Math 290 | Name: | Dr. R. Beezer
Proof SLE-1 | | Spring 2008

Pass | No Pass

- First due date: **Tuesday, February 5**, in class.
- As a graded assignment, this will be your own work. No discussions with others, writing is your own.
- Present your final version of your proof on seperate paper, using just one side. Staple this sheet on the front.
- Do not include any scratch work. Just present a final version.
- Write with complete sentences.
- Retry: only use theorems and definitions from the relevant chapter, or earlier.
- Retry: begin with a new sheet of paper, starting your proof over.
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SLE-1 (Section HSE)

Suppose that the coefficient matrix of a homogeneous system of equations has a column of zeros. Prove that the system has infinitely many solutions.

Math 290 Name: Dr. R. Beezer
Proof SLE-2 Spring 2008

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SLE-2 (Section NM)

Suppose that $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$ is a 2×2 matrix where $ad - bc \neq 0$. Prove that A is nonsingular. Hints: One approach is to consider two cases, $a = 0$ and $a \neq 0$. No matter what approach you choose, think carefully about the possibility of dividing by zero throughout your proof.

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Proof V-1 Spring 2008

Pass No Pass

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V-1 (Section VO)

Prove Property AAC of Theorem VSPCV. That is:

If $\mathbf{u}$, $\mathbf{v}$, $\mathbf{w} \in \mathbb{C}^m$, then $\mathbf{u} + (\mathbf{v} + \mathbf{w}) = (\mathbf{u} + \mathbf{v}) + \mathbf{w}$.

Write your own proof in the style of proofs of Property DSCA (Theorem VSPCV) and Property CC (Solution VO.T13).

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Proof V-2 Spring 2008

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V-2 (Section LI)

Prove that the set of standard unit vectors (Definition SUV) is linearly independent.

Math 290 Name: Dr. R. Beezer
Proof M-1 Spring 2008

PASS NO PASS

- First due date: **Thursday, March 6**, in class.
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M-1 (Section MM)

Suppose that A is an $m \times n$ matrix with a row where every entry is zero. Suppose that B is an $n \times p$ matrix. Prove that AB has a row where every entry is zero. Hints: Theorem EMP should be useful, and you want to be explicit about which row of A has the zeros and which row of AB has the zeros.

Math 290 | Name: | Dr. R. Beezer
Proof M-2 | | Spring 2008

PASS | NO PASS

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M-2 (Section MM)

Use Theorem EMP to prove part (2) of Theorem MMIM: If A is an $m \times n$ matrix and I_m is the identity matrix of size m, then $I_m A = A$.

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Proof VS-1 Spring 2008

PASS NO PASS

- First due date: **Friday, March 28**, in class.
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VS-1 (Section S)

Give an example of using Theorem TSS by proving that $W = \left\{ \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} \,\middle|\, 5x_1 + 3x_2 - 8x_3 = 0 \right\}$ is a subspace of $\mathbb{C}^3$.

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Proof VS-2 | | Spring 2008

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VS-2 (Section PD)

Carefully read Exercise PD.T60 and its solution (Solution PD.T60). Prove the "more general" result given in the solution, using the book's solution as a model.

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Proof D&E-1 | | Spring 2008

Pass | No Pass

- First due date: **Friday, April 11**, in class.
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D&E-1 (Section DM)

Prove that the inverse of an elementary matrix is a single elementary matrix. Hint: seek inspiration from Exercise RREF.T10

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Proof D&E-2 Spring 2008

PASS NO PASS

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D&E-2 (Section EE)

Suppose that A is a matrix that is equal to its inverse, $A = A^{-1}$. Prove that the only possible eigenvalues of A are $\lambda = 1$ and $\lambda = -1$. Give an example of matrix that is equal to its inverse and actually has both of these possible values as eigenvalues.

Math 290 | Name: | Dr. R. Beezer
Proof LT-1 | | Spring 2008

Pass | No Pass

- First due date: **Thursday, April 24**, in class.
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LT-1 (Section LT)

Prove that the function

$$T\colon \mathbb{C}^3 \mapsto \mathbb{C}^2, \quad T\left(\begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}\right) = \begin{bmatrix} 2x_1 - x_2 + 5x_3 \\ 3x_1 + 8x_3 \end{bmatrix}$$

is a linear transformation.

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Proof LT-2 | | Spring 2008

PASS | NO PASS

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LT-2 (Section IVLT)

Suppose $T\colon U \mapsto V$ is a surjective linear transformation and $\dim(U) = \dim(V)$. Prove that T is an invertible linear transformation.

Math 290 | Name: | Dr. R. Beezer
Proof R-1 | | Spring 2008

PASS NO PASS

- First due date: **Monday, May 5**, in class.
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R-1 (Section MR)

Consider the two linear transformations,

$$T\colon M_{22} \mapsto P_2, \qquad T\left(\begin{bmatrix} a & b \\ c & d \end{bmatrix}\right) = (2a - b + 3c + d) + (2b - c + 2d)\,x + (4a - 2b + 3c + d)\,x^2$$

$$S\colon P_2 \mapsto \mathbb{C}^2, \qquad S\left(p + qx + rx^2\right) = \begin{bmatrix} 2p + q - 3r \\ 5p + 2q - 4r \end{bmatrix}$$

and the bases of M_{22}, P_2 and $\mathbb{C}^2$ (respectively)

$$B = \left\{ \begin{bmatrix} 1 & 1 \\ 1 & -1 \end{bmatrix}, \begin{bmatrix} 3 & 2 \\ 1 & -4 \end{bmatrix}, \begin{bmatrix} 2 & 3 \\ 3 & -4 \end{bmatrix}, \begin{bmatrix} -2 & -4 \\ -5 & 4 \end{bmatrix} \right\}$$

$$C = \left\{ 1 + x,\ -2 - 3x + x^2,\ -2 - 2x + x^2 \right\}$$

$$D = \left\{ \begin{bmatrix} 2 \\ 5 \end{bmatrix}, \begin{bmatrix} 1 \\ 3 \end{bmatrix} \right\}$$

Verify the conclusion of Theorem MRCLT. In other words, build the three matrix representations of T, S and $S \circ T$ individually and check that they are related by the matrix product in the theorem.

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Proof R-2 Spring 2008

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R-2 (Section VR)

Let C be the crazy vector space from Section VS (Definition CVS). From Example DC, we know C has dimension 2. By Theorem CFDVS we can conclude that C must be isomorphic to $\mathbb{C}^2$. Construct a function $T\colon \mathbb{C}^2 \mapsto C$ that is a candidate for an isomophism between these two vector spaces by giving an *explicit* formula for T. Then give a convincing argument that T is indeed an isomorphism.
