Computer vision :- Object detection. (extra lab) ←

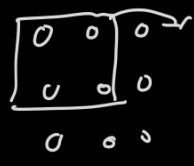
Sequence Learning :

So far: Tabular data $\left(\underline{x} \in \mathbb{R}^d, y \in \mathbb{R} \text{ or } y \in \{0,1\}\right)$

↓

MLP

Spatial data (grid structures, image data) $\left(\underline{x} \in \mathbb{R}^{h \times w \times d}, y \in \mathbb{R} \text{ or } y \in \{\cdot\,\cdot\}\right)$



↓

CNN

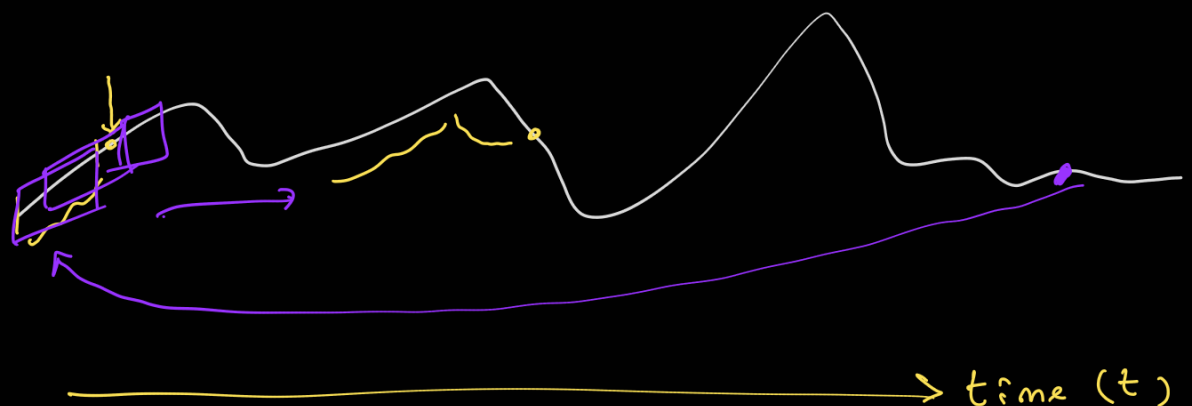
→ Each of these problems: i.i.d.

↓

$\underline{x} \sim P_{data}$ violate assumption.

↓

data demonstrates temporal dependency or temporal structure

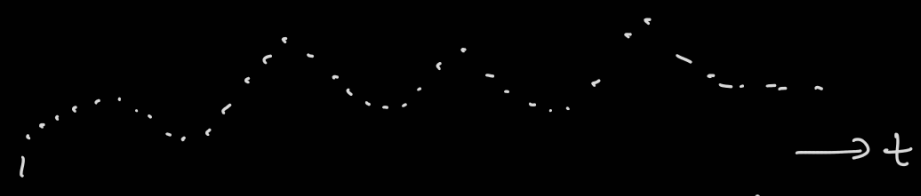


e.g. census data
video frames in a video

Temporal models.

→ Language model. (NLP course)

Time series:



a stock price x_t where $t \in \mathbb{Z}^+$

Goal: What is x_t ? (predict).

prices: → x_1 ---- x_{100} $\boxed{x_{101}}$?

$x_{101} = f(x_1, x_2, \ldots, x_{100}; \theta)$

l.r.

$x_t \sim P(x_t \mid x_{t-1}, \ldots, x_1)$

x_t: not observed yet

$x_{t-1}, \ldots, x_1$: observed.

approximated. 2 ways.

① autoregressive models. ② observed values + domain information.

- Without latent values.
- With latent values.

"latent" → not directly observed.

"inferred"

without latent values.

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x_1 x_2 x_3 x_τ. x_T.

time window: $\tau < T$

feat$_1$	feat$_2$	feat$_3$ ...	feat$_{\tau-1}$	Target (τ)
x_1	x_2	x_3	$x_{\tau-1}$	x_τ
x_2	x_3	x_4	x_τ	$x_{\tau+1}$
⋮				

(X, y)

Training

↓

model (L.R. , D.R) ..

autoregressive model without latent variables.

$$p(x_t \mid x_{t-1}, \dots x_1)$$

↓

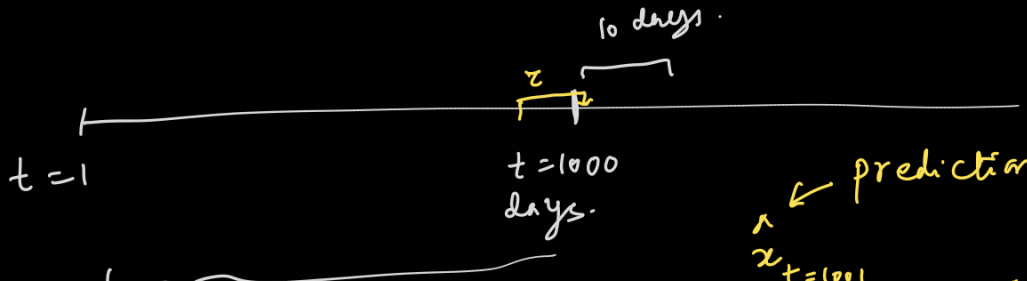
$$p(x_t \mid x_{t-1}, \dots, x_{t-\tau})$$

↓

$$x_t = f(x_1, \dots, x_{t-\tau}; \theta).$$

Testing

10 step ahead.



$\hat{x}_{t=1001}$ ← prediction

$\hat{x}_{1002} = M(\hat{x}_{1001}, x_{1000}, \dots, x_{1002-\tau})$

$\hat{x}_{1003} = M(\hat{x}_{1002}, \hat{x}_{1001}, x_{1003} \dots)$

$\hat{x}_{1011} = M(\hat{} \; \hat{} \; \hat{} \; \hat{} \; \dots)$

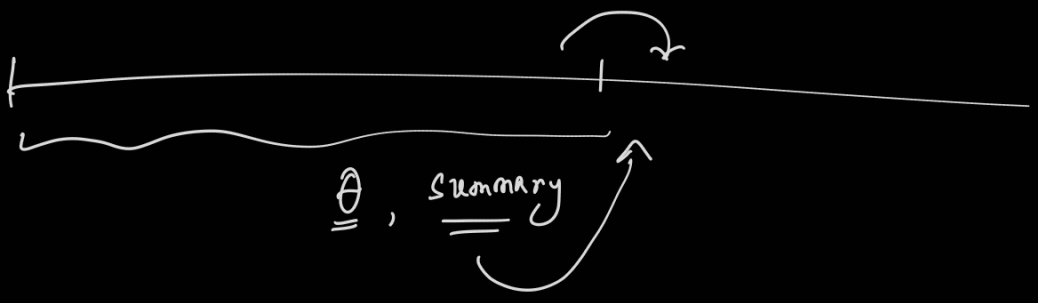
e_1 (

e_2 (

τ length is large.

Solution: 1. Keep a summary

$\underline{\theta}$, keep with the model.



summary.

$\underline{h}$, $\underline{\theta}$

$$x_t \sim p(x_t \mid x_{t-1}, \cdots, x_{t-\tau})$$

$$x_t = f(x_{t-1}, \cdots, x_{t-\tau}, \underbrace{h_{t-\tau}}_{\text{summary}}; \underline{\theta})$$

NN

"latent variable"

RNN

$$x_t = f(x_{t-1}, h_{t-1}; \underline{\theta})$$

- x_{t-1}: previous input
- h_{t-1}: prev. summary ($x_1 \cdots x_{t-2}$)
- $\underline{\theta}$: parameter.

The role of the summary:

S1: "I play tennis on Fridays" → $\underline{h}$

S2: "On Fridays, I play tennis."

Q: On what days of the week the subject plays tennis?

Context

Summary

Summarize:

Modelling

Joint distribution.

RNN model joint distributions of sequences.

↓

Generative models.

Ex: "I play tennis on Fridays"

$P(\text{I play} \dots \text{Friday}) = P(\text{I})\, P(\text{play} \mid \text{I})\, P(\text{tennis} \mid \text{I}, \text{play})\, P(\text{on} \mid \text{I}, \text{play}, \text{tennis})\, P(\text{Fridays} \mid \text{I}, \text{play}, \text{tennis}, \text{on})$

$P(x_1, \dots x_t) = P(x_1)\, P(x_2 \mid x_1)\, P(x_3 \mid x_1, x_2) \dots P(x_t \mid x_1, \dots x_{t-1})$

Midsem

1. Prelim: ML generalisation. . . -
2. MLP: , optimisation, ... (Numericals
3. CNN: conv. numerical

Type: MCQ* Fill in the blanks → short. (number, word)

(multiple answer correct)

No negative marking

5 : 3 correct.