

Lab 3

COMP9021, Session 1, 2015

1 Finding particular sequences of prime numbers

Write a program that finds all sequences of 6 consecutive prime 5-digit numbers, so of the form (a, b, c, d, e, f) with $b = a + 2$, $c = b + 4$, $d = c + 6$, $e = d + 8$, and $f = e + 10$. So a, b, c, d and e are all 5-digit prime numbers and no number between a and b , between b and c , between c and d , between d and e , and between e and f is prime.

The expected output is:

The solutions are:

13901	13903	13907	13913	13921	13931
21557	21559	21563	21569	21577	21587
28277	28279	28283	28289	28297	28307
55661	55663	55667	55673	55681	55691
68897	68899	68903	68909	68917	68927

2 Decoding a multiplication

Write a program that decodes all multiplications of the form

```
      *  *  *
x     *  *
-----
*  *  *  *
*  *  *
-----
*  *  *  *
```

such that the sum of all digits in all 4 columns is constant.

The expected output is:

411 * 13 = 5343, all columns adding up to 10.
425 * 23 = 9775, all columns adding up to 18.

3 Decoding a sequence of operations

Write a program that finds all possible ways of inserting $+$ and $-$ signs in the sequence 123456789 (at most one sign before any digit) such that the resulting arithmetic expression evaluates to 100.

Here are a few hints.

- 1 can either be preceded by $-$, or optionally be preceded by $+$; so 1 starts a negative or a positive number.
- All other digits can be preceded by $-$ and start a new number to be subtracted to the running sum, or be preceded by $+$ and start a new number to be added to the running sum, or not be preceded by any sign and be part of a number which it is not the leftmost digit of. That gives 3^8 possibilities for all digits from 2 to 9. We can generate a number N in $[0, 3^8 - 1]$. Then we can:
 - consider the remainder division of N by 3 to decide which of the three possibilities applies to 2;
 - consider the remainder division of $\frac{N}{3}$ by 3 to decide which of the three possibilities applies to 3;
 - consider the remainder division of $\frac{N}{3^2}$ by 3 to decide which of the three possibilities applies to 4;
 - ...

The expected output is (the ordering could be different):

```
1 + 23 - 4 + 5 + 6 + 78 - 9 = 100
123 - 4 - 5 - 6 - 7 + 8 - 9 = 100
123 + 45 - 67 + 8 - 9 = 100
123 + 4 - 5 + 67 - 89 = 100
12 + 3 + 4 + 5 - 6 - 7 + 89 = 100
123 - 45 - 67 + 89 = 100
12 - 3 - 4 + 5 - 6 + 7 + 89 = 100
1 + 2 + 34 - 5 + 67 - 8 + 9 = 100
1 + 2 + 3 - 4 + 5 + 6 + 78 + 9 = 100
-1 + 2 - 3 + 4 + 5 + 6 + 78 + 9 = 100
12 + 3 - 4 + 5 + 67 + 8 + 9 = 100
1 + 23 - 4 + 56 + 7 + 8 + 9 = 100
```