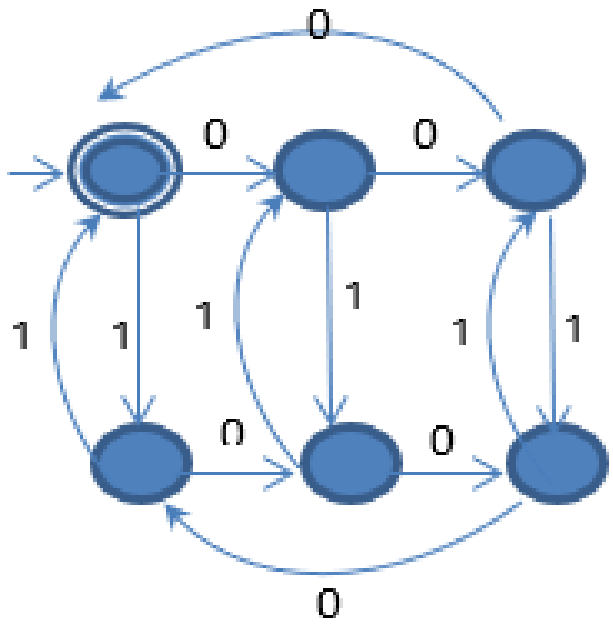
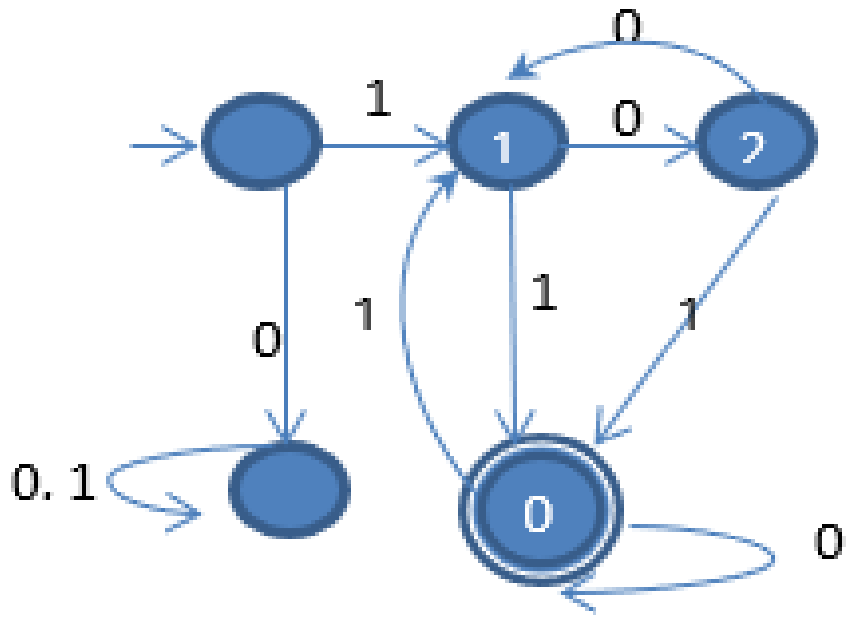
PR

b. Jumlah 0 dpt dibagi 3 dan jumlah 1 dapat dibagi 2



c. bilangan biner, diawali angka 1, bernilai kelipatan 3



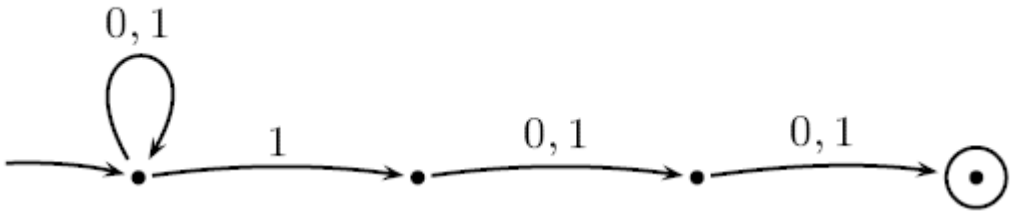
NFA (Nondeterministic Finite Automata)

Soal

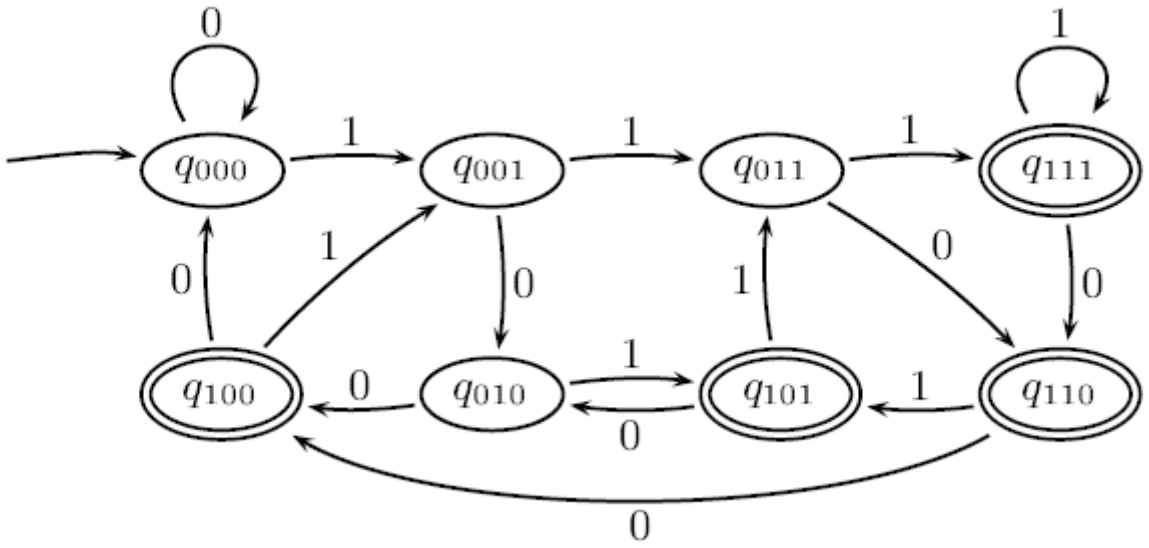
- Buat FA utk Language yg menerima string dgn angka 1 pada posisi ke-3 dari kanan, contoh accepted string: 100, 0100, 101, dst

Language yg menerima string dgn angka 1 pada posisi ke-3 dari kanan

NFA:

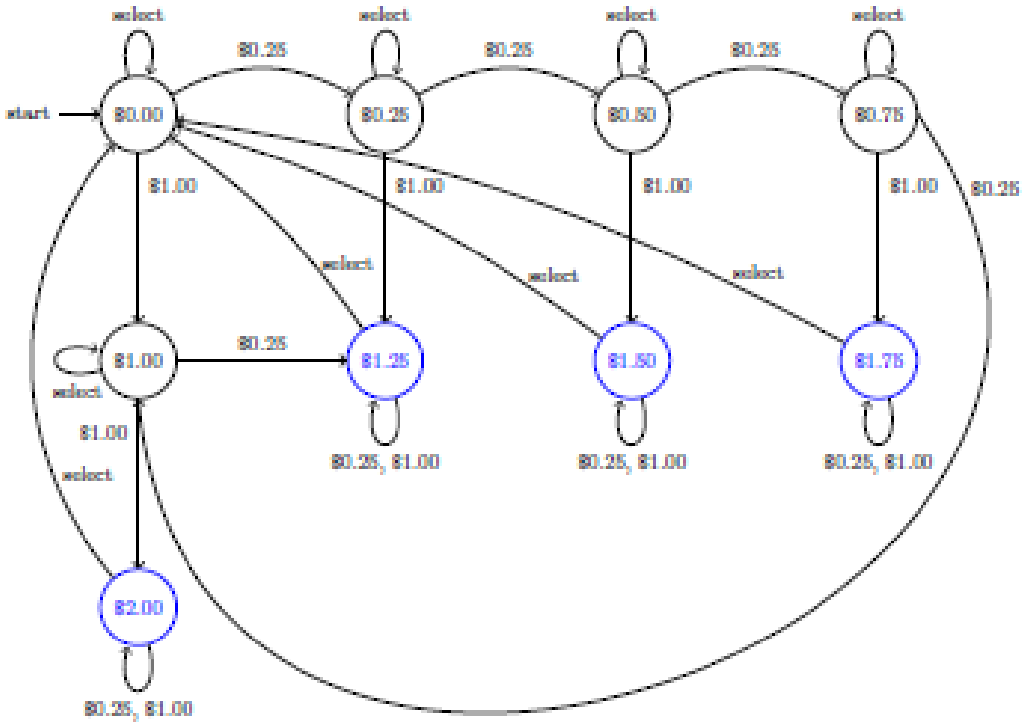


DFA:

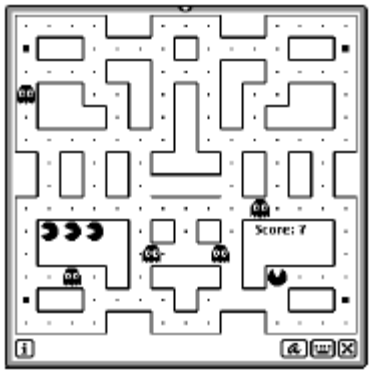


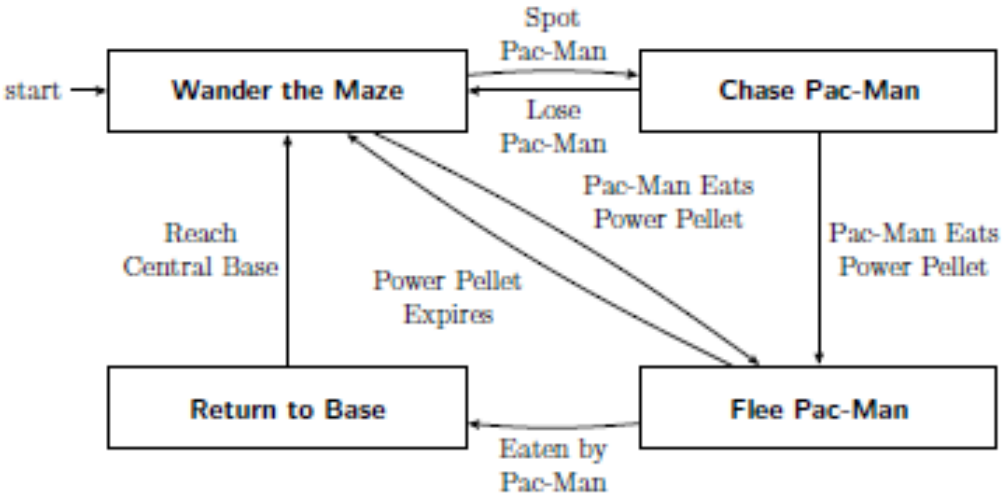
Contoh

- Vending Machine

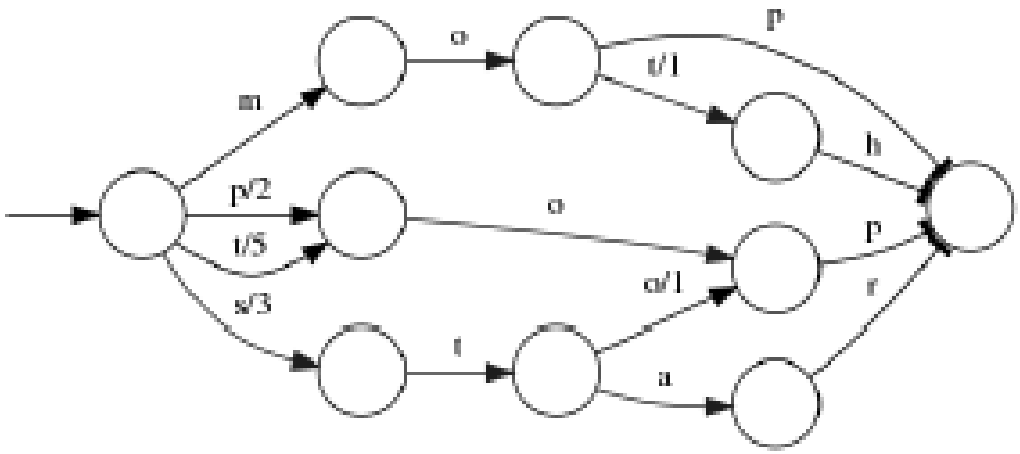


Pac Man

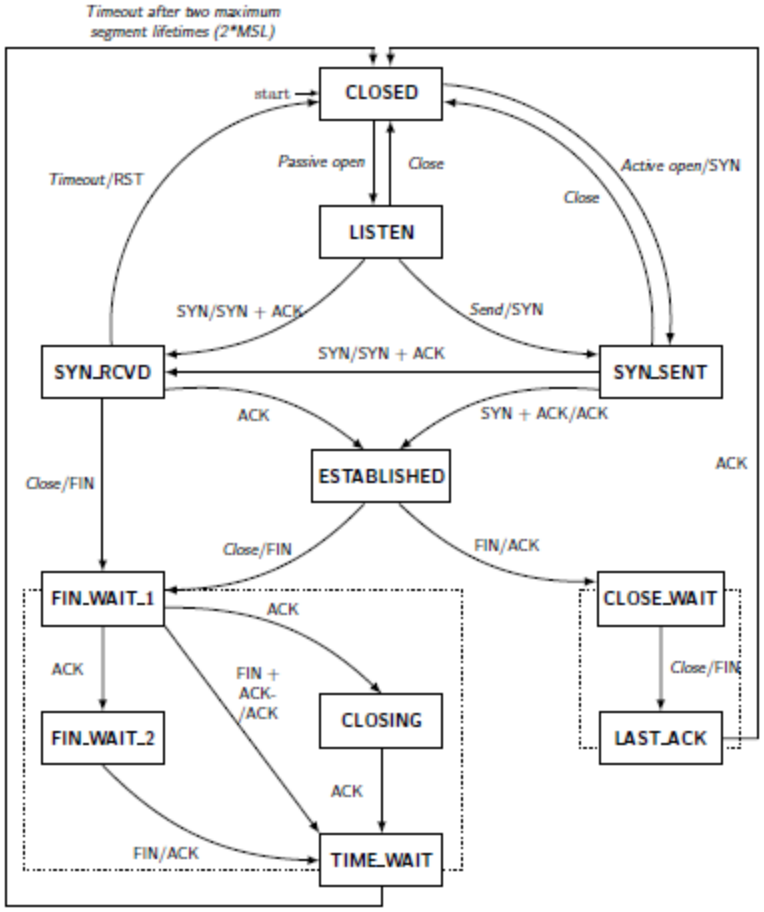

Score: 7


start
Wander the Maze
Spot Pac-Man
Lose Pac-Man
Chase Pac-Man
Pac-Man Eats Power Pellet
Reach Central Base
Power Pellet Expires
Pac-Man Eats Power Pellet
Return to Base
Flee Pac-Man
Eaten by Pac-Man

Keyword Indexing



TCP (Transmission Control Protocol)



Nondeterministic

- δ(state, input symbol) = {lebih dari satu state}
- Notasi Formal
  - Q: sekumpulan state
  - Σ: input alphabet
  - δ: fungsi transisi
  - start state pada Q, biasanya q_0
  - sekumpulan final state (F dimana $F \subseteq Q$)

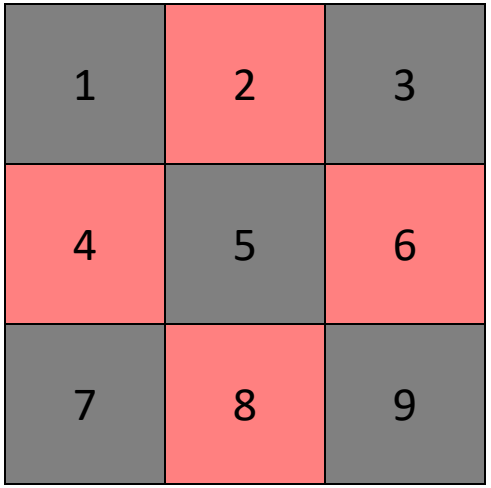
Fungsi Transisi pd NFA

- Basis: $\delta(q, \epsilon) = \{q\}$
- Induction: jika $\delta(q, w)$ = sekumpulan states (p); maka $\delta(q, wa) = \delta$(semua states di p, a)

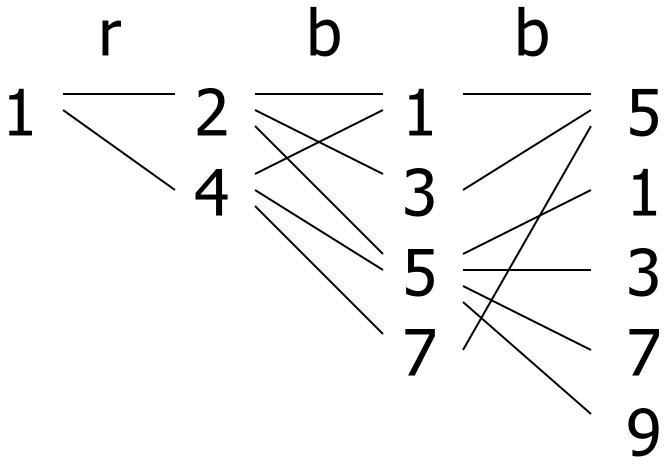
Language dari NFA

- string w diterima NFA jika salah satu state hasil dari $\delta(q_0, w)$ adalah final state
- language dari NFA adalah kumpulan string yang diterima NFA tsb

Contoh: Chessboard

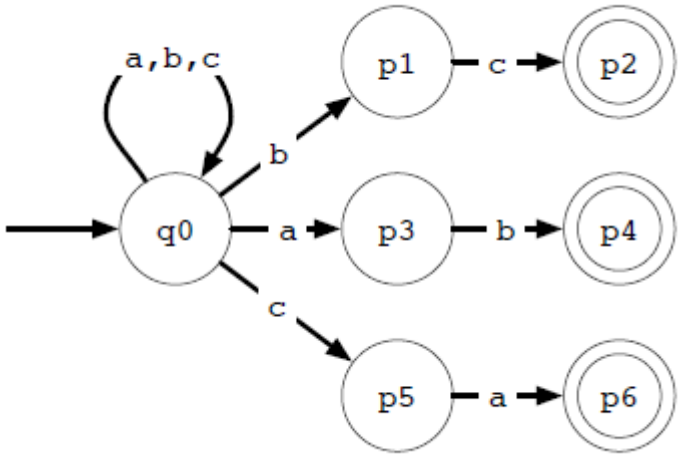


		r	b
→	1	2,4	5
	2	4,6	1,3,5
	3	2,6	5
	4	2,8	1,5,7
	5	2,4,6,8	1,3,7,9
	6	2,8	3,5,9
	7	4,8	5
	8	4,6	5,7,9
*	9	6,8	5



← Accept, since final state reached

An NFA for the language of all strings over $\{a, b, c\}$ that end with one of ab, bc, and ca.

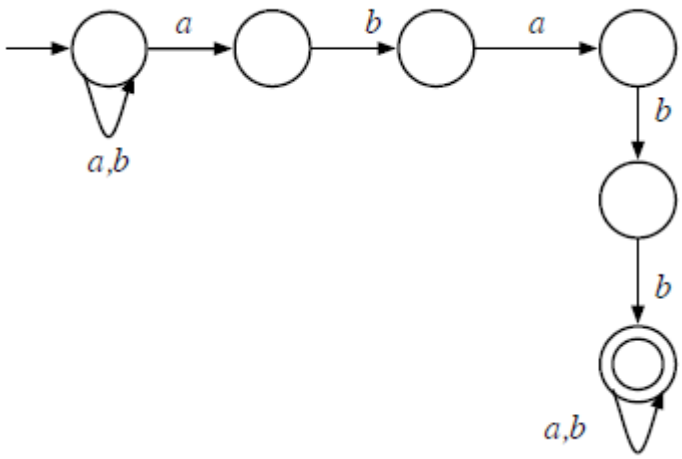


Latihan Soal

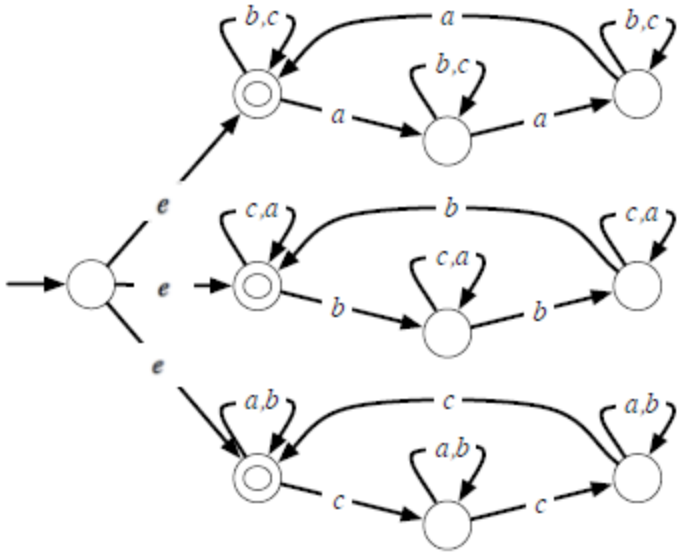
An NFA for the language of all strings over $\{a, b\}$ that contain $ababb$.

An NFA for the language of all strings over $\{a, b, c\}$ for which one of (the number of occurrences of a), (the number of occurrences of b), and (the number of occurrences of c) is a multiple of 3.

An NFA for the language of all strings over $\{a, b\}$ that contain $ababb$.



An NFA for the language of all strings over $\{a, b, c\}$ for which one of (the number of occurrences of a), (the number of occurrences of b), and (the number of occurrences of c) is a multiple of 3.



EKIVALENSI NFA - DFA

Ekivalensi DFA dan NFA

- DFA dapat diubah ke NFA
- Jika pada DFA, ada $\delta_D(q, a) = p$, maka pada NFA ditulis sbb: $\delta_N(q, a) = \{p\}$
- NFA yang diubah dari DFA hanya memiliki 1 state

Ekivalensi DFA dan NFA

- Untuk setiap NFA, juga ada DFA yang menerima language yang sama
- Metode: subset construction
- DFA akan memiliki
  - state yang lebih banyak (maksimum 2^Q)
  - input dan start state tetap
  - final state: semua state baru DFA yang memiliki informasi state F pada NFA

Contoh: Subset Construction

		r	b
→	1	2,4	5
	2	4,6	1,3,5
	3	2,6	5
	4	2,8	1,5,7
	5	2,4,6,8	1,3,7,9
	6	2,8	3,5,9
	7	4,8	5
	8	4,6	5,7,9
*	9	6,8	5

	r	b
→ {1}	{2,4}	{5}
{2,4}		
{5}		

Alert: What we're doing here is the *lazy* form of DFA construction, where we only construct a state if we are forced to.

Contoh: Subset Construction

		r	b
→	1	2,4	5
	2	4,6	1,3,5
	3	2,6	5
	4	2,8	1,5,7
	5	2,4,6,8	1,3,7,9
	6	2,8	3,5,9
	7	4,8	5
	8	4,6	5,7,9
*	9	6,8	5

	r	b
→ {1}	{2,4}	{5}
{2,4}	{2,4,6,8}	{1,3,5,7}
{5}		
{2,4,6,8}		
{1,3,5,7}		

Contoh: Subset Construction

		r	b
→	1	2,4	5
	2	4,6	1,3,5
	3	2,6	5
	4	2,8	1,5,7
	5	2,4,6,8	1,3,7,9
	6	2,8	3,5,9
	7	4,8	5
	8	4,6	5,7,9
*	9	6,8	5

		r	b
→	{1}	{2,4}	{5}
	{2,4}	{2,4,6,8}	{1,3,5,7}
	{5}	{2,4,6,8}	{1,3,7,9}
	{2,4,6,8}		
	{1,3,5,7}		
*	{1,3,7,9}		

Contoh: Subset Construction

		r	b
→	1	2,4	5
	2	4,6	1,3,5
	3	2,6	5
	4	2,8	1,5,7
	5	2,4,6,8	1,3,7,9
	6	2,8	3,5,9
	7	4,8	5
	8	4,6	5,7,9
*	9	6,8	5

		r	b
→	{1}	{2,4}	{5}
	{2,4}	{2,4,6,8}	{1,3,5,7}
	{5}	{2,4,6,8}	{1,3,7,9}
	{2,4,6,8}	{2,4,6,8}	{1,3,5,7,9}
	{1,3,5,7}		
*	{1,3,7,9}		
*	{1,3,5,7,9}		

Contoh: Subset Construction

		r	b
→	1	2,4	5
	2	4,6	1,3,5
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	4	2,8	1,5,7
	5	2,4,6,8	1,3,7,9
	6	2,8	3,5,9
	7	4,8	5
	8	4,6	5,7,9
*	9	6,8	5

		r	b
→	{1}	{2,4}	{5}
	{2,4}	{2,4,6,8}	{1,3,5,7}
	{5}	{2,4,6,8}	{1,3,7,9}
	{2,4,6,8}	{2,4,6,8}	{1,3,5,7,9}
	{1,3,5,7}	{2,4,6,8}	{1,3,5,7,9}
*	{1,3,7,9}		
*	{1,3,5,7,9}		

Example: Subset Construction

		r	b
→	1	2,4	5
	2	4,6	1,3,5
	3	2,6	5
	4	2,8	1,5,7
	5	2,4,6,8	1,3,7,9
	6	2,8	3,5,9
	7	4,8	5
	8	4,6	5,7,9
*	9	6,8	5

		r	b
→	{1}	{2,4}	{5}
	{2,4}	{2,4,6,8}	{1,3,5,7}
	{5}	{2,4,6,8}	{1,3,7,9}
	{2,4,6,8}	{2,4,6,8}	{1,3,5,7,9}
	{1,3,5,7}	{2,4,6,8}	{1,3,5,7,9}
*	{1,3,7,9}	{2,4,6,8}	{5}
*	{1,3,5,7,9}		

Example: Subset Construction

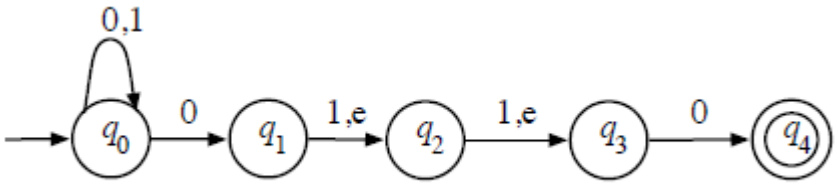
		r	b
→	1	2,4	5
	2	4,6	1,3,5
	3	2,6	5
	4	2,8	1,5,7
	5	2,4,6,8	1,3,7,9
	6	2,8	3,5,9
	7	4,8	5
	8	4,6	5,7,9
*	9	6,8	5

		r	b
→	{1}	{2,4}	{5}
	{2,4}	{2,4,6,8}	{1,3,5,7}
	{5}	{2,4,6,8}	{1,3,7,9}
	{2,4,6,8}	{2,4,6,8}	{1,3,5,7,9}
	{1,3,5,7}	{2,4,6,8}	{1,3,5,7,9}
*	{1,3,7,9}	{2,4,6,8}	{5}
*	{1,3,5,7,9}	{2,4,6,8}	{1,3,5,7,9}

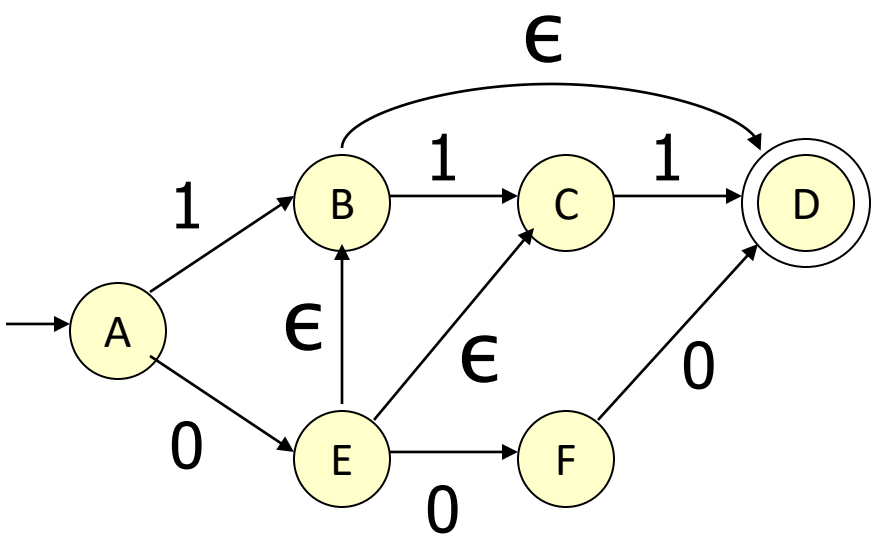
NFA dgn ϵ–Transition

Contoh Soal

An NFA for the language of all strings over $\{0, 1\}$ that end with one of 0110, 010, and 00.



NFA dgn ϵ-Transition

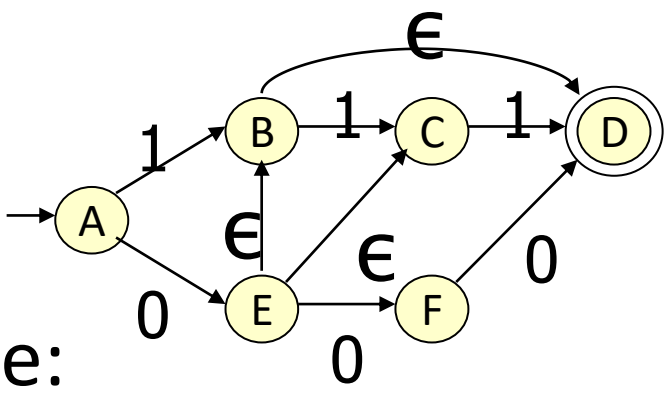


		0	1	ϵ
→	A	{E}	{B}	∅
	B	∅	{C}	{D}
	C	∅	{D}	∅
*	D	∅	∅	∅
	E	{F}	∅	{B, C}
	F	{D}	∅	∅

- memungkinkan adanya transisi antar state dgn input ϵ

Closure of States

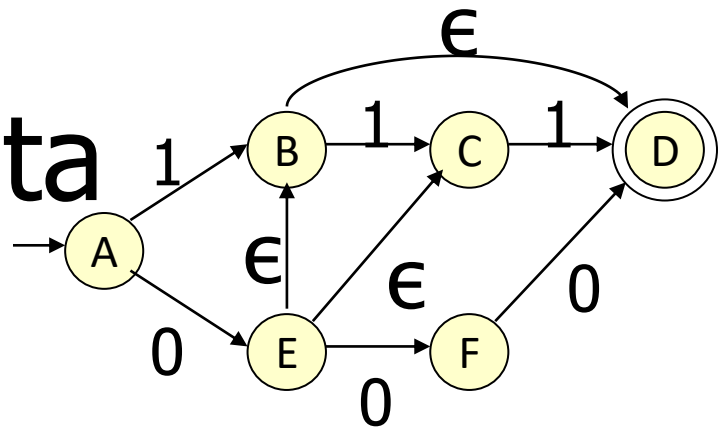
- CL(q) = sekumpulan state yang bisa dicapai dari state q dengan hanya mengikuti busur berlabel ϵ
- CL(A) = {A}
- CL(E) = {B, C, D, E}
- Closure dari kumpulan state:
  - gabungan closure setiap state



Extended Delta

- Basis: $\hat{\delta}(q, \epsilon) = CL(q)$.
- Induction: $\hat{\delta}(q, xa)$ sbb:
  1. misal $\hat{\delta}(q, x) = S$.
  2. = union dari $CL(\delta(p, a))$ utk semua p di S.
- Intuisi: $\hat{\delta}(q, w)$ adalah sekumpulan state yang dapat dicapai dari q dengan mengikuti path busur w

Cth: Extended Delta



- $\hat{\delta}(A, \epsilon) = CL(A) = \{A\}$.
- $\hat{\delta}(A, 0) = CL(\{E\}) = \{B, C, D, E\}$.
- $\hat{\delta}(A, 01) = CL(\{C, D\}) = \{C, D\}$.
- *Language* dari sebuah ϵ-NFA adalah sekumpulan string w dimana $\hat{\delta}(q_0, w)$ mengandung final state.

Ekivalensi antara NFA dan ϵ-NFA

- setiap NFA adalah ϵ-NFA, hny tnp transisi ϵ
- daftar state, state awal dan
- setiap fungsi transisi pd NFA: $\delta_N(q, a)$ adl:
  - misal S = CL(q) dimana S adl kumpulan state
  - $\delta_N(q, a)$ adl union semua p pada S yaitu $\delta\epsilon(p, a)$

Contoh: ϵ-NFA-to-NFA

Interesting closures: CL(B) = {B,D}; CL(E) = {B,C,D,E}

		0	1	ϵ
→	A	{E}	{B}	∅
	B	∅	{C}	{D}
	C	∅	{D}	∅
*	D	∅	∅	∅
	E	{F}	∅	{B, C}
	F	{D}	∅	∅

ϵ-NFA

Krn closures dr B dan E meliputi final state D.

		0	1
→	A	{E}	{B}
*	B	∅	{C}
	C	∅	{D}
*	D	∅	∅
*	E	{F}	{C, D}
	F	{D}	∅

Krn closure dr E mencakup B dan C; yg memiliki transisi 1 ke C dan D.