ASSIGNMENT: 05

Name: Abhijeet Biswas
SRN: 201900400
Roll No: 05
Div: B

Question 5: Implement the following algorithms: Constraint Satisfaction
1. Map coloring
2. Crypt -Arithmetic
3. Crossword Puzzle.

Code:

1. Map Colouring and cryptarithmetic

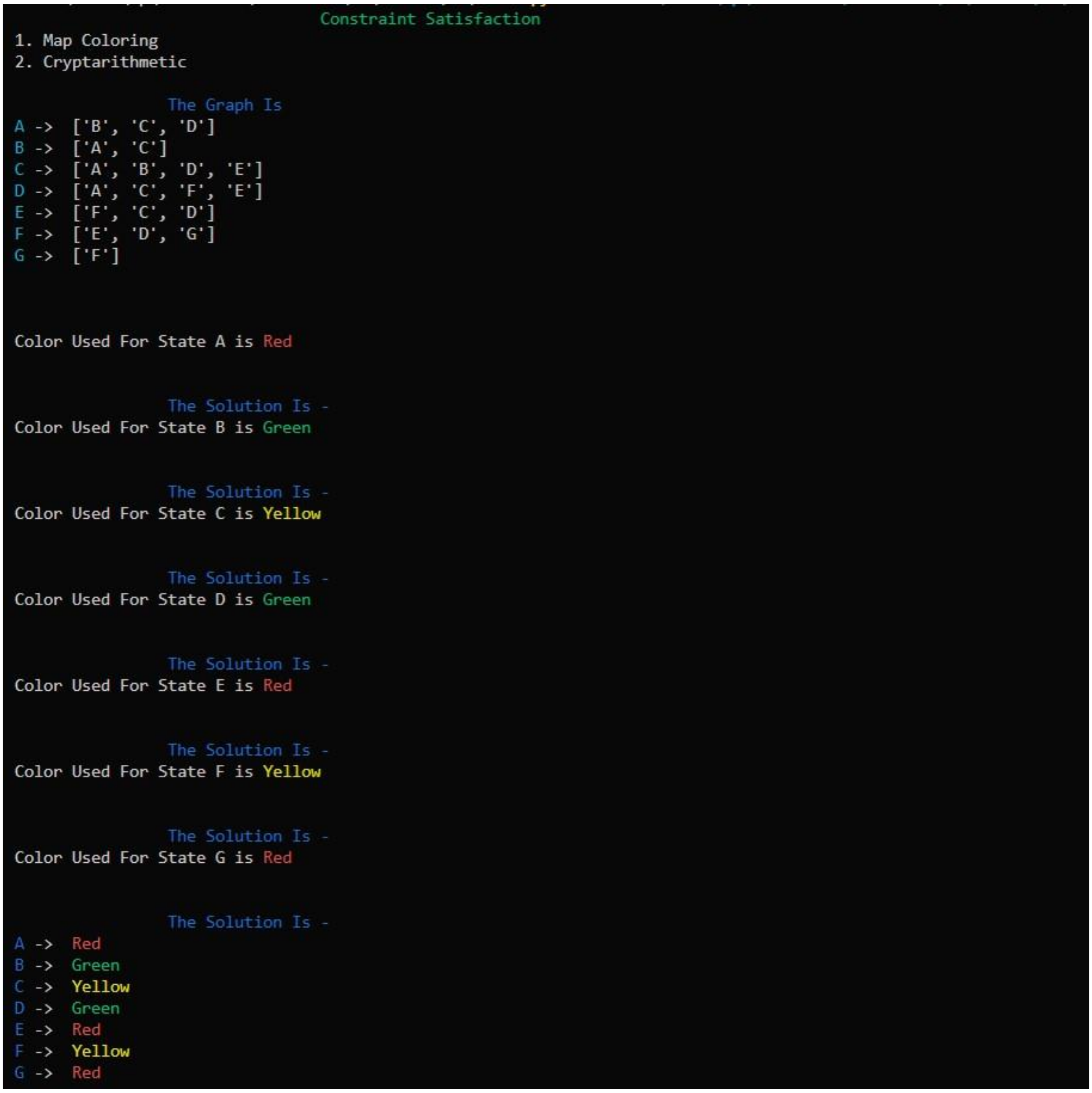
```
#Mapcoloring and cryptarithmetic


from colorama import Fore, Back, Style, init

init(strip=False)

init(autoreset=True)

class map_coloring():

 # Colors Used

    colors = [Fore.RED+'Red', Fore.GREEN+'Green', Fore.YELLOW+'Yellow',Fore.MAGENTA+'Violet']

 # Map

    states = ['A', 'B', 'C', 'D', 'E', 'F', 'G']

    neighbors = {}

    neighbors['A'] = ['B', 'C', 'D']

    neighbors['B'] = ['A', 'C']

    neighbors['C'] = ['A', 'B', 'D', 'E']

    neighbors['D'] = ['A', 'C', 'F', 'E']
    neighbors['E'] = ['F', 'C', 'D']
    neighbors['F'] = ['E', 'D', 'G']
    neighbors['G'] = ['F']
# Output
    colors_of_states = {}
    def print_graph(self):
        for key in self.neighbors:
            print(Fore.CYAN+ key + Fore.WHITE + ' -> ', self.neighbors[key])
    def promising(self, state, color):
        for neighbor in self.neighbors.get(state):
            color_of_neighbor = self.colors_of_states.get(neighbor)
            if color_of_neighbor == color:
                return False
        return True
    def get_color_for_state(self, state):
        for color in self.colors:
            if self.promising(state, color):
                return color
    def start(self):
        print(Fore.BLUE+"\n\n\t\tThe Graph Is ")
        self.print_graph()
        print("\n\n")
        for state in self.states:
            self.colors_of_states[state] = self.get_color_for_state(state)
            print(f"Color Used For State {state} is {self.colors_of_states[state]}")
            print(Fore.BLUE+"\n\n\t\tThe Solution Is - ")
        for key in self.colors_of_states:
            print(Fore.BLUE+key + Fore.WHITE+' -> ', self.colors_of_states[key])
```

```
class cryptarithmetic():
    solved = False
    count = 0
    def start(self):
        word1 = input("Enter First Word - ").upper()
        word2 = input("Enter Second Word - ").upper()
        result = input("Enter Result - ").upper()
        values = []
        visited = [False for x in range(10)]
        equation = [word1, word2, result]
        # Get Unique Words
        set = []
        for c in word1:
            if c not in set:
                set.append(c)
        for c in word2:
            if c not in set:
                set.append(c)
        for c in result:
            if c not in set:
                set.append(c)
        if len(set) > 10:
            print("\nNo Solution (as values will repeat)\n")
            exit()
        print("Solution Is - ")
        print(f"\t{word1}\n+\n\t{word2}\n---------\n\t{result}\n\n")
        self.solve(set, values, visited, equation)
    def solve(self, letters, values, visited, equation):
        if len(letters) == len(values):
            map = {}
            for letter, val in zip(letters, values):
                map[letter] = val
            if map[equation[0][0]] == 0 or map[equation[1][0]] == 0 or
map[equation[2][0]] == 0:
                return
            word1, word2, res = "", "", ""
            for c in equation[0]:
                word1 += str(map[c])
            for c in equation[1]:
                word2 += str(map[c])
            for c in equation[2]:
                res += str(map[c])
            if int(word1) + int(word2) == int(res):
                self.count += 1
                print(Fore.GREEN+f"Result {self.count} = {word1} + {word2} = {res}\n")
                solved = True
            return
        for i in range(10):
            if not visited[i]:
                visited[i] = True
                values.append(i)
                self.solve(letters, values, visited, equation)
                values.pop()
                visited[i] = False
```

```
print(Fore.GREEN+"\t\t\t\tConstraint Satisfaction")

print("1. Map Coloring\n2. Cryptarithmetic\n")

choice = int(input("\nEnter Choice - "))

if choice == 1:

    temp = map_coloring()

    temp.start()

elif choice == 2:

    temp = cryptarithmetic()

    temp.start()
```

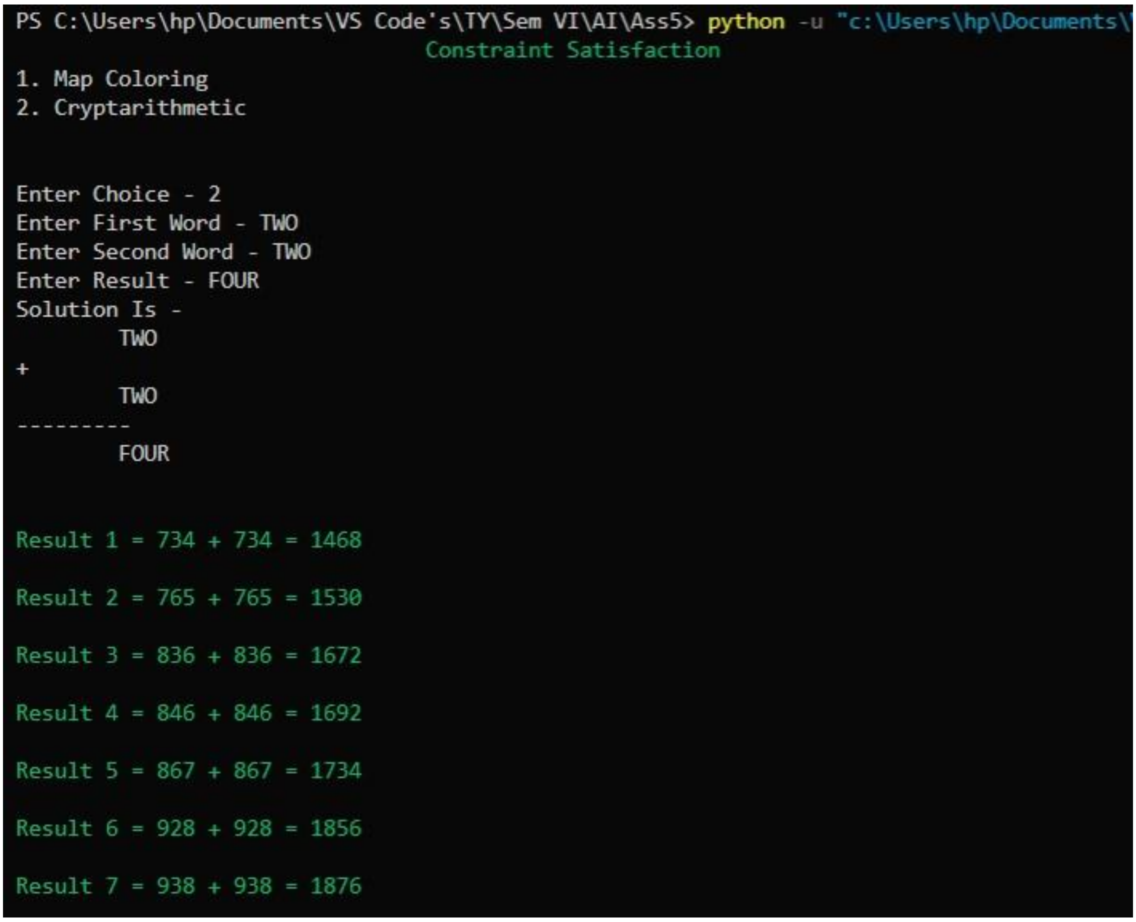
Output:

Map Colouring -



```
                                Constraint Satisfaction
1. Map Coloring
2. Cryptarithmetic

                The Graph Is
A ->  ['B', 'C', 'D']
B ->  ['A', 'C']
C ->  ['A', 'B', 'D', 'E']
D ->  ['A', 'C', 'F', 'E']
E ->  ['F', 'C', 'D']
F ->  ['E', 'D', 'G']
G ->  ['F']



Color Used For State A is Red


                The Solution Is -
Color Used For State B is Green


                The Solution Is -
Color Used For State C is Yellow


                The Solution Is -
Color Used For State D is Green


                The Solution Is -
Color Used For State E is Red


                The Solution Is -
Color Used For State F is Yellow


                The Solution Is -
Color Used For State G is Red


                The Solution Is -
A ->  Red
B ->  Green
C ->  Yellow
D ->  Green
E ->  Red
F ->  Yellow
G ->  Red
```

Cryptarithmetic -



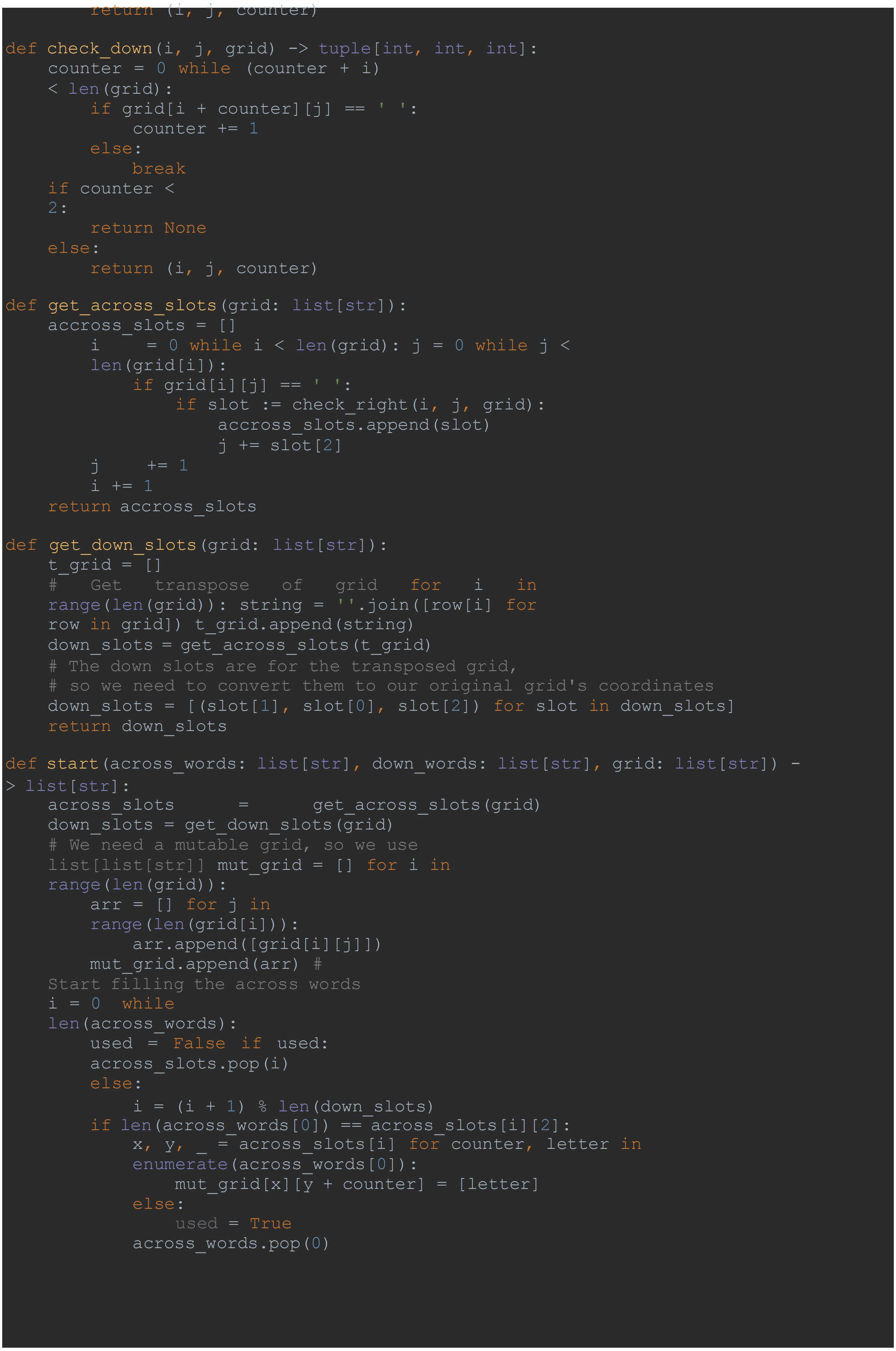
```
PS C:\Users\hp\Documents\VS Code's\TY\Sem VI\AI\Ass5> python -u "c:\Users\hp\Documents\
                                   Constraint Satisfaction
1. Map Coloring
2. Cryptarithmetic


Enter Choice - 2
Enter First Word - TWO
Enter Second Word - TWO
Enter Result - FOUR
Solution Is -
        TWO
+
        TWO
---------
        FOUR


Result 1 = 734 + 734 = 1468

Result 2 = 765 + 765 = 1530

Result 3 = 836 + 836 = 1672

Result 4 = 846 + 846 = 1692

Result 5 = 867 + 867 = 1734

Result 6 = 928 + 928 = 1856

Result 7 = 938 + 938 = 1876
```

Cross Word Puzzle –

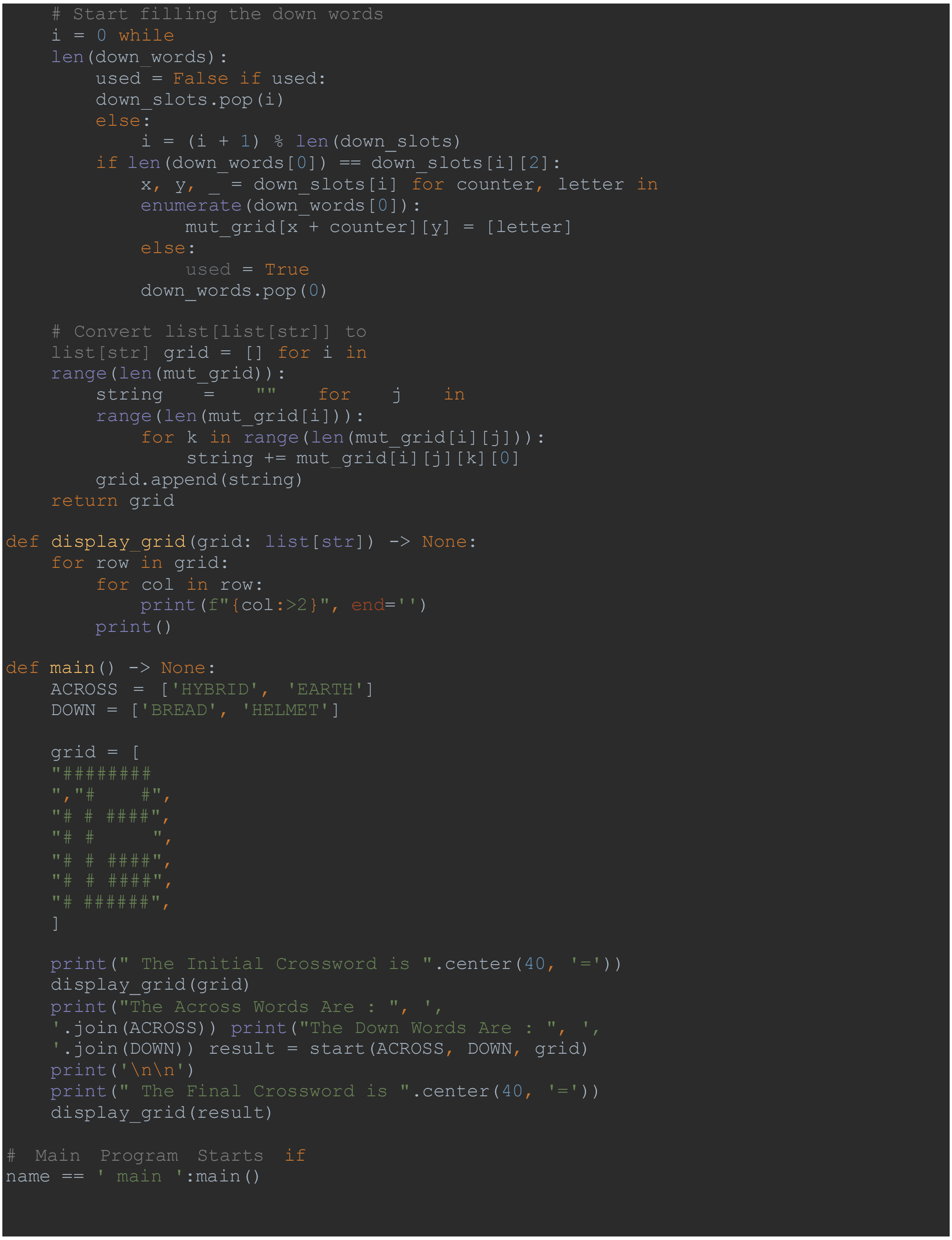
Code –

```
# Assignment 5 Part 3 Crossword Puzzle
from typing import List


def check_right(i, j, grid) -> tuple[int, int, int]:counter = 0 while (counter + j) <

    len(grid[i]):

        if grid[i][j + counter] == ' ':counter += 1

        else:

            break if
```

```
    else:
```



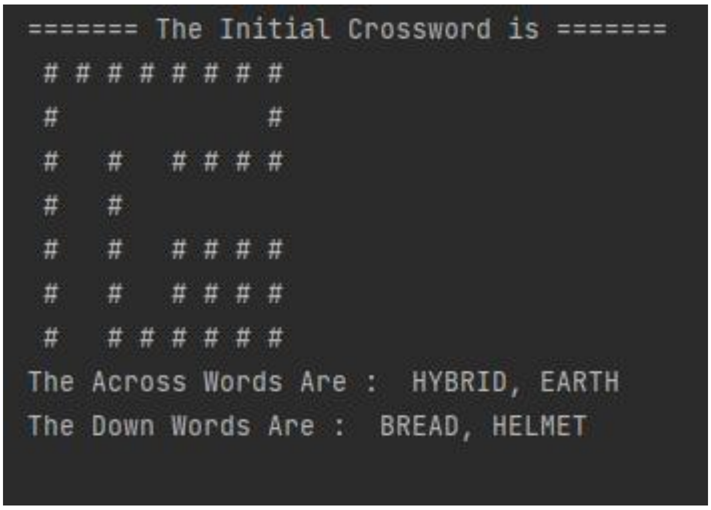
```
        return (i, j, counter)

def check_down(i, j, grid) -> tuple[int, int, int]:
    counter = 0 while (counter + i)
    < len(grid):
        if grid[i + counter][j] == ' ':
            counter += 1
        else:
            break
    if counter <
    2:
        return None
    else:
        return (i, j, counter)

def get_across_slots(grid: list[str]):
    accross_slots = []
        i    = 0 while i < len(grid): j = 0 while j <
        len(grid[i]):
            if grid[i][j] == ' ':
                if slot := check_right(i, j, grid):
                    accross_slots.append(slot)
                    j += slot[2]
        j    += 1
        i += 1
    return accross_slots

def get_down_slots(grid: list[str]):
    t_grid = []
    #   Get   transpose   of   grid   for   i   in
    range(len(grid)): string = ''.join([row[i] for
    row in grid]) t_grid.append(string)
    down_slots = get_across_slots(t_grid)
    # The down slots are for the transposed grid,
    # so we need to convert them to our original grid's coordinates
    down_slots = [(slot[1], slot[0], slot[2]) for slot in down_slots]
    return down_slots

def start(across_words: list[str], down_words: list[str], grid: list[str]) -
> list[str]:
    across_slots       =       get_across_slots(grid)
    down_slots = get_down_slots(grid)
    # We need a mutable grid, so we use
    list[list[str]] mut_grid = [] for i in
    range(len(grid)):
        arr = [] for j in
        range(len(grid[i])):
            arr.append([grid[i][j]])
        mut_grid.append(arr) #
    Start filling the across words
    i = 0  while
    len(across_words):
        used  =  False  if  used:
        across_slots.pop(i)
        else:
            i = (i + 1) % len(down_slots)
        if len(across_words[0]) == across_slots[i][2]:
            x, y, _ = across_slots[i] for counter, letter in
            enumerate(across_words[0]):
                mut_grid[x][y + counter] = [letter]
            else:
                used = True
            across_words.pop(0)
```



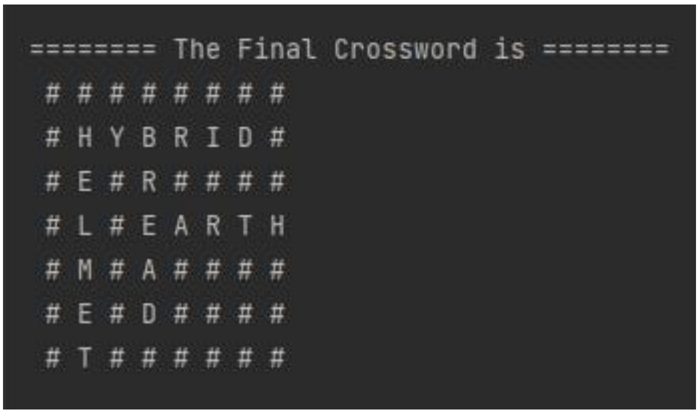
```
    # Start filling the down words
    i = 0 while
    len(down_words):
        used = False if used:
        down_slots.pop(i)
        else:
            i = (i + 1) % len(down_slots)
        if len(down_words[0]) == down_slots[i][2]:
            x, y, _ = down_slots[i] for counter, letter in
            enumerate(down_words[0]):
                mut_grid[x + counter][y] = [letter]
            else:
                used = True
            down_words.pop(0)

    # Convert list[list[str]] to
    list[str] grid = [] for i in
    range(len(mut_grid)):
        string    =    ""    for    j    in
        range(len(mut_grid[i])):
            for k in range(len(mut_grid[i][j])):
                string += mut_grid[i][j][k][0]
        grid.append(string)
    return grid

def display_grid(grid: list[str]) -> None:
    for row in grid:
        for col in row:
            print(f"{col:>2}", end='')
        print()

def main() -> None:
    ACROSS = ['HYBRID', 'EARTH']
    DOWN = ['BREAD', 'HELMET']

    grid = [
    "########
    ","#      #",
    "# # ####",
    "# #     ",
    "# # ####",
    "# # ####",
    "# ######",
    ]

    print(" The Initial Crossword is ".center(40, '='))
    display_grid(grid)
    print("The Across Words Are : ", ',
    '.join(ACROSS)) print("The Down Words Are : ", ',
    '.join(DOWN)) result = start(ACROSS, DOWN, grid)
    print('\n\n')
    print(" The Final Crossword is ".center(40, '='))
    display_grid(result)

#  Main  Program  Starts  if
name == ' main ':main()
```

Output –

Input –



```
======= The Initial Crossword is =======
 # # # # # # # #
 #             #
 #   #   # # # #
 #   #
 #   #   # # # #
 #   #   # # # #
 #   # # # # # #
The Across Words Are :  HYBRID, EARTH
The Down Words Are :  BREAD, HELMET
```



```
======== The Final Crossword is ========
 # # # # # # # #
 # H Y B R I D #
 # E # R # # # #
 # L # E A R T H
 # M # A # # # #
 # E # D # # # #
 # T # # # # # #
```