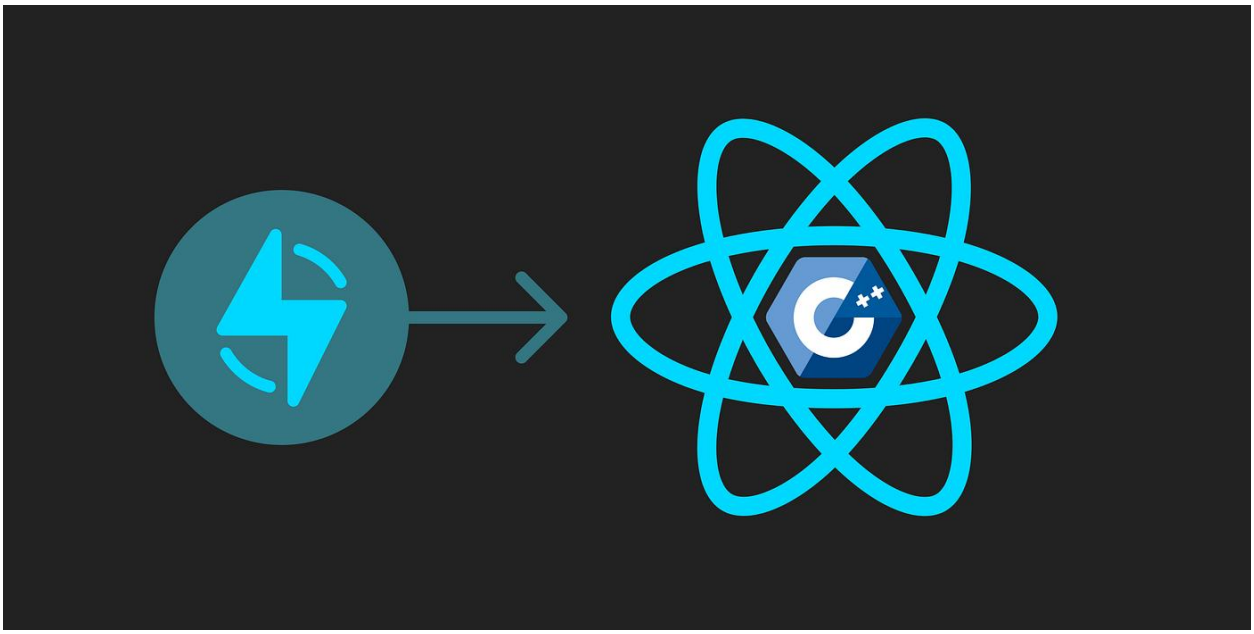
Compiler Construction

Language Name: React++

Language Theme: Modern Web Framework terminologies with C++ Structure



Project Phase # 01 Documentation	
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Section	G1
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Project Topic	Lexical Analyzer (Tokenization, Error handling and Line Number track of each token)

1. Regex Definitions:

Token Name	Regex	Description / Example
IDENTIFIER (variables)	@[_a-zA-Z][a-zA-Z0-9]*	Variables must start with @, e.g., @count
NUMBER (int/float/exp)	[0-9]+(\.[0-9]+)?([eE][+-]?[0-9]+)?	123, 3.14, 1e-5
INTEGER	[0-9]+	42
FLOAT	[0-9]*\.[0-9]+	.5, 3.14 (require at least one digit after . recommended)
STRING_LITERAL	\"([^\"\n]*)\"	"Hello World"
CHAR_LITERAL	\'[a-zA-Z0-9!@#$%^&*(_)`\,./;’]\'	'A', '$'
MULTI_LINE_COMMENT	\[:[^\]]*:\]	from [: to :] (may span lines)
SINGLE_LINE_COMMENT	:[^=<>!~].*$	from : to end-of-line
OUTPUT_OPERATOR	<<	render << "Hi"$
INPUT_OPERATOR	>>	fetch >> @name$
EQ_OPERATOR	:=	equality test operator
NEQ_OPERATOR	~=	not-equal operator
ARITHMETIC OPS	\+ - * / %	+, -, *, /, %
RELATIONAL OPS	< > <= >= ==	comparators
BLOCK_START	</	custom block start
BLOCK_END	\\>	custom block end
END_OF_STATEMENT	\$	explicit statement terminator $
PUNCTUATION	\(\) , ;	parentheses, comma, semicolon
WHITESPACE	[\t\r\n]+	skip in lexer
RE’s for invalid cases are defined in scanner.l		

2. Punctuations:

Symbol	Meaning
</	Block start
\>	Block end
$	Statement terminator
:	Single-line comment start
[: :]	Multi-line comment delimiters
( ) , ;	Parentheses, comma, semicolon

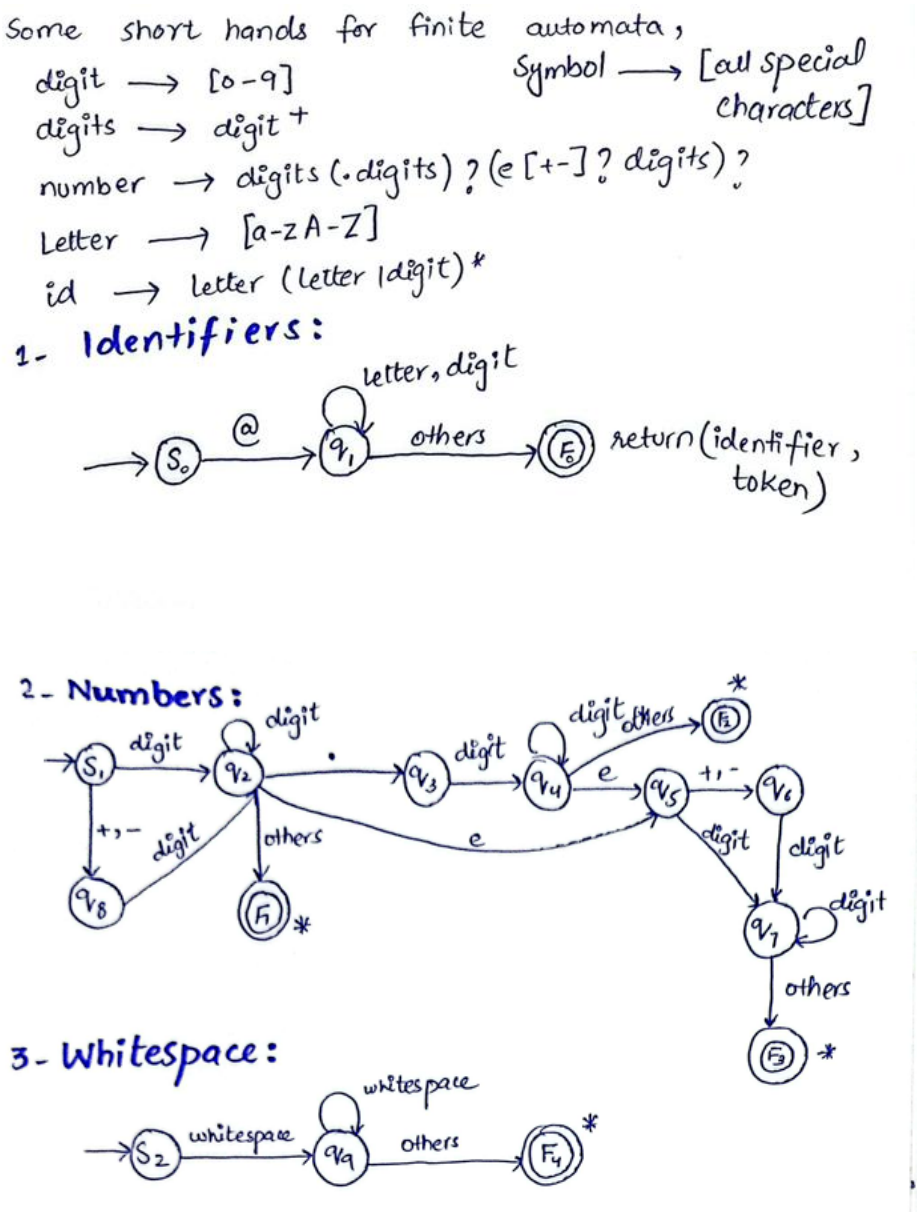
3. Keywords:

Keyword	Equivalent (C++)	Example usage
state	int	state @count = 0$
scale	float	scale @speed = 1.5$
tag	char	tag @grade = 'A'$
content	string	content @name = "Rameez"$
lock	const	lock @PI = 3.14$
detect	auto	detect @value = 20$
toggle	bool	toggle @isTrue = false$
render	cout	render << "Hi"$
fetch	cin	fetch >> @name$
promise	if	promise (@x > 0) ... deceit ...
deceit	else	deceit</….\>
navigate	for	navigate (@i=0; @i<5; @i=@i+1) </ ... \>
observe	while	observe (@x < 10) </ ... \>
dispatch	do	dispatch </ ... \> observe (@cond)$
route	switch	route (@opt) </ path(...) ... \>
path	case	branch inside route
rerender	continue	loop continue
unmount	break	loop break
redirect	goto	redirect @label$
send	return	send @value$
root	main	state root() </ ... \>

4. Operators:

Operator	Purpose
<<	Output operator (render)
>>	Input operator (fetch)
:=	Equality operator (custom choice)
~=	Not equal
+ - * / %	Arithmetic
< > <= >= ==	Relational
and, or, ~	Logical (word-form)

5. Finite Automata (Numbers & Identifiers):



Explanation of Keyword Design (React++)

1. Why These Keywords Were Chosen

- The keywords were selected to **bridge C++ fundamentals with modern web development terminology**.
- Each keyword closely **resembles a C++ construct** (for example, **state** refers to **int**, **scale** refers to **float**, **promise** refers to **if**) but uses **names inspired by React/Web frameworks**.
- This design helps students **relate procedural logic to real-world frameworks** where similar concepts (state, render, dispatch, etc.) are widely used.
- The naming convention maintains **clarity, memorability, and contextual meaning**, so even a beginner can intuitively understand the keyword's role.

2. Reason for Punctuation and Operator Design

- The **punctuation symbols** such as </, \>, and $ were chosen to **differentiate React++ from traditional C-like syntax** while maintaining readability.
    1. </ and \> replace { and } to resemble **HTML/React component structure**, making the code visually familiar to web developers.
    2. $ is used as an **explicit statement terminator**, ensuring clear line endings and simplifying lexical analysis.
    3. [: :] are used for comments to avoid conflicts with other operators and to give a **distinct, custom syntax style**.
- The **operators** are designed to balance **C++ familiarity and clarity**:
    1. Operators like :=, ~= were introduced to make **assignment and comparison visually distinct**, reducing ambiguity during tokenization.
    2. Logical words such as and, or, and ~ (for NOT) are **word-based** for readability and beginner friendliness.
    3. Arithmetic (+, -, *,**, /, %) and relational (<, >, <=, >=) operators follow C++ conventions for smooth learning transition.
    4. The I/O operators << and >> are retained from C++ to keep **semantic consistency** with output/input operations like render and fetch.

3. Why React++ Is Unique

- React++ integrates **programming syntax with web-inspired semantics**, giving a feeling of "code meets UI".
- It uses </ **and** \> as block delimiters, resembling HTML/JSX, helping students mentally map logic blocks to UI components.
- The **explicit $ statement terminator** provides readability and ensures simpler lexical boundaries.
- By adopting **promise, render, dispatch, route** etc., learners can transition more smoothly from traditional programming to **component-based web frameworks**.
- The language serves as a **conceptual bridge** understanding C++ flow while becoming familiar with React-like concepts.

Sample Program:

```
[: --- Multi-line comment example --- :]
state root()
</
    : Single-line comment starts here
    state @x = 5$
    scale @y = 2.5$
    scale @exp = 3.14e+2$
    tag @grade = 'A'$
    content @msg = "Hello"$

    @1invalid = 99$       : invalid identifier
```

```
    'AB'                  : invalid char
    "Unclosed string      : will trigger unterminated string error

    promise (@x >= 5 and @y < 100)
        render << @msg$
    deceit
        render << "Bye"$
    navigate (@x = 0; @x < 3; @x = @x + 1)
    </ render << "Loop"$ \>
    send 0$
\>
```

Sample Tokens:

Comments are ignored by analyzer just printed on console not in file.

```
ubuntu@ubuntu:~$ flex scanner.l
ubuntu@ubuntu:~$ gcc lex.yy.c -lfl -o scanner
ubuntu@ubuntu:~$ ./scanner < sample.txt
MultiLine: [: --- Multi-line comment example --- :]
Comment: : Single-line comment starts here
Comment: : invalid identifier
Comment: : invalid char
All tokens written to output.txt successfully!
```

Tokens generated by Lex:

Line No.	Token Type	Lexeme / Value
2	KEYWORD	state
2	KEYWORD	root
2	PUNCTUATION	(
2	PUNCTUATION	)
3	PUNCTUATION	</
5	KEYWORD	state
5	IDENTIFIER	@x
5	OPERATOR	=
5	INTEGER	5
5	END OF LINE	$
6	KEYWORD	scale
6	IDENTIFIER	@y

6	OPERATOR	=
6	FLOAT	2.5
6	END OF LINE	$
7	KEYWORD	scale
7	IDENTIFIER	@exp
7	OPERATOR	=
7	EXPONENTIAL NUMBER	3.14e+2
7	END OF LINE	$
8	KEYWORD	tag
8	IDENTIFIER	@grade
8	OPERATOR	=
8	CHAR	'A'
8	END OF LINE	$
9	KEYWORD	content
9	IDENTIFIER	@msg
9	OPERATOR	=
9	STRING	"Hello"
9	END OF LINE	$
11	INVALID IDENTIFIER	@1invalid
11	OPERATOR	=
11	INTEGER	99
11	END OF LINE	$
12	INVALID CHAR	'AB'
13	UNTERMINATED STRING	"Unclosed string
14	KEYWORD	promise
14	PUNCTUATION	(
14	IDENTIFIER	@x
14	OPERATOR	>=
14	INTEGER	5
14	INVALID IDENTIFIER	and
14	IDENTIFIER	@y
14	OPERATOR	<
14	INTEGER	100
14	PUNCTUATION	)
15	KEYWORD	render
15	OPERATOR	<<
15	IDENTIFIER	@msg
15	END OF LINE	$
16	KEYWORD	deceit
17	KEYWORD	render
17	OPERATOR	<<
17	STRING	"Bye"
17	END OF LINE	$
18	KEYWORD	navigate
18	PUNCTUATION	(

18	IDENTIFIER	@x
18	OPERATOR	=
18	INTEGER	0
18	ERROR	;
18	IDENTIFIER	@x
18	OPERATOR	<
18	INTEGER	3
18	ERROR	;
18	IDENTIFIER	@x
18	OPERATOR	=
18	IDENTIFIER	@x
18	OPERATOR	+
18	INTEGER	1
18	PUNCTUATION	)
19	PUNCTUATION	</
19	KEYWORD	render
19	OPERATOR	<<
19	STRING	"Loop"
19	END OF LINE	$
19	PUNCTUATION	>
20	KEYWORD	send
20	INTEGER	0
20	END OF LINE	$
21	PUNCTUATION	>

Note: The **Regular Expressions (REs)** used for **error detection** (such as invalid identifiers, invalid characters, and unterminated strings) are explicitly defined within the **Lexical Analyzer**. Any lexical pattern **not matched by the defined Regular Expressions (REs)** is automatically classified as an **error token**.
Such unmatched inputs are handled by the **catch-all rule** `(.)` in the Lexical Analyzer, ensuring that every undefined or invalid symbol is properly detected and reported.