## Turing Machines used in Testing

### Example Turing Machines

Addition:

0

1011+1100

0

set

set \* \* r set

set \_ \_ l check

check 0 0 l check

check 1 1 r accept

check + + \_ clean

accept \* \* r accept

accept \_ \_ l dc

dc 0 1 l dc

dc 1 0 \_ gotofirst

gotofirst \* \* l gotofirst

gotofirst + + l ic

ic 0 1 r set

ic 1 0 l ic

ic \_ 1 r set

clean \* \_ r clean

clean \_ \_ l end

end \_ \_ l end

end \* \* \_ halt

Subtraction:

0

1011~0110

0

set

set 0 0 r set

set 1 1 r set

set ~ ~ r set

set \_ \_ l check

check 0 0 l check

check 1 1 r accept

check ~ ~ \_ clean

accept 0 0 r accept

accept 1 1 r accept

accept ~ ~ r accept

accept \_ \_ l dc

dc 0 1 l dc

dc 1 0 \_ gotofirst

gotofirst 0 0 l gotofirst

gotofirst 1 1 l gotofirst

gotofirst ~ ~ l dc2

dc2 0 1 l dc2

dc2 1 0 r set

dc2 \_ \_ r clean\_r

clean\_r 0 \_ r clean\_r

clean\_r 1 \_ r clean\_r

clean\_r ~ \_ r clean\_r

clean\_r \_ \_ \_ reject

clean ~ \_ r clean

clean 0 \_ r clean

clean \_ \_ l end

end \_ \_ l end

end 0 0 \_ halt

end 1 1 \_ halt

Parity Calculator:

1

10101011110

0

a

a 1 r b

b 1 r a

a 0 r a

b 0 r b

a \_ \_ even

b \_ \_ odd

Palindrome Checker:

0

10100101

0

a

a 1 i r a1

a 0 o r a0

a \* \* r a

a \_ \_ \_ accepthalt

a1 \* \* r a1

a1 \_ \_ l a1check

a1check 1 i l acceptreset

a1check \* \* l a1check

a1check \_ \_ r rejecthalt

a0 \* \* r a0

a0 \_ \_ l a0check

a0check 0 o l acceptreset

a0check \* \* l a0check

a0check \_ \_ r rejecthalt

acceptreset \* \* l acceptreset

acceptreset \_ \_ r a

### Additional Machines

interface\_open

1

10101011110

0

a

a 1 r b

b 1 r a

a 0 r a

b 0 r b

a \_ \_ even

b \_ \_ odd

interface\_move

0

101

2

a

a \* \* r h

interface\_multiMove

3

2

101

1

101

1

a

a 11 11 rr h

interface\_multiTrackStates

4

2

0

a

0

b

a 1 1 r h

b 0 0 r h

interface\_longTape

0

111111111111111111111111111111111111111111111111111111111111111111111111111111111111111

0

nocode

nocode i s \_ needed

dtm\_write\_left

0

11010101

7

a

a \* \* l a

a \_ 3 \_ h

dtm\_write\_middle

0

11010101

7

a

a \* \* l b

b \* \* l c

c \* \* l d

d \* 3 \_ h

dtm\_write\_right

0

11010101

0

a

a \* \* r a

a \_ 3 \_ h

dtm\_right

0

010

1

a

a \* \* r h

dtm\_left

0

010

1

a

a \* \* l h

dtm\_stay

0

010

1

a

a \* \* \_ h

dtm\_state

0

10

0

a

a 1 0 r b

ndtm\_generic

2

10010

0

a

a 1 0 r a

a 1 1 r a

a 0 0 r a

a 0 1 r a

a \_ \_ l halt

dtm\_generic

0

1000000000000000001

0

a

a \* \* r a

a \_ \_ l b

b \* \* l b

b \_ \_ r a

validate\_lineNumber

0

1000000000000000001

0

a

a \* \* r a

validate\_sameRead

0

1000000000000000001

0

a

a \* \* r a

a \* 1 r a

validate\_duplicate

0

1000000000000000001

0

a

a \* \* r a

a \* \* r a

validate\_fieldMissing

0

1000000000000000001

0

a

a \* r a

validate\_fieldExtra

0

1000000000000000001

0

a

a \* \* \* r a

validate\_moveWrong

0

1000000000000000001

0

a

a \* \* s a

validate\_tapeMissing

3

3

100000000001

0

1001

0

100001

0

a

a 10 101 rrr b

validate\_defaultKey

0

1000000\*00000000001

0

a

a \* \* r a

validate\_utm\_instructionTape

5

3

11rb|b11ra|a00ra|b00rb|a---e|b---o

0

a

0

10101011110

0

q0

q0 \*a\* \*a\* \_\_\_ qa

qa \*\*\_ \*\*\_ \_\_\_ qa-

qa \*\*1 \*\*1 \_\_\_ qa1

qa1 a\*\* a\*\* r\_\_ qa1acceptstate

qa1 \*\*\* \*\*\* r\_\_ qa1reject

qa1reject |\*\* |\*\* r\_\_ qa1

validate\_utm\_stateTape

5

3

a11rb|b11ra|a00ra|b00rb|a---e|b---o

0

ab

0

10101011110

0

q0

q0 \*a\* \*a\* \_\_\_ qa

qa \*\*\_ \*\*\_ \_\_\_ qa-

qa \*\*1 \*\*1 \_\_\_ qa1

qa1 a\*\* a\*\* r\_\_ qa1acceptstate

qa1 \*\*\* \*\*\* r\_\_ qa1reject

qa1reject |\*\* |\*\* r\_\_ qa1

qa1reject \*\*\* \*\*\* r\_\_ qa1reject

qa1reject \_\*\* \_\*\* \_\_\_ qhalt\_reject

qa1acceptstate 1\*\* 1\*\* r\_\_ qwrite

qa1acceptstate \*\*\* \*\*\* r\_\_ qa1reject

validate\_commented

0

1

0

a

//a 0 r a

a 1 0 r a

validate\_dtmTapes

4

3

10101110

0

a

1011011

0

a

10110101

0

a

a 0 1 r a

dtm\_trimedges\_leftBound

0

10101

0

a

a \* \* l b

b \* \* l c

dtm\_trimedges\_rightBound

0

10101

4

a

a \* \* r b

b \* \* r c

dtm\_trimedges\_left

0

10101

0

a

a \* \* l b

b \* \* l c

c \* 1 l d

d \* \* r d

d 1 1 \_ h

dtm\_trimedges\_right

0

10101

4

a

a \* \* r b

b \* \* r c

c \* 1 r d

d \* \* l d

d 1 1 \_ h

dtm\_generic\_halting

0

1000000000000000001

0

a

a \* \* r a

a \_ \* l b

b \* \* l b

b \_ \* r h

debug\_single

0

101+111

0

set

set 0 0 r set

set 1 1 r set

set + + r set

set \_ \_ l check

check 0 0 l check

check 1 1 r accept

check + + \_ clean

accept 0 0 r accept

accept 1 1 r accept

accept + + r accept

accept \_ \_ l dc

dc 0 1 l dc

dc 1 0 \_ gotofirst

gotofirst 0 0 l gotofirst

gotofirst 1 1 l gotofirst

gotofirst + + l ic

ic 0 1 r set

ic 1 0 l ic

ic \_ 1 r set

clean + \_ r clean

clean 0 \_ r clean

clean \_ \_ l end

end \_ \_ l end

end 0 0 \_ halt

end 1 1 \_ halt

debug\_multiTape

3

3

10000101

0

10000101

0

10000100

0

a

a 111 000 rrr a

a 000 111 rrr a

debug\_multiTrack

4

3

101+111

0

set

1+1

0

set

10101110+101011

0

set

set 0 0 r set

set 1 1 r set

set + + r set

set \_ \_ l check

check 0 0 l check

check 1 1 r accept

check + + \_ clean

accept 0 0 r accept

accept 1 1 r accept

accept + + r accept

accept \_ \_ l dc

dc 0 1 l dc

dc 1 0 \_ gotofirst

gotofirst 0 0 l gotofirst

gotofirst 1 1 l gotofirst

gotofirst + + l ic

ic 0 1 r set

ic 1 0 l ic

ic \_ 1 r set

clean + \_ r clean

clean 0 \_ r clean

clean \_ \_ l end

end \_ \_ l end

end 0 0 \_ halt

end 1 1 \_ halt

dtm\_defaultcase

0

1234567890

0

a

a \* 0 r a

a \_ \_ \_ h

dtm\_defaultcase\_override

0

1234567890

0

a

a \* 0 r a

a 4 \* r a

a \_ \_ \_ h

dtm\_defaultcase\_override\_multiple

0

1234567890

0

a

a \* 0 r a

a 4 \* r a

a 5 6 r a

a \_ \_ \_ h

rom\_defaultcase\_override\_multiple

1

10101011110

0

a

a 1 r b

b 1 r a

a \* r a

b \* r b

a \_ \_ even

b \_ \_ odd

mtam\_defaultcase\_write\_none

3

3

111

0

000

0

111

0

a

a 101 \*\*\* rrr a

mtam\_defaultcase\_write\_partial

3

3

111

0

000

0

333

0

a

a 103 \*2\* rrr a

mtam\_defaultcase\_override\_full

3

3

111

0

000

0

333

0

a

a \*\*\* \*23 rrr a

a 103 \*\*4 rrr a

a \_\_\_ \*\*\* \_\_\_ h

mtam\_defaultcase\_override\_partial

3

3

111

0

000

0

333

0

a

a \*\*\* \*23 rrr a

a \*0\* \*\*4 rrr a

a \_\_\_ \*\*\* \_\_\_ h

mtam\_defaultcase\_override\_highPriority

3

3

111

0

000

0

333

0

a

a \*\*\* \*23 rrr a

a \*0\* \*\*4 rrr a

a \*03 \*34 rrr a

a \_\_\_ \*\*\* \_\_\_ h

mtam\_defaultcase\_override\_both

3

3

111

0

000

0

333

0

a

a \*\*\* \*23 rrr a

a \*0\* \*\*4 rrr a

a 103 214 rrr a

a \_\_\_ \*\*\* \_\_\_ h

mtrm\_defaultcase\_write\_none

3

3

111

0

000

0

111

0

a

a 101 \*\*\* rrr a

mtrm\_defaultcase

4

3

2

0

a

2

0

a

2

0

a

a 1 \* r a

a \_ \* \_ halt

a \* 1 r a

mtrm\_defaultcase\_seperateLists

4

3

1

0

c

1

0

a

1

0

b

a 1 a r a

a \_ \* \_ halt

b 2 b r b

b \_ \* \_ halt

b \* 2 r b

c 3 c \_ c

c \* \* \_ halt

defaultkey\_custom

0

1011+1100

0

set

set 8 8 r set

set \_ \_ l check

check 0 0 l check

check 1 1 r accept

check + + \_ clean

accept 8 8 r accept

accept \_ \_ l dc

dc 0 1 l dc

dc 1 0 \_ gotofirst

gotofirst 8 8 l gotofirst

gotofirst + + l ic

ic 0 1 r set

ic 1 0 l ic

ic \_ 1 r set

clean 8 \_ r clean

clean \_ \_ l end

end \_ \_ l end

end 8 8 \_ halt

fsm\_straightLine

0

111111

0

a

a 1 0 r b

fsm\_branchingLine\_2

0

10101101

0

a

a 1 0 r b

a 0 1 r c

fsm\_branchineLine\_3

0

10101101

0

a

a 1 0 r b

a 0 1 r c

a \_ \_ r d

fsm\_looping\_middle

0

111111

0

a

a 1 0 r a

fsm\_looping\_up

0

111111

0

a

a 1 0 r b

a 0 1 r c

b 1 0 r b

fsm\_looping\_down

0

111111

0

a

a 1 0 r b

a 0 1 r c

c 1 0 r c

fsm\_arcing\_middle

0

111111

0

a

a 1 0 r b

b 1 0 l a

fsm\_arcing\_up

0

111111

0

a

a 1 0 r b

a 0 1 r c

b 1 0 l a

fsm\_arcing\_down

0

111111

0

a

a 1 0 r b

a 0 1 r c

c 1 0 l a

fsm\_multitape

3

3

0

0

0

a

a 000 111 rlr b

a 111 000 lrl c

fsm\_nondeterministic

2

00000

0

a

a 0 1 r b

a 0 2 r b

fsm\_universal

5

3

a11rb|b11ra|a00ra|b00rb|a---e|b---o

0

a

0

10101011110

0

q0

q0 \*a\* \*a\* \_\_\_ qa

qa \*\*\_ \*\*\_ \_\_\_ qa-

qa \*\*1 \*\*1 \_\_\_ qa1

qa1 a\*\* a\*\* r\_\_ qa1acceptstate

qa1 \*\*\* \*\*\* r\_\_ qa1reject

qa1reject |\*\* |\*\* r\_\_ qa1

qa1reject \*\*\* \*\*\* r\_\_ qa1reject

fsm\_overlap

0

0

a

a 0 1 r b

a 1 0 l b

fsm\_overlap\_noChange

0

1010110

0

a

a 0 0 r b

a 1 1 l b

fsm\_overlap\_sameWrite

0

1010110

0

a

a 0 1 r b

a 1 0 r b

fsm\_overlap\_sameMove

0

1010110

0

a

a 0 1 r b

a 1 0 r b

fsm\_overlap\_both

0

1010110

0

a

a 0 1 r b

a 1 1 r b

dtm\_utm

0

1000000000000000001

0

a

a 0 0 r a

a 1 1 r a

a \_ \_ l b

b 0 0 l b

b 1 1 l b

b \_ \_ r h

rom\_utm

1

1000000000000000001

0

a

a 0 r a

a 1 r a

a \_ l b

b 0 l b

b 1 l b

b \_ r h

utm\_53states

0

0

a

a 1 1 r b

b 1 1 r c

c 1 1 r b

d 1 1 r c

e 1 1 r b

f 1 1 r c

g 1 1 r b

h 1 1 r c

i 1 1 r b

j 1 1 r c

k 1 1 r b

l 1 1 r c

m 1 1 r b

n 1 1 r c

o 1 1 r b

p 1 1 r c

q 1 1 r b

r 1 1 r c

s 1 1 r b

t 1 1 r c

u 1 1 r b

v 1 1 r c

w 1 1 r b

x 1 1 r b

y 1 1 r c

z 1 1 r b

A 1 1 r b

B 1 1 r c

C 1 1 r b

D 1 1 r c

E 1 1 r b

F 1 1 r c

G 1 1 r b

H 1 1 r c

I 1 1 r b

J 1 1 r c

K 1 1 r b

L 1 1 r c

M 1 1 r b

N 1 1 r c

O 1 1 r b

P 1 1 r c

Q 1 1 r b

R 1 1 r c

S 1 1 r b

T 1 1 r c

U 1 1 r b

V 1 1 r c

W 1 1 r b

X 1 1 r c

Y 1 1 r b

Z 1 1 r c

53rdstate 1 1 r x