Data Authoring Environments
An Overview
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.

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Dubberly Design Office · An Overview of Data Authoring Environments · July 2, 2018
Origins
Starting with “Strings”
Text Editors
The principle difference between line editors and display editors is that display editors provide instant feedback to user commands, whereas line editors require sometimes lengthy input before any effects are seen. The advantage of instant feedback, of course, is that if a mistake is made, it can be corrected immediately, before more damage is done. Editing in `ed` requires more strategy and forethought; but if you are up to the task, it can be quite efficient.

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 app = require('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.
```javascript
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) {
        const
```
Visual Studio Code

Microsoft
Notebooks

Query & Response Environments
Mathematica

Stephen Wolfram
Simple spectral analysis

An illustration of the Discrete Fourier Transform:

\[ X_k = \sum_{n=0}^{N-1} x_n e^{-\frac{2\pi i k n}{N}} \quad k = 0, \ldots, N-1 \]

using windowing, to reveal the frequency content of a sound signal.

We begin by loading a datafile using SciPy's audio file support:

```python
In [1]: from scipy.io import wavfile
   ...:
   ...: rate, x = wavfile.read('test_mono.wav')
```

And we can easily view its spectral structure using matplotlib's built-in `specgram` routine:

```python
In [2]: fig, (ax1, ax2) = plt.subplots(1, 2, figsize=(12, 4))
   ...:
   ...: ax1.plot(x); ax1.set_title('Raw audio signal')
   ...:
   ...: ax2.specgram(x); ax2.set_title('Spectrogram');
```

Fernando Pérez
Fernando Pérez and Others
Tonic/RunKit

Francisco Tolmasky
Observable

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
1.3.2

ThingLab 1977

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GeometricObject

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Alan Borning
Austin Henderson at Xerox PARC
Hypercard 1987-1998

Bill Atkinson for Apple
ToolBook

Asymetrix (Later SumTotal Systems)
1.3.6

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

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.
Microsoft
Atlassian (Suite) 2002-Today

Mike Cannon-Brookes and Scott Farquhar
This Season’s Featured Artists

Mike Cannon-Brookes and Scott Farquhar

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Apple
Apollo 11

Summary
This is a research paper about the Apollo 11 moon mission in which Neil Armstrong, Buzz Aldrin, and Michael Collins landed at Tranquility Base on the moon. The Apollo 11 lunar module, AKA The Eagle, landed on the moon on July 20, 1969. When they landed, the message they sent back to Mission Control was “Tranquility Base here. The Eagle has landed.”

The Spacecraft
The Apollo 11 mission had three spacecraft: the Command Module Columbia, a Service Module, and the Lunar Module Eagle. Columbia was the only part of the spacecraft to return to Earth.

Design
The key NASA spacecraft involved in the Apollo 11 mission were the following: a Saturn V rocket, an Apollo CSM-107 (Command/Service Module) and an Apollo LM-5 (Lunar Module, AKA “The Eagle”).

Command module
The Command/Service Module (CSM) was one of two spacecraft, along with the Lunar Module, used for the United States Apollo program which landed astronauts on the Moon. It was built for NASA by North American Aviation. It was launched by itself into an Earth orbit, and then ejected with the Saturn IB launch vehicle, and three times by itself and nine times with the Lunar Module as part of the Apollo spacecraft assembly on the larger Saturn V launch vehicle, which was capable of landing it on the Moon.

Service module
The Service Module contained oxygen, water, and electric power for the command module. It also housed the service propulsion system. The module contained fuel for the spacecraft into lunar orbit and later landed it back.
Asana

Dustin Moskovitz and Justin Rosenstein

2008-Today
GitHub

Tom Preston-Werner for GitHub Inc (Now Microsoft)

2008-Today
Wave

Google

2009-2011
Trello

Joel Spolsky at Fog Creek (Later Atlassian)
Bits to Atoms

Computation meets Business & Industry
Spreadsheets

Functional Programming – with a visual interface – became the PC’s first ‘Killer App’
### VisiCalc

**1979-1983**

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**Subtotal** | 13155.50  
**9.75% Tax** | 1282.66   
**Total**     | 14438.16   

**Software Arts**
### Q1 Income

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Lotus Software
### Excel

Microsoft Excel - pairs.xls

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Source: [https://en.wikipedia.org/wiki/FIFA_World_Cup](https://en.wikipedia.org/wiki/FIFA_World_Cup)
Data Analysis

From Simple Languages to Expansive Environments and Hosted Compute Platforms
SAS Institute

1976-2013
Ross Ihaka and Robert Gentleman (Now the R Core Team)
Foundry

Palantir

-Foundry
Simulation
MATLAB

Cleve Moler, Steve Bangert and Jack Little for MathWorks

1984-Today
AVS Express

1991-Today

Advanced Visual Systems Inc
Ansys

1970-Today

ANSYS Inc
LabView

National Instruments

1986-Today
3D (Solid Geometry) Modeling
Rhino

Robert McNeel & Associates

1980-Today
Fusion 360

2013-Today

Autodesk
Design Machine
Creative Tools for Everyone
Graphics

Direct-Manipulation + Computer Graphics
Sketchpad 1963

Ivan Sutherland
Illustrator

Adobe Systems

1987-Today
Photoshop

1990-Today

Adobe Systems
Sketch

2010-Today

Bohemian Coding
Figma

2016-Today
Presentation

From Outline to Slides to Demo
Powerpoint

Sales Presentation for Fabrikam Headquarters Design

Microsoft

1987-Today
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

Microsoft

2000-2012
Ableton Live

2001-Today
GarageBand

Apple

2004-Today
Wick Editor

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

2017-Today
World Wide Web

Design & Development Environments
Dreamweaver

Macromedia (Later Adobe)
Squarespace

For those that don't know, Squarespace is a new website design tool that has become extremely popular over the past few years.

This tool is absolutely amazing and I use it every single day for my personal websites, and nearly all of my client websites. In fact I make a majority of my income doing Squarespace consulting.

Over two years ago I began building websites on Squarespace, and I have seen it grow and morph over time into one of the most robust website platforms on the internet.

**Why Squarespace is so great**

Anyone who has ever built a website before, or hired someone to build it knows that it can be extremely expensive. A custom coded site or Wordpress site can generally cost $3,000 and up. Then you also have expensive costs to maintain that site overtime with the constantly changing internet.

Anthony Casalena and Others
3.4.3

Wordpress

Automattic

2005-Today
iWeb 2006-2011

Apple
Yahoo! Pipes

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

2007-2015
iAd Producer

Apple

2010-2016
JSFiddle

Oskar Krawczyk, Piotr Zalewa
CodePen

Tim Sabat, Alex Vazquez, Chris Coyier
Webflow

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

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

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

2001-Today
Lauren McCarthy at MIT (Now at UCLA, Dept. of Design Media Arts)
Digital Drawing

Painterly Approaches + Computational Methods
The Manual Input Workstation

Golan Levin and Zachary Lieberman
Alchemy

Karl D.D. Willis and Jacob Hina
Georg Petschnigg, Andrew S. Allen, Julian Walker and Jonathan Harris for FiftyThree
Bleank
Dynamic Brushes

Tablet-based Drawing Interface

Node.js server to facilitate communication

PC-based Authoring Interface

Jennifer Jacobs
Lightbox
Visual Interfaces

Across the (Design-Development) Divide
Node-Based (Graph)

Environments afford the Visual Authoring of Programs
4.1.1

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

Pierre-Olivier Latour for PixelShox (Acquired by Apple)

2002-2003
TouchDesigner

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

2000-Today
4.1.8

NodeBox

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
Praxis Live

2012-Today

Praxis Live

Neil C Smith
Loligo

Vanja Cuk
Interaction Prototyping

Empower designers to Build ‘Working-Prototypes’
Net Lab Toolkit (NTK)

Philip van Allen at ArtCenter College of Design
Pixate

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

2013-2016
Origami Studio

2016-Today

Facebook
Avocado for Quartz Composer  

Marco Triverio at IDEO LABS
Framer Studio

Koen Bok and Jorn van Dijk for Framer

2013-Today
Form

Max Weisel for RelativeWave (Acquired by Google)
Noodl 2014-Today

Topp Design
René

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

Epic Games
ShaderForge for Unity 2013-2018

Freya Holmér
Lens Studio

Snap Inc

2017-Today
AR Studio

2017-Today
Lobe AI

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

Brett Jones, Kevin Karsch and Rajinder Sodhi
Design-Development Toolchain Integration

Has decreased the distance between Design & Engineering
Paint Code

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

2016-Today
Abstract

Elastic Projects

2016-Today
React Studio

2017-Today

Neonto Ltd
Compositor Lab

- Aa The quick brown fox jump...
- Aa The quick brown fox jumps over the...
- Aa The quick brown fox jumps over the lazy ...
- Aa The quick brown fox jumps over the lazy dog
- Aa The quick brown fox jumps over the lazy dog

2017-Today

Compositor Inc
Meet Alva,
a radically new digital design tool built
for cross-functional product teams.

Alva lets you design interactive products
based on the same components your
engineers are using for production websites.

Built from ground up with an
entirely new workflow in mind.

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

Google and MIT Computer Science and Artificial Intelligence Lab
Luna Studio

Wojciech Daniło, Marcin Kostrzewa

2017-Today
AppMaker

- 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.
Dynamic Modeling Tools

Support System Visualizing
Mendix Business Modeler

2005-Today

Mendix
Kumu

Jeff and Ryan Mohr for Kumu Inc
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.
IDE: Environments & Experiments
What Is & What’s Next
Traditional IDEs

Integrated Development Environments

Cooper Software for Microsoft
Visual Studio

1997-Today
Xcode

2003-Today

Apple
Android Studio

Google

2013-Today
Structure Editing

At Nested Levels of Abstraction
Scheme Bricks
Code Bubbles for Eclipse

Computer Science at Brown University

2010
Work Flow

Step-based Programming
Automator

2005-Today

Apple
IFTTT

When new video is uploaded, automatically creates new post with video embed on your blog

Twitter DM thanks for follow + newsletter promotion

created June 27, 2012
last triggered 1 day ago
triggered 48 times

Alexander Tibbets, Linden Tibbets
Siri Shortcuts

Apple
Visible State Editors

Introduce Transparency to Traditional Programming
Whyline

Andrew Ko at Carnegie Mellon University (HCI Institute)
Learnable Programming (Essay) 2012

Bret Victor
Media for Thinking The Unthinkable (MSP)

2013

Bret Victor
### Xcode Playgrounds

#### 2015–Today

**Newton's Cradle and UIKit Dynamics**

This playground uses UIKit Dynamics to create a Newton's Cradle. Commonly seen as a toy to the young, Newton's Cradles are a device that illustrates conservation of momentum and energy.

Let's create an instance of our UIKit Dynamics based Newton's Cradle. Try adding more colors to the array to increase the number of balls in the device.

```swift
let newtonsCradle = NewtonsCradle(dynamics: [UIB, IB, IB, IB])
```

#### Behavior

Adjust elasticity and resistance to change how the balls react to collisions.

```swift
newtonsCrAdle.cradleNewton.elasticity = 0.6
newtonsCrAdle.cradleNewton.resistance = 1.8
```

#### Shape and rotation

![Newton's Cradle and UIKit Dynamics](image)

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**Apple**
Reza Ali

Fragment 2017
CityScope

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
5.5.1

Drawing Dynamic Visualizations

Bret Victor

2013
ShaderShop

Toby Schachman for Communication Design Group at SAP
Appaaratus

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

Softimage, Co.

1988-2001
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

Side Effects Software Inc

1996-Today
Blender
Maya

1998-Today

Alias Systems Corporation (Later Autodesk)
Learnable Programming

Offers a ‘Gentle Introduction’
Turtle

Seymour Papert and Others at the MIT Logo Lab

1969
Q-Basic

Microsoft
LEGO Mindstorms RCX

1998-2006

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

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

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

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

2017-Today

Sony
Toio

Sony
2017-Today
Joy-Con Garage

2018-Today

Nintendo
Game Authoring

From video games to VR/AR/MR
StarEdit

Blizzard Entertainment
Alice

Randy Pausch and Others at Carnegie Mellon University
GameMaker

Mark Overmars
Unreal Engine

Epic Games

1998-Today
Unity

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

Linden Lab
Spore

Maxis

2008
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

Rockstar Games

2013
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

Markus Persson, Jens Bergensten at Mojang
SimCity (Series)

1989-2014

Various
Tiny Wheels

Robbie Tilton

2017
Dreams

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 Architecture at Technische Universität München
DesignSpace 2016

Thomas Van Bouwe
VR Editor for Unreal Engine

Epic Games

2016-Today
TiltBrush

Google

2016-Today
Tomáš Mariancik
ArchiCAD (Predictive Design)  

Graphisoft SE (Part of the Nemetschek Group)
Local Simulation

(i.e. Urban, Regional, etc)
Gotham

2004-Today

Palantir
CartoDB

2011-Today
MARK43 Computer Aided Dispatch

2012-Today

Mark43 Inc
UrbanFootprint

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

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

Boeing

2016
GE Predix (Digital Twin) 2016-Today

General Electric and ANSYS
Hololens App: Air Force Asset Planning

Royal Australian Air Force
CREATE (Community Robotics, Education and Technology Empowerment) Lab at Carnegie Mellon University
Replica

Sidewalk Labs (Part of Alphabet)
Global View

‘Macroscopes’
DigitalGlobe AnswerFactory

DigitalGlobe (Part of MAXAR)
ArcGIS

1999-Today

Esri
Google Earth

Intrinsic Graphics (Later Keyhole Inc, Google)
Orbital Insight

Orbital Insight Inc 2013-Today
Design Patterns
Preliminary Sketches
THE MODEL

DATA/LOGIC

VIEW

\[ f(x) = \text{SUM}(\cdot) \]

2.1.3, 2.2.3, 2.4.3

DATA/LOGIC LAYER
MULTIPLE VIEWS

5.4.9, 5.4.3, 4.3.2, 7.2.1
LIVE COMPILE

LIVE "FIDDLE"

X
Y
Z

EDITABLE RESULT

X: 2.2
Y: 6.0
Z: 3.4

4.1, 5.4, 7.4, 4.2, 4
QUERY & RESPONSE

1.2.4, 1.2.1, 1.2.6