	COL +26 (HWI)
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Anst.	(a) $\frac{1}{2.01} = \frac{1.01}{2.01}$
	a) $\frac{1}{1.01} \frac{2.01}{2.03} \frac{x_1}{x_2} = \frac{1.01}{1.02}$
	$\Rightarrow x_1 + 2.01x_2 = 1.01 & 1.01x_1 + 2.03x_2 = 1.02$
A CONTRACTOR OF THE PARTY OF TH	7 4 + 2.01.42
	on sowing these two equations:
- Durch	on solving these two equations: $\alpha_2 = 0.1 & \alpha_1 = 1$
TAP HOLD	taking b+ Ab we get
	taking $b+\Delta b$ we get $x_1 + 2.01 \times x_2 = 1.01 & 1.01 \times 1.01 \times 1.03 \times 1.001$
11.	on solving there two use get
	on solving these two we get $x = 0 & x_1 = 1.01$
2000	12 2 29 101
	001 [1-47]
-	b) we have $f(b) = [-1, •1]$
	& f(b+ab) = [0, 1.01, 0]
	1012-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1
	Using a form
	$K = \frac{129}{9} \frac{1911}{9}$
	11 Az 16/11 x16 = 7
	here 1 Ay - f(b+Ab) -f(b) = [2.01,-1]
	$4 \Delta x = [0,0,0001]^{T}$
	& 1 K = L 0, 0.0001
1 + 1.15	$K = \frac{2.01}{1} = \frac{2.0502 \times 10^4}{10^4}$
	2.0001 /
7	0.0001/1.02
	which is very large & should be because
	small perturbation in to changes f(b) to
	which is very large & should be because small perturbation in b changes f(b) to a large extent

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Ans 2	a) Two situations in which loss of
	accuracy can occur are
7.73 E A	1) when by very close to 4ac
	2) when + 1/ b2-4ac is very close to
	accuracy can occur are 1) when b^2 is very close to $4ac$ 2) when $+\sqrt{b^2-4ac}$ is very close to $-b$, this can happen when $b>>ac$
635	can affect both roots
	The second condition will only affect the
	The first condition in which b^2 is close to 4ac can affect both roots The second condition will only affect the root $\frac{1}{2}$ because of subtraction $\frac{1}{2}$ a
	1
	of two very close numbers
	b) $-b + \sqrt{b^2 - 4ac} \times -b + \sqrt{b^2 - 4ac}$ $-b + \sqrt{b^2 - 4ac}$
	$2a \qquad -b \mp \sqrt{b^2 - 4ac}$
	⇒ 4ac - 2c
	$\Rightarrow 4ac = 2c$ $2a(-b \mp \sqrt{b^2-4ac}) = a-b \mp \sqrt{b^2-4ac}$
	Since we want to avoid the 2nd cancellation
,	error we should use - b - 12-4ac for
	2a
	first root & 2c for 2nd root
	-b-162-4ac

V)	
Ani 3	f(x) = (x-1)*(x-1)
- Arces	$\tilde{f}(\alpha) = (f(\alpha)\Theta) \otimes (f(\alpha)\Theta)$
1 4	$f(x) = (x-1)*(x-1)$ $\hat{f}(x) = (f(x)\Theta)*(f(x)\Theta)$ $\hat{f}(x) = (x(1+\epsilon_1)-1)*(x(1+\epsilon_1)-1)*(1+\epsilon_2)*$
	(17-63)
	$\frac{1}{2} f(x) - f(x) = (x(1+\epsilon_1)-1)^2(1+\epsilon_2)^2(1+\epsilon_3) - (x-1)^2 $
	71.03.103.1
	Since $ E_1 , E_2 , E_3 \leq E_m$ & from the above equation we can see
A TOO	& from the above equation we can see
	$ \tilde{f}(x) - f(x) \leq (x(1+\epsilon_m)-1)^2(1+\epsilon_m)^3 - (x-1)^2 $ on opening & re-arranging terms
	on opening & re-arranging terms
	$ \tilde{f}(x) - f(x) \le \xi_m(5x^2 - 8x + 3) + 3\xi_m^2((x - 1)^2 + x^2\xi_m^2)$
1 212	$42x\xi(x-1)+2x(x-1)+\xi x$
13 1 .	$\frac{1+(x)-+(x)}{(+2x)(x-1)+2x(x-1)+6x^{2}}$ $ \tilde{f}(x)-f(x) < \epsilon_{m} 5x^{2}-8x+3 + O(\epsilon_{m}^{2})\cdot c_{2}^{2}$
1,5	
**	1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2
Any 4	a) when we multiply a matrix A with
	rector or we get linear combination of
(9)	
	$Ax = a_1x_1 + a_2x_2 + + a_nx_n$
(ci)An	A (A)Zera Lada A (C)Zera A
	Take C = AB
-	[c, c2] = [A b, b2
	From columnisse interpretation
1 12 2	thus each column of C is linear combination
	Thus each comment of
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3.3	PREMION 6
	of columns of A, thus Rank (C) < Rank (A)
	Take $B = \begin{bmatrix} b_1 \\ b_2 \end{bmatrix}$ & $x^T = [x_1, x_2, \dots x_n]$
(14 64)	
111-20-	$\frac{b_n}{b_n} = \frac{b_n}{b_n}$
-	$Z = x^{T}B = x_{1}b_{1} + x_{2}b_{2} + + x_{n}b_{n}$ here Z is linear combination of rows of B
10.7	here Z is linear combination of rows of B
Salar Salar	
(1-70)	C = AB can be shown as
	Land to the second seco
20	$ \begin{array}{c c} Rc_1 & = & Ra_1 \\ Rc_2 & & Ra_2 \\ \vdots & & & B \end{array} $
235-1	Rcz Raz B
Charles And I	
1 4	Ren Ran
	Rck - Rak·B
	A Victoria of the second of th
J. G. Cara	thus each row of C is linear combination
V	of rows of B so Rank (c) < Rank (B)
	De la resta de la
	Hence Rank (C) < min (Rank (A), Rank (B))
	also Rank (A) < min(m,n)
	& Rank B & min(n,p)
	1 0 1(1) = Rank (100) 1 m
	Do Rank(C) = Rank(AB) ≤ n
-1-0.711 Big	
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	[24]

And 4(b) Given A is full rank Suppose A maps non-zero vectors to zero vectors

let
$$A = \begin{bmatrix} a_1 | a_2 - ... a_n \end{bmatrix} & x = \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

then $a_1x_1 + a_2x_2 + - - + a_nx_n = 0$ which says that a linear combination of columns of A is zero; but we know that A is full rank \Rightarrow \exists no linear combination of columns of A that add up is zero (with x \neq 0)

Thus its a contradiction. Hence A maps non zero vectors to non zero vectors · for linear independent vectors: suppose V,, Vz, ---, Vk are linearly Independent thus C1V1 + C2V2+--+ CKVK=0 ⇒ C1=G=--CK=0 multiplying by A we get $C_1 A V_1 + C_2 A V_2 + --- + C_k A V_k = 0 \Rightarrow C_1 = C_2 = -- = C_k = 0$ which says AV, AV2, ---, AVk ave linearly inde

Ans 5(a) ||x|| = ||x+y-y||using triangle inequality $||x|| \leq ||x+y|| + ||-y||$ Since 11-411 z. 11411 11x11 < 11x+y11 + 11y11 Gires 11x+y11 > 11x11-11y11 operating similarly with 1/411 we get $||y|| \leq ||y+x|| + ||x||$ > 11x+y11 > 11y11 - 11x11 Dince we are finding lower bound 30 HXTYH > mase (1121+4)H, so 11x+y11 ≥ max (11x11-11y11, 11y11-11x11) And 6(b) Our dataset is [9.9999997, 9.9999966, 9.99999972] nee on hand calculation mean (µ) = 9,999999 7833... variance = 1.803 x 10-14 Using functions var/ & var? $varl = 4.263 \times 10^{-14}$ $varl = 1.802 (x 10^{-14})$ Error in var2 = |(1.803-1.802) x lo-14| = 0.001 x 10-14 = 10-17 Error in varel = | (4.263-1.803) X10-19 \$ 2.46x 10-14 clearly error in varel = 103x (enor in var2).

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Ans(6c) we can use kahan's summation method where we keep a seperate running compensation (a variable to accumulate small errors.

when n is large then calculating summation by adding summands can induc will accumulate more & more error