# Compiler Design

## An Introduction

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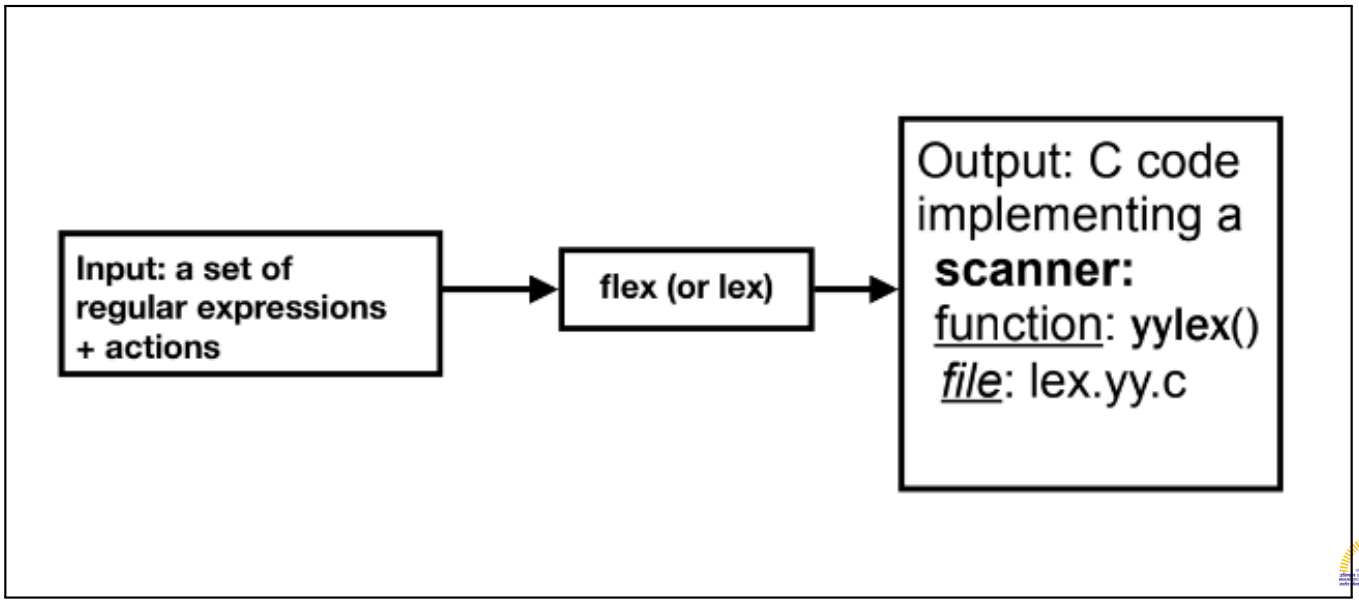
- **flex (and lex)**: Overview

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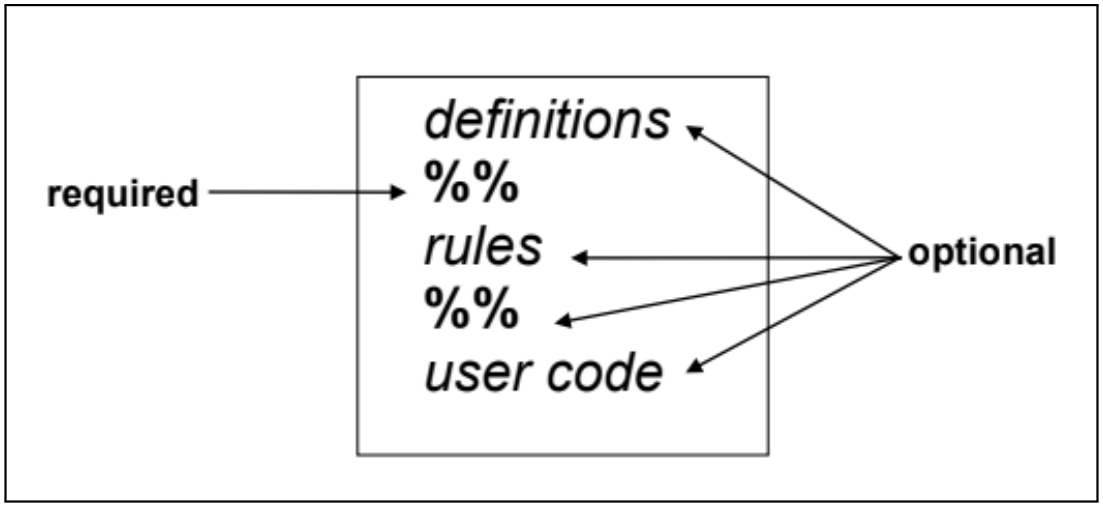
# Skeleton of a lex specification

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




- Shortest possible legal flex input:

```
%%
```

# Skeleton of a lex specification

| **Section** | **Purpose** |
|---|---|
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# Skeleton of a lex specification

| **Section** | **Purpose** |
|---|---|
| Definition Section | This part will be embedded into *.c |
| Rules Section | define how to scan and<br>what action to take for each token |
| User Code | any user code.<br>For example, a main function to<br>call the scanning function yylex(). |

# flex input format

**Definitions:**

- name definitions, each of the form

| **name** | **definition** |
|---|---|
| DIGIT | $[0-9]$ |

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

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# 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.

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# Lex Rules

**Example of Lex Rules**

- $< Reg.Exp > < action >$

| **Pattern** | **Action** |
|---|---|
| int | printf("Key word: Integer"); |
| $[0-9]+$ | printf("Number"); |

# Patterns

**Patterns**

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

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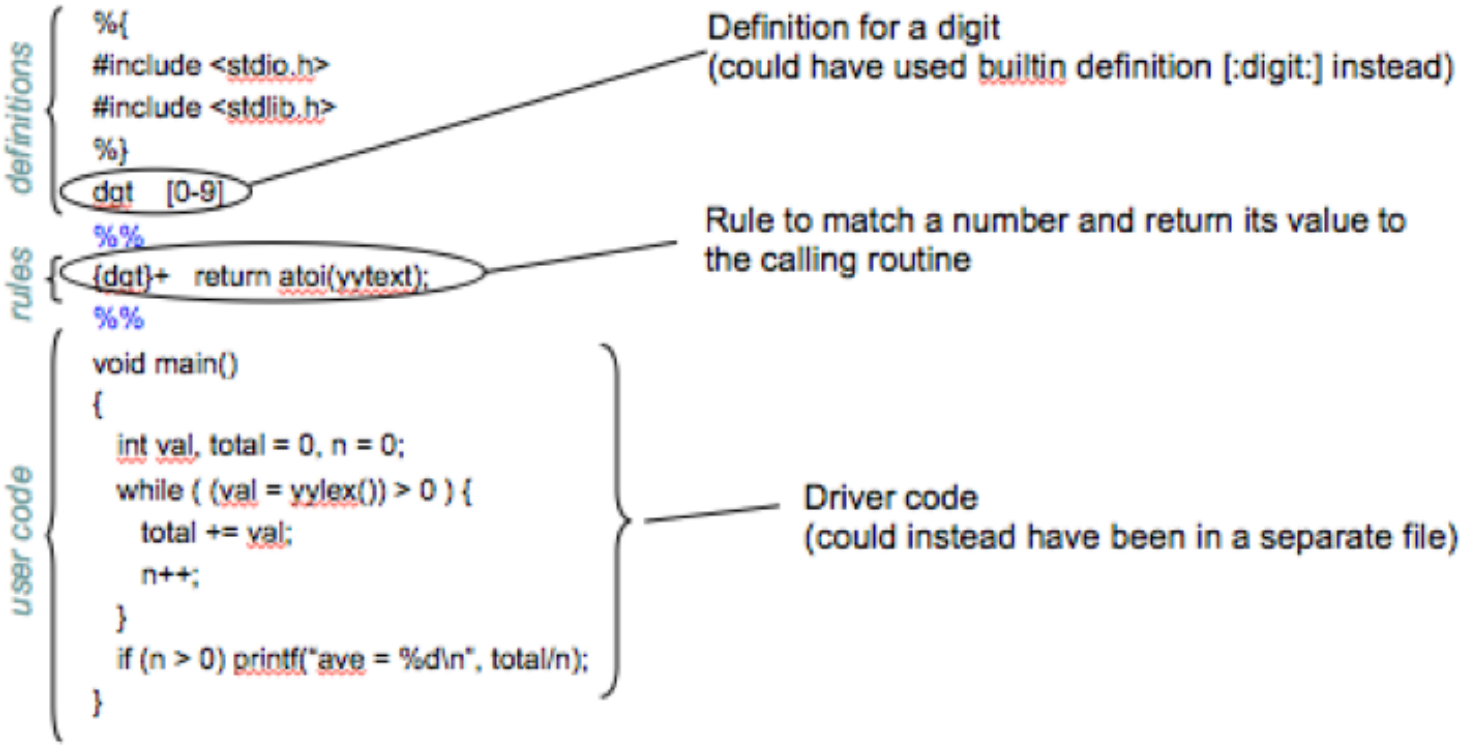
# Example

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



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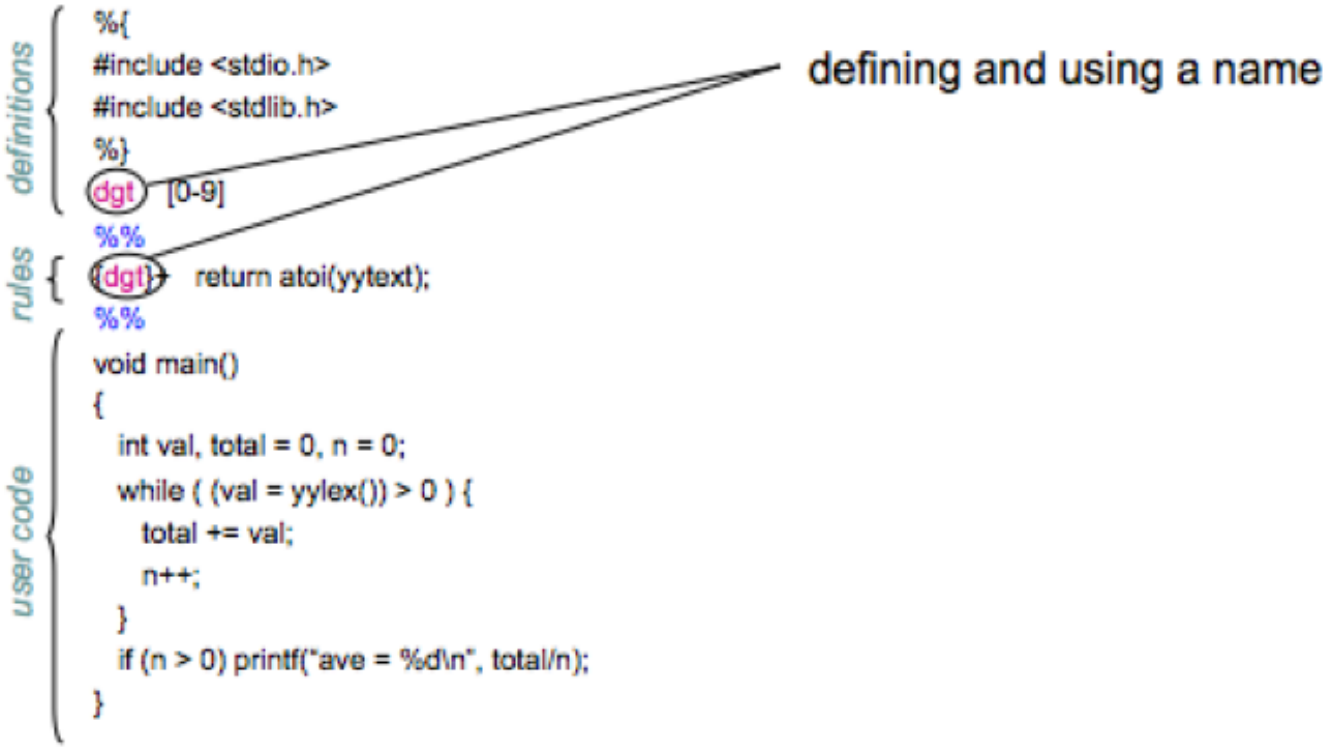

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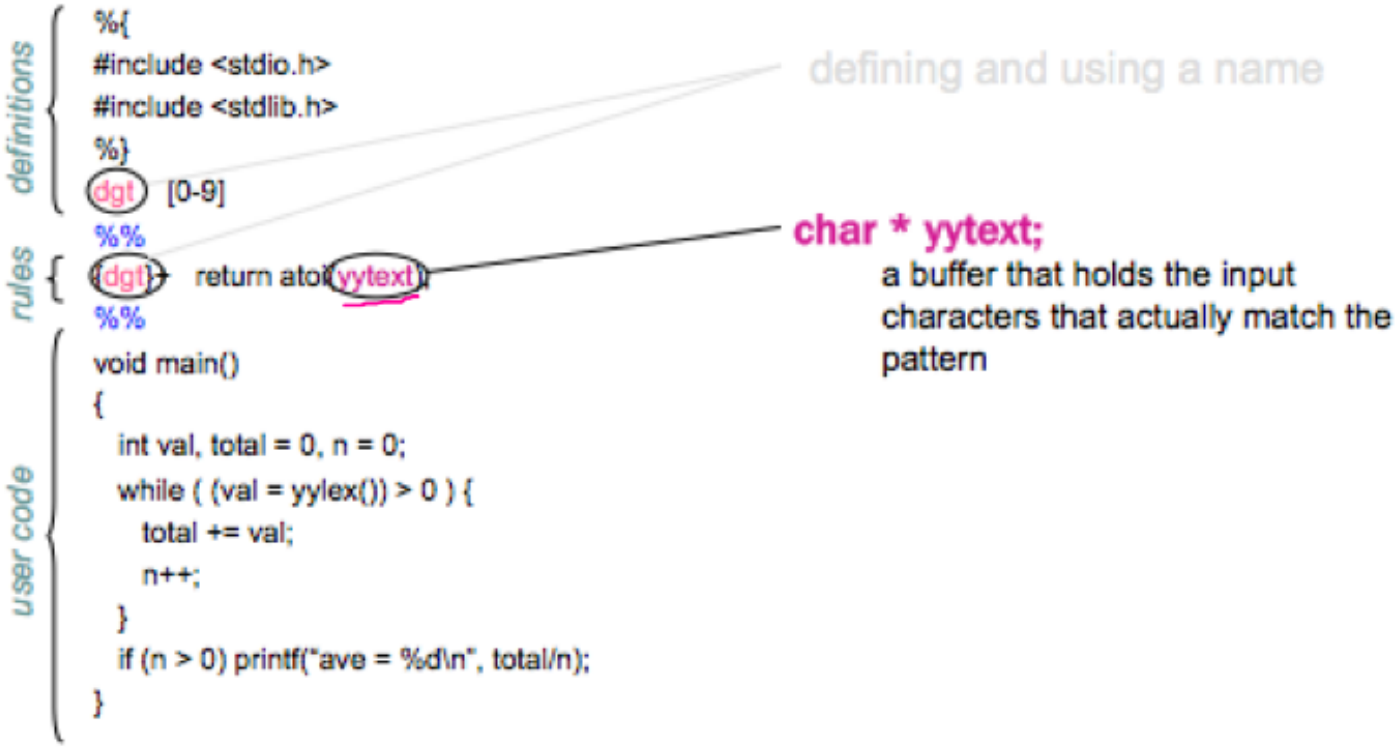

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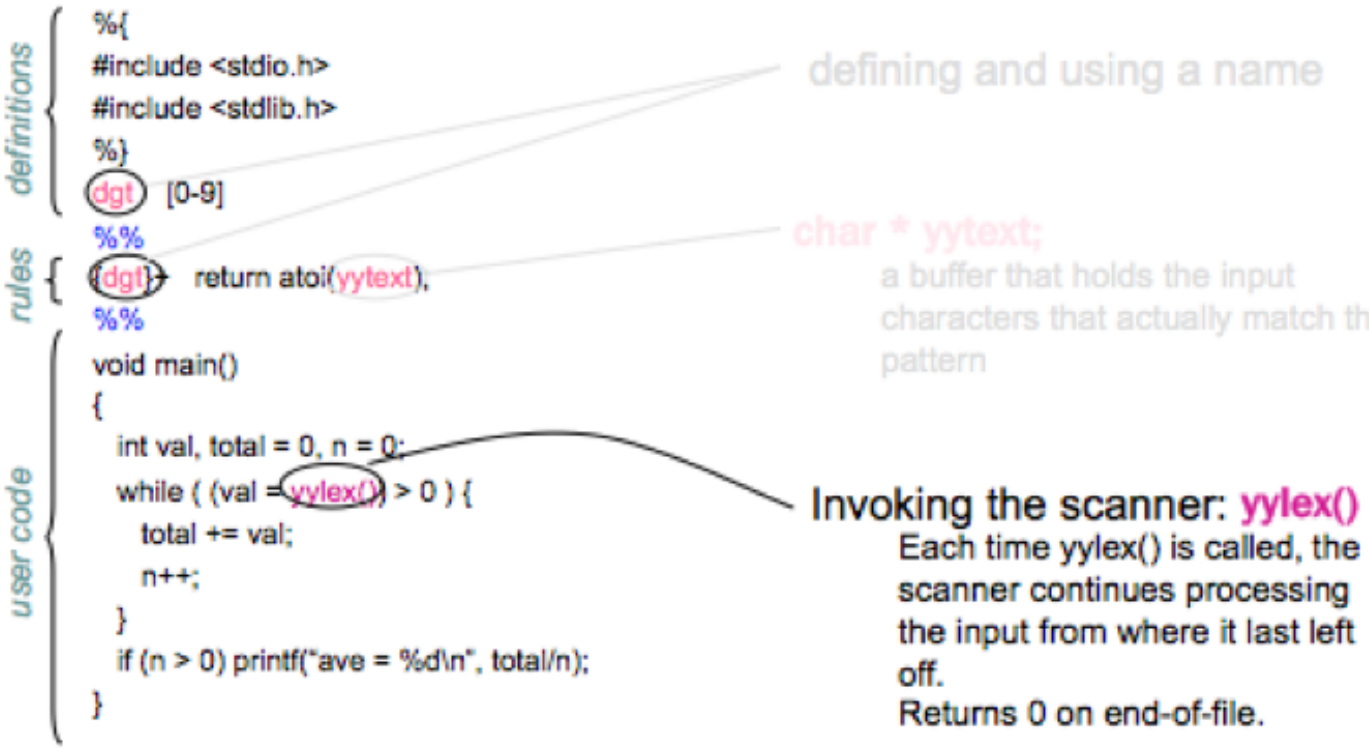

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# Lex library routines

## 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 yywarp() always returns 1.

# Lex Predefined Variables

## Lex Predefined Variables

- **yytext** – a string containing the lexeme.
- **yyleng** – 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**

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# lex program, a main() function

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

```
main(){
yyin = fopen(filename, "r");
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- Here filename corresponds to input file and the yylex() routine is called which returns the tokens. yyin is FILE pointer declared by Lex part.

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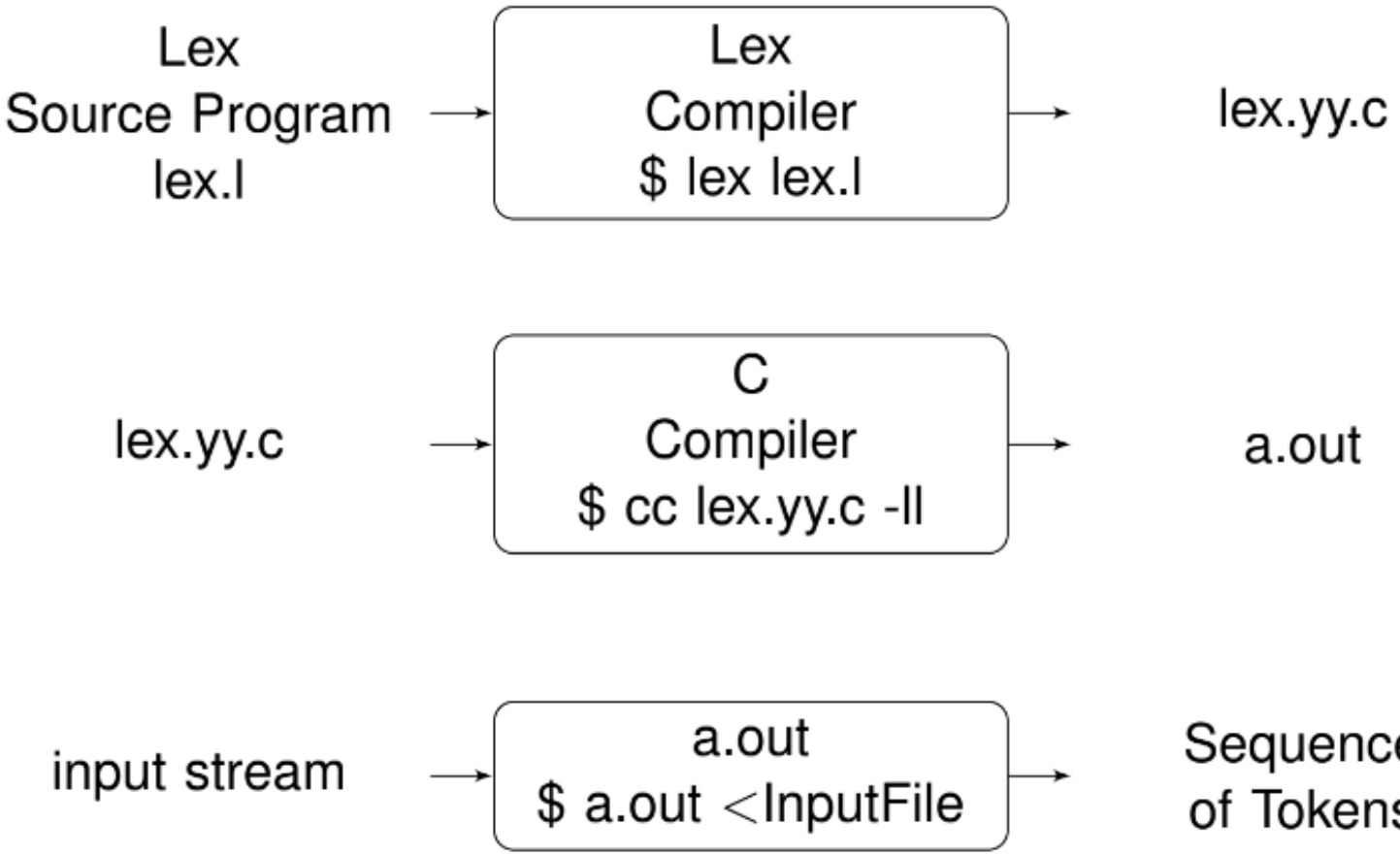
## Lexical Analyser Generators — Lex



# Assignment

**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.

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## tokendef LEX.h

### 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
/*
.
.
.*/
```

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# References


- Alfred V. Aho, Ravi Sethi, Jeffrey D Ullman, “Compilers Principles Techniques and Tools”, Pearson Education.


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