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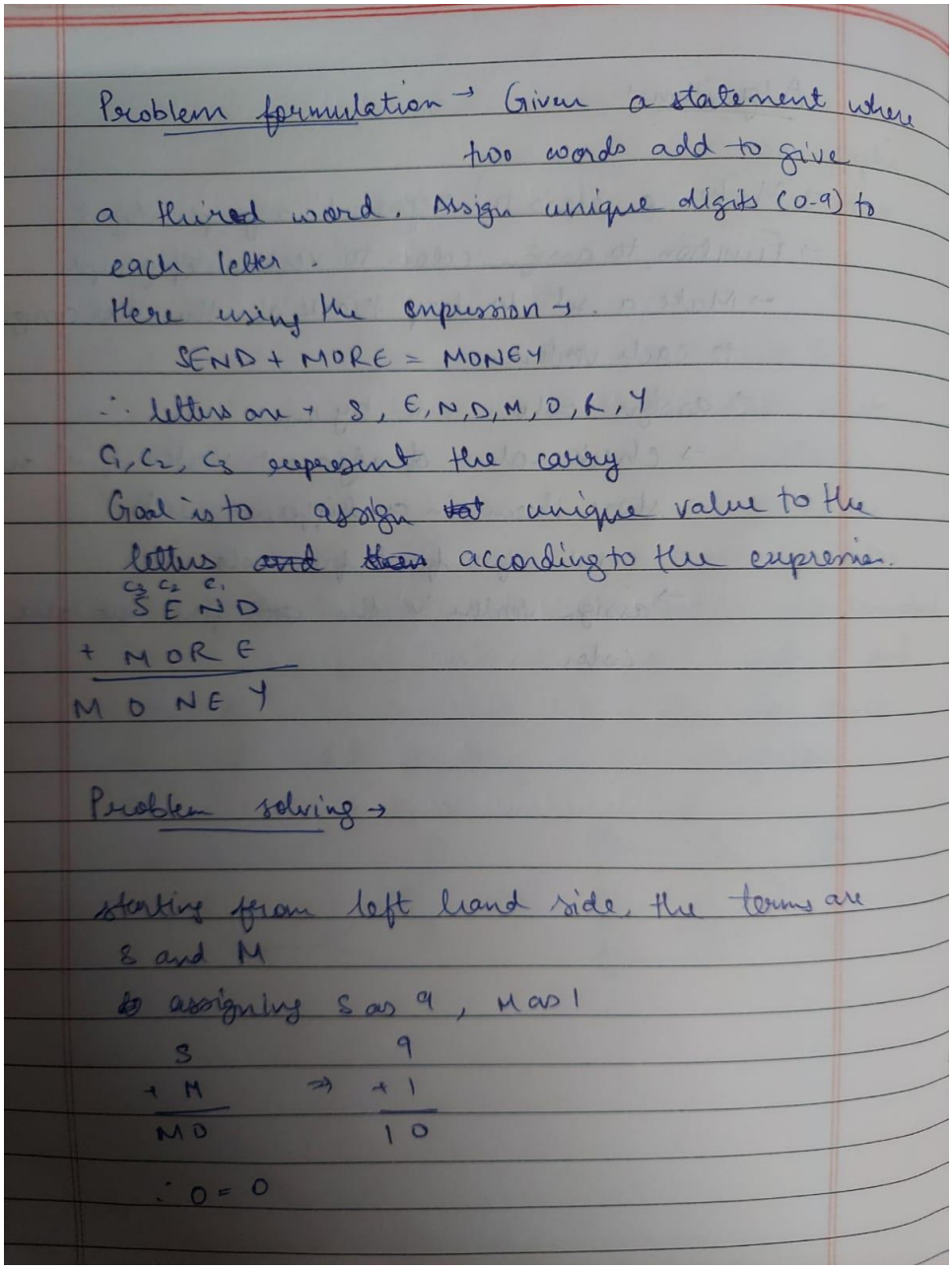
AI Lab 3

Aim- Implementation of Constraint Satisfaction Problems



Problem formulation → Given a statement where two words add to give a third word. Assign unique digits (0-9) to each letter.

Here using the expression →

SEND + MORE = MONEY

∴ letters are → S, E, N, D, M, O, R, Y

C_1, C_2, C_3 represent the carry

Goal is to assign unique value to the letters according to the expression.

$C_3\ C_2\ C_1$

S E N D

\+ M O R E

M O N E Y

Problem solving →

starting from left hand side, the terms are S and M

assigning S as 9, M as 1

S → 9

\+ M → \+ 1

M O → 1 0

∴ O = 0

now →

$$\begin{array}{r} E \\ +\ 0 \\ \hline N \end{array}$$

considering E as 5

$$\begin{array}{r} 5 \\ +\ 0 \\ \hline 5 \end{array}$$

not possible as $E \neq N$

∴ assuming $C_2 = 1$

$$\begin{array}{r} C_2 \\ E \\ +\ 0 \\ \hline N \end{array} \rightarrow \begin{array}{r} 1 \\ 5 \\ +\ 0 \\ \hline 6 \end{array}$$

$\therefore N = 6$

$$\begin{array}{r} N \\ +R \\ \hline E \end{array} \rightarrow \begin{array}{r} 6 \\ +8 \\ \hline 14 \end{array}$$

not possible as $E = 5$

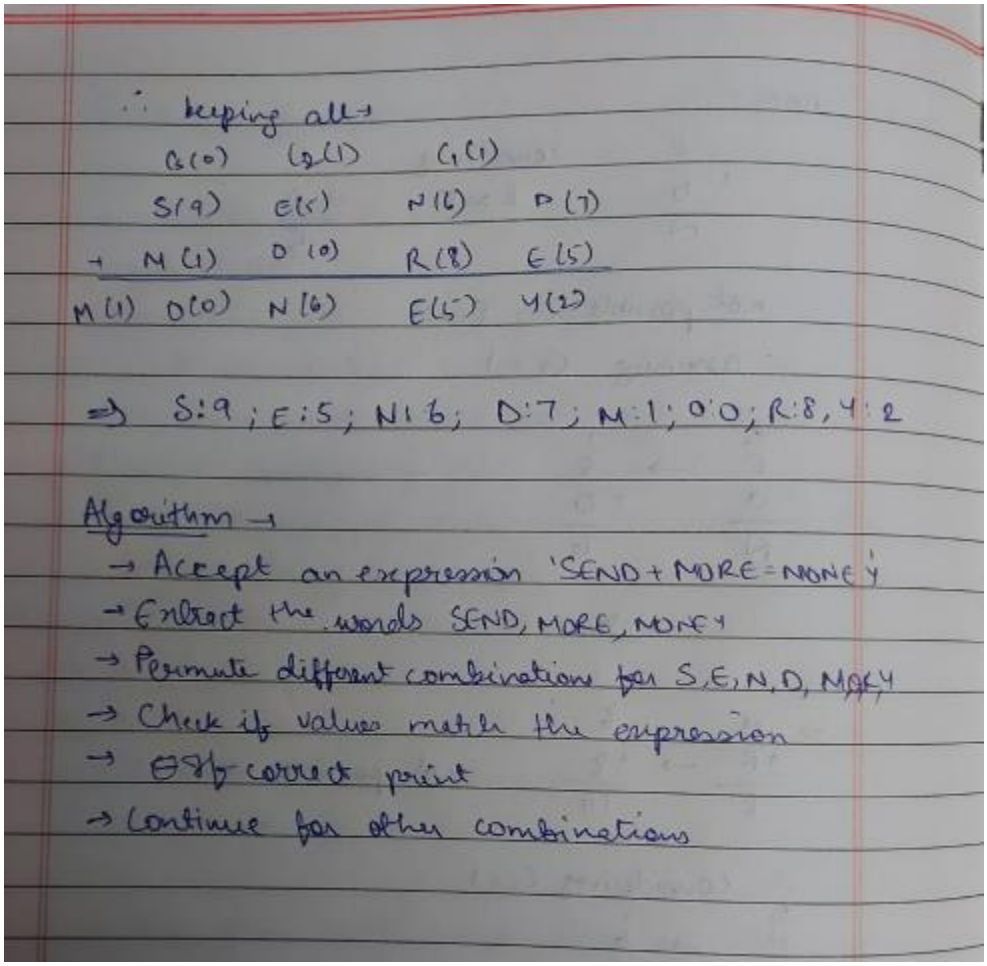
∴ considering $C_3 = 1$

$$\begin{array}{r} C_3 \\ N \\ +R \\ \hline E \end{array} \rightarrow \begin{array}{r} 1 \\ 6 \\ +8 \\ \hline 15 \end{array}$$

$\therefore R = 8$

On last two, 1 carry must be produced.

$$\therefore \begin{array}{r} D \\ +E \\ \hline Y \end{array} \rightarrow \begin{array}{r} 7 \\ +5 \\ \hline 12 \end{array}$$



Code-

```
import itertools


def get_value(word, substitution):
    s = 0
    factor = 1
    for letter in reversed(word):
        s += factor * substitution[letter]
        factor *= 10
    return s


def solve2(equation):
    left, right = equation.lower().replace(' ', '').split('=')
```

```
    left = left.split('+')
    letters = set(right)
    for word in left:
        for letter in word:
            letters.add(letter)
    letters = list(letters)

    digits = range(10)
    for perm in itertools.permutations(digits, len(letters)):
        sol = dict(zip(letters, perm))

        if sum(get_value(word, sol) for word in left) == get_value(right, sol):
            print(' + '.join(str(get_value(word, sol)) for word in left) + " = {} (mapping:
{})".format(get_value(right, sol), sol))

solve2('SEND + MORE = MONEY ')
```

Output-