

Final Assessment, Compiler Lab

CSE-0302 Summer 2021

kh Md Shahnayas, UG02-49-18-008
*Department of Computer Science and Engineering
State University of Bangladesh (SUB)
Dhaka, Bangladesh
shahnayas01@gmail.com*

Abstract—ASSIGNMENT-4: Question: Suppose, a given C source program has been scanned, filtered, lexically analyzed and tokenized as that were done in earlier sessions. In addition, line numbers have been assigned to the source code lines for generating proper error messages. As the first step to Syntax Analysis, we now perform detection of simple syntax errors like duplication of tokens except parentheses or braces, unbalanced braces or parentheses problem, unmatched ‘else’ problem, etc. Duplicate identifier declarations must also be detected with the help of the Symbol Table.

Screenshot of Code For Assignment 4:(Screenshots are added serially)

ASSIGNMENT-5:

Question: Implement the following grammar in C.

$\text{;stat} \rightarrow ;\text{asgn_stat} <> \text{dscn_stat} <> \text{loop_stat} <> \text{asgn_stat} >$
 $\text{Bid} = <\text{expn}> <\text{expn}> \text{B} <\text{smplexpn}> <\text{extn}> <\text{extn}> \text{B} <\text{relop}> <\text{smplexpn}> | <\text{dcsn_stat}>$
 $\text{Bif}(<\text{expn}>) <\text{stat}> <\text{extn1}> <\text{extn1}> \text{Belse} <\text{stat}> | <\text{loop_stat}> \text{Bwhile}(<\text{expn}>) <\text{stat}>$
 $\text{for}(<\text{asgn_stat}>; <\text{expn}>; <\text{asgn_stat}>) <\text{stat}> <\text{relop}> \text{B} ==! ==<=>= <\text{Note} : <\text{smplexpn}>$
can be implemented using the materials demonstrated in this session.

Screenshot of Code For Assignment-5:(Screenshots are added serially)

ASSIGNMENT-6:

Question: Suppose, you are given the following grammar and the input string abcd. You are required to perform the following tasks manually: 1. Find the FIRST and FOLLOW sets of each of the non-terminals. 2. Construct the predictive parsing table for LL(1) method. 3. Demonstrate the moves of the LL(1) parser on the given input. 4. Construct the LR(0) automaton for the grammar. 5. Construct the parsing table for LR(1) parsing with the grammar. 6. Demonstrate the moves of the LR(1) parser on the given input.

Screenshot of Code For Assignment-6:(Screenshots are added serially)

The screenshot shows the Code::Blocks IDE interface with the following details:

- Title Bar:** main.c [Assignment-4] - Code::Blocks 20.03
- Menu Bar:** File Edit View Search Project Build Debug Fortran wxSmith Tools Tools+ Plugins Doxygen Settings Help
- Toolbar:** Includes icons for file operations like Open, Save, Find, and Run.
- Project Explorer:** Shows a workspace named "Assignment-4" containing a "Sources" folder with "main.c".
- Code Editor:** The main window displays the "main.c" source code. A vertical green margin line is positioned at column 1. The code implements logic to check for comments in a file and handle them accordingly.

```
#include <stdio.h>
#include <stdlib.h>

FILE *fp , *fp2;

void check_comment(char a)
{
    char x;

    if( a == '/') //checking if the character starts with '/', it will be a comment
    {
        if((x=fgetc(fp))=='*')
            check_block_comment();

        else if( x == '/') // else if the next character '/', it is the beginning of single line comment
        {
            check_single_comment();
        }
        else
        {
            // when both the cases fail then it is not a comment
            fputc(a,fp2);
            fputc(x,fp2);
        }
    }

    // when all the conditions are false, add the character as it is in the new file.
    else
        fputc(a,fp2);
}
```

- Status Bar:** Shows the file path (Users\pc\OneDrive\Documents\Assignment-4\Assignment-4\main.c), file type (C/C++), encoding (Windows (CR+LF)), code page (WINDOWS-1252), current line (Line 87, Col 2, Pos 1644), and status (Insert, Read/Write, default).
- System Tray:** Shows the Windows logo, battery level, temperature (85°F), and date/time (12:18 AM, 9/25/2021).

Fig. 1. Assignment-4, ScreenShot-1

main.c [Assignment-4] - Code::Blocks 20.03

File Edit View Search Project Build Debug Fortran wxSmith Tools Tools+ Plugins DoxyBlocks Settings Help

<global> check_comment(char a) : void

management Projects Files FSymbols X

Workspace Assignment-4 Sources main.c

```
27 // when all the conditions are false, add the character as it is in the new file.
28 else
29     fputc(a, fp2);
30 }
31
32
33
34 // function for block comments
35 void check_block_comment()
36 {
37
38     char x,y;
39
40     while((x=fgetc(fp))!=EOF) // the block comment has started
41     {
42
43         if(x=='/*')
44         {
45             y=fgetc(fp); // check if it ends
46
47             if(y=='/')
48                 return;
49         }
50     }
51
52
53
54
55 // function for single line comments
56 void check_single_comment()
57 {
```

Activate Windows
Go to Settings to activate Windows.

C:\Users\pc\OneDrive\Documents\Assignment-4\Assignment-4\main.c C/C++ Windows (CR+LF) WINDOWS-1252 Line 30, Col 22, Pos 720 Insert Read/Write default 12:19 AM 9/25/2021

This screenshot shows the Code::Blocks IDE interface. The main window displays a C program named 'main.c' with line numbers 27 to 57. The code implements functions to handle block and single-line comments. The 'check_comment' function adds characters to a file pointer 'fp2' when no comment conditions are met. The 'check_block_comment' function reads characters from 'fp' until it finds a closing '*/'. The 'check_single_comment' function is currently empty. The status bar at the bottom provides file information and system details like date and time.

Fig. 2. Assignment-4, ScreenShot-2

main.c [Assignment-4] - Code::Blocks 20.03

File Edit View Search Project Build Debug Fortran wxSmith Tools Tools+ Plugins DoxyBlocks Settings Help

<global> main(void) : int

management Projects Files FSymbols X

Assignment-4

Workspace Sources main.c

```
55 // function for single line comments
56 void check_single_comment()
57 {
58     char x,y;
59
60     while((x=fgetc(fp))!=EOF)
61     {
62
63         if(x=='\n')
64             return; // if the comment ends return from the function
65
66     }
67
68 }
69
70
71 int main(void)
72 {
73     char c;
74
75     fp = fopen ("textfield.txt","r"); // first file in read mode
76     fp2 = fopen ("solved.txt","w"); // second file in write mode
77
78     while(
79         (c=fgetc(fp))!=EOF)
80         check_comment(c); // checking for the beginning of a comment
81
82         // closing both files
83         fclose(fp);
84         fclose(fp2);
85 }
```

Activate Windows
Go to Settings to activate Windows.

C:\Users\pc\OneDrive\Documents\Assignment-4\Assignment-4\main.c C/C++ Windows (CR+LF) WINDOWS-1252 Line 83, Col 16, Pos 1606 Insert Read/Write default 12:20 AM 9/25/2021

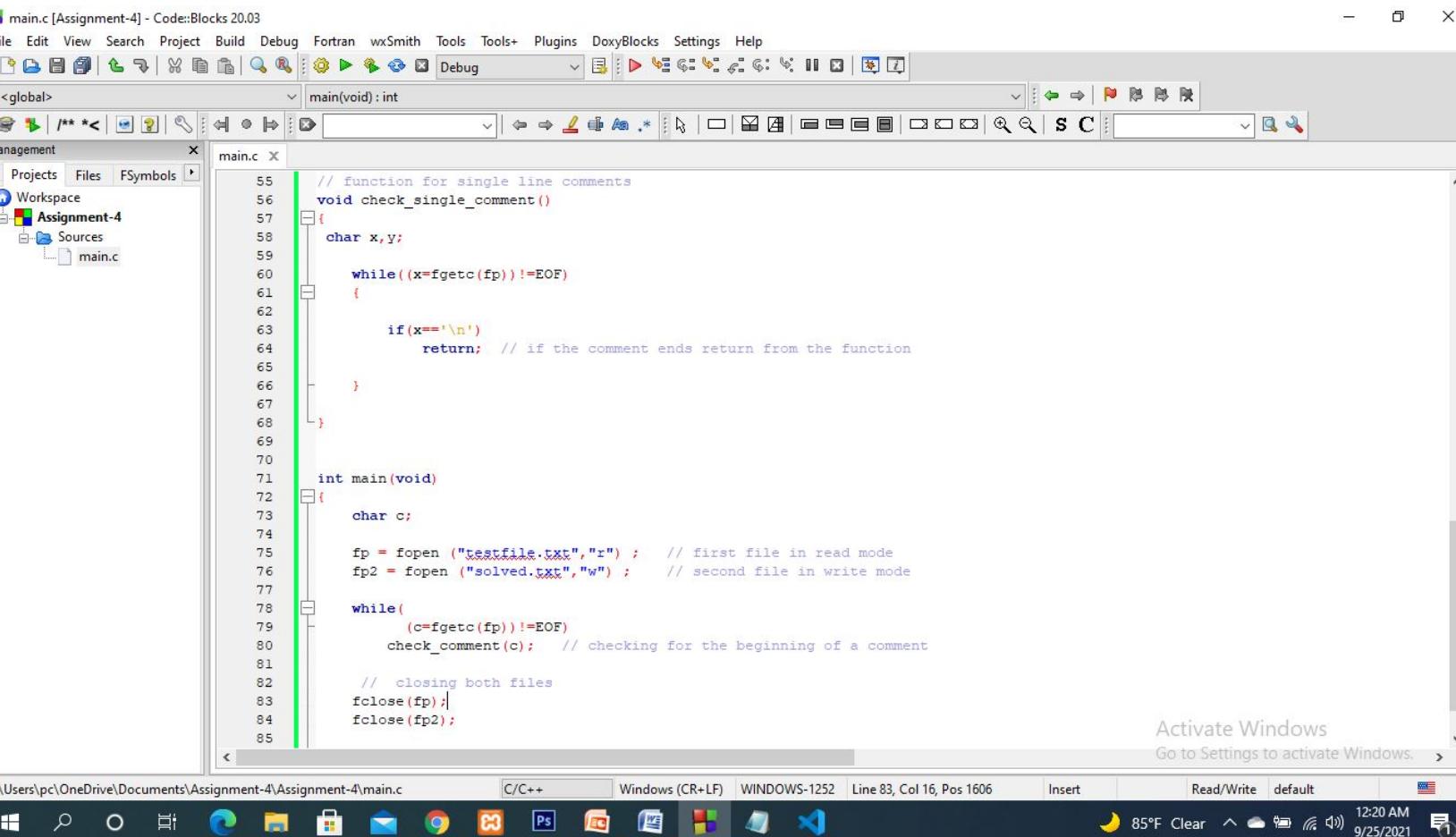


Fig. 3. Assignment-4, ScreenShot-3

main.c [Assignment-4] - Code::Blocks 20.03

File Edit View Search Project Build Debug Fortran wxSmith Tools Tools+ Plugins DoxyBlocks Settings Help

Debug

<global>

main.c X

```
58     char x,y;
59
60     while((x=fgetc(fp))!=EOF)
61     {
62
63         if(x=='\n')
64             return; // if the comment ends return from the function
65
66     }
67
68 }
69
70
71     int main(void)
72 {
73     char c;
74
75     fp = fopen ("testfile.txt","r"); // first file in read mode
76     fp2 = fopen ("solved.txt","w"); // second file in write mode
77
78     while(
79         (c=fgetc(fp))!=EOF)
80         check_comment(c); // checking for the beginning of a comment
81
82         // closing both files
83     fclose(fp);
84     fclose(fp2);
85
86
87     return 0;
88 }
```

Activate Windows
Go to Settings to activate Windows.

C:\Users\pc\OneDrive\Documents\Assignment-4\Assignment-4\main.c C/C++ Windows (CR+LF) WINDOWS-1252 Line 88, Col 1, Pos 1646 Insert Read/Write default 12:20 AM 9/25/2021

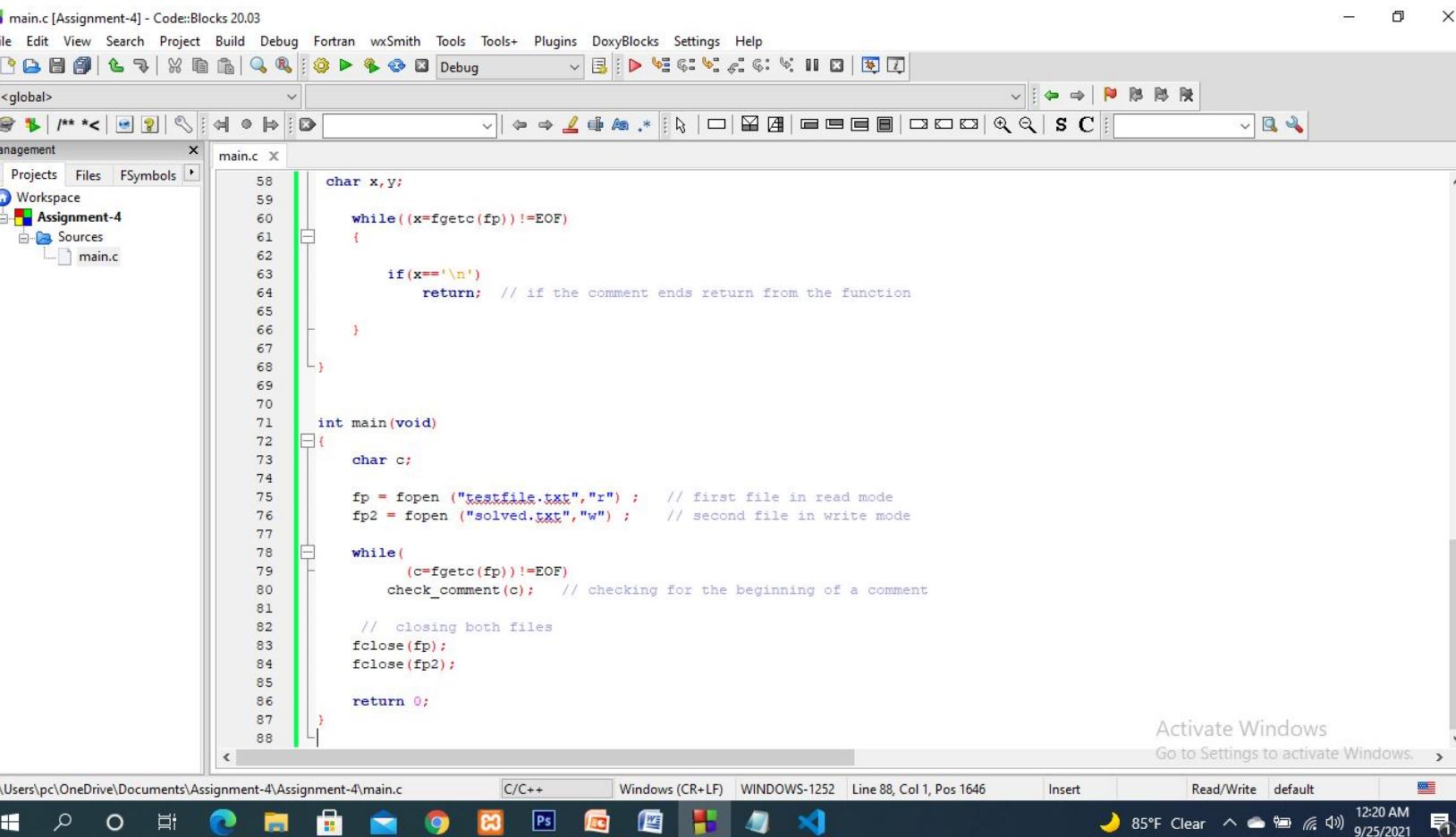


Fig. 4. Assignment-4, ScreenShot-4

main.cpp [Assignment5] - Code::Blocks 20.03

File Edit View Search Project Build Debug Fortran wxSmith Tools Tools+ Plugins DoxyBlocks Settings Help

<global>

main.cpp x

```
#include<stdio.h>
#include<string.h>

int i,j,k,l,m,n=0,o,p,nv,z=0,t,x=0;
char str[10],temp[20],temp2[20],temp3[20];

struct prod
{
    char lhs[10],rhs[10][10];
    int n;
}pro[10];

void findter()
{
    for(k=0;k<n;k++)
    {
        if(temp[i]==pro[k].lhs[0])
        {
            for(t=0;t<pro[k].n;t++)
            {
                for(l=0;l<20;l++)
                    temp2[l]='\0';
                for(l=i+1;l<strlen(temp);l++)
                    temp2[l-i-1]=temp[l];
                for(l=i;l<20;l++)
                    temp[l]='\0';
                for(l=0;l<strlen(pro[k].rhs[t]);l++)
                    temp[i+l]=pro[k].rhs[t][l];
                strcat(temp,temp2);
                if(str[i]==temp[i])
                    return;
            }
        }
    }
}
```

Activate Windows
Go to Settings to activate Windows.

C:\Users\pc\OneDrive\Documents\Assignment-5\Assignment5\main.cpp C/C++ Windows (CR+LF) WINDOWS-1252 Line 1, Col 1, Pos 0 Insert Read/Write default 11:24 PM 9/24/2021

Fig. 5. Assignment-5,ScreenShot-1

main.cpp [Assignment5] - Code::Blocks 20.03

File Edit View Search Project Build Debug Fortran wxSmith Tools Tools+ Plugins DoxyBlocks Settings Help

<global> main() : int

management Projects Files FSymbols

Workspace Assignment5 Sources main.cpp

```
main.cpp x
31         return;
32     else if(str[i]!=temp[i] && temp[i]>=65 && temp[i]<=90)
33         break;
34     }
35     break;
36 }
37 if(temp[i]>=65 && temp[i]<=90)
38     findter();
39 }

int main()
40 {
41     FILE *f;
42     //    scanf("%s");
43
44     for(i=0;i<10;i++)
45         pro[i].n=0;
46
47     f=fopen("in.txt","r");
48     while(!feof(f))
49     {
50         fscanf(f,"%s",pro[n].lhs);
51         if(n>0)
52         {
53             if( strcmp(pro[n].lhs,pro[n-1].lhs) == 0 )
54             {
55                 pro[n].lhs[0]='\0';
56                 fscanf(f,"%s",pro[n-1].rhs[pro[n-1].n]);
57                 pro[n-1].n++;
58                 continue;
59             }
60         }
61     }
62 }
```

Activate Windows
Go to Settings to activate Windows.

C:\Users\pc\OneDrive\Documents\Assignment-5\Assignment5\main.cpp C/C++ Windows (CR+LF) WINDOWS-1252 Line 59, Col 28, Pos 1342 Insert Read/Write default 11:25 PM 86°F Clear 9/24/2021

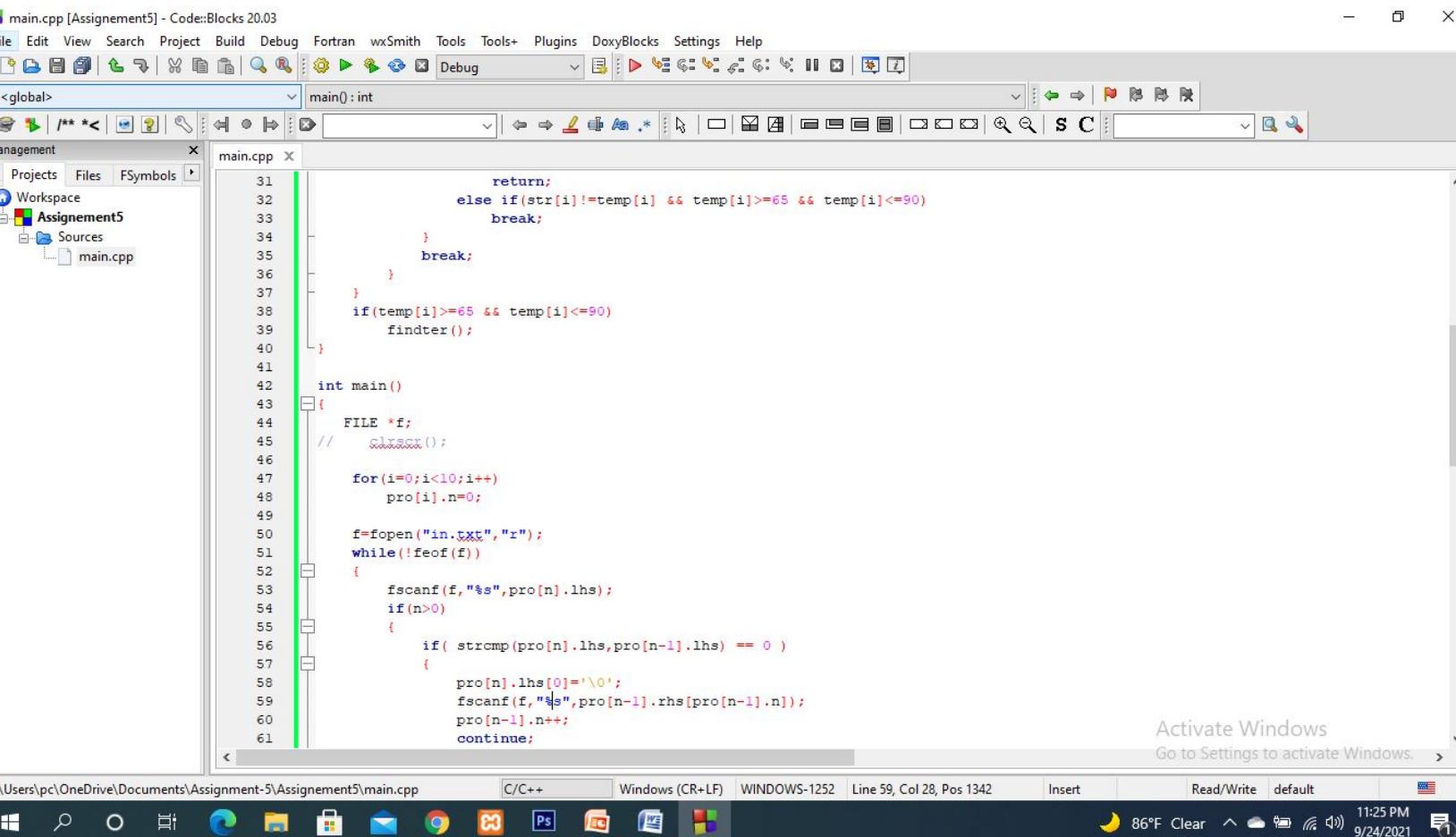


Fig. 6. Assignment-5,ScreenShot-2

main.cpp [Assignment5] - Code::Blocks 20.03

File Edit View Search Project Build Debug Fortran wxSmith Tools Tools+ Plugins DoxyBlocks Settings Help

<global> main() : int

management Projects Files FSymbols

Workspace Assignment5 Sources main.cpp

main.cpp

```
61         continue;
62     }
63     fscanf(f,"%s",pro[n].rhs[pro[n].n]);
64     pro[n].n++;
65     n++;
66 }
n--;

printf("\n\nTHE GRAMMAR IS AS FOLLOWS\n\n");
for(i=0;i<n;i++)
    for(j=0;j<pro[i].n;j++)
        printf("%s -> %s\n",pro[i].lhs,pro[i].rhs[j]);

while(1)
{
    for(l=0;l<10;l++)
        str[0]=NULL;

printf("\n\nENTER ANY STRING ( 0 for EXIT ) : ");
scanf("%s",str);
if(str[0]=='0')
    break;

for(j=0;j<pro[0].n;j++)
{
    for(l=0;l<20;l++)
        temp[l]=NULL;
    strcpy(temp,pro[0].rhs[j]);
}

m=0;
```

Activate Windows
Go to Settings to activate Windows.

C:\Users\pc\OneDrive\Documents\Assignment-5\Assignment5\main.cpp C/C++ Windows (CR+LF) WINDOWS-1252 Line 89, Col 28, Pos 2065 Insert Read/Write default 11:25 PM 9/24/2021

Fig. 7. Assignment-5,ScreenShot-3

main.cpp [Assignment5] - Code::Blocks 20.03

File Edit View Search Project Build Debug Fortran wxSmith Tools Tools+ Plugins DoxyBlocks Settings Help

<global>

main.cpp x

```
89     strcpy(temp,pro[0].rhs[j]);  
90  
91     m=0;  
92     for(i=0;i<strlen(str);i++)  
93     {  
94         if(str[i]==temp[i])  
95             m++;  
96         else if(str[i]!=temp[i] && temp[i]>=65 && temp[i]<=90)  
97         {  
98             findter();  
99             if(str[i]==temp[i])  
100                m++;  
101            }  
102            else if( str[i]!=temp[i] && (temp[i]<65 || temp[i]>90) )  
103                break;  
104            }  
105  
106            if(m==strlen(str) && strlen(str)==strlen(temp))  
107            {  
108                printf("\n\nTHE STRING can be PARSED !!!");  
109                break;  
110            }  
111            }  
112  
113            if(j==pro[0].n)  
114                printf("\n\nTHE STRING can NOT be PARSED !!!");  
115            }  
116  
117 //     cin.ignore(numeric_limits<streamsize>::max(), '\n');  
118  
119 }
```

Activate Windows
Go to Settings to activate Windows.

C:\Users\pc\OneDrive\Documents\Assignment-5\Assignment5\main.cpp C/C++ Windows (CR+LF) WINDOWS-1252 Line 119, Col 1, Pos 2896 Insert Read/Write default 86°F Clear 11:26 PM 9/24/2021

Fig. 8. Assignment-5,ScreenShot-4

The screenshot shows the Code::Blocks IDE interface with the following details:

- Title Bar:** main.c [Assignment-6-Ques-1] - Code::Blocks 20.03
- Menu Bar:** File Edit View Search Project Build Debug Fortran wxSmith Tools Tools+ Plugins DoxyBlocks Settings Help
- Toolbar:** Includes icons for file operations, search, and various build options.
- Project Explorer:** Shows the workspace named "Assign-6-Ques-1" containing a single source file "main.c".
- Code Editor:** Displays the C code for "main.c".
- Status Bar:** Provides information about the file path (Users\pc\OneDrive\Documents\Assignment-6-Ques-1\Assignment-6-Ques-1\main.c), current file type (C/C++), encoding (Windows (CR+LF)), character set (WINDOWS-1252), line number (Line 196), column number (Col 2), position (Pos 5217), and other system details like temperature (85°F) and date/time (9/25/2021).

```
#include<stdio.h>
#include<string.h>

int i,j,l,m,n=0,o,p,nv,z=0,x=0;
char str[10],temp,temp2[10],temp3[20],*ptr;

struct prod
{
    char lhs[10],rhs[10][10],ft[10],fol[10];
    int n;
}pro[10];

void findter()
{
    int k,t;
    for(k=0;k<n;k++)
    {
        if(temp==pro[k].lhs[0])
        {
            for(t=0;t<pro[k].n;t++)
            {
                if( pro[k].rhs[t][0]<65 || pro[k].rhs[t][0]>90 )
                    pro[i].ft[strlen(pro[i].ft)]=pro[k].rhs[t][0];
                else if( pro[k].rhs[t][0]>=65 && pro[k].rhs[t][0]<=90 )
                {
                    temp=pro[k].rhs[t][0];
                    if(temp=='$')
                        pro[i].ft[strlen(pro[i].ft)]='#';
                    findter();
                }
            }
        }
    }
}
```

Fig. 9. Assignment-6,ques1

The screenshot shows the Code::Blocks IDE interface with the following details:

- Title Bar:** main.c [Assignment-6-Ques-1] - Code::Blocks 20.03
- Menu Bar:** File Edit View Search Project Build Debug Fortran wxSmith Tools Tools+ Plugins DoxyBlocks Settings Help
- Toolbar:** Includes icons for file operations, search, and build.
- Search Bar:** finder(): void
- Project Explorer:** Shows the workspace named "Assign-6-Ques-1" containing a single source file "main.c".
- Code Editor:** Displays the C code for "main.c". The code includes functions `findter()` and `findfol()`. The `findfol()` function iterates through arrays `pro` and `rhs`, comparing characters and concatenating strings if certain conditions are met. A green vertical bar highlights the current line of code.
- Status Bar:** Provides information about the file path (Users\pc\OneDrive\Documents\Assignment-6-Ques-1\Assignment-6-Ques-1\main.c), code editor settings (C/C++), and system status (Windows (CR+LF), WINDOWS-1252, Line 31, Col 14, Pos 794).
- System Tray:** Shows the date and time (12:58 AM 9/25/2021) and system icons.

```
main.c [Assignment-6-Ques-1] - Code::Blocks 20.03
File Edit View Search Project Build Debug Fortran wxSmith Tools Tools+ Plugins DoxyBlocks Settings Help
Projects Files FSymbols
Assign-6-Ques-1 Sources main.c
main.c
29         findter();
30
31     }
32     }
33     break;
34   }
35 }
36
37 void findfol()
38 {
39   int k,t,pl,chk;
40   char *ptrl;
41   for(k=0;k<n;k++)
42   {
43     chk=0;
44     for(t=0;t<pro[k].n;t++)
45     {
46       ptrl=strchr(pro[k].rhs[t],temp);
47       if( ptrl )
48       {
49         pl=ptrl-pro[k].rhs[t];
50         if(pro[k].rhs[t][pl+1]>=65 && pro[k].rhs[t][pl+1]<=90)
51         {
52           for(ol=0;ol<n;ol++)
53             if(pro[ol].lhs[0]==pro[k].rhs[t][pl+1])
54             {
55               strcat(pro[i].fol,pro[ol].ft);
56               chk++;
57             }
58         }
59       else if(pro[k].rhs[t][pl+1]=='\0')
      }
```

Fig. 10. Assignment-6,ques1

main.c [Assign-6-Ques-1] - Code::Blocks 20.03

File Edit View Search Project Build Debug Fortran wxSmith Tools Tools+ Plugins DoxyBlocks Settings Help

finder(): void

main.c

```
59     else if(pro[k].rhs[t][pl+1]=='\0')
60     {
61         temp=pro[k].lhs[0];
62         if(pro[l].rhs[j][p]==temp)
63             continue;
64         if(temp=='$')
65             strcat(pro[i].fol,"$");
66         findfol();
67         chk++;
68     }
69     else
70     {
71         pro[i].fol[strlen(pro[i].fol)]=pro[k].rhs[t][pl+1];
72         chk++;
73     }
74 }
75 if(chk>0)
76     break;
77 }
78 }
79 }

int main()
80 {
81     FILE *f;
82     //clrscr();
83
84     for(i=0;i<10;i++)
85         pro[i].n=0;
86
87     f=fopen("tab5.txt", "r");
88
89 }
```

Activate Windows
Go to Settings to activate Windows.

C/C++ Windows (CR+LF) WINDOWS-1252 Line 31, Col 14, Pos 794 Insert Read/Write default 12:59 AM 9/25/2021

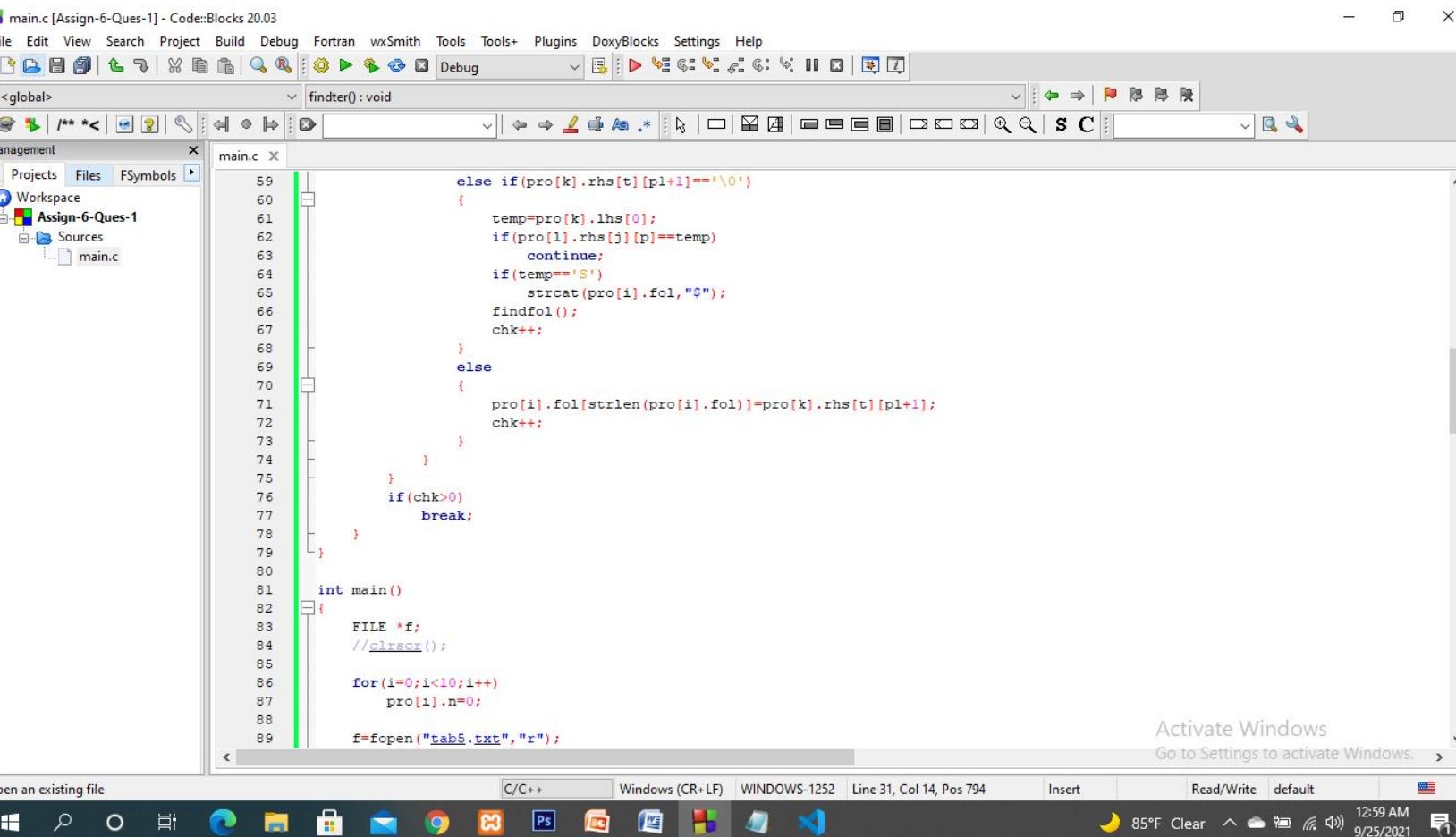
A screenshot of the Code::Blocks IDE interface. The title bar shows 'main.c [Assign-6-Ques-1] - Code::Blocks 20.03'. The menu bar includes File, Edit, View, Search, Project, Build, Debug, Fortran, wxSmith, Tools, Tools+, Plugins, DoxyBlocks, Settings, and Help. A toolbar with various icons is above the editor. The left sidebar shows a project tree with 'Assign-6-Ques-1' selected, containing 'Sources' and 'main.c'. The main window displays the C code for 'main.c'. The code uses a loop to read from a file named 'tab5.txt' and process its contents. Lines 59 through 78 handle the logic for finding specific characters in the file. Line 79 starts the main function. Lines 80 through 89 open the file and initialize arrays. The status bar at the bottom shows 'C/C++ Windows (CR+LF) WINDOWS-1252 Line 31, Col 14, Pos 794' and 'Insert Read/Write default'. A system tray icon for Windows 10 is visible, showing the date and time as '12:59 AM 9/25/2021'.

Fig. 11. Assignment-6,ques1

The screenshot shows the Code::Blocks IDE interface with the following details:

- Title Bar:** main.c [Assignment-6-Ques-1] - Code::Blocks 20.03
- Menu Bar:** File Edit View Search Project Build Debug Fortran wxSmith Tools Tools+ Plugins Doxygen Settings Help
- Toolbar:** Includes icons for file operations, search, and build.
- Project Explorer:** Shows the workspace named "Assign-6-Ques-1" containing a single source file "main.c".
- Code Editor:** Displays the C code for "main.c". The code reads from a file "tab5.txt", processes its contents, and prints the grammar rules. It also initializes a global variable "pro[0].ft[0] = '#';".

```
main.c X
87     pro[i].n=0;
88
89     f=fopen("tab5.txt", "r");
90     while(!feof(f))
91     {
92         fscanf(f,"%s",pro[n].lhs);
93         if(n>0)
94         {
95             if( strcmp(pro[n].lhs,pro[n-1].lhs) == 0 )
96             {
97                 pro[n].lhs[0]='\0';
98                 fscanf(f,"%s",pro[n-1].rhs[pro[n-1].n]);
99                 pro[n-1].n++;
100                continue;
101            }
102        }
103        fscanf(f,"%s",pro[n].rhs[pro[n].n]);
104        pro[n].n++;
105        n++;
106    }
107
108    printf("\n\nTHE GRAMMAR IS AS FOLLOWS\n\n");
109    for(i=0;i<n;i++)
110    {
111        for(j=0;j<pro[i].n;j++)
112            printf("%s -> %s\n",pro[i].lhs,pro[i].rhs[j]);
113
114    pro[0].ft[0]='#';
115    for(i=0;i<n;i++)
116    {
117        for(j=0;j<pro[i].n;j++)
118        {
```

- Status Bar:** Shows the file path (Users\pc\OneDrive\Documents\Assignment-6-Ques-1\Assign-6-Ques-1\main.c), the current tab (C/C++), encoding (Windows (CR+LF)), character set (WINDOWS-1252), line number (Line 108), column (Col 45), position (Pos 2683), and various mode indicators (Insert, Read/Write, default).
- System Tray:** Shows the Windows taskbar with icons for search, start, file explorer, mail, browser, and other system functions. The date and time are also displayed.

Fig. 12. Assignment-6,ques1

The screenshot shows the Code::Blocks IDE interface with the following details:

- Title Bar:** main.c [Assignment-6-Ques-1] - Code::Blocks 20.03
- Menu Bar:** File Edit View Search Project Build Debug Fortran wxSmith Tools Tools+ Plugins DoxyBlocks Settings Help
- Toolbar:** Includes icons for file operations, search, and debugging.
- Code Editor:** Displays the `main()` function with line numbers 115 to 145. The code handles matrix operations and printing results.
- Project Explorer:** Shows the workspace with a project named "Assignment-6-Ques-1" containing a source file "main.c".
- Status Bar:** Provides information about the current file path (\Users\pc\OneDrive\Documents\Assignment-6-Ques-1\Assignment-6-Ques-1\main.c), file type (C/C++), encoding (Windows (CR+LF)), and line/col/pos (Line 108, Col 45, Pos 2683).
- System Tray:** Shows weather (85°F Clear), date (9/25/2021), and time (1:02 AM).

```
main.c [Assignment-6-Ques-1] - Code::Blocks 20.03
File Edit View Search Project Build Debug Fortran wxSmith Tools Tools+ Plugins DoxyBlocks Settings Help
Debug
<global> main() : int
management
Projects Files FSymbols
Assign-6-Ques-1
Sources main.c
115     {
116         for(j=0;j<pro[i].n;j++)
117         {
118             if( pro[i].rhs[j][0]<65 || pro[i].rhs[j][0]>90 )
119             {
120                 pro[i].ft[strlen(pro[i].ft)] = pro[i].rhs[j][0];
121             }
122             else if( pro[i].rhs[j][0]>=65 && pro[i].rhs[j][0]<=90 )
123             {
124                 temp=pro[i].rhs[j][0];
125                 if(temp=='$')
126                     pro[i].ft[strlen(pro[i].ft)]='#';
127                 findter();
128             }
129         }
130     }
131
132     printf("\n\nFIRST\n");
133     for(i=0;i<n;i++)
134     {
135         printf("\n%s -> ",pro[i].lhs);
136         for(j=0;j<strlen(pro[i].ft);j++)
137         {
138             for(l=j-1;l>=0;l--)
139                 if(pro[i].ft[l]==pro[i].ft[j])
140                     break;
141                 if(l== -1)
142                     printf("%c",pro[i].ft[j]);
143         }
144     }
145 
```

Fig. 13. Assignment-6,ques1

The screenshot shows the Code::Blocks IDE interface with the following details:

- Title Bar:** main.c [Assignment-6-Ques-1] - Code::Blocks 20.03
- Menu Bar:** File Edit View Search Project Build Debug Fortran wxSmith Tools Tools+ Plugins DoxyBlocks Settings Help
- Toolbar:** Includes icons for file operations, search, and debugging.
- Project Explorer:** Shows the workspace with a project named "Assignment-6-Ques-1" containing a source file "main.c".
- Code Editor:** Displays the C code for "main.c". The code performs matrix operations, specifically finding the transpose of a matrix and concatenating it with the original matrix. It uses nested loops and conditional statements to iterate through elements and compare them.

```
141     if(l==-1)
142         printf("%c",pro[i].ft[j]);
143     }
144 }
145
146 for(i=0;i<n;i++)
147     temp2[i]=pro[i].lhs[0];
148 pro[0].fol[0]='$';
149 for(i=0;i<n;i++)
150 {
151     for(l=0;l<n;l++)
152     {
153         for(j=0;j<pro[i].n;j++)
154         {
155             ptr=strchr(pro[l].rhs[j],temp2[i]);
156             if( ptr )
157             {
158                 p=ptr-pro[l].rhs[j];
159                 if(pro[l].rhs[j][p+1]>=65 && pro[l].rhs[j][p+1]<=90)
160                 {
161                     for(o=0;o<n;o++)
162                         if(pro[o].lhs[0]==pro[l].rhs[j][p+1])
163                             strcat(pro[i].fol,pro[o].ft);
164                 }
165                 else if(pro[l].rhs[j][p+1]=='\0')
166                 {
167                     temp=pro[l].lhs[0];
168                     if(pro[l].rhs[j][p]==temp)
169                         continue;
170                     if(temp=='$')
171                         strcat(pro[i].fol,"$");
172                 }
173             }
174         }
175     }
176 }
```

- Status Bar:** Shows the file path (Users\pc\OneDrive\Documents\Assignment-6-Ques-1\Assignment-6-Ques-1\main.c), compiler (C/C++), encoding (Windows (CR+LF)), character set (WINDOWS-1252), line (Line 108), column (Col 45), position (Pos 2683), and various system status indicators like battery level, temperature, and date/time (1:03 AM, 9/25/2021).

Fig. 14. Assignment-6,ques1

main.c [Assign-6-Ques-1] - Code::Blocks 20.03

File Edit View Search Project Build Debug Fortran wxSmith Tools Tools+ Plugins DoxyBlocks Settings Help

<global> main() : int

management x

Projects Files FSymbols

Workspace Assign-6-Ques-1 Sources main.c

main.c x

```
167     temp=pro[1].lhs[0];
168     if(pro[1].rhs[j][p]==temp)
169         continue;
170     if(temp=='$')
171         strcat(pro[i].fol,"$");
172     findfol();
173 }
174 else
175     pro[i].fol[strlen(pro[i].fol)]=pro[1].rhs[j][p+1];
176 }
177 }
178 }
179 }
180
181 printf("\n\nFOLLOW\n");
182 for(i=0;i<n;i++)
183 {
184     printf("\n%s -> ",pro[i].lhs);
185     for(j=0;j<strlen(pro[i].fol);j++)
186     {
187         for(l=j-1;l>=0;l--)
188             if(pro[i].fol[l]==pro[i].fol[j])
189                 break;
190         if(l==-1)
191             printf("%c",pro[i].fol[j]);
192     }
193     printf("\n");
194 //getch();
195 }
196
197 }
```

Activate Windows
Go to Settings to activate Windows.

open an existing file C/C++ Windows (CR+LF) WINDOWS-1252 Line 108, Col 45, Pos 2683 Insert Read/Write default 1:04 AM 85°F Clear 9/25/2021

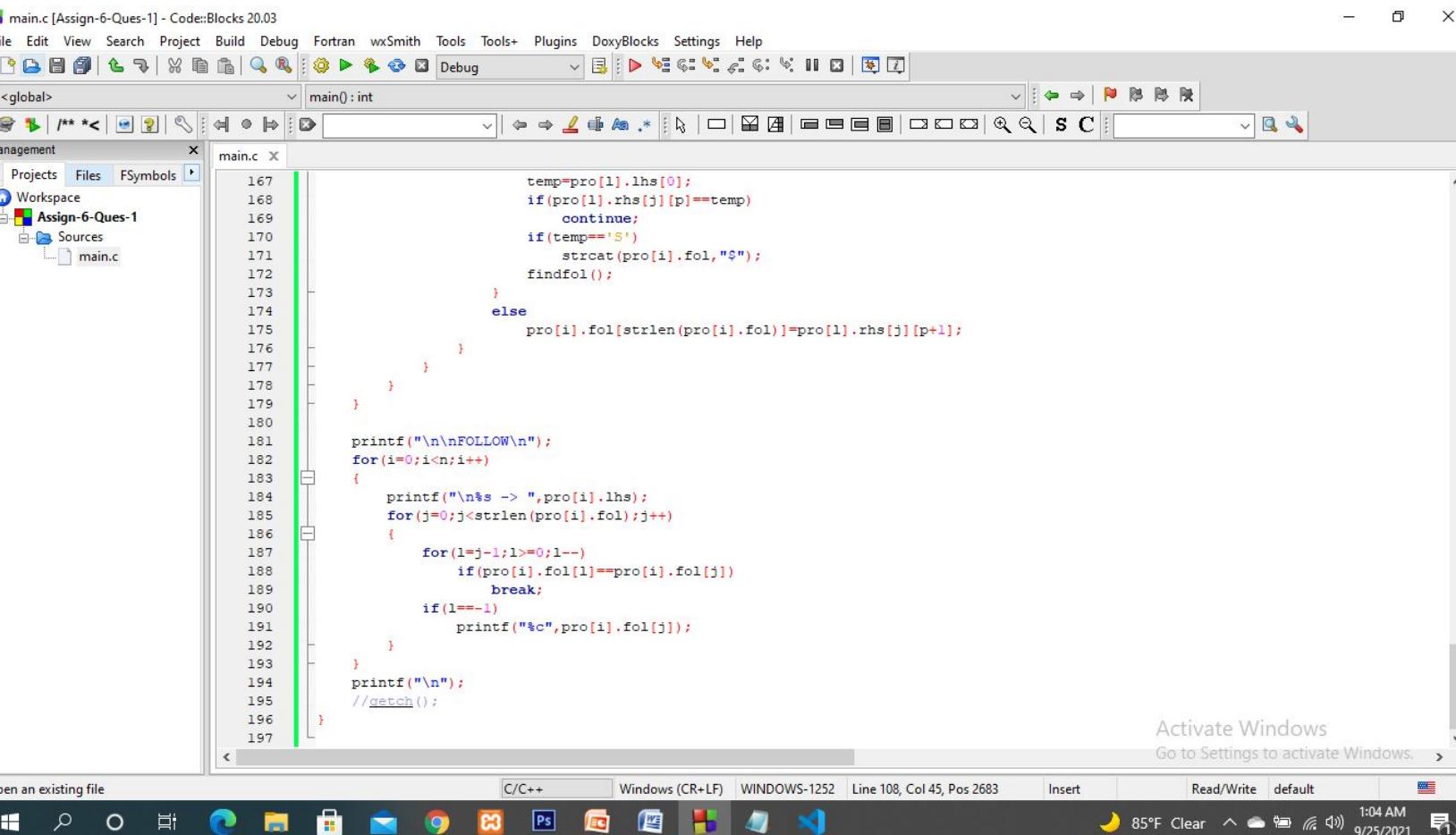
A screenshot of the Code::Blocks IDE interface. The title bar shows "main.c [Assign-6-Ques-1] - Code::Blocks 20.03". The menu bar includes File, Edit, View, Search, Project, Build, Debug, Fortran, wxSmith, Tools, Tools+, Plugins, DoxyBlocks, Settings, and Help. The toolbar has various icons for file operations like Open, Save, Build, Run, and Debug. The status bar at the bottom shows "Line 108, Col 45, Pos 2683" and the date/time "1:04 AM 85°F Clear 9/25/2021". The code editor window displays "main.c" with lines 167 to 197 of C code. The code implements a FOLLOW set computation for a grammar. The code uses standard C libraries like `strcat` and `getch`. The code editor has syntax highlighting for C code. The left sidebar shows the project structure with "Assign-6-Ques-1" selected, containing "Sources" and "main.c". A message "Activate Windows" with a link to "Go to Settings to activate Windows." is displayed in the center of the screen.

Fig. 15. Assignment-6,ques1

*main.c [Assign-6-Ques-2] - Code::Blocks 20.03

File Edit View Search Project Build Debug Fortran wxSmith Tools Tools+ Plugins DoxyBlocks Settings Help

readFromFile(): void

management X

Projects Files FSymbols X

Workspace Assign-6-Ques-2 Sources main.c

```
1 #include<stdio.h>
2 #include<string.h>
3 #define TSIZE 128
4 int table[100][TSIZE];
5 char terminal[TSIZE];
6 char nonterminal[26];
7
8 struct product {
9     char str[100];
10    int len;
11 }pro[20];
12 int no_pro;
13 char first[26][TSIZE];
14 char follow[26][TSIZE];
15 char first_rhs[100][TSIZE];
16 int isNT(char c) {
17     return c >= 'A' && c <= 'Z';
18 }
19 void readFromFile() {
20     FILE* fptr;
21     fptr = fopen("text.txt", "r");
22     char buffer[255];
23     int i;
24     int j;
25     while (fgets(buffer, sizeof(buffer), fptr)) {
26         printf("%s", buffer);
27         j = 0;
28         nonterminal[buffer[0] - 'A'] = 1;
29         for (i = 0; i < strlen(buffer) - 1; ++i) {
30             if (buffer[i] == '|') {
31                 ++no_pro;
```

Activate Windows
Go to Settings to activate Windows.

C:\Users\pc\OneDrive\Documents\Assignment-6-Ques-2\Assign-6-Ques-2\main.c C/C++ Windows (CR+LF) WINDOWS-1252 Line 19, Col 1, Pos 341 Insert Modified Read/Write default 1:21 AM 86°F Haze 9/25/2021

Fig. 16. Assignment-6 ques2,3

*main.c [Assign-6-Ques-2] - Code::Blocks 20.03

File Edit View Search Project Build Debug Fortran wxSmith Tools Tools+ Plugins DoxyBlocks Settings Help

readFromFile(): void

management X

Projects Files FSymbols X

Workspace Assign-6-Ques-2 Sources main.c

```
31     ++no_pro;
32     pro[no_pro - 1].str[j] = '\0';
33     pro[no_pro - 1].len = j;
34     pro[no_pro].str[0] = pro[no_pro - 1].str[0];
35     pro[no_pro].str[1] = pro[no_pro - 1].str[1];
36     pro[no_pro].str[2] = pro[no_pro - 1].str[2];
37     j = 3;
38 }
39 else {
40     pro[no_pro].str[j] = buffer[i];
41     ++j;
42     if (!isNT(buffer[i]) && buffer[i] != '-' && buffer[i] != '>') {
43         terminal[buffer[i]] = 1;
44     }
45 }
46
47 pro[no_pro].len = j;
48 ++no_pro;
49 }
50 }
51 void add_FIRST_A_to_FOLLOW_B(char A, char B) {
52     int i;
53     for (i = 0; i < TSIZE; ++i) {
54         if (i != '^')
55             follow[B - 'A'][i] = follow[B - 'A'][i] || first[A - 'A'][i];
56     }
57 }
58 void add_FOLLOW_A_to_FOLLOW_B(char A, char B) {
59     int i;
60     for (i = 0; i < TSIZE; ++i) {
61         if (i != '^')
```

Activate Windows
Go to Settings to activate Windows.

C:\Users\pc\OneDrive\Documents\Assignment-6-Ques-2\Assign-6-Ques-2\main.c C/C++ Windows (CR+LF) WINDOWS-1252 Line 19, Col 1, Pos 341 Insert Modified Read/Write default 86°F Haze 1:22 AM 9/25/2021

Fig. 17. Assignment-6 ques2,3

*main.c [Assign-6-Ques-2] - Code::Blocks 20.03

File Edit View Search Project Build Debug Fortran wxSmith Tools Tools+ Plugins DoxyBlocks Settings Help

readFromFile(): void

Management X

Projects Files FSymbols X

Workspace Assign-6-Ques-2 Sources main.c

```
60     for (i = 0; i < TSIZE; ++i) {
61         if (i != '^')
62             follow[B - 'A'][i] = follow[B - 'A'][i] || follow[A - 'A'][i];
63     }
64 }
65 void FOLLOW() {
66     int t = 0;
67     int i, j, k, x;
68     while (t++ < no_pro) {
69         for (k = 0; k < 26; ++k) {
70             if (!nonterminal[k]) continue;
71             char nt = k + 'A';
72             for (i = 0; i < no_pro; ++i) {
73                 for (j = 3; j < pro[i].len; ++j) {
74                     for (x = j + 1; x < pro[i].len; ++x) {
75                         char sc = pro[i].str[x];
76                         if (isNT(sc)) {
77                             add_FIRST_A_to_FOLLOW_B(sc, nt);
78                             if (first[sc - 'A'][ '^'])
79                                 continue;
80                         }
81                     }
82                 }
83             }
84         }
85     }
86 }
87 if (x == pro[i].len)
88     add_FOLLOW_A_to_FOLLOW_B(pro[i].str[0], nt);
89 }
90 }
```

Activate Windows
Go to Settings to activate Windows.

C:\Users\pc\OneDrive\Documents\Assignment-6-Ques-2\Assign-6-Ques-2\main.c C/C++ Windows (CR+LF) WINDOWS-1252 Line 19, Col 1, Pos 341 Insert Modified Read/Write default 1:24 AM 9/25/2021 86°F Haze

Fig. 18. Assignment-6 ques2,3

*main.c [Assign-6-Ques-2] - Code::Blocks 20.03

File Edit View Search Project Build Debug Fortran wxSmith Tools Tools+ Plugins DoxyBlocks Settings Help

<global> FOLLOW():void

management X

Projects Files FSymbols X

Workspace Assign-6-Ques-2 Sources main.c

```
88     add_FOLLOW_A_to_FOLLOW_B(pro[i].str[0], nt);
89 }
90 }
91 }
92 }
93 }
94 }
95 void add_FIRST_A_to_FIRST_B(char A, char B) {
96     int i;
97     for (i = 0; i < TSIZE; ++i) {
98         if (i != '^') {
99             first[B - 'A'][i] = first[A - 'A'][i] || first[B - 'A'][i];
100        }
101    }
102 }
103 void FIRST() {
104     int i, j;
105     int t = 0;
106     while (t < no_pro) {
107         for (i = 0; i < no_pro; ++i) {
108             for (j = 0; j < pro[i].len; ++j) {
109                 char sc = pro[i].str[j];
110                 if (isNT(sc)) {
111                     add_FIRST_A_to_FIRST_B(sc, pro[i].str[0]);
112                     if (first[sc - 'A'][^] == 1)
113                         continue;
114                 } else {
115                     first[pro[i].str[0] - 'A'][sc] = 1;
116                 }
117             }
118             break;
}
```

Activate Windows
Go to Settings to activate Windows.

C:\Users\pc\OneDrive\Documents\Assignment-6-Ques-2\Assign-6-Ques-2\main.c C/C++ Windows (CR+LF) WINDOWS-1252 Line 90, Col 1, Pos 2805 Insert Modified Read/Write default 1:24 AM 86°F Haze 9/25/2021

Fig. 19. Assignment-6 ques2,3

The screenshot shows the Code::Blocks IDE interface with the following details:

- Title Bar:** *main.c [Assign-6-Ques-2] - Code::Blocks 20.03
- Menu Bar:** File, Edit, View, Search, Project, Build, Debug, Fortran, wxSmith, Tools, Tools+, Plugins, DoxyBlocks, Settings, Help
- Toolbar:** Includes icons for Open, Save, Build, Run, Stop, and various project management tools.
- Project Explorer:** Shows the workspace named "Assign-6-Ques-2" containing a single source file "main.c".
- Code Editor:** The main window displays the C code for "main.c". The code implements a function to calculate FIRST sets for a grammar. It includes functions like "FOLLOW()", "add_FIRST_A_to_FIRST_RHS_B()", and "FIRST_RHS()". The code uses character arrays and loops to iterate through symbols and strings.
- Status Bar:** Shows the file path "C:\Users\pc\OneDrive\Documents\Assignment-6-Ques-2\Assign-6-Ques-2\main.c", build configuration "C/C++", encoding "Windows (CR-LF)", code page "WINDOWS-1252", line information "Line 90, Col 1, Pos 2805", and file status "Insert".
- System Tray:** Shows system icons for battery, signal strength, and date/time.

Fig. 20. Assignment-6 ques2,3

*main.c [Assign-6-Ques-2] - Code::Blocks 20.03

File Edit View Search Project Build Debug Fortran wxSmith Tools Tools+ Plugins DoxyBlocks Settings Help

<global> FOLLOW():void

management Projects Files FSymbols X

Workspace Assign-6-Ques-2 Sources main.c

```
148         break;
149     }
150     if (j == pro[i].len)
151         first_rhs[i]['^'] = 1;
152     ++
153 }
154 }
155 }
156 int main() {
157     readFromFile();
158     follow[pro[0].str[0] - 'A'][('$')] = 1;
159     FIRST();
160     FOLLOW();
161     FIRST_RHS();
162     int i, j, k;
163
164     printf("\n");
165     for (i = 0; i < no_pro; ++i) {
166         if (i == 0 || (pro[i - 1].str[0] != pro[i].str[0])) {
167             char c = pro[i].str[0];
168             printf("FIRST OF %c: ", c);
169             for (j = 0; j < TSIZE; ++j) {
170                 if (first[c - 'A'][j]) {
171                     printf("%c ", j);
172                 }
173             }
174             printf("\n");
175         }
176     }
177
178     printf("\n");
```

Activate Windows
Go to Settings to activate Windows.

C:\Users\pc\OneDrive\Documents\Assignment-6-Ques-2\Assign-6-Ques-2\main.c C/C++ Windows (CR+LF) WINDOWS-1252 Line 90, Col 1, Pos 2805 Insert Modified Read/Write default 1:25 AM 86°F Haze 9/25/2021

Fig. 21. Assignment-6 ques2,3

*main.c [Assign-6-Ques-2] - Code::Blocks 20.03

File Edit View Search Project Build Debug Fortran wxSmith Tools Tools+ Plugins DoxyBlocks Settings Help

Debug FOLLOW():void

management

Projects Files FSymbols

Workspace Assign-6-Ques-2 Sources main.c

main.c

```
178     printf("\n");
179     for (i = 0; i < no_pro; ++i) {
180         if (i == 0 || (pro[i - 1].str[0] != pro[i].str[0])) {
181             char c = pro[i].str[0];
182             printf("FOLLOW OF %c: ", c);
183             for (j = 0; j < TSIZE; ++j) {
184                 if (follow[c - 'A'][j]) {
185                     printf("%c ", j);
186                 }
187             }
188             printf("\n");
189         }
190     }

191     printf("\n");
192     for (i = 0; i < no_pro; ++i) {
193         printf("FIRST OF %s: ", pro[i].str);
194         for (j = 0; j < TSIZE; ++j) {
195             if (first_rhs[i][j]) {
196                 printf("%c ", j);
197             }
198         }
199         printf("\n");
200     }
201     include '$' in the parse table
202     terminal['$'] = 1;

203     terminal['^'] = 0;

204     printf("\n");
205     printf("\n***** LL(1) PARSING TABLE *****\n");
```

Activate Windows
Go to Settings to activate Windows.

Users\pc\OneDrive\Documents\Assignment-6-Ques-2\Assign-6-Ques-2\main.c C/C++ Windows (CR+LF) WINDOWS-1252 Line 90, Col 1, Pos 2805 Insert Modified Read/Write default 1:26 AM 86°F Haze 9/25/2021

Fig. 22. Assignment-6 ques2,3

*main.c [Assign-6-Ques-2] - Code::Blocks 20.03

File Edit View Search Project Build Debug Fortran wxSmith Tools Tools+ Plugins DoxyBlocks Settings Help

global FOLLOW():void

management Projects Files FSymbols Workspace Assign-6-Ques-2 Sources main.c

```
208 printf("\n\t***** LL(1) PARSING TABLE *****\n");
209 printf("\t-----\n");
210 printf("%-10s", "");
211 for (i = 0; i < TSIZE; ++i) {
212     if (terminal[i])    printf("%-10c", i);
213 }
214 printf("\n");
215 int p = 0;
216 for (i = 0; i < no_pro; ++i) {
217     if (i != 0 && (pro[i].str[0] != pro[i - 1].str[0]))
218         p = p + 1;
219     for (j = 0; j < TSIZE; ++j) {
220         if (first_rhs[i][j] && j != '^') {
221             table[p][j] = i + 1;
222         }
223         else if (first_rhs[i]['^']) {
224             for (k = 0; k < TSIZE; ++k) {
225                 if (follow[pro[i].str[0] - 'A'][k])
226                     table[p][k] = i + 1;
227             }
228         }
229     }
230 }
231 k = 0;
232 for (i = 0; i < no_pro; ++i) {
233     if (i == 0 || (pro[i - 1].str[0] != pro[i].str[0])) {
234         printf("%-10s", pro[i].str[0]);
235         for (j = 0; j < TSIZE; ++j) {
236             if (table[k][j]) {
237                 printf("%-10s", pro[table[k][j] - 1].str);
238             }
239         }
240     }
241 }
```

Activate Windows
Go to Settings to activate Windows.

C:\Users\pc\OneDrive\Documents\Assignment-6-Ques-2\Assign-6-Ques-2\main.c C/C++ Windows (CR+LF) WINDOWS-1252 Line 90, Col 1, Pos 2805 Insert Modified Read/Write default 1:27 AM 86°F Haze 9/25/2021

Fig. 23. Assignment-6 ques2,3

*main.c [Assign-6-Ques-2] - Code::Blocks 20.03

File Edit View Search Project Build Debug Fortran wxSmith Tools Tools+ Plugins DoxyBlocks Settings Help

<global> FOLLOW():void

management Projects Files FSymbols X

Workspace Assign-6-Ques-2 Sources main.c

```
218     p = p + 1;
219     for (j = 0; j < TSIZE; ++j) {
220         if (first_rhs[i][j] && j != '^') {
221             table[p][j] = i + 1;
222         }
223         else if (first_rhs[i]['^']) {
224             for (k = 0; k < TSIZE; ++k) {
225                 if (follow[pro[i].str[0] - 'A'][k]) {
226                     table[p][k] = i + 1;
227                 }
228             }
229         }
230     }
231     k = 0;
232     for (i = 0; i < no_pro; ++i) {
233         if (i == 0 || (pro[i - 1].str[0] != pro[i].str[0])) {
234             printf("%-10s", pro[i].str[0]);
235             for (j = 0; j < TSIZE; ++j) {
236                 if (table[k][j]) {
237                     printf("%-10s", pro[table[k][j] - 1].str);
238                 }
239                 else if (terminal[j]) {
240                     printf("%-10s", "");
241                 }
242             }
243             ++k;
244         }
245         printf("\n");
246     }
247 }
```

Activate Windows
Go to Settings to activate Windows.

C:\Users\pc\OneDrive\Documents\Assignment-6-Ques-2\Assign-6-Ques-2\main.c C/C++ Windows (CR+LF) WINDOWS-1252 Line 90, Col 1, Pos 2805 Insert Modified Read/Write default 86°F Haze 1:27 AM 9/25/2021

Fig. 24. Assignment-6 ques2,3

main.cpp [Assign-6-Ques-456] - Code::Blocks 20.03

File Edit View Search Project Build Debug Fortran wxSmith Tools Tools+ Plugins DoxyBlocks Settings Help

<global> main() : int

management Projects Files FSymbols Workspace Assign-6-Ques-456 Sources main.cpp

main.cpp

```
1 #include<bits/stdc++.h>
2 #define error(x) cerr<<#x<<" = "<<x<<'\n'
3 using namespace std;
4 set<char> ss;
5 map<char,vector<vector<char>>> mp;
6 bool dfs(char i, char org, char last, map<char,vector<vector<char>>> &mp) {
7     bool rtake = false;
8     for(auto r : mp[i]){
9         bool take = true;
10        for(auto s : r){
11            if(s == i) break;
12            if(!take) break;
13            if(!(s>='A'&&s<='Z') &&s != 'e'){
14                ss.insert(s);
15                break;
16            }
17            else if(s == 'e'){
18                if(org == i||i == last)
19                    ss.insert(s);
20                rtake = true;
21                break;
22            }
23            else{
24                take = dfs(s,org,r[r.size()-1],mp);
25                rtake |= take;
26            }
27        }
28    }
29    return rtake;
30 }
31 map<int,map<char,set<pair<deque<char>,deque<char>>>> f;
```

Activate Windows
Go to Settings to activate Windows.

C:\Users\pc\OneDrive\Documents\Assignment-6-Part-4,5,6\Assign-6-Ques-456\main... C/C++ Windows (CR+LF) WINDOWS-1252 Line 318, Col 2, Pos 9632 Insert Read/Write default 86°F Haze 3:33 AM 9/25/2021

Fig. 25. Assignment-6 ques4,5,6

The screenshot shows the Code::Blocks IDE interface with the following details:

- Title Bar:** main.cpp [Assignment-6-Ques-456] - Code::Blocks 20.03
- Menu Bar:** File Edit View Search Project Build Debug Fortran wxSmith Tools Tools+ Plugins DoxyBlocks Settings Help
- Toolbar:** Includes icons for file operations, search, and build.
- Project Explorer:** Shows the workspace named "Assign-6-Ques-456" containing a single source file "main.cpp".
- Code Editor:** Displays the content of main.cpp. The code implements a depth-first search (DFS) algorithm using maps and sets to find paths between characters 'A' and 'Z'. The code uses nested loops to iterate through character pairs and their occurrences.

```
31 map<int, map<char, set<pair<deque<char>, deque<char>>> f;
32 map<int, vector<pair<int, char>>> g;
33 int num = -1;
34 void dfs2(char c, char way, int last, pair<deque<char>, deque<char>> curr) {
35     map<char, set<pair<deque<char>, deque<char>>> mp2;
36     int rep = -2;
37     if(last != -1){
38         for(auto q : g[last]){
39             if(q.second == way){
40                 rep = q.first;
41                 mp2 = f[q.first];
42             }
43         }
44     }
45     mp2[c].insert(curr);
46     int count = 10;
47     while(count--){
48         for(auto q : mp2){
49             for(auto r : q.second){
50                 if(!r.second.empty()){
51                     if(r.second.front() >= 'A' && r.second.front() <= 'Z'){
52                         for(auto s : mp[r.second.front()]){
53                             deque<char> st, emp;
54                             for(auto t : s) st.push_back(t);
55                             mp2[r.second.front()].insert({emp, st});
56                         }
57                     }
58                 }
59             }
60         }
61     }
}
```

- Status Bar:** Shows the file path (Users\pc\OneDrive\Documents\Assignment-6-Part-4,5,6\Assign-6-Ques-456\main...), file type (C/C++), encoding (Windows (CR+LF)), code page (WINDOWS-1252), line number (Line 318, Col 2, Pos 9632), and other system information like temperature (86°F Haze) and date (9/25/2021).

Fig. 26. Assignment-6 ques4,5,6

The screenshot shows the Code::Blocks IDE interface with the following details:

- Title Bar:** main.cpp [Assignment-6-Ques-456] - Code::Blocks 20.03
- Menu Bar:** File Edit View Search Project Build Debug Fortran wxSmith Tools Tools+ Plugins DoxyBlocks Settings Help
- Toolbar:** Includes icons for file operations, search, and build.
- Project Explorer:** Shows the workspace with a project named "Assign-6-Ques-456" containing a source file "main.cpp".
- Code Editor:** Displays the C++ code for "main.cpp". The code implements a search algorithm, likely Depth-First Search (DFS), using vectors and stacks. It reads input from "inputslx.txt" and outputs results to "outputlx.txt".

```
main.cpp X
62     for(auto q : f){
63         if(q.second == mp2){
64             g[last].push_back({q.first,way});
65             return;
66         }
67     }
68     if(rep == -2){
69         f[++num] = mp2;
70         if(last != -1)
71             g[last].push_back({num,way});
72     }
73     else{
74         f[rep] = mp2;
75     }
76     int cc = num;
77     for(auto q : mp2){
78         for(auto r : q.second){
79             if(!r.second.empty()){
80                 r.first.push_back(r.second.front());
81                 r.second.pop_front();
82                 dfs2(q.first,r.first.back(),cc,r);
83             }
84         }
85     }
86 }
87 int main(){
88     int i,j;
89     ifstream fin("inputslx.txt");
90     string num;
91     vector<int> fs;
92     vector<vector<int>> a;
```

- Status Bar:** Shows the current file is "C/C++", encoding is "WINDOWS-1252", line 318, column 2, position 9632, and the system status: "Activate Windows Go to Settings to activate Windows."
- Taskbar:** Shows standard Windows taskbar icons for Start, Search, Task View, File Explorer, Mail, Google Chrome, File Explorer, and Task Manager.
- System Tray:** Shows battery level at 86%, Haze mode, and the date/time: 9/25/2021 3:34 AM.

Fig. 27. Assignment-6 ques4,5,6

The screenshot shows the Code::Blocks IDE interface with the following details:

- Title Bar:** main.cpp [Assign-6-Ques-456] - Code::Blocks 20.03
- Menu Bar:** File Edit View Search Project Build Debug Fortran wxSmith Tools Tools+ Plugins DoxyBlocks Settings Help
- Toolbar:** Includes icons for file operations, search, and build.
- Project Explorer:** Shows a workspace named "Assign-6-Ques-456" containing a "Sources" folder with "main.cpp".
- Code Editor:** Displays the content of main.cpp. The code implements a parser for a grammar defined in num. It uses vectors and maps to store symbols and their first and second derivatives. The code includes logic to handle terminals ('|') and non-terminals (char symbols).

```
vector<vector<int>> a;
char start;
bool flag = 0;
cout<<"Grammar: "<<'\n';
while(getline(fin,num)){
    if(flag == 0) start = num[0],flag = 1;
    cout<<num<<'\n';
    vector<char> temp;
    char s = num[0];
    for(i=3;i<num.size();i++){
        if(num[i] == '|'){
            mp[s].push_back(temp);
            temp.clear();
        }
        else temp.push_back(num[i]);
    }
    mp[s].push_back(temp);
}
map<char, set<char>> fmp;
for(auto q : mp){
    ss.clear();
    dfs(q.first,q.first,q.first,mp);
    for(auto g : ss) fmp[q.first].insert(g);
}
cout<<'\n';
cout<<"FIRST: "<<'\n';
for(auto q : fmp){
    string ans = "";
    ans += q.first;
    ans += " = {";
    for(char x : q.second) {
```

- Status Bar:** Shows the file path (Users\pc\OneDrive\Documents\Assignment-6-Part-4,5,6\Assign-6-Ques-456\main...), file type (C/C++), encoding (Windows (CR+LF)), character set (WINDOWS-1252), line number (Line 318, Col 2, Pos 9632), and various mode indicators (Insert, Read/Write, default).
- System Tray:** Shows system status including temperature (86°F), haze, battery level, and date/time (9/25/2021, 3:35 AM).

Fig. 28. Assignment-6 ques4,5,6

The screenshot shows the Code::Blocks IDE interface with the following details:

- Title Bar:** main.cpp [Assignment-6-Ques-456] - Code::Blocks 20.03
- Menu Bar:** File Edit View Search Project Build Debug Fortran wxSmith Tools Tools+ Plugins DoxyBlocks Settings Help
- Toolbar:** Includes icons for file operations, search, and build.
- Project Explorer:** Shows the workspace named "Assign-6-Ques-456" containing a single source file "main.cpp".
- Code Editor:** Displays the C++ code for "main.cpp". The code uses a map of sets to group characters based on their adjacent pairs. It includes logic to handle punctuation and whitespace.

```
122     for(char r : q.second) {
123         ans += r;
124         ans += ',';
125     }
126     ans.pop_back();
127     ans+=")";
128     cout<<ans<<'\n';
129 }
130 map<char, set<char>> gmp;
131 gmp[start].insert('$');
132 int count = 10;
133 while(count--){
134     for(auto q : mp){
135         for(auto r : q.second){
136             for(i=0;i<r.size()-1;i++){
137                 if(r[i]>='A'&&r[i]<='Z'){
138                     if(!(r[i+1]>='A'&&r[i+1]<='Z')) gmp[r[i]].insert(r[i+1]);
139                     else {
140                         char temp = r[i+1];
141                         int j = i+1;
142                         while(temp>='A'&&temp<='Z'){
143                             if(*fmp[temp].begin()=='e'){
144                                 for(auto g : fmp[temp]){
145                                     if(g=='e') continue;
146                                     gmp[r[i]].insert(g);
147                                 }
148                             }
149                             j++;
150                             if(j<r.size()){
151                                 temp = r[j];
152                                 if(!(temp>='A'&&temp<='Z')){
153                                     gmp[r[i]].insert(temp);
154                                 }
155                             }
156                         }
157                     }
158                 }
159             }
160         }
161     }
162 }
```

- Status Bar:** Shows the file path (Users\pc\OneDrive\Documents\Assignment-6-Part-4,5,6\Assign-6-Ques-456\main...), file type (C/C++), build configuration (Windows (CR+LF)), compiler (WINDOWS-1252), line number (Line 318, Col 2, Pos 9632), and other system information like temperature (86°F Haze).

Fig. 29. Assignment-6 ques4,5,6

The screenshot shows the Code::Blocks IDE interface with the following details:

- Title Bar:** main.cpp [Assign-6-Ques-456] - Code::Blocks 20.03
- Menu Bar:** File Edit View Search Project Build Debug Fortran wxSmith Tools Tools+ Plugins DoxyBlocks Settings Help
- Toolbar:** Includes icons for file operations, search, and build.
- Project Explorer:** Shows the workspace named "Assign-6-Ques-456" containing a single source file "main.cpp".
- Code Editor:** Displays the C++ code for "main.cpp". The code handles character input and processing using std::map containers (gmp) for sets of characters. It includes logic for handling uppercase letters and punctuation. The code is color-coded for syntax highlighting.
- Status Bar:** Provides information about the current file (C:\Users\pc\OneDrive\Documents\Assignment-6-Part-4,5,6\Assign-6-Ques-456\main...), the current line (Line 318, Col 2, Pos 9632), and the current mode (Insert).
- System Tray:** Shows system status including temperature (86°F), haze, battery level, and date/time (9/25/2021, 3:36 AM).

```
152         gmp[r[i]].insert(temp);
153         break;
154     }
155     else{
156         for(auto g : gmp[q.first]) gmp[r[i]].insert(g);
157         break;
158     }
159     else{
160         for(auto g : fmp[temp]){
161             gmp[r[i]].insert(g);
162         }
163         break;
164     }
165     }
166     }
167     }
168     }
169     }
170     }
171     if(r.r.size()-1>='A'&&r.r.size()-1<='Z'){
172         for(auto g : gmp[q.first]) gmp[r[i]].insert(g);
173     }
174     }
175     }
176     cout<<'\n';
177     cout<<"FOLLOW: "<<'\n';
178     for(auto q : gmp){
179         string ans = "";
180         ans += q.first;
181         ans += " = {";
182     }
```

Fig. 30. Assignment-6 ques4,5,6

The screenshot shows the Code::Blocks IDE interface with the following details:

- Title Bar:** main.cpp [Assignment-6-Ques-456] - Code::Blocks 20.03
- Menu Bar:** File Edit View Search Project Build Debug Fortran wxSmith Tools Tools+ Plugins DoxyBlocks Settings Help
- Toolbar:** Includes icons for file operations, search, and build.
- Project Explorer:** Shows the workspace named "Assignment-6-Ques-456" containing a single source file "main.cpp".
- Code Editor:** Displays the C++ code for "main.cpp". The code involves string manipulation, deque usage, and a map of pairs. It includes comments and several lines of code starting with numbers 182, 183, etc.
- Status Bar:** Provides information about the file path (Users\pc\OneDrive\Documents\Assignment-6-Part-4,5,6\Assign-6-Ques-456\main...), file type (C/C++), encoding (Windows (CR+LF)), and current position (Line 238, Col 2, Pos 7219).
- System Tray:** Shows system status including temperature (86°F), haze, battery level, and date/time (9/25/2021, 3:40 AM).

```
ans += " = {";
for(char r : q.second) {
    ans += r;
    ans += ',';
}
ans.pop_back();
ans+="}";
cout<<ans<<'\n';
}
string temp = "";
temp+= '.';
temp+=start;
deque<char> emp;
deque<char> st;
st.push_back(start);
dfs2('!', 'k', -1, {emp, st});
cout<<"\nProductions: "<<'\n';
int cc = 1;
set<char> action, go;
map<pair<char, deque<char>>, int> pos;
for(auto q : mp) {
    go.insert(q.first);
    for(auto r : q.second) {
        cout<<"r"<<cc<<": ";
        string ans = "";
        ans += q.first;
        ans+=">";
        deque<char> temp;
        for(auto s : r) ans += s, temp.push_back(s);
        pos[{q.first, temp}] = cc;
        for(auto s : r){
```

Fig. 31. Assignment-6 ques4,5,6

The screenshot shows the Code::Blocks IDE interface with the following details:

- Title Bar:** main.cpp [Assign-6-Ques-456] - Code::Blocks 20.03
- Menu Bar:** File Edit View Search Project Build Debug Fortran wxSmith Tools Tools+ Plugins DoxyBlocks Settings Help
- Toolbar:** Includes icons for file operations like Open, Save, Find, and Run.
- Project Explorer:** Shows the workspace named "Assign-6-Ques-456" containing a single source file "main.cpp".
- Code Editor:** The main window displays the C++ code for "main.cpp". The code involves reading from a file, processing characters, and printing results. It includes loops for reading characters and strings, and a nested loop for processing a graph structure. The code uses standard C++ libraries like `string`, `vector`, and `map`.
- Status Bar:** Shows the file path (Users\pc\OneDrive\Documents\Assignment-6-Part-4,5,6\Assign-6-Ques-456\main...), encoding (C/C++), character set (Windows (CR-LF)), and current position (Line 238, Col 2, Pos 7219).
- System Tray:** Shows system icons for battery, signal, and date/time (3:41 AM 9/25/2021).

```
main.cpp [Assign-6-Ques-456] - Code::Blocks 20.03
File Edit View Search Project Build Debug Fortran wxSmith Tools Tools+ Plugins DoxyBlocks Settings Help
Projects Files FSymbols
Workspace Assign-6-Ques-456
Sources main.cpp

main.cpp x
212         for(auto s : r) {
213             if(s>='A' && s<='Z') go.insert(s);
214             else action.insert(s);
215         }
216         cout<<ans<<'\n';
217         cc++;
218     }
219 }
220
221 cout<<"\nGraph: "<<'\n';
222 for(auto mp2 : f) {
223     cout<<' \n';
224     cout<<"\n";
225     cout<<mp2.first<<" : \n";
226     for(auto q : mp2.second) {
227         string ans = "";
228         ans += q.first;
229         ans += "->";
230         for(auto r : q.second) {
231             for(auto t : r.first) ans+=t;
232             ans+=',';
233             for(auto t : r.second) ans+=t;
234             ans+=')';
235         }
236         ans.pop_back();
237         for(auto tt : ans) {
238             if(tt == '!') cout<<start<<'\n';
239             else cout<<tt;
240         }
241         cout<<'\n';
242     }
}

Activate Windows
Go to Settings to activate Windows.

Users\pc\OneDrive\Documents\Assignment-6-Part-4,5,6\Assign-6-Ques-456\main... C/C++ Windows (CR-LF) WINDOWS-1252 Line 238, Col 2, Pos 7219 Insert Read/Write default
86°F Haze 3:41 AM 9/25/2021
```

Fig. 32. Assignment-6 ques4,5,6

The screenshot shows the Code::Blocks IDE interface with the following details:

- Title Bar:** main.cpp [Assignment-6-Ques-456] - Code::Blocks 20.03
- Menu Bar:** File Edit View Search Project Build Debug Fortran wxSmith Tools Tools+ Plugins DoxyBlocks Settings Help
- Toolbar:** Includes icons for file operations, search, and build.
- Project Explorer:** Shows a workspace named "Assign-6-Ques-456" containing a "Sources" folder with "main.cpp".
- Code Editor:** Displays the content of main.cpp. The code is a C++ program that outputs a parsing table. It includes loops for states (q), transitions (r), actions (a), and symbols (s). It uses cout for output and various conditionals to determine the output based on state, transition, and action.

```
243     }
244     cout<<'\n';
245     cout<<"Edges: "<<'\n';
246     for(auto q : g){
247         for(auto r : q.second){
248             cout<<"I"<<q.first<<" -> "<<r.second<<" -> " <<"I"<<r.first<<"\n";
249         }
250     }
251     action.insert('$');
252     cout<<"\nParsing Table:"<<'\n';
253     cout<<"St.\t\tAction & Goto"<<'\n';
254     int tot = f.size();
255     cout<<" \t";
256     for(auto q : action) cout<<q<<'\t';
257     for(auto q : go) cout<<q<<'\t';
258     cout<<'\n';
259     for(i=0;i<tot;i++){
260         cout<<"\t"<<i<<'\t';
261         for(auto q : action){
262             if(g.count(i)){
263                 int flag = 0;
264                 for(auto r : g[i]){
265                     if(r.second == q){
266                         flag = 1;
267                         cout<<"S"<<r.first<<"\t";
268                         break;
269                     }
270                 }
271                 if(!flag) cout<<"-"\t;
272             }
273         }
274     }
275 }
```

- Status Bar:** Shows the path "Users\pc\OneDrive\Documents\Assignment-6-Part-4,5,6\Assignment-6-Ques-456\main...", file type "C/C++", encoding "Windows (CR+LF)", code page "WINDOWS-1252", line "Line 238, Col 2, Pos 7219", and other system information like "Insert", "Read/Write", and "default".
- System Tray:** Shows icons for battery, signal strength, and date/time (9/25/2021, 3:42 AM).

Fig. 33. Assignment-6 ques4,5,6

main.cpp [Assign-6-Ques-456] - Code::Blocks 20.03

File Edit View Search Project Build Debug Fortran wxSmith Tools Tools+ Plugins DoxyBlocks Settings Help

<global> main() : int

management Projects Files FSymbols

Workspace Assign-6-Ques-456 Sources main.cpp

main.cpp

```
int flag = 0;
for(auto r : f[i]){
    if(r.first == '!!'){
        if(q == '$'){
            cout<<"AC\t";
            flag = 1;
        }
        else cout<<"-\t";
    }
}
if(!flag){
    for(auto r : f[i]){
        char ccc = r.first;
        deque<char> chk = (*r.second.begin()).first;
        int cou = 1;
        for(auto r : gmp[ccc])){
            if(q == r){
                cout<<r<<pos[{ccc,chk}]<<"\t";
            }
            cou++;
        }
    }
}
for(auto q : go){
    if(g.count(i)){
        int flag = 0;
        for(auto r : g[i]){
            if(r.second == q){
                flag = 1;
            }
        }
    }
}
```

Activate Windows
Go to Settings to activate Windows.

Open an existing file C/C++ Windows (CR+LF) WINDOWS-1252 Line 238, Col 2, Pos 7219 Insert Read/Write default 86°F Haze 3:43 AM 9/25/2021

Fig. 34. Assignment-6 ques4,5,6

The screenshot shows the Code::Blocks IDE interface. The title bar reads "main.cpp [Assign-6-Ques-456] - Code::Blocks 20.03". The menu bar includes File, Edit, View, Search, Project, Build, Debug, Fortran, wxSmith, Tools, Tools+, Plugins, DoxyBlocks, Settings, and Help. The toolbar has various icons for file operations like Open, Save, Find, and Build. The status bar at the bottom shows the path "Users\pc\OneDrive\Documents\Assignment-6-Part-4,5,6\Assign-6-Ques-456\main...", the code editor mode "C/C++", encoding "Windows (CR+LF)", character set "WINDOWS-1252", line information "Line 238, Col 2, Pos 7219", and settings for Insert, Read/Write, and default. The bottom right corner displays system information: "86°F Haze", "3:44 AM", and the date "9/25/2021". The main workspace shows the "Projects" tab with "Assign-6-Ques-456" selected, the "Files" tab, and the "FSymbols" tab. The code editor window displays the "main.cpp" file with the following content:

```
289     for(auto r : gmp[ccc]) {
290         if(q == r) {
291             cout<<"r"<<pos[{ccc,chk}]<<"\t";
292         }
293         cou++;
294     }
295 }
296 }
297 }
298
299 for(auto q : go){
300     if(g.count(i)){
301         int flag = 0;
302         for(auto r : g[i]){
303             if(r.second == q){
304                 flag = 1;
305                 cout<<r.first<<"\t";
306                 break;
307             }
308         }
309         if(!flag) cout<<"-"
```

Fig. 35. Assignment-6 ques4,5,6