linear algrebra Cheat Sheet

by afalita6 via cheatography.com/171839/cs/36095/

Inverse of a matrix

Triangular or diagonal matrix	1/diagonal entries
Permuted matrix	P transpose
Other	rref ([A eye()])

Multiplication of Matrix + angle

Way 1	A*B full multiplication
Way 2	[row A]*B
Way 3	[col A]*B
Way 3	B11*col(A1)+B21*col(A2)
Find entry 2,3	[row A2]*[columnB3] = 1 number
Rank 1 matrix	[a11*rowB1; a21*rowB1;a31*r-owB1] + ...
Angle	cos(theta) = (**v*w**)/(||**v**||*||**w**||)
Outer Product	[column1]*[1 # #] find numbers that work

Linear Transformation and dependency

Linear Indepe-ndent	Linearly independent if rref(A) ---> #pivots = #row
Linear transf-ormation (x and y given)	T (u + v) = T (u) + T (v), T (cu) = cT (u), where c is a number. T is one-to-one if T(u)=0⇒u=0 T is onto if Col(T) = Rm.

Projections or Ax=b is inconsistent

formula	A'*A*xhat=A'*
Step 1	rref ([A'*A A'*b])
Step 2	xhat = last column of rref
Step 3	bhat = A*xhat --> bhat is the vector spaned A closest to v and the projection of the vector onto subspace
Step 4	be = b - bhat --> be is the vector perpendicular
Step 4	error vector/distance = norm (be) (1/sqr of components of b swuares)

Projections or Ax=b is inconsistent (cont)

For regression	step 1: f(x) = [x][b], step 2: A = [x.^0 ...] and y = given, step 3: do LSE and find xhat which will be a,b,c

Ax = b

Echelon form	Leading entries in every row are farther to the right than the row above. To do = elimination steps
Reduced Echelon form (rref)	echelon + columns of leading entries are all 0 except the entry which must be a 1. To do = eliminations steps down to right, then left to top
Ax=b with LU	L = identity but a21 = -λ1, a31 = -λ2, a32 = -λ3. U =

Ax = b (A and b specified)

Echelon form	Leading entries in every row are farther to the right than the row above. To do = elimination steps
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Ax=b with LU	L = identity but a21 = -λ1, a31 = -λ2, a32 = -λ3. U = echelon. Then do Ly=b - given (solve for y), then Ux=y (solve for x)

Ax = b (A and b specified) (cont)

Ax=b with CR	tMaybe not full rank. C = columns of A that have a pivot in R. R = rref form. To find x --> using R to find FV, pivots, and special solutions (if b not 0 do rref([A b])), if one soln is given then add that in gen sol and just do rref(A)

Eigenvectors and Eigenvalues

v	eigenvector
λ	eigenvalue
Finding λ	1. Diag or triang = entries of diag. 2. 2x2 do λ = m +- sqrt (m^2 - p), where m = (a11+a-22)/2, and p = a11*a22 - a12*a21
Finding v	rref ([A - λ*eye]) and find FV, pivots, and ss
Diagonali-zation	A = P*D*P^(-1), where P = [eigenvectors] , D = diag(λ)
When can we diagon-alize*	Only when: square, real λ, and if repeated λ - look rref ([A - λ*eye]) and only 1 pivot.
A = Q*D*Q'	Q = special solutions form rref ([A - λ*eye]) for every λ, and then doing norm(q1) for all of them. D = diag(λs)
Is λ an eigenvalue	Do rref ([A - λ*eye]) and has to be only 1 pivot (linearly dependent)
Positive definite	λs all positive
Semipo-sitive definite	λs all positive and at least a 0

Eigenvectors and Eigenvalues (cont)

Indefinite	λ at least one is negative

Vector Spaces and Basis

Subspace	If u and v are in W , then u + v are in W , and cu is in W
Basis B for V	A linearly independent set such that Span (B) = V To show sthg is a basis, show it is linearly independent (rref(A) has NO FV) and spans(no row of 0's).
Row(A)	Space spanned by the rows of A: Row-reduce A and choose the rows that contain the pivots. Row(A) = R^n, dim = rank, Basis of Row = R in A = CR
Col(A)	Space spanned by columns of A: Row-reduce A and choose the columns of A that contain the pivots. Col(A) = R^m, dim = rank, Basis of Col = C in A = CR
Null(A) / Vector in Null	Solutions of Ax = 0. Row-reduce A. Null(A) = R^n, dim = n-rank, Basis of Null = rref(A), FV, pivots, special solutions
LeftNull(A)	Solutions of A'x = 0. Row-reduce A'. LeftNull(A) = R^m, dim = m-rank, Basis of LeftNull = rref(A'), FV, pivots, special solutions
Rank(A)	number of pivots
Is v in Null	do A*v and it needs to equal to vector 0
find v in ColA	same vectors as in matrix

Vector Spaces and Basis (cont)

Is v in col space of B	is B*x=v consistent? do rref([B v]) and see if consistent

Gram-Schmidt steps

A	q1 = A(:,1)	Q = q1	xhat = (q1'*-A(:,2))/(-q1'*q1)
ahat = Q*xhat	q2 = A(:,2) - ahat	Q(:,2) = q2	Q(:,1) = 1/(q'1-*q1)*q1
Q(:,2) = 1/(q'2-*q2)*q2	Q = [Q(:,1) Q(:,2)]	R = Q'*A	if 3x3 keep going

Orthogonality

v and u are othogonal	if **v*u** = 0
W⊥:	Set of v which are orthogonal to every w in W.
Orthogonal projection:	If {u1 · · · uk } is a basis for W , then orthogonal projection of y on W is: yˆ=(y·u1/u1*u1)+··-·+(y·u1/uk*uk), and y − yˆ is orthogonal to yˆ, shortest distance btw y and W is ||y−yˆ||
Basis of W⊥:	basis of Null(Mw)
Equalities between basis	(RowA)' = NullA and vice versa. (ColA)'=LeftNullA and vice versa