Homework in Math 128B
Spring 2011

Expectations. To do as well as you are capable of doing in Math 128B, you should expect to do **at least:**

13–15 hours of work each week outside of class.

Proof homework. In many homework problems, you will be asked to "Prove…" or "Show that…" or "Explain why…" something is true. In these problems, the point is basically to give a logical explanation in complete sentences, i.e., a *proof.* For more details, see the handout on writing proofs, downloadable from the course webpage

You will have several chances to work on, and revise, all homework problems. Specifically, this process has 3 steps: outline, submission, and revision.

1. An outline of each problem set will be due in the class before the completed version is due, and will be discussed briefly in that class. For example, the outline for problem set 01 is due **Wed Feb 02**. In that class, we will spend a few minutes discussing that outline and what PS01 is asking you to do.

   In each outline, you should do the following:

   (a) **Write down the definitions of all terms from the reading that you have not previously encountered** (e.g., ring, subring, ideal). The point is to show that you understand what the assigned problems are asking.

   You do not need to repeat definitions that have appeared before, just new ones. Also, **please do not write out the theorems** involved in each chapter

   (b) **Write down a plan for every problem.** The way you do this depends on the problem. (In particular, you need to do enough work on a problem to tell what methods are needed!) See the handout on proof for more about definitions, theorems, assumptions, conclusions, and different methods of proof.

   - If the problem is a computation, just note what needs to be computed (what form should the final answer take?).
   - If the problem is an "if-then" proof, write down what you are **assuming** in your proof, and write down the **conclusion** you are trying to reach.
   - If the problem involves proving that "There exists (blah blah)", write down the name of the object that you need to construct, and write down an assume-conclude structure for the properties that the constructed object needs to have.
   - If the problem involves proof by contradiction, write down the initial assumptions that you hope will lead to a contradiction.
   - If the problem involves proof by induction, write down an outline for the base case of the induction (usually either "there exists" or "if-then"), and then write down an assume-conclude pair for the induction step.

   See below for some examples.

   Late outlines will not be accepted, but to allow for illness, etc., your lowest outline grade will be dropped.

2. Submit the completed version. (For PS01, this will be on **Mon Feb 07**.) You do not need to include your outline with the completed version.

3. After you get the graded problem set back, you have as many chances as you want to revise the problems as much as you like, usually until the class before the next in-class exam. (For example, the last chance to revise PS01 is **Mon Feb 21**.) Each time you submit a revision,

please attach the original completed version and all previous revisions, so I know how many points to add on to your score. (Please arrange the versions with the **newest on the top**, down to the original version on the bottom.) You do not need to revise/rewrite problems that you have previously gotten correct; just correct the ones you got wrong.

Revising missed problem sets: It is possible to "revise" a problem set that is not turned in on the due date. However, each time you miss a due date, all previous homework from missed due dates becomes unrevisable. Note that "missing" a due date can also include turning a homework that, in my judgement, does not represent a sufficient effort to continue with the course. (I'll let you know quite clearly that your effort is insufficient if it happens.)

Rules for working together: The basic rule about working together is that you are encouraged to talk to each other about homework, as everyone learns from such discussion, but you are not allowed to copy solutions. Please also do not let others "borrow" or make xeroxes of your homework.

Homework copying will, in general, result in a grade of 0 both for the person copying and the person being copied from. After repeated offenses, I will file a report of academic dishonesty with the university.

How to do an outline (examples)

The outline for PS01 should go basically as follows.

Relevant definitions: Please collect all relevant new definitions at the beginning of your outline. For example:

Defn. A *ring* is a set R with two binary operations (etc.)

Defn. A ring R is *commutative* if (etc.)

Defn. A *unity* element in a ring is (etc.)

Notes for each problem. This will vary slightly from problem to problem. Again, the different types of proof and their corresponding outline styles are:

- *"If-then" proof:* Write down your assumption and your conclusion.
- *"There exists..." proof:* Name of the object you need to construct, assume-conclude structure for the properties of that object.
- *Proof by contradiction:* (rare) State initial assumptions that will lead to a contradiction.
- *Induction:* (very rare) Outline for the base case; assume-conclude pair for the induction step.

Examples:

Computation: (PS01, 7) Final answer is list of all zero divsors in $\mathbb{Z} \oplus \mathbb{Q}$, units in $\mathbb{Z} \oplus \mathbb{Q}$, and idempotents in $\mathbb{Z} \oplus \mathbb{Q}$.

If-then: (Ch. 12, prob. 12)
Assume: R commutative ring, $a, b, c \in R$, a a unit in R.
Assume: b divides c.

Conclude: ab divides c.
(and converse)

There exists: For the following problem:

> Prove that if a and b are integers, s and t are positive integers, and $\gcd(s,t) = 1$, then there exists some integer n such that $n = a \pmod{s}$ and $n = b \pmod{t}$.

A first attempt might be:
Assume: a, b, s, t integers, $s, t > 0$, $\gcd(s,t) = 1$.
Conclude: There exists some integer n such that $n = a \pmod{s}$ and $n = b \pmod{t}$.

A better outline would be:
Assume: a, b, s, t integers, $s, t > 0$, $\gcd(s,t) = 1$.
(Some method or algorithm for finding n)
Conclude: $n = a \pmod{s}$ and $n = b \pmod{t}$.