

# Compiler Design Laboratory (CS 753)

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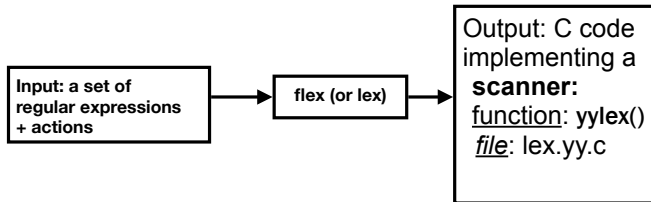
lex/flex

- ▶ We refer to the tool as Lex compiler , and to its input specification as the Lex language.

## flex (and lex): Overview

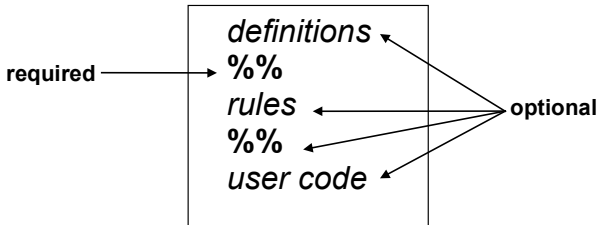
### Scanner generator

- Helps write programs whose control flow is directed by instances of regular expressions in the input stream.



## flex input format

A Lex program (the lex.l file ) consists of three parts:



- ▶ Shortest possible legal flex input:

%%

## Definitions

- ▶ name definitions, each of the form

*name definition*

e.g.:

- ▶ name definitions, each of the form

<i>DIGIT</i>	<i>[0-9]</i>
CommentStart	<i>“/*”</i>
ID	<i>[a-zA-Z][a-zA-Z0-9]*</i>

- ▶ stuff to be copied verbatim into the flex output enclosed in *%{ ..... }%*, or (e.g., declarations, #includes):

## Lex Rules

- ▶ The rules portion of the input contains a sequence of rules.
- ▶ Each rule has the following form

*Regular\_Expression* *Action*

where:

- ▶ *Regular\_Expression* describes a pattern to be matched on the input.
- ▶ *action* must begin on the same line.

## Example of Lex Rules

*< Reg.Exp > < action >*

Pattern	Action
int	printf("Keyword: INTEGER ");
[0-9]+	printf("Number ");

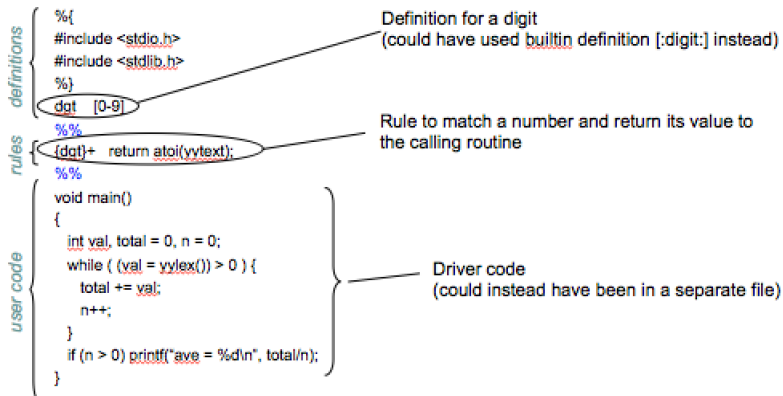


## Patterns

- ▶ Essentially, extended regular expressions.
  - ▶ Syntax: similar to *grep* (see *man* page).
  - ▶ `<< EOF >>` to match “end of file”.
- ▶ Character classes:
  - `[:alpha:]`, `[:digit:]`, `[:alnum:]`, `[:space:]`, etc. (see *man* page).
- ▶ `{name}` where *name* was defined earlier.

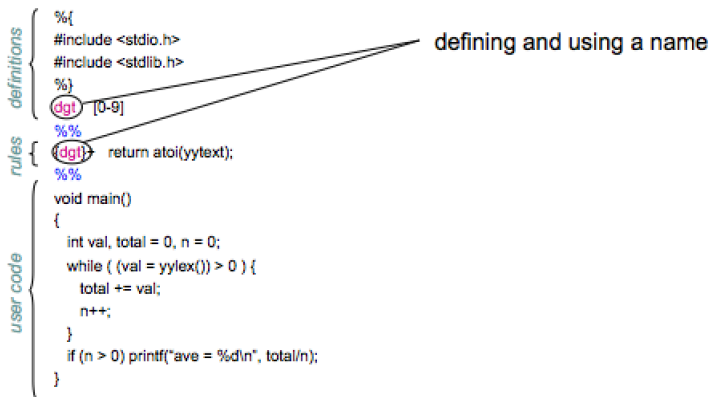
## Example

A flex program to read a file of (positive) integers and compute the average:



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A flex program to read a file of (positive) integers and compute the average:

```
%{
#include <stdio.h>
#include <stdlib.h>
}%
(digit) [0-9]
%%
(digit) return atoi(yytext);
%%

void main()
{
    int val, total = 0, n = 0;
    while ( (val = yylex()) > 0 ) {
        total += val;
        n++;
    }
    if (n > 0) printf("ave = %d\n", total/n);
}
```

**definitions**

**rules**

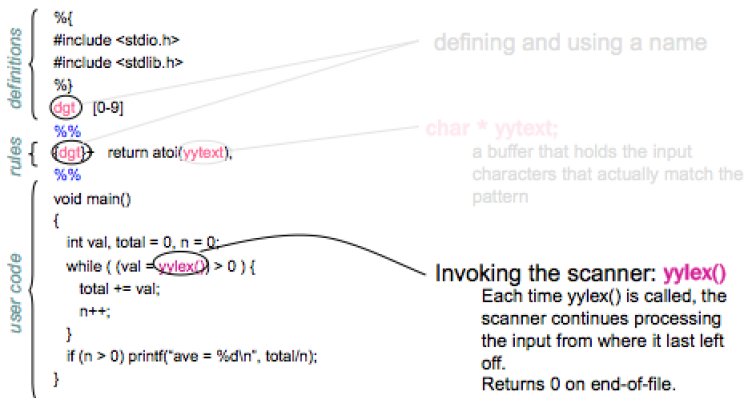
**user code**

defining and using a name

**char \* yytext;**  
a buffer that holds the input characters that actually match the pattern

## Example

A flex program to read a file of (positive) integers and compute the average:



## Lex library routines

- ▶ *yylex()*  
The default main() contains a call of yylex()
- ▶ *yymore()*  
return the next token.
- ▶ *yyless(n)*  
retain the first n characters in yytext.
- ▶ *yywrap()*
  - ▶ is called whenever Lex reaches an end-of-file.
  - ▶ The default yywrap() always returns 1.

## Lex Predefined Variables

- ▶ *yytext* – a string containing the lexeme
- ▶ *yylen* – the length of the lexeme
- ▶ *yyin* – the input stream pointer
  - the default input of default main() is **stdin**
- ▶ *yyout* – the output stream pointer
  - the default output of default main() is **stdout**

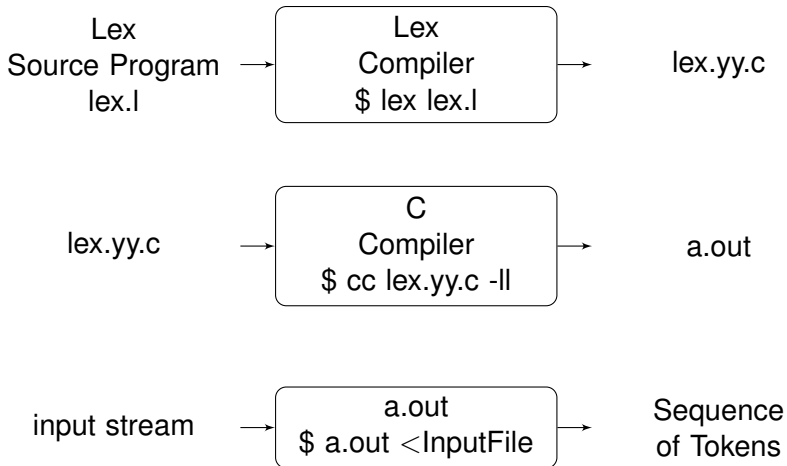
In lex program, a `main()` function is generally included as:

```
main(){  
    yyin = fopen(filename, "r");  
    while(yylex());  
}
```

- ▶ Here **filename** corresponds to input file and the `yylex()` routine is called which returns the tokens. `yyin` is *FILE* pointer declared by Lex part.



## Lexical Analyser Generators — Lex



## Assignment

Implement a lexical analyzer using the tool: lex/flex for the following types of tokens:

- ▶ Arithmetic, Relational, Logical, Bitwise and Assignment Operators of C.
- ▶ Reserved words: int, float, char, for, while, if and else
- ▶ Identifier.
- ▶ Integer Constants.
- ▶ Parentheses, Curly braces

Take a complete C program as input and generate the above-mentioned tokens.

## tokendef\_LEX.h

```
/* Single caharacter lexemes */
#define LPAREN_TOK '('
#define GT_TOK '>'
#define RPAREN_TOK ')'
#define EQ_TOK '='
#define MINUS_TOK '-'
#define SEMICOLON_TOK ';'
/*
.
.
.*/
/* Reserved words */
#define WHILE_TOK 256
/*
.
.
.*/
/* Identifier, constants..*/
#define ID_TOK 350
#define INTCONST 351
/*
.
.
.*/
```