

Practical Data Science (Linear Algebra)

Write R Scripts or use R to perform any mathematical operations while solving the following problems.

Problem 1: Applying Vector Algebra

- 1) Find the scalar projection of a onto b in 3-dimensions, where $a = j + \frac{1}{2}k$ and $b = 2i - j + 4k$.
- 2) Find the co-ordinates of point $(2, 3)$ along the new basis formed by vectors $v_1 = (4, 6)$, $v_2 = (0, 1)$.
- 3) Find the angle between the following 3-dimensional vectors:
 - a. $(1, 3, 4)$, $(2, 1, 6)$
 - b. $(2, 1, 3)$, $(6, 3, 9)$

Problem 2: How much will it rain in longer run?

Suppose that days are either rainy (r) or sunny (s). If on any particular day it is rainy, then the next day will be rainy with probability $\frac{2}{3}$ and sunny with probability $\frac{1}{3}$. Similarly, if on any particular day it is sunny, then the next day will be rainy with probability $\frac{1}{4}$ and sunny with probability $\frac{3}{4}$. What is the long-run fraction of days that will be rainy?

Problem 3: Android vs Apple IOS

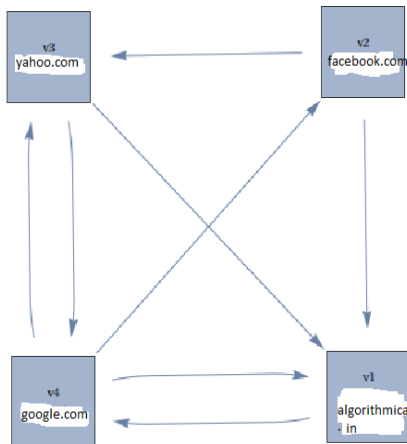
Assume that customers are using Apple IOS and Google Android for their mobiles. For each cycle $\frac{1}{3}$ of IOS users switch to Android and $\frac{2}{3}$ stays. Also let's assume that $\frac{1}{2}$ of the Android OS users switch to IOS and $\frac{1}{2}$ stay for each cycle. Answer the following questions:

- a) How many users will stay with Android and IOS after 10 cycles if initial vector is $(1000, 800)$?
- b) What will be long term behavior of customers?

Problem 4: Computing Page Ranks

For the web depicted below, do the following tasks:

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- Assuming each site has one unit of importance, construct the system of equations that computes the page ranks based on link structure discussed in class. Verify that the sum of each row values equal to one.
- Construct the matrix notation for solving the linear equations built in part a.
- What will be the ranks of pages after 2 iterations assuming each page has equal chance to visit initially?
- What will be the long term ranks of pages assuming each page has equal chance to visit initially?
- Find the eigen-vector corresponding to the eigenvalue $\lambda = 1$?