

CSCI 356 – Programming Assignment 3

Samples (StdOut + StdErr)

```
~/Documents/Terms/2017-09 - Fall
```

```
./main.rb < tapes/q2-test1-s.tape
```

```
Loading instruction table
```

```
found sentinel on line 21
```

```
Input string: "abaabb", size: 6
```

```
+-----  
| abaabb
```

```
+↑-----  
q0
```

```
Accepting Final States: [8]
```

```
BEGIN EXECUTION
```

```
+-----  
| abaabb
```

```
+↑-----  
q1
```

```
+-----  
| Ybaabb
```

```
+↑-----  
q2
```

```
+-----  
| Ybaabb
```

```
+↑-----  
q3
```

```
+-----  
| Xbaabb
```

```
+↑-----  
q1
```

```
+-----  
| XYaabb
```

```
+↑-----  
q1
```

```
+-----  
| XYaabb
```

```
+↑-----  
q2
```

```
+-----  
| XXXYYb
```

```
+-----↑  
q1
```

```
+-----  
| XXXYY
```

```
+-----↑  
q1
```

```
+-----  
| XXXYY
```

```
+-----↑  
q4
```

```
+-----  
| XXXYYb
```

```
+-----↑  
q5
```

```
+-----  
| XXXYYb
```

```
+-----↑  
q5
```

```
+-----  
| XXXYYb
```

```
+-----↑  
q5
```

```
+-----  
| XXaYYb
```

```
+-----↑  
q6
```

```
+-----  
| XXaYYb
```

```
+-----↑  
q6
```

```
+-----  
| XXaYYb
```

```
+-----↑  
q6
```

```

+-----
| XYYabb
+-----
+  ↑ -----
  q2
+-----
| XYYabb
+-----
+  ↑ -----
  q3
+-----
| XYYabb
+-----
+  ↑ -----
  q1
+-----
| XYYabb
+-----
+  ↑ -----
  q1
+-----
| XYYabb
+-----
+  ↑ -----
  q2
+-----
| XYYabb
+-----
+  ↑ -----
  q2
+-----
| XYYabb
+-----
+  ↑ -----
  q3
+-----
| XXXYbb
+-----
+  ↑ -----
  q1
+-----
| XXXYbb
+-----
+  ↑ -----
  q1

```

```

+-----
| XXaYYb
+-----
+  ↑ -----
  q4
+-----
| XXaYbb
+-----
+  ↑ -----
  q5
+-----
| XXaYbb
+-----
+  ↑ -----
  q5
+-----
| XXaYbb
+-----
+  ↑ -----
  q5
+-----
| XaaYbb
+-----
+  ↑ -----
  q6
+-----
| XaaYbb
+-----
+  ↑ -----
  q6
+-----
| XaaYbb
+-----
+  ↑ -----
  q6
+-----
| XaaYbb
+-----
+  ↑ -----
  q4
+-----
| Xaabb
+-----
+  ↑ -----
  q5

```

```

+-----
| Xaabbb
+---↑---
  q5
+-----
| Xaabbb
+---↑---
  q5
+-----
| aaabbb
+---↑---
  q6
+-----
| aaabbb
+---↑---
  q6
+-----
| aaabbb
+---↑---
  q6
+-----
| aaabbb
+---↑---
  q4
+-----
| aaabbb
+---↑---
  q7
+-----
| aaabbb
+---↑---
  q7
+-----
| aaabbb
+---↑---
  q7

```

```

q7
+-----
| aaabbb
+---↑---
  q8
HALT
ACCEPT
aaabbb

```

```

~/Documents/Terms/2017-09 - Fall/
./main.rb < tapes/q2-test2-s.tape
Loading instruction table
found sentinel on line 21

Input string: "bbbbaaaba", size: 8
+-----
| bbbbaaaba
+^-----
  q0

Accepting Final States: [8]

BEGIN EXECUTION
+-----
| bbbbaaaba
+^-----
  q1
+-----
| Ybbbaaaba
+^-----
  q1
+-----
| YYbaaaba
+^-----
  q1
+-----
| YYYaaaba
+^-----
  q1
+-----
| YYYYaaba
+^-----
  q2
+-----
| YYYYaaba
+^-----
  q2

```

```

+-----
| YYYYaaba
+^-----
  q2
+-----
| YYYYaaba
+^-----
  q2
+-----
| YYYYaaba
+^-----
  q3
+-----
| XYYYaaba
+^-----
  q1
+-----
| XYYYaaba
+^-----
  q1
+-----
| XYYYaaba
+^-----
  q1
+-----
| XYYYaaba
+^-----
  q1
+-----
| XYYYaaba
+^-----
  q1
+-----
| XYYYaaba
+^-----
  q2
+-----
| XYYYaaba
+^-----
  q2
+-----
| XYYYaaba
+^-----
  q2

```

```

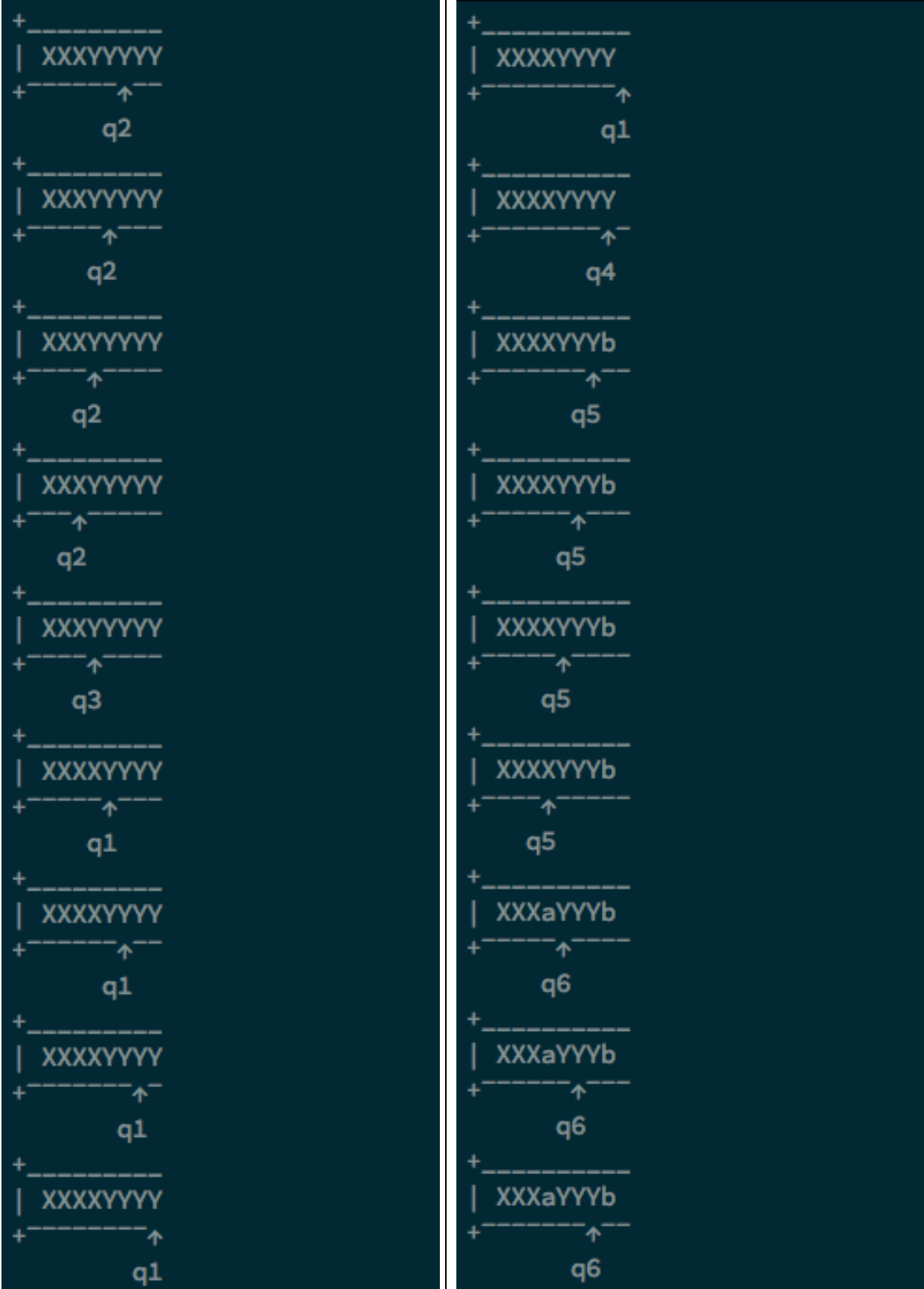
+-----
| XYYYYaba
+---↑---
    q2
+-----
| XYYYYaba
+---↑---
    q2
+-----
| XYYYYaba
+---↑---
    q3
+-----
| XYYYYaba
+---↑---
    q1
+-----
| XYYYYaba
+---↑---
    q1
+-----
| XYYYYaba
+---↑---
    q1
+-----
| XYYYYaba
+---↑---
    q1
+-----
| XYYYYYba
+---↑---
    q2
+-----
| XYYYYYba
+---↑---
    q2

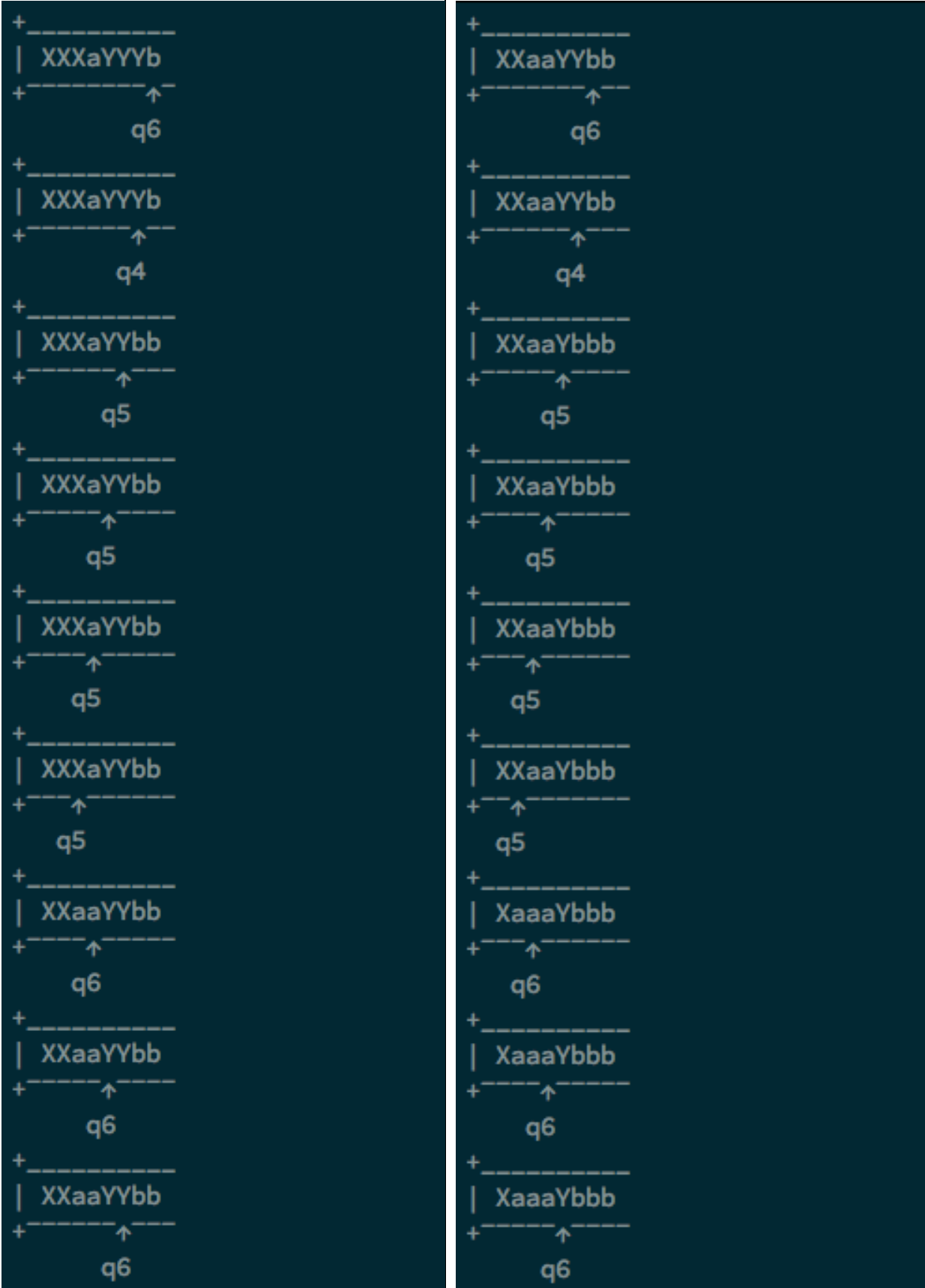
```

```

+-----
| XXYYYYba
+---↑---
    q2
+-----
| XXYYYYba
+---↑---
    q2
+-----
| XXYYYYba
+---↑---
    q3
+-----
| XXXYYYYba
+---↑---
    q1
+-----
| XXXYYYYba
+---↑---
    q1
+-----
| XXXYYYYba
+---↑---
    q1
+-----
| XXXYYYYba
+---↑---
    q1
+-----
| XXXYYYYba
+---↑---
    q1
+-----
| XXXYYYYa
+---↑---
    q1
+-----
| XXXYYYYY
+---↑---
    q2

```





```

+-----+
| XaaaYbbb
+-----+
      ↑
      q6

+-----+
| XaaaYbbb
+-----+
      ↑
      q4

+-----+
| Xaaabbbb
+-----+
      ↑
      q5

+-----+
| Xaaabbbb
+-----+
      ↑
      q5

+-----+
| Xaaabbbb
+-----+
      ↑
      q5

+-----+
| Xaaabbbb
+-----+
      ↑
      q5

+-----+
| aaaabbbb
+-----+
      ↑
      q6

+-----+
| aaaabbbb
+-----+
      ↑
      q6

+-----+
| aaaabbbb
+-----+
      ↑
      q6

```

```

+-----+
| aaaabbbb
+-----+
      ↑
      q6

+-----+
| aaaabbbb
+-----+
      ↑
      q4

+-----+
| aaaabbbb
+-----+
      ↑
      q7

+-----+
| aaaabbbb
+-----+
      ↑
      q7

+-----+
| aaaabbbb
+-----+
      ↑
      q7

+-----+
| aaaabbbb
+-----+
      ↑
      q7

+-----+
| aaaabbbb
+-----+
      ↑
      q8
HALT
ACCEPT
aaaabbbb

```


file: tapes/q2-test1.tape

```

0 1 R
1a2YL
1Y1YR
1b1YR
1 4 L
2Y2YL
2X3XR
2 3 R
3Y1XR
4Y5bL
4a7aL
4 8 S
5a5aL
5Y5YL
5X6aR
6a6aR
6Y6YR
6b4bL
7a7aL
7 8 S
-1
abaabb
8
-1
Accepts language of strings with same
number of a's and b's.
```

file: tapes/q2-test2.tape

```

0 1 R
1a2YL
1Y1YR
1b1YR
1 4 L
2Y2YL
2X3XR
2 3 R
3Y1XR
4Y5bL
4a7aL
4 8 S
5a5aL
5Y5YL
5X6aR
6a6aR
6Y6YR
6b4bL
7a7aL
7 8 S
-1
bbbaaaba
8
-1
Accepts language of strings with same
number of a's and b's.
```

Source Code

file : main.rb

```

#!/usr/bin/env ruby
require 'io/console'
require './tmdisplay'

ARGV.include?('-v') ? verbose = true : verbose = false

# Arbitrary deterministic Turing Machine
#
# The visual display of configuration sequences as the machine performs its
# computation is streamed to StdErr.
# The HALT signal, acceptance message and the final contents of the tape is
# streamed to StdOut.

$stderr.puts "Loading instruction table"
instructions_table = []
loop do
  line = $stdin.gets
  # chomp: removes all trailing newlines, won't work if nil
  break if line.nil? || line.chomp == "-1"
```

```

    $stderr.puts "#{stdin.lineno} : #{line.chomp.inspect}" if verbose
    instructions_table.push line.chomp
end
$stderr.puts "found sentinel on line #{stdin.lineno}"

input_string = stdin.gets.chomp
$stderr.puts "\nInput string: #{input_string.inspect}, \"\
    \"size: #{input_string.length}\"
input_string.prepend ' ' if input_string[0] != ' '
tape = input_string

final_states = []
state = 0
position = 0
count=0

print_tape_head_diagram tape, state, position

# To permit acceptance by final state, enter on separate lines followed by -1
loop do
  line = stdin.gets#.chomp # won't work if nil
  break if line.nil? || line.chomp == "-1"
  final_states.push line.hex
end
$stderr.puts "\nAccepting Final States: #{final_states}"

$stderr.puts "\nBEGIN EXECUTION"
loop do
  # Filter to find next instruction
  state_instructions = instructions_table.select {|ins| ins[0].hex == state }
  $stderr.puts "\n1. Instructions for current state: \"\
    \"#{state_instructions.inspect}\" if verbose
  possible_instructions = state_instructions.select do |ins|
    ins[1] == tape[position]
  end
  $stderr.puts "2. Possible instructions: \"\
    \"#{possible_instructions.inspect}\" if verbose
  if possible_instructions.empty?
    # DEFINITION: a TM halts when it reaches a state/symbol pair for which no
    # transition is defined. (from class notes)
    $stdout.puts "HALT"
    break
  end
  next_instruction = possible_instructions.first
  $stderr.puts "3. Executing next instruction: \"\
    \"#{next_instruction.inspect}\" if verbose

  # execute next instruction
  state = next_instruction[2].hex
  tape[position] = next_instruction[3]
  position += 1 if next_instruction[4] == 'R'
  position -= 1 if next_instruction[4] == 'L'
end

```

```

# same position if 'S'
$stderr.puts "position: #{position}" if verbose

# Add blanks if needed, also needed for tape with only blank
tape.concat ' ' if tape[position].nil?

print_tape_head_diagram tape, state, position
end

if final_states.include? state
  $stdout.puts "ACCEPT"
elsif !(final_states.empty?)
  $stdout.puts "REJECT"
end
$stdout.puts tape

exit 0

```

file: tmdisplay.rb

```

def print_tape_head_diagram(tape, state, position)
  top_edge = '+'
  tape.length.times { top_edge.concat '_' }#; top_edge.concat '+'
  $stderr.puts top_edge
  $stderr.print '|'; $stderr.print tape; $stderr.puts '#|'
  bottom_edge = '+'; position.times { bottom_edge.concat '-' }
  bottom_edge.concat '^'
  (tape.length - position - 1).times { bottom_edge.concat '-' }
  #bottom_edge.concat '+'
  $stderr.puts bottom_edge
  state_line = ' '
  (position-1).times { state_line.concat ' ' }
  state_line.concat "q#{state}"
  $stderr.puts state_line
end

```