

Homework 1

September 4th 2019

Return your solutions (i.e., .cpp files) to tuomas.lunttila@uef.fi by September 18th.

1. Sound travels through air as a result of collisions of the molecules in the air. The temperature of the air affects the speed of the molecules, which in turn affects the speed of sound. The velocity of sound in dry air can be approximated by the formula

$$v = 331.3 + 0.61T_C,$$

where T_C is the temperature of the air in degrees Celsius and the velocity (v) is meters/second.

Write a C++ program that allows the user to input a starting and an ending temperature. Within this temperature range, the program should output the temperature and the corresponding velocity in one-degree increments. Don't forget to do some basic sanity checks, for example that the given temperature range is at least somewhat reasonable.

2. Write a C++ program that finds all prime numbers (alkuluku in Finnish) less than or equal to a number n given as user input. Since the list may be very long, output only the number of primes found.

For full points the program should be reasonably fast, i.e. for n of the order of 10^8 the computation on a typical laptop should take seconds (or less), not minutes. This means that the simplest "loop through all numbers testing for divisors" solutions will not be fast enough. You will probably find the vector class useful.

For a bonus point: calculate also the sum of reciprocals of prime numbers less than n , i.e.,

$$\sum_{\substack{p \text{ prime} \\ p \leq n}} \frac{1}{p},$$

and reciprocals of twin primes less than n :

$$\sum_{\substack{p, p+2 \text{ prime} \\ p+2 \leq n}} \left(\frac{1}{p} + \frac{1}{p+2} \right).$$