CS5014 Machine Learning

Lecture 2 Maths background review

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So why this review session ?

Maths is essential . . .

- for CS5014 (all other (data) *science* modules)
- we use a lot of maths
  - rigorous and concise way of communicating results
  - help us understand why *and* why not algorithms work

Review some key concepts

- not complete; just a small subset
- set the level of math maturity we expect

Self-assessment for yourself

- find the weak or rusty area
- do self studies

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Mathematics for machine learning

Linear algebra

- leap forward from scalar maths e.g. $a + b = c$
  - $a, b, c$are scalars: $1 + 2 = 3$
  - $a, b, c$are vectors: $\begin{bmatrix}1\\2\end{bmatrix} + \begin{bmatrix}2\\1\end{bmatrix} = \begin{bmatrix}3\\3\end{bmatrix}$

Probability theory and statistics

- study of uncertainty: uncertainty is the norm
  - e.g. rain tomorrow? blood pressure measurement (reading error)?
- how to generalise your results
  - from one sample to the universe: vaccine trial

Calculus

- study of continuous (real-valued) functions (using approximation *polynomial*)
  - $y = sin(x)$ is well approximated by $y = x$ when $x \approx 0$
- useful when we do optimisation

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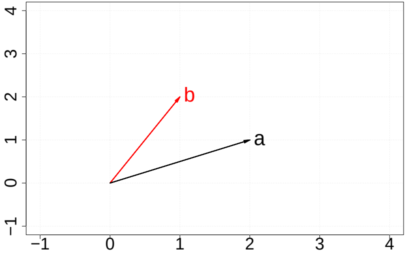
Linear algebra: Basic concepts

- vectors
- norms and distances
- linear independence
- matrices, linear transformation
- matrix arithmetics
- rank, determinant, trace

Vector

A vector is a collection of n salars

- $\boldsymbol{a} \in R^n$, default option is column vector i.e. $n \times 1$
- represents a **displacement** from $\mathbf{0}$ to $\boldsymbol{a}$ in R^n
- e.g. $\boldsymbol{a} = \begin{bmatrix} 2 \\ 1 \end{bmatrix}, \boldsymbol{b} = \begin{bmatrix} 1 \\ 2 \end{bmatrix}$ (or $\boldsymbol{a} = [2, 1]^T$ to save space)



experiment