07 - Lexical Analysis

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Outline

1. Lexical Analysis
2. Regular Expressions
3. Tokenization
4. L++

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3 Tokenization
4 L++

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    2. Screener

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- These productions are the **lexemes** of a language.
- Example lexemes include:
  - Literals
  - Identifiers
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- It is possible to use recursive descent for this, but this would be overkill for a lexer!

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- This is also known as “regular expression parsing”, because the language processed by the lexer is a regular grammar.

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- If something does not match the rules of the lexer's language, it is flagged as an invalid sequence.

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  - `*`: zero or more
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- **escaping literals** The special characters in regular expressions can all be escaped in the usual way. `\(, \), \|, \., \*, \*, \*, \?, \\`

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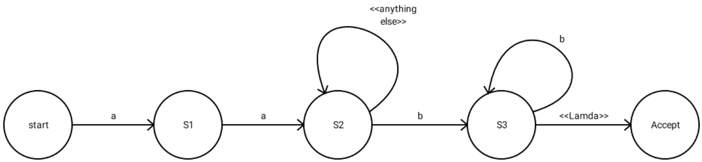
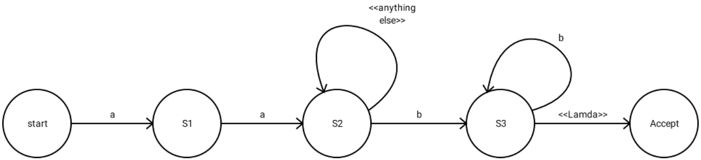
- A DFA is a graph where states are represented by vertices.
- Edges show transitions from each state for a given character or set of characters.
- For example: `aa.*b+` becomes the DFA:



Coding a DFA



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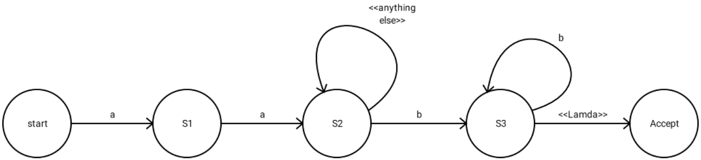

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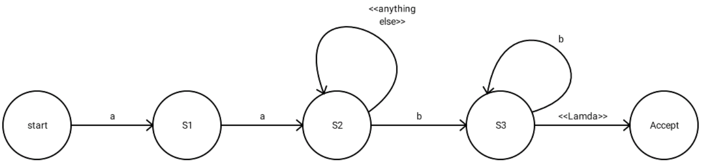

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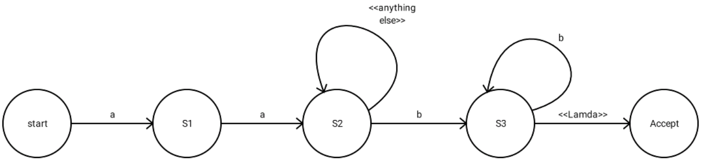

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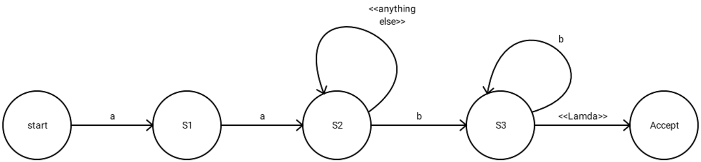

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- Within the loop, we add `if` statements to transition the state. Any invalid transition returns an error.

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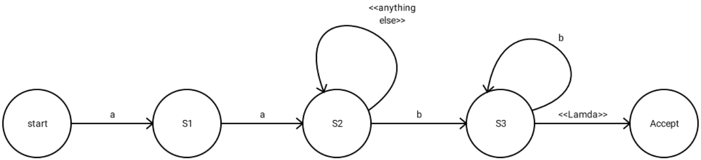

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- **Activity**: Let's code the above DFA!

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- We often need to store some additional information about a token:

```
struct Token {
    Token_Type type;
    string text;
};
```

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  4. Emit the token indicated by the current state.

Tokenizing a String

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- `symbol` is set to the emitted token.

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The Grammar of L++

$\langle \textit{program} \rangle$ ::= <expression>

$\langle \textit{expression} \rangle$ ::= <term> <expression-tail>

$\langle \textit{expression-tail} \rangle$ ::= λ | ’+’ <term> <expression-tail>

$\langle \textit{term} \rangle$ ::= <factor> <term-tail>

$\langle \textit{term-tail} \rangle$ ::= λ | ’*’ <factor> <term-tail>

$\langle \textit{factor} \rangle$ ::= <integer> | ’(’ <expression> ’)’

$\langle \textit{integer} \rangle$ ::= <unit> | <unit><integer>

$\langle \textit{unit} \rangle$ ::= ’0’ | ’1’ | ’2’ | ’3’ | ’4’ | ’5’ | ’6’ | ’7’ | ’8’ | ’9’

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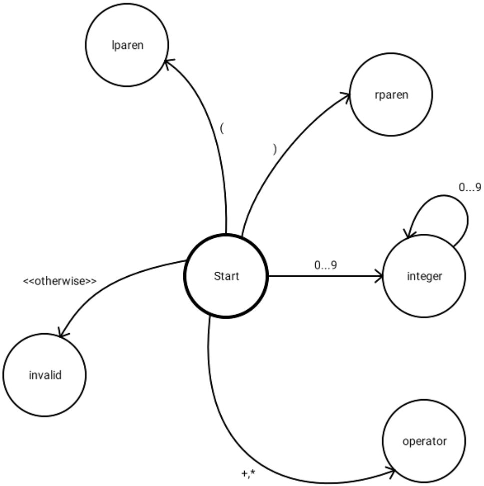
- `integer := (0|1|2|3|4|5|6|7|8|9)+`
- `operator := +|*`
- `lparen := \(`
- `rparen := \)`
- `invalid :=` anything else.

L++ DFA


lparen
rparen
(
)
0...9
Start
0...9
integer
<<otherwise>>
invalid
operator
+,*