Autoencdoer & matrix completion

Lecture 20

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Outline

1. Discuss several other roles of autoencoder.

   Semi-supervised learning

   A generatrive model

   Matrix completion

   Anomaly detection

2. Explore in depth how to use autoencoder for anomaly detection.

Semi-supervised learning (SSL)

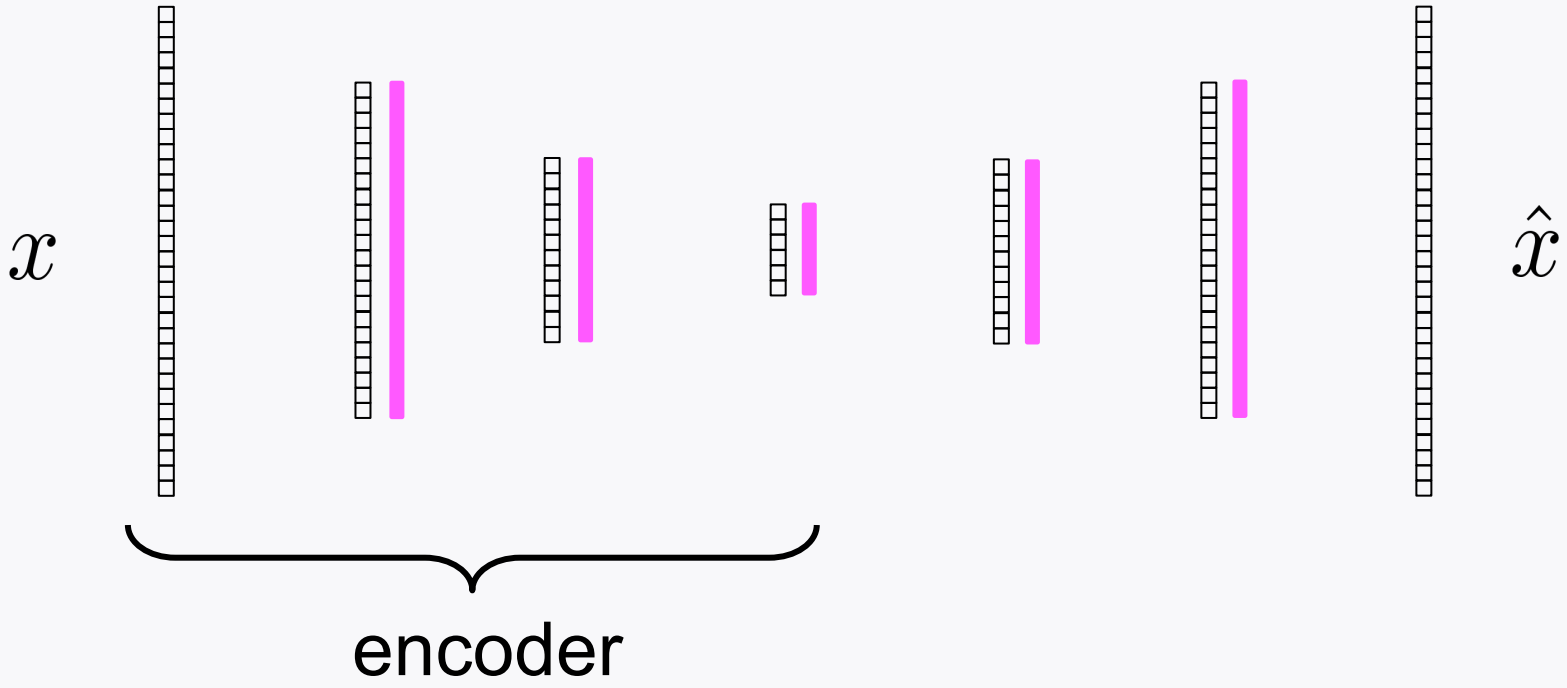
A learning methodology that exploits two datasets:

1. $\{x^{(i)}\}_{i=1}^{m}$ unlabled

2. $\{(x^{(i)}, y^{(i)})\}_{i=1}^{m_{\text{label}}}$ labled

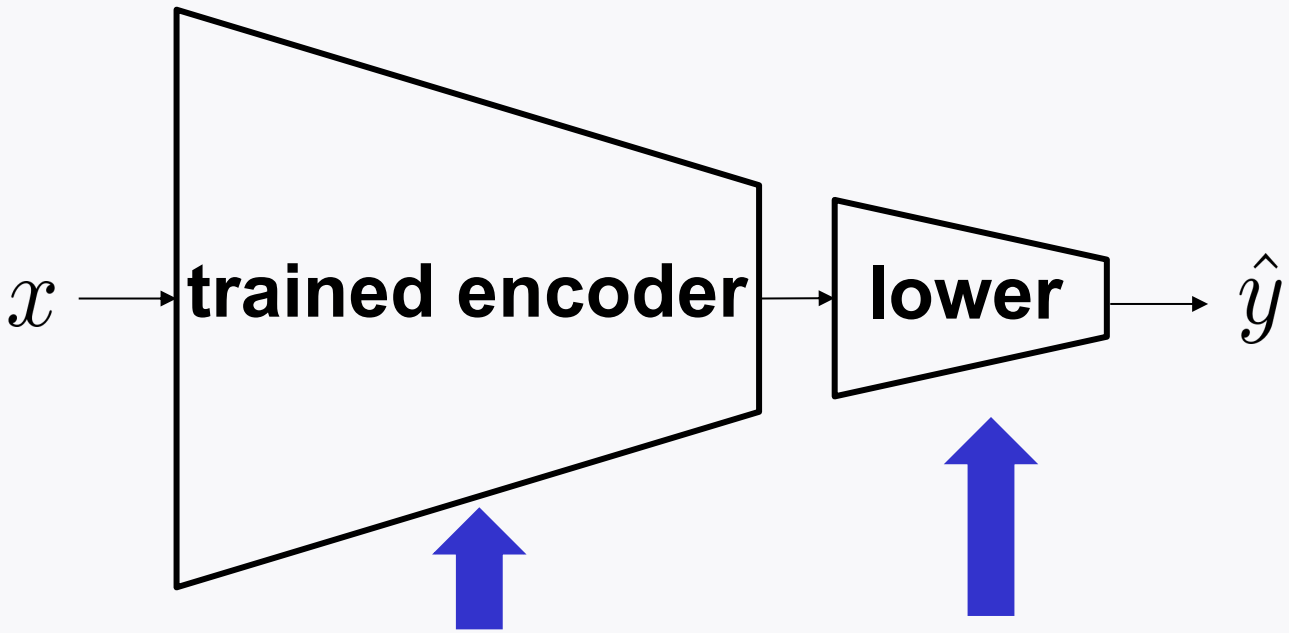
$m_{\text{label}} \ll m$

Autoencoder for SSL?



The trained encoder can serve as a **pretrained** network for a very complex task.

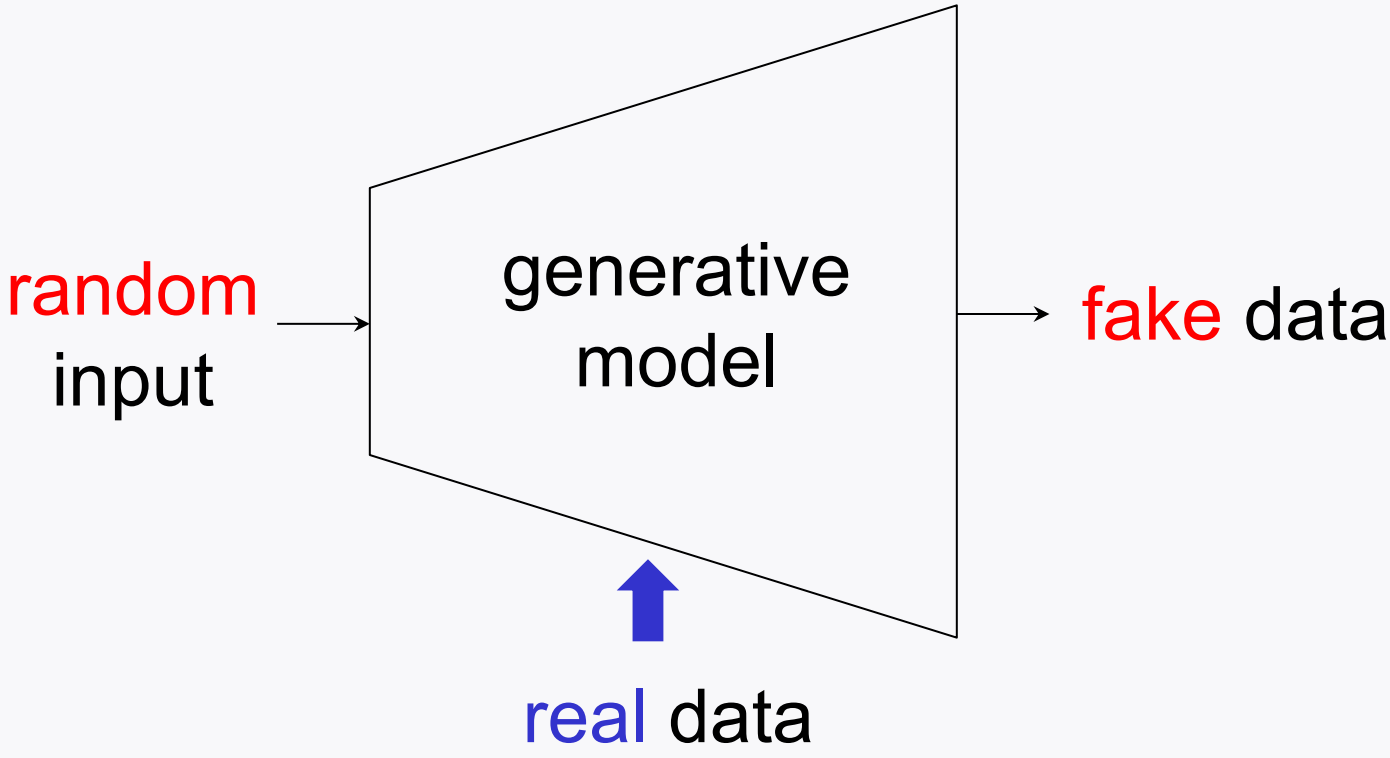
How to use trained encoder for SSL?



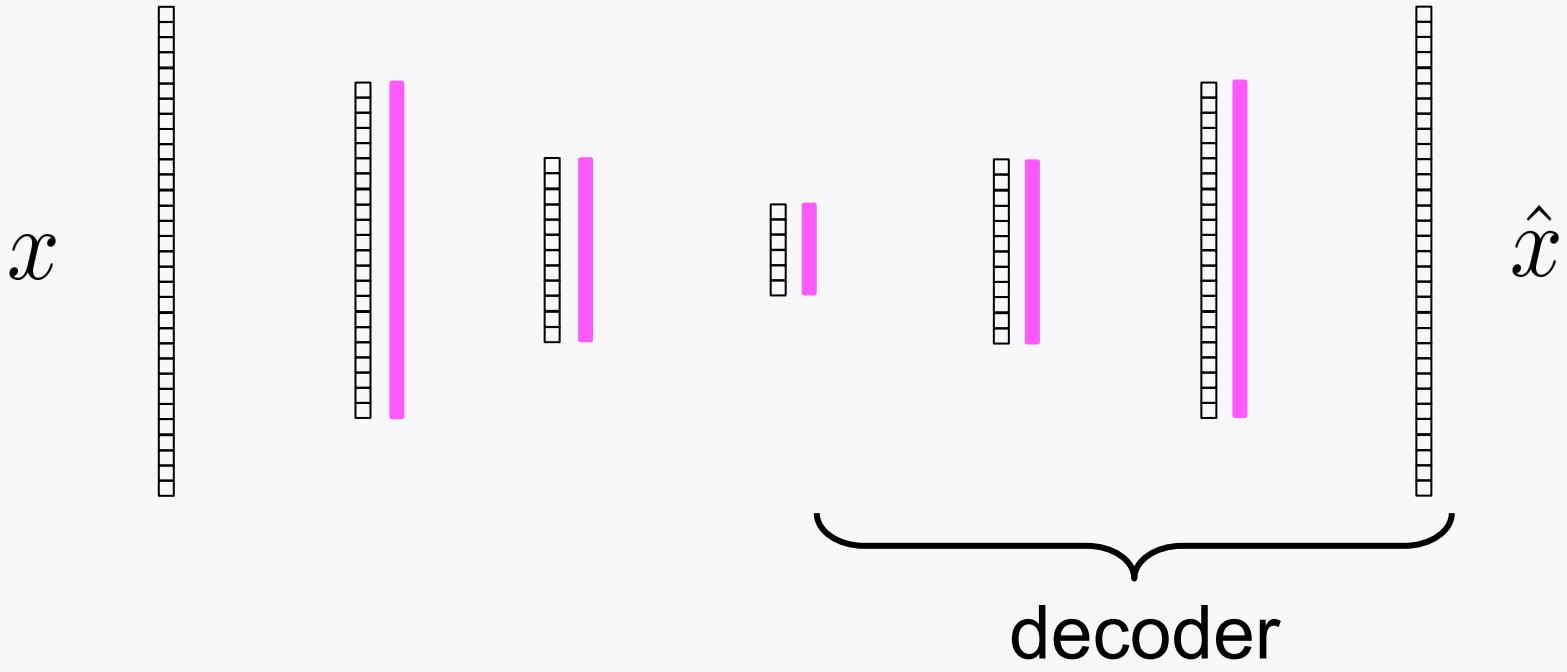
$$m_{\text{label}} \ll m$$

A generative model

A model that generates fake data which has a similar distribution as that of real data.

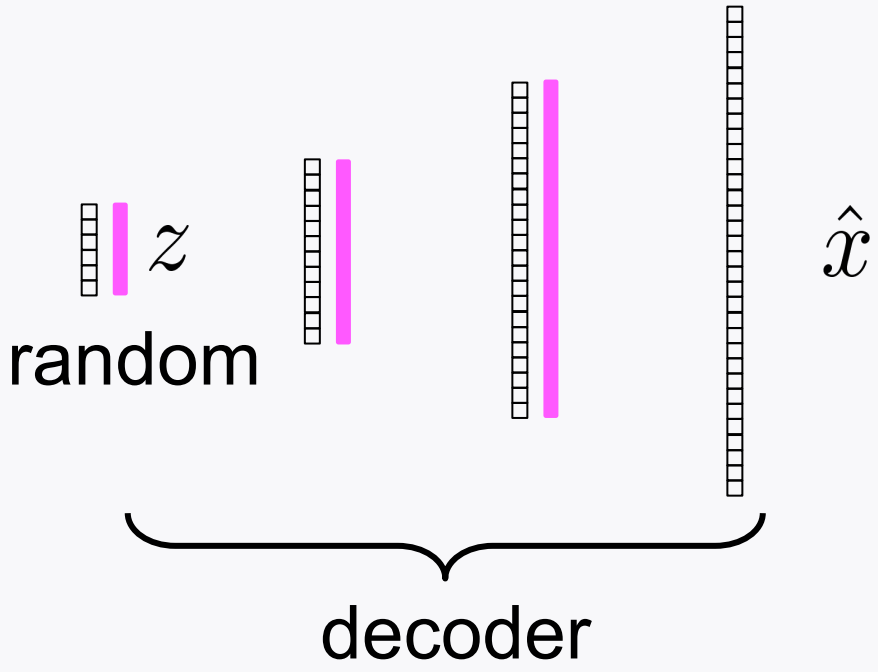


Autoencoder for a generative model?



The trained decoder can serve as a **generative model**.

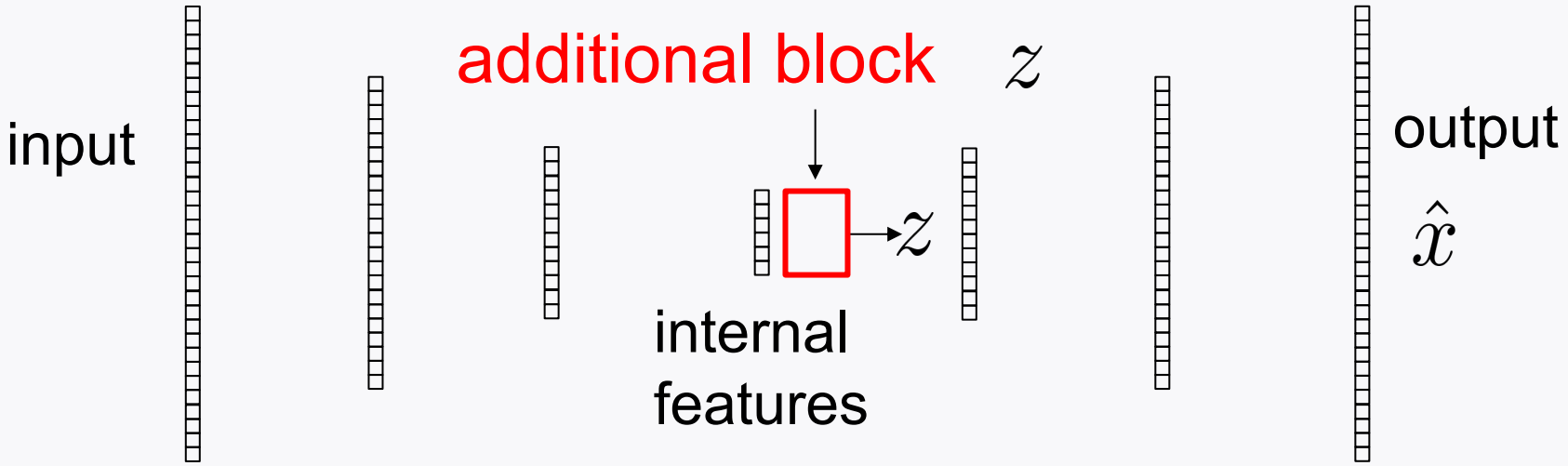
How to use trained decoder for a G-model?



Turns out: A random input z with a similiar distribution as that of real data yields realistic $\hat{x}$

To ensure the similar distribution with real data, often employ: Variational autoencoder (VAE).

Variational autoencoder (VAE)



VAE is a slight variant equipped with an additional block intended for ensuring the similar statistics.

Recommend: Do not divide into details.

Just remember the role and how to use in TensorFlow.

How to use autoencoder for anomaly detection?

Will explain it via one mini-project done with Hyundai Motors:

센서데이터를 활용한 차량 이상감지

실시간 모니터링 센서

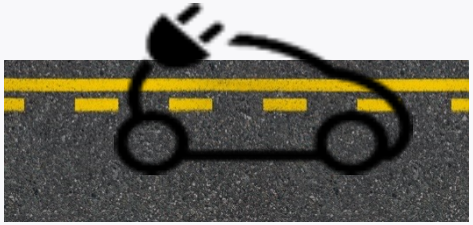
목표: 다양한 센서신호로 부터 **차량 이상**을 감지

센서데이터

언덕길

커브길

내리막



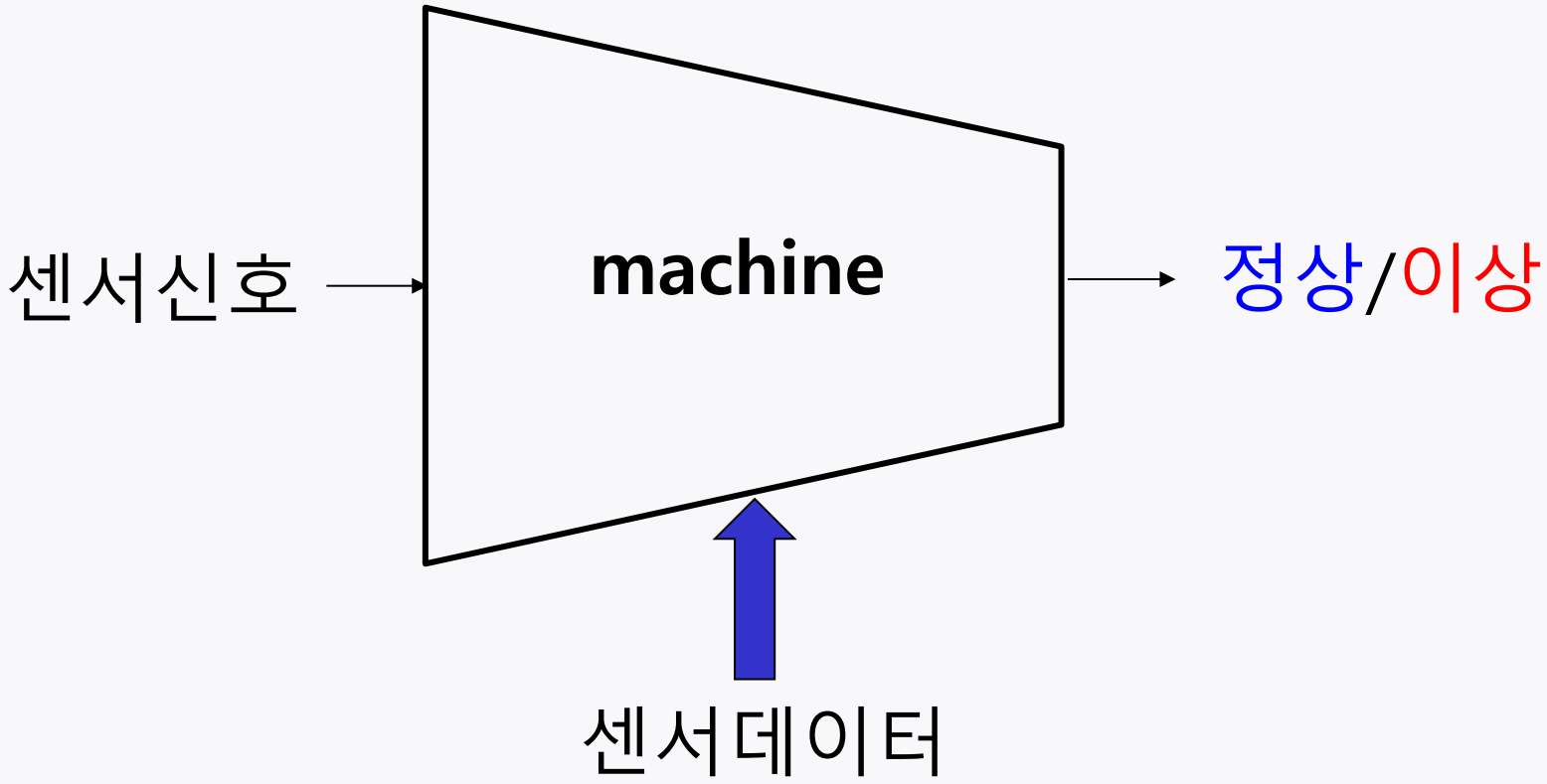
주행상황

고속도로

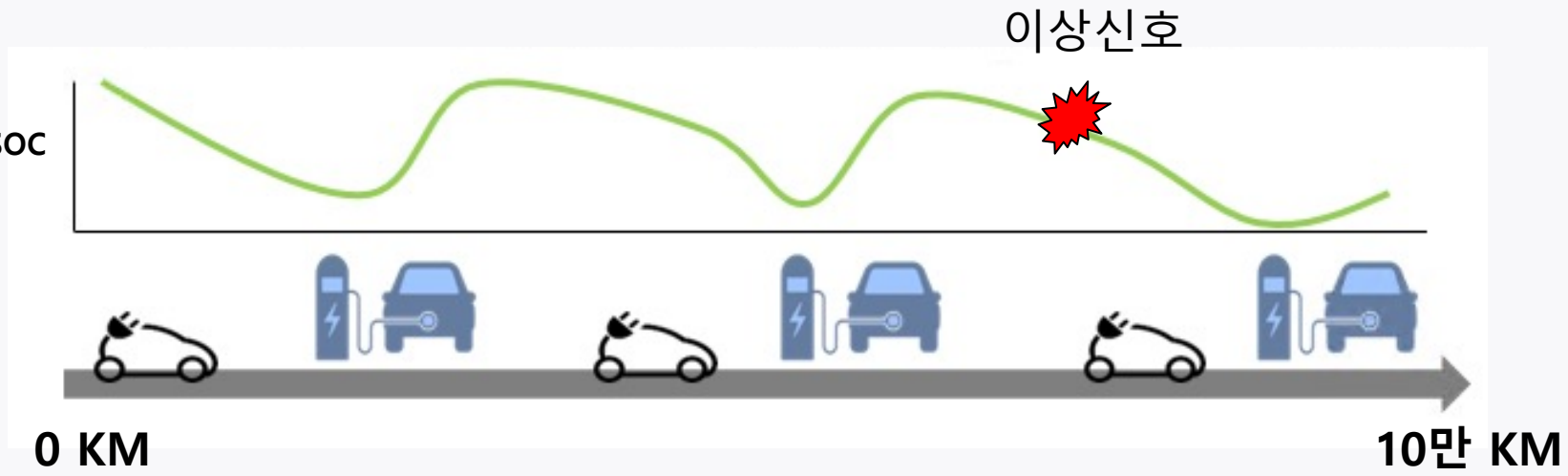
도심/교차로

다양한 주행 상황에 대한 센서데이터 보유

Task



Challenge

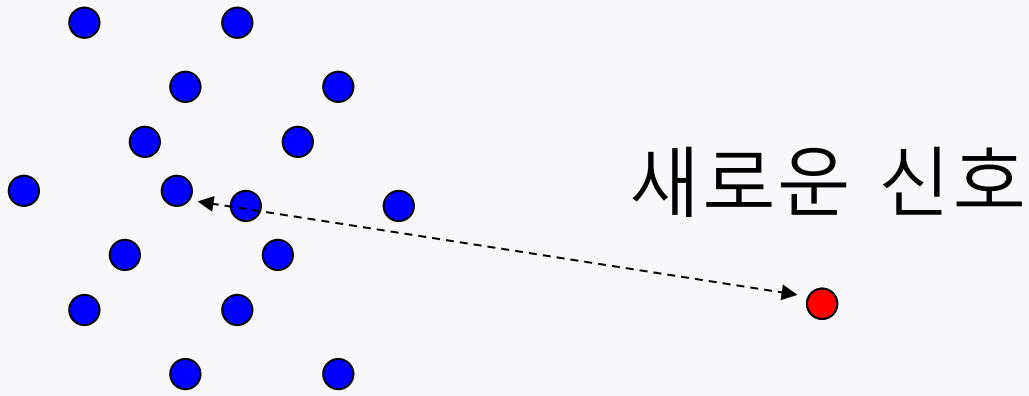


"이상"신호 관련 example 부족

➡ **지도학습이 어려움**

데이터 분포를 활용하는 방법

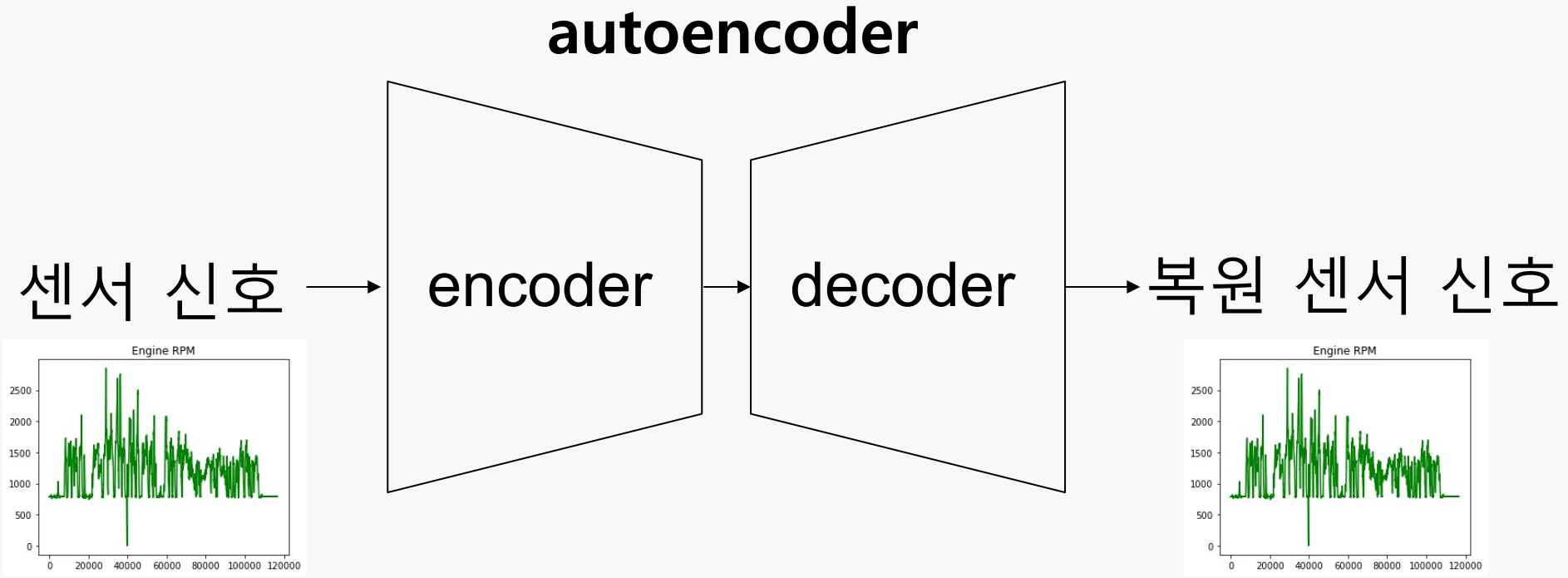
- : 정상신호



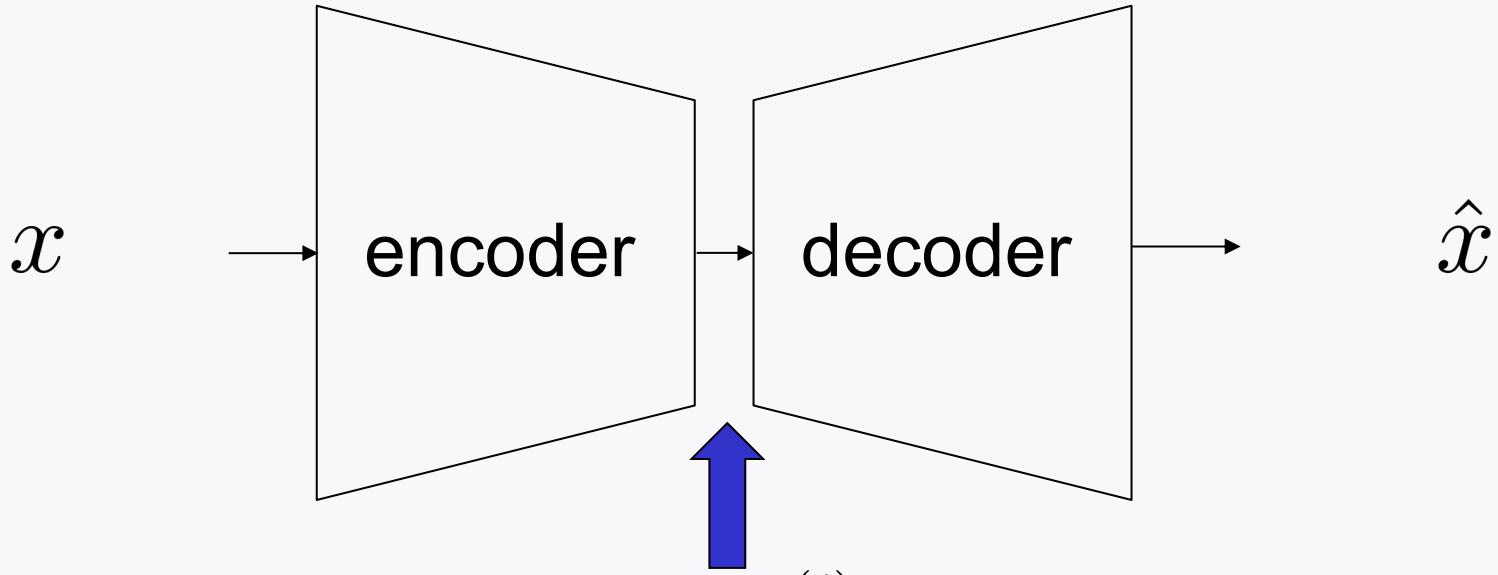
정상신호 분포 **학습**

➡ 데이터 분포 차이를 이용하여 이상신호 감지

정상신호로만 autoencoder 학습시킴



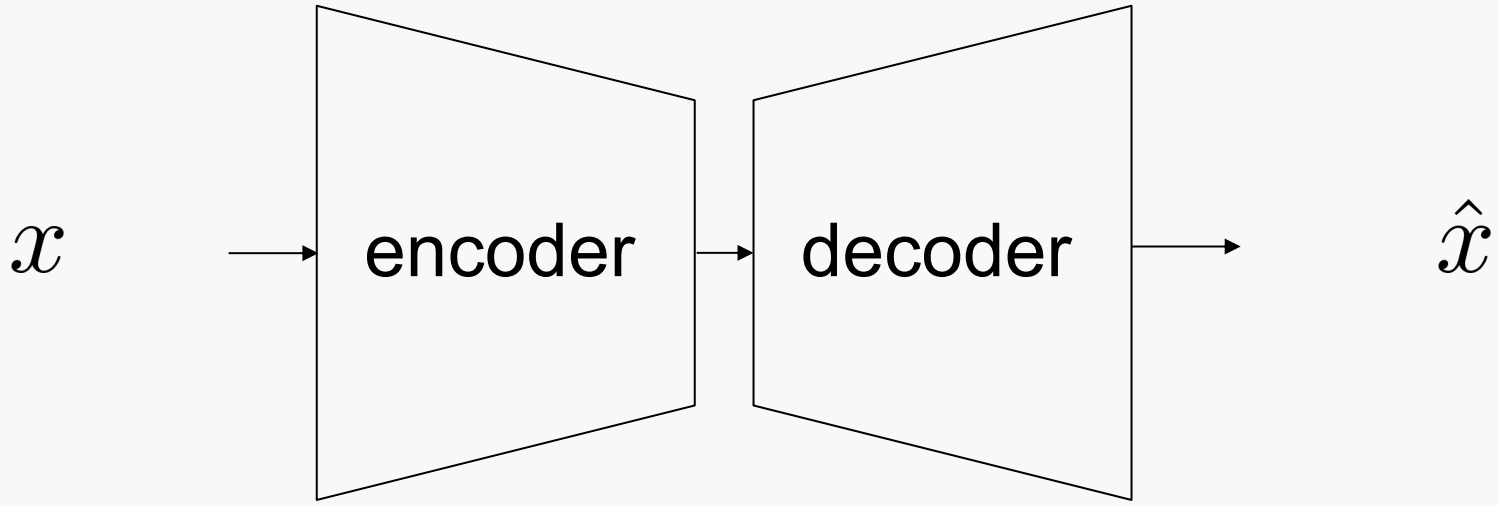
학습방법



$$\min_{w} \frac{1}{m} \sum_{i=1}^{m} (x^{(i)} - \hat{x}^{(i)})^2$$

reconstruction loss

이상감지 방법



reconstruction loss < threshold ➡ 정상

reconstruction loss > threshold ➡ 이상

Look ahead

1. Figure out what matrix completion (MC) is.

2. Explore a connection to fusion learning.

3. Study one recent MC techinique which leverages autoencoder.