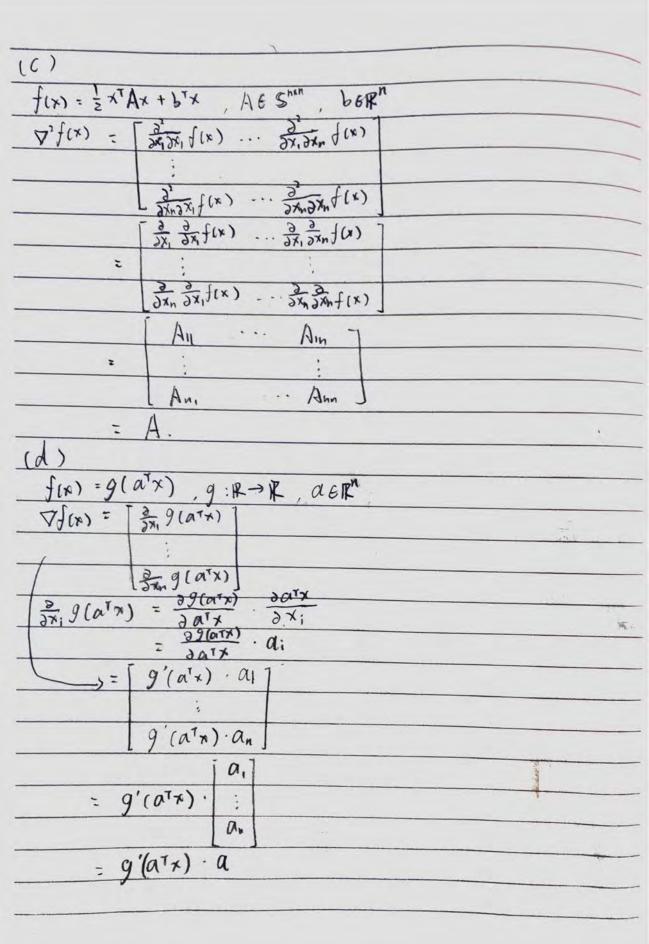
Stanford, (5229, 2018, autumn, ps 0. f: R" → R (a). f(x) = \(\frac{1}{2}\x^T Ax + b^T x . , A \(\epsilon\), \(b \epsilon\). Vf(x) = Vx(=xTAx+bTx). = [dx. (= x Ax + b Tx) ラスn(ラxTAx+bTx) Ox (= E & Ayxixj + Ebixi). DXn (= = = Aij xi x + = b; x;) 37. (= (= Aijx,x) + EDAilxix, + IEAijkix;) + Ebix;) 版Aijx;+产A:17;)+b, 3x A . x . = 2 A 11 ×1 = A:1x; +b, 产Ain Xin + bn - XAIIXI = (xTA) + b = ATX+b = Axtb.

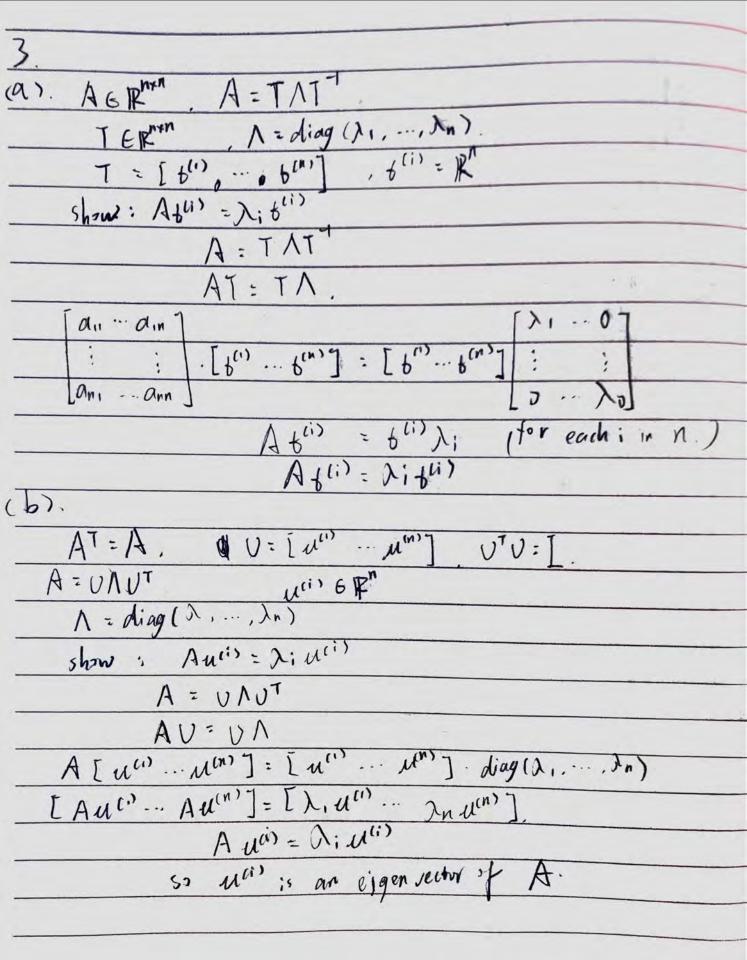
$$\begin{bmatrix} x_{1}, x_{2}, \dots, x_{n} \end{bmatrix} \xrightarrow{A_{11}} A_{11} & A_{12} & A_{13} & A_{14} & A_{15} \\ A_{11} & x_{1} & A_{12} & x_{1} & A_{14} & A_{15} & A_{15} & A_{15} \\ & \vdots & & \vdots & & \vdots & & \vdots \\ \sum_{i=1}^{N} \sum_{i=1}^{N} A_{ij} x_{i} x_{j} & & & & \vdots \\ A_{ij} & x_{i} & x_{i} & x_{$$



```
-.. Oxioxn g(atx),
                  1 3 (a'x)
J' f(x) =
                                        -.. Jandan g(a x)]
                   - Jx. dx. g(atx)
     \frac{\partial}{\partial x_i \partial x_j} g(\alpha^T x) = \frac{\partial}{\partial x_i} \frac{\partial}{\partial x_j} g(\alpha^T x)
                          = \frac{\partial}{\partial x_i} \cdot g'(\alpha^T x) \cdot \alpha_j
= \alpha_j \frac{\partial}{\partial x_i} \cdot g'(\alpha^T x)
                           = a; data g'(ata) · da; ata
                           = aj · g" (atx) · ai
                           = ai · aj · g" (at x).
                       a.a.g"(atx) -.. a.ang"(atx)
                      [an a. 9"(a"x) - anan g"(a"x)
                                       a.a. ... aidn
                = 9"(atx)
                                                  · · · andn
                                    Lana,
               = 9"(a"x) a a"
```

36 Rn A : ZZT >0 ? let x 6 Rn $x^T A x = x^T 3 3^T x$ $= \sum_{i=1}^{N} x_i 3_i \cdot \sum_{i=1}^{N} x_i 3_i$ = (= xi3i)2 > 0. 50. A & O. (b) null space: let x68" . Ax = 381x = 7. × xi 3i rank: M(A) = { x612 : 3 x=0} rank (A) = rank (327) { min (rank (3), lank (31))

AGRAXI BGRMXN AZ0 PSD? x6 Rn let xTAx>0. PSD: TERM XT BABT TO MAN (XTB) A (BT x) MA (BTX) TALBTX) SMM BT x= 46 18". 4T A 4 30. S. BABT is PSD.



(c) AIS PSD, AZO.
xGR", xTAX >, o.
) i (A) menas ith a oigenvalue of A.
show: Di(A) 30 for each; , X; (A) = Di
Abii> = libii>
(bui) TA bui) 30.
(bu) 1 > 1 bus 30
入(ti)) ti) zs.
4. γ ρ ₍₁₎ ¹ ² 2.
入7,2