

Introduction to Machine Learning

CSE474/574: Lecture 1

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Outline

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1 Warmup

A fair coin

- Probability of heads?
- 5 heads in a row?
- 5th head after seen 4 heads in a row?
- *Gambler's Fallacy*
- If I know that probability of two people bringing a bomb on a plane is very low, should I bring a bomb along to make myself safer?
- *Inverse Gambler's Fallacy*

The conditional probabilities of observing heads or tails can be computed by applying the Bayes' Theorem.

$$P(5H|4H) = \frac{P(4H|5H) \times P(4H)}{P(4H)}$$

The key thing to note here is that $P(4H|5H)$ is 1 because we have already “seen” the outcome of observing 4 heads, it is no longer random.

Consider a different game in which “winning” means getting at least 1 head in 4 tosses. In the beginning the probability of winning is:

$$1 - \left(\frac{1}{2}\right)^4 = 93.75\%$$

Now if we toss a tail in the first trial, will my winning probability stay the same or change, and would it increase or decrease? According to the *Gambler's Fallacy* it should increase. However actually the probability of winning will get revised to:

$$1 - \left(\frac{1}{2}\right)^3 = 87.5\%$$

So actually by getting a tails in the first toss, we lower our probability of winning by over 6%.

Matrix Vector Products

- Let $[3, 4]$ denote a vector in a 2D space
- Multiply with a number?

$$2 \begin{bmatrix} 3 \\ 4 \end{bmatrix}$$

- Multiply with a matrix?

$$\begin{bmatrix} 2 & 1 \\ -2 & 3 \end{bmatrix} \begin{bmatrix} 3 \\ 4 \end{bmatrix}$$

- For a matrix, find a vector such that matrix-vector product \equiv scalar-vector product.

For a given matrix A , we are interested in finding a vector \mathbf{x} such that:

$$A\mathbf{x} = \lambda\mathbf{x}$$

where λ is a scalar. The solution is the set of **Eigenvectors**.

2 Human Learning

- What do we learn?
 - Concepts (this is a chair, that is not a chair)
 - Distinguishing concepts (this is a chair, that is a table)
 - Other things (language, juggling, using a remote)
- How do we learn?
 1. Teaching (Passive).
 2. Experience (Active).
 - (a) Examples.
 - (b) Queries.
 - (c) Experimentation.

References