First Impressions

1. You should be able to calculate the interesting objects we have been studying since the last test:
   (a) homogeneous coordinates and perspective projections
   (b) determinates
   (c) Cramer’s rule – and how it relates to inverses
   (d) area and volume (using determinates)
   (e) area and volume after a linear transformation
   (f) Null spaces, column spaces, and row spaces
   (g) Kernel and Range
   (h) dimension of Null space, row space, column space, kernel, or range.
   (i) the coordinate mapping, the change of coordinate matrix, and the change of coordinate matrix from a basis $\mathcal{B}$ to a basis $\mathcal{C}$
   (j) the rank of a matrix
   (k) the basis of a vector space

2. You should understand what effect row reducing a matrix $A$ has on $\det A$, $\text{Nul}(A)$, $\text{Row}(A)$, $\text{Col}(A)$, $\text{rank}(A)$, and their dimensions.

3. Know the definition of a basis, linear independence, span, etc. You won’t be asked to regurgitate these on the exam, but you will need to be able to use them and convince me that you knew what you were using. We have a lot of theorems relating these concepts to each other as well. For instance, you should understand when a spanning set becomes a basis, and how to make it one if it isn’t, etc.

4. There will be one problem (not too hard) from the computer graphics section.

5. Expect about 1/3 short answers, 1/3 calculate, and 1/3 show type questions.
Other thoughts

1. As with the last exam, there is a lot of interplay between the various topics we have covered. Knowing how things are related is always a good idea.

2. The test will cover sections 2.7-4.7, excluding 2.8 and 2.9. However, that doesn’t mean that things from the first exam won’t come up. For instance, you may have to use the IMT (we use it nearly every time we prove a theorem), you will certainly need to know things about row reducing (how to do it, that it doesn’t change a the solutions to a system of linear equations, etc), you might need to know that $T(0) = 0$ for any linear transformation $T$, etc., etc. For that reason, you may bring your note card from the last exam, and one new note-card for this exam. (I won’t ask you to do something like LU factorization, or to prove any of the theorems from before).

3. Calculators will be allowed on the exam. Be sure to read the directions carefully. I reserve the right to ask you to do something by hand in the instructions (same as last time, there is really no need to worry here, because it would have to be something I could do by hand!). If you do have occasion to use a calculator, you need to be fairly meticulous about what happened. For example: “I used the calculator to find the reduced row echelon form of the matrix $A$, and the result is . . . ” I will bring a TI-83 to class, and it may be borrowed during the test. Be advised: because I am allowing the use of calculators, this means that I am more interested in problem setup, than in the answer. Be sure your work expresses to me that you understand the setup.

4. All assigned problems are free game. Things done in class our free game as well.

Specifics

1. How to do translation using homogeneous coordinates

2. How to find the image of a shape under the perspective projection (with a given center of projection)

3. The determinate
   (a) How do you calculate it?
   (b) What about triangular matrices?
   (c) How do row/column operations affect things?
   (d) What does a determinate measure?
   (e) Other stuff (products, transpose, etc.)
   (f) Applications (Cramer’s rule, Inverse formula, area and volume – especially after linear transformation)

4. Vector Spaces

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(a) What is a vector space (what are its properties, do you know any examples, how do you tell if a set is a vector space, etc.)?

(b) How do you tell if a subset is a subspace?

(c) How do spanning sets play into vector spaces?

(d) Null spaces, Row spaces, Column spaces, kernel, range:
   i. How do you calculate these?
   ii. What are their dimensions (and how are they related)?
   iii. How are these concepts related to each other?
   iv. How can you find a basis of each?

(e) Bases
   i. What are they, and what are their significance?
   ii. What does this have to do with spanning sets?
   iii. What does this have to do with linearly independent sets?
   iv. How do you calculate one?
   v. How can the coordinate mapping be used to manipulate bases?
   vi. How can the coordinate mapping be used to test for linear independence, for spanning, or for dimension?
   vii. What do bases (and especially dimension) tell you about subspaces and whether or not they are strictly smaller than the vector space they sit in.

(f) The coordinate mapping
   i. Know how to calculate the mapping. How does it work? What does it do?
   ii. This is a one-to-one, onto linear transformation, and thus an isomorphism. What does that entail/imply?
   iii. How can this map be used to understand dimension, bases, etc.?
   iv. What does this mean graphically?
   v. How do you find the various change of basis matrices associated with a coordinate mapping?

(g) IMT: we added to it ... don’t be surprised if it bites back.