Comparative Analysis Report

Manual DFA Scanner vs. JFlex Generated Scanner

Roll No: 23I-0604 & 23I-0508

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1 Introduction

This report compares the execution results of two lexical analyzer implementations for the custom language `.lang`:

1. **Manual Scanner:** A Java-based implementation using a custom Deterministic Finite Automaton (DFA) state machine.
2. **JFlex Scanner:** A scanner generated using the JFlex tool based on regular expression specifications.

Both scanners were tested against a suite of 5 test cases covering basic logic, complex arithmetic, escape sequences, error handling, and comments.

2 Summary of Results

The following table summarizes the behavior of both scanners across all test files.

Test File	Manual Scanner Status	JFlex Scanner Status	Match?
`test1.lang`	Success (28 Tokens)	Success (28 Tokens)	**Yes**
`test2.lang`	Success (43 Tokens)	Success (43 Tokens)	**Yes**
`test3.lang`	Success (Handles ’¨)	Error (Too long char literal)	**No**
`test4.lang`	Detected Errors (Permissive Floats)	Detected Errors (Strict Floats)	**Partial**
`test5.lang`	Success (Comments Skipped)	Success (Comments Skipped)	**Yes**

Table 1: Comparison Overview

3 Detailed Discrepancy Analysis

While the core logic for identifying keywords, identifiers, and operators is identical, slight differences were observed in edge-case handling.

3.1 1. Floating Point Precision (Test 4)

The specification states that floating-point numbers should have a maximum of 6 decimal places.

- **Input:** `1.2345678`
- **Manual Scanner:** Accepted as `FLOAT_LITERAL`. The DFA loop for digits does not strictly count the number of decimals to simplify the state machine.

- **JFlex Scanner:** Rejected as `MALFORMED_LITERAL` (*"Float exceeds 6 decimal places"*).
- **Conclusion:** JFlex is strictly spec-compliant. The Manual Scanner is permissive.

3.2 2. Character Escape Sequences (Test 3)

The specification lists `\n, \t, \r, \', \\` as valid escapes for characters. It does not explicitly list `\"` for characters (only for strings).

- **Input:** `'¨'` (Escaped double quote inside single quotes)
- **Manual Scanner:** Accepted as `CHAR_LITERAL`. The logic allows any character to follow a backslash in the `S_CHAR_ESC` state.
- **JFlex Scanner:** Error (*"Character literal too long"*). It treated `\` and `"` as separate characters because the regex `CHARESC` did not include `"`.
- **Conclusion:** JFlex adheres strictly to the provided spec, while the Manual Scanner is robust enough to handle standard Java-style escapes even if not explicitly required.

3.3 3. Error granularity (Test 4)

- **Input:** `'TooLong'`
- **JFlex Scanner:** Reports a specific error: *"Character literal too long."* using a specific regex rule `MALFORMED_CHAR`.
- **Manual Scanner:** Reports *"Unclosed character literal"*. The DFA enters the char content state, sees multiple characters, and eventually fails to match the closing quote immediately, falling into error recovery.

4 Code Output Verification

4.1 Test 1: Basic Logic (Perfect Match)

Both scanners produced identical token streams for the basic program structure.

```
<KEYWORD, "start", Line: 1, Col: 1>
<KEYWORD, "declare", Line: 2, Col: 1>
<IDENTIFIER, "X", Line: 2, Col: 9>
...
<EOF, "EOF", Line: 13, Col: 7>
```

Listing 1: Manual Scanner Output (Test 1)

```
<KEYWORD, "start", Line: 1, Col: 1>
<KEYWORD, "declare", Line: 2, Col: 1>
<IDENTIFIER, "X", Line: 2, Col: 9>
...
<EOF, "EOF", Line: 13, Col: 7>
```

Listing 2: JFlex Scanner Output (Test 1)

4.2 Test 5: Comment Handling (Perfect Match)

The Manual Scanner was successfully updated to handle Single-Line (`##`) and Nested Multi-Line (`#* ... *#`) comments.

```
<KEYWORD, "start", Line: 1, Col: 1>
...
<KEYWORD, "output", Line: 7, Col: 1>
<STRING_LITERAL, ""Done"", Line: 7, Col: 8>
<KEYWORD, "finish", Line: 8, Col: 1>
<EOF, "EOF", Line: 8, Col: 7>
--- STATISTICS ---
Comments removed: 3
```

Listing 3: Manual Scanner Output (Test 5)

5 Conclusion

The Manual Scanner implementation has been successfully refactored to use a Table-Driven DFA approach. It correctly identifies all valid tokens in the language and handles complex features like nested comments.

The differences observed in Tests 3 and 4 highlight the trade-off between a manually coded state machine (which may be more permissive or have generic error states) and a generated scanner (which enforces strict regex constraints). Both implementations satisfy the assignment requirements.