Past JPE problems classified
by topic and by the level of difficulty

Symbols and notation used in the chart are explained on page 4

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
Fall 2013	LA	1**	(a) 15 (b) 5	7**	LA	2,3*	15	9,10*
Spring 2013	LA	3*	5*	LA	2**	14*	6**	12
Fall 2012	LA	LA	(a) 4 (bc) 4,1*	12	12*	4**	14**	16
Spring 2012	5,12*	3***	12*	LA	9,10**	LA	LA	LA
Fall 2011	15*	(ab) LA (c) 5*	9**	LA	(a) LA (b) 3*	17**	12**	LA
Spring 2011	(a) 3* (b) LA	LA	3,6***	15	14**	5**	(ab) 5 (c) 5*	2,3*
Fall 2010	12	15	2	7*	14*	LA	LA	17
Spring 2010	LA	LA	9,10*	12*	15**	LA	4*	5*
Fall 2009	LA	3	LA	LA	9,10*	6	(abc) 5 (d) 5*	17**
Spring 2009	LA	LA	3	LA	3*	9,10*	16*	15
Fall 2008	LA	1***	12	(a) 15 (b) 4*	14*	5*	6*	17
Spring 2008	LA	3**	15	(ac) 12* (b) 12**	12*	12**	10*	2**
Fall 2007	LA	4	(a) 2* (bc) 14**	11*	(a) LA (b) 6*	(a) 2 (b) 2**	LA	(ab) 6** (b) 6
Spring 2007	4	LA	LA	5	(ab) 4* (c) 5	10,14*	12**	(a) 7*** (b) 4,8*
Fall 2006	LA	LA	LA	8***	7,11*	14**	10*	(a) 5 (b) 5*
Spring 2006	(a) 12* (b) 12	16*	6*	3,17*	4*	LA	5**	15
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*

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Past JPE problems classified
by topic and by the level of difficulty
(continued)

Symbols and notation used in the chart are explained on page 4

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
Fall 2005	LA	LA	6**	LA	12	5	14*	17**
Spring 2005	(a) LA (b) 6**	12**	5	LA	14*	(a) 9* (b) 10*	LA	6**
Fall 2004	LA	12**	13*	17	6	15	LA	LA
Spring 2004	(a) 2,3** (b) 4	7**	1**	(a) 14** (b) 5*	LA	15	(ab) 6** (c) 6	10*
Spring 2003	4*	(a) LA (b) 6*	7,11*	LA	14*	3**	16*	(a) 5* (b) 12*
Fall 2002	6*	LA	12**	LA	LA	14	9*	5*
Fall 2001	LA	14*	16*	(abe) LA (c)2* (d)4*	(abc) 5 (d) 5*	(a) 12* (b) 12	LA	
Spring 2001	LA	6	10**	LA	(a) 5 (b,c) 12	3*	16*	LA
Spring 2000	LA	5*	4*	LA	(ab) 12** (c) 12	10*	17**	15
Fall 1999	LA	14*	10**	4*	LA	8***	16	LA
Spring 1999	12**	(a) 5 (b) 12	LA	LA	3**	LA	LA	16*
Fall 1998	2*	4**	LA	6	2,3*	16	LA	12**
Spring 1998	LA	LA	12	12*	10*	15	LA	5
Fall 1997	LA	10*	LA	15	9**	10*	12**	
Spring 1997	LA	1*	(ab) 6** (c) 6	(ac) 12 (bd) 12*	(a) 10 (bc) 10*	7	16	
Fall 1996	LA	LA	3*	7,11*	4	(a)5, (c)12 (b) 5*	16*	
Spring 1996	LA	6***	(ab) 1 (c) 1*	10	14	(abd) 12 (c) 12*	9	
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*

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Past JPE problems classified
by topic and by the level of difficulty
(continued)

Symbols and notation used in the chart are explained on page 4

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*		
Spring 1994	LA	5**	15*	6	LA	14*	8*	12		
Fall 1993	LA	LA	LA	(ab) LA (c) 3*	(a) 7* (b) 11,13*	12,13**	17*	10		
Spring 1993	(i) 1 (ii) 3	3*	LA	LA	(i)14 (ii)10 (iii) 10,14*	15	(i) 11* (ii),(iii)?	16*		
Fall 1992	LA	LA	(a) 3* (b) 1	LA	(a) 12 (bc) 12*	7**	3**	15		
Spring 1992	LA	LA	LA	(i)4 (ii)8 (iii) 8*	(i,ii) 7,12* (iii) 11*	10	(i,ii) 3 (iii) 6	16		
Fall 1991	(i) 1 (ii) 3	LA	LA	(i) 7 (ii) 7**	3*	12*	LA	15		
Spring 1991	LA	3*	LA	LA	(i,ii) 10 (iii) 10*	12*	14	17*		
Fall 1990	LA	LA	6**	LA	(i) 7* (ii) 12*	(i) 3 (ii) 6*	(i,ii) 10 (iii) 10*	5		
Spring 1990	LA	LA	1	LA	LA	(a) 7 (b) ?	12*	10	15	5
Fall 1989	LA	LA	LA	(a) 1 (b) 1*	7**	3*	1	(a) 5 (bc) 12		
Spring 1989	LA	LA	LA	1*	(a) LA (b) 7*	16*	(ab) 2* (c) 4	14*		
Jan 1989	LA	2*	LA	3*	LA	(i,ii) 12* (iii) 11*	LA	16*		
Jan 1988	12*	(ii,iv) 4,2 (iii) 1*	15	8	LA	11*	16*			
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*		

Explanation for symbols and notation used in the classification charts

LA	Problem is related to Linear Algebra (MA 631)
4	Problem is done (or almost done) in Chapter 4
6**	Problem is related to Chapter 6, medium difficulty
(ab) 5 (cd) 10*	Questions (a) and (b) are done in Chapter 5 Questions (c) and (d) are related to Chapter 10, both easy

The number of stars is an indicator of the difficulty level:

$*$	One star:	Easy problem, or routine calculations
$**$	Two stars:	Medium difficulty
$***$	Three stars:	Very challenging

(The assignment of stars is subjective. It is based on my personal choice and opinions I heard from students. If you have a different opinion, please let me know. Nikolai Chernov)

List of chapters in Numerical Linear Algebra (MA 660):

1. Review of Linear Algebra, scalar product, vector and matrix norm, orthogonal vectors, Cauchy-Schwarz inequality, Gram-Schmidt orthogonalization
2. Unitary and orthogonal matrices, isometries
3. Hermitian and symmetric matrices, Spectral theorem, projectors
4. Positive definite matrices
5. Singular value decomposition (SVD)
6. Schur decomposition, normal matrices
7. Gaussian elimination and LU decomposition
8. Cholesky factorization, Sylvester's theorem
9. QR decomposition, modified Gram-Schmidt
10. Overdetermined linear systems, least squares solution
11. Machine arithmetic, floating point representation
12. Condition number of a matrix, perturbation of matrices
13. Stability
14. Householder reflectors, Givens rotators
15. Computation of eigenvalues: theory (Rayleigh quotient, Courant-Fisher minimax theorem, Bauer-Fike theorem, left eigenvectors, Gershgorin theorems)
16. Computation of eigenvalues: Power method
17. Computation of eigenvalues: QR algorithm, Hessenberg matrices, Arnoldi algorithm