Homework 1

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1 Exercises 1.1 - 5

Algorithm 1 Finding common elements in two sorted lists

Input: An array $A_1[0..m-1]$ for m sorted numbers;
Another sorted array $A_2[0..n-1]$ with n numbers;
Output: Ensemble of classifiers on the current batch, A_c;

```
1: i ← 0
2: while (i < m)and(j < n) do
3:    if A1[i] == A2[i] then
4:       printA[i]
5:       i ← i + 1
6:       j ← j + 1
7:    else if A1[i] > A2[i] then
8:       j ← j + 1
9:    else
10:      i ← i + 1
11:   end if
12: end while
```

2 Exercises 1.1 - 6

a.

m = 31415, n = 14142
Step 1: $r = 31415 \mod 14142 = 3131, m \leftarrow 14142, n \leftarrow 3131$
Step 2: $r = 14142 \mod 3131 = 1618, m \leftarrow 3131, n \leftarrow 1618$
Step 3: $r = 3131 \mod 1618 = 1513, m \leftarrow 1618, n \leftarrow 1513$
Step 4: $r = 1618 \mod 1513 = 105, m \leftarrow 1513, n \leftarrow 105$
Step 5: $r = 1513 \mod 105 = 43, m \leftarrow 105, n \leftarrow 43$
Step 6: $r = 105 \mod 43 = 19, m \leftarrow 43, n \leftarrow 19$
Step 7: $r = 43 \mod 19 = 5, m \leftarrow 19, n \leftarrow 5$
Step 8: $r = 19 \mod 5 = 4, m \leftarrow 5, n \leftarrow 4$
Step 9: $r = 5 \mod 4 = 1, m \leftarrow 4, n \leftarrow 1$

Step 10: $r = 4 \mod 1 = 0, m \leftarrow 1, n \leftarrow 0$

Step 11: return 1

b.

Using consecutive integer checking algorithm, every time the value of t is decreased, it takes two divisions. There are 28284 divisions in total.

Using Euclid's algorithm, there are 10 divisions.

Euclid's algorithm is 28284/10 = 2828.4 times faster in terms of divisions.

3 Exercises 1.1 - 7

Prove the equality gcd(m, n) = gcd(n, m mod n) for every pair of positive integers m and n.

4 Exercises 1.2 - 4

Algorithm 2 finding real roots

Input: arbitrary real coefficients a, b, and c

1: $d \leftarrow b^2 - 4 * a * c$
2: **if** $d < 0$ **then**
3: **return** $false$
4: **else if** $d = 0$ **then**
5: $x_1 \leftarrow (-b + sqrt(d))/(2 * a)$
6: **return** x_1
7: **else if** $d > 0$ **then**
8: $x_1 \leftarrow (-b + sqrt(d))/(2 * a)$
9: $x_2 \leftarrow (-b - sqrt(d))/(2 * a)$
10: **return** x_1, x_2
11: **end if**

5 Exercises 1.2 - 9

6 Exercises 1.3 - 1