Deep Learning 4 (Anomaly Detection)

What is an anomaly?

$X \subseteq \mathbb{R}^D$, prob. distribution P^+ on X

Anomalies $A = \{x \in X \mid p^+(x) \leq \tau\}$

$\tau \rightarrow$ prob. threshold

Approaches:

Classification: learn separating surface between inlier and outlier data (e.g. sphere)

Probabilistic: learn probability of inlier data $p(x)$, define outliers based on threshold $p^+(x) \leq \tau$

Reconstruction: learn reconstruction model of data $x \mapsto \text{proj}_\theta(x)$ and classify outliers based on reconstruction error

Why deep anomaly detection? → extract high-level features

Energy-Based Models

$$p(x|\vartheta) = \frac{1}{Z} e^{-E(x,\vartheta)} \qquad A = \{x \in X \mid E(x,\vartheta) \geq \underbrace{-\log(Z\tau)}_{\tau'}\}$$

Summary

- many deep methods for anomaly detection
- best method depends strongly on particular problem