Construct a **Turing machine** that **accepts** the language:
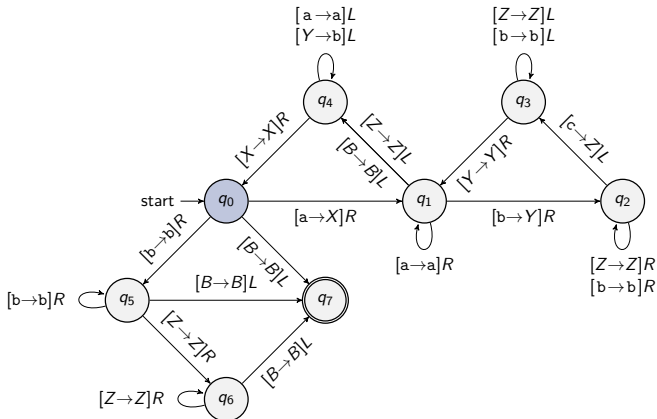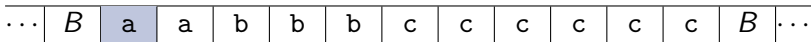
$$L(M) = \{a^i b^j c^{i \times j} \mid i, j \geq 0\}$$

$\cdots$	B	a	a	b	b	b	c	c	c	c	c	c	B	$\cdots$

1: **while** there are a's **do**
2:      Find and Replace a with X
3:      **while** there are b's **do**
4:          Find and Replace b with Y
5:          Find and Replace c with Z
6:      Roll back all Y's to b's
7: Check if only b's and Z's are left

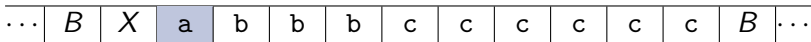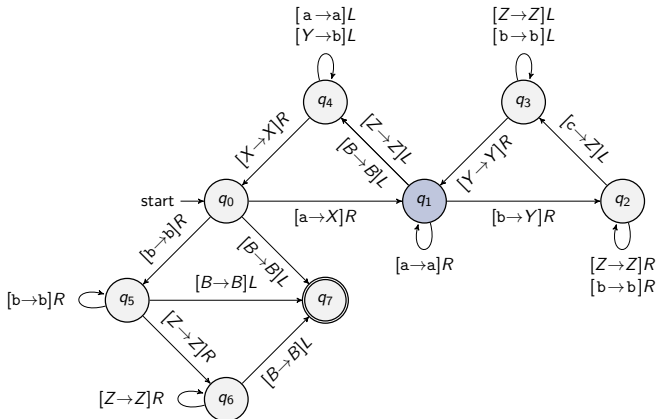Construct a **Turing machine** that **accepts** the language:

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Find and Replace a with X.

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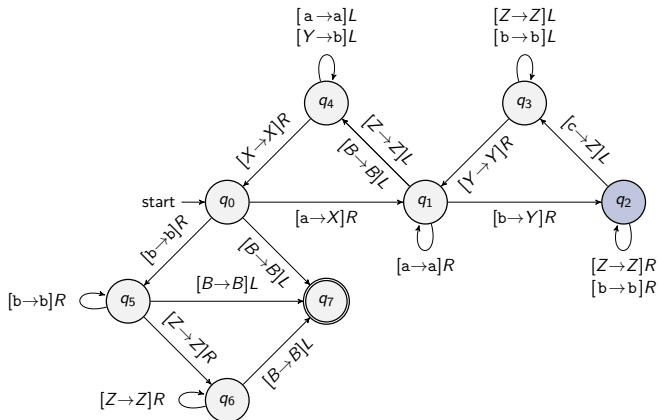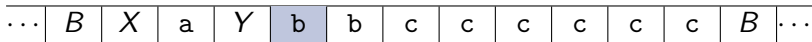| ⋯	B	X	a	b	b	b	c	c	c	c	c	c	B	⋯

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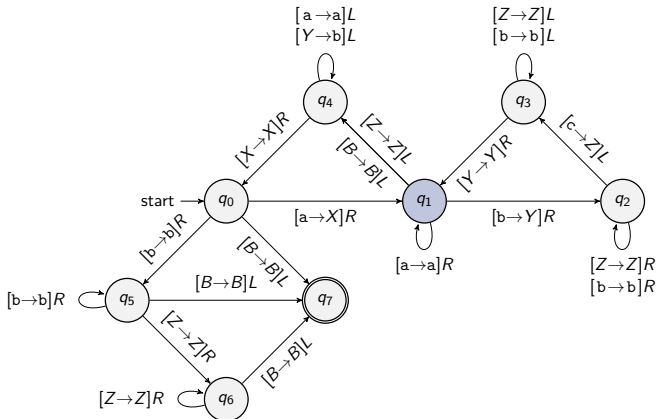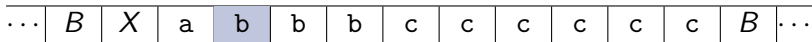
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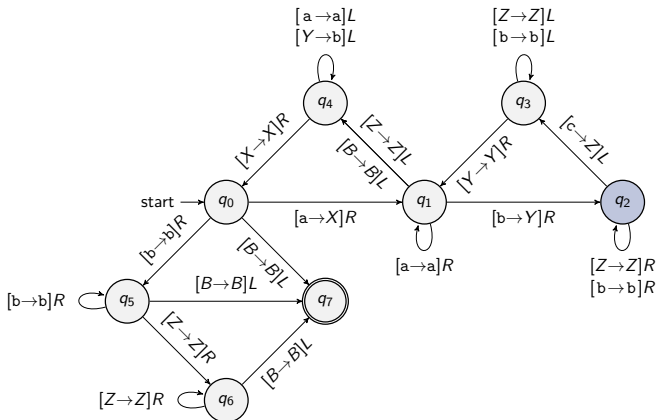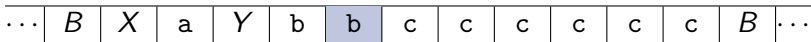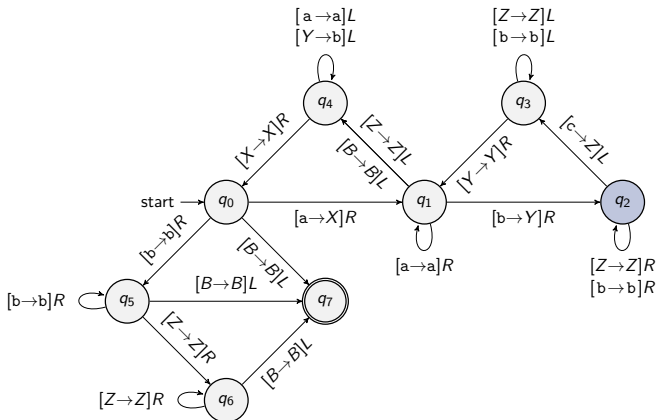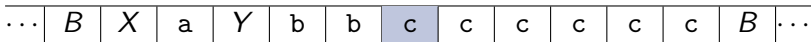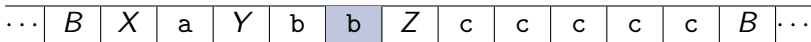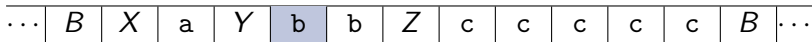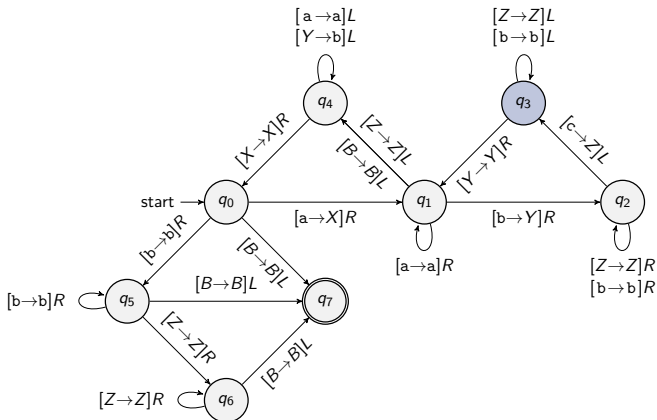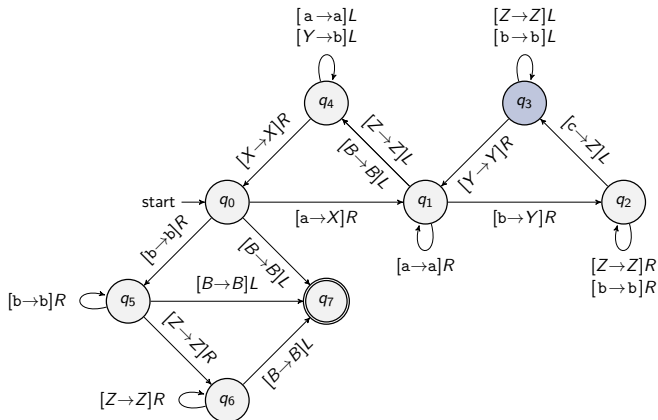Construct a **Turing machine** that **accepts** the language:

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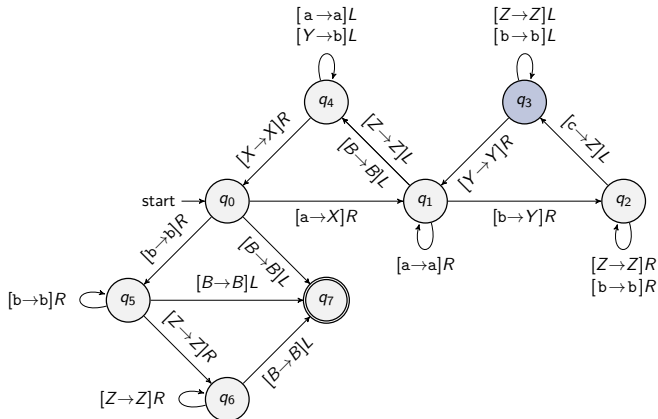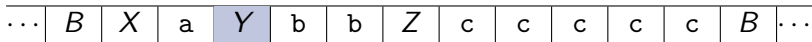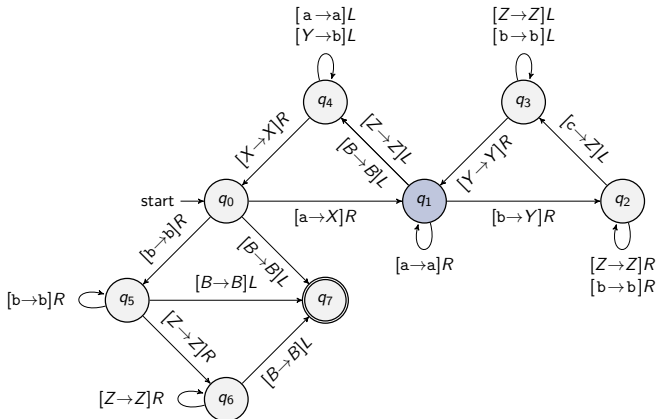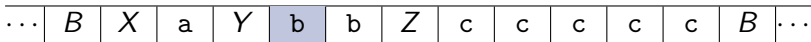| $\cdots$	B	X	a	Y	b	b	c	c	c	c	c	c	B	$\cdots$

Find and Replace c with Z.

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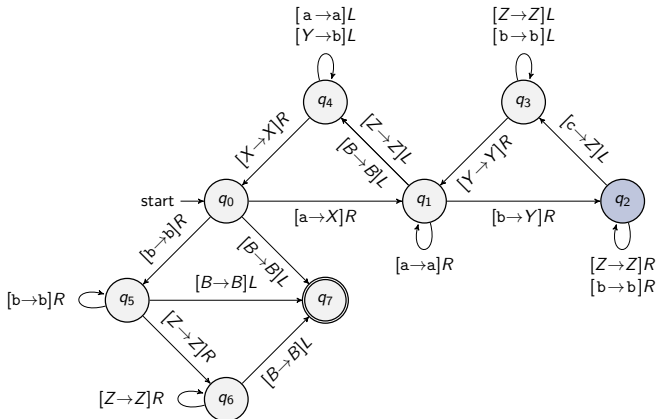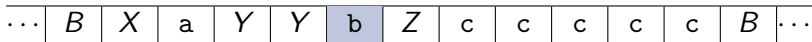Construct a **Turing machine** that **accepts** the language:

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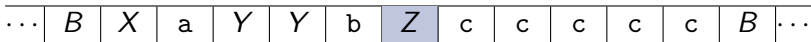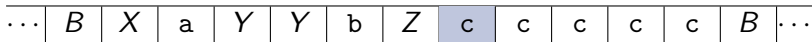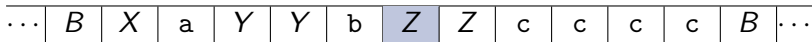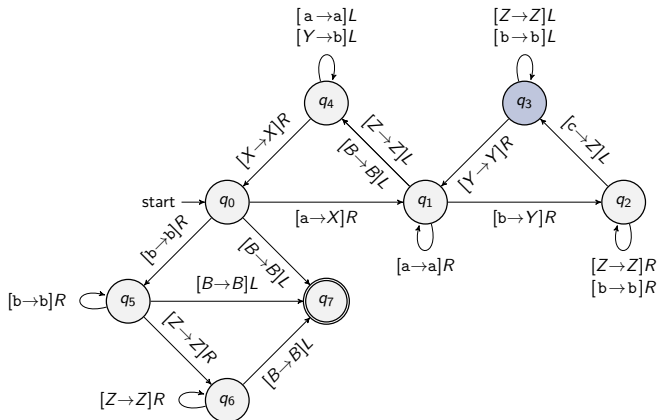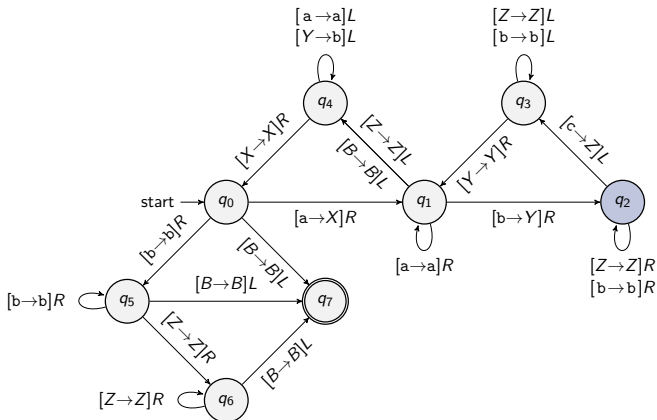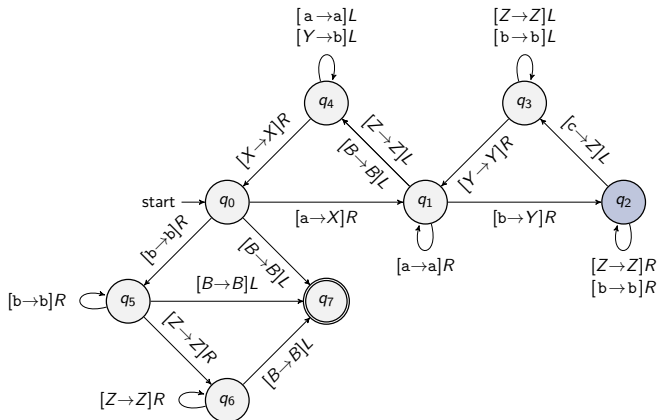| $\cdots$	B	X	a	Y	b	b	c	c	c	c	c	c	B	$\cdots$

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···	B	X	a	Y	b	b	Z	c	c	c	c	c	B	···

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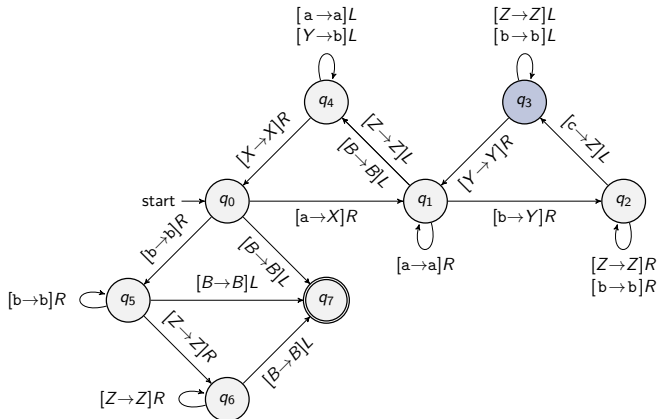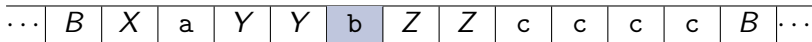$$L(M) = \{\mathtt{a}^i \mathtt{b}^j \mathtt{c}^{i \times j} \mid i, j \geq 0\}$$
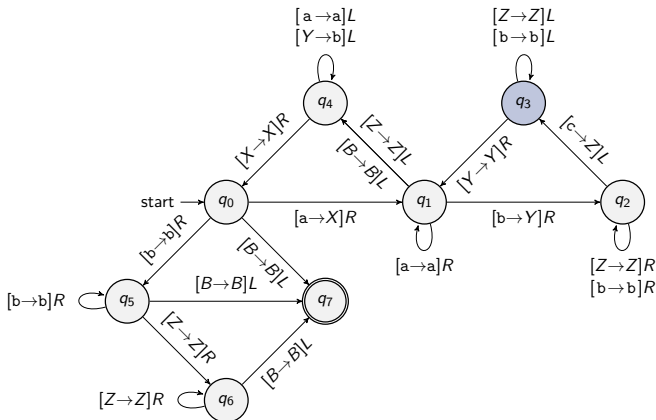
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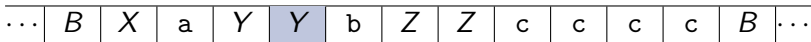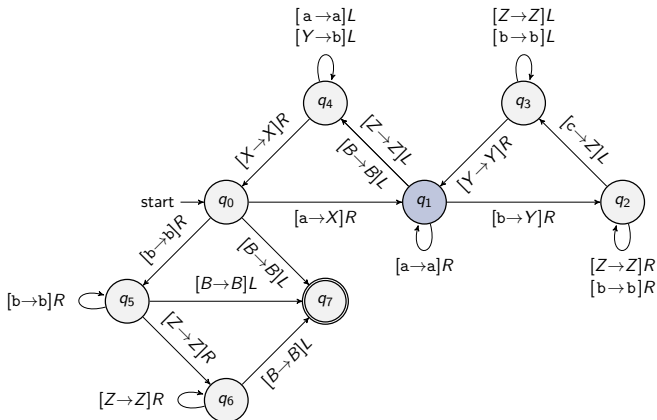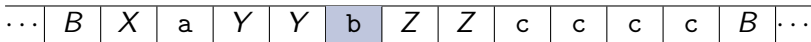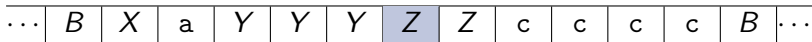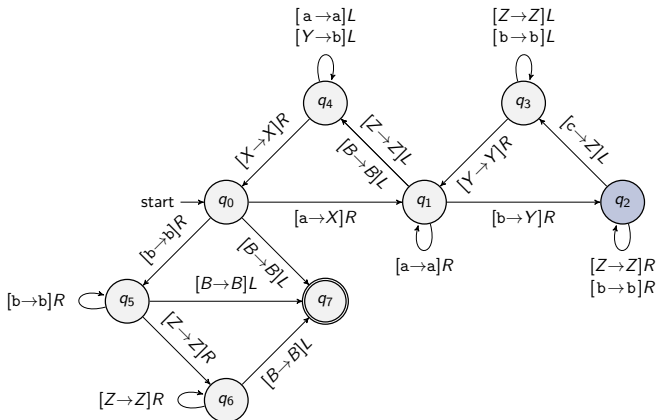| $\cdots$ | B | X | a | Y | b | b | Z | c | c | c | c | c | B | $\cdots$ |

Repeat until no b's left.

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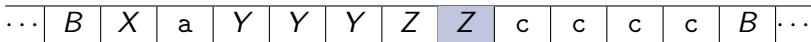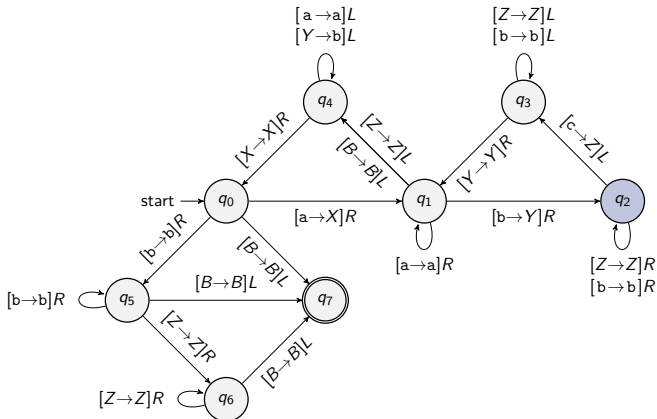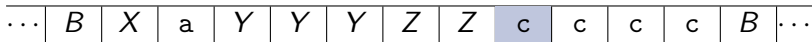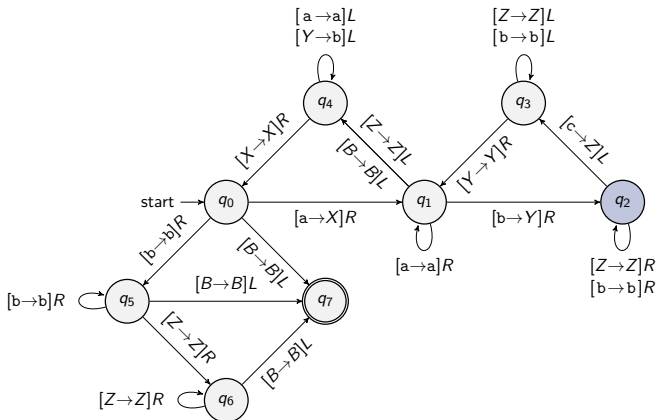$$L(M) = \{a^i b^j c^{i \times j} \mid i, j \geq 0\}$$

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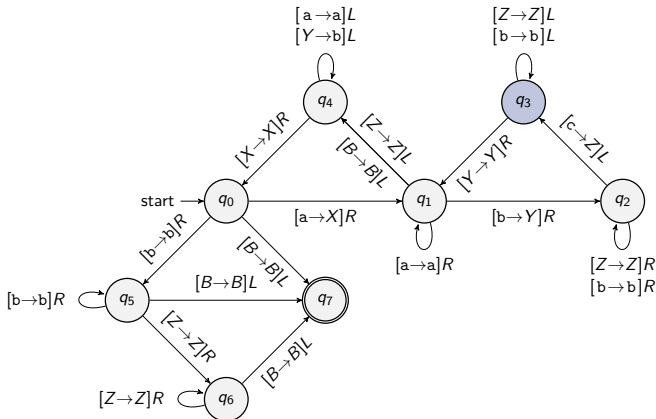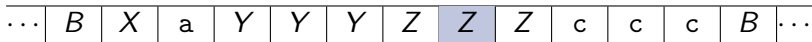$$L(M) = \{a^i b^j c^{i \times j} \mid i, j \geq 0\}$$

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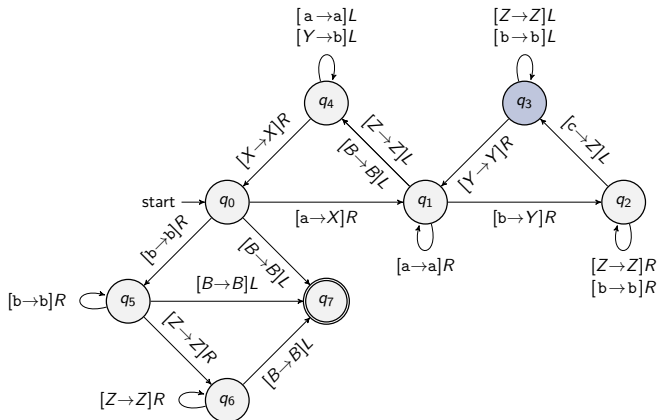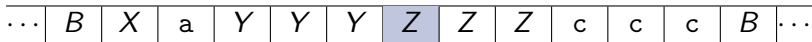$$L(M) = \{a^i b^j c^{i \times j} \mid i, j \geq 0\}$$

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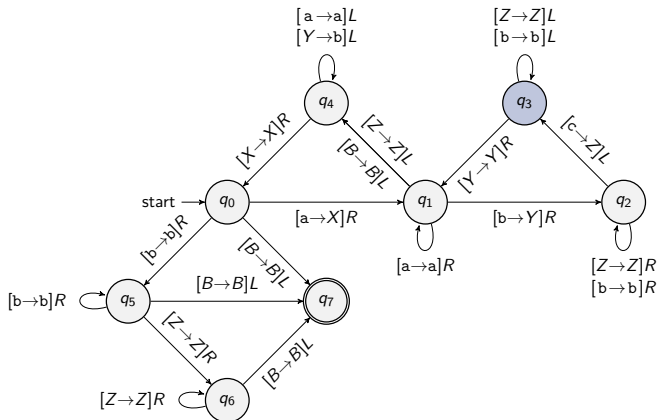$$L(M) = \{a^i b^j c^{i \times j} \mid i, j \geq 0\}$$

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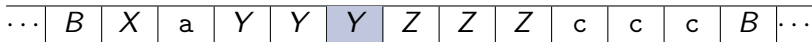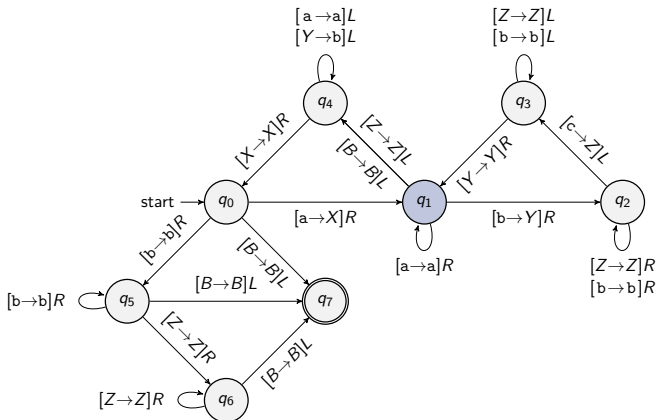$$L(M) = \{a^i b^j c^{i \times j} \mid i, j \geq 0\}$$

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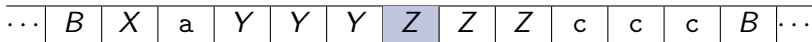$$L(M) = \{a^i b^j c^{i \times j} \mid i, j \geq 0\}$$

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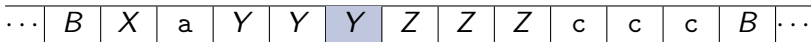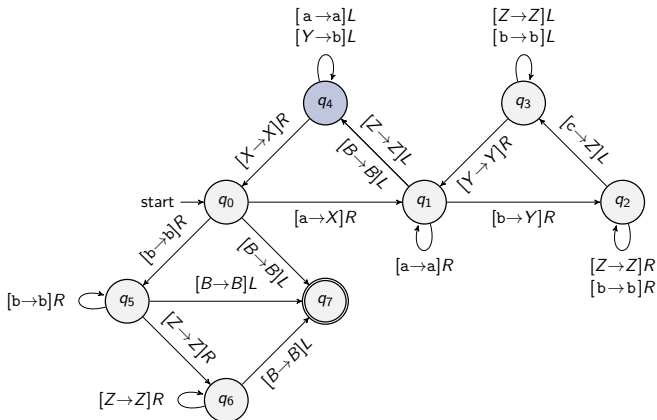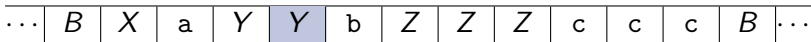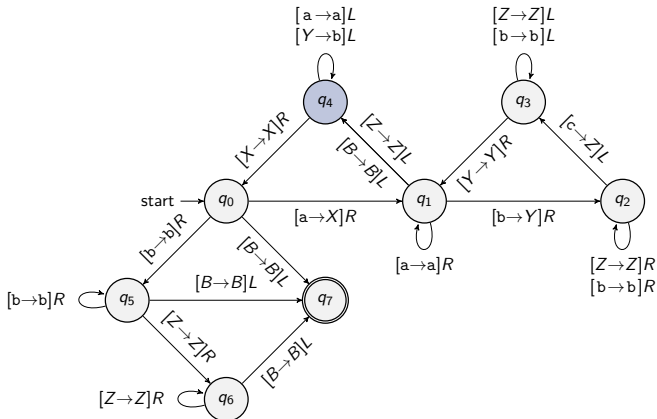Construct a **Turing machine** that **accepts** the language:

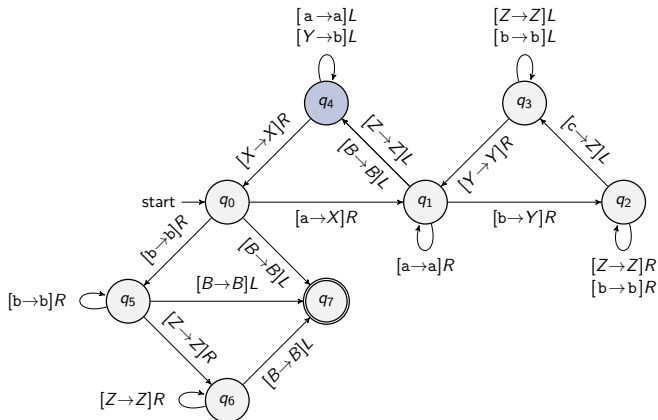$$L(M) = \{a^i b^j c^{i \times j} \mid i, j \geq 0\}$$

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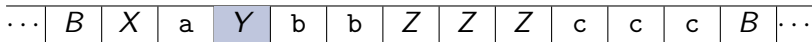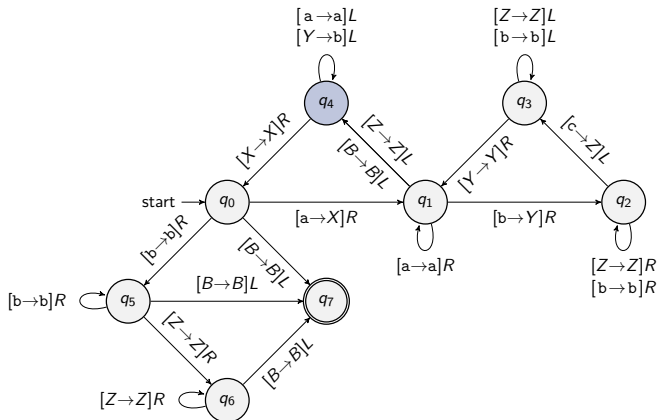$$L(M) = \{a^i b^j c^{i \times j} \mid i, j \geq 0\}$$

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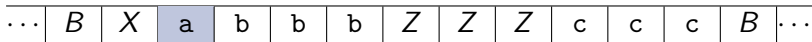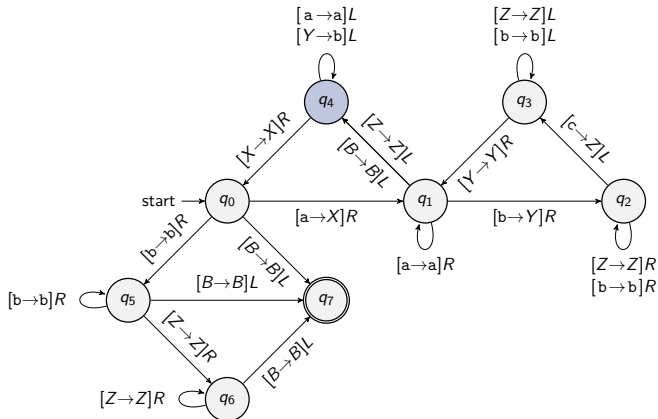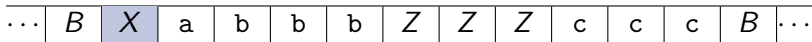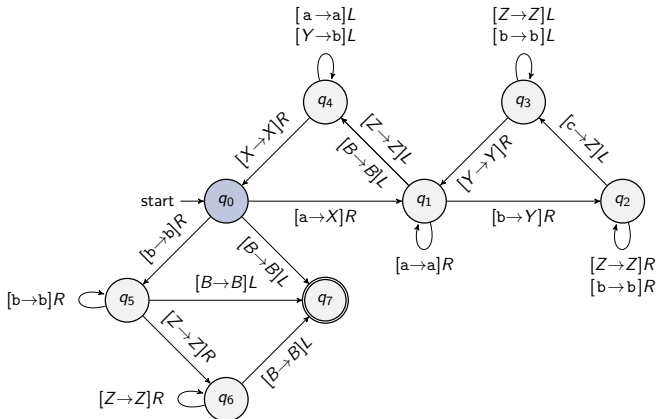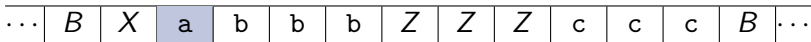

Roll back all Y's to b's

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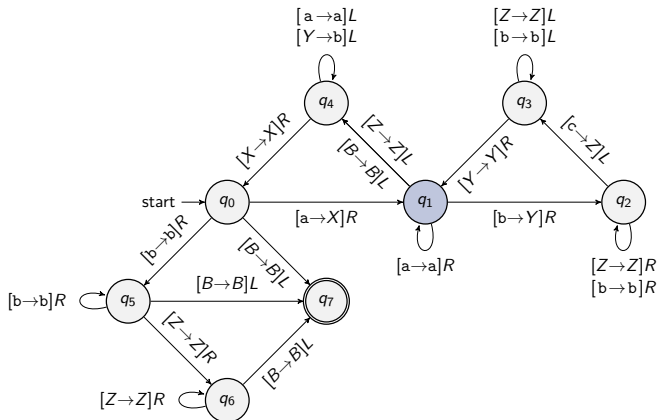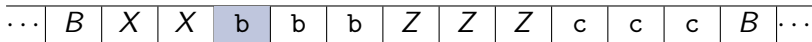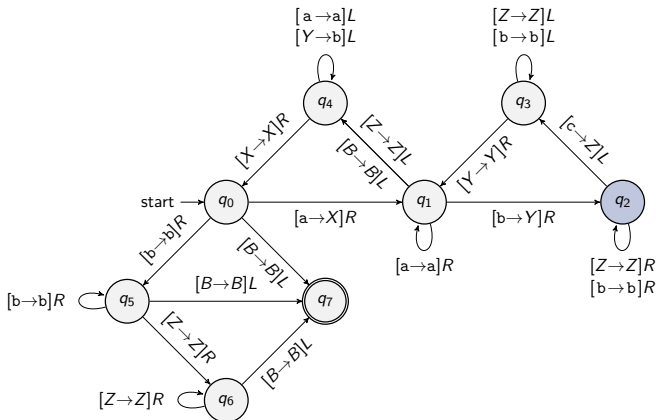Construct a **Turing machine** that **accepts** the language:

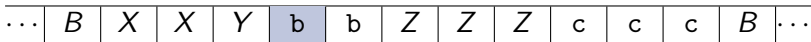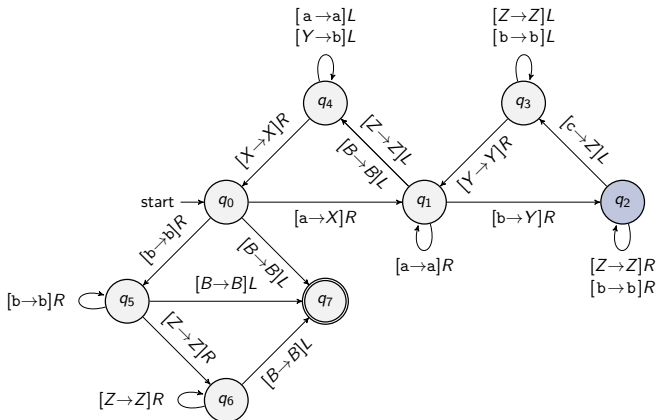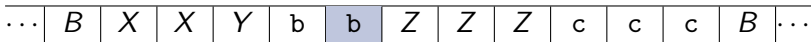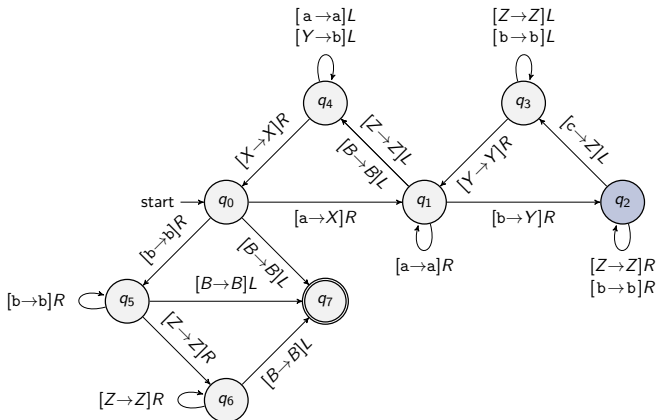$$L(M) = \{a^i b^j c^{i \times j} \mid i, j \geq 0\}$$

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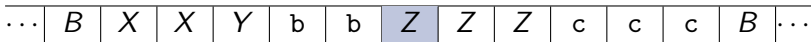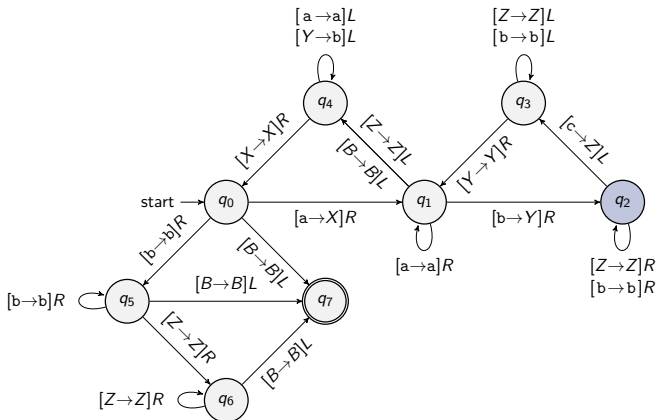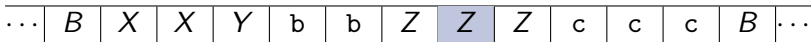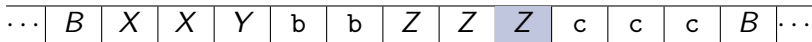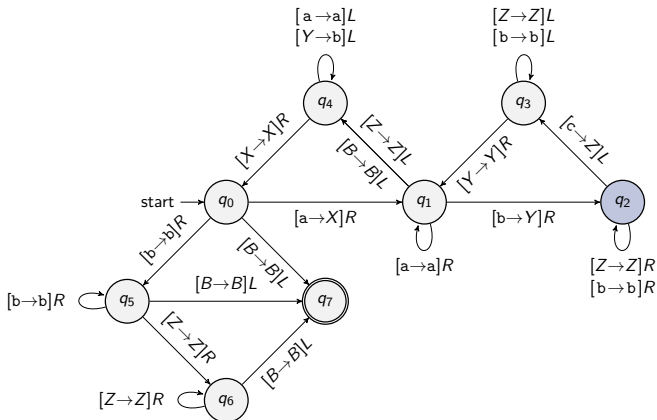| ···	B	X	a	b	b	b	Z	Z	Z	c	c	c	B	···

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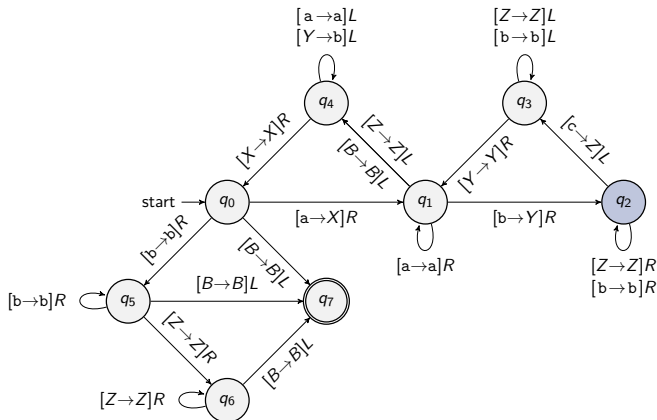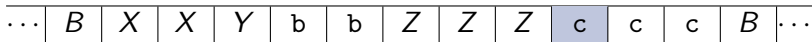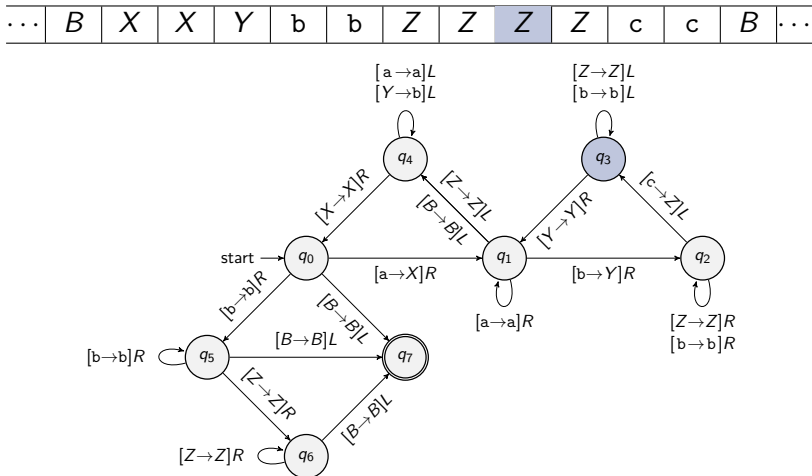$$L(M) = \{a^i b^j c^{i \times j} \mid i, j \geq 0\}$$

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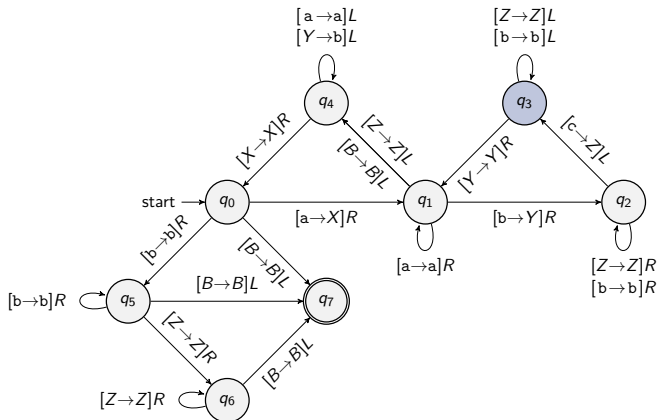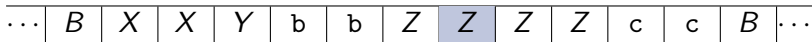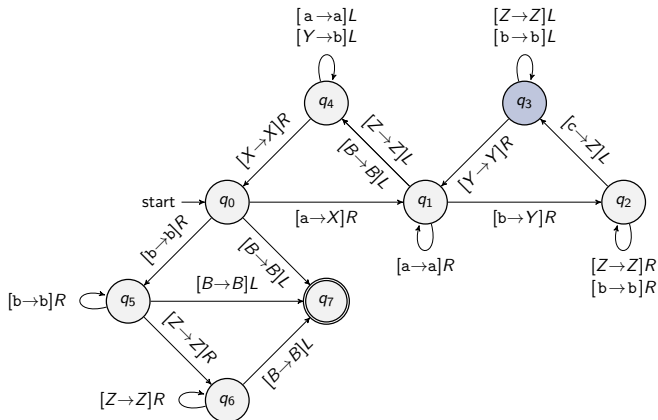
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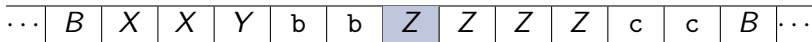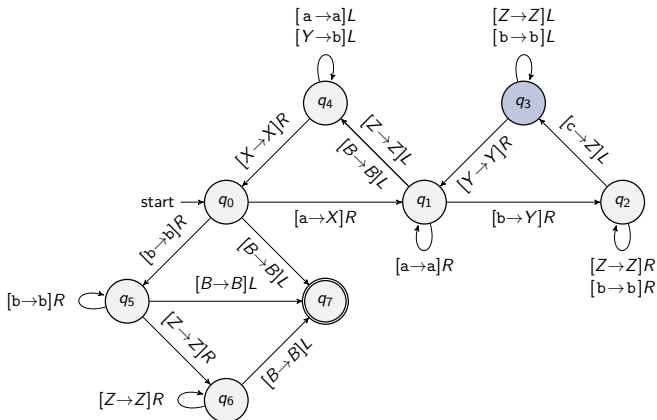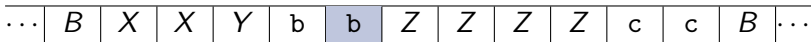$$L(M) = \{a^i b^j c^{i \times j} \mid i, j \geq 0\}$$

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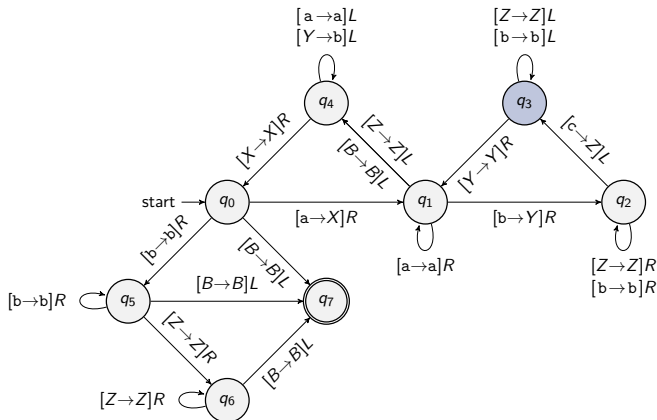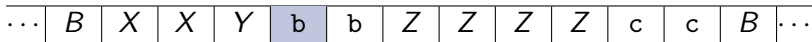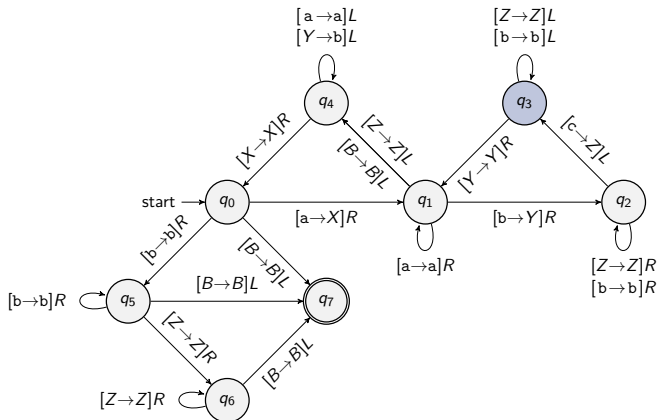$$L(M) = \{a^i b^j c^{i \times j} \mid i, j \geq 0\}$$

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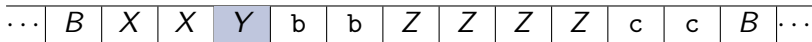$$L(M) = \{a^i b^j c^{i \times j} \mid i, j \geq 0\}$$

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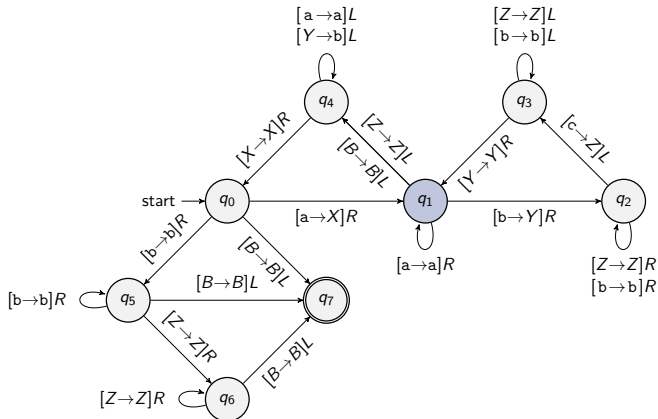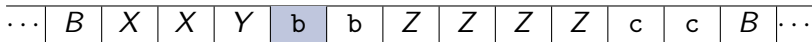$$L(M) = \{a^i b^j c^{i \times j} \mid i, j \geq 0\}$$

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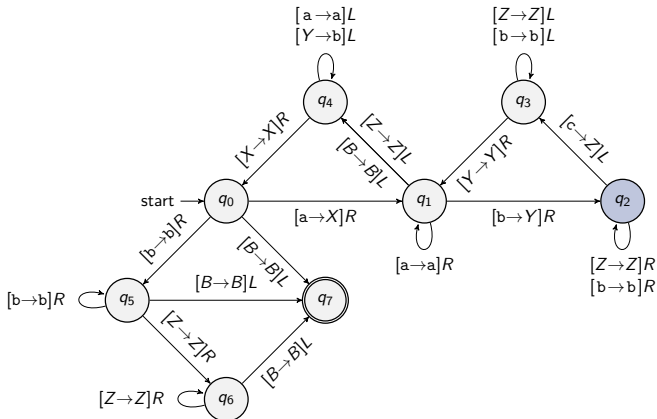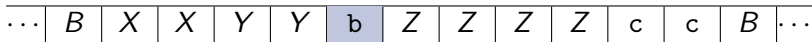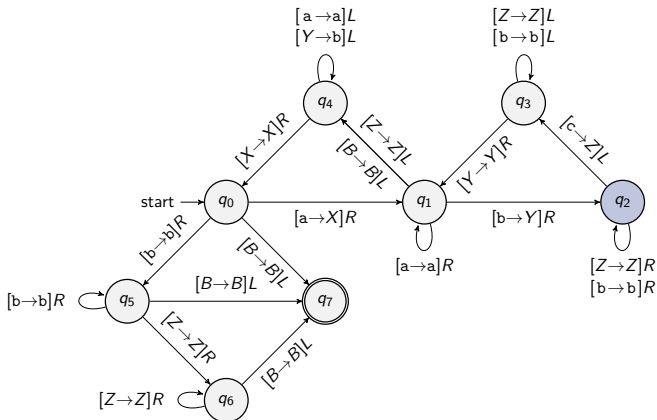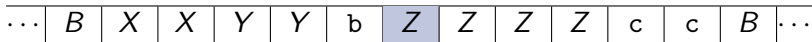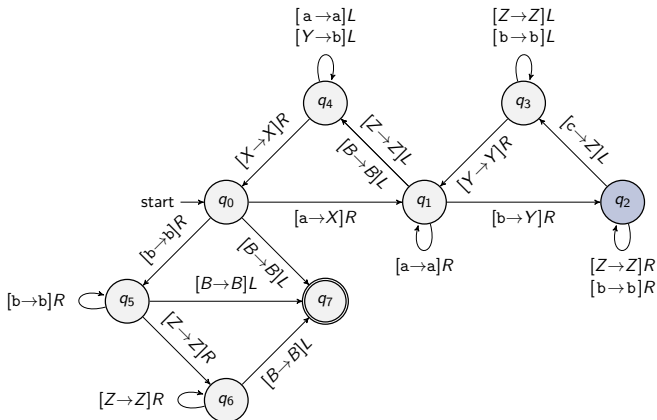
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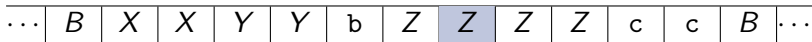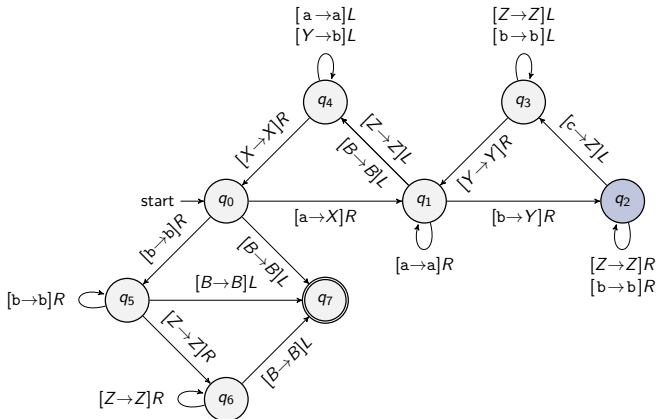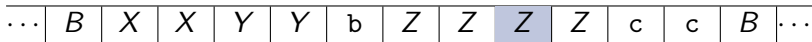$$L(M) = \{a^i b^j c^{i \times j} \mid i, j \geq 0\}$$

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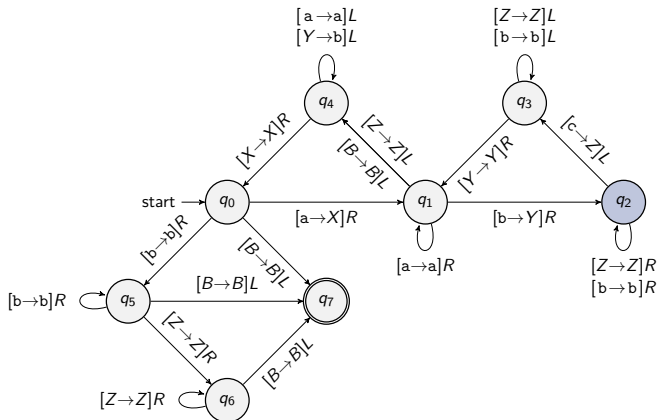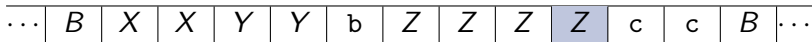$$L(M) = \{a^i b^j c^{i \times j} \mid i, j \geq 0\}$$

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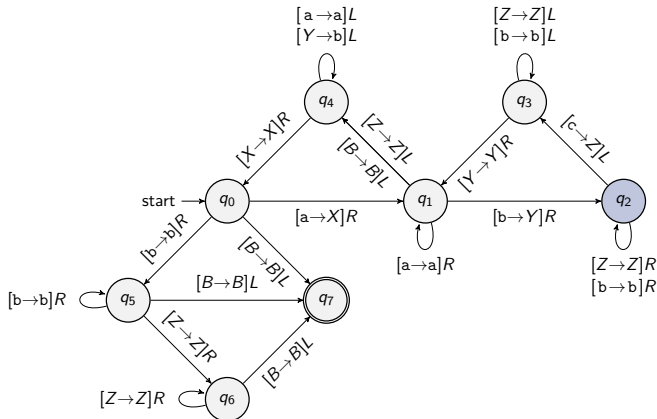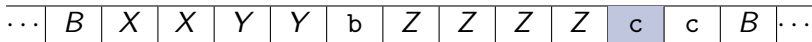$$L(M) = \{a^i b^j c^{i \times j} \mid i, j \geq 0\}$$

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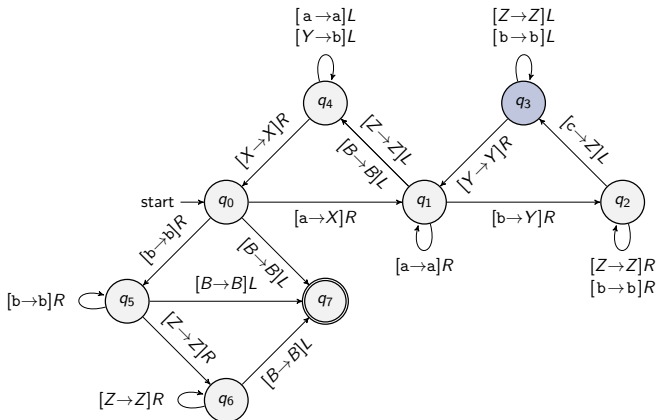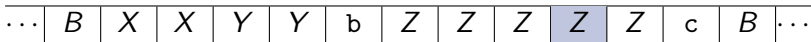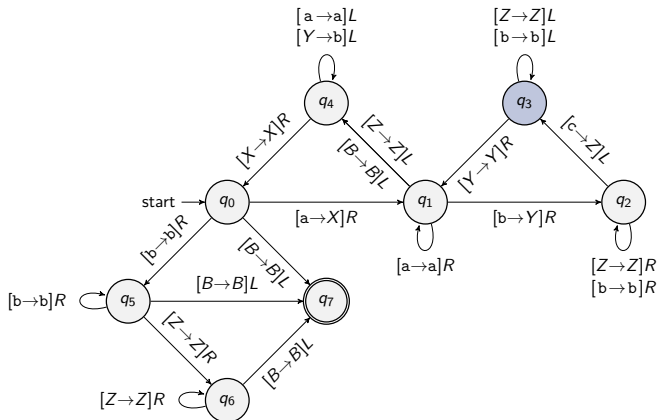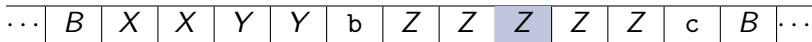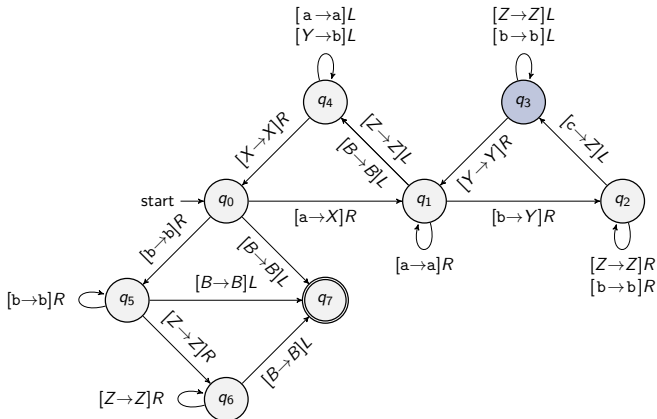| $\cdots$	B	X	X	Y	Y	b	Z	Z	Z	Z	c	c	B	$\cdots$

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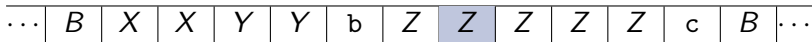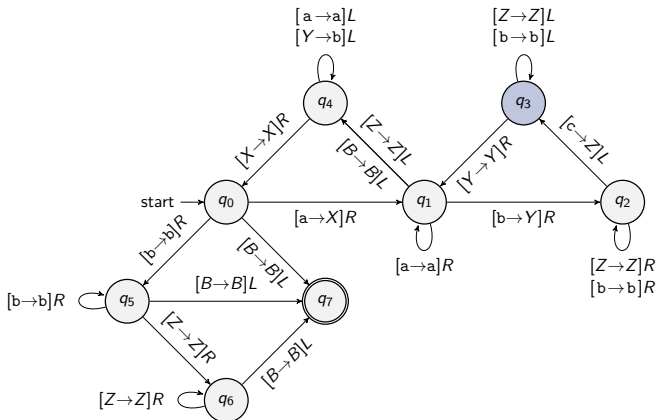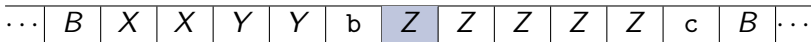$$L(M) = \{a^i b^j c^{i \times j} \mid i, j \geq 0\}$$

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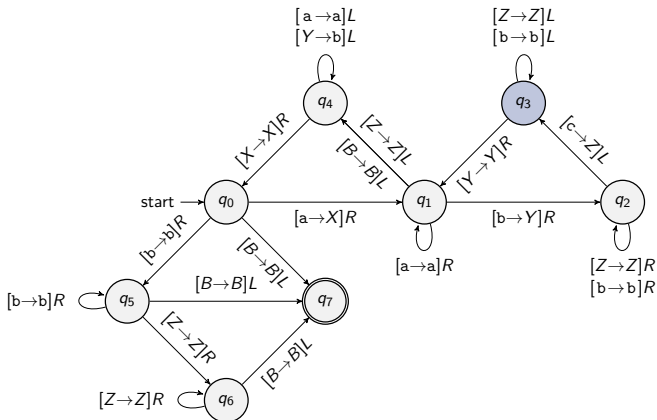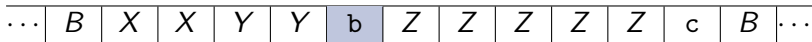$$L(M) = \{a^i b^j c^{i \times j} \mid i, j \geq 0\}$$

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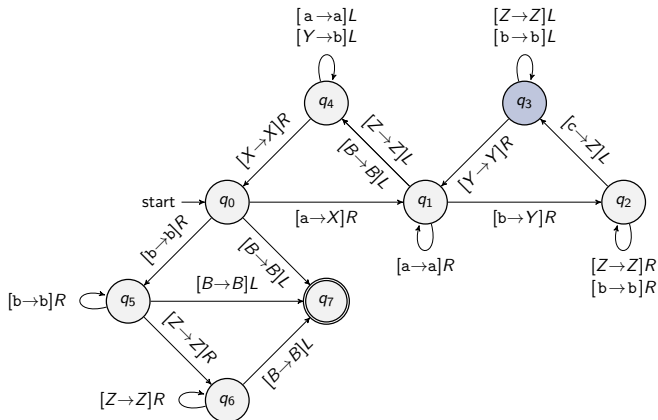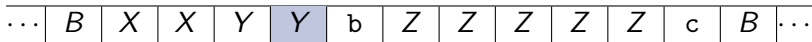$$L(M) = \{a^i b^j c^{i \times j} \mid i, j \geq 0\}$$

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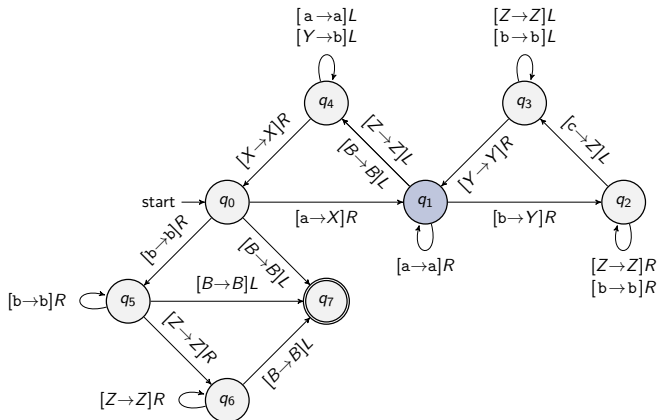$$L(M) = \{a^i b^j c^{i \times j} \mid i, j \geq 0\}$$

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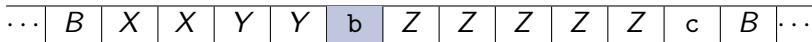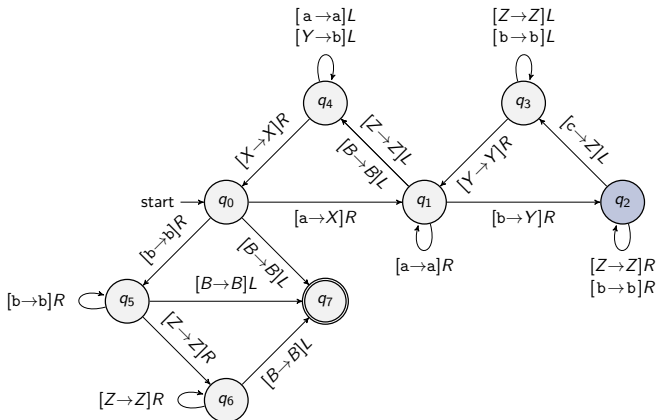$$L(M) = \{a^i b^j c^{i \times j} \mid i, j \geq 0\}$$

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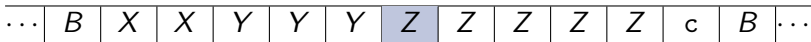$$L(M) = \{a^i b^j c^{i \times j} \mid i, j \geq 0\}$$

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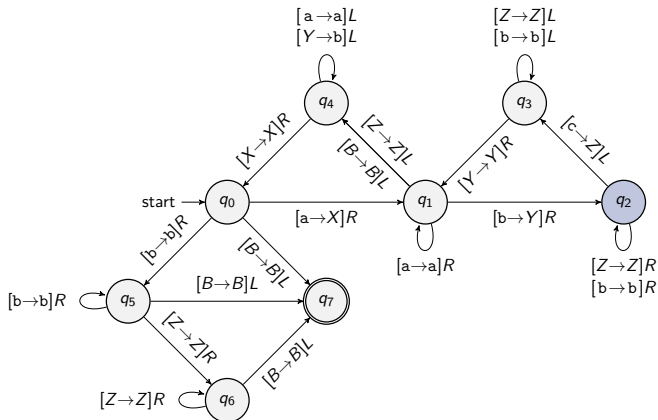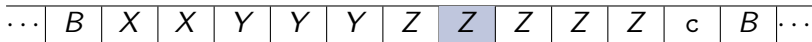$$L(M) = \{a^i b^j c^{i \times j} \mid i, j \geq 0\}$$

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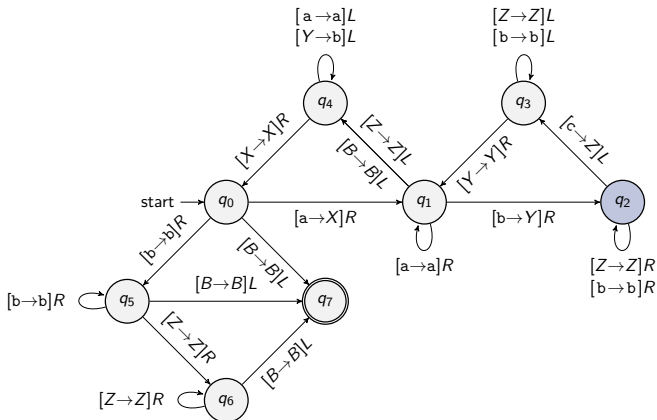$$L(M) = \{a^i b^j c^{i \times j} \mid i, j \geq 0\}$$

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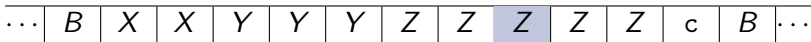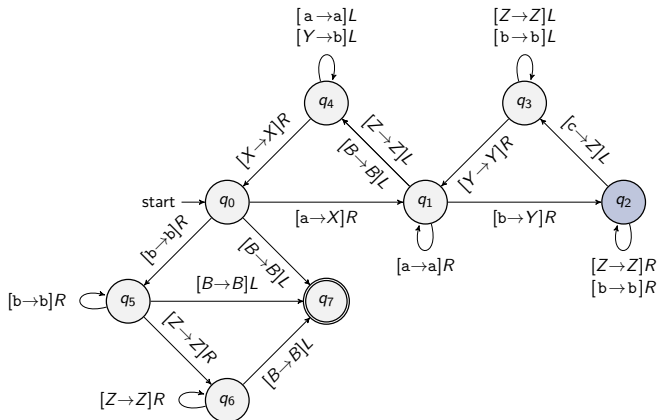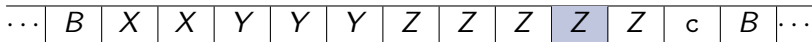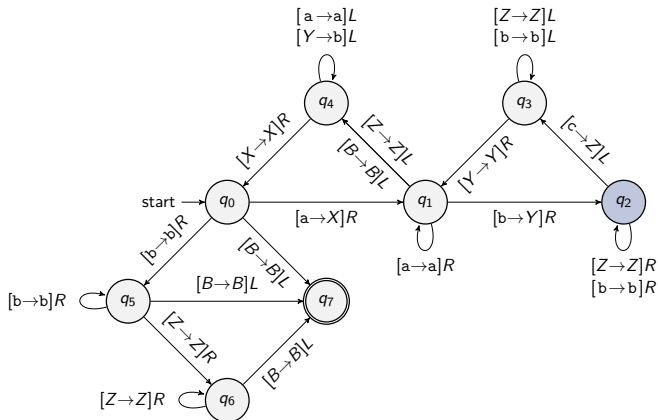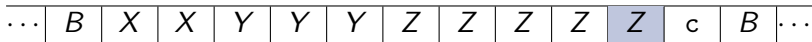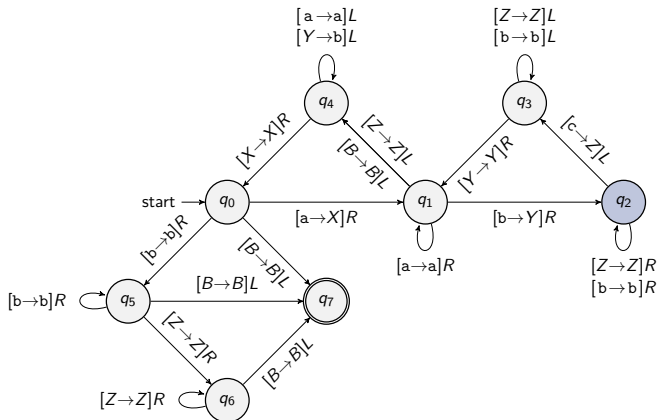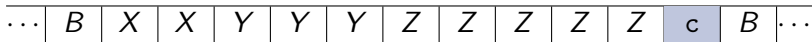| $\cdots$	B	X	X	Y	Y	Y	Z	Z	Z	Z	Z	c	B	$\cdots$

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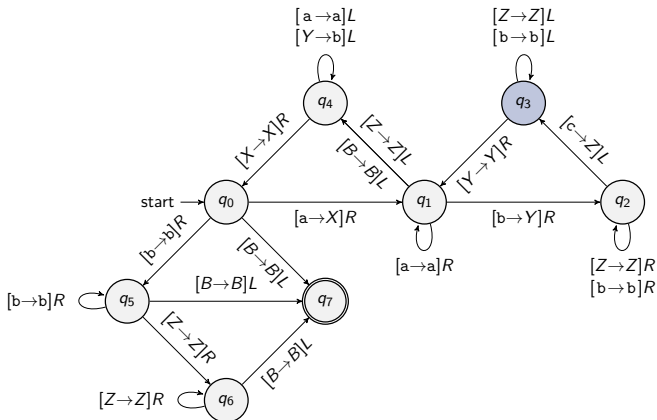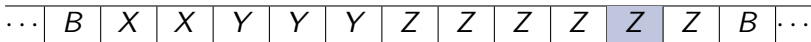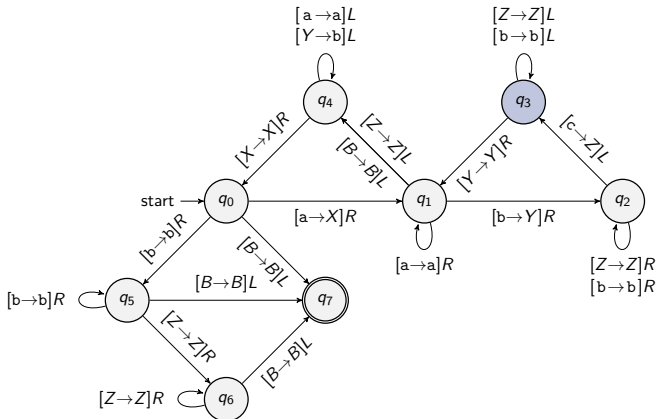
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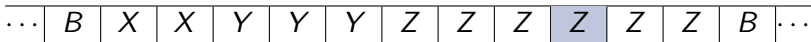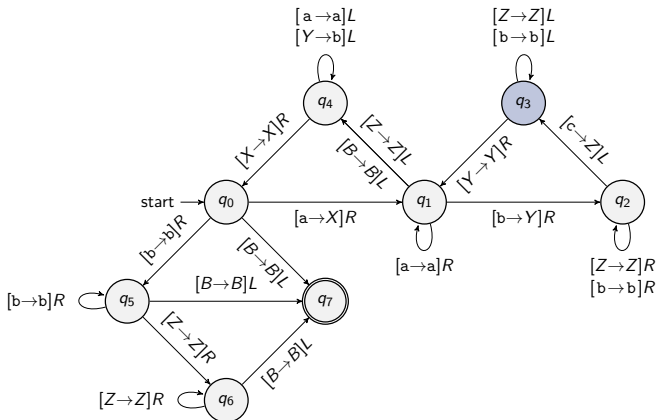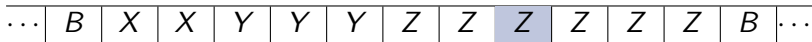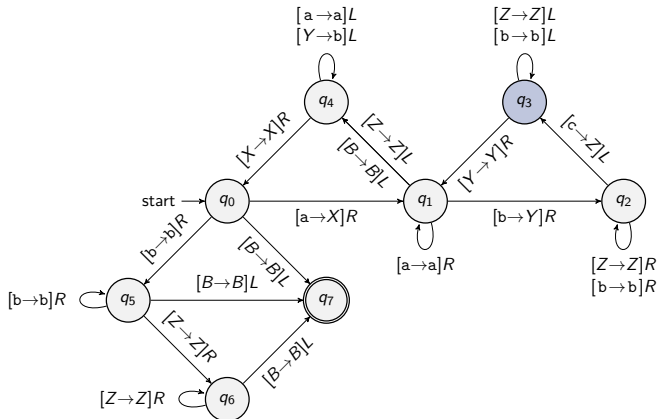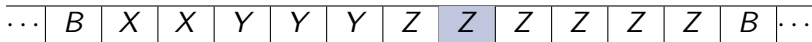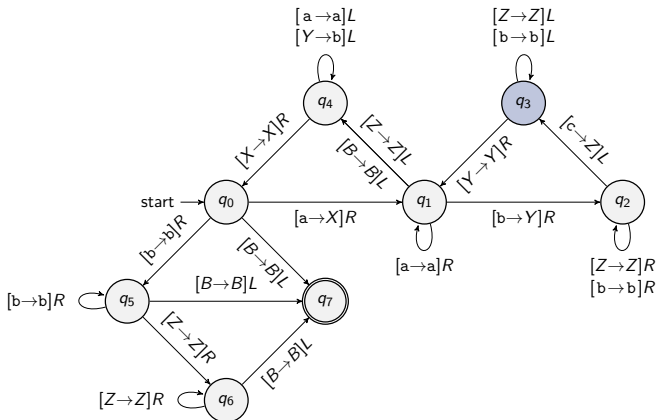| $\cdots$	B	X	X	Y	Y	Y	Z	Z	Z	Z	Z	c	B	$\cdots$

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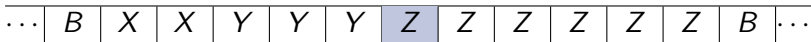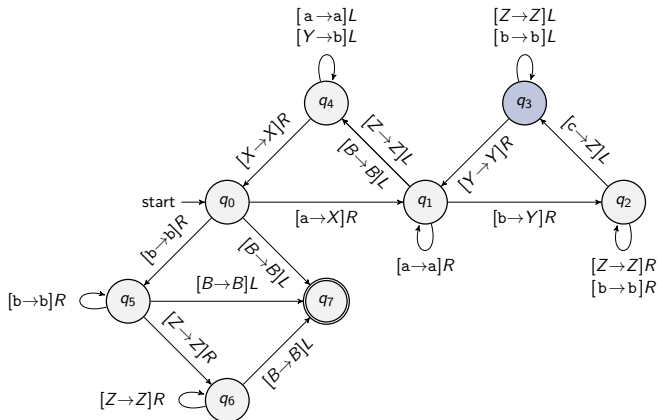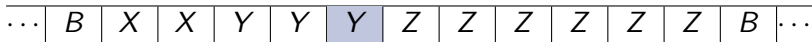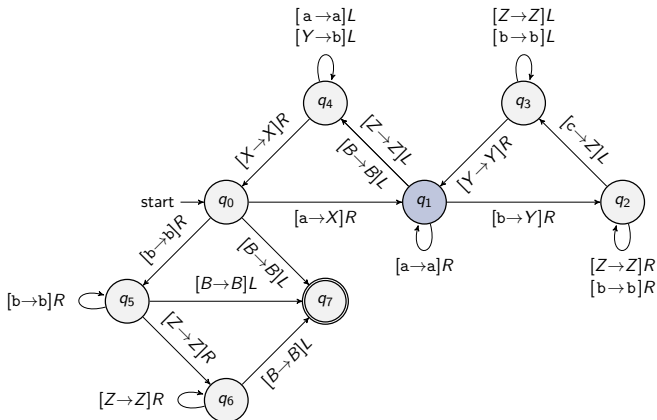| $\cdots$	B	X	X	Y	Y	Y	Z	Z	Z	Z	Z	Z	B	$\cdots$

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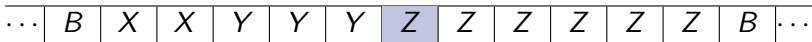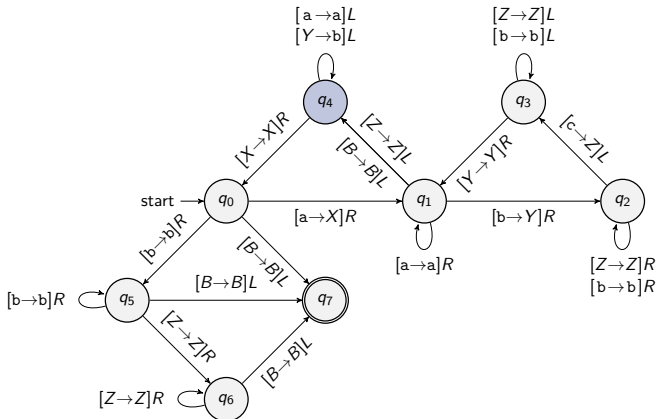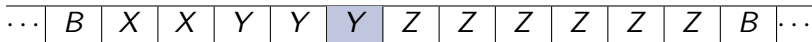$$L(M) = \{a^i b^j c^{i \times j} \mid i, j \geq 0\}$$

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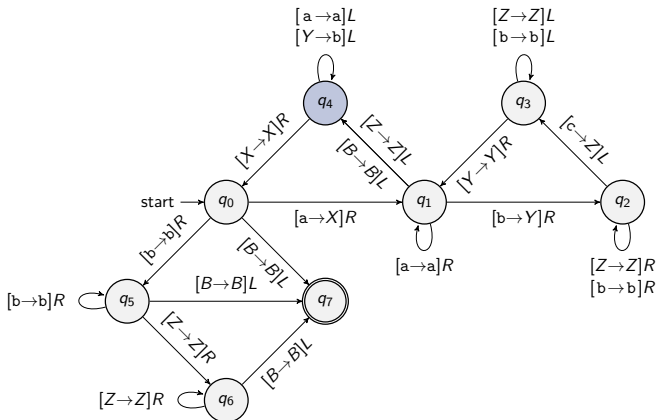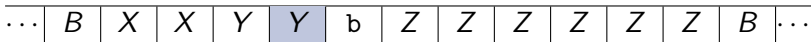$$L(M) = \{a^i b^j c^{i \times j} \mid i, j \geq 0\}$$

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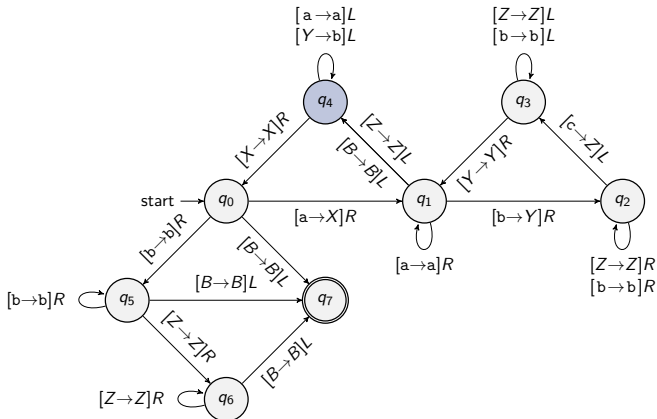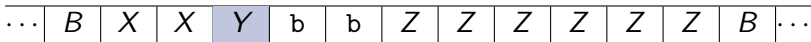$$L(M) = \{a^i b^j c^{i \times j} \mid i, j \geq 0\}$$

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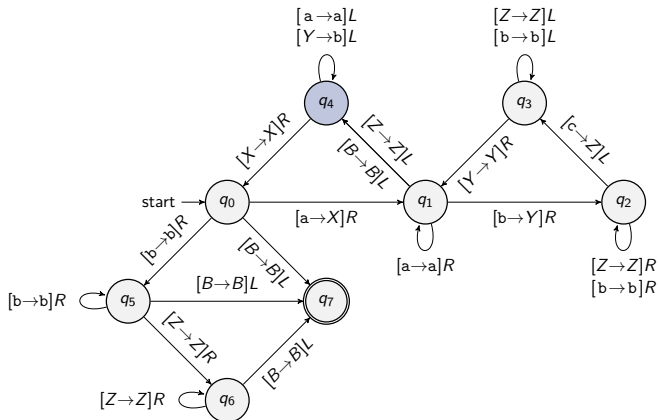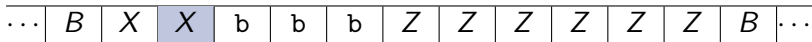$$L(M) = \{a^i b^j c^{i \times j} \mid i, j \geq 0\}$$

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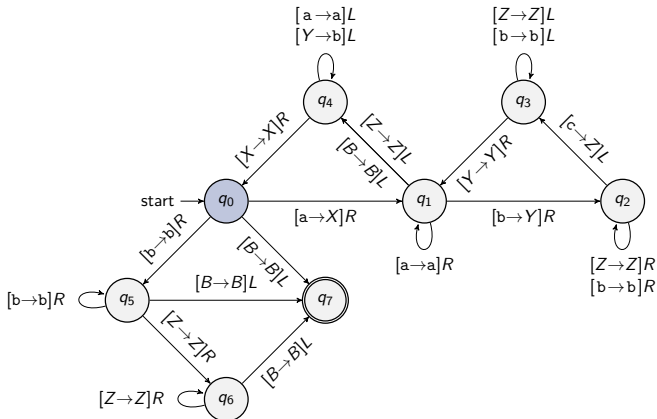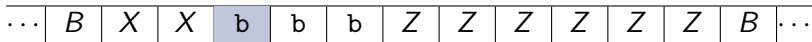$$L(M) = \{a^i b^j c^{i \times j} \mid i, j \geq 0\}$$

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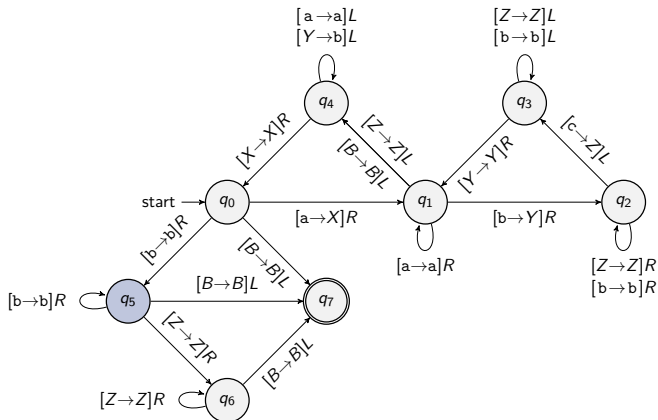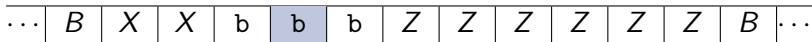Construct a **Turing machine** that **accepts** the language:

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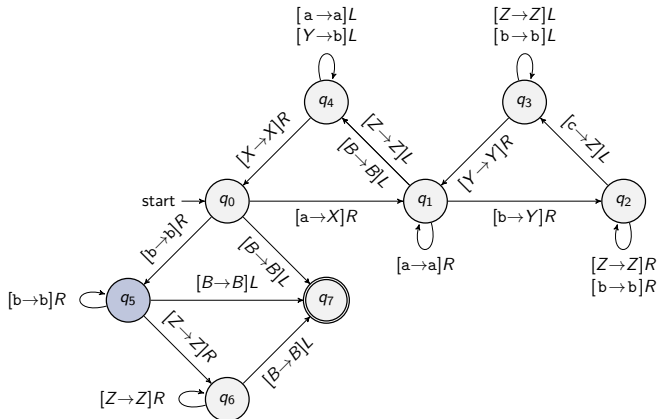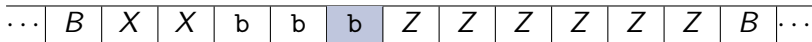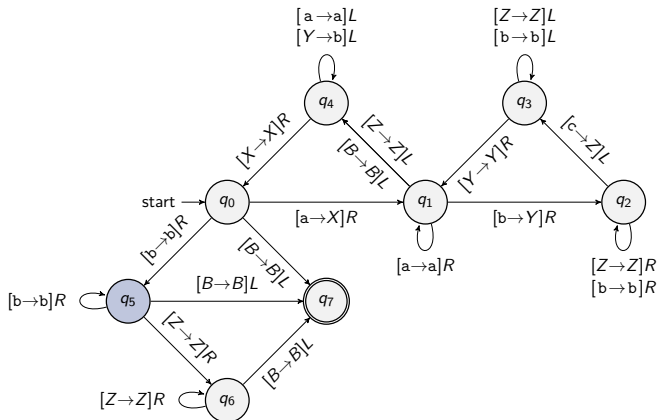

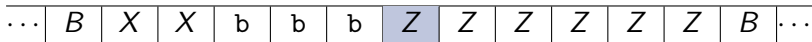Check if only b's and Z's are left.

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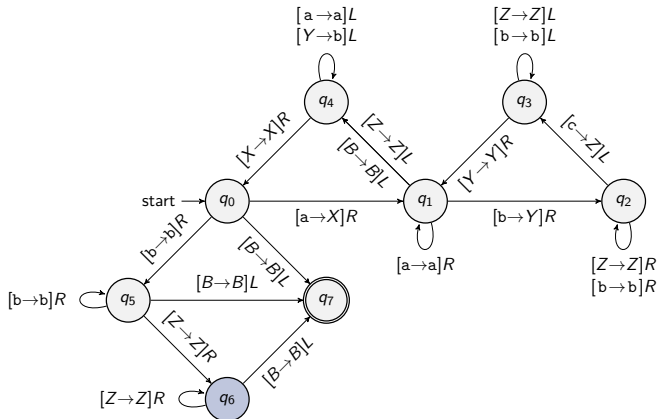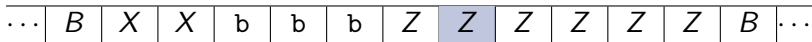$$L(M) = \{a^i b^j c^{i \times j} \mid i, j \geq 0\}$$

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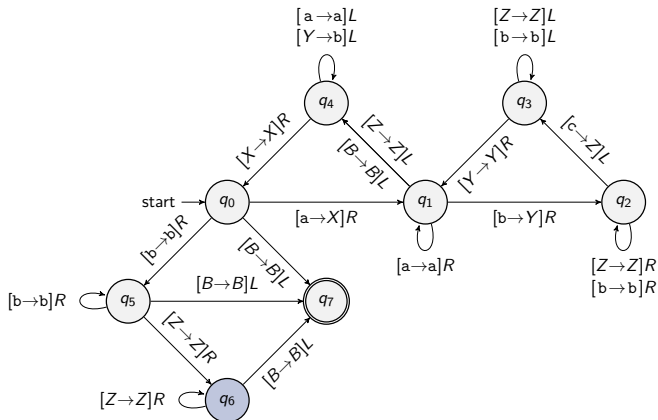$$L(M) = \{a^i b^j c^{i \times j} \mid i, j \geq 0\}$$

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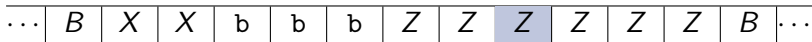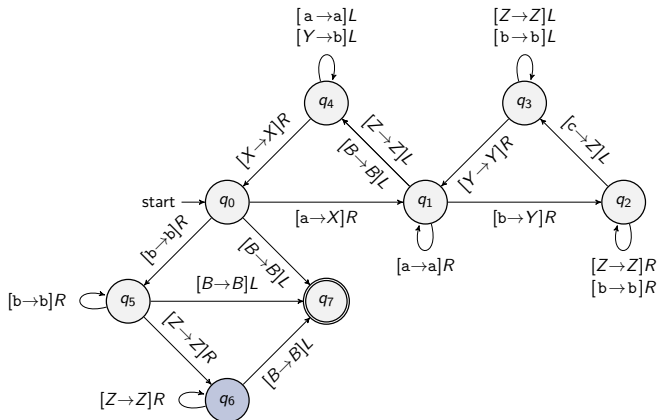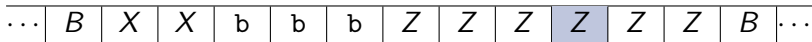$$L(M) = \{a^i b^j c^{i \times j} \mid i, j \geq 0\}$$

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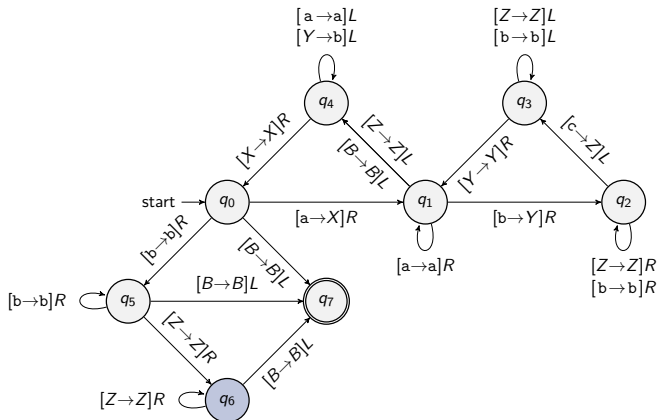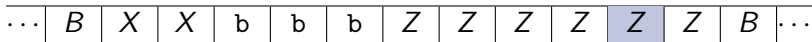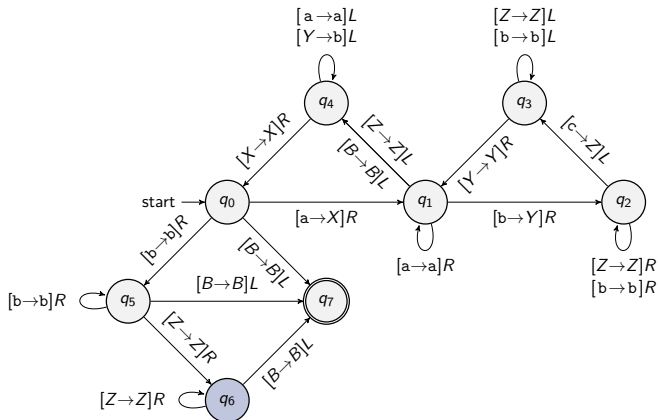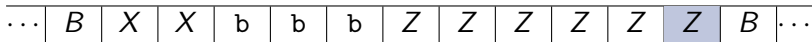$$L(M) = \{ a^i b^j c^{i \times j} \mid i, j \geq 0 \}$$

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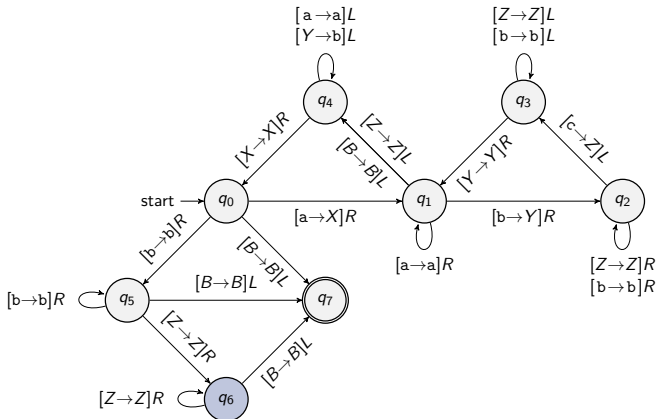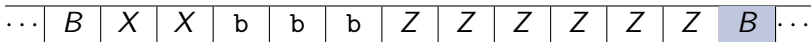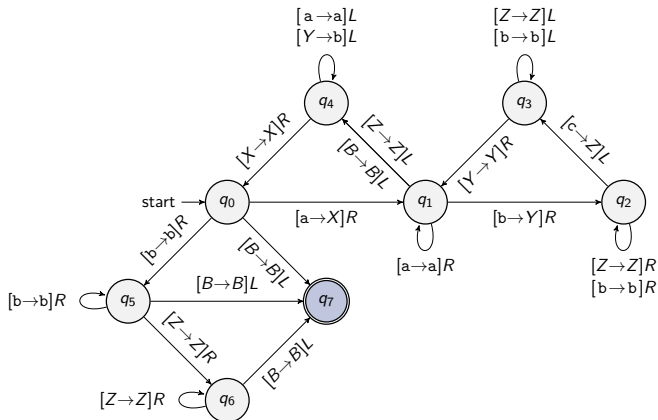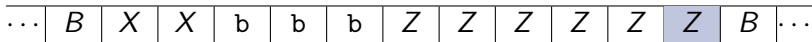$$L(M) = \{a^i b^j c^{i \times j} \mid i, j \geq 0\}$$

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Accept!