컴파일러 구성 과제#2

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1. Code

1.1 scanner_lab.l

```
%{
/*
 * scanner_lab.l - lexical analyzer
 *렉스를 통해 토큰을 쪼개고  종류를 정한다.
 * Programmer - 이경연, 박소현
 *
 * date - 19.04.26
 *
 *
 *
*/

#include <stdio.h>
#include <stdlib.h>
#include "tn.h"
#include "glob.h"

%}
%%

"const"                                 return(TCONST);
"else"                                  return(TELSE);
"if"                                    return(TIF);
"int"                                   return(TINT);
"return"                        return(TRETURN);
"void"                                  return(TVOID);
"while"                                 return(TWHILE);

"+"                                     return(TPLUS);
"-"                                     return(TMINUS);
"*"                                     return(TMUL);
"/"                                     return(TDIV);
"%"                                     return(TPERCENT);
```

```
"="                             return(TASSIGN);
"+="                                                return(TADDASSIGN);
"-="                                                return(TSUBASSIGN);
"*="                                                return(TMULASSIGN);
"/="                                                return(TDIVASSIGN);
"%="                                                return(TMODASSIGN);

"!"                            return(TNOT);
"&&"                                                return(TAND);
"||"                                                return(TOR);


"=="                                                return(TEQUAL);
"!="                                                return(TNOTEQU);
"<"                             return(TLESS);
">"                             return(TGREAT);
"<="                                                return(TEQLESS);
">="                                                return(TEQGREAT);

"++"                                                return(TINC);
"--"                                                return(TDEC);


"("                                                 return(TSMALLBRACE_L);
")"                                                 return(TSMALLBRACE_R);
"["                                                 return(TBIGBRACE_L);
"]"                                                 return(TBIGBRACE_R);
"{"                                                 return(TMIDBRACE_L);
"}"                                                 return(TMIDBRACE_R);
[,]                                                 return(TCOLON);
[;]                                                 return(TSEMICOLON);

[₩n]                                      return(TNEWLINE);
[ ₩t]                                                         ;



"/*"([^*]|₩*+[^*/])*₩**"*/"               ;
```

```
"//".*                                              ;



0[0-7]+                 return(TOCTA);
0(x|X)[0-9A-Fa-f]+          return(THEXA);
0|[1-9][0-9]*              return(TNUMBER);
[+-]?([0-9]*₩.[0-9]+)([eE][-+]?[0-9]+)? return(TREAL);

[A-Za-z_][A-Za-z0-9_][A-Za-z0-9_][A-Za-z0-9_][A-Za-z0-9_][A-Za-z0-9_][A-Za-z0-9_][A-Za-z0-9_][A-Za-z0-9_]+               return(TLONGERR);
[A-Za-z_][A-Za-z0-9_]*                  return(TIDENT);
₩"(([^₩"]|₩₩₩")*[^₩₩])?₩"                    return(TSTRING);
₩'[^'][']                   return(TCHAR);

[1-9][0-9]*[A-Za-z0-9_]+                       return(TERROR_DIGIT_START);
[A-Za-z_]+[^A-Za-z0-9_ ₩n₩t(){}[]]+[A-Za-z0-9_]*?    return(TERROR_ILL_CHAR_1);
[^A-Za-z0-9_ ₩n₩t(){}[]]+[A-Za-z0-9_]*?       return(TERROR_ILL_CHAR_2);
.                          return(TERROR);
%%

int yywrap()
{
            return 1;
}
```

1.2 main.c

```
/*
main.c-렉스로 부터 받은 토큰들을 케이스에 따라 다르게 출력하고, 식별자는 해시테이블 작업을 수행한다.
programmer-이경연, 박소현
date-19.04.26
*/
#include <stdio.h>
#include <stdlib.h>
#include "tn.h"
```

```
#include "glob.h"

//식별자로 인식된 종류의 토큰을 처리하는 함수이다.
//식별자들은 ST을 거쳐 Hstable에 저장한다
void iden_handler(char * yt) {
    int i;
    yytext_for_ht = yt;
    input_char = yt[indexyy];
    leng = strlen(yt);
    ReadID();
    err = noerror;
    if (err == noerror) {
        if (nextfree == STsize) {
            err = overst;
            PrintError(err);
        }
        ST[nextfree++] = '₩0';
        ComputeHS(nextid, nextfree); //읽어온 값들에 대해 hash code를 계산
        LookupHS(nextid, hashcode);    //계산된 hash code값이 hash table에 이미 있는지 확인

        //hash table에 해당 hash code값이 없을 경우
        if (!found&&ST[nextid] != NULL) {
            //변수의 길이가 너무 길지 않을 경우
            if ((nextfree - nextid - 1) <= 10) {
                ADDHT(hashcode); //해당 hash code를 hash table에 저장해준다.
            }
            //변수의 길이가 너무 길 경우
            else  if ((nextfree - nextid - 1) > 10) {
                nextfree = nextid; //string table에 변수가 저장되지 않도록 nextid값을 다시 nextfree에 넣어준다.
            }
        }
        //hash table에 해당 hash code값이 있는 경우
        else if (found) {
            nextfree = nextid; //string table에 변수가 저장되지 않도록 nextid값을
```

```
다시 nextfree에 넣어준다.
                    }
          }


}




//lex로부터 나온 토큰의 종류에 따라 출력을 다르게한다.
//에러가 날 경우 PrintError.c를 통해 에러를 구분해 출력한다.
void main()
{
          PrintHeading();
          int linenum = 1;
          int base;
          int value;
          char * yt;
          enum tokentypes tn;   // token number
          extern char *yytext;
          while ((tn = yylex()) != TEOF) {
                    //printf("Line number= %d₩t", linenum);
                    PrintError(noerror);
                    switch (tn) {

                              //예약어
                    case TCONST: printf("%d                TCONST              %22s₩n",
linenum, yytext); break;
                    case TELSE: printf("%d                 TELSE               %22s₩n",
linenum, yytext); break;
                    case TIF: printf("%d                   TIF                 %22s₩n",
linenum, yytext); break;
                    case TINT: printf("%d                  TINT                %22s₩n",
linenum, yytext); break;
                    case                    TRETURN:                        printf("%d
TRETURN               %22s₩n", linenum, yytext); break;
```

```
                case TVOID: printf("%d                    TVOID                    %22s₩n",
linenum, yytext); break;
                case                    TWHILE:                    printf("%d
TWHILE                    %22s₩n", linenum, yytext); break;

                        //사칙연산자
                case TPLUS: printf("%d                    TPLUS                    %22s₩n",
linenum, yytext); break;
                case                    TMINUS:                    printf("%d
TMINUX                    %22s₩n", linenum, yytext); break;
                case TMUL: printf("%d                    TMUL                    %22s₩n",
linenum, yytext); break;
                case TDIV: printf("%d                    TDIV                    %22s₩n",
linenum, yytext); break;
                case                    TPERCENT:                    printf("%d
TPERCENT                    %22s₩n", linenum, yytext); break;
                        //배정연산자
                case                    TADDASSIGN:                    printf("%d
TADDASSIGN                    %16s₩n", linenum, yytext); break;
                case                    TSUBASSIGN:                    printf("%d
TSUBASSIGN                    %16s₩n", linenum, yytext); break;
                case                    TMULASSIGN:                    printf("%d
TMULASSIGN                    %16s₩n", linenum, yytext); break;
                case                    TDIVASSIGN:                    printf("%d
TDIVASSIGN                    %16s₩n", linenum, yytext); break;
                case                    TMODASSIGN:                    printf("%d
TMODASSIGN                    %16s₩n", linenum, yytext); break;
                case                    TASSIGN:                    printf("%d
TASSIGN                    %16s₩n", linenum, yytext); break;

                        //논리연산자
                case TNOT: printf("%d                    TNOT                    %21s₩n",
linenum, yytext); break;
                case TAND: printf("%d                    TAND                    %21s₩n",
linenum, yytext); break;
                case TOR: printf("%d                    TOR                    %21s₩n",
linenum, yytext); break;
```

```
                    //관계연산자
            case TEQUAL: printf("%d
TEQUAL          %19s₩n", linenum, yytext); break;
            case TNOTEQU: printf("%d
TNOTEQU         %19s₩n", linenum, yytext); break;
            case TLESS: printf("%d          TLESS          %19s₩n",
linenum, yytext); break;
            case TGREAT: printf("%d
TGREAT          %19s₩n", linenum, yytext); break;
            case TEQLESS: printf("%d
TEQLESS         %19s₩n", linenum, yytext); break;
            case TEQGREAT: printf("%d
TEQGREAT        %19s₩n", linenum, yytext); break;
                    //증감연산자
            case TINC: printf("%d          TINC          %21s₩n",
linenum, yytext); break;
            case TDEC: printf("%d          TDEC          %21s₩n",
linenum, yytext); break;

                    //Identifier
            case TIDENT:
                    printf("%d
TIDENT          %18s          %d₩n", linenum, yytext, nextfree);
                    yt = yytext;   iden_handler(yt); indexyy = 0;   break;
                    //스트링과 캐릭터
            case TSTRING:printf("%d
TSTRING         %18s₩n", linenum, yytext); break;
            case TCHAR:printf("%d
TCHAR           %18s₩n", linenum, yytext); break;



                    //특수기호
            case TSMALLBRACE_L: printf("%d
TSAMLL_L        %18s₩n", linenum, yytext); break;
            case TSMALLBRACE_R: printf("%d
TSMALL_R        %18s₩n", linenum, yytext); break;
```

```
                case        TBIGBRACE_L:        printf("%d
TLARGE_L            %18s₩n", linenum, yytext); break;
                case        TBIGBRACE_R:        printf("%d
TLARGE_R            %18s₩n", linenum, yytext); break;
                case        TMIDBRACE_L:        printf("%d
TMID_L              %18s₩n", linenum, yytext); break;
                case        TMIDBRACE_R:        printf("%d
TMID_R              %18s₩n", linenum, yytext); break;
                case        TCOLON:             printf("%d
TCOLON              %18s₩n", linenum, yytext); break;
                case        TSEMICOLON:         printf("%d
TSEMICOLON          %18s₩n", linenum, yytext); break;




                        //WHITE SPACE
                case        TBLANK:             printf("%d
TBLANK              %18s₩n", linenum, yytext); break;
                case TTAB: printf("%d        TTAB        %18s₩n",
linenum, yytext); break;
                case TNEWLINE: linenum++; break;



                        /*여기부터 따로 정의한 토큰*/

                        //ERROR
                case TERROR:PrintError(illsp); printf("₩tline number[%d]    =>  %s₩n",
linenum, yytext); break;
                case TERROR_DIGIT_START: PrintError(illid); printf("₩tline number[%d]
=>  %s₩n", linenum, yytext); break;
                case TERROR_ILL_CHAR_1: PrintError(illsp); printf("₩tline number[%d]
=>  %s₩n", linenum, yytext); break;
                case TERROR_ILL_CHAR_2: PrintError(illsp); printf("₩tline number[%d]
=>  %s₩n", linenum, yytext); break;
```

```
        case TLONGERR: PrintError(toolong); printf("₩tline number[%d] =>  %s₩n", linenum, yytext); break;

            //수
        case TREAL: printf("%d            TREAL            %18s₩n", linenum, yytext); break;
        case TNUMBER: printf("%d TNUMBER            %18s₩n", linenum, yytext); break;
        case TOCTA:
            base = 1;
            value = 0;
            for (int i = strlen(yytext) - 1; i >= 0; i--) {
                value += (yytext[i] - 48) * base;
                base = base * 8;
            }
            printf("%d            TOCTA            %18d₩n", linenum, value); break;
        case THEXA:
            base = 1;
            value = 0;
            for (int i = strlen(yytext) - 1; i >= 0; i--) {
                if (yytext[i] >= '0' && yytext[i] <= '9') {
                    value += (yytext[i] - 48) * base;
                    base = base * 16;
                }
                else if (yytext[i] >= 'A' && yytext[i] <= 'F') {
                    value += (yytext[i] - 55) * base;
                    base = base * 16;
                }
            }
            printf("%d            THEXA            %18d₩n", linenum, value); break;
        }
    }
    PrintHStable();
}
```

1.3 PrintError.c

```
/*
PrintError.c- 오류라고 인식된 토큰을 출력할때 어떤 에러메시지를 남길지 관리한다.
programmer-이경연, 박소현
date-19.04.26
*/
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include "glob.h"



//err에 저장된 값에 따라 다른 에러문이 출력되도록 해주는 함수
void PrintError(ERRORtypes err) {
        //String table의 크기보다 더 많은 값들이 저장된 경우
        if (err == overst) {
                printf("...Error... OVERFLOW");
                //                      PrintHStable();
        }
        else if (err == toolong)    //변수의 길이가 너무 긴 경우
                printf("...Error...  too long");
        //변수 이름이 숫자로 시작되는 경우
        else if (err == illid) {
                printf("...Error... Start with digit");
        }
        //정의되지않은 문자가 나올 경우
        else if (err == illsp) {
                printf("...Error... illegal char");
        }
}
```

1.4 Hstable.c

```
/*
PrintError.c- 오류라고 인식된 토큰을 출력할때 어떤 에러메시지를 남길지 관리한다.
programmer-이경연, 박소현
date-19.04.26
*/
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include "glob.h"



//err에 저장된 값에 따라 다른 에러문이 출력되도록 해주는 함수
void PrintError(ERRORtypes err) {
        //String table의 크기보다 더 많은 값들이 저장된 경우
        if (err == overst) {
                printf("...Error... OVERFLOW");
                //                  PrintHStable();
        }
        else if (err == toolong)   //변수의 길이가 너무 긴 경우
                printf("...Error...   too long");
        //변수 이름이 숫자로 시작되는 경우
        else if (err == illid) {
                printf("...Error... Start with digit");
        }
        //정의되지않은 문자가 나올 경우
        else if (err == illsp) {
                printf("...Error... illegal char");
        }
}
```

1.5 glob.h

```
#pragma once
/*
glob.h- 프로젝트에 필요한 글로벌 변수를 선언
```

```
programmer-이경연, 박소현
date-19.04.26
*/

#define STsize 300   //size of string table
#define HTsize 100     //size of hash table

#define FALSE 0
#define TRUE 1

//letter, digit, 그리고 seperator에 대해 특정 문자가 해당 변수에 속하는지 체크할 때 사용
#define isLetter(ch) (((ch) >= 'a' && (ch) <= 'z') || ((ch) >= 'A' && (ch) <= 'Z') || (ch) == '_')
#define isDigit(x) (((x)<='9' && (x)>='0'))
#define isSeperator(s) ((s) == ' ' | (s) == '₩n' | (s) == '₩t' | (s) == ';' | (s) == '.' | (s) == ',' | (s) ==
'?' | (s) == '!')

typedef struct HTentry *HTpointer;
typedef struct HTentry {
        int index;     //index of identifier in ST
        HTpointer next;     //pointer to next identifier
}HTentry;
//나올 수 있는 여러 종류의 에러타입들을 미리 지정해둔다.
enum errorTypes { noerror, illsp, illid, overst, toolong };
typedef enum errorTypes ERRORtypes;
HTpointer HT[HTsize];
char ST[STsize];

void PrintError(ERRORtypes err);
void PrintHeading();
void PrintHStable();
void ComputeHS(int nid, int nfree);
void LookupHS(int nid, int hscode);
void ADDHT(int hscode);

int nextid ;
int nextfree ;
int hashcode ;
int sameid ;
int found;

ERRORtypes err;
int line_num;

char *yytext_for_ht;
char input_char;
int indexyy;
int leng;
```

1.6 tokentypes.h

```

/*
tokentypes.h- 토큰들의 종류를 Enum으로 선언한 헤더.
programmer-이경연, 박소현
date-19.04.26
*/
enum tokentypes {

        TEOF,

        TCONST, TELSE, TIF, TINT, TRETURN, TVOID, TWHILE,

        TPLUS, TMINUS, TMUL, TDIV, TPERCENT,

        TADDASSIGN, TSUBASSIGN, TMULASSIGN, TDIVASSIGN, TMODASSIGN, TASSIGN,

        TNOT, TAND, TOR,

        TEQUAL, TNOTEQU, TLESS, TGREAT, TEQLESS, TEQGREAT,

        TINC, TDEC,



        TNEWLINE, TBLANK, TTAB,
	TBIGBRACE_L,	TBIGBRACE_R,	TMIDBRACE_L,	TMIDBRACE_R,	TSMALLBRACE_L,
TSMALLBRACE_R,
	TCOLON,

	TIDENT,	TSEMICOLON,TSTRING,TCHAR,



	TNUMBER, TREAL,	TOCTA, THEXA,

	TERROR_DIGIT_START, TERROR_ILL_CHAR_1, TERROR_ILL_CHAR_2, TLONGERR, TERROR
};
```

2.No error in the input data file

2.1 Input data_1

```
hi my nickname is ml23is
my height is 175.56 cm
         [JANE]
while(true)
//test
```

```
--------------------------------------------------------------------------------------------------------------
------
Line number                 Token type                          Token                         ST-index
--------------------------------------------------------------------------------------------------------------
------

1                  TIDENT                                   hi                      0
1                  TIDENT                                   my                      3
1                  TIDENT                             nickname                      6
1                  TIDENT                                   is                      15
1                  TIDENT                               ml23is                      18
2                  TIDENT                                   my                      25
2                  TIDENT                               height                      25
2                  TIDENT                                   is                      32
2                  TREAL                               175.56
2                  TIDENT                                   cm                      32
3                  TLARGE_L                                   [
3                  TIDENT                                 JANE                      35
3                  TLARGE_R                                   ]
4                  TWHILE                                 while
4                  TSAMLL_L                                   (
4                  TIDENT                                 true                      40
4                  TSMALL_R                                   )
```

2.2 Input data_2

```
The ||bus  is red
{Tom} is a (cat)
Sam1! ha%=s a bad //leg
Pam% has;a         dog,"test="
```

```
--------------------------------------------------------------------------------------------------------------
------
Line number                Token type                          Token                          ST-index
--------------------------------------------------------------------------------------------------------------
------

1                  TIDENT                                  The                      0
1                  TOR                                      ||
1                  TIDENT                                  bus                      4
1                  TIDENT                                   is                      8
1                  TIDENT                                  red                      11
2                  TMID_L                                    {
2                  TIDENT                                  Tom                      15
2                  TMID_R                                    }
2                  TIDENT                                   is                      19
2                  TIDENT                                    a                      19
2                  TSAMLL_L                                    (
2                  TIDENT                                  cat                      21
2                  TSMALL_R                                    )
3                  TIDENT                                 Sam1                      25
3                  TNOT                                      !
3                  TIDENT                                   ha                      30
3                  TMODASSIGN                               %=
3                  TIDENT                                    s                      33
3                  TIDENT                                    a                      35
3                  TIDENT                                  bad                      35
4                  TIDENT                                  Pam                      39
4                  TPERCENT                                      %
4                  TIDENT                                  has                      43
4                  TSEMICOLON                                    ;
4                  TIDENT                                    a                      47
4                  TIDENT                                  dog                      47
4                  TCOLON                                    ,
4                  TSTRING                              "test="
```

2.3 Input data_3

```
THIS CREature has ( 5 ) legs
||
dog != {cat || hippo}
return ans
/*just for fun*/
```

```
-----------------------------------------------------------------------------------------------------------------
Line number                    Token type                            Token                         ST-index
-----------------------------------------------------------------------------------------------------------------


1                   TIDENT                              THIS                      0
1                   TIDENT                          CREature                      5
1                   TIDENT                               has                      14
1                   TSAMLL_L                               (
1                   TNUMBER                                5
1                   TSMALL_R                               )
1                   TIDENT                              legs                      18
2                   TOR                                  ||
3                   TIDENT                               dog                       23
3                   TNOTEQU                                !=
3                   TMID_L                                {
3                   TIDENT                               cat                      27
3                   TOR                                  ||
3                   TIDENT                             hippo                       31
3                   TMID_R                                 }
4                   TRETURN                               return
4                   TIDENT                               ans                      37
```

3.With error in the input data file

3.1 Input data_1

```
Let       s -= keep th3e exaMples simple !=
0x12      ex₩a3Mple && data should == not ha4ve err_ors
Do you0x23 0x23SUPER it longkdjsljfksdj&*
'@'@
3Asdsd
```

```
--------------------------------------------------------------------------------------------------------------
------
Line number                 Token type                           Token                          ST-index
--------------------------------------------------------------------------------------------------------------
------

1                  TIDENT                                        Let                       0
1                  TIDENT                                          s                       4
1                  TSUBASSIGN                                     -=
1                  TIDENT                                       keep                       6
1                  TIDENT                                       th3e                       11
1                  TIDENT                                   exaMples                       16
1                  TIDENT                                     simple                       25
1                  TNOTEQU                                        !=
2                  THEXA                                       18
2                  TIDENT                                         ex                       32
...Error... illegal char      line number[2]     =>  ₩
2                  TIDENT                                     a3Mple                       35
2                  TAND                                           &&
2                  TIDENT                                       data                       42
2                  TIDENT                                     should                       47
2                  TEQUAL                                         ==
2                  TIDENT                                        not                       54
2                  TIDENT                                      ha4ve                       58
2                  TIDENT                                    err_ors                       64
3                  TIDENT                                         Do                       72
3                  TIDENT                                   you0x23                        75
3                  THEXA                                       35
3                  TIDENT                                      SUPER                       83
3                  TIDENT                                         it                       89
...Error...  too long         line number[3]     =>  longkdjsljfksdj
...Error... illegal char      line number[3]     =>  &
3                  TMUL                                            *
4                  TCHAR                                       '@'
...Error... illegal char      line number[4]     =>  @
...Error... Start with digit  line number[5]     =>  3Asdsd
```

3.2 Input data_2

```
'string'
's'
"string"
//'STRING'@@
```

```
------------------------------------------------------------------------------------------------------------------
------
Line number                  Token type                           Token                           ST-index
------------------------------------------------------------------------------------------------------------------
------

...Error... illegal char      line number[1]     =>  '
1                 TIDENT                               string                          0
1                 TCHAR                                  '
'
1                 TIDENT                                    s                          7
...Error... illegal char      line number[1]     =>  '
2                 TSTRING                             "string"
```

3.3 Input data_3

```
While(true){


          12.55kk
                    1255kk
          "12.55KK"
          }
/*
END TOOOOOLOOOONGGGEKJGKEJGKEJ!!
*/
longlonglong71616;
```

```
--------------------------------------------------------------------------------------------------------------------
Line number                  Token type                              Token                          ST-index
--------------------------------------------------------------------------------------------------------------------


1                   TIDENT                                  While                          0
1                   TSAMLL_L                                       (
1                   TIDENT                                   true                          6
1                   TSMALL_R                                       )
1                   TMID_L                                       {
3                   TREAL                                 12.55
3                   TIDENT                                    kk                           11
...Error... Start with digit          line number[4]      =>   1255kk
5                   TSTRING                              "12.55KK"
6                   TMID_R                                       }
...Error...   too long     line number[8]      =>   longlonglong71616
8                   TSEMICOLON                                       ;
```

4.Data file given from professor

4.1 Input data_1

```
int main(void)          {
                //2019 compiler!!

                const int a = 8;
                int A = 0x12 + 011; //hex + oct
                while(A >= 10){
                }
                return 0;
}
```

```
----------------------------------------------------------------------------------------------------------------
Line number                 Token type                           Token                          ST-index
----------------------------------------------------------------------------------------------------------------


1                  TINT                                  int
1                  TIDENT                              main                       0
1                  TSAMLL_L                                (
1                  TVOID                                 void
1                  TSMALL_R                                )
1                  TMID_L                                {
4                TCONST                              const
4                  TINT                                  int
4                  TIDENT                                 a                        5
4                  TASSIGN                              =
4                  TNUMBER                                8
4                  TSEMICOLON                               ;
5                  TINT                                  int
5                  TIDENT                                 A                        7
5                  TASSIGN                              =
5                  THEXA                                18
5                  TPLUS                                   +
5                  TOCTA                                 9
5                  TSEMICOLON                               ;
6                  TWHILE                              while
6                  TSAMLL_L                                (
6                  TIDENT                                 A                        9
6                  TEQGREAT                                >=
6                  TNUMBER                               10
6                  TSMALL_R                                )
6                  TMID_L                                {
7                  TMID_R                                }
8                  TRETURN                              return
8                  TNUMBER                                0
```

8	TSEMICOLON	;
9	TMID_R	}

4.2 Input data_2

```
#include <stdio.h>

void main(VOID) {

          //string str1 = "";
          string str1 = "₩"";
          string str2 = "blah blah";
          if( !flag )
                    printf("%s₩n", str1 + str2 + str1;);
}
```

```
-----------------------------------------------------------------------------------------------------------------
Line number                Token type                          Token                         ST-index
-----------------------------------------------------------------------------------------------------------------


1                 TIDENT                              While                         0
1                 TSAMLL_L                                  (
1                 TIDENT                               true                         6
1                 TSMALL_R                                  )
1                 TMID_L                                  {
3                 TREAL                             12.55
3                 TIDENT                                kk                          11
...Error... Start with digit         line number[4]      =>   1255kk
5                 TSTRING                           "12.55KK"
6                 TMID_R                                  }
...Error...   too long    line number[8]      =>   longlonglong71616
8                 TSEMICOLON                                   ;
```

4.3 Input data_3

```
/* average of 2integers */
float average(int a, int b)
{
            int tooLongIdent = 0X13;
            float result = (a + b) / 2.0000f;
            return result;
}
```

```
-------------------------------------------------------------------------------------------------------------------
Line number              Token type                    Token                        ST-index
-------------------------------------------------------------------------------------------------------------------


2                TIDENT                        float                    0
2                TIDENT                       average                    6
2                TSAMLL_L                           (
2                TINT                            int
2                TIDENT                           a                      14
2                TCOLON                            ,
2                TINT                            int
2                TIDENT                           b                      16
2                TSMALL_R                           )
3                TMID_L                           {
4                TINT                            int
...Error...   too long    line number[4]     =>   tooLongIdent
4                TASSIGN                         =
4                THEXA                           19
4                TSEMICOLON                           ;
5                TIDENT                        float                    18
5                TIDENT                       result                    18
5                TASSIGN                         =
5                TSAMLL_L                           (
5                TIDENT                           a                      25
5                TPLUS                             +
5                TIDENT                           b                      25
5                TSMALL_R                           )
5                TDIV                            /
5                TREAL                      2.0000
5                TIDENT                           f                     25
5                TSEMICOLON                           ;
6                TRETURN                          return
6                TIDENT                       result                    27
6                TSEMICOLON                           ;
7                TMID_R                           }
```

4.4 Input data_4

```
2 x 12=24 >011
31.2456~~~IsBiggerThan 30!
            , Visit"₩₩₩₩₩₩." + "ewha" + "." + "ac.kr" ^^
else~
            "eportal //.ewha.ac.kr
```

```
-----------------------------------------------------------------------------------------------------------------
Line number               Token type                          Token                            ST-index
-----------------------------------------------------------------------------------------------------------------


1                  TNUMBER                                  2
1                  TIDENT                                  x                       0
1                  TNUMBER                                 12
1                  TASSIGN                                =
1                  TNUMBER                                 24
1                  TGREAT                                  >
1                  TOCTA                                  9
2                  TREAL                           31.2456
...Error... illegal char   line number[2]      =>   ~
...Error... illegal char   line number[2]      =>   ~
...Error... illegal char   line number[2]      =>   ~
...Error...   too long     line number[2]      =>   IsBiggerThan
2                  TNUMBER                                 30
2                  TNOT                                     !
3                  TCOLON                                   ,
3                  TIDENT                              Visit                      2
3                  TSTRING                           "₩₩₩₩₩₩."
3                  TPLUS                                    +
3                  TSTRING                              "ewha"
3                  TPLUS                                    +
3                  TSTRING                                 "."
3                  TPLUS                                    +
3                  TSTRING                             "ac.kr"
...Error... illegal char   line number[3]      =>   ^
...Error... illegal char   line number[3]      =>   ^
4                  TELSE                                  else
...Error... illegal char   line number[4]      =>   ~
...Error... illegal char   line number[5]      =>   "
5                  TIDENT                            eportal                      8
```

4.5 Input data_

```
int 2arr[2] = {0xAB, 0Xc2};
void main(){


        SU@M( arr[0], arr[1]); // add
"} 21.
```

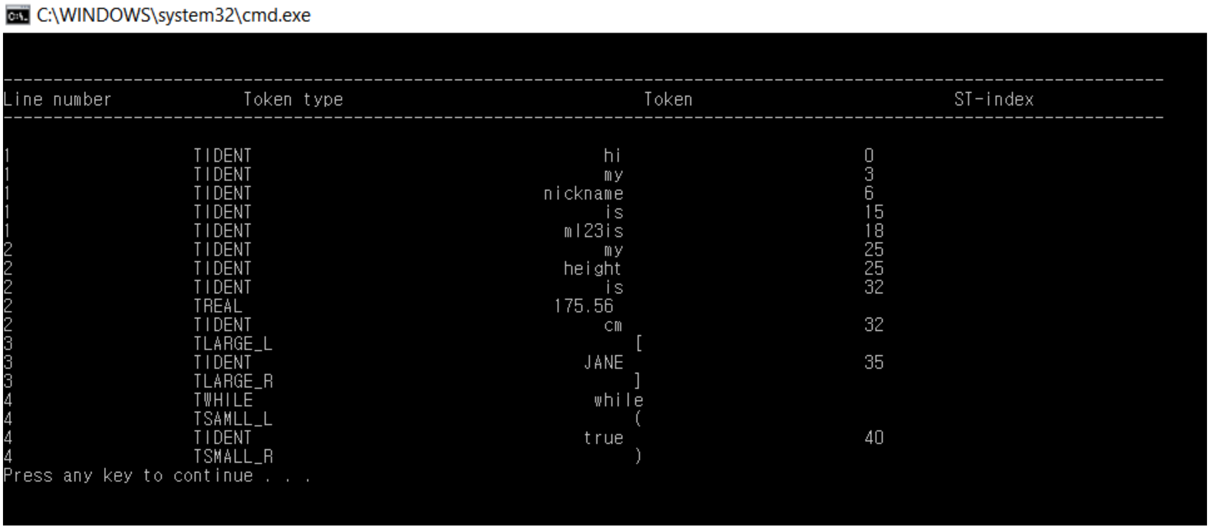
```
----------------------------------------------------------------------------------------------
------------------------
Line number              Token type                               Token
ST-index
----------------------------------------------------------------------------------------------
------------------------

1                  TINT                                     int
...Error... Start with digit      line number[1]     =>  2arr
1                  TLARGE_L                                    [
1                  TNUMBER                                    2
1                  TLARGE_R                                    ]
1                  TASSIGN                                =
1                  TMID_L                                   {
1                  THEXA                                 171
1                  TCOLON                                   ,
1                  THEXA                                   2
1                  TMID_R                                   }
1                  TSEMICOLON                                   ;
2                  TVOID                                   void
2                  TIDENT                                main                        0
2                  TSAMLL_L                                    (
2                  TSMALL_R                                    )
2                  TMID_L                                   {
4                  TIDENT                                  SU                        5
...Error... illegal char  line number[4]     =>  @
4                  TIDENT                                   M                        8
4                  TSAMLL_L                                    (
4                  TIDENT                                 arr                        10
4                  TLARGE_L                                    [
4                  TNUMBER                                    0
4                  TLARGE_R                                    ]
4                  TCOLON                                   ,
4                  TIDENT                                 arr                        14
4                  TLARGE_L                                    [
4                  TNUMBER                                    1
4                  TLARGE_R                                    ]
4                  TSMALL_R                                    )
4                  TSEMICOLON                                   ;
...Error... illegal char  line number[5]     =>  "
5                  TMID_R                                   }
5                  TNUMBER                                   21
...Error... illegal char  line number[5]     =>  .
```

5. Screenshots

1. No error in the input data file

1.1 Input_data1

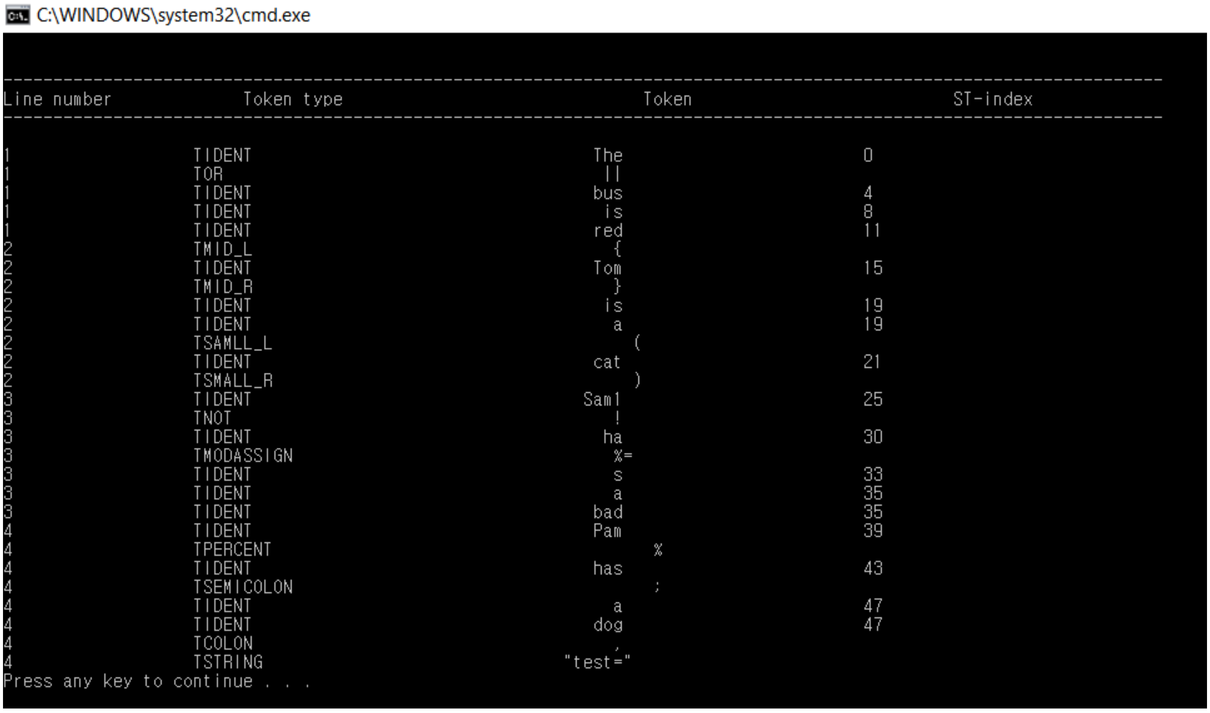


C:\WINDOWS\system32\cmd.exe

```
--------------------------------------------------------------------------------------------------------------------
Line number             Token type                              Token                          ST-index
--------------------------------------------------------------------------------------------------------------------

1                  TIDENT                                   hi                        0
1                  TIDENT                                   my                        3
1                  TIDENT                             nickname                        6
1                  TIDENT                                   is                        15
1                  TIDENT                               ml23is                        18
2                  TIDENT                                   my                        25
2                  TIDENT                               height                        25
2                  TIDENT                                   is                        32
2                  TREAL                               175.56
2                  TIDENT                                   cm                        32
3                  TLARGE_L                                    [
3                  TIDENT                                 JANE                        35
3                  TLARGE_R                                    ]
4                  TWHILE                                  while
4                  TSAMLL_L                                    (
4                  TIDENT                                 true                        40
4                  TSMALL_R                                    )
Press any key to continue . . .
```

1.2 Input_data2

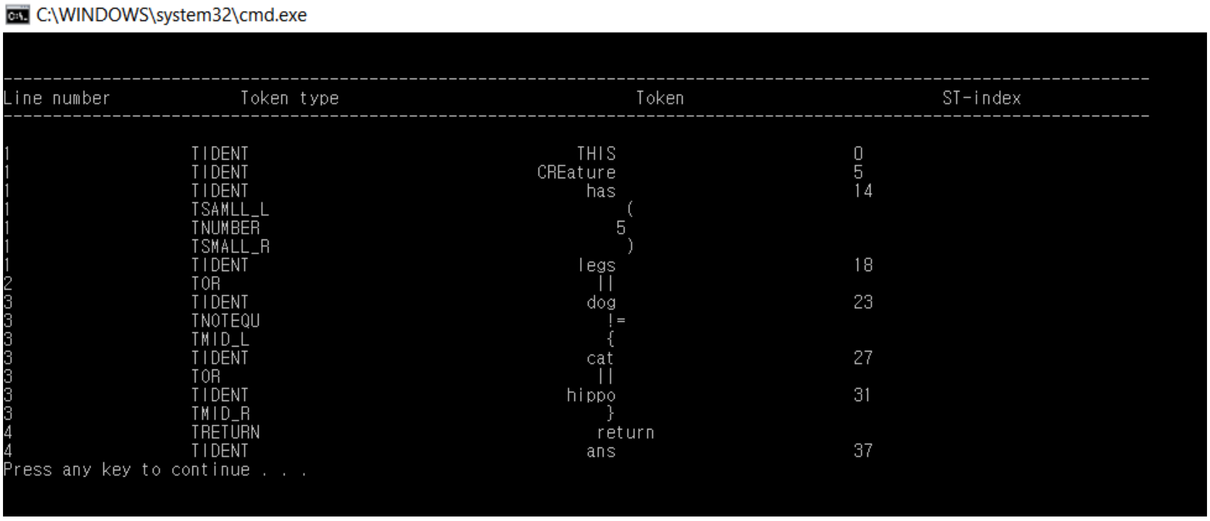


C:\WINDOWS\system32\cmd.exe

```
--------------------------------------------------------------------------------------------------------------------
Line number             Token type                              Token                          ST-index
--------------------------------------------------------------------------------------------------------------------

1                  TIDENT                                  The                        0
1                  TOR                                      ||
1                  TIDENT                                  bus                        4
1                  TIDENT                                   is                        8
1                  TIDENT                                  red                        11
2                  TMID_L                                    {
2                  TIDENT                                  Tom                        15
2                  TMID_R                                    }
2                  TIDENT                                   is                        19
2                  TIDENT                                    a                        19
2                  TSAMLL_L                                    (
2                  TIDENT                                  cat                        21
2                  TSMALL_R                                    )
3                  TIDENT                                 Sam1                        25
3                  TNOT                                      !
3                  TIDENT                                   ha                        30
3                  TMODASSIGN                                %=
3                  TIDENT                                    s                        33
3                  TIDENT                                    a                        35
3                  TIDENT                                  bad                        35
3                  TIDENT                                  Pam                        39
4                  TPERCENT                                      %
4                  TIDENT                                  has                        43
4                  TSEMICOLON                                    ;
4                  TIDENT                                    a                        47
4                  TIDENT                                  dog                        47
4                  TCOLON                                    ,
4                  TSTRING                              "test="
Press any key to continue . . .
```

1.3 Input_data3

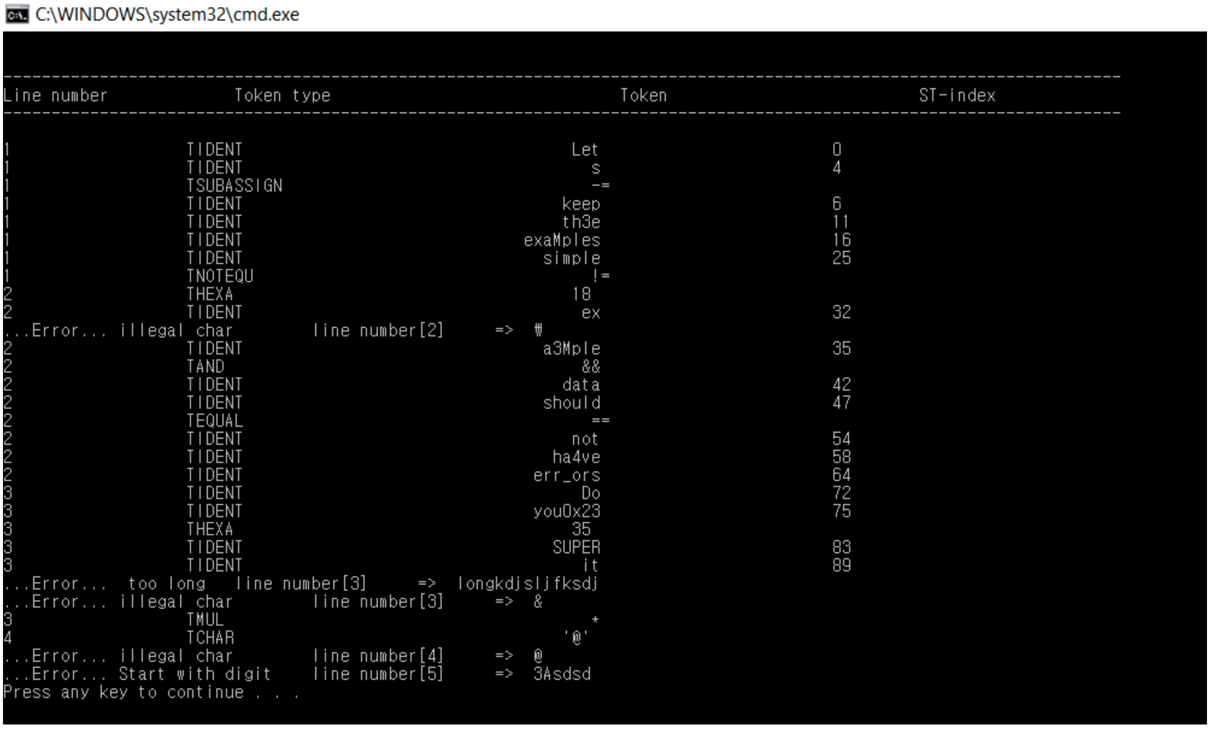


```
---------------------------------------------------------------------------------------------------------------------
Line number             Token type                               Token                          ST-index
---------------------------------------------------------------------------------------------------------------------

1                  TIDENT                                  THIS                        0
1                  TIDENT                              CREature                        5
1                  TIDENT                                   has                        14
1                  TSAMLL_L                                     (
1                  TNUMBER                                     5
1                  TSMALL_R                                     )
1                  TIDENT                                  legs                        18
2                  TOR                                       ||
3                  TIDENT                                   dog                        23
3                  TNOTEQU                                    !=
3                  TMID_L                                     {
3                  TIDENT                                   cat                        27
3                  TOR                                       ||
3                  TIDENT                                 hippo                        31
3                  TMID_R                                     }
4                  TRETURN                                   return
4                  TIDENT                                   ans                        37
Press any key to continue . . .
```

2. With error in the input data file

2.1 Input_data1

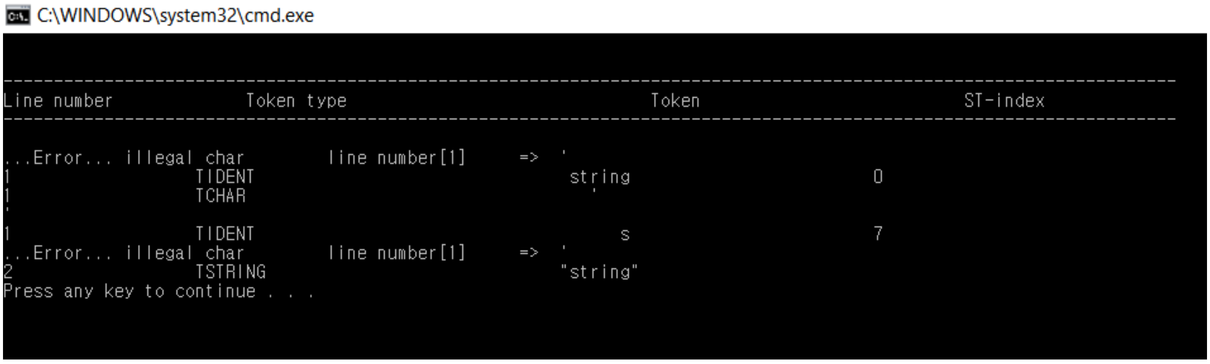


C:\WINDOWS\system32\cmd.exe

```
--------------------------------------------------------------------------------------------------------------
Line number              Token type                                      Token                          ST-index
--------------------------------------------------------------------------------------------------------------

1                   TIDENT                                      Let                         0
1                   TIDENT                                        s                         4
1                   TSUBASSIGN                                    -=
1                   TIDENT                                     keep                         6
1                   TIDENT                                     th3e                         11
1                   TIDENT                                 exaMples                         16
1                   TIDENT                                   simple                         25
1                   TNOTEQU                                       !=
2                   THEXA                                       18
2                   TIDENT                                       ex                         32
...Error... illegal char        line number[2]      =>  ₩
2                   TIDENT                                   a3Mple                         35
2                   TAND                                         &&
2                   TIDENT                                     data                         42
2                   TIDENT                                   should                         47
2                   TEQUAL                                        ==
2                   TIDENT                                      not                         54
2                   TIDENT                                    ha4ve                         58
2                   TIDENT                                  err_ors                         64
3                   TIDENT                                       Do                         72
3                   TIDENT                                  you0x23                         75
3                   THEXA                                       35
3                   TIDENT                                    SUPER                         83
3                   TIDENT                                       it                         89
...Error...  too long   line number[3]      =>  longkdjsljfksdj
...Error... illegal char        line number[3]      =>  &
3                   TMUL                                           *
4                   TCHAR                                      '@'
...Error... illegal char        line number[4]      =>  @
...Error... Start with digit    line number[5]      =>  3Asdsd
Press any key to continue . . .
```

2.2 Input_data2



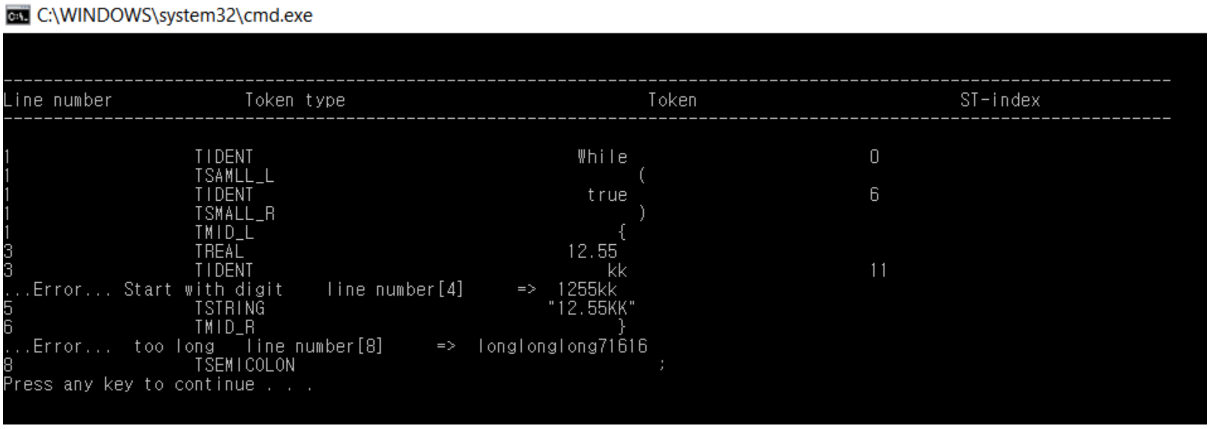
C:\WINDOWS\system32\cmd.exe

```
--------------------------------------------------------------------------------------------------------------------
Line number              Token type                                      Token                             ST-index
--------------------------------------------------------------------------------------------------------------------

...Error... illegal char        line number[1]      =>  '
1                   TIDENT                                   string                         0
1                   TCHAR                                       '
'

1                   TIDENT                                        s                         7
...Error... illegal char        line number[1]      =>  '
2                   TSTRING                                "string"
Press any key to continue . . .
```

2.3 Input_data3



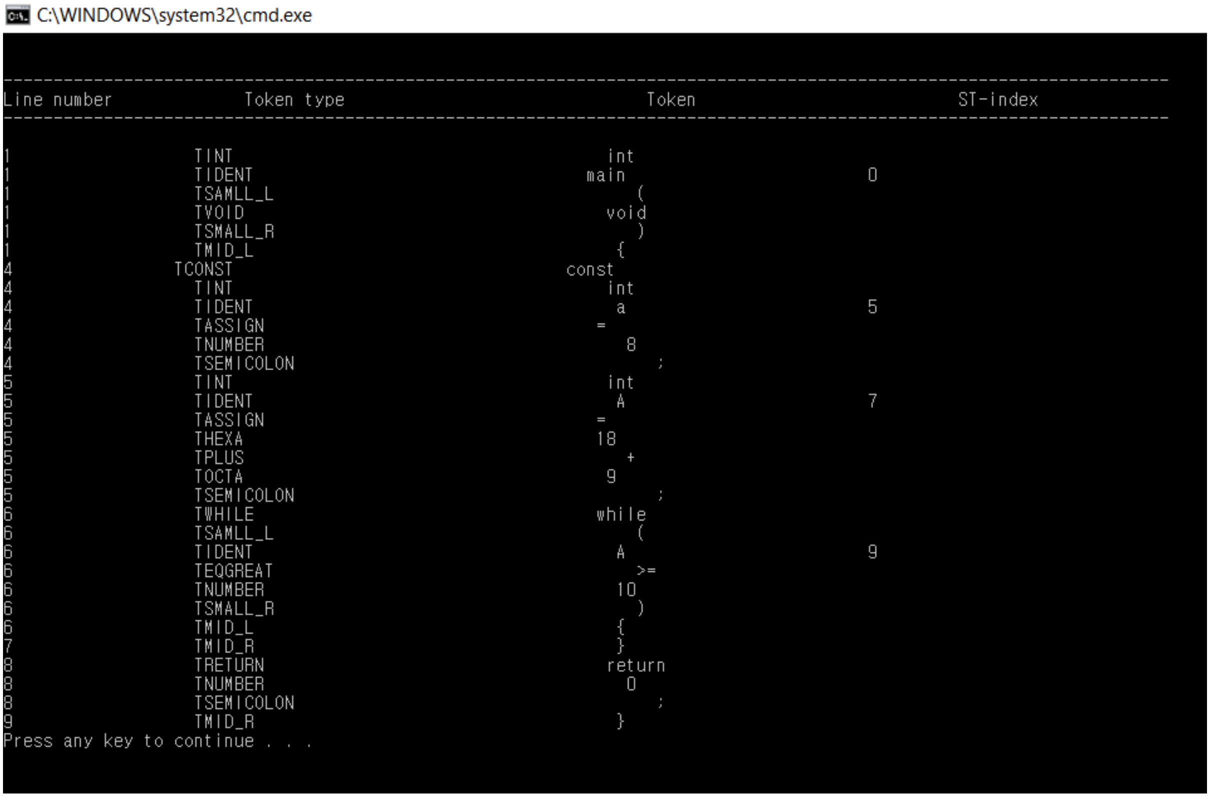
C:\WINDOWS\system32\cmd.exe

```
---------------------------------------------------------------------------------------------------------------------
Line number             Token type                              Token                          ST-index
---------------------------------------------------------------------------------------------------------------------

1                  TIDENT                                While                         0
1                  TSAMLL_L                                     (
1                  TIDENT                                 true                         6
1                  TSMALL_R                                     )
1                  TMID_L                                     {
3                  TREAL                                12.55
3                  TIDENT                                    kk                        11
...Error... Start with digit    line number[4]     =>  1255kk
5                  TSTRING                            "12.55KK"
6                  TMID_R                                     }
...Error...  too long   line number[8]     =>  longlonglong71616
8                  TSEMICOLON                                     ;
Press any key to continue . . .
```

3. Data file given from Professor

3.1 testdata1

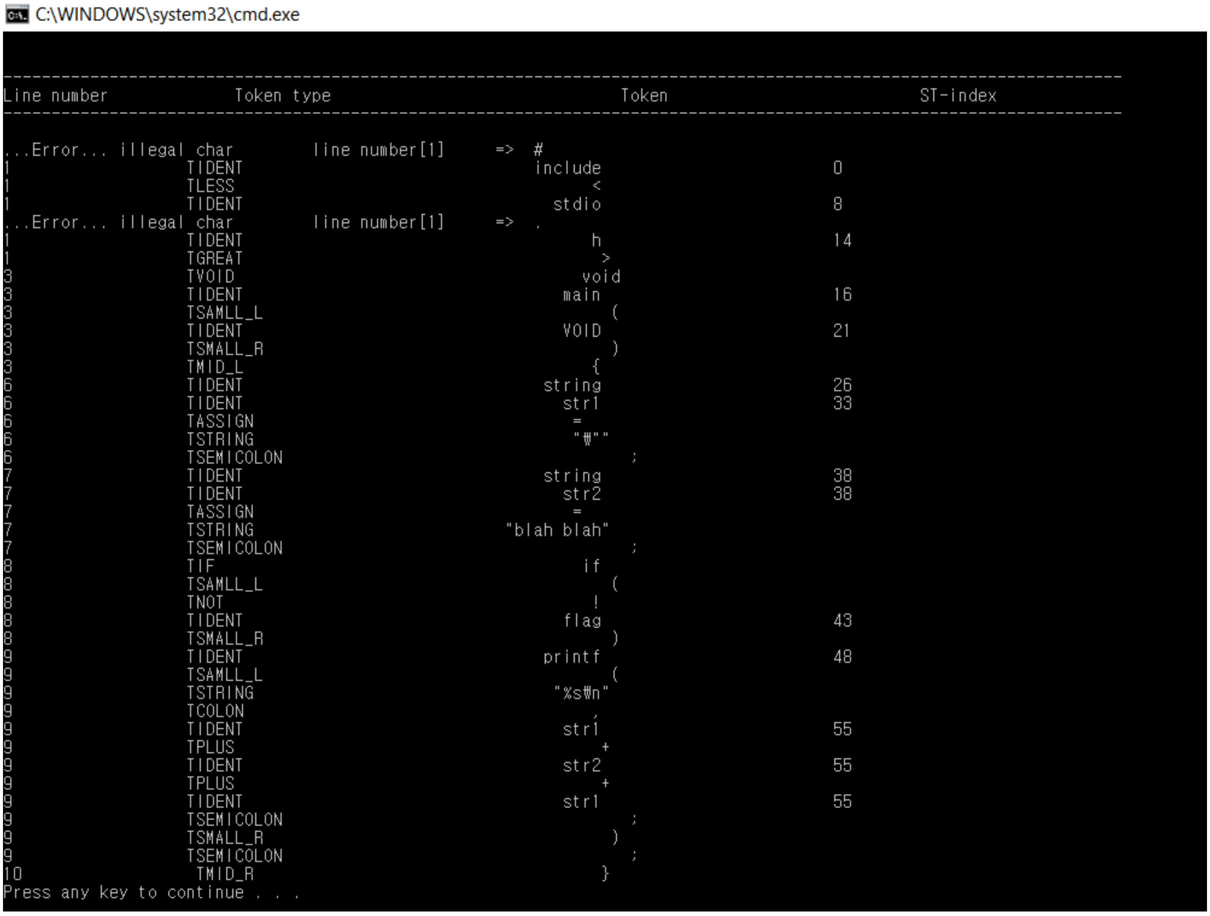


C:\WINDOWS\system32\cmd.exe

```
---------------------------------------------------------------------------------------------------------------------
Line number             Token type                              Token                          ST-index
---------------------------------------------------------------------------------------------------------------------

1                  TINT                                     int
1                  TIDENT                                 main                        0
1                  TSAMLL_L                                    (
1                  TVOID                                    void
1                  TSMALL_R                                    )
1                  TMID_L                                    {
4                TCONST                                 const
4                  TINT                                     int
4                  TIDENT                                    a                        5
4                  TASSIGN                                 =
4                  TNUMBER                                    8
4                  TSEMICOLON                                    ;
5                  TINT                                     int
5                  TIDENT                                    A                        7
5                  TASSIGN                                 =
5                  THEXA                                   18
5                  TPLUS                                      +
5                  TOCTA                                    9
5                  TSEMICOLON                                    ;
6                  TWHILE                                  while
6                  TSAMLL_L                                    (
6                  TIDENT                                    A                        9
6                  TEQGREAT                                    >=
6                  TNUMBER                                   10
6                  TSMALL_R                                    )
6                  TMID_L                                    {
7                  TMID_R                                    }
8                  TRETURN                                  return
8                  TNUMBER                                    0
8                  TSEMICOLON                                    ;
9                  TMID_R                                    }
Press any key to continue . . .
```

3.2 testdata2

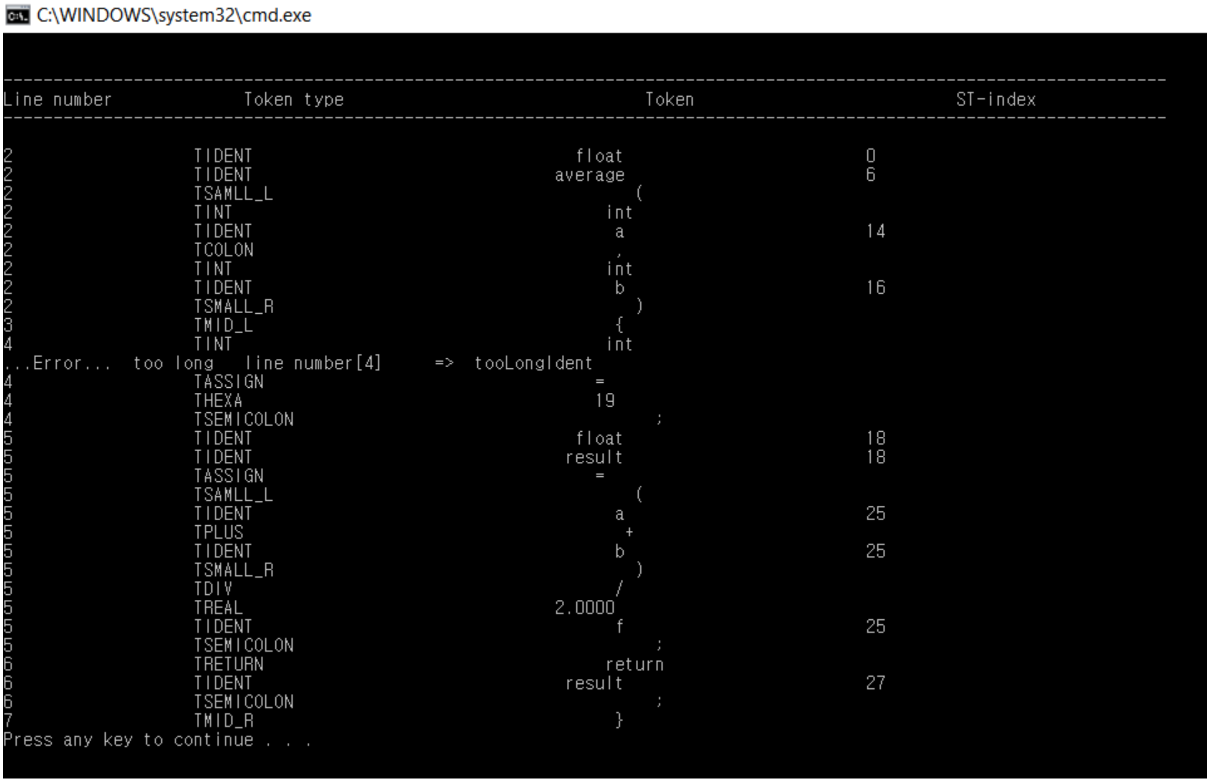


C:\WINDOWS\system32\cmd.exe

```
---------------------------------------------------------------------------------------------------------------------
Line number             Token type                              Token                          ST-index
---------------------------------------------------------------------------------------------------------------------

...Error... illegal char        line number[1]     =>  #
1                  TIDENT                              include                         0
1                  TLESS                                     <
1                  TIDENT                                stdio                         8
...Error... illegal char        line number[1]     =>  .
1                  TIDENT                                    h                         14
1                  TGREAT                                     >
3                  TVOID                                    void
3                  TIDENT                                 main                         16
3                  TSAMLL_L                                    (
3                  TIDENT                                 VOID                         21
3                  TSMALL_R                                    )
3                  TMID_L                                    {
6                  TIDENT                               string                         26
6                  TIDENT                                 str1                         33
6                  TASSIGN                                 =
6                  TSTRING                                  "₩""
6                  TSEMICOLON                                    ;
7                  TIDENT                               string                         38
7                  TIDENT                                 str2                         38
7                  TASSIGN                                 =
7                  TSTRING                          "blah blah"
7                  TSEMICOLON                                    ;
8                  TIF                                      if
8                  TSAMLL_L                                    (
8                  TNOT                                      !
8                  TIDENT                                 flag                         43
8                  TSMALL_R                                    )
9                  TIDENT                               printf                         48
9                  TSAMLL_L                                    (
9                  TSTRING                                "%s₩n"
9                  TCOLON                                    ,
9                  TIDENT                                 str1                         55
9                  TPLUS                                      +
9                  TIDENT                                 str2                         55
9                  TPLUS                                      +
9                  TIDENT                                 str1                         55
9                  TSEMICOLON                                    ;
9                  TSMALL_R                                    )
9                  TSEMICOLON                                    ;
10                  TMID_R                                    }
Press any key to continue . . .
```

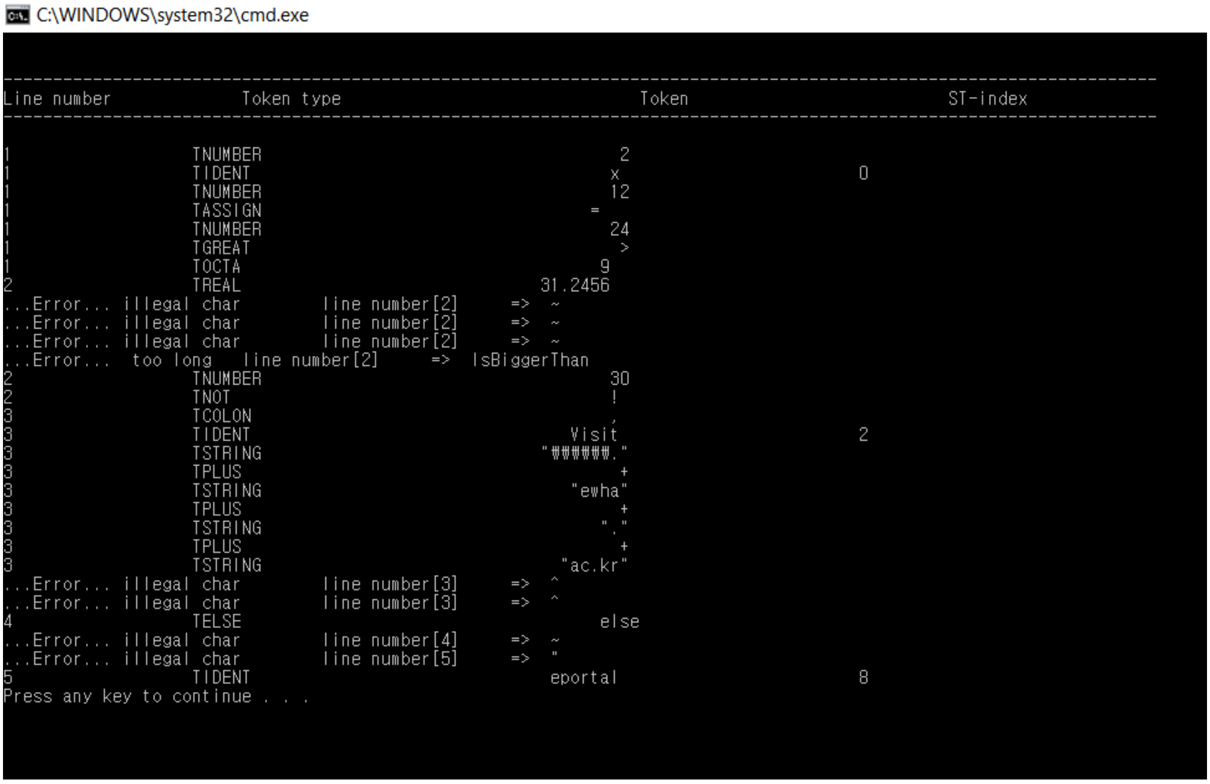
3.3 testdata3



```
--------------------------------------------------------------------------------------------------------------------
Line number             Token type                              Token                          ST-index
--------------------------------------------------------------------------------------------------------------------

2                  TIDENT                                float                        0
2                  TIDENT                              average                        6
2                  TSAMLL_L                                    (
2                  TINT                                     int
2                  TIDENT                                    a                        14
2                  TCOLON                                    ,
2                  TINT                                     int
2                  TIDENT                                    b                        16
2                  TSMALL_R                                    )
3                  TMID_L                                    {
4                  TINT                                     int
...Error...  too long   line number[4]     =>  tooLongIdent
4                  TASSIGN                                 =
4                  THEXA                                   19
4                  TSEMICOLON                                    ;
5                  TIDENT                                float                        18
5                  TIDENT                               result                        18
5                  TASSIGN                                 =
5                  TSAMLL_L                                    (
5                  TIDENT                                    a                        25
5                  TPLUS                                      +
5                  TIDENT                                    b                        25
5                  TSMALL_R                                    )
5                  TDIV                                      /
5                  TREAL                               2.0000
5                  TIDENT                                    f                        25
5                  TSEMICOLON                                    ;
6                  TRETURN                                  return
6                  TIDENT                               result                        27
6                  TSEMICOLON                                    ;
7                  TMID_R                                    }
Press any key to continue . . .
```

3.4 testdata4

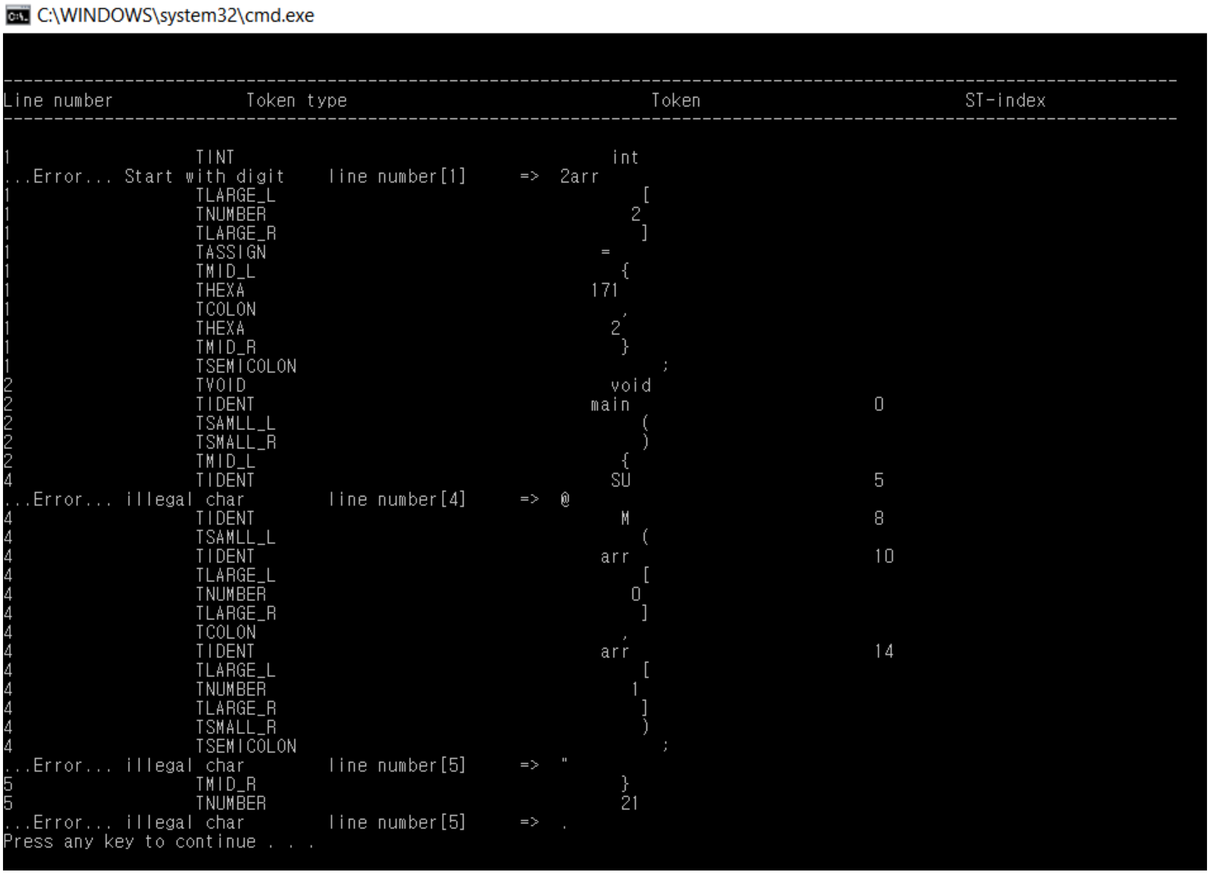


C:\WINDOWS\system32\cmd.exe

```
--------------------------------------------------------------------------------------------------------------------
Line number             Token type                              Token                          ST-index
--------------------------------------------------------------------------------------------------------------------

1                  TNUMBER                                    2
1                  TIDENT                                    x                        0
1                  TNUMBER                                   12
1                  TASSIGN                                 =
1                  TNUMBER                                   24
1                  TGREAT                                     >
1                  TOCTA                                    9
2                  TREAL                              31.2456
...Error... illegal char        line number[2]     =>  ~
...Error... illegal char        line number[2]     =>  ~
...Error... illegal char        line number[2]     =>  ~
...Error...  too long   line number[2]     =>  IsBiggerThan
2                  TNUMBER                                   30
2                  TNOT                                      !
3                  TCOLON                                    ,
3                  TIDENT                                Visit                        2
3                  TSTRING                            "₩₩₩₩₩₩."
3                  TPLUS                                      +
3                  TSTRING                               "ewha"
3                  TPLUS                                      +
3                  TSTRING                                  "."
3                  TPLUS                                      +
3                  TSTRING                              "ac.kr"
...Error... illegal char        line number[3]     =>  ^
...Error... illegal char        line number[3]     =>  ^
4                  TELSE                                    else
...Error... illegal char        line number[4]     =>  ~
...Error... illegal char        line number[5]     =>  "
5                  TIDENT                              eportal                        8
Press any key to continue . . .
```

3.5 testdata5



C:\WINDOWS\system32\cmd.exe

```
------------------------------------------------------------------------------------------------------------------------
Line number              Token type                                        Token                           ST-index
------------------------------------------------------------------------------------------------------------------------

1                   TINT                                          int
...Error... Start with digit    line number[1]      =>  2arr
1                   TLARGE_L                                         [
1                   TNUMBER                                         2
1                   TLARGE_R                                         ]
1                   TASSIGN                                      =
1                   TMID_L                                         {
1                   THEXA                                       171
1                   TCOLON                                         ,
1                   THEXA                                         2
1                   TMID_R                                         }
1                   TSEMICOLON                                         ;
2                   TVOID                                         void
2                   TIDENT                                      main                        0
2                   TSAMLL_L                                         (
2                   TSMALL_R                                         )
2                   TMID_L                                         {
4                   TIDENT                                        SU                        5
...Error... illegal char        line number[4]      =>  @
4                   TIDENT                                         M                        8
4                   TSAMLL_L                                         (
4                   TIDENT                                       arr                        10
4                   TLARGE_L                                         [
4                   TNUMBER                                         0
4                   TLARGE_R                                         ]
4                   TCOLON                                         ,
4                   TIDENT                                       arr                        14
4                   TLARGE_L                                         [
4                   TNUMBER                                         1
4                   TLARGE_R                                         ]
4                   TSMALL_R                                         )
4                   TSEMICOLON                                         ;
...Error... illegal char        line number[5]      =>  "
5                   TMID_R                                         }
5                   TNUMBER                                        21
...Error... illegal char        line number[5]      =>  .
Press any key to continue . . .
```