Master seminar: Solving localization problem in first person computer games with deep learning

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April 25, 2017

Outline

Importance of unsupervised learning for AI

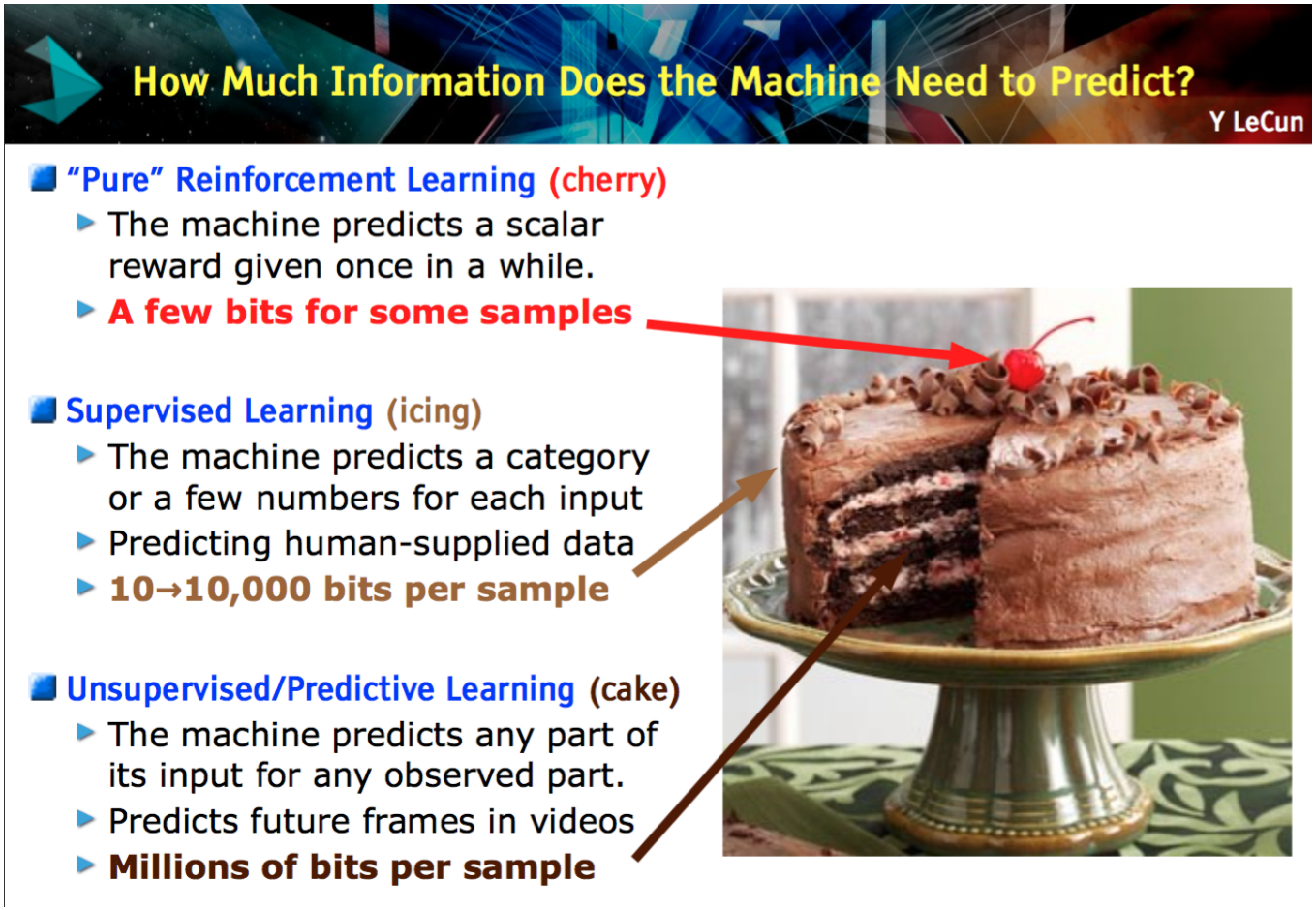


Figure: Slide from "Predictive learning" opening address given by Yann Lecun at NIPS2016.

Key components of finding a solutions

- Sufficient amount of training data
- Computational feasibility of the problem

Localization

Localization as a task of extracting, tracking or predicting object's position in some environment from available sensory data

Localization example: Tracking

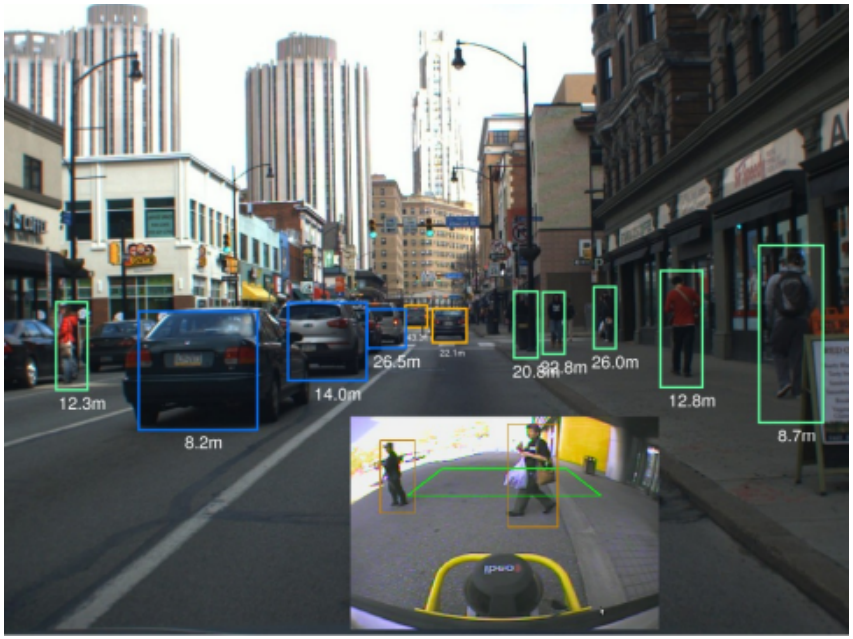


Figure: Pedestrian tracking visualization [1].

[1] H. Cho et. al. "Real-Time Pedestrian and Vehicle Detection for Automotive Active Safety Systems"

Localization example: SLAM

Figure: Example solution of SLAM problem on PC3 dataset (courtesy of University of Michigan).

Localization example: surgery

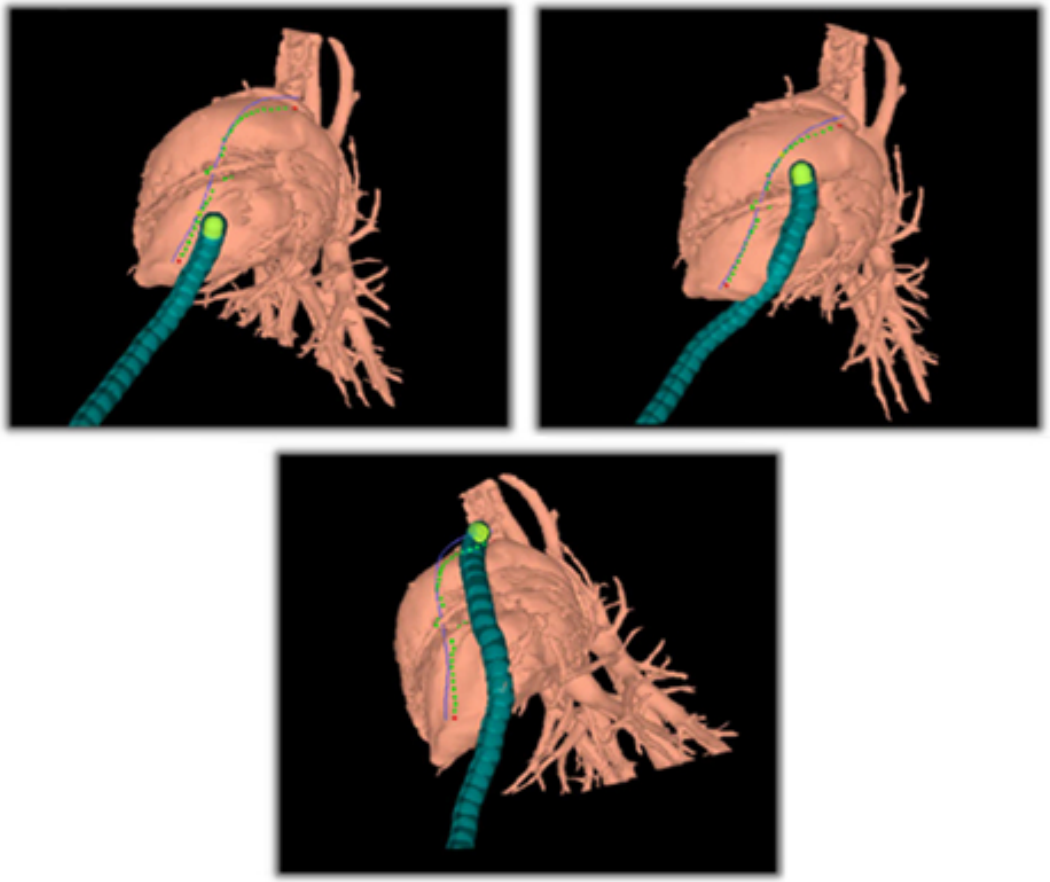


Figure: Mapping the position of a tool in minimally invasive surgery [http://biorobotics.ri.cmu.edu/research/medicalSLAM.html].

Motivation. Continuied

Goal of this work: reconstruction of the actors trajectory in first-person shooter (games) from visual data.

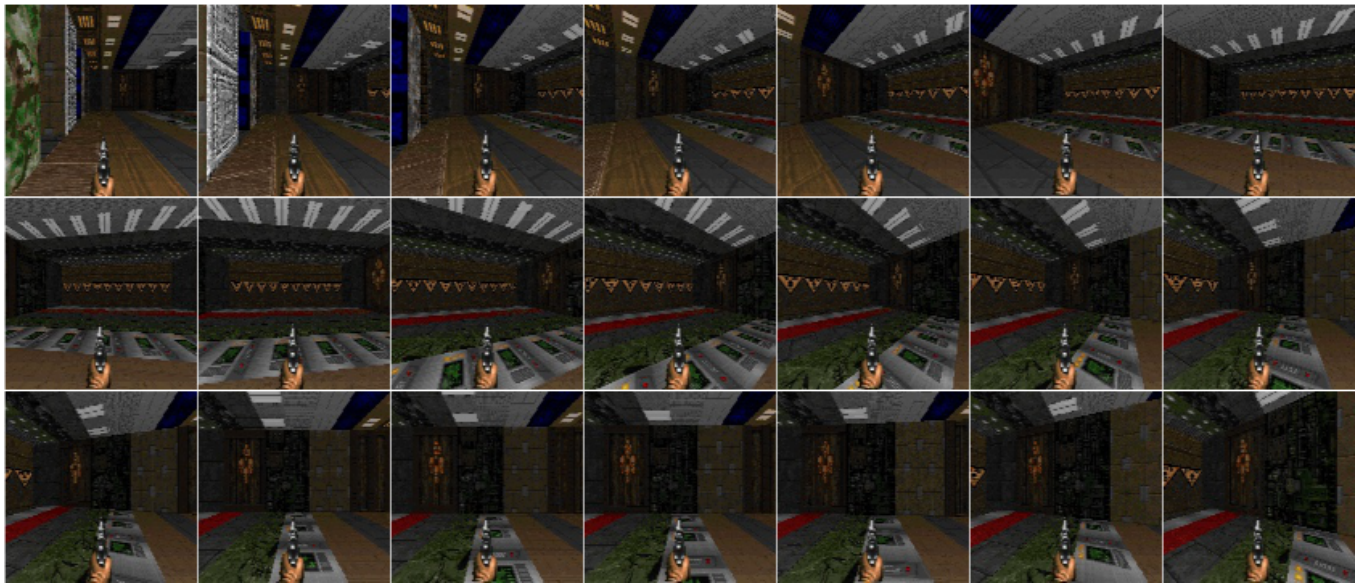
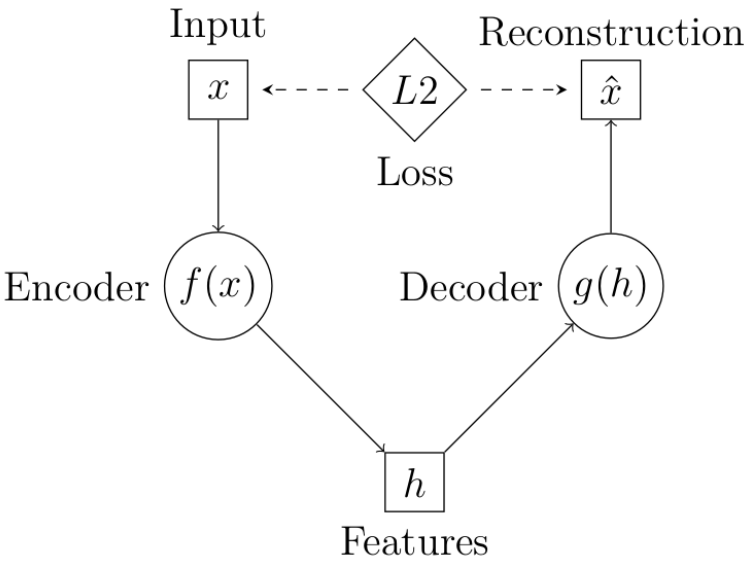


Figure: Example visual data.

Autoencoder model

Autoencoders learn to project the input x into some embedding space $h \in H$ and simultaneously reconstruct the original information $\hat{x}$.



- $f : \mathbb{R}^N \rightarrow \mathbb{R}^M$
- $g : \mathbb{R}^M \rightarrow \mathbb{R}^N$

Model pre-training. Motivation

Extremely high compression rates 76200 (160*120*4) $\rightarrow$ 3..6 are notoriously difficult to learn.

Common irregularities in the manifold space

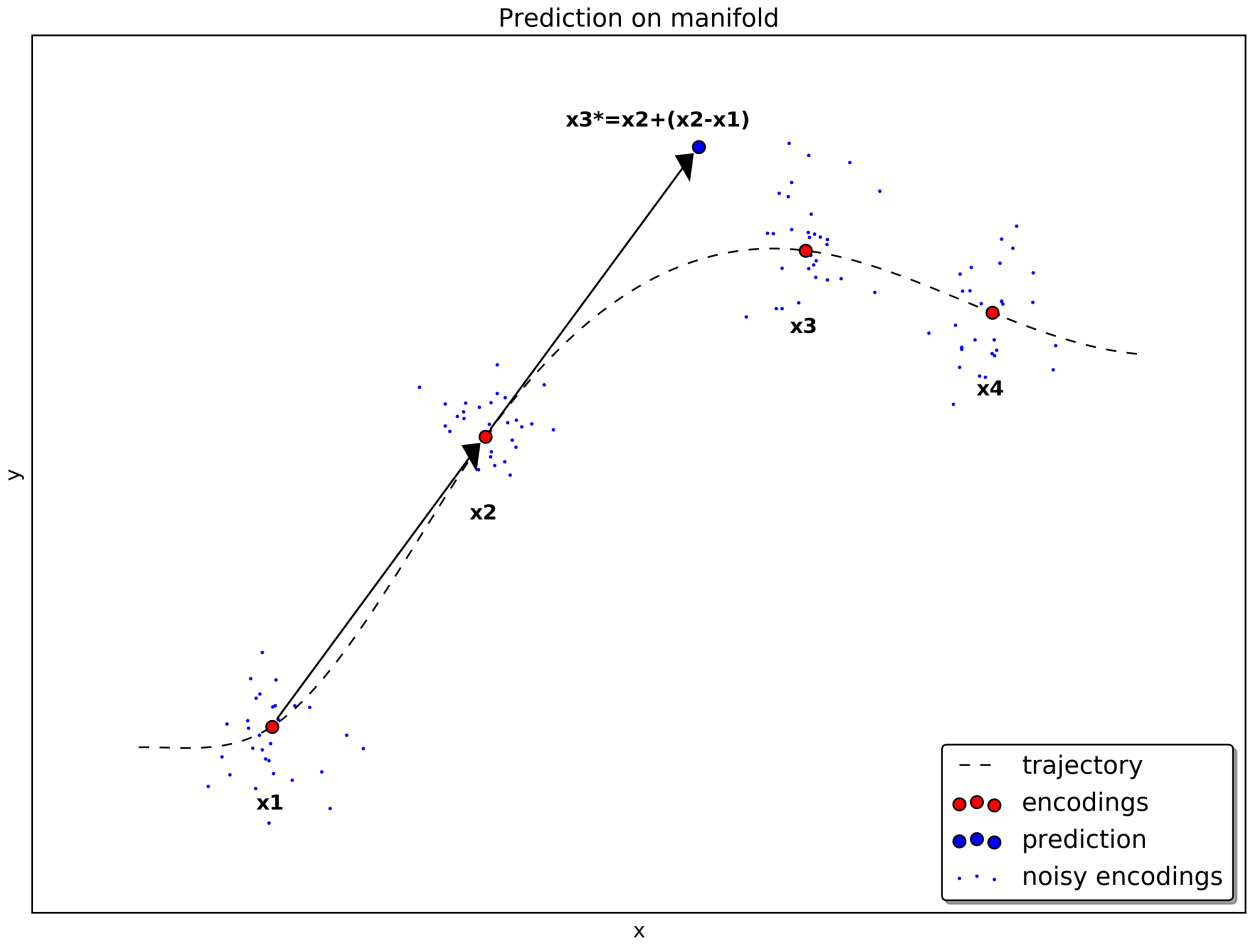
1. High density region
2. Low density regions
3. High curvature of the manifold

Common irregularities in the manifold space

1. High density region
   - Apply random noise in the encoding space to increase "save" distance between frames
2. Low density regions
   - Add "max-distance" penalty
3. High curvature of the manifold
   - Regularize local continuity of in the embedding space

Predictive regularization

Try to estimate positional encoding of the next frame using last two frames of the video.



Model regularization

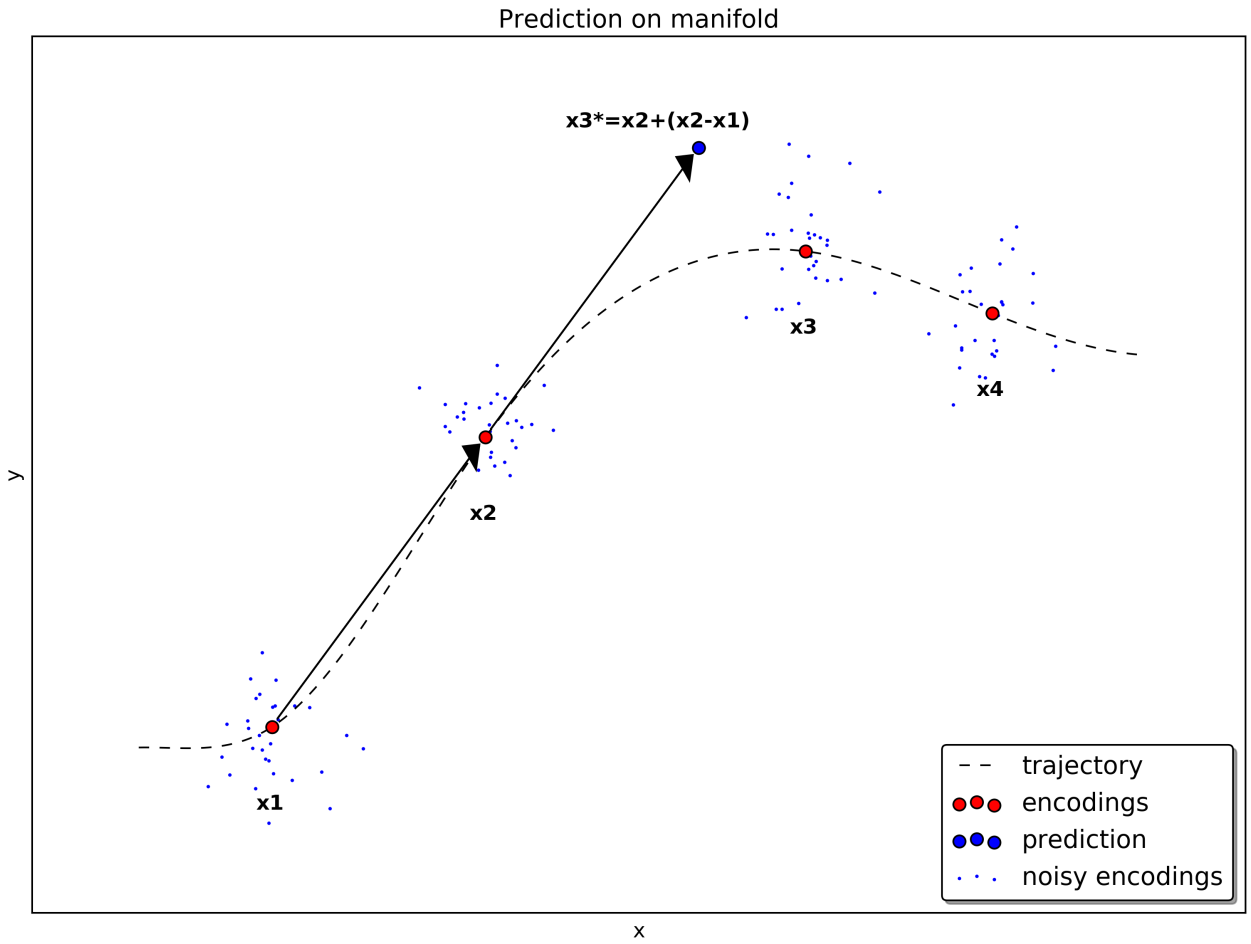


Figure: Complete model with regularization.

Complete model structure

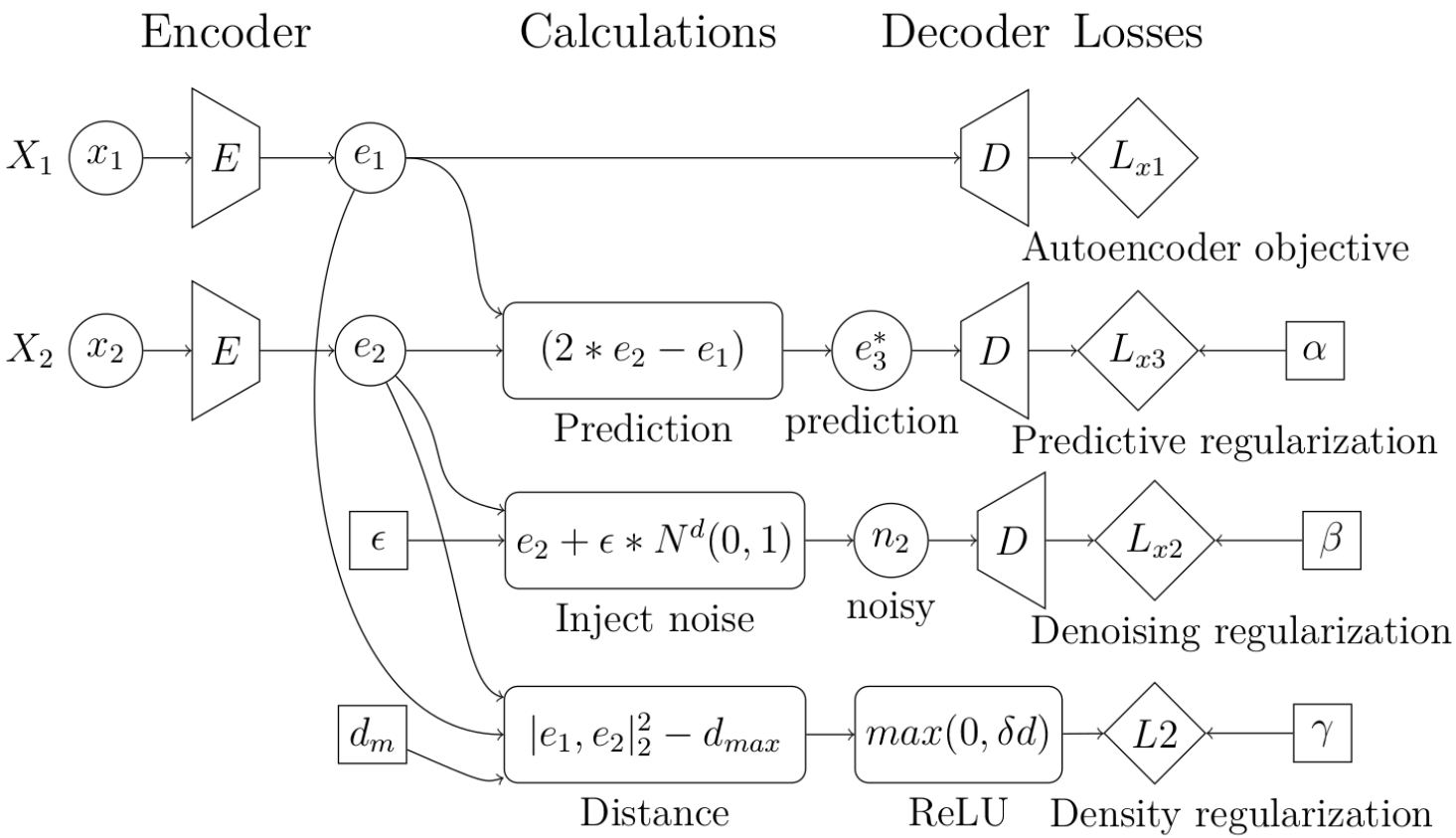


Figure: Complete model with regularization.

Metrics

Data collection

Data collection

Definition

Summary

- The **first main message** of your talk in one or two lines.

- Outlook
  - Something you haven't solved.
  - Something else you haven't solved.