STRING INPUT FILES
The following files contain a string used to test the NTMs.

String Files	String
str1.txt	a
str2.txt	aaab
str3.txt	aaaaa
str4.txt	aaabbbcd

NTM INPUT FILES
The following csv files where used to read in the NTM and its information in the following format:

- Line 1: Name of machine
- Line 2: List of state names for Q
- Line 3: List of characters from Σ
- Line 4: List of characters from Γ
- Line 5: The start state
- Line 6: Accept state
- Line 7: Reject state
- The rest of the lines are the transitions which include the following separated by commas
    - The name of a state that the machine might be in.
    - A character from Σ.
    - The name of a state that the machine may go into if that character was found next
    - on the input.
    - The character from Γ that should replace the current tape cell.
    - Either a R, L, or S denoting which direction to move the head next.

NTM Files	Content
a+.csv	a+ q1,q2,qacc a a,_ q1 qacc qrej q1,a,q1,a,R q1,a,q2,a,R q2,_,qacc,_,S
a*b*c*.csv	a*b*c* q1,q2,q3,q4,qacc,qrej

	a,b,c a,b,c_ q0 qacc qrej q0,a,q0,a,R q0,a,q1,a,R q0,a,q2,a,R q0,a,q3,a,R q1,b,q1,b,R q1,b,q2,b,R q1,b,q3,b,R q2,c,q2,c,R q2,c,q3,c,R q3,_,qacc,_,R q0,b,q1,b,R q0,b,q2,b,R q0,b,q3,b,R q0,c,q2,c,R q0,c,q3,c,R q0,_,q3,_,S

OUTPUT

The following files were run and its output shown in the terminal is displayed.

Input	Output
./ntm_isadurni.py a+.csv str1.txt	Name of Machine: a+ Initial String: a Total transitions simulated: 3 String accepted in 2 transitions. Tree of Configurations: Depth 0: [['', 'q1', 'a']] Depth 1: [['a', 'q1', '_'], ['a', 'q2', '_']] Depth 2: [['a', 'qacc', '_']]
./ntm_isadurni.py a+.csv str2.txt	Name of Machine: a+ Initial String: aaab Total transitions simulated: 6 String rejected at depth 3. Tree of Configurations: Depth 0: [['', 'q1', 'aaab']] Depth 1: [['a', 'q1', 'aab'], ['a', 'q2', 'aab']] Depth 2: [['aa', 'q1', 'ab'], ['aa', 'q2', 'ab']] Depth 3: [['aaa', 'q1', 'b'], ['aaa', 'q2', 'b']]
./ntm_isadurni.py a+.csv str3.txt	Name of Machine: a+

	Initial String: aaaaa Total transitions simulated: 11 String accepted in 6 transitions. Tree of Configurations: Depth 0: [['', 'q1', 'aaaaa']] Depth 1: [['a', 'q1', 'aaaa'], ['a', 'q2', 'aaaa']] Depth 2: [['aa', 'q1', 'aaa'], ['aa', 'q2', 'aaa']] Depth 3: [['aaa', 'q1', 'aa'], ['aaa', 'q2', 'aa']] Depth 4: [['aaaa', 'q1', 'a'], ['aaaa', 'q2', 'a']] Depth 5: [['aaaaa', 'q1', '_'], ['aaaaa', 'q2', '_']] Depth 6: [['aaaaa', 'qacc', '_']]
./ntm_isadurni.py a*b*c*.csv str1.txt	Name of Machine: a*b*c* Initial String: a Total transitions simulated: 7 String accepted in 3 transitions. Tree of Configurations: Depth 0: [['', 'q0', 'a']] Depth 1: [['a', 'q0', '_'], ['a', 'q1', '_'], ['a', 'q2', '_'], ['a', 'q3', '_']] Depth 2: [['a_', 'q3', '_'], ['a_', 'qacc', '_']] Depth 3: [['a__', 'qacc', '_']]
./ntm_isadurni.py a*b*c*.csv str2.txt	Name of Machine: a*b*c* Initial String: aaab Total transitions simulated: 20 String accepted in 5 transitions. Tree of Configurations: Depth 0: [['', 'q0', 'aaab']] Depth 1: [['a', 'q0', 'aab'], ['a', 'q1', 'aab'], ['a', 'q2', 'aab'], ['a', 'q3', 'aab']] Depth 2: [['aa', 'q0', 'ab'], ['aa', 'q1', 'ab'], ['aa', 'q2', 'ab'], ['aa', 'q3', 'ab']] Depth 3: [['aaa', 'q0', 'b'], ['aaa', 'q1', 'b'], ['aaa', 'q2', 'b'], ['aaa', 'q3', 'b']] Depth 4: [['aaab', 'q1', '_'], ['aaab', 'q2', '_'], ['aaab', 'q3', '_'], ['aaab', 'q1', '_'], ['aaab', 'q2', '_'], ['aaab', 'q3', '_']] Depth 5: [['aaab_', 'qacc', '_'], ['aaab_', 'qacc', '_']]
./ntm_isadurni.py a*b*c*.csv str4.txt	Name of Machine: a*b*c* Initial String: aaabbbcd Total transitions simulated: 34 String rejected at depth 7. Tree of Configurations: Depth 0: [['', 'q0', 'aaabbbcd']] Depth 1: [['a', 'q0', 'aabbbcd'], ['a', 'q1', 'aabbbcd'], ['a', 'q2', 'aabbbcd'], ['a', 'q3', 'aabbbcd']] Depth 2: [['aa', 'q0', 'abbbcd'], ['aa', 'q1', 'abbbcd'], ['aa', 'q2', 'abbbcd'], ['aa', 'q3', 'abbbcd']] Depth 3: [['aaa', 'q0', 'bbbcd'], ['aaa', 'q1', 'bbbcd'], ['aaa',

	'q2', 'bbbcd'], ['aaa', 'q3', 'bbbcd']] Depth 4: [['aaab', 'q1', 'bbcd'], ['aaab', 'q2', 'bbcd'], ['aaab', 'q3', 'bbcd'], ['aaab', 'q1', 'bbcd'], ['aaab', 'q2', 'bbcd'], ['aaab', 'q3', 'bbcd']] Depth 5: [['aaabb', 'q1', 'bcd'], ['aaabb', 'q2', 'bcd'], ['aaabb', 'q3', 'bcd'], ['aaabb', 'q1', 'bcd'], ['aaabb', 'q2', 'bcd'], ['aaabb', 'q3', 'bcd']] Depth 6: [['aaabbb', 'q1', 'cd'], ['aaabbb', 'q2', 'cd'], ['aaabbb', 'q3', 'cd'], ['aaabbb', 'q1', 'cd'], ['aaabbb', 'q2', 'cd'], ['aaabbb', 'q3', 'cd']] Depth 7: [['aaabbbc', 'q2', 'd'], ['aaabbbc', 'q3', 'd'], ['aaabbbc', 'q2', 'd'], ['aaabbbc', 'q3', 'd']]

ANALYSIS RESULTS

The results are organized in this table and non determinism was calculated by dividing the number of transitions or configurations by the depth.

NTM	String	Result	Depth	# Transitions	Nondeterminism
a+	a	accepted	2	3	3/2 = 1.5
a+	aaab	rejected	3	6	6/3 = 2
a+	aaaaa	accepted	6	11	11/6 = 1.8333
a*b*c*	a	accepted	3	7	3/3 = 1
a*b*c*	aaab	accepted	5	20	20/5 = 4
a*b*c*	aaabbbcd	rejected	7	34	34/7 = 4.8571

Average Nondeterminism for a+: 1.7778
Average Nondeterminism for a*b*c*: 3.2857