

# Stat 598W: Homework 1

Due Thursday Jan 22 (sveinno@purdue.edu). Include a word/pdf document with your code and relevant output.

## Problem 1

Write a program that generates a list of the first 20 Ruth-Aaron pairs of integers. A pair of numbers  $(n, n + 1)$  is a Ruth-Aaron pair if the sum of their prime factors is the same. For example,  $(714, 715)$  is a Ruth-Aaron pair because  $714 = 2 * 3 * 7 * 17$ ,  $715 = 5 * 11 * 13$ , and  $2 + 3 + 7 + 17 = 5 + 11 + 13$ . Another example is  $(8, 9)$  because  $2 + 2 + 2 = 3 + 3$ .

## Problem 2

The mathematical combinations function  $C(n, k)$  is usually defined in terms of factorials, as follows:

$$C(n, k) = \frac{n!}{k!(n - k)!}.$$

The values of  $C(n, k)$  can also be arranged geometrically to form a triangle in which  $n$  increases as you move down the triangle and  $k$  increases as you move from left to right. The resulting structure, which is called Pascal's triangle after the French mathematician Blaise Pascal, is arranged like this:

$$\begin{array}{ccccccc} & & & & C(0,0) & & \\ & & & & C(1,0) & C(1,1) & \\ & & & C(2,0) & C(2,1) & C(2,2) & \\ & & C(3,0) & C(3,1) & C(3,2) & C(3,3) & \\ C(4,0) & C(4,1) & C(4,2) & C(4,3) & C(4,4) & & \\ & & \dots & & & & \end{array}$$

Pascal's triangle has the property that every entry is the sum of the two entries above it, except along the left and right edges, where the values are always 1. For example,  $C(6, 2) = C(5, 1) + C(5, 2)$ . Use these relationships to write a recursive implementation of the  $C(n, k)$  function that uses no loops and no multiplication. For extra marks, also write a function that displays the first rows of the Pascal triangle.

## Problem 3

Write a function

```
string removeCharacters(string str, string remove);
```

that returns a new string consisting of the characters in `str` after removing all instances of the characters in `remove`. For example, if you call

```
removeCharacters("counterrevolutionaries", "aeiou")
```

the function should return `"cntrrvltnrs"`, which is the original string after removing all of its vowels.

Also write a function that instead of returning a new string, removes the letters from the string passed as the first argument. Its declaration should be

```
void removeCharacters(string &str, string remove);
```