Part1 :

I mainly think that there are three main differences between DFA and NFA. First, DFA is faster, but does not provide Backtrack function, NFA is relatively slow, but provides Backtrack function [1]. Second, NFA is expression-based, while DFA is text-based. Finally, the DFA engine must be in a certain state at any time, and the NFA engine may be in any one of a set of states[2]. Therefore, the NFA engine must record all possible paths. The reason why NFA can provide the function of Backtrack is that right here.

1. García, P., de Parga, M. V., Álvarez, G. I., & Ruiz, J. (2008). Universal automata and NFA learning. *Theoretical Computer Science*, *407*(1-3), 192-202.

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| 1. Bollig, B., Katoen, J. P., Kern, C., Leucker, M., Neider, D., & Piegdon, D. R. (2010, July). libalf: The automata learning framework. In *International Conference on Computer Aided Verification* (pp. 360-364). Springer, Berlin, Heidelberg. |

Part2 :

q0

a

a\*

a\*b + b

q1

Part 3:

S -> aSA |

A -> aAb | b |

Part 4:

q0

q1

q5

a

b

q2

a

q3

b

q4

b

b

q6

a

a

Part 5:

L(ab\*a\*) L ((b)\*ab) = ab

q0

a

q1

b

q2

Part 6:

q0

q1

a

b

a

q2

b

q3

q4

q5

q6

q7

b

a

b

a

a

b

b

a

a

b