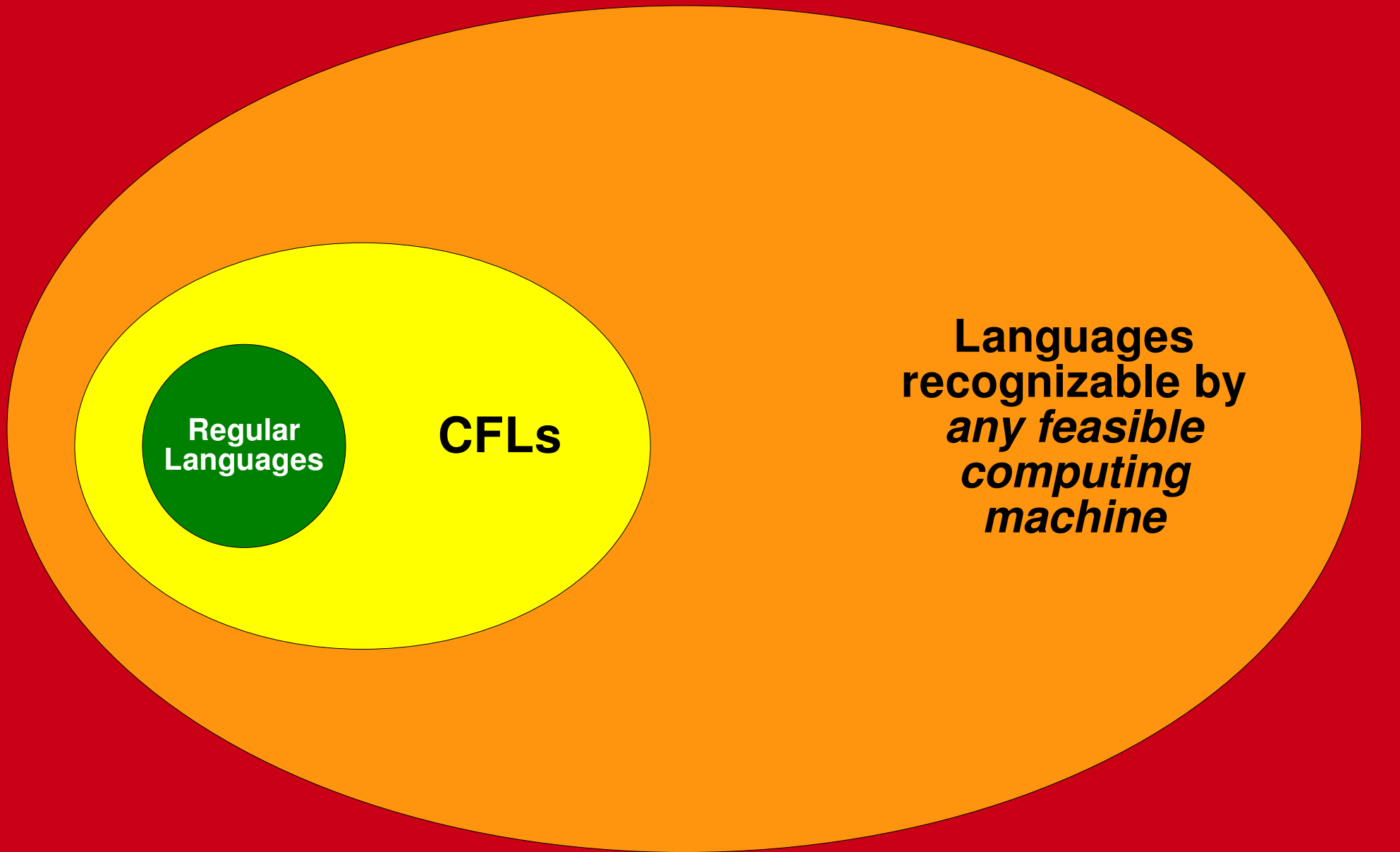


Turing Machines

Part One

What problems can we solve with a computer?



All Languages

That same drawing, to scale.

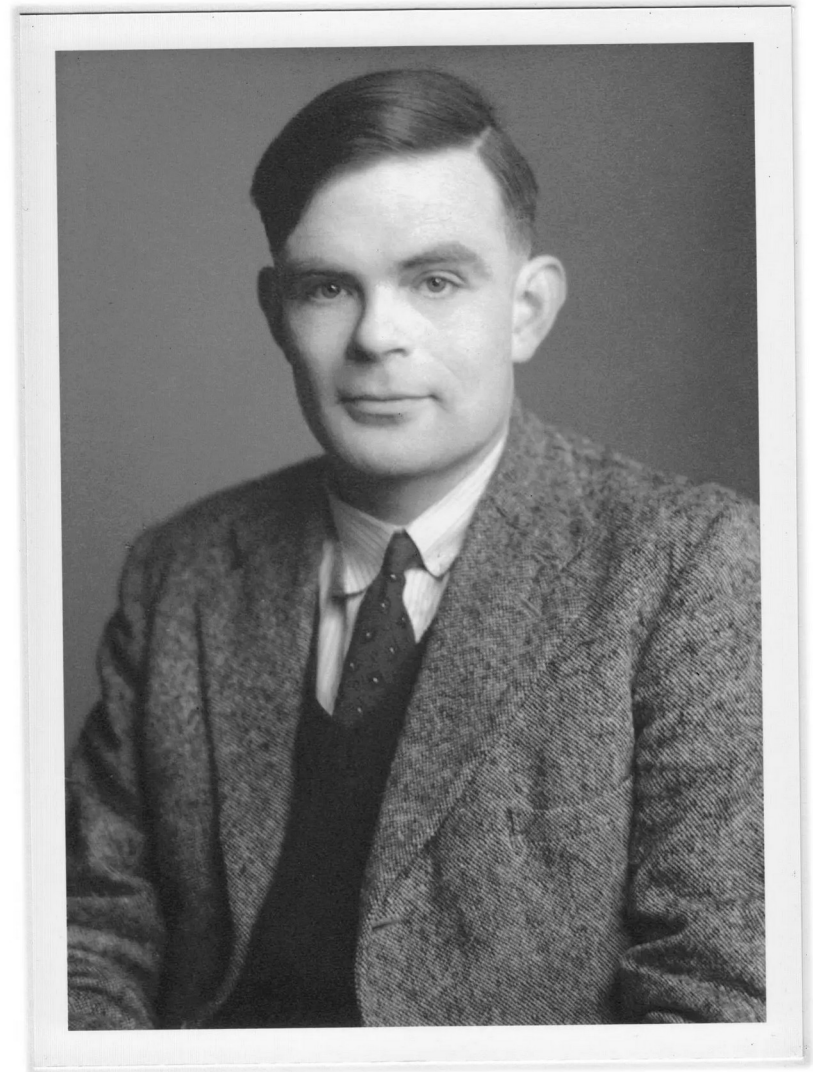
The Problem

- Finite automata accept precisely the regular languages.
- We may need unbounded memory to recognize context-free languages.
 - e.g. $\{ \mathbf{a}^n \mathbf{b}^n \mid n \in \mathbb{N} \}$ requires unbounded counting.
- How do we model a computing device that has unbounded memory?

A Brief History Lesson

Turing Machines

- In March 1936, Alan Turing (aged 23!) published a paper detailing the ***a-machine*** (for ***automatic machine***), an automaton for computing on real numbers.
- They're now more popularly referred to as ***Turing machines*** in his honor.
- He also later made contributions to computational biology, artificial intelligence, cryptography, etc. Seriously, Google this guy.



$$\begin{array}{r} 27182818284590 \\ + 31415926535897 \\ \hline \end{array}$$

$$\begin{array}{r} 27182818284590 \\ + 31415926535897 \\ \hline 7 \end{array}$$

$$\begin{array}{r} 27182818284\overset{1}{5}90 \\ + 31415926535897 \\ \hline 27182818284\overset{1}{5}90 \\ 31415926535897 \\ \hline 58598745804797 \end{array}$$

$$\begin{array}{r}
 27182818284^1590 \\
 + 31415926535^1897 \\
 \hline
 487
 \end{array}$$

										1	1	1		
	2	7	1	8	2	8	1	8	2	8	4	5	9	0
+	3	1	4	1	5	9	2	6	5	3	5	8	9	7
<hr/>														
											0	4	8	7

									1	1	1	1		
	2	7	1	8	2	8	1	8	2	8	4	5	9	0
+	3	1	4	1	5	9	2	6	5	3	5	8	9	7
<hr/>										<hr/>				
										2	0	4	8	7

$$\begin{array}{r} 27182818 \\ + 31415926 \\ \hline 585987 \end{array}$$

Carry values (1) are shown above the digits 2, 8, 4, and 5 in the second row.

$$\begin{array}{r}
 27182818284590 \\
 + 31415926535897 \\
 \hline
 27182818284590 \\
 + 31415926535897 \\
 \hline
 58598764821487
 \end{array}$$

							1		1	1	1	1		
	2	7	1	8	2	8	1	8	2	8	4	5	9	0
+	3	1	4	1	5	9	2	6	5	3	5	8	9	7
<hr/>							4	4	8	2	0	4	8	7

					1		1		1	1	1	1		
	2	7	1	8	2	8	1	8	2	8	4	5	9	0
+	3	1	4	1	5	9	2	6	5	3	5	8	9	7
<hr/>						7	4	4	8	2	0	4	8	7

					1		1		1	1	1	1		
	2	7	1	8	2	8	1	8	2	8	4	5	9	0
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					8	7	4	4	8	2	0	4	8	7

					1		1		1	1	1	1		
	2	7	1	8	2	8	1	8	2	8	4	5	9	0
+	3	1	4	1	5	9	2	6	5	3	5	8	9	7
<hr/>				9	8	7	4	4	8	2	0	4	8	7

				1		1		1	1	1	1		
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<hr/>													
			5	9	8	7	4	4	8	2	0	4	8 7

					1		1		1	1	1	1		
	2	7	1	8	2	8	1	8	2	8	4	5	9	0
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		8	5	9	8	7	4	4	8	2	0	4	8	7

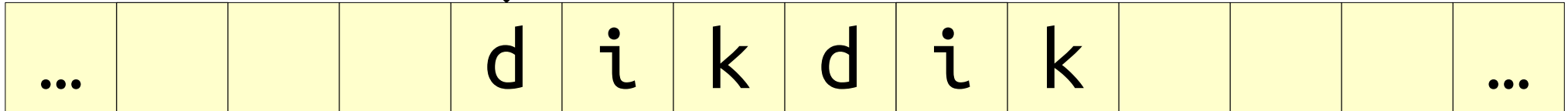
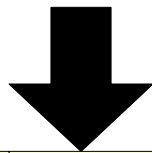
					1		1		1	1	1	1		
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Key Idea: Even if you need huge amounts of scratch space to perform a calculation, at each point in the calculation you only need access to a small amount of that scratch space.

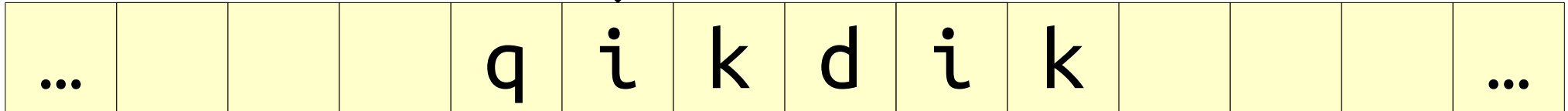
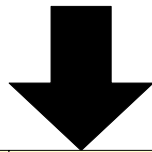
Turing Machines

- To provide his machines extra memory, Turing gave his machines access to an *infinite tape* subdivided into a number of *tape cells*.
- A Turing machine can only see one tape cell at a time, the one pointed at by the *tape head*.
- The Turing machine can
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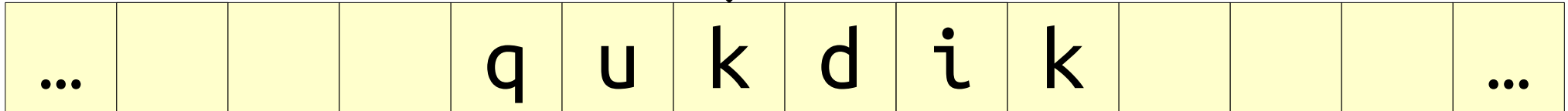
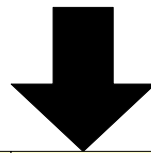
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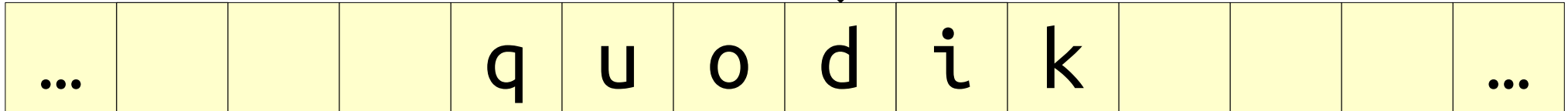
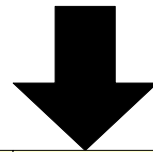
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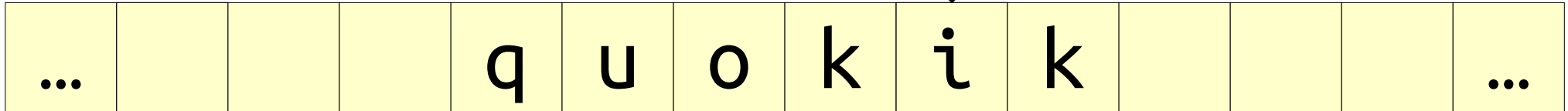
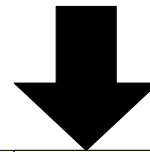
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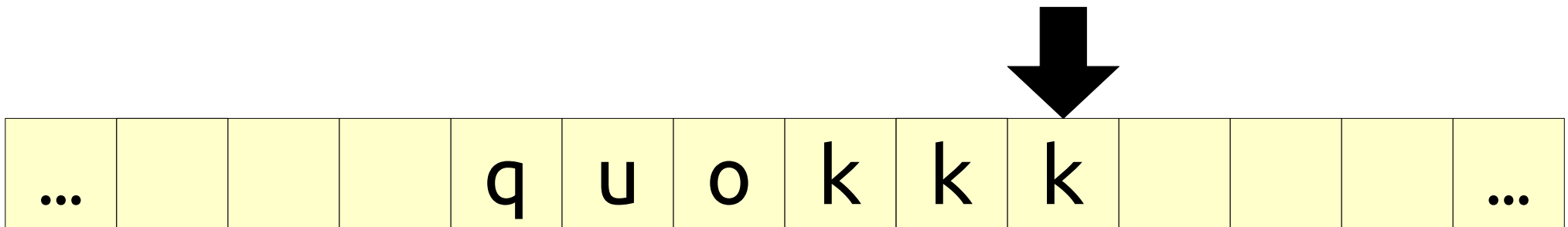
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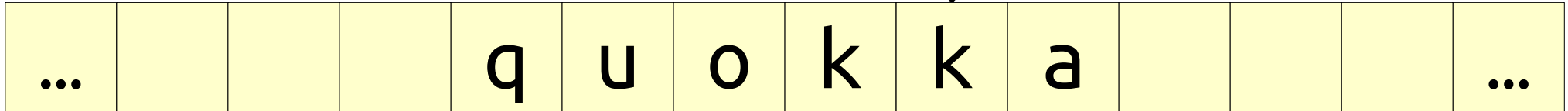
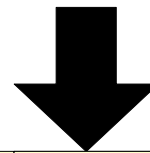
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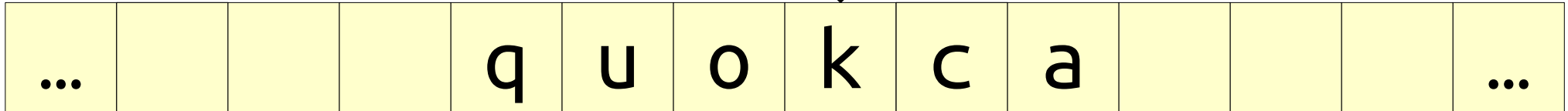
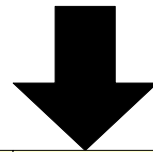
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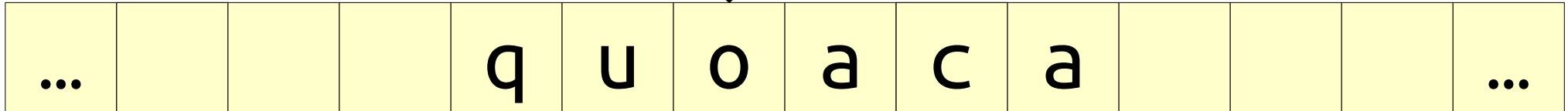
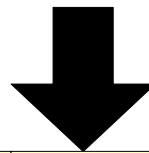
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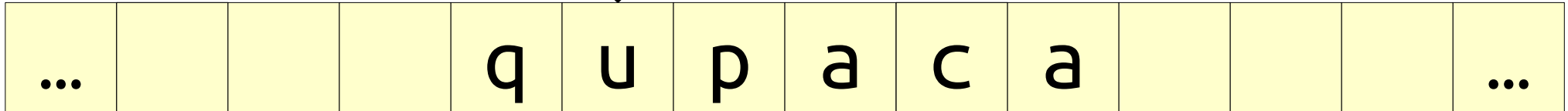
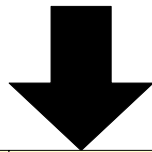
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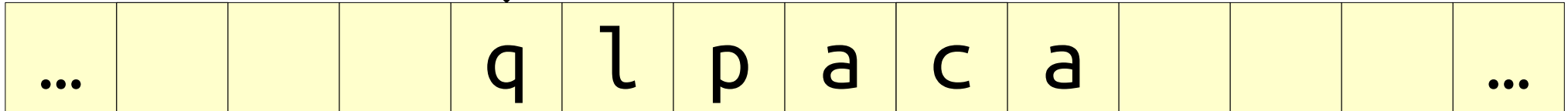
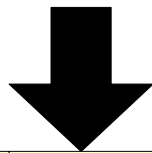
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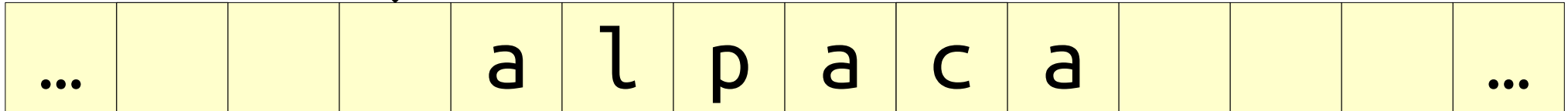
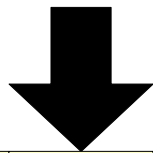
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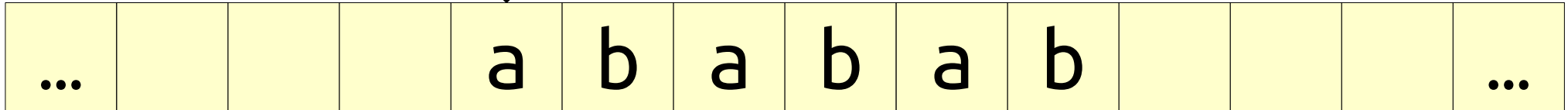
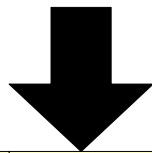
- Over the years, there have been many simplifications and edits to Turing's original automata.
 - In practice, electronic computers are written in terms of individual instructions rather than states and transitions.
 - Turing's original paper deals with computing individual real numbers; we typically want to compute functions of inputs.
- What we're going to present as "Turing machines" in this class differ significantly from Turing's original description, while retaining the core essential ideas.
 - (Our model is closer to Emil Post's *Formulation 1* and Hao Wang's *Basic Machine B*, for those of you who are curious.)
- If you'd like to learn more about Turing's original version of the Turing machine, come chat with me after class!

Turing Machines

- A TM is a series of instructions that control a tape head as it moves across an infinite tape.
- The tape begins with the input string written somewhere, surrounded by infinitely many blank cells.
 - Rule: The input string cannot contain blank cells.
- The tape head begins above the first character of the input. (If the input is ϵ , the tape head points somewhere on a blank tape.)

Start:

```
If Blank Return True  
If 'b' Return False  
Write 'x'  
Move Right  
If Not 'b' Return False  
Write 'x'  
Move Right  
Goto Start
```

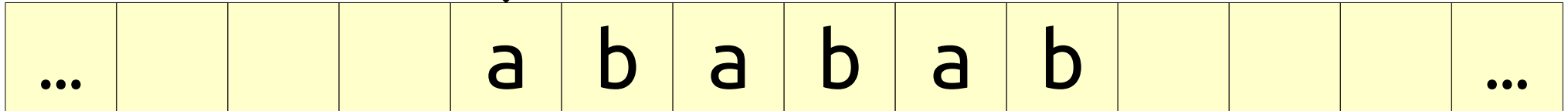
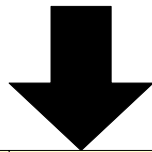


Turing Machines

- We begin at the Start label.
- Labels indicate different sections of code. The name Start is special and means “begin here.”
- Labels have no effect when executed. We just move to the next line.

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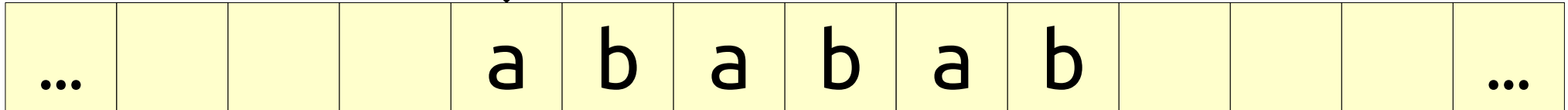
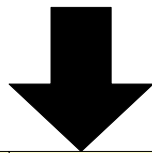


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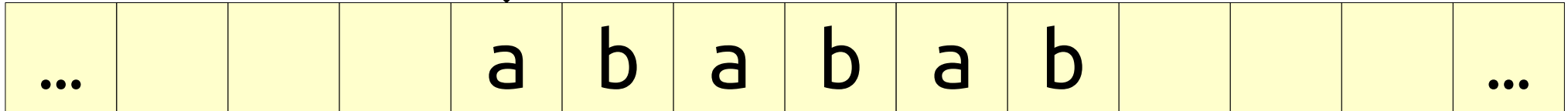
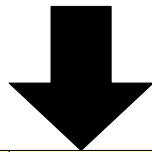
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Turing Machines

- A statement of the form
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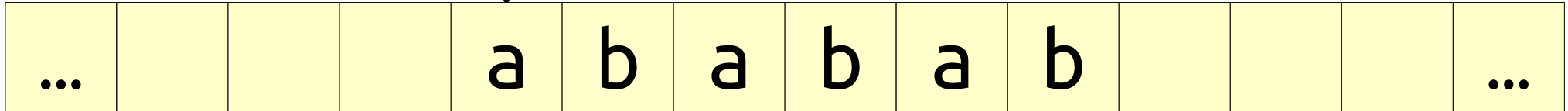
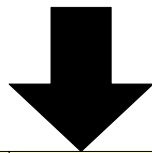
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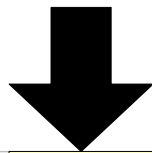
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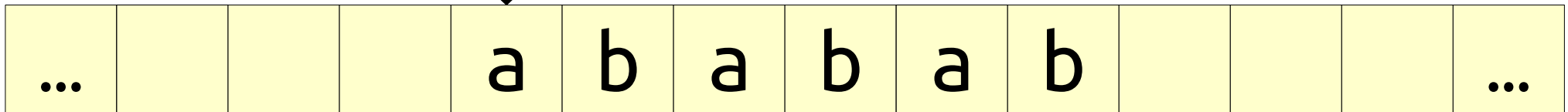
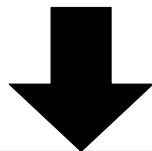
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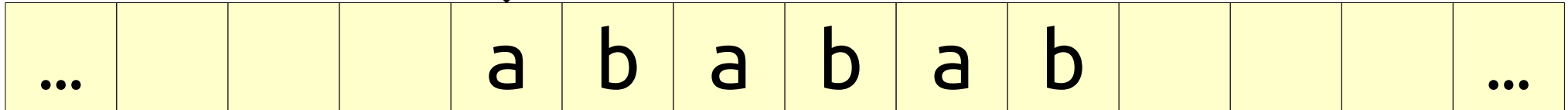
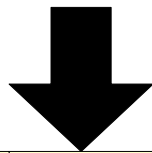
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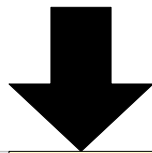
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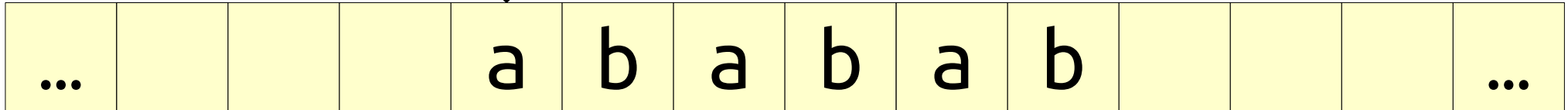
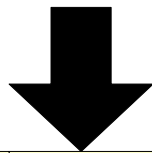
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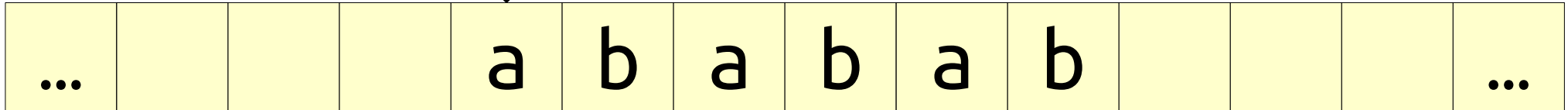
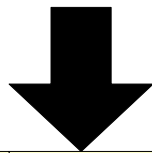
Move Right

If Not 'b' Return False

Write 'x'

Move Right

Goto Start



Turing Machines

- The statement
Write *symbol*
writes *symbol* to the
cell under the tape
head.
- The *symbol* can
either be Blank or a
character in quotes.

Start:

If Blank Return True

If 'b' Return False

Write 'x'

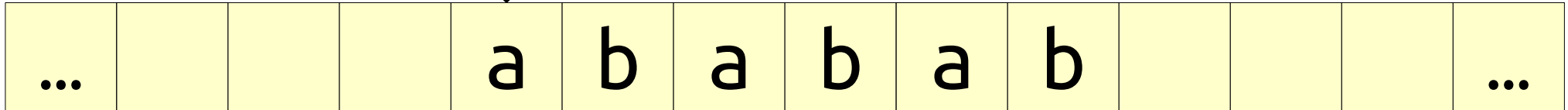
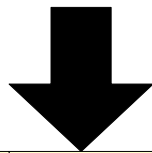
Move Right

If Not 'b' Return False

Write 'x'

Move Right

Goto Start



Turing Machines

- The statement
Write *symbol*
writes *symbol* to the
cell under the tape
head.
- The *symbol* can
either be Blank or a
character in quotes.

Start:

If Blank Return True

If 'b' Return False

Write 'x'

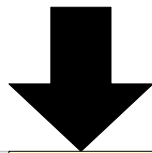
Move Right

If Not 'b' Return False

Write 'x'

Move Right

Goto Start



Turing Machines

- The statement
Write *symbol*
writes *symbol* to the
cell under the tape
head.
- The *symbol* can
either be Blank or a
character in quotes.

Start:

If Blank Return True

If 'b' Return False

Write 'x'

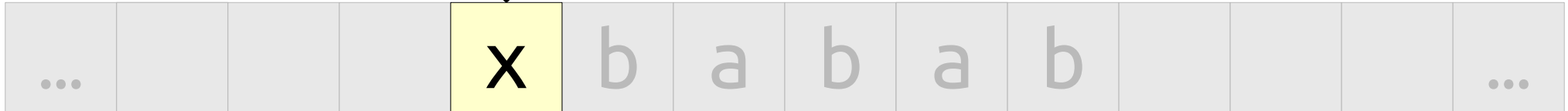
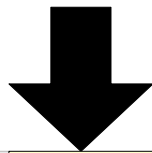
Move Right

If Not 'b' Return False

Write 'x'

Move Right

Goto Start



Turing Machines

- The statement
Write *symbol*
writes *symbol* to the
cell under the tape
head.
- The *symbol* can
either be Blank or a
character in quotes.

Start:

If Blank Return True

If 'b' Return False

Write 'x'

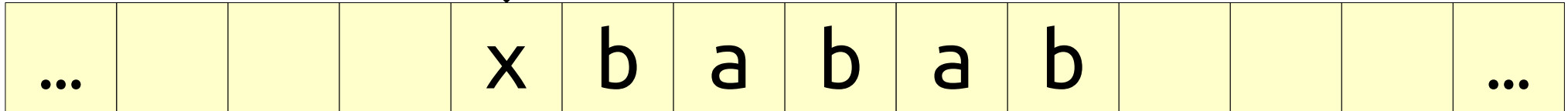
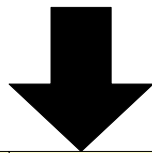
Move Right

If Not 'b' Return False

Write 'x'

Move Right

Goto Start



Turing Machines

- The statement
Write *symbol*
writes *symbol* to the
cell under the tape
head.
- The *symbol* can
either be Blank or a
character in quotes.

Start:

If Blank Return True

If 'b' Return False

Write 'x'

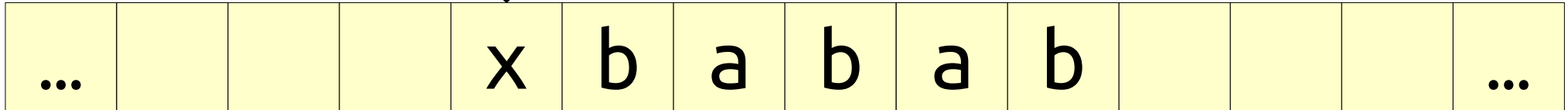
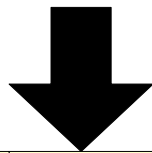
Move Right

If Not 'b' Return False

Write 'x'

Move Right

Goto Start



Turing Machines

- The command
Move *direction*
moves the tape head one step in the indicated direction (either Left or Right).

Start:

If Blank Return True

If 'b' Return False

Write 'x'

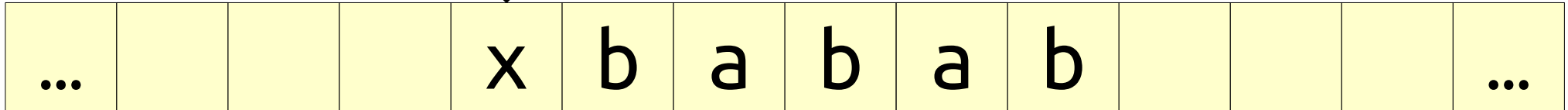
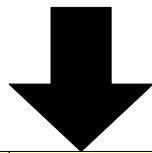
Move Right

If Not 'b' Return False

Write 'x'

Move Right

Goto Start



Turing Machines

- The command
Move *direction*
moves the tape head one step in the indicated direction (either Left or Right).

Start:

If Blank Return True

If 'b' Return False

Write 'x'

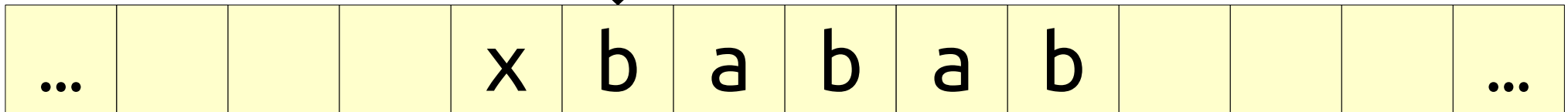
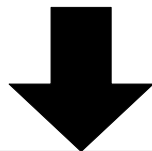
Move Right

If Not 'b' Return False

Write 'x'

Move Right

Goto Start



Turing Machines

- The command
Move *direction*
moves the tape
head one step in
the indicated
direction (either
Left or Right).

Start:

If Blank Return True

If 'b' Return False

Write 'x'

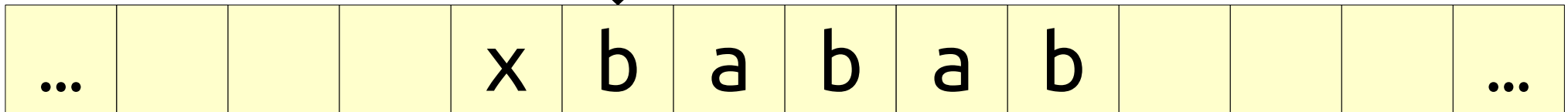
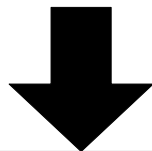
Move Right

If Not 'b' Return False

Write 'x'

Move Right

Goto Start



Turing Machines

- A statement of the form
If Not *symbol command*
sees if the cell under
the tape head holds
symbol.
- If so, nothing happens.
- If not, it executes
command.

Start:

If Blank Return True

If 'b' Return False

Write 'x'

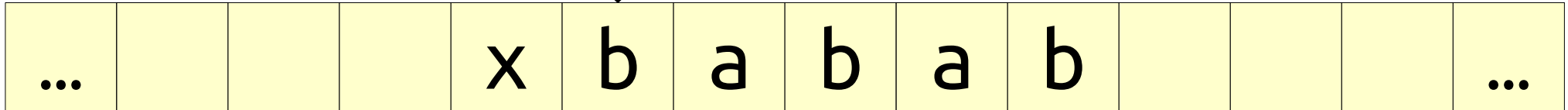
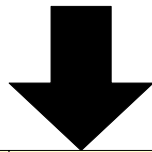
Move Right

If Not 'b' Return False

Write 'x'

Move Right

Goto Start



Turing Machines

- A statement of the form
If Not *symbol command*
sees if the cell under
the tape head holds
symbol.
- If so, nothing happens.
- If not, it executes
command.

Start:

If Blank Return True

If 'b' Return False

Write 'x'

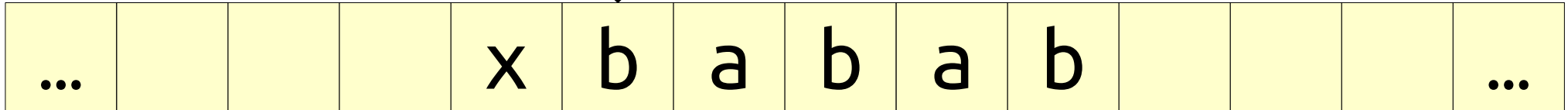
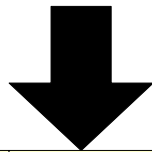
Move Right

If Not 'b' Return False

Write 'x'

Move Right

Goto Start



Turing Machines

- A statement of the form
If Not *symbol command*
sees if the cell under
the tape head holds
symbol.
- If so, nothing happens.
- If not, it executes
command.

Start:

If Blank Return True

If 'b' Return False

Write 'x'

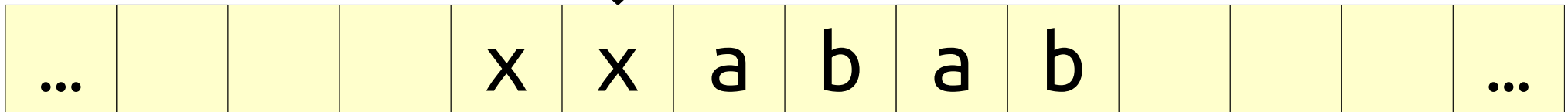
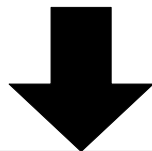
Move Right

If Not 'b' Return False

Write 'x'

Move Right

Goto Start



Turing Machines

- A statement of the form
If Not *symbol command*
sees if the cell under
the tape head holds
symbol.
- If so, nothing happens.
- If not, it executes
command.

Start:

If Blank Return True

If 'b' Return False

Write 'x'

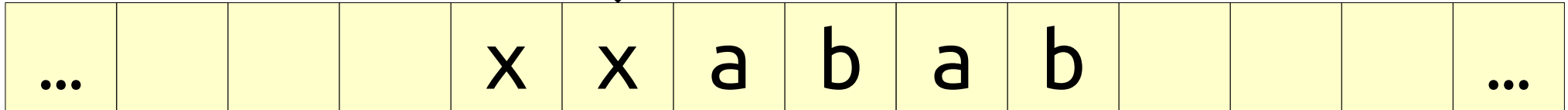
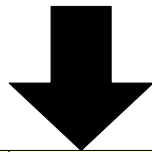
Move Right

If Not 'b' Return False

Write 'x'

Move Right

Goto Start



Turing Machines

- A statement of the form
If Not *symbol* *command*
sees if the cell under
the tape head holds
symbol.
- If so, nothing happens.
- If not, it executes
command.

Start:

If Blank Return True

If 'b' Return False

Write 'x'

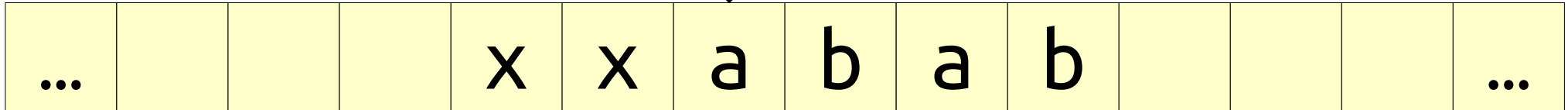
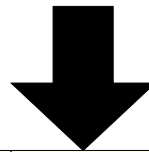
Move Right

If Not 'b' Return False

Write 'x'

Move Right

Goto Start

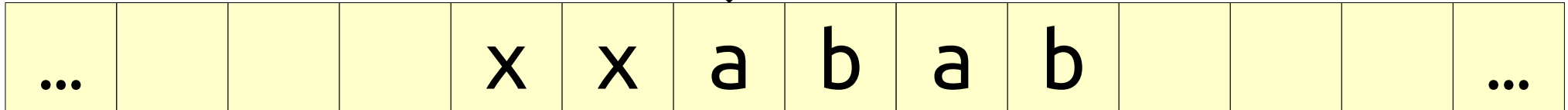
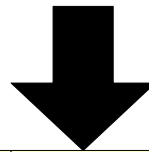


Turing Machines

- A statement of the form
If Not *symbol* *command*
sees if the cell under
the tape head holds
symbol.
- If so, nothing happens.
- If not, it executes
command.

Start:

```
If Blank Return True  
If 'b' Return False  
Write 'x'  
Move Right  
If Not 'b' Return False  
Write 'x'  
Move Right  
Goto Start
```

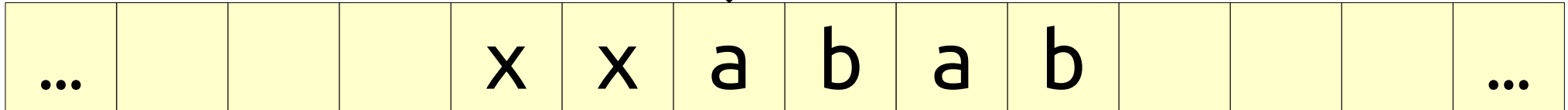
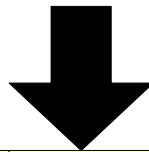


Turing Machines

- The command
Goto *label*
jumps to the indicated label.
- This program just has a Start label, but most interesting programs have other labels beyond this.

Start:

```
If Blank Return True  
If 'b' Return False  
Write 'x'  
Move Right  
If Not 'b' Return False  
Write 'x'  
Move Right  
Goto Start
```

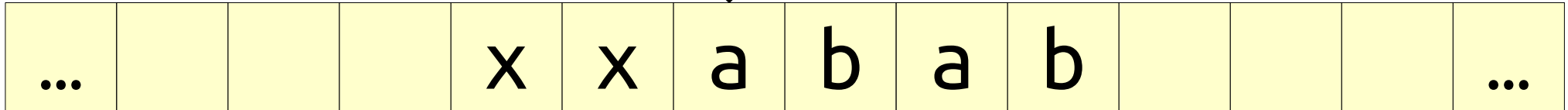
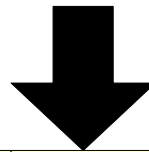


Turing Machines

- The command
Goto *label*
jumps to the indicated label.
- This program just has a Start label, but most interesting programs have other labels beyond this.

Start:

```
If Blank Return True  
If 'b' Return False  
Write 'x'  
Move Right  
If Not 'b' Return False  
Write 'x'  
Move Right  
Goto Start
```

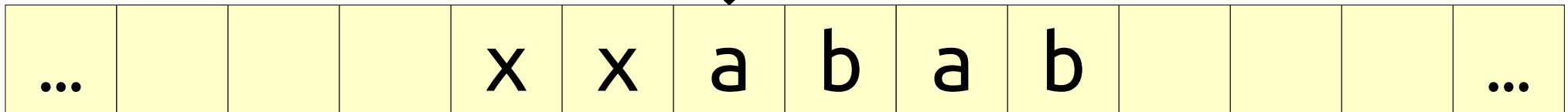
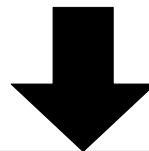


Turing Machines

- A TM stops when executing the
Return *result*
command.
- Here, *result* can be either True or False.
- (If we “fall off” the bottom of the program, the TM acts as though it executes the Return False command.)

Start:

```
If Blank Return True
If 'b' Return False
Write 'x'
Move Right
If Not 'b' Return False
Write 'x'
Move Right
Goto Start
```



Turing Machines

- A TM stops when executing the
Return *result*
command.
- Here, *result* can be either True or False.
- (If we “fall off” the bottom of the program, the TM acts as though it executes the Return False command.)

Start:

If Blank Return True

If 'b' Return False

Write 'x'

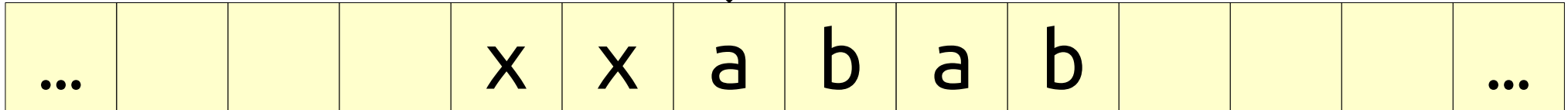
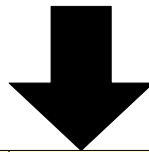
Move Right

If Not 'b' Return False

Write 'x'

Move Right

Goto Start



Turing Machines

- A TM stops when executing the
Return *result*
command.
- Here, *result* can be either True or False.
- (If we “fall off” the bottom of the program, the TM acts as though it executes the Return False command.)

Start:

If Blank Return True

If 'b' Return False

Write 'x'

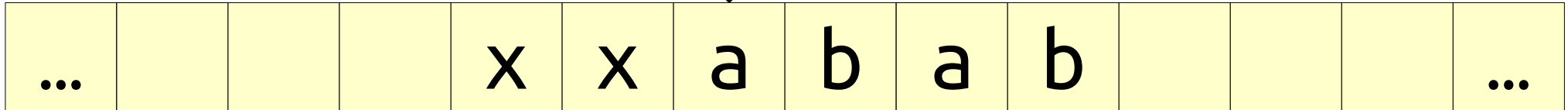
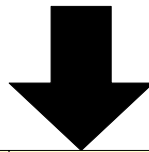
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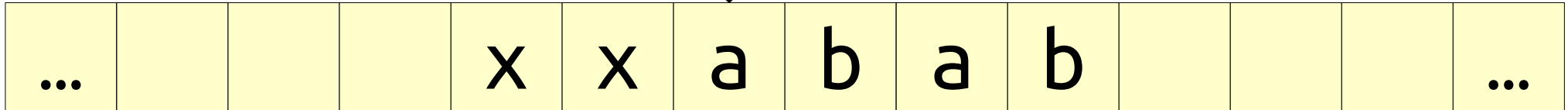
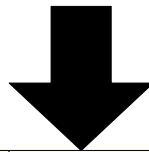
Move Right

If Not 'b' Return False

Write 'x'

Move Right

Goto Start



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Return *result*
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- Here, *result* can be either True or False.
- (If we “fall off” the bottom of the program, the TM acts as though it executes the Return False command.)

Start:

If Blank Return True

If 'b' Return False

Write 'x'

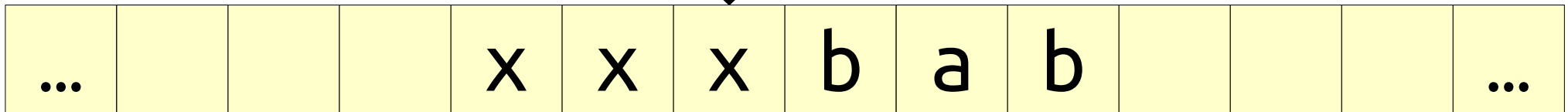
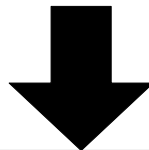
Move Right

If Not 'b' Return False

Write 'x'

Move Right

Goto Start



Turing Machines

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If Blank Return True

If 'b' Return False

Write 'x'

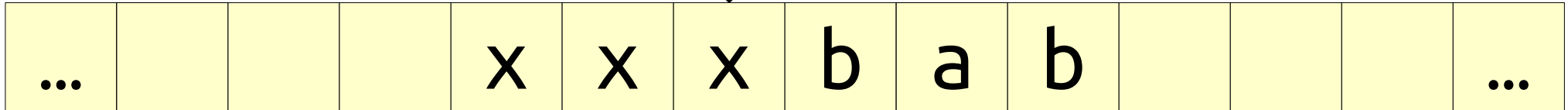
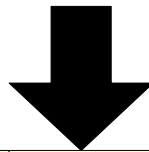
Move Right

If Not 'b' Return False

Write 'x'

Move Right

Goto Start



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Return *result*
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If 'b' Return False

Write 'x'

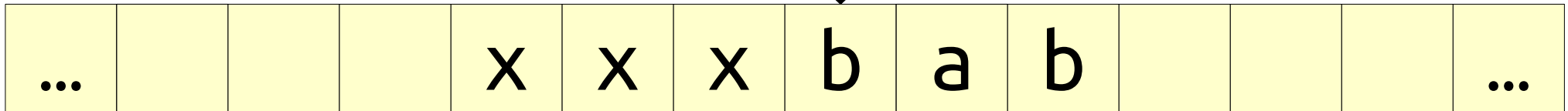
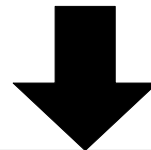
Move Right

If Not 'b' Return False

Write 'x'

Move Right

Goto Start



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- (If we “fall off” the bottom of the program, the TM acts as though it executes the Return False command.)

Start:

If Blank Return True

If 'b' Return False

Write 'x'

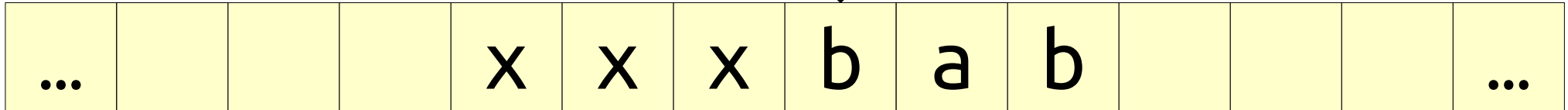
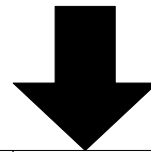
Move Right

If Not 'b' Return False

Write 'x'

Move Right

Goto Start



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- A TM stops when executing the
Return *result*
command.
- Here, *result* can be either True or False.
- (If we “fall off” the bottom of the program, the TM acts as though it executes the Return False command.)

Start:

If Blank Return True

If 'b' Return False

Write 'x'

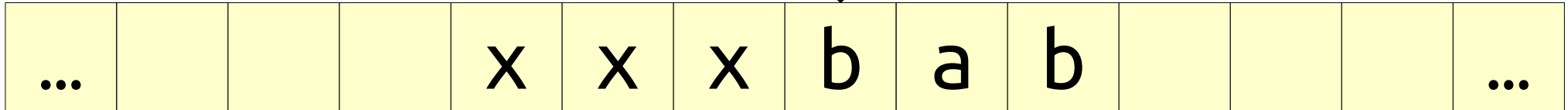
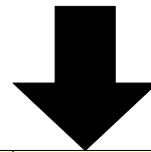
Move Right

If Not 'b' Return False

Write 'x'

Move Right

Goto Start



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- Here, *result* can be either True or False.
- (If we “fall off” the bottom of the program, the TM acts as though it executes the Return False command.)

Start:

If Blank Return True

If 'b' Return False

Write 'x'

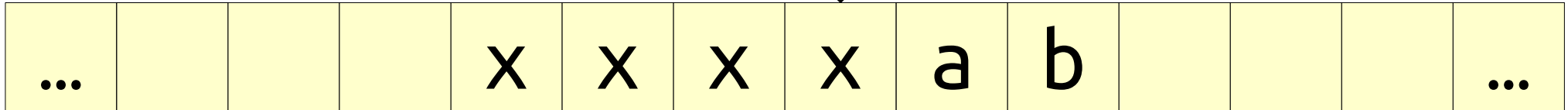
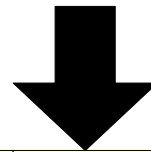
Move Right

If Not 'b' Return False

Write 'x'

Move Right

Goto Start



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Return *result*
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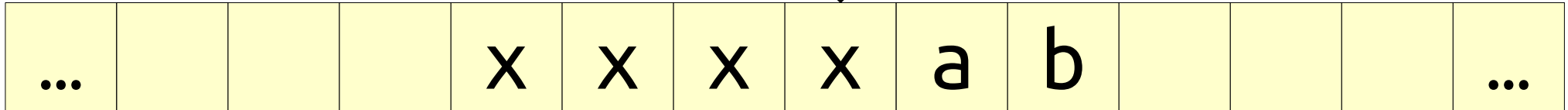
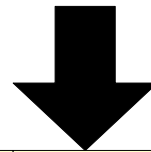
Move Right

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Move Right

Goto Start



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If Blank Return True

If 'b' Return False

Write 'x'

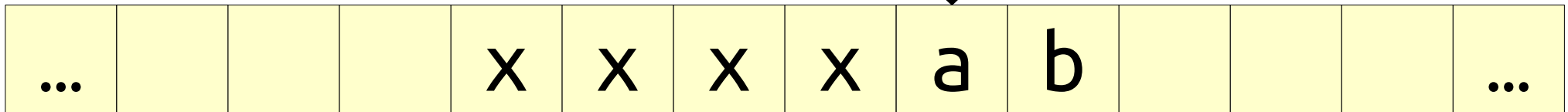
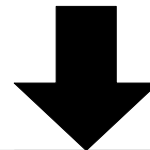
Move Right

If Not 'b' Return False

Write 'x'

Move Right

Goto Start

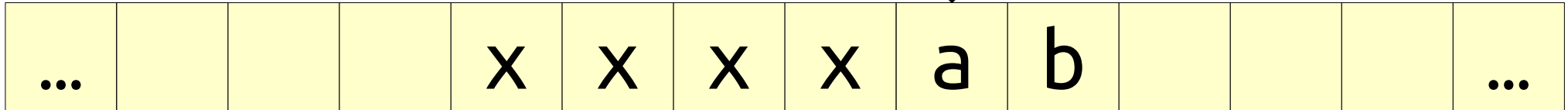
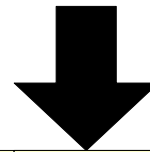


Turing Machines

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Start:

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If 'b' Return False  
Write 'x'  
Move Right  
If Not 'b' Return False  
Write 'x'  
Move Right  
Goto Start
```

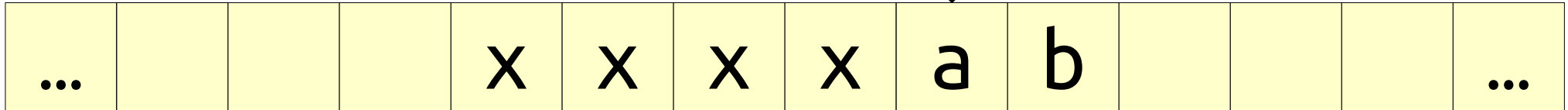
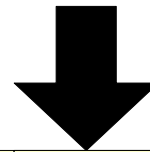


Turing Machines

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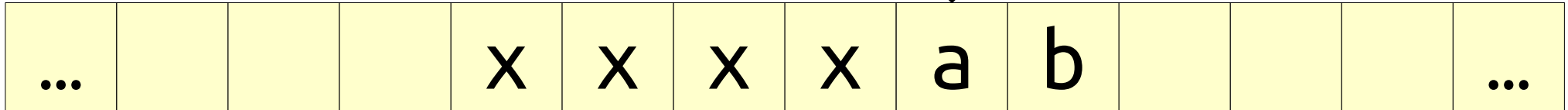
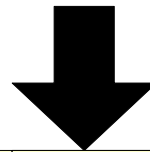
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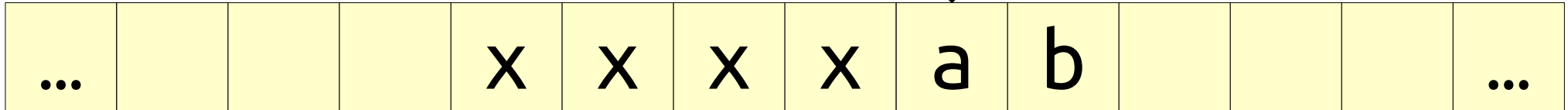
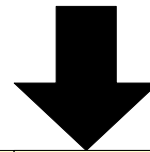
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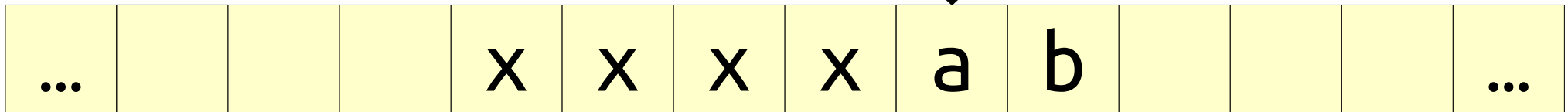
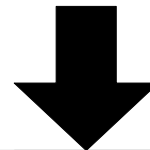
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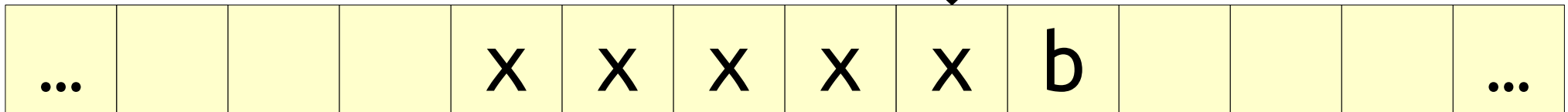
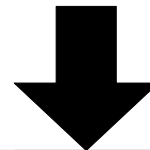
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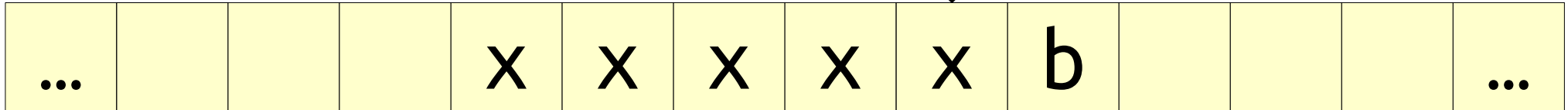
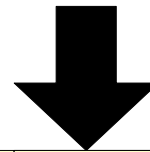
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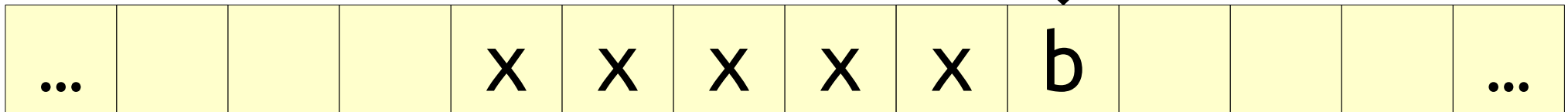
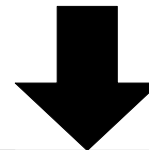
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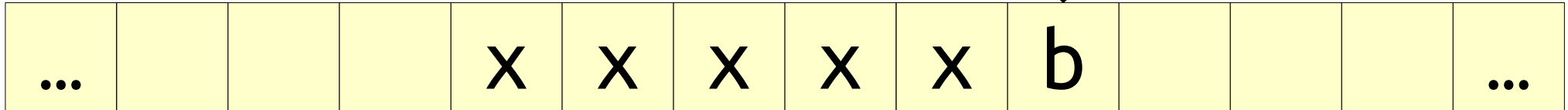
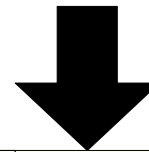
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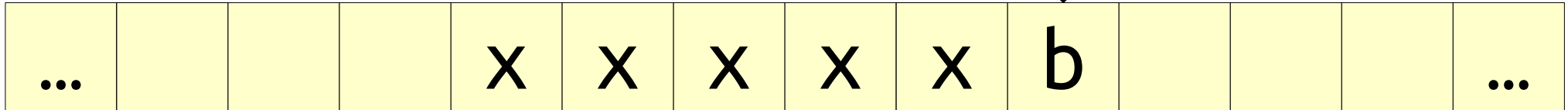
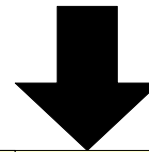
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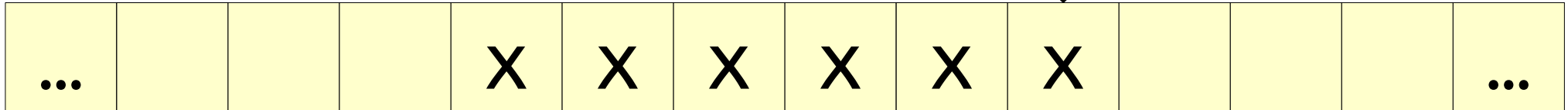
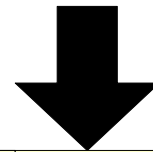
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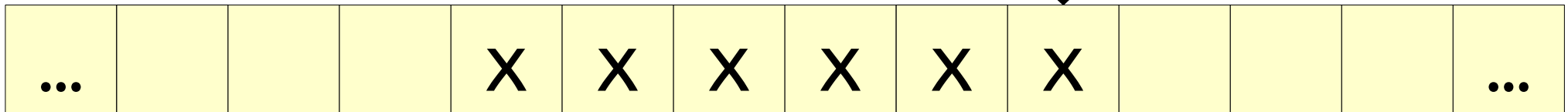
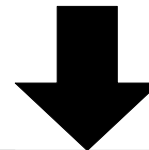
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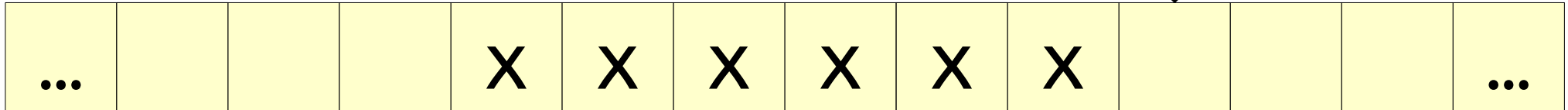
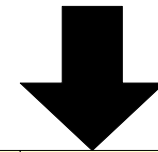
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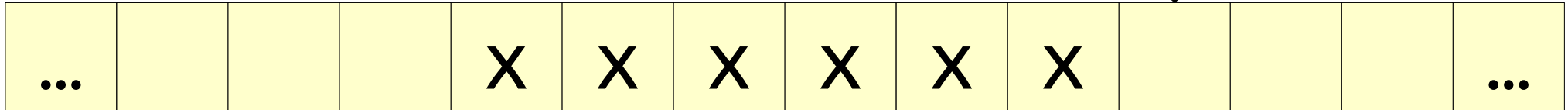
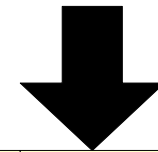


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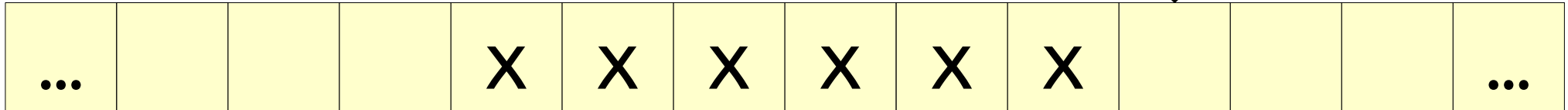
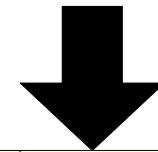


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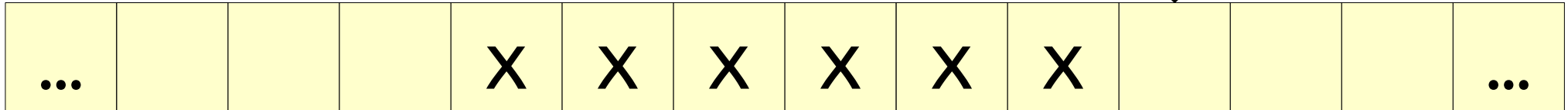
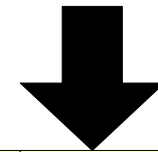
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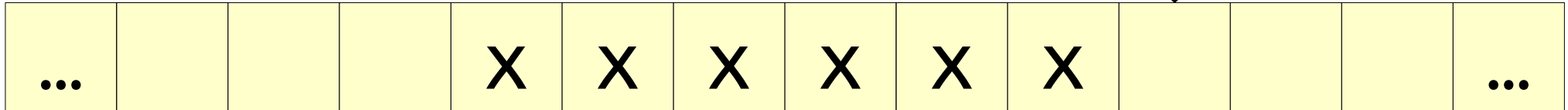
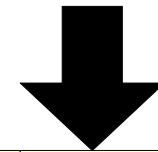
Move Right

If Not 'b' Return False

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Goto Start



Turing Machines

- This TM initially started up with the string ababab on its tape, so this means that TM returns true on the input ababab, not xxxxxx.
- An intuition for this: we gave this program an input. It therefore returned true with respect to that input, not whatever internal data it generated in making its decision.

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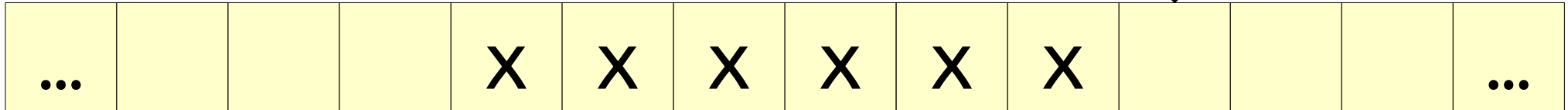
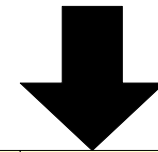
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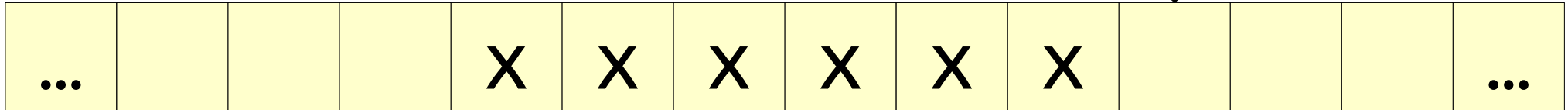
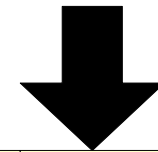


Turing Machines

- To summarize, we only have six commands:
 - Move *direction*
 - Write *symbol*
 - Goto *label*
 - Return *result*
 - If *symbol command*
 - If Not *symbol command*
- Despite their simplicity, TMs are *surprisingly* powerful. The rest of this lecture explores why.

Start:

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Write 'x'
Move Right
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Programming Turing Machines

Our First Challenge

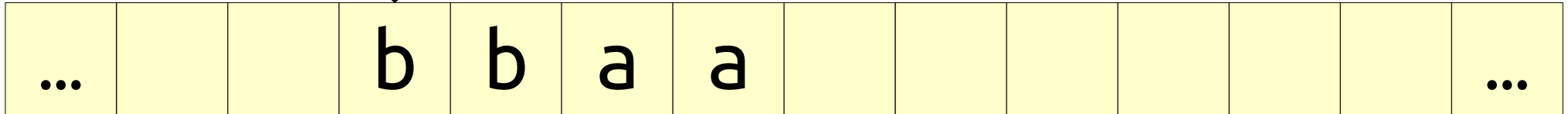
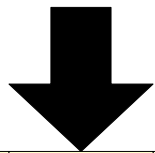
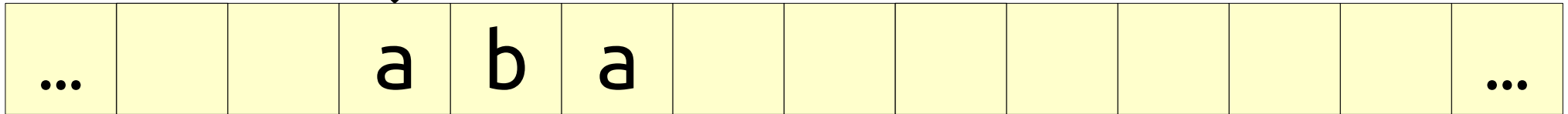
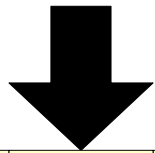
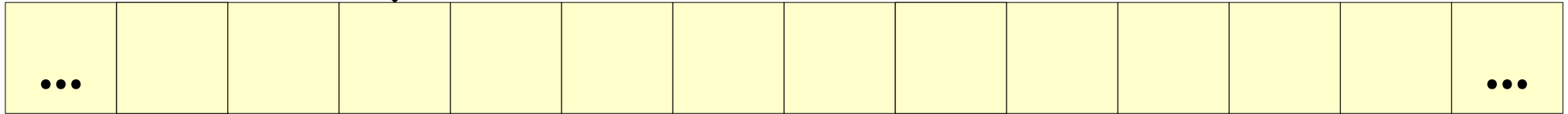
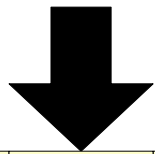
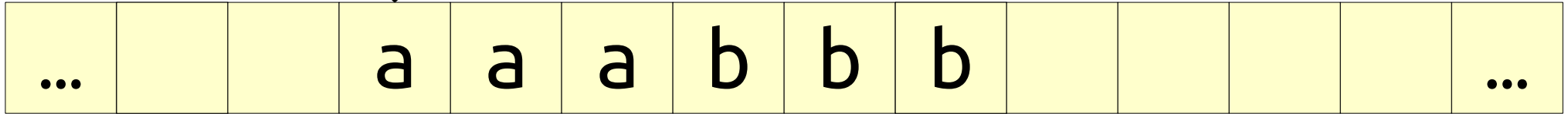
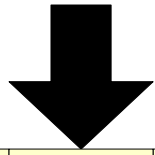
- The language

$$\{ \mathbf{a}^n \mathbf{b}^n \mid n \in \mathbb{N} \}$$

is a canonical example of a nonregular language. It's not possible to check if a string is in this language given only finite memory.

- Turing machines, however, are powerful enough to do this. Let's see how.

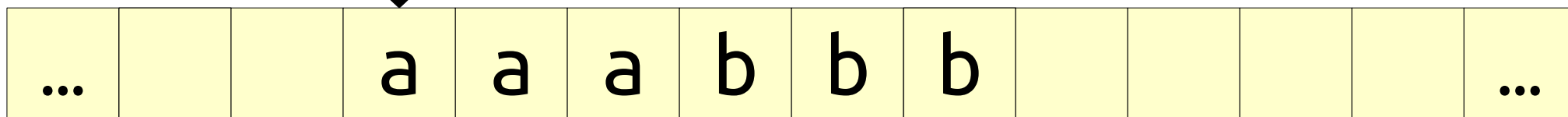
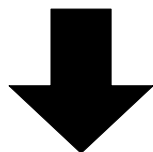
$$L = \{ \mathbf{a}^n \mathbf{b}^n \mid n \in \mathbb{N} \}$$



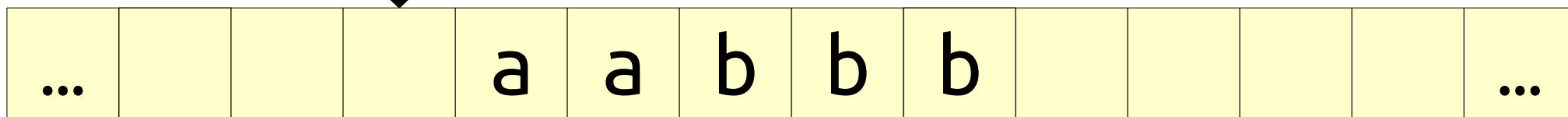
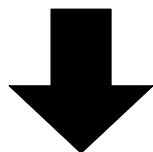
A Recursive Approach

- We can process our string using this recursive approach:
 - The string ε is in L .
 - The string **a** w **b** is in L if and only if w is in L .
 - Any string starting with **b** is not in L .
 - Any string ending with **a** is not in L .
- All that's left to do now is write a TM that implements this.

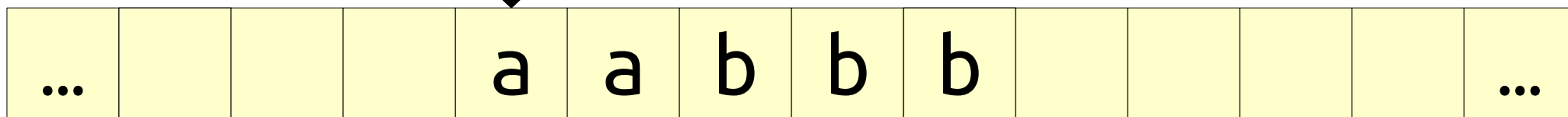
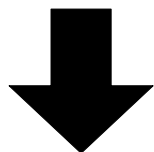
A Sketch of our TM



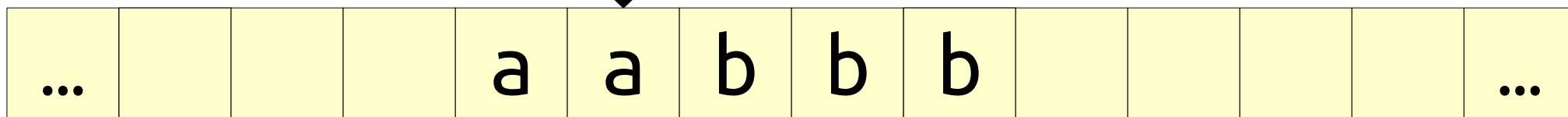
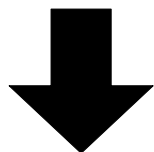
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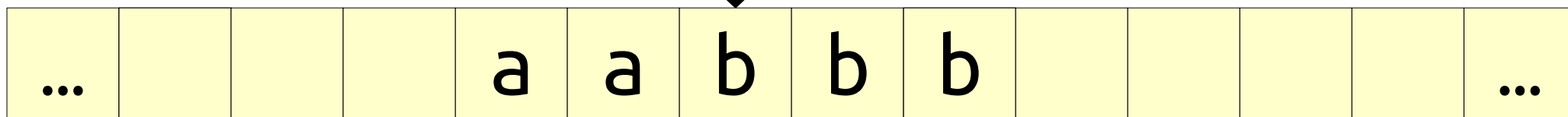
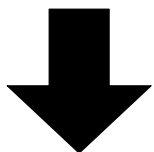
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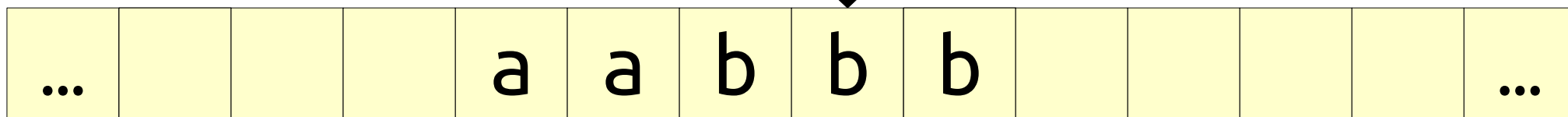
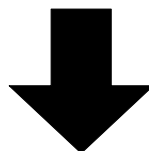
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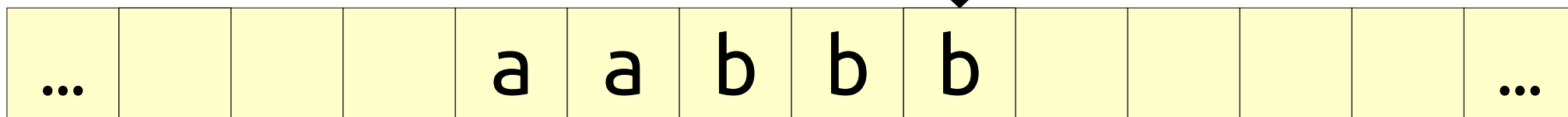
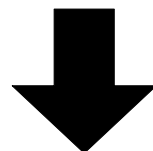
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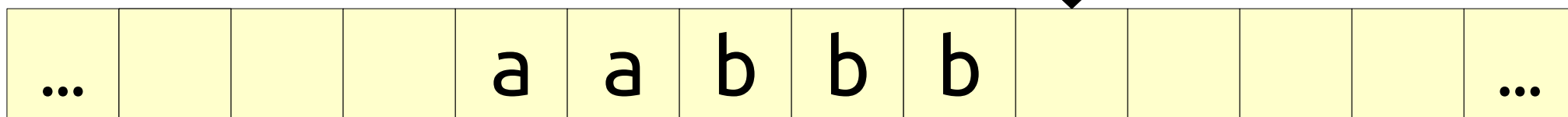
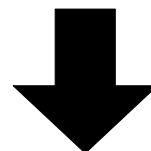
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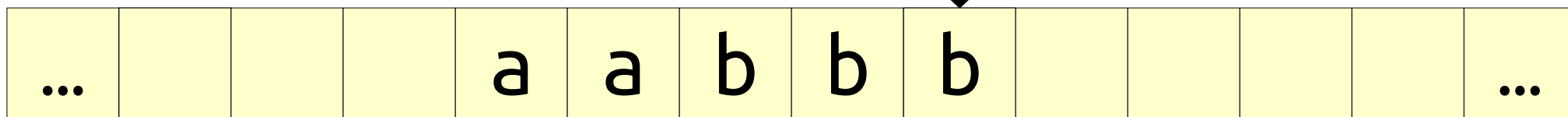
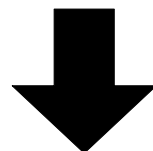
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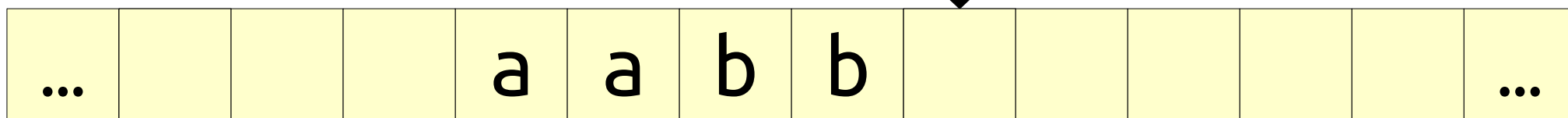
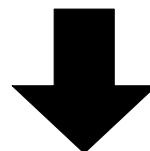
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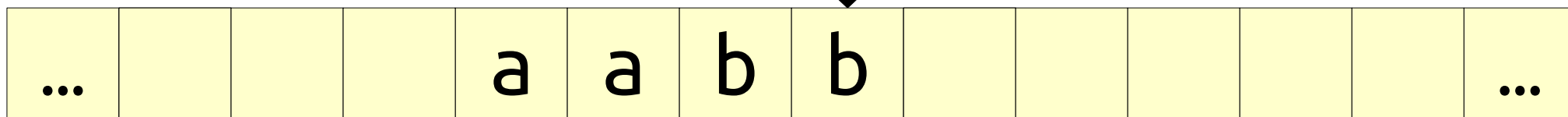
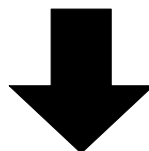
A Sketch of our TM



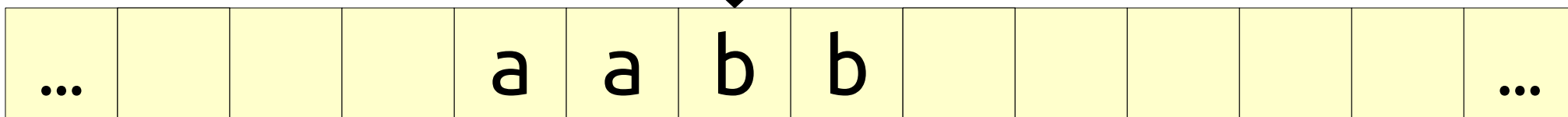
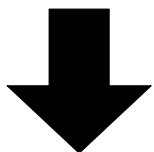
A Sketch of our TM



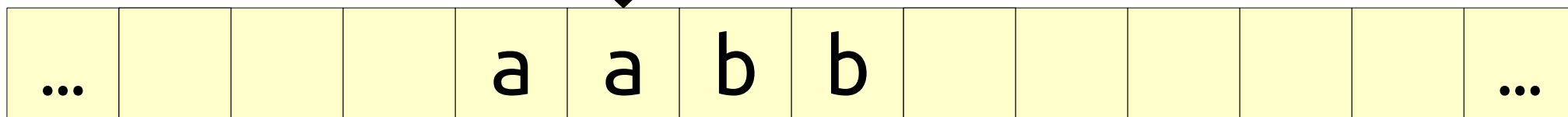
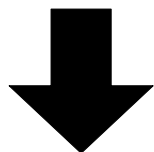
A Sketch of our TM



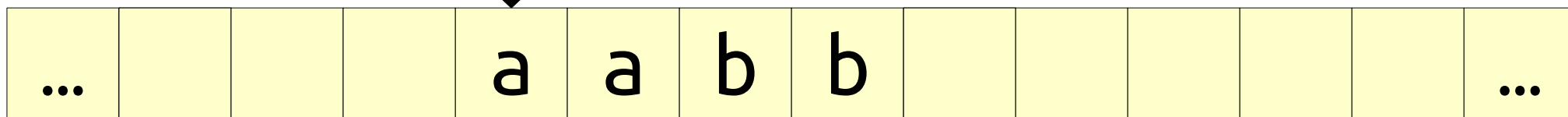
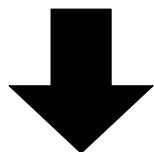
A Sketch of our TM



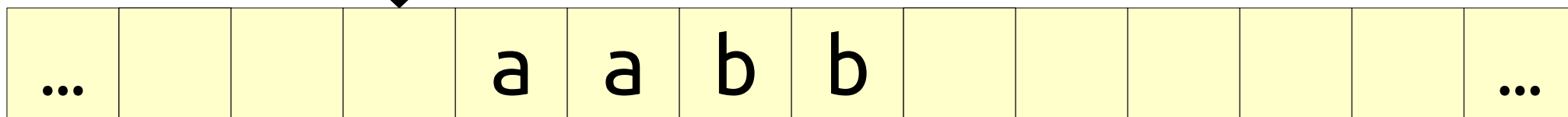
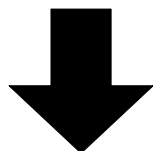
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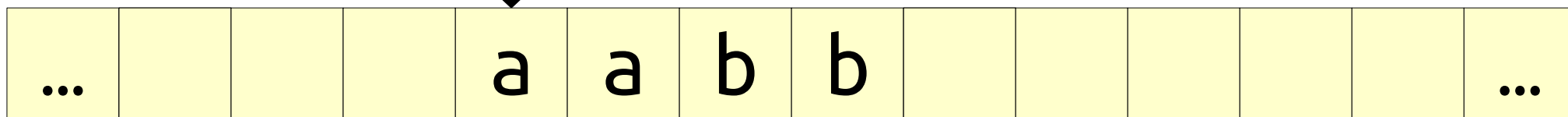
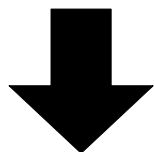
A Sketch of our TM



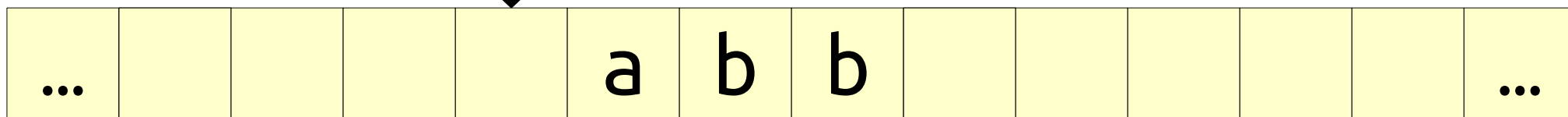
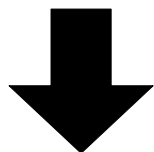
A Sketch of our TM



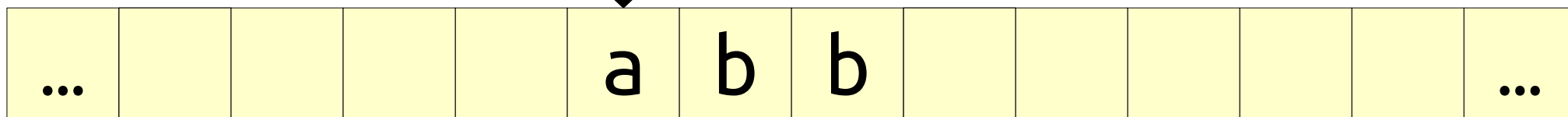
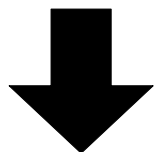
A Sketch of our TM



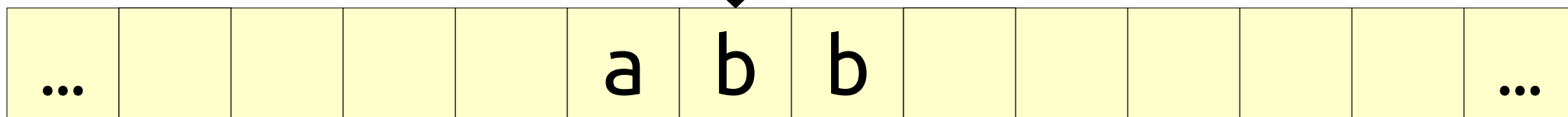
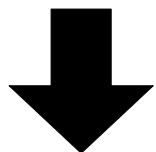
A Sketch of our TM



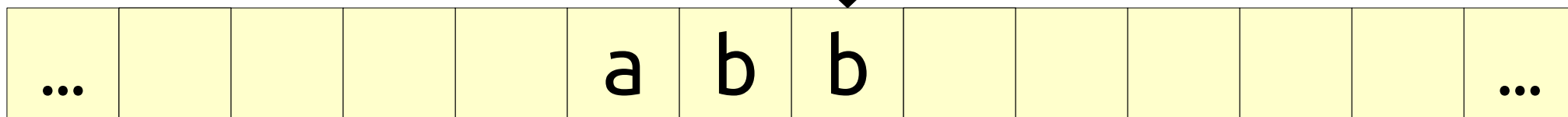
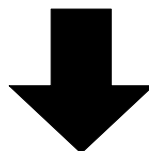
A Sketch of our TM



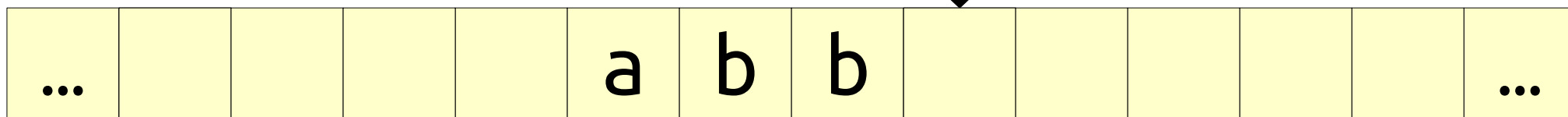
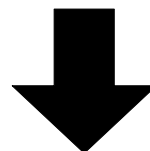
A Sketch of our TM



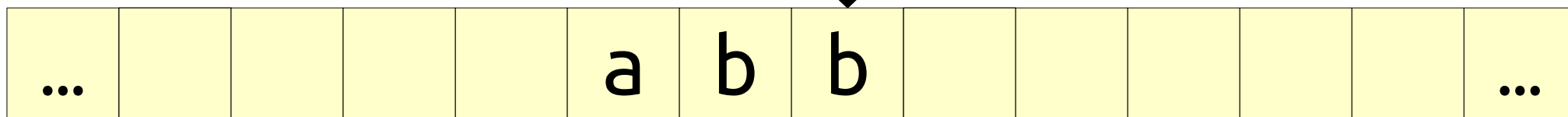
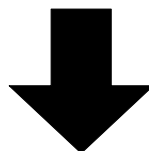
A Sketch of our TM



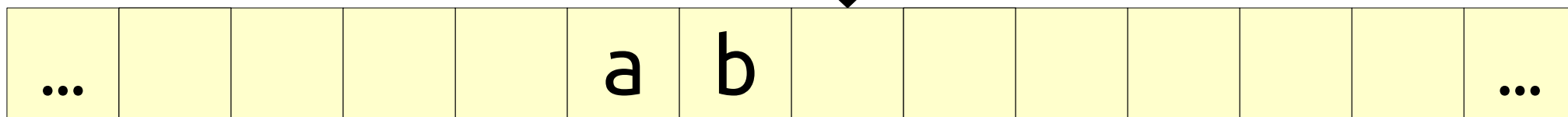
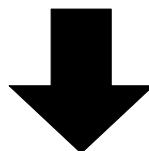
A Sketch of our TM



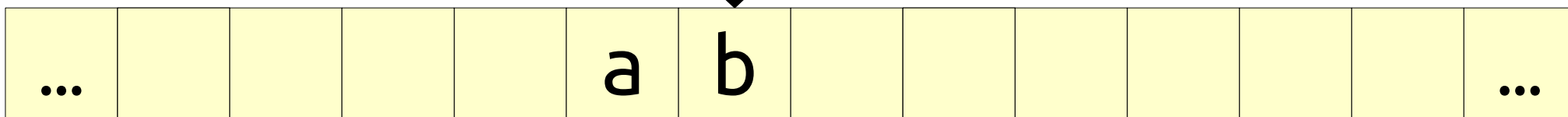
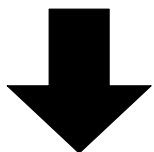
A Sketch of our TM



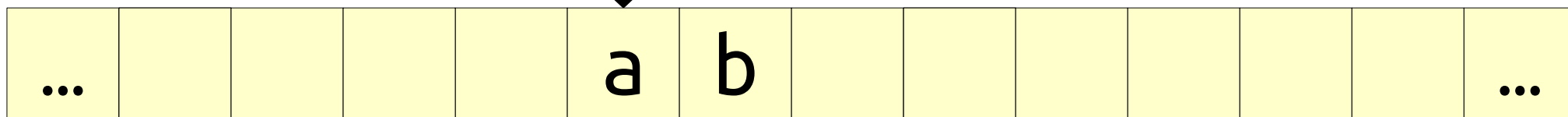
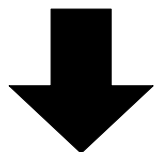
A Sketch of our TM



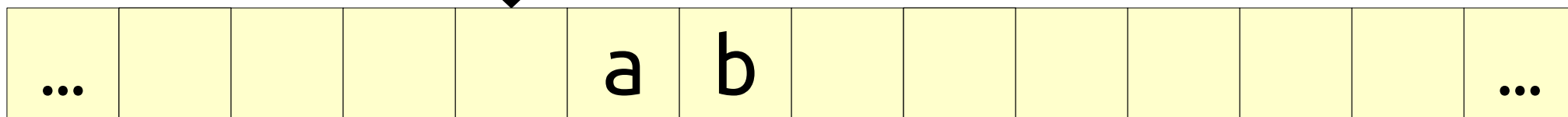
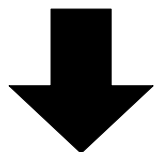
A Sketch of our TM



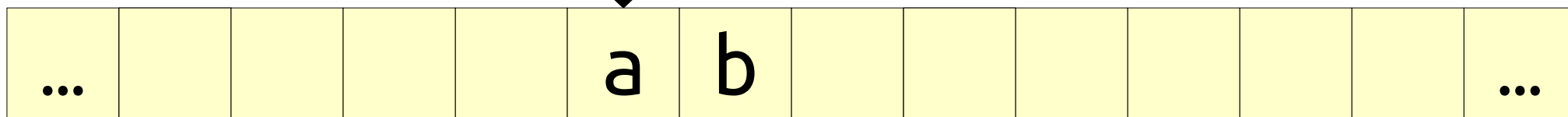
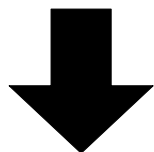
A Sketch of our TM



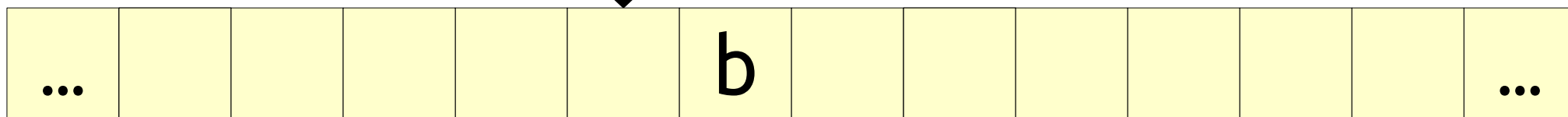
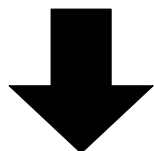
A Sketch of our TM



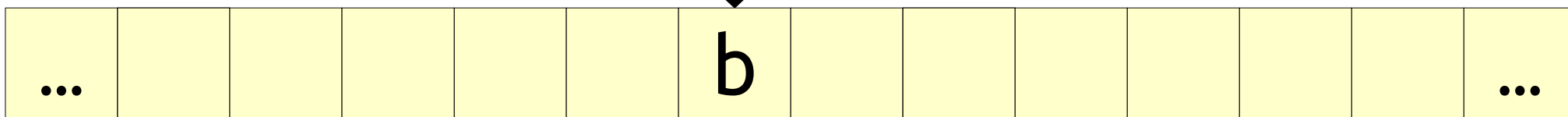
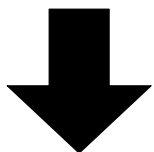
A Sketch of our TM



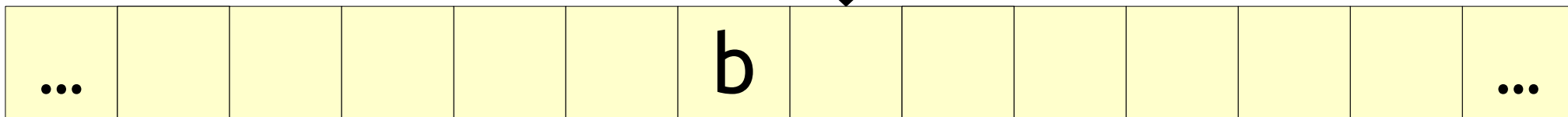
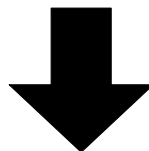
A Sketch of our TM



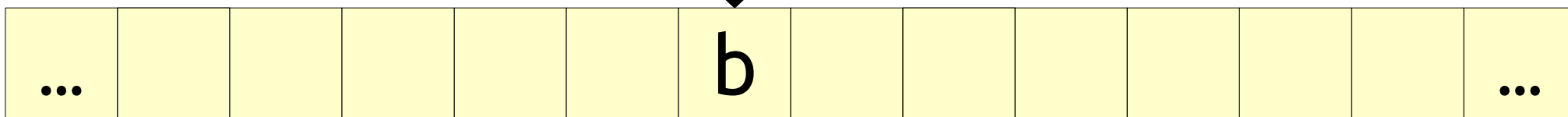
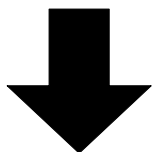
A Sketch of our TM



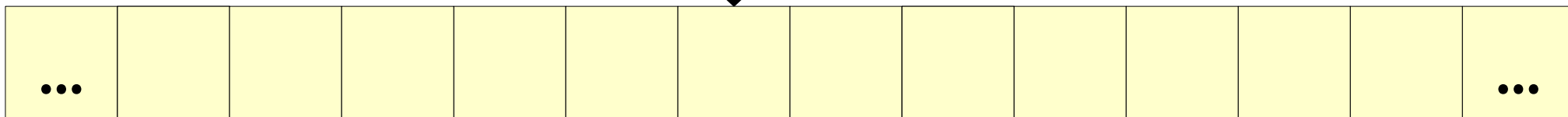
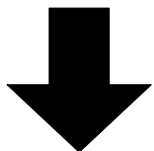
A Sketch of our TM

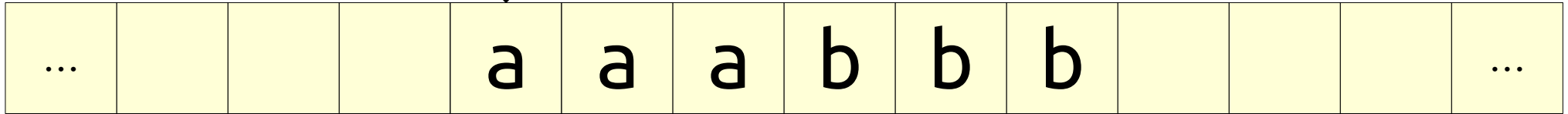
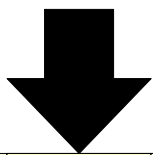


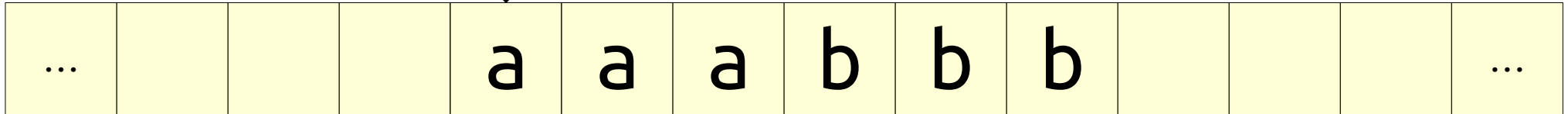
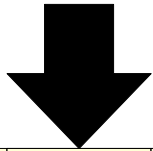
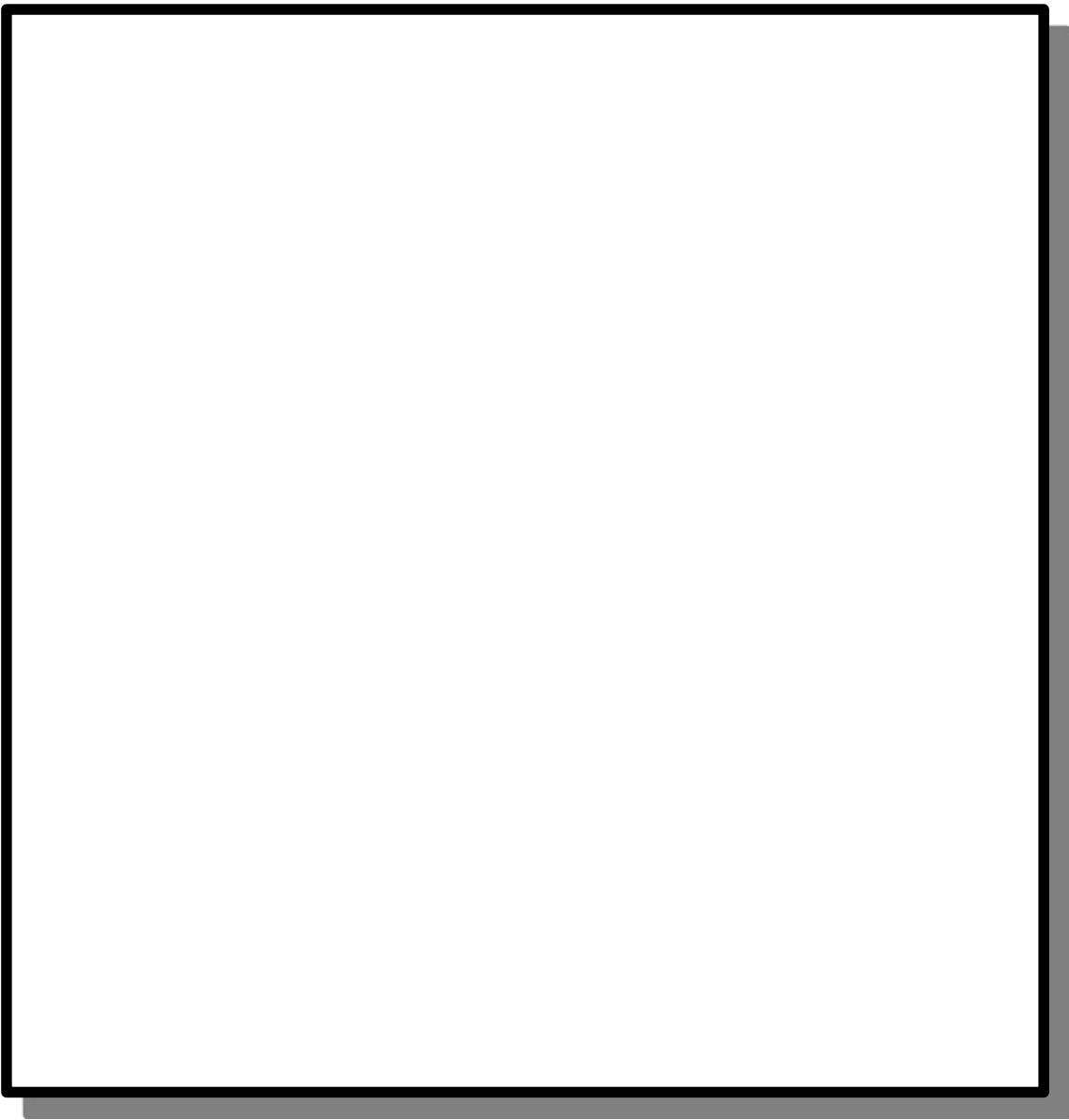
A Sketch of our TM



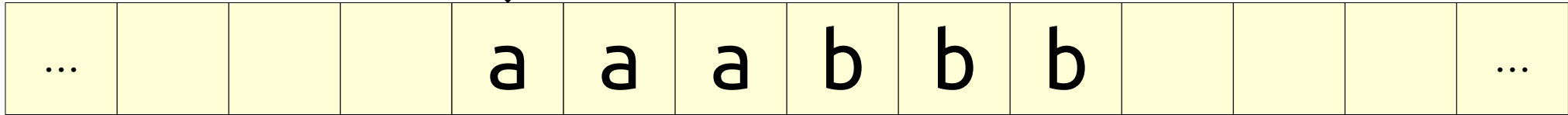
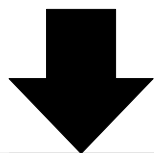
A Sketch of our TM



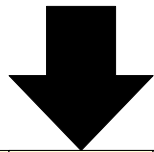




Start:



Start:



...

a

a

a

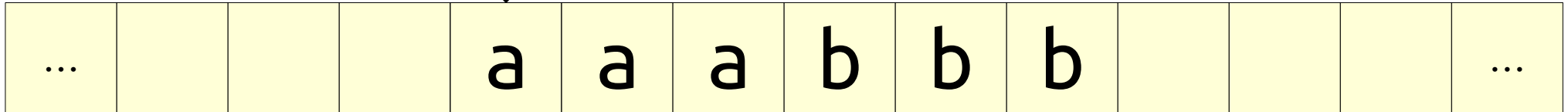
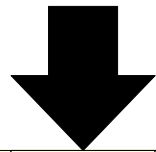
b

b

b

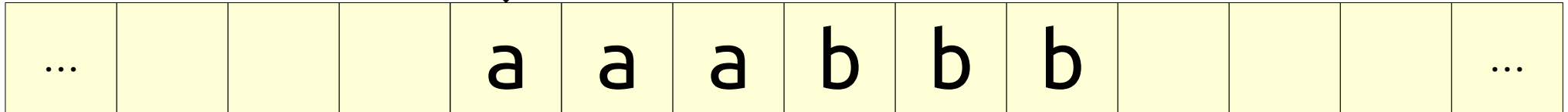
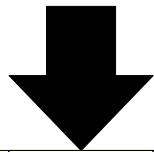
...

Start:

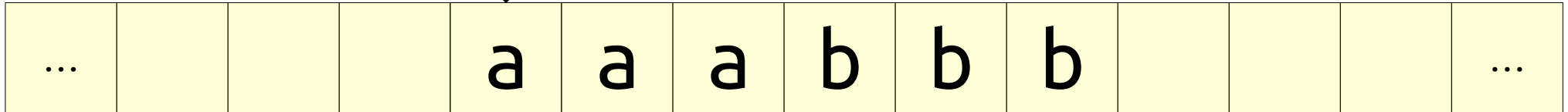
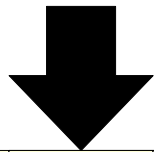


Start:

If Blank Return True



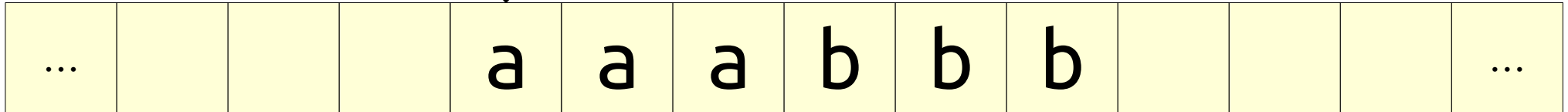
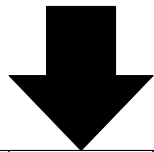
Start:
If Blank Return True



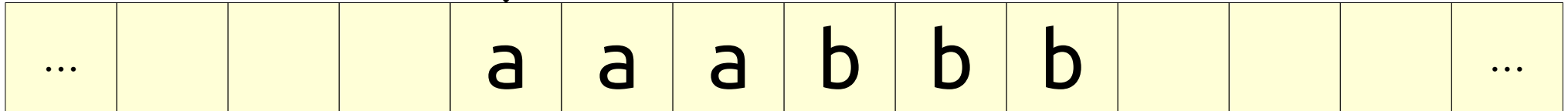
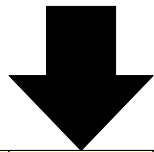
Start:

If Blank Return True

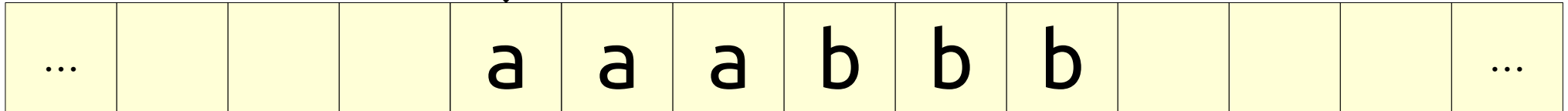
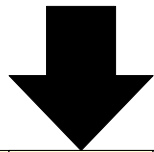
If 'b' Return False



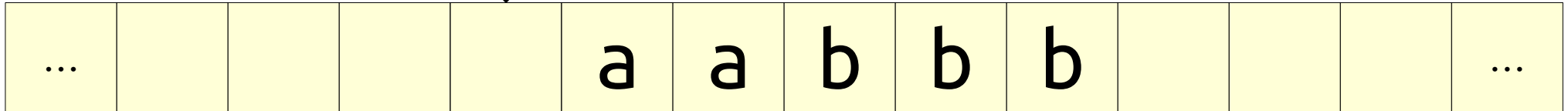
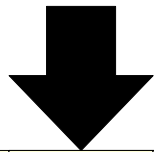
Start:
If Blank Return True
If 'b' Return False



Start:
If Blank Return True
If 'b' Return False
Write Blank



Start:
If Blank Return True
If 'b' Return False
Write Blank

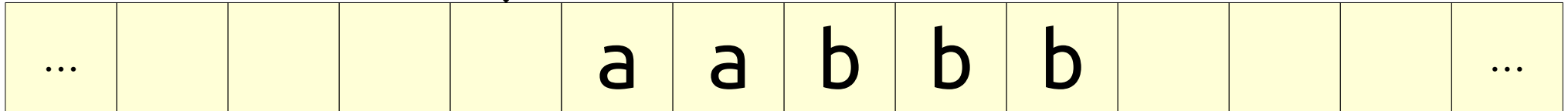
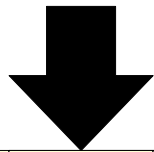


Start:

If Blank Return True

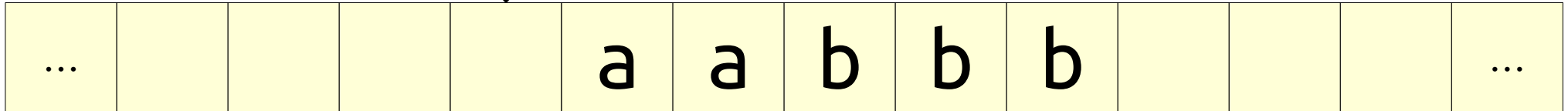
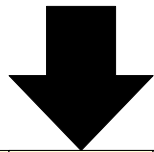
If 'b' Return False

Write Blank



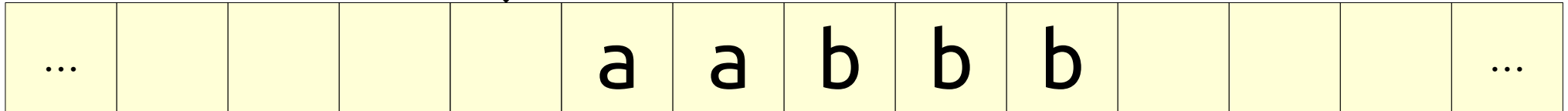
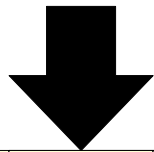
```
Start:  
  If Blank Return True  
  If 'b' Return False  
  Write Blank
```

ZipRight:




```
Start:  
  If Blank Return True  
  If 'b' Return False  
  Write Blank
```

ZipRight:



Start:

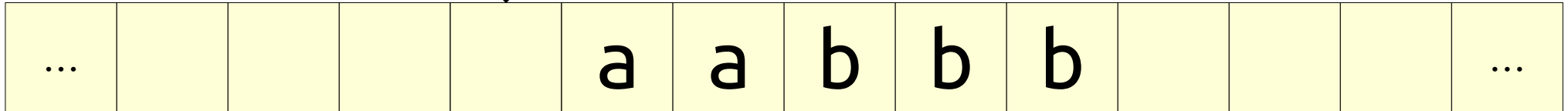
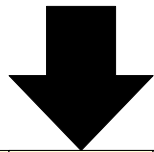
If Blank Return True

If 'b' Return False

Write Blank

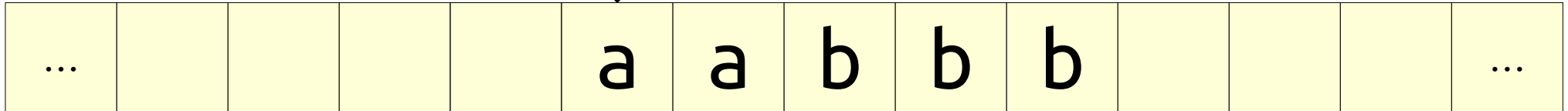
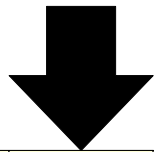
ZipRight:

Move Right



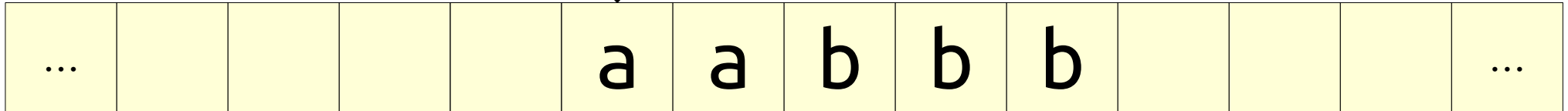
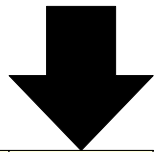
```
Start:  
  If Blank Return True  
  If 'b' Return False  
  Write Blank
```

```
ZipRight:  
  Move Right
```



```
Start:  
  If Blank Return True  
  If 'b' Return False  
  Write Blank
```

```
ZipRight:  
  Move Right
```



Start:

If Blank Return True

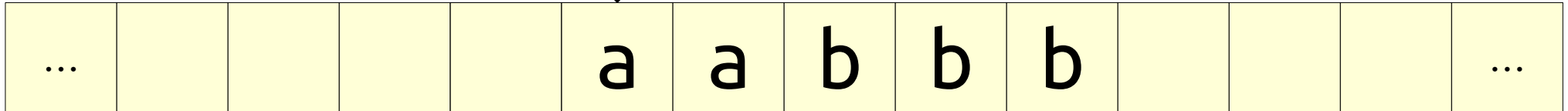
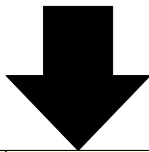
If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight



Start:

If Blank Return True

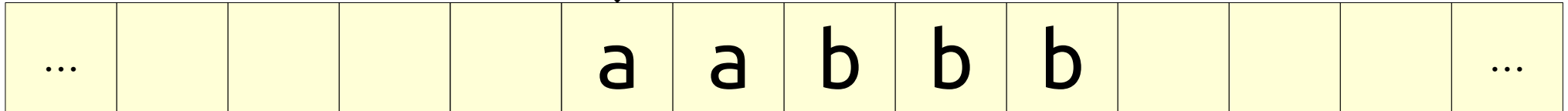
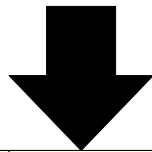
If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight



Start:

If Blank Return True

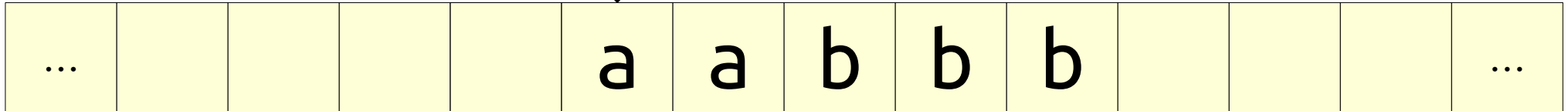
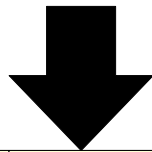
If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight



Start:

If Blank Return True

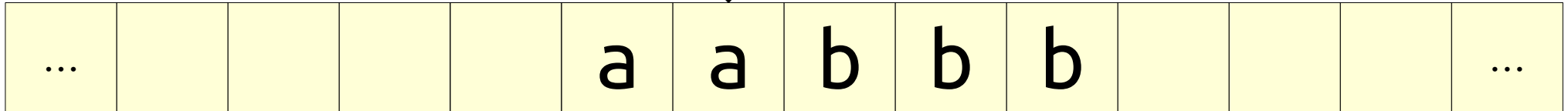
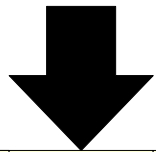
If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight



Start:

If Blank Return True

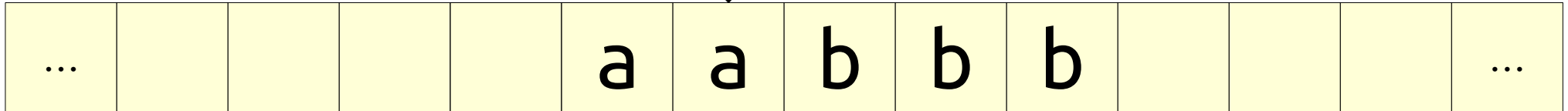
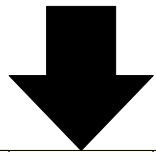
If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight



Start:

If Blank Return True

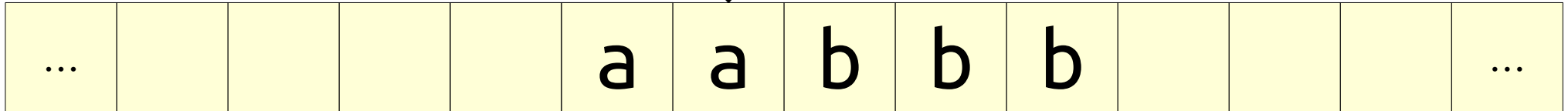
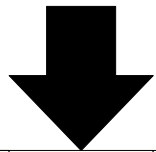
If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight



Start:

If Blank Return True

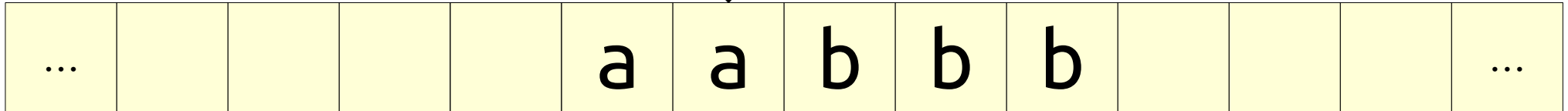
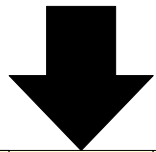
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ZipRight:

Move Right

If Not Blank Goto ZipRight



Start:

If Blank Return True

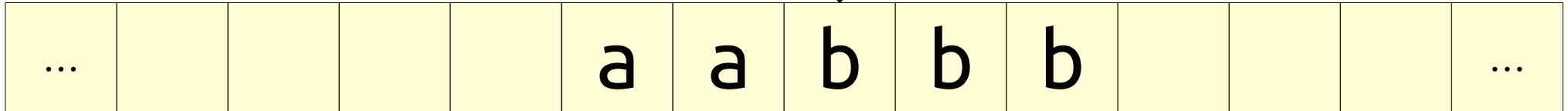
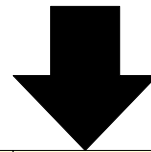
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ZipRight:

Move Right

If Not Blank Goto ZipRight



Start:

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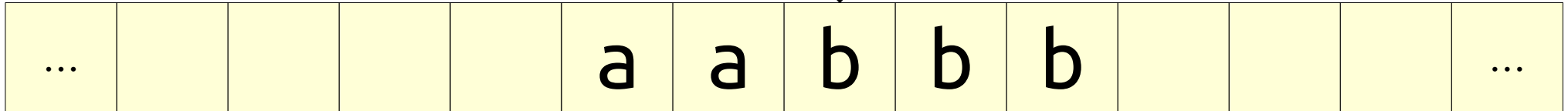
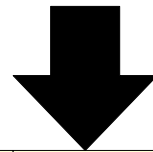
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Move Right

If Not Blank Goto ZipRight



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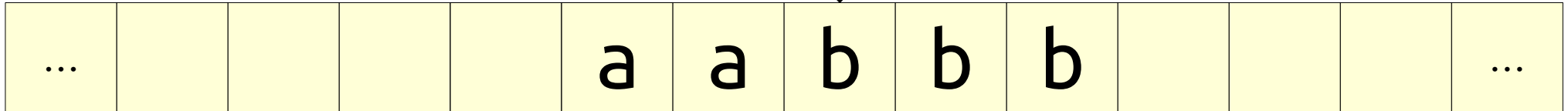
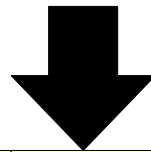
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Move Right

If Not Blank Goto ZipRight



Start:

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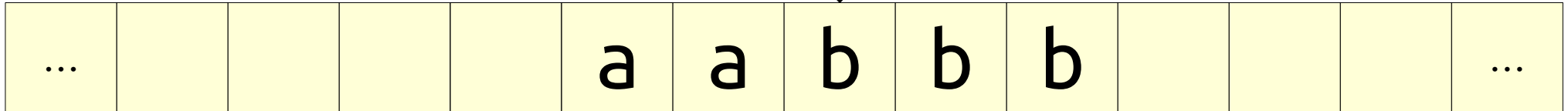
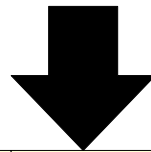
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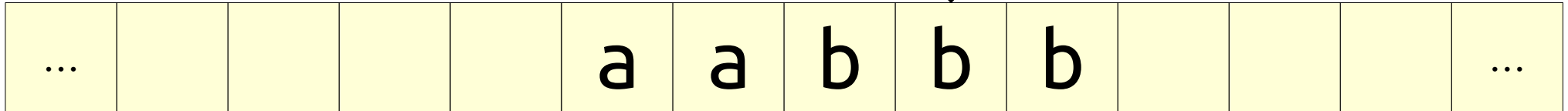
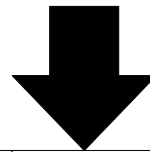
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Move Right

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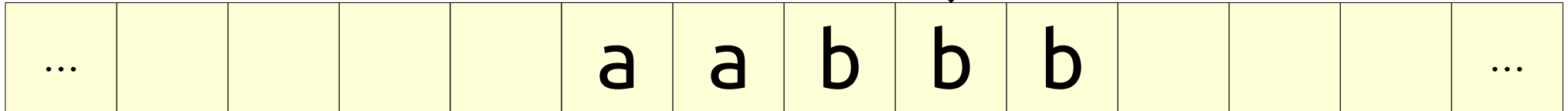
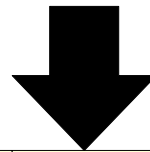
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Move Right

If Not Blank Goto ZipRight



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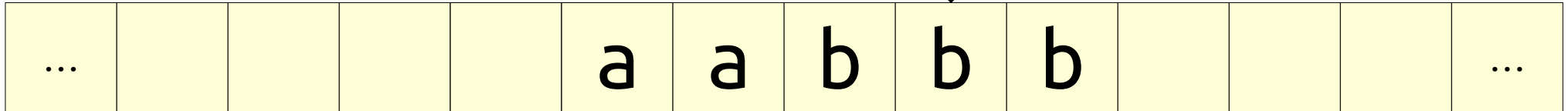
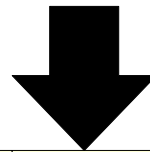
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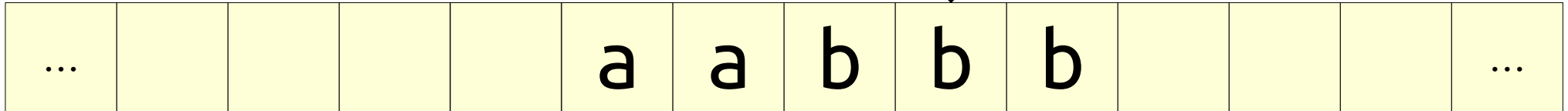
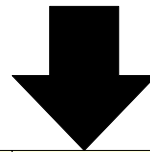
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If Not Blank Goto ZipRight



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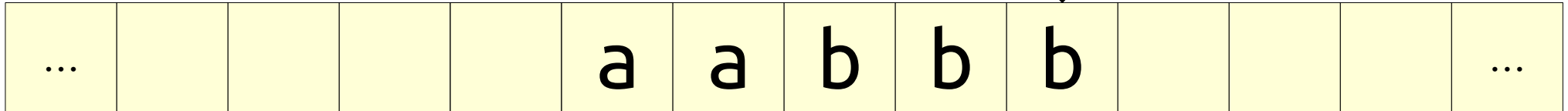
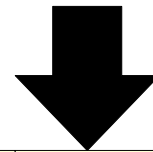
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Move Right

If Not Blank Goto ZipRight



Start:

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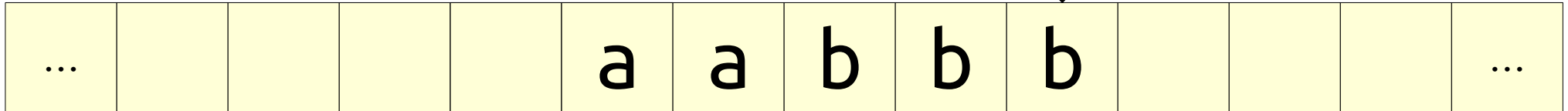
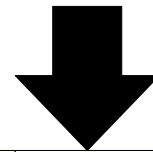
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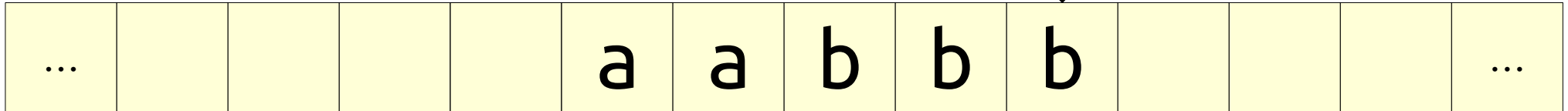
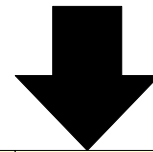
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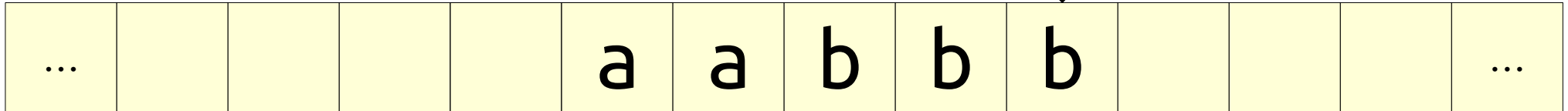
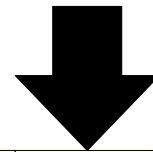
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If Not Blank Goto ZipRight



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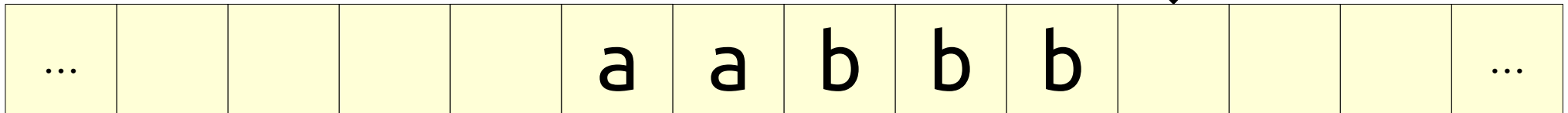
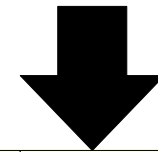
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Move Right

If Not Blank Goto ZipRight



Start:

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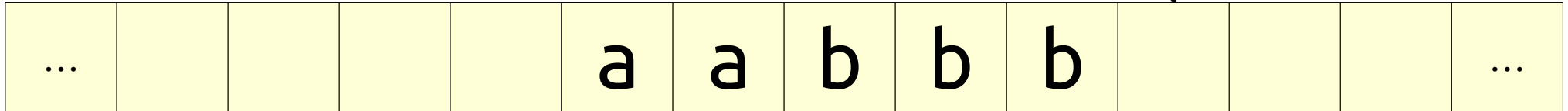
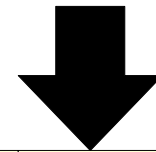
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Move Right

If Not Blank Goto ZipRight



Start:

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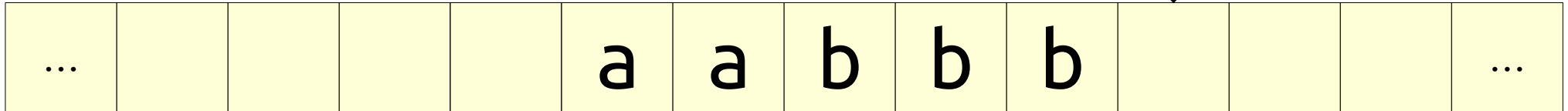
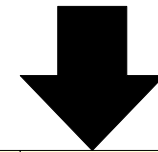
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If Not Blank Goto ZipRight



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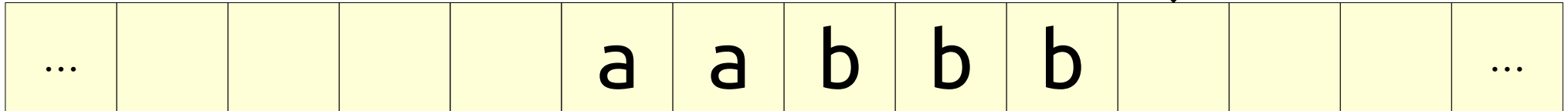
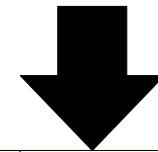
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If Not Blank Goto ZipRight

Move Left



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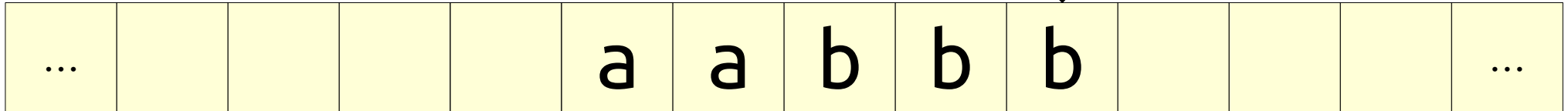
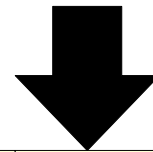
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If Not Blank Goto ZipRight

Move Left



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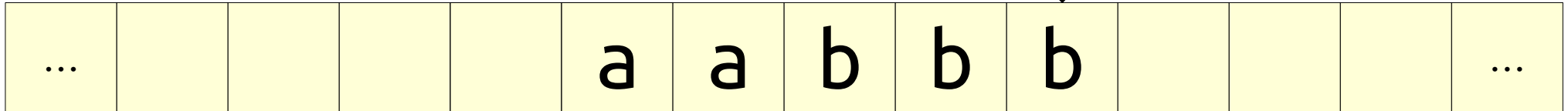
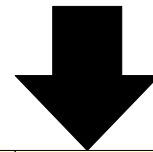
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Move Left



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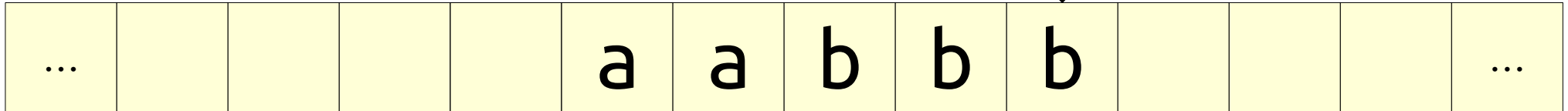
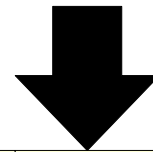
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If Not Blank Goto ZipRight

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If Not 'b' Return False



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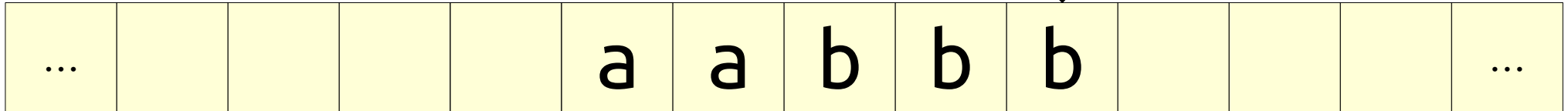
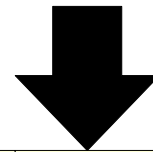
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If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False



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ZipRight:

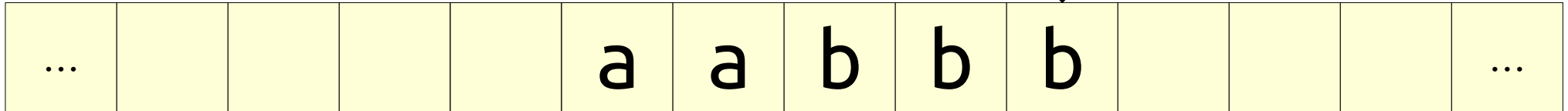
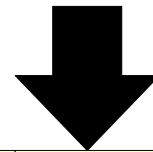
Move Right

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Move Left

If Not 'b' Return False

Write Blank



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ZipRight:

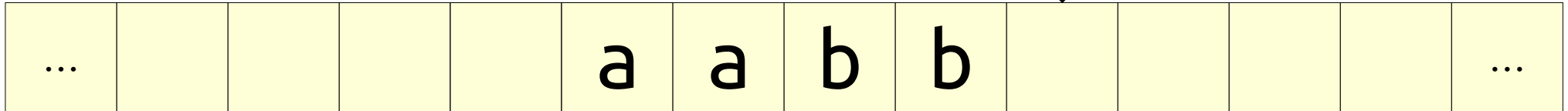
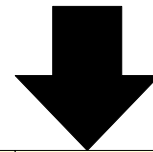
Move Right

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Move Left

If Not 'b' Return False

Write Blank



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If 'b' Return False

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ZipRight:

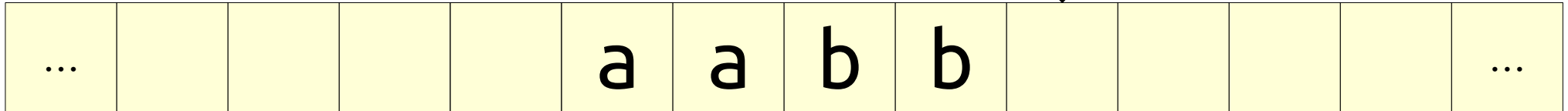
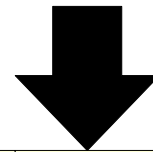
Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank



Start:

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If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

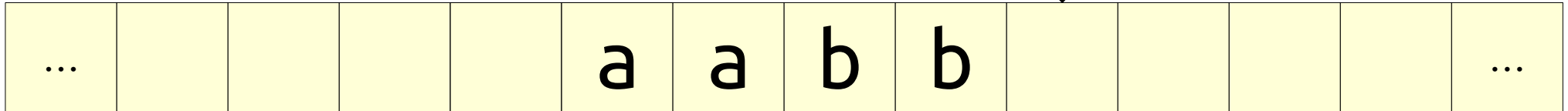
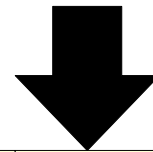
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ZipLeft:

Move Left

If Not Blank Goto ZipLeft



Start:

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If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

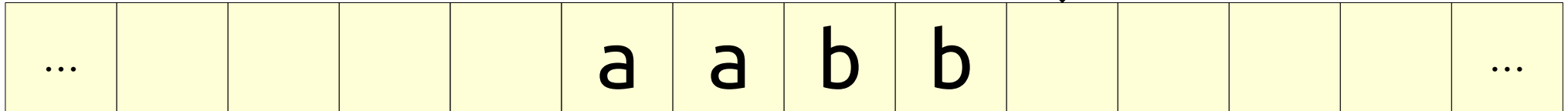
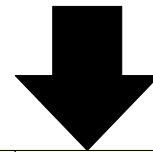
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Move Left

If Not Blank Goto ZipLeft



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

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Move Left

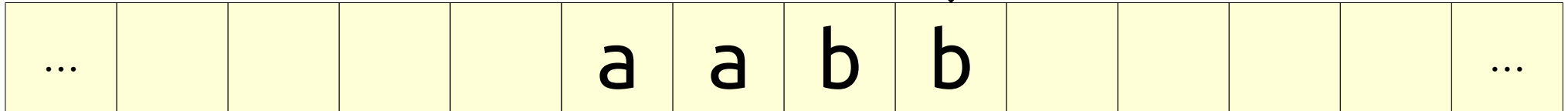
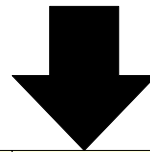
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Move Left

If Not Blank Goto ZipLeft



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

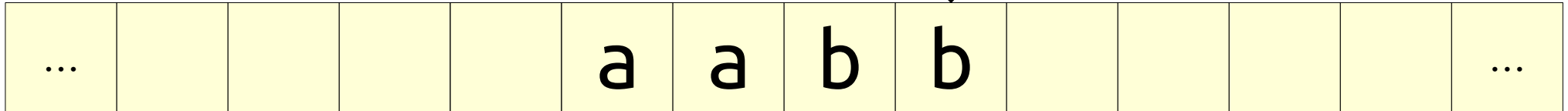
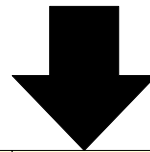
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Move Left

If Not Blank Goto ZipLeft



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

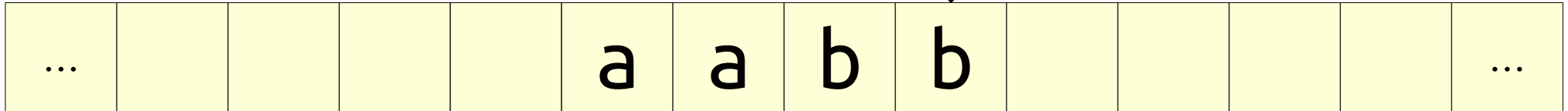
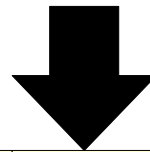
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Move Left

If Not Blank Goto ZipLeft



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

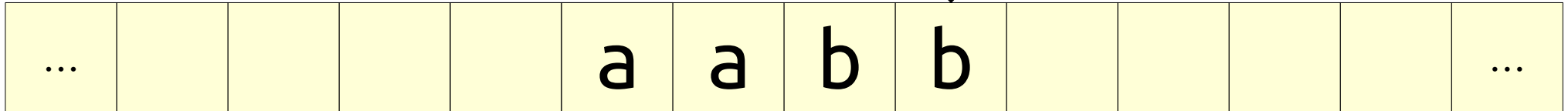
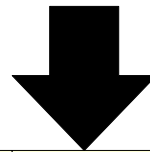
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Move Left

If Not Blank Goto ZipLeft



Start:

If Blank Return True

If 'b' Return False

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ZipRight:

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If Not Blank Goto ZipRight

Move Left

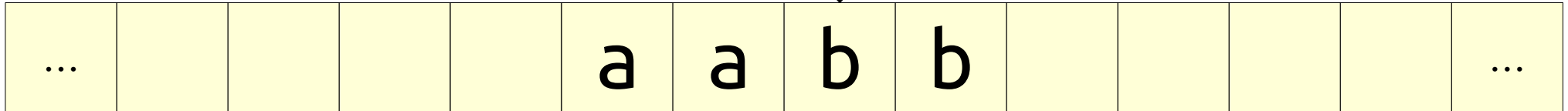
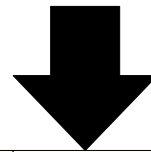
If Not 'b' Return False

Write Blank

ZipLeft:

Move Left

If Not Blank Goto ZipLeft



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

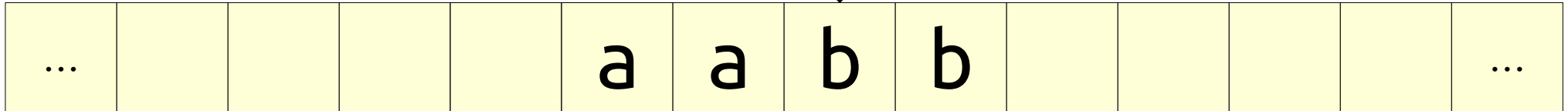
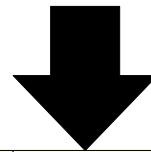
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Write Blank

ZipLeft:

Move Left

If Not Blank Goto ZipLeft



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

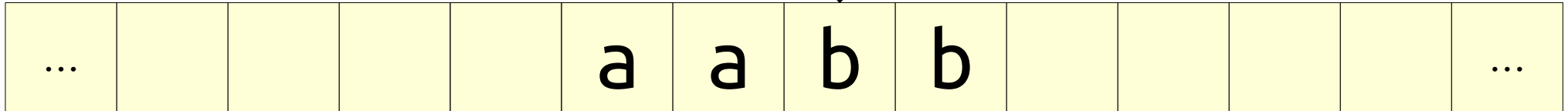
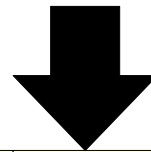
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If Not Blank Goto ZipLeft



Start:

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ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

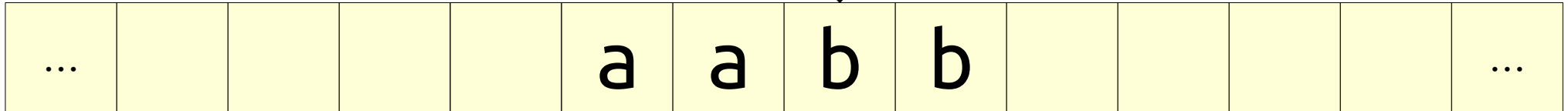
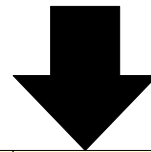
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Move Left

If Not Blank Goto ZipLeft



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ZipRight:

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Move Left

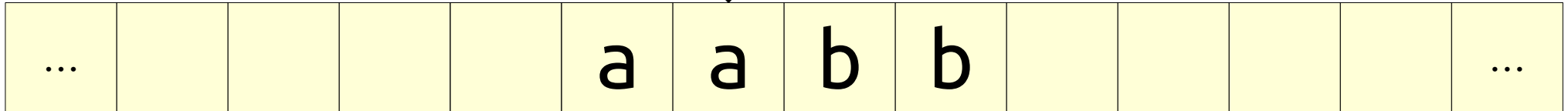
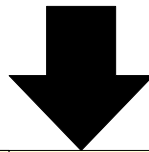
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Move Left

If Not Blank Goto ZipLeft



Start:

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If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

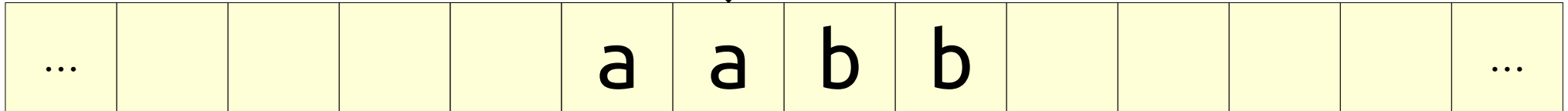
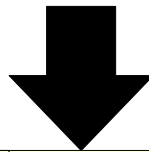
If Not 'b' Return False

Write Blank

ZipLeft:

Move Left

If Not Blank Goto ZipLeft



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

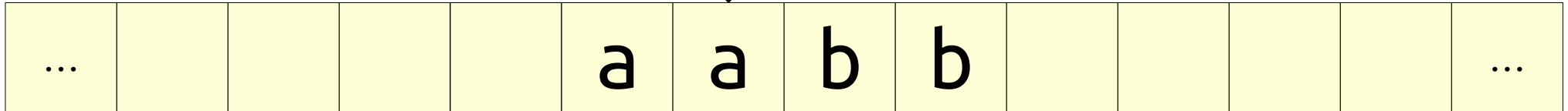
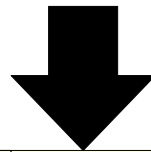
If Not 'b' Return False

Write Blank

ZipLeft:

Move Left

If Not Blank Goto ZipLeft



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

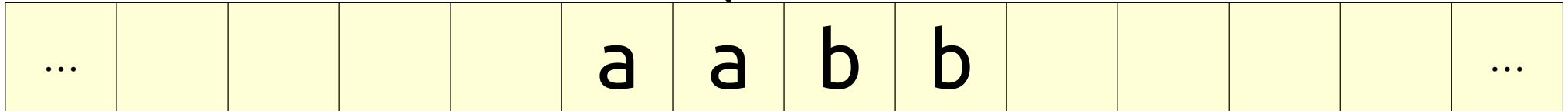
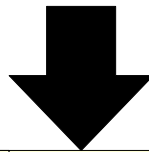
If Not 'b' Return False

Write Blank

ZipLeft:

Move Left

If Not Blank Goto ZipLeft



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

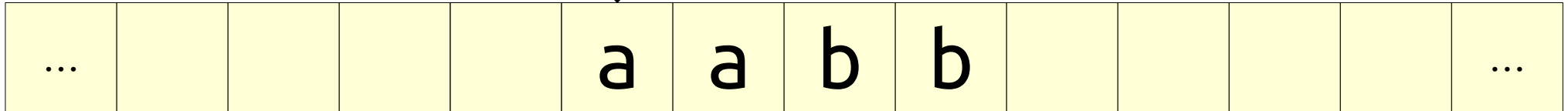
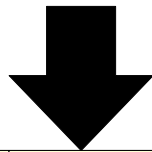
If Not 'b' Return False

Write Blank

ZipLeft:

Move Left

If Not Blank Goto ZipLeft



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

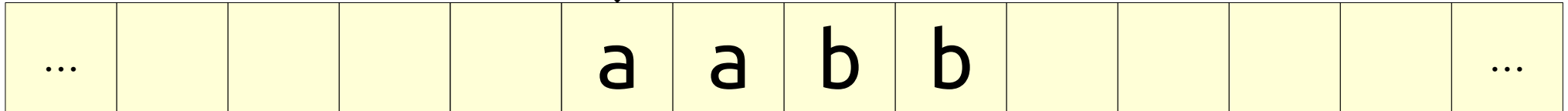
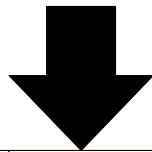
If Not 'b' Return False

Write Blank

ZipLeft:

Move Left

If Not Blank Goto ZipLeft



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

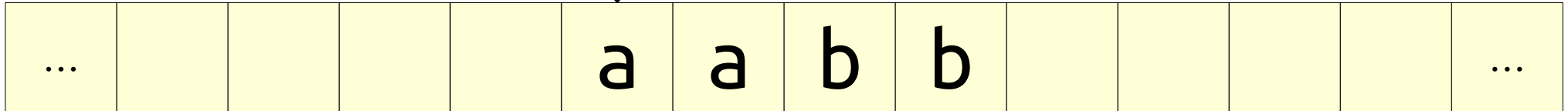
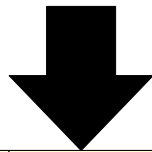
If Not 'b' Return False

Write Blank

ZipLeft:

Move Left

If Not Blank Goto ZipLeft



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

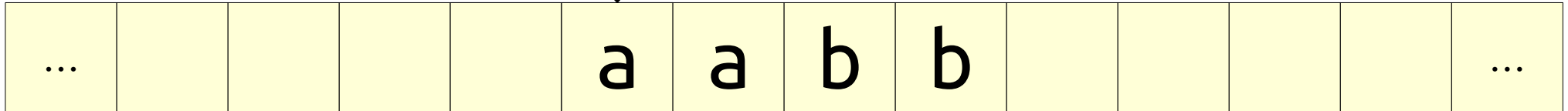
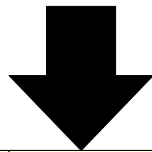
If Not 'b' Return False

Write Blank

ZipLeft:

Move Left

If Not Blank Goto ZipLeft



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

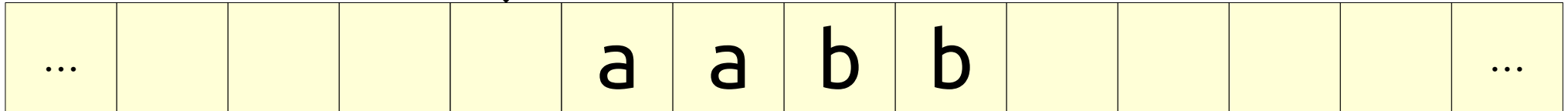
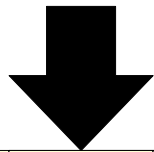
If Not 'b' Return False

Write Blank

ZipLeft:

Move Left

If Not Blank Goto ZipLeft



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

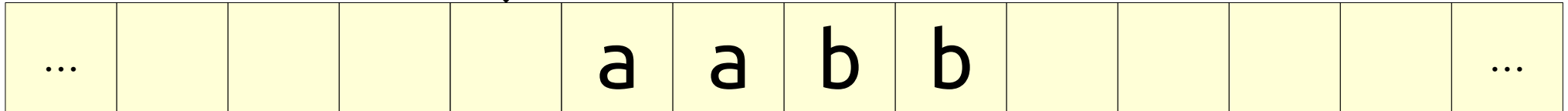
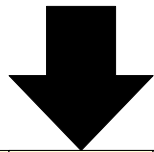
If Not 'b' Return False

Write Blank

ZipLeft:

Move Left

If Not Blank Goto ZipLeft



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

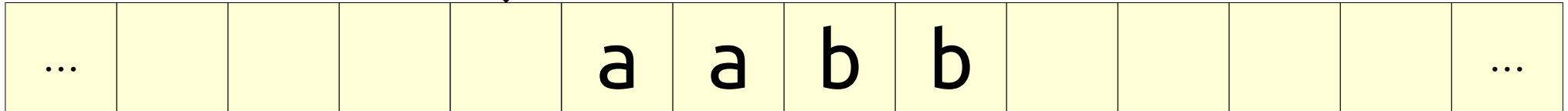
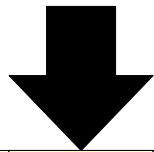
If Not 'b' Return False

Write Blank

ZipLeft:

Move Left

If Not Blank Goto ZipLeft



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

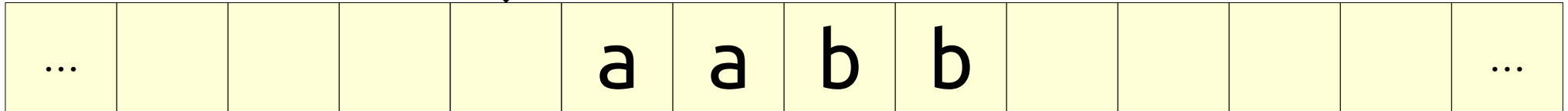
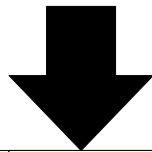
Write Blank

ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

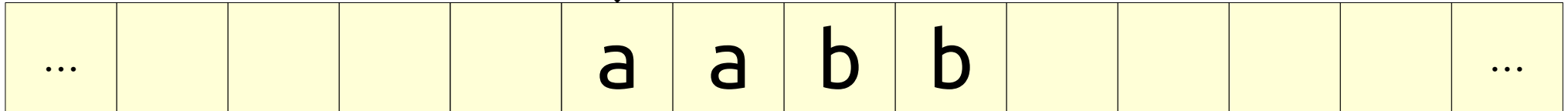
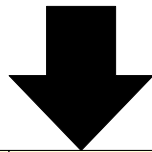
Write Blank

ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

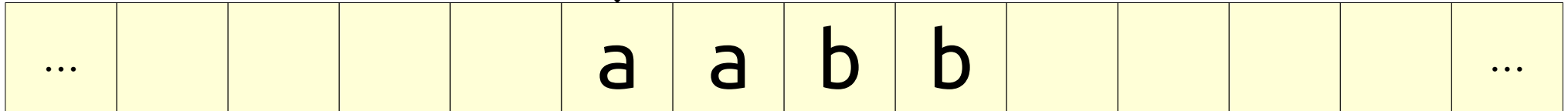
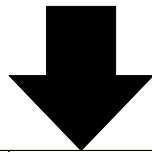
Write Blank

ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

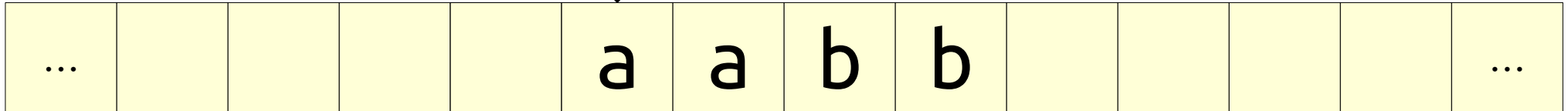
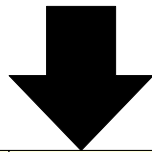
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

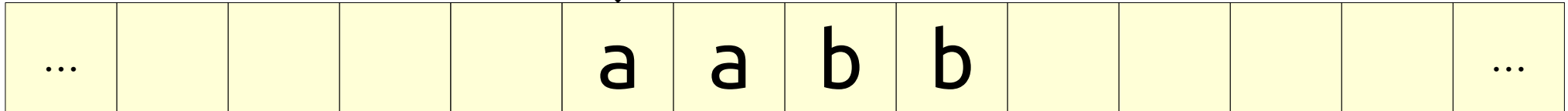
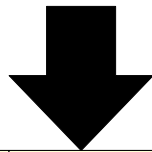
```
If Blank Return True  
If 'b' Return False  
Write Blank
```

ZipRight:

```
Move Right  
If Not Blank Goto ZipRight  
Move Left  
If Not 'b' Return False  
Write Blank
```

ZipLeft:

```
Move Left  
If Not Blank Goto ZipLeft  
Move Right  
Goto Start
```



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

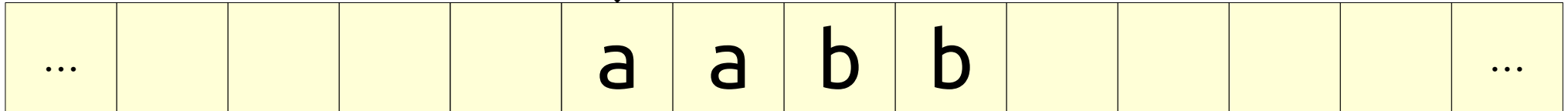
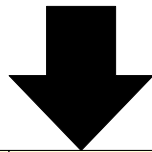
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

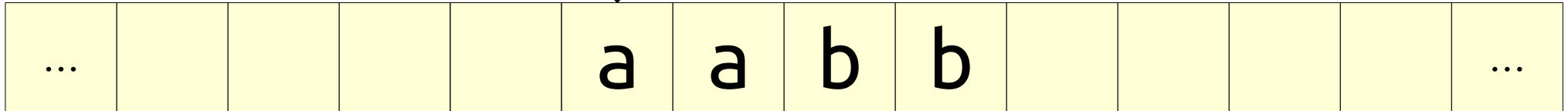
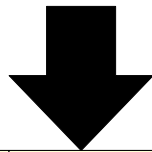
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

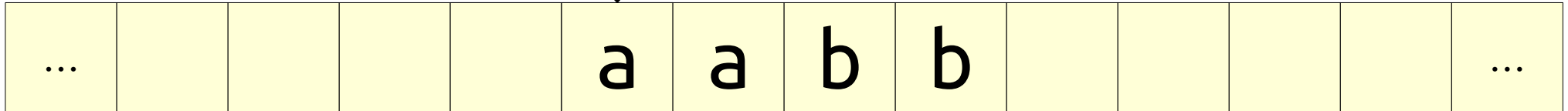
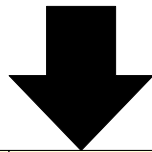
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

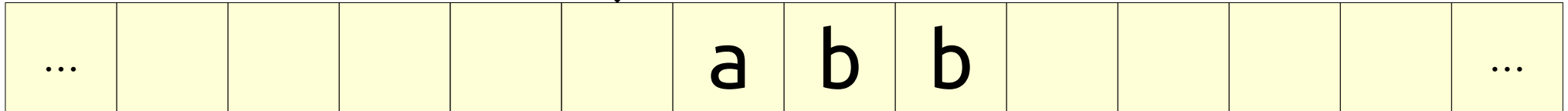
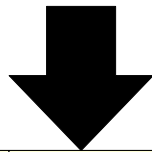
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

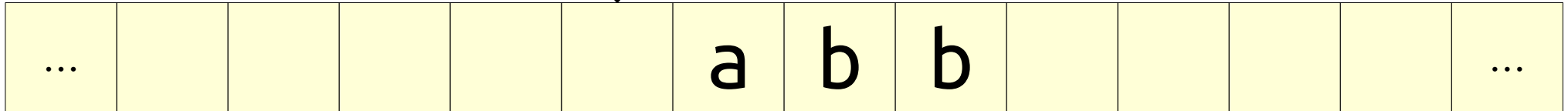
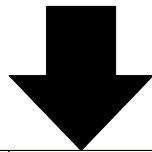
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

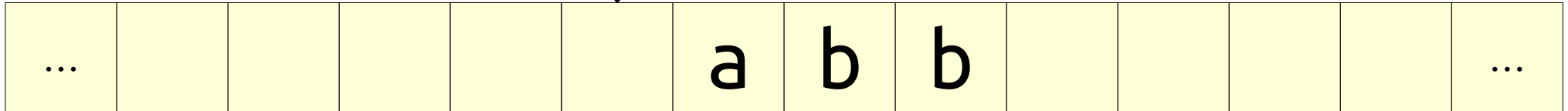
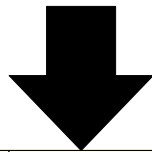
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

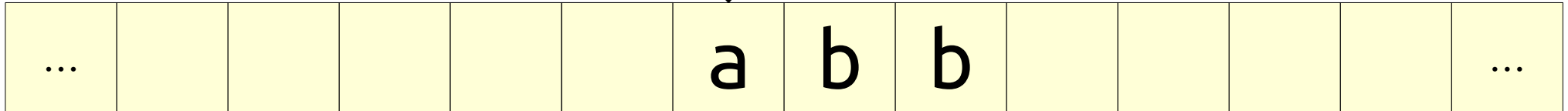
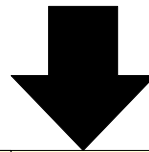
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

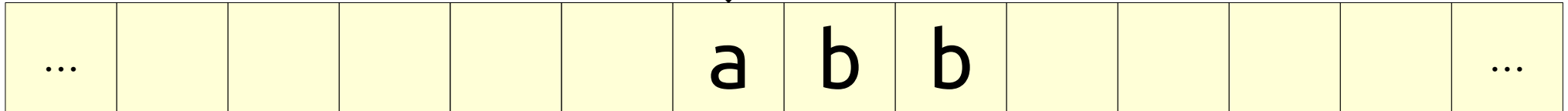
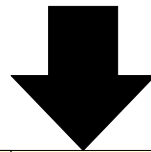
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

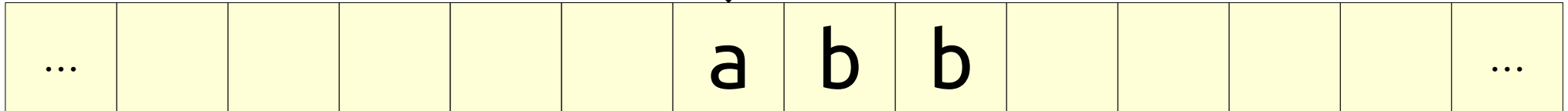
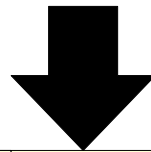
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

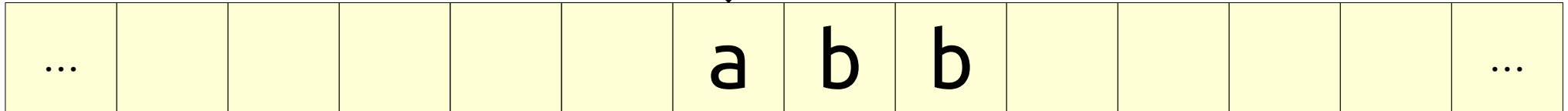
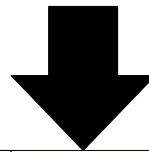
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

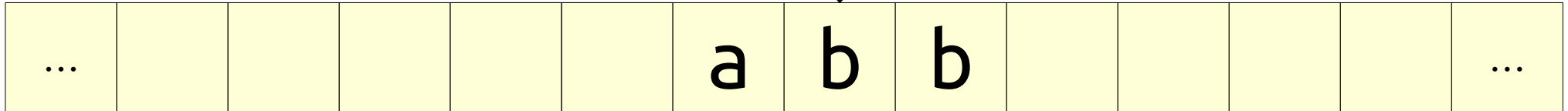
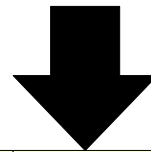
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

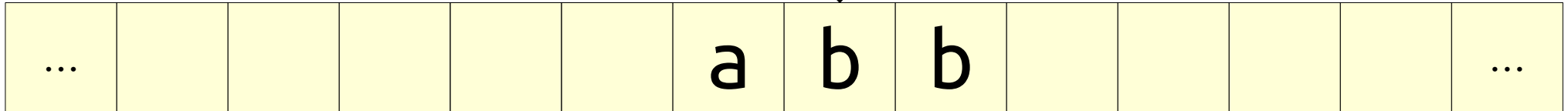
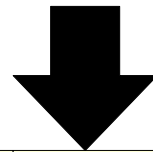
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

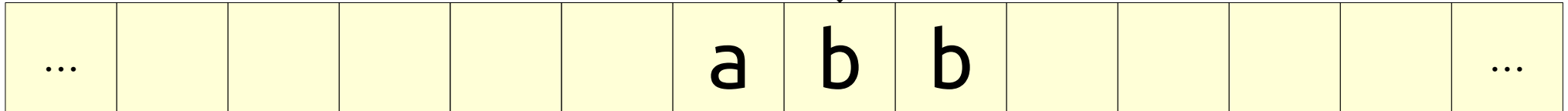
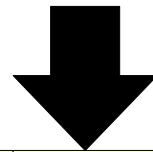
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

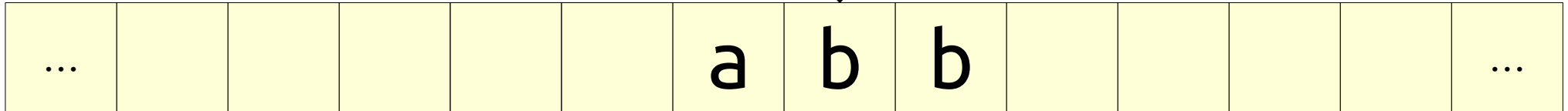
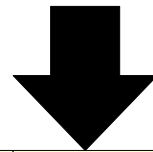
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

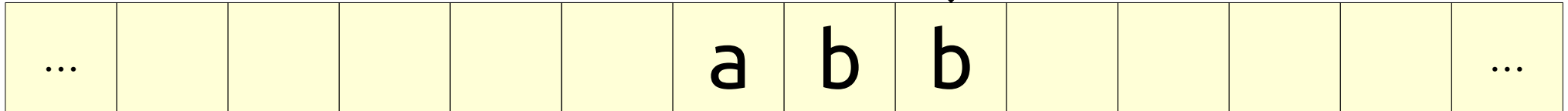
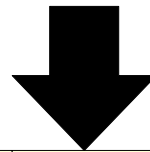
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

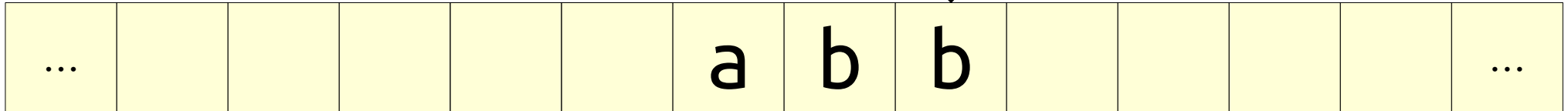
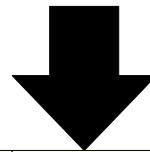
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

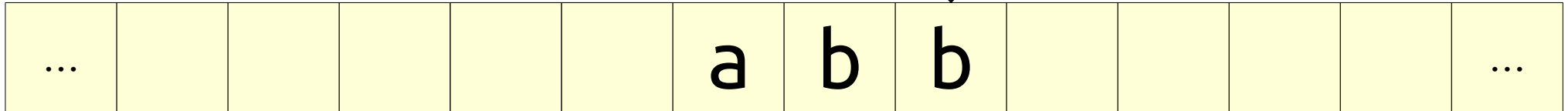
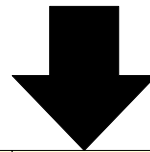
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

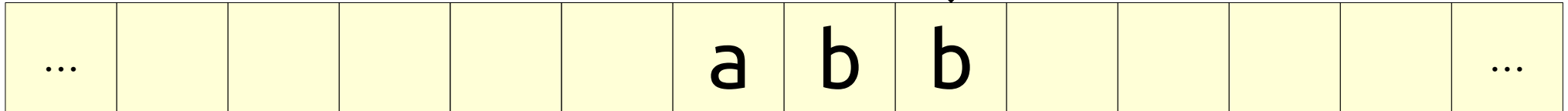
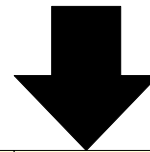
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

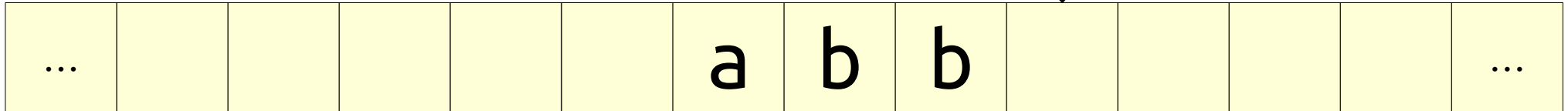
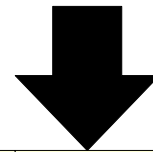
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

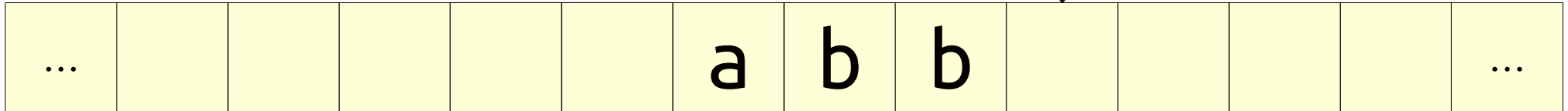
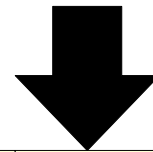
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

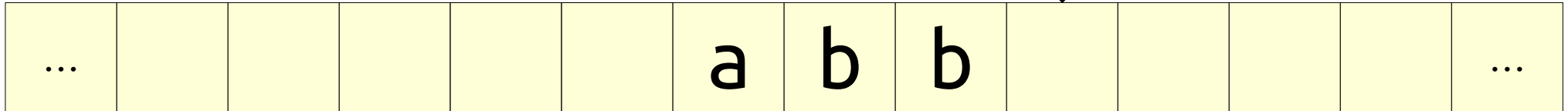
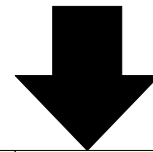
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

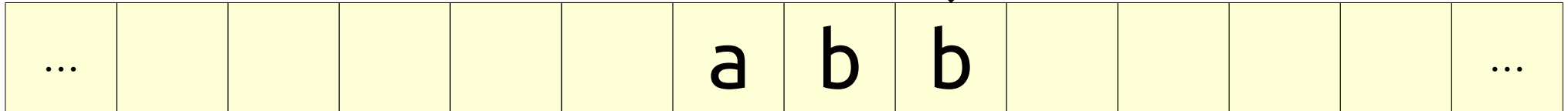
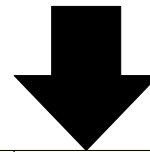
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

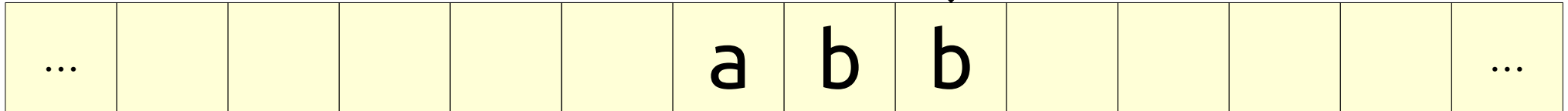
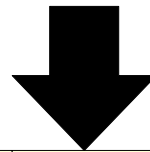
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

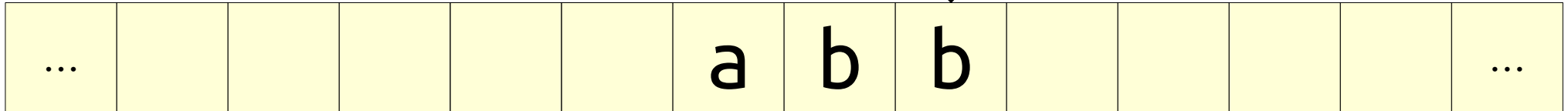
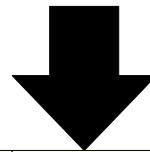
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

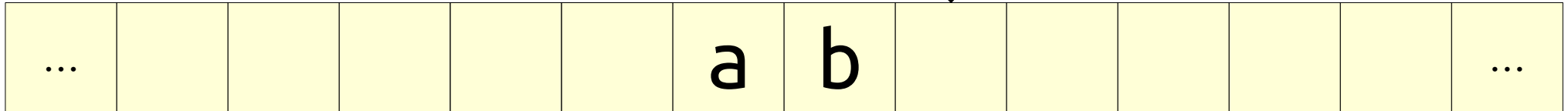
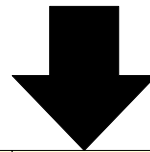
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

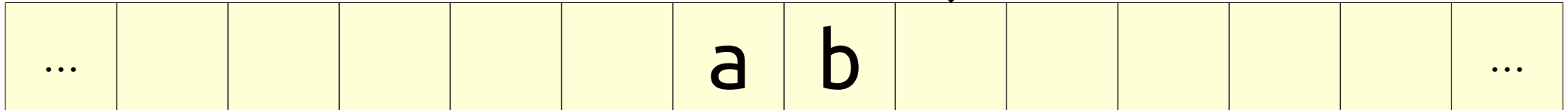
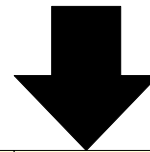
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

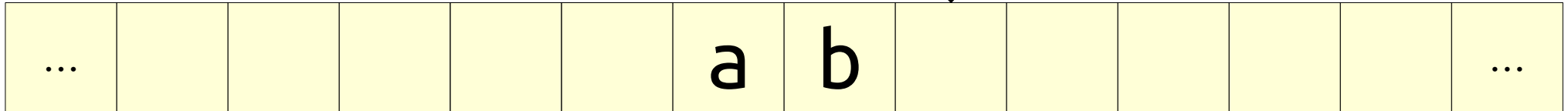
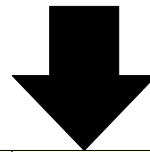
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

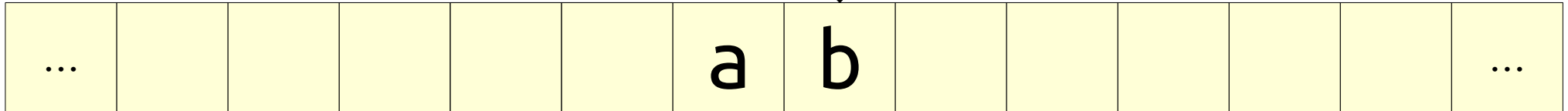
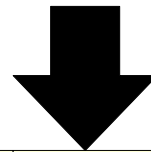
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

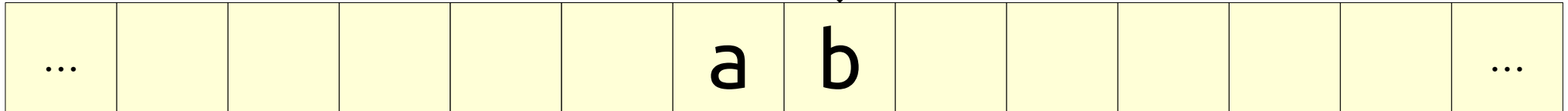
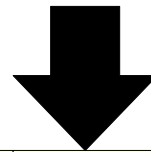
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

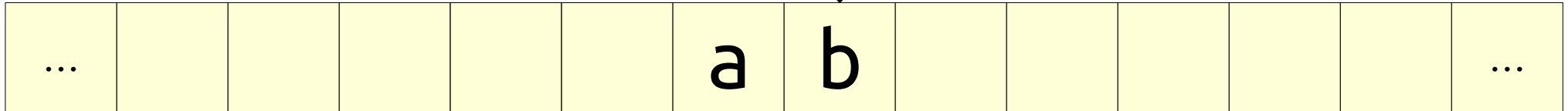
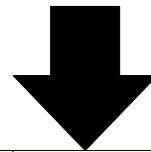
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

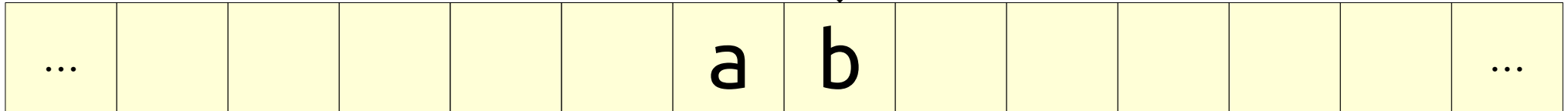
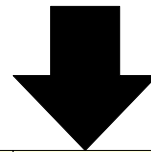
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

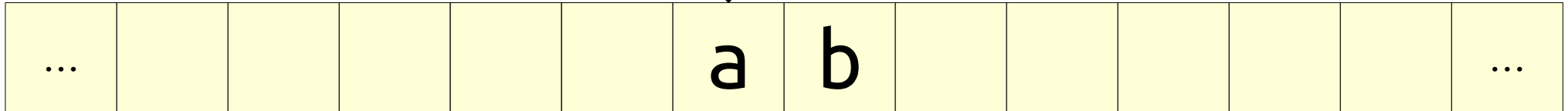
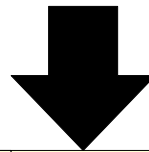
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

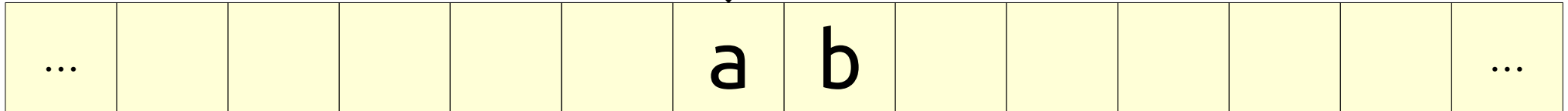
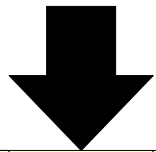
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

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If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

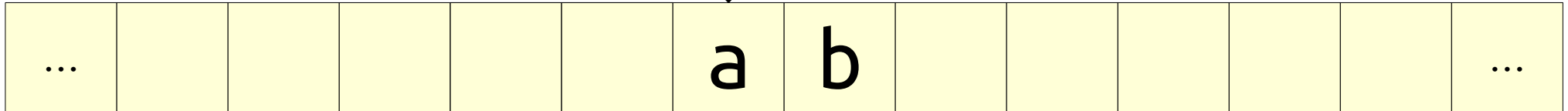
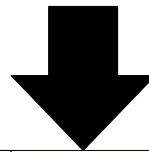
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

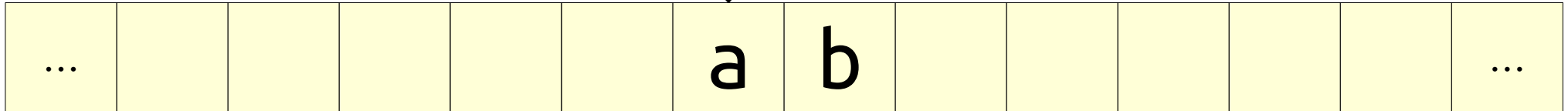
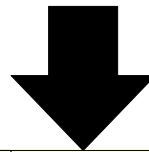
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

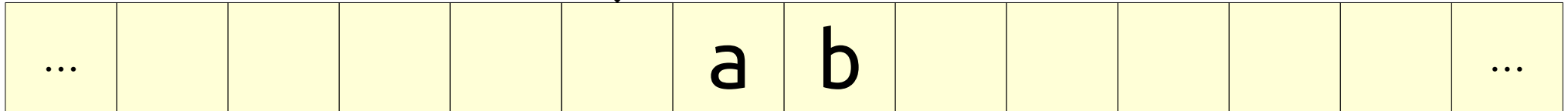
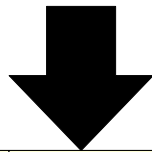
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

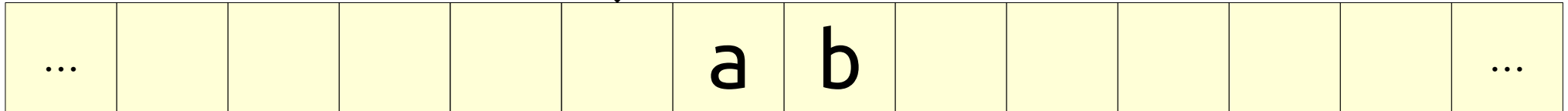
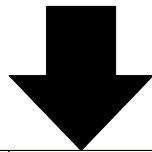
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

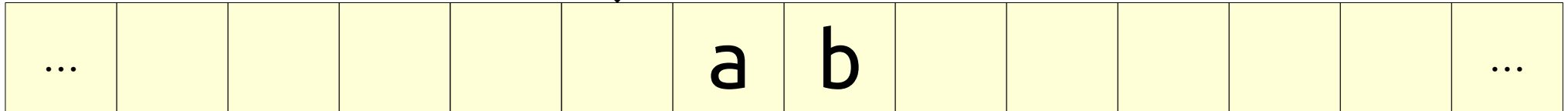
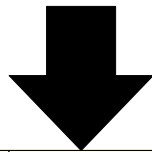
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

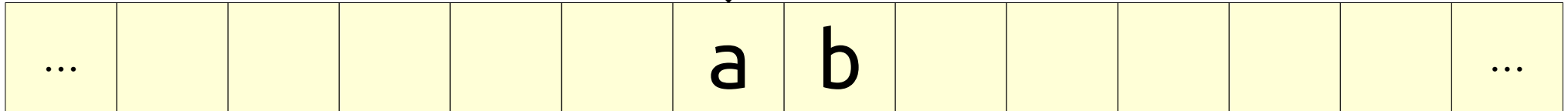
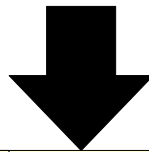
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

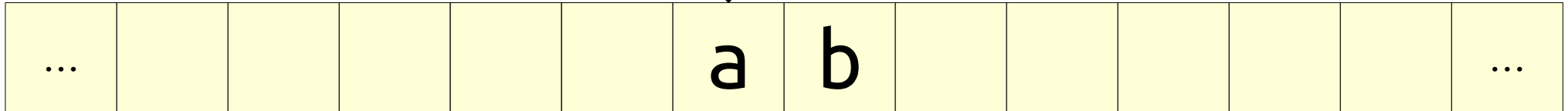
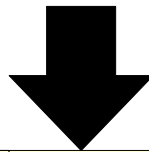
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

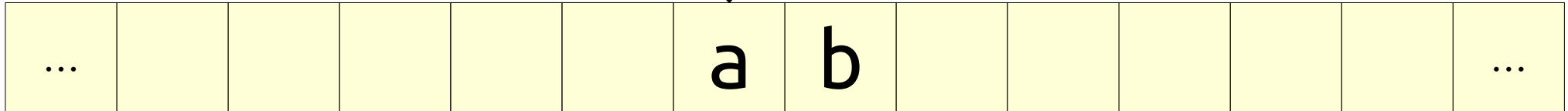
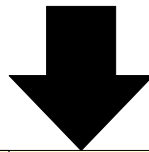
```
If Blank Return True  
If 'b' Return False  
Write Blank
```

ZipRight:

```
Move Right  
If Not Blank Goto ZipRight  
Move Left  
If Not 'b' Return False  
Write Blank
```

ZipLeft:

```
Move Left  
If Not Blank Goto ZipLeft  
Move Right  
Goto Start
```



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

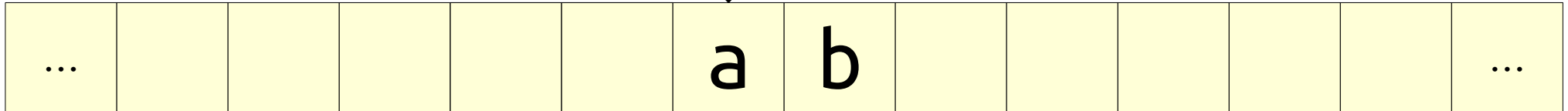
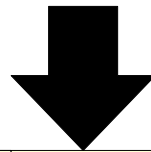
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

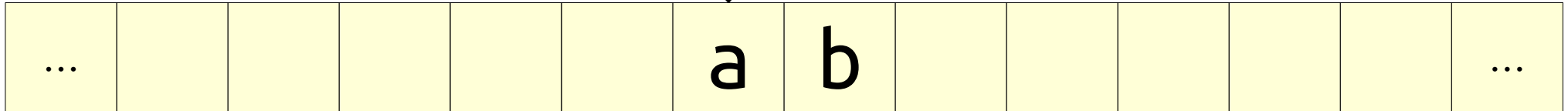
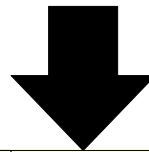
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

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If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

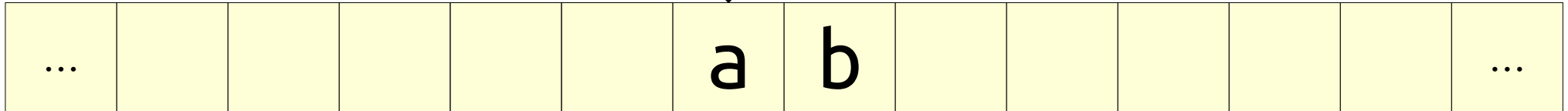
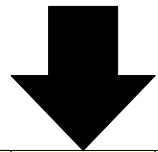
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If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

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If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

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Write Blank

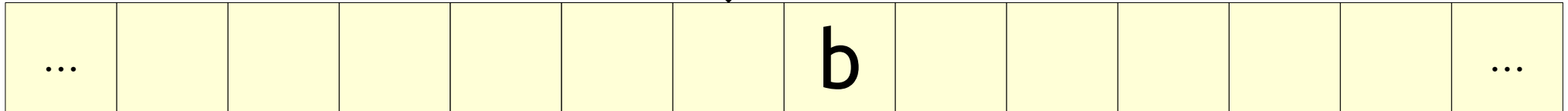
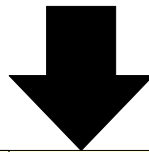
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

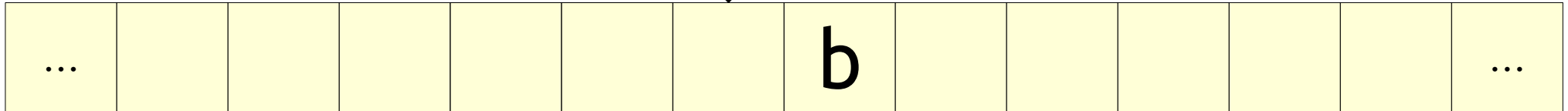
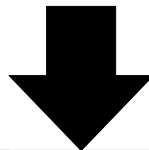
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

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If 'b' Return False

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ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

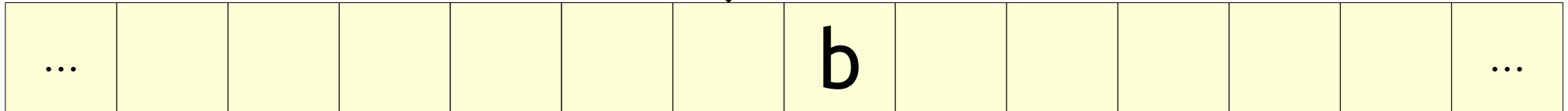
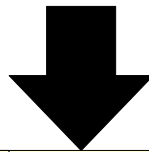
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

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If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

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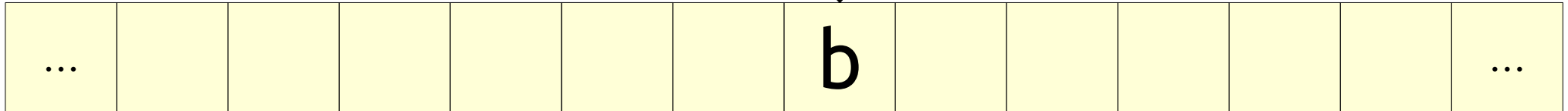
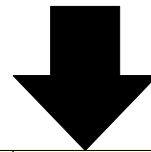
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

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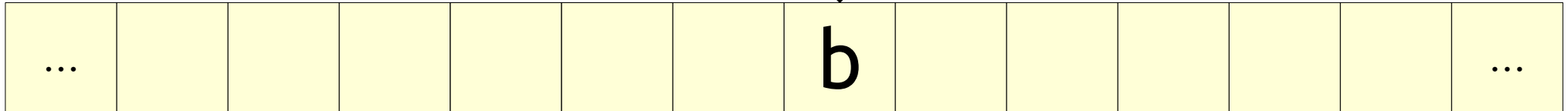
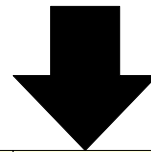
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

If Blank Return True

If 'b' Return False

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ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

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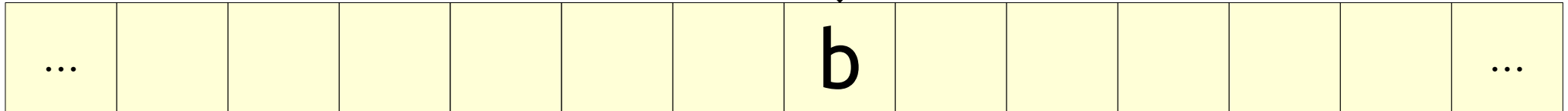
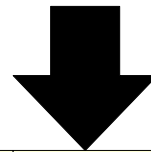
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

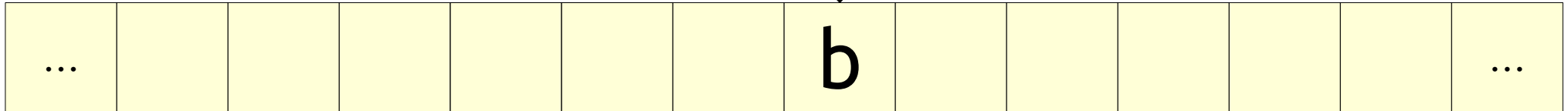
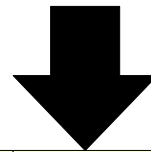
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

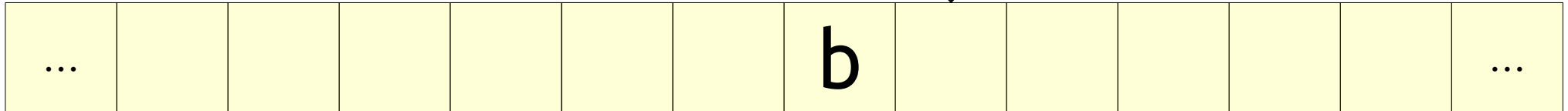
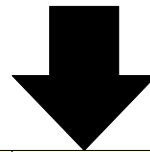
ZipLeft:

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If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

If Blank Return True

If 'b' Return False

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ZipRight:

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If Not Blank Goto ZipRight

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If Not 'b' Return False

Write Blank

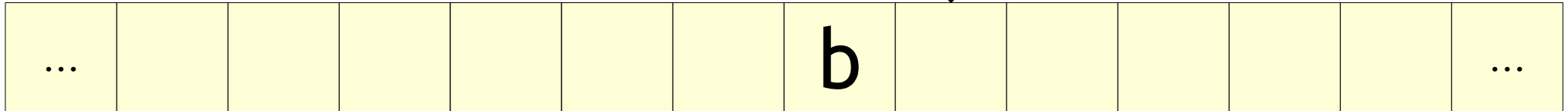
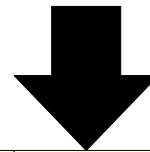
ZipLeft:

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If Not Blank Goto ZipLeft

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Goto Start



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If Blank Return True

If 'b' Return False

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ZipRight:

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If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

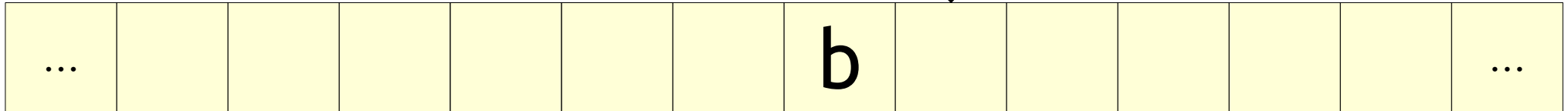
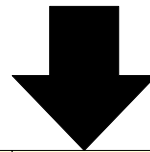
ZipLeft:

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If Not Blank Goto ZipLeft

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Goto Start



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ZipRight:

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If Not Blank Goto ZipRight

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Write Blank

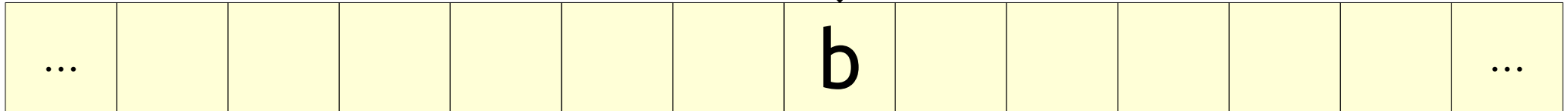
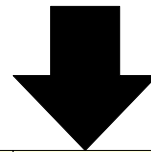
ZipLeft:

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Goto Start



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

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If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

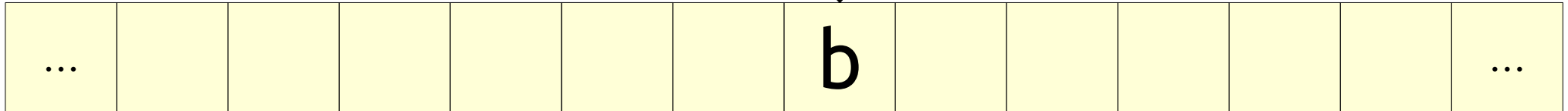
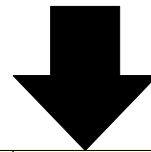
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Goto Start



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If Blank Return True

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ZipRight:

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If Not Blank Goto ZipRight

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If Not 'b' Return False

Write Blank

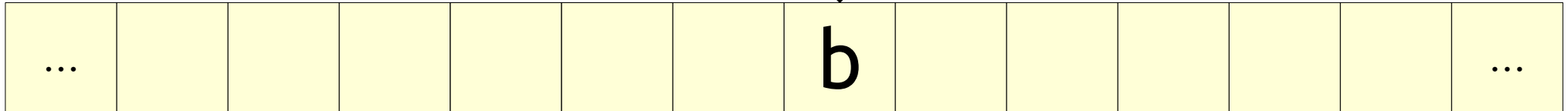
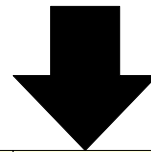
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If 'b' Return False

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ZipRight:

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If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

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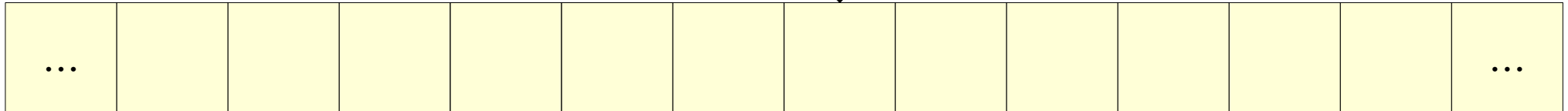
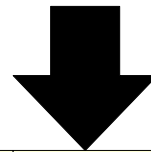
ZipLeft:

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Goto Start



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ZipRight:

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If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

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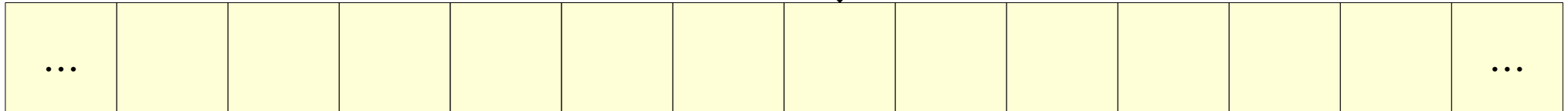
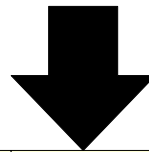
ZipLeft:

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If Not Blank Goto ZipLeft

Move Right

Goto Start



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If Blank Return True

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ZipRight:

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If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

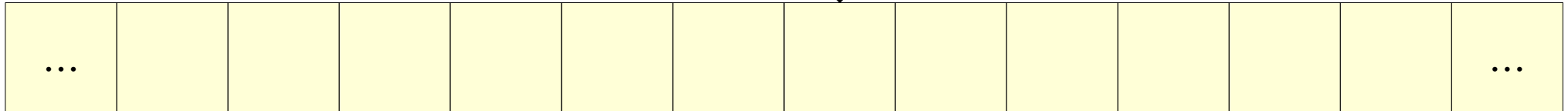
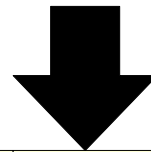
ZipLeft:

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Move Right

Goto Start



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If Blank Return True

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ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

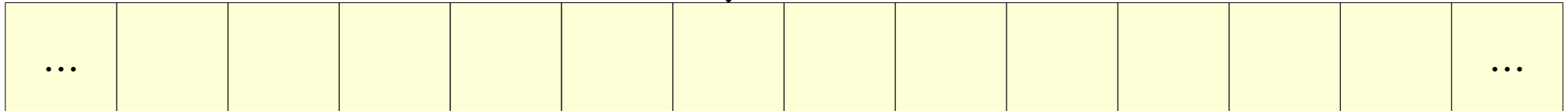
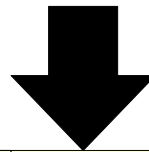
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

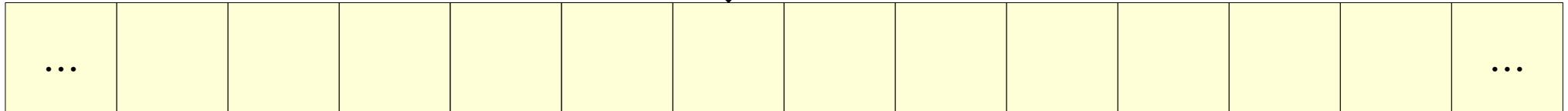
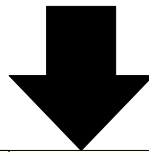
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

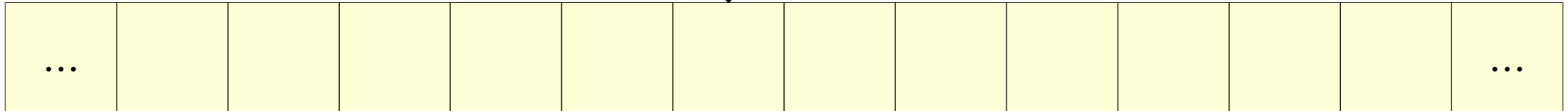
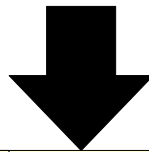
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

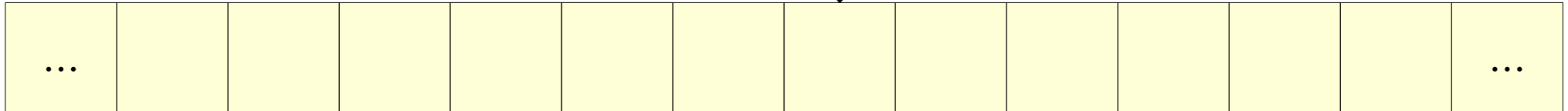
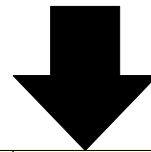
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

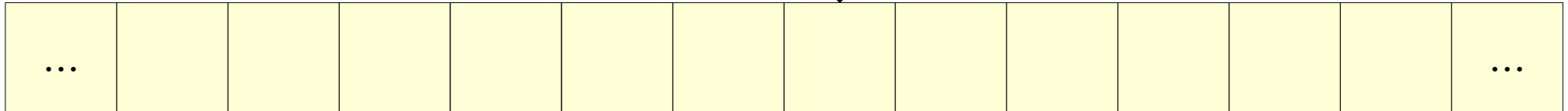
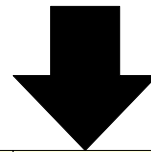
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

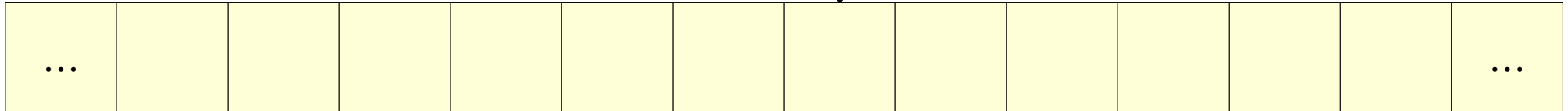
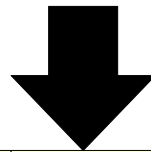
```
If Blank Return True  
If 'b' Return False  
Write Blank
```

ZipRight:

```
Move Right  
If Not Blank Goto ZipRight  
Move Left  
If Not 'b' Return False  
Write Blank
```

ZipLeft:

```
Move Left  
If Not Blank Goto ZipLeft  
Move Right  
Goto Start
```



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

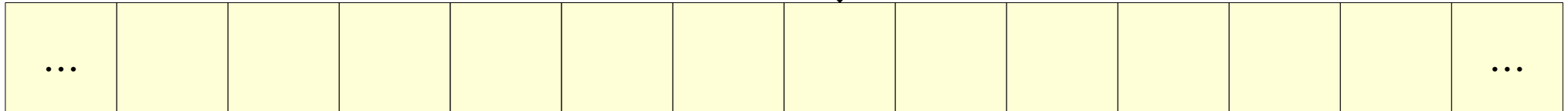
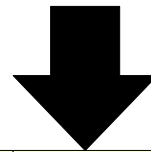
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Start:

If Blank Return True

If 'b' Return False

Write Blank

ZipRight:

Move Right

If Not Blank Goto ZipRight

Move Left

If Not 'b' Return False

Write Blank

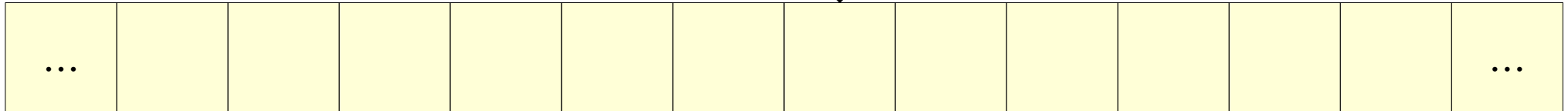
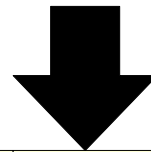
ZipLeft:

Move Left

If Not Blank Goto ZipLeft

Move Right

Goto Start



Time-Out for Announcements!

Second Midterm Complete

- You're done with the second midterm exam – congratulations!
- We're going to do our best to get the second midterm graded before Friday. However, as of now we can't promise "yes, it will definitely be graded by then."
- Have any questions about the exam? Post them on EdStem or come chat with us in person.

Your Questions

“What class at Stanford were you most surprised by (i.e. you didn't think you would like it/had to take it and ended up loving it)?”

Without a doubt, ENGR 50 (Intro to Materials Science and Engineering). I signed up for the course because it was required and was floored by how interesting and useful it was. I still remember some of the demos the professor and the TAs did in lecture and am surprised by how helpful it's been to know the basic concepts from that class.

“whats your favorite cuisine / food /
comfort food”

It's really hard for me to just pick one, so I won't. I'm a huge fan of just about everything spanning from the Eastern Mediterranean through the Indian subcontinent. But in terms of straight-up comfort food, probably a bowl of French lentils cooked with aromatics and bok choy.

“What software do you use for your slides?”

It's LibreOffice, the default presentation software that comes with Ubuntu Linux. It's free, and I get what I pay for.

Back to CS103!

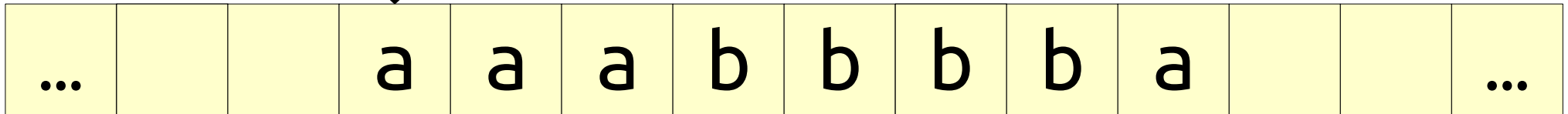
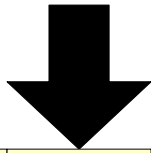
Our Next Challenge

- Let's now take aim at this more general language:

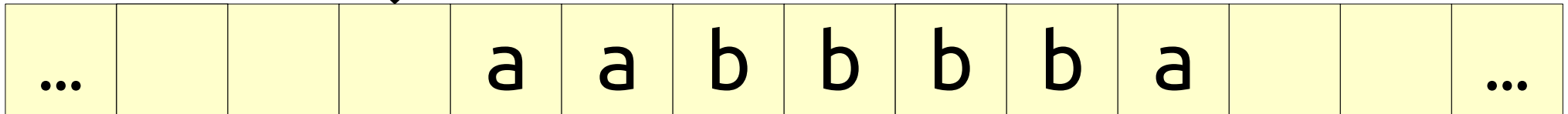
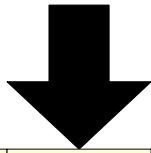
$$\{ w \in \{\mathbf{a}, \mathbf{b}\}^* \mid w \text{ has an equal number of } \mathbf{a}\text{'s and } \mathbf{b}\text{'s} \}$$

- This language is not regular (do you see why?)
- It is context-free, but it's a bit tricky to write a CFG for it. (This is a great exercise!)
- Let's see how to design a TM for it.

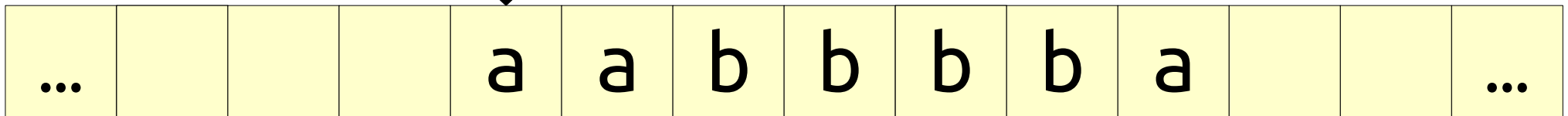
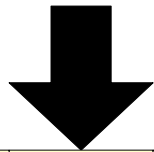
A Caveat



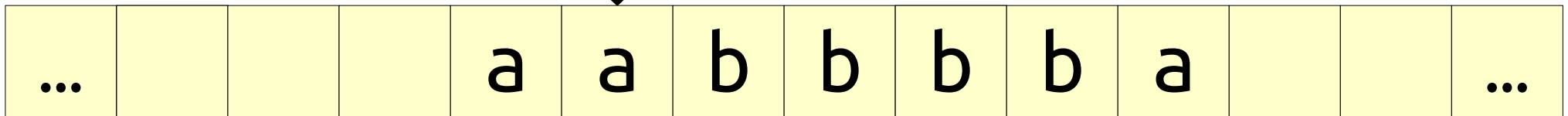
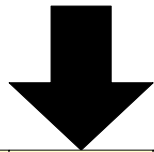
A Caveat



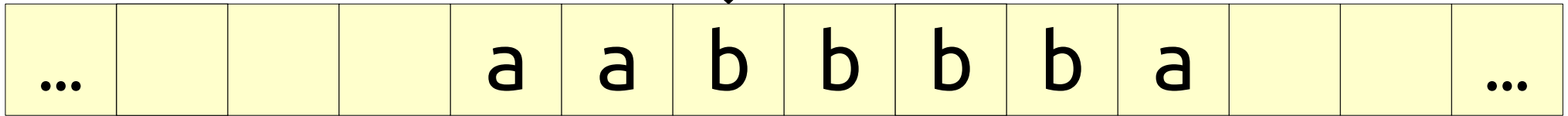
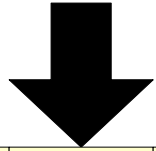
A Caveat



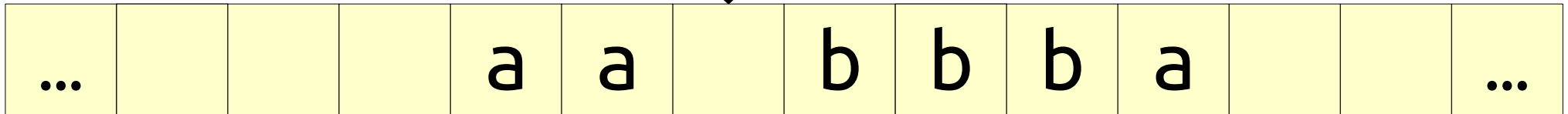
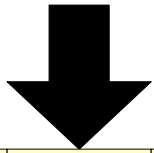
A Caveat



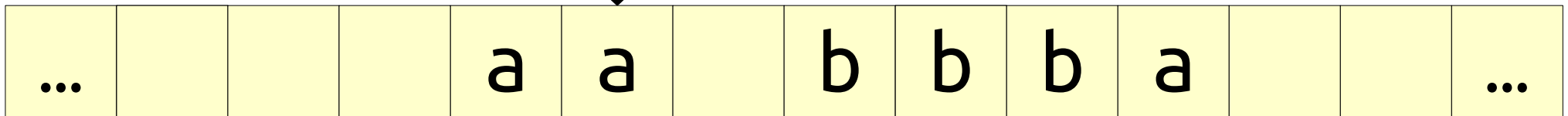
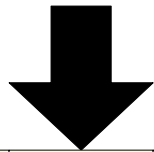
A Caveat



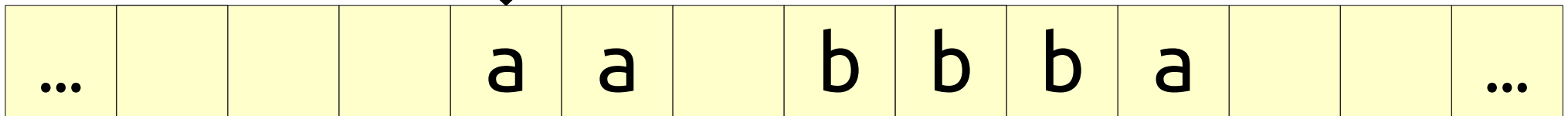
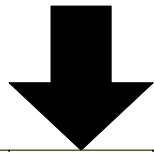
A Caveat



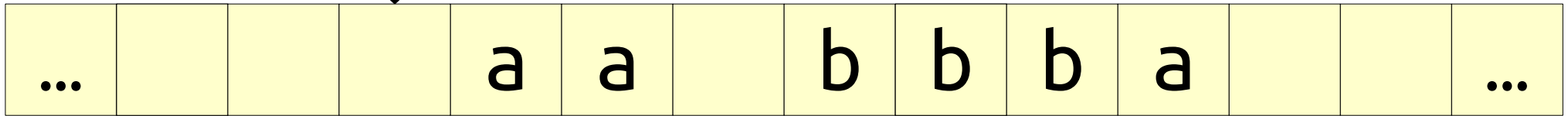
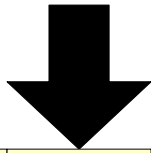
A Caveat



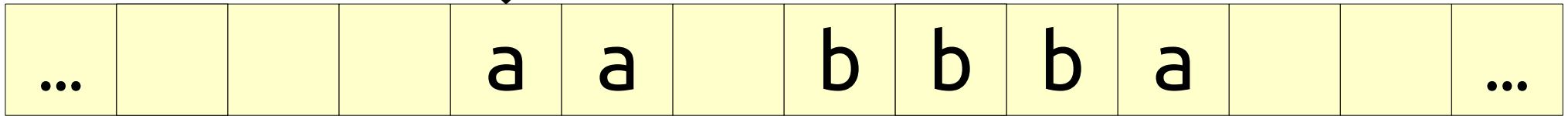
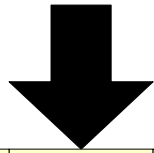
A Caveat



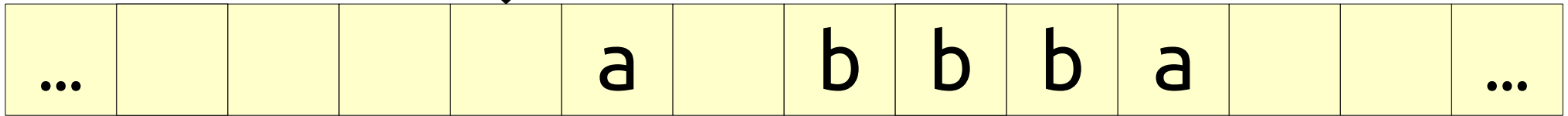
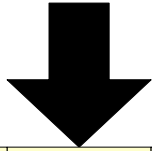
A Caveat



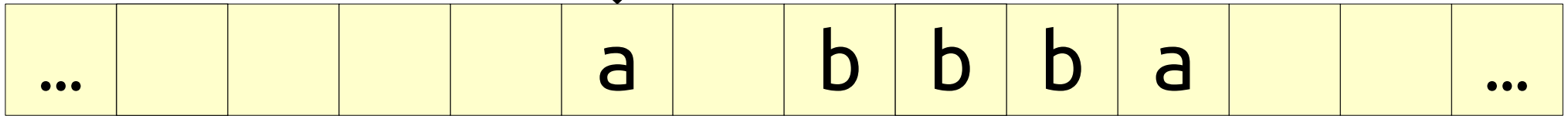
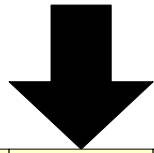
A Caveat



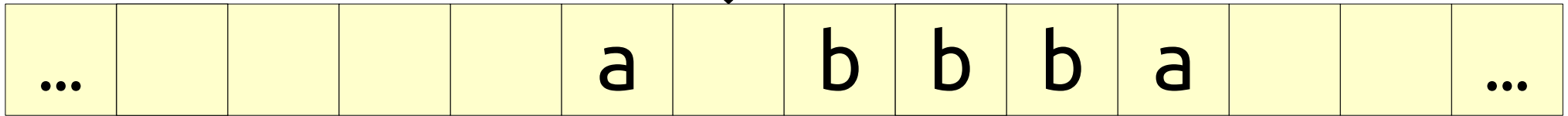
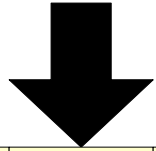
A Caveat



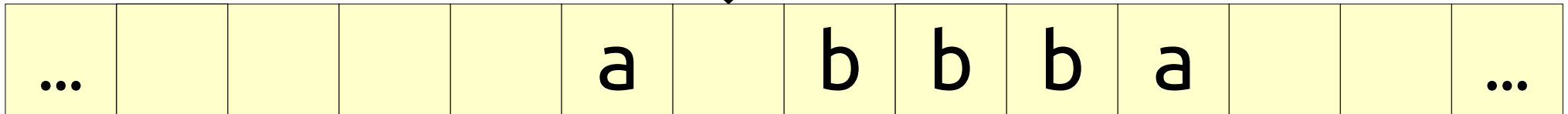
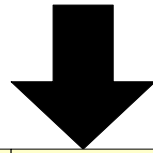
A Caveat



A Caveat

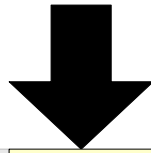


A Caveat



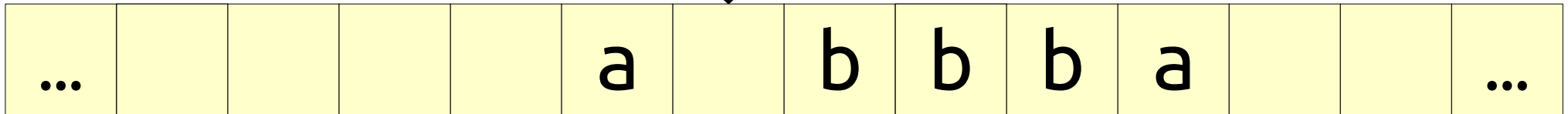
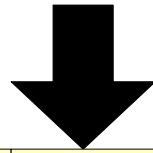
How do we know that
this blank isn't one of
the infinitely many
blanks after our input
string?

A Caveat



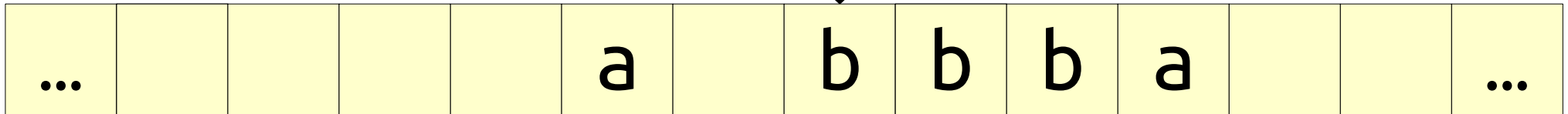
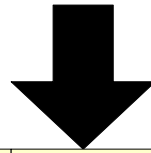
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A Caveat

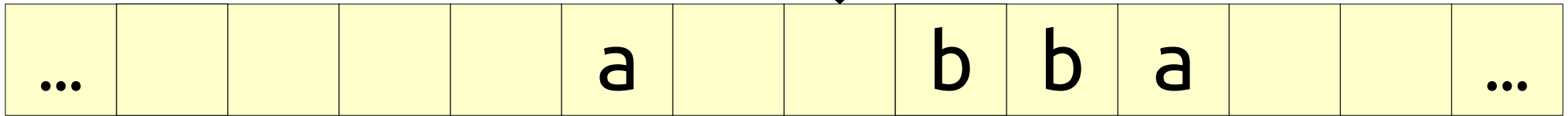
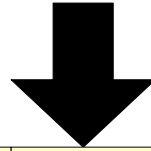


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this blank isn't one of
the infinitely many
blanks after our input
string?

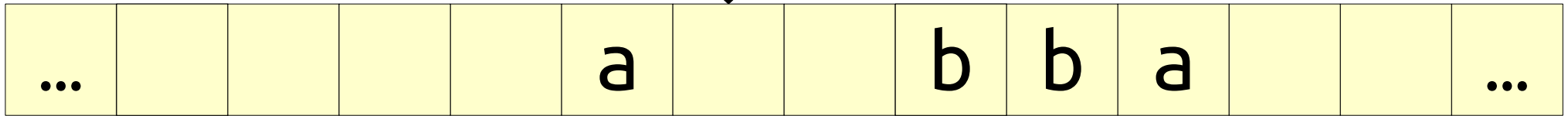
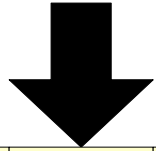
A Caveat



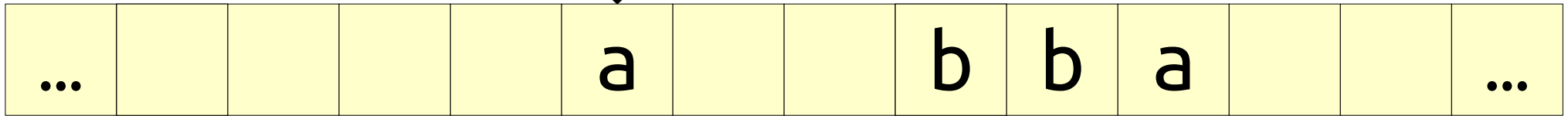
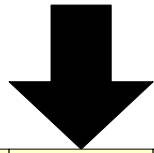
A Caveat



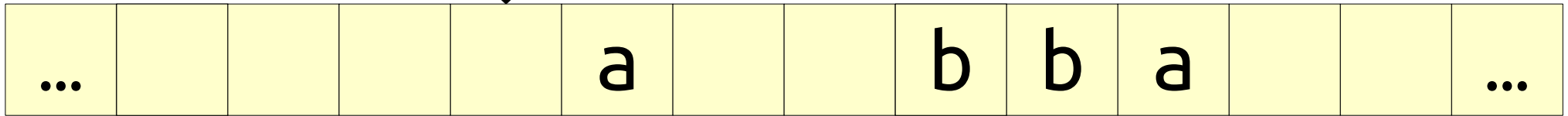
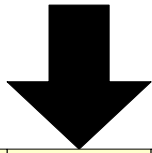
A Caveat



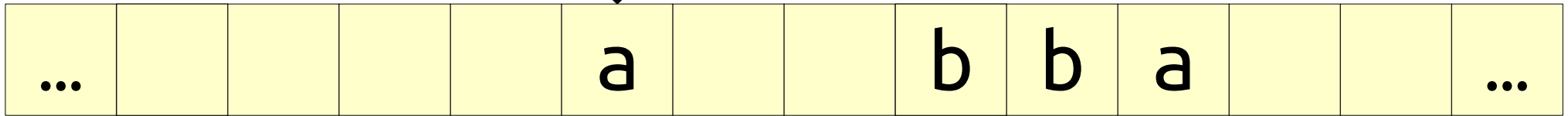
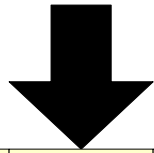
A Caveat



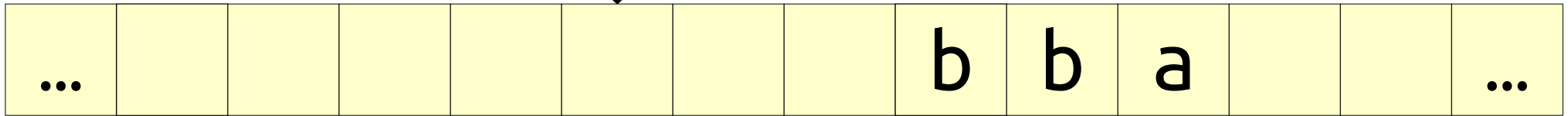
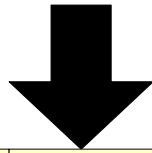
A Caveat



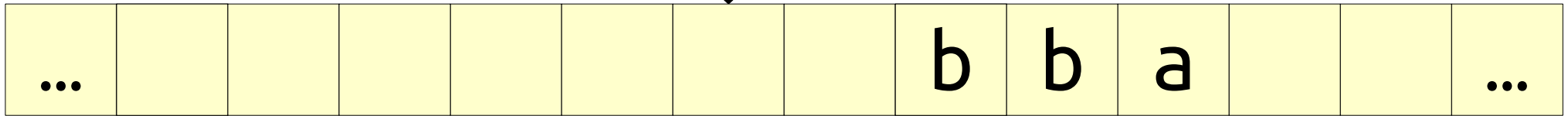
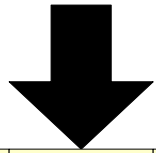
A Caveat



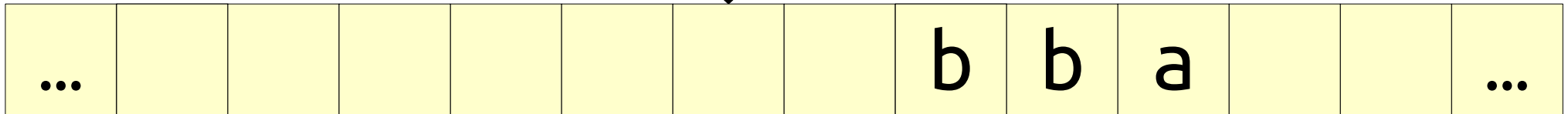
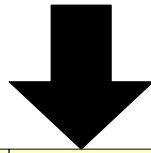
A Caveat



A Caveat

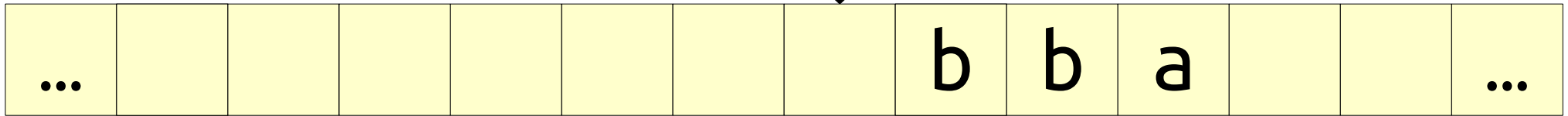
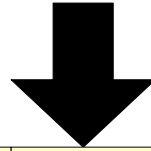


A Caveat

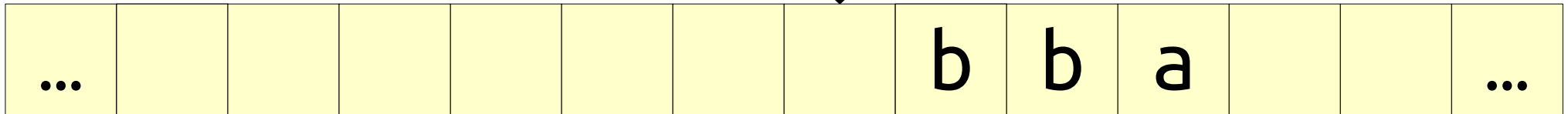
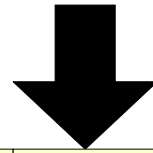


How do we know that
this blank isn't one of
the infinitely many
blanks after our input
string?

A Caveat

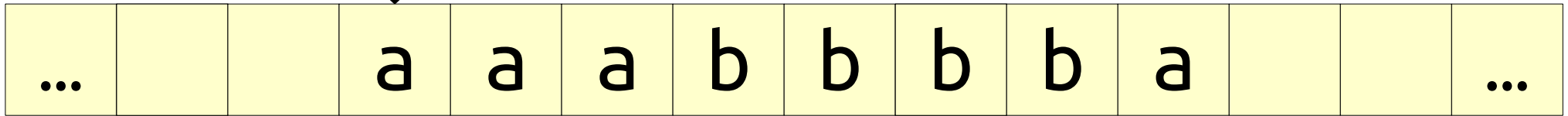
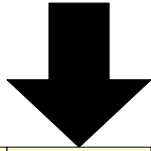


A Caveat

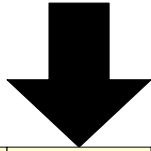


How do we know that
this blank isn't one of
the infinitely many
blanks after our input
string?

One Solution

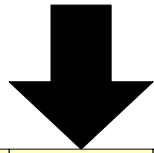


One Solution



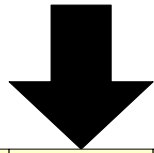
...			x	a	a	b	b	b	b	a			...
-----	--	--	---	---	---	---	---	---	---	---	--	--	-----

One Solution



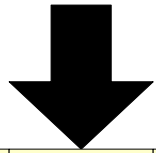
...			x	a	a	b	b	b	b	a			...
-----	--	--	---	---	---	---	---	---	---	---	--	--	-----

One Solution



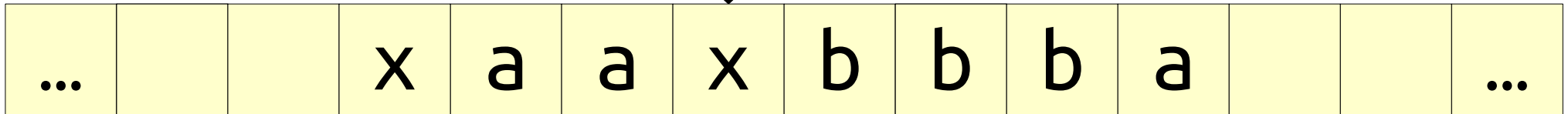
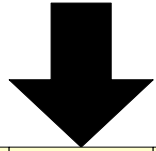
...			x	a	a	b	b	b	b	a			...
-----	--	--	---	---	---	---	---	---	---	---	--	--	-----

One Solution

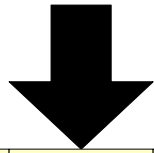


...			x	a	a	b	b	b	b	a			...
-----	--	--	---	---	---	---	---	---	---	---	--	--	-----

One Solution

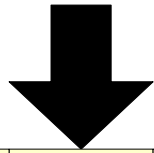


One Solution



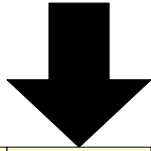
...			x	a	a	x	b	b	b	a			...
-----	--	--	---	---	---	---	---	---	---	---	--	--	-----

One Solution



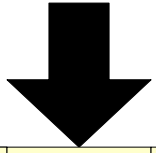
...			x	a	a	x	b	b	b	a			...
-----	--	--	---	---	---	---	---	---	---	---	--	--	-----

One Solution



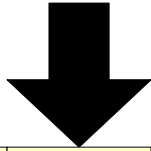
...			x	a	a	x	b	b	b	a			...
-----	--	--	---	---	---	---	---	---	---	---	--	--	-----

One Solution



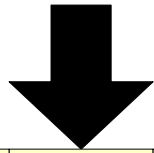
...			x	a	a	x	b	b	b	a			...
-----	--	--	---	---	---	---	---	---	---	---	--	--	-----

One Solution



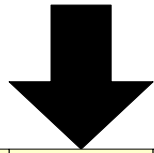
...			x	a	a	x	b	b	b	a			...
-----	--	--	---	---	---	---	---	---	---	---	--	--	-----

One Solution



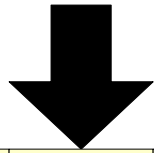
...			x	a	a	x	b	b	b	a			...
-----	--	--	---	---	---	---	---	---	---	---	--	--	-----

One Solution



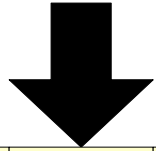
...			x	x	a	x	b	b	b	a			...
-----	--	--	---	---	---	---	---	---	---	---	--	--	-----

One Solution



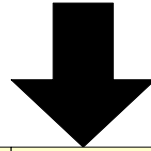
...			x	x	a	x	b	b	b	a			...
-----	--	--	---	---	---	---	---	---	---	---	--	--	-----

One Solution



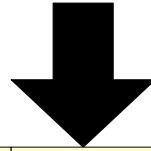
...			x	x	a	x	b	b	b	a			...
-----	--	--	---	---	---	---	---	---	---	---	--	--	-----

One Solution



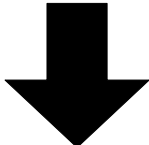
...			x	x	a	x	b	b	b	a			...
-----	--	--	---	---	---	---	---	---	---	---	--	--	-----

One Solution



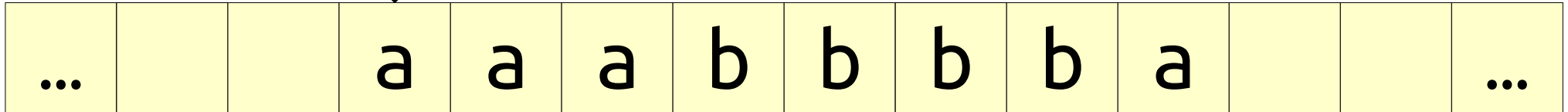
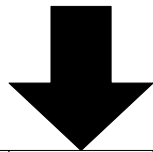
...			x	x	a	x	x	b	b	a			...
-----	--	--	---	---	---	---	---	---	---	---	--	--	-----

Start:

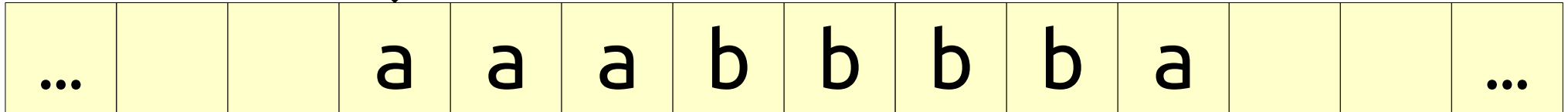
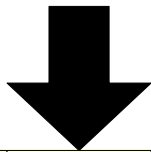


...			a	a	a	b	b	b	b	a			...
-----	--	--	---	---	---	---	---	---	---	---	--	--	-----

Start:

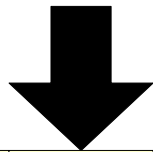


Start:



Start:

If 'a' Goto FoundA

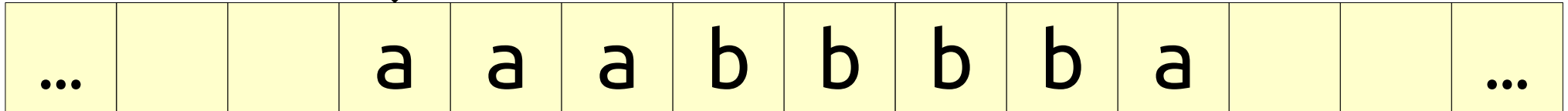
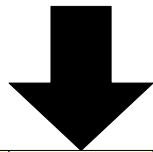


...			a	a	a	b	b	b	b	a			...
-----	--	--	---	---	---	---	---	---	---	---	--	--	-----

Start:

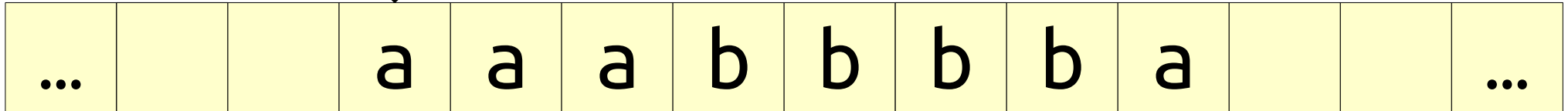
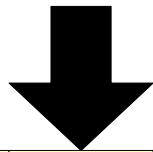
If 'a' Goto FoundA

FoundA:



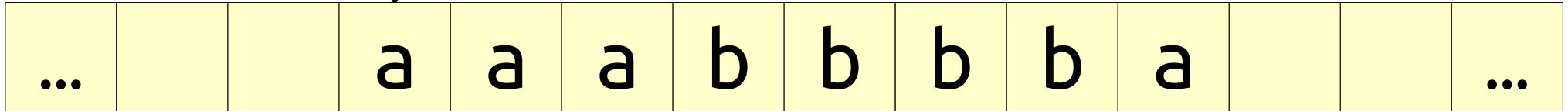
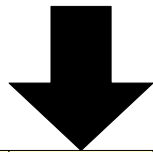
Start:
If 'a' Goto FoundA

FoundA:



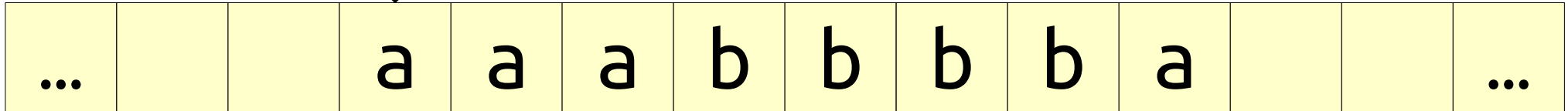
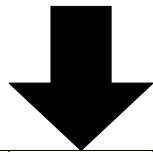
Start:
If 'a' Goto FoundA

FoundA:



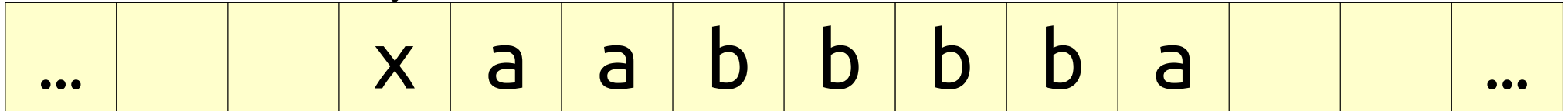
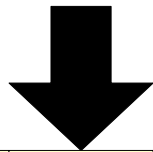
```
Start:  
  If 'a' Goto FoundA
```

```
FoundA:  
  Write 'x'
```



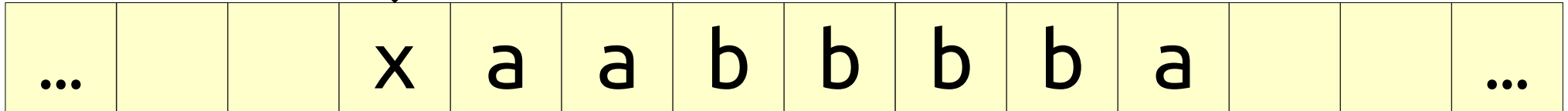
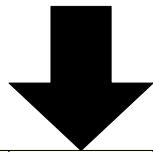
```
Start:  
  If 'a' Goto FoundA
```

```
FoundA:  
Write 'x'
```



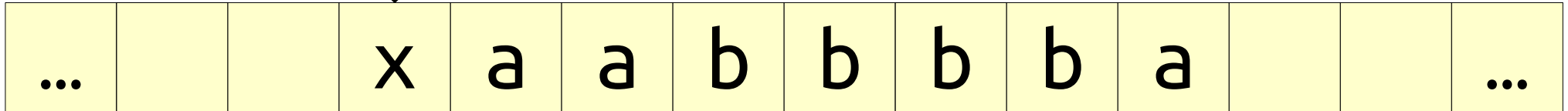
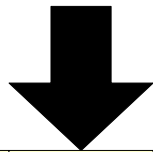
```
Start:  
  If 'a' Goto FoundA
```

```
FoundA:  
  Write 'x'
```



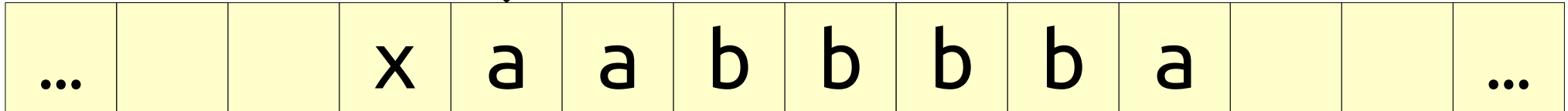
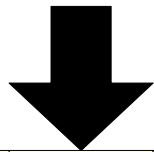
```
Start:  
  If 'a' Goto FoundA
```

```
FoundA:  
  Write 'x'  
  Move Right
```



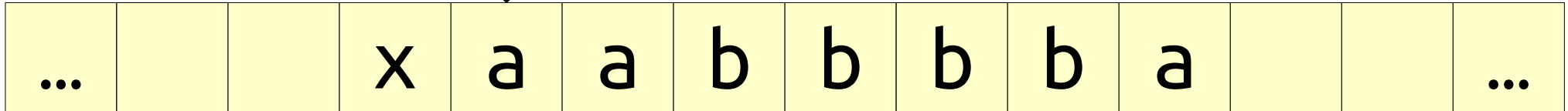
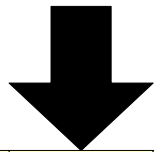
```
Start:  
  If 'a' Goto FoundA
```

```
FoundA:  
  Write 'x'  
  Move Right
```




```
Start:  
  If 'a' Goto FoundA
```

```
FoundA:  
  Write 'x'  
  Move Right  
  If 'a' ?
```

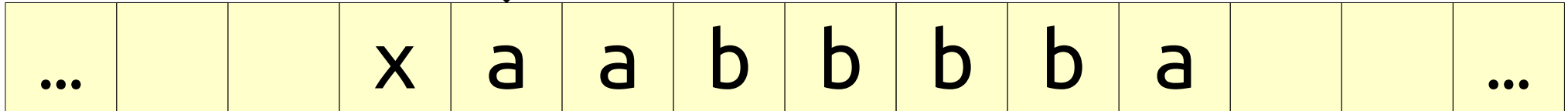
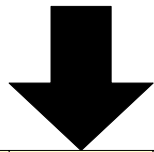


```
Start:  
  If 'a' Goto FoundA
```

```
FoundA:  
  Write 'x'
```

```
  Move Right
```

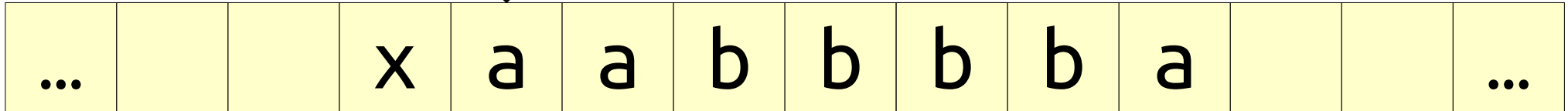
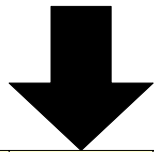
```
  If 'a' ?
```



```
Start:  
  If 'a' Goto FoundA
```

```
FoundA:  
  Write 'x'
```

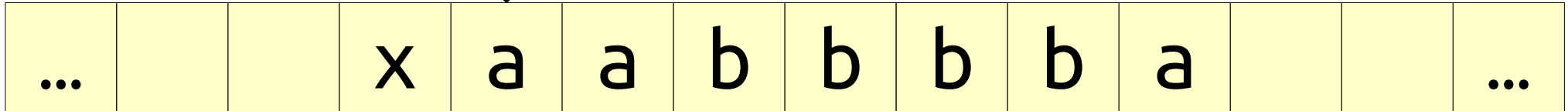
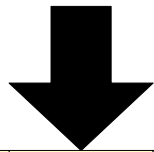
```
LoopA:  
  Move Right  
  If 'a' ?
```



```
Start:  
  If 'a' Goto FoundA
```

```
FoundA:  
  Write 'x'
```

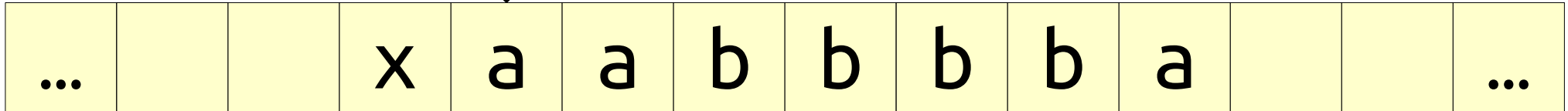
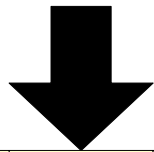
```
LoopA:  
  Move Right  
  If 'a' Goto LoopA
```



```
Start:  
  If 'a' Goto FoundA
```

```
FoundA:  
  Write 'x'
```

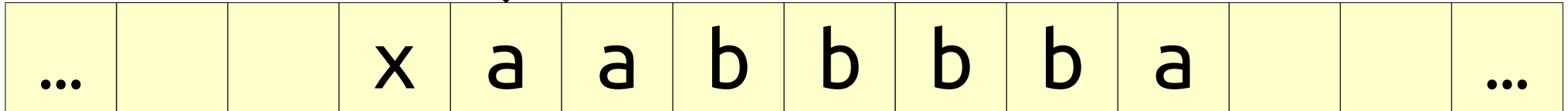
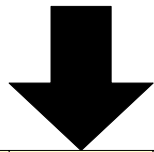
```
LoopA:  
  Move Right  
  If 'a' Goto LoopA
```



```
Start:  
  If 'a' Goto FoundA
```

```
FoundA:  
  Write 'x'
```

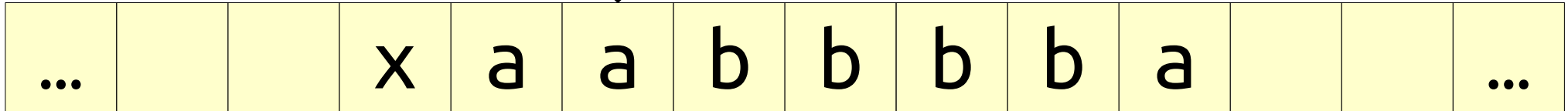
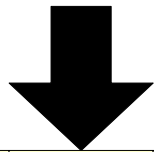
```
LoopA:  
  Move Right  
  If 'a' Goto LoopA
```



```
Start:  
  If 'a' Goto FoundA
```

```
FoundA:  
  Write 'x'
```

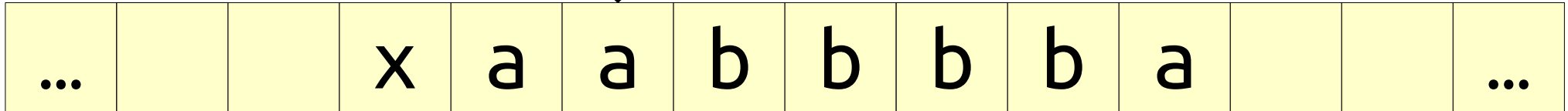
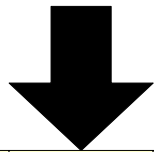
```
LoopA:  
  Move Right  
  If 'a' Goto LoopA
```



```
Start:  
  If 'a' Goto FoundA
```

```
FoundA:  
  Write 'x'
```

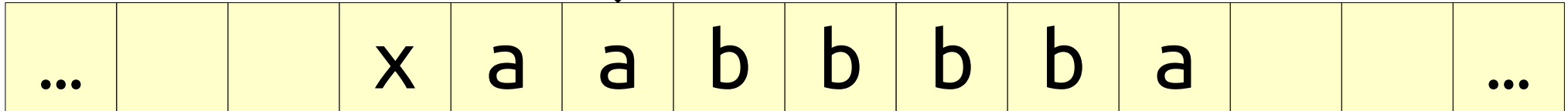
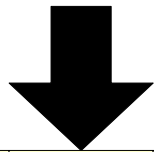
```
LoopA:  
  Move Right  
  If 'a' Goto LoopA
```




```
Start:  
  If 'a' Goto FoundA
```

```
FoundA:  
  Write 'x'
```

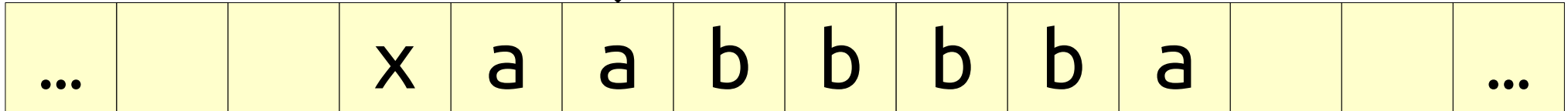
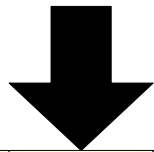
```
LoopA:  
  Move Right  
  If 'a' Goto LoopA
```



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Start:  
  If 'a' Goto FoundA
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FoundA:  
  Write 'x'
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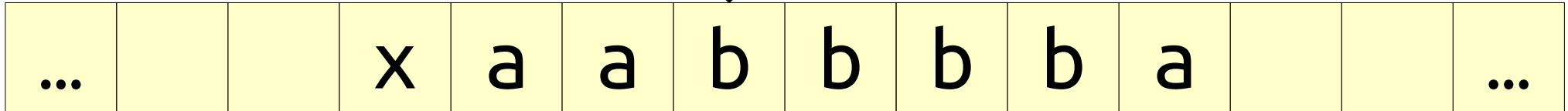
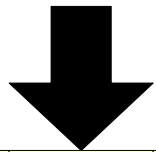
```
LoopA:  
  Move Right  
  If 'a' Goto LoopA
```



```
Start:  
  If 'a' Goto FoundA
```

```
FoundA:  
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```

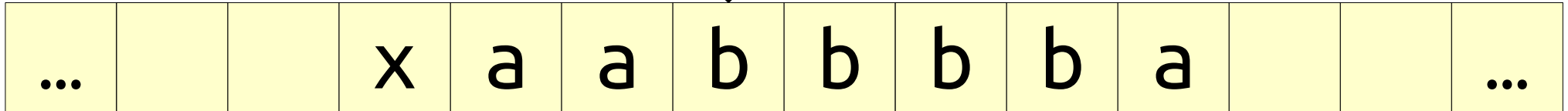
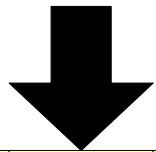
```
LoopA:  
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Start:  
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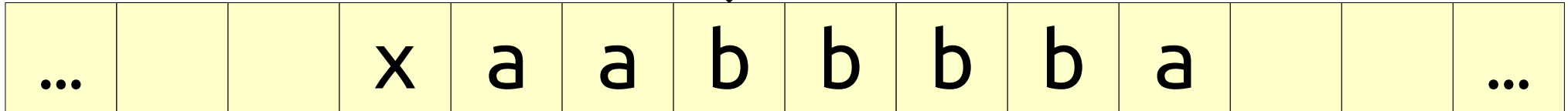
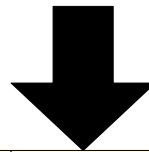
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LoopA:  
  Move Right  
  If 'a' Goto LoopA
```



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Start:  
  If 'a' Goto FoundA
```

```
FoundA:  
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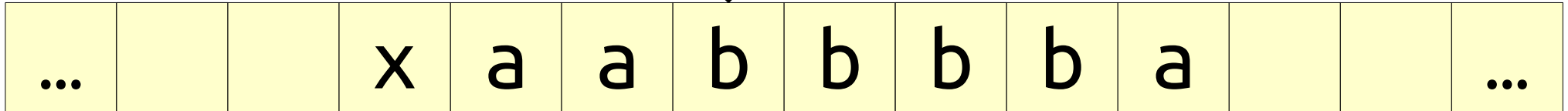
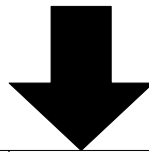
```
LoopA:  
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  If 'a' Goto LoopA
```



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Start:  
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```

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FoundA:  
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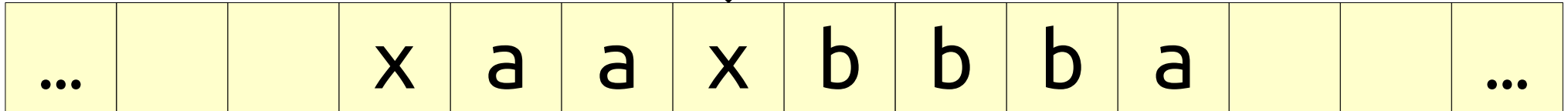
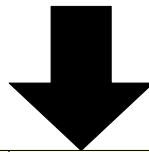
```
LoopA:  
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```



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```

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FoundA:  
  Write 'x'
```

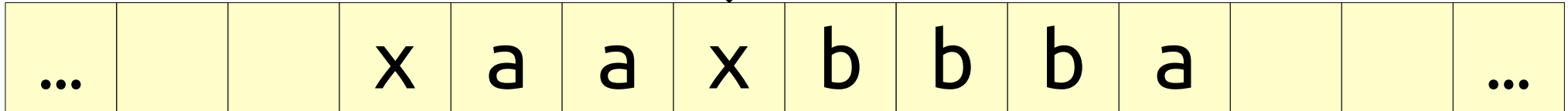
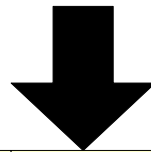
```
LoopA:  
  Move Right  
  If 'a' Goto LoopA  
  Write 'x'
```



```
Start:  
  If 'a' Goto FoundA
```

```
FoundA:  
  Write 'x'
```

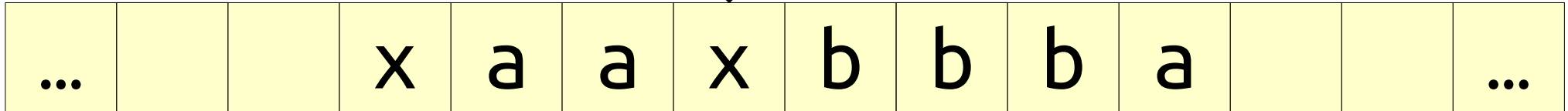
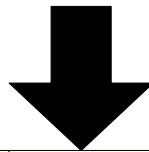
```
LoopA:  
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  If 'a' Goto LoopA  
  Write 'x'
```




```
Start:  
  If 'a' Goto FoundA
```

```
FoundA:  
  Write 'x'
```

```
LoopA:  
  Move Right  
  If 'a' Goto LoopA  
  Write 'x'  
  Goto GoHome
```

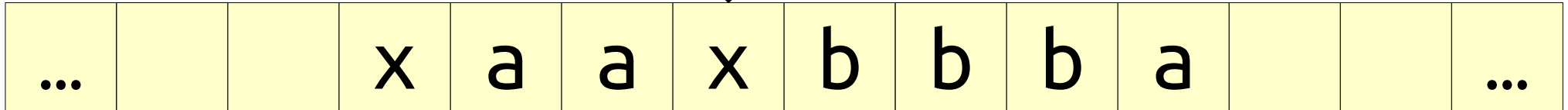
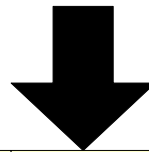


```
Start:  
  If 'a' Goto FoundA
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FoundA:  
  Write 'x'
```

```
LoopA:  
  Move Right  
  If 'a' Goto LoopA  
  Write 'x'  
  Goto GoHome
```

```
GoHome:  
  Move Left  
  If Not Blank Goto GoHome  
  Move Right  
  Goto Start
```



Start:

If 'a' Goto FoundA

FoundA:

Write 'x'

LoopA:

Move Right

If 'a' Goto LoopA

Write 'x'

Goto GoHome

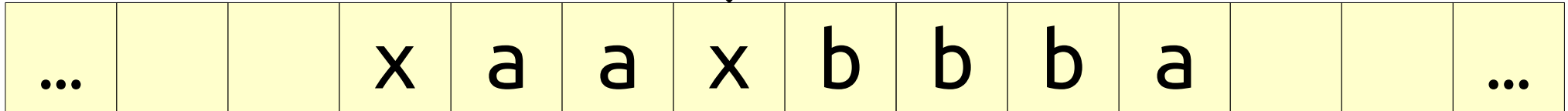
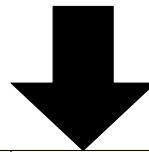
GoHome:

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

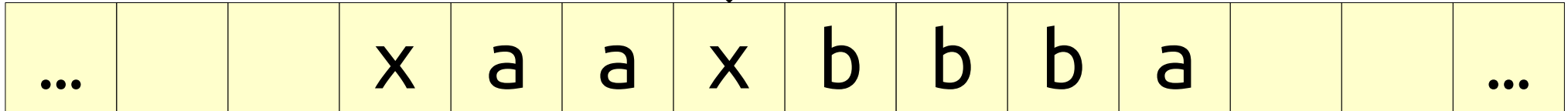
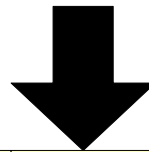


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 Write 'x'
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GoHome:
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 If Not Blank Goto GoHome
 Move Right
 Goto Start

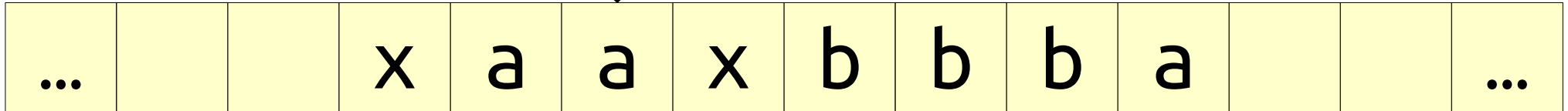
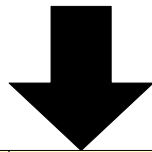


Start:
 If 'a' Goto FoundA

FoundA:
 Write 'x'

LoopA:
 Move Right
 If 'a' Goto LoopA
 Write 'x'
 Goto GoHome

GoHome:
 Move Left
 If Not Blank Goto GoHome
 Move Right
 Goto Start

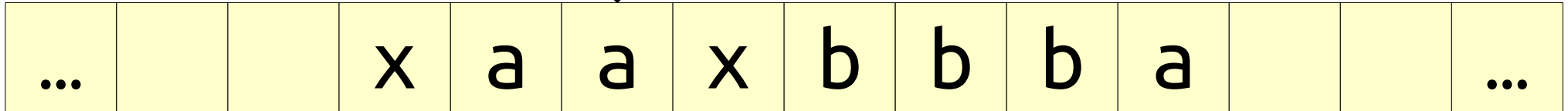
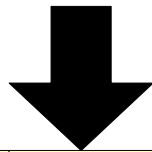


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  If 'a' Goto LoopA  
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LoopA:

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 Write 'x'

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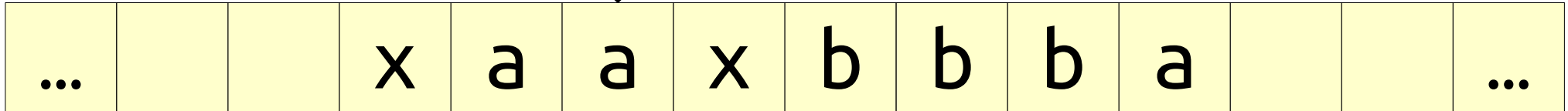
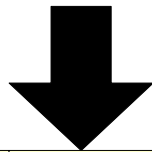
GoHome:

 Move Left

 If Not Blank Goto GoHome

 Move Right

 Goto Start

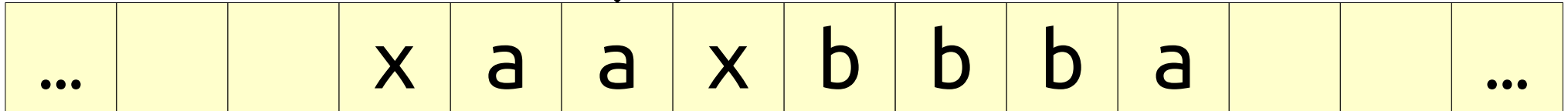
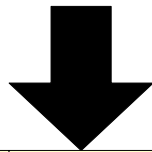


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GoHome:
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 Goto Start

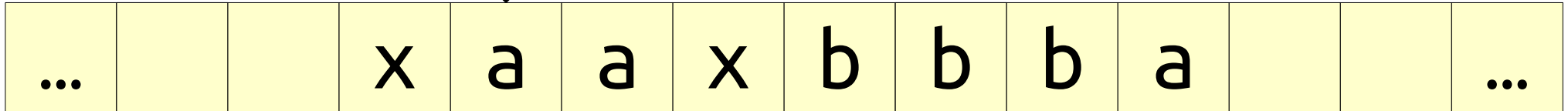
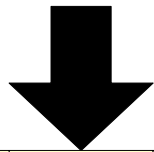


Start:
 If 'a' Goto FoundA

FoundA:
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 Move Right
 If 'a' Goto LoopA
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GoHome:
 Move Left
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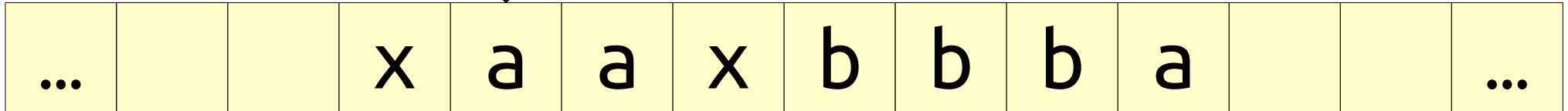
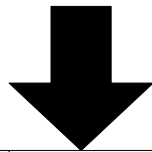


```
Start:  
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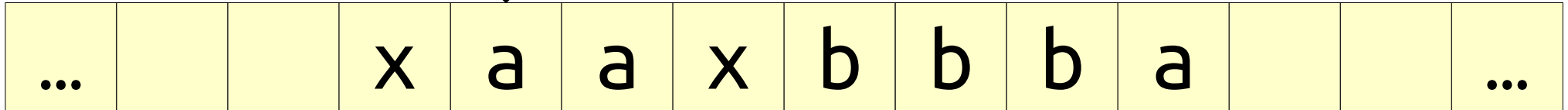
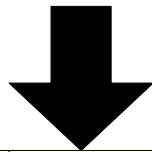
GoHome:

 Move Left

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 Move Right

 Goto Start

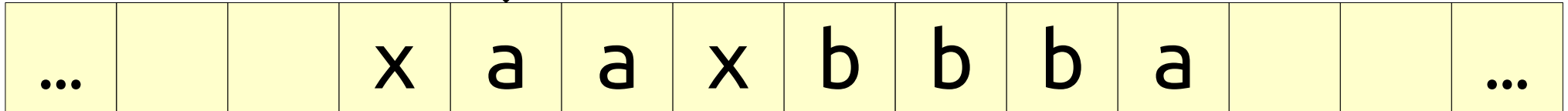
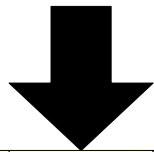


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GoHome:
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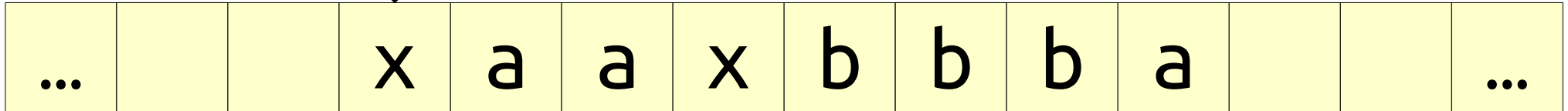
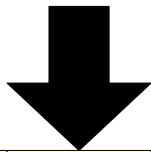


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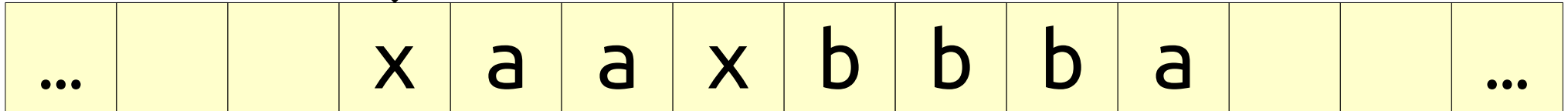
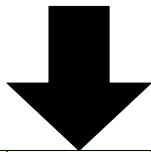


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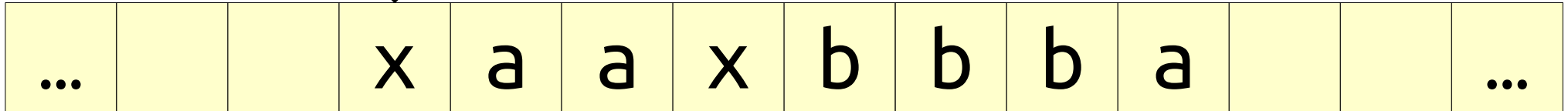
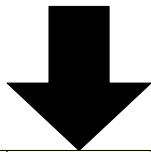
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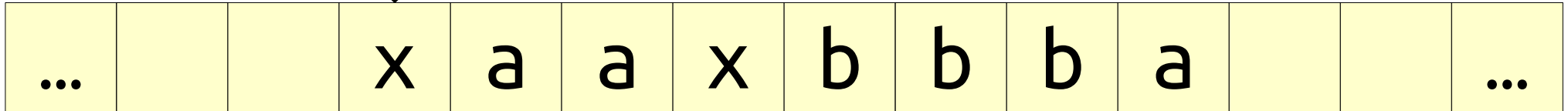
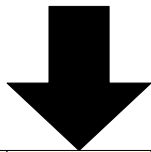


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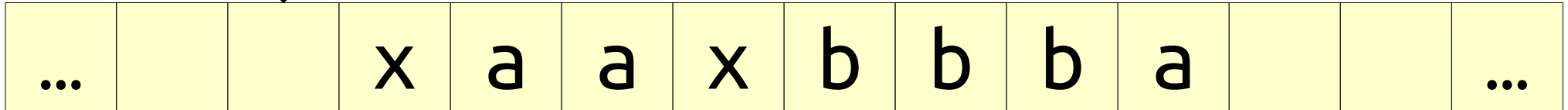
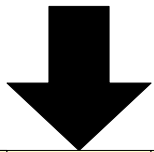



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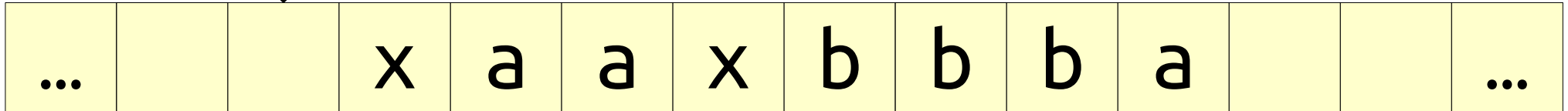
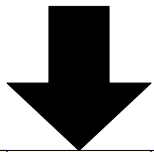


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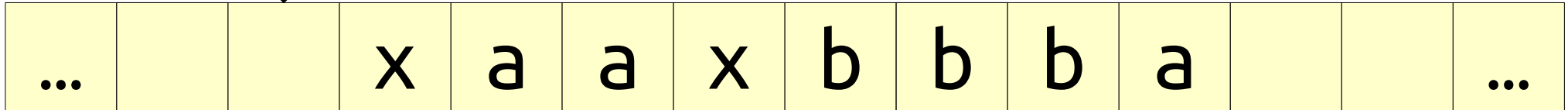
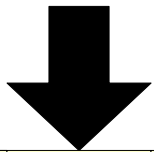


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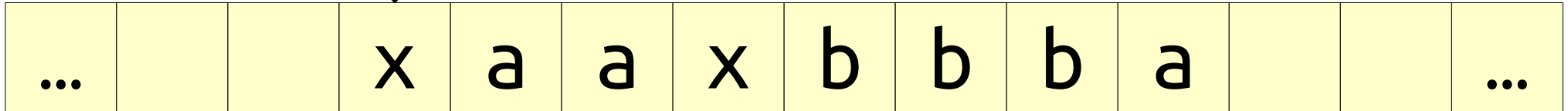
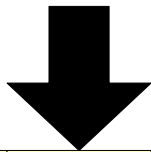


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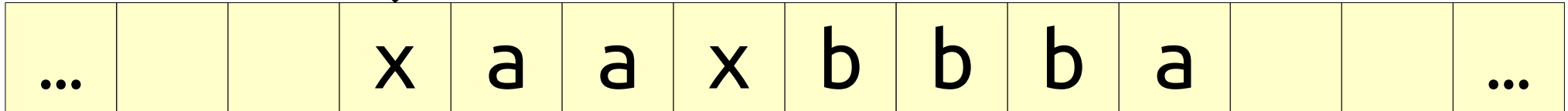
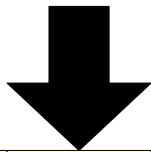


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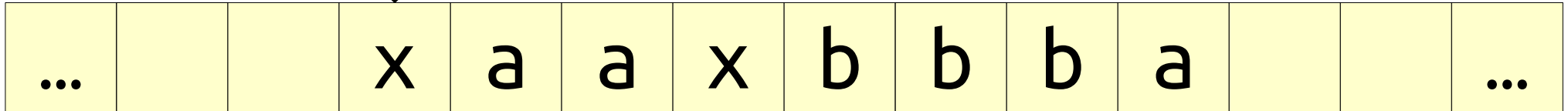
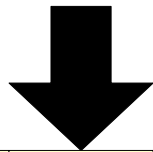
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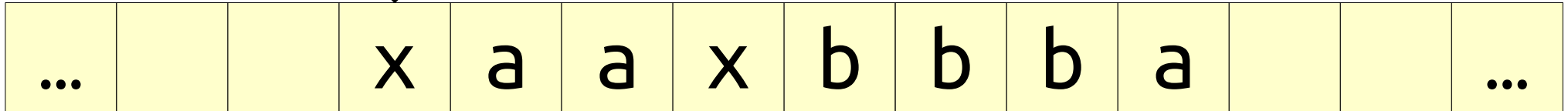
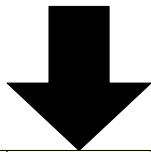
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Move Right

Goto Start

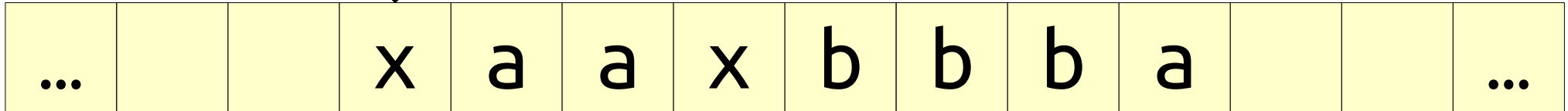
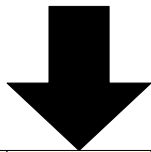


```
Start:  
  If 'a' Goto FoundA
```

```
FoundA:  
  Write 'x'
```

```
LoopA:  
  Move Right  
  If 'a' Goto LoopA  
  Write 'x'  
  Goto GoHome
```

```
GoHome:  
  Move Left  
  If Not Blank Goto GoHome  
  Move Right  
  Goto Start
```



Start:

If 'a' Goto FoundA

Move Right

FoundA:

Write 'x'

LoopA:

Move Right

If 'a' Goto LoopA

Write 'x'

Goto GoHome

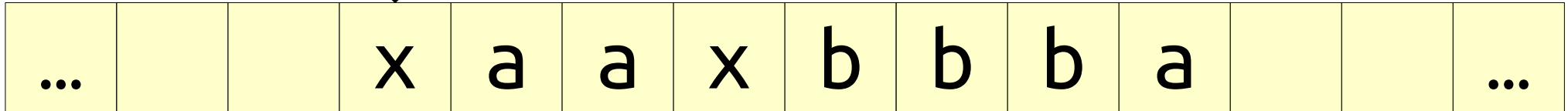
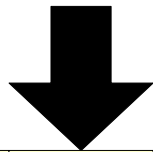
GoHome:

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start



Start:

If 'a' Goto FoundA

Move Right

FoundA:

Write 'x'

LoopA:

Move Right

If 'a' Goto LoopA

Write 'x'

Goto GoHome

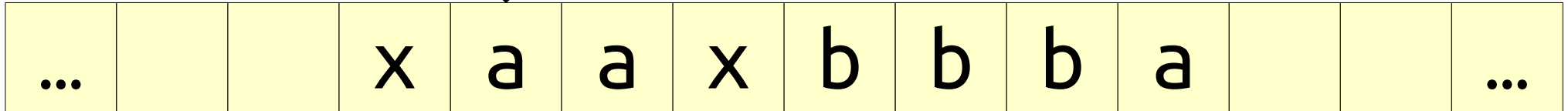
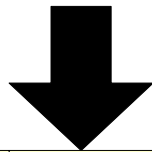
GoHome:

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start



Start:

If 'a' Goto FoundA
Move Right

FoundA:

Write 'x'

LoopA:

Move Right

If 'a' Goto LoopA

Write 'x'

Goto GoHome

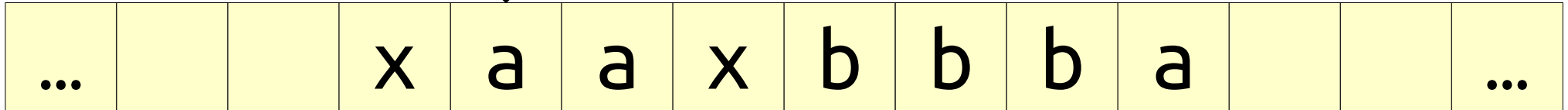
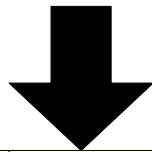
GoHome:

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start



Start:

If 'a' Goto FoundA

Move Right

Goto Start

FoundA:

Write 'x'

LoopA:

Move Right

If 'a' Goto LoopA

Write 'x'

Goto GoHome

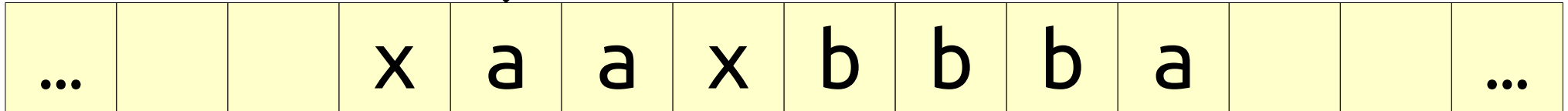
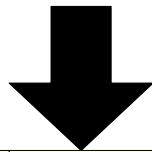
GoHome:

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start



Start:

```
If 'a' Goto FoundA  
Move Right  
Goto Start
```

FoundA:

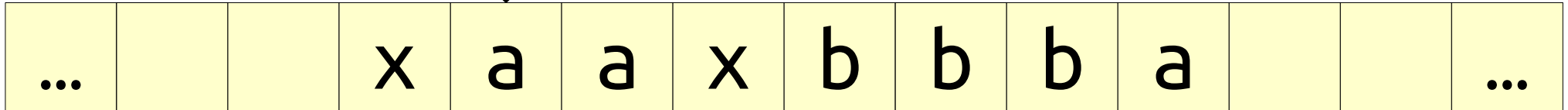
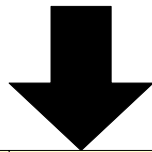
```
Write 'x'
```

LoopA:

```
Move Right  
If 'a' Goto LoopA  
Write 'x'  
Goto GoHome
```

GoHome:

```
Move Left  
If Not Blank Goto GoHome  
Move Right  
Goto Start
```



Start:

If 'a' Goto FoundA

Move Right

Goto Start

FoundA:

Write 'x'

LoopA:

Move Right

If 'a' Goto LoopA

Write 'x'

Goto GoHome

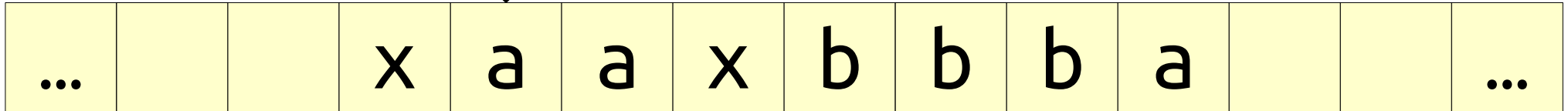
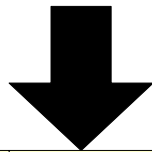
GoHome:

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

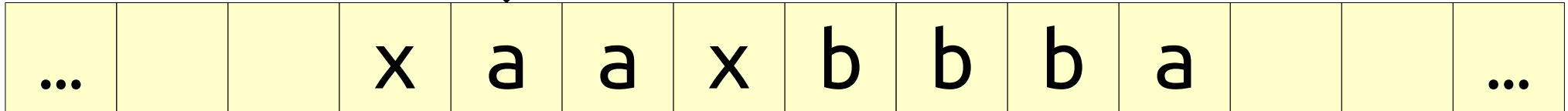
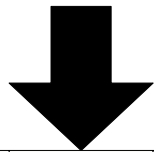


```
Start:  
  If 'a' Goto FoundA  
  Move Right  
  Goto Start
```

```
GoHome:  
  Move Left  
  If Not Blank Goto GoHome  
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```

FoundA:

```
  Write 'x'  
LoopA:  
  Move Right  
  If 'a' Goto LoopA  
  Write 'x'  
  Goto GoHome
```

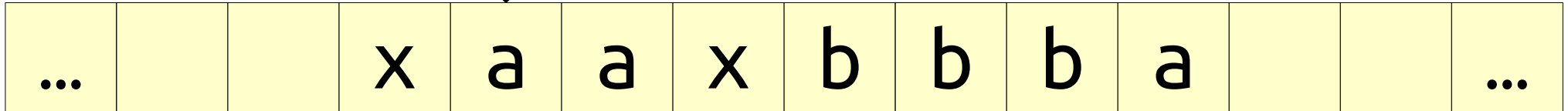
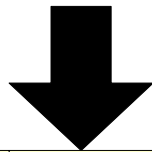


```
Start:  
  If 'a' Goto FoundA  
  Move Right  
  Goto Start
```

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FoundA:  
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LoopA:  
  Move Right  
  If 'a' Goto LoopA  
  Write 'x'  
  Goto GoHome
```

```
GoHome:  
  Move Left  
  If Not Blank Goto GoHome  
  Move Right  
  Goto Start
```



Start:

```
If 'a' Goto FoundA  
Move Right  
Goto Start
```

FoundA:

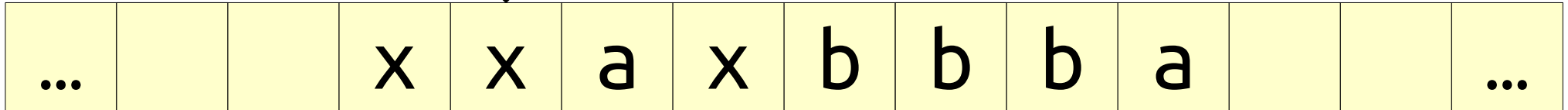
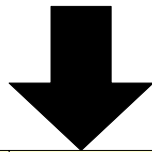
Write 'x'

LoopA:

```
Move Right  
If 'a' Goto LoopA  
Write 'x'  
Goto GoHome
```

GoHome:

```
Move Left  
If Not Blank Goto GoHome  
Move Right  
Goto Start
```

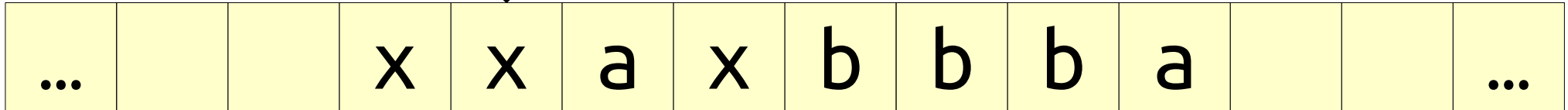
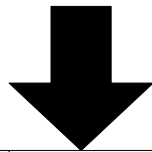


```
Start:  
  If 'a' Goto FoundA  
  Move Right  
  Goto Start
```

```
FoundA:  
  Write 'x'
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```
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  If 'a' Goto LoopA  
  Write 'x'  
  Goto GoHome
```

```
GoHome:  
  Move Left  
  If Not Blank Goto GoHome  
  Move Right  
  Goto Start
```

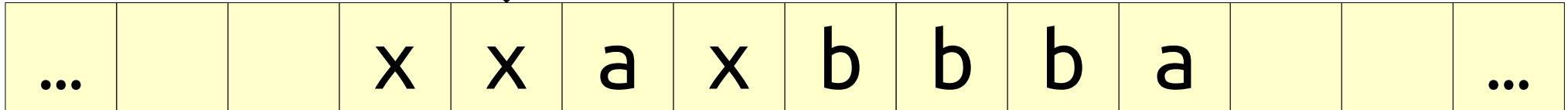
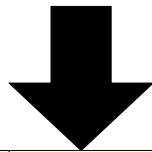


```
Start:  
  If 'a' Goto FoundA  
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LoopA:

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If 'a' Goto LoopA
```

```
Write 'x'
```

```
Goto GoHome
```

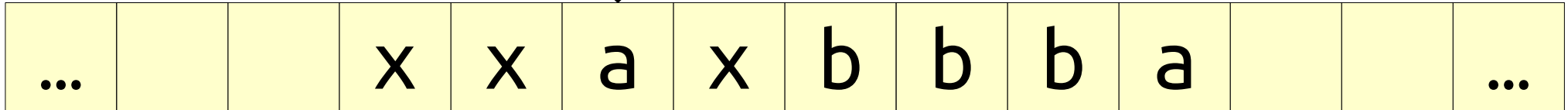
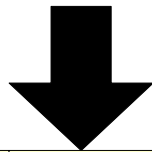
GoHome:

```
Move Left
```

```
If Not Blank Goto GoHome
```

```
Move Right
```

```
Goto Start
```



Start:

```
If 'a' Goto FoundA  
Move Right  
Goto Start
```

FoundA:

```
Write 'x'
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LoopA:

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Move Right
```

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If 'a' Goto LoopA
```

```
Write 'x'
```

```
Goto GoHome
```

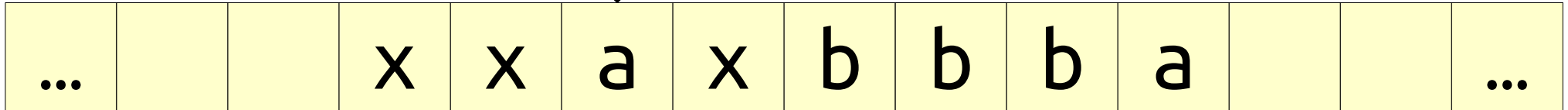
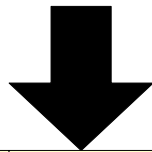
GoHome:

```
Move Left
```

```
If Not Blank Goto GoHome
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Move Right
```

```
Goto Start
```



Start:

```
If 'a' Goto FoundA  
Move Right  
Goto Start
```

FoundA:

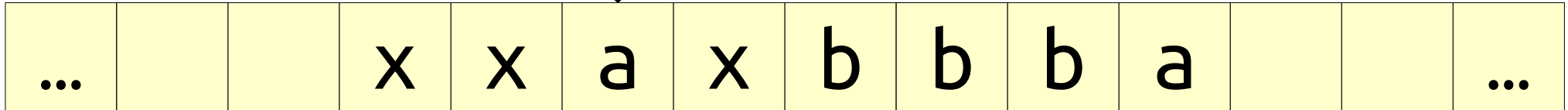
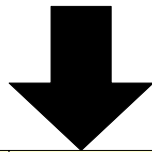
```
Write 'x'
```

LoopA:

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Move Right  
If 'a' Goto LoopA  
Write 'x'  
Goto GoHome
```

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Start:

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LoopA:

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Move Right
```

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If 'a' Goto LoopA
```

```
Write 'x'
```

```
Goto GoHome
```

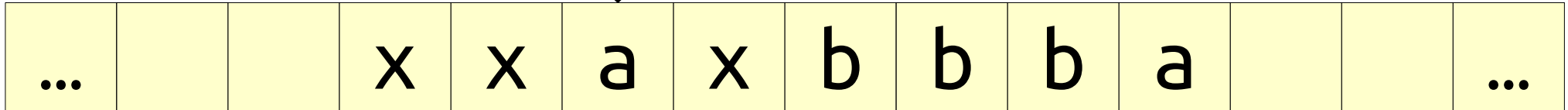
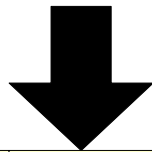
GoHome:

```
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Goto Start
```



Start:

```
If 'a' Goto FoundA  
Move Right  
Goto Start
```

FoundA:

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Write 'x'
```

LoopA:

```
Move Right
```

```
If 'a' Goto LoopA
```

```
Write 'x'
```

```
Goto GoHome
```

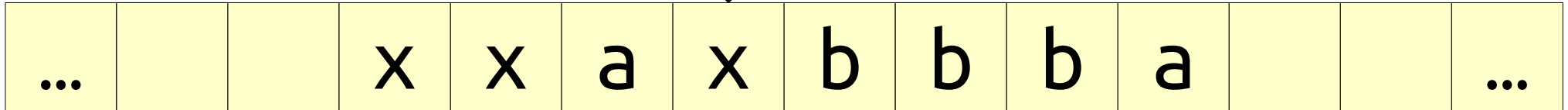
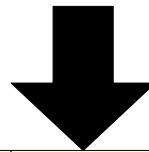
GoHome:

```
Move Left
```

```
If Not Blank Goto GoHome
```

```
Move Right
```

```
Goto Start
```



Start:

```
If 'a' Goto FoundA  
Move Right  
Goto Start
```

FoundA:

```
Write 'x'
```

LoopA:

```
Move Right
```

```
If 'a' Goto LoopA
```

```
Write 'x'
```

```
Goto GoHome
```

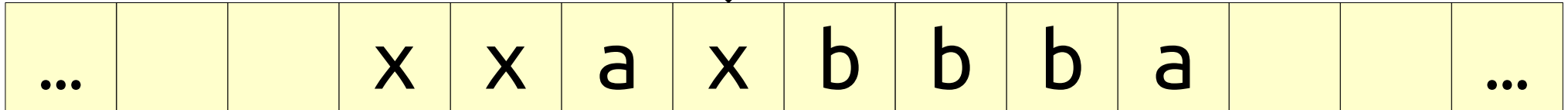
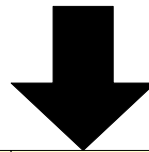
GoHome:

```
Move Left
```

```
If Not Blank Goto GoHome
```

```
Move Right
```

```
Goto Start
```



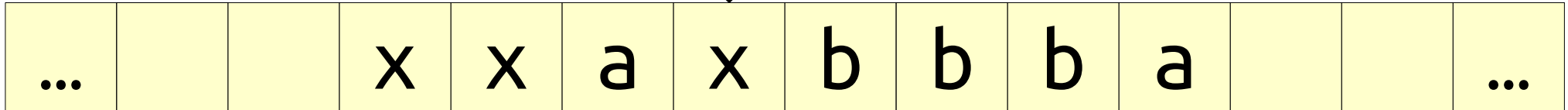
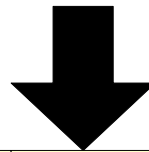
```
Start:  
  If 'a' Goto FoundA  
  Move Right  
  Goto Start
```

```
FoundA:  
  Write 'x'
```

```
LoopA:  
  Move Right  
  If 'a' Goto LoopA
```

```
Write 'x'  
Goto GoHome
```

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GoHome:  
  Move Left  
  If Not Blank Goto GoHome  
  Move Right  
  Goto Start
```



Start:

```
If 'a' Goto FoundA  
Move Right  
Goto Start
```

FoundA:

```
Write 'x'
```

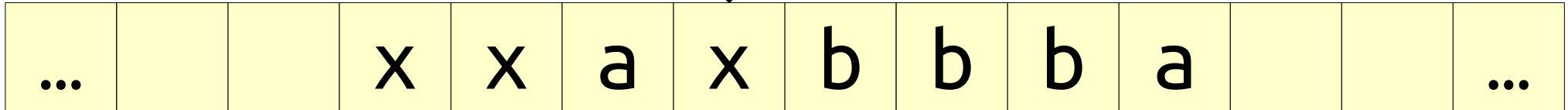
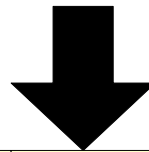
LoopA:

```
Move Right  
If 'a' Goto LoopA
```

```
Write 'x'  
Goto GoHome
```

GoHome:

```
Move Left  
If Not Blank Goto GoHome  
Move Right  
Goto Start
```



Start:

```
If 'a' Goto FoundA  
Move Right  
Goto Start
```

FoundA:

```
Write 'x'
```

LoopA:

```
Move Right
```

```
If 'a' Goto LoopA
```

```
If 'x' Goto LoopA
```

```
Write 'x'
```

```
Goto GoHome
```

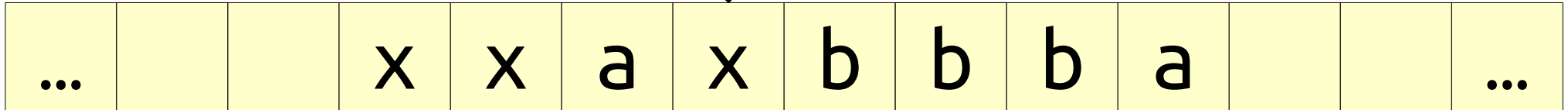
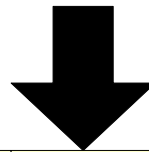
GoHome:

```
Move Left
```

```
If Not Blank Goto GoHome
```

```
Move Right
```

```
Goto Start
```



Start:

```
If 'a' Goto FoundA  
Move Right  
Goto Start
```

FoundA:

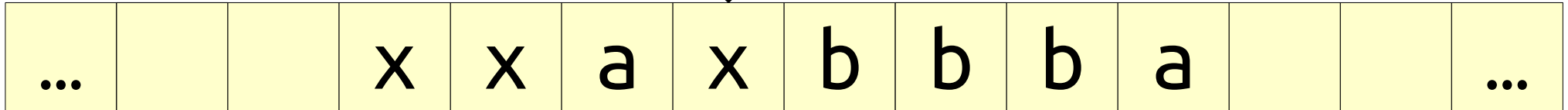
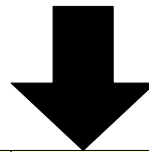
```
Write 'x'
```

LoopA:

```
Move Right  
If 'a' Goto LoopA  
If 'x' Goto LoopA  
Write 'x'  
Goto GoHome
```

GoHome:

```
Move Left  
If Not Blank Goto GoHome  
Move Right  
Goto Start
```



Start:

```
If 'a' Goto FoundA  
Move Right  
Goto Start
```

FoundA:

```
Write 'x'
```

LoopA:

```
Move Right
```

```
If 'a' Goto LoopA
```

```
If 'x' Goto LoopA
```

```
Write 'x'
```

```
Goto GoHome
```

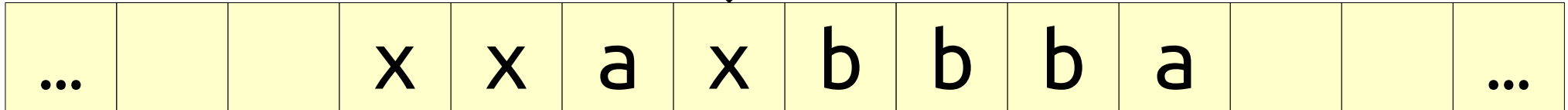
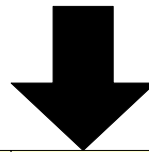
GoHome:

```
Move Left
```

```
If Not Blank Goto GoHome
```

```
Move Right
```

```
Goto Start
```

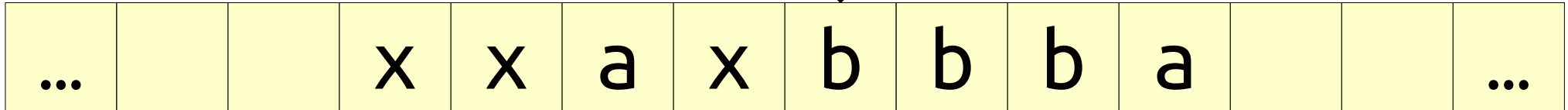
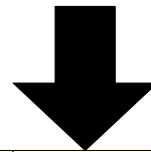


```
Start:  
  If 'a' Goto FoundA  
  Move Right  
  Goto Start
```

```
FoundA:  
  Write 'x'
```

```
LoopA:  
  Move Right  
  If 'a' Goto LoopA  
  If 'x' Goto LoopA  
  Write 'x'  
  Goto GoHome
```

```
GoHome:  
  Move Left  
  If Not Blank Goto GoHome  
  Move Right  
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```



Start:

```
If 'a' Goto FoundA  
Move Right  
Goto Start
```

FoundA:

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Write 'x'
```

LoopA:

```
Move Right
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If 'a' Goto LoopA
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```
Write 'x'
```

```
Goto GoHome
```

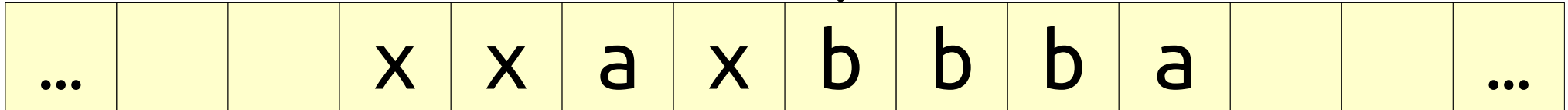
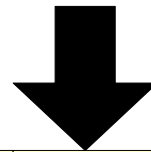
GoHome:

```
Move Left
```

```
If Not Blank Goto GoHome
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```
Move Right
```

```
Goto Start
```



Start:

```
If 'a' Goto FoundA  
Move Right  
Goto Start
```

FoundA:

```
Write 'x'
```

LoopA:

```
Move Right
```

```
If 'a' Goto LoopA
```

```
If 'x' Goto LoopA
```

```
Write 'x'
```

```
Goto GoHome
```

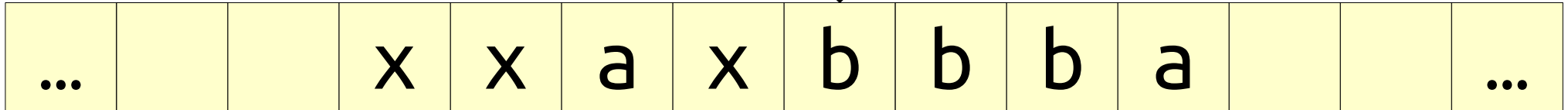
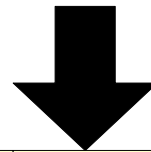
GoHome:

```
Move Left
```

```
If Not Blank Goto GoHome
```

```
Move Right
```

```
Goto Start
```



Start:

```
If 'a' Goto FoundA  
Move Right  
Goto Start
```

FoundA:

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Write 'x'
```

LoopA:

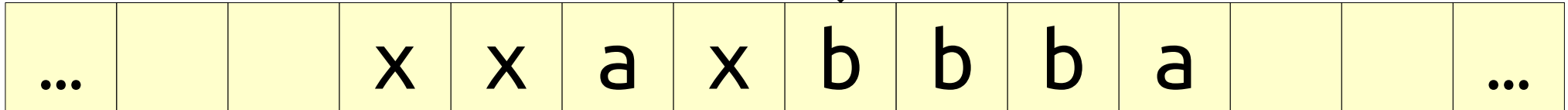
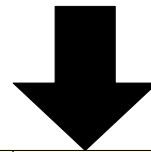
```
Move Right  
If 'a' Goto LoopA  
If 'x' Goto LoopA
```

```
Write 'x'
```

```
Goto GoHome
```

GoHome:

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If Not Blank Goto GoHome  
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Goto Start
```

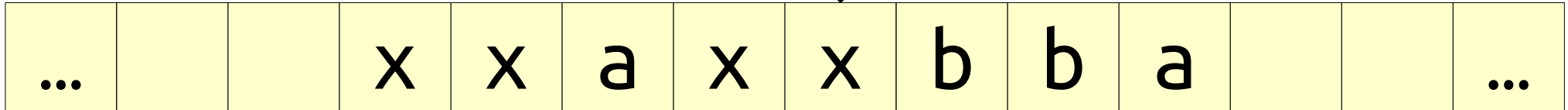
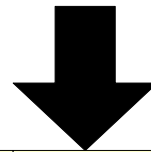


```
Start:  
  If 'a' Goto FoundA  
  Move Right  
  Goto Start
```

```
FoundA:  
  Write 'x'
```

```
LoopA:  
  Move Right  
  If 'a' Goto LoopA  
  If 'x' Goto LoopA  
  Write 'x'  
  Goto GoHome
```

```
GoHome:  
  Move Left  
  If Not Blank Goto GoHome  
  Move Right  
  Goto Start
```

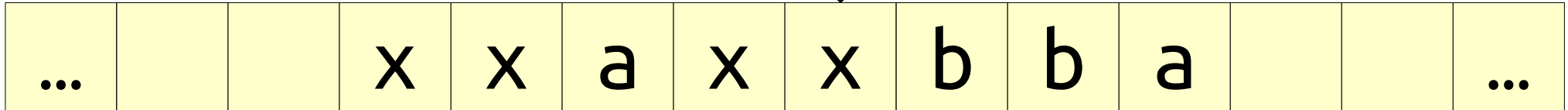
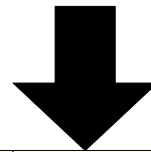


```
Start:  
  If 'a' Goto FoundA  
  Move Right  
  Goto Start
```

```
FoundA:  
  Write 'x'
```

```
LoopA:  
  Move Right  
  If 'a' Goto LoopA  
  If 'x' Goto LoopA  
  Write 'x'  
  Goto GoHome
```

```
GoHome:  
  Move Left  
  If Not Blank Goto GoHome  
  Move Right  
  Goto Start
```



Start:

```
If 'a' Goto FoundA  
Move Right  
Goto Start
```

FoundA:

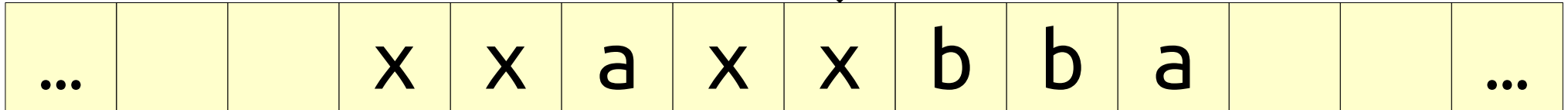
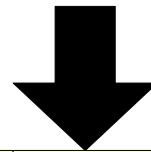
```
Write 'x'
```

LoopA:

```
Move Right  
If 'a' Goto LoopA  
If 'x' Goto LoopA  
Write 'x'  
Goto GoHome
```

GoHome:

```
Move Left  
If Not Blank Goto GoHome  
Move Right  
Goto Start
```



Start:

```
If 'a' Goto FoundA  
Move Right  
Goto Start
```

FoundA:

```
Write 'x'
```

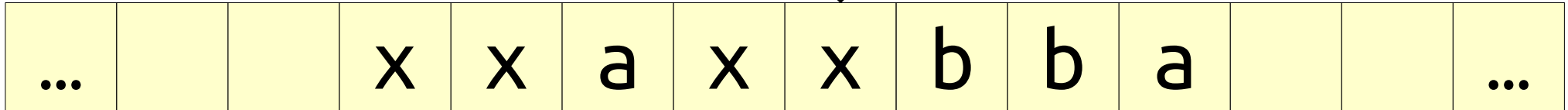
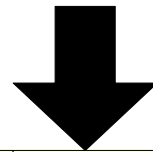
LoopA:

```
Move Right  
If 'a' Goto LoopA  
If 'x' Goto LoopA  
Write 'x'  
Goto GoHome
```

GoHome:

```
Move Left
```

```
If Not Blank Goto GoHome  
Move Right  
Goto Start
```



Start:

```
If 'a' Goto FoundA  
Move Right  
Goto Start
```

FoundA:

```
Write 'x'
```

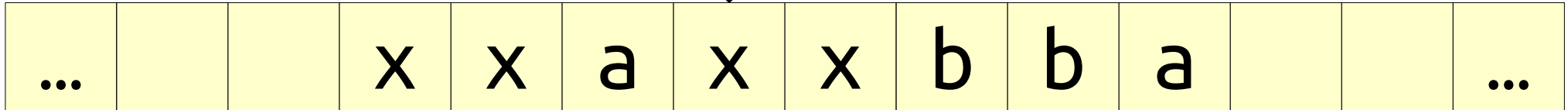
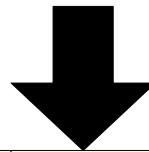
LoopA:

```
Move Right  
If 'a' Goto LoopA  
If 'x' Goto LoopA  
Write 'x'  
Goto GoHome
```

GoHome:

```
Move Left
```

```
If Not Blank Goto GoHome  
Move Right  
Goto Start
```

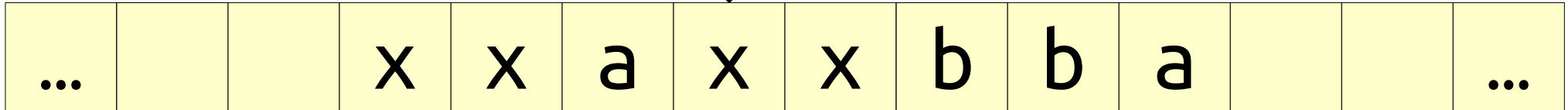
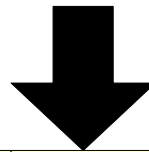


```
Start:  
  If 'a' Goto FoundA  
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FoundA:  
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LoopA:  
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```
GoHome:  
  Move Left  
  If Not Blank Goto GoHome  
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  Goto Start
```



Start:

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If 'a' Goto FoundA  
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```

FoundA:

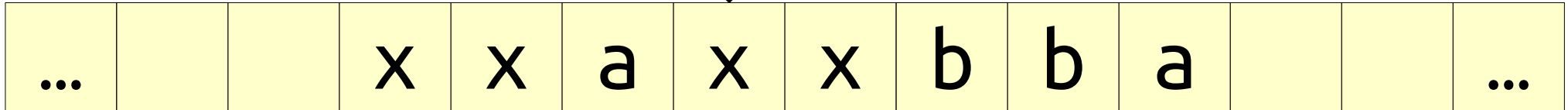
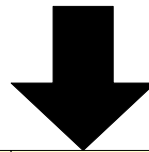
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Write 'x'
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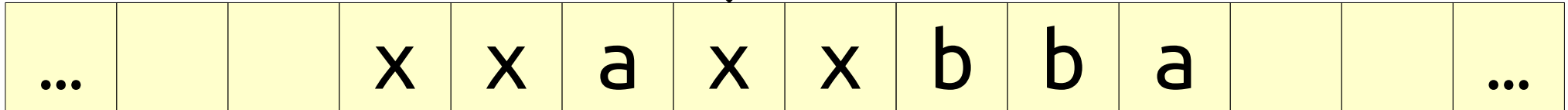
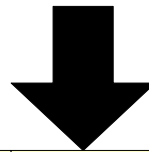
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Start:

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If 'a' Goto FoundA  
Move Right  
Goto Start
```

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Write 'x'
```

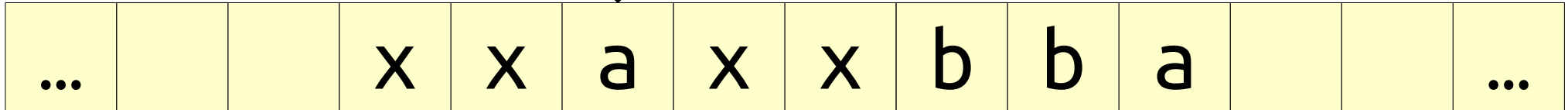
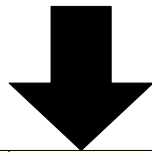
LoopA:

```
Move Right  
If 'a' Goto LoopA  
If 'x' Goto LoopA  
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Goto GoHome
```

GoHome:

```
Move Left
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```
If Not Blank Goto GoHome  
Move Right  
Goto Start
```

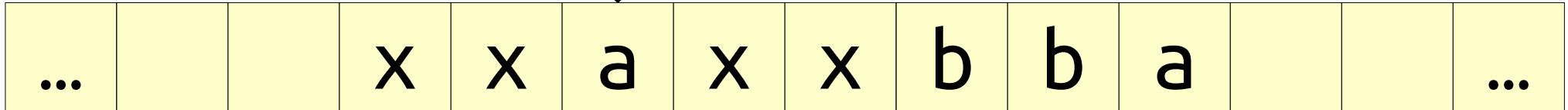
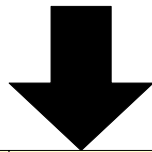


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Start:

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If 'a' Goto FoundA  
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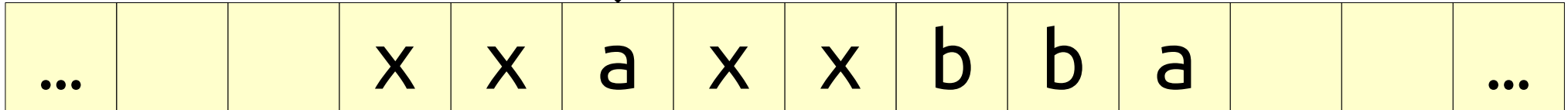
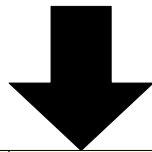
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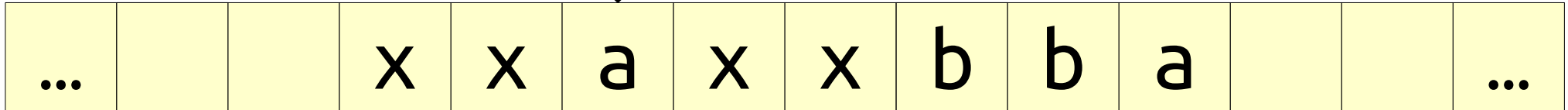
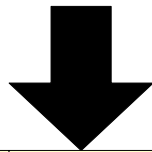
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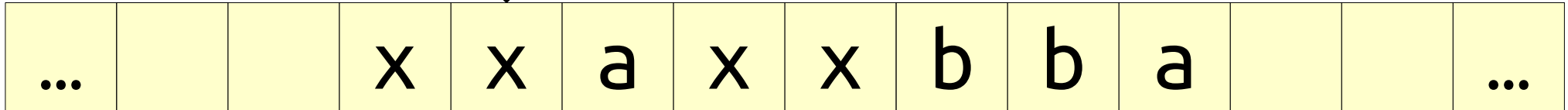
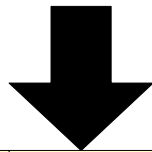
LoopA:

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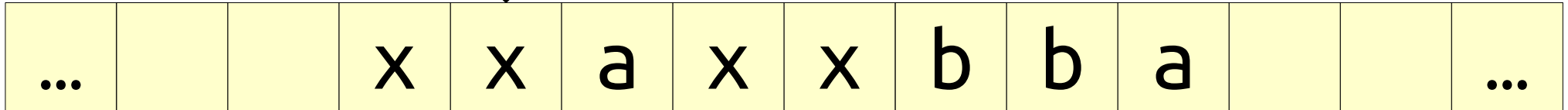
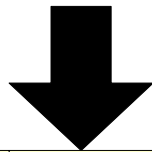


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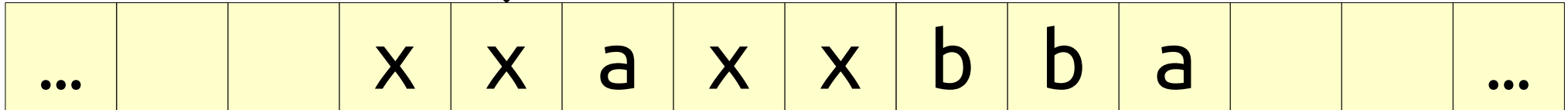
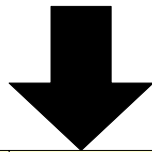
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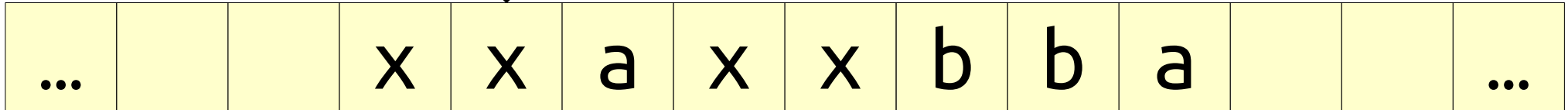
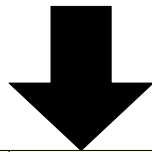
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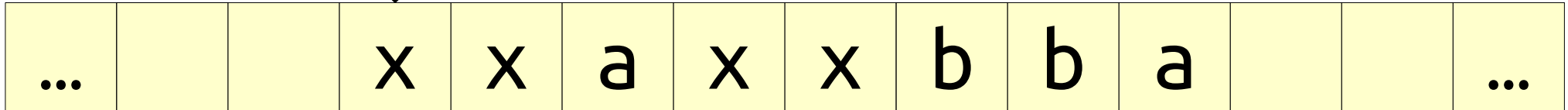
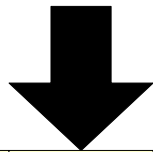
LoopA:

```
Move Right  
If 'a' Goto LoopA  
If 'x' Goto LoopA  
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Goto GoHome
```

GoHome:

```
Move Left
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If Not Blank Goto GoHome  
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Goto Start
```

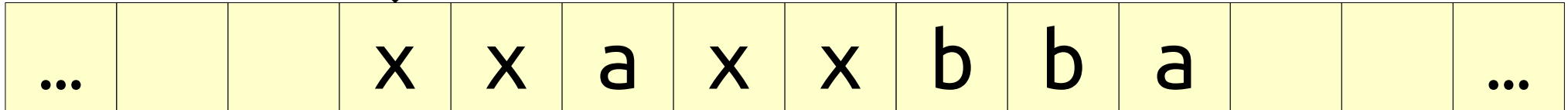
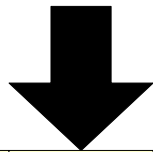


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Start:

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FoundA:

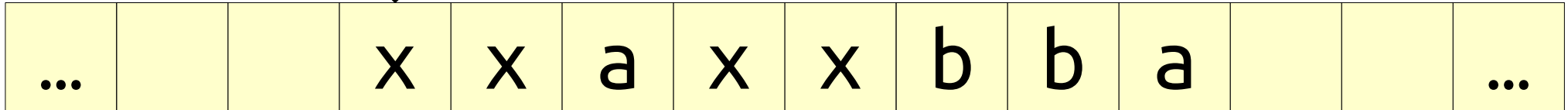
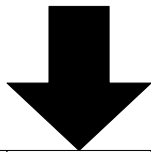
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LoopA:

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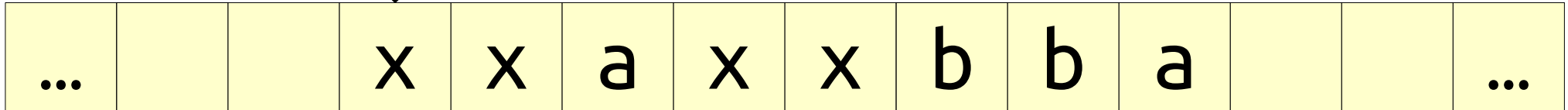
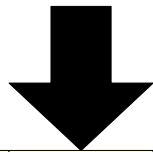
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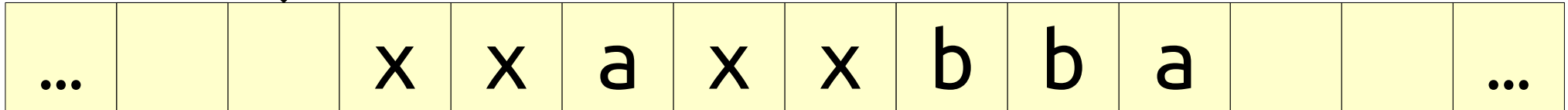
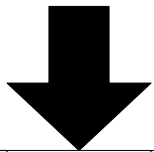


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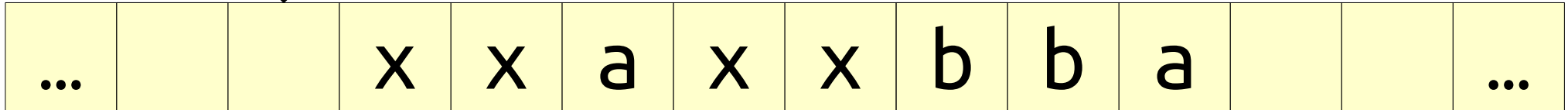
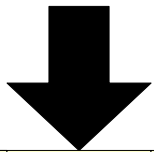


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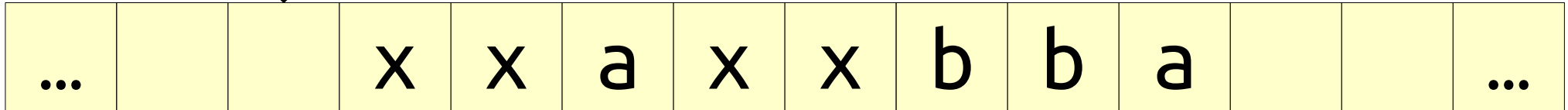
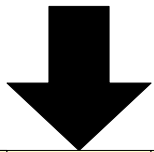



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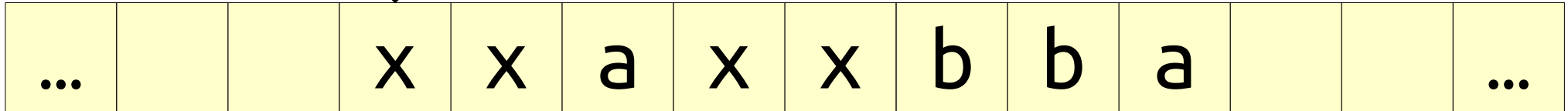
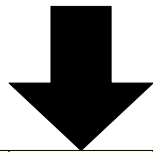


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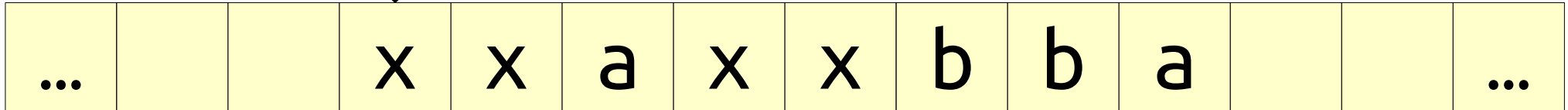
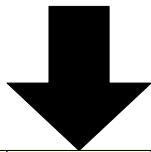


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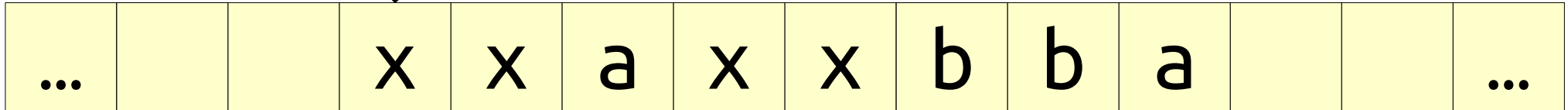
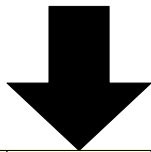
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Goto Start

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Write 'x'

Goto GoHome

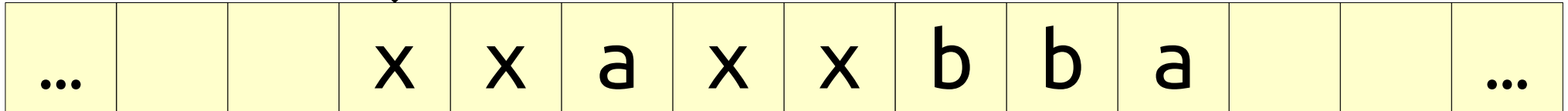
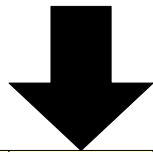
GoHome:

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start



Start:

If 'a' Goto FoundA

Move Right

Goto Start

FoundA:

Write 'x'

LoopA:

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

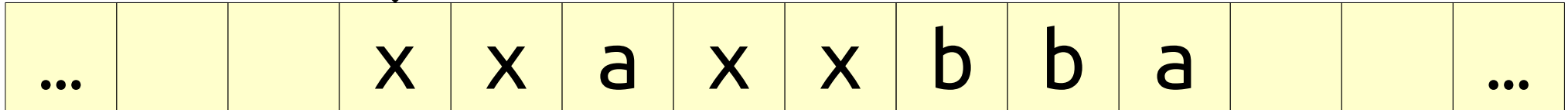
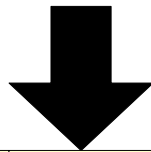
GoHome:

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start



Start:

If 'a' Goto FoundA

Move Right

Goto Start

FoundA:

Write 'x'

LoopA:

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

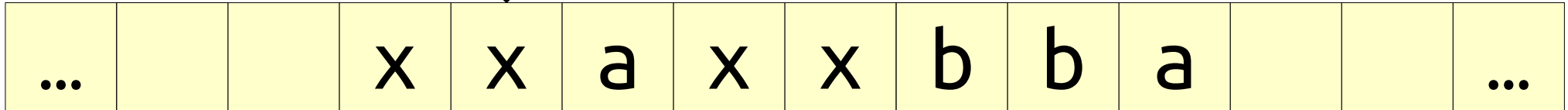
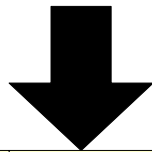
GoHome:

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start



Start:

If 'a' Goto FoundA

Move Right

Goto Start

FoundA:

Write 'x'

LoopA:

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

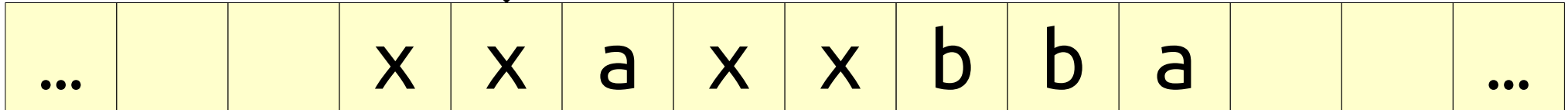
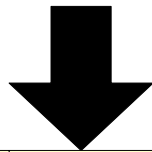
GoHome:

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start



Start:

```
If 'a' Goto FoundA  
Move Right  
Goto Start
```

FoundA:

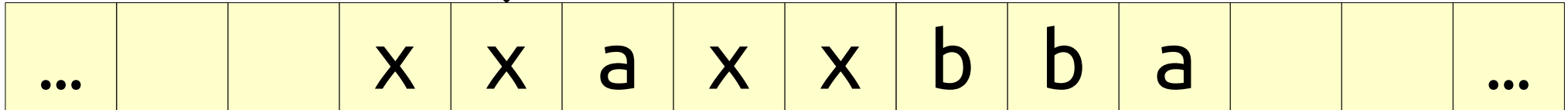
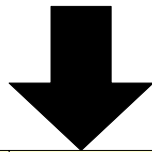
```
Write 'x'
```

LoopA:

```
Move Right  
If 'a' Goto LoopA  
If 'x' Goto LoopA  
Write 'x'  
Goto GoHome
```

GoHome:

```
Move Left  
If Not Blank Goto GoHome  
Move Right  
Goto Start
```



Start:

If 'a' Goto FoundA

Move Right

Goto Start

FoundA:

Write 'x'

LoopA:

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

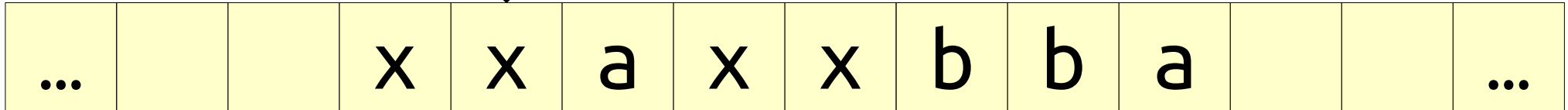
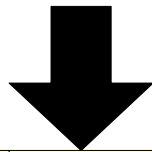
GoHome:

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start



Start:

If 'a' Goto FoundA

Move Right

Goto Start

FoundA:

Write 'x'

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Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

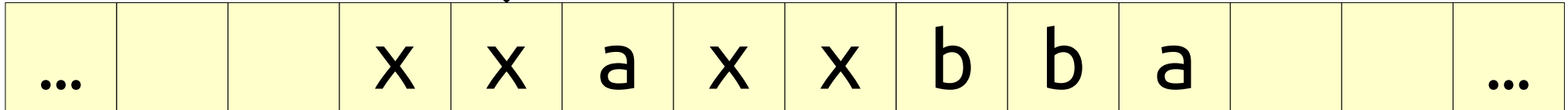
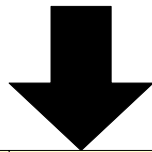
GoHome:

Move Left

If Not Blank Goto GoHome

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Goto Start



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If 'a' Goto FoundA

Move Right

Goto Start

FoundA:

Write 'x'

LoopA:

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

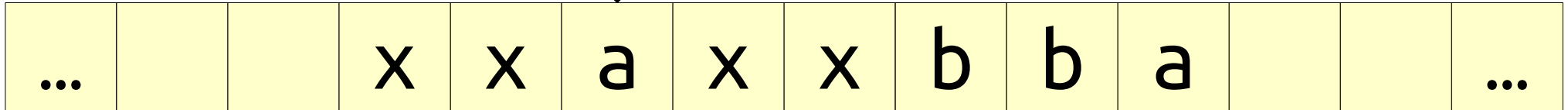
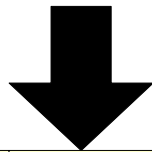
GoHome:

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start



Start:

If 'a' Goto FoundA

Move Right

Goto Start

FoundA:

Write 'x'

LoopA:

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

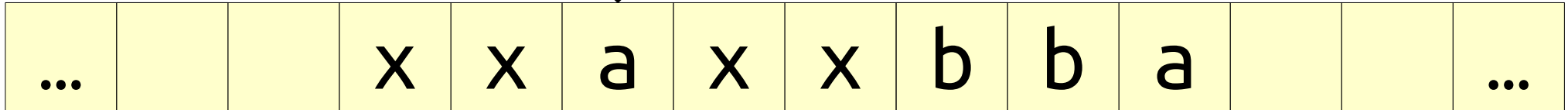
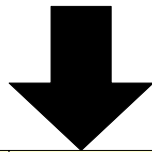
GoHome:

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start



Start:

```
If 'a' Goto FoundA  
Move Right  
Goto Start
```

FoundA:

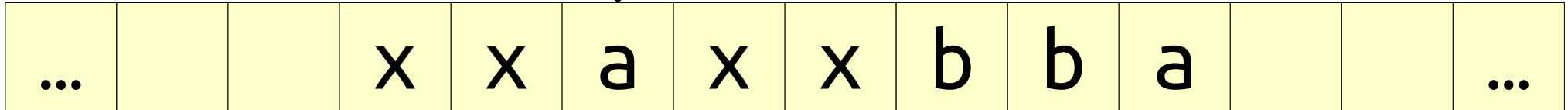
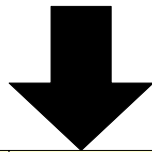
```
Write 'x'
```

LoopA:

```
Move Right  
If 'a' Goto LoopA  
If 'x' Goto LoopA  
Write 'x'  
Goto GoHome
```

GoHome:

```
Move Left  
If Not Blank Goto GoHome  
Move Right  
Goto Start
```



Start:

If 'a' Goto FoundA

Move Right

Goto Start

FoundA:

Write 'x'

LoopA:

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

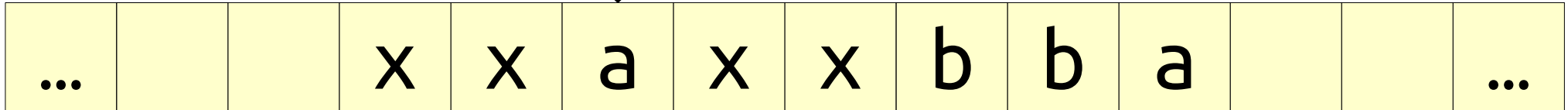
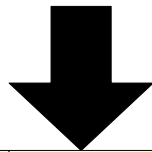
GoHome:

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

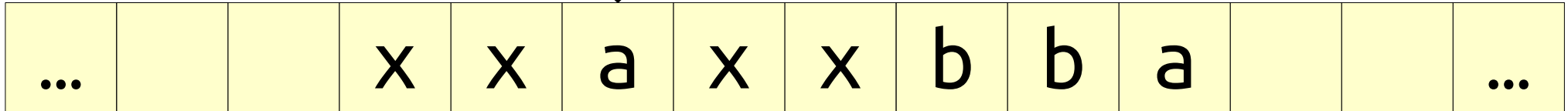
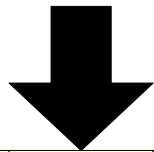


```
Start:  
  If 'a' Goto FoundA  
  Move Right  
  Goto Start
```

```
GoHome:  
  Move Left  
  If Not Blank Goto GoHome  
  Move Right  
  Goto Start
```

FoundA:

```
  Write 'x'  
LoopA:  
  Move Right  
  If 'a' Goto LoopA  
  If 'x' Goto LoopA  
  Write 'x'  
  Goto GoHome
```



Start:

```
If 'a' Goto FoundA  
Move Right  
Goto Start
```

FoundA:

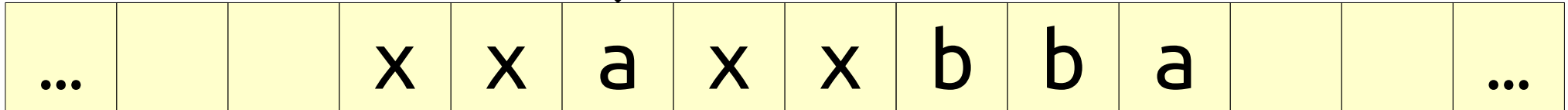
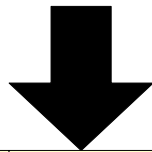
```
Write 'x'
```

LoopA:

```
Move Right  
If 'a' Goto LoopA  
If 'x' Goto LoopA  
Write 'x'  
Goto GoHome
```

GoHome:

```
Move Left  
If Not Blank Goto GoHome  
Move Right  
Goto Start
```



Start:

```
If 'a' Goto FoundA  
Move Right  
Goto Start
```

FoundA:

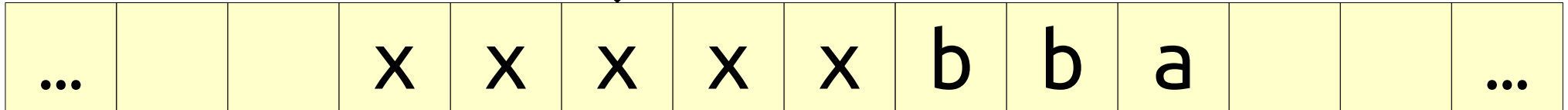
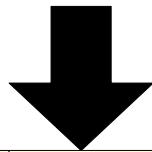
Write 'x'

LoopA:

```
Move Right  
If 'a' Goto LoopA  
If 'x' Goto LoopA  
Write 'x'  
Goto GoHome
```

GoHome:

```
Move Left  
If Not Blank Goto GoHome  
Move Right  
Goto Start
```



Start:

```
If 'a' Goto FoundA  
Move Right  
Goto Start
```

FoundA:

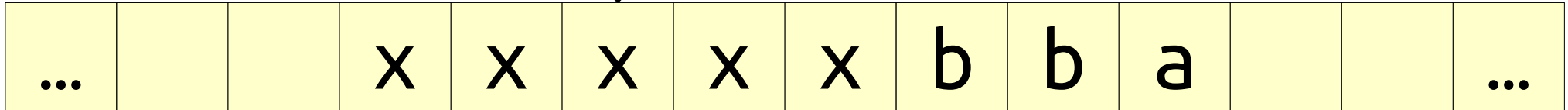
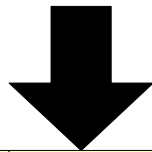
```
Write 'x'
```

LoopA:

```
Move Right  
If 'a' Goto LoopA  
If 'x' Goto LoopA  
Write 'x'  
Goto GoHome
```

GoHome:

```
Move Left  
If Not Blank Goto GoHome  
Move Right  
Goto Start
```



Start:

```
If 'a' Goto FoundA  
Move Right  
Goto Start
```

FoundA:

```
Write 'x'
```

LoopA:

```
Move Right
```

```
If 'a' Goto LoopA
```

```
If 'x' Goto LoopA
```

```
Write 'x'
```

```
Goto GoHome
```

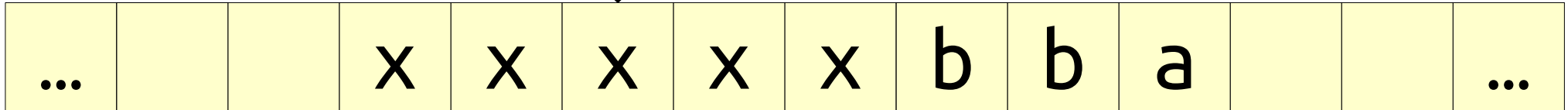
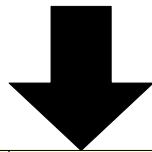
GoHome:

```
Move Left
```

```
If Not Blank Goto GoHome
```

```
Move Right
```

```
Goto Start
```



Start:

```
If 'a' Goto FoundA  
Move Right  
Goto Start
```

FoundA:

```
Write 'x'
```

LoopA:

```
Move Right
```

```
If 'a' Goto LoopA
```

```
If 'x' Goto LoopA
```

```
Write 'x'
```

```
Goto GoHome
```

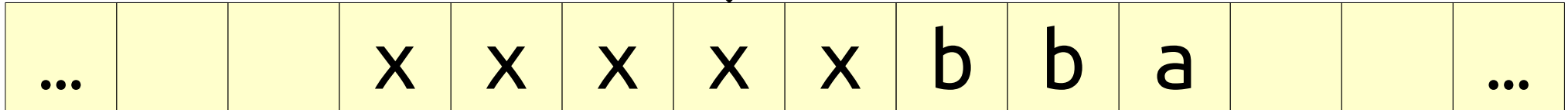
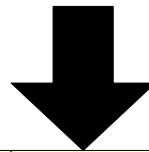
GoHome:

```
Move Left
```

```
If Not Blank Goto GoHome
```

```
Move Right
```

```
Goto Start
```



Start:

```
If 'a' Goto FoundA  
Move Right  
Goto Start
```

FoundA:

```
Write 'x'
```

LoopA:

```
Move Right
```

```
If 'a' Goto LoopA
```

```
If 'x' Goto LoopA
```

```
Write 'x'
```

```
Goto GoHome
```

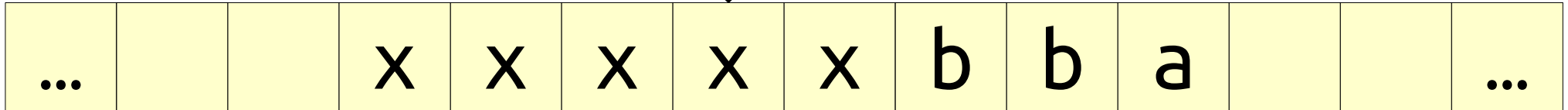
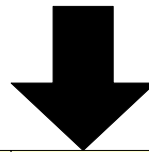
GoHome:

```
Move Left
```

```
If Not Blank Goto GoHome
```

```
Move Right
```

```
Goto Start
```



Start:

```
If 'a' Goto FoundA  
Move Right  
Goto Start
```

FoundA:

```
Write 'x'
```

LoopA:

```
Move Right
```

```
If 'a' Goto LoopA
```

```
If 'x' Goto LoopA
```

```
Write 'x'
```

```
Goto GoHome
```

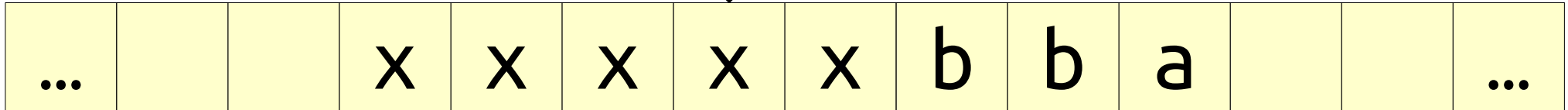
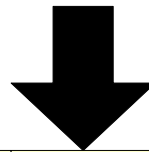
GoHome:

```
Move Left
```

```
If Not Blank Goto GoHome
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```
Move Right
```

```
Goto Start
```



Start:

```
If 'a' Goto FoundA  
Move Right  
Goto Start
```

FoundA:

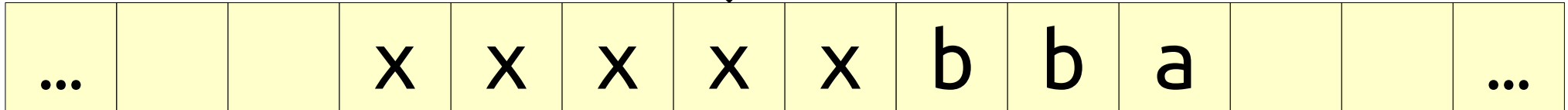
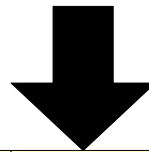
```
Write 'x'
```

LoopA:

```
Move Right  
If 'a' Goto LoopA  
If 'x' Goto LoopA  
Write 'x'  
Goto GoHome
```

GoHome:

```
Move Left  
If Not Blank Goto GoHome  
Move Right  
Goto Start
```

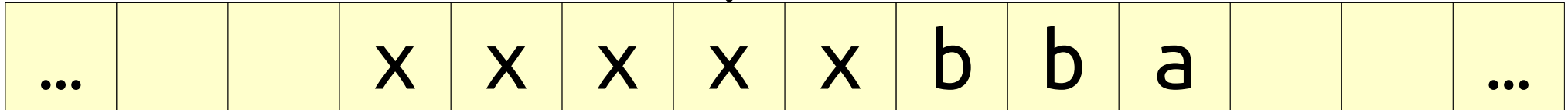
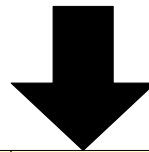



```
Start:  
  If 'a' Goto FoundA  
  Move Right  
  Goto Start
```

```
FoundA:  
  Write 'x'
```

```
LoopA:  
  Move Right  
  If 'a' Goto LoopA  
  If 'x' Goto LoopA  
  Write 'x'  
  Goto GoHome
```

```
GoHome:  
  Move Left  
  If Not Blank Goto GoHome  
  Move Right  
  Goto Start
```

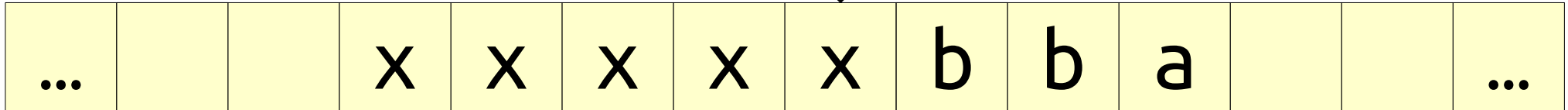
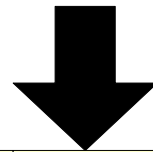


```
Start:
  If 'a' Goto FoundA
  Move Right
  Goto Start
```

```
FoundA:
  Write 'x'
```

```
LoopA:
  Move Right
  If 'a' Goto LoopA
  If 'x' Goto LoopA
  Write 'x'
  Goto GoHome
```

```
GoHome:
  Move Left
  If Not Blank Goto GoHome
  Move Right
  Goto Start
```



Start:

```
If 'a' Goto FoundA  
Move Right  
Goto Start
```

FoundA:

```
Write 'x'
```

LoopA:

```
Move Right
```

```
If 'a' Goto LoopA
```

```
If 'x' Goto LoopA
```

```
Write 'x'
```

```
Goto GoHome
```

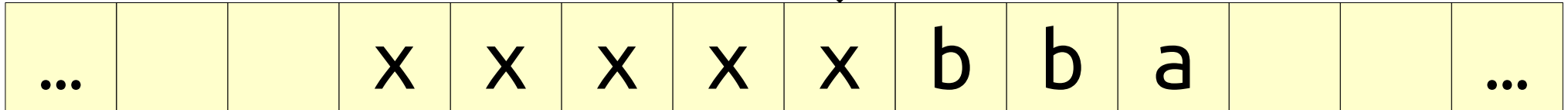
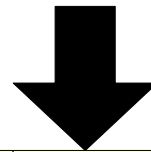
GoHome:

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Write 'x'
```

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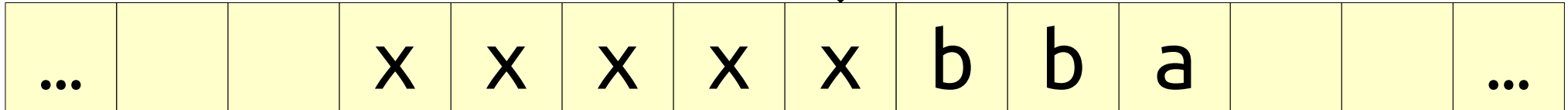
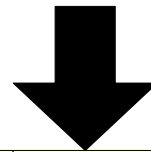
GoHome:

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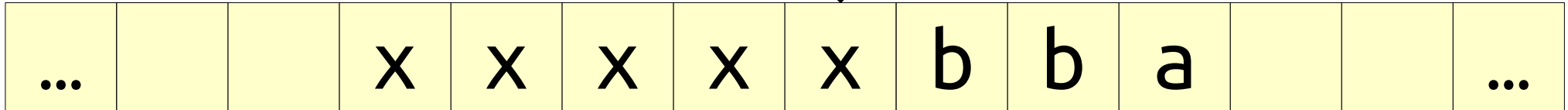
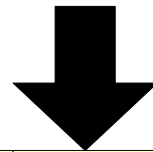


```
Start:  
  If 'a' Goto FoundA  
  Move Right  
  Goto Start
```

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FoundA:  
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```

```
LoopA:  
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  If 'a' Goto LoopA  
  If 'x' Goto LoopA  
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  Goto GoHome
```

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GoHome:  
  Move Left  
  If Not Blank Goto GoHome  
  Move Right  
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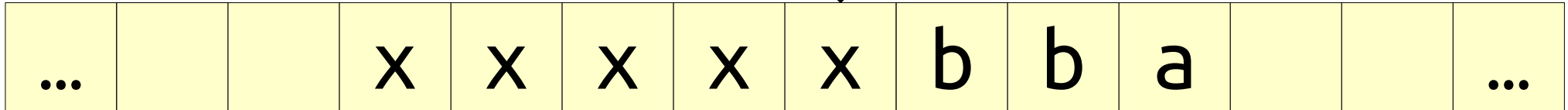
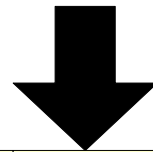


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Start:  
  If 'a' Goto FoundA  
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If 'a' Goto LoopA
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If 'x' Goto LoopA
```

```
Write 'x'
```

```
Goto GoHome
```

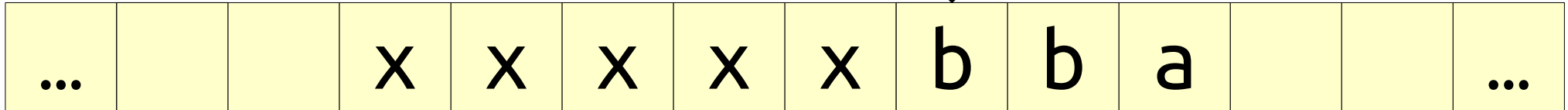
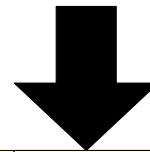
GoHome:

```
Move Left
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If Not Blank Goto GoHome
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Goto Start
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Move Right  
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```

```
If 'x' Goto LoopA
```

```
Write 'x'
```

```
Goto GoHome
```

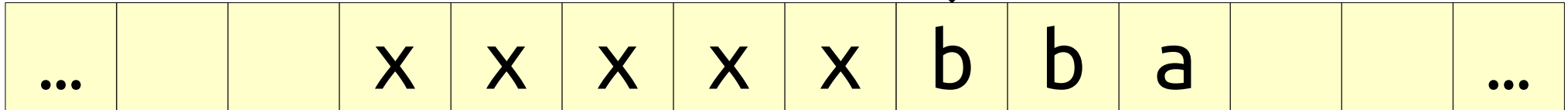
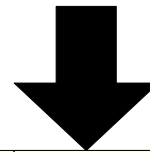
GoHome:

```
Move Left
```

```
If Not Blank Goto GoHome
```

```
Move Right
```

```
Goto Start
```



Start:

```
If 'a' Goto FoundA  
Move Right  
Goto Start
```

FoundA:

```
Write 'x'
```

LoopA:

```
Move Right
```

```
If 'a' Goto LoopA
```

```
If 'x' Goto LoopA
```

```
Write 'x'
```

```
Goto GoHome
```

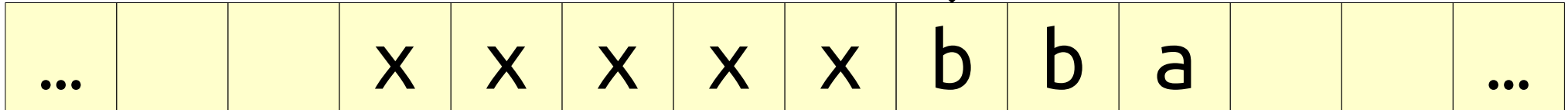
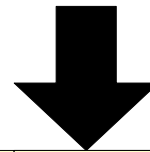
GoHome:

```
Move Left
```

```
If Not Blank Goto GoHome
```

```
Move Right
```

```
Goto Start
```



Start:

```
If 'a' Goto FoundA  
Move Right  
Goto Start
```

FoundA:

```
Write 'x'
```

LoopA:

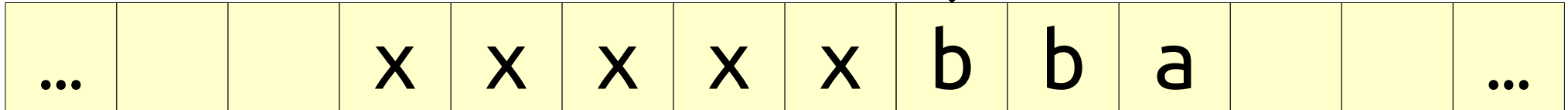
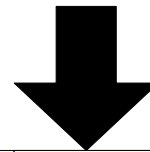
```
Move Right  
If 'a' Goto LoopA  
If 'x' Goto LoopA
```

```
Write 'x'
```

```
Goto GoHome
```

GoHome:

```
Move Left  
If Not Blank Goto GoHome  
Move Right  
Goto Start
```

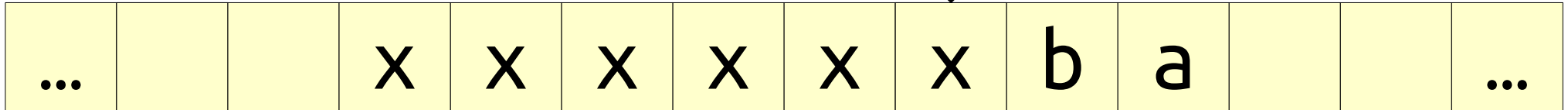
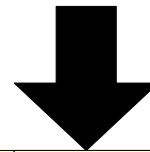


```
Start:  
  If 'a' Goto FoundA  
  Move Right  
  Goto Start
```

```
FoundA:  
  Write 'x'
```

```
LoopA:  
  Move Right  
  If 'a' Goto LoopA  
  If 'x' Goto LoopA  
  Write 'x'  
  Goto GoHome
```

```
GoHome:  
  Move Left  
  If Not Blank Goto GoHome  
  Move Right  
  Goto Start
```

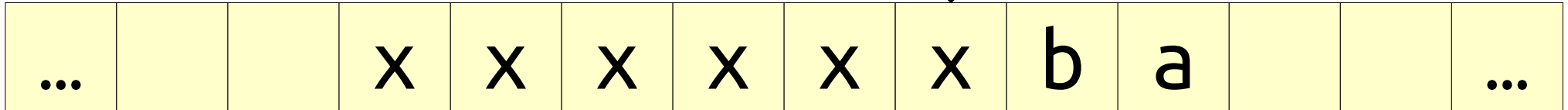
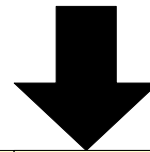


```
Start:
  If 'a' Goto FoundA
  Move Right
  Goto Start
```

```
FoundA:
  Write 'x'
```

```
LoopA:
  Move Right
  If 'a' Goto LoopA
  If 'x' Goto LoopA
  Write 'x'
  Goto GoHome
```

```
GoHome:
  Move Left
  If Not Blank Goto GoHome
  Move Right
  Goto Start
```



Start:

```
If 'a' Goto FoundA  
Move Right  
Goto Start
```

FoundA:

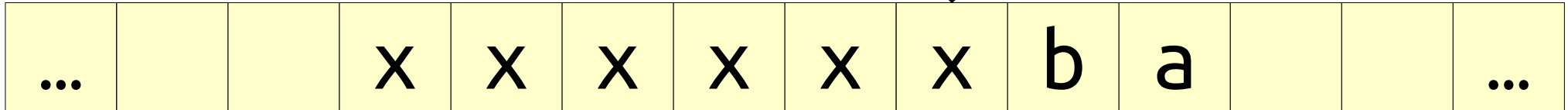
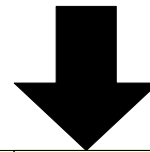
```
Write 'x'
```

LoopA:

```
Move Right  
If 'a' Goto LoopA  
If 'x' Goto LoopA  
Write 'x'  
Goto GoHome
```

GoHome:

```
Move Left  
If Not Blank Goto GoHome  
Move Right  
Goto Start
```



Start:

```
If 'a' Goto FoundA  
Move Right  
Goto Start
```

FoundA:

```
Write 'x'
```

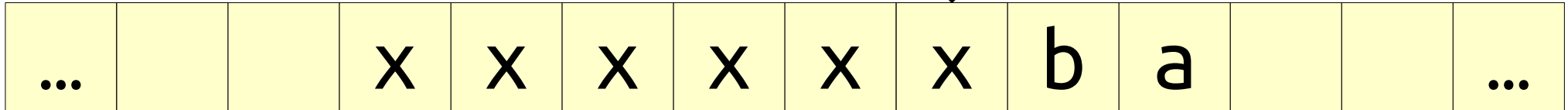
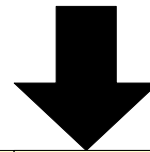
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Goto Start
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Start:

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If 'a' Goto FoundA  
Move Right  
Goto Start
```

FoundA:

```
Write 'x'
```

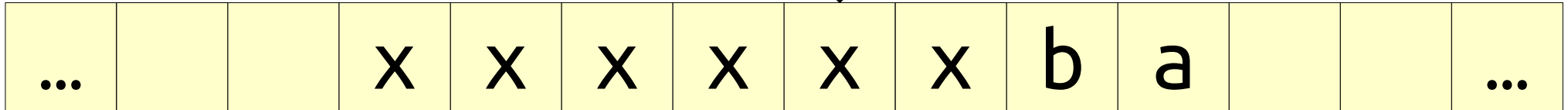
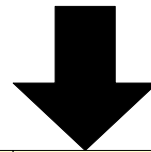
LoopA:

```
Move Right  
If 'a' Goto LoopA  
If 'x' Goto LoopA  
Write 'x'  
Goto GoHome
```

GoHome:

```
Move Left
```

```
If Not Blank Goto GoHome  
Move Right  
Goto Start
```

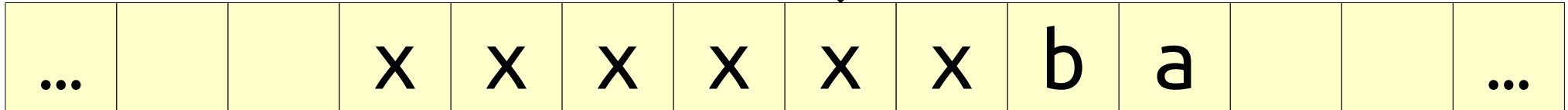
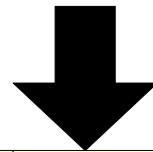


```
Start:  
  If 'a' Goto FoundA  
  Move Right  
  Goto Start
```

```
FoundA:  
  Write 'x'
```

```
LoopA:  
  Move Right  
  If 'a' Goto LoopA  
  If 'x' Goto LoopA  
  Write 'x'  
  Goto GoHome
```

```
GoHome:  
  Move Left  
  If Not Blank Goto GoHome  
  Move Right  
  Goto Start
```



Start:

```
If 'a' Goto FoundA  
Move Right  
Goto Start
```

FoundA:

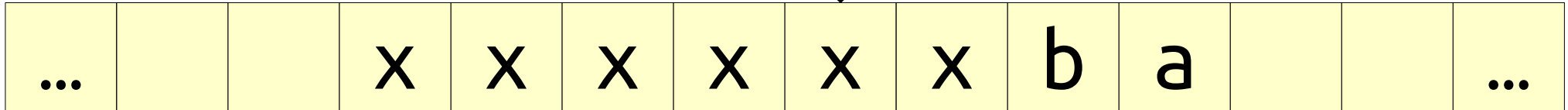
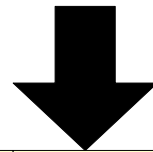
```
Write 'x'
```

LoopA:

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If 'a' Goto LoopA  
If 'x' Goto LoopA  
Write 'x'  
Goto GoHome
```

GoHome:

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Move Left  
If Not Blank Goto GoHome  
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Start:

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If 'a' Goto FoundA  
Move Right  
Goto Start
```

FoundA:

```
Write 'x'
```

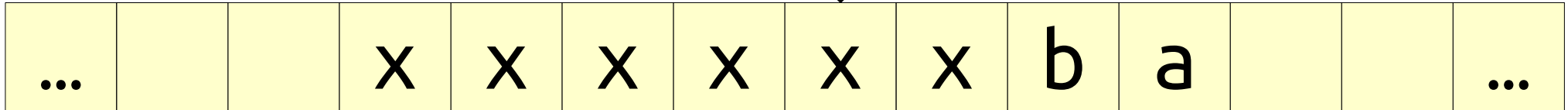
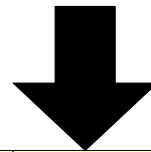
LoopA:

```
Move Right  
If 'a' Goto LoopA  
If 'x' Goto LoopA  
Write 'x'  
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GoHome:

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If Not Blank Goto GoHome  
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Goto Start
```



Start:

```
If 'a' Goto FoundA  
Move Right  
Goto Start
```

FoundA:

```
Write 'x'
```

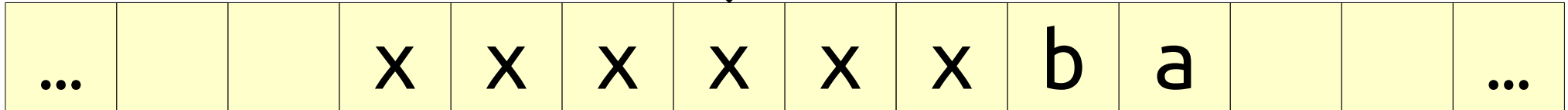
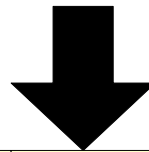
LoopA:

```
Move Right  
If 'a' Goto LoopA  
If 'x' Goto LoopA  
Write 'x'  
Goto GoHome
```

GoHome:

```
Move Left
```

```
If Not Blank Goto GoHome  
Move Right  
Goto Start
```

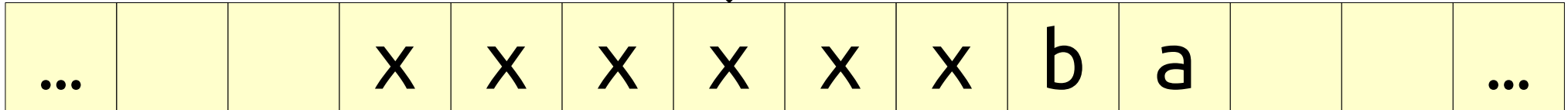
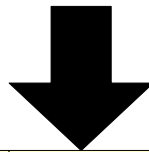


```
Start:  
  If 'a' Goto FoundA  
  Move Right  
  Goto Start
```

```
FoundA:  
  Write 'x'
```

```
LoopA:  
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  If 'a' Goto LoopA  
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  Write 'x'  
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```
GoHome:  
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  If Not Blank Goto GoHome  
  Move Right  
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```



Start:

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If 'a' Goto FoundA  
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Goto Start
```

FoundA:

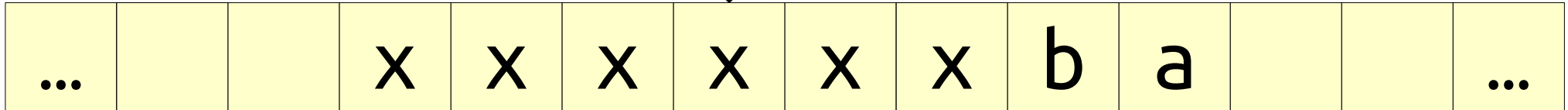
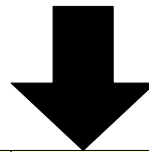
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Write 'x'
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GoHome:

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Move Left  
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Goto Start
```

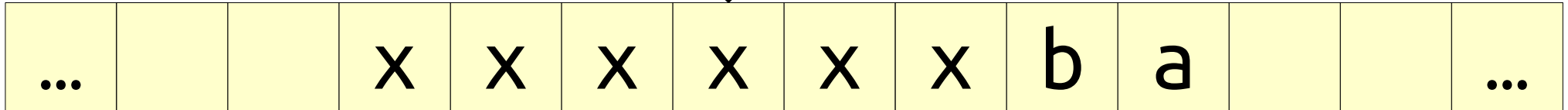
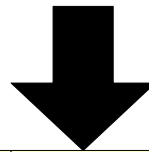


```
Start:  
  If 'a' Goto FoundA  
  Move Right  
  Goto Start
```

```
FoundA:  
  Write 'x'
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If 'a' Goto FoundA  
Move Right  
Goto Start
```

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```
Write 'x'
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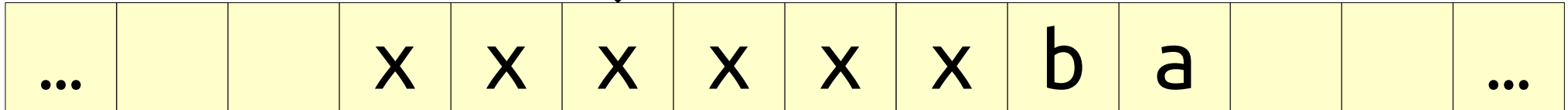
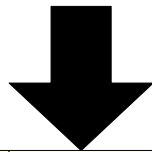
LoopA:

```
Move Right  
If 'a' Goto LoopA  
If 'x' Goto LoopA  
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```

GoHome:

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If Not Blank Goto GoHome  
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```

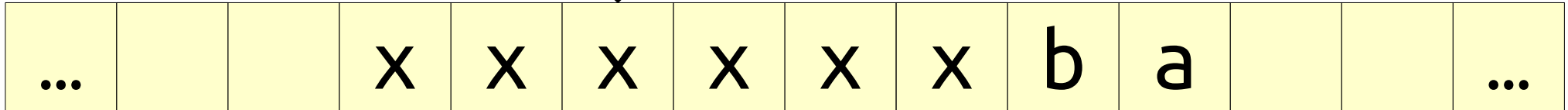
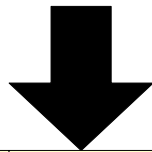


```
Start:  
  If 'a' Goto FoundA  
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  Goto Start
```

```
FoundA:  
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```
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If 'a' Goto FoundA  
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FoundA:

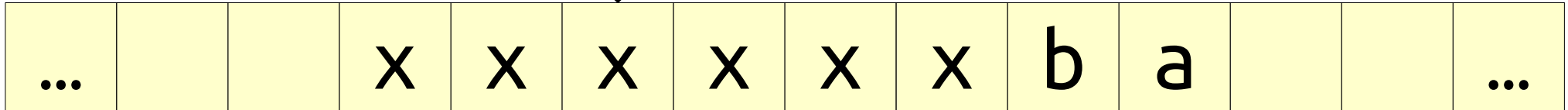
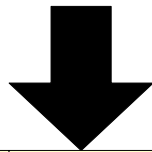
```
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LoopA:

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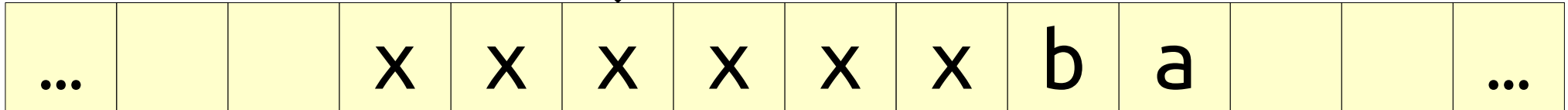
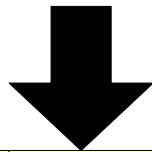
LoopA:

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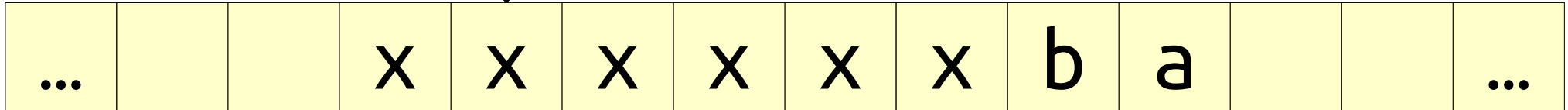
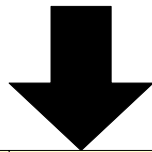
LoopA:

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If 'a' Goto LoopA  
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GoHome:

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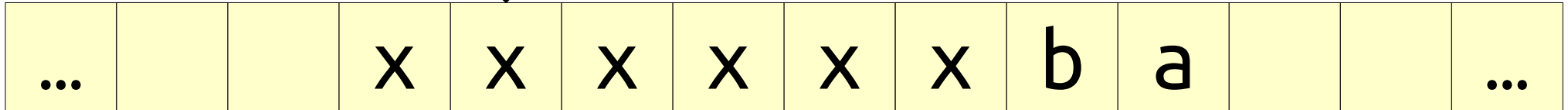
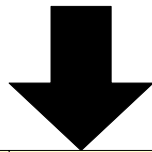


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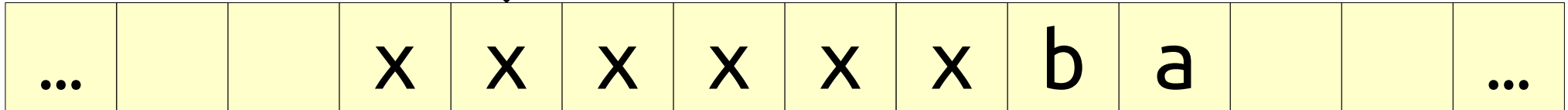
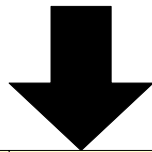
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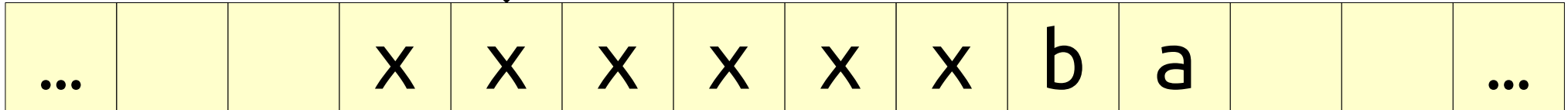
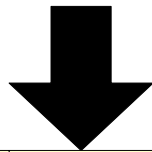
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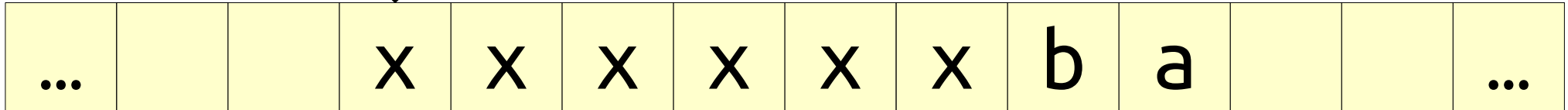
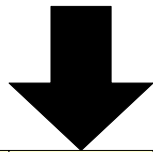
LoopA:

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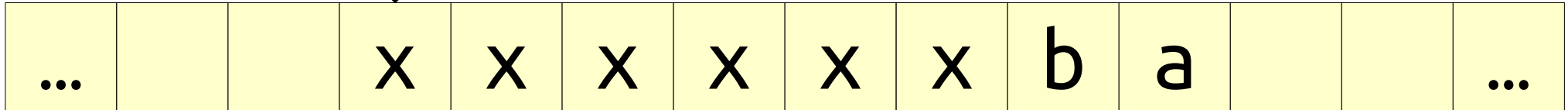
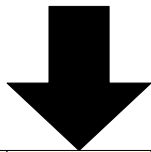


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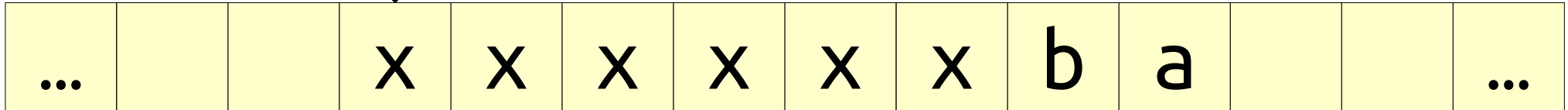
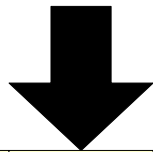
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```

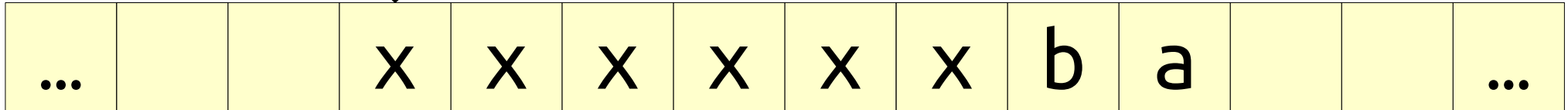
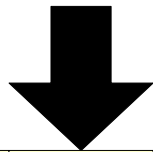
LoopA:

```
Move Right  
If 'a' Goto LoopA  
If 'x' Goto LoopA  
Write 'x'  
Goto GoHome
```

GoHome:

```
Move Left
```

```
If Not Blank Goto GoHome  
Move Right  
Goto Start
```

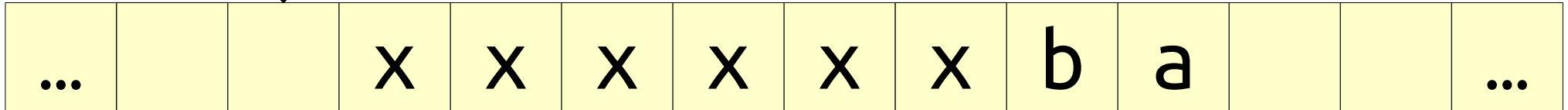
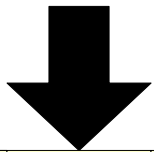


```
Start:  
  If 'a' Goto FoundA  
  Move Right  
  Goto Start
```

```
FoundA:  
  Write 'x'
```

```
LoopA:  
  Move Right  
  If 'a' Goto LoopA  
  If 'x' Goto LoopA  
  Write 'x'  
  Goto GoHome
```

```
GoHome:  
  Move Left  
  If Not Blank Goto GoHome  
  Move Right  
  Goto Start
```

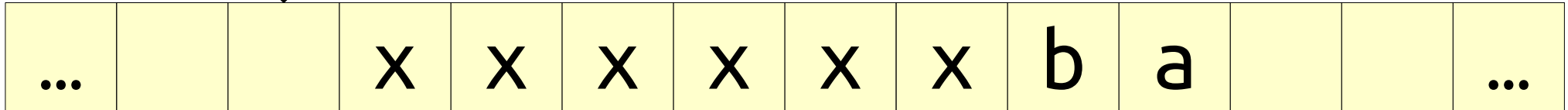
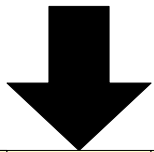


```
Start:  
  If 'a' Goto FoundA  
  Move Right  
  Goto Start
```

```
FoundA:  
  Write 'x'
```

```
LoopA:  
  Move Right  
  If 'a' Goto LoopA  
  If 'x' Goto LoopA  
  Write 'x'  
  Goto GoHome
```

```
GoHome:  
  Move Left  
  If Not Blank Goto GoHome  
  Move Right  
  Goto Start
```

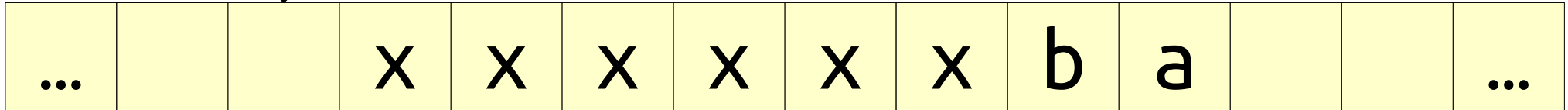
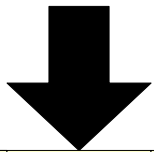


```
Start:  
  If 'a' Goto FoundA  
  Move Right  
  Goto Start
```

```
FoundA:  
  Write 'x'
```

```
LoopA:  
  Move Right  
  If 'a' Goto LoopA  
  If 'x' Goto LoopA  
  Write 'x'  
  Goto GoHome
```

```
GoHome:  
  Move Left  
  If Not Blank Goto GoHome  
  Move Right  
  Goto Start
```

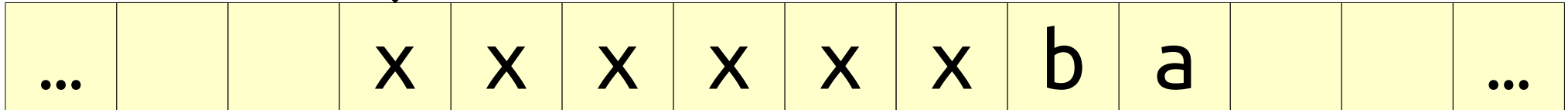
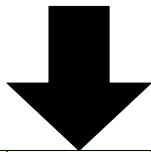


```
Start:
  If 'a' Goto FoundA
  Move Right
  Goto Start
```

```
FoundA:
  Write 'x'
```

```
LoopA:
  Move Right
  If 'a' Goto LoopA
  If 'x' Goto LoopA
  Write 'x'
  Goto GoHome
```

```
GoHome:
  Move Left
  If Not Blank Goto GoHome
  Move Right
  Goto Start
```

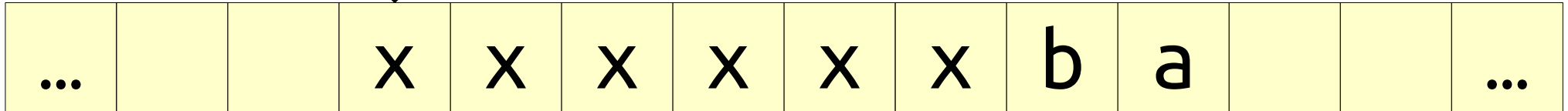
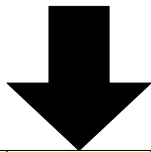


```
Start:  
  If 'a' Goto FoundA  
  Move Right  
  Goto Start
```

```
FoundA:  
  Write 'x'
```

```
LoopA:  
  Move Right  
  If 'a' Goto LoopA  
  If 'x' Goto LoopA  
  Write 'x'  
  Goto GoHome
```

```
GoHome:  
  Move Left  
  If Not Blank Goto GoHome  
  Move Right  
  Goto Start
```



Start:

```
If 'a' Goto FoundA  
Move Right  
Goto Start
```

FoundA:

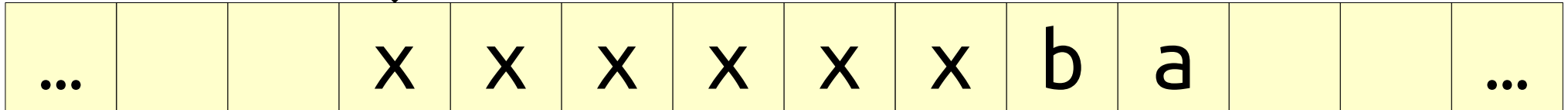
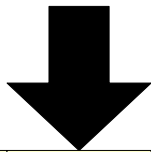
```
Write 'x'
```

LoopA:

```
Move Right  
If 'a' Goto LoopA  
If 'x' Goto LoopA  
Write 'x'  
Goto GoHome
```

GoHome:

```
Move Left  
If Not Blank Goto GoHome  
Move Right  
Goto Start
```



Start:

If 'a' Goto FoundA

Move Right

Goto Start

FoundA:

Write 'x'

LoopA:

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

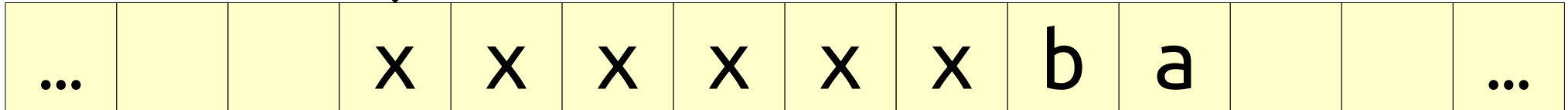
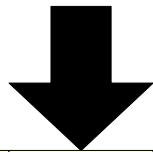
GoHome:

Move Left

If Not Blank Goto GoHome

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Write 'x'

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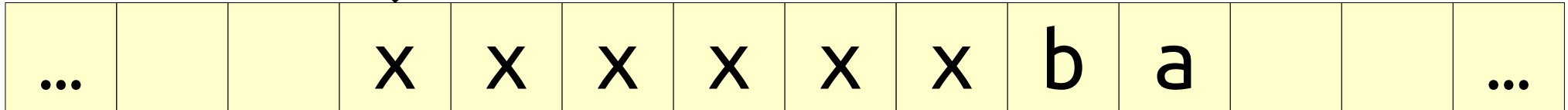
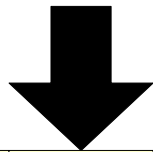
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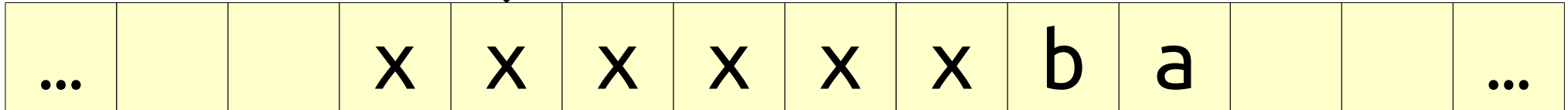
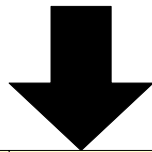
GoHome:

Move Left

If Not Blank Goto GoHome

Move Right

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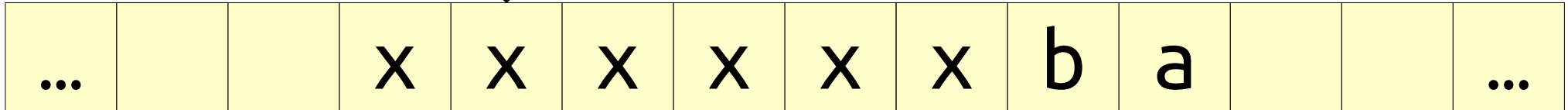
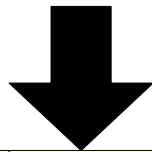
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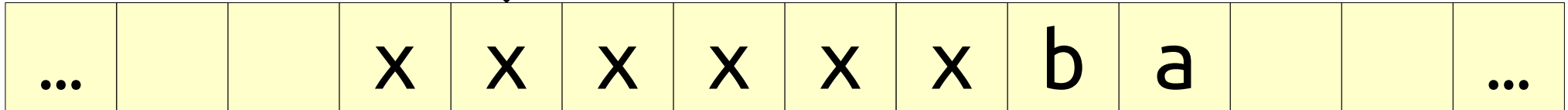
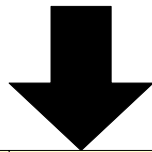
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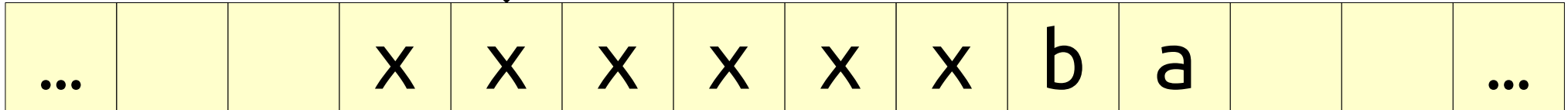
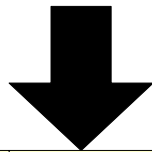
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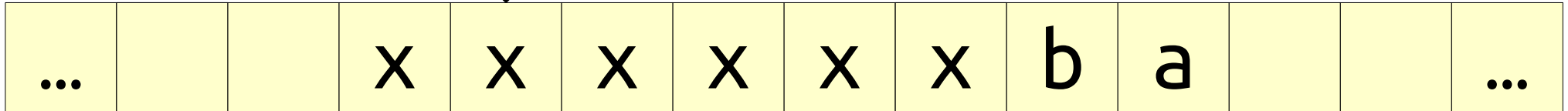
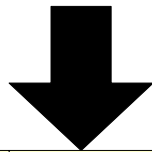
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If 'x' Goto LoopA

Write 'x'

Goto GoHome

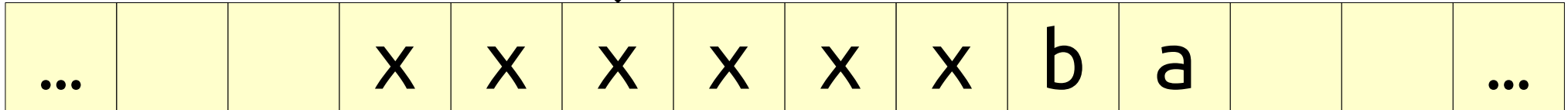
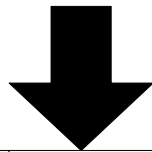
GoHome:

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start



Start:

If 'a' Goto FoundA

Move Right

Goto Start

FoundA:

Write 'x'

LoopA:

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

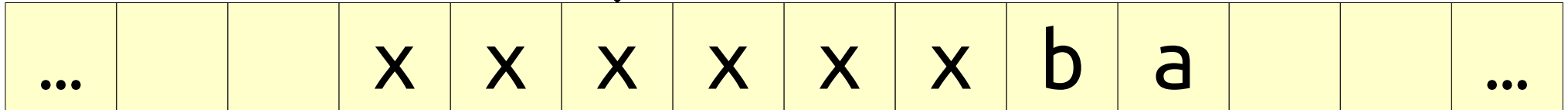
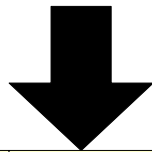
GoHome:

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If Not Blank Goto GoHome

Move Right

Goto Start



Start:

```
If 'a' Goto FoundA  
Move Right  
Goto Start
```

FoundA:

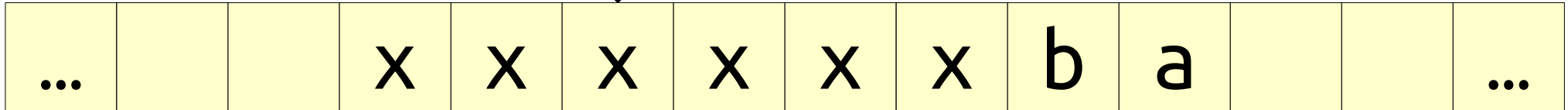
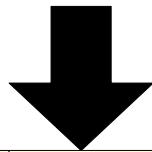
```
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```

LoopA:

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If 'x' Goto LoopA  
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Goto Start

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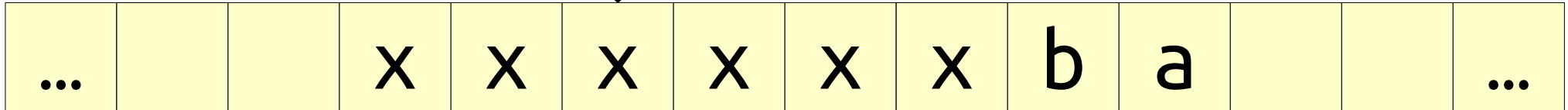
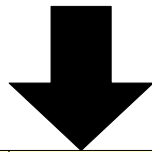
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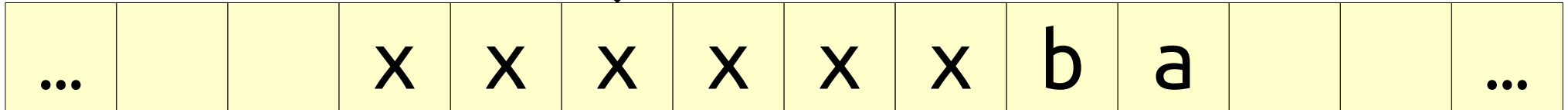
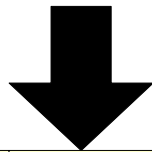
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If 'x' Goto LoopA

Write 'x'

Goto GoHome

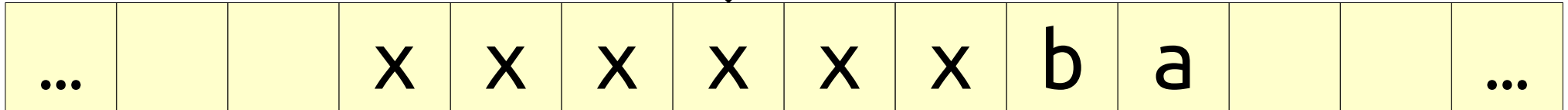
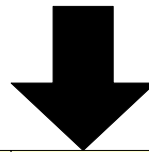
GoHome:

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start



Start:

If 'a' Goto FoundA

Move Right

Goto Start

FoundA:

Write 'x'

LoopA:

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

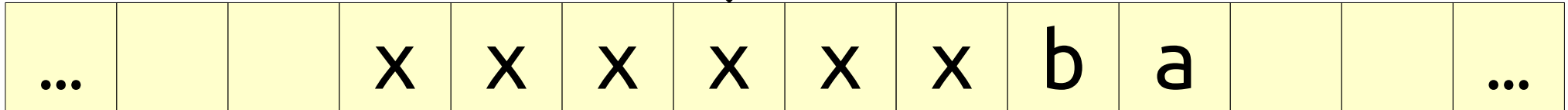
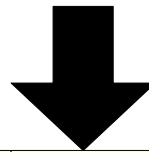
GoHome:

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start



Start:

```
If 'a' Goto FoundA  
Move Right  
Goto Start
```

FoundA:

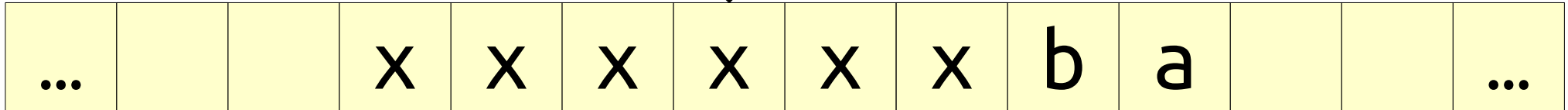
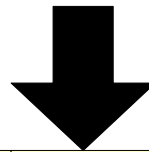
```
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```

LoopA:

```
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If 'a' Goto LoopA  
If 'x' Goto LoopA  
Write 'x'  
Goto GoHome
```

GoHome:

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```



Start:

If 'a' Goto FoundA

Move Right

Goto Start

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LoopA:

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Goto GoHome

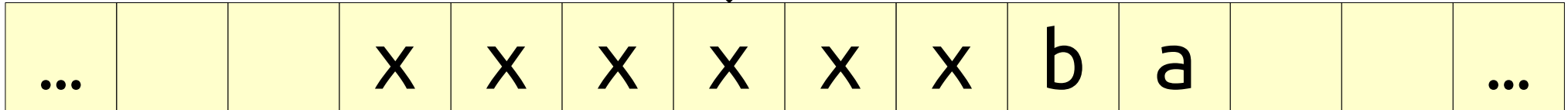
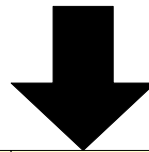
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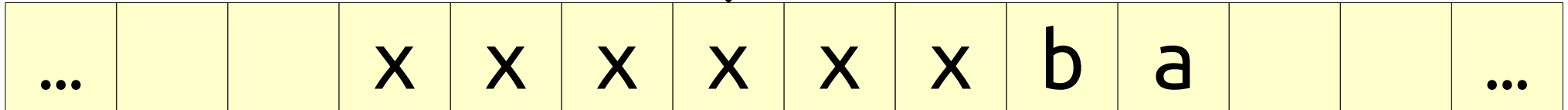
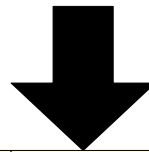
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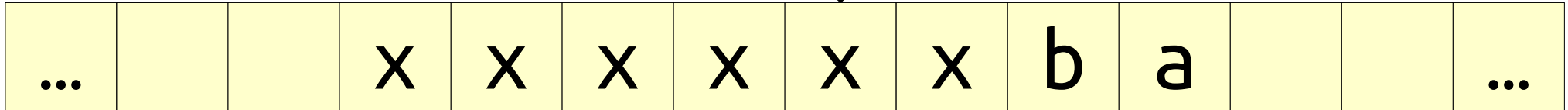
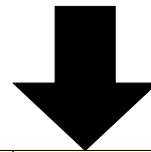


```
Start:  
  If 'a' Goto FoundA  
  Move Right  
  Goto Start
```

```
FoundA:  
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```
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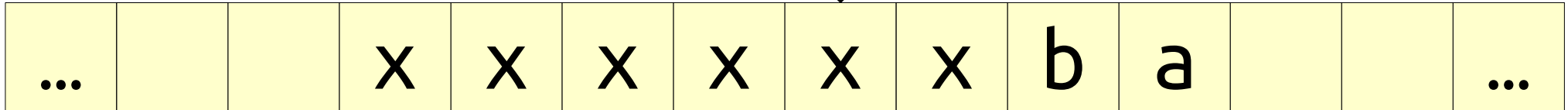
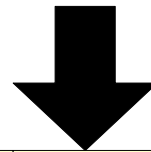
GoHome:

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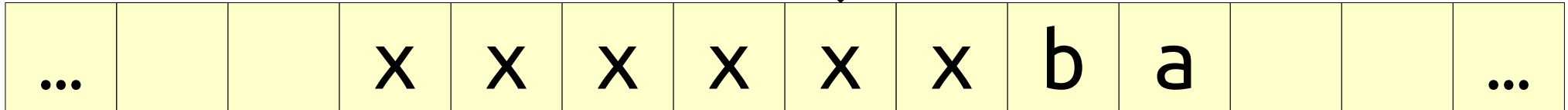
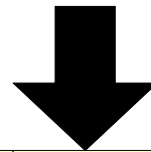
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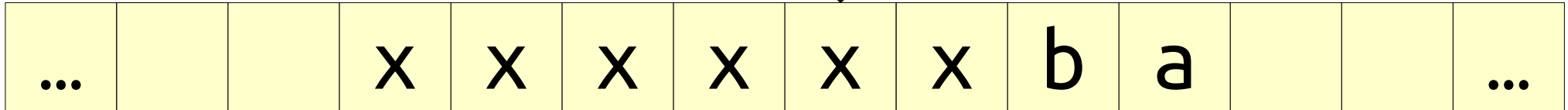
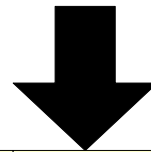
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Goto GoHome

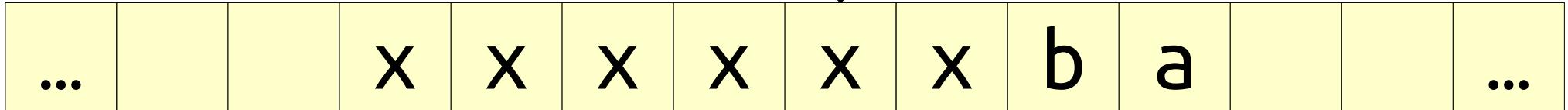
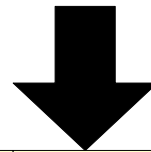
GoHome:

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start



Start:

If 'a' Goto FoundA

Move Right

Goto Start

FoundA:

Write 'x'

LoopA:

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

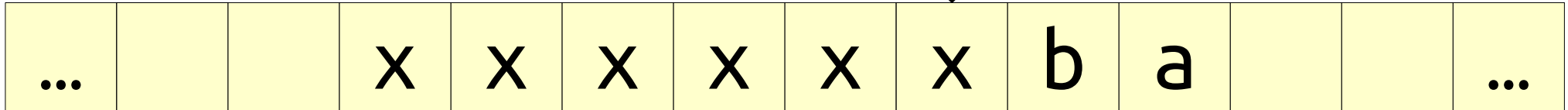
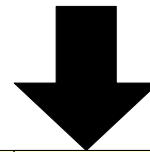
GoHome:

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start



Start:

If 'a' Goto FoundA

Move Right

Goto Start

FoundA:

Write 'x'

LoopA:

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

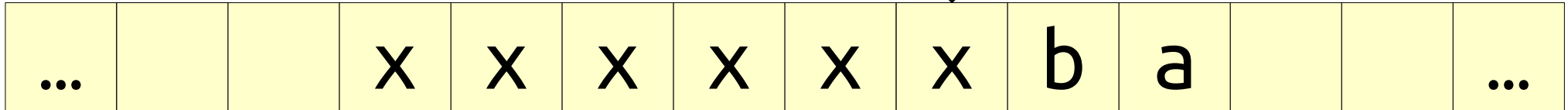
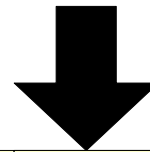
GoHome:

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start



Start:

```
If 'a' Goto FoundA  
Move Right  
Goto Start
```

FoundA:

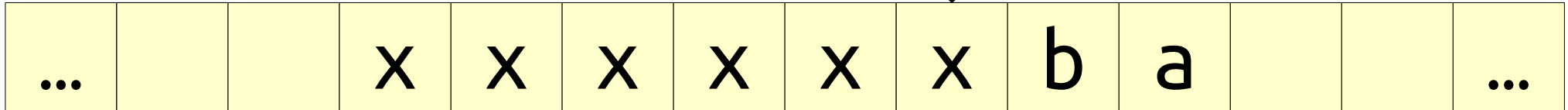
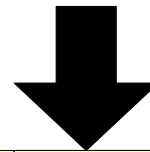
```
Write 'x'
```

LoopA:

```
Move Right  
If 'a' Goto LoopA  
If 'x' Goto LoopA  
Write 'x'  
Goto GoHome
```

GoHome:

```
Move Left  
If Not Blank Goto GoHome  
Move Right  
Goto Start
```



Start:

If 'a' Goto FoundA

Move Right

Goto Start

FoundA:

Write 'x'

LoopA:

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

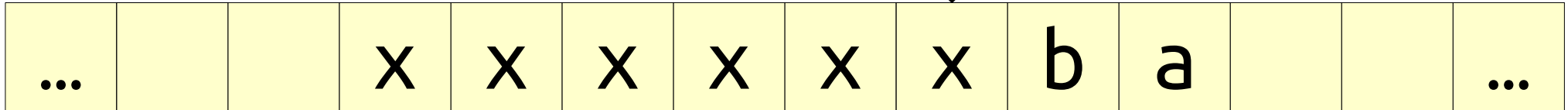
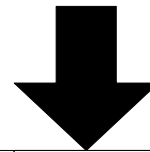
GoHome:

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start



Start:

If 'a' Goto FoundA

Move Right

Goto Start

FoundA:

Write 'x'

LoopA:

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

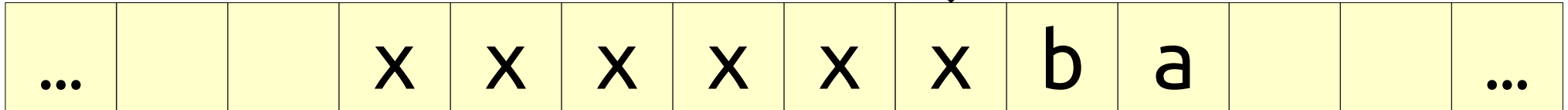
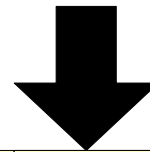
GoHome:

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start



Start:

If 'a' Goto FoundA

Move Right

Goto Start

FoundA:

Write 'x'

LoopA:

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

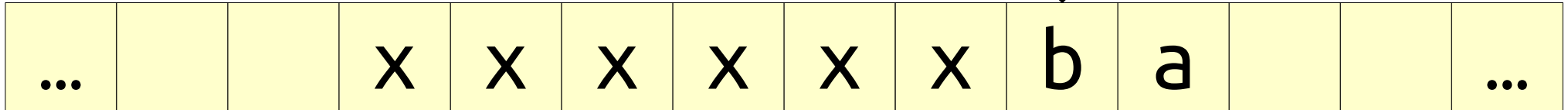
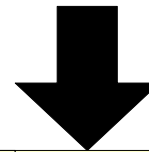
GoHome:

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start



Start:

```
If 'a' Goto FoundA  
Move Right  
Goto Start
```

FoundA:

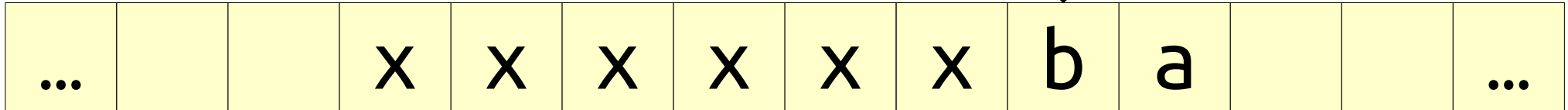
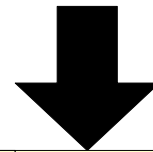
```
Write 'x'
```

LoopA:

```
Move Right  
If 'a' Goto LoopA  
If 'x' Goto LoopA  
Write 'x'  
Goto GoHome
```

GoHome:

```
Move Left  
If Not Blank Goto GoHome  
Move Right  
Goto Start
```



Start:

If 'a' Goto FoundA

Move Right

Goto Start

FoundA:

Write 'x'

LoopA:

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

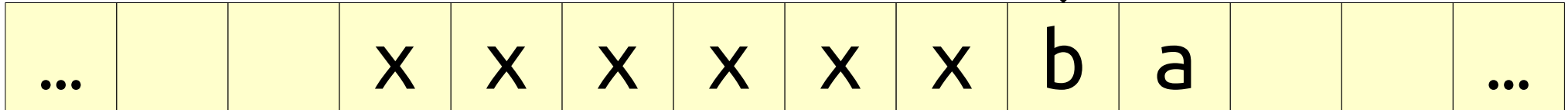
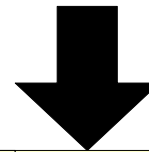
GoHome:

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start



Start:

If 'a' Goto FoundA

Move Right

Goto Start

FoundA:

Write 'x'

LoopA:

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

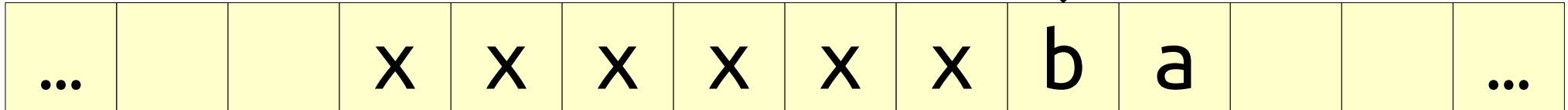
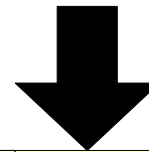
GoHome:

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start



Start:

If 'a' Goto FoundA

Move Right

Goto Start

FoundA:

Write 'x'

LoopA:

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

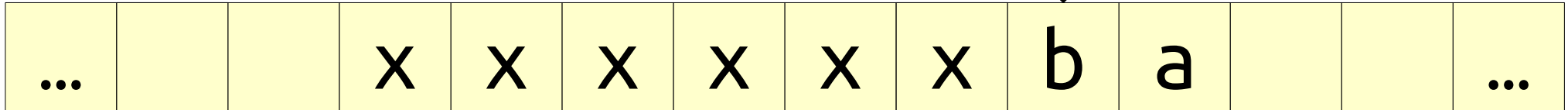
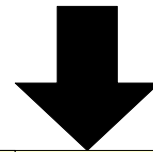
GoHome:

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start



Start:

If 'a' Goto FoundA

If 'b' Goto FoundB

Move Right

Goto Start

FoundA:

Write 'x'

LoopA:

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

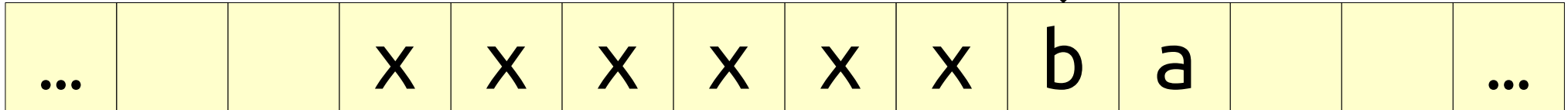
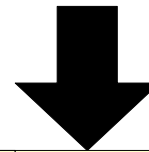
GoHome:

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start



Start:

If 'a' Goto FoundA

If 'b' Goto FoundB

Move Right

Goto Start

FoundA:

Write 'x'

LoopA:

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

GoHome:

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

FoundB:

Write 'x'

LoopB:

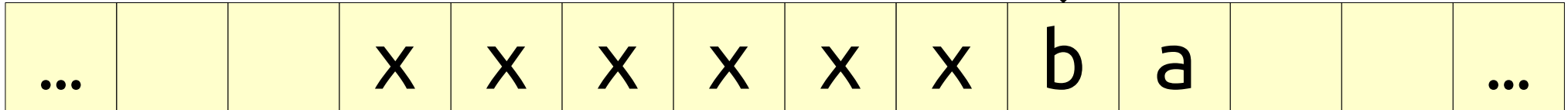
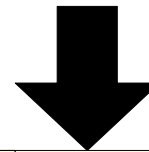
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome

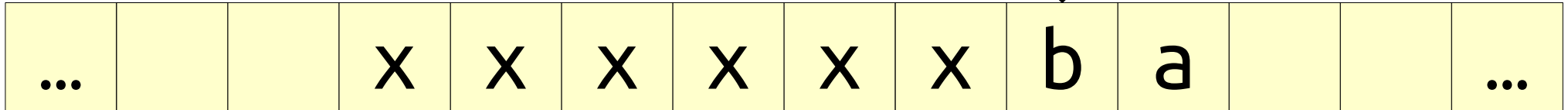
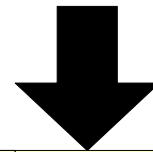


```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
  Move Right
  Goto Start
```

```
FoundA:
  Write 'x'
LoopA:
  Move Right
  If 'a' Goto LoopA
  If 'x' Goto LoopA
  Write 'x'
  Goto GoHome
```

```
GoHome:
  Move Left
  If Not Blank Goto GoHome
  Move Right
  Goto Start
```

```
FoundB:
  Write 'x'
LoopB:
  Move Right
  If 'b' Goto LoopB
  If 'x' Goto LoopB
  Write 'x'
  Goto GoHome
```

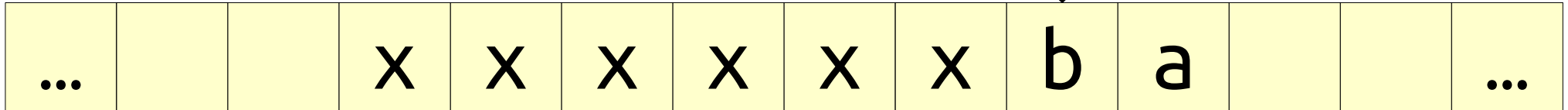
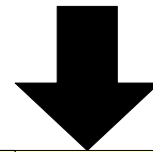


```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
  Move Right
  Goto Start
```

```
FoundA:
  Write 'x'
LoopA:
  Move Right
  If 'a' Goto LoopA
  If 'x' Goto LoopA
  Write 'x'
  Goto GoHome
```

```
GoHome:
  Move Left
  If Not Blank Goto GoHome
  Move Right
  Goto Start
```

```
FoundB:
  Write 'x'
LoopB:
  Move Right
  If 'b' Goto LoopB
  If 'x' Goto LoopB
  Write 'x'
  Goto GoHome
```

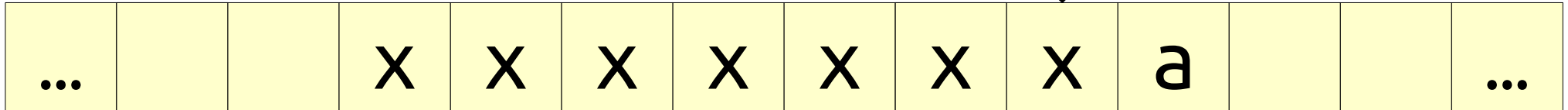
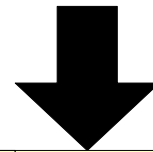


```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
  Move Right
  Goto Start
```

```
FoundA:
  Write 'x'
LoopA:
  Move Right
  If 'a' Goto LoopA
  If 'x' Goto LoopA
  Write 'x'
  Goto GoHome
```

```
GoHome:
  Move Left
  If Not Blank Goto GoHome
  Move Right
  Goto Start
```

```
FoundB:
  Write 'x'
LoopB:
  Move Right
  If 'b' Goto LoopB
  If 'x' Goto LoopB
  Write 'x'
  Goto GoHome
```

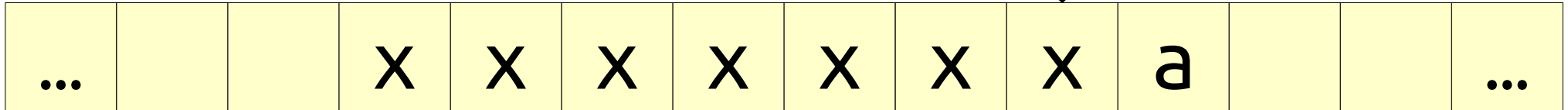
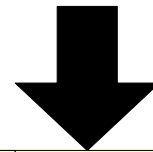


```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
  Move Right
  Goto Start
```

```
FoundA:
  Write 'x'
LoopA:
  Move Right
  If 'a' Goto LoopA
  If 'x' Goto LoopA
  Write 'x'
  Goto GoHome
```

```
GoHome:
  Move Left
  If Not Blank Goto GoHome
  Move Right
  Goto Start
```

```
FoundB:
  Write 'x'
LoopB:
  Move Right
  If 'b' Goto LoopB
  If 'x' Goto LoopB
  Write 'x'
  Goto GoHome
```

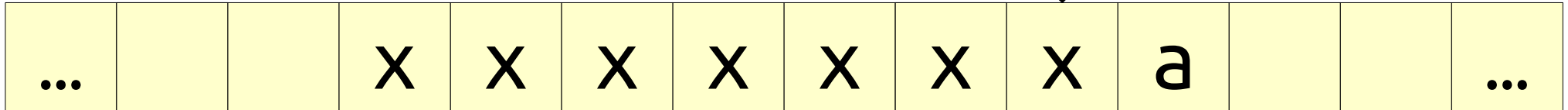
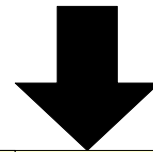


```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
  Move Right
  Goto Start
```

```
FoundA:
  Write 'x'
LoopA:
  Move Right
  If 'a' Goto LoopA
  If 'x' Goto LoopA
  Write 'x'
  Goto GoHome
```

```
GoHome:
  Move Left
  If Not Blank Goto GoHome
  Move Right
  Goto Start
```

```
FoundB:
  Write 'x'
LoopB:
  Move Right
  If 'b' Goto LoopB
  If 'x' Goto LoopB
  Write 'x'
  Goto GoHome
```

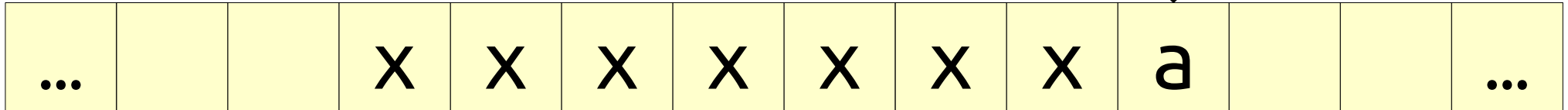
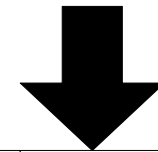


```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
  Move Right
  Goto Start
```

```
FoundA:
  Write 'x'
LoopA:
  Move Right
  If 'a' Goto LoopA
  If 'x' Goto LoopA
  Write 'x'
  Goto GoHome
```

```
GoHome:
  Move Left
  If Not Blank Goto GoHome
  Move Right
  Goto Start
```

```
FoundB:
  Write 'x'
LoopB:
  Move Right
  If 'b' Goto LoopB
  If 'x' Goto LoopB
  Write 'x'
  Goto GoHome
```

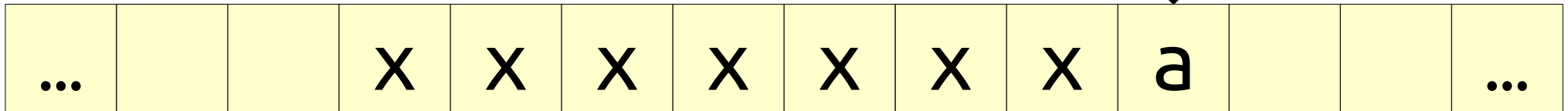
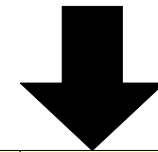



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
  Move Right
  Goto Start
```

```
FoundA:
  Write 'x'
LoopA:
  Move Right
  If 'a' Goto LoopA
  If 'x' Goto LoopA
  Write 'x'
  Goto GoHome
```

```
GoHome:
  Move Left
  If Not Blank Goto GoHome
  Move Right
  Goto Start
```

```
FoundB:
  Write 'x'
LoopB:
  Move Right
  If 'b' Goto LoopB
  If 'x' Goto LoopB
  Write 'x'
  Goto GoHome
```



Start:

```
If 'a' Goto FoundA  
If 'b' Goto FoundB  
Move Right  
Goto Start
```

FoundA:

```
Write 'x'
```

LoopA:

```
Move Right  
If 'a' Goto LoopA  
If 'x' Goto LoopA  
Write 'x'  
Goto GoHome
```

GoHome:

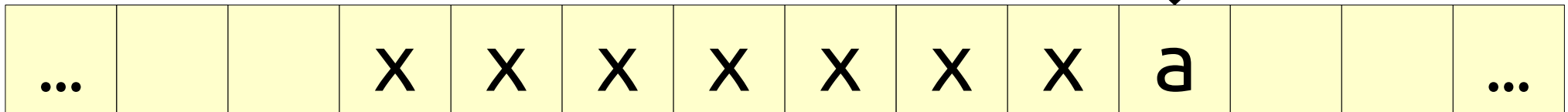
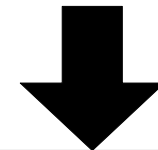
```
Move Left  
If Not Blank Goto GoHome  
Move Right  
Goto Start
```

FoundB:

```
Write 'x'
```

LoopB:

```
Move Right  
If 'b' Goto LoopB  
If 'x' Goto LoopB  
Write 'x'  
Goto GoHome
```

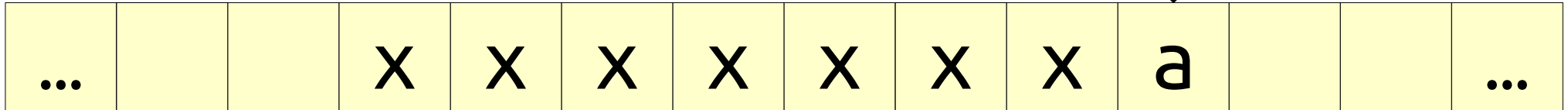
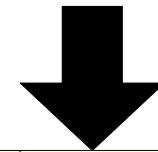


```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
  Move Right
  Goto Start
```

```
FoundA:
  Write 'x'
LoopA:
  Move Right
  If 'a' Goto LoopA
  If 'x' Goto LoopA
  Write 'x'
  Goto GoHome
```

```
GoHome:
  Move Left
  If Not Blank Goto GoHome
  Move Right
  Goto Start
```

```
FoundB:
  Write 'x'
LoopB:
  Move Right
  If 'b' Goto LoopB
  If 'x' Goto LoopB
  Write 'x'
  Goto GoHome
```



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
Move Right
Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

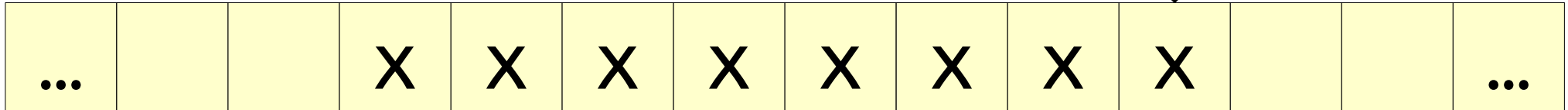
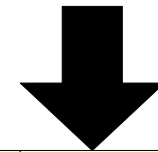
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
Move Right
Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

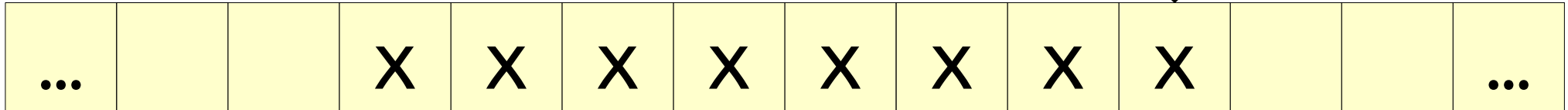
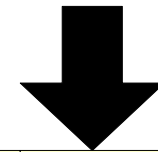
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
Move Right
Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

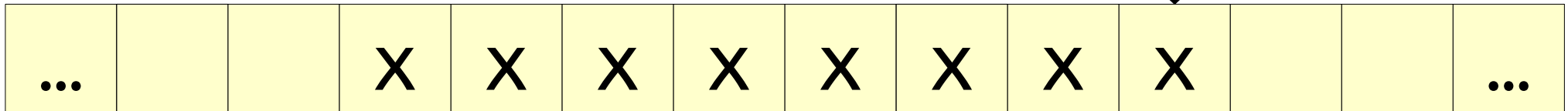
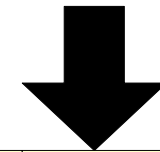
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
Move Right
Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

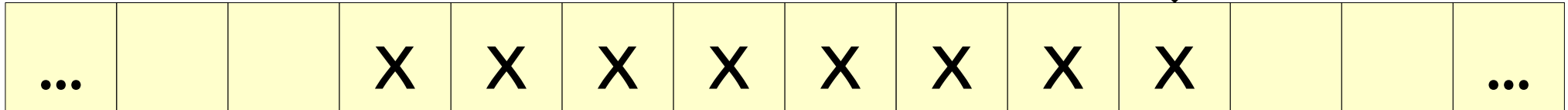
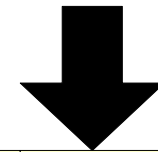
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
Move Right
Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

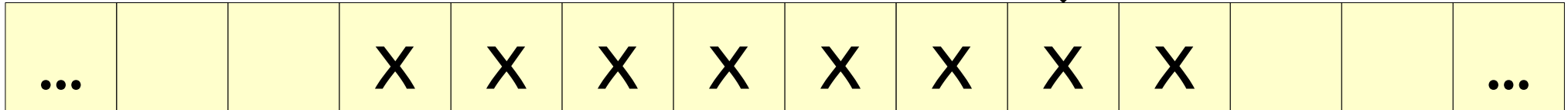
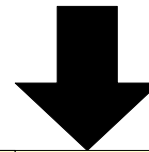
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome




```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
  Move Right
  Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

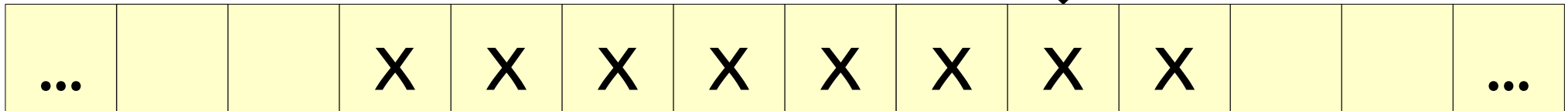
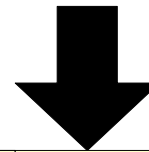
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
Move Right
Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

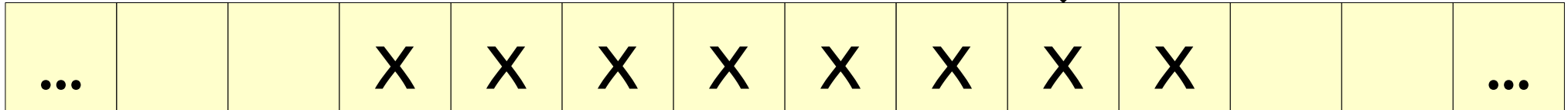
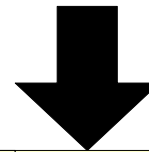
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
Move Right
Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

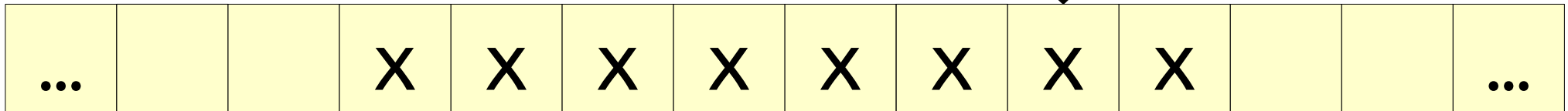
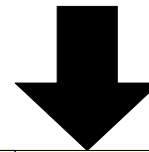
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
Move Right
Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

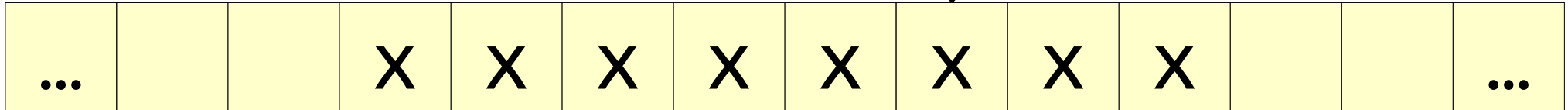
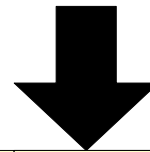
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
Move Right
Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

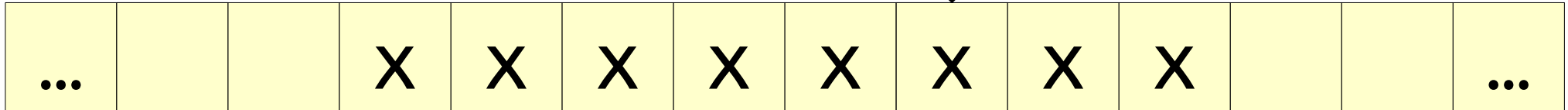
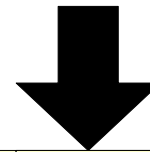
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
Move Right
Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

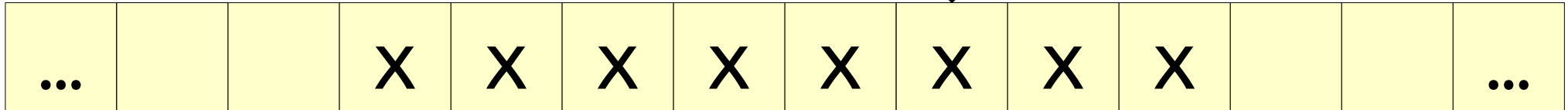
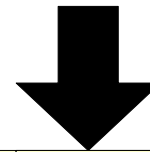
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
  Move Right
  Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

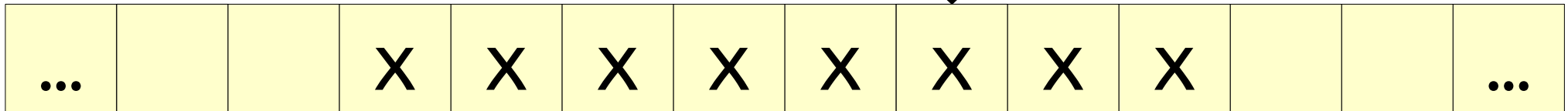
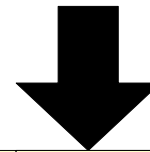
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
  Move Right
  Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

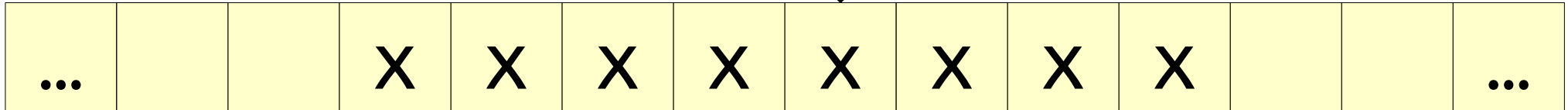
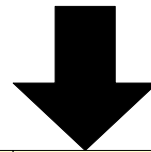
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome




```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
Move Right
Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

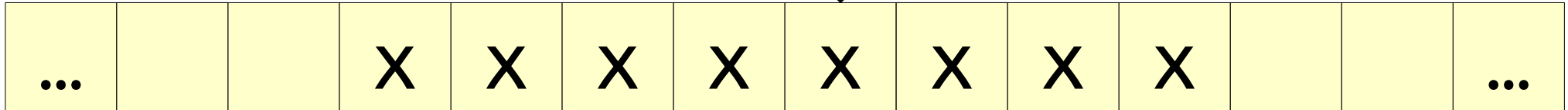
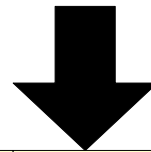
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
Move Right
Goto Start
```

If 'b' Goto FoundB

Move Right

FoundA:

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

FoundB:

Write 'x'

LoopB:

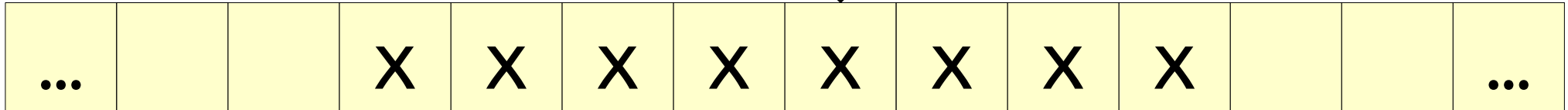
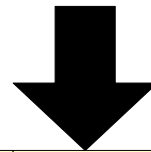
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
Move Right
Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

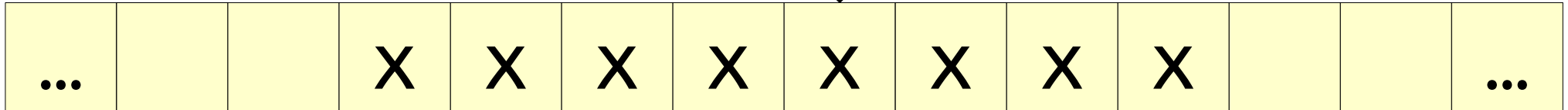
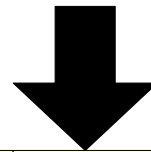
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
  Move Right
  Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

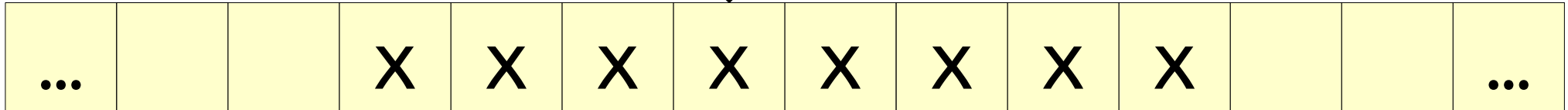
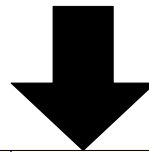
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
  Move Right
  Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

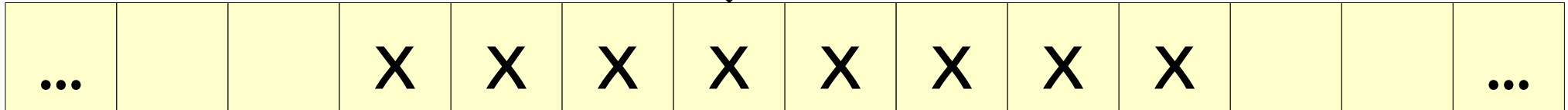
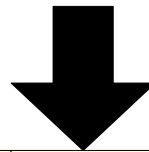
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
Move Right
Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

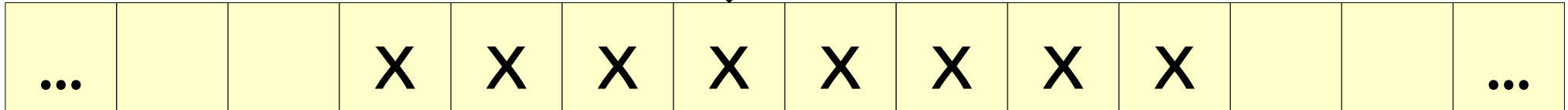
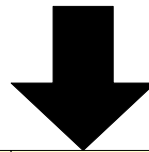
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
  Move Right
  Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

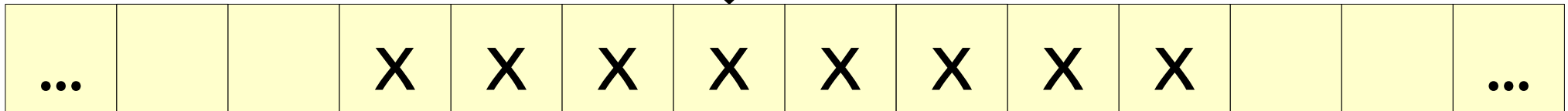
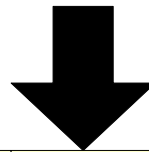
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
Move Right
Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

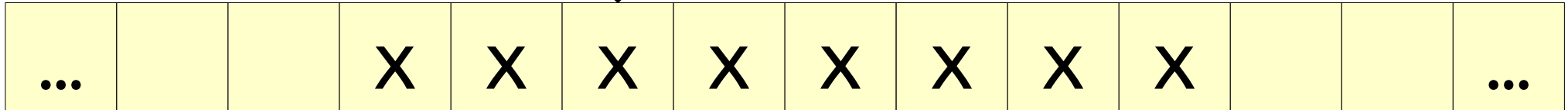
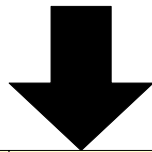
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome




```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
Move Right
Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

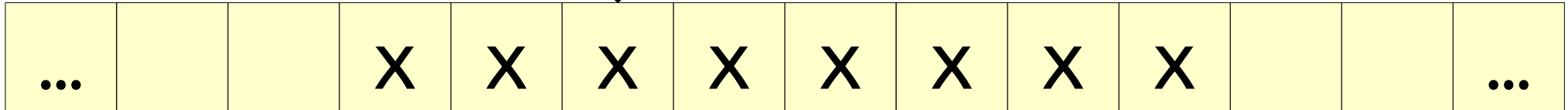
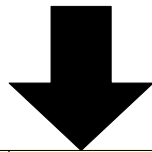
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
  Move Right
  Goto Start
```

If 'b' Goto FoundB

Move Right

FoundA:

Write 'x'

LoopA:

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

FoundB:

Write 'x'

LoopB:

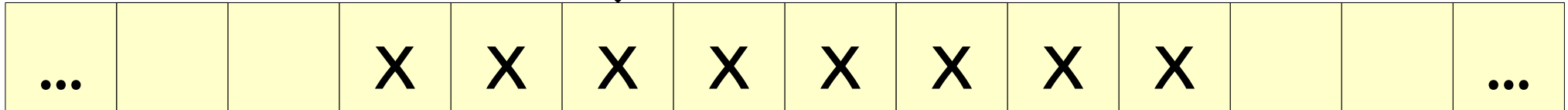
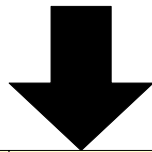
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
  Move Right
  Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

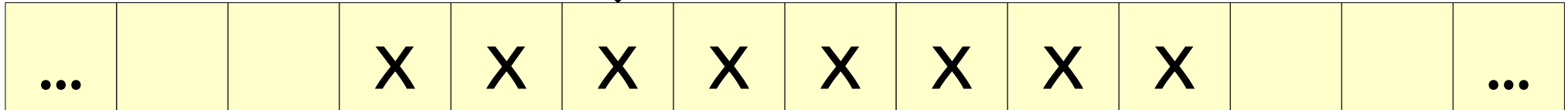
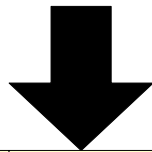
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
  Move Right
  Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

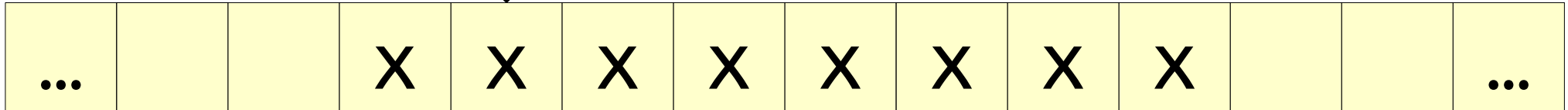
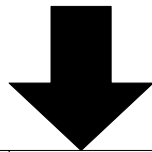
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
Move Right
Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

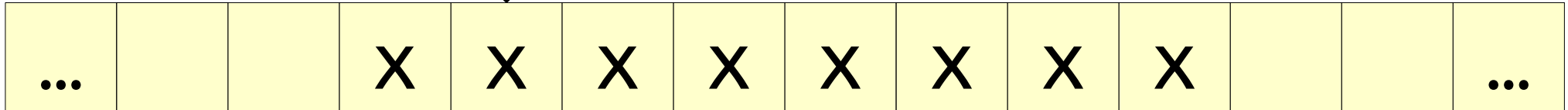
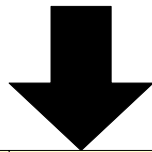
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
  Move Right
  Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

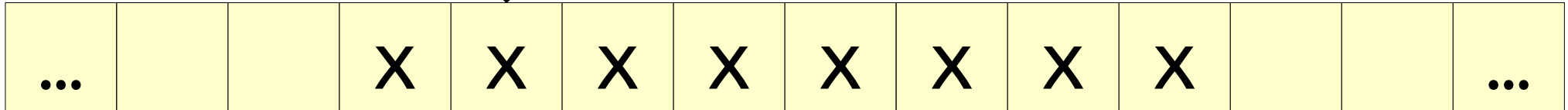
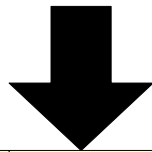
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
  Move Right
  Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

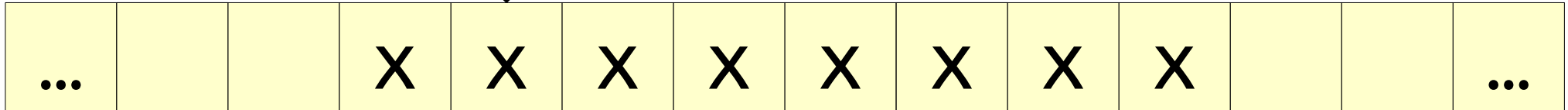
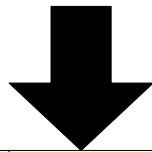
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
  Move Right
  Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

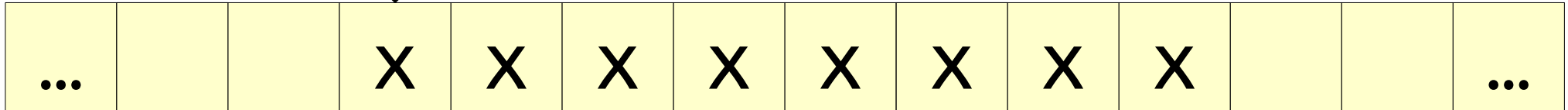
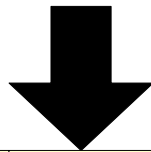
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome




```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
Move Right
Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

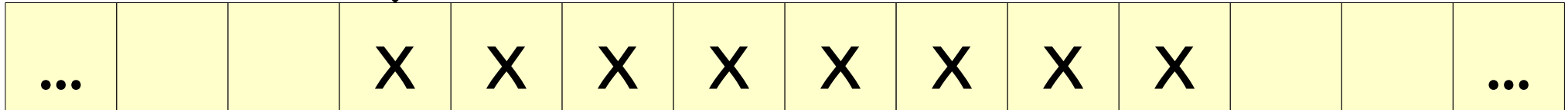
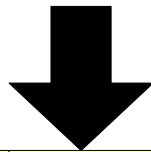
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
  Move Right
  Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

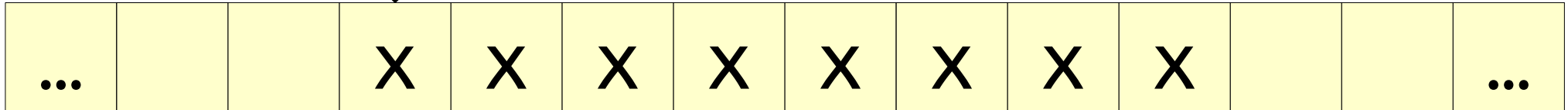
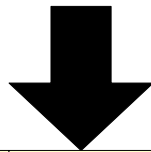
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
  Move Right
  Goto Start
```

```
FoundA:
  Write 'x'
```

```

LoopA:
    Move Right
    If 'a' Goto LoopA
    If 'x' Goto LoopA
    Write 'x'
    Goto GoHome

```

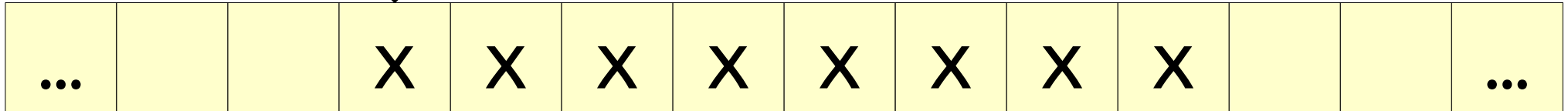
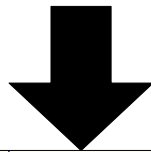
```
Move Left
If Not Blank Goto GoHome
Move Right
Goto Start
```

```
FoundB:
  Write 'x'
```

```

LoopB:
    Move Right
    If 'b' Goto LoopB
    If 'x' Goto LoopB
    Write 'x'
    Goto GoHome

```



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
Move Right
Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

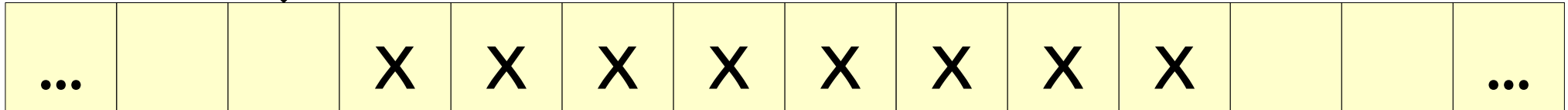
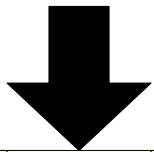
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
  Move Right
  Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

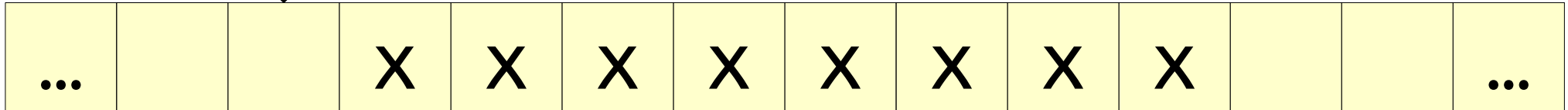
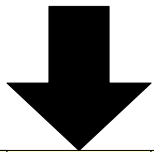
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

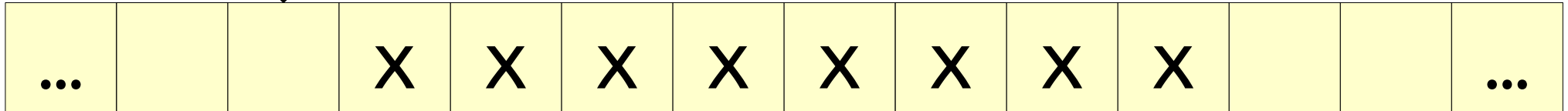
Write 'x'

Goto GoHome



```
FoundA:
    Write 'x'
LoopA:
    Move Right
    If 'a' Goto LoopA
    If 'x' Goto LoopA
    Write 'x'
    Goto GoHome
```

```
FoundB:
    Write 'x'
LoopB:
    Move Right
    If 'b' Goto LoopB
    If 'x' Goto LoopB
    Write 'x'
    Goto GoHome
```



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
  Move Right
  Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

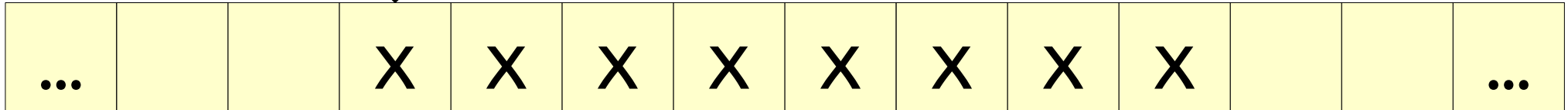
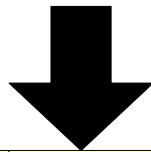
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
Move Right
Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

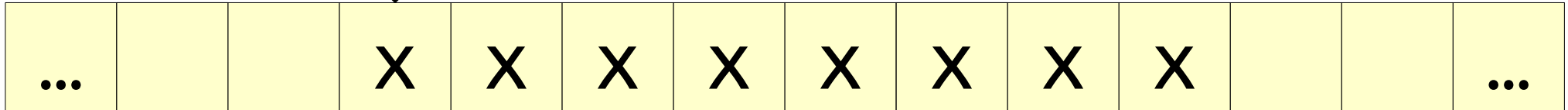
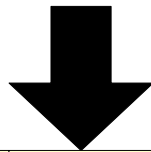
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



Start:

```
If 'a' Goto FoundA
If 'b' Goto FoundB
Move Right
Goto Start
```

FoundA:

Write 'x'

LoopA:

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

GoHome:

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

FoundB:

Write 'x'

LoopB:

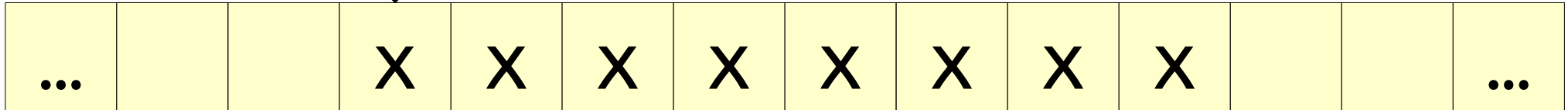
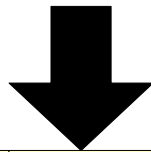
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



Start:

If 'a' Goto FoundA

If 'b' Goto FoundB

Move Right

Goto Start

FoundA:

Write 'x'

LoopA:

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

GoHome:

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

FoundB:

Write 'x'

LoopB:

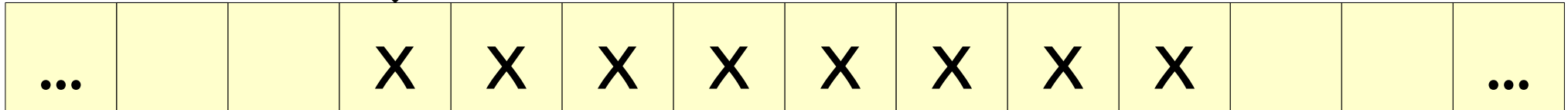
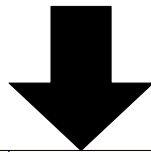
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
Move Right
Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

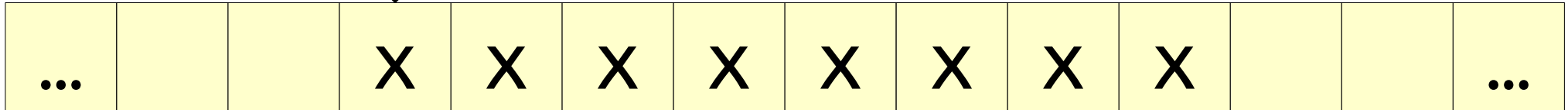
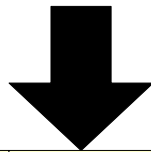
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
  Move Right
  Goto Start
```

If 'b' Goto FoundB

Goto Start

```
FoundA:
  Write 'x'
```

LoopA:

If 'a' Goto LoopA

If 'x' Goto LoopA

Goto GoHome

```
GoHome:
  Move Left
  If Not Blank Goto GoHome
  Move Right
  Goto Start
```

If Not Blank Goto GoHome

Goto Start

```
FoundB:
  Write 'x'
```

Write 'x'

LoopB:

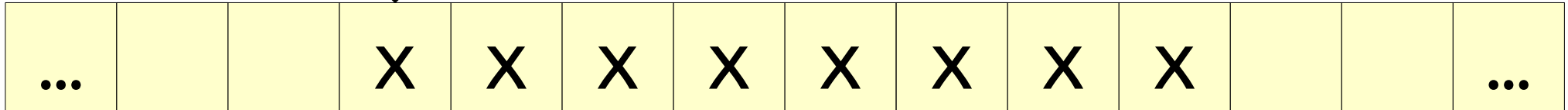
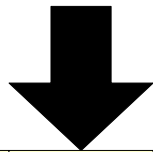
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
  Move Right
  Goto Start
```

If 'b' Goto FoundB

Goto Start

```
FoundA:
  Write 'x'
```

LoopA:

If 'a' Goto LoopA

If 'x' Goto LoopA

Goto GoHome

```
GoHome:
  Move Left
  If Not Blank Goto GoHome
  Move Right
  Goto Start
```

If Not Blank Goto GoHome

Goto Start

```
FoundB:
  Write 'x'
```

LoopB:

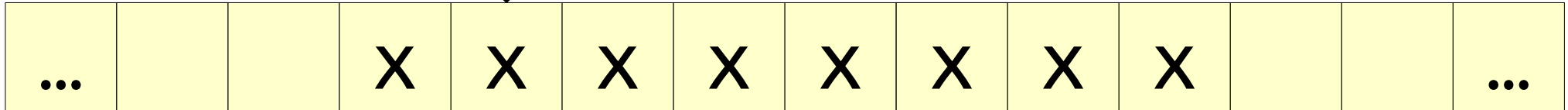
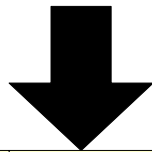
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
  Move Right
  Goto Start
```

If 'b' Goto FoundB

Goto Start

```
FoundA:
  Write 'x'
```

LoopA:

If 'a' Goto LoopA

Write 'x'

Goto GoHome

```
GoHome:
  Move Left
  If Not Blank Goto GoHome
  Move Right
  Goto Start
```

If Not Blank Goto GoHome

Goto Start

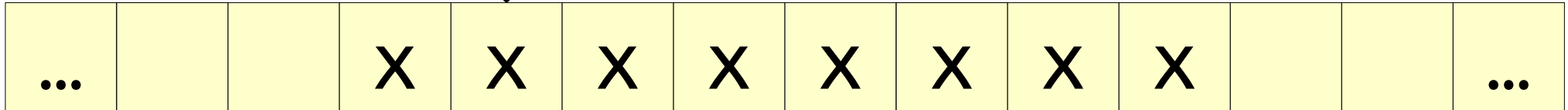
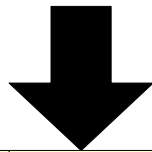
```
FoundB:
  Write 'x'
```

LoopB:

If 'b' Goto LoopB

Write 'x'

Goto GoHome



Start:

```
If 'a' Goto FoundA
If 'b' Goto FoundB
Move Right
Goto Start
```

FoundA:

Write 'x'

LoopA:

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

GoHome:

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

FoundB:

Write 'x'

LoopB:

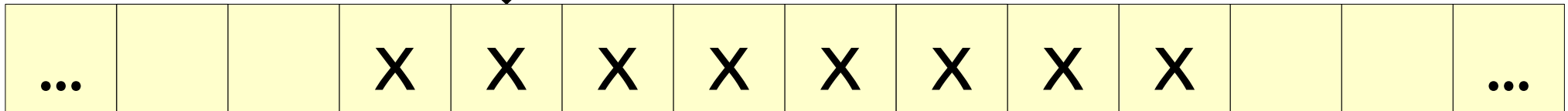
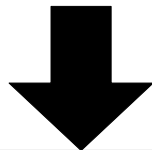
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



Start:

If 'a' Goto FoundA

If 'b' Goto FoundB

Move Right

Goto Start

FoundA:

Write 'x'

LoopA:

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

GoHome:

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

FoundB:

Write 'x'

LoopB:

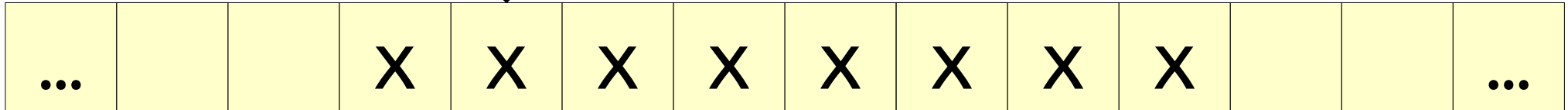
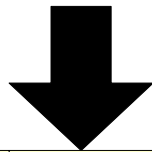
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome




```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
Move Right
Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'x' Goto LoopA

Goto GoHome

If Not Blank Goto GoHome

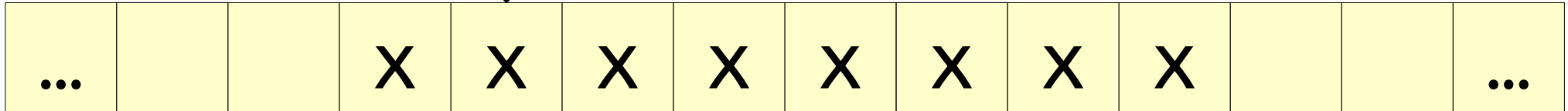
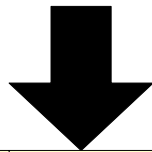
Goto Start

Write 'x'

Move Right

If 'x' Goto LoopB

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
  Move Right
  Goto Start
```

If 'b' Goto FoundB

Goto Start

```
FoundA:
  Write 'x'
```

LoopA:

If 'a' Goto LoopA

If 'x' Goto LoopA

Goto GoHome

```
GoHome:
  Move Left
  If Not Blank Goto GoHome
  Move Right
  Goto Start
```

If Not Blank Goto GoHome

Goto Start

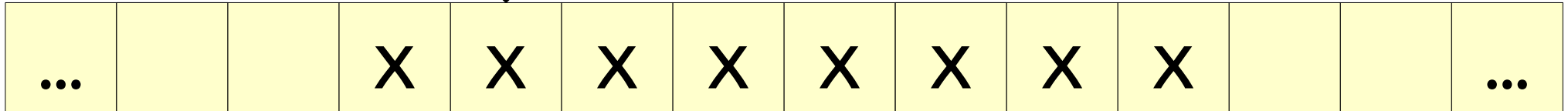
```
FoundB:
  Write 'x'
```

LoopB:

If 'b' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
  Move Right
  Goto Start
```

If 'b' Goto FoundB

Goto Start

```
FoundA:
  Write 'x'
```

LoopA:

If 'a' Goto LoopA

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

```
GoHome:
  Move Left
  If Not Blank Goto GoHome
  Move Right
  Goto Start
```

If Not Blank Goto GoHome

Move Right

Goto Start

```
FoundB:
  Write 'x'
```

Write 'x'

LoopB:

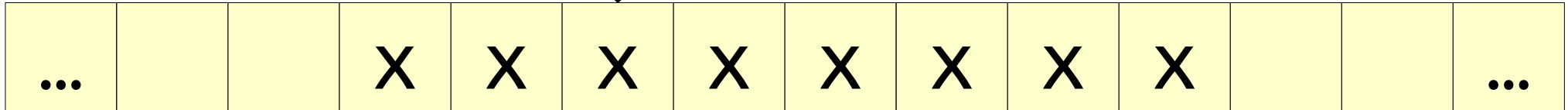
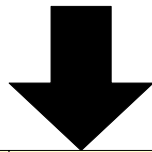
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
  Move Right
  Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'x' Goto LoopA

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

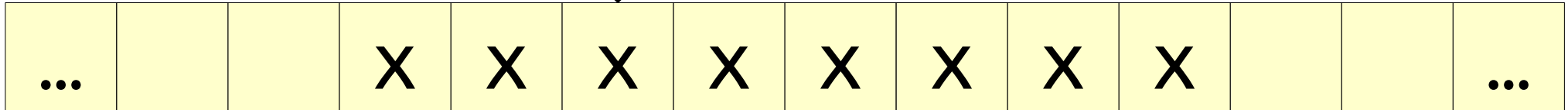
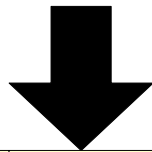
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



Start:

```
If 'a' Goto FoundA
If 'b' Goto FoundB
Move Right
Goto Start
```

FoundA:

Write 'x'

LoopA:

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

GoHome:

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

FoundB:

Write 'x'

LoopB:

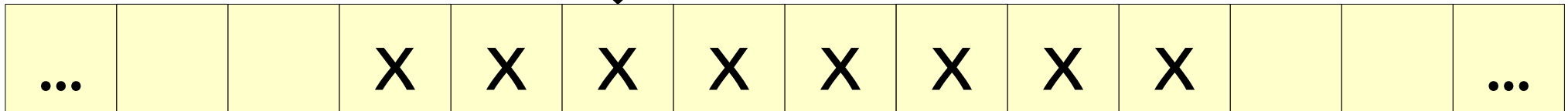
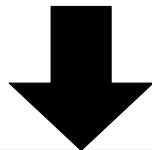
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



Start:

If 'a' Goto FoundA

If 'b' Goto FoundB

Move Right

Goto Start

FoundA:

Write 'x'

LoopA:

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

GoHome:

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

FoundB:

Write 'x'

LoopB:

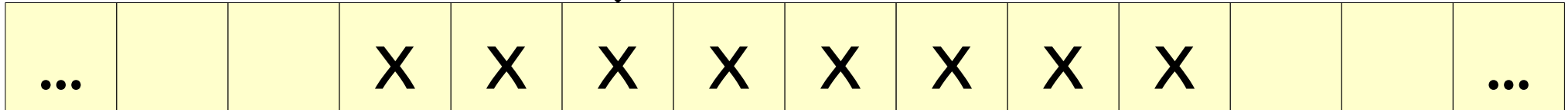
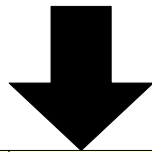
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
Move Right
Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'x' Goto LoopA

Goto GoHome

If Not Blank Goto GoHome

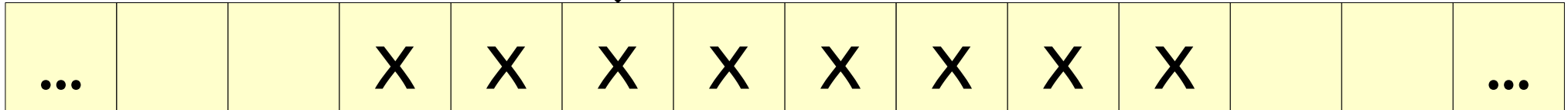
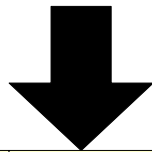
Goto Start

Write 'x'

Move Right

If 'x' Goto LoopB

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
  Move Right
  Goto Start
```

If 'b' Goto FoundB

Goto Start

```
FoundA:
  Write 'x'
```

LoopA:

If 'a' Goto LoopA

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

```
GoHome:
    Move Left
    If Not Blank Goto GoHome
    Move Right
    Goto Start
```

If Not Blank Goto GoHome

Move Right

Goto Start

```
FoundB:
  Write 'x'
```

Write 'x'

LoopB:

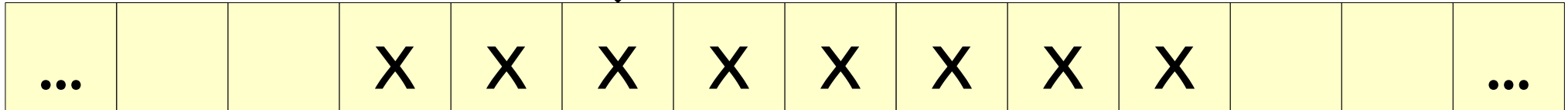
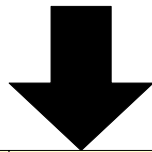
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome




```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
  Move Right
  Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

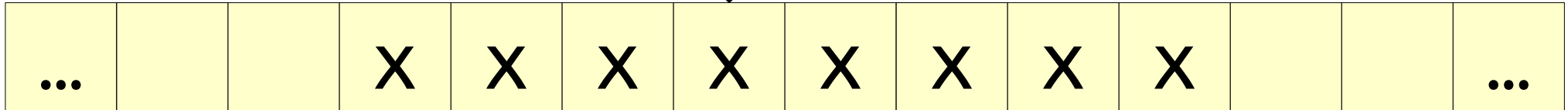
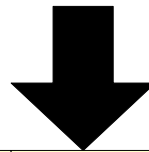
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
  Move Right
  Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'x' Goto LoopA

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

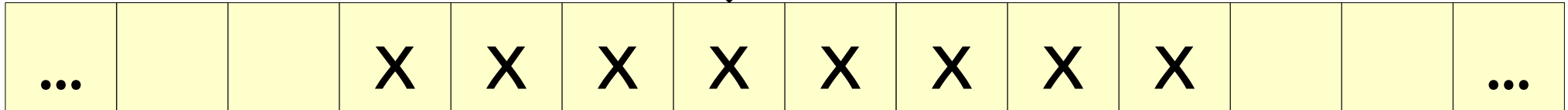
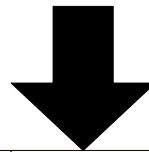
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



Start:

```
If 'a' Goto FoundA
If 'b' Goto FoundB
Move Right
Goto Start
```

FoundA:

Write 'x'

LoopA:

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

GoHome:

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

FoundB:

Write 'x'

LoopB:

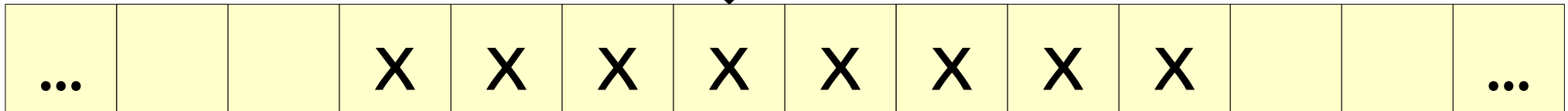
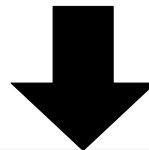
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



Start:

If 'a' Goto FoundA

If 'b' Goto FoundB

Move Right

Goto Start

FoundA:

Write 'x'

LoopA:

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

FoundB:

Write 'x'

LoopB:

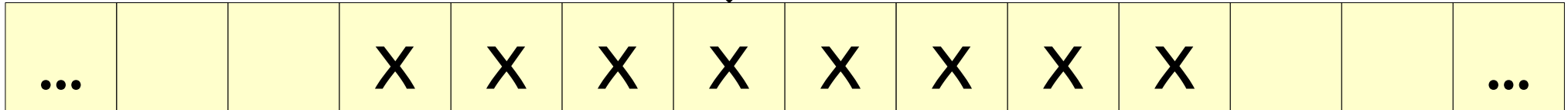
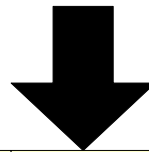
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
    If 'a' Goto FoundA
    If 'b' Goto FoundB
Move Right
Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

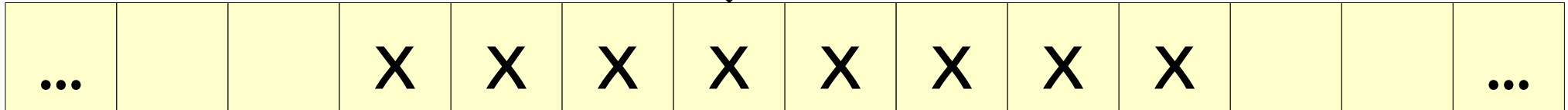
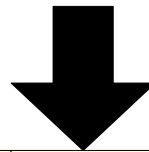
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
    If 'a' Goto FoundA
    If 'b' Goto FoundB
Move Right
Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

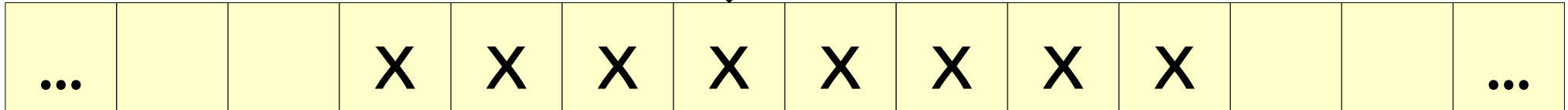
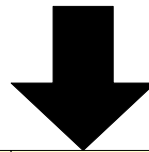
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
  Move Right
  Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

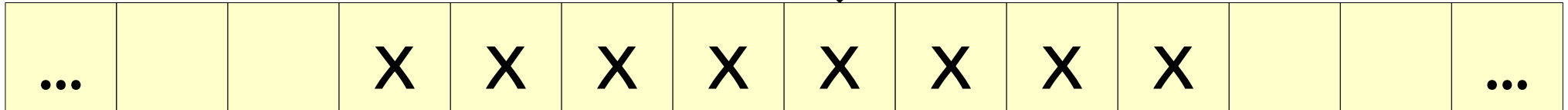
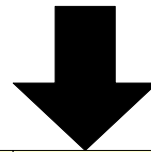
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
  Move Right
  Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'x' Goto LoopA

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

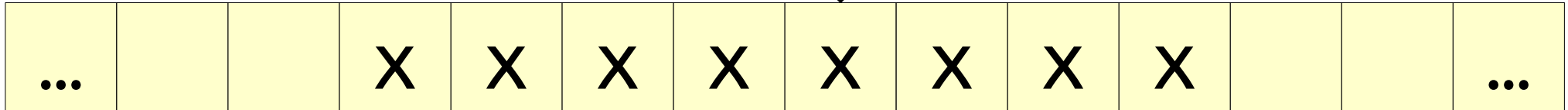
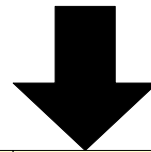
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



Start:

```
If 'a' Goto FoundA
If 'b' Goto FoundB
Move Right
Goto Start
```

FoundA:

Write 'x'

LoopA:

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

GoHome:

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

FoundB:

Write 'x'

LoopB:

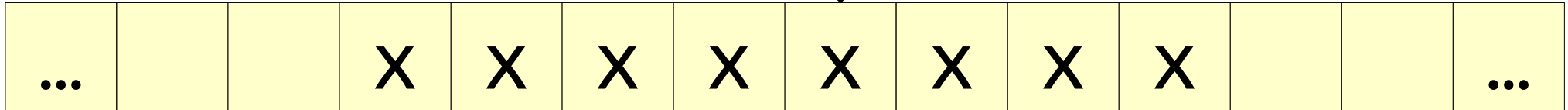
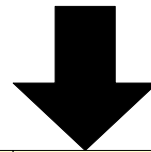
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



Start:

If 'a' Goto FoundA

If 'b' Goto FoundB

Move Right

Goto Start

FoundA:

Write 'x'

LoopA:

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

GoHome:

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

FoundB:

Write 'x'

LoopB:

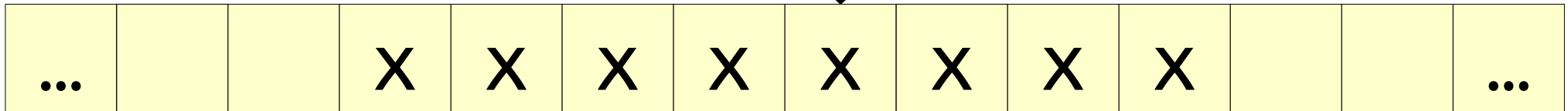
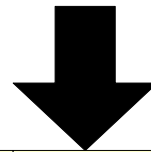
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
Move Right
Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

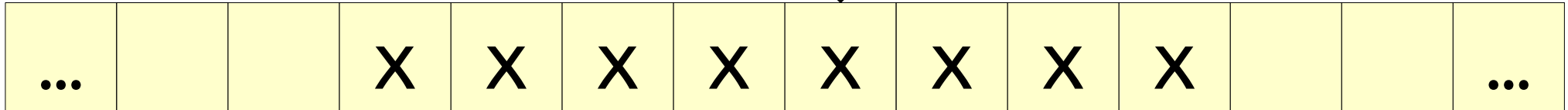
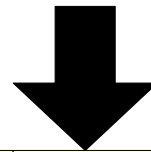
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
    If 'a' Goto FoundA
    If 'b' Goto FoundB
Move Right
Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

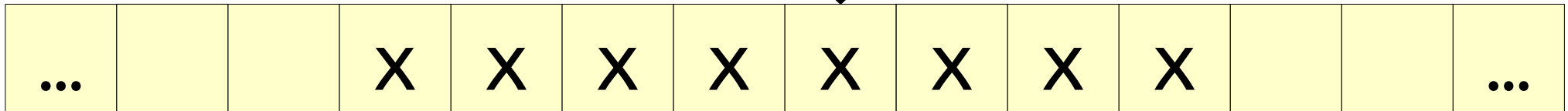
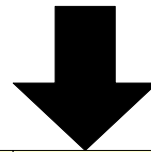
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
  Move Right
  Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

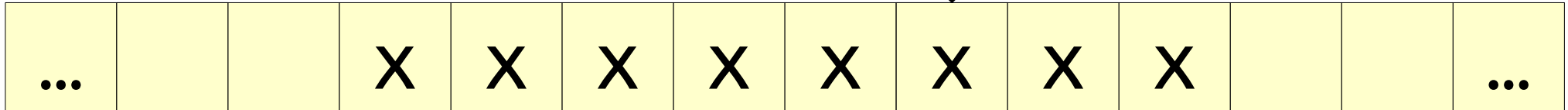
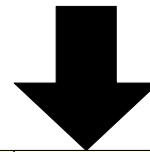
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
  Move Right
  Goto Start
```

If 'b' Goto FoundB

Goto Start

```
FoundA:
  Write 'x'
```

LoopA:

If 'a' Goto LoopA

Write 'x'

Goto GoHome

If Not Blank Goto GoHome

Goto Start

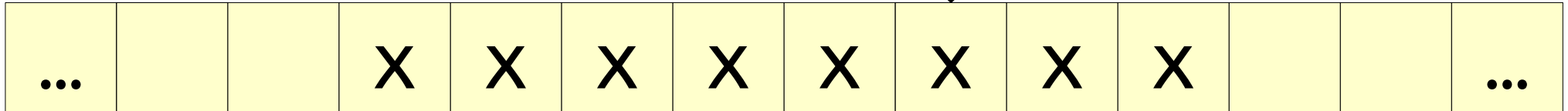
```
FoundB:
  Write 'x'
```

LoopB:

If 'b' Goto LoopB

Write 'x'

Goto GoHome



Start:

```
If 'a' Goto FoundA
If 'b' Goto FoundB
Move Right
Goto Start
```

FoundA:

Write 'x'

LoopA:

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

GoHome:

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

FoundB:

Write 'x'

LoopB:

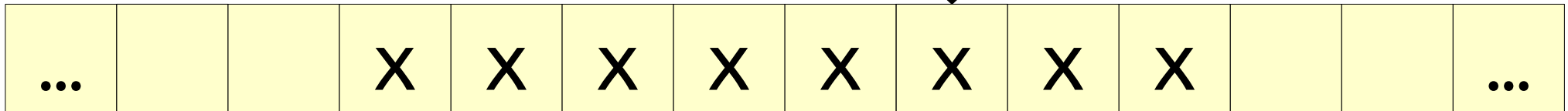
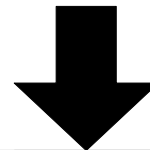
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



Start:

If 'a' Goto FoundA

If 'b' Goto FoundB

Move Right

Goto Start

FoundA:

Write 'x'

LoopA:

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

GoHome:

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

FoundB:

Write 'x'

LoopB:

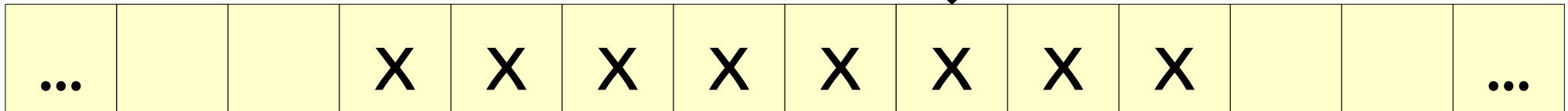
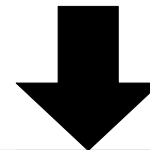
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome




```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
Move Right
Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

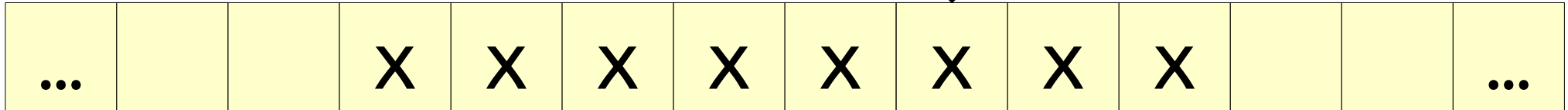
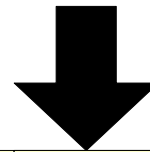
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
  Move Right
  Goto Start
```

If 'b' Goto FoundB

Goto Start

```
FoundA:
  Write 'x'
```

LoopA:

If 'a' Goto LoopA

If 'x' Goto LoopA

Goto GoHome

```
GoHome:
  Move Left
  If Not Blank Goto GoHome
  Move Right
  Goto Start
```

If Not Blank Goto GoHome

Goto Start

```
FoundB:
  Write 'x'
```

LoopB:

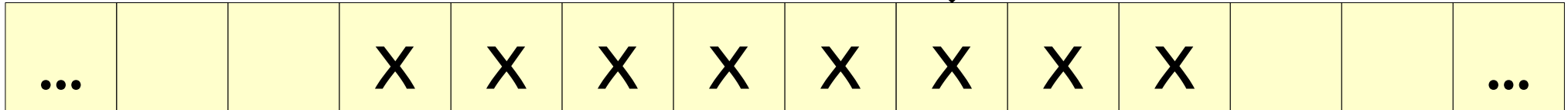
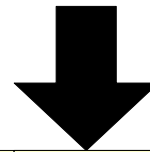
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
  Move Right
  Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

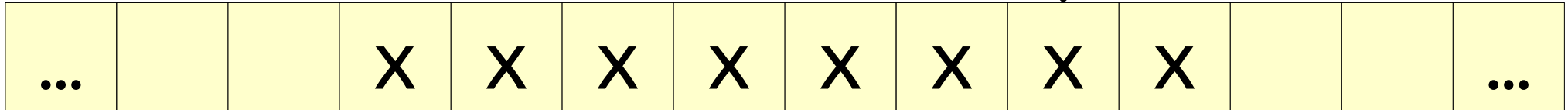
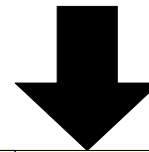
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
  Move Right
  Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'x' Goto LoopA

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

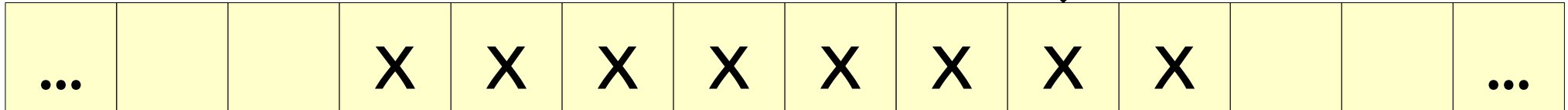
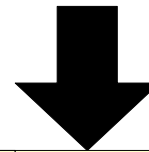
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



Start:

```
If 'a' Goto FoundA
If 'b' Goto FoundB
Move Right
Goto Start
```

FoundA:

Write 'x'

LoopA:

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

GoHome:

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

FoundB:

Write 'x'

LoopB:

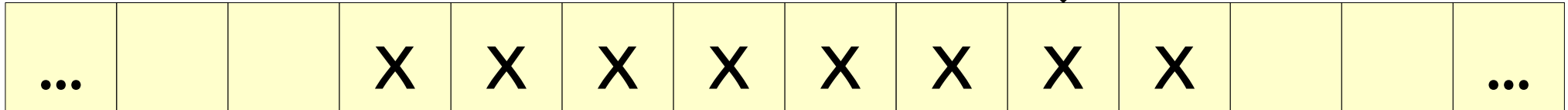
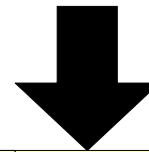
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



Start:

If 'a' Goto FoundA

If 'b' Goto FoundB

Move Right

Goto Start

FoundA:

Write 'x'

LoopA:

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

GoHome:

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

FoundB:

Write 'x'

LoopB:

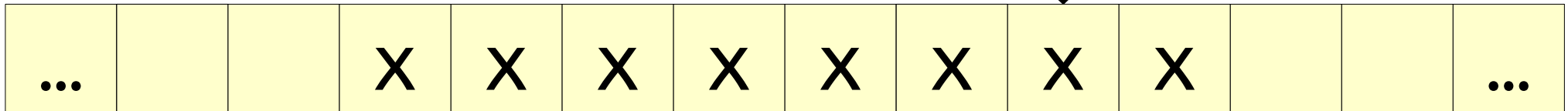
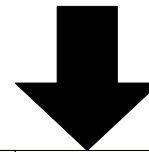
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
Move Right
Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

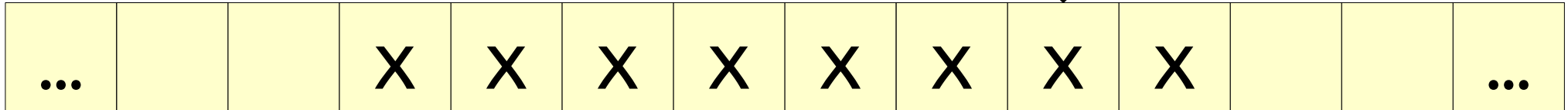
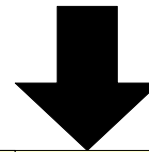
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
  Move Right
  Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

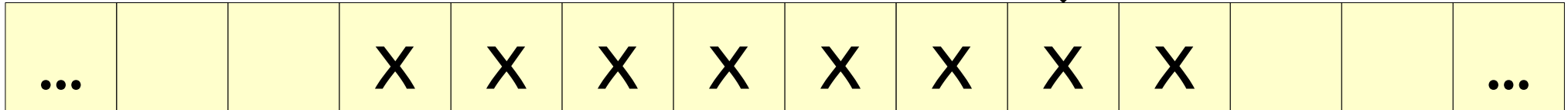
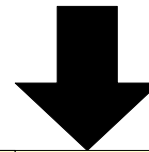
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome




```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
  Move Right
  Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

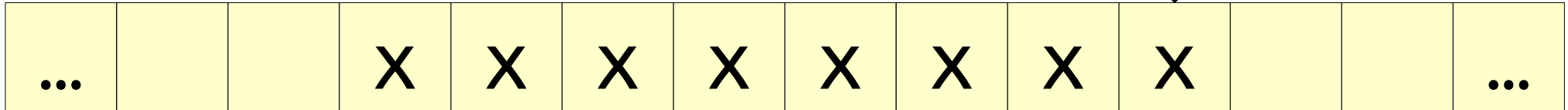
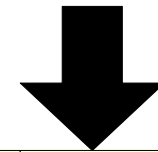
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
  Move Right
  Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'x' Goto LoopA

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

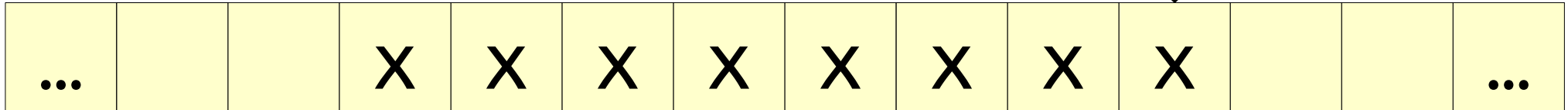
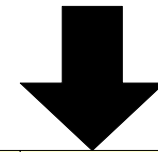
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



Start:

```
If 'a' Goto FoundA
If 'b' Goto FoundB
Move Right
Goto Start
```

FoundA:

Write 'x'

LoopA:

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

GoHome:

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

FoundB:

Write 'x'

LoopB:

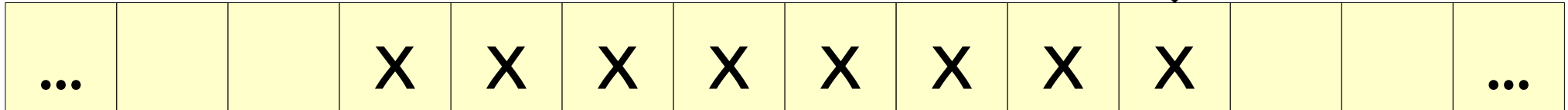
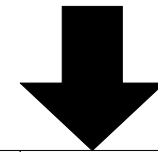
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



Start:

If 'a' Goto FoundA

If 'b' Goto FoundB

Move Right

Goto Start

FoundA:

Write 'x'

LoopA:

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

GoHome:

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

FoundB:

Write 'x'

LoopB:

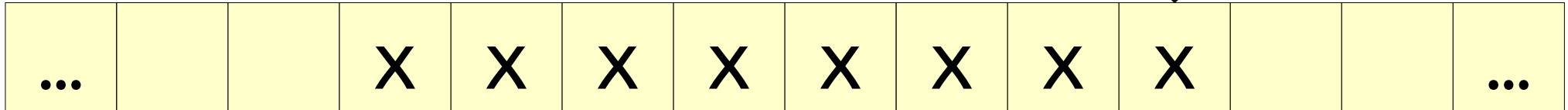
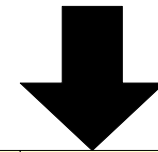
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
Move Right
Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

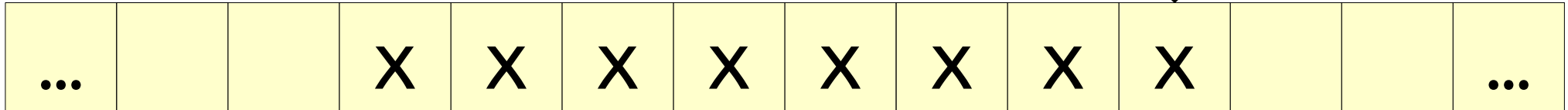
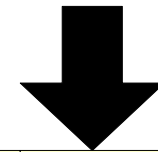
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
  Move Right
  Goto Start
```

If 'b' Goto FoundB

Goto Start

```
FoundA:
  Write 'x'
```

LoopA:

If 'a' Goto LoopA

If 'x' Goto LoopA

Goto GoHome

```
GoHome:
    Move Left
    If Not Blank Goto GoHome
    Move Right
    Goto Start
```

If Not Blank Goto GoHome

Goto Start

```
FoundB:
  Write 'x'
```

LoopB:

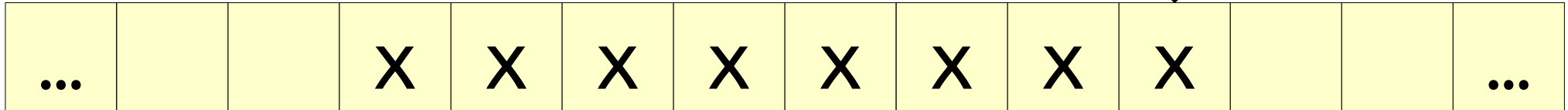
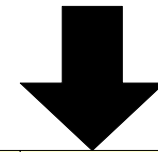
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
  Move Right
  Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

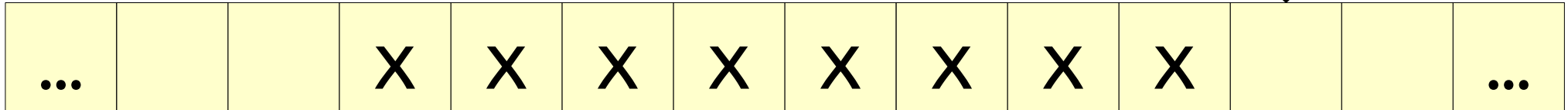
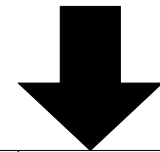
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
  Move Right
  Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

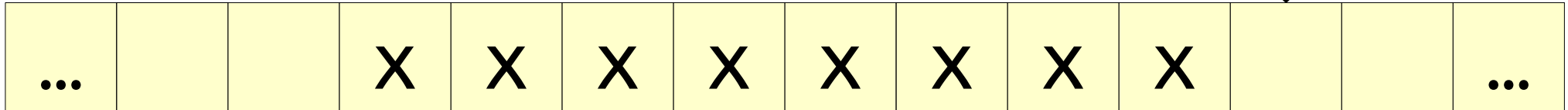
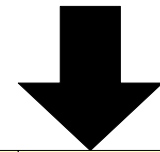
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



Start:

```
If 'a' Goto FoundA
If 'b' Goto FoundB
Move Right
Goto Start
```

FoundA:

Write 'x'

LoopA:

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

GoHome:

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

FoundB:

Write 'x'

LoopB:

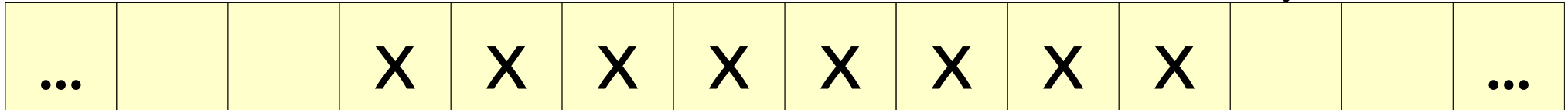
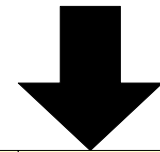
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



Start:

If 'a' Goto FoundA

If 'b' Goto FoundB

Move Right

Goto Start

FoundA:

Write 'x'

LoopA:

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

GoHome:

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

FoundB:

Write 'x'

LoopB:

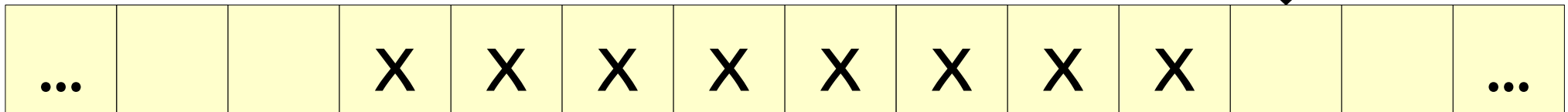
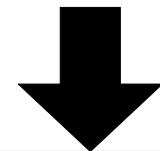
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
Move Right
Goto Start
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

LoopB:

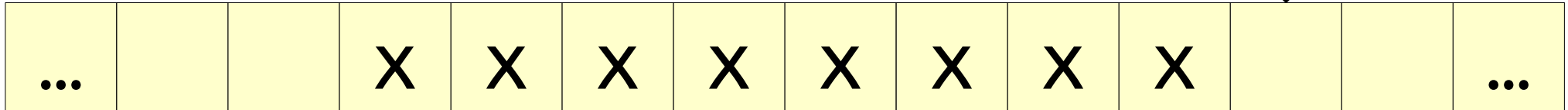
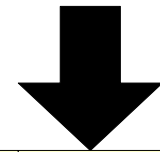
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
```

If 'b' Goto FoundB

Goto Start

Write 'x'

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

Write 'x'

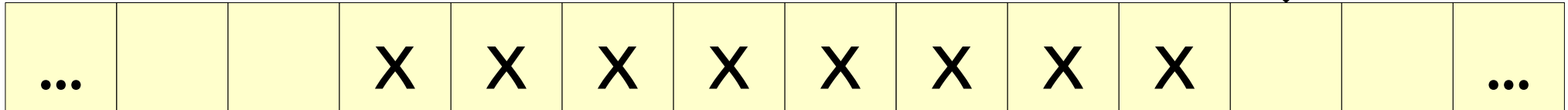
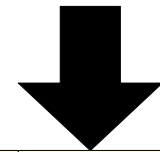
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
```

Move Right
Goto Start

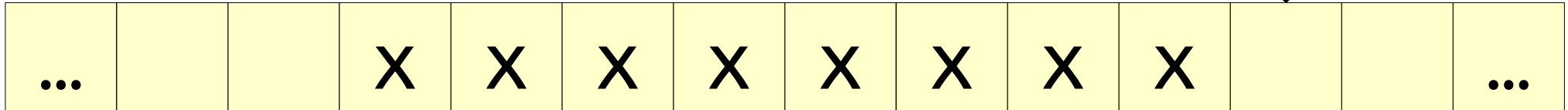
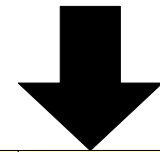
Write 'x'

```
Move Right
If 'a' Goto LoopA
If 'x' Goto LoopA
Write 'x'
Goto GoHome
```

```
Move Left
If Not Blank Goto GoHome
Move Right
Goto Start
```

Write 'x'

```
Move Right
If 'b' Goto LoopB
If 'x' Goto LoopB
Write 'x'
Goto GoHome
```



```
Start:
  If 'a' Goto FoundA
```

If 'b' Goto FoundB

If Blank Return True

Move Right

Goto Start

FoundA:
Write 'x'

Write 'x'

LoopA:
Move Right

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

```
GoHome:
    Move Left
```

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

```
FoundB:
    Write 'x'
```

Write 'x'

LoopB:
Move Right

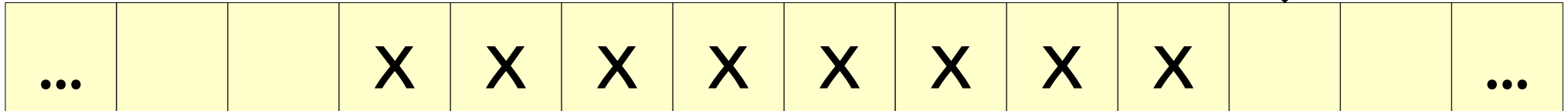
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



```
Start:
  If 'a' Goto FoundA
  If 'b' Goto FoundB
```

If 'b' Goto FoundB

If Blank Return True

Move Right

Goto Start

FoundA:
Write 'x'

Write 'x'

LoopA:
Move Right

Move Right

If 'a' Goto LoopA

If 'x' Goto LoopA

Write 'x'

Goto GoHome

Move Left

If Not Blank Goto GoHome

Move Right

Goto Start

```
FoundB:
  Write 'x'
```

Write 'x'

LoopB:
Move Right

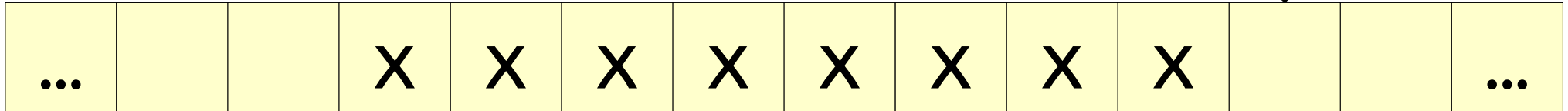
Move Right

If 'b' Goto LoopB

If 'x' Goto LoopB

Write 'x'

Goto GoHome



Start:

```
If 'a' Goto FoundA
If 'b' Goto FoundB
If Blank Return True
Move Right
Goto Start
```

FoundA:

```
Write 'x'
```

LoopA:

```
Move Right
If 'a' Goto LoopA
If 'x' Goto LoopA
Write 'x'
Goto GoHome
```

GoHome:

```
Move Left
If Not Blank Goto GoHome
Move Right
Goto Start
```

FoundB:

```
Write 'x'
```

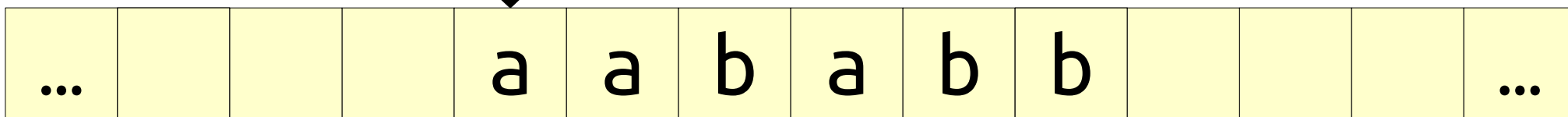
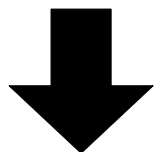
LoopB:

```
Move Right
If 'b' Goto LoopB
If 'x' Goto LoopB
Write 'x'
Goto GoHome
```

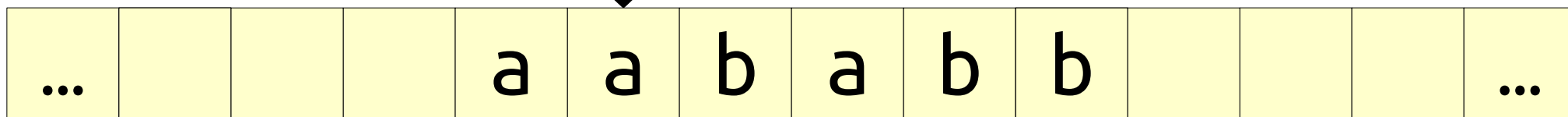
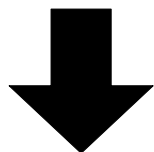

Another Idea

- We just built a TM for the language
$$\{ w \in \{\mathbf{a}, \mathbf{b}\}^* \mid w \text{ has the same number of } \mathbf{a}'\text{s and } \mathbf{b}'\text{s} \}.$$
- An observation: this would be a *lot* easier to test for if all the \mathbf{a} 's came before all the \mathbf{b} 's.
 - In fact, that would turn this into checking if the string has the form $\mathbf{a}^n\mathbf{b}^n$, which we already know how to do!
- **Idea:** Could we sort the characters of our input string?

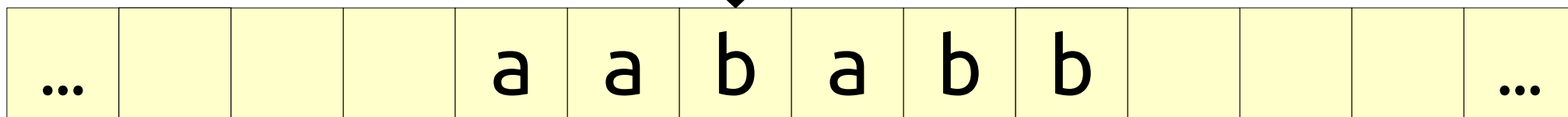
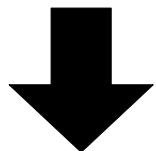
The Idea



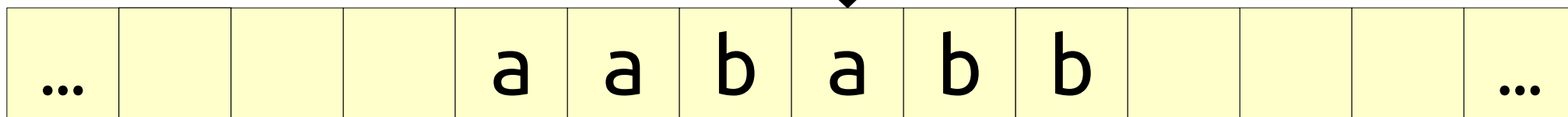
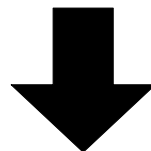
The Idea



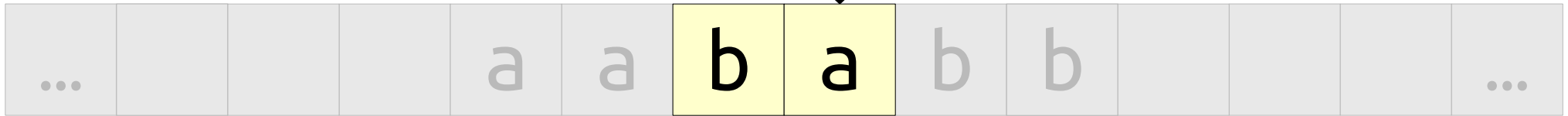
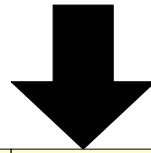
The Idea



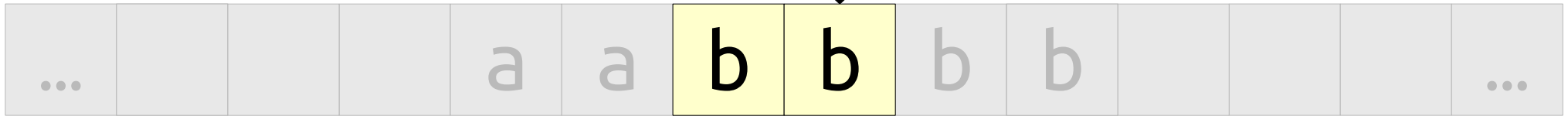
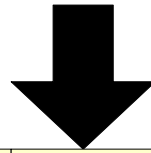
The Idea



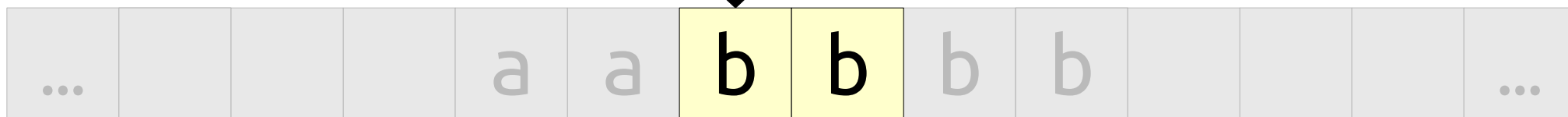
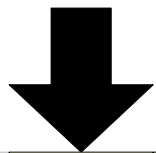
The Idea



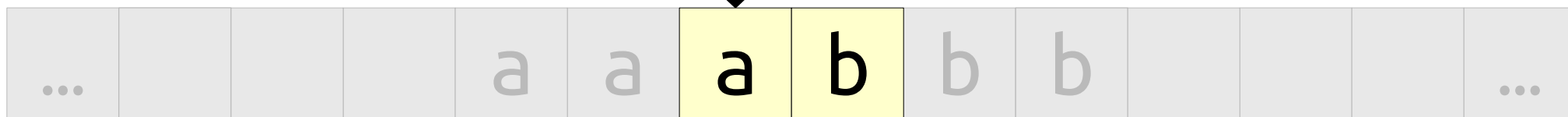
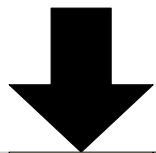
The Idea



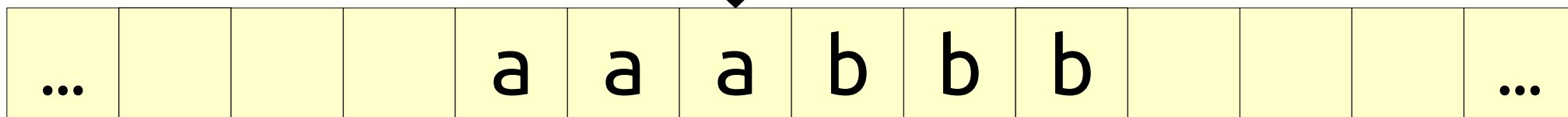
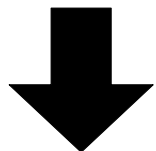
The Idea



The Idea



The Idea



Exploring This Idea

Cool TM Tricks 1: ***Fibonacci Numbers***

Fibonacci Numbers

...		a	a	a	a	a	a	a	a	a	a	a	a	a			...
-----	--	---	---	---	---	---	---	---	---	---	---	---	---	---	--	--	-----

...		x	y	a	a	a	a	a	a	a	a	a	a	a			...
-----	--	---	---	---	---	---	---	---	---	---	---	---	---	---	--	--	-----

...		y	y	x	a	a	a	a	a	a	a	a	a	a			...
-----	--	---	---	---	---	---	---	---	---	---	---	---	---	---	--	--	-----

...		x	x	x	y	y	a	a	a	a	a	a	a	a			...
-----	--	---	---	---	---	---	---	---	---	---	---	---	---	---	--	--	-----

...		y	y	y	y	y	x	x	x	a	a	a	a	a			...
-----	--	---	---	---	---	---	---	---	---	---	---	---	---	---	--	--	-----

...		x	x	x	x	x	x	x	x	y	y	y	y	y			...
-----	--	---	---	---	---	---	---	---	---	---	---	---	---	---	--	--	-----

$\{ \mathbf{a}^n \mid n \text{ is a Fibonacci number} \}$

0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, ...

Cool TM Tricks 2: ***Decimal Fibonacci***

Decimal Fibonacci

...		1	3														...
-----	--	---	---	--	--	--	--	--	--	--	--	--	--	--	--	--	-----

...		a	a	a	a	a	a	a	a	a	a	a	a	a			...
-----	--	---	---	---	---	---	---	---	---	---	---	---	---	---	--	--	-----

$\{ w \in \{0, 1, 2, \dots, 9\}^* \mid w, \text{ interpreted as a base-10 number, is a Fibonacci number. } \}$

Summary for Today

- Turing machines are abstract computers that issue commands to an infinite tape subdivided into cells.
- Each step of the TM can move the tape head, change what's on the tape, or jump to a different part of the program.
- TMs can be composed together to build larger TMs out of smaller ones.

Next Time

- ***The Church-Turing Thesis***
 - How powerful are Turing machines?
- ***Decidability and Recognizability***
 - Two notions of “solving a problem.”