7. Prediction

Prediction

on classification, actually what we got here should remind you

a linear classifier that goes through origin with respect

to this parameter theta hat w.

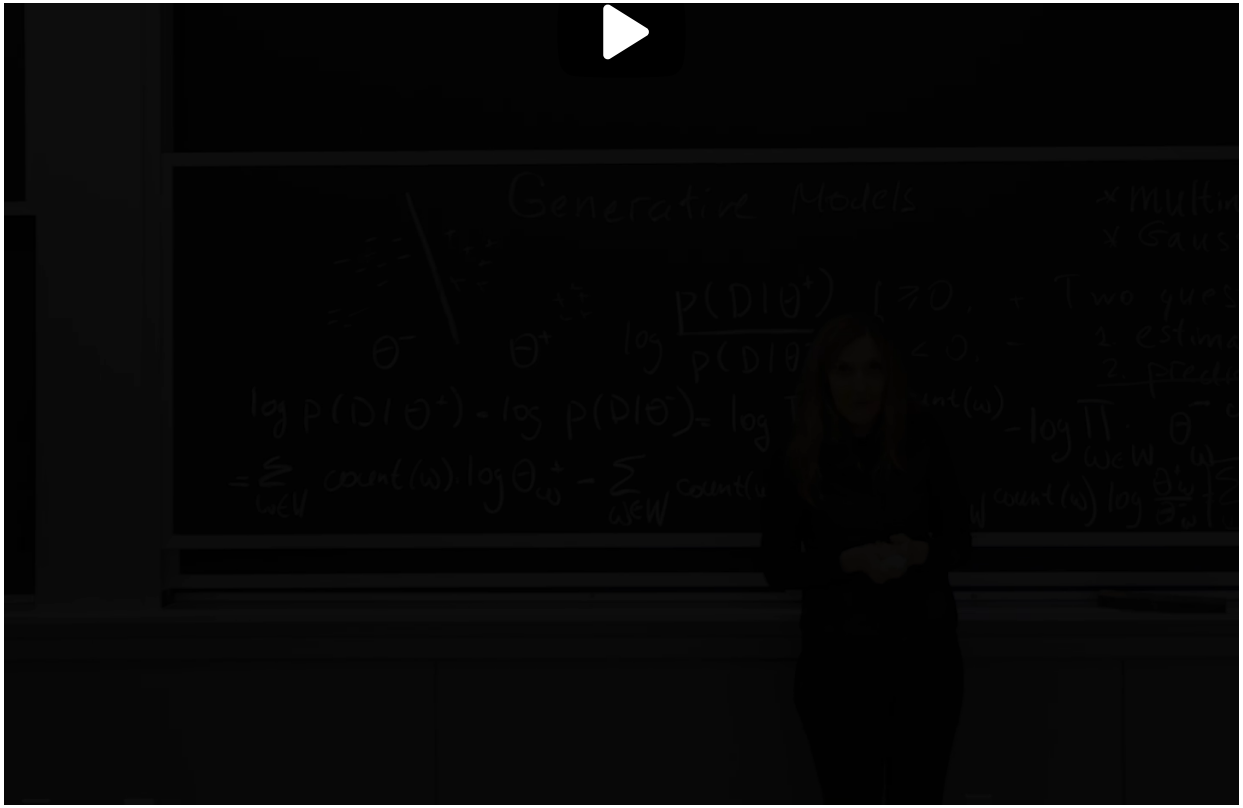
So despite the fact that we went kind

of in a very different way, what we

got with our generative model, we still

get a linear classifier, just get there in a different way.

OK?



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Predictions of a generative multinomial model

1/1 point (graded)

Consider using a multinomial generative model M for the task of binary classification consisting of two classes which are denoted by + (positive class) and - (negative class).

Let the parameters of M that maximize the likelihood of training data for the positive class be denoted by θ^+ and for the negative class be denoted by θ^-.

Also, suppose that we classify a new document D to belong to the positive class iff

$$log\frac{P(D|\theta^+)}{P(D|\theta^-)} \geq 0$$

where $P(D|\theta)$ stands for the probability that document D is generated using a multinomial distribution with parameters θ.

Which of the following option(s) is/are true about this generative classifier? Choose all that apply from the statements below:

- [x] A document is classified as positive iff $P(D|\theta^+) \geq P(D|\theta^-)$ ✔
- [ ] A document is classified as positive iff $P(D|\theta^+) < P(D|\theta^-)$
- [x] The generative classifier M can be shown to be equivalent to a linear classifier given by $\sum_{w \in W} count(w) \times \theta'_w \geq 0$ where $\theta' = log\frac{\theta^+_w}{\theta^-_w}$ ✔

- The generative classifier M can be shown to be equivalent to a linear classifier given by $\sum_{w \in W} count\,(w) \times \theta'_w \geq 0$ where $\theta' = log\frac{\theta^-_w}{\theta^+_w}$

✔

Solution:

Note that we classify a new document D to belong to the positive class iff $log\frac{P(D|\theta^+)}{P(D|\theta^-)} \geq 0$ and to the negative class otherwise.

$$log\frac{P\,(D|\theta^+)}{P\,(D|\theta^-)} \geq 0$$

is equivalent to

$$P\,(D|\theta^+) \geq P\,(D|\theta^-)$$

.

Recall from the lecture that,

$$log\frac{P\left(D|\theta^{+}\right)}{P\left(D|\theta^{-}\right)}$$

$$= logP\left(D|\theta^{+}\right) - logP\left(D|\theta^{-}\right)$$

$$= log\Pi_{w\in W}\left(\theta_{w}^{+}\right)^{count(w)} - log\Pi_{w\in W}\left(\theta_{w}^{-}\right)^{count(w)}$$

$$= \sum_{w\in W} count\left(w\right) log\theta_{w}^{+} - \sum_{w\in W} count\left(w\right) log\theta_{w}^{-}$$

$$= \sum_{w\in W} count\left(w\right) log\frac{\theta_{w}^{+}}{\theta_{w}^{-}}$$

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Answers are displayed within the problem

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