CSE231: Data Structures

Lecture 06

by

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WORD/TEXT PROCESSING

The operations usually associated with word processing are the following

- **Insertion**: Inserting a string in the middle of the text
- **Deletion**: Deleting a string from the text
- **Replacement**: Replacing on string in the text by another

WORD/TEXT PROCESSING

Insertion

Suppose in a given text T we want to insert a string S so that S begins in position K. We denote this operation by

INSERT(text, position, string)

For example,

INSERT ('ABCDEFG', 3, 'XYZ') = 'ABXYZCDEFG'
INSERT ('ABCDEFG', 6, 'XYZ') = 'ABCDEXYZFG'

WORD/TEXT PROCESSING

```
char* INSERT(char* S1,int K,char*S2)
{
 char RESULT[80];
 strcpy(RESULT,SUBSTR(S1,1,K-1));
 strcat(RESULT,S2);
 strcat(RESULT,SUBSTR(S1,K,strlen(S1)-K+1));
 return(RESULT);
}
```

WORD/TEXT PROCESSING

Deletion

Suppose in a given text T we want to delete the substring which begins at position K and has length L. We denote this operation by

DELETE(text, position, length)

For example,

DELETE(' ABCDEFG ', 4, 2) = ' ABCFG '
DELETE(' ABCDEFG ', 2, 4) = ' AFG '

WORD/TEXT PROCESSING

```
char* DELETE(char* S1,int K,int L)
{
 char RESULT[80];
 strcpy(RESULT,SUBSTR(S1,1,K-1));
 strcat(RESULT,SUBSTR(S1,K+L,strlen(S1)-K-L+1));
 return(RESULT);
}
```

WORD/TEXT PROCESSING

(a) Suppose T = 'ABCDEFG' and P = 'CD'. Then INDEX(T, P) = 3 and LENGTH(P) = 2. Hence

DELETE ('ABCDEFG', 3, 2) = 'ABEFG'

(b) Suppose T = 'ABCDEFG' and P = 'DC'. Then INDEX(T, P) = 0 and LENGTH(P) = 2. Hence, by the "zero case,"

DELETE('ABCDEFG ', 0, 2) = ' ABCDEFG '

as expected.

WORD/TEXT PROCESSING

Suppose after reading into the computer a text T and a pattern P, we want to delete every occurrence of the pattern P in the text T. This can be accomplished by repeatedly applying

DELETE(T, INDEX(T, P), LENGTH(P))

until INDEX(T, P) = 0 (i.e., until P does not appear in T). An algorithm which accomplishes this follows.

WORD/TEXT PROCESSING

A text T and a pattern P are in memory. This algorithm deletes every occurrence of P in T.

1. [Find index of P.] Set K := INDEX(T, P).
2. Repeat while K ¹ 0:
   (a) [Delete P from T.]
   Set T := DELETE(T, INDEX(T, P), LENGTH(P))
   (b) [Update index.] Set K := INDEX(T, P).
   [End of loop.]
3. Write : T.
4. Exit.

WORD/TEXT PROCESSING

Replacement

Suppose in a given text T we want to replace the first occurrence of a pattern P_1 by a pattern P_2. We will denote this operation by

REPLACE(text, $pattern_1$, $pattern_2$)

For example

REPLACE('XABYABZ', 'AB', 'C') = 'XCYABZ'
REPLACE('XABYABZ' , 'BA', 'C') = 'XABYABZ'

WORD/TEXT PROCESSING

Replacement function can be executed by using the following three steps:

$K := INDEX(T, P_1)$
$T := DELETE(T, K, LENGTH(P_1))$
$INSERT(T, K, P_2)$

PATTERN MATCHING ALGORITHMS

Pattern matching is the problem of deciding whether or not a given string pattern P appears in a string text T.

Remark: During the discussion of pattern matching algorithms, characters are sometimes denoted by lowercase letters (a, b, c, ...) and exponents may be used to denote repetition; e.g.,

$a^2b^3ab^2$ for *aabbbabb* and $(cd)^3$ for *cdcdcd*

PATTERN MATCHING ALGORITHMS

- **First Pattern Matching Algorithm**

  It is the obvious one in which we compare a given pattern P with each of the substrings of T, moving from left to right, until we get a match.

$$W_K = \text{SUBSTRING}(T, K, \text{LENGTH}(P))$$

```
#include <iostream>
#include <cstring>
using namespace std;


int main()
{
    char P[80] = {"bab"};
    char T[80] = {"aabbbabb"};
    int R, S, K, L, MAX, INDEX;
    R = strlen(P);
    S = strlen(T);
    K = 0;
    MAX = S - R;
    while(K <= MAX){
        for(L = 0; L < R; L++){
            if(P[L] != T[K+L]){
                break;
            }
        }
        if(L == R){
            INDEX = K;
            break;
        }else{
            K = K + 1;
        }
    }
    if (K > MAX){
        INDEX = -1;
    }
    cout << "P = " << P << endl;
    cout << "T = " << T << endl;
    if(INDEX != -1){
        cout << "\nIndex of P in T is " << INDEX << endl ;
    }else{
        cout << "\nP does not exist in T" << endl;
    }
    return 0;
}
```

PATTERN MATCHING ALGORITHMS

- **Second Pattern Matching Algorithm**

  The second pattern matching algorithm uses a table which is derived from a particular pattern P but is independent of the text T.

PATTERN MATCHING ALGORITHMS

P = aaba

Inputs: a, b

States: Q0 = “”

Q1 = a

Q2 = aa

Q3 = aab

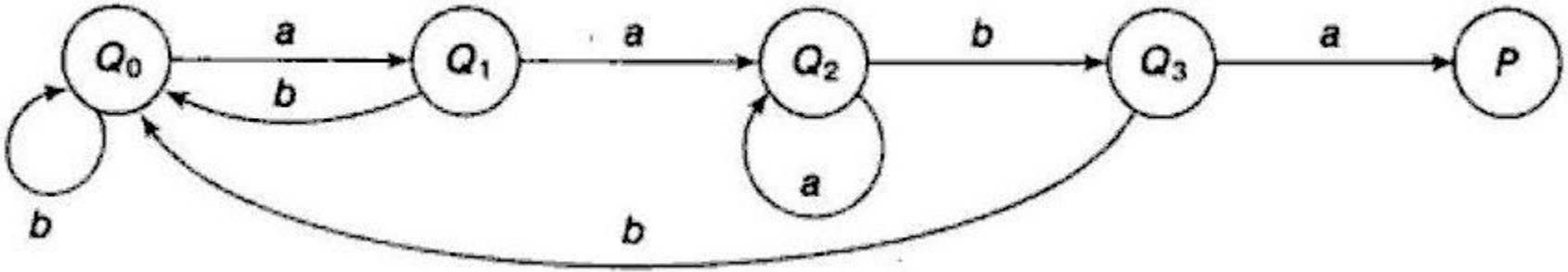
Q4 = aaba = P

PATTERN MATCHING ALGORITHMS

	a	**b**
Q0	Q1	Q0
Q1	Q2	Q0
Q2	Q2	Q3
Q3	P	Q0

PATTERN MATCHING ALGORITHMS

	a	b
Q0	Q1	Q0
Q1	Q2	Q0
Q2	Q2	Q3
Q3	P	Q0



```
#include <iostream>
#include <cstring>
using namespace std;

char F(char, char);
int state[4][2];

int main()
{
    char P[80] = {"aaba"};
    char T[80] = {"abcaabaca"};
    int N, K, S, I, INDEX;

    state[0][0] = 1; state[0][1] = 0;
    state[1][0] = 2; state[1][1] = 0;
    state[2][0] = 2; state[2][1] = 3;
    state[3][0] = -1; state[3][1] = 0;

    N = strlen(T), K = 0, S = 0;
    while(K<N && S != -1){
        if(T[K] == 'a'){ I = 0; }
        if(T[K] == 'b'){ I = 1; }
        if(T[K] == 'x'){ I = 2; }
        S = F(S, I);
        K = K+1;
    }

    if(S == -1){ INDEX = K-strlen(P); }
    else{ INDEX = -1; }

    cout << "P = " << P << endl;
    cout << "T = " << T << endl;

    if(INDEX != -1){
endl;    cout << "\nIndex of P in T is " << INDEX <<
    }else{
        cout << "\nP does not exist in T\n";
    }

    return 0;
}

char F(char SK, char TK){
    return state[SK][TK];
}
```

Thank You!