Madeline Thomas
BIOS 611
Final Project

Quantifying and Categorizing ***Frutiger Aero*** and Related Aesthetics

Powerpoint template (free) from : https://www.smiletemplates.com

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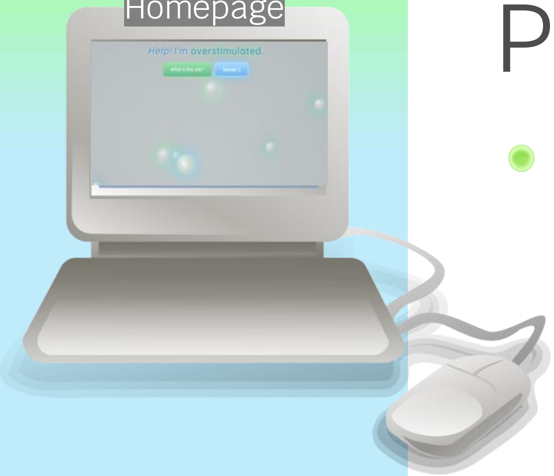
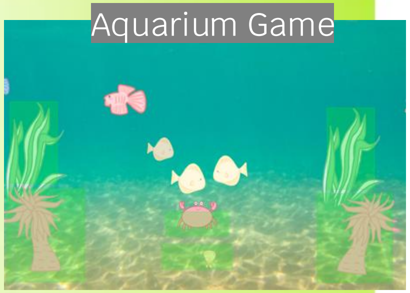
Hello!

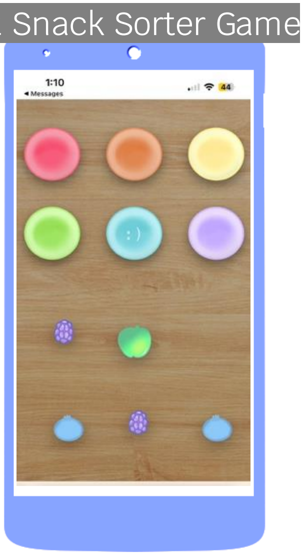
- My name is Madeline
- I’m a scientist ⌬
- I work in a computational chemistry lab
  - which I have come to realize is just data science + some clever computational techniques applied to chemistry
- I also love art + **design!**
- In the past year, I became interested in an aesthetic called *Frutiger Aero*

https://frutigeraeroarchive.org/wallpapers


Homepage


Aquarium Game

Project Motivation


Fruit Snack Sorter Game

- I am making a **website** (not live yet)
  - All HTML and JS based
  - mobile and desktop compatible
- A collection of browser-based login-free, ad-free, and free-free games designed to calm you down when you are overwhelmed (not be addictive)
- Made with art drawn by ME!
  + music by the amazing Alzea
- This website is also inspired by *Frutiger Aero*
  1. Because I like it
  2. Because many people report a nostalgic, calming effect when engaging with this style of media

https://www.reddit.com/r/FrutigerAero/comments/1dchju4/why_does_frutiger_aero_make_me_feel_this_way/
https://www.reddit.com/r/FrutigerAero/comments/171eak1/how_does_frutiger_aero_make_you_feel_what_does_it/
https://medium.com/@mitalisechochamber/frutiger-aero-and-the-nostalgia-of-early-2000s-tech-a-bittersweet-reminiscence-a60f9c1c3726

Project Motivation

- Hence, I have been looking at lots of *Frutiger Aero* – related media for inspiration

- As I told people about my project, many of them asked me, what is *Frutiger Aero*?
  - Honestly, this was hard to answer without showing photos

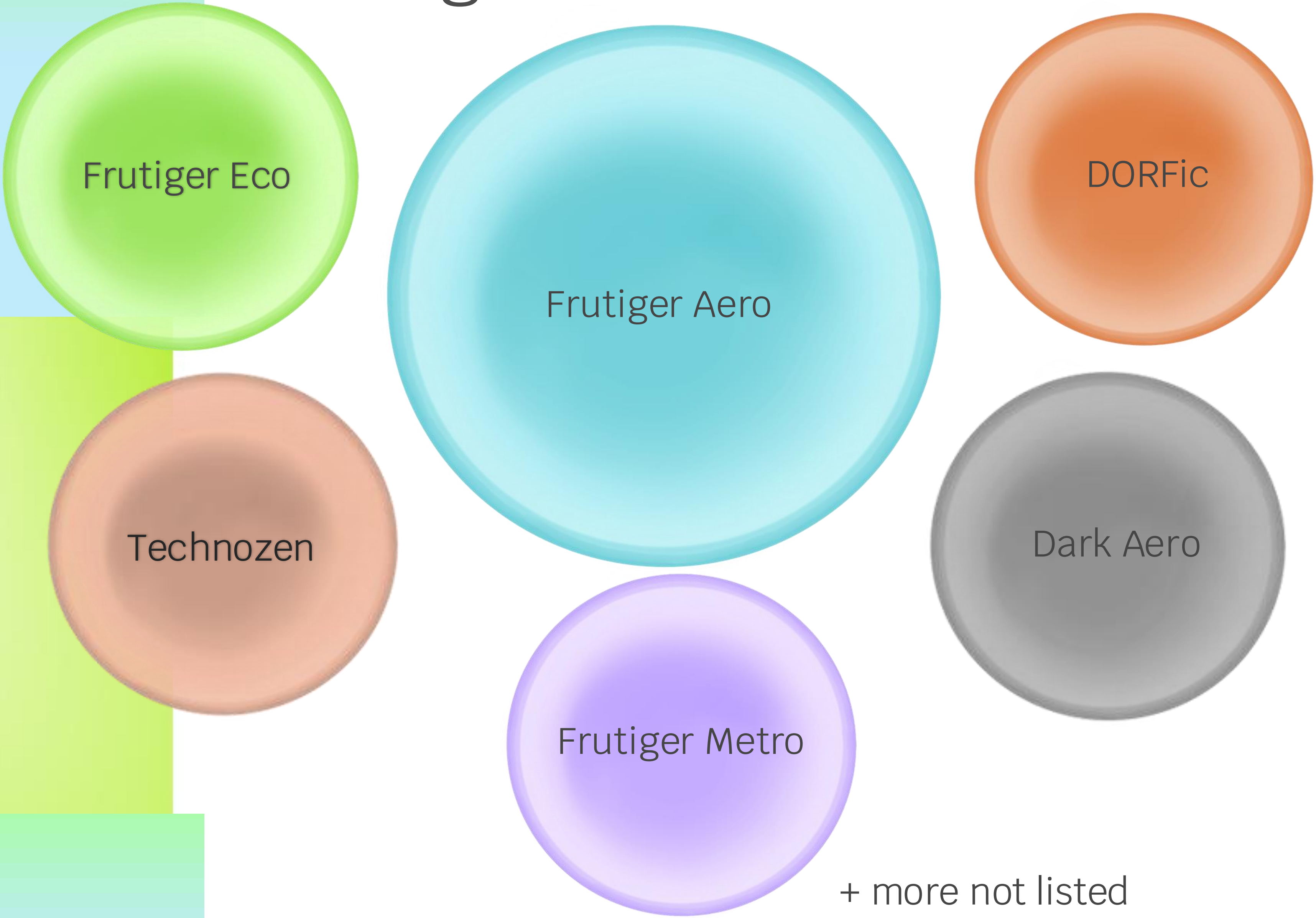
Which got me thinking…

Is there a way I could understand this aesthetic more *scientifically*?

In other words, could I quantify and categorize *Frutiger Aero* and its related aesthetics?

- First, I needed to understand precisely what sort of data (media) I would need to gather and how I would label it

Background



Frutiger Eco

Frutiger Aero

DORFic

Technozen

Dark Aero

Frutiger Metro

+ more not listed

Frutiger Aero

2017

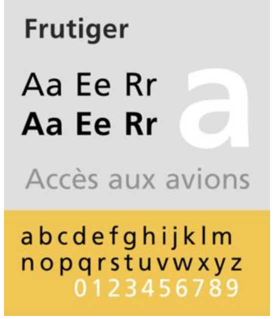
by Sofi Xian

Background

A retrospective, internet-created aesthetic label describing a specific movement from the mid-2000s to the early-2010s

Adrian Frutiger

: a Swiss designer who created the Frutiger typeface in 1976 (+other typefaces)



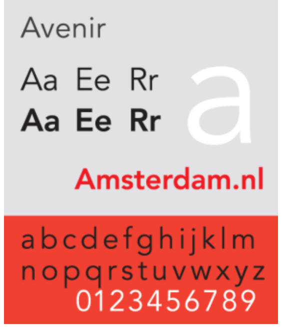
Frutiger

Aa Ee Rr
Aa Ee Rr

a

Accès aux avions

abcdefghijklm
nopqrstuvwxyz
0123456789



Avenir

Aa Ee Rr
Aa Ee Rr

a

Amsterdam.nl

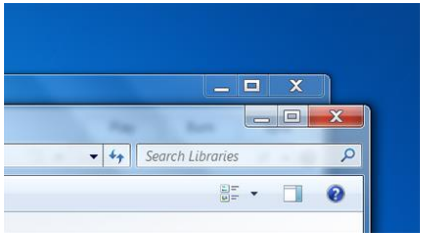
abcdefghijklm
nopqrstuvwxyz
0123456789

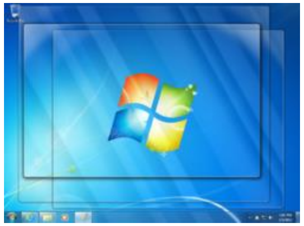
FRUTI
GER
STONES

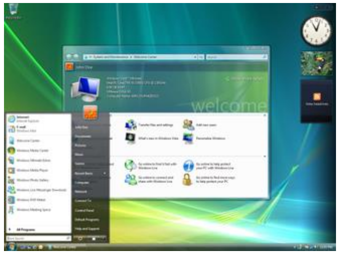
Windows Aero

: Microsoft's design language introduced with *Windows Vista* (2006) and *Windows 7* (2009)

A: Authentic **E**: Energetic **R**: Reflective **O**: Open







https://en.wikipedia.org/wiki/Frutiger_(typeface)
https://en.wikipedia.org/wiki/Adrian_Frutiger
https://en.wikipedia.org/wiki/Windows_Aero

DORFic

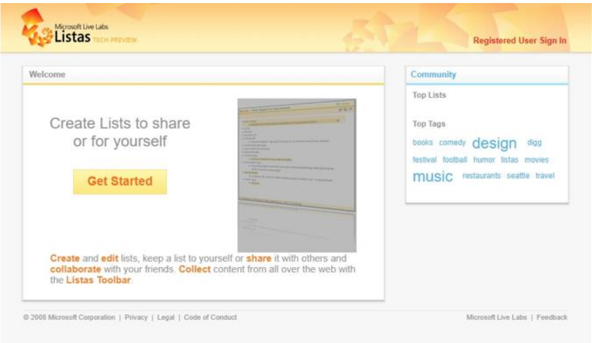
2023

On Aesthetics Wiki

Background

D O R Fic

Daylight Orange Red Graphic


Microsoft Live Labs Listas TECH PREVIEW

Registered User Sign In

Welcome

Create Lists to share or for yourself

Get Started

Create and edit lists, keep a list to yourself or share it with others and collaborate with your friends. Collect content from all over the web with the Listas Toolbar.

Community

Top Lists

Top Tags

books comedy design digg festival football humor listas movies music restaurants seattle travel

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Microsoft Live Labs | Feedback

Microsoft Office Standard 2007
Microsoft
Microsoft Office Word 2007
Microsoft
Microsoft Office PowerPoint 2007

https://aesthetics.fandom.com/wiki/DORFic

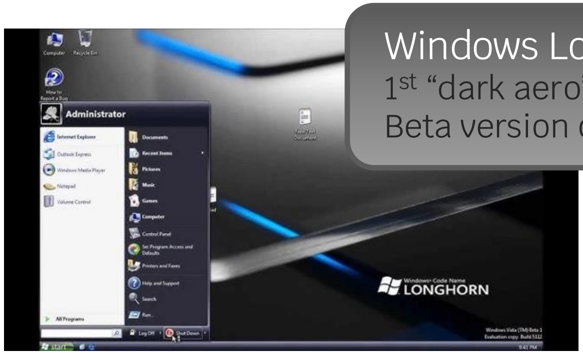
Background

Dark Aero

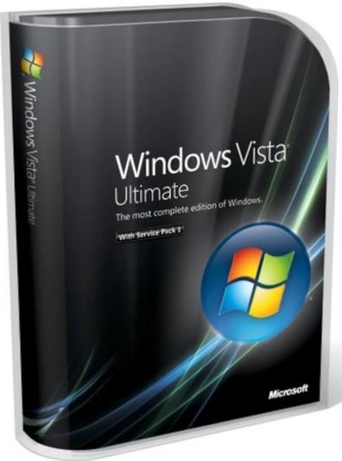
?

All the futuristic elements of Frutiger Aero *without* nature (more emphasis on technology)

Gaming



Windows Longhorn *(2001-2006)*
1st "dark aero"
Beta version of Windows Vista



Programming

DJs

https://aesthetics.fandom.com/wiki/Frutiger_Eco

Frutiger Metro

2023

On Aesthetics Wiki

Background

vector graphics

clean geometric outlines

maximalist, non-photorealistic design

https://www.google.com/search?client=safari&rls=en&q=frutiger+metro&ie=UTF-8&oe=UTF-8

Background

separate from the meaning of “Zen” in Buddhism
➔ more associated with the west’s interest in minimalist Asian aesthetics

Technozen
?

Influenced by mid-late 2000s Japanese tech

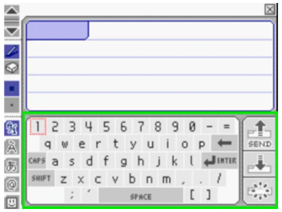
cozy, yet professional

harmony between **technology** and nature

✧ technology should *improve* life, not *dominate* it

minimalistic

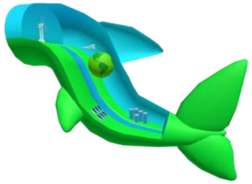
white light



https://aesthetics.fandom.com/wiki/Technozen

Frutiger Eco
?

Background



Eco

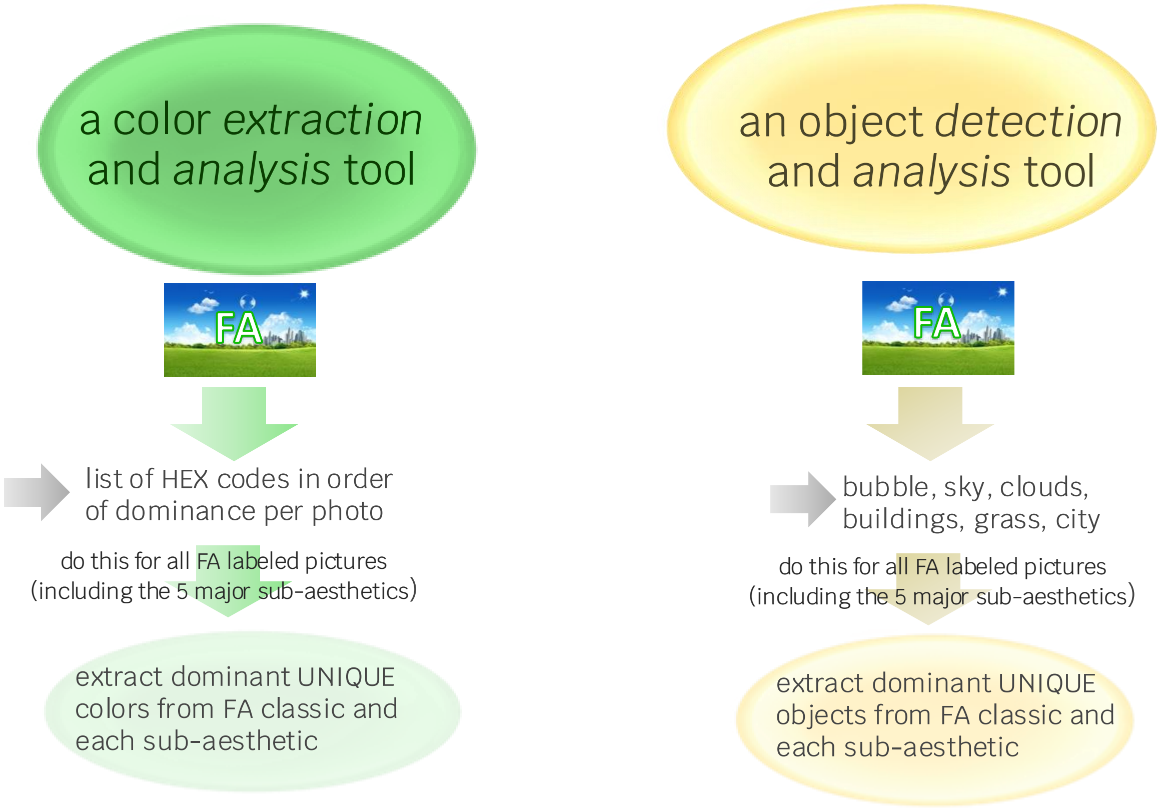
Stemming from ecology

- renewable energy
- futuristic, healthy coexistence with nature
- utopian future

https://aesthetics.fandom.com/wiki/Frutiger_Eco

Plan

- Goal: *quantify* and *categorize* Frutiger Aero and its related aesthetics
- *Build* (or *implement* externally) 2 tools:



a color *extraction* and *analysis* tool

list of HEX codes in order of dominance per photo

do this for all FA labeled pictures (including the 5 major sub-aesthetics)

extract dominant UNIQUE colors from FA classic and each sub-aesthetic

an object *detection* and *analysis* tool

bubble, sky, clouds, buildings, grass, city

do this for all FA labeled pictures (including the 5 major sub-aesthetics)

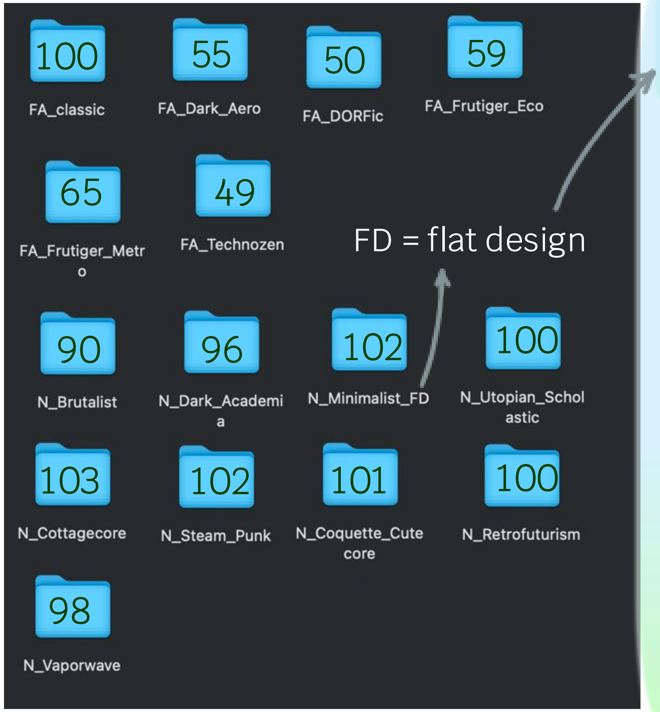
extract dominant UNIQUE objects from FA classic and each sub-aesthetic

Image Collection

Image *Sources*:

+ hand-labeled images

Images *Collected*:



100 FA_classic
55 FA_Dark_Aero
50 FA_DORFic
59 FA_Frutiger_Eco
65 FA_Frutiger_Metro
49 FA_Technozen
90 N_Brutalist
96 N_Dark_Academia
102 N_Minimalist_FD
100 N_Utopian_Scholastic
103 N_Cottagecore
102 N_Steam_Punk
101 N_Coquette_Cutecore
100 N_Retrofuturism
98 N_Vaporwave

FD = flat design

skeuomorphic design	flat design
digital object try to closely emulate their real-world counterparts	uses 2D elements, bright colors, and simple shapes with a focus on functionality

https://www.storyly.io/post/skeuomorphism-vs-flat-design

Image Pre-Processing

- Done for all image folders (FA_ and N_)

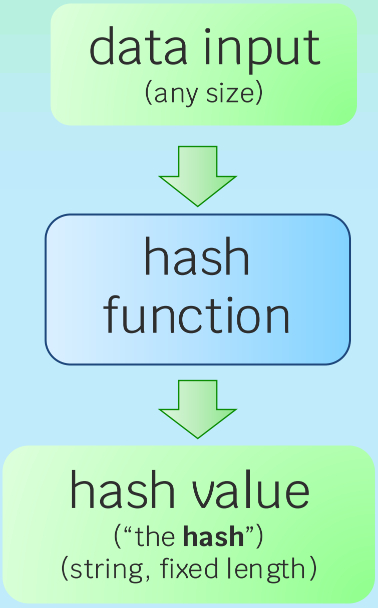
Pre-Processing:

- convert all images to PNGs
  - Language: Python
  - Library: Pillow (a PIL: Python Imaging Library fork)
  - Workflow:
    - load image
    - convert to RGB (standardize color)
  - save as .png

- compare all images to ensure no duplicates
  - Language: Python
  - Libraries: imagehash, Pillow
  - Workflow:
    - compute a hash (with average_hash()) per image
    - if a hash already exists in the image record -> delete the duplicate,

- rename images (by folder): 0.png, 1.png, …
  - Language: Bash

What is a *hash*?

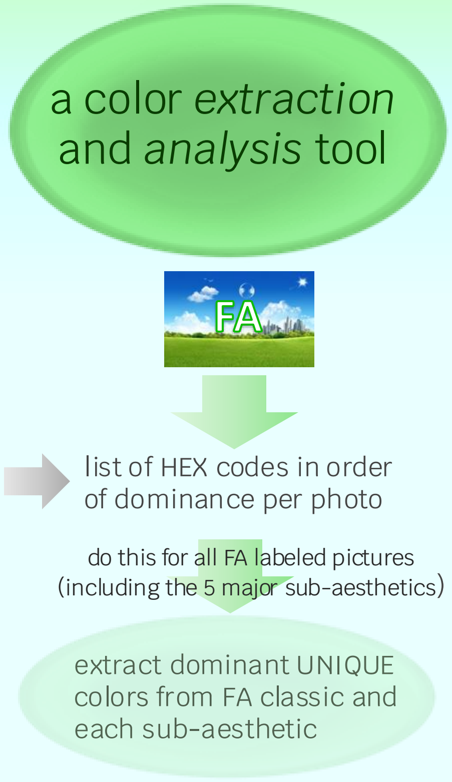


data input
(any size)

hash function

hash value
("the **hash**")
(string, fixed length)

*one-way (not reversible)
same input always produces the same hash (deterministic)



a color *extraction* and *analysis* tool

FA

list of HEX codes in order of dominance per photo

do this for all FA labeled pictures (including the 5 major sub-aesthetics)

extract dominant UNIQUE colors from FA classic and each sub-aesthetic

libraries

colorfindr
extracts colors from images

magrittr
the pipe operator (%>%)

grDevices
color conversion

Image Color Extraction

- Done only for folders under images starting with FA (classic + 5 sub-aesthetics)

Script:

extract_all_FA.R

- Libraries: colorfindr, dplyr, magrittr, grDevices
- Workflow
  - loop over all folders starting with FA and for each .png
  - load images and extract colors with get_colors()
  - expand pixels by frequency (weight by brightness)
  - apply k-means clustering (k=8) to group similar colors in RGB space
  - output the top 8 colors (hex) to #color.txt files (where for 1.png, #=1)

Image Color Extraction

a color *extraction* and *analysis* tool

list of HEX codes in order of dominance per photo

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Example

32.png

extract_all_FA.R

#99D855	#BCE69B	#5CAA2B
#D9F2EA	#B2E5EB	#86CBDE
#62AAC7	#387A9B	

(done for 350 images)

Image Color Analysis

- Done only for folders under images starting with FA (classic + 5 sub-aesthetics)

Script:

extract_FA_colors.R

- Libraries: dplyr, magrittr, grDevices, readr
- Workflow:
  - read all the *color.txt files under FA_* folders
  - convert hex to normalized RGB values
  - weight the colors by frequency across the images for a given folder
  - perform k-means clustering (k = 30) in RGB space
  - save cluster centroids (30 colors as hex codes) as the dominant aesthetic colors to colors.txt

a color *extraction* and *analysis* tool

list of HEX codes in order of dominance per photo

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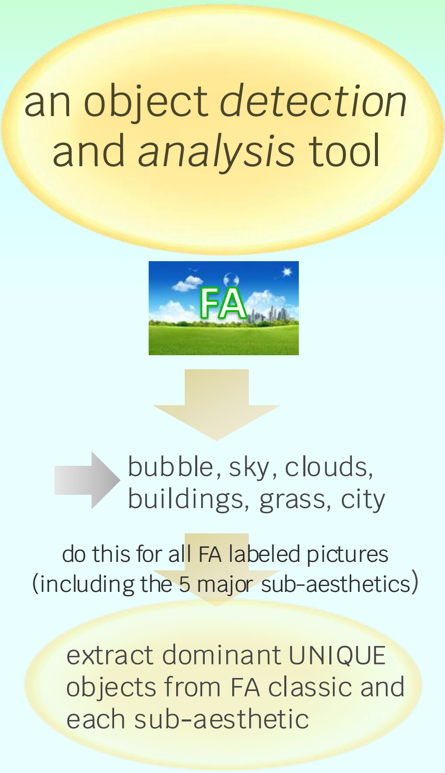
library

readr
efficiently read and write text files in R



an object *detection* and *analysis* tool

bubble, sky, clouds, buildings, grass, city

do this for all FA labeled pictures (including the 5 major sub-aesthetics)

extract dominant UNIQUE objects from FA classic and each sub-aesthetic

Image Object Detection

- Done only for folders under images starting with FA (classic + 5 sub-aesthetics)

Script:

FA_google_vision.py

- Libraries: pathlib, requests, base64, os
- Workflow
  - loop over all folders starting with FA and for each .png
  - read the image file and encode it in Base64
  - send to the Google Cloud Vision API for LABEL_DETECTION (with a max of 10 lablels)
  - receive a JSON response with the detected object labels with confidence scores
  - write the results to #object.txt files (where for 1.png, #=1)

https://docs.cloud.google.com/vision/docs/labels

an object *detection* and *analysis* tool

bubble, sky, clouds, buildings, grass, city

do this for all FA labeled pictures (including the 5 major sub-aesthetics)

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https://docs.cloud.google.com/vision/docs/labels

Image Object Detection

Google Cloud Vision API

- cloud-based ML service that analyzes image content

Base64

- a method to conver binary image data to plain text
- allows image to safely includes in your web request (JSON body)

JSON

- (JavaScript Object Notation)
- a text format for structured data exchange
- use for API requests and response

LABEL_DETECTION

- a feature of the Google Vision API that returns descriptive tags for images, each with a confidence score (0-1) showing how certain the model is

an object *detection* and *analysis* tool

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Image Object Detection

How does the Google Cloud Vision API's LABEL_DETECTION work?

1. Image Request

- image is sent to Vision API endpoint as a Base64-encoded string (put in JSON body)

2. Cloud Processing

- Google uses its pre-trained deep learning (DL) models to analyze the image with convolutional neural networks (CNNs)
- these DL models compare the visual features (colors, shapes, textures, etc.) to millions of examples
- finally, it predicts which entities are present in the image

3. JSON Response

- API returns a JSON object with a list of labelAnnotations, each with
  - description (human-readable name [sky])
  - *score* (confidence 0-1)
  - topicality (how central is the label to context of the image)
  - mid (optional Knowledge Graph ID for concept)

Image Object Detection

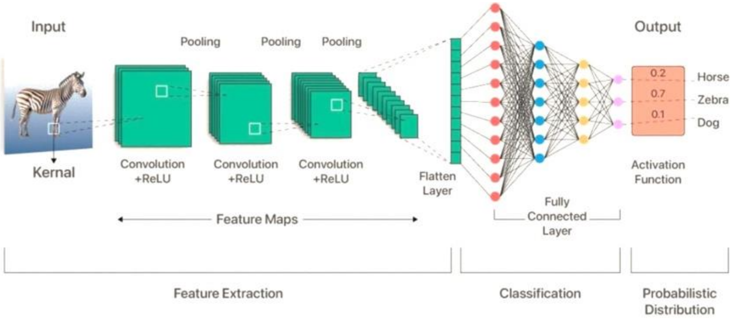
Deep Learning (**DL**)

a subtype of ML; uses *artificial neural networks* with many layers to learn complex patterns from large amounts of data

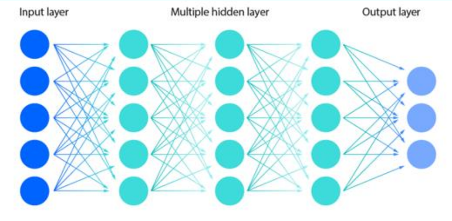
Convolutional Neural Networks(**CNN**s)

a subtype of DL; designed to analyze visual data

1. Convolutional Layer +ReLU
   : 1st, (+ intermediate), input, filter, feature map
   * convolution: moving across image and checking for patterns by region (receptive field); output = feature map (convolved feature)
   ***has many of these layers w/ increasing *receptive fields* (filter size + information from previous layers)
2. Pooling Layer
   : intermediate, conduct dim red on input parameters
3. Fully-connected Layer
   : final; performs classification w/ the features extracted + filters



artificial neural networks: many connected "neurons", each intermediate connection with a weight



filter (kernel)

small matrix of numbers (ex. 3x3) used by convolutions to detect patterns in images

ReLU (Rectified Linear Unit)

an *activation function* (a mathematical rule that determines how strongly a neuron should be activated) applied after each convolution (adds nonlinearity

$f(x) = \max(0,x)$

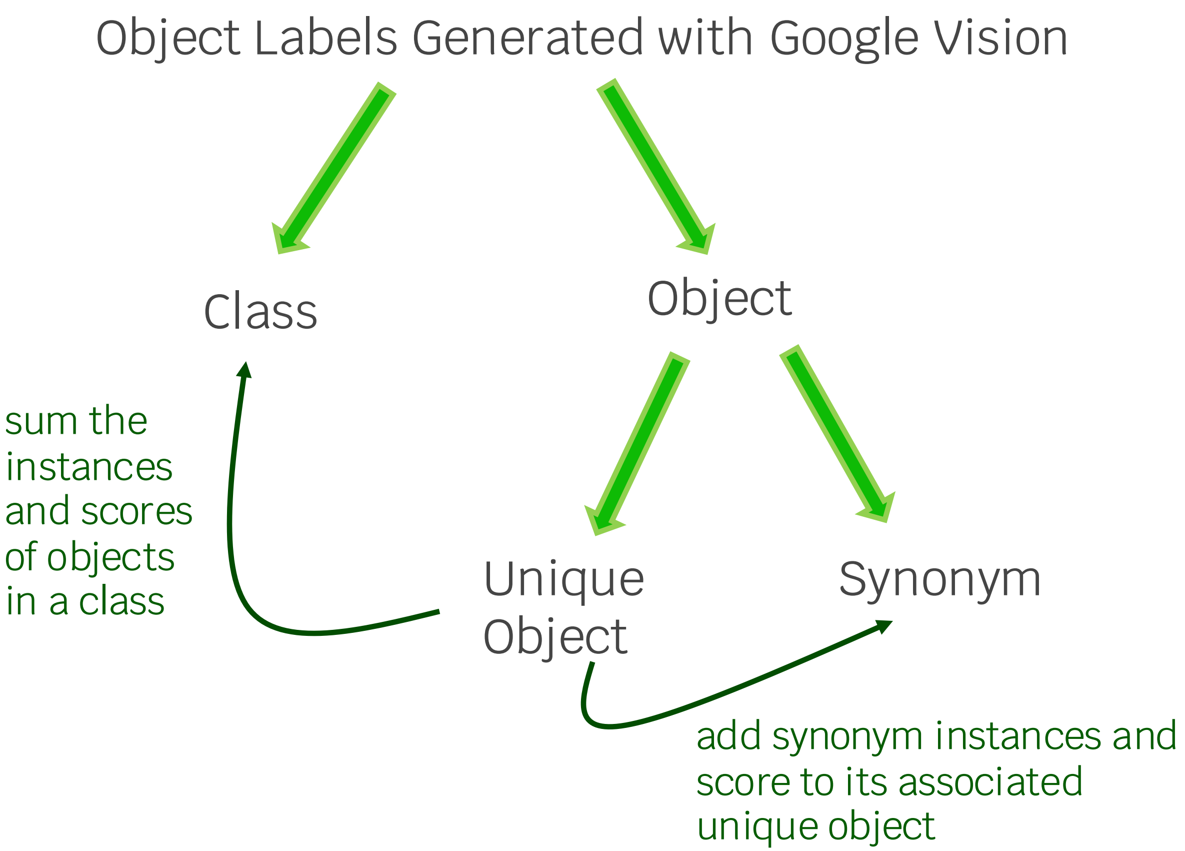
https://www.geeksforgeeks.org/artificial-intelligence/artificial-neural-networks-and-its-applications/

https://www.ibm.com/think/topics/convolutional-neural-networks

Image Object Analysis

- Done only for folders under images starting with FA (classic + 5 sub-aesthetics)

Characterizing Object Data By-Hand



Object Labels Generated with Google Vision

Class

Object

Unique Object

Synonym

sum the instances and scores of objects in a class

add synonym instances and score to its associated unique object

an object *detection* and *analysis* tool

bubble, sky, clouds, buildings, grass, city

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https://frutigeraeroarchive.org/wallpapers

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Image Object Analysis

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Embedding Vectors for Object Labels

Object Labels Generated with Google Vision

Send each label to Vertex AI

- Model: text-embedding-005
- API request contains only the text label
- Returns 768-dimensional vector + Save results

Plot

Load all vectors from each aesthetic

Run **3D t-SNE** to map 768 → 3 dimensions

- Plot with **Plotly**
- Hover label = object name
- Point size ∝ instance count
- One interactive 3D scatter per aesthetic

Concluding Thoughts

- I made something cool!
  - *cool* for designers and artists
  - and *cool* for programmers and data scientists!

- It is also useful for me!
  - I will use it as a game design inspiration board

Some of the *Cool* Data Science in my Project

- Data Cleaning
- Feature Engineering
- PCA
- t-SNE
- Interactive Visualizations
- Convolutional Neural Networks
- Embedding Vectors