Math 133
Fall 2013

UPDATED GENERAL INFORMATION — OCTOBER 21, 2013

Here is the fourth homework assignment, which should be completed by on **Friday, November 1, 2013.** Some questions in the first midterm examination are very likely to be along the lines of items in this and the previous assignments.

The following references are to the file `math133exercises02.f13.pdf` in the course directory.

- **Section II.3:** 3, 6, 7, 9
- **Section II.4:** 4, 6, 10, 11
- **Section II.5:** 3, 4

The following references are to the file `math133exercises02a.f13.pdf` in the course directory.

- Additional exercises for Sections II.3 and II.4: C2, C3, C5

The following references are to the file `math133exercises02b.f13.pdf` in the course directory.

- Exercises on affine equivalence: T1, T2, T4

(The next page discusses Quiz 1 and Examination 1)

Solution to Quiz 1

We are given a trapezoid whose vertices are $A = (0,0)$, $B = (x,0)$ where x is positive, $C = (1,1)$ and $D = (0,1)$, and the problem asks for the point at which the two diagonals AC and BD meet.

There are several ways of solving this problem, but we shall use vectors and the methods described in Unit I of the notes. A typical point on the line joining A and C has the form $(1-s)A + sC$ for some real number s, while a typical point on the line joining b and D has the form $tB + (1-t)D$ for some real number t. If we use the given values for the point coordinates, we see that the common point has the form

$$s(1,1) \ + \ (1-s)(0,0) \quad = \quad t(0,1) \ + \ (1-t)(x,0)$$

for suitably chosen real numbers s and t. This vector equation is equivalent to a system of two equations in s and t obtained by equating the first and second coordinates on the two sides of the equation:

$$s \ = \ (1-t)x \ , \qquad s \ = \ t$$

The solution to this system of equations is $t = s = x/(x+1)$, and if we substitute this back into the original expression(s) for the intersection point we see that its coordinates are given by

$$\left(\frac{x}{x+1} \, , \, \frac{x}{x+1} \right) \ .$$

The quizzes had precise numerical values for x, but this solution works in both cases.■

Study hints for the first examination

Here are some suggestions for studying to take the first exam. Nothing from Section I.2 will be on the exam, and the main things to know from Section I.1 will be the perpendicular projection formula and the condition on vectors which is equivalent to the additivity of distances:

$$d(X,Y) \quad = \quad d(X,Z) \ + \ d(Z,Y)$$

In Sections I.3 and I.4, the main thing is to be able to work the basic sorts of examples in the homework and in Section I.5; computational problems involving barycentric coordinates are particularly important to understand. For Sections II.1 and II.2, it is important to know the basic incidence axioms and the basic axioms and definitions involving betweenness (including the definitions of segments and rays, both in terms of betweenness and in terms of vector algebra). Also, it is important to know how to work basic sorts of exercises as in the homework and notes, which requires knowing the theorems in these sections and also the theorem in `betweenness.pdf`. The assigned problems from all covered sections, Exercises II.2.4 – II.2.6, II.2.8 – II.2.9 and II.2.11, Exercises L1 – L4 in `math133exercises01b.pdf` and the unassigned exercises from B.1 – B.10 should also be understood. Material on convex functions will not be covered on this examination (but it might be on another examination, with the final examination the most likely place).

There will be **NO** *formal* proofs to complete on the examination (although at least some problems might require a little reasoning that is on the edge of being abstract). About a fourth will involve statements and understanding of basic definitions and results, and the remainder will be devoted to working out examples like those in the homework and the notes.