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Experiment No. 4

AIM : Experiment using dynamic programming approach: finding longest common subsequence of two strings

THEORY:
The longest common subsequence (LCS) is defined as the longest subsequence that is common to all the given sequences, provided that the elements of the subsequence are not required to occupy consecutive positions within the original sequences.
If S1 and S2 are the two given sequences then, Z is the common subsequence of S1 and S2 if Z is a subsequence of both S1 and S2. Furthermore, Z must be a **strictly increasing sequence** of the indices of both S1 and S2

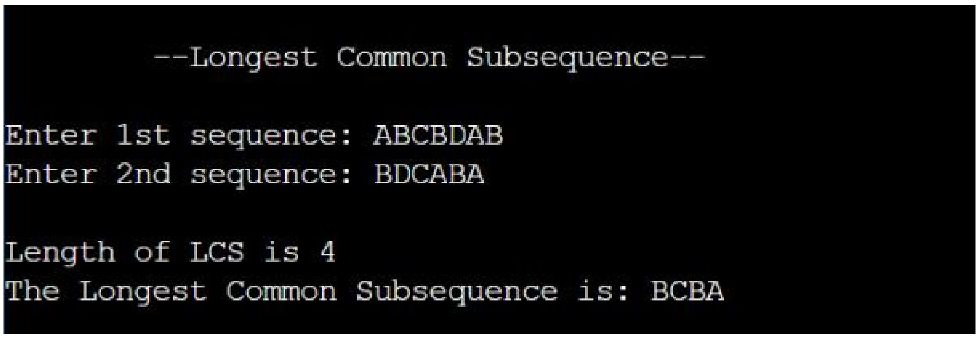
ALGORITHM :
In dynamic programming approach we store the values of longest common subsequence in a two dimentional array which reduces the time complexity to **O(n * m)** where n and m are the lengths of the strings. Let the input sequences be X and Y of lengths m and n respectively. And let dp[n][m] be the length of LCS of the two sequences X and Y.
We iterate through a two dimentional loops of lengths n and m and use the following algorithm to update the table dp[][]:-
• If any of the loop variable i or j is 0 , then dp[i][j] = 0.
• if X[i-1] = Y[j-1] ,i.e., when the characters at ith and jth index matches, dp[i][j] = 1 + dp[i-1][j-1].• Otherwise, store the maximum value we get after considering either
the charater X[i] or the character Y[j],i.e.,dp[i][j] = max(dp[i][j-1],dp[i-1][j]).
To retrieve the subsequence, follow a bottom-up approach.When the length of subsequence considering the Y[j] is greater than that considering X[i],decrement j, increment i when the length of subsequence considering the Y[j] is less than that considering

X[i].Whenever the the length of subsequence considering the Y[j] is equal to that considering X[i],include the character in the answer.

PROGRAM:

```
#include<stdio.h>
#include<string.h>
int i,j,m,n,c[20][20];
char x[20],y[20],b[20][20];
int max(int a, int b);
void print(int i,int j)
{
if(i==0 || j==0)
return;
if(b[i][j]=='c')
{
print(i-1,j-1);
printf("%c",x[i-1]);
}
else if(b[i][j]=='u')
print(i-1,j);
else
print(i,j-1);
}
void lcs()
{
m=strlen(x);
n=strlen(y);
for(i=0;i<=m;i++){
c[i][0]=0; for(i=0;i<=n;i++){
c[0][i]=0;
//c, u and l denotes cross, upward and downward directions
respectively
for(i=1;i<=m;i++){
for(j=1;j<=n;j++)
{
if(x[i-1]==y[j-1])
{
c[i][j]=c[i-1][j-1]+1;
b[i][j]='c';
}
else if(c[i-1][j]>=c[i][j-1])
{
c[i][j]=c[i-1][j];
b[i][j]='u';
}
else
{
c[i][j]=c[i][j-1];
b[i][j]='l';
}
}
}
}
}
}
int max(int a, int b)
{
if(a>b){
return a;
}
else
return b;
}
// Returns length of LCS for X[0..m-1], Y[0..n-1]
int lcs_length(char* x, char* y,int m,int n){
if (m == 0 || n == 0)
return 0;
if (x[m - 1] == y[n - 1])
return 1 + lcs_length(x, y, m - 1, n - 1);
else
return max(lcs_length(x, y, m, n - 1), lcs_length(x, y, m - 1, n));
}
int main()
{
printf("\n\t--Longest Common Subsequence--\n");
printf("\nEnter 1st sequence: ");
scanf("%s",x);
printf("Enter 2nd sequence: ");
scanf("%s",y);
printf("\nLength of LCS is %d", lcs_length(x, y, m, n));
printf("\nThe Longest Common Subsequence is: ");
lcs();
print(m,n);
return 0;
}
```

OUTPUT :



```
        --Longest Common Subsequence--

Enter 1st sequence: ABCBDAB
Enter 2nd sequence: BDCABA

Length of LCS is 4
The Longest Common Subsequence is: BCBA
```

ANALYSIS :
Naive Recursive approach in **O(2n)** time-complexity.
Dynamic Programming approach in **O(n * m)** time-complexity.

CONCLUSION:
In this experiment I understood about how to find the longest common subsequence of two given sequences using dynamic programming