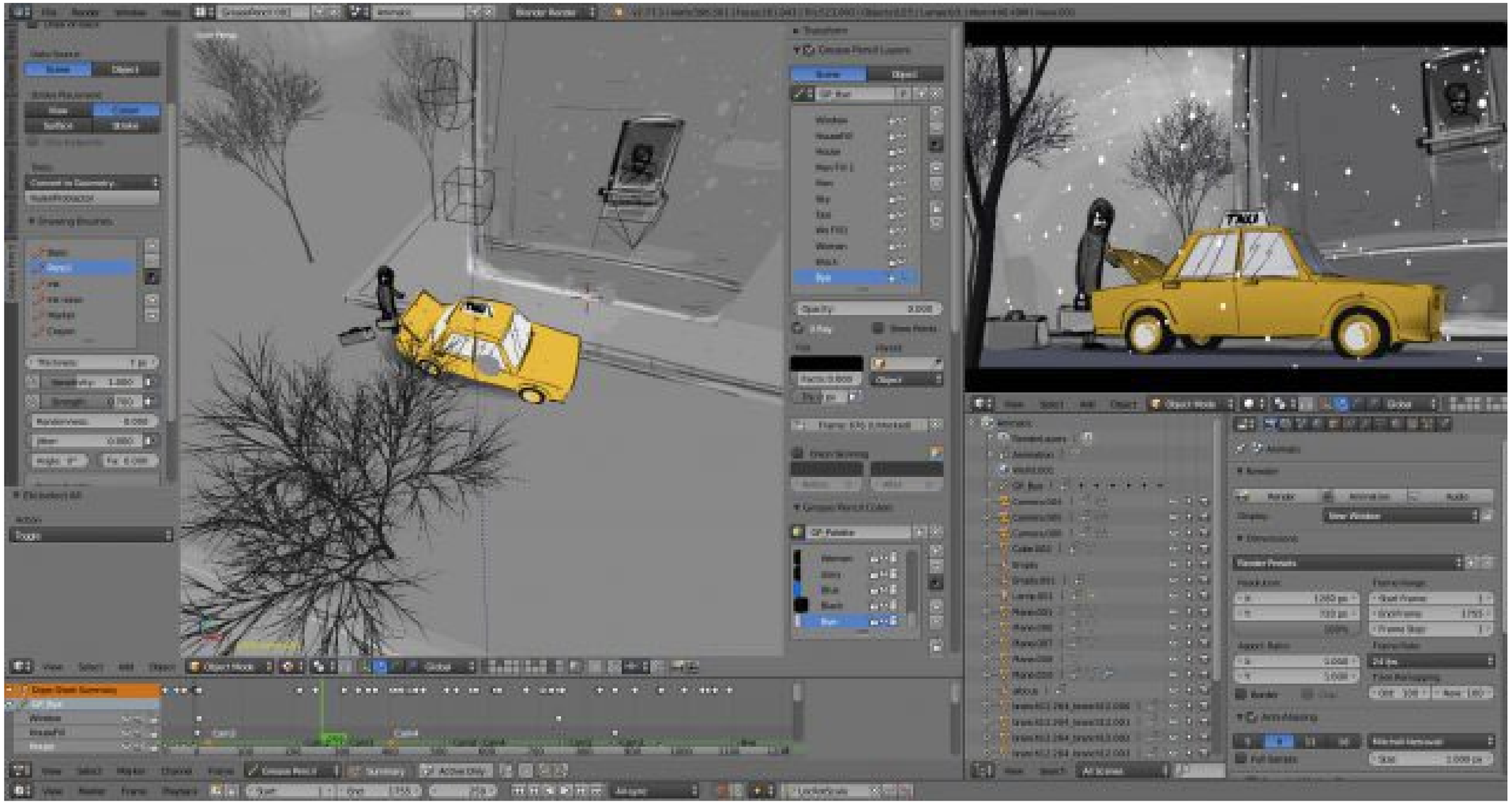
1996-Today



Side Effects Software Inc

Blender

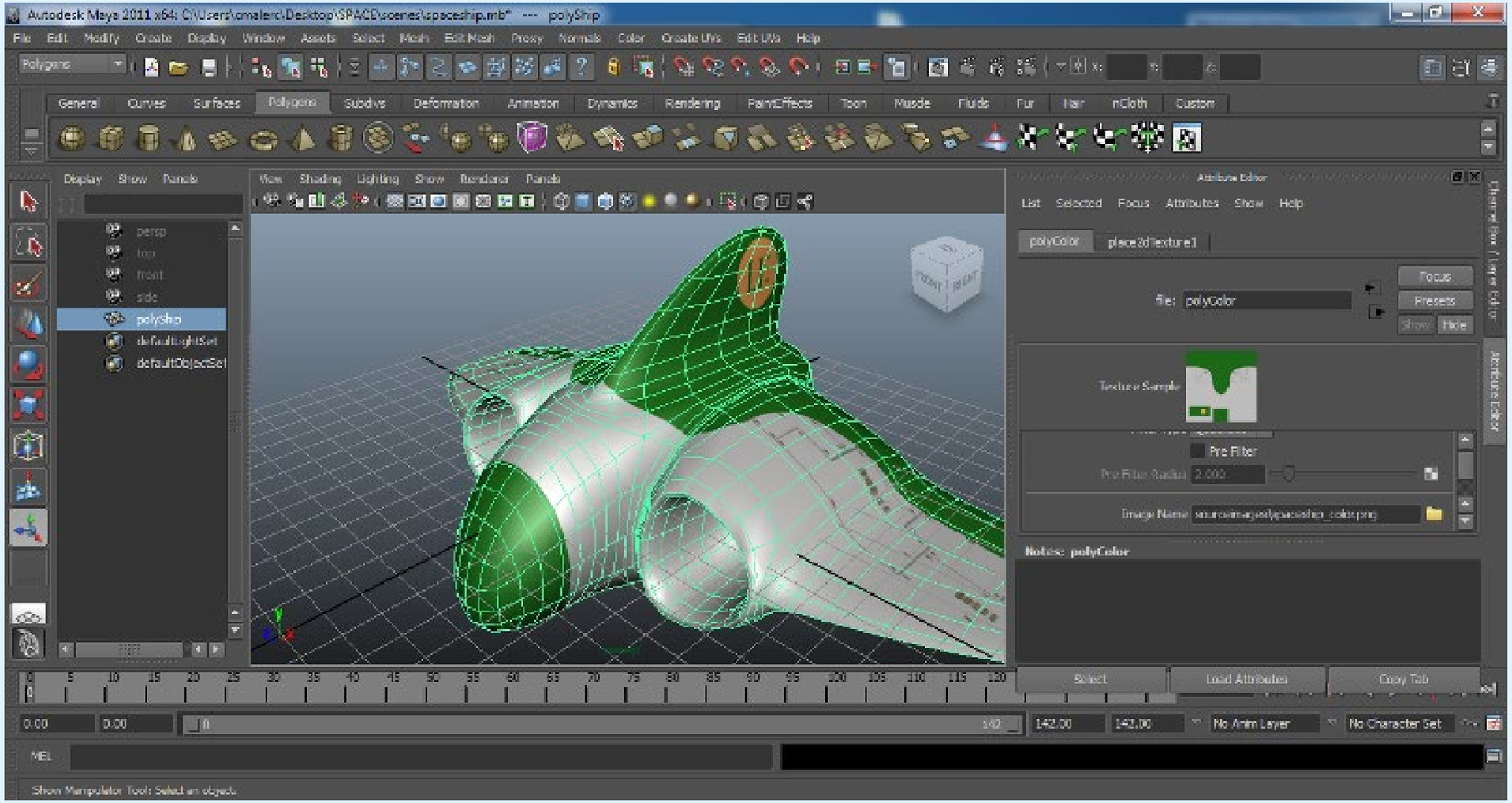
1998-Today



Blender Foundation

Maya

1998-Today



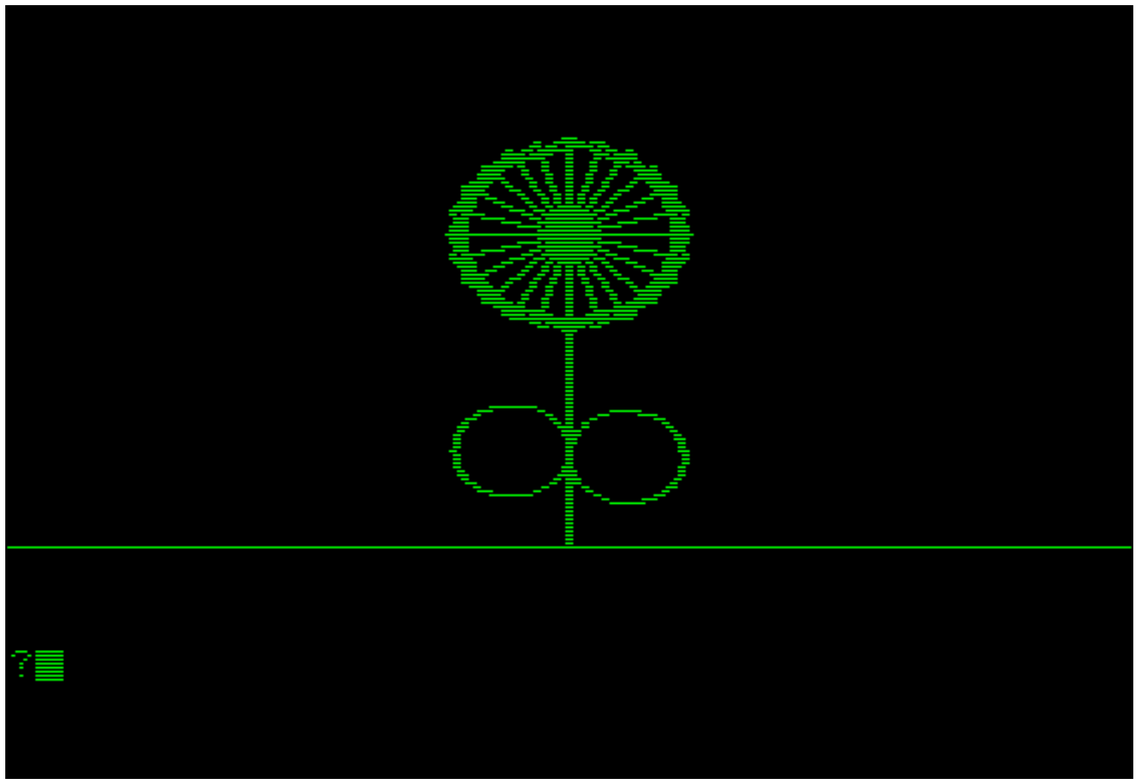
Alias Systems Corporation (Later Autodesk)

Learnable Programming

Offers a ‘Gentle Introduction’

LOGO

1967-

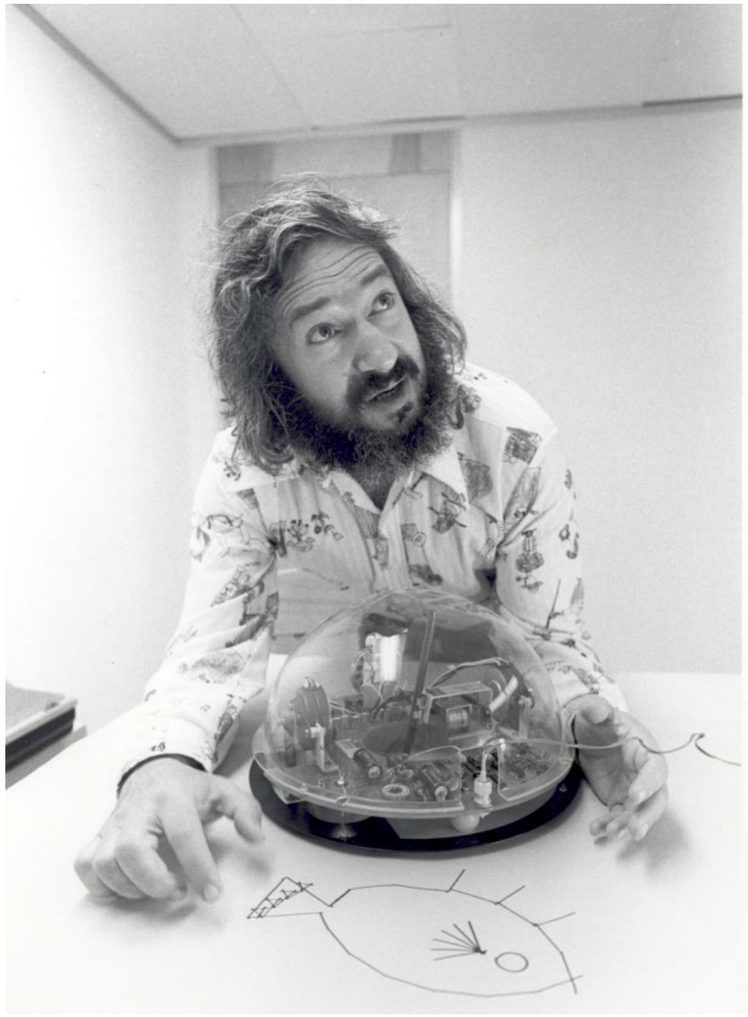


```
TO BOAST
PRINT [WHO'S THE GREATEST?]
IF REQUEST = [MR. SYD LEXIA] THEN PRINT
 [OF COURSE!] STOP
PRINT [TRY AGAIN]
BOAST
END

TO CHAT
PRINT [WHAT'S YOUR NAME?]
PRINT SE [HELLO] REQUEST
PRINT [TYPE SOMETHING YOU LIKE]
PRINT SE [I'M GLAD YOU LIKE] REQUEST
END

TO TIME
PRINT [EXCUSE ME, WHAT TIME IS IT?]
MAKE "TIME REQUEST
<PRINT :TIME [I'M LATE!]>
PRINT [SEE YOU LATER.]
END
```

Wally Feurzeig, Seymour Papert, Cynthia Solomon at MIT

Turtle

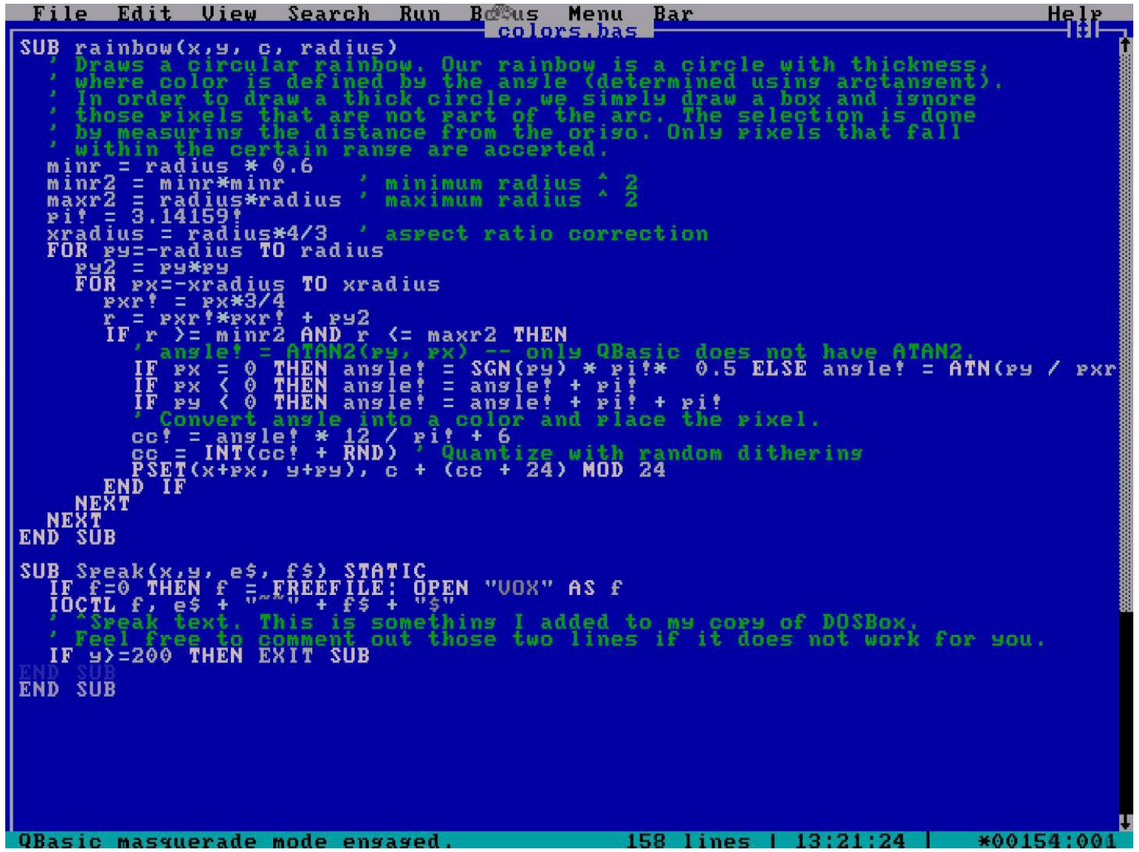
1969



Seymour Papert and Others at the MIT Logo Lab

Q-Basic

1991



Microsoft

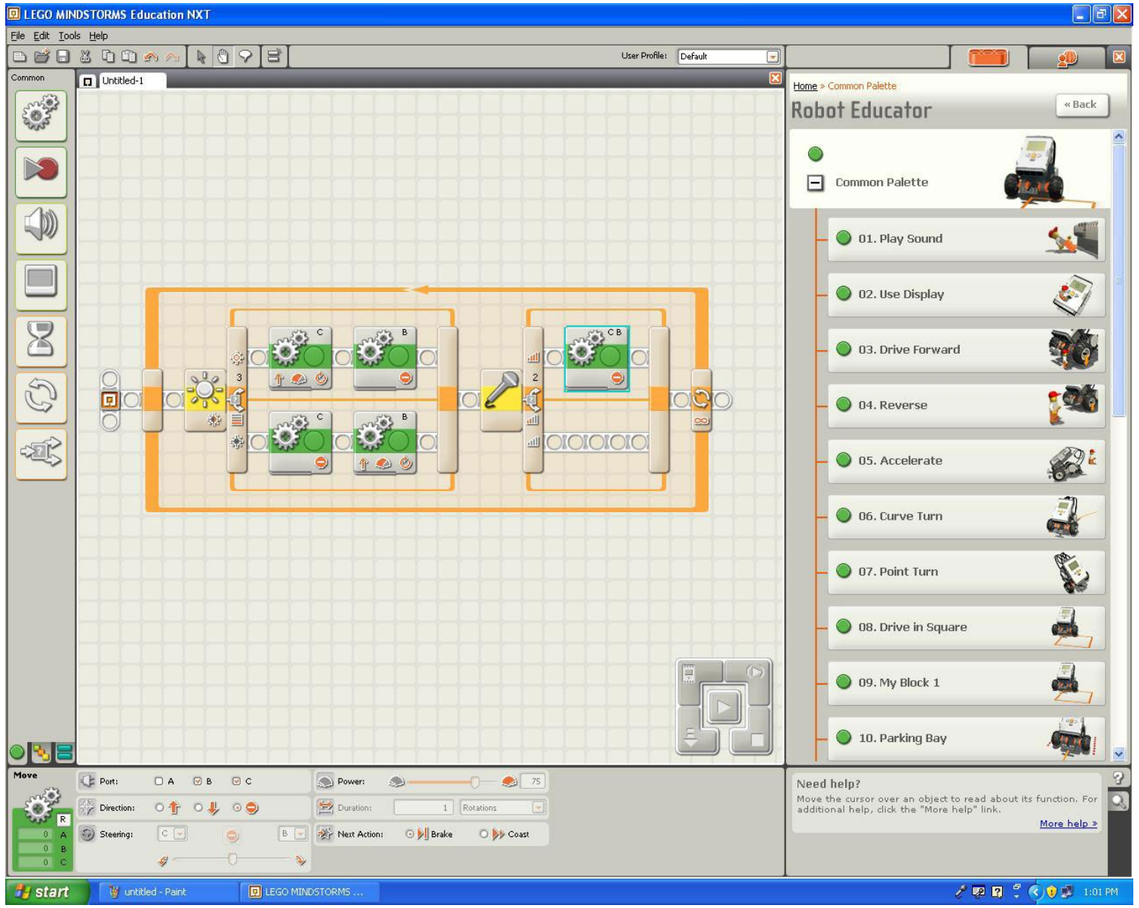
LEGO Mindstorms RCX

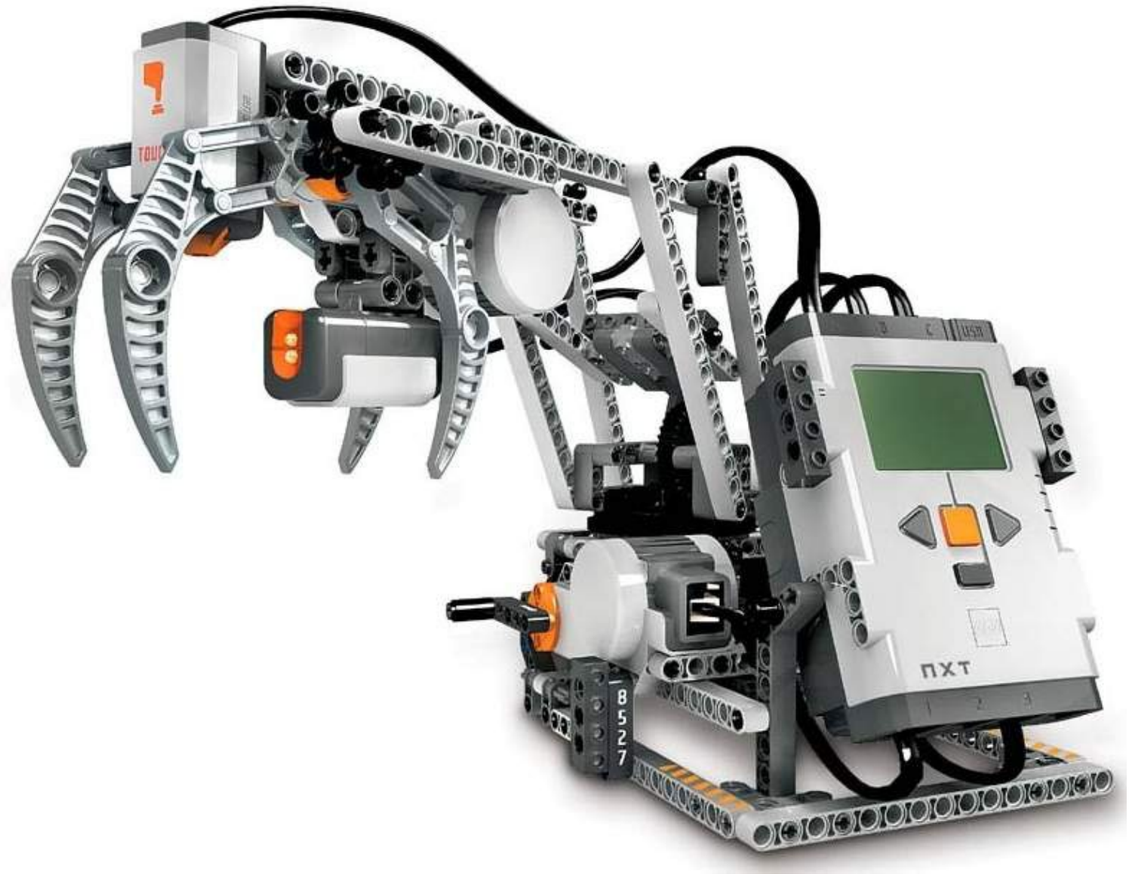
1998-2006

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

LEGO Mindstorms NXT

2006-2013

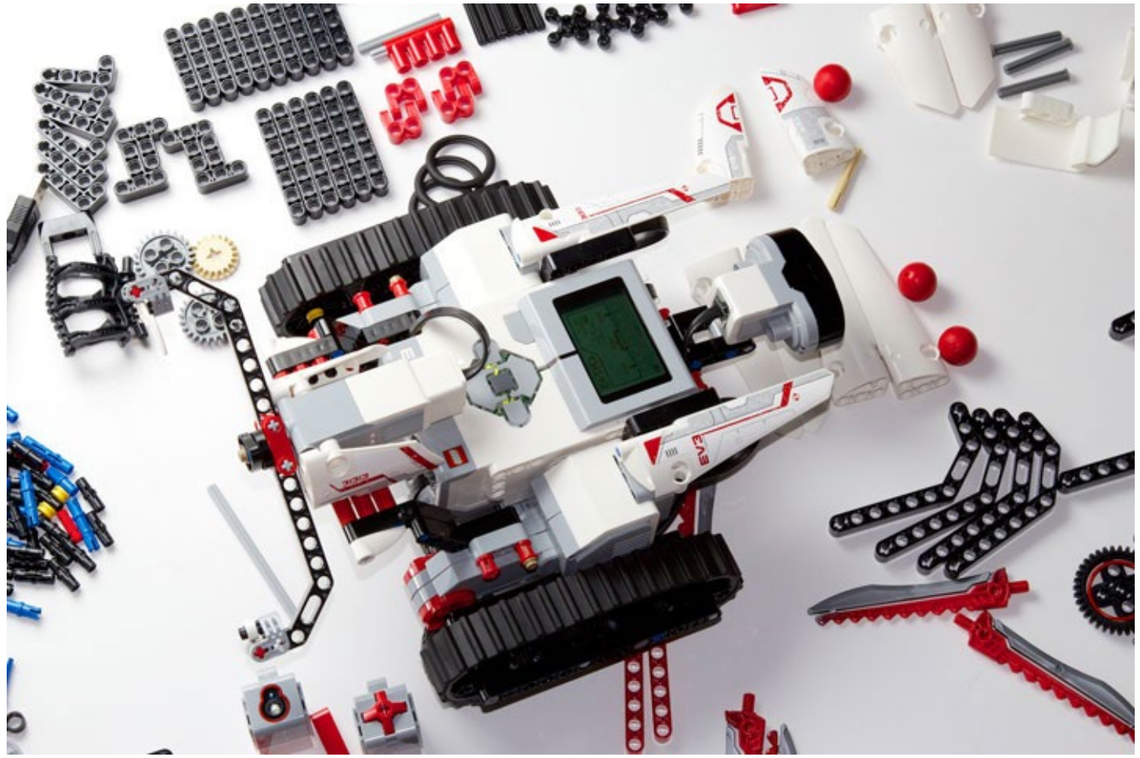




LEGO in Partnership with the MIT Media Lab (Lifelong Learning Group)

LEGO Mindstorms EV3

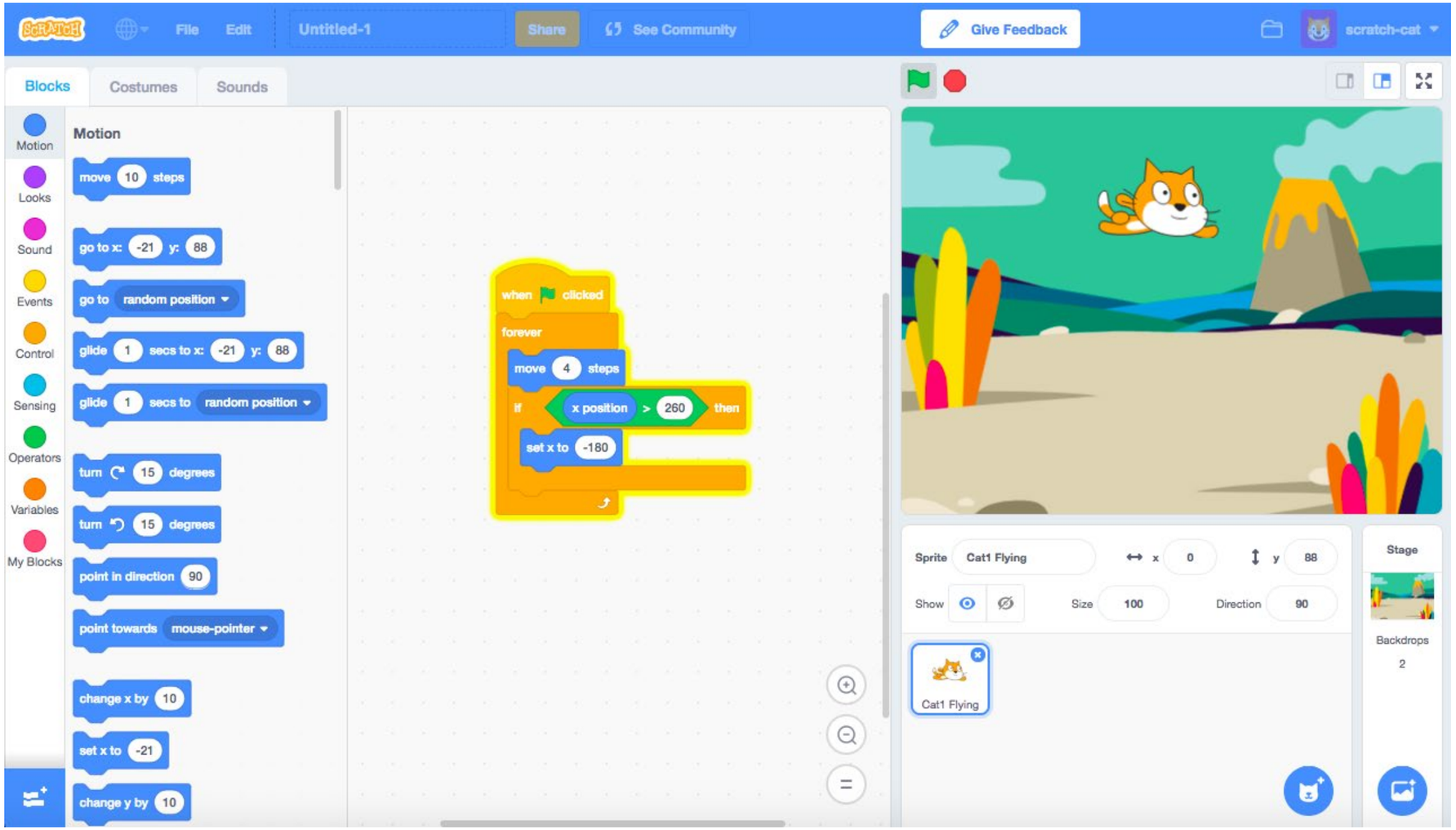
2013-Today



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)

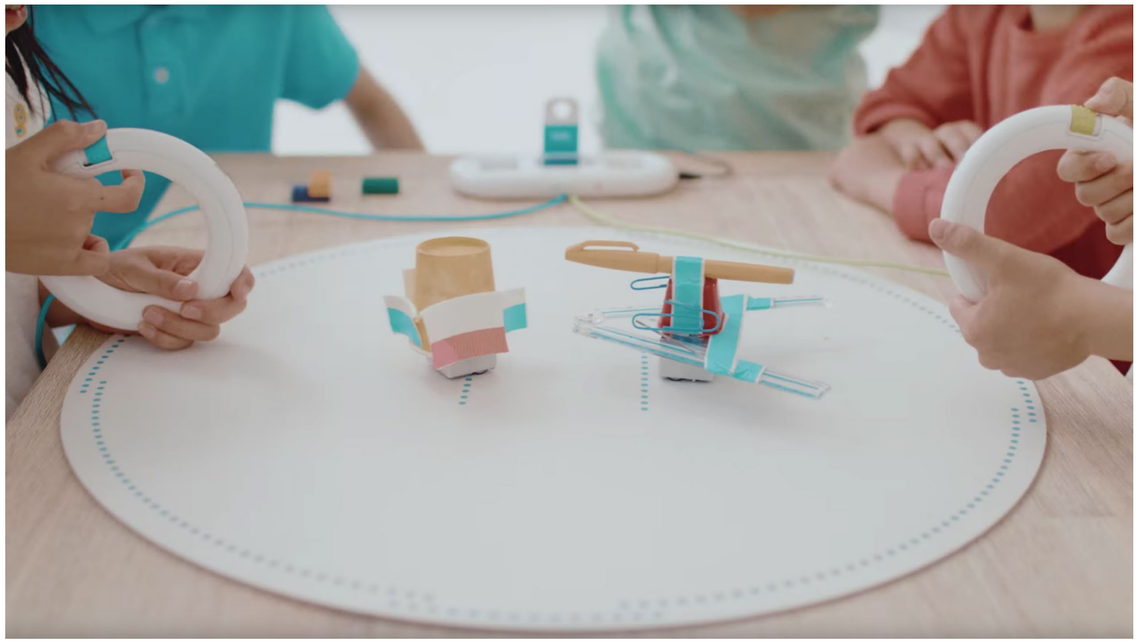
Koov

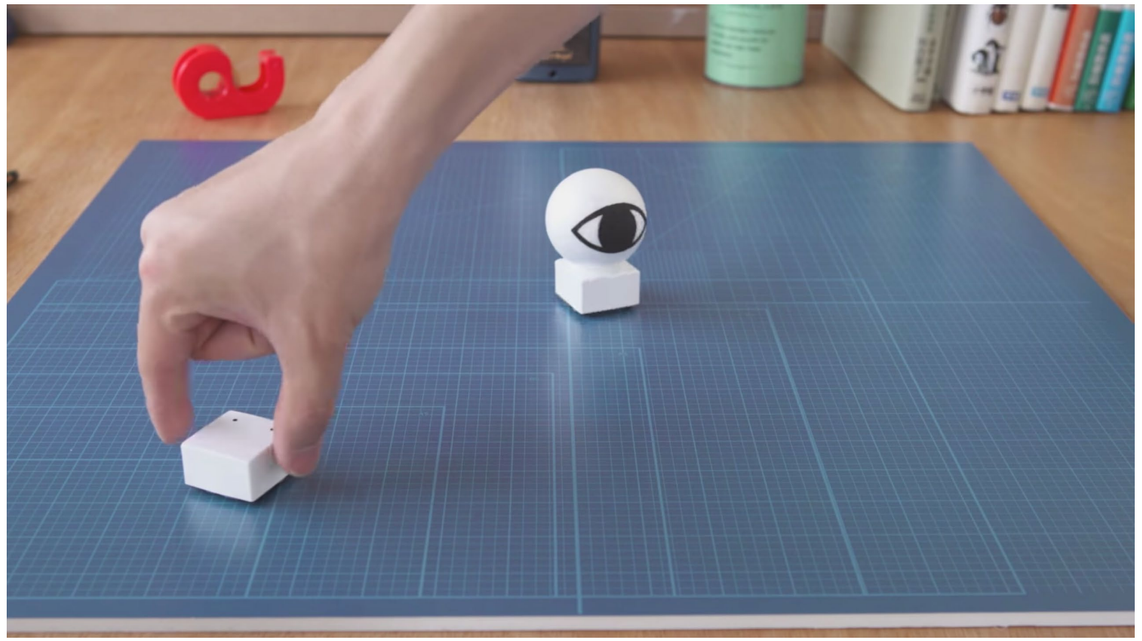
2017-Today

Sony

Toio

2017-Today

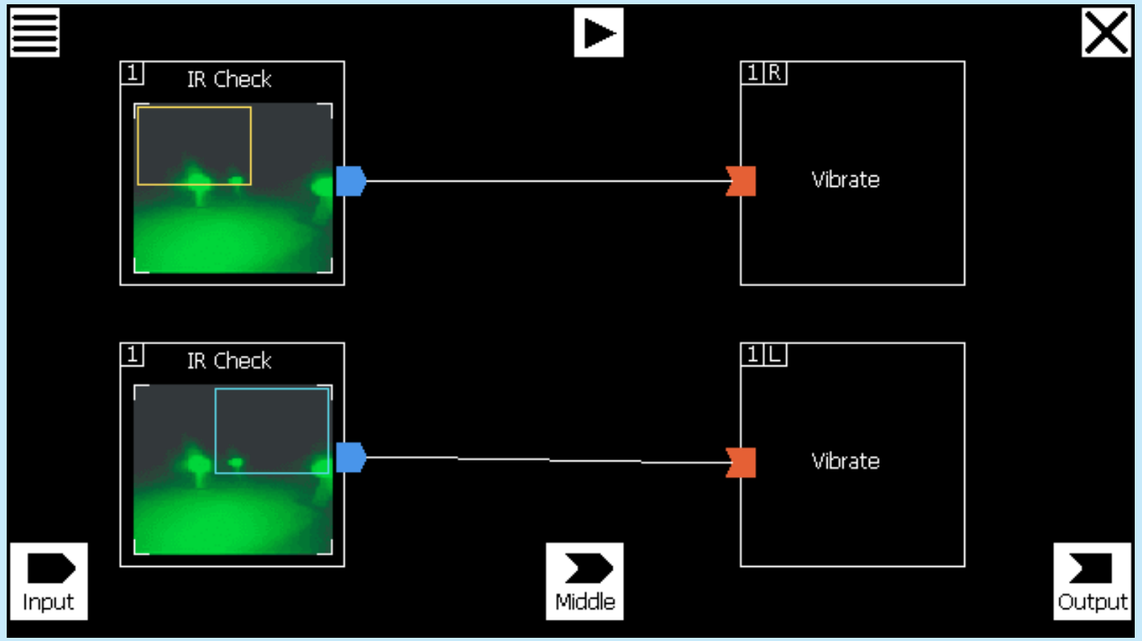




Sony

Joy-Con Garage

2018-Today



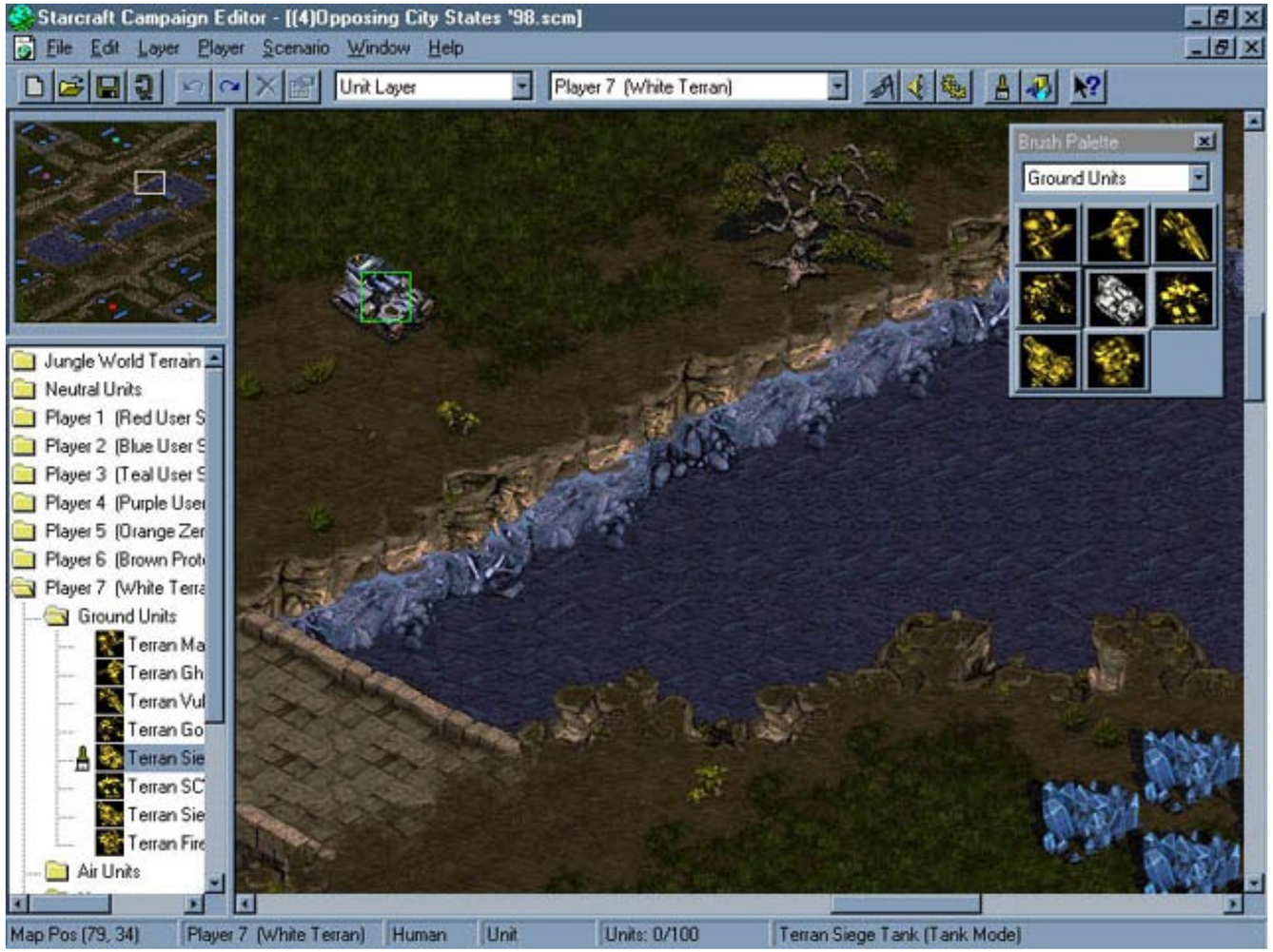
Nintendo

Game Authoring

From video games to VR/AR/MR

StarEdit

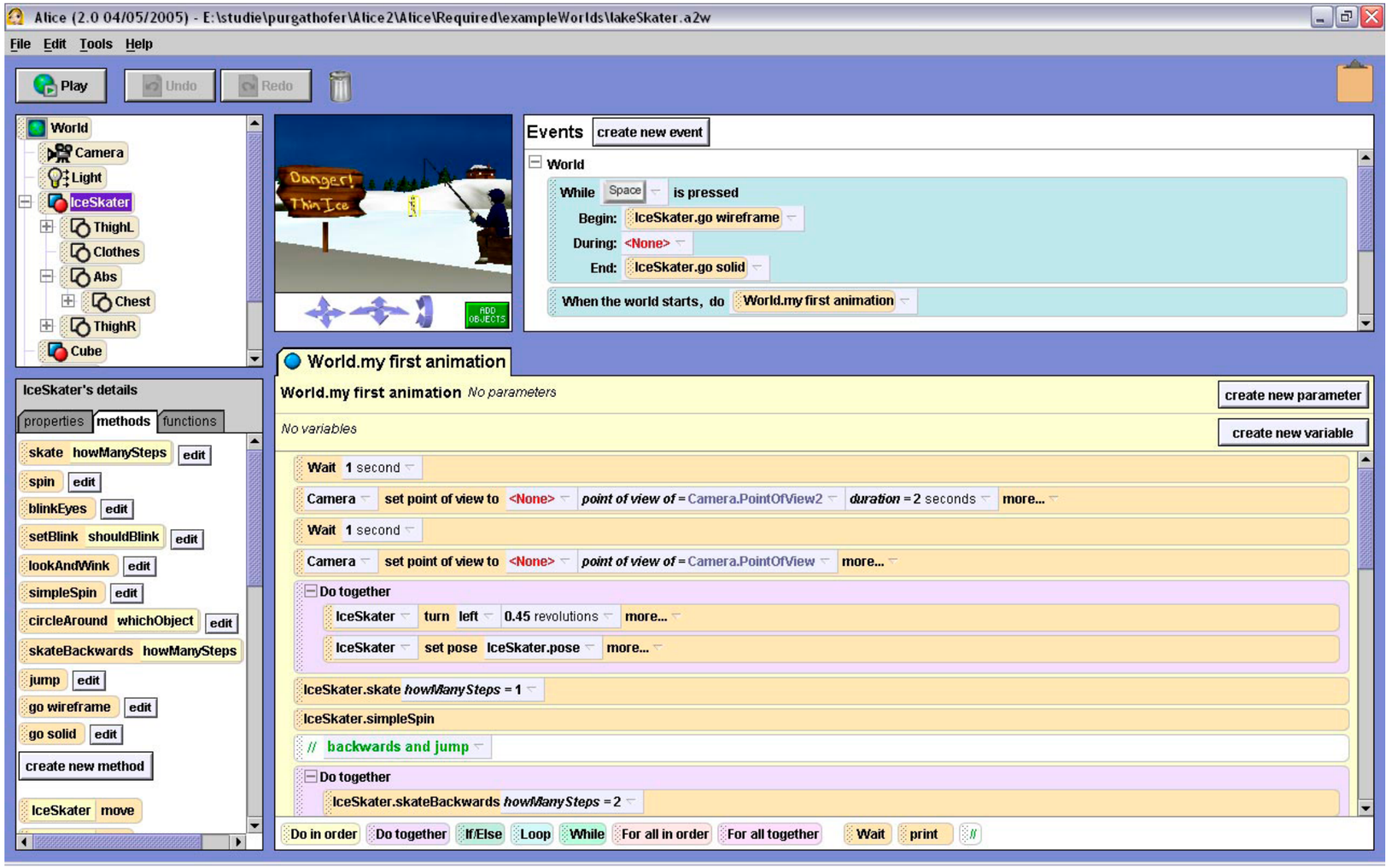
1998



Blizzard Entertainment

Alice

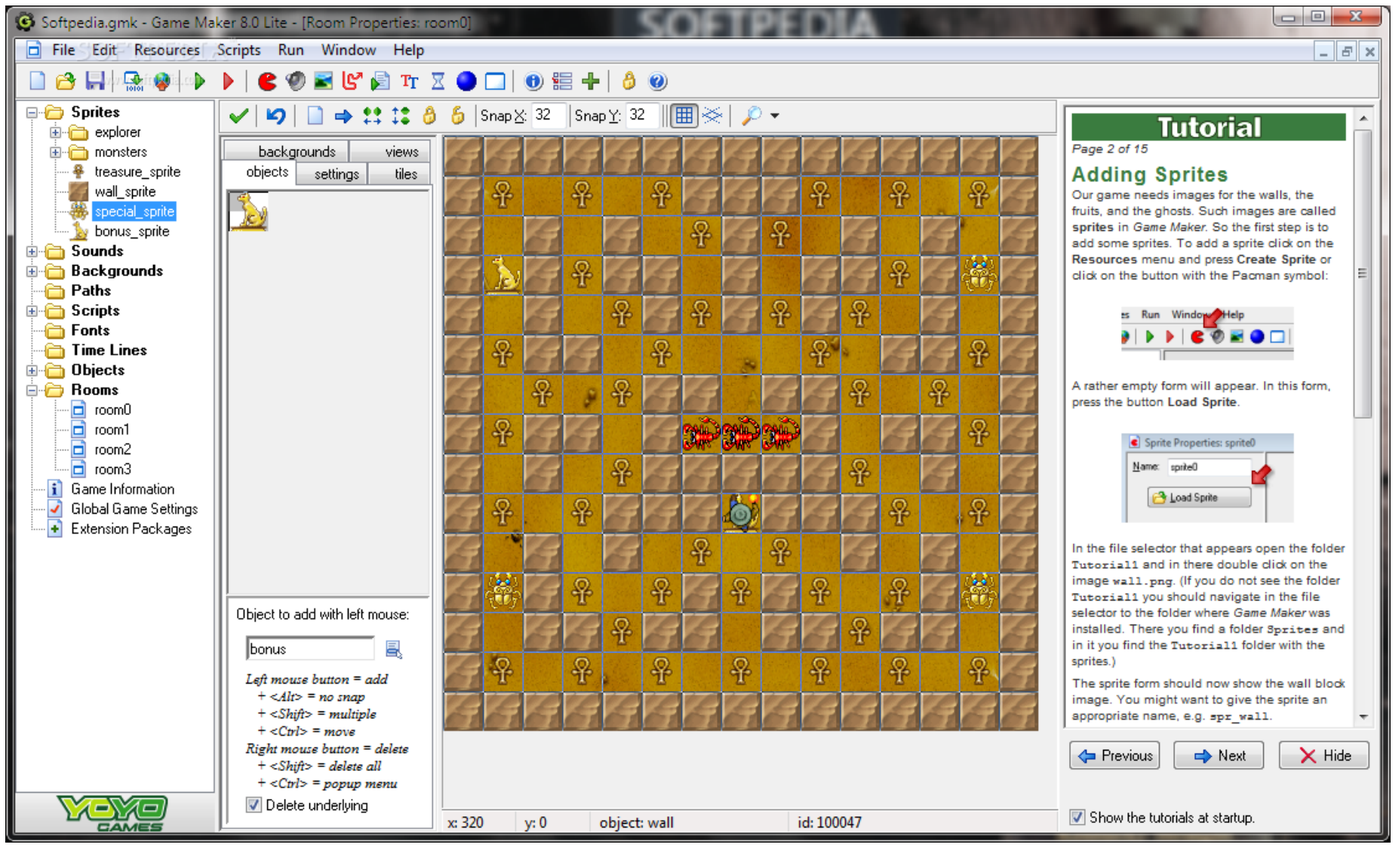
1998-Today

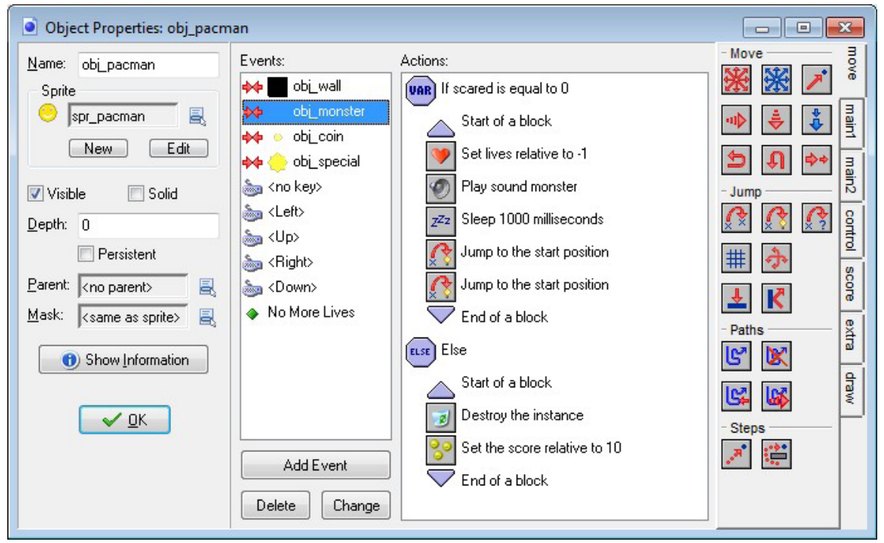


Randy Pausch and Others at Carnegie Mellon University

GameMaker

1999-Today

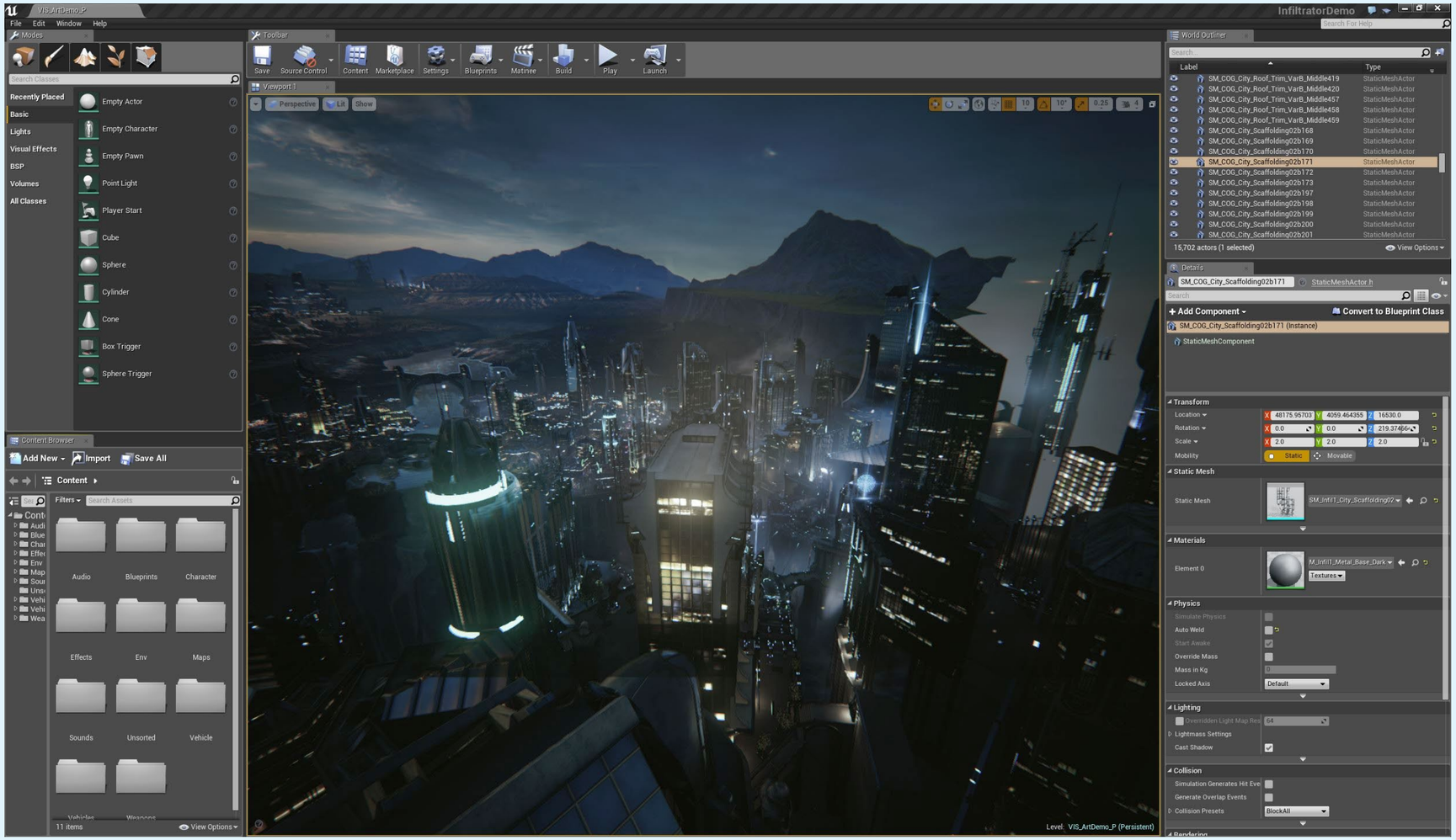




Mark Overmars

Unreal Engine

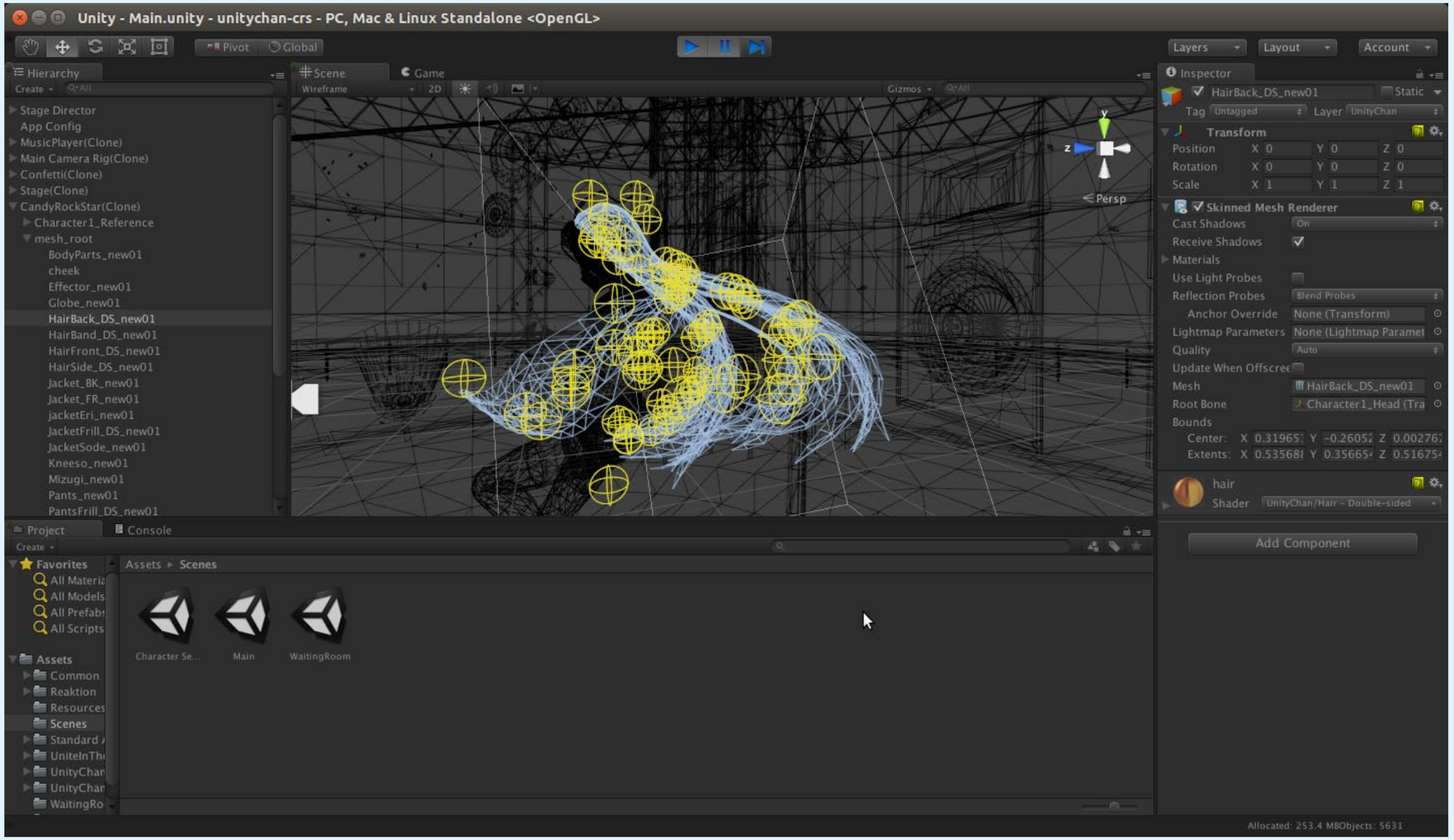
1998-Today



Epic Games

Unity

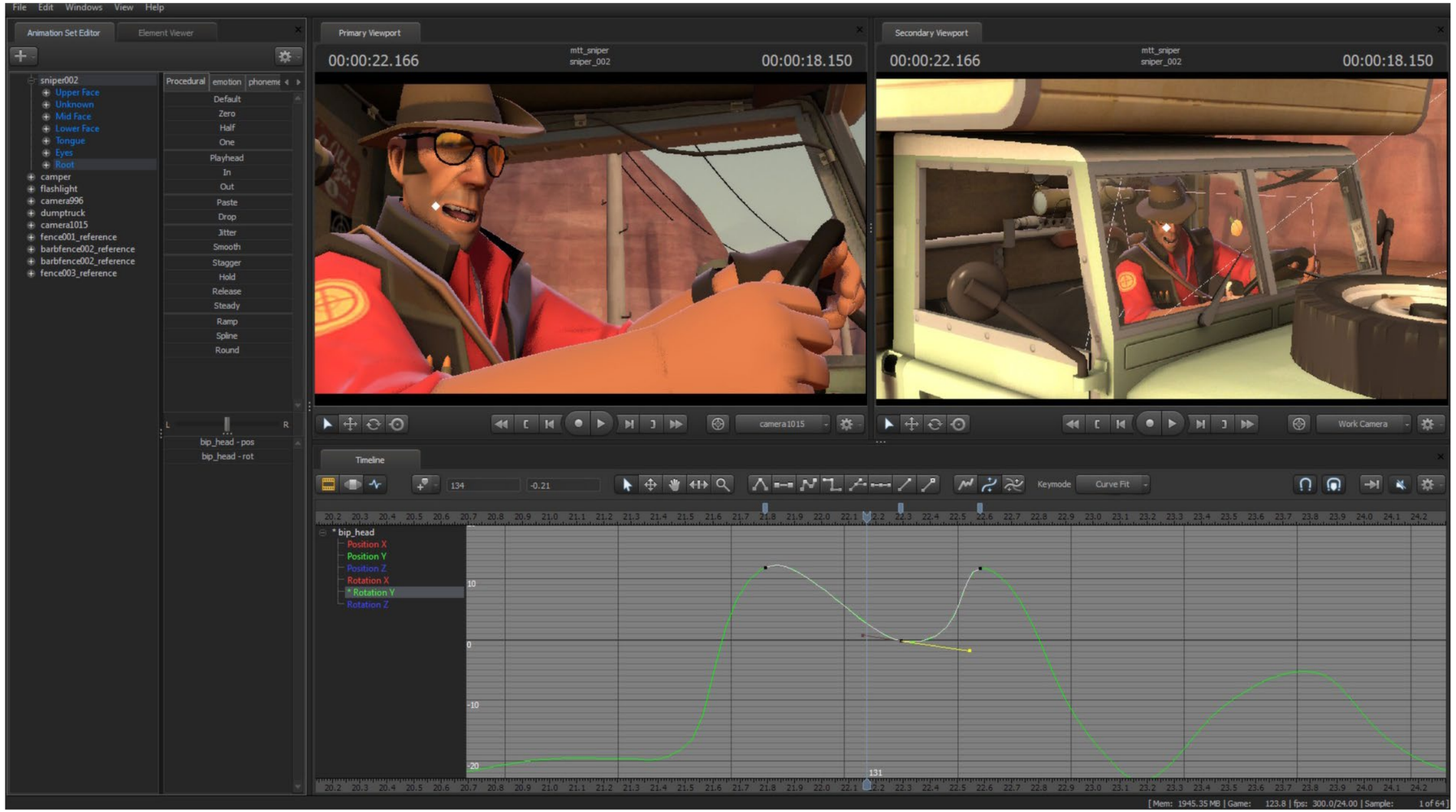
2005-Today



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

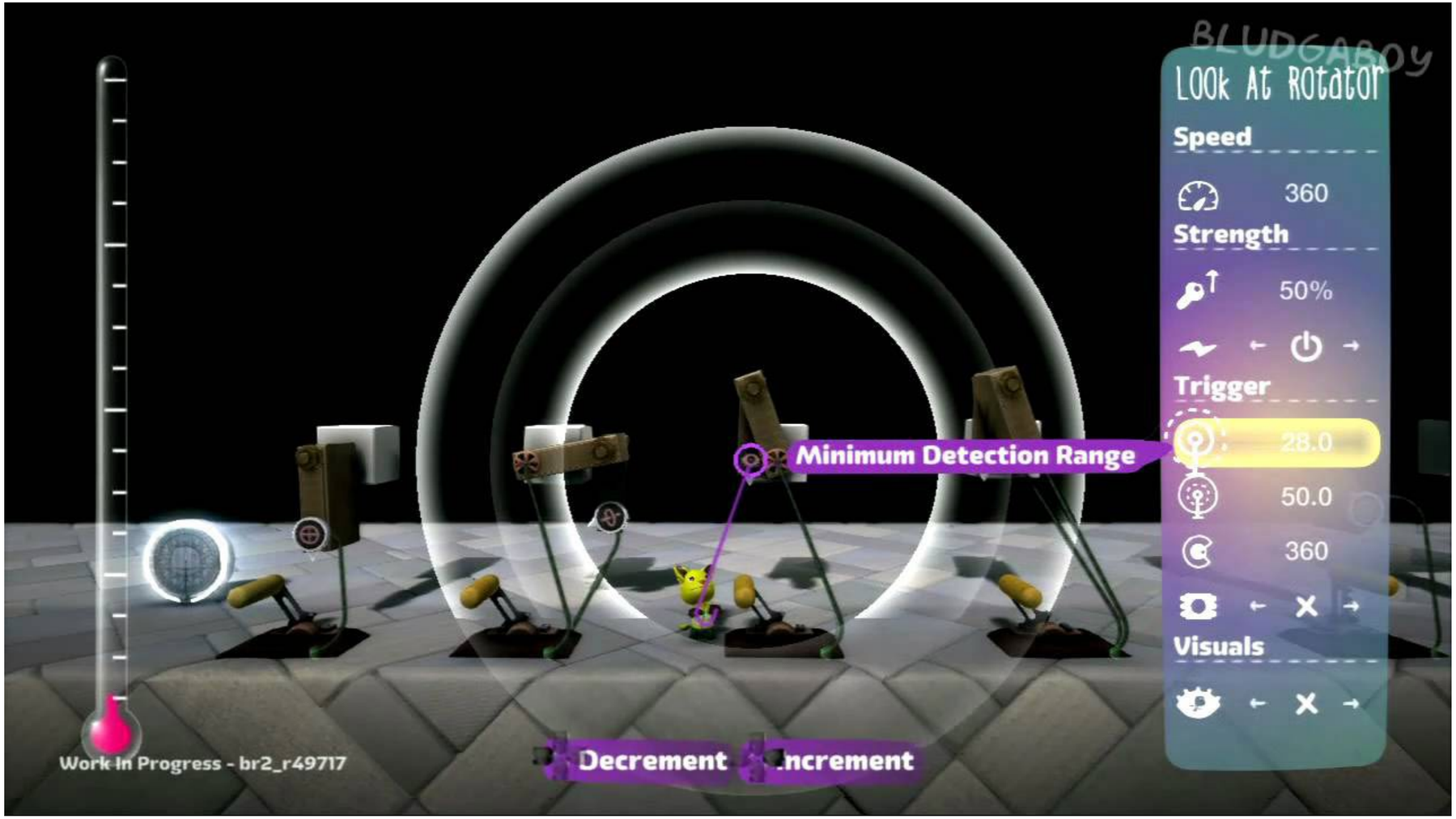
Spore

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

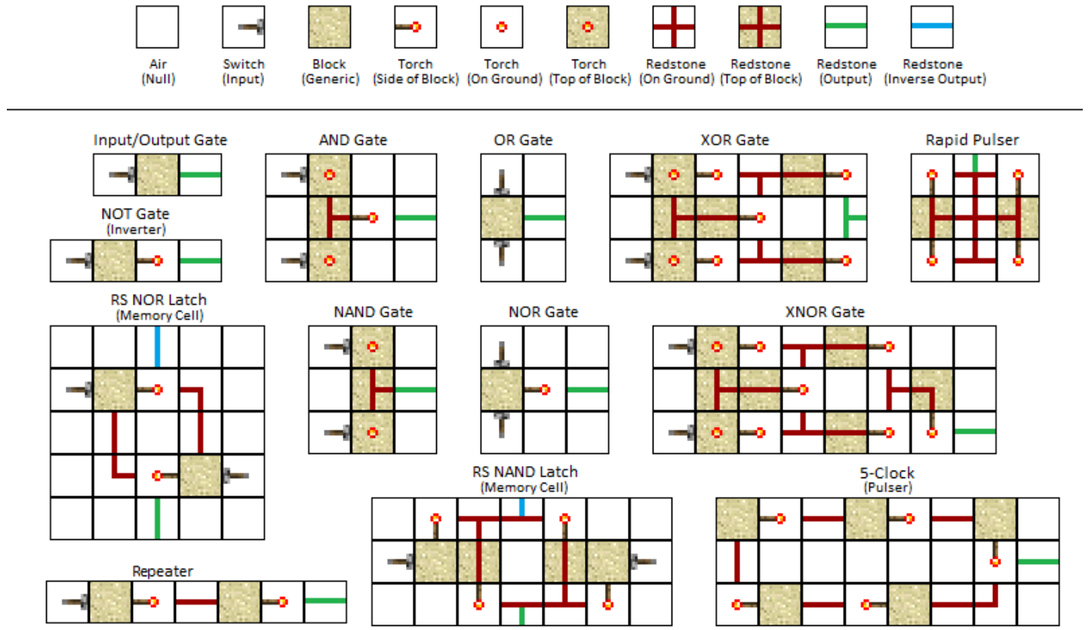
The Incredible Machine (Series)

1993-2011

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

Minecraft

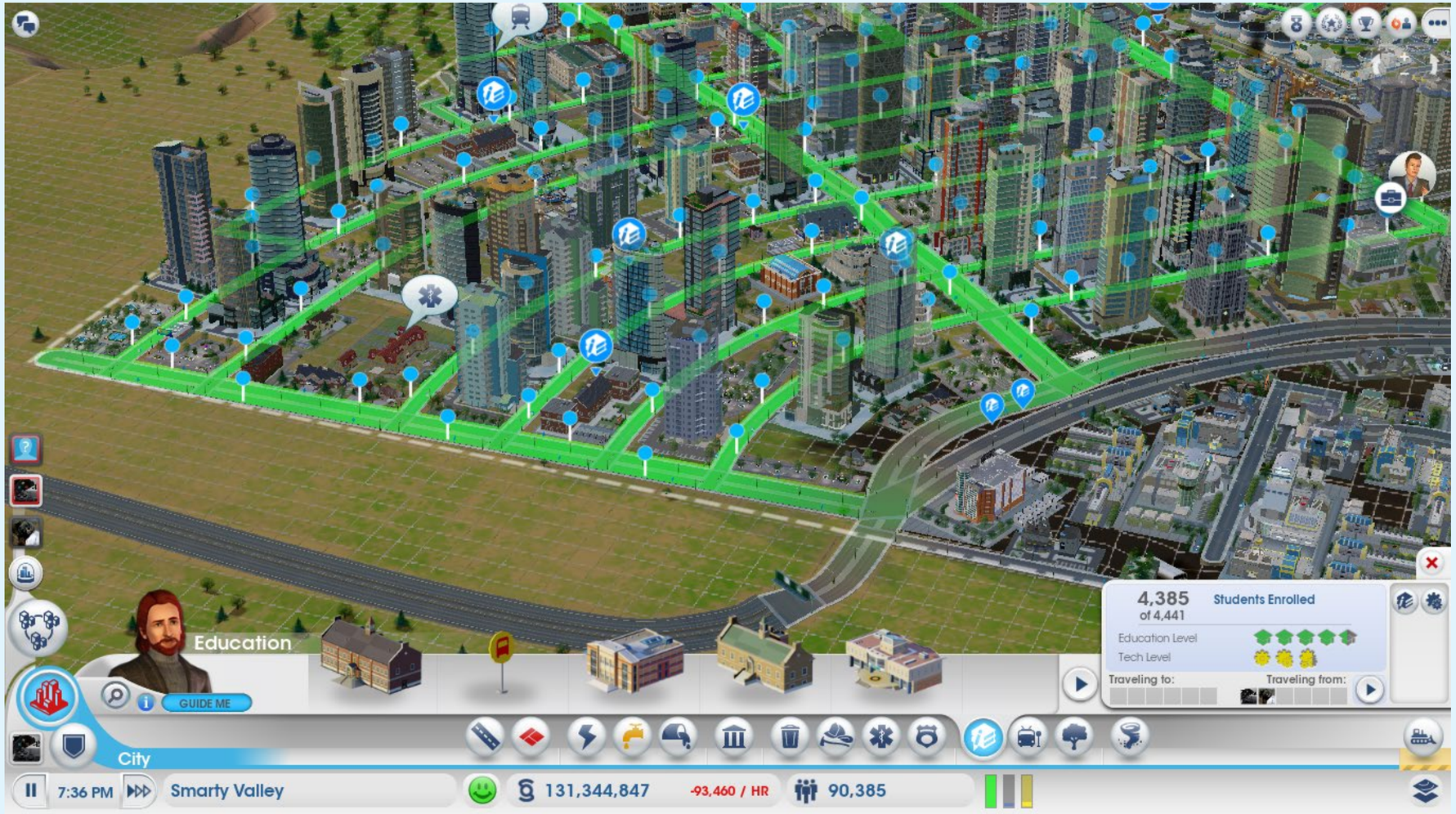
2009-Today



Markus Persson, Jens Bergensten at Mojang

SimCity (Series)

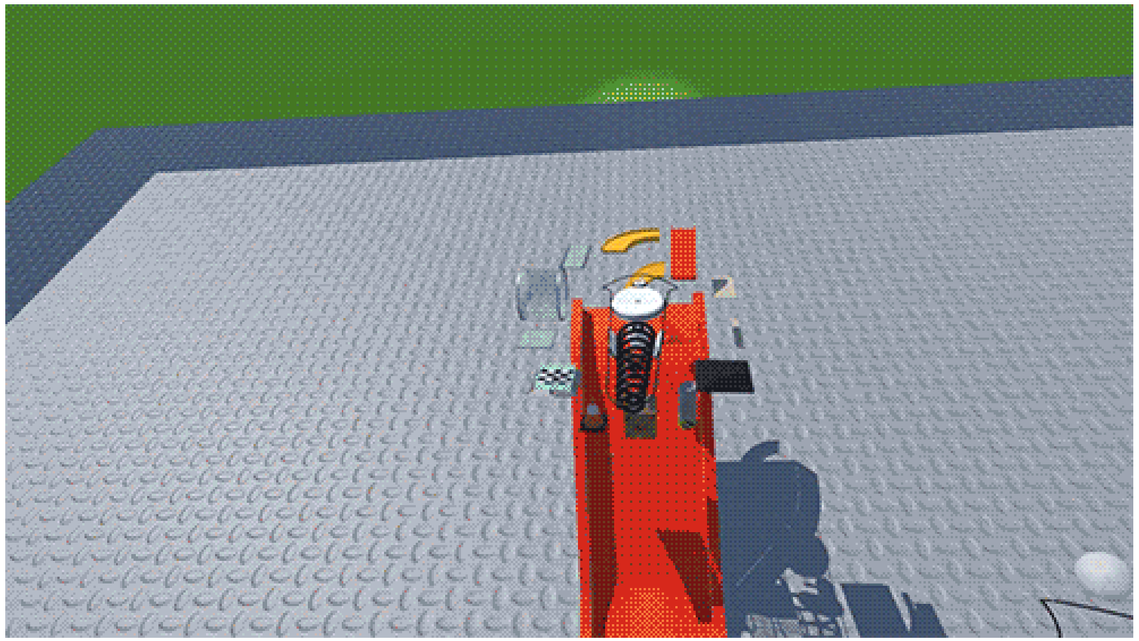
1989-2014

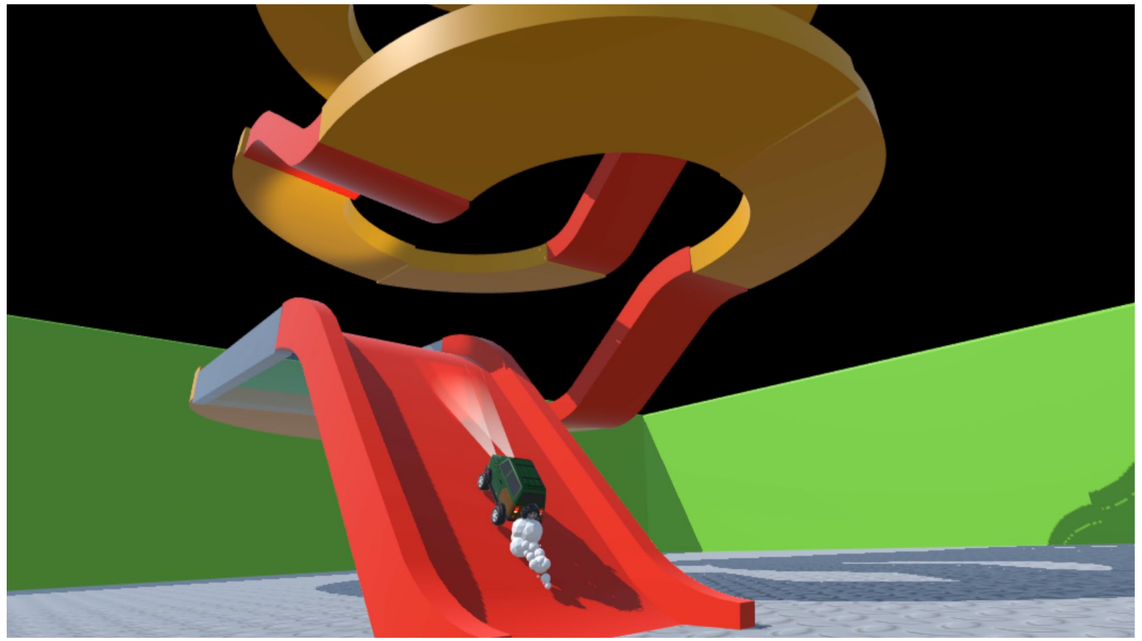


Various

Tiny Wheels

2017





Robbie Tilton

Dreams

2018

Media Molecule

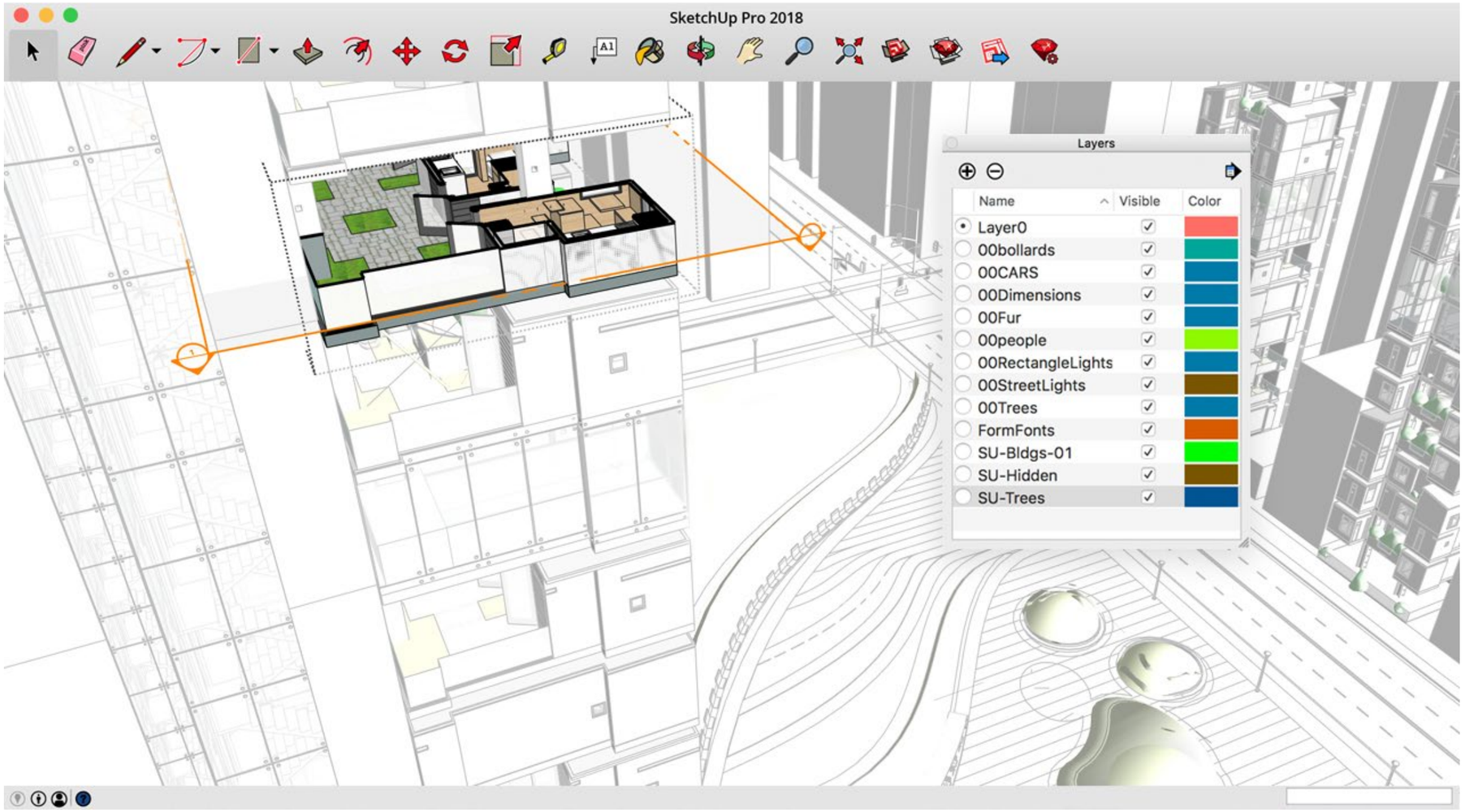
Remaking Reality

Measure, Simulate, Predict & Act

Reality Design

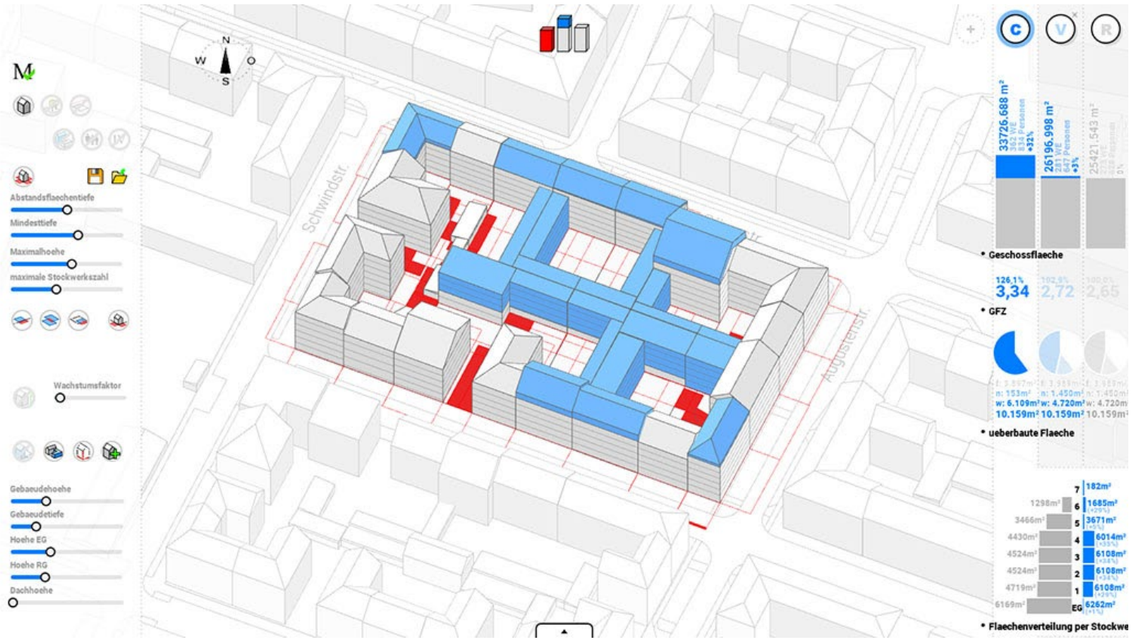
SketchUp

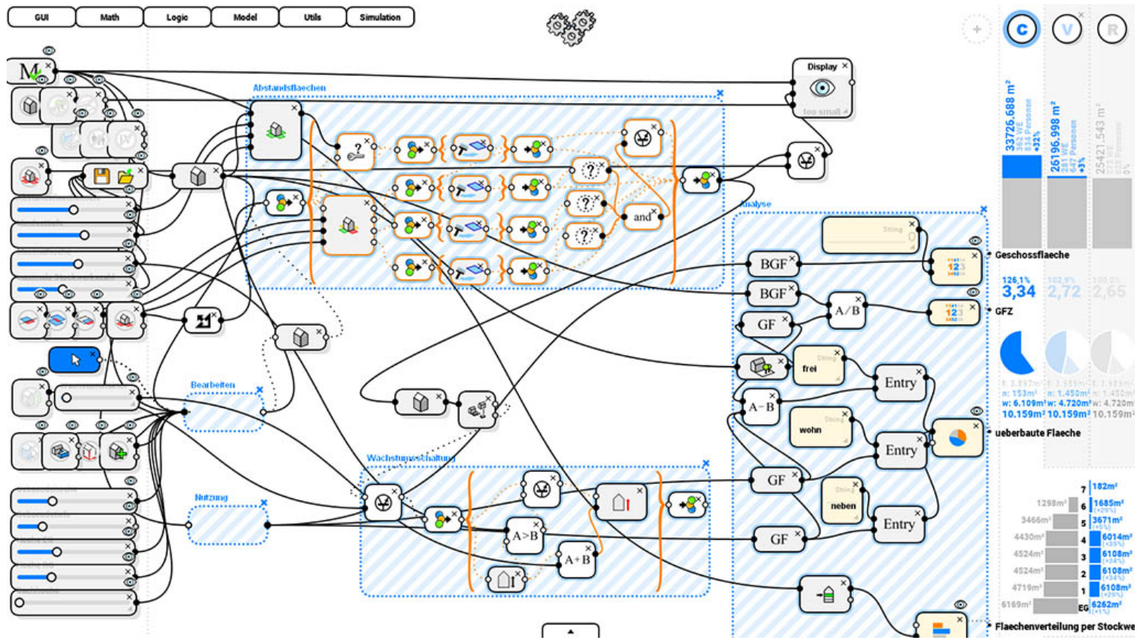
2000-Today



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

Urban Strategy Playground (Suite) 2013-Today

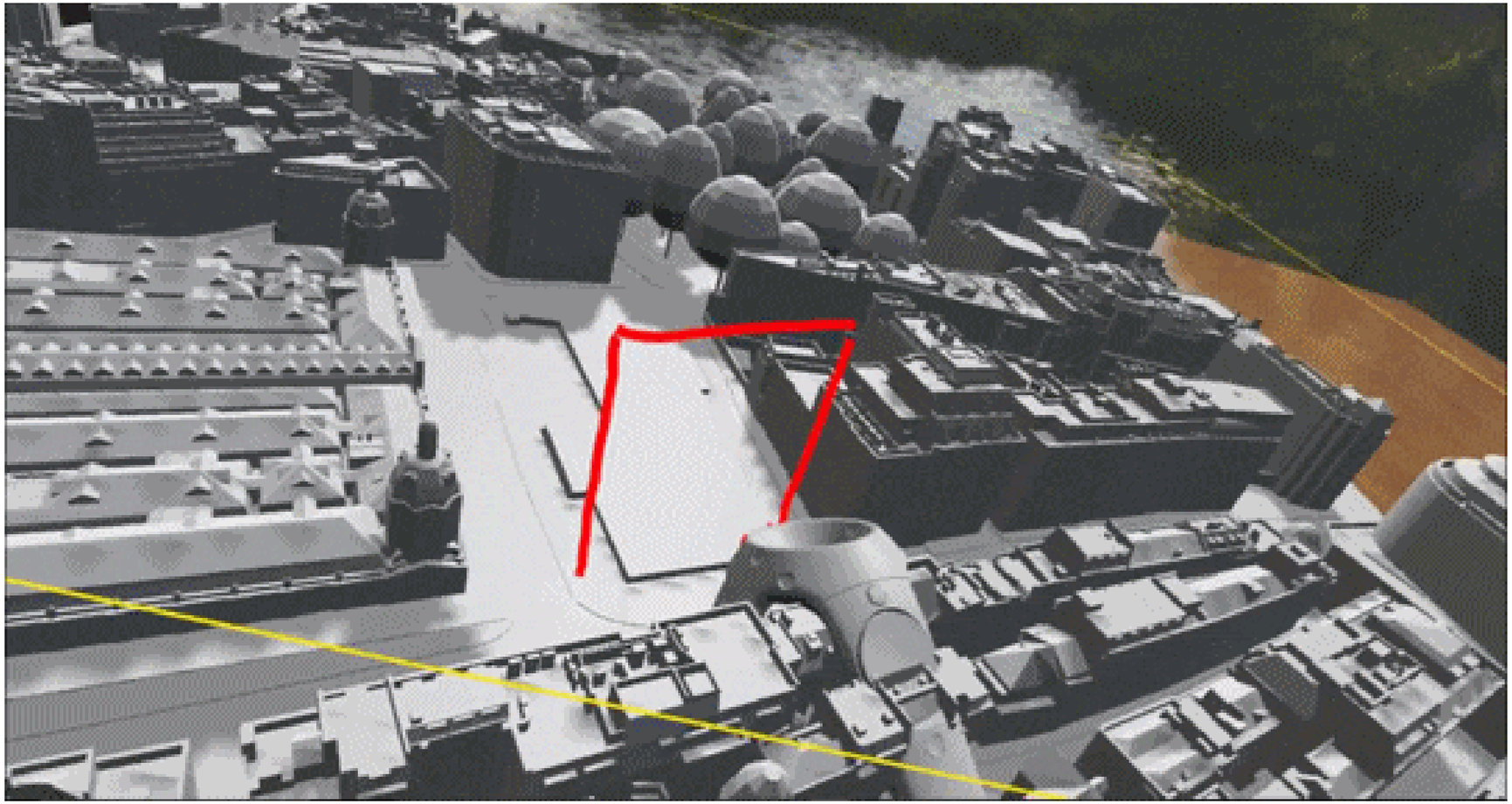




USP Research Group in the Department of Architekture at Technische Universität München

DesignSpace

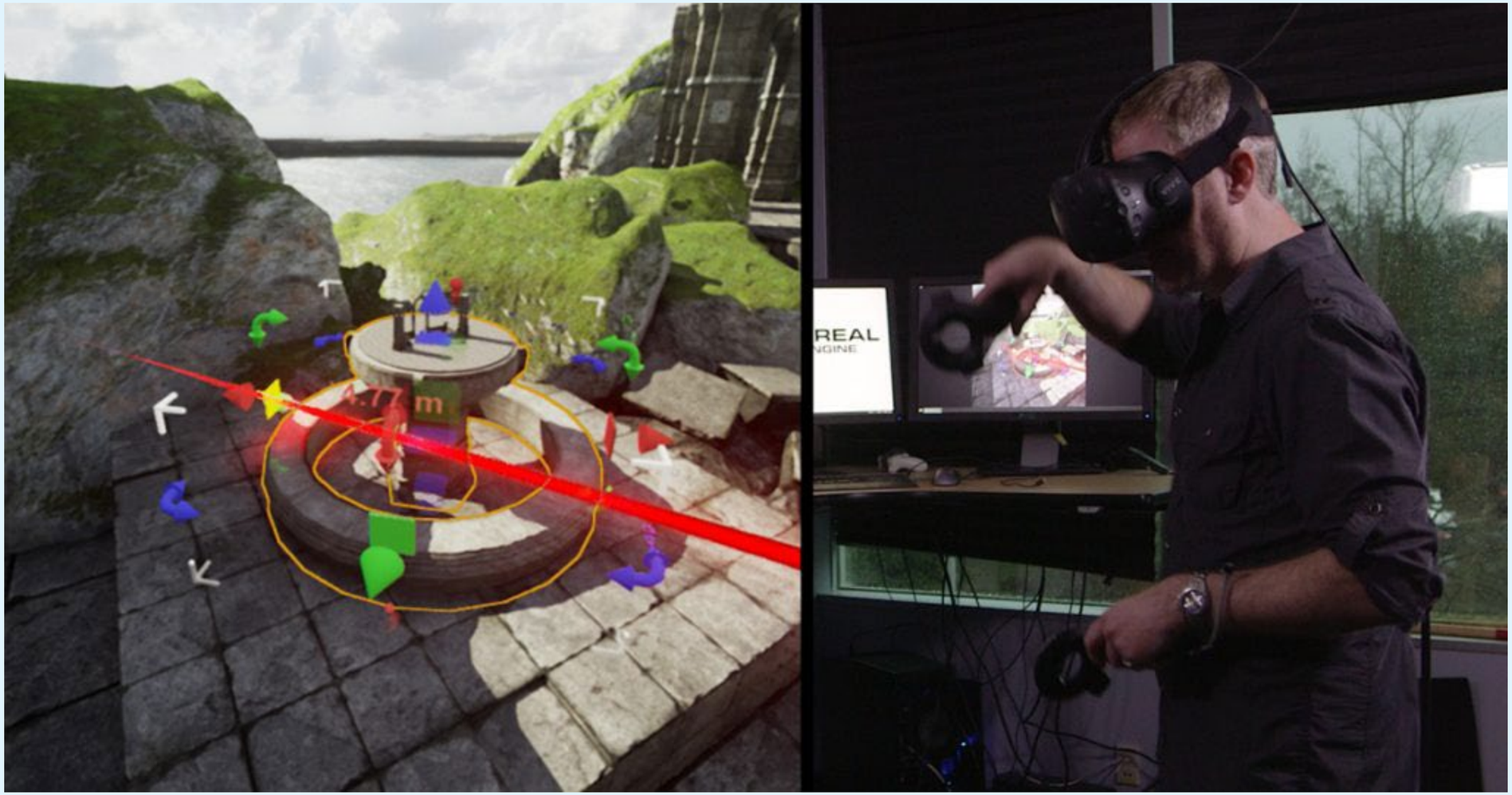
2016



Thomas Van Bouwe

VR Editor for Unreal Engine

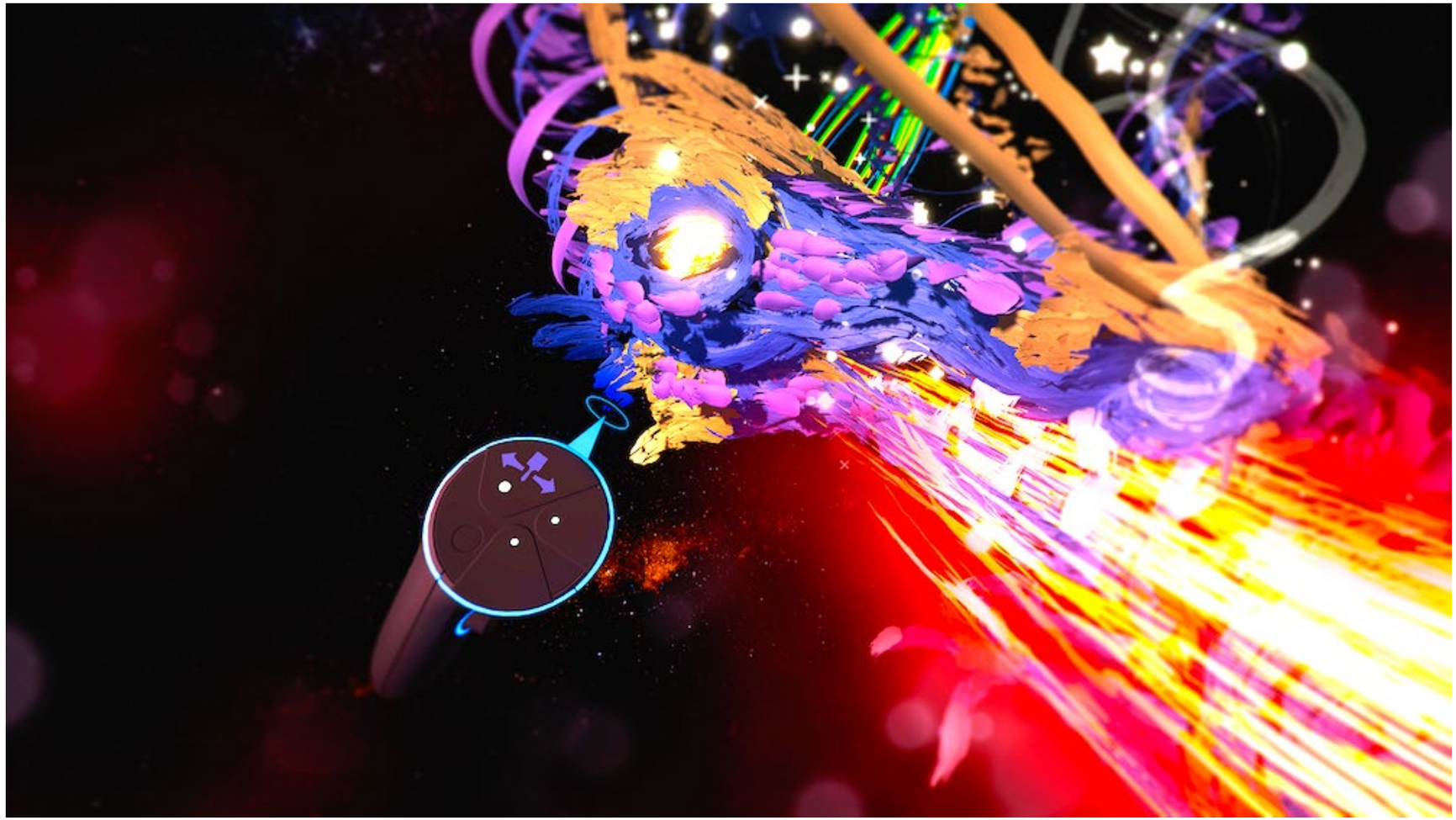
2016-Today



Epic Games

TiltBrush

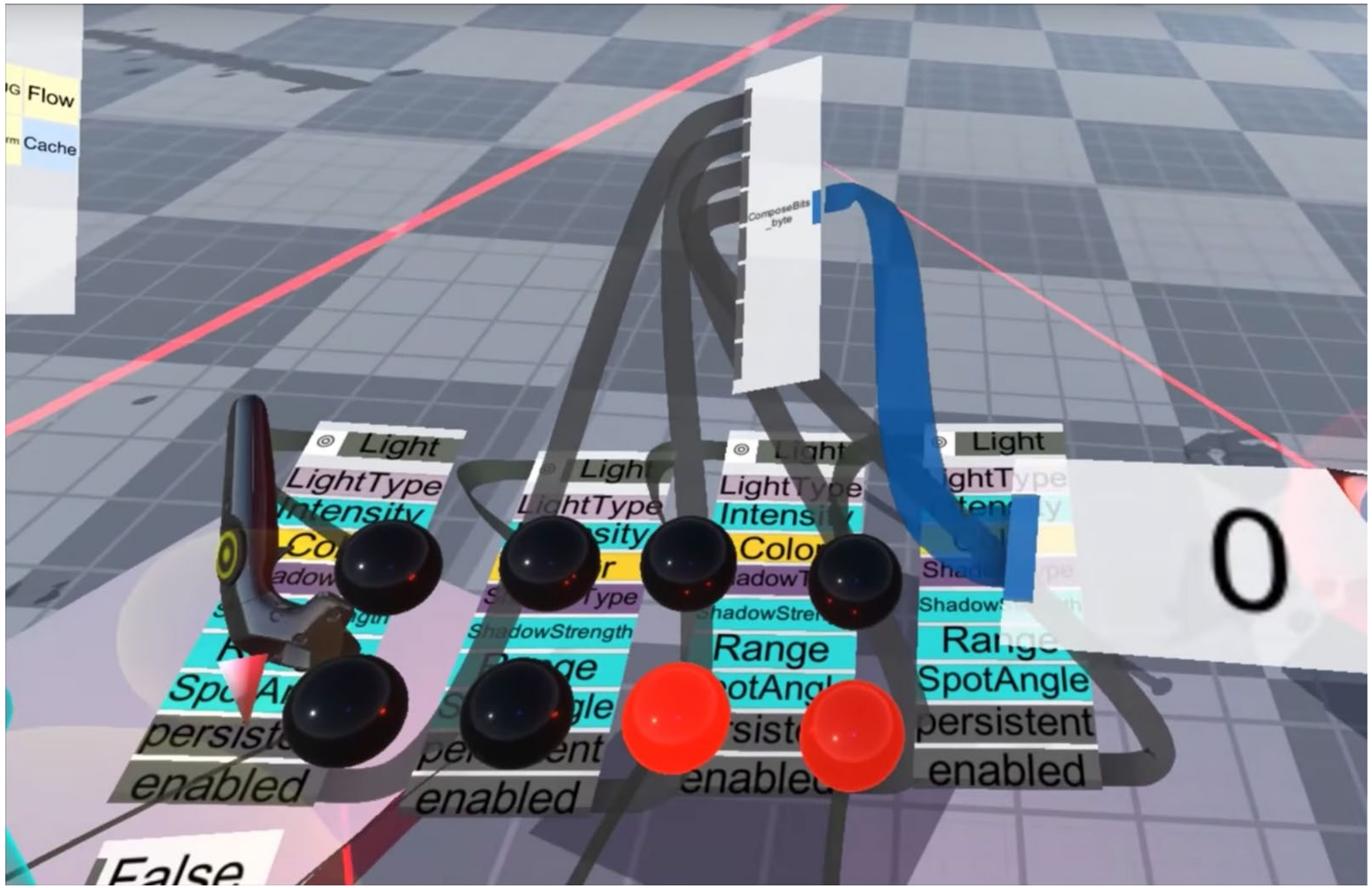
2016-Today



Google

LogiX

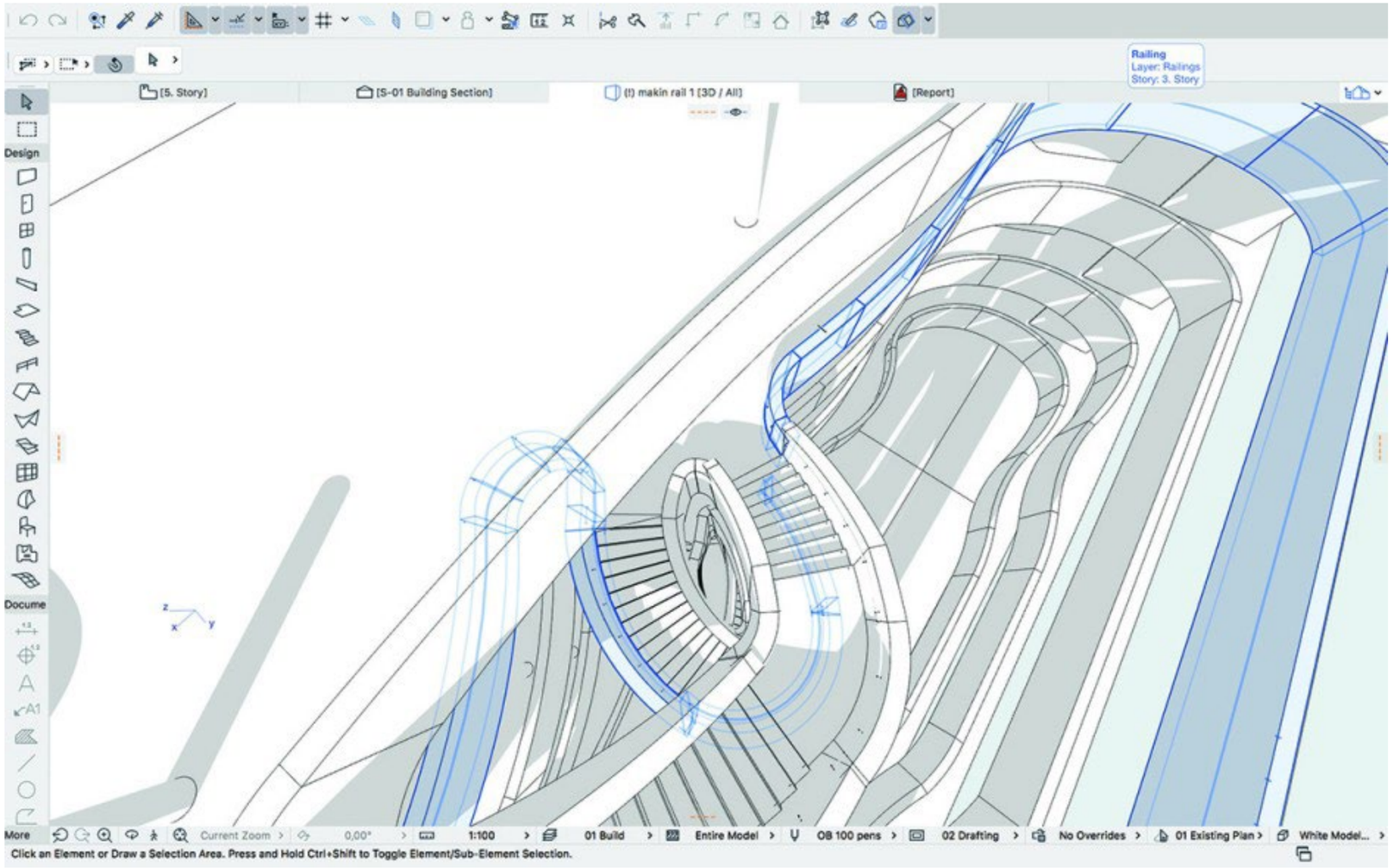
2017



Tomáš Mariancík

ArchiCAD (Predictive Design)

2018-Today



Graphisoft SE (Part of the Nemetschek Group)

Local Simulation

(i.e. Urban, Regional, etc)

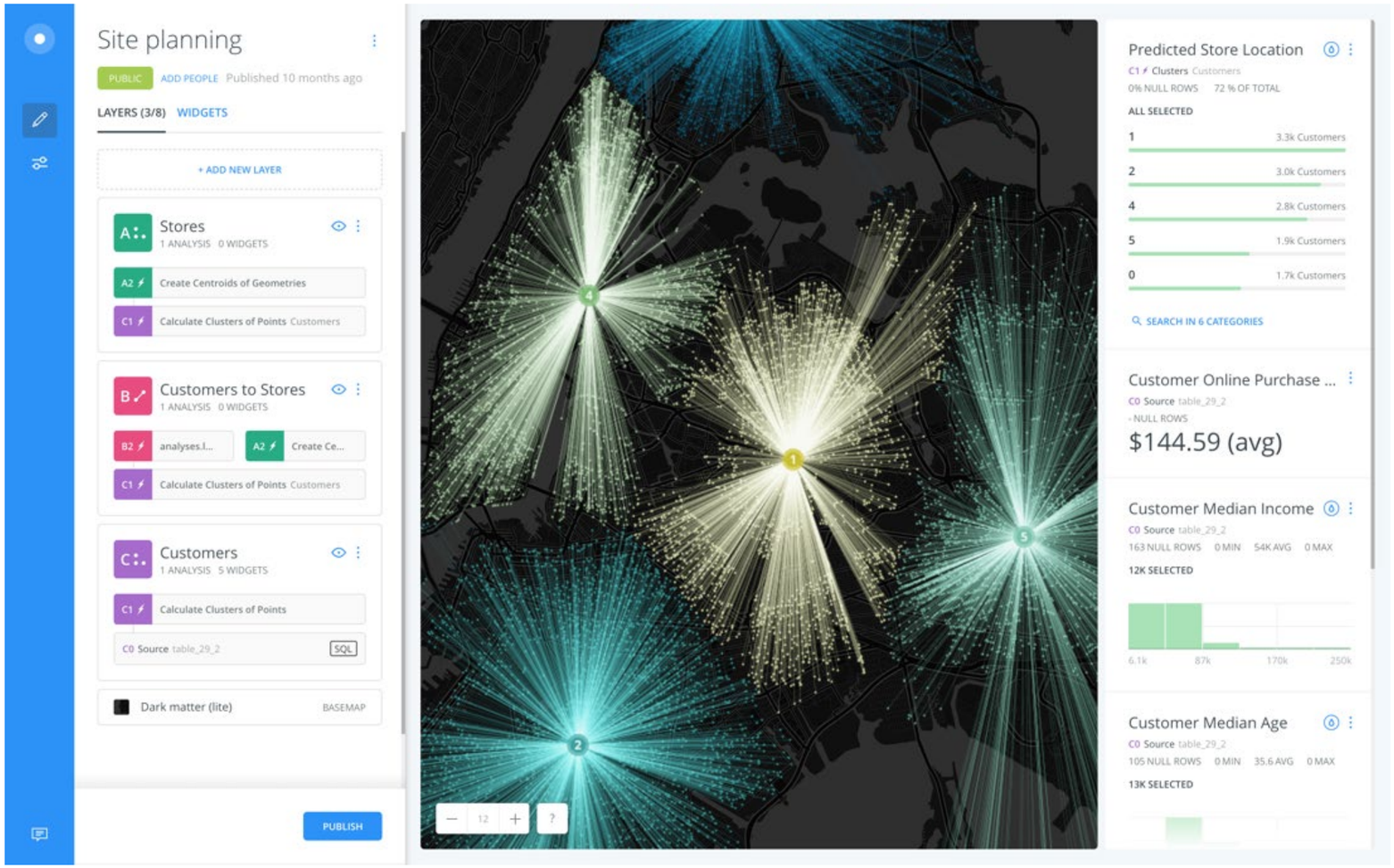
Gotham

2004-Today

Palantir

CartoDB

2011-Today



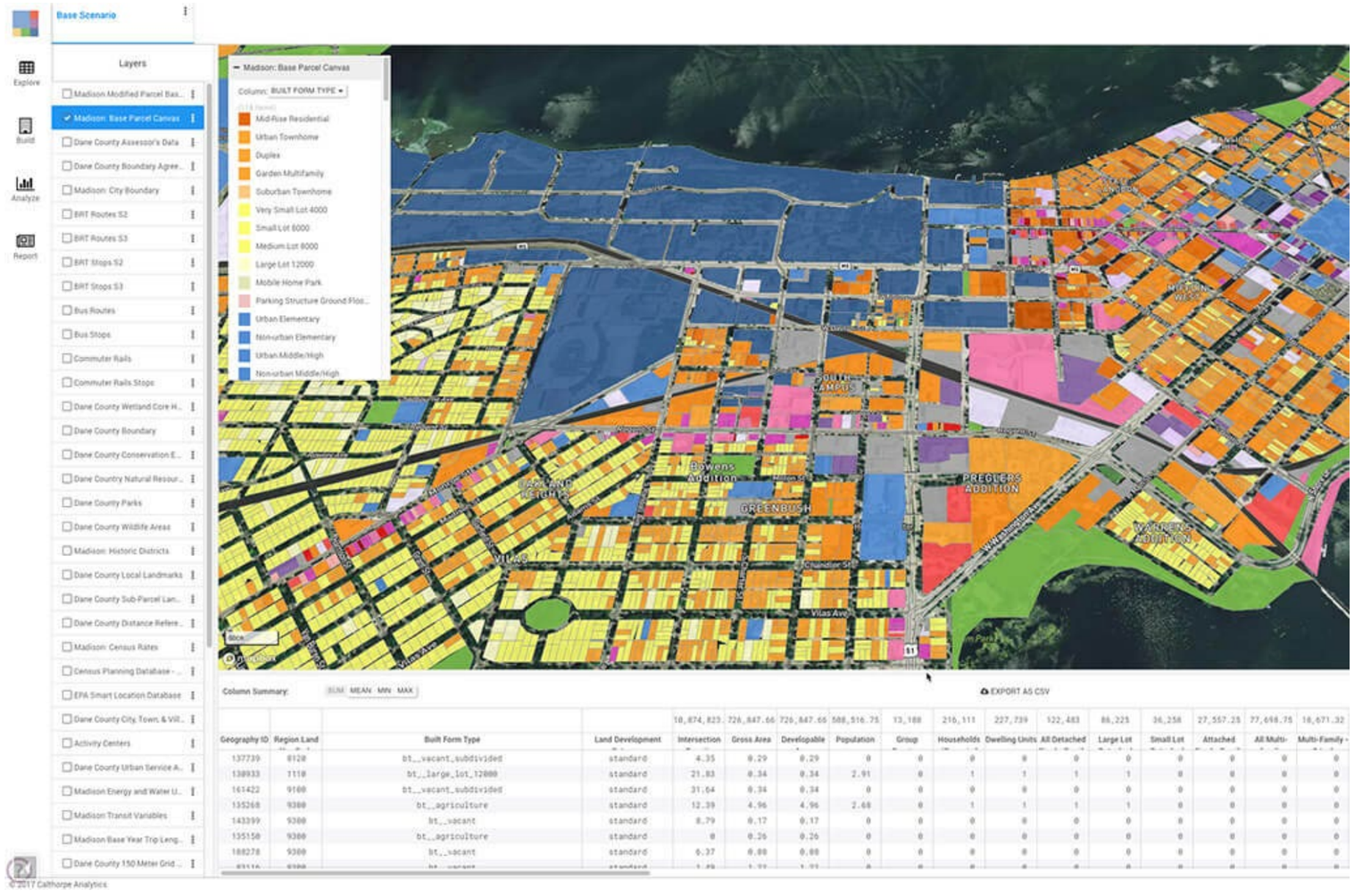
CARTO

MARK43 Computer Aided Dispatch 2012-Today

Mark43 Inc

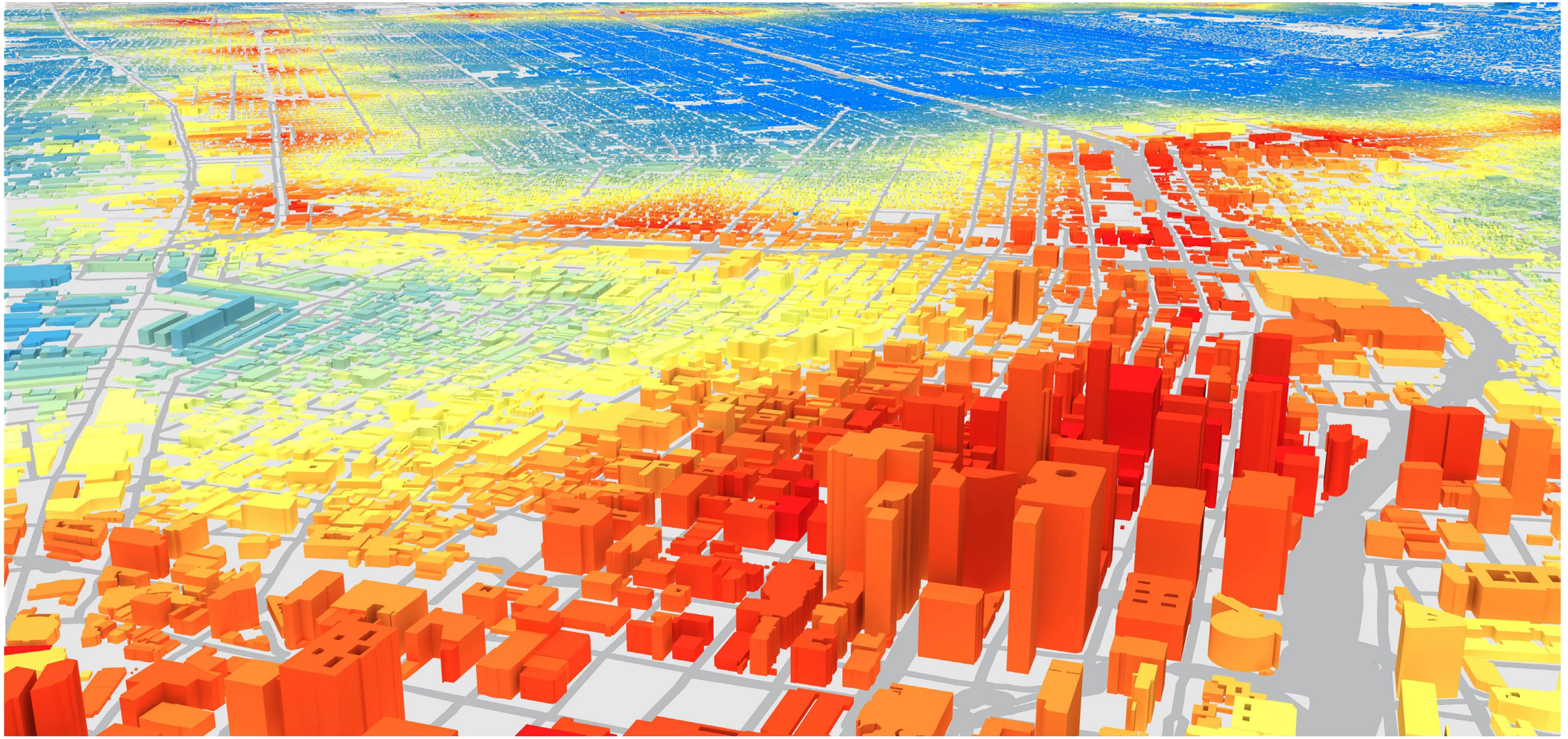
UrbanFootprint

2014-Today



Joe Distefano, Peter Calthorpe for Calthorpe Analytics

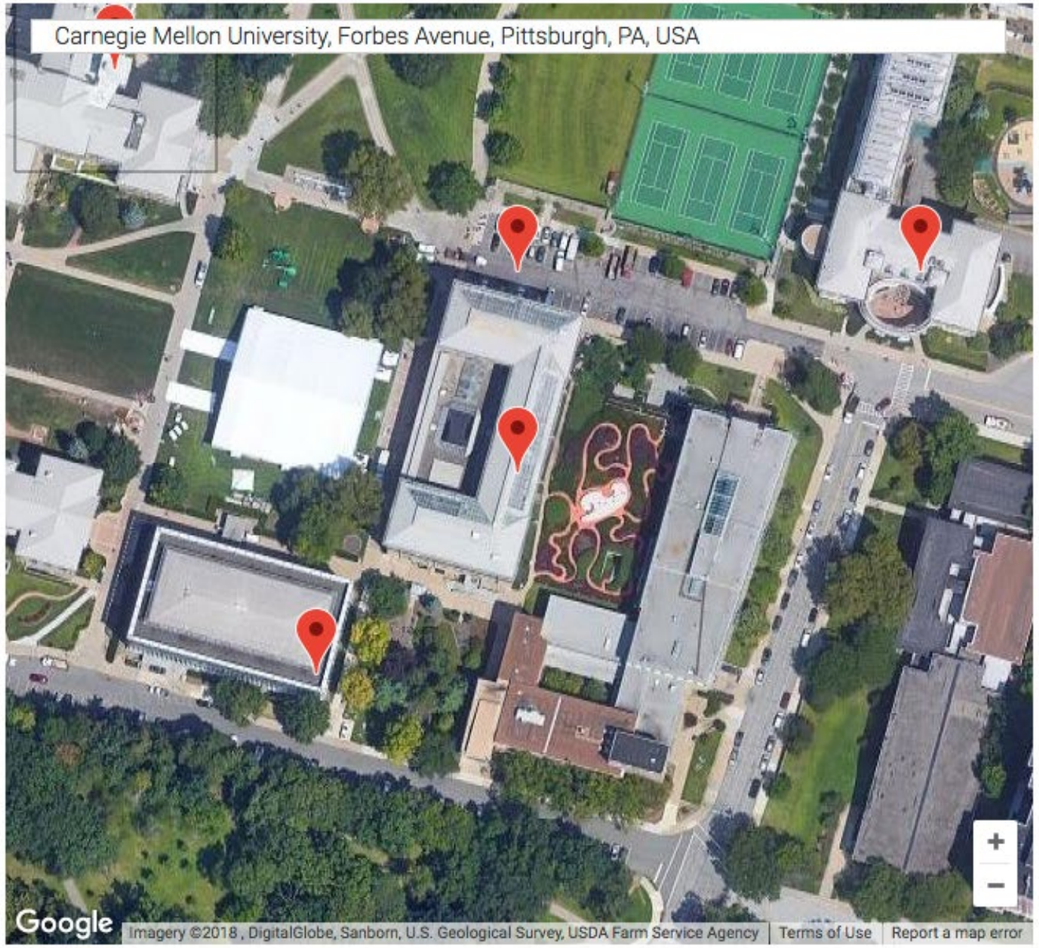
Urban Network Analysis Toolbox 2015-Today

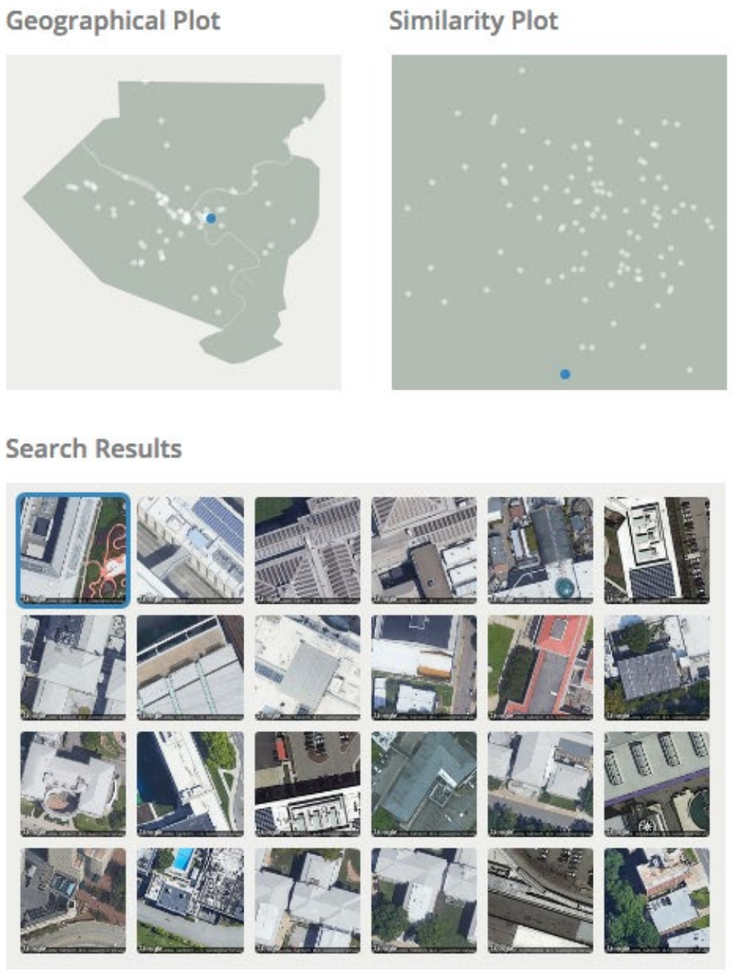


CIty Form Lab at the Harvard University Graduate School of Design

TerraPattern

2016





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

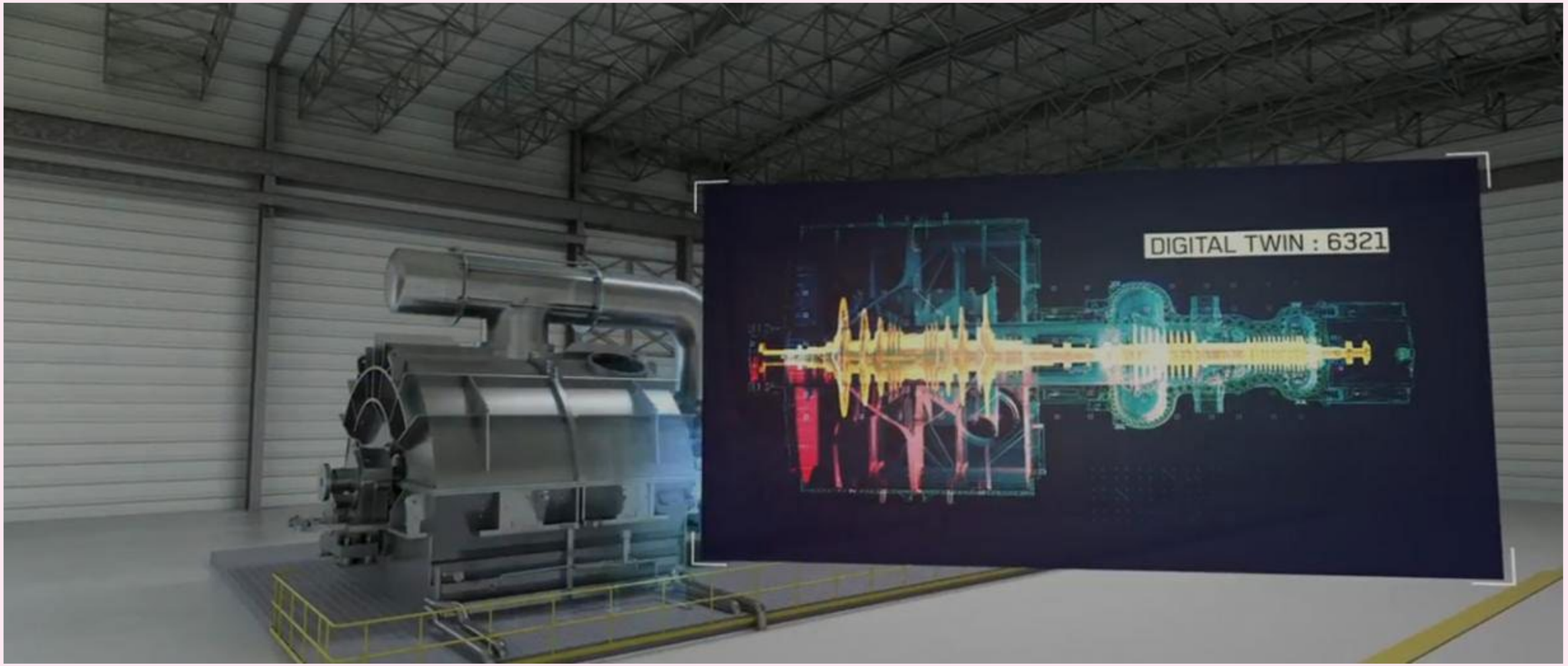
Hololens App: Forest Fire Fighting

2016

Boeing

GE Predix (Digtial Twin)

2016-Today



General Electric and ANSYS

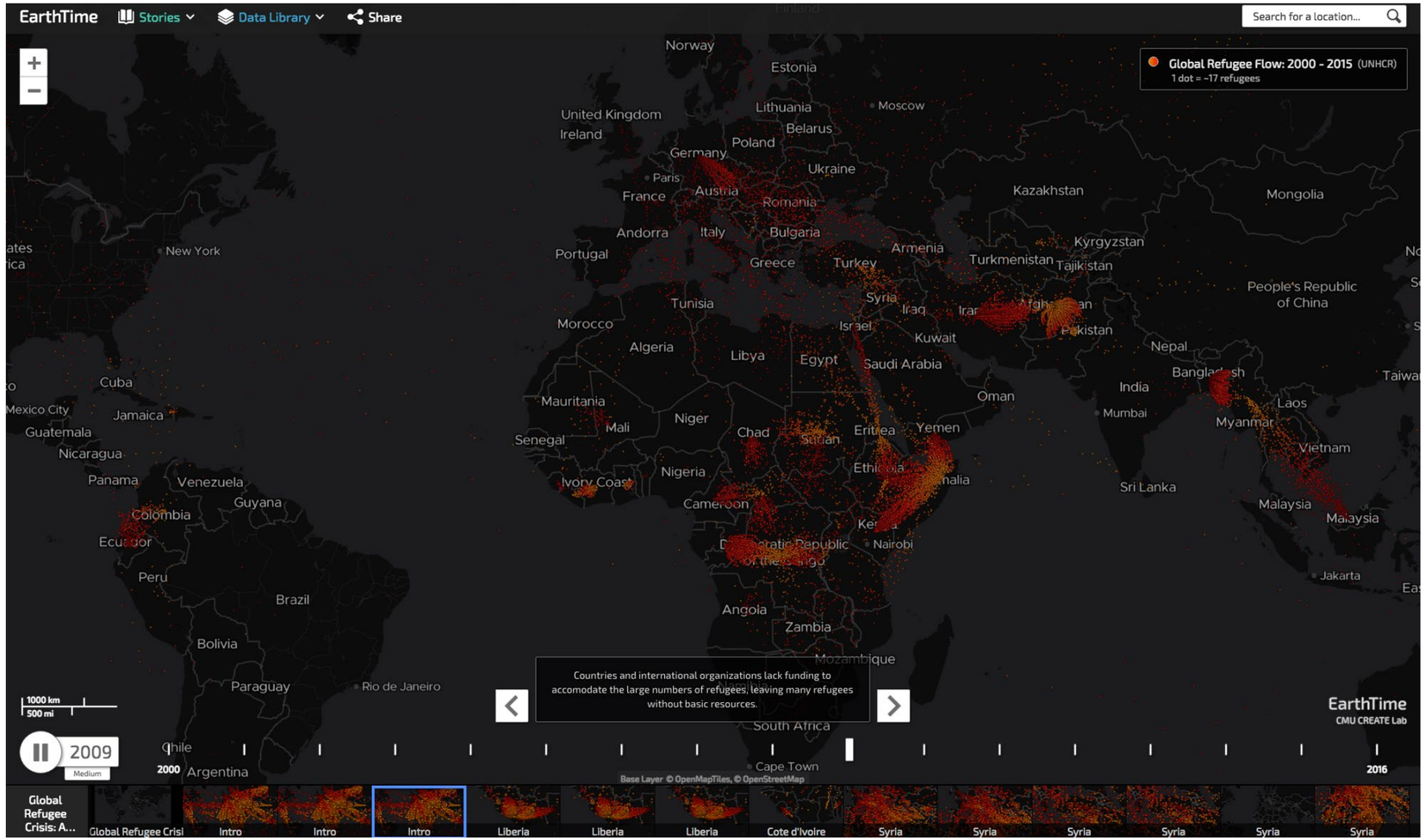
Hololens App: Air Force Asset Planning

2017

Royal Australian Air Force

EarthTime

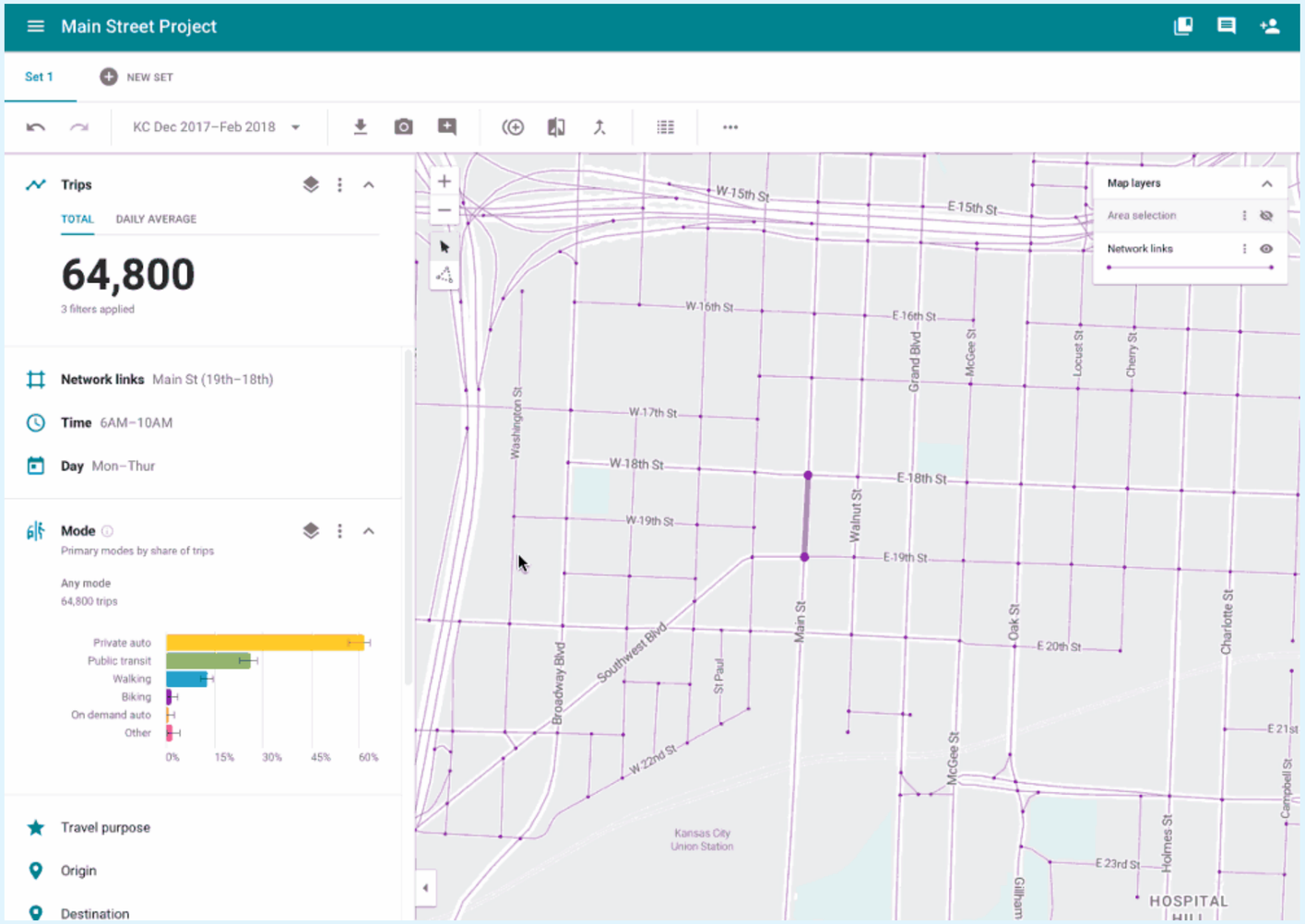
2018



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

Replica

2018-Today



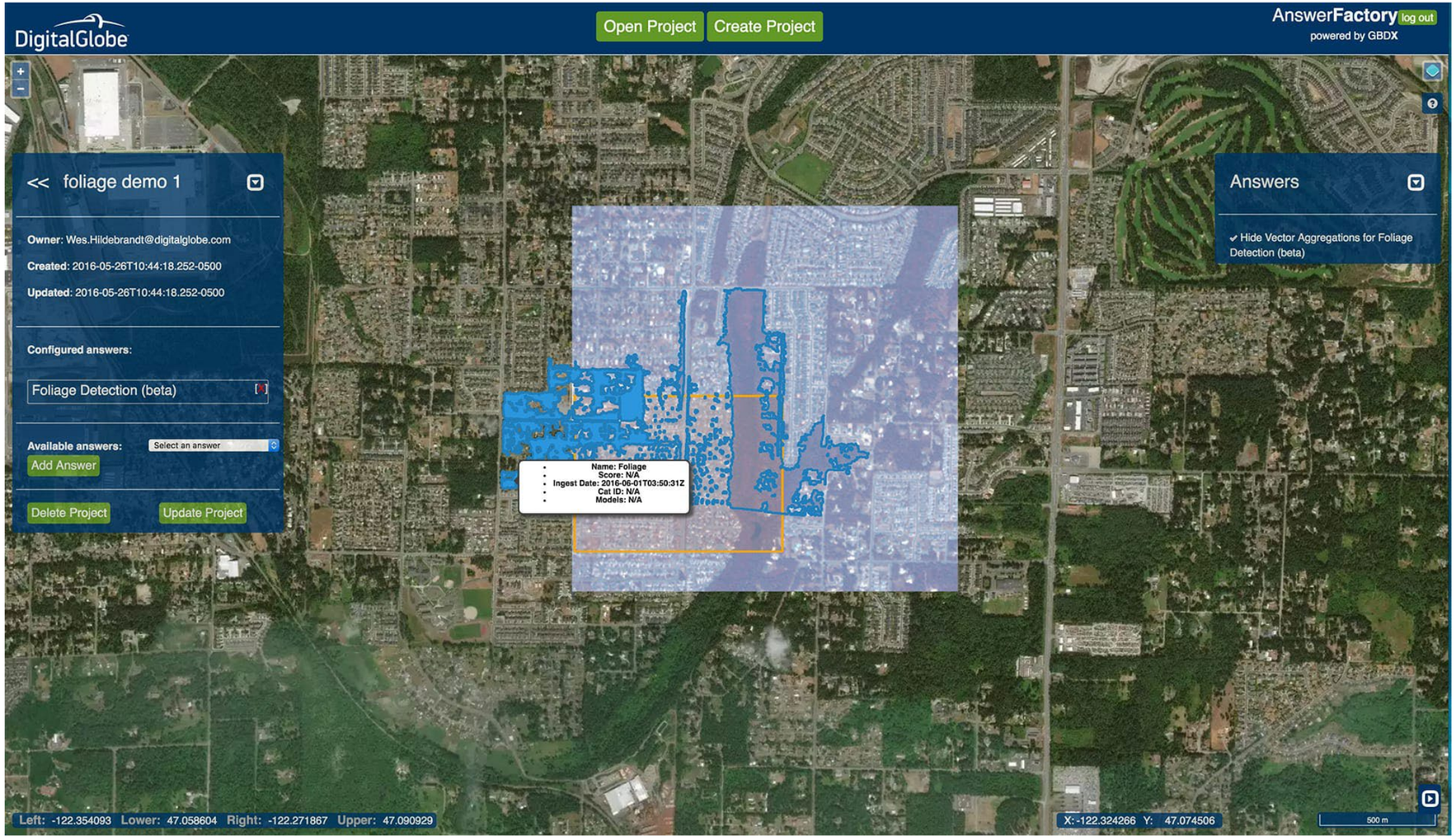
Sidewalk Labs (Part of Alphabet)

Global View

‘Macroscopes’

DigitalGlobe AnswerFactory

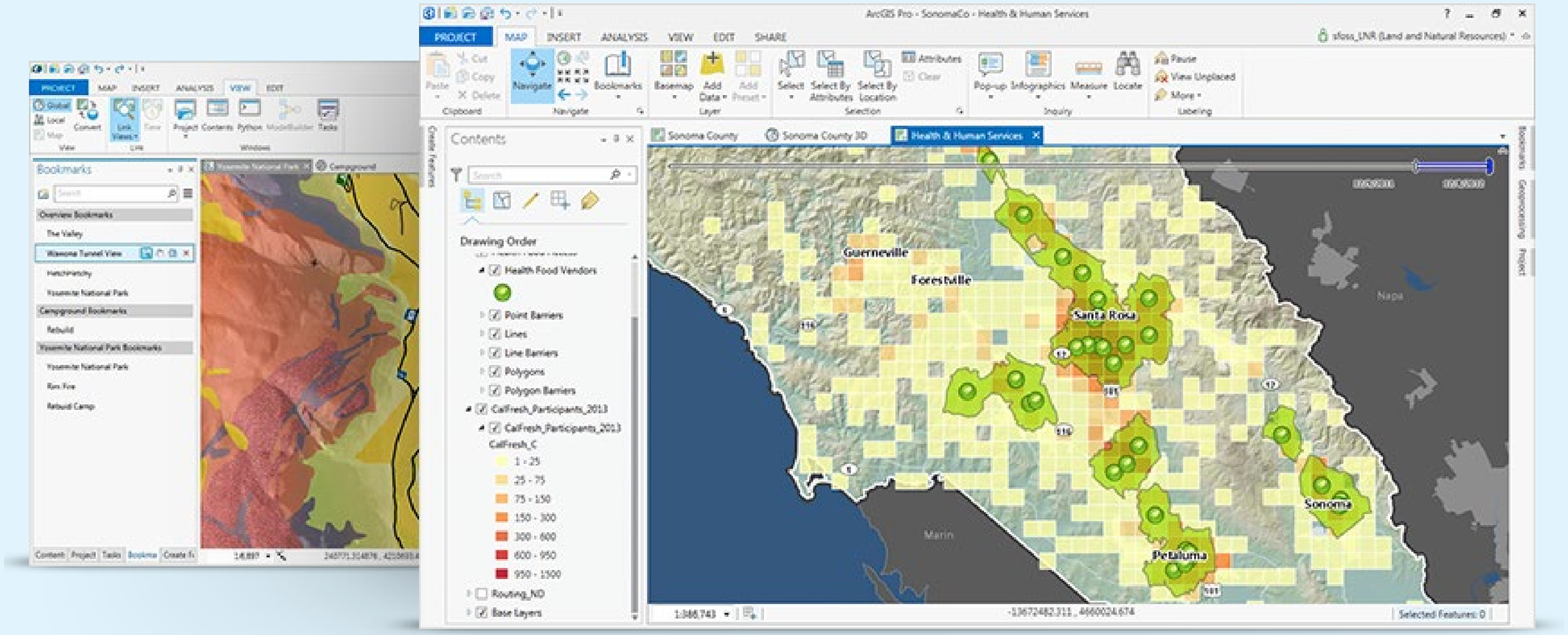
1992-Today



DigitalGlobe (Part of MAXAR)

ArcGIS

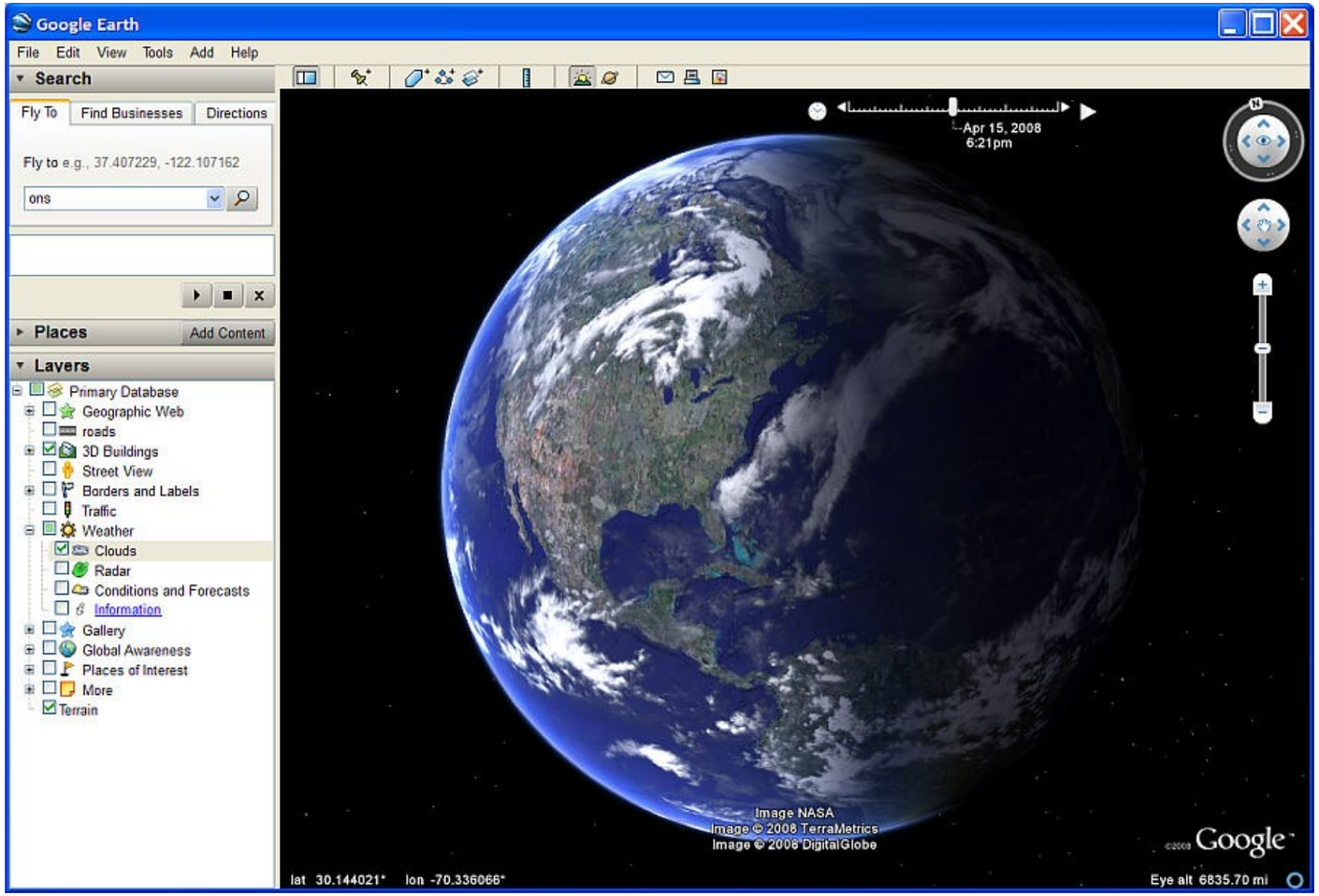
1999-Today



Esri

Google Earth

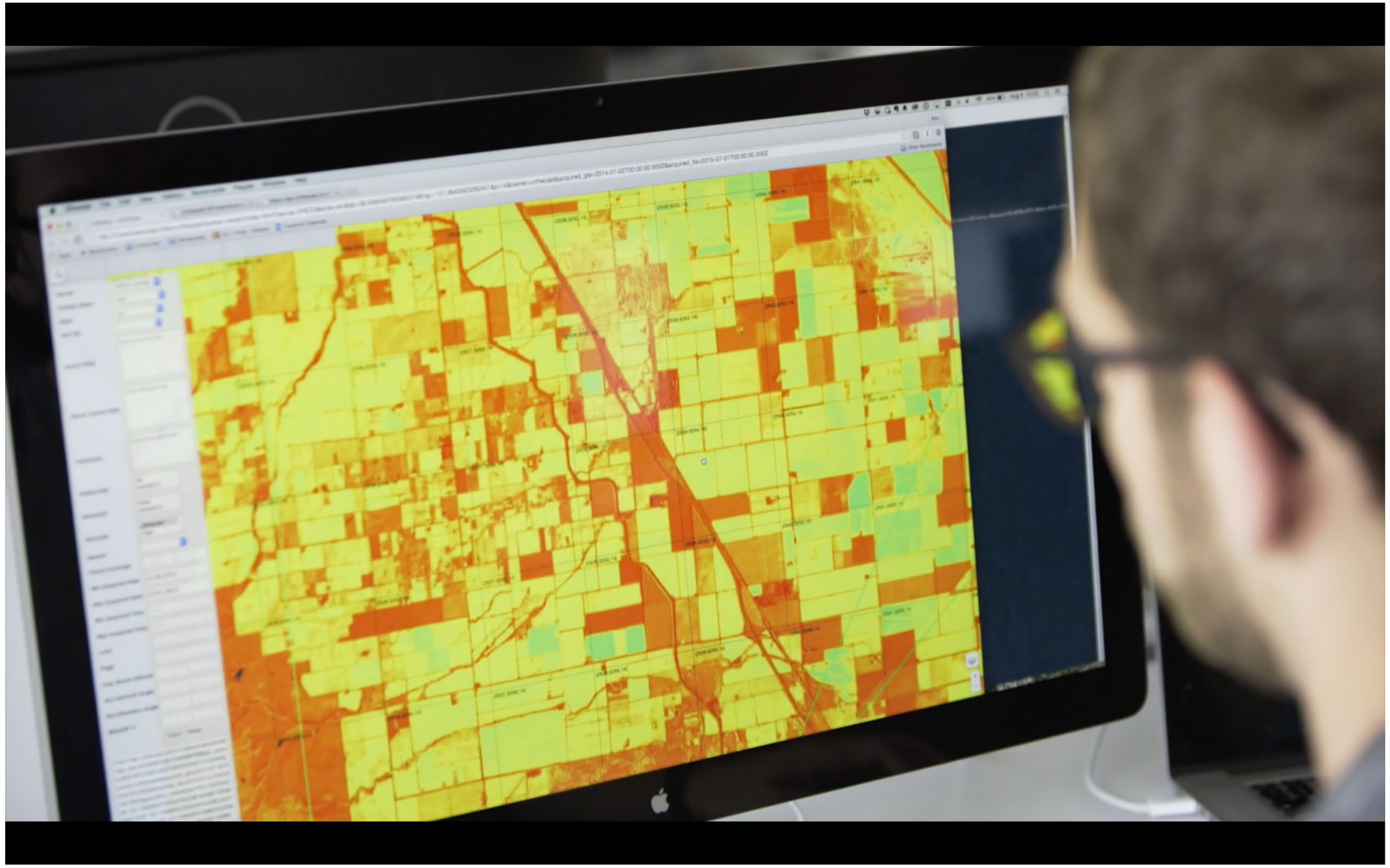
2001-Today



Intrinsic Graphics (Later Keyhole Inc, Google)

UrtheCast

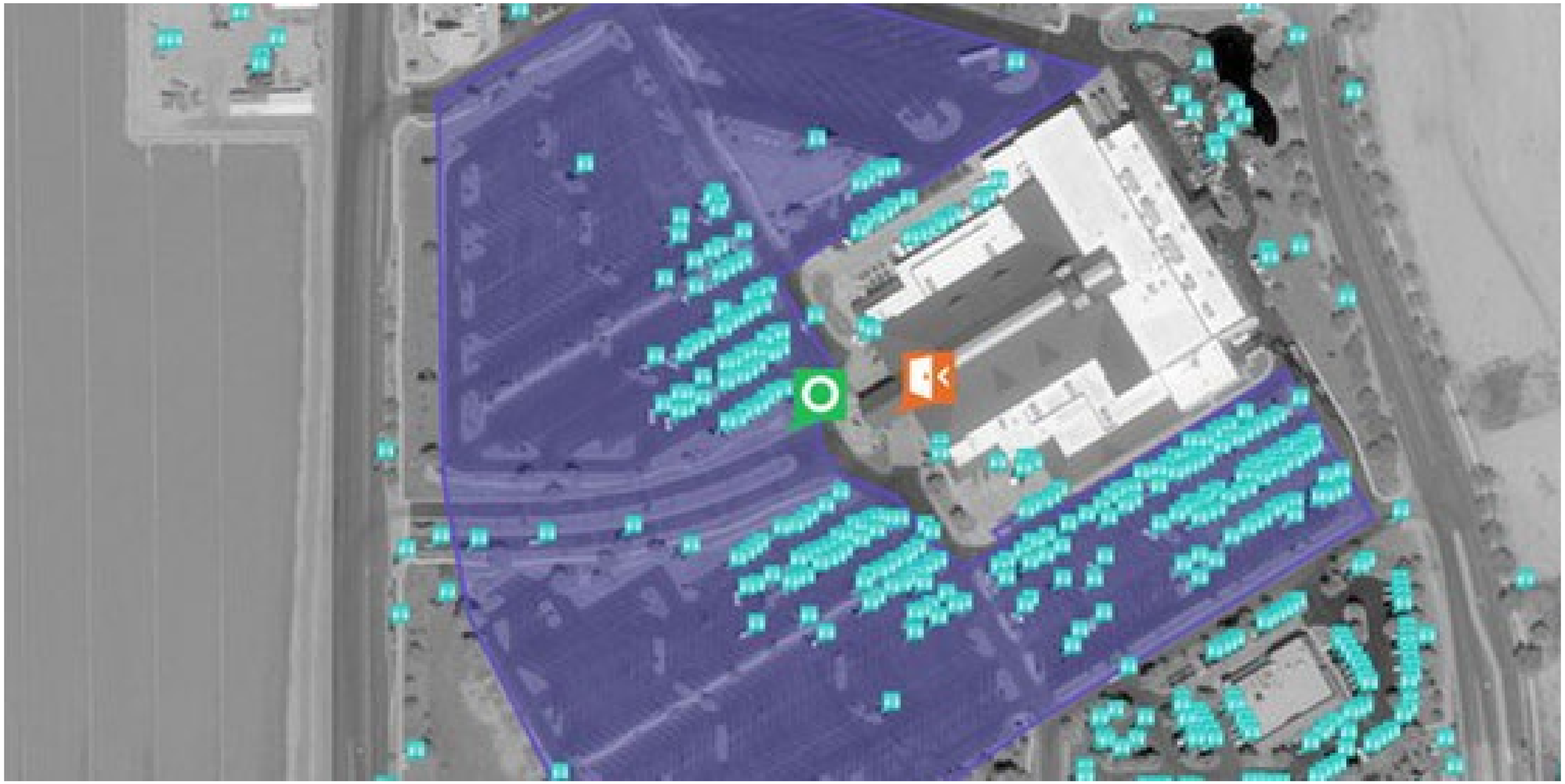
2004-Today



UrtheCast Corp

Orbital Insight

2013-Today

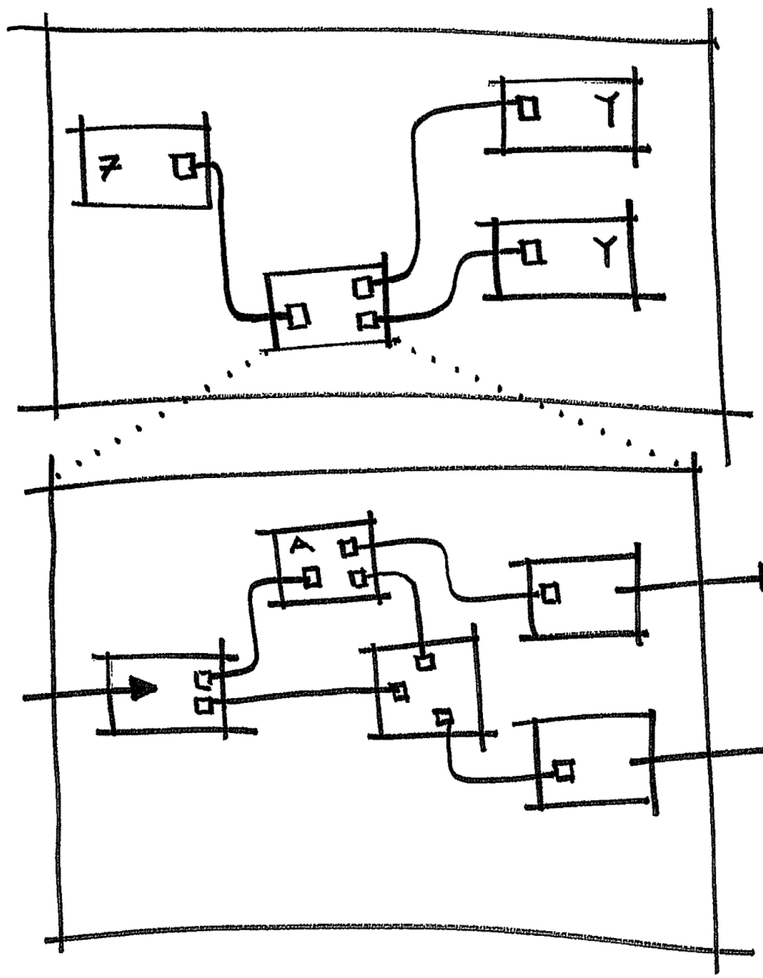


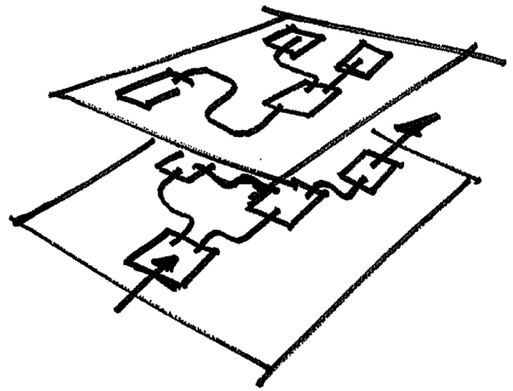
Orbital Insight Inc

Design Patterns

Preliminary Sketches

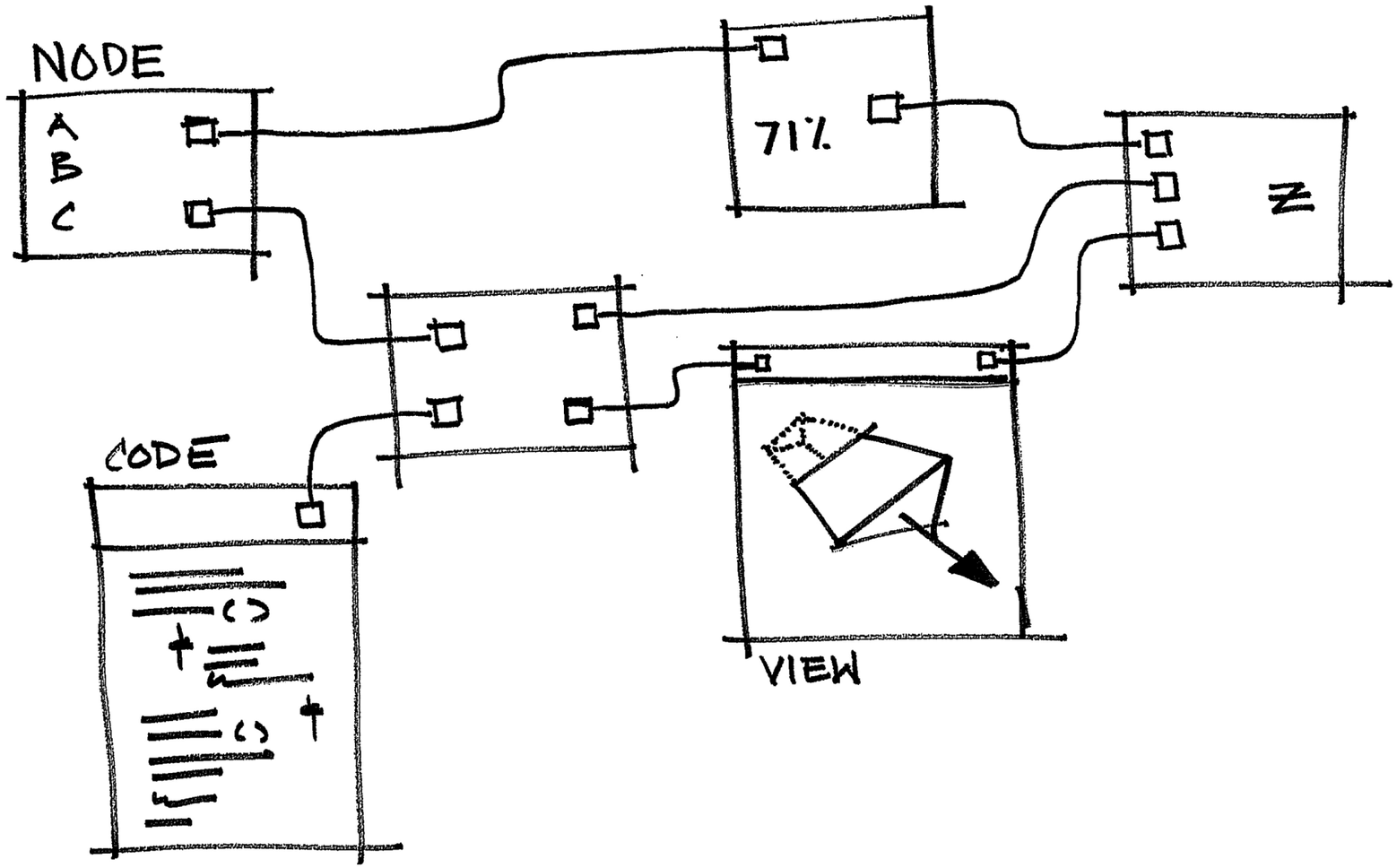
NESTED STRUCTURE





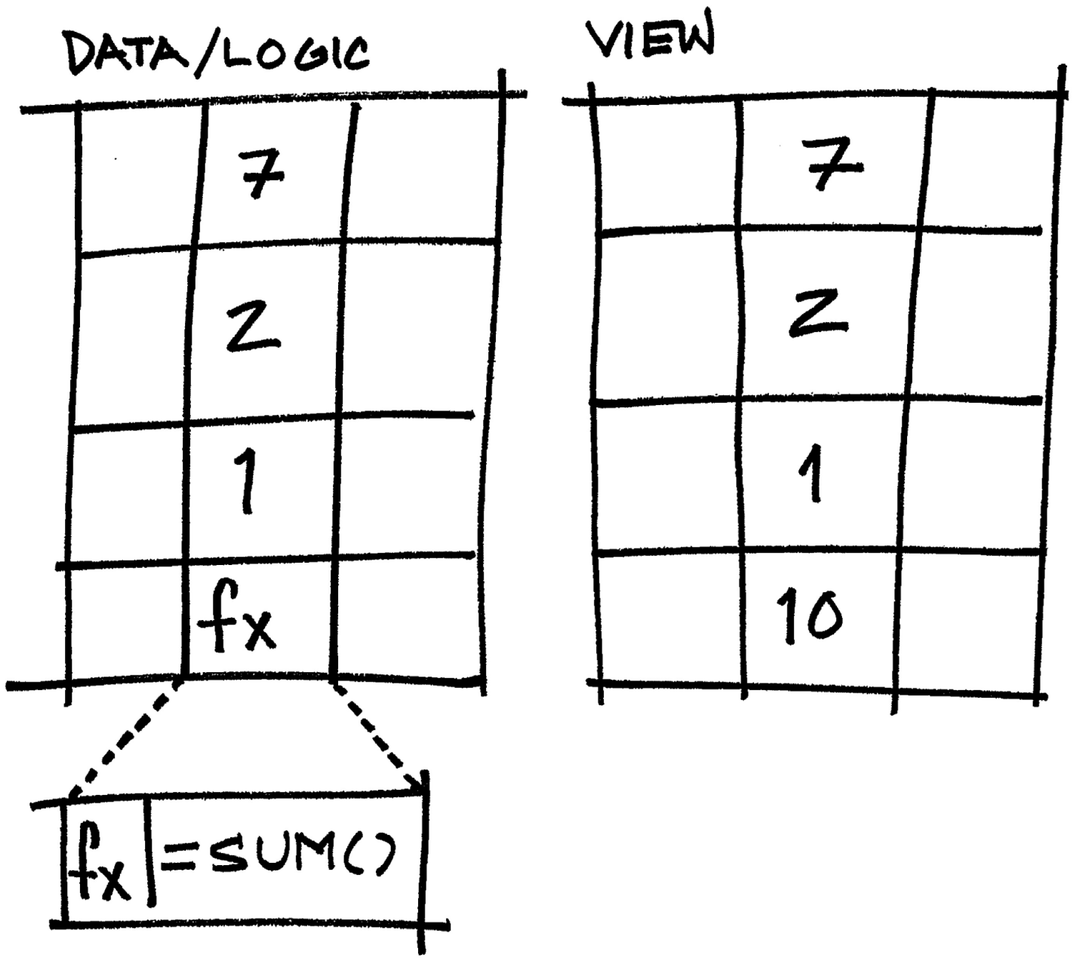
4.3.6, 4.1.6, 1.3.4

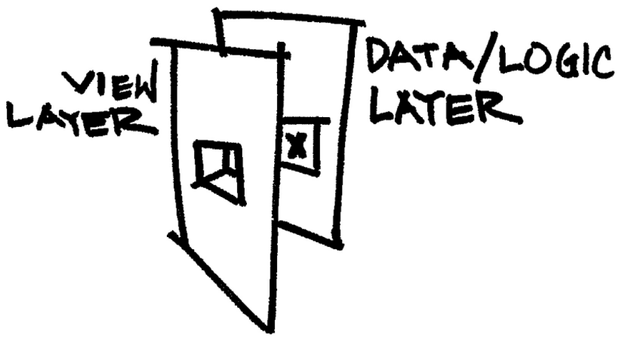
GRAPH (NODE-LINK) ENVIRONMENT



4.1.8, 4.3.1, 4.1.1

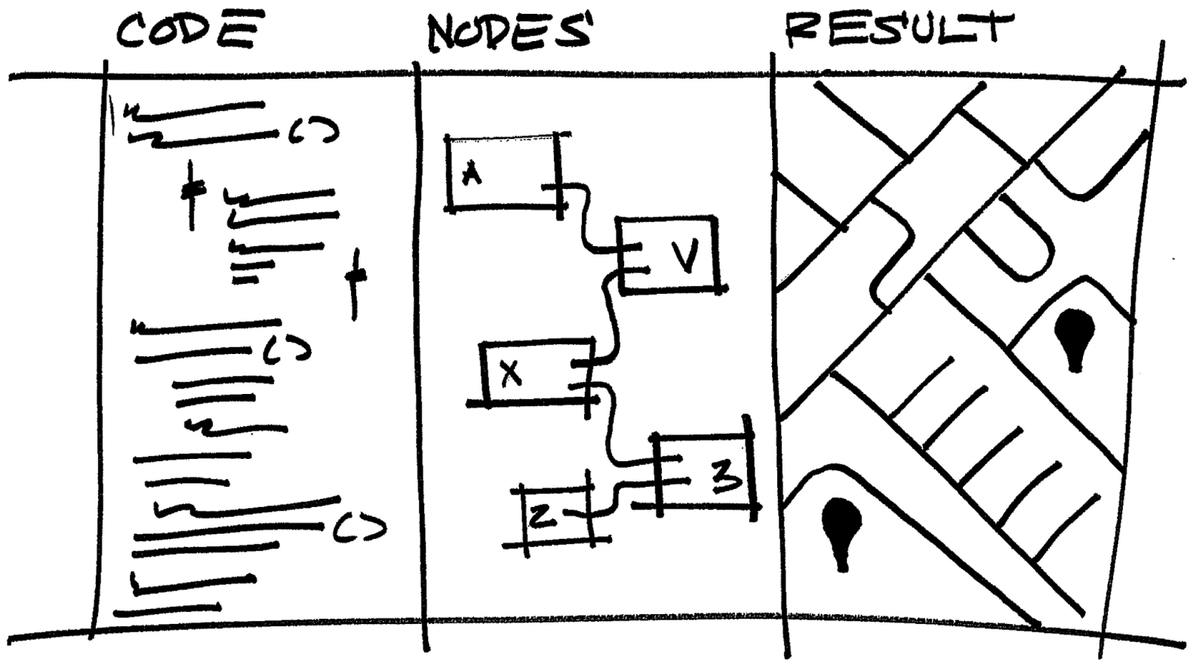
KEYHOLE MODEL





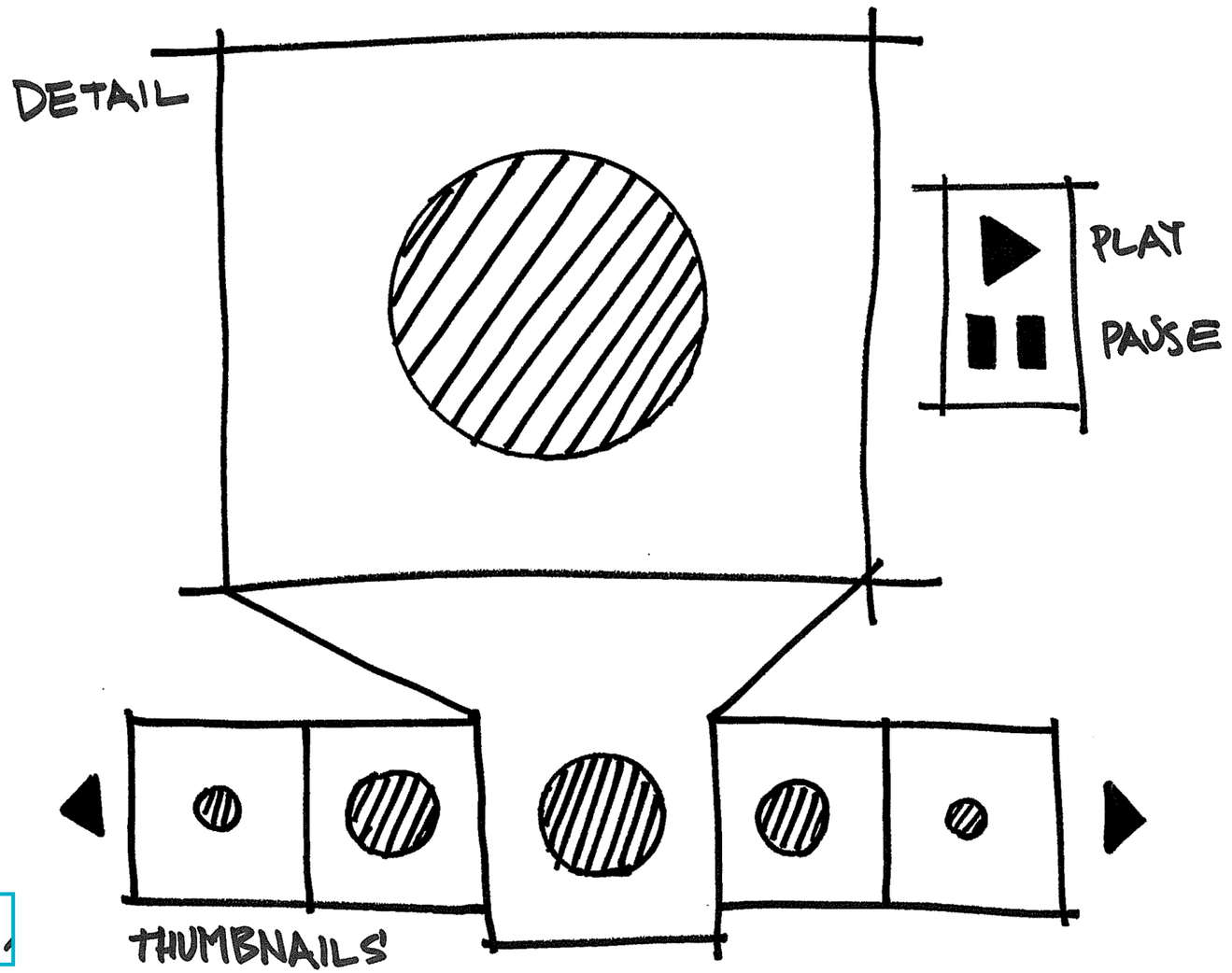
2.1.3, 2.2.3, 2.4.3

MULTIPLE VIEWS



5.4.9, 5.4.3, 4.3.2, 7.2.1

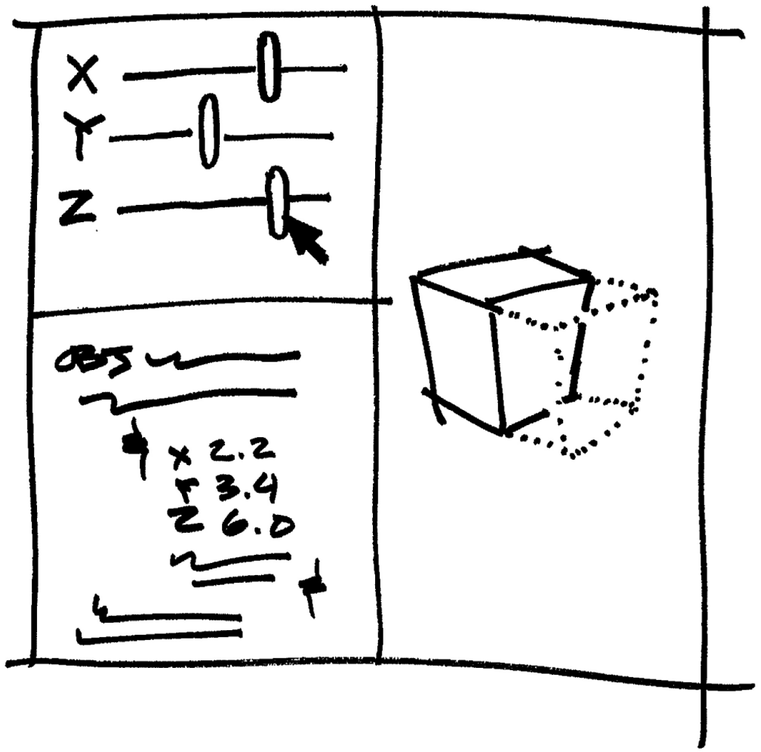
TIMELINE-BASED



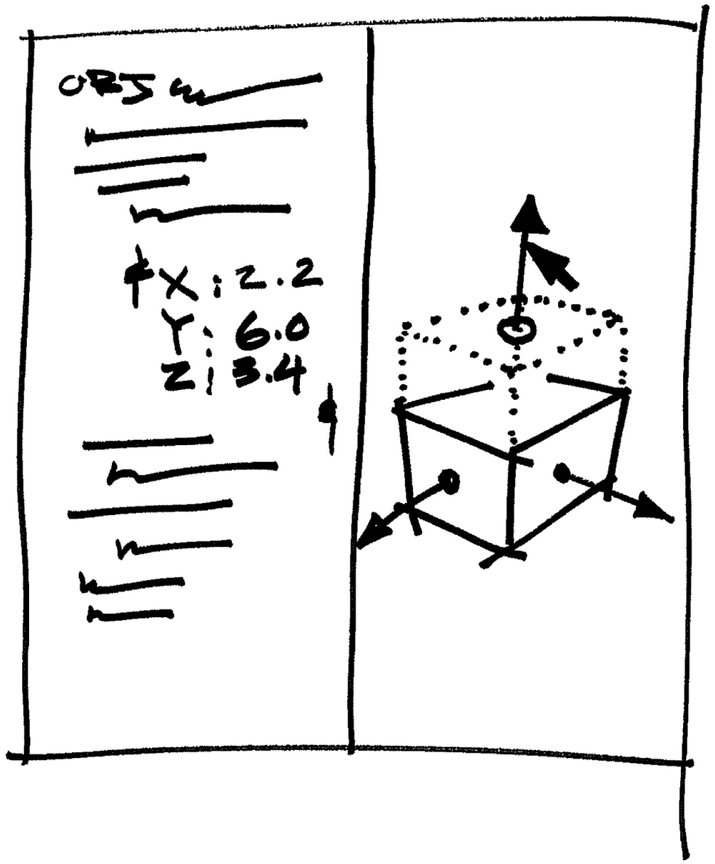
3.3.3, 6.3.6, 6.1.7

LIVE COMPILE

LIVE "FIDDLE"

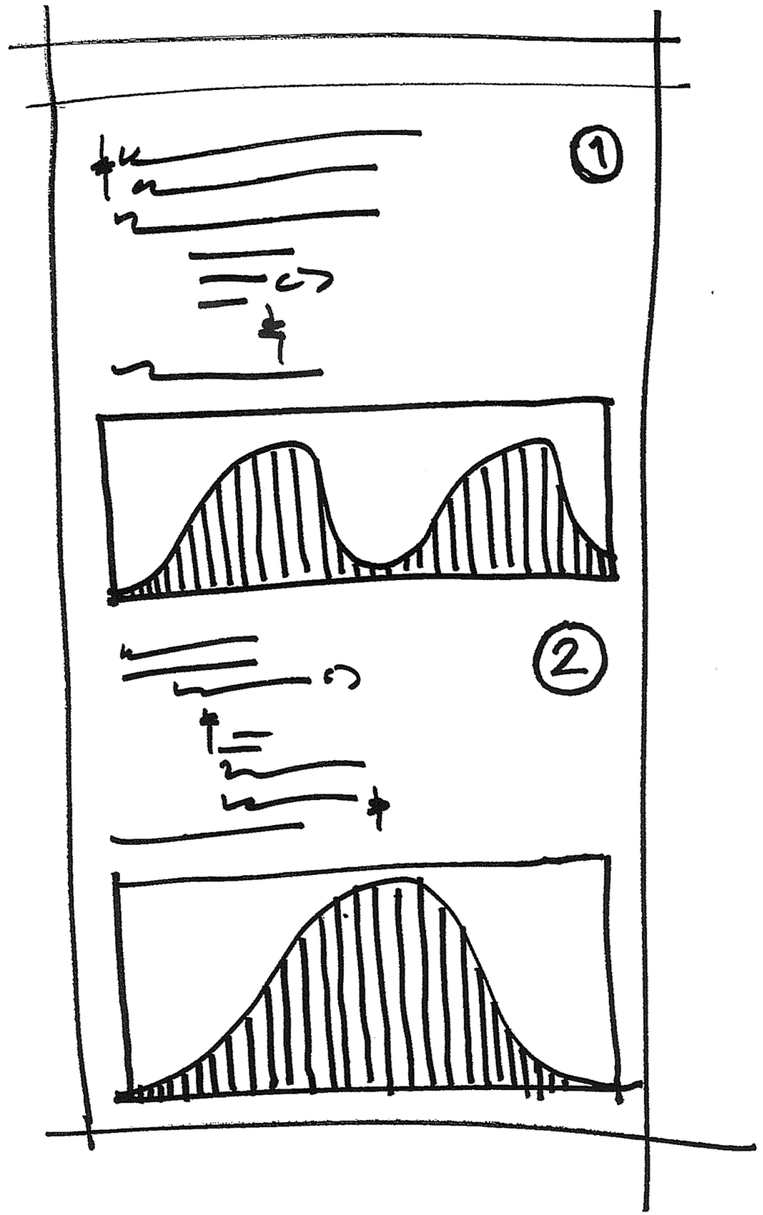


EDITABLE RESULT



4.1.9, 5.4.7, 4.2.4

QUERY & RESPONSE



1.2.4, 1.2.1, 1.2.6

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