# Math 1062, Spring 2012, Homework 1

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**Due: Friday, January 20, 2012**

- You may work with other people (cite them explicitly in your write up) and you can find the LaTeX of this file at `http://wstein.org/edu/2012/1062/hw/`.
- I will have office hours 11am–2pm in Padelford C423 on Thursday, January 19.
- For this assignment, it is easiest for me if you email your solutions as a Sage worksheet (an `.sws` file) to `wstein@uw.edu`, which you get by clicking "File... Save worksheet to a file..." in the Sage notebook.

## 1 Math 480 (Undergrad) Homework

1. Compute $1 + 2 + 3 + \cdots + 2012$, i.e., the sum of the positive integers up to 2012, in any way using Sage.
2. Write a function `f` that takes as input a list with odd length and deletes the middle entry from the list. For example,

```
sage: v = [1, 2, 8, 15, '7']
sage: f(v)
sage: v
[1, 2, 15, '7']
```

   Your function does *not* have to deal gracefully with bad input. [Hint: The Python `del` statement and `len` functions are both relevant. Part of this exercise is to look them up somewhere.]
3. How many digits does $n!$ have, where $n = 10^6$? [Hint: Relevant functions are `str`, `len`, and `factorial`.]
4. Write a function `f` that takes as input a list, and returns a sorted list of the number of times each type of object appears in the list. For example,

```
sage: f([2, 1/3, 'hi', 3, 'abc', 'xyz'])
[1,2,3]
```

   since there is 1 `Rational`, 2 `Integer`'s and 3 `str`'s. Your function does *not* have to deal gracefully with bad input. [Hint: You may find the `set` command useful.]

## 2 Math 582 (Graduate Student) Homework

The problems in this section are aimed at graduate students. Undergrads may also do them, but they will neither count for or against their course grade.

Do the problems in Section 1 above, and also do the following:

1. Compute $1 + 2 + 3 + \cdots + 2012$ in at least 4 "reasonably different" ways using Sage. (Your answer to the undergrad problem above counts for one of the ways.)

2. Implement a function that takes as input an integer $n$ and outputs a list of the prime numbers up to $n$. Your function should not use the `is_prime`, `prime_range`, `primes`, or similar commands in Sage, and should not be a big table lookup. Your function need not be efficient, except that it has to at least work for $n \leq 1000$ in a reasonable amount of time. (Basically, implement some variant of the Sieve of Eratosthenes, or just implement a primality test such as trial division and test each integer for primality.)

3. The following problem is a warm up for a problem we will have later that involves "dealing with" that Mathematica poster on the 4th floor of Padelford.

   (a) Draw a plot of the real and imaginary parts of the Riemann Zeta function $\zeta(s)$ for $s = \frac{1}{2} + it$ for $1 \leq t \leq 200$.

   (b) Draw a complex plot of the Riemann Zeta function in some region of your choice using the `complex_plot` command.