UNIVERSITY OF ASIA PACIFIC

MID SEMESTER EXAMINATION

SPRING 2021
CSE 401

Mathematics for Computer Science

HASAN TAHSIN RAFSAN
18101009
A1 SECTION
ROLL 9
4TH YEAR
1ST SEMESTER
DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
13 SEPTEMBER 2021

University of Asia Pacific

Admit Card

Mid-Term Examination of Spring, 2021

Financial Clearance	PAID

Registration No : 18101009

Student Name : Hasan Tahsin Rafsan

Program : Bachelor of Science in Computer Science and Engineering

SI.NO.	COURSE CODE	COURSE TITLE	CR.HR.	EXAM. SCHEDULE
1	CSE 400	Project / Thesis	3.00	
2	CSE 401	Mathematics for computer Science	3.00	
3	CSE 403	Artificial Intelligence and Expert Systems	3.00	
4	CSE 404	Artificial Intelligence and Expert Systems Lab	1.50	
5	CSE 405	Operating Systems	3.00	
6	CSE 406	Operating Systems Lab	1.50	
7	CSE 407	ICTLaw, Policy and Ethics	2.00	
8	CSE 410	Software Development	1.50	
9	CSE 427	Topics of Current Interest	3.00	

Total Credit: 21.50

1. Examinees are not allowed to enter the examination hall after 30 minutes of commencement of examination for mid semester examinations and 60 minutes for semester final examinations.

2. No examinees shall be allowed to submit their answer scripts before 50% of the allocated time of examination has elapsed.

3. No examinees would be allowed to go to washroom within the first 60 minutes of final examinations.

**4. No student will be allowed to carry any books, bags, extra paper or cellular phone or objectionable items/incriminating paper in the examination hall.
Violators will be subjects to disciplinary action.**

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Ans: 1

(b) . Naive Bayes: If I have a hypothesis A & data B which bears the hypothesis then. the equation is

$$P(A|B) = \frac{P(B|A) \ast P(A)}{P(B)}.$$

P(A) = independent probability of A event
prior probability

P(B) = independent probability of B. event

P(A|B) = coditional probability of A given B.

P(B|A) = conditional probability of B given A.

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(a)

here, id = 1810109.

$A = 9+1 = 10$

function $f(x,y,z) = x+y+2z$ ———

constraint $x^2+y^2+z^2 = A$

$\Rightarrow x^2+y^2+z^2 = 10$ ———

Now, $g(x,y,z) \overset{\text{will}}{=} x^2+y^2+z^2-10 = 0$

Rule of lagrange Multiplier

$f(x,y,z) - \lambda \, g(x,y,z) = 0$ ——— (1)

$\Rightarrow x+y+2z - \lambda(x^2+y^2+z^2-10) = 0$

$\Rightarrow x+y+2z - \lambda x^2 - \lambda y^2 - \lambda z^2 + 10\lambda = 0$ ——— (1)

$\Rightarrow$

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for ①

Now, partially derive with respect to x.

$1 + 0 + 0 - 2\lambda x - 0 - 0 + 0 = 0$.

$\Rightarrow 1 - 2\lambda x = 0 \Rightarrow 1 = 2\lambda x$

$\Rightarrow 2\lambda x = 1$

$\Rightarrow x = \frac{1}{2\lambda}$ ———

for ①.

Now, partially derive w.r.to y.

$0 + 1 + 0 - 0 - 2\lambda y - 0 + 0 = 0$

$\Rightarrow 1 - 2\lambda y = 0$

$\Rightarrow 1 = 2\lambda y$

$\Rightarrow y = \frac{1}{2\lambda}$ ———

for ①

partially derive with r. to z.

$0 + 0 + 2 - 0 - 0 - 2\lambda z + 0 = 0$

$\Rightarrow 2 - 2\lambda z = 0 \Rightarrow 2\lambda z = 2$

$\Rightarrow z = \frac{2}{2\lambda} = \frac{1}{\lambda}$

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$\therefore x = \frac{1}{2\lambda}$

$y = \frac{1}{2\lambda}$

$z = \frac{1}{\lambda}$

we will put this value into

$x^2 + y^2 + z^2 = 10$.

$\left(\frac{1}{2\lambda}\right)^2 + \left(\frac{1}{2\lambda}\right)^2 + \left(\frac{1}{\lambda}\right)^2 = 10$

$\Rightarrow \frac{1}{4\lambda^2} + \frac{1}{4\lambda^2} + \frac{1}{\lambda^2} = 10$

$\Rightarrow \frac{1+1+4}{4\lambda^2} = 10$

$\Rightarrow \frac{6}{4\lambda^2} = 10$

$\Rightarrow 40\lambda^2 = 6$

$\Rightarrow \lambda^2 = \frac{\cancel{40}\,20}{\cancel{6}\,3} = \frac{20}{3}$

$\Rightarrow \lambda = \pm\sqrt{20/3} = \pm \frac{2\sqrt{15}}{3}$

$\Rightarrow$

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Now, when

$$\lambda = +\frac{2\sqrt{15}}{3}, \text{ then}$$

$$x = \frac{1}{2\lambda} = \frac{1}{2 * \frac{2\sqrt{15}}{3}} = \frac{\sqrt{15}}{20}$$

$$Y = \frac{1}{2\lambda} = \frac{1}{2 * \frac{2\sqrt{15}}{3}} = \frac{\sqrt{15}}{20}$$

$$z = \frac{1}{\lambda} = \frac{1}{\frac{2\sqrt{15}}{3}} = \frac{\sqrt{15}}{10}$$

when

$$\lambda = -\frac{2\sqrt{15}}{3} \text{ then.}$$

$$x = \frac{1}{2\lambda} = \frac{1}{2 * \left(\frac{-2\sqrt{15}}{3}\right)} = -\frac{\sqrt{15}}{20}$$

$$Y = \frac{1}{2\lambda} = \frac{1}{2 * \left(\frac{-2\sqrt{15}}{3}\right)} = -\frac{\sqrt{15}}{20}.$$

$$z = \frac{1}{\lambda} = \frac{1}{-\frac{2\sqrt{15}}{3}} = -\frac{\sqrt{15}}{10}$$

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so, $\lambda = 2\sqrt{15}/3$. $(x,y,z) = \left(\frac{\sqrt{15}}{20}, \frac{\sqrt{15}}{20}, \frac{\sqrt{15}}{10}\right)$

$\lambda = -\frac{2\sqrt{15}}{3}$ $(x,y,z) = \left(-\frac{\sqrt{15}}{20}, -\frac{\sqrt{15}}{20}, -\frac{\sqrt{15}}{10}\right)$

now, $f(x,y,z) = x+y+2z$.

$f\left(\frac{\sqrt{15}}{20}, \frac{\sqrt{15}}{20}, \frac{\sqrt{15}}{10}\right) = \left(\frac{\sqrt{15}}{20} + \frac{\sqrt{15}}{20} + 2\frac{\sqrt{15}}{10}\right)$

$= \frac{3\sqrt{15}}{10} = 1.161895$

$f\left(-\frac{\sqrt{15}}{20}, -\frac{\sqrt{15}}{20}, -\frac{\sqrt{15}}{10}\right) = \left(-\frac{\sqrt{15}}{20}\right) + \left(-\frac{\sqrt{15}}{20}\right) + 2\left(-\frac{\sqrt{15}}{10}\right)$

$= -\frac{3\sqrt{15}}{10} = -1.161895$

so, our maximum value will be 1.161895 (Ans)

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Ans :- 2

(b) The expected value of head from first coin toss.

$k-1$ is failures.

success p (heads) is

$P(X=k) = (1-p)^{k-1}p$.

k is the total no of toss including heads.

So the expected value of x for a given p is $\frac{1}{p} = 2$.

$$E(X) = \frac{p}{1-p} \sum_{n=1}^{\infty} n p^n = \frac{p}{1-p} \cdot n \left(\frac{d}{dn} \frac{1}{1-n}\right)$$

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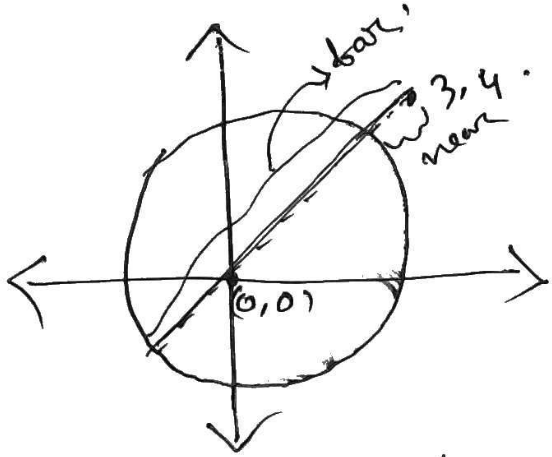
Ans : 3

(b) constrained optimization ~~prob~~ optimization. real life example.



~~center~~ Here, this is a circle, where center is 0,0. lets think our equation of circle is $x^2 + y^2 = 4$.

A ~~center is~~ point (3, 4) is given outside the circle. Now, determine the nearest & farest points of the circle from this point

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we can solve this real life problem with a contrained optimization technique.

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ⓐ Given dataset →

$x_1 = [4, 9, 3, 5]$

$x_2 = [2, 1, 6, 3]$

my id = 18101009

$a = 18101009 \bmod 3 + 1 = 3$

$b = 181010009 \bmod 5 + 1 = 5$

ⓑ data set →

x_1	4	3	3	5
x_2	2	1	5	3

calculate mean.

$\overline{x_1} = (4+3+3+5) * \frac{1}{4} = 3.75$

$\overline{x_2} = (2+1+5+3) * \frac{1}{4} = 2.75$

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cov matrix

$$\text{cov}\cdot(x_1, x_1) = \frac{1}{N-1}\sum_{k=1}^{N}(x_{1k}-\bar{x}_1)^2$$

$$= \frac{1}{4-1}\left\{(4-3.75)^2+(3-3.75)^2+(3-3.75)^2+(5-3.75)^2\right\}$$

$$= \frac{1}{3} * \frac{11}{4} = 0.9166\ldots$$

$$\text{cov}(x_1, x_2) = \frac{1}{N-1}\sum_{k=1}^{N}(x_{1k}-\bar{x}_1)(x_{2k}-\bar{x}_2)$$

$$= \frac{1}{3} * \left\{(4-3.75)(2-2.75)+(3-3.75)(1-2.75)+(3-3.75)(5-2.75)+(5-3.75)(3-2.75)\right\}$$

$$= \frac{1}{3} * -\frac{1}{4} = -\frac{1}{12} = -0.0833\ldots$$

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$$\mathrm{cov}(x_2, x_1) = \frac{1}{N-1} \sum_{k=1}^{N} (x_{2k} - \bar{x}_2)(x_{1k} - \bar{x}_1)$$

$$= -0.08333$$

$$\mathrm{cov}(x_2, x_2) = \frac{1}{N-1} \sum_{k=1}^{N} (x_{2k} - \bar{x}_2)^2$$

$$= \frac{1}{3} \{ (2-2.75)^2 + (1-2.75)^2 + (5-2.75)^2 + (3-2.75)^2 \}$$

$$= 2.9166$$

so, matrix

$$= \begin{bmatrix} 0.9166 & -0.0833 \\ -0.0833 & 2.9166 \end{bmatrix}$$

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eigen values.

$$\det(S-\lambda I)=0,$$

$$=\begin{vmatrix} 0.9166-\lambda & -0.0833 \\ -0.0833 & 2.9166-\lambda \end{vmatrix}=0$$

$$\Rightarrow (0.9166-\lambda)(2.9166-\lambda)-(-0.0833)*(-0.0833)$$

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~~(0.9166)(2.91~~

Here, we will get by solving equations

$$\lambda_1 = 2.92$$

$$\lambda_2 = 0.913$$

$$\lambda = \begin{bmatrix} \lambda_1 \\ \lambda_2 \end{bmatrix} = \begin{bmatrix} 2.92 \\ 0.913 \end{bmatrix}$$

λ is eigen values. (Ans)