Knut M. Synstad @knutsynstad

Hello, I'm Knut. A designer that codes.

Work in systems/UX/UI. Exploring AI/ML.

Formerly electronics in Norwegian Navy.



Computation and AI is of increasing importance for design.

As a:

- **Tool**, augmenting the design process.
- **Medium**, for sharing information.
- Material, to be shaped into products.

After Hugh Dubberly





There are many exciting examples ...





A visual introduction to machine learning By Stephanie Yee and Tony Chu

Machine learning is ...

"the science of getting computers to act without being explicitly programmed."

-Stanford University

Year

2015

Address

<u>r2d3.us/visual-intro-to-machine-learning-part-1/</u>



R2 D3

A visual introduction to machine learning

🔇 English

In machine learning, computers apply statistical learning techniques to automatically identify patterns in data. These techniques can be used to make highly accurate predictions.

Keep scrolling. Using a data set about homes, we will create a machine learning model to distinguish homes in New York from homes in San Francisco.





☆ 👴 :



How to Use t-SNE Effectively By Martin Wattenberg, Fernanda Viégas, and Ian Johnson

t-Distributed Stochastic Neighbor Embedding (t-SNE) is ...

"a technique for dimensionality reduction that is particularly well suited for the visualization of high-dimensional datasets." -Laurens van der Maaten

Year

2016

Address

distill.pub/2016/misread-tsne/

How to Use t-SNE Effectively

Although extremely useful for visualizing high-dimensional data, t-SNE plots can sometimes be mysterious or misleading. By exploring how it behaves in simple cases, we can learn to use it more effectively.



MARTIN WATTENBERG Google Brain FERNANDA VIÉGAS Google Brain IAN JOHNSON Google Cloud Oct. 13 2016 Citation: Wattenberg, et al., 2016

A popular method for exploring high-dimensional data is something called t-SNE, introduced by van der Maaten and Hinton in 2008 [1]. The technique has become widespread in the field of machine learning, since it has an almost magical ability to create compelling two-dimensional "maps" from data with hundreds or even thousands of dimensions. Although impressive, these images can be tempting to misread. The purpose of this note is to prevent some common misreadings.



Font Map By Kevin Ho (IDEO)

Year

2017

Address

fontmap.ideo.com/

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View on Google Fonts

Similar Fonts

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It made me wonder...





What would it take to organize the logos of the Fortune 500, by visual similarity?







Turns out, a lot.

A sequence of data transformations are needed.

- 1. Data wrangling
- 2. Feature detection
- 3. Feature selection
- 4. Distance matrix
- 5. Dimensionality reduction
- 6. Linear assignment
- 7. Data visualization

Let's go through them step-by-step.

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1. Data wrangling

Every summer, Fortune Magazine publishes its Fortune 500 list online.

Address fortune.com/fortune500/2017/

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Search Fortune 500 2017

Results

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RANK	NAME	REVENUES (\$M)	REVENUE PERCENT CHANGE	PROFITS (\$M)	PROFITS PERCENT CHANGE	ASSETS (\$M)	MARKET VALUE — AS OF MARCH 31, 2017 (\$M)	EMPLOYEES
1	Walmart	\$485,873	0.8%	\$13,643	-7.2%	\$198,825	\$218,619	2,300,00
2	Berkshire Hathaway	\$223,604	6.1%	\$24,074	0.0%	\$620,854	\$411,035	367,700
3	Apple	\$215,639	-7.7%	\$45,687	-14.4%	\$321,686	\$753,718	116,000
4	Exxon Mobil	\$205,004	-16.7%	\$7,840	-51.5%	\$330,314	\$340,056	72,700
5	McKesson	\$192,487	6.2%	\$2,258	53%	\$56,563	\$31,439	68,000
6	UnitedHealth Group	\$184,840	17.7%	\$7,017	20.7%	\$122,810	\$157,793	230,000
7	CVS Health	\$177,526	15.8%	\$5,317	1.5%	\$94,462	\$81,310	204,000
8	General Motors	\$166,380	9.2%	\$9,427	-2.7%	\$221,690	\$52,968	225,000
9	AT&T	\$163,786	11.6%	\$12,976	-2.8%	\$403,821	\$255,679	268,540
10	Ford Motor	\$151,800	1.5%	\$4,596	-37.7%	\$237,951	\$46,349	201,000
11	AmerisourceBergen	\$146,850	8%	\$1,427.9	-	\$33,656	\$19,229	18,500



With a spreadsheet as a reference, vector logos were collected.

Many came form WikiMedia, some from corporate websites, and even annual reports.

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	035	Johnson & Johnson	yes								
	036	Procter & Gamble	yes								
	037	Valero Energy	yes								
	038	Target	yes								
	039	Freddie Mac	yes								
	040	Lowe's	ves								



1. Data wrangling

Artwork came from multiple sources, and in multiple file formats, requiring some standardization.

- Crop to fit.
- Convert to a uniform file format (SVG)
- Remove non-essential tags (e.g., vendor tags)
- Generate uniformly sized bitmap images (PNG)



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2. Feature detection

Intimidated by neural networks, I tried, and immediately failed, to describe the logos by hand ...

	-							
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	6	UnitedHealth Group	UnitedHealth Group	TRUE	sans	033D6E		
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	13	Verizon	Verizon	FALSE	sans	CD030A		
	14	Chevron	Chevron	FALSE	sans	0056A2		
	15	Costco	Costco WHOLESALE	FALSE	sans	E31837		
	16	Fannie Mae	Fannie Mae	FALSE	slab	000F2B		
	17	Kroger	Kroger	FALSE	sans	0067B1		
	18	Amazon.com	Amazon	FALSE	sans	FF9900		
	19	Walgreens Boots Alliance	Walgreens Boots Alliance	FALSE	sans	232C64		
	20	Hewlett-Packard Company	hp	FALSE	sans	0096D6		
	21	Cardinal Health	CardinalHealth	FALSE	sans	E41F35		
	22	Express Scripts Holding	EXPRESS SCRIPTS	FALSE	sans	1162A5		
	23	J.P. Morgan Chase	JPMorgan Chase & Co	TRUE	serif	414141		
	24	Boeing	BOEING	FALSE	sans	1D439C		
	25	Microsoft	Microsoft	FALSE	sans	737373		
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	27	Wells Fargo						
	28	Home Depot						
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2. Feature detection

I was bound to fail.

"Humans rarely choose things in absolute terms. We don't have an internal value meter that tells us how much things are worth.

Rather, we focus on the relative advantage of one thing over another, and estimate value accordingly."

-Dan Ariely

Professor of Psychology and Behavioral Economics at Duke University "Predictably Irrational" 2018



2. Feature detection

I used Keras, Tensorflow, and a pre-trained general-purpose image classification model, to describe each logo's shape.

Language Python

Model ResNet50 Input: 1024×1024 px png

Walmart **X**

Output: Quantified presence of 2048 features

0.02772	0.00000	0.00000	0.00000	1.09299	0.00000
0.01938	0.55155	0.00009	0.00014	0.00000	0.00000
0.33905	0.10659	1.46157	0.08142	0.00411	0.00000
0.00000	0.36360	0.00000	0.03051	1.01659	0.05828
0.10766	0.00000	0.68964	0.00040	0.00000	1.51671
0.01628	0.00000	0.01213	0.00000	0.00000	0.00000
0.06907	0.00000	0.00892	0.00000	0.06411	0.08882
0.00000	0.00000	0.00000	0.02236	0.00000	0.05602
0.06424	0.00000	1.22857	1.15797	0.20735	0.49470
0.09517	0.11458	0.00000	0.00105	0.09719	1.76852
0.05036	0.00000	0.00000	0.00509	0.00000	0.00000
0.00000	0.14901	0.00000	0.00000	0.07446	0.25466
0.40862	0.00000	0.00000	0.01263	0.00183	0.12038
0.00457	0.00000	0.06357	0.37006	0.34136	0.02781
0.05190	0.05535	0.00000	0.00242	0.00000	0.00000
0.00065	0.00000	0.00000	0.01920	0.00000	0.00000
0.23270	0.0000	0.10789	0.00000	0.0000	4.78532



The top two colors were found using k-means clustering.

K-means clustering attempts to partition all colored pixels into k clusters of "similar" appearance.



Input: 1024×1024 px png

Walmart >

Output: Two most prominent colors as RGB values

0 124.86442 197.96974	255 194.16913 31.88876
#007DC6	#FFC220





For each logo, thousands of features were generated

2048 from neural network

- + 6 from k-means clustering
- = 2054 features



The neural network also produced some "noise." This was removed through principal component analysis (PCA).

- 2048 from neural network
- 1998 PCA
- 50 features describing shape
- 6 features describing color ╋
- 56 features



4. Distance matrix

To combine the two feature sets, they must first be normalized independently.



Each feature is a dimension for describing a logo. Together, they form an n-dimensional space—the "space of logos."

This enables calculating the Euclidean distance between two points (logos) within the spacea measurement of their similarity.

$$d(\mathbf{p},\mathbf{q}) = \sqrt{(p_1-q_1)^2 + (p_2-q_2)^2 + \dots + (p_i-q_i)^2 + \dots + (p_n-q_i)^2 + \dots$$



$$\overline{(q_n)^2} = \sqrt{\sum_{i=1}^n {(p_i-q_i)^2}}.$$



Calculating all pairwise distances yields a distance matrix.

Walmart	Berkshire Hathaway	Apple	Exxon Mobil	McKesson	UnitedHealth Group	CVS Health	
0	22.65585	30.05652	20.74215	14.98730	19.48658	26.64625	Walmart
22.65585t	0	20.30818	15.83581	17.60751	11.07304	32.29748	Berkshire Hathaw
30.05652	20.30818	0	25.22732	28.32987	20.34397	37.80716	Apple
20.74215	15.83581	25.22732	0	17.84799	16.52740	26.67482	Exxon Mobil
14.98730	17.60751	28.32987	17.84799	0	14.83402	30.27049	McKesson
19.48658	11.07304	20.34397	16.52740	14.83402	0	32.93077	UnitedHealth Grou
26.64625	32.29748	37.80716	26.67482	30.27049	32.93077	0	CVS Health
27.11042	31.06151	37.25250	29.44294	28.88743	31.78418	31.17721	General Motors
49.49596	53.56491	54.49421	53.04318	51.71548	52.81218	51.24819	AT&T



up



5. Dimensionality reduction

Reducing the dimensionality of the distance matrix results in a point cloud that can be plotted.

Algorithm t-SNE

Steps

750

Epsilon 10

Perplexity 20



5. Dimensionality reduction

Each point corresponds with a Fortune 500 company logo and can be replaced by their logo.

Still need to resolve:

- Boundary violations
- Overlapping logos







Introducing a grid to align points solves both problems.

Pairing cells and points is an assignment problem a form of optimization.

Cells per side 30

Number of cells 900







6. Linear assignment

Each point is assigned to a cell. The further a point moves, the more it distorts the data.

The goal is to achieve the lowest overall distortion.

Algorithm Jonker-Volgenant

Cells per side 30







6. Linear assignment

Result of the linear assignment.

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6. Linear assignment

This output is one of many in a "space of solutions."

By surfacing parameters, users can manipulate the outcome.



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For manipulation of the solution space to be possible, it must be wrapped in a larger context—a user interface.





An interactive exhibit requires some transformations to be calculated live—in the browser.

- 1. Data wrangling
- 2. Feature detection
- 3. Feature selection
- 4. Distance matrix
- 5. Dimensionality reduction
- 6. Linear assignment
- 7. Data visualization

Pre-calculated

Live

It simply isn't feasible to calculate it all in the main UI thread it would block the UI, or worse, crash the browser. The heavy lifting must be moved to additional threads.



Time



7. Data visualization

The result is an interactive visualization, where users can adjust the parameters, to find similarities and differences, in the logos of the Fortune 500.

Let's take a look: fortune500.knutsynstad.com

Source code github.com/knutsynstad/fortune500



Special thanks to Hugh Dubberly Ryan Keisler Cody Wackerman

Knut Synstad @knutsynstad

Presentation posted at knutsynstad.com/fortune500.pdf

Appendix



Abstract

This interactive visualization uses a neural network to analyze a set of logos (in this case the Fortune 500), find similarities and differences, and display the results. Users can adjust the parameters of the display format. The related paper describes how the code works (the analysis and display process). Code is available, enabling others to replicate the process, apply it to their own data sets (other sets of symbols), or to extend it to other uses.

Introduction

Much of what designers are called upon to do involves looking at how artifacts or features "fit-in" and "stand-out". That is, designers are often concerned with similarity and difference—seeing them, understanding them, and manipulating them. For example, a new icon must fit into a system and also be distinct from it.

A common step in developing products and identity systems is to collect examples from competitors and discuss them with clients. Now, software can chead up the process, while also enabling inclusion of much larger data set

Calculating visualization

Step 186 of 250 (74%)

Start exploring

Abstract

This interactive visualization uses a neural network to analyze a set of logos (in this case the Fortune 500), find similarities and differences, and display the results. Users can adjust the parameters of the display format. The related paper describes how the code works (the analysis and display process). Code is available, enabling others to replicate the process, apply it to their own data sets (other sets of symbols), or to extend it to other uses.

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A common step in developing products and identity systems is to collect examples from competitors and discuss them with clients. Now, software can chead up the process, while also enabling inclusion of much larger data set

Start exploring



Instructions

- Scroll to change zoom level

- Click-and-drag to move (pan)

- Click the edit icon to manipulate

CROWN PATTERSON

Edit —







CROWN PATTERSON

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Epsilon	Learning rate.
Perplexity	A guess about the number of visually similar neighbors each logo has.
Steps	Solution improves with every step, but the calculation takes longer.
Enable	Align to grid.
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TEXTRON OSHKOSH Charter

Using machine learning to discover visual patterns in the logos of the highest earning companies in America, the Fortune 500.

Visualizations are calculated in real time, enabling viewers to tune the knobs and dials of the underlying algorithms.

The code is available on GitHub.





Thanks to Fortune Magazine Ryan Keisler Hugh Dubberly Cody Wackerman

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Monica Miller DDO

Created by

Knut M. Synstad





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