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CASE STUDY RESEARCH ASSIGNMENT

BSCS-III (5TH SEMESTER)
SECTION A (EVENING)

INTRODUCTION:

PAPER TITLE: "DNA PATTERN ANALYSIS USING FA, MEALY AND MOORE MACHINES"

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PURPOSE:

- DEOXYRIBONUCLEIC ACID(DNA) IS A SERIES OF GENES MADE BY THE MIXTURE OF NUCLEOTIDES.
- DNA PATTERNS ARE GRAPHS OF DNA OR RNA SEQUENCES. IT IS AN ARRANGEMENT OF QUALITIES MADE OF MIX OF NUCLEOTIDES.
- THESE NUCLEOTIDES ARE ALSO CALLED **CODONS** AND **COMBINATION OF CODONS** WHICH HELPS IN PROTEIN.
- THERE ARE FOUR NUCLEOTIDES THAT HELPS TO UNDERSTAND PATTERN AND TRANSCRIBE INTO RNA PATTERN AND THEN THIS RNA PATTERN TRANSLATES INTO PROTEIN FOR FINDING ANY PROBLEM IN PATTERN.
- THE FOUR IMPORTANT NUCLEOTIDES ARE **CYTOSINE** (C), **ADENINE** (A), **THYMINE** (T) AND **GUANINE** (G).
- THERE ARE METHODS IN THEORETICAL COMPUTER SCIENCE SUCH AS **FINITE AUTOMATA, MEALY MACHINE** AND **MOORE MACHINE** TO EXAMINE PATTERNS OF DNA AND ANALYZE ANY CHANGE IN NUCLEOTIDES TO PREVENT VARIOUS GENETIC DISORDERS.

NEED:

- DNA PATTERNS ARE GRAPHS OF DNA OR RNA SEQUENCES. IT IS AN ARRANGEMENT OF QUALITIES MADE OF MIX OF NUCLEOTIDES. THE ADJUSTMENT IN THE ARRANGEMENT OF THESE NUCLEOTIDES CAN CHANGE THE HEREDITARY DATA THAT CAUSE NUMEROUS ISSUES IN LIVING CREATURES. SO IT IS USEFUL TO FIND OUT SUCH CHANGE IN NUCLEOTIDES TO PREVENT SUCH TYPE OF DISORDERS AND ABNORMALITIES.
- THERE ARE MANY METHODS TO ANALYZE THE DNA PATTERN,ESPECIALLY IN COMPUTER SCIENCE TO DETECT IT FROM ANY CHANGE IN THE SEQUENCE OF NUCLEOTIDES. FINITE AUTOMATA IS USED TO ANALYZE SUCH PATTERNS.

METHODOLOGY

DNA PATTERN: DNA SEQUENCE CONSTITUTES A COMBINATION OF NUCLEOTIDES. THESE NUCLEOTIDES ARE ALSO CALLED AS CODONS. IN DNA CONSISTS OF COMBINATIONS OF FOUR CODONS WHICH ARE KNOWN AS CYTOSINE (C), ADENINE (A), THYMINE (T) AND GUANINE (G). THIS DNA PATTERN CONVERTED INTO RNA WITH THE HELP OF DIFFERENT ENZYMES AND URACIL (U) REPLACES THE THYMINE.

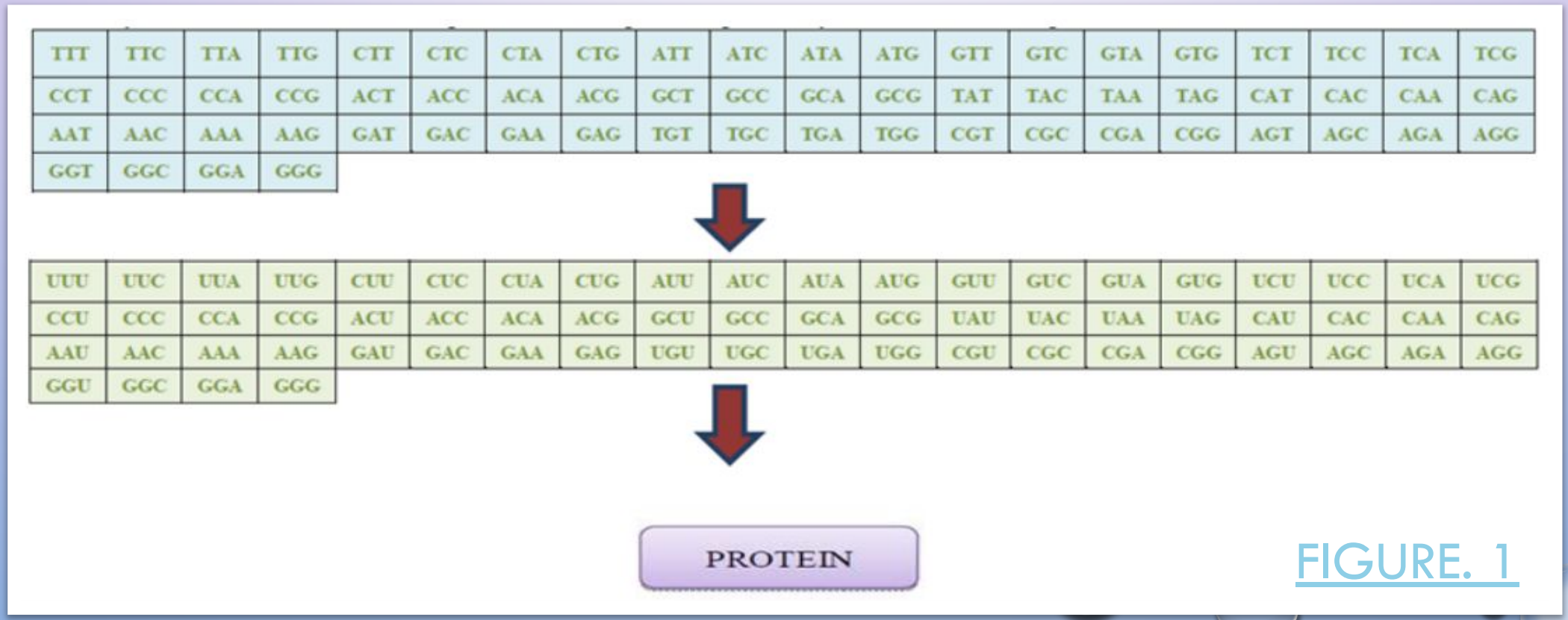


FIGURE. 1

1) DNA PATTERN ANALYSIS WITH FINITE AUTOMATA

IN THE PROPOSED MODEL, EIGHT STATES WERE USED TO ANALYZE DNA NORMAL AND ABNORMAL PATTERNS USING JFLAP.

Q = { 1 , 2 , 3 , 4 , 5 , 6 , 7 , 8 }

Σ = { A , T , C , G }

THE 8 STATES OF DNA PATTERN, IN WHICH ON EVERY STATE WERE CHECKED FOR THE INPUTS OF DNA GENERAL PATTERN, IF AN INPUT WAS ACCEPTED BY GIVEN MACHINE IT WAS TO BE REGARDED AS A NORMAL PATTERN OTHERWISE SOME ABNORMALITY IN SPECIFIC PATTERN WAS BE ASSUMED.

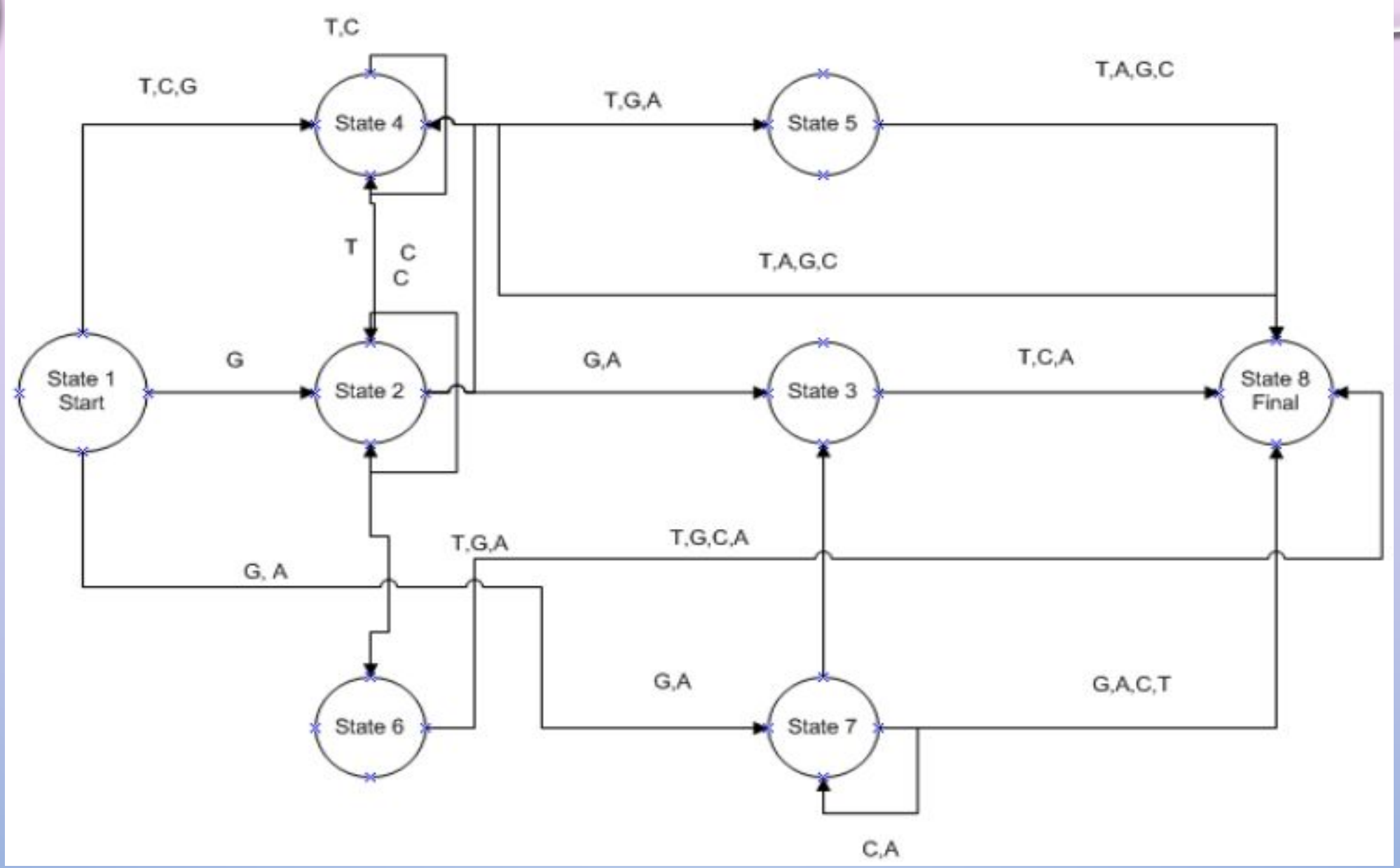


FIGURE: FA OF DNA PATTERN

2) DNA PATTERN ANALYSIS WITH MEALY MACHINES:

THERE ARE MANY INPUTS FOR DNA PATTERN, AS MENTIONED ABOVE IN FIGURE. 1.

RANDOM INPUTS WERE SELECTED AND CHECKED FOR MEALY MACHINES ACCEPTANCE. IN CASE THE MACHINE ACCEPTED THE INPUT ON EVERY STAGE, THE DNA WAS NORMAL OTHERWISE IT WAS ABNORMAL. THERE IS GENERAL MODEL IN WHICH ON EVERY INPUT CHECK MACHINE THAT IS ACCEPTED OR REJECTED.

INPUT (A, G, C, T)

THERE ARE FIVE STATES.

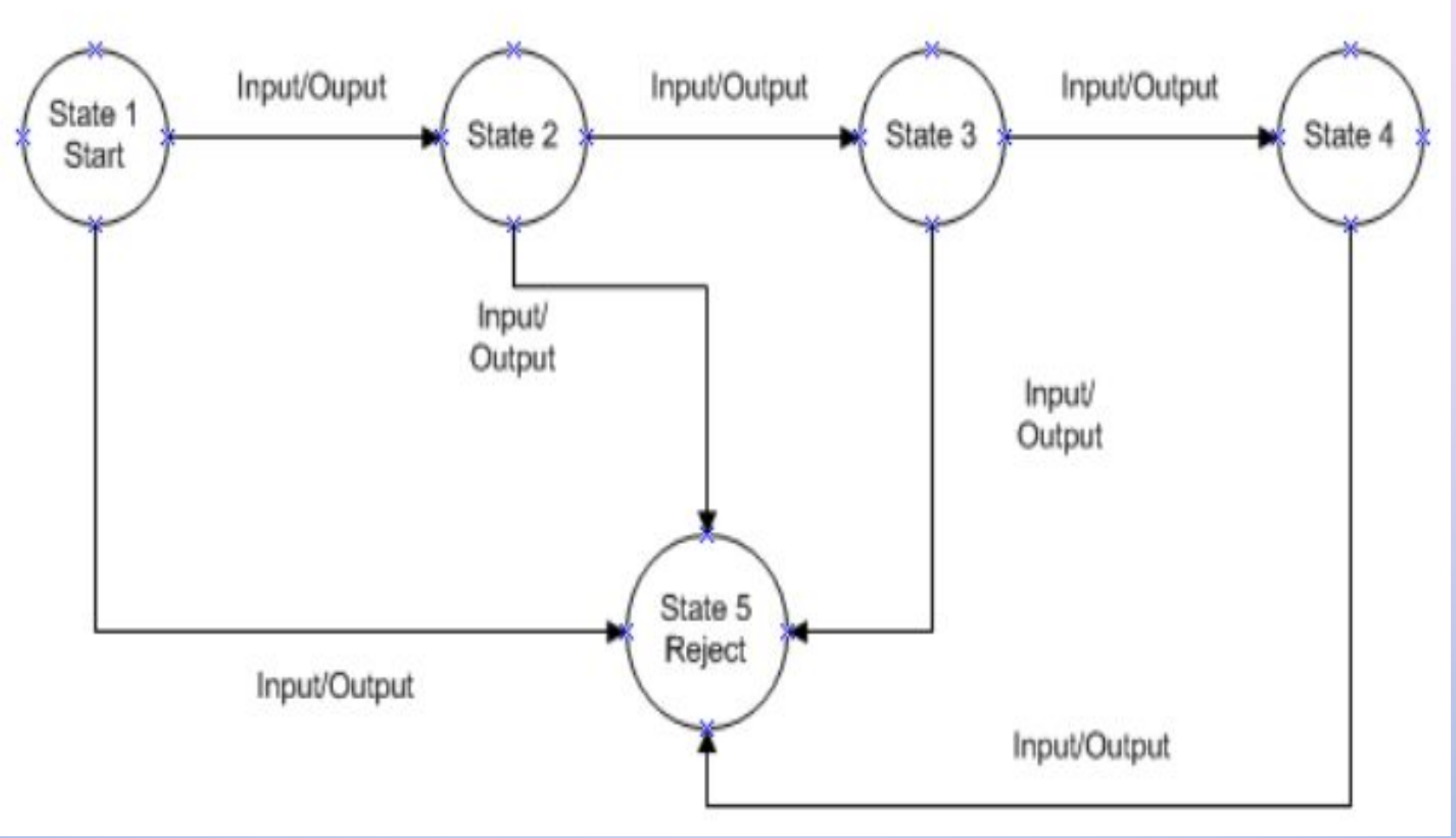
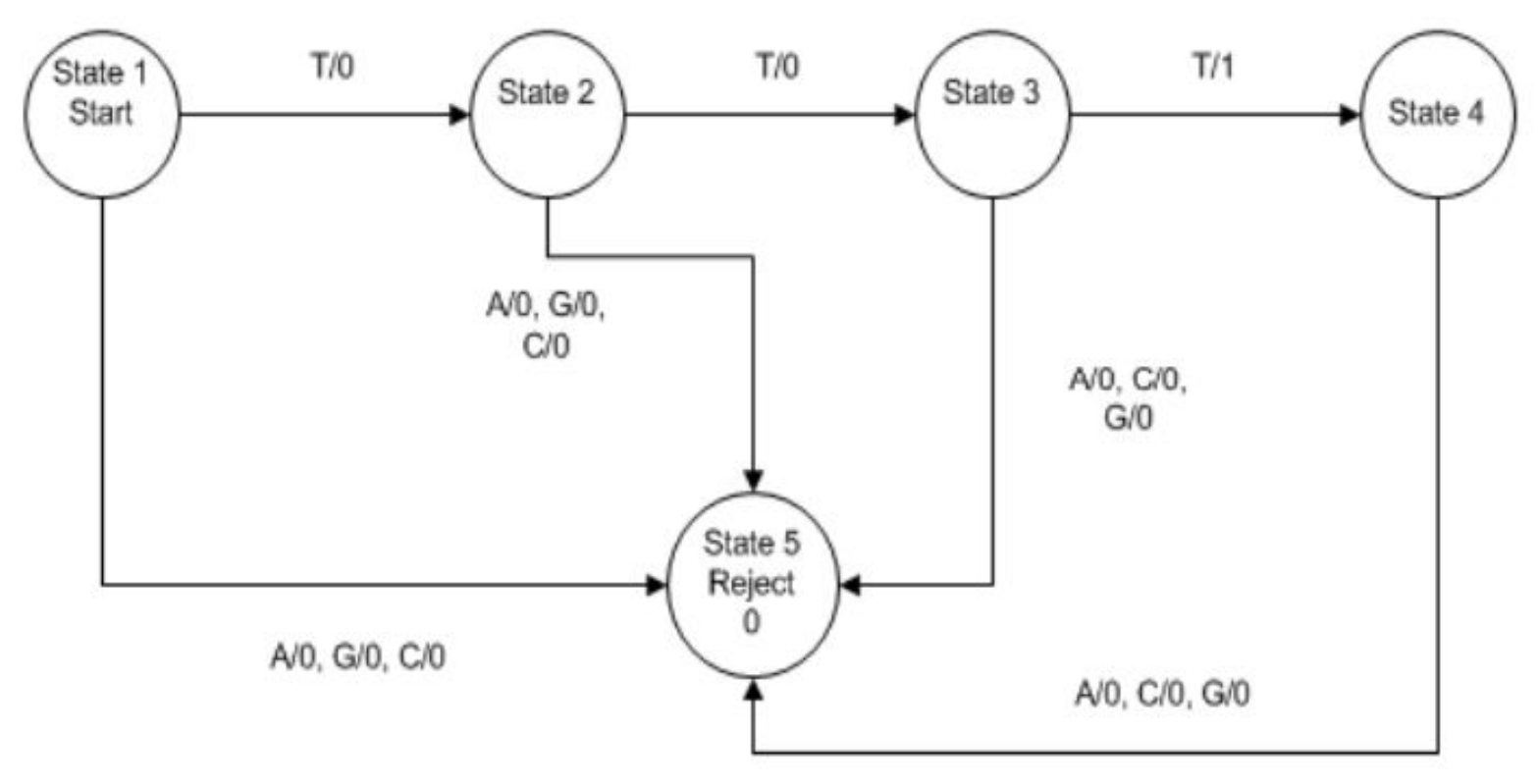


FIGURE: GENERAL MODEL OF MEALY MACHINE FOR EVERY INPUT.

- The following model accepts TTT from DNA pattern.



EXPERIMENT MODEL OF MEALY MACHINE FOR SPECIFIC INPUT.

3) DNA PATTERN ANALYSIS WITH MOORE MACHINES:

THERE ARE MANY INPUTS FOR DNA PATTERN, AS MENTIONED ABOVE IN FIGURE. 1.

SO FROM THAT FIGURE RANDOM INPUTS WERE SELECTED AND CHECKED FOR EVERY INPUT THAT MOORE MACHINES ACCEPTANCE . IT WAS INFERRED THAT IN CASE THE MACHINE ACCEPTED THE INPUT ON EVERY STAGE, THE DNA WILL BE NORMAL OTHERWISE IT WAS PROVEN TO BE ABNORMAL. THERE IS A GENERAL MODEL THROUGH WHICH VARIOUS INPUTS CAN BE CHECKED FOR THE ACCEPTANCE AND REJECTION BY THE MACHINE.

INPUT (A, G, C, T)

THERE ARE FIVE STATES.

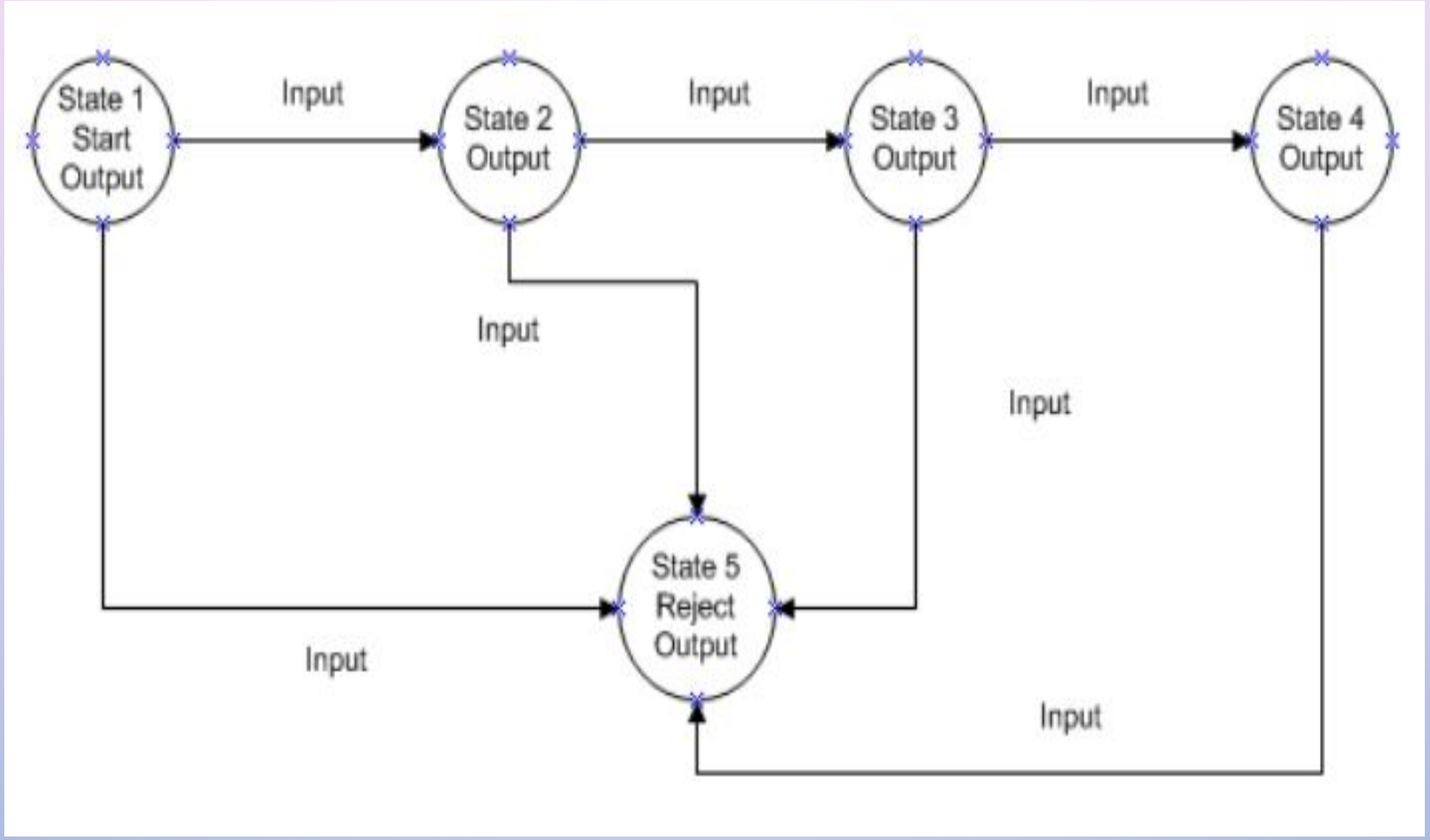
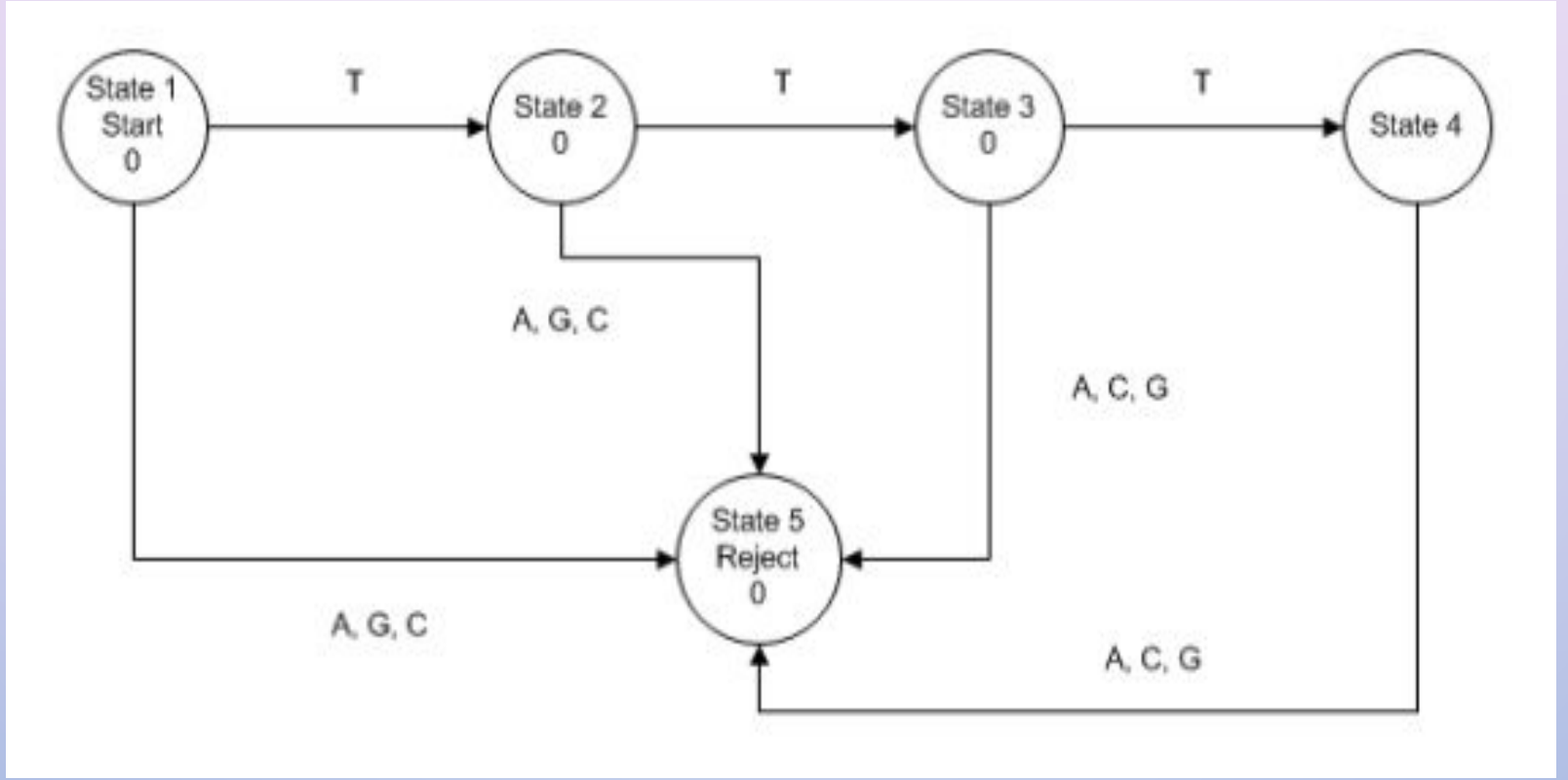


FIGURE: GENERAL MODEL OF MOORE MACHINE FOR EVERY INPUT.

- The following model accepts TTT from DNA pattern.



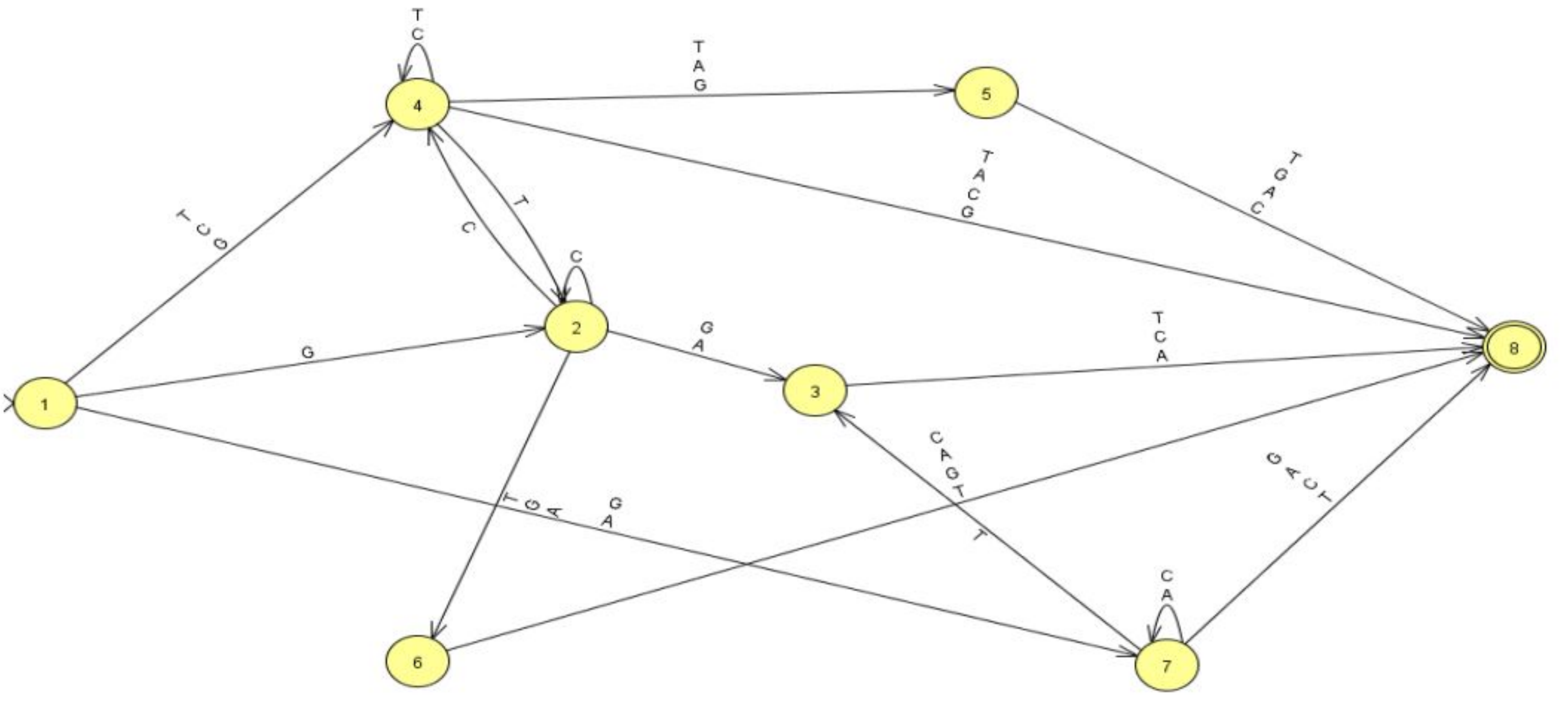
EXPERIMENT MODEL OF MOORE MACHINE FOR SPECIFIC INPUT.

EXPERIMENTS AND RESULTS

1) DNA PATTERN ANALYSIS USING FINITE AUTOMATA

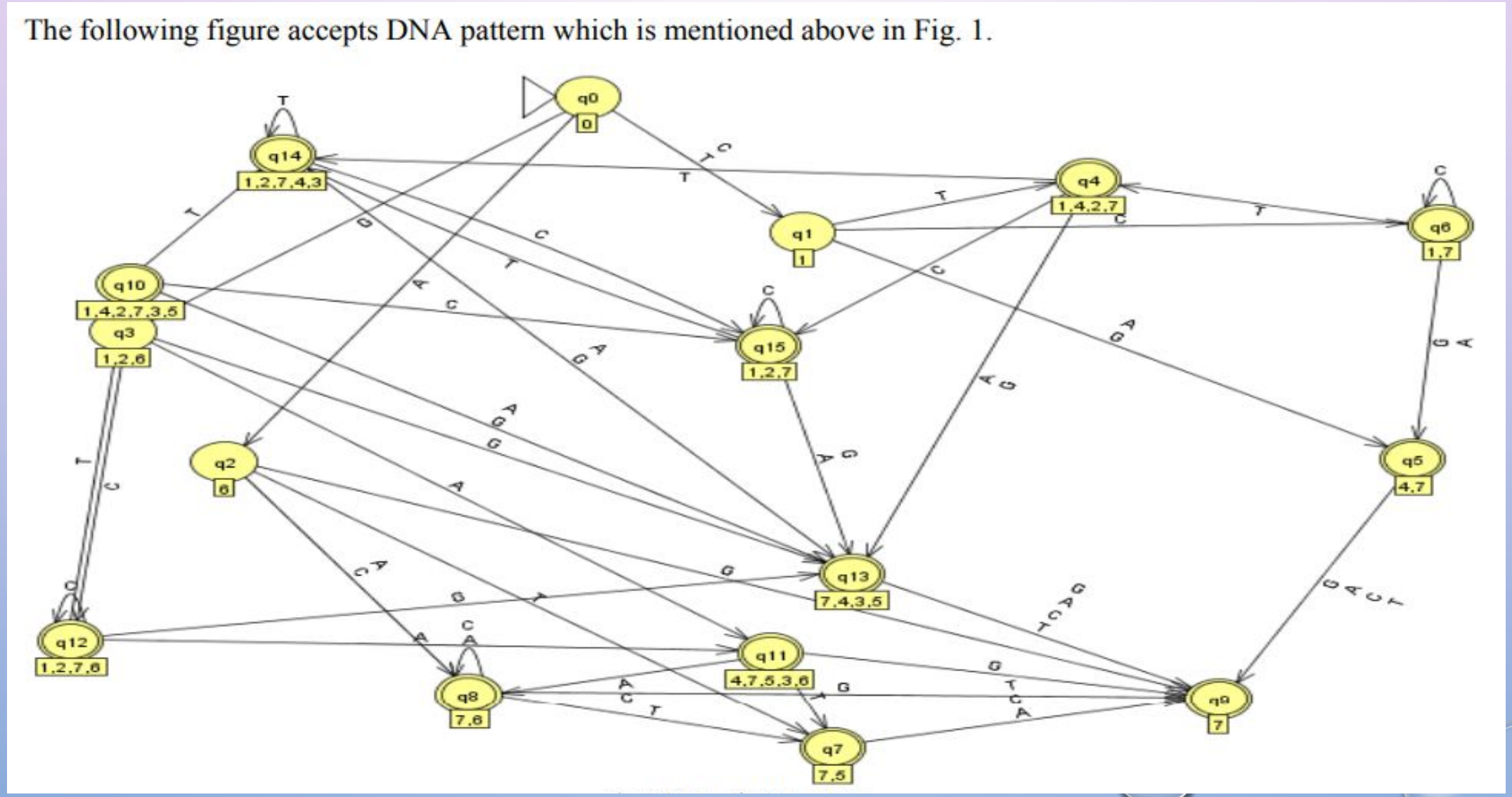
NFA (NON-DETERMINISTIC FINITE AUTOMATA)

The following figure accepts DNA pattern which is mentioned above in Fig. 1.



DFA (DETERMINISTIC FINITE AUTOMATA)

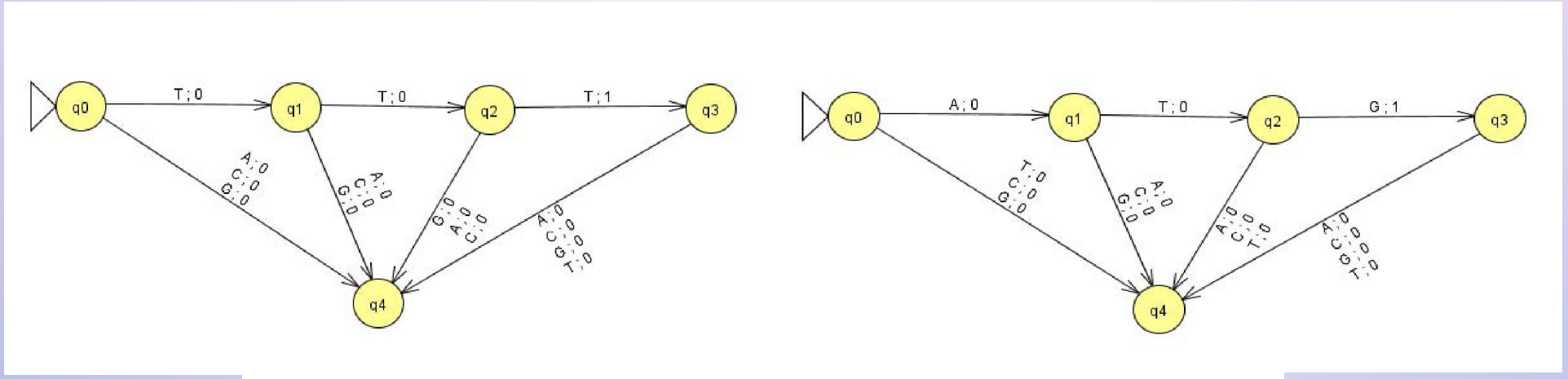
The following figure accepts DNA pattern which is mentioned above in Fig. 1.

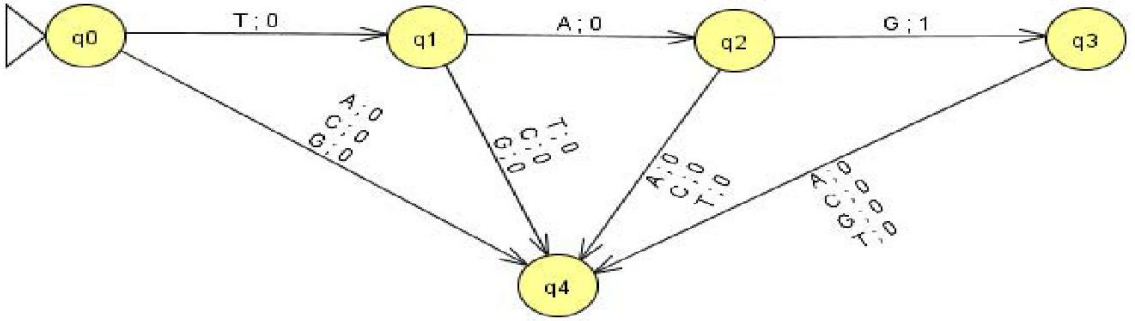


RESULT:

Input	Result
TTT	Accept
TCG	Accept
TAG	Accept
GTA	Accept
TCG	Accept
AAA	Accept
GGT	Accept
GGA	Accept
TCT	Accept
ACA	Accept
GGT	Accept
GGC	Accept
GGA	Accept
GGG	Accept
CGC	Accept
ATC	Accept
ATCG	Reject
GGTA	Reject

2) DNA PATTERN ANALYSIS USING MEALY MACHINES FOR TTT,ATG,TAG



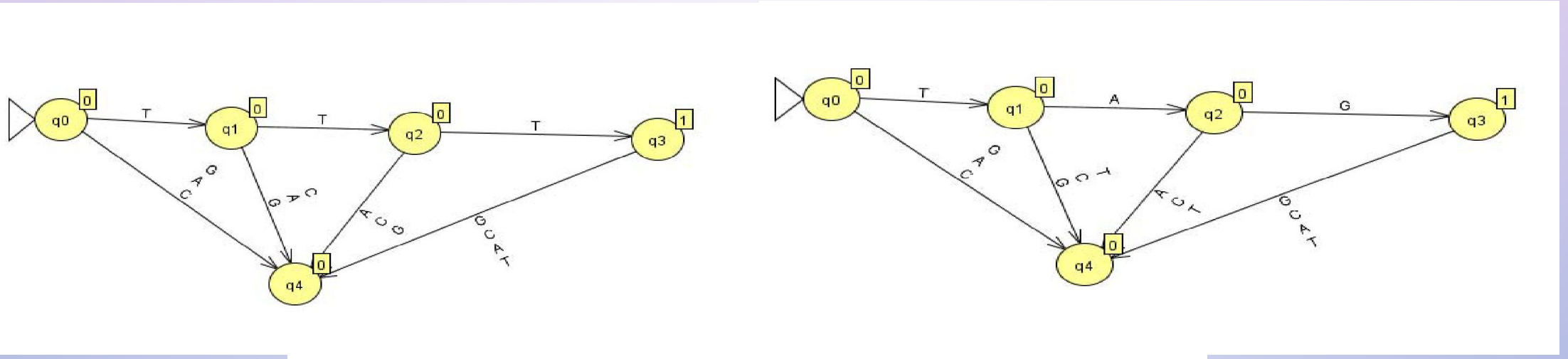


TTT RESULT:

Input	Result
TTT	001
TGA	00
AGT	0

TTT ACCEPTANCE IN MEALY MACHINES

3.) DNA PATTERN ANALYSIS USING MOORE MACHINES FOR TTT , TAG , CGA



CGA RESULT:

Input	Result
TTT	00
TGA	00
AGT	00
CGA	0001

'CGA' ACCEPTANCE IN MOORE MACHINES

CONCLUSION:

MEALY MACHINE IS MUCH BETTER THAN MOORE MACHINE. THE RESULTS SHOW THE PERFORMANCE OF MEALY MACHINES IS BETTER FOR ANALYZING THE DNA PATTERN BECAUSE THE OUTPUT DEPENDS BOTH UPON PRESENT STATE AND PRESENT INPUT. GENERALLY, IT HAS FEWER STATES THAN MOORE MACHINE. OUTPUT CHANGES AT THE CLOCK EDGES. MEALY MACHINES REACT FASTER TO INPUTS.

FUTURE WORK:

- IN FUTURE WE WORK TO ANALYZE PATTERN OF DNA THROUGH OTHER COMPUTATIONAL MODELS COMPARE WITH THESE MACHINES FOR PERFORMANCE.