Density Estimation

E.g.: Assuming tweets from an account are independently generated randomly. Create a robot account that generates more such tweets.

$f(\text{Tweet}) = \text{Score of the tweet}$

wisdomofchopra.com

It has been said by some that the thoughts and tweets of Mr. Chopra are indistinguishable from a set of profound sounding words put together in a random order, particularly the tweets tagged with "#cosmisconciousness". This site aims to test that claim! Each "quote" is generated from a list of words that can be found in Deepak Chopra's Twitter stream randomly stuck together in a sentence.

"A formless void transforms total mysteries"

RECEIVE MORE WISDOM...

Tweet the wisdom

Disclaimer: This is intended for entertainment purposes only. It in no way reflects the thoughts of any real person.

Density Estimation

"A formless void transforms total mysteries"

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To generate such sentences randomly, we need to be able to assign a probability score to every possible 128 character sentence, giving high scores to those that are likely to be from the original source.

A density estimation model takes in several samples from a random source, and outputs a model that assigns a probability score to every possible instance.

Density Estimation

Σ

sum over
all tweets 10^{8}
{a .. z}

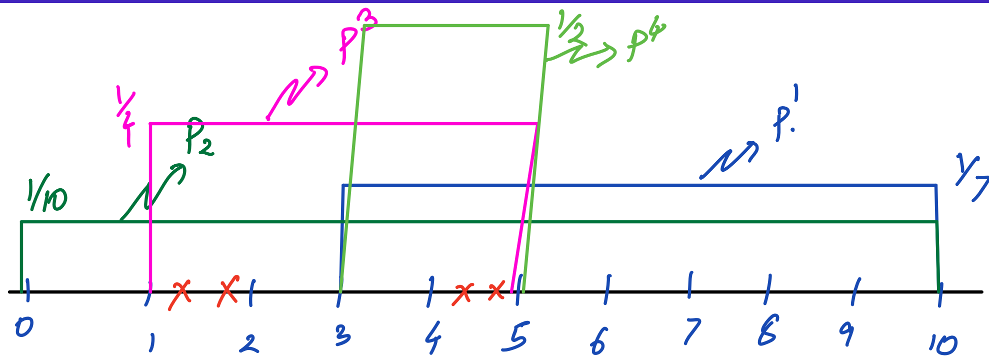
$P(\text{tweet}) = 1$

- Data: $\{\mathbf{x}^1, \mathbf{x}^2, \ldots, \mathbf{x}^n\}$
- $\mathbf{x}^i \in \mathbb{R}^d$
- Probability mapping $P : \mathbb{R}^d \rightarrow \mathbb{R}_+$ that 'sums' to one.
- Goal : $P(\mathbf{x})$ is large if $\mathbf{x} \in$ Data, and low otherwise.
- Loss $= \frac{1}{n} \sum_{i=1}^{n} -\log\left(P(\mathbf{x}^i)\right)$

$P(x^i)$ is large.

$P(\text{anything}) = 10^{10}$

Density Estimation Illustration 1



$x^1 : [1.2]$

$x^2 : [1.9]$

$x^3 : [4.3]$

$x^4 : [4.8]$

p^1 = Uniform in $[3, 10]$ $\quad 0, 0, \frac{1}{7}, \frac{1}{7}$

p^2 = Uniform in $[0, 10]$ $\quad \frac{1}{10}, \frac{1}{10}, \frac{1}{10}, \frac{1}{10}$

p^3 = Uniform in $[1, 5]$ $\quad \frac{1}{4}, \frac{1}{4}, \frac{1}{4}, \frac{1}{4}$

p^4 = Uniform in $[3, 5]$ $\quad 0, 0, \frac{1}{2}, \frac{1}{2}$

$$\text{loss}[p^4] = \text{loss}[p^1] = \infty > \text{loss}[p^2] > \text{loss}[p^3]$$

Density Estimation Illustration 2

$d=2$

$(1.1,\ 1.3)$

$(0.9,\ 0.7)$

$(2.1,\ -1)$

$(5.1,\ 0.1)$

$(2.2,\ -0.9)$

$(5.1,\ 0.0)$

$(0.9,\ 1.2)$

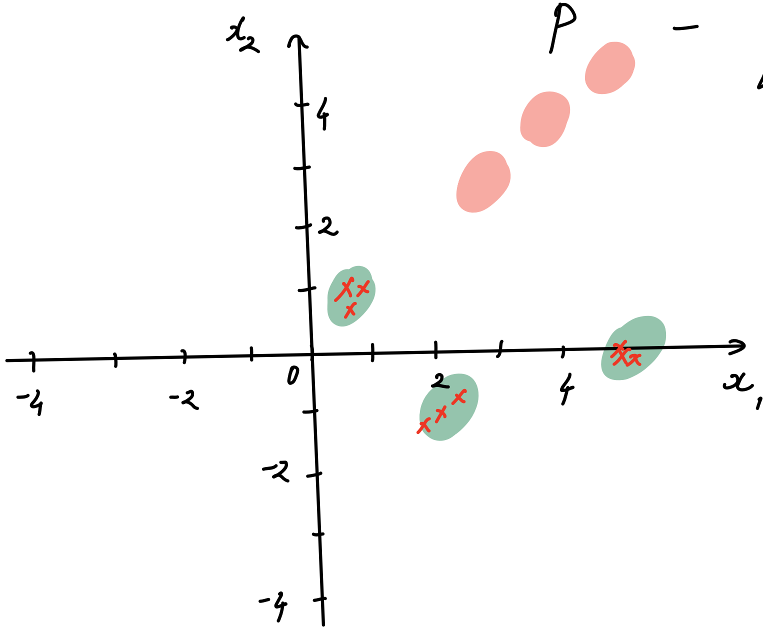
$(1.9,\ -1.1)$

$(4.8,\ -0.1)$

Gaussian Mixture Model

$p^1 - \begin{bmatrix}3\\3\end{bmatrix},\ \begin{bmatrix}5\\5\end{bmatrix}\ \begin{bmatrix}4\\4\end{bmatrix}$

$p^2 - \begin{bmatrix}1\\1\end{bmatrix}\ \begin{bmatrix}2\\-1\end{bmatrix}\ \begin{bmatrix}5\\0\end{bmatrix}$



Clustering