Computational Fabrication

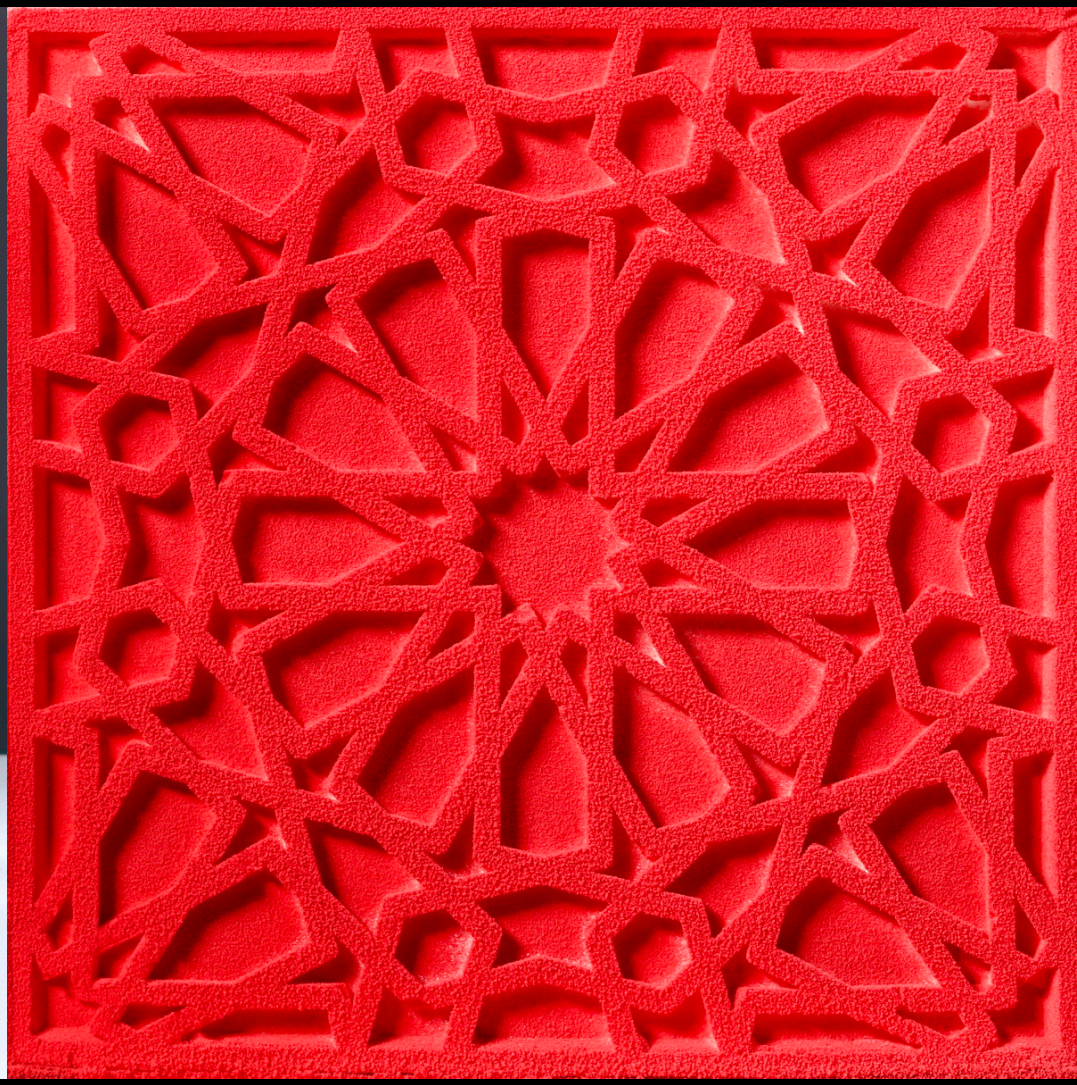
CS 491 and 591
Professor: Leah Buechley

Pastry Chef and Artist: Dinara Kasko

https://www.dinarakasko.com/
https://www.instagram.com/dinarakasko/

Dinara Kasko

Dinara Kasko



Dinara Kasko

https://www.youtube.com/watch?v=TU0ZOfMwDXA&ab_channel=DinaraKasko

Dinara Kasko

Tiling Assignment due 11/21

https://handandmachine.org/classes/computational_fabrication/2023/11/05/large-assignment-5-tiling/

questions?

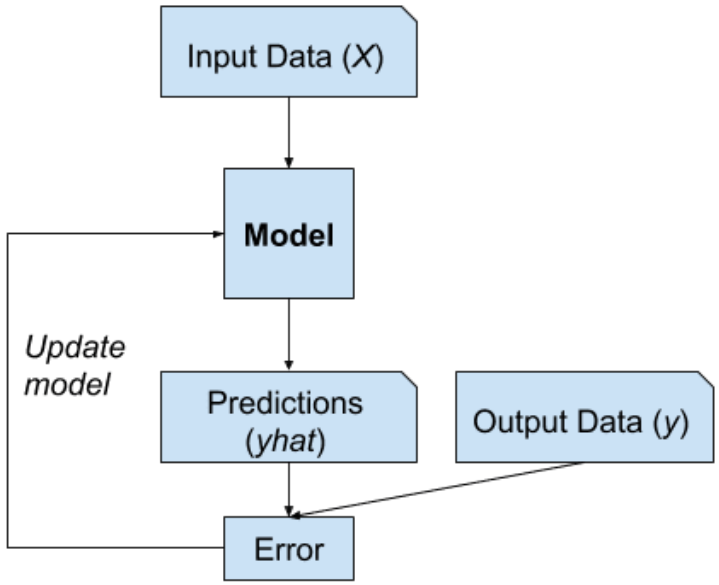
Machine Learning for Design

Introduction to GANs
Generative Adversarial Networks

Machine Learning Overview

Supervised Learning:

- Training data with labels; known desired outcome
- Goal: make a prediction about the world
- Prediction is falsifiable
- You can test how well the model is doing. There is a clear error rate.
- Examples:
  - Image recognition
  - Speech recognition



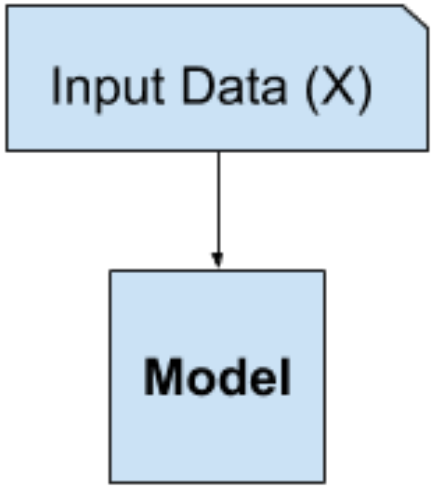
https://machinelearningmastery.com/what-are-generative-adversarial-networks-gans/

https://wiki.pathmind.com/generative-adversarial-network-gan

Machine Learning Overview

Unsupervised Learning:

- Training data does not include labels
- Goal: find patterns in data
- No prediction
- Result is NOT falsifiable
- You cannot test how well the model is doing. There is no clear error rate.
- Examples:
  - Clustering
  - Identifying non-obvious outliers (ie: fraud detection)

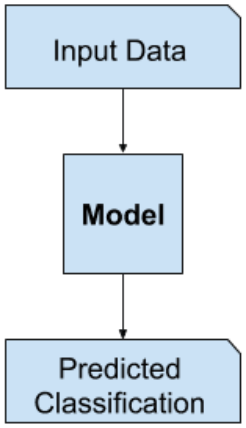


questions?

Discriminative vs. Generative

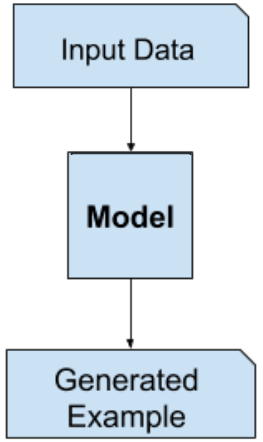
Discriminative

- Goal: make a prediction about the world; classification.
- Supervised Learning



Generative

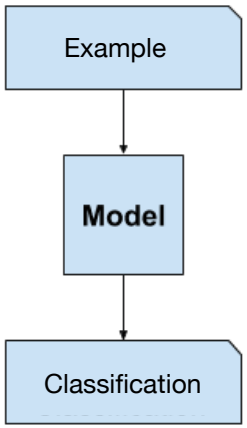
- Goal: generate an example based on existing knowledge
- Unsupervised Learning



Discriminative vs. Generative

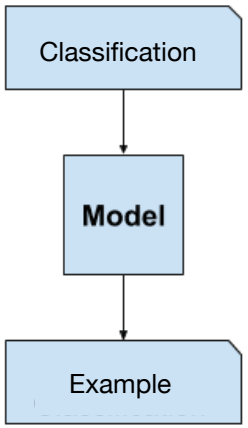
Discriminative

- Goal: given an example, provide a classification
- Supervised Learning



Generative

- Goal: given a classification, generate an example
- Unsupervised Learning



questions?

GAN =
Generative Adversarial Network

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https://wiki.pathmind.com/generative-adversarial-network-gan

Generative Adversarial Networks

- A particular generative approach.
- Two different "adversarial" networks are used to train a model. A generator and a discriminator.

Ian J. Goodfellow, Jean Pouget-Abadie, Mehdi Mirza, Bing Xu, David Warde-Farley, Sherjil Ozair, Aaron Courville, and Yoshua Bengio. 2014. *Generative Adversarial Networks*. *arXiv:1406.2661*. http://arxiv.org/abs/1406.2661

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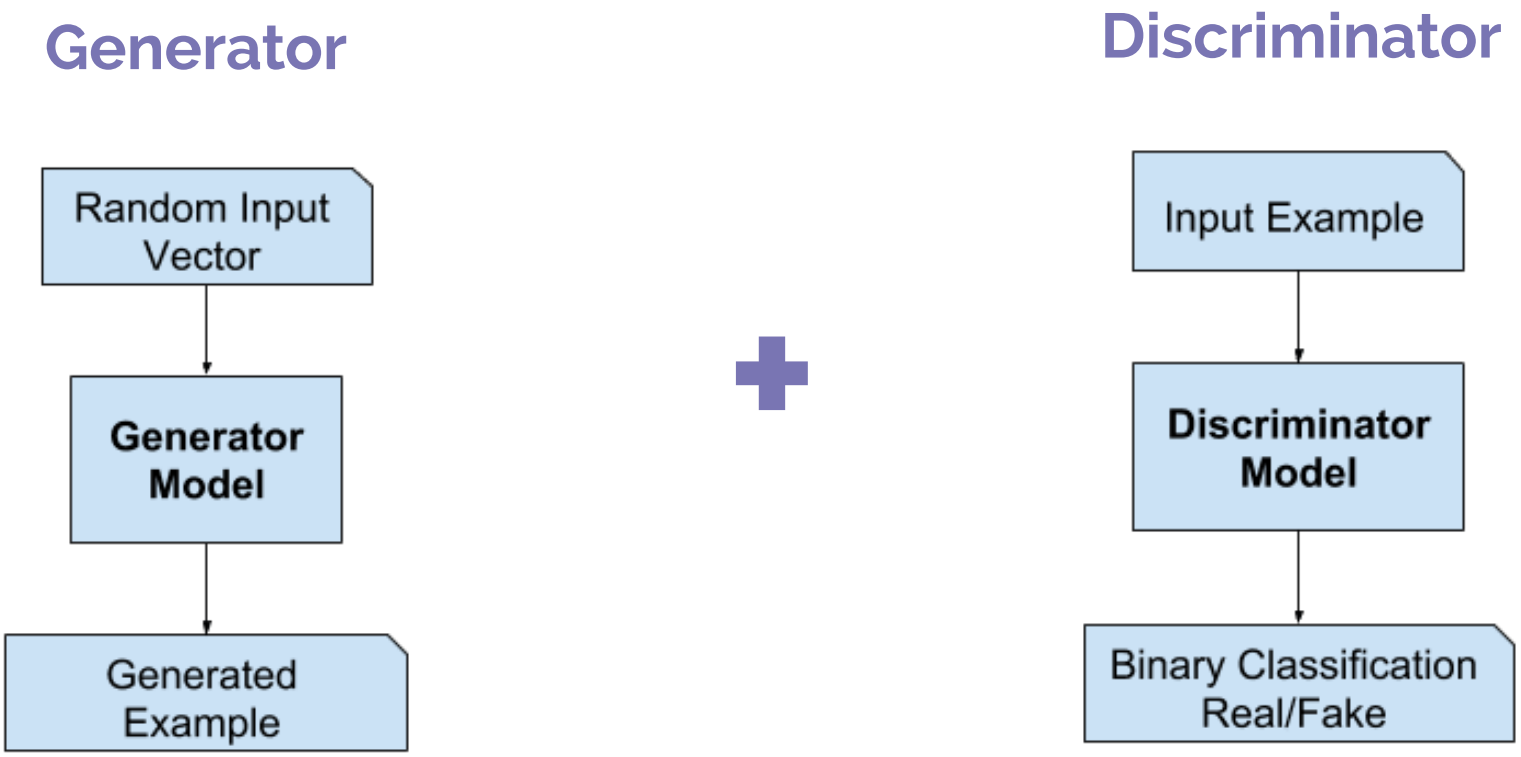
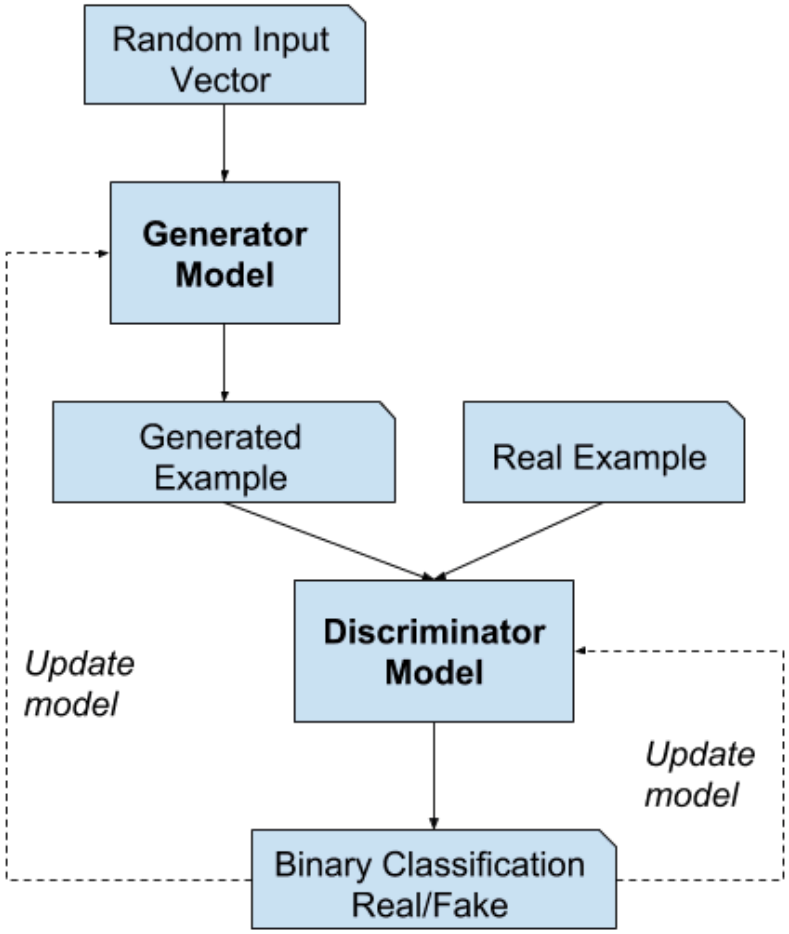
Generative Adversarial Networks



Generative Adversarial Networks



Models trained in tandem.

Both get better at the same time.

questions?

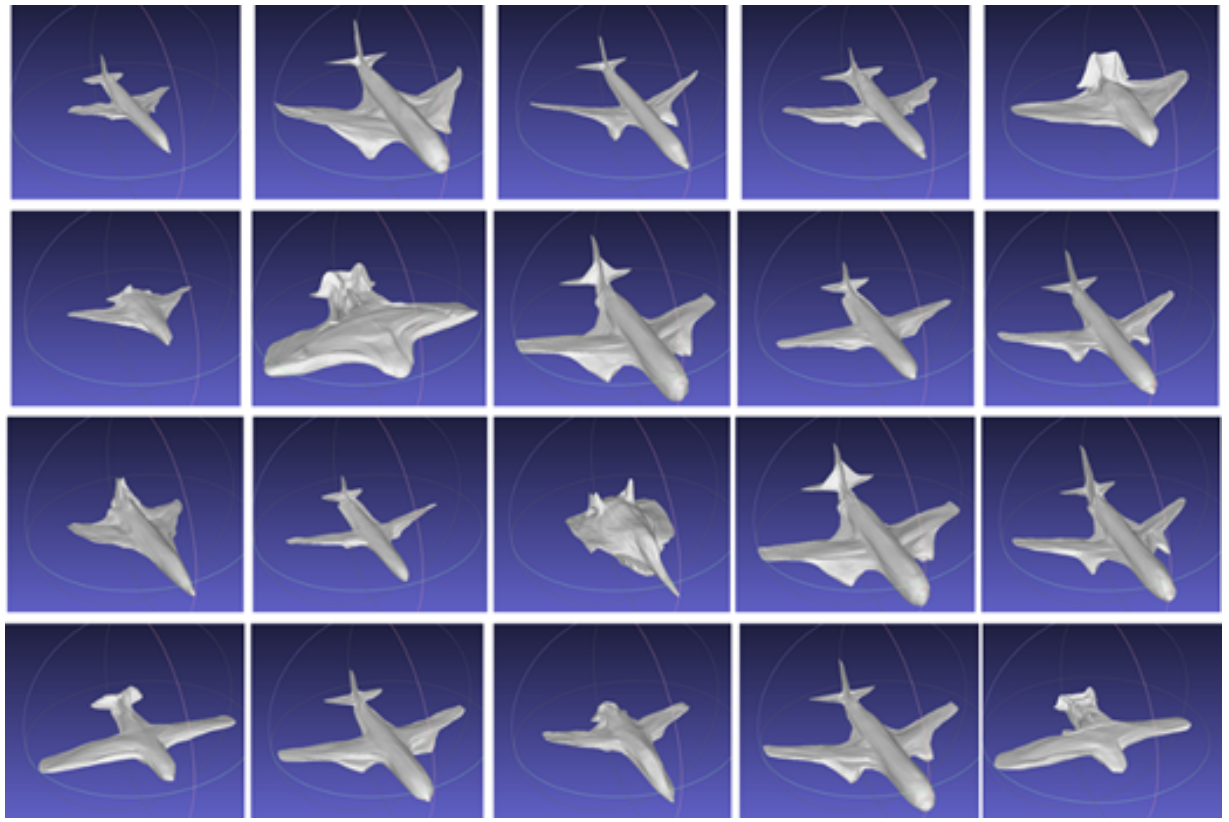
2D vs. 3D

2D: Amazing!

https://legacy.midjourney.com/showcase/recent/

3D: Much Harder Problem

- Much larger search space
- Functional 3D object vs. 2D image
- With images our brains fill in a lot of the blanks
- Still in infancy



Dule Shu, James Cunningham, Gary Stump, Simon W. Miller, Michael A. Yukish, Timothy W. Simpson, and Conrad S. Tucker. 2019. 3D Design Using Generative Adversarial Networks and Physics-Based Validation. Journal of Mechanical Design 142, 071701. https://doi.org/10.1115/1.4045419

Today we'll focus on 2D

Generated photos of human faces

1. Tero Karras, Timo Aila, Samuli Laine, and Jaakko Lehtinen. 2018. Progressive Growing of GANs for Improved Quality, Stability, and Variation. *arXiv:1710.10196 [cs, stat]*. Retrieved April 17, 2022 from http://arxiv.org/abs/1710.10196

Designed to Deceive: Do These People Look Real to You?

By Kashmir Hill and Jeremy White

Nov. 21, 2020

https://www.nytimes.com/interactive/2020/11/21/science/artificial-intelligence-fake-people-faces.html

Machine Learning and GAN Tools

- General machine learning libraries (API)
  - Keras (Python)
  - PyTorch (Python, C++, Java)
  - TensorFlow (Python, Javascript, +non-supported languages)
- Machine Learning library for artists and designers: https://ml4a.net/ (Python, Javascript (p5js))
- Example end-user ML based tools:
  - Deep Dream: https://deepdreamgenerator.com/
  - Runway: https://runwayml.com/
  - Midjourney: https://www.midjourney.com

Exploring off the shelf tools

Midjourney: text to image generator

https://legacy.midjourney.com/showcase/recent/

Midjourney exploration
https://www.midjourney.com

Deep Dream

Nettrice Gaskins
https://www.nettricegaskins.com/

Exploring Deep Dream

Open https://deepdreamgenerator.com/

Sign up and take a 10 minutes to create:

1) a portrait of a person
or
2) a designed object (chair, vase, building, etc.)

Share images

questions?

Thank you!

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