Math 133
Fall 2018

UPDATED GENERAL INFORMATION — OCTOBER 28, 2018

Here is the homework assignment for the remainder of Unit II, which should be completed by the date of the first exam on **Friday, November 2, 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 following references are to the file `math133exercises02c.f13.pdf` in the course directory.

- Exercises on 3-dimensional incidence: J1 – J4

Basic knowledge for Examination 1

The exam will be mainly on Unit II. You will need to know all the basic geometric and algebraic definitions and descriptions, all of the axioms in Unit II (incidence, betweenness, linear and angular measurement, congruence, parallelism), how to test for betweenness and separation in terms of vectors and coordinates, and the main geometrical results from Unit II (an active rather than passive understanding is highly recommended). There will be nothing specifically on geometrical transformations as discussed in Sections II.4 and II.5. Regarding 3-dimensional geometry, aside from the interpretations in terms of vectors the main things to consider are the results involving incidence.

Several of the problems on the exam will involve reasoning or proofs. Examples for the expected level of reasoning will be given below.

Aside from the standard files for notes, exercises and solutions, a review of `betweenness.pdf`, `betweenness2.pdf`, **separation.pdf**, and `examples 01*.pdf` (where $*$ denotes a wild card substitution) are strongly recommended. In addition, you should know the following characterization of space separation using vectors. This is a direct generalization of the criterion in the previously cited separation document:

FACT. *If P is a plane in the coordinate plane $\mathbb{R}^3$ which is defined by the equation*

$$D \quad = \quad g(x,y,z) \quad = \quad Ax \ + \ By \ + \ Cz$$

where at least on of A, B, C is nonzero, then the two half-spaces determined by P are the sets where $g(x,y,z) > D$ and $g(x,y,z) < D$.

Practice problems for the first examination

The previously recommended exercises, especially from Unit II, are all suggested for review. Here are some suggestions for studying to take the first exam.

1. Given $\angle abc$ and a line L in the same plane, if these two sets meet in three points then either $L = ab$ or $L = ac$.

2. Verify the statement about ruler functions made in the lectures: If L is a line and $h : L \to \mathbb{R}$ is a ruler function, and $g : \mathbb{R} \to \mathbb{R}$ is defined by $g(t) = \varepsilon t + K$ where K is an arbitrary constant and $\varepsilon = \pm 1$, then the composite $g \circ f$ is also a ruler function. — For the sake of completeness, we say that f is a ruler function if it is a 1–1 correspondence from L to $\mathbb{R}$ under which the distances between two points on L equals the distance between the corresponding real numbers (see the first page of Section II.3).

3. Given ΔABC, let $D \in (AB)$ and $E \in (BC)$, and let $X \in (DE)$. Prove that X and B lie on the same side of AC.

4. If P is the plane in $\mathbb{R}^3$ defined by the equation $5x+y+3z = 7$, determine which of the following points lie on the same side of P as $(1, 0, -1)$ and which do not: $(-1, -4, 9)$, $(-2. -3, 4)$, $(1, -1, 1)$, $(2, -8, 1)$

5. Suppose that we are given ΔABC with $B * A * D$ and $B * C * E$, and suppose that $X \in (AC)$. Prove that there is a point Y such that $B * X * Y$.

6. Suppose that we are given isosceles triangle ABC in the plane with $|AB| = |AC|$, and let D be such that the ray $[AD$ bisects $\angle BAC$: $|\angle BAD| = |\angle DAC| = \frac{1}{2}|\angle BAC|$. Prove that D is the midpoint of $[BC]$.