Tecnológico de Monterrey

Tecnológico de Monterrey - Campus Monterrey
School of Engineering and Sciences
Engineering in Computational Technologies
Analysis and Design of Advanced Algorithms

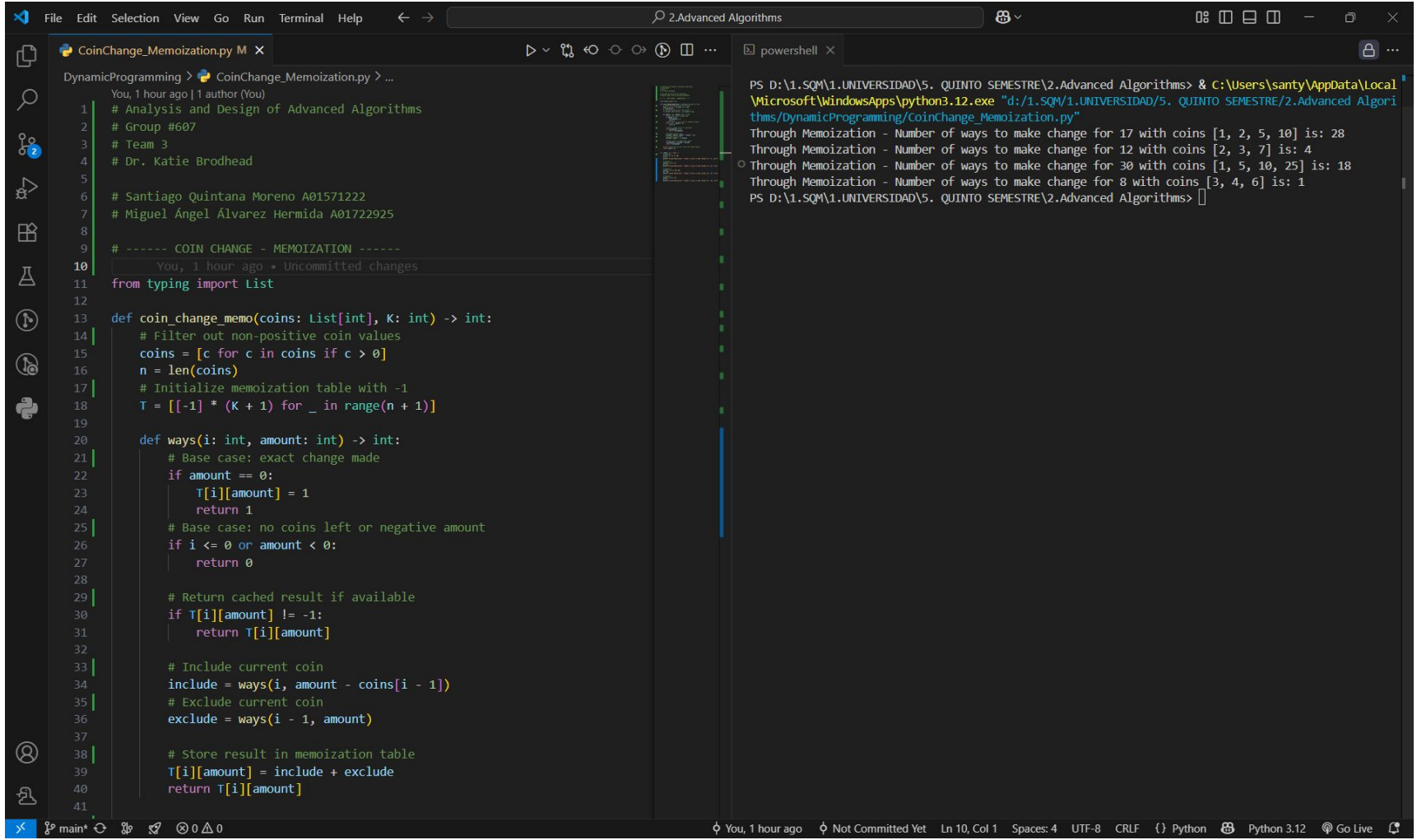
Class Activity 3:
Coin Change through Memoization and Tabulation

Group: 607
Team #3
Dr. Katie Brodhead

Santiago Quintana Moreno A01571222
Miguel Ángel Álvarez Hermida a01722925

Memoization

https://colab.research.google.com/drive/12s4kv6mmSyGB3o2UOUn_3k_f2I9e1Vhv?usp=sharing


File Edit Selection View Go Run Terminal Help
2.Advanced Algorithms
CoinChange_Memoization.py M
DynamicProgramming > CoinChange_Memoization.py > ...
You, 1 hour ago | 1 author (You)
Analysis and Design of Advanced Algorithms
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------ COIN CHANGE - MEMOIZATION ------
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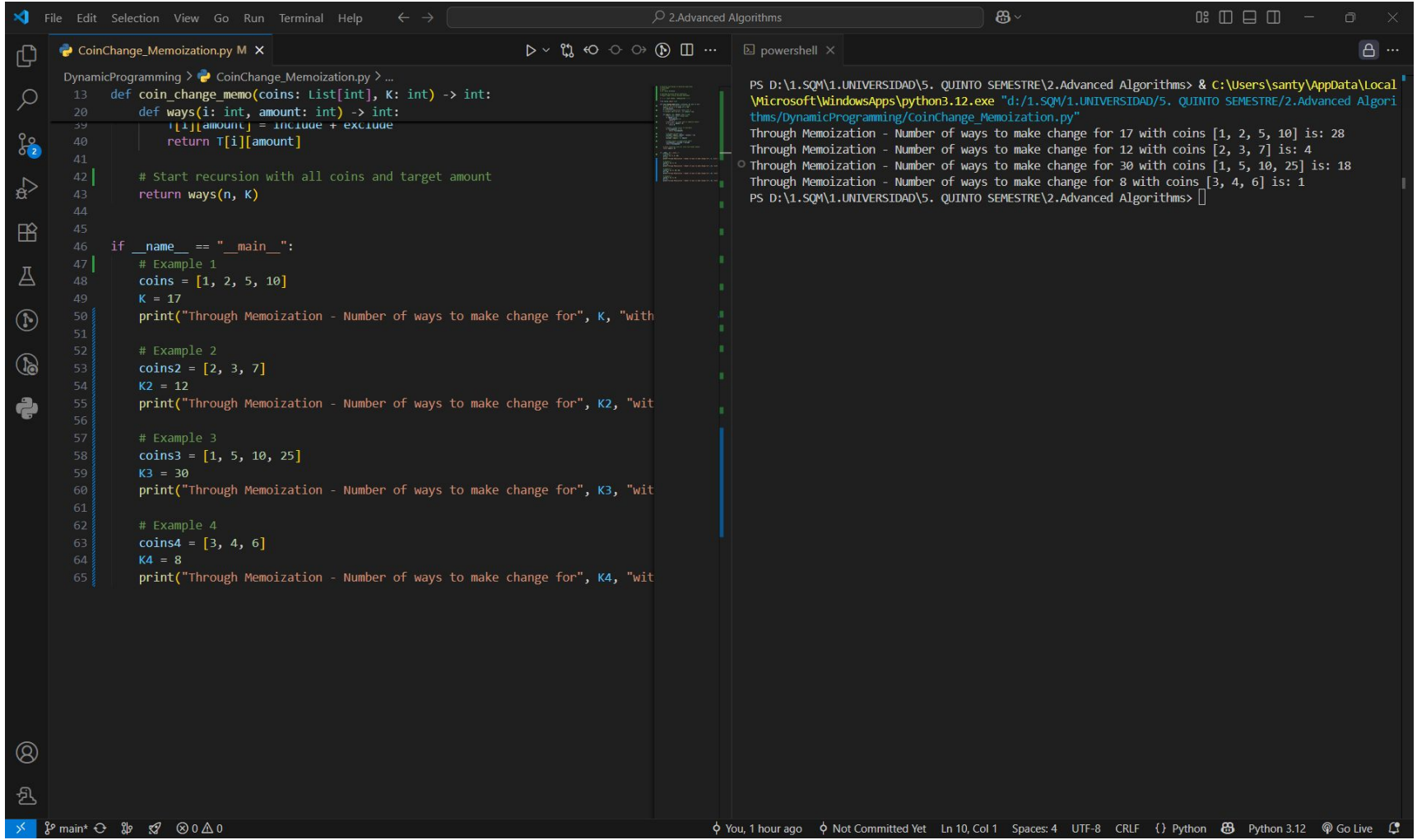
from typing import List
def coin_change_memo(coins: List[int], K: int) -> int:
# Filter out non-positive coin values
coins = [c for c in coins if c > 0]
n = len(coins)
# Initialize memoization table with -1
T = [[-1] * (K + 1) for _ in range(n + 1)]
def ways(i: int, amount: int) -> int:
# Base case: exact change made
if amount == 0:
T[i][amount] = 1
return 1
# Base case: no coins left or negative amount
if i <= 0 or amount < 0:
return 0
# Return cached result if available
if T[i][amount] != -1:
return T[i][amount]
# Include current coin
include = ways(i, amount - coins[i - 1])
# Exclude current coin
exclude = ways(i - 1, amount)
# Store result in memoization table
T[i][amount] = include + exclude
return T[i][amount]
powershell
PS D:\1.SQM\1.UNIVERSIDAD\5. QUINTO SEMESTRE\2.Advanced Algorithms> & C:\Users\santy\AppData\Local\Microsoft\WindowsApps\python3.12.exe "d:/1.SQM/1.UNIVERSIDAD/5. QUINTO SEMESTRE/2.Advanced Algorithms/DynamicProgramming/CoinChange_Memoization.py"
Through Memoization - Number of ways to make change for 17 with coins [1, 2, 5, 10] is: 28
Through Memoization - Number of ways to make change for 12 with coins [2, 3, 7] is: 4
Through Memoization - Number of ways to make change for 30 with coins [1, 5, 10, 25] is: 18
Through Memoization - Number of ways to make change for 8 with coins [3, 4, 6] is: 1
PS D:\1.SQM\1.UNIVERSIDAD\5. QUINTO SEMESTRE\2.Advanced Algorithms>
main* 0 0 0
You, 1 hour ago Not Committed Yet Ln 10, Col 1 Spaces: 4 UTF-8 CRLF Python Python 3.12 Go Live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DynamicProgramming > CoinChange_Memoization.py > ...
def coin_change_memo(coins: List[int], K: int) -> int:
def ways(i: int, amount: int) -> int:
T[i][amount] = include + exclude
return T[i][amount]
Start recursion with all coins and target amount
return ways(n, K)
if __name__ == "__main__":
# Example 1
coins = [1, 2, 5, 10]
K = 17
print("Through Memoization - Number of ways to make change for", K, "with
# Example 2
coins2 = [2, 3, 7]
K2 = 12
print("Through Memoization - Number of ways to make change for", K2, "wit
# Example 3
coins3 = [1, 5, 10, 25]
K3 = 30
print("Through Memoization - Number of ways to make change for", K3, "wit
# Example 4
coins4 = [3, 4, 6]
K4 = 8
print("Through Memoization - Number of ways to make change for", K4, "wit
powershell
PS D:\1.SQM\1.UNIVERSIDAD\5. QUINTO SEMESTRE\2.Advanced Algorithms> & C:\Users\santy\AppData\Local\Microsoft\WindowsApps\python3.12.exe "d:/1.SQM/1.UNIVERSIDAD/5. QUINTO SEMESTRE/2.Advanced Algorithms/DynamicProgramming/CoinChange_Memoization.py"
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PS D:\1.SQM\1.UNIVERSIDAD\5. QUINTO SEMESTRE\2.Advanced Algorithms>
main*
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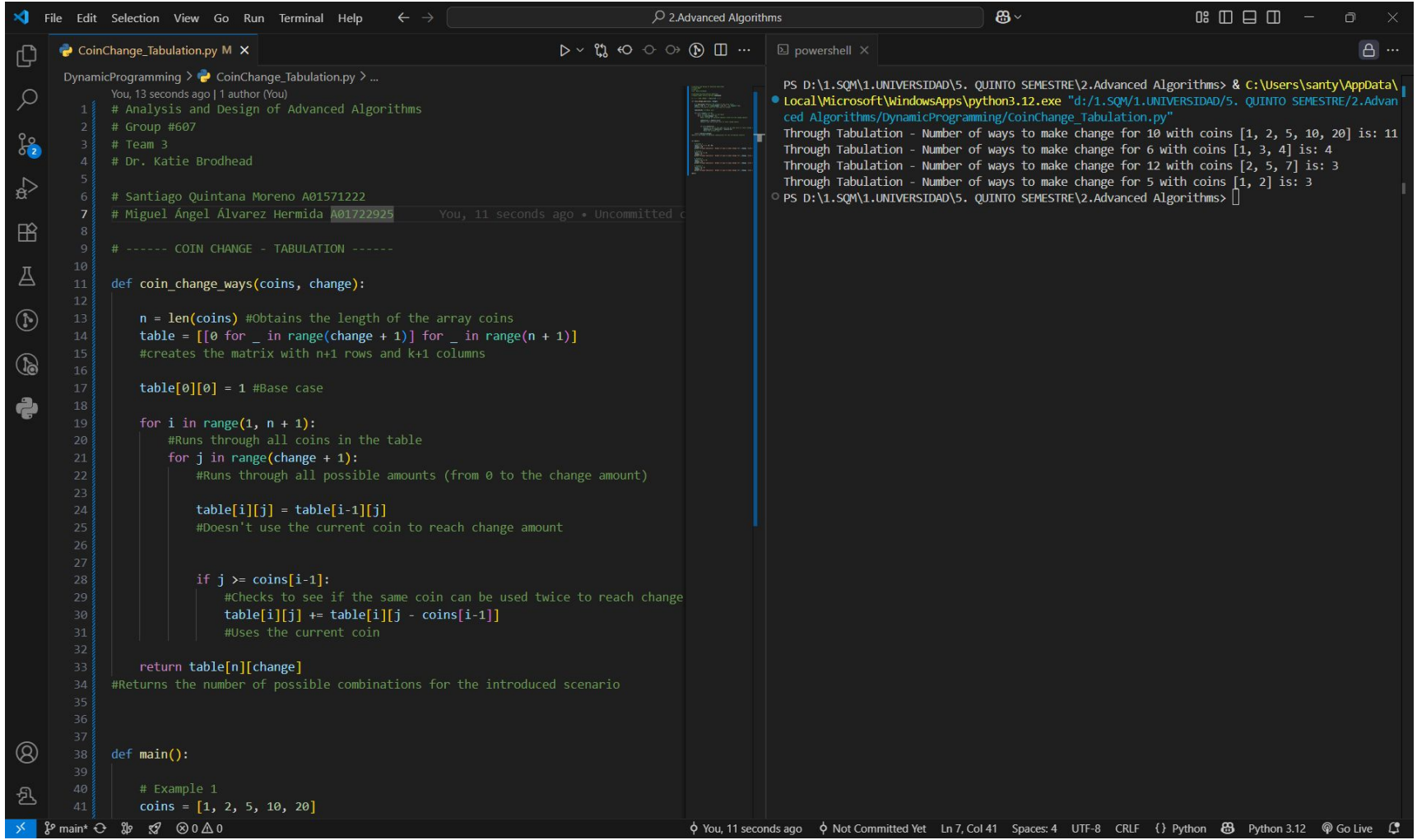
Python
Python 3.12
Go Live

Tabulation

https://colab.research.google.com/drive/1JbaVguyeyGA0QgnP9NjaiZJtHDy17n3y?usp=sharing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2.Advanced Algorithms
CoinChange_Tabulation.py M
DynamicProgramming > CoinChange_Tabulation.py > ...
You, 13 seconds ago | 1 author (You)
# Analysis and Design of Advanced Algorithms
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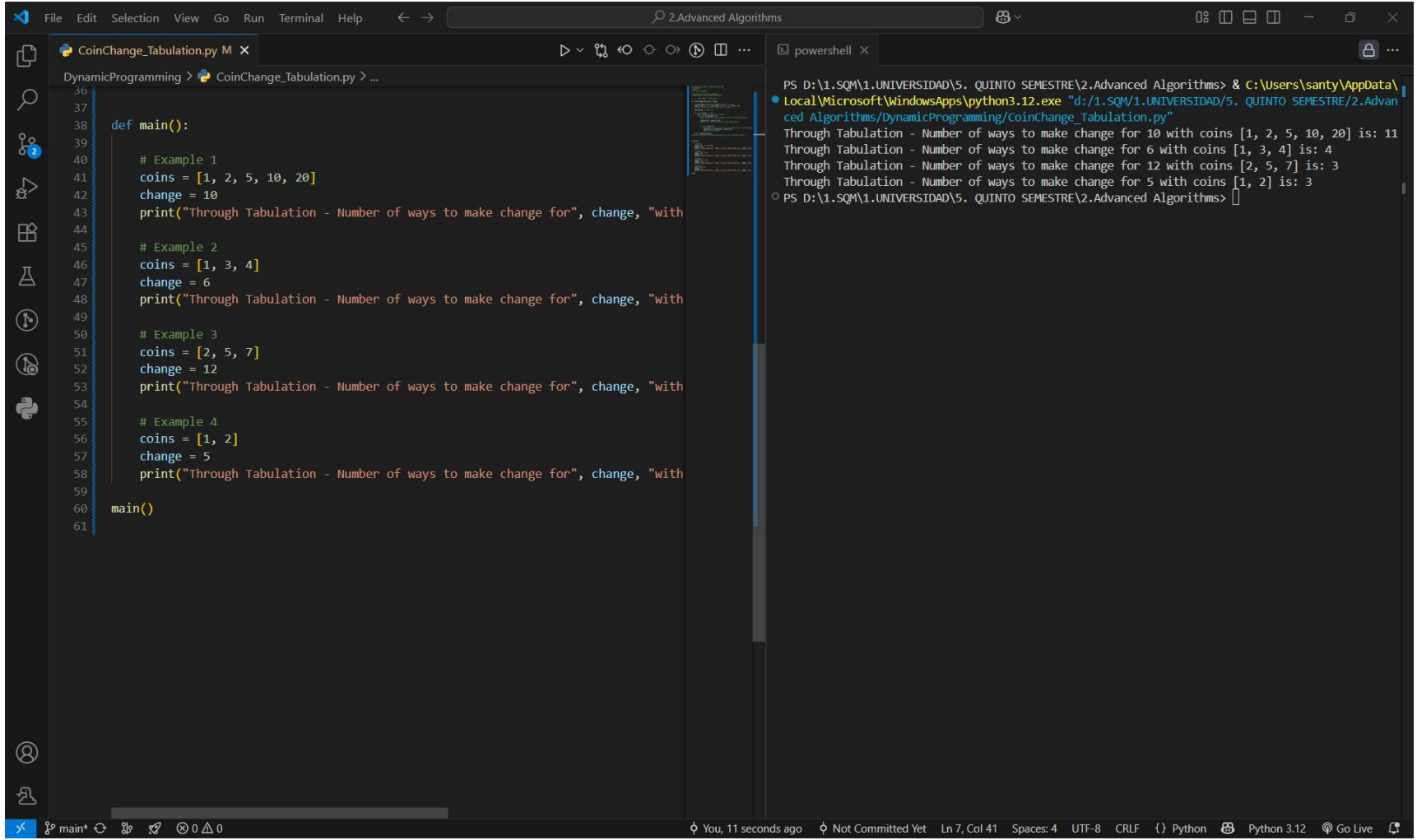
# Santiago Quintana Moreno A01571222
# Miguel Ángel Álvarez Hermida A01722925 You, 11 seconds ago • Uncommitted c
# ------ COIN CHANGE - TABULATION ------
def coin_change_ways(coins, change):
n = len(coins) #Obtains the length of the array coins
table = [[0 for _ in range(change + 1)] for _ in range(n + 1)]
#creates the matrix with n+1 rows and k+1 columns
table[0][0] = 1 #Base case
for i in range(1, n + 1):
#Runs through all coins in the table
for j in range(change + 1):
#Runs through all possible amounts (from 0 to the change amount)
table[i][j] = table[i-1][j]
#Doesn't use the current coin to reach change amount
if j >= coins[i-1]:
#Checks to see if the same coin can be used twice to reach change
table[i][j] += table[i][j - coins[i-1]]
#Uses the current coin
return table[n][change]
#Returns the number of possible combinations for the introduced scenario
def main():
# Example 1
coins = [1, 2, 5, 10, 20]
powershell
PS D:\1.SQM\1.UNIVERSIDAD\5. QUINTO SEMESTRE\2.Advanced Algorithms> & C:\Users\santy\AppData\Local\Microsoft\WindowsApps\python3.12.exe "d:/1.SQM/1.UNIVERSIDAD/5. QUINTO SEMESTRE/2.Advanced Algorithms/DynamicProgramming/CoinChange_Tabulation.py"
Through Tabulation - Number of ways to make change for 10 with coins [1, 2, 5, 10, 20] is: 11
Through Tabulation - Number of ways to make change for 6 with coins [1, 3, 4] is: 4
Through Tabulation - Number of ways to make change for 12 with coins [2, 5, 7] is: 3
Through Tabulation - Number of ways to make change for 5 with coins [1, 2] is: 3
PS D:\1.SQM\1.UNIVERSIDAD\5. QUINTO SEMESTRE\2.Advanced Algorithms>
main* 0 0 You, 11 seconds ago Not Committed Yet Ln 7, Col 41 Spaces: 4 UTF-8 CRLF Python Python 3.12 Go Live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2.Advanced Algorithms
CoinChange_Tabulation.py M
DynamicProgramming > CoinChange_Tabulation.py > ...
def main():
# Example 1
coins = [1, 2, 5, 10, 20]
change = 10
print("Through Tabulation - Number of ways to make change for", change, "with
# Example 2
coins = [1, 3, 4]
change = 6
print("Through Tabulation - Number of ways to make change for", change, "with
# Example 3
coins = [2, 5, 7]
change = 12
print("Through Tabulation - Number of ways to make change for", change, "with
# Example 4
coins = [1, 2]
change = 5
print("Through Tabulation - Number of ways to make change for", change, "with
main()
powershell
PS D:\1.SQM\1.UNIVERSIDAD\5. QUINTO SEMESTRE\2.Advanced Algorithms> & C:\Users\santy\AppData\Local\Microsoft\WindowsApps\python3.12.exe "d:/1.SQM/1.UNIVERSIDAD/5. QUINTO SEMESTRE/2.Advanced Algorithms/DynamicProgramming/CoinChange_Tabulation.py"
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Through Tabulation - Number of ways to make change for 5 with coins [1, 2] is: 3
PS D:\1.SQM\1.UNIVERSIDAD\5. QUINTO SEMESTRE\2.Advanced Algorithms>
main* 0 0 0
You, 11 seconds ago Not Committed Yet Ln 7, Col 41 Spaces: 4 UTF-8 CRLF {} Python Python 3.12 Go Live

REFERENCES

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