LINEAR ALGEBRA MATH 2130
SECTION 6,
8TH–14TH WEEK SYLLABUS
2:00 – 2:50 MWF ROOM MUEN E131
FUNDAMENTALS ON LINEAR TRANSFORMATIONS; THE ALGEBRA AND GEOMETRY OF SOLVING THEM

PROF. MICHAEL D. FRIED, OFFICE MATH. DEPT. #223

To my understanding we have three weeks until Spring Break, the Week of March 24. Then, three weeks until the week of Easter Sunday. Then, two weeks until Final exams start, with the last three weeks more like a week and a half, including preparation for the final. I'm calling it seven more weeks of classes.

As always, as we do material I will use updating emails to be more precise and to elaborate on what happens in class about problems, and student comments.

(1) We have already been doing vector spaces and subspaces in our many discussions on *row reduced (echelon) form*.
  - Problem set 2 including the discussion on change of basis.
  - §4.7, especially around using the idea of $n \times n$ invertible matrices is the dominant theme.

(2) Determinants, §3.1-3.3.
  - *Algebraically* the key ingredient is that a determinant is a map from $n \times n$ matrices, $\mathbb{M}_n(\mathbb{R}) \xrightarrow{\mathrm{Det}} \mathbb{R}$.
  - Further, for $n = 4$ (or any other n) for a fixed $1 \le j \le n$, say $j = 2$, fix $= \{\vec{\boldsymbol{a}}_1, \vec{\boldsymbol{a}}_3, \vec{\boldsymbol{a}}_4\}$, and consider all matrices M_n, for which only the 2nd column is not fixed.
  - Then, $M(\boldsymbol{x}) \stackrel{\text{def}}{=} (\vec{\boldsymbol{a}}_1 | \boldsymbol{x} | \vec{\boldsymbol{a}}_3 | \vec{\boldsymbol{a}}_4) \mapsto \mathrm{Det}(M(\boldsymbol{x}))$ is a linear transformation in the variable $\boldsymbol{x}$.
  - *Geometrically* the determinant of A is essentially the volume of the *parallel-piped* with sides the columns of A.

(3) §5.1–§5.4: *Eigenvalues* and *Eigenvectors* or how changing basis can put certain matrices in diagonal form.
  - p. 278, Thm. 5: The diagonalization theorem. The key definition is *similarity of (square) matrices* §5.2.
  - p. 279: A is similar to DAD^{-1} for any invertible matrix D.

(4) §6.1–§6.3: Inner product, orthoganity, orthogonal projections and maybe the *Gram-Schmidt* Theorem.

(5) §7.1–7.2: Diagonalization of symmetric matrices – *quadratic forms* and the *Spectral Theorem*.
  - On the midterm there was a particular question: If A is *any* matrix, show AA^T is symmetric.
  - Quadratic forms are given as $\vec{\boldsymbol{x}}^T A(\vec{\boldsymbol{x}})$, A any symmetric matrix.

E-mail address: `michael.fried@Colorado.edu`
E-mail address: `michaeldavidfried@gmail.com`
E-mail address: `mfried@math.uci.edu`