# Final Project's Report

# Language and Automata Theory

## "SPOK Token Recognizer + Parser"

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## 1. Program Specification

We use Java Programming Language for the syntax, with the program referencing dictionary tables consist of Subject, Predicate, Object, and Adverb(S-P-O-K). The program later asks the sentence input from user, try to determine which words categorized in which table (*Token Recognizer*), then the program will parse the result of previous recognition with *Parser Program* that only recognizes 4 patterns (S-P, S-P-O, S-P-K, S-P-O-K).

If the sentence's token is in the table, and matches the parser, then the output will show that the sentence is accepted, but if otherwise, it will show that it is not accepted. Also, if there is one or many words that is not in the *Dictionary Table*, then the output will show that it is not from the *Dictionary Table*.

## 2. Dictionary Table:

| Subject(S) | Predicate(P) | Object(O) | Adverb(K) |
|:---:|:---:|:---:|:---:|
| saya | masak | ayam | gurih |
| kamu | main | bola | keras |
| dia | makan | nasi | biru |
| kami | minum | kopi | pahit |
| itu | tidur | soda | enak |

## 3. Finite State Machines

- **Subject's FA (M1)**
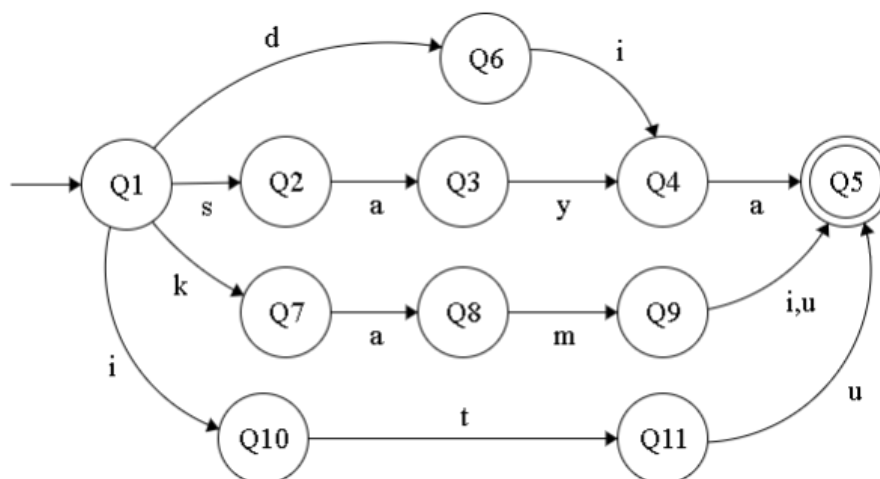
M1 = (Q, $\Sigma$, $\delta$, q1 , F)
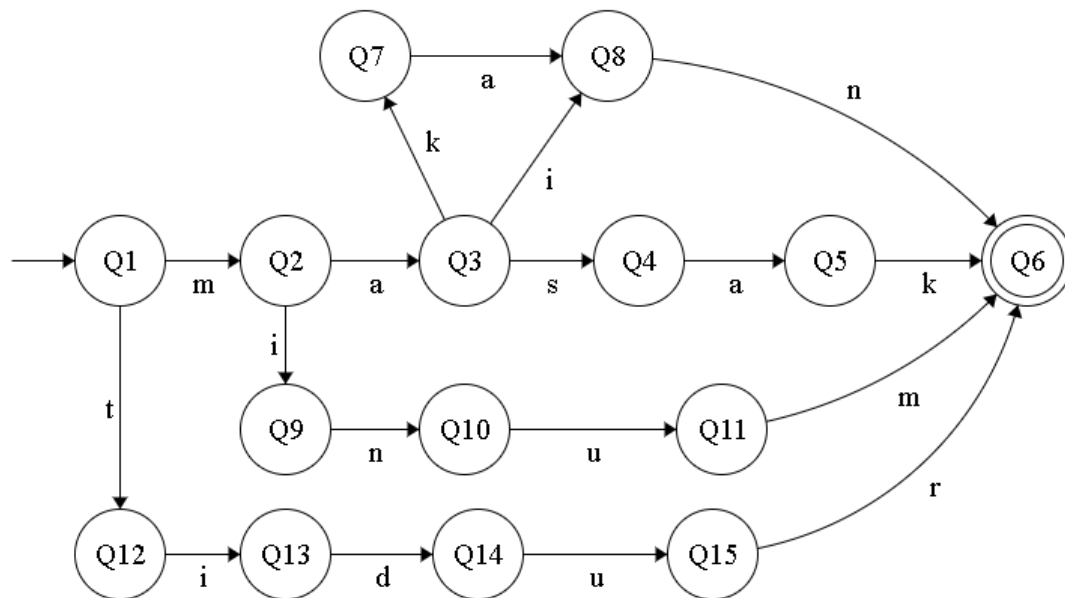Q = {Q1,Q2,Q3,Q4,Q5,Q6,Q7,Q8,Q9,Q10,Q11}
$\Sigma$ = {a,d,i,k,m,s,t,u,y}
q1 = Q1
F = {Q5}
$\delta$ =

|  | a | d | i | k | m | s | t | u | y |
|---|---|---|---|---|---|---|---|---|---|
| Q1 | {} | {Q6} | {Q10} | {Q7} | {} | {Q2} | {} | {} | {} |
| Q2 | {Q3} | {} | {} | {} | {} | {} | {} | {} | {} |
| Q3 | {} | {} | {} | {} | {} | {} | {} | {} | {Q4} |
| Q4 | {Q5} | {} | {} | {} | {} | {} | {} | {} | {} |
| Q5 | {} | {} | {} | {} | {} | {} | {} | {} | {} |
| Q6 | {} | {} | {Q4} | {} | {} | {} | {} | {} | {} |
| Q7 | {Q8} | {} | {} | {} | {} | {} | {} | {} | {} |
| Q8 | {} | {} | {} | {} | {Q9} | {} | {} | {} | {} |
| Q9 | {} | {} | {Q5} | {} | {} | {} | {} | {Q5} | {} |
| Q10 | {} | {} | {} | {} | {} | {} | {Q11} | {} | {} |
| Q11 | {} | {} | {} | {} | {} | {} | {} | {Q5} | {} |

- **Predicate's FA (M2)**



M2 = (Q, $\Sigma$, $\delta$, q1 , F)
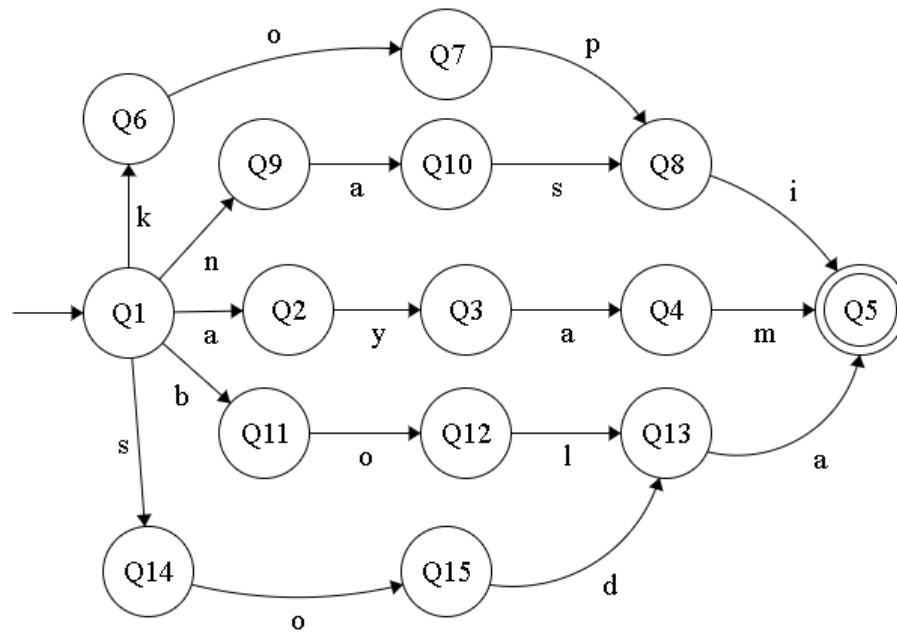Q = {Q1,Q2,Q3,Q4,Q5,Q6,Q7,Q8,Q9,Q10,Q11,12,13,14,15}
$\Sigma$ = {a,d,i,k,m,n,r,s,t,u}
q1 = Q1
F = {Q6}
$\delta$ =

| | a | d | i | k | m | n | r | s | t | u |
|---|---|---|---|---|---|---|---|---|---|---|
| Q1 | {} | {} | {} | {} | {Q2} | {} | {} | {} | {} | {} |
| Q2 | {Q3} | {} | {Q9} | {} | {} | {} | {} | {} | {} | {} |
| Q3 | {} | {} | {Q8} | {Q7} | {} | {} | {} | {Q4} | {} | {} |
| Q4 | {Q5} | {} | {} | {} | {} | {} | {} | {} | {} | {} |
| Q5 | {} | {} | {} | {Q6} | {} | {} | {} | {} | {} | {} |
| Q6 | {} | {} | {} | {} | {} | {} | {} | {} | {} | {} |
| Q7 | {Q8} | {} | {} | {} | {} | {} | {} | {} | {} | {} |
| Q8 | {} | {} | {} | {} | {} | {Q6} | {} | {} | {} | {} |
| Q9 | {} | {} | {} | {} | {} | {Q10} | {} | {} | {} | {} |
| Q10 | {} | {} | {} | {} | {} | {} | {} | {} | {} | {Q11} |
| Q11 | {} | {} | {} | {} | {Q6} | {} | {} | {} | {} | {} |
| Q12 | {} | {} | {Q13} | {} | {} | {} | {} | {} | {} | {} |
| Q13 | {} | {Q14} | {} | {} | {} | {} | {} | {} | {} | {} |
| Q14 | {} | {} | {} | {} | {} | {} | {} | {} | {} | {Q15} |
| Q15 | {} | {} | {} | {} | {} | {} | {Q6} | {} | {} | {} |

- **Object's FA (M3)**



M3 = (Q, $\Sigma$, $\delta$, q1 , F)
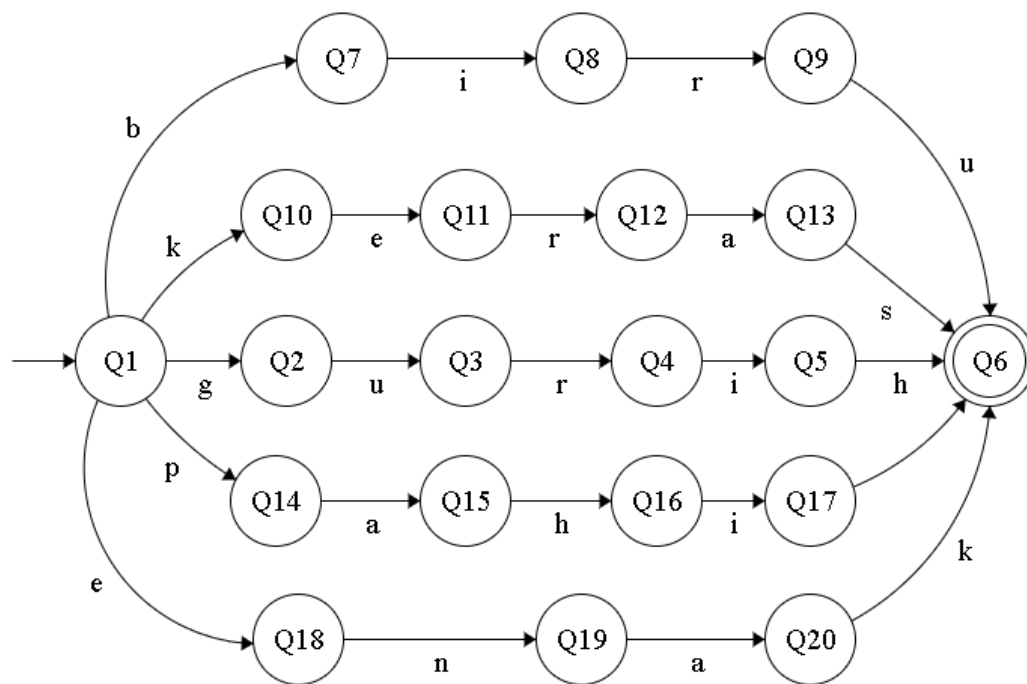Q = {Q1,Q2,Q3,Q4,Q5,Q6,Q7,Q8,Q9,Q10,Q11,Q12,Q13,Q14,Q15}
$\Sigma$ = {a,b,d,i,k,l,m,n,o,p,s,y}
q1 = Q1
F = {Q5}

$\delta =$

| | a | b | d | i | k | l | m | n | o | p | s | y |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Q1 | {Q2} | {Q11} | {} | {} | {Q6} | {} | {} | {Q9} | {} | {} | {} | {} |
| Q2 | {} | {} | {} | {} | {} | {} | {} | {} | {} | {} | {} | {Q3} |
| Q3 | {Q4} | {} | {} | {} | {} | {} | {} | {} | {} | {} | {} | {} |
| Q4 | {} | {} | {} | {} | {} | {} | {Q5} | {} | {} | {} | {} | {} |
| Q5 | {} | {} | {} | {} | {} | {} | {} | {} | {} | {} | {} | {} |
| Q6 | {} | {} | {} | {} | {} | {} | {} | {} | {Q7} | {} | {} | {} |
| Q7 | {} | {} | {} | {} | {} | {} | {} | {} | {} | {Q8} | {} | {} |
| Q8 | {} | {} | {} | {Q5} | {} | {} | {} | {} | {} | {} | {} | {} |
| Q9 | {Q10} | {} | {} | {} | {} | {} | {} | {} | {} | {} | {} | {} |
| Q10 | {} | {} | {} | {} | {} | {} | {} | {} | {} | {} | {Q8} | {} |
| Q11 | {} | {} | {} | {} | {} | {} | {} | {} | {Q12} | {} | {} | {} |
| Q12 | {} | {} | {} | {} | {} | {Q13} | {} | {} | {} | {} | {} | {} |
| Q13 | {Q5} | {} | {} | {} | {} | {} | {} | {} | {} | {} | {} | {} |
| Q14 | {} | {} | {} | {} | {} | {} | {} | {} | {Q15} | {} | {} | {} |
| Q15 | {} | {} | {Q13} | {} | {} | {} | {} | {} | {} | {} | {} | {} |

- **Adverb's FA (M4)**



M1 = (Q, $\sum$, $\delta$, q1 , F)

Q = {Q1,Q2,Q3,Q4,Q5,Q6,Q7,Q8,Q9,Q10,Q11,Q12,Q13,Q14,Q15,Q17,Q18,Q19,Q20}

$\sum$ = {a,b,e,g,h,i,k,n,p,r,s,t,u}

q1 = Q1

F = {Q5}

$\delta =$

| | a | b | e | g | h | i | k | n | p | r | s | t | u |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Q1 | {} | {Q7} | {Q18} | {Q2} | {} | {} | {Q10} | {} | {Q14} | {} | {} | {} | {} |
| Q2 | {} | {} | {} | {} | {} | {} | {} | {} | {} | {} | {} | {} | {Q3} |
| Q3 | {} | {} | {} | {} | {} | {} | {} | {} | {} | {Q4} | {} | {} | {} |
| Q4 | {} | {} | {} | {} | {} | {Q5} | {} | {} | {} | {} | {} | {} | {} |
| Q5 | {} | {} | {} | {} | {Q6} | {} | {} | {} | {} | {} | {} | {} | {} |
| Q6 | {} | {} | {} | {} | {} | {} | {} | {} | {} | {} | {} | {} | {} |
| Q7 | {} | {} | {} | {} | {} | {Q8} | {} | {} | {} | {} | {} | {} | {} |
| Q8 | {} | {} | {} | {} | {} | {} | {} | {} | {} | {Q9} | {} | {} | {} |
| Q9 | {} | {} | {} | {} | {} | {} | {} | {} | {} | {} | {} | {} | {Q6} |
| Q10 | {} | {} | {Q11} | {} | {} | {} | {} | {} | {} | {} | {} | {} | {} |
| Q11 | {} | {} | {} | {} | {} | {} | {} | {} | {} | {Q12} | {} | {} | {} |
| Q12 | {Q13} | {} | {} | {} | {} | {} | {} | {} | {} | {} | {} | {} | {} |
| Q13 | {} | {} | {} | {} | {} | {} | {} | {} | {} | {} | {Q6} | {} | {} |
| Q14 | {Q15} | {} | {} | {} | {} | {} | {} | {} | {} | {} | {} | {} | {} |
| Q15 | {} | {} | {} | {} | {Q16} | {} | {} | {} | {} | {} | {} | {} | {} |
| Q16 | {} | {} | {} | {} | {} | {Q17} | {} | {} | {} | {} | {} | {} | {} |
| Q17 | {} | {} | {} | {} | {} | {} | {} | {} | {} | {} | {} | {Q6} | {} |
| Q18 | {} | {} | {} | {} | {} | {} | {} | {Q19} | {} | {} | {} | {} | {} |
| Q19 | {Q20} | {} | {} | {} | {} | {} | {} | {} | {} | {} | {} | {} | {} |
| Q20 | {} | {} | {} | {} | {} | {} | {Q6} | {} | {} | {} | {} | {} | {} |

4. **Context Free Grammar**

G = ({S,P,O,K}, {s,p,o,k}, S, Z)
Z =
S -> spP
P -> oO | kK | okK | λ
O -> λ
K -> λ

5. **Parse Table**

| | s | p | o | k | EOS |
|---|---|---|---|---|---|
| S | spP | Error | Error | Error | Error |
| P | Error | Error | {oO,okK} | kK | λ |
| O | Error | Error | Error | Error | λ |
| K | Error | Error | Error | error | λ |

## 6. Pushdown Automata
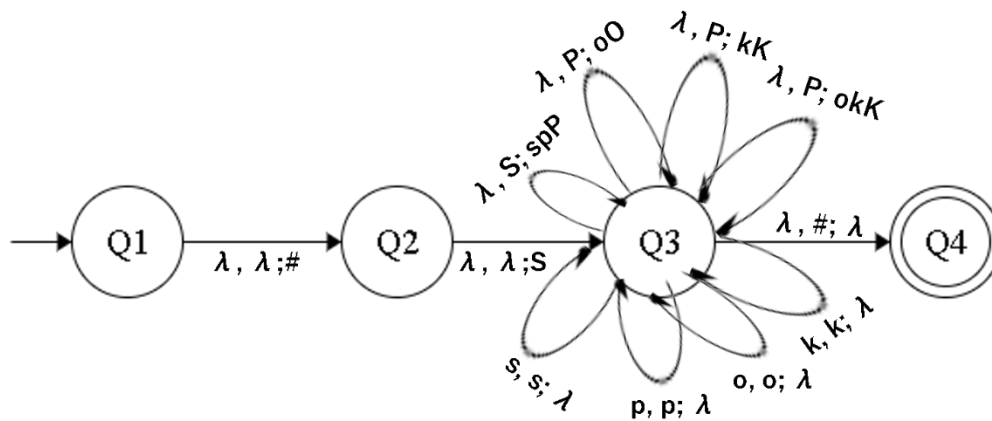


## 7. Program Testing

| Input | Phase 1 | Phase 2 | Description |
|---|---|---|---|
| saya tidur | S-P | Valid | The program recognizes the sentence's pattern S-P from the *Parser Program*, which fits the 1st *Parser Pattern* (SP). Therefore, the sentence is accepted. |
| kami main bola | S-P-O | Valid | The program recognizes the sentence's pattern S-P-O from the *Parser Program*, which fits the 2nd Parser *Pattern* (SPO). Therefore, the sentence is accepted. |
| dia makan enak | S-P-K | Valid | The program recognizes the sentence's pattern S-P-K from the *Parser Program*, which fits the 3rd *Parser Pattern* (SPK). Therefore, the sentence is accepted. |
| kamu minum kopi pahit | S-P-O-K | Valid | The program recognizes the sentence's pattern S-P-O-K from the *Parser Program*, which fits the 4th *Parser Pattern* (SPOK). Therefore, the sentence is accepted. |

| | | | |
|---|---|---|---|
| masak<br>saya<br>gurih<br>ayam | P-O-K-S | Not Valid | The program recognizes the sentence's pattern P-O-K-S from the *Parser Program,* which doesn't fit the requirement for a sentence to be accepted. Therefore, the sentence is not valid. |
| dirinya<br>memilah<br>debu<br>lara | Error | Not Valid. | The program doesn't recognize one or many words from the sentence that belongs to the dictionary. Therefore, the output is not valid. |