CIS 419/519: Applied Machine Learning — Fall 2024

Homework 0

Handed Out: August 28 — *Due: 7:59 pm September 4*

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1 Declaration

- **Person(s) discussed with:** *Your answer*
- **Affiliation to the course: student, TA, prof etc.** *Your answer*
- **Which question(s) in coding / written HW did you discuss?** ***Your answer***
- **Briefly explain what was discussed.** *Your answer*

2 Multiple Choice & Written Questions

1. (a) **C**

   (b) **A**

2. (a) **D**

   (b) **A**

3. (a) **A**

   (b) **A**

4. (a) **B**

   (b) We are given that

$$\begin{aligned} Var(x) &= E[(X - E[X])^2] && (1)\\ &= E[(x^2 - 2xE[x] + E[x]^2)] && (2)\\ &= E[x^2] - E(2xE[x]) + E[E[x]^2] && (3)\\ &= E[x^2] - 2 \cdot E[x] \cdot E[x] + E[x]^2 && (4)\\ &= E[x^2] - 2E[x]^2 + E[x]^2 && (5)\\ &= E[x^2] - E[x]^2 && (6) \end{aligned}$$

   We know that $E[2xE[x]] = 2E[x]E[x] = 2E[x]^2$ because $E[x]$ is a constant. Furthermore we know that $E[E[x]^2] = E[x]^2$ because $E[x]$ is a constant. Thus, our equation for variance $Var(x) = E[(X - E[X]^2)]$ reduces down to $E[x^2] - E[x]^2$.

5. (a) **C**
   (b) **D**
   (c) **A**

6. (a) We are given a 2x2 matrix. We can find the eigenvalues of a 2x2 matrix by solving the following equation: $det(A - \lambda \cdot I) = 0$. Since A is 2x2 we know then $I = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$. And also, because A is a 2x2 matrix, then the determinant of any 2x2 matrix given elements $\begin{bmatrix} a & b \\ c & d \end{bmatrix}$ $det(M) = ad - bc$. Thus, we can solve for the eigenvalues of A by solving the equation:

$$\begin{aligned} det(A - \lambda \cdot I) &= 0 \\ = det(\begin{bmatrix} 4-\lambda & 2 \\ 1 & 5-\lambda \end{bmatrix}) &= 0 \\ = (4-\lambda)(5-\lambda) - 2 &= 0 \\ = 20 - 9\lambda + \lambda^2 - 2 &= 0 \\ = \lambda^2 - 9\lambda + 18 &= 0 \\ = (\lambda - 6)(\lambda - 3) &= 0 \\ \lambda &= 6, 3 \end{aligned}$$

Thus, the two eigenvalues for the matrix A is 6 and 3.

   (b)

3 Python Programming Questions

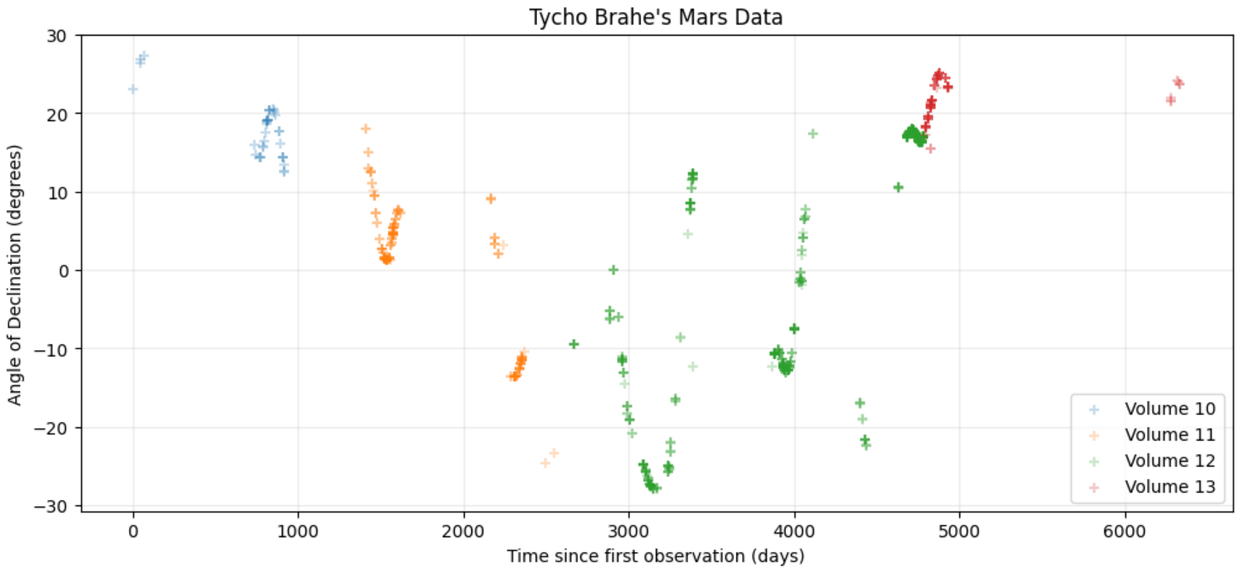

Figure 1: Figure 1