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CISP - 440

Assignment 13.42

12/13/2018

Part 0 - State Machine Generator

Description:

The goal of this assignment was to implement some code that is able to generate a state table given a string. This code is then able to scan a set of characters until it finds a certain combination. It was our job to implement the function that would turn a string into a state table.

Source Code:

```
//Code written by Quinn Roemer, based on code by Professor Ross.
#include <iostream>
#include <fstream>
#include <string>

using namespace std;

#define STATES 20

//Char array holds state table.
char nextState[STATES][2];

//Global variables to hold a count and the current state.
char state = 0;
int counter = 0;

//Hard coded input string
string instr = "abbbbbbaaaaaba";

//Prints out the nextState char.
void print_StateTable()
{
    cout << "s\ta\tb\n\n";

    int l = instr.length() + 1;
    for (int s = 0; s < l; s++) {
        cout << s << "\t";
        for (int ch = 0; ch < 2; ch++)
            cout << (int)nextState[s][ch] << "\t";
        cout << endl;
    }
}

//Compares first n characters of str1, with last n characters of str2.
int strncmp_olap(string str1, string str2, int n)
{
    int i, j;
```

```

int l1 = str1.length();
int l2 = str2.length();

for (i = 0, j = l2 - n; i < n; i++, j++)
{
    if (str1[i] != str2[j])
    {
        return true;
    }
}

return false;
}

//Generate a state table for a sequence detector
void generate_StateTable(void)
{
    int length = instr.length();

    string str;
    string current;

    for (int count = 0; count <= length; count++)
    {

        //Checking overlap on A.
        str.assign(instr, 0, count);
        current = str + 'a';

        cout << "State: " << count << endl;

        for (int index = current.length(); index >= 0; index--)
        {
            if (!strncmp_olap(instr, current, index))
            {

                cout << "In state " << count << " go to state " << index << " for A" <<

endl;

                //Place correct state in state table.
                nextState[count][0] = index;

                break;
            }
        }

        //Checking overlap on b.
        str.assign(instr, 0, count);
        current = str + 'b';
    }
}

```

```

        for (int index = current.length(); index >= 0; index--)
        {
            if (!strncmp_olap(instr, current, index))
            {
                cout << "In state " << count << " go to state " << index << " for B" <<
endl << endl;

                //Place correct state in state table.
                nextState[count][1] = index;
                break;
            }
        }
    }
}

//A State Machine
void process(char ch)
{
    //Print current char
    //cout << ch;

    //Move to next state
    state = nextState[state][ch - 'a'];

    //Output count if we are in the accept state
    if (state == 14)
    {
        cout << counter + 2 << ", "; //+2 for notepad.
    }

    counter++;
}

//Main function to execute.
void main()
{
    generate_StateTable();
    cout << "Complete state table for " << instr << "..." << endl;
    print_StateTable();

    char ch;

    //Open a file
    ifstream in("monkeyData.txt");
    if (!in)
    {
        cout << "Error opening file";
        return;
    }
}

```

```
cout << "\nThe string " << instr << " was found at locations: ";

//Read characters from file and process them
while (in)
{
    in.get(ch);
    if (in)
    {
        process(ch);
    }
}

cout << endl;
}
```

Output:

Note: The following 5 outputs will be for a given string in monkeyData.txt. Each output will be split into two pictures. The string it is for will be listed above the first picture of a given output.

String = "abbbbbbaaaaaba"



```
C:\WINDOWS\system32\cmd.exe

State: 0
In state 0 go to state 1 for A
In state 0 go to state 0 for B

State: 1
In state 1 go to state 1 for A
In state 1 go to state 2 for B

State: 2
In state 2 go to state 1 for A
In state 2 go to state 3 for B

State: 3
In state 3 go to state 1 for A
In state 3 go to state 4 for B

State: 4
In state 4 go to state 1 for A
In state 4 go to state 5 for B

State: 5
In state 5 go to state 1 for A
In state 5 go to state 6 for B

State: 6
In state 6 go to state 1 for A
In state 6 go to state 7 for B

State: 7
In state 7 go to state 8 for A
In state 7 go to state 0 for B

State: 8
In state 8 go to state 9 for A
In state 8 go to state 2 for B

State: 9
In state 9 go to state 10 for A
In state 9 go to state 2 for B

State: 10
In state 10 go to state 11 for A
In state 10 go to state 2 for B

State: 11
In state 11 go to state 12 for A
In state 11 go to state 2 for B

State: 12
In state 12 go to state 1 for A
In state 12 go to state 13 for B

State: 13
In state 13 go to state 14 for A
In state 13 go to state 3 for B

State: 14
In state 14 go to state 1 for A
In state 14 go to state 2 for B

Complete state table for abbbbbbaaaaaba...
s      a      b
```

Output 1 (1 of 2)

```
C:\WINDOWS\system32\cmd.exe
Complete state table for abbbbbbbaaaaaba...
s      a      b
0       1      0
1       1      2
2       1      3
3       1      4
4       1      5
5       1      6
6       1      7
7       8      0
8       9      2
9      10      2
10     11      2
11     12      2
12      1     13
13     14      3
14      1      2

The string abbbbbbbaaaaaba was found at locations: 5077, 53880, 57482, 61285, 66494, 80262, 119794, 169265, 242783, 25
9711, 269479, 271361, 283906, 294517, 313362, 396414, 397377, 451759, 474456, 483354, 486143, 492499, 517816, 518153,
529233, 603810, 607742, 610225, 660560, 681593, 691197, 697109, 715967, 729454, 744731, 745794, 762426, 769510, 7736
23, 785018, 808429, 832841, 866329, 878156, 886661, 895209, 907118, 920754, 934252, 937950, 955080, 969094, 982463, 9
85894, 987694,
Press any key to continue . . .
```

Output 1 (2 of 2)

String = "abbbbaabbbbaaa"

```
C:\WINDOWS\system32\cmd.exe
State: 0
In state 0 go to state 1 for A
In state 0 go to state 0 for B

State: 1
In state 1 go to state 1 for A
In state 1 go to state 2 for B

State: 2
In state 2 go to state 1 for A
In state 2 go to state 3 for B

State: 3
In state 3 go to state 1 for A
In state 3 go to state 4 for B

State: 4
In state 4 go to state 1 for A
In state 4 go to state 5 for B

State: 5
In state 5 go to state 6 for A
In state 5 go to state 0 for B

State: 6
In state 6 go to state 7 for A
In state 6 go to state 2 for B

State: 7
In state 7 go to state 1 for A
In state 7 go to state 8 for B

State: 8
In state 8 go to state 1 for A
In state 8 go to state 9 for B

State: 9
In state 9 go to state 1 for A
In state 9 go to state 10 for B

State: 10
In state 10 go to state 1 for A
In state 10 go to state 11 for B

State: 11
In state 11 go to state 12 for A
In state 11 go to state 0 for B

State: 12
In state 12 go to state 13 for A
In state 12 go to state 2 for B

State: 13
In state 13 go to state 14 for A
In state 13 go to state 8 for B

State: 14
In state 14 go to state 1 for A
In state 14 go to state 2 for B

Complete state table for abbbbaabbbbaaa...
s      a      b
```

Output 2 (1 of 2)


```
C:\WINDOWS\system32\cmd.exe
Complete state table for abbbbaabbbbaaa...
s      a      b
0       1      0
1       1      2
2       1      3
3       1      4
4       1      5
5       6      0
6       7      2
7       1      8
8       1      9
9       1     10
10      1     11
11      12      0
12      13      2
13      14      8
14      1      2

The string abbbbaabbbbaaa was found at locations: 3692, 45918, 64066, 65730, 68524, 102266, 114614, 118318, 136108, 1
40600, 154295, 201246, 214378, 216635, 234324, 236956, 240713, 300866, 310298, 326261, 336370, 430809, 451785, 464929
, 492593, 524330, 558423, 576431, 591517, 599976, 606468, 640610, 660601, 690676, 693867, 696466, 713356, 718577, 731
507, 741857, 743229, 752968, 793695, 802751, 821602, 840639, 843170, 853711, 863020, 866081, 878779, 885092, 889436,
900534, 923351, 954342, 955282, 965049, 967668, 977052, 995191,
Press any key to continue . . .
```

Output 2 (2 of 2)

String = "aaaaaaaaabaaaaaaaa"

```
C:\WINDOWS\system32\cmd.exe
State: 0
In state 0 go to state 1 for A
In state 0 go to state 0 for B

State: 1
In state 1 go to state 2 for A
In state 1 go to state 0 for B

State: 2
In state 2 go to state 3 for A
In state 2 go to state 0 for B

State: 3
In state 3 go to state 4 for A
In state 3 go to state 0 for B

State: 4
In state 4 go to state 5 for A
In state 4 go to state 0 for B

State: 5
In state 5 go to state 6 for A
In state 5 go to state 0 for B

State: 6
In state 6 go to state 7 for A
In state 6 go to state 0 for B

State: 7
In state 7 go to state 7 for A
In state 7 go to state 8 for B

State: 8
In state 8 go to state 9 for A
In state 8 go to state 0 for B

State: 9
In state 9 go to state 10 for A
In state 9 go to state 0 for B

State: 10
In state 10 go to state 11 for A
In state 10 go to state 0 for B

State: 11
In state 11 go to state 12 for A
In state 11 go to state 0 for B

State: 12
In state 12 go to state 13 for A
In state 12 go to state 0 for B

State: 13
In state 13 go to state 14 for A
In state 13 go to state 0 for B

State: 14
In state 14 go to state 15 for A
In state 14 go to state 0 for B

State: 15
In state 15 go to state 7 for A
In state 15 go to state 8 for B
```

Output 3 (1 of 2)

```
C:\WINDOWS\system32\cmd.exe
Complete state table for aaaaaabaaaaaa...
s      a      b
0       1      0
1       2      0
2       3      0
3       4      0
4       5      0
5       6      0
6       7      0
7       7      8
8       9      0
9      10      0
10     11      0
11     12      0
12     13      0
13     14      0
14     15      0
15      7      8

The string aaaaaabaaaaaa was found at locations: 9056, 10857, 99115, 112437, 117500, 142126, 147356, 232769, 305324,
379599, 380854, 401160, 405362, 419031, 437357, 467445, 493911, 496837, 499375, 578092, 621662, 739214, 756885, 802
906, 817966, 878708, 897099, 907729, 972969,
Press any key to continue . . .
```

Output 3 (2 of 2)

String = "aabbbababaaababbaaaa"

```
C:\WINDOWS\system32\cmd.exe
State: 0
In state 0 go to state 1 for A
In state 0 go to state 0 for B

State: 1
In state 1 go to state 2 for A
In state 1 go to state 0 for B

State: 2
In state 2 go to state 2 for A
In state 2 go to state 3 for B

State: 3
In state 3 go to state 1 for A
In state 3 go to state 4 for B

State: 4
In state 4 go to state 1 for A
In state 4 go to state 5 for B

State: 5
In state 5 go to state 6 for A
In state 5 go to state 0 for B

State: 6
In state 6 go to state 2 for A
In state 6 go to state 7 for B

State: 7
In state 7 go to state 8 for A
In state 7 go to state 0 for B

State: 8
In state 8 go to state 2 for A
In state 8 go to state 9 for B

State: 9
In state 9 go to state 10 for A
In state 9 go to state 0 for B

State: 10
In state 10 go to state 11 for A
In state 10 go to state 0 for B

State: 11
In state 11 go to state 12 for A
In state 11 go to state 3 for B

State: 12
In state 12 go to state 2 for A
In state 12 go to state 13 for B

State: 13
In state 13 go to state 14 for A
In state 13 go to state 4 for B

State: 14
In state 14 go to state 2 for A
In state 14 go to state 15 for B

State: 15
In state 15 go to state 1 for A
In state 15 go to state 16 for B
```

Output 4 (1 of 2)

```
C:\WINDOWS\system32\cmd.exe

State: 16
In state 16 go to state 17 for A
In state 16 go to state 0 for B

State: 17
In state 17 go to state 18 for A
In state 17 go to state 0 for B

State: 18
In state 18 go to state 19 for A
In state 18 go to state 3 for B

State: 19
In state 19 go to state 20 for A
In state 19 go to state 3 for B

State: 20
In state 20 go to state 2 for A
In state 20 go to state 3 for B

Complete state table for aabbbababaaababbaaaa...
s      a      b
0       1      0
1       2      0
2       2      3
3       1      4
4       1      5
5       6      0
6       2      7
7       8      0
8       2      9
9      10      0
10     11      0
11     12      3
12     2     13
13     14      4
14     2     15
15     1     16
16     17      0
17     18      0
18     19      3
19     20      3
20     2       3

The string aabbbababaaababbaaaa was found at locations: 184444, 291637,
Press any key to continue . . .
```

Output 4 (2 of 2)

String = "aaaabababaaaaabbbaaa"

```
C:\WINDOWS\system32\cmd.exe
State: 0
In state 0 go to state 1 for A
In state 0 go to state 0 for B

State: 1
In state 1 go to state 2 for A
In state 1 go to state 0 for B

State: 2
In state 2 go to state 3 for A
In state 2 go to state 0 for B

State: 3
In state 3 go to state 4 for A
In state 3 go to state 0 for B

State: 4
In state 4 go to state 4 for A
In state 4 go to state 5 for B

State: 5
In state 5 go to state 6 for A
In state 5 go to state 0 for B

State: 6
In state 6 go to state 2 for A
In state 6 go to state 7 for B

State: 7
In state 7 go to state 8 for A
In state 7 go to state 0 for B

State: 8
In state 8 go to state 2 for A
In state 8 go to state 9 for B

State: 9
In state 9 go to state 10 for A
In state 9 go to state 0 for B

State: 10
In state 10 go to state 11 for A
In state 10 go to state 0 for B

State: 11
In state 11 go to state 12 for A
In state 11 go to state 0 for B

State: 12
In state 12 go to state 13 for A
In state 12 go to state 0 for B

State: 13
In state 13 go to state 14 for A
In state 13 go to state 5 for B

State: 14
In state 14 go to state 4 for A
In state 14 go to state 15 for B

State: 15
In state 15 go to state 6 for A
In state 15 go to state 16 for B
```

Output 5 (1 of 2)

```
C:\WINDOWS\system32\cmd.exe
State: 16
In state 16 go to state 17 for A
In state 16 go to state 0 for B

State: 17
In state 17 go to state 18 for A
In state 17 go to state 0 for B

State: 18
In state 18 go to state 19 for A
In state 18 go to state 0 for B

State: 19
In state 19 go to state 20 for A
In state 19 go to state 0 for B

State: 20
In state 20 go to state 4 for A
In state 20 go to state 5 for B

Complete state table for aaaabababaaaaabbbaaa...
s      a      b
0       1      0
1       2      0
2       3      0
3       4      0
4       4      5
5       6      0
6       2      7
7       8      0
8       2      9
9      10      0
10     11      0
11     12      0
12     13      0
13     14      5
14      4     15
15      6     16
16     17      0
17     18      0
18     19      0
19     20      0
20      4      5

The string aaaabababaaaaabbbaaa was found at locations: 250176, 729136, 729137,
Press any key to continue . . .
```

Output 5 (2 of 2)

Conclusion

This assignment was fun. I always enjoy working on huge files that no human would be able to process in a reasonable time. It really demonstrates the power of computers and why they are used so often. Looking forward to our next assignment!