

Language

A	$\{0,1\}$
T	$A \cup \{,\} \cup \{_, X\}$
L	$\{1, 10, 11, 100, 101, 110, 111, 1000, 1001, \dots\}$
$f(s)$	$1s, s$

Duplicate and append one

State	Description
q_0	Append a comma.
q_1	Move left to start.
q_2	Check if 0 or 1, mark X.
q_3	Move right to end, append 0.
q_4	Move right to end, append 1.
q_5	Move left to X, overwrite 0, back to q_2 .
q_6	Move left to X, overwrite 1, back to q_2 .
q_7	Move to start, prepend 1.
q_8	Back to start, end.

State	Input	Write	Move	Next
q_0	—	,	L	q_1
q_0	0	0	R	q_0
q_0	1	1	R	q_0
q_0	,	,	R	q_f
q_0	X	X	R	q_f
q_1	—	—	R	q_2
q_1	0	0	L	q_1
q_1	1	1	L	q_1
q_1	,	,	R	q_f
q_1	X	X	R	q_f
q_2	—	—	R	q_f
q_2	0	X	R	q_3
q_2	1	X	R	q_4
q_2	,	,	R	q_7
q_2	X	X	R	q_f
q_3	—	0	L	q_5
q_3	0	0	R	q_3
q_3	1	1	R	q_3
q_3	,	,	R	q_3
q_3	X	X	R	q_f
q_4	—	1	L	q_6
q_4	0	0	R	q_4
q_4	1	1	R	q_4
q_4	,	,	R	q_4
q_4	X	X	R	q_f
q_5	—	—	L	q_f
q_5	0	0	L	q_5
q_5	1	1	L	q_5
q_5	,	,	L	q_5
q_5	X	0	R	q_2
q_6	—	—	L	q_f
q_6	0	0	L	q_6
q_6	1	1	L	q_6
q_6	,	,	L	q_6
q_6	X	1	R	q_2
q_7	—	1	L	q_8
q_7	0	0	L	q_7
q_7	1	1	L	q_7
q_7	,	,	L	q_7
q_7	X	X	L	q_7
q_8	—	—	R	q_a
q_8	0	0	R	q_f
q_8	1	1	R	q_f
q_8	,	,	R	q_f
q_8	X	X	R	q_f

Add

State Description

q_0	Right to comma.
q_1	Decrease by 1, go to final states if no 1.
q_2	Left to start.
q_3	Increase by 1, use X as comma if overflow.
q_4	Delete to comma/X, replace X with 1.
q_5	Left to start.

State	Input	Write	Move	Next
q_0	—	—	L	q_f
q_0	0	0	R	q_0
q_0	1	1	R	q_0
q_0	,	,	R	q_1
q_0	X	X	R	q_1
q_1	—	—	L	q_4
q_1	0	1	R	q_1
q_1	1	0	L	q_2
q_1	,	,	L	q_f
q_1	X	X	L	q_f
q_2	—	—	R	q_3
q_2	0	0	L	q_2
q_2	1	1	L	q_2
q_2	,	,	L	q_2
q_2	X	X	L	q_2
q_3	—	—	R	q_f
q_3	0	1	R	q_0
q_3	1	0	R	q_2
q_3	,	X	L	q_0
q_3	X	X	L	q_f
q_4	—	—	L	q_f
q_4	0	—	L	q_4
q_4	1	1	L	q_f
q_4	,	—	L	q_5
q_4	X	1	L	q_5
q_5	—	—	R	q_a
q_5	0	0	L	q_5
q_5	1	1	L	q_5
q_5	,	,	L	q_f
q_5	X	X	L	q_f

Divide by two

Hello

State	Description
q_0	Delete 0, move right.

State	Input	Write	Move	Next
q_0	—	—	L	q_f
q_0	0	—	R	q_0
q_0	1	1	R	q_f
q_0	,	,	R	q_f
q_0	X	X	R	q_f

Remove leading zeros

Fails on string meaning zero.

State	Description
q_0	Move right to end.
q_1	Delete zeros.
q_2	Left to end.

State	Input	Write	Move	Next
q_0	—	—	L	q_1
q_0	0	0	R	q_0
q_0	1	1	R	q_0
q_0	,	,	R	q_f
q_0	X	X	R	q_f
q_1	—	—	R	q_f
q_1	0	—	L	q_0
q_1	1	1	L	q_2
q_1	,	,	R	q_f
q_1	X	X	R	q_f
q_2	—	—	R	q_a
q_2	0	0	R	q_2
q_2	1	1	R	q_2
q_2	,	,	R	q_f
q_2	X	X	R	q_f

Check if 1

State	Description
q_0	Check if first bit 1.
q_1	Check if second bit blank.

State	Input	Write	Move	Next
q_0	—	—	R	q_f
q_0	0	0	R	q_f
q_0	1	1	R	q_1
q_0	,	,	R	q_f
q_0	X	X	R	q_f
q_1	—	—	L	q_a
q_1	0	0	L	q_f
q_1	1	1	L	q_f
q_1	,	,	R	q_f
q_1	X	X	R	q_f

Check if even

State	Description
q_0	Check if first bit 0.

State	Input	Write	Move	Next
q_0	—	—	R	q_f
q_0	0	0	R	q_a
q_0	1	1	R	q_f
q_0	,	,	R	q_f
q_0	X	X	R	q_f