CENG444: Lexical Analysis (Scanning)

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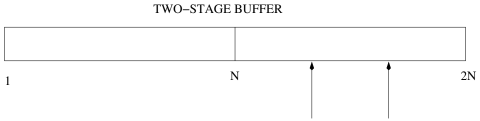
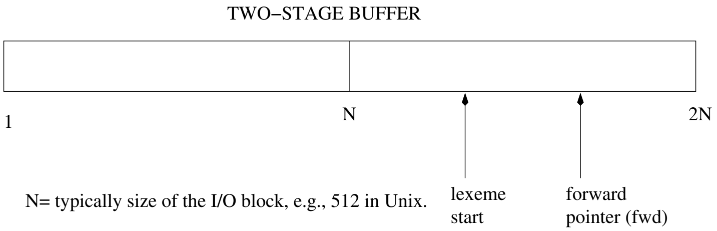
- Converting a character stream into a token stream (token recognition).
- 1. Ad hoc (customized) lex analyzers

  2. Lexical analyzer generators (e.g. lex)
- Lexical analysis is the only I/O-bound stage in compiling; need efficient I/O handling.
- Customized lexical analysis:

  Take care of I/O efficiently: buffering





fwd $>$ 2N ? Load first half and reset fwd

fwd $>$ N ? Load second half and advance

1 $<$ fwd $<$ 2N and no more characters : use sentinels.

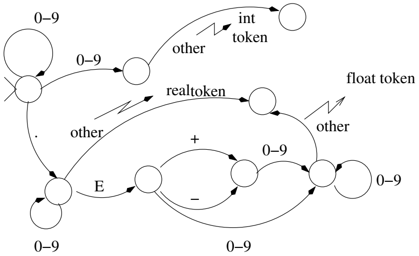
what if token size can be greater than N ?

- LEX ANALYSIS USING FSMs

  automated tools for I/O handling and pattern recognition.

  Patterns for tokens in most PLs are regular; FSMs can be used for efficient recognition.

- Design a grammar for token; write a NFA for it; convert to DFA; then minimize the DFA.



USE OF EXTENDED REG. EXP. NOTATION in LeX

- It is only for notational convenience; does not extend the power above type-3 languages.

ex: digits, non-digits, and letters

```
[0-9]      [^0-9]      [A-Za-z]
```

ex: decimal with up to 5 digits in fraction.

```
{digit}+\.{digit}{1,5}
```

- FORTRAN allows keywords to be used as names of variables

  ex: `IF` in Fortran `IF=3`

  ```
   IF(I,J)=3    IF(I+J,3)=4      IF(I)=4
  ```

  ```
   IF(A.EQ.B) A=3
  ```

  ```
  IF/(\(({num}|{id}|{op})(,|{num}|{id}|{op}*\))?=
  ```

- But this is only an approximation; you need to know *expression syntax* of FORTRAN.

- Ambiguity in pattern match: more than one pattern is satisfied

  Use the longest match: `"//".*` matches till the end of line.

What we will look at

- Regular expressions
- Thomson's construction
- `sed` syntax for REs
- antLR scanning and symbol table generation.