A Simple Regex to NFA Converter + Visualizer

Presented and made by:

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Overview:

This is, as the title implies, a very simple Regular Expression String to Nondeterministic Finite Automaton Converter, with an element of visualization.

Mechanisms:

The first part is the NFA Parser:

This component prepares the regular expression before building the NFA. It works in three main steps:

1. Concatenation Insertion: Automatically inserts explicit concatenation operators (.) between characters that should be concatenated (for example, converting ab into a.b).
2. Postfix Conversion: Converts the concatenated regular expression from infix to postfix form using the Shunting Yard Algorithm.
3. Integration Step: Combines both steps into one function that first adds concatenation symbols, then converts the result to postfix, and finally sends it to the NFA builder for processing.

The second part is the NFA Builder:

This part takes a postfix regular expression and builds its matching NFA using Thompson's Algorithm. It processes the expression symbol by symbol, creating and connecting small NFAs using ε-transitions for operations like union (|), concatenation (.), and repetition (*). Finally, it outputs all states, start and accept states, and transitions in a clear format so the visualization part can display the NFA easily.

The third part is the Visualization & UI:

The frontend receives NFA data from the backend and visually represents it using ReactFlow. The process goes:

1. Parsing the JSON response taken from the NFA Builder.
2. Constructing the graph using ReactFlow.
3. Generating a layout to avoid intersections between States and Transitions.

Alongside some Styling and Interactability provided by ReactFlow.

Input format:

Regular expression string (e.g. a|b)

Output format:

NFA data structure as JSON & NFA Visualization

e.g.:

```
{
  "states": ["q0", "q1", "q2", "q3", "q4", "q5"],
  "start": "q0",
  "accept": "q5",
  "transitions": [
    {"from": "q0", "to": "q1", "symbol": "a"},
    {"from": "q1", "to": "q2", "symbol": "ε"},
    {"from": "q2", "to": "q3", "symbol": "b"},
    {"from": "q2", "to": "q4", "symbol": "c"},
    {"from": "q3", "to": "q2", "symbol": "ε"},
    {"from": "q4", "to": "q2", "symbol": "ε"},
    {"from": "q2", "to": "q5", "symbol": "d"}
  ]
}
```

Programming Language, Tools & Libraries:

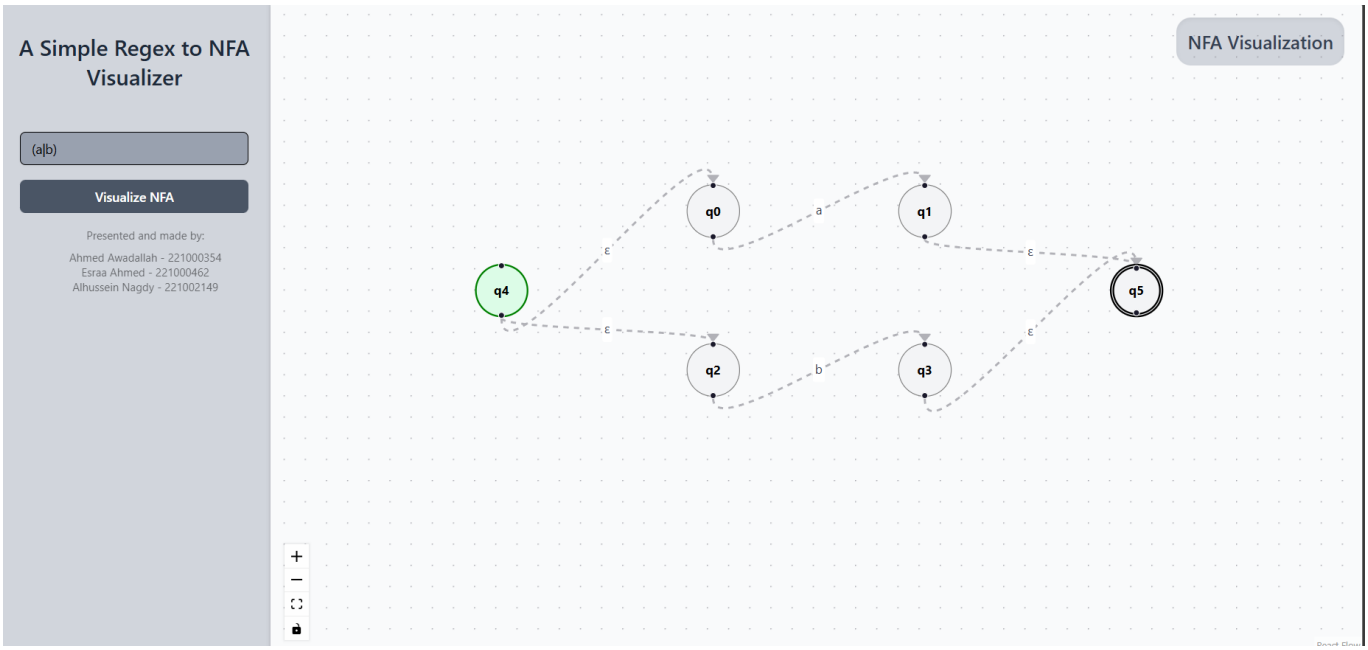
Backend & API: Python

Using FastAPI, Pydantic, Uvicorne

Frontend & Visualization: Javascript

Using React.ts, ReactFlow, ShadCN, and Tailwind for CSS

Screenshots & Samples:


A Simple Regex to NFA Visualizer
(a|b)
Visualize NFA
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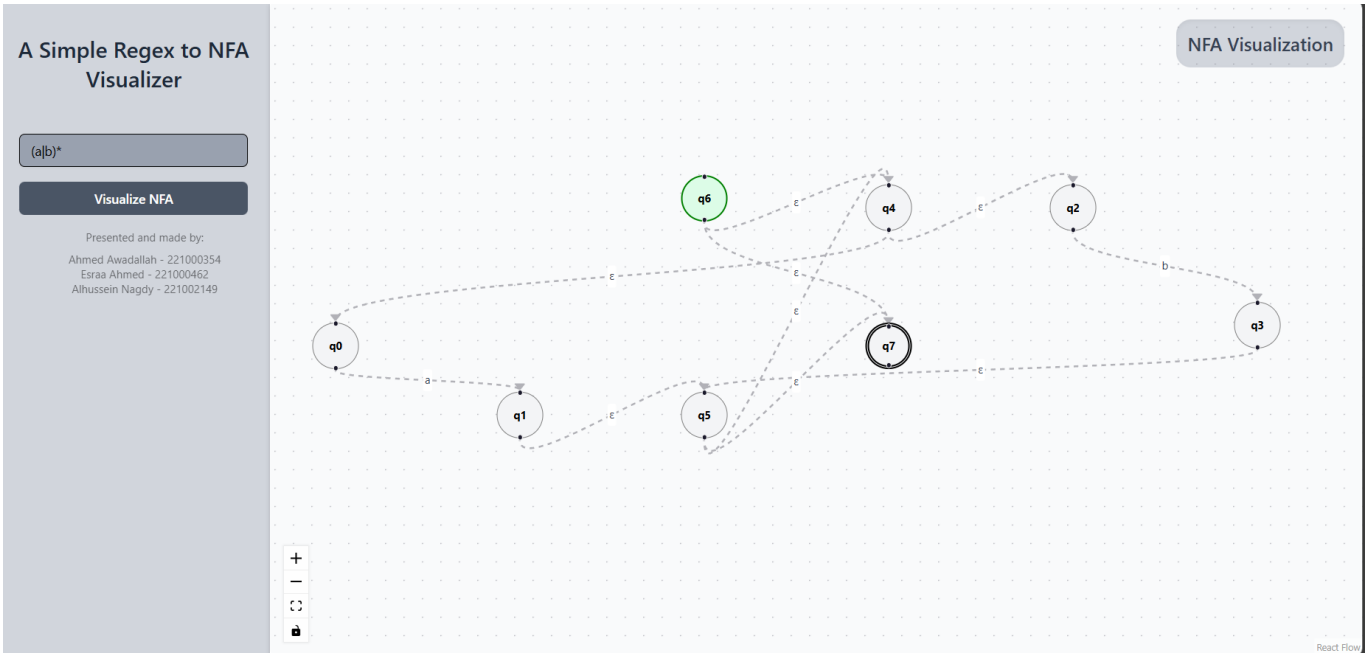
NFA Visualization
q0
q1
q2
q3
q4
q5
a
b
ε


A Simple Regex to NFA Visualizer
(a|b)*
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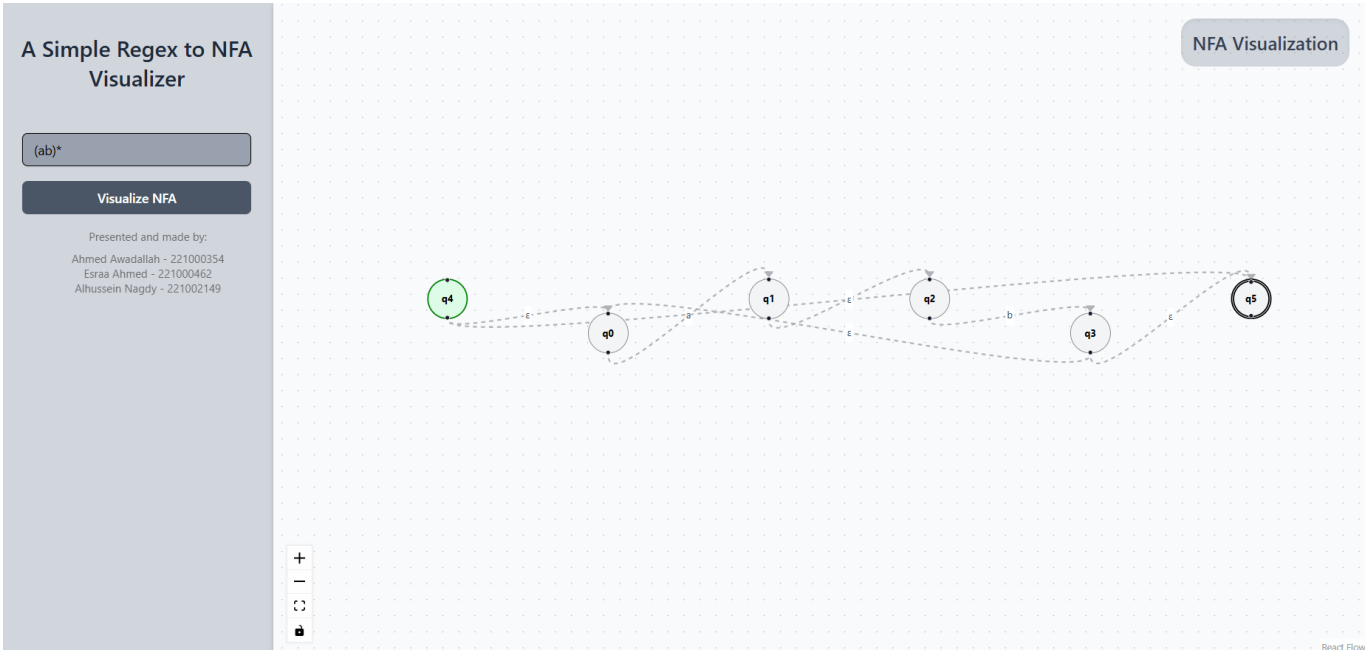
NFA Visualization
q0
q1
q2
q3
q4
q5
q6
q7
a
b
ε


A Simple Regex to NFA Visualizer
(ab)*
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NFA Visualization
q0
q1
q2
q3
q4
q5
a
b
ε