Theory Of Computation Report

“A Tale of 3 Monkeys and 3 Humans”

A Project by :

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The Problem Statement AKA The Tale

- **There are six characters in this story – A Big Monkey, Two Small Monkeys and Three humans.**
- All the six characters wish to reach the other bank of a River, "**Tears of TOC** ". xD
- At one time only two people can travel on the boat with the catch being only a human or the big monkey can row the boat !
- But you see the monkeys over here are of a special tribe, if they are more in number than the number of humans they can kill all the humans !
- In other words, **the number of humans on each bank must always be equal or more than the number of monkeys.**
- **Can you help all our six protagonists in the story reach the other side of the bank ?**

Input Sequence format for the Turing Machine

- The sequence of travel of all the characters from Bank A to Bank B has to be separated by a '#'
- Aliases of our characters:
    - Human : h
    - Big monkey: b
    - Small monkey: s

Eg) Lets say one sequence is,

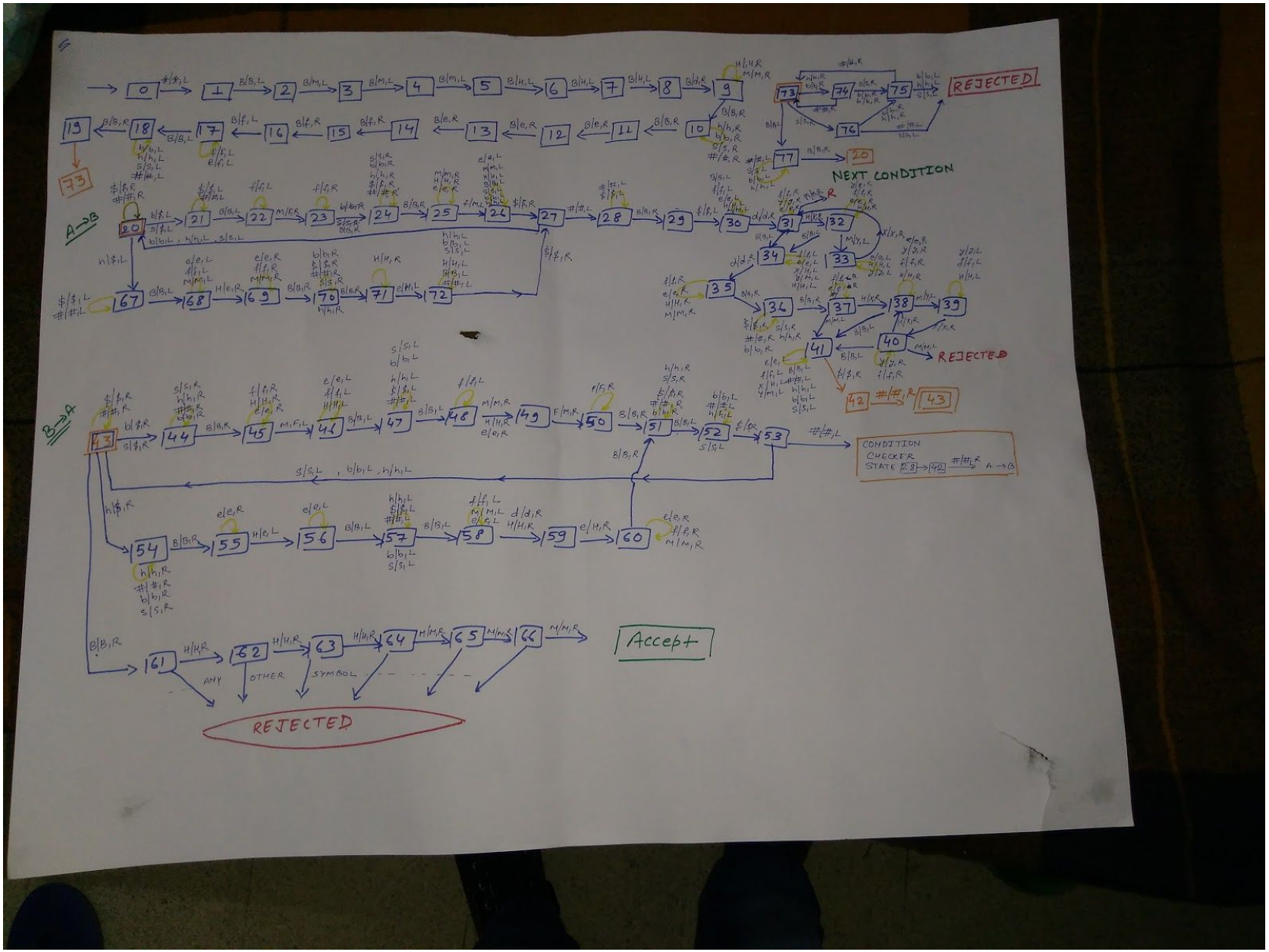
A to B : bs

B to A : b

A to B : h

The above sequence would be represented as : **bs#b#h#**

Design of the Turing Machine


REJECTED
NEXT CONDITION
A→B
REJECTED
B→A
CONDITION CHECKER
STATE 28 → 42 #H,R A→B
Accept
ANY
OTHER
SYMBOL
REJECTED

How is the Turing Machine Working ?

The Turing Machine is following the following steps to figure out whether the entered sequence of travel is a valid answer to the puzzle :

1. Initialization of counters on both banks.
2. A Check for Maximum of two travellers on each boat trip and one of the rowers is a valid protagonist (h or b).
3. Increment / Decrement both the counters for all the travellers.
4. Condition Check Logic (To be explained later)
5. Loop to 3 until all the travellers on the boat have been processed.

How is the Condition Check Logic working ?

The condition check logic checks whether the number of humans is more than or equal to the number of Monkeys at either bank.

Eg)

- HHHMM : Valid
- HHMM : Valid
- HHMMM : Rejected
- MMM : Works fine !

Turing Machine Simulation Code using Morphitt Turing machine Simulator

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; Load a program from the menu or write your own!

; Turing machine to simulate river puzzle

;One possible solution:
;bs#b#bs#b#hh#hs#bh#hs#hh#b#bs#b#bs#

;'<current state> <current symbol> <new symbol> <direction> <new state>'

0 b b l 1
0 s s l 1
0 h h l 1
0 _ _ r rejectstart

rejectstart _ : r rejectstarta
rejectstarta _ - r rejectstartb
rejectstartb * ( * halt-rejectstartb

1 _ _ l 2

2 _ M l 3

3 _ M l 4

4 _ M l 5

5 _ H l 6

6 _ H l 7

7 _ H l 8

8 _ d r 9

9 H H r 9
```

9 M M r 9
9 _ _ r 10

10 h h r 10
10 b b r 10
10 s s r 10
10 # # r 10
10 _ _ r 11

11 _ e r 12

12 _ e r 13

13 _ e r 14

14 _ f r 15

15 _ f r 16
16 _ f r 17

17 e e l 17
17 f f l 17
17 _ _ l 18

18 e e l 18
18 f f l 18
18 s s l 18
18 # # l 18
18 b b l 18
18 h h l 18
18 _ _ l 19

19 b b l 19
19 s s l 19
19 h h l 19
19 # # l 19
19 _ _ r 73

73 b b r 74

73 s s r 76
73 h h r 74
73 _ _ l 77

74 # # r 73
74 s s r 75
74 b b r 75
74 h h r 75

75 # # r 73
75 b b r rej1
75 h h r rej1
75 s s r rej1

76 # # l rej1
76 s s l rej1
76 b b r 75
76 h h r 75

77 # # l 77
77 s s l 77
77 b b l 77
77 h h l 77
77 _ _ r 20

20 # # r 20
20 $ $ r 20
20 b $ l 21
20 s $ l 21
20 h $ l 67
20 _ _ r 61

21 $ $ l 21
21 # # l 21
21 _ _ l 22

22 f f l 22
22 M f r 23

23 f f r 23
23 _ _ r 24

24 $ $ r 24
24 # # r 24
24 b b r 24
24 s s r 24
24 h h r 24
24 _ _ r 25

25 e e r 25
25 H H r 25
25 M M r 25
25 f M l 26

26 M M l 26
26 H H l 26
26 _ _ l 26
26 s s l 26
26 b b l 26
26 h h l 26
26 e e l 26
26 # # l 26
26 $ $ r 27

27 b b l 20
27 h h l 20
27 s s l 20
27 # # l 28
28 # # l 28
28 $ $ l 28
28 _ _ r 29

29 $ $ l 30

30 f f l 30
30 e e l 30
30 H H l 30
30 M M l 30

30 _ _ l 30
30 d d r 31

31 e e r 31
31 Y Y r 31
31 f f r 31
31 _ _ l 34
31 M M l 34
31 H X r 32

32 Y Y r 32
32 H H r 32
32 e e r 32
32 _ _ l 34
32 f f r 32
32 M Y l 33

33 Y Y l 33
33 H H l 33
33 e e l 33
33 X X r 93

93 H X r 32
93 Y Y r 93
93 f f r 93
93 e e r 93
93 M M r rej2
93 _ _ l 34

rej2 * * r rej2a
rej2a _ _ r rej2b
rej2b * * r rej2b
rej2b _ _ r rej2c
rej2c * * r rej2c
rej2c _ _ l rej2ca
rej2ca * _ l rej2ca
rej2ca _ _ l rej2cb
rej2cb * _ l rej2cb
rej2cb d : r rej2cc

rej2cc * - r rej2cc
rej2cc * (* halt-rej2cc

34 f f l 34
34 e e l 34
34 X H l 34
34 Y M l 34
34 H H l 34
34 d d r 35

35 f f r 35
35 e e r 35
35 H H r 35
35 M M r 35
35 _ _ r 36
36 $ $ r 36
36 # # r 36
36 b b r 36
36 s s r 36
36 h h r 36
36 _ _ r 37

37 f f r 37
37 e e r 37
37 H X r 38
37 M M l 41

38 f f r 38
38 e e r 38
38 Y Y r 38
38 H H r 38
38 M Y l 39
38 _ _ l 41

39 f f l 39
39 Y Y l 39
39 H H l 39
39 e e l 39
39 X X r 40

40 H X r 38
40 Y Y r 40
40 f f r 40
40 e e r 40
40 _ _ l 41
40 M M l rej3

rej3 * * r rej3
rej3 _ _ l rej3a
rej3a * _ l rej3a
rej3a d : r rej3b
rej3b * - r rej3c
rej3c * (* halt-rej3c

41 # # l 41
41 h h l 41
41 e e l 41
41 f f l 41
41 _ _ l 41
41 b b l 41
41 s s l 41
41 h h l 41
41 H H l 41
41 X H l 41
41 Y M l 41
41 $ $ r 42

42 # # r 43
43 $ $ r 43
43 # # r 43
43 b $ r 44
43 s $ r 44
43 h $ r 54
43 _ _ r 61

61 H H r 62
61 e e r rej3
62 H H r 63

62 e e r rej3
63 H H r 64
63 e e r rej3
64 M M r 65
64 f f r rej3
65 M M r 66
65 f f rej3
66 M M r accept
66 f f rej3

accept * _ l accept
accept d : r accept1
accept1 _ - r accept1
accept1 _) * halt-accept1

44 h h r 44
44 # # r 44
44 b b r 44
44 s s r 44
44 _ _ r 45

45 e e r 45
45 H H r 45
45 f f r 45
45 M f l 46

46 f f l 46
46 e e l 46
46 H H l 46
46 _ _ l 47

47 * * l 47
47 _ _ l 48

48 f f l 48
48 M M r 49
48 H H r 49
48 e e r 49

49 f M r 50

50 f f r 50
50 _ _ r 51

51 $ $ r 51
51 # # r 51
51 b b r 51
51 s s r 51
51 h h r 51
51 _ _ l 52

52 b b l 52
52 # # l 52
52 h h l 52
52 s s l 52
52 $ $ r 53

53 # # l 78
53 b b l 43
53 h h l 43
53 s s l 43

54 h h r 54
54 # # r 54
54 b b r 54
54 s s r 54
54 _ _ r 55

55 e e r 55
55 H e l 56

56 e e l 56
56 _ _ l 57

57 * * l 57
57 _ _ l 58

58 f f l 58

58 M M I 58
58 e e I 58

58 d d r 59
58 H H r 59

59 e H r 60

60 e e r 60
60 f f r 60
60 M M r 60
60 _ _ r 51

78 # # I 78
78 $ $ I 78
78 _ _ r 79

79 $ $ I 80

80 _ _ I 80
80 f f I 80
80 e e I 80
80 H H I 80
80 M M I 80
80 d d r 81

81 e e r 81
81 Y Y r 81
81 f f r 81
81 _ _ I 84
81 M M I 84
81 H X r 82

82 Y Y r 82
82 f f r 82
82 e e r 82
82 H H r 82
82 M Y I 83

82 _ _ l 84

83 Y Y l 83
83 H H l 83
83 e e l 83
83 X X r 94

94 H X r 82
94 Y Y r 94
94 f f r 94
94 e e r 94
94 M M r rej2
94 _ _ l 84

84 f f l 84
84 e e l 84
84 X H l 84
84 Y M l 84
84 H H l 84
84 d d r 85

85 f f r 85
85 e e r 85
85 H H r 85
85 M M r 85
85 _ _ r 86

86 * * r 86
86 _ _ r 87

87 f f r 87
87 e e r 87
87 H X r 88
87 M M l 91

88 e e r 88

88 Y Y r 88
88 f f r 88
88 H H r 88
88 M Y l 89
88 _ _ l 91

89 Y Y l 89
89 f f l 89
89 e e l 89
89 H H l 89
89 X X r 90

90 M M l rej3
90 H X r 88
90 Y Y r 90
90 e e r 90
90 f f r 90
90 _ _ l 91

91 # # l 91
91 h h l 91
91 e e l 91
91 f f l 91
91 _ _ l 91
91 b b l 91
91 s s l 91
91 h h l 91
91 H H l 91
91 X H l 91
91 Y M l 91
91 $ $ r 92

92 # # r 20

67 $ $ l 67
67 # # l 67

67 _ _ l 68

68 M M l 68
68 f f l 68
68 e e l 68
68 H e r 69

69 M M r 69
69 f f r 69
69 e e r 69
69 _ _ r 70

70 # # r 70
70 $ $ r 70
70 b b r 70
70 s s r 70
70 h h r 70
70 _ _ r 71

71 H H r 71
71 e H l 72

72 H H l 72
72 _ _ l 72
72 # # l 72
72 s s l 72
72 b b l 72
72 h h l 72
72 $ $ r 27

rej1 * _ r rej1
rej1 f _ r rej1a
rej1a f _ r rej1b
rej1b f _ l rej1c
rej1c * _ l rej1c
rej1c d : r rej1d
rej1d _ - r rej1d
rej1d _ (r halt-rej1d