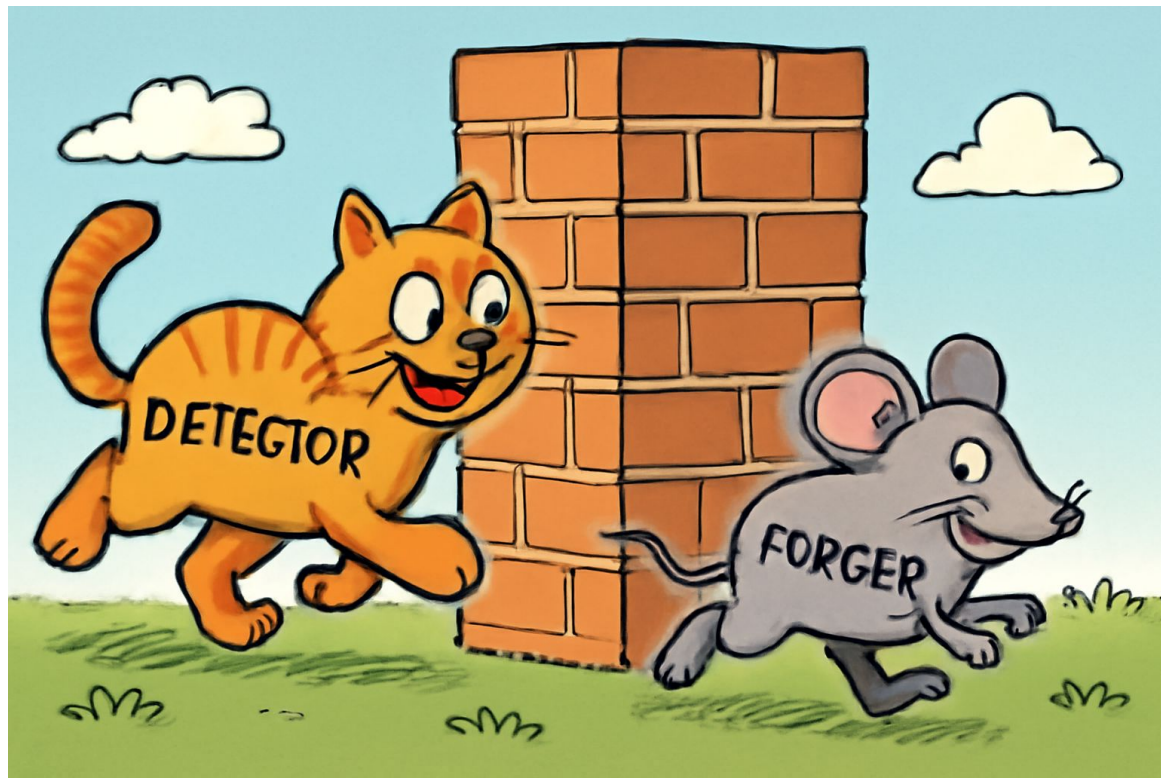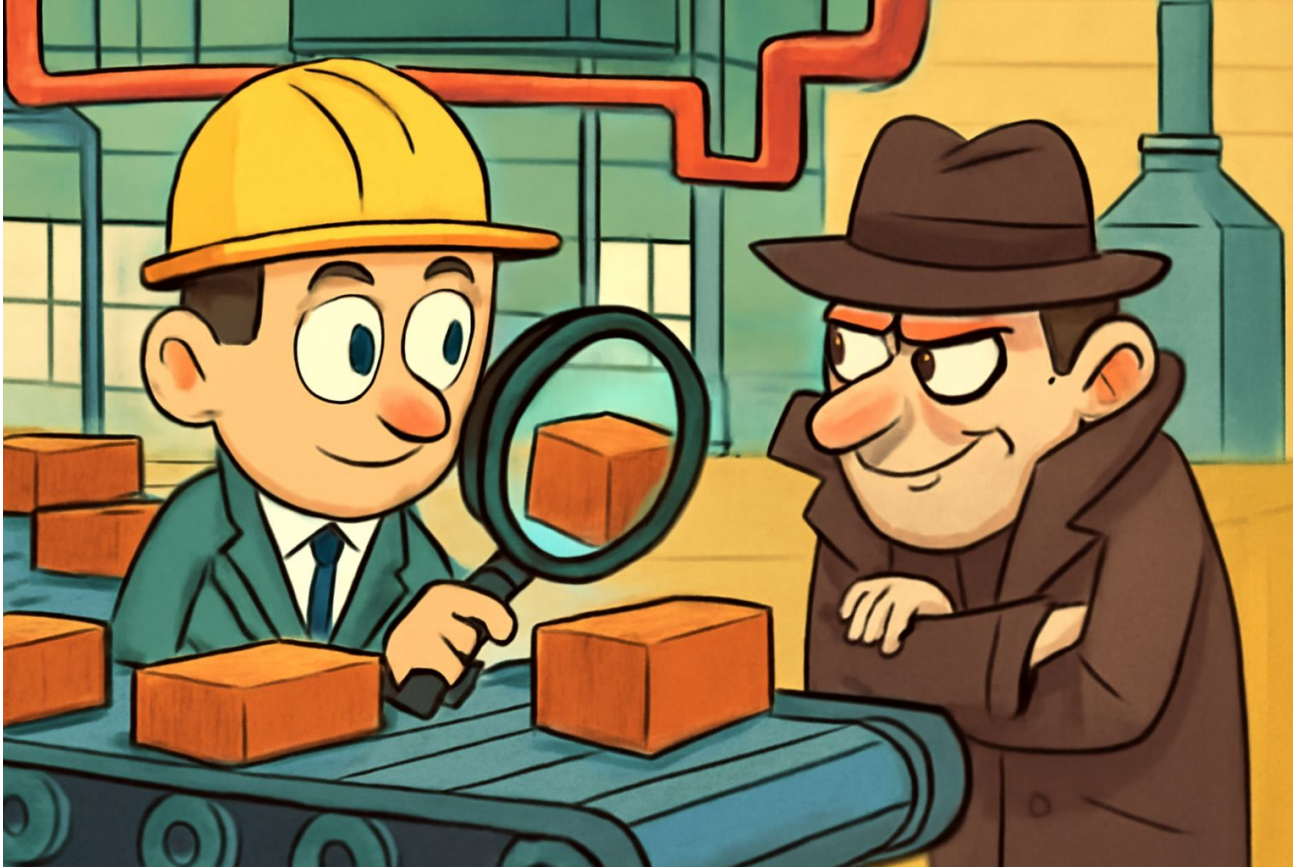# Understanding GANs

Brickki vs. The Forgers: The Cat & Mouse Game of AI

Your First Day – Trouble Already

First day as **Head of Quality Control.**

Company: **Brickki** – maker of high-quality building blocks.

Issue: counterfeit bricks mixed into our product bags.

The Problem - Counterfeit Invasion

Fake bricks **damage customer trust.**

Must be detected before reaching customers.

Your mission: intercept fakes on the production line.

Becoming the Expert Detector

Initial detection is **tricky**.

Customer **feedback** helps identify patterns.

Gradually become skilled at spotting subtle defects.

The Forgers Strike Back

Forgers **improve** fake brick quality.

Differences are now minimal.

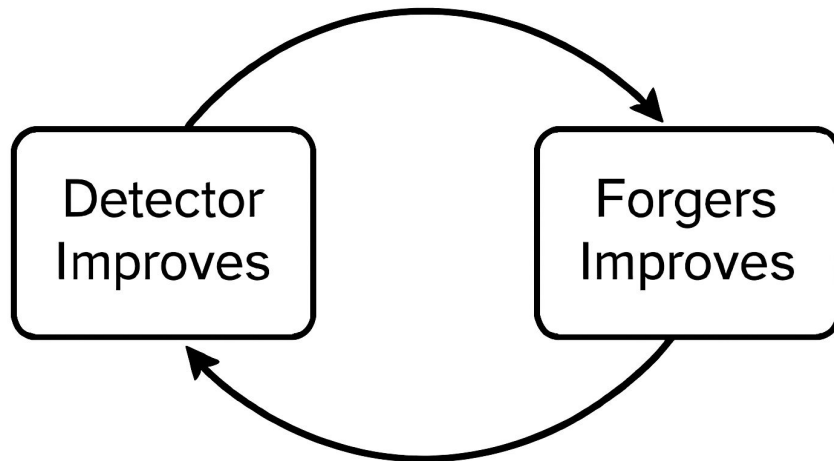**Detection becomes much harder.**

REAL BRICK

FAKE BRICK

Retaliation & Retraining

You **study** new fakes and improve your detection skills.

Forgers adapt their methods again.

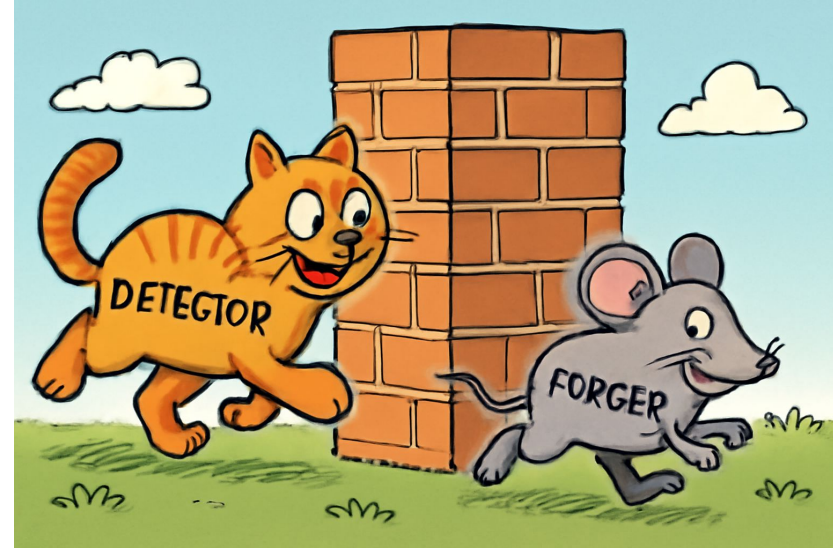**Cycle repeats: both sides improving.**

The Endless Cat & Mouse Game

Both real and fake bricks get better over time.

Differences become extremely subtle.

Rivalry drives **continuous improvement.**

From Bricks to AI

Forgers → Generator (creates fakes).

You → Discriminator (detects fakes).

Both improve by competing.

What Makes GANs So Impressive?

Can create photo-realistic images, videos, audio.

Used for:

- Image generation
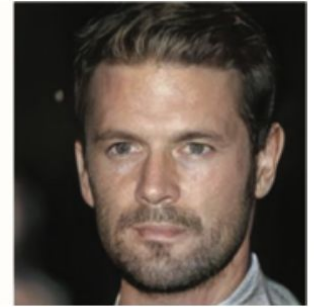- Super-resolution
- Deepfakes
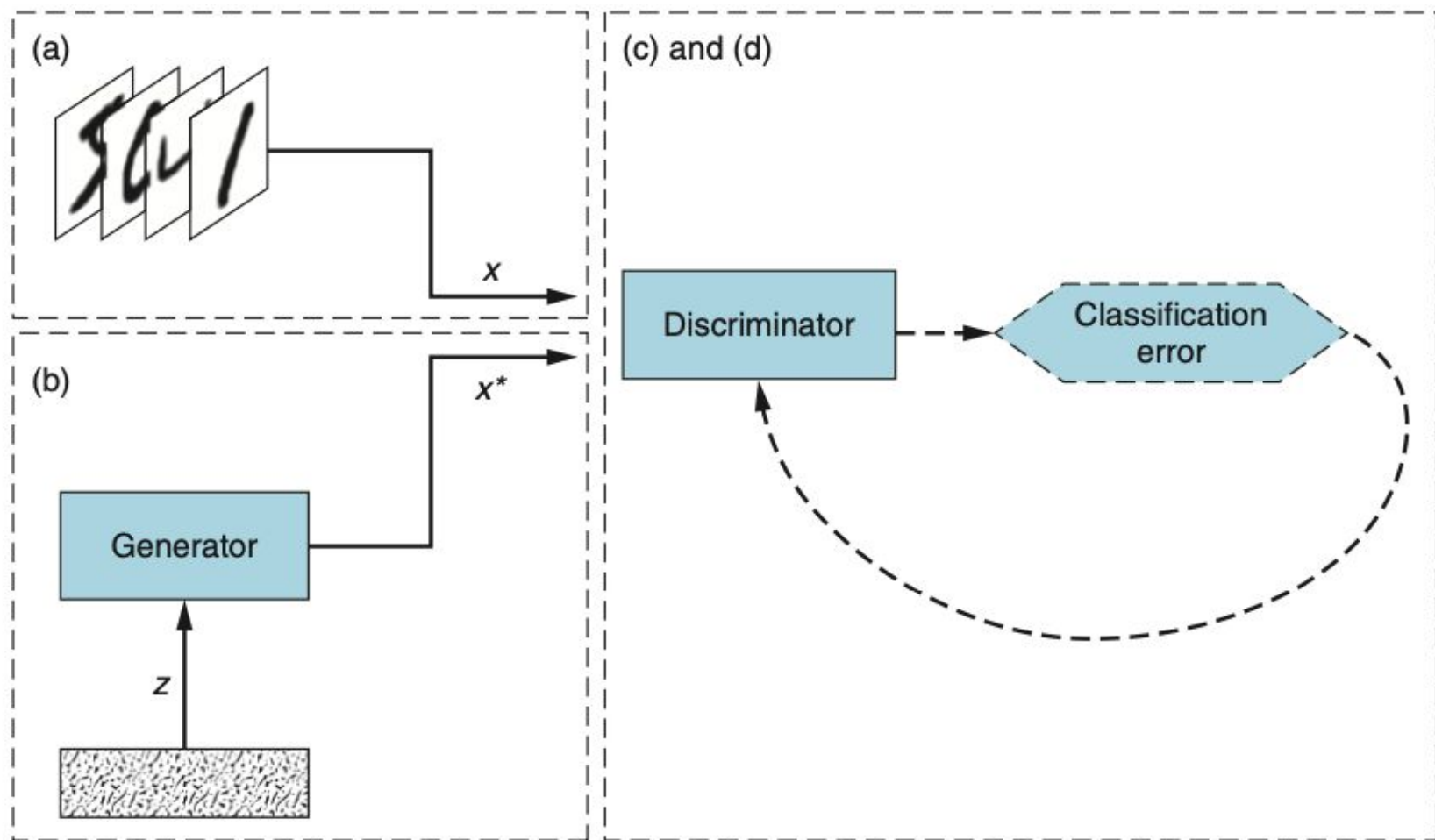- Art & design

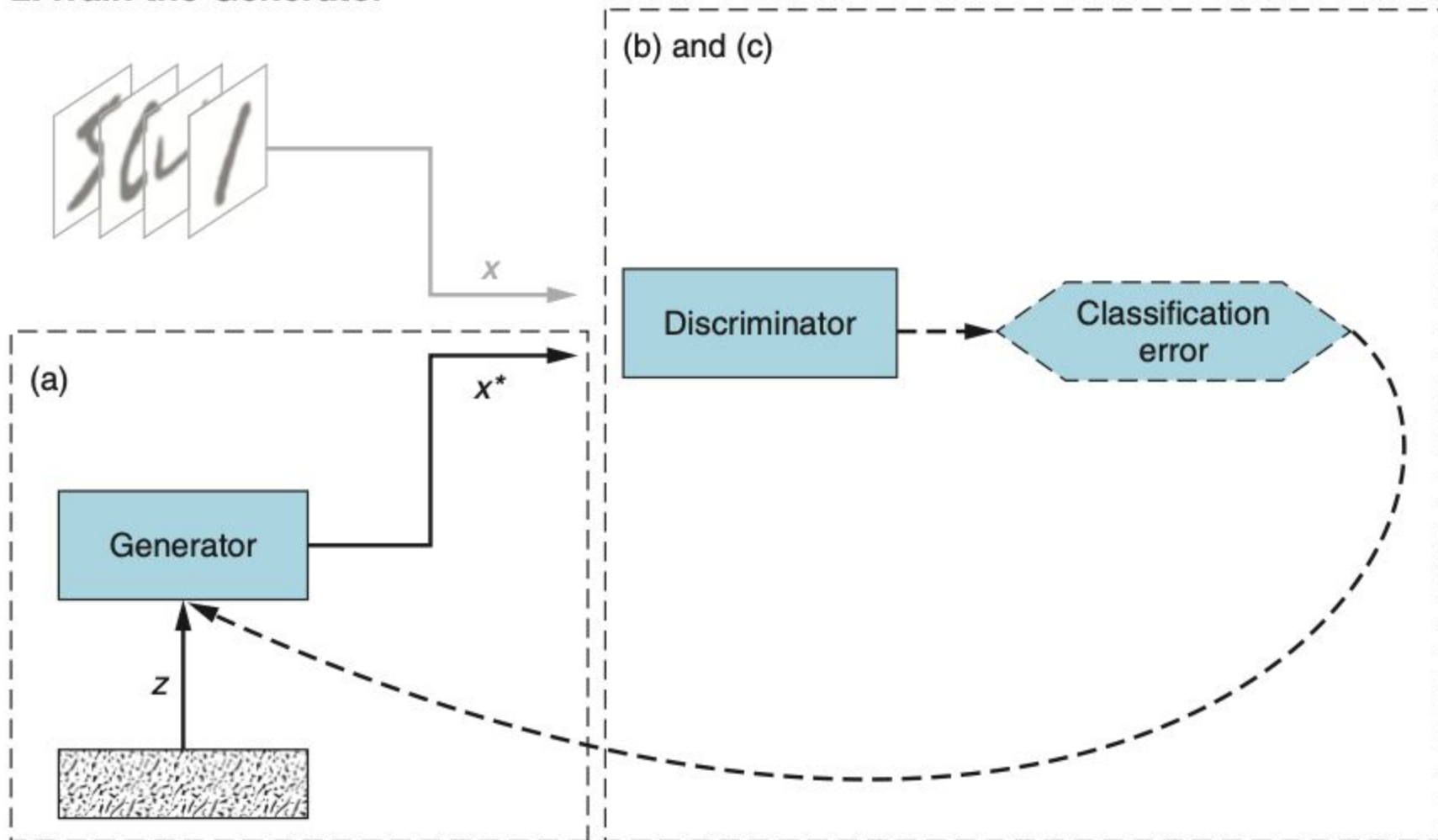2014   2015   2016   2017

Figure 1.1   Progress in human face generation
(Source: "The Malicious Use of Artificial Intelligence: Forecasting, Prevention, and Mitigation," by Miles Brundage et al., 2018, https://arxiv.org/abs/1802.07228.)
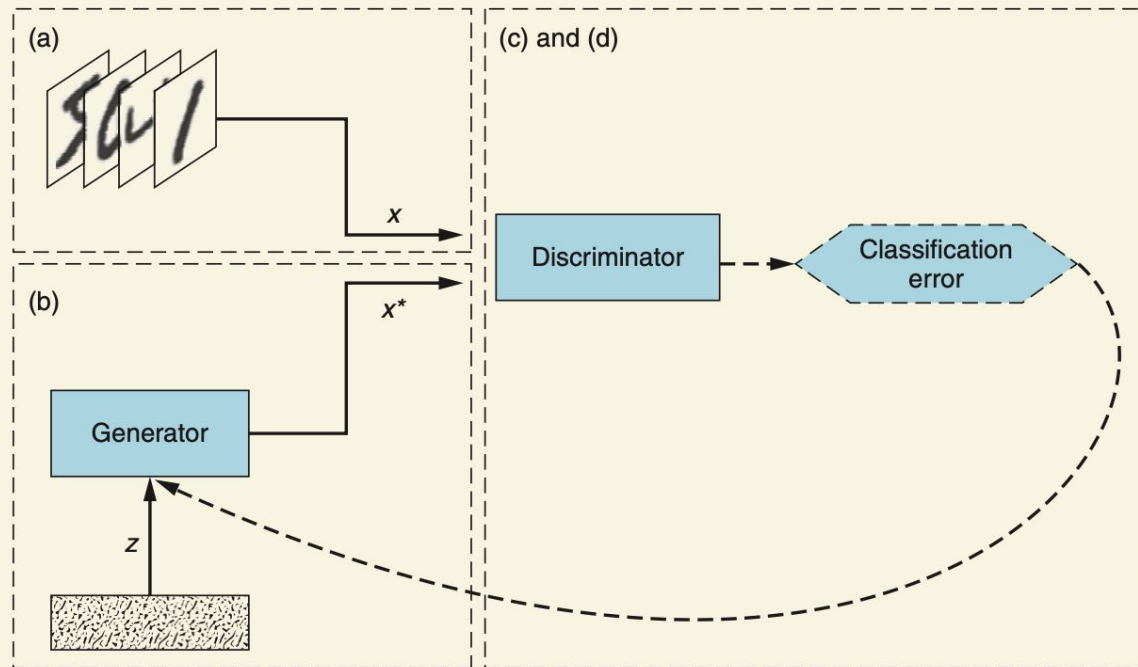
1. Train the Discriminator

(a)

(c) and (d)

x

(b)

x^*

Discriminator

Classification error

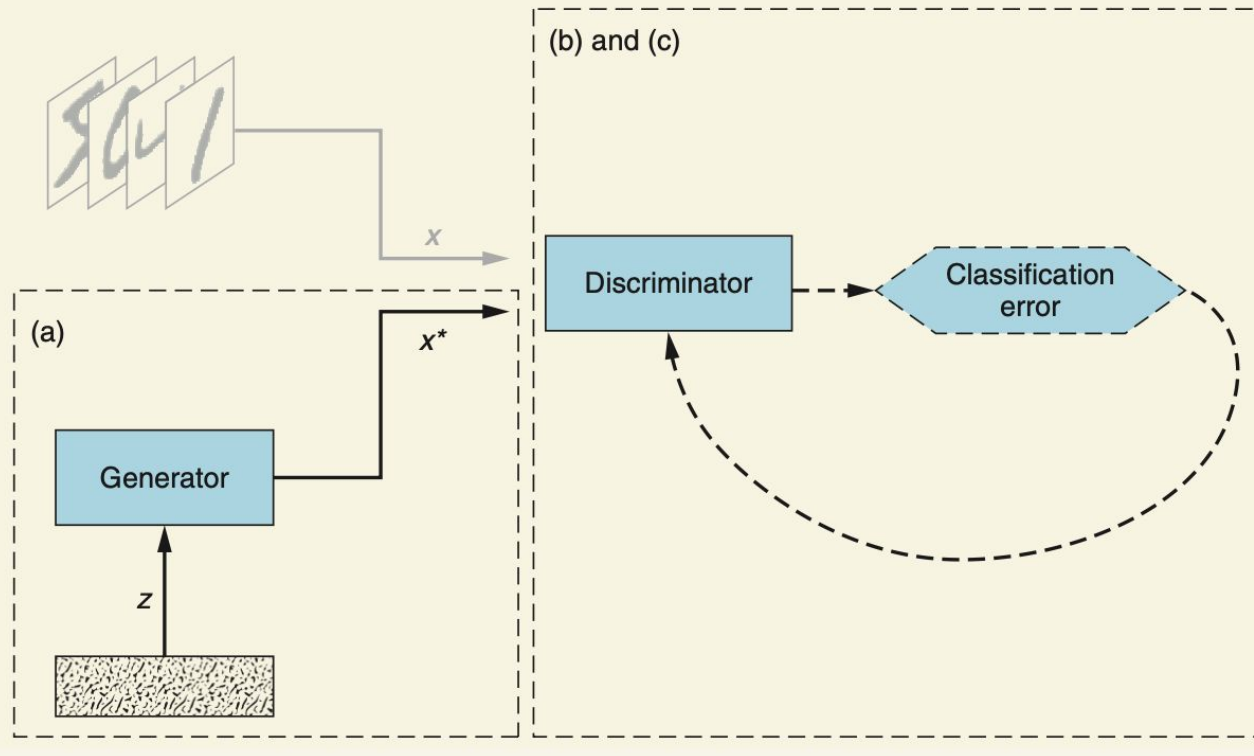Generator

z

2. Train the Generator

1 Train the Discriminator:

a Take a random real example x from the training dataset.

b Get a new random noise vector z and, using the Generator network, synthesize a fake example $x*$.

c Use the Discriminator network to classify x and $x*$.

d Compute the classification errors and backpropagate the total error to update the Discriminator weights and biases, seeking to *minimize* the classification errors.

2 Train the Generator:

2 Train the Generator:

a Get a new random noise vector z and, using the Generator network, synthesize a fake example x^*.

b Use the Discriminator network to classify x^*.

c Compute the classification error and backpropagate the error to update the Generator weights and biases, seeking to *maximize* the Discriminator's error.

Quiz Time!

What is the main goal of the Generator in a GAN?

a) To detect fake data.

b) To create fake data that looks real.

c) To classify data into categories.

d) To stop the Discriminator from learning.

Quiz Time!

Why do GANs improve over time during training?

a) They use more layers in the neural network.

b) Both Generator and Discriminator learn from each other's mistakes.

c) The learning rate keeps increasing.

d) The model memorizes the training set.

Quiz Time!

Which of the following is NOT a common application of GANs?

a) Image generation

b) Image super-resolution

c) Predicting stock prices

d) Deepfake video creation

Quiz Time!

True or False:

In an ideal GAN training process, the Generator becomes so good that the Discriminator can no longer tell real from fake better than random guessing.