**Formal Languages - CS6055**

Coursework Report

[ Project Manager] Hasan Khan – 21002595

Fabian Hasan - 22044754

Kiril Kirilov – 20006870

Innocent Elohim - 21035711

A document with text and images

Description automatically generated

Contents

[**Transition Diagram** 2](#_Toc183014589)

[**Testing the NFA** 3](#_Toc183014590)

[**Transition Relation** 3](#_Toc183014591)

[**Converting NFA to a DFA** 4](#_Toc183014592)

[**Minimize the DFA** 6](#_Toc183014593)

[**Transition Diagram** 11](#_Toc183014594)

[**Testing the Simplified DFA** 11](#_Toc183014595)

[**Project Conclusion** 12](#_Toc183014596)

# **Transition Diagram**

L = {W ∈ (0,1)\* and Alphabet (0,1) : W = { | ∑ | = 2n, n ∈ ℕ}, { | (0,1)\* = n, n ∈ ℤ}, { | 0 | = 2} }

A graph paper with a diagram

Description automatically generated

# **Testing the NFA**

**Accepted:**

1. 0000

A0000 ⊢ B000 ⊢ C00 ⊢ E0 ⊢ F -> Final State

1. 001100

A001100 ⊢ B01100 ⊢ C1100 ⊢ D100 ⊢ C00 ⊢ E0 ⊢ F -> Final State

1. 10001001

A10001001 ⊢ A0001001 ⊢ B001001 ⊢ C01001 ⊢ D1001 ⊢ C001 ⊢ E01 ⊢ F1 ⊢ F -> Final State

**Not Accepted:**

1. 000

A000 ⊢ B00 ⊢ C0 ⊢ E -> Not Final State

1. 01000

A0100 ⊢ B100 ⊢ ∅ -> Not Final State

1. 100100

A100100 ⊢ A00100 ⊢ B0100 ⊢ C100 ⊢ D00 ⊢ C0 ⊢ E -> Not Final State

# **Transition Relation**

|  |
| --- |
| **Q X ∑** |
| A0 |
| A1 |
| B0 |
| B1 |
| C0 |
| C1 |
| D0 |
| D1 |
| E0 |
| E1 |
| F0 |
| F1 |

|  |
| --- |
| **Q** |
| A |
| B |
| C |
| D |
| E |
| F |

# **Converting NFA to a DFA**

|  |  |  |
| --- | --- | --- |
|  | 0 | 1 |
| {A} | {A,B} | {A} |
| {A,B) | {A,B,C) | {A} |
| {A,B,C) | {A,B,C,D,E} | {A,D} |
| {A,B,C,D,E} | {A,B,C,D,E,F} | {A,C, D} |
| {A,D} | {A,B,C) | {A,C} |
| {A,B,C,D,E,F} | {A,B,C,D,E,F} | {A,C,D,F} |
| {A,C,D} | {A,B,C,D,E} | {A,C,D} |
| {A,C} | {A,B,D,E} | {A,D} |
| {A,C,D,F} | {A,B,C,D,E,F} | {A,C,D,F} |
| {A,B,D,E} | {A,B,C,F} | {A,C} |
| {A,B,C,F} | {A,B,C,D,E,F} | {A,D,F} |
| {A,D,F} | {A,B,C,F} | {A,C,F} |
| {A,C,F} | {A,B,D,E,F} | {A,D,F} |
| {A,B,D,E,F} | {A,B,C,F} | {A,C,F} |

**Renaming new states:**

|  |  |
| --- | --- |
| {A} | A |
| {A,B) | B |
| {A,B,C) | C |
| {A,B,C,D,E} | D |
| {A,D} | E |
| {A,B,C,D,E,F} | F |
| {A,C,D} | G |
| {A,C} | H |
| {A,C,D,F} | I |
| {A,B,D,E} | J |
| {A,B,C,F} | K |
| {A,D,F} | L |
| {A,C,F} | M |
| {A,B,D,E,F} | N |

A graph paper with a diagram

Description automatically generated

# **Minimize the DFA**

|  |  |  |
| --- | --- | --- |
|  | **0** | **1** |
| A | B | A |
| B | C | A |
| C | D | E |
| D | F | G |
| E | C | H |
| F | F | I |
| G | D | G |
| H | J | H |
| I | F | I |
| J | K | H |
| K | F | L |
| L | K | M |
| M | N | L |
| N | K | M |

F = {F,I,K,L,M,N}

Q-F = {A,B,C,D,E,G,H,J}

|  |  |  |  |
| --- | --- | --- | --- |
|  | 0/// | 0 | 1 |
| Q-F | A | B ∈ Q-F | A ∈ Q-F |
| B | C ∈ Q-F | A ∈ Q-F |
| C | D ∈ Q-F | E ∈ Q-F |
| D | F ∈ F | G ∈ Q-F |
| E | C ∈ Q-F | H ∈ Q-F |
| G | F ∈ F | I ∈ F |
| H | J ∈ Q-F | H ∈ Q-F |
| J | K ∈ F | H ∈ Q-F |
|  |  |  |  |
| F | F | F ∈ F | I ∈ F |
| I | F ∈ F | I ∈ F |
| K | F ∈ F | L ∈ F |
| L | K ∈ F | M ∈ F |
| M | N ∈ F | L ∈ F |
| N | K ∈ F | M ∈ F |

A = F,I,K,L,M,N

B = A,B,C,D,E,G,H,J

|  |  |  |  |
| --- | --- | --- | --- |
|  | 1/// | 0 | 1 |
| A | F | A | A |
| I | A | A |
| K | A | A |
| L | A | A |
| M | A | A |
| N | A | A |
|  |  |  |  |
| B | A | B | B |
| B | B | B |
| C | B | B |
| D | A | B |
| E | B | B |
| G | A | A |
| H | B | B |
| J | A | B |

A’ = {F,I,K,L,M,N}

B’ = {A,B,C,E,H}

C’ = {D,J}

D’ = {G}

|  |  |  |  |
| --- | --- | --- | --- |
|  | 2/// | 0 | 1 |
| A’ | F | A | A |
| I | A | A |
| K | A | A |
| L | A | A |
| M | A | A |
| N | A | A |
|  |  |  |  |
| B’ | A | B | B |
| B | B | B |
| C | C | B |
| E | B | B |
| H | C | B |
|  |  |  |  |
| C’ | D | A | D |
| J | A | B |
|  |  |  |  |
| D’ | G | A | A |

A’’ = {F,I,K,L,M,N}

B’’ = {A,B,E}

C’’ = {C,H)

D’’ = {D}

E’’ = {J}

F’’ = {G}

|  |  |  |  |
| --- | --- | --- | --- |
|  | 3/// | **0** | **1** |
| A’’ | F | A | A |
| I | A | A |
| K | A | A |
| L | A | A |
| M | A | A |
| N | A | A |
|  |  |  |  |
| B’’ | A | B | B |
| B | C | B |
| E | C | C |
|  |  |  |  |
| C’’ | C | D | B |
| H | E | C |
|  |  |  |  |
| D’’ | D | A | G |
|  |  |  |  |
| E’’ | J | A | C |
|  |  |  |  |
| F’’ | G | A | A |

A’’’ = {F,I,K,L,M,N}

B’’’ = {A}

C’’’ = {B}

D’’’ = {E}

E’’’ = {C}

F’’’ = {H}

G’’’ = {D}

H’’’ = {J}

I’’’ = {G}

|  |  |  |  |
| --- | --- | --- | --- |
|  | 4/// | 0 | 1 |
| A’’’ | F | A | A |
| I | A | A |
| K | A | A |
| L | A | A |
| M | A | A |
| N | A | A |
|  |  |  |  |
| B’’’ | A | C | B |
|  |  |  |  |
| C’’’ | B | E | B |
|  |  |  |  |
| D’’’ | E | E | F |
|  |  |  |  |
| E’’’ | C | G | D |
|  |  |  |  |
| F’’’ | H | H | F |
|  |  |  |  |
| G’’’ | D | A | I |
|  |  |  |  |
| H’’’ | J | A | F |
|  |  |  |  |
| I’’’ | G | A | A |

# 

# **Transition Diagram**

A graph paper with a diagram

Description automatically generated

# **Testing the Simplified DFA**

**Accepted:**

1. 0000

B0000 ⊢ C000 ⊢ E00 ⊢ G0 ⊢ A -> Final State

1. 001100

B001100 ⊢ C01100 ⊢ E1100 ⊢ D100 ⊢ F00 ⊢ H0 ⊢ A -> Final State

1. 10001001

B10001001 ⊢ B0001001 ⊢ C001001 ⊢ E01001 ⊢ G1001 ⊢ I001 ⊢ A01 ⊢ A1 ⊢ A -> Final State

**Not Accepted:**

1. 000

B000 ⊢ C00 ⊢ E0 ⊢ G -> Not Final State

1. 01000

B0100 ⊢ C100 ⊢ B00 ⊢ C0 ⊢ E -> Not Final State

1. 100100

B100100 ⊢ B00100 ⊢ C0100 ⊢ E100 ⊢ D00 ⊢ E0 ⊢ G -> Not Final State

# **Project Conclusion**

We have all contributed to this coursework. We had scheduled weekly meetings via Whatsapp to discuss progress on given tasks. Hasan, the project manager, decided that Hasan and Fabain would work on parts A – D while Innocent and Kiril worked on parts E – G. The work had gone smoothly and there were no issues between members. This report was pieced together by Hasan and Fabian. Fabian drew the diagrams in a much neater manner.

Our meetings were scheduled on a weekly basis to meet every Wednesday. All members had turned up and we discussed progress and offered insights to the next parts. Overall, each group member can agree that the coursework went as expected in terms of work distribution. It was fair since we helped each other even though the task allocation was separate.