UCS1602:
COMPILER DESIGN

Lexical analyser generator

Session Objectives

- To learn structure of LEX specification
- To write the lexical analyser to recognize different tokens using LEX

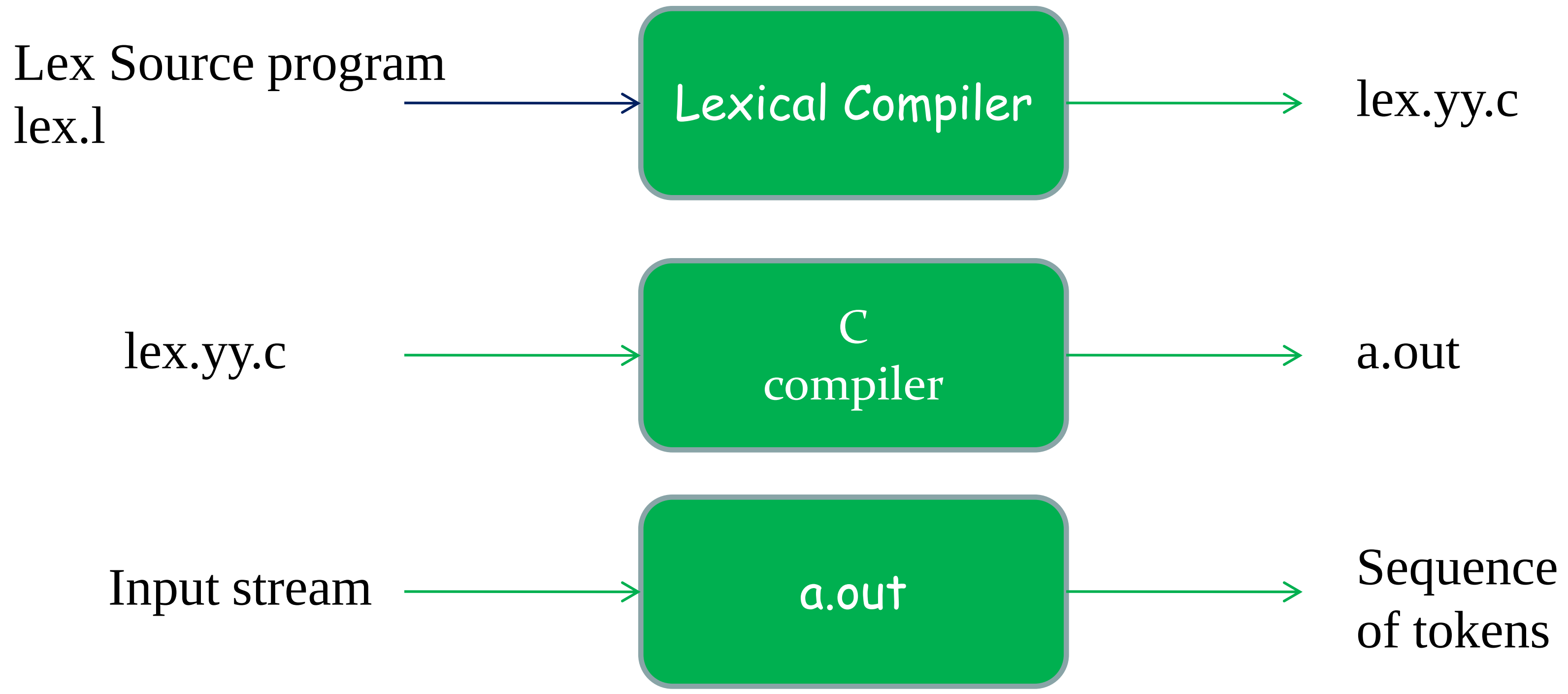
Session Outcomes

- At the end of this session, participants will be able to
  - Write the LEX specification for various tokens

Outline

- Structure of LEX program
- LEX specification for different tokens

Lexical Analyzer Generator - Lex



Lex Specification

- A *lex specification* consists of three parts:

  regular definitions, C declarations in `%{ %}`
  `%%`
  translation rules
  `%%`
  user-defined auxiliary procedures

- The *translation rules* are of the form:

  p_1 { *action*$_1$ }
  p_2 { *action*$_2$ }
  …
  p_n { *action*$_n$ }

Regular Expressions in Lex

`x`	match the character **`x`**
`\.`	match the character **`.`**
"*string*"	match contents of string of characters
`.`	match any character except newline
`^`	match beginning of a line
`$`	match the end of a line
`[xyz]`	match one character **`x`**, **`y`**, or **`z`** (use **`\`** to escape **`-`**)
`[^xyz]`	match any character except **`x`**, **`y`**, and **`z`**
`[a-z]`	match one of **`a`** to **`z`**
r**`*`**	closure (match zero or more occurrences)
r**`+`**	positive closure (match one or more occurrences)
r**`?`**	optional (match zero or one occurrence)
r_1r_2	match r_1 then r_2 (concatenation)
r_1 **`|`** r_2	match r_1 or r_2 (union)
`(` r **`)`**	grouping
r_1**`\`**r_2	match r_1 when followed by r_2
`{`d**`}`**	match the regular expression defined by d

Example Lex Specification 1

Translation rules

Contains the matching lexeme

Invokes the lexical analyzer

```
%{
#include <stdio.h>
%}
%%
[0-9]+   { printf("%s\n", yytext); }
.|\n     { }
%%
main()
{ yylex();
}
```

```
lex spec.l
gcc lex.yy.c -ll
./a.out spec.l
```

Example Lex Specification 2

Translation rules

Regular definition

```
%{
#include <stdio.h>
int ch = 0, wd = 0, nl = 0;
%}
delim       [ \t]+
%%
\n          { ch++; wd++; nl++; }
{delim}     { ch+=yyleng; wd++; }
.           { ch++; }
%%
main()
{ yylex();
  printf("%8d%8d%8d\n", nl, wd, ch);
}
```

Example Lex Specification 3

Translation rules

Regular definitions

```
%{
#include <stdio.h>
%}
digit       [0-9]
letter      [A-Za-z]
id          {letter}({letter}|{digit})*
%%
{digit}+    { printf("number: %s\n", yytext); }
{id}        { printf("ident: %s\n", yytext); }
.           { printf("other: %s\n", yytext); }
%%
main()
{ yylex();
}
```

Example Lex Specification 4

```
%{ /* definitions of manifest constants */
#define LT (256)
…
%}
delim      [ \t\n]
ws         {delim}+
letter     [A-Za-z]
digit      [0-9]
id         {letter}({letter}|{digit})*
number     {digit}+(\.{digit}+)?(E[+\-]?{digit}+)?
%%
{ws}       { }
if         {return IF;}
then       {return THEN;}
else       {return ELSE;}
{id}       {yylval = install_id(); return ID;}
{number}   {yylval = install_num(); return NUMBER;}
"<"        {yylval = LT; return RELOP;}
"<="       {yylval = LE; return RELOP;}
"="        {yylval = EQ; return RELOP;}
"<>"       {yylval = NE; return RELOP;}
">"        {yylval = GT; return RELOP;}
">="       {yylval = GE; return RELOP;}
%%
int install_id()
…
```

Return token to parser

Token attribute

Install **`yytext`** as identifier in symbol table

Summary

- LEX specification
- yylex
- yytext
- yyleng
- Pattern

Check your understanding?

Write the lex specification to recognize the following tokens:

a. Key words
b. Function call
c. Relational operators