

**Exercise 1** The coin-change problem consists of the following: Given a set of  $n$  coins  $\{c_1, c_2, \dots, c_n\}$ , each of which is a positive integer, and an amount  $A$ , also a positive integer, find whether it is possible to get a change for  $A$ . Assume that  $A \geq c_i, i = 1, \dots, n$ .

- a) Consider the two following backtracking algorithms for this problem. Discuss the difference between the two approaches and write the first call.

**Function** *Coin1*( $A, i$ )

```

if  $A = 0$  then
  return true
if  $A < 0$  or  $i > n$  then
  return false
if Coin1( $A - c_i, i + 1$ ) = true then
  return true
if Coin1( $A, i + 1$ ) = true then
  return true
return false

```

Allows  
Repeated  
Coins

**Function** *Coin2*( $A, i$ )

```

if  $A = 0$  then
  return true
if  $A < 0$  then
  return false
for  $j = i + 1, \dots, n$  do
  if Coin2( $A - c_j, j$ ) = true then
    return true
return false

```

- b) Draw the recursion call trees that describe the search process of the two algorithms above for the following input data:  $c_1 = 3, c_2 = 5, c_3 = 7$  and  $A = 12$ ; provide only information about the arguments of the recursion call at each node of the tree.

- c) What is the best ordering of the coins with respect to the running time of both backtracking algorithms? 7 primary

- d) If you want to know the number of possible ways of making change, what needs to be modified in both algorithms? em very de true e false, retornar 0 e 1 e acumular

- e) If you want to know the least number of coins to make the change, what needs to be modified in both algorithms? min (1 + use coin, dont use this coin) acumulado resposta

$A = 7$

$\{3, 5, 7\}$

**Exercise 2** Read the problem *Zé Manel is setting up a computer network* in EA2025\_PL in Mooshak and solve it using a backtracking approach.



