

DNA Microswimmers and GANs

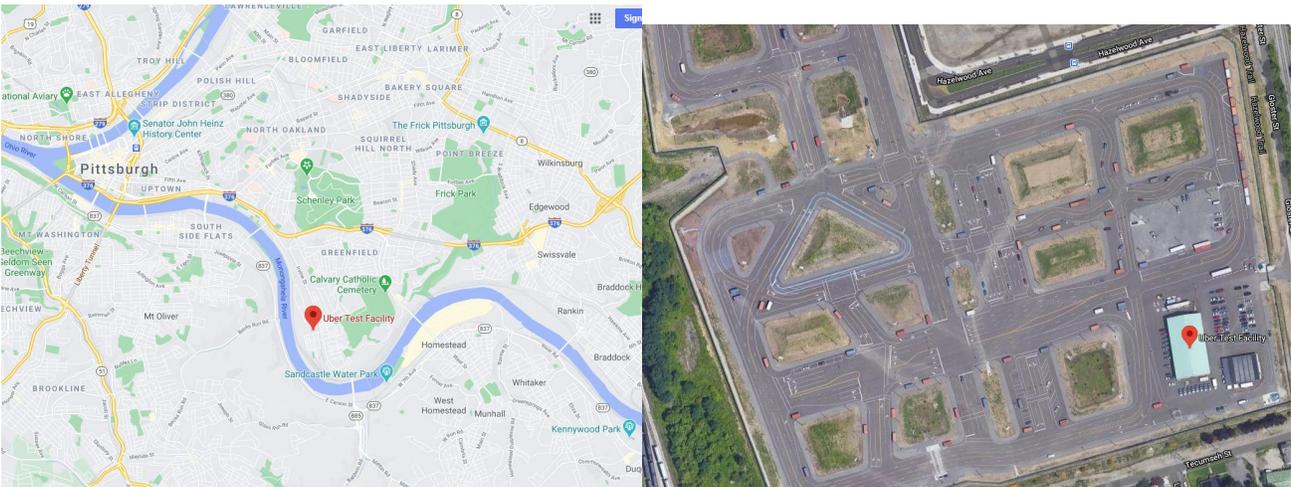
Generative Adversarial Networks

Student Sheet

Materials Needed: Pencil or pen, computer or laptop with internet access.

Background - Examples where machine learning is used in daily life.

- Netflix recommendations – ML algorithms learn what movies you like and recommend other shows that are similar
- Self-driving cars use reinforcement learning and other tools to learn to drive (recall that these self-driving cars have been in accidents!)
 - Did you know that there's an Uber Self Driving Car test facility in Pittsburgh? It's located in the Hazelwood neighborhood.



(images: maps.google.com)

- The research company, DeepMind, built a computer algorithm called AlphaGo that beat the most highly-ranked human Go player in the world, Lee Seidol
- E-mail spam filters have been trained to distinguish between spam messages and real e-mails
- DeepMind is also building AlphaStar, a computer algorithm designed to defeat the greatest human players in the game of StarCraft 2
- Facebook's DeepFace, facial recognition project is also a ML endeavor

GAN – Guides and Artists – (NOTE: This activity was designed for remote learners, please modify the script accordingly based on your modality. There is an example of how to do this activity in the accompanying session video from 11/14/20.)

For this activity, you will need at least 2 people per group. The first person in the group will be the Guide and will explain the activity (on the Activity Sheet), and then choose an animal from the list

below. The second person will be the Artist, more participants in the group will be additional Artists. There will be four attempts each round and then the Guide will switch at the end of each round.

Some animals that would be good to suggest for the Artist include:

(Tip: don't let them choose their own animal during these first few rounds).

However, Guides won't sharing what the actual animal is with the Artists. It will be a mystery!

- Cat
- Dog
- Elephant
- Spider
- Penguin
- Centipede
- Tiger
- Mouse
- Butterfly
- Chicken
- Eagle
- Rhino

Note: It helps to recommend animals that are really distinctive so that it is easier to draw them.

It is best to have a timer or timer app available for the purposes of the Guides and Artists activity.

Directions (for remote learners):

If you'd like, you could say something such as:

"For this activity we're going to model a GAN. You'll need a pen or pencil and the Machine Learning and GAN Activity Sheet. Everyone will have the opportunity to be a Guide and also an Artist, but in order to make it a really successful activity, I'll need to know who can turn their cameras on and unmute themselves. If you have that ability, please so as it'll make this activity a lot more fun and interactive!"

NOTE: If an Artist does not have a working camera or does not want to turn it on, they can still see the feedback that other Artists receive and use it to inform their next drawing. Hopefully they will have access to a chat feature as well. ASCII drawings in chat are a good adaptation if cameras are unavailable.

"I'll start out by being the first Guide and I will choose an animal for round one. I won't tell you what that animal is, and basically, your job as an Artist, will be to begin by drawing any animal for 30 seconds in box A. Stick figures are encouraged! Once those first 30 seconds are up, I'll ask everyone to please show their work, and I will give hints as to what this animal needs in order to be more like the animal that I have chosen. Please make a note of the hint I've given you ...and of the hints that I've given others as well. Then, another 30 seconds will go up on the clock and you as Artists will begin drawing in Box B. We'll repeat this process another two more times or until someone has the correct animal. Then we'll move onto round 2 and someone else will be the Guide."

Round 1 – Box A

"Artists, let's begin Round 1 by drawing your animal in Box A. Try to predict what animal I have chosen! You'll have 30 seconds!"

Once the 30 seconds are up have students hold up their work to the camera. The Guide will then give feedback to each Artist. The Guide gets to see all the Artists' pictures (they can hold their drawing up to the camera) and gives each Artist ONE piece of feedback. Examples are as follows:

"Zoe, the animal you drew should not have a tail."

"Shawn, the animal you drew should have more legs."

"Cara, the animal that you drew should not have wings."

"Matthew, the animal you drew should have fins."

Round 1 – Box B-D

"Artists, now begin by drawing in Box _____. Use the hint that I've given you, and maybe the hint I've given to other Artists as well. Try to predict what animal I have chosen! You'll have 30 seconds!"

After each round (especially the first because in this round the Guides are modeling how to be a good Guide!), discuss the 3 questions below the table. The second question is related to the next activity.

For subsequent rounds there are 4 spaces. If more rounds are necessary, encourage students to use a separate sheet of paper.

GAN – Autodraw

Autodraw, from Google, brings together drawings by artists and ML!

Instruct students to go to the Autodraw website: <https://www.autodraw.com>

Follow the same steps to draw their same animals on the Autodraw site. For this first demonstration, share your screen as you draw the first animal. Make a note of how many lines/strokes/click and draws that it took for the program to recognize what you were trying to draw.

Have students test subsequent animals as well. Discuss differences between this software and the first activity.

Supplemental

Big discussion topics in AI.

In AI research right now, lots of scientists are debating about whether it makes more sense to design machine learning tools that can do very specific things, or if we would be better off designing very general tools.

- i.e. a GAN is very good at generating images, but it cannot learn to drive a car.

- Equivalent to designing a prosthetic hand that can do anything vs. designing a prosthetic hand that is specifically for writing or rock climbing.
- Another major challenge in AI right now is building large datasets that we can train different models with.
 - We have already built some very popular datasets containing images, videos, and writing (like Shakespeare's plays).
 - What other kinds of data should we collect?