# CS 361, Pretest

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*Due: Tuesday, August 30th*

This is a take-home "pretest" to test your math background for this course. It will be graded! Please show all your work.

**Graded Problems:**

1. Find the solutions to this equation $x^2 - x - 1 = 0$

2. Assume that $x - y = 2$ and $x + 2y = 8$ for unknown variables $x$ and $y$. What are the values of $x$ and $y$?

3. Assume you know that some function $f$ is of the form $f(x) = ax^2 + bx$, where the coefficients $a$ and $b$ are unknown. Assume further that $f(1) = 2$ and $f(2) = 10$. What are the coefficients $a$ and $b$?

4. For each of the following equations, say whether it is always true, or if it may be false. If the equation is always true, say why. If it's false, give values for which it is false. All logs are base 2 unless stated otherwise.

    (a) $2^{\log n} = n$

    (b) $a^{\log b} = b^{\log a}$.

    (c) $\log 4x = \log 4 + \log x$

    (d) $\log x^2 = 2 \log x$

    (e) $\log_8 x = (\log_2 x)/4$ (that is, *log* base 8 of $x$ is *log* base 2 of $x$ divided by 4.

5. What is $\sum_{i=0}^{\infty} 2^{-i} = 1 + 1/2 + 1/4 + 1/8 + \ldots$

6. Prove, by induction on $n$, that $\sum_{i=0}^{n} 2^i = 2^{n+1} - 1$

7. Prove, by induction on $n$, that $\sum_{i=1}^{n} i^2 = 1^2 + 2^2 + 3^2 + \cdots + n^2 = n(n+1)(2n+1)/6$.

8. Let's say you have 2 blue blocks, and 2 green blocks, and 1 red block that are otherwise indistinguishable. How many different columns of height 5 can be built from these 5 blocks? For this problem, BRBGG and GGBRB will be considered to be two different columns (i.e. there is a bottom up ordering).

**Ungraded Questions:**

1. What is your full current email address?

2. Circle the algorithms and data structures that you could code in a language of your choice:

   Mergesort   Quicksort   Linked List   Binary Tree   Heap