Erge	invalue problems	Treb 21, 2006	EVP-1 EVP-1 EVP-1 EVP-1 FRITTING MA Comennondina
	patrix A has an $e \lambda$ if $A \times =$		ind conerponding
Durmarially sour	det A - AI = 0 ng cigenvalue problems ins trains formation	(Juratos, Householder, Q	non-trival solutions X. Lalgorian) use suntarry transformation
		A: real R: ort Complex us D: diagonal mat det RT(A-A)	nitary matrix $R^T = R^T$
Gy		det IR 1 det IA: det IA-XII	- XII det (R ^T)
(î) Da	egy of all modern agonalize the matri	x A by applying	
	A -> P,-1 A P, -	$\begin{array}{ccc} P_{2}^{-1} & (P_{1}^{+} \land P_{1}) \\ P_{2}^{-1} & P_{1} & P_{2} & P_{3} & \rightarrow \end{array}$	

(ii) If we obtain the diagonal matrix, then the eigenvectors are columns of the accumulated transformation

 $X_R = P_1 \cdot P_2 \cdot P_3 - \cdots$

The are interested only in leigenvalue frot eigenvectors,

It is enough to trunsform the matrix A to be triangular

(upper or lower triangular). → Gravessian etrumonation

Figenvaluer: diagonal elements of upper or lower

triangular matrix

· How to implement the stategy:

(i) Construct undividual Pi's to reform specific tasks

such as zeroing a particular off-diagonal element

(Jacobi transformation) or zeroing a whole particular

pow or column (Householder transformation).

Then Therate the finite sequence of the transformations

until the deviation of the matrix from diagonal

is negligibly small.

Most of the way and follow up with factorization method.

(QR or QL method)

Factorization we that:

Watrix A = Fither or Fith = Fig. ... D

Multiply by Fither might Fith Fither = Fire Fither.

EVP-3

·E	genpackages of Canned Eigenputine	
nite plane in the second section of the section of the second section of the secti	http://www.netlib.org/	ali paliatinishi ka sakiniya shiika aasaanin ka sakin ka saka saka saka saka saka saka saka
		ang kalingga, manahanina pakasi kada ang kilaban katana kata kada katang pana ara atahan kalingsi.
this garges and about the six is a local growing to a real acceptant the southern the shadow the section of this	Always a good idea to think first what	
ng ngangangan na sakan sa na	kind of matricer you want to diagonalize	ing pagangan
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	- real, symmetric, banded lonly a small # of Sub-	or sweediogens.
gojektorijak medisenstromonimonimi sostatiki i gojoonaksi minimaan periodak kojini jog operation	- real, symmetric	indige filipped filipped process of the section as the section of
and the state of t	- real, non symmetric	analija sila para para salah na kata n
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	- all eigenvaluer and no eigenvectors	and the second s
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	- all etgenvaluer and all corresponding e	igen vediors)
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	> This will save compute time and stone	Le Company de la company de la constitució de la
		· 1990 (1990)
	Often many eigenpactages deal with generalize	Belle A
atematember skill in morn i steme kullikung occument in gen komika sin kalpatik kesis kesis ke	ergervalre problem	
general de la companya de la company		endigi jahrijanska ka el titu kommune salainin ka ana sa asani makata ka ka tandari mininta ta ta di sa asani
	$A \cdot X = \lambda B \cdot X$	
	A, B: matrice	

Jungspierre state and spiele state and s	Notivation of dealing with diagonalization of	La constitución de la constituci
talyali sangingah Kaliginia anakanca inigaha katina tendari kaliginia katina katina kaliginia katina katina ka	real symmetric matrices >	T
etti ja saajassi kantaspaiskai ja suudintiisi kon ka kususunna virtiinin ka kusissa.		
ta digitaliya karinda na karinda karin	· Many physics problems deal with eigenproblems	4
ium enerātās addisālaizālis esma sasalvelvitursilāsinisālēja saskraterilinomekles palvēl	Herman matrices	ningstigligitetisis jajanis, a neistelien nemphonyainya ing true to dan interiorisis nina tariwa nomentha
almostiadopalmi krainos promotinos, kien un aplintos independante a constituto do con	e A: Hermitian matrix	
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as lilaises establisti as en anticipitante mon estapator de el monocordo	A = B + iC B, C: real matrices	andra gigilialis gipin varantirani sarara i manga inata perantandahar sebenja inata kenalai inata kenalai sebe Sebenja sebenja sebenj Sebenja sebenja sebenj
aka da ja	N×n Complex eigenvalue problem:	animona qualificial primi monemente premi mana anima anima monemente del mana anima monemente del mana anima m
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Parameterisian erisian		samilia kalingan sa ing kamanan kanan kanan Jagan kan
taria en la companya de la companya	$\Rightarrow (B+iC)(y+iZ) = \lambda(y+iZ)$	inger ing digital mengangkan pengangkan peng
interprise (g. Luga kina si anti qilika 18 pengkan tersion ili kina bir senitari kati shifa ta kina kati kati shifa qil	=> 2n×2n real eigenvelve problem:	
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	[B] S]	<u>a ja ja</u>
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i i recensi proprie cui in comi i recensi proprie con i con	So \$1, \$2,, In one eigenvalue of A,	
u soli, v ni jednoga u postok poživinjego go pomorne kopopozici po večetnim dinate d 2 minus	In engenvalue of Eq. Q are 1, 1, 12, 12,, 1	min har problem
entronientes proprietas de la constitución de la constitución de la constitución de la constitución de la const	2n engenvalue of Eq. Q are 1, 1, 1/2, 1/2, 1/2 Tolory engenvalue problem of 140 complex 2n+2 Engenvalue problem of 2n+2 Engenvalue problem of 2n+2	M KM, SIMMO
an tampan kangga ka	The state of the same of the s	energia de la companya del companya de la companya del companya de la companya de

$$AT = A = Hermitian$$

$$A = \begin{pmatrix} b_{11} + iC_{11} & b_{12} + iC_{12} \\ b_{21} + iC_{21} & b_{22} + iC_{22} \end{pmatrix}$$

$$AT = \begin{cases} b_{11} - \lambda C_{11} & b_{21} - \lambda C_{21} \\ b_{12} - \lambda C_{12} & b_{22} - \lambda C_{22} \end{cases}$$

$$AT = A \Rightarrow C_{11} = 0, C_{22} = 0$$

$$b_{21} = b_{12}, C_{21} = C_{12}$$

$$\begin{pmatrix} b_{11} & b_{12} + iC_{12} \\ b_{12} - iC_{12} & b_{22} \end{pmatrix} \begin{pmatrix} g_{1} + iZ_{1} \\ g_{2} + iZ_{2} \end{pmatrix} = \lambda \begin{pmatrix} g_{1} + iZ_{1} \\ g_{2} + iZ_{2} \end{pmatrix}$$

$$b_{1}(y_{1}+\lambda z_{1})+(b_{12}+\lambda C_{12})(y_{2}+\lambda z_{2})=\lambda(y_{1}+\lambda z_{1})$$

$$(b_{2}-\lambda C_{12})(y_{1}+\lambda z_{1})+b_{22}(y_{2}+\lambda z_{2})=\lambda(y_{2}+\lambda z_{2})$$

	$\frac{1}{12} \frac{1}{12} \frac$
The control of the co	$\begin{array}{cccccccccccccccccccccccccccccccccccc$
	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$
in de partir de la companya del la companya de la companya del la companya de la companya del la companya de la companya de la companya del la compan	Eigenvalue problem of nxn complex Hermitian matrix = Eigenvalue problem of 2nx2n real symmetric matrix (1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1
	- Ergenvertors of a Hermiteian matrix can be made orthonormal - Similarity fransformation: - Hermitein - diagon/zed
en e	

Jumenja ili va inni issa assa ili	Piscuss algorithms to calculate all ligaritatives and
rige (Approximation) proper and all annot group active high an allowed year connection	eventures of a complex, Hermitian matrix
gengepagologiga poljanjoka nervali osa kallikų til maka liena kirki kanta arbineti.	eigenvalues of a complex, Hermitian motrix and a real, symmetric, tridiagonal matrix
uningaga tangga kasalah	
acan arang an arang a	Jacobi Transformations of a Symmetric Matrix)
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www.most ki kaswo phaamaphaaa	transformations (each transformation consisting of
	a plane notation designed to annihilate one of
en-ulgis geneta (keng (dikum tang ulgis mar minim tanda yan sepengan tanda sebapa kan	the off-diagonal elements) until the matrix becomes
inglestic significações para propriedas de servições de servições de servições de servições de servições de se Todos servições de servições para proprieda de servições de servições de servições de servições de servições d	diagonal to markine precision.
and the second s	
	Eigenvectors: columns of the matrix consisty of
	the product of the transformations
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gangan saifu gangangan gang dialipus nganandaripan na mangangan an man	The matrice of order > 10, use the QR or QL method.
ugungan ing gagasasa pal-pan nasat tanon di Pranasa ing ing ing ang ilang ang ilang ang ilang ang ilang ang ilang an	
esconsissiones de traciones d'escritationes de dévinte de l'éville préditation en sur élément de l'éville de l	· Transform the matrix A to A'
nangaphaggygggggggggggggggggggggggggggggggg	A = DT A D = 3 8 to column protection
nga panggang panggan Panggang panggang pa	$A' = P_{pq}^T \cdot A \cdot P_{pq} \qquad (= \cos \phi)$
regardina anticologica de la compositiva della c	S = Stud
da juga fasinismi morrani param	where PP8 = CS = P+h low
grunn galat gundgigi gapagasahik pinin sesenasa kulumusaga menemekanti	Jacobs rotation of the second
egia mininggi pang gilipang kilanda serenana di ananasa da an ang termasa mena mena mena	
pelia apara anticiti sate en	

PAS. A = changer only nows p and & of A (=), aip aiz --- a'np a'ng ---Eq. (AT = A) Parp = carp - sarg Jumph Org = carg + sarp > r + p, r + 2 clavery app = C2app + 52agg - 25capg - 5 agg = 52app + C2agg + 25capg -- 6 app = (c2-52) app + SC(app - agg) - D $\frac{\partial p_{g}^{\prime}=0}{\partial p_{g}^{\prime}=0} \Rightarrow \theta = \cot 2\phi = \frac{C^{2}-S^{2}}{2SC} = \frac{\partial p_{g}-\partial g_{g}}{\partial \rho_{g}} = 0$ @ is determined by app, aps, aps. Let $t = \frac{2}{6}$. $t^2 + 2t0 - 1 = 0$ of 0<057 choose smaller not of the eg. such as t= fortfort

description de la constitución d	If 0 > 1, t = 30
	$t_{\text{vom}} C^{2}+5^{2}=1 \Rightarrow C = \frac{1}{100}$
opust, si in international utura districtiva di Arteria in incoloratione di Arteria in internationale di Arteri	$S=t_{C}$
iki kaka kata kata kata kata kata kata k	To reduce round off error, replace Eg O by apg =0.
	Replace Egs. Q.Q.Q. by (old value + a small correction).
	$a_{pp} = (1-S^{2}) a_{pp} + S a_{qq} - 2SC a_{pq}$ $= (1-S^{2}) (a_{pp} - a_{qq}) - 2SC a_{pq}$ $= (2S^{2}) (-2S^{2}) (a_{pp} - a_{qq}) - 2SC a_{pq}$ $= (2S^{2}) (-2S^{2}) (a_{pp} - a_{qq}) - 2SC a_{pq}$ $= (2S^{2}) (-2S^{2}) (a_{pp} - a_{qq}) - 2SC a_{pq}$
	= 0 = 5x (53+C2) apg
dan marikat jain nen ilijenen, kenna kekita matat kalpuiden aken kekitat da	= Ope - take
	$\frac{Qq'_{g} = Qq_{g} + tQp_{g}}{Q'_{rp} = Q_{rp} - S(Q_{rq} + TQ_{rp})}$
d popular plane tie company se set in part de part part, by his disposition is increased printented the	$a_{rg} = a_{rg} + s(a_{rp} - \tau a_{rg})$
	Where $Z = \tan \frac{4}{3} = \frac{5}{1+2}$ Successive transformations
eg digegene opera de se geograpia de la geograpia de la constitución de la constitución para dela se del primer La constitución de la constitución	Convergence of Jacobs method: undo previously set Zeros but the off-diagona
distriction de la constitución d	Use $S = \sum_{t=0}^{2} Q_{ts} ^{2}$ elements get smaller at each votation.

212+012=	(Carp-Sarg)2+(Carg+Sarp)2
. Selectivities and determinant annual summer replacements and selection of the selection o	= C2arp2 + 52arg + C2arg + 52arp2 - 250arparg
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t 1984-rengen zona (zona 1984-rengen partieren partieren zuen zuen zuen zuen 2008 aus der deutsche der der deutsche der deutsche	= arp*+ arg*
is the container that the container of	$S' = S - 2 \alpha_{pq} ^2$
ginti detaketimooja esal esaldesta talam etaketiin osalamin oleh etaketiin osalamin oleh etaketiin osala siila	$5''=5'-2 \alpha_{P8} ^2-2 \alpha_{P8} ^2$
	$\frac{1}{2}$
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tana (If tragonal elements are layer compared to off-diagonal
t. Card antivirele data al-empte material de entre propries assesses en entre river en entre presentación de	Clerents, you may diagonalize
Messee kanalikutela mahkututa kata kata kata kata kata kata kat	(A-kI) where to in the maximum value
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i and make kemili militari biran biran biran biran biran sa	Then the eigenvalues are $\lambda_i - k$
were state to the design of the property of the design of the state of	
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section and interview to the characteristic conditions through the condition of the conditions that conditions the condition	
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$$S' = \sum_{r \neq s} |\alpha'_{rs}|^2 = S - 2|\alpha_{pg}|^2 \ge 0$$

=> S value is bounded below by zero.

S value converge monotonically.

Eigenvaluer and eigenvectors:

 $D = V^{T} \cdot A \cdot V$

diagonal matrix

where V = Pi-Pzilziii

t Jacobs notation matrix

diagonal elements of D: eigenvaluer

Columns of V: leigenvectors

At each stage of calculation, columns of V

can be obtained by

Instially, V = I

order in which the elements are annihilated	age agricultura proprieta de la compansión
P12, P13, : P10 ; P23, P24, P2n;; Pn	allada tallisiyada kikkesineese kiisi -suurriisi erittiinirikiise ki koomoonissini Jarriik 19.
aiz, ais,, am; azs, az4, are killer	
· One sweep: $\frac{n(n-1)}{2}$ rotations	
Thertran Surers	
lo Isweep=1,50 < 50 Hermons or guers	ad produced in the management of the artistic form of the artistic form of the artistic form of the artistic form of
) PO IR=1, N-1, N	Statistica en la sectiva de la compania de la compania en la compania en la compania en la compania en la comp Statistica de la compania de la compania en la comp
Jacobs transformation: Jacobs matrix PIP. IG	agus milli sagus a magallaid lain ann ain in an tao an deann ann an aile an ann ain an an ain an an ain an an a In ain an
END DO	
	appatan side terili ili. Sapatan sanatan sanata
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To remain or sweets	ang ang kang dan pang ang kang da ang pang ang kang dan pang ang kang dan pang ang kang dan pang dan pang dan Bang dan pang dan pa
6× (6=0; i<=49; i++) {	ing separat di seria
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for (ig=ip+1: ig <= n-1; 18++) {	ing pagana and paganapagana and an araba air and an araba an araba an araba an araba air an araba air an araba An araba an araba air an araba a
: { Jacobs transformation: Pap, 29}	
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7	age language de para language ana siste amo di anno ance al monitorio del biolo del biolo canto de monto mon
	ing a second principal particular distribution and the second second second second second second second second
	and for the second seco
	alla di separa di seria di se
	4.1

	Two in the fire ments in the contract of the c
	(7) During the first three sweeps, carry out the
	Jacobi transformation or notation for (P.8) elevent
inistation province de des titus revien à a triple des des primer les indes autres organisment de	only if $ a_{pq} > \frac{1}{5} \frac{S_0}{N^2}$ where $S_0 = \frac{5}{12} \frac{ a_{pq} }{ a_{pq} }$
user, que por escuencia la mera qui presença indicipa addici con tradición de sino escretario de servicio de La companio de servicio de s	(17) After four sweeps, if $ aps \ll app $ and $ aps \ll ass $, set $ aps = 0$ and $skip$ the rotation.
nicing this is complian and property over a classes appelantively resistant and remove interest and the content of the	Set 10/31-0 am 3ETP TOTAL
2	eduction of a symmetric matrix to Tridiagonal form Growns and Householder reduction >
incontraction and an explanation a	Reduce a real symmetric motrix to a tridiagonal form using Givens or Householder method
	Find eigenvalue and eigenvectors, using OR or
	al algorithm of the tridiagonal matrix
	Grvens method =
oursianus mite dispersació harren para prestriegie personan é particular de sale a sorren titte e particular p	Similar to the Jacobi transformation.
mily a saiden ang a tarumungan kharum na akunangan kuntaran kharitara kharitara kharitara kharitara kharitara Baran kharitara khari	Using the segnence
escon municipar son de quantidam en esperando de solución de candida de la Carra en esta de mesa de fest	P ₂₃ , P ₂₄ ,, P _{2n} . P ₃₄ ,, P _{3n} , P _{n-1} n,
	annihilate a31, a41,, an, 1: a42, a52,; an n-2
	(Here Poz is used to make ag, p. 7 Zero)
	From Eq. @ (EVP-8), agp= ap=0
aaa kaa koonneen kan jirga ja	=> Cap18+5ap10=0=>= == ton0=- ap18

p=tan=[-apre] We can find out air. air, air, air, air using the calculated of. CE LOVA, S= STN \$ 2 Householder method = Reduce an nxn symmetric matrix A to a tridiagonal farm by 91-2 orthogonal transformations. Each transformation annihilates the required part of a whole column and whole corresponding 1000. · House holder matrix P=1-2 W. WT W=1 where w= a real vertor with 100/2=1 P 85 orthogonal because P2 = ((- 2w.wr) (1- 2w.wr) = (-4ww+ + w(w+w)w+ PT = (1-2WWT) T = 1 - 2 ww = P

nxn matrix

Rewrite
$$P = I - \frac{\vec{u} \cdot \vec{u}}{H}$$
 where $H = \frac{1}{2}|\vec{u}|^2$

Suppose that \vec{X} : first column vator of A .

Choose $\vec{U} = \vec{X} + |\vec{X}| \hat{e}_1$ $\hat{e}_1 = \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}$

What does P do to \vec{X} ?

 $P \cdot \vec{X} = \begin{bmatrix} 1 - \vec{u} \cdot \vec{u}^T \end{bmatrix} \cdot \vec{X}$
 $= \vec{X} \cdot (\vec{X} + |\vec{X}| \hat{e}_1)^T \cdot \vec{X}$
 $= \vec{X} \cdot (\vec{X} + |\vec{X}| \hat{e}_1)^T \cdot \vec{X}$
 $= \vec{X} \cdot \vec{u} = \frac{1}{|\vec{X}|^2} + \frac{1}{2}|\vec{X}| \vec{X}$,

 $= \vec{X} \cdot \vec{u} = \frac{1}{|\vec{X}|^2} + \frac{1}{2}|\vec{X}| \vec{X}$,

Applying P to $\vec{X} \Rightarrow make$ all the elements \vec{m} the vertor \vec{X} can but the first one.

A -> tribraryonal form:

Chappie \vec{X} for the first Householder matrix \vec{Y} as lower \vec{x} . For the first down of \vec{X} is $\vec{y} = \vec{y} = \vec{y}$

$$= P_2 \cdot A' \cdot P_2$$

$$= P_2 \cdot P_1 \cdot A \cdot P_1 \cdot P_2$$

$$= \begin{bmatrix} \alpha_{11} & k & 0 & \cdots & 0 \\ k & 0'_{22} & k' & 0 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots & \vdots \\ 0 & 0 & \vdots & \ddots & \vdots \\ 0 & 0 & \vdots & \ddots & \vdots \\ 0 & 0 & \vdots & \ddots & \vdots \\ 0 & 0 & \vdots & \ddots & \vdots \\ 0 & 0 & \vdots & \ddots & \vdots \\ 0 & 0 & \vdots & \ddots & \vdots \\ 0 & 0 & \vdots & \ddots & \vdots \\ 0 & 0 & 0 & \vdots \\$$

Treb 23, 2006

- In the original algorithm, Levory the elements starts from 11th column of A not the first column not the first column. - Variables are calculated in the tollowing order: U, H, P, R, F, A At any stage m, A is bridingond in zer last m 1 pws and whenes, If the eigenvectors of the final tridingonal · Egenvertors of matrix A matrix are found (using the QR or QL algorithm), the eigen vectors of A: Joseph In John Market Will the P's are Since we start with nth column, $\mathcal{L}_{n-1} = \mathcal{L}_{n-2}$ $Q_j = P_2 \cdot Q_{0+1} \quad (j = n-3, \dots, 1)$

 $Q = Q_1$

JEZ FIRI E · Refinement = - At the stage m (=1,2, ..., n-2), the valor at = [air, aiz, in, ai, i-2, ai, i-1 ± te, 0, -0] what i= n-m+1=n,n-1,...,3 l = √ai2+ ··· +ai2+ Pefine $E = \frac{\hat{S}'}{|S|} |a_{ik}|$ 2f E 25 very small, skip the transformation Otherwise rescale and by E. ax -> ax -> ax / E use the scaled variables for the bounstonantia When you have a matrix whose elements vary over many orders of magnitude, permute the many elemate such that the smaller elements go to the top lett-hand corner, This is because we start our reduction from the bottom right-hand corner, and that mixing small and large clonents can cause significant voundoff enors.

	Section (Section)	With tridoughed makers, QL)=) QH) E Ligenvalue and eigenvalors of Tridiag	UP-19
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