Логи

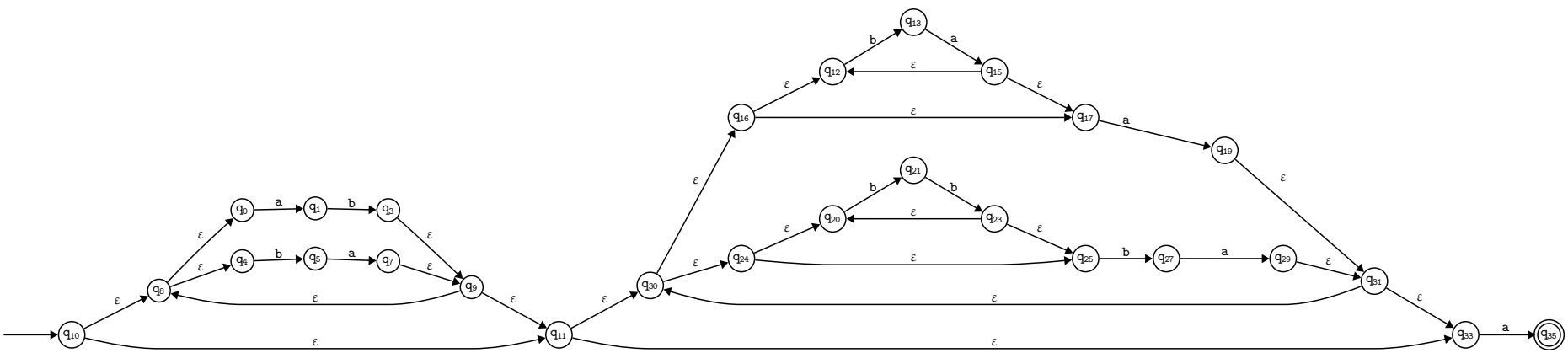
Лучшая команда разработчиков по ТФЯ

2023 г.

Построение `Thompson :: Regex → NFA`

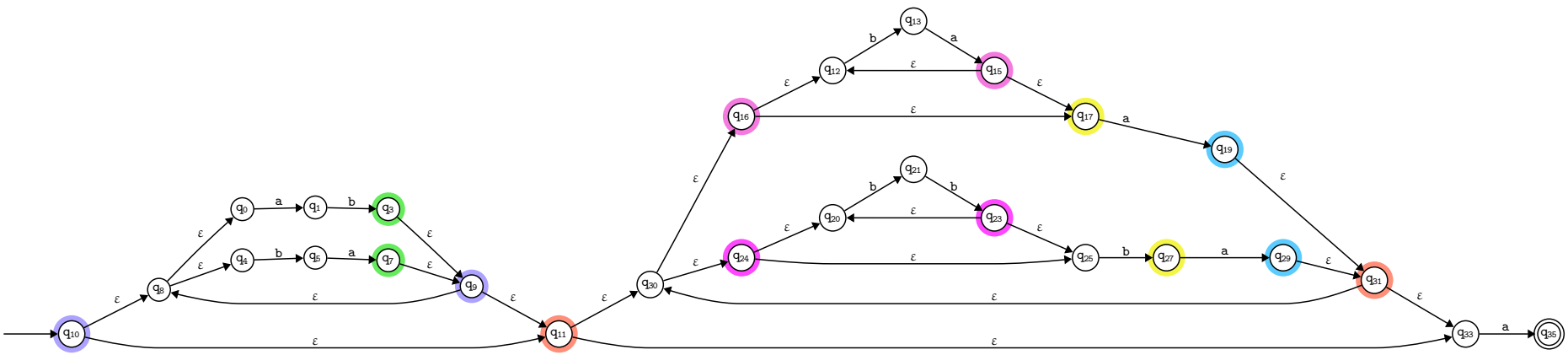
Регулярное выражение: `(ab | ba)*((ba)*a | (bb)*ba)*a`

Автомат:

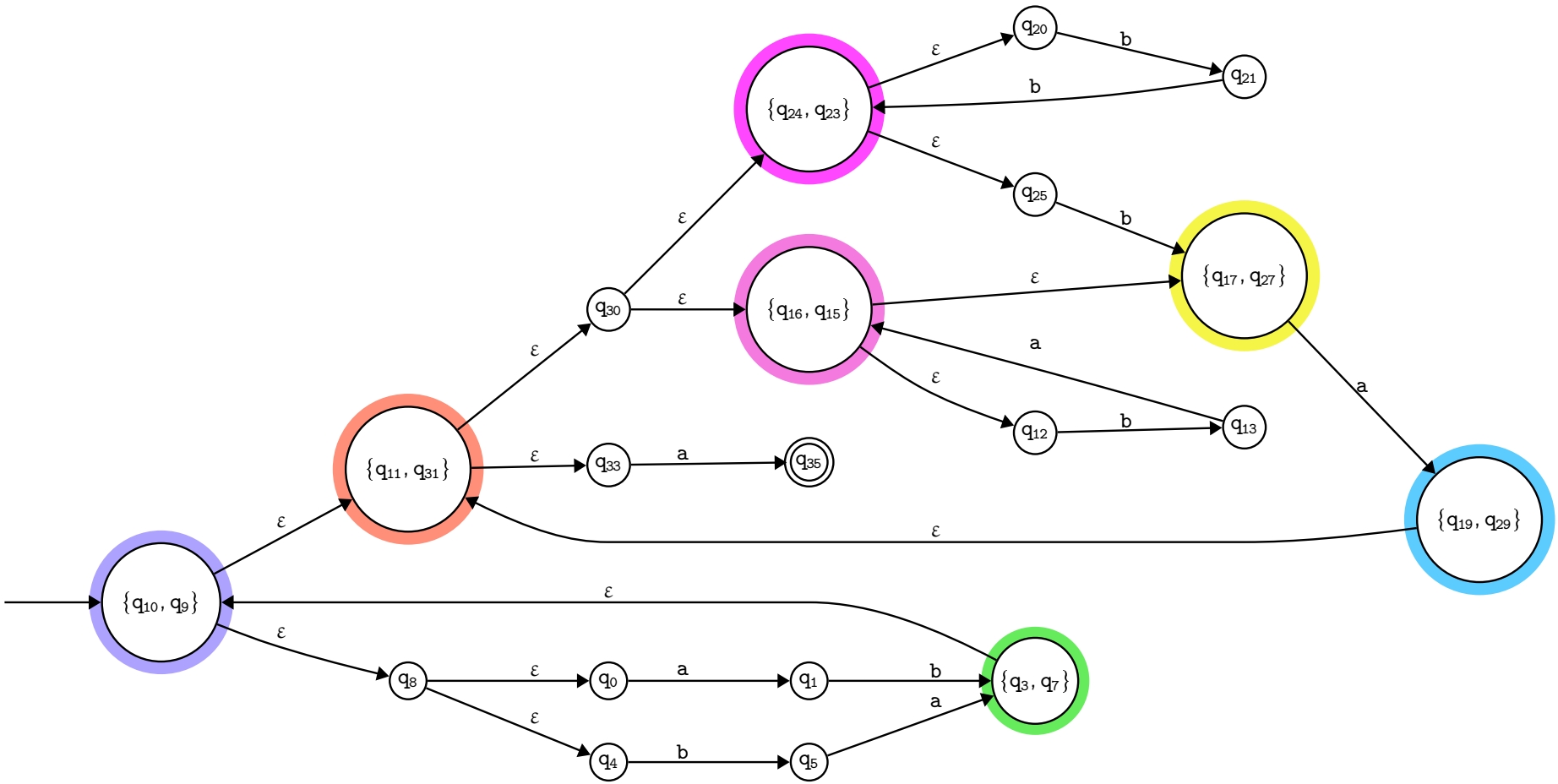


Преобразование `MergeBisim :: NFA → NFA`

Исходный автомат:



Итоговый автомат:

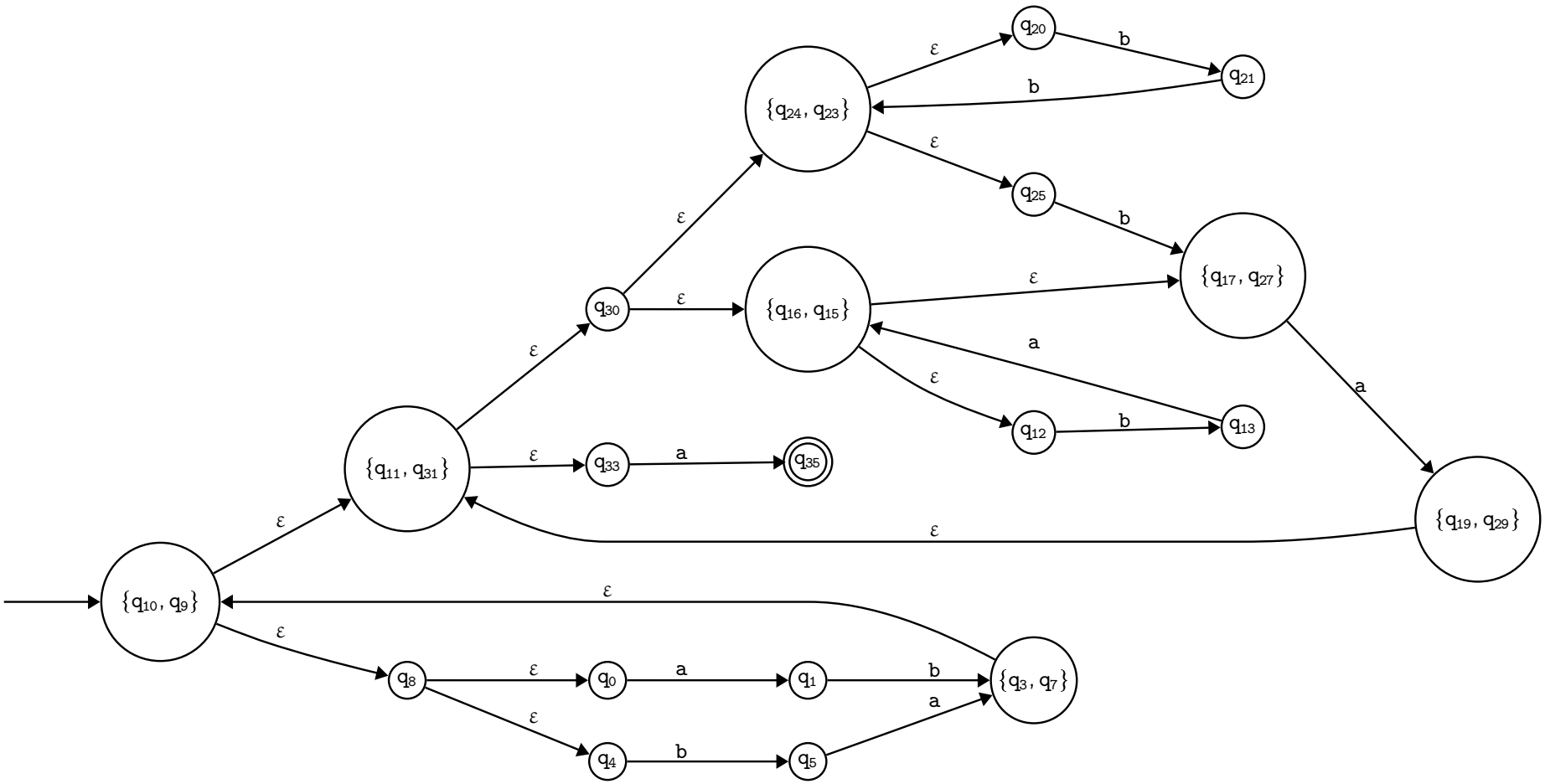


Классы эквивалентности по бисимуляции:

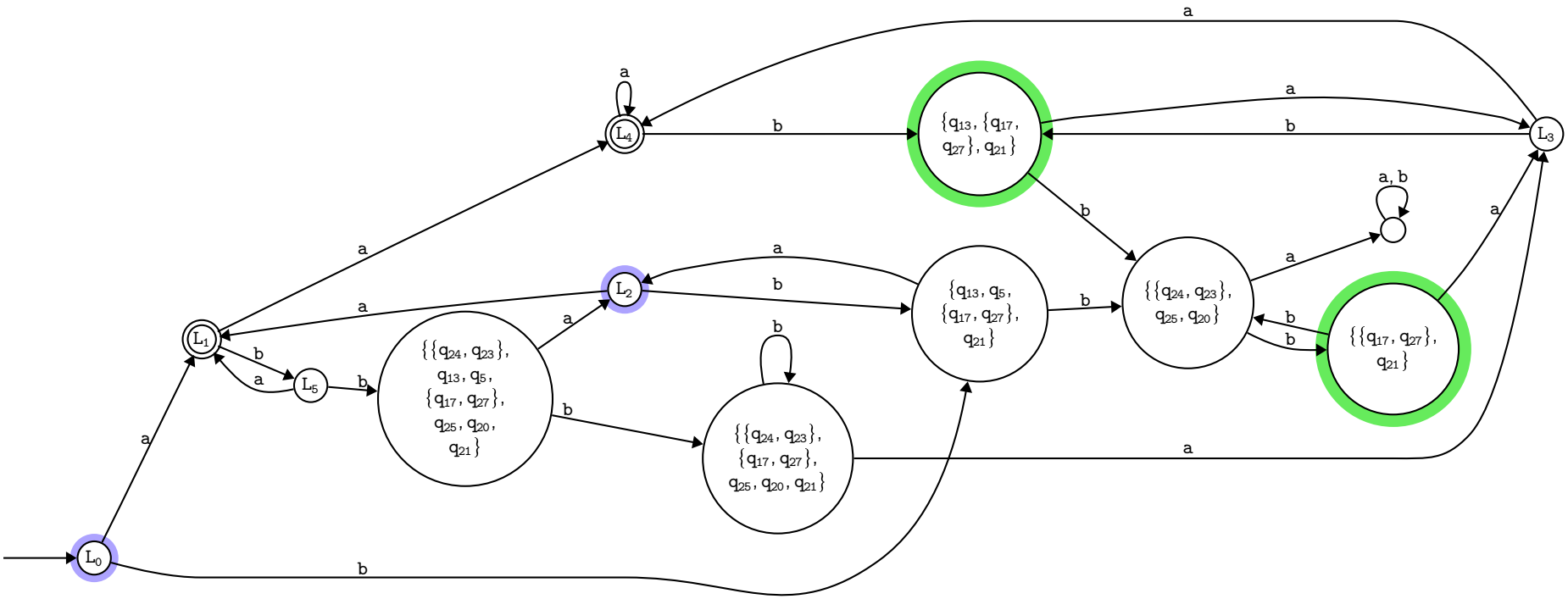
$\{q_{35}\}; \{q_{11}, q_{31}\}; \{q_8\}; \{q_{16}, q_{15}\}; \{q_{24}, q_{23}\}; \{q_{10}, q_9\}; \{q_{30}\}; \{q_3, q_7\}; \{q_{19}, q_{29}\}; \{q_{33}\}; \{q_0\}; \{q_{13}\}; \{q_5\}; \{q_{17}, q_{27}\}; \{q_{12}\}; \{q_{25}\}; \{q_4\}; \{q_{20}\}; \{q_{21}\}; \{q_1\};$

Преобразование `Minimize :: NFA → DFA`

Автомат до преобразования:

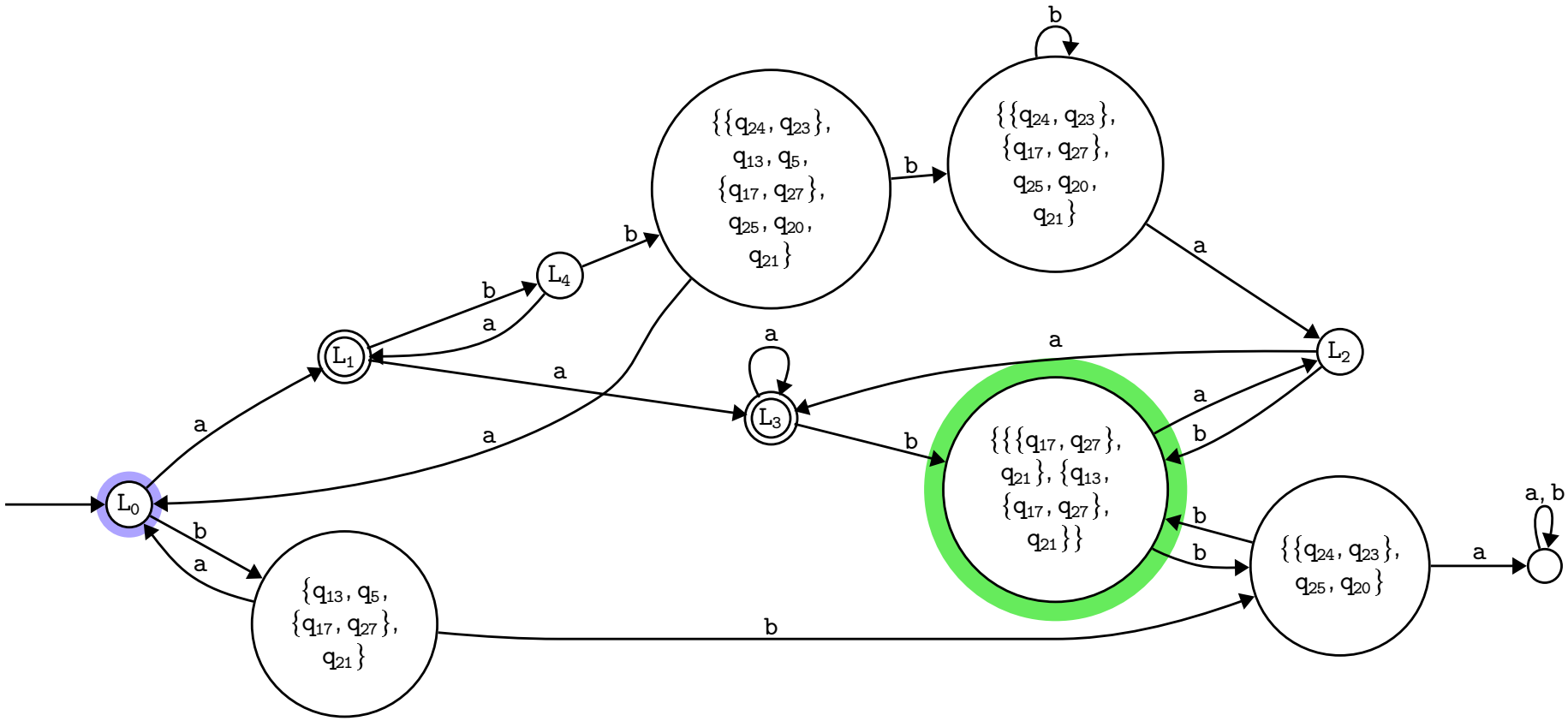


Автомат после предварительной детерминизации:


a
a
b
{q13, {q17, q27}, q21}
a
b
L3
a, b
b
a
a
a
L2
b
{q13, q5, {q17, q27}, q21}
b
{{q24, q23}, q25, q20}
a
b
b
{{q17, q27}, q21}
L1
b
a
L5
b
{{q24, q23}, q13, q5, {q17, q27}, q25, q20, q21}
a
b
b
{{q24, q23}, {q17, q27}, q25, q20, q21}
a
a
L0
b

Имя	Подробная метка состояния
L_0	$\{\{q_{11}, q_{31}\}, q_8, \{q_{16}, q_{15}\}, \{q_{24}, q_{23}\}, \{q_{10}, q_9\}, q_{30}, q_{33}, q_0, \{q_{17}, q_{27}\}, q_{12}, q_{25}, q_4, q_{20}\}$
L_1	$\{q_{35}, \{q_{11}, q_{31}\}, \{q_{16}, q_{15}\}, \{q_{24}, q_{23}\}, q_{30}, \{q_{19}, q_{29}\}, q_{33}, \{q_{17}, q_{27}\}, q_{12}, q_{25}, q_{20}, q_1\}$
L_2	$\{\{q_{11}, q_{31}\}, q_8, \{q_{16}, q_{15}\}, \{q_{24}, q_{23}\}, \{q_{10}, q_9\}, q_{30}, \{q_3, q_7\}, \{q_{19}, q_{29}\}, q_{33}, q_0, \{q_{17}, q_{27}\}, q_{12}, q_{25}, q_4, q_{20}\}$
L_3	$\{\{q_{11}, q_{31}\}, \{q_{16}, q_{15}\}, \{q_{24}, q_{23}\}, q_{30}, \{q_{19}, q_{29}\}, q_{33}, \{q_{17}, q_{27}\}, q_{12}, q_{25}, q_{20}\}$
L_4	$\{q_{35}, \{q_{11}, q_{31}\}, \{q_{16}, q_{15}\}, \{q_{24}, q_{23}\}, q_{30}, \{q_{19}, q_{29}\}, q_{33}, \{q_{17}, q_{27}\}, q_{12}, q_{25}, q_{20}\}$
L_5	$\{\{q_{11}, q_{31}\}, q_8, \{q_{16}, q_{15}\}, \{q_{24}, q_{23}\}, \{q_{10}, q_9\}, q_{30}, \{q_3, q_7\}, q_{33}, q_0, q_{13}, \{q_{17}, q_{27}\}, q_{12}, q_{25}, q_4, q_{20}, q_{21}\}$

Автомат после преобразования:


L0
L1
L2
L3
L4
{{q24, q23}, q13, q5, {q17, q27}, q25, q20, q21}
{{q24, q23}, {q17, q27}, q25, q20, q21}
{{{q17, q27}, q21}, {q13, {q17, q27}, q21}}
{q13, q5, {q17, q27}, q21}
{{q24, q23}, q25, q20}
a
b
a, b

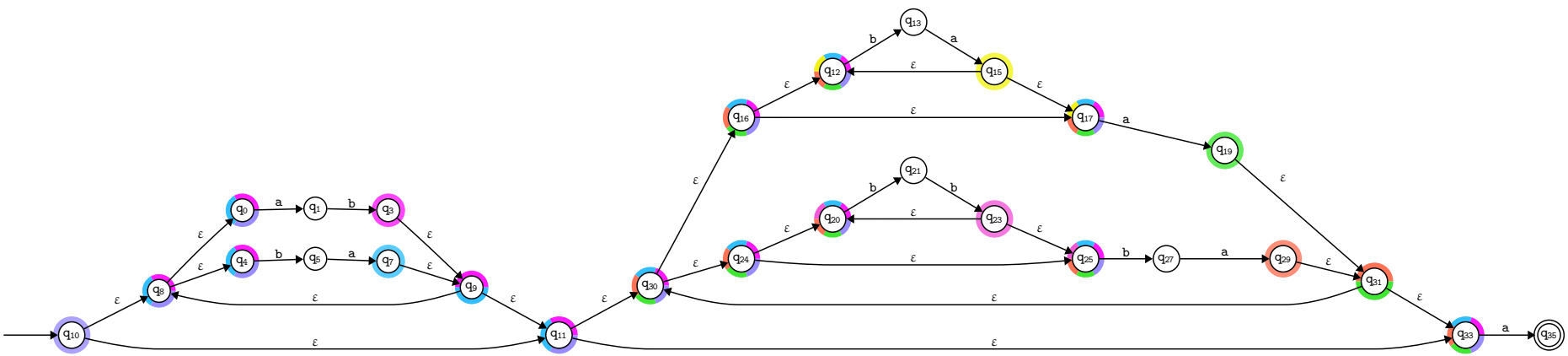
Имя	Подробная метка состояния
L_0	$\{\{\{q_{11}, q_{31}\}, q_8, \{q_{16}, q_{15}\}, \{q_{24}, q_{23}\}, \{q_{10}, q_9\}, q_{30}, q_{33}, q_0, \{q_{17}, q_{27}\}, q_{12}, q_{25}, q_4, q_{20}\}, \{\{q_{11}, q_{31}\}, q_8, \{q_{16}, q_{15}\}, \{q_{24}, q_{23}\}, \{q_{10}, q_9\}, q_{30}, \{q_3, q_7\}, \{q_{19}, q_{29}\}, q_{33}, q_0, \{q_{17}, q_{27}\}, q_{12}, q_{25}, q_4, q_{20}\}\}$
L_1	$\{q_{35}, \{q_{11}, q_{31}\}, \{q_{16}, q_{15}\}, \{q_{24}, q_{23}\}, q_{30}, \{q_{19}, q_{29}\}, q_{33}, \{q_{17}, q_{27}\}, q_{12}, q_{25}, q_{20}, q_1\}$
L_2	$\{\{q_{11}, q_{31}\}, \{q_{16}, q_{15}\}, \{q_{24}, q_{23}\}, q_{30}, \{q_{19}, q_{29}\}, q_{33}, \{q_{17}, q_{27}\}, q_{12}, q_{25}, q_{20}\}$
L_3	$\{q_{35}, \{q_{11}, q_{31}\}, \{q_{16}, q_{15}\}, \{q_{24}, q_{23}\}, q_{30}, \{q_{19}, q_{29}\}, q_{33}, \{q_{17}, q_{27}\}, q_{12}, q_{25}, q_{20}\}$
L_4	$\{\{q_{11}, q_{31}\}, q_8, \{q_{16}, q_{15}\}, \{q_{24}, q_{23}\}, \{q_{10}, q_9\}, q_{30}, \{q_3, q_7\}, q_{33}, q_0, q_{13}, \{q_{17}, q_{27}\}, q_{12}, q_{25}, q_4, q_{20}, q_{21}\}$

Классы эквивалентности:

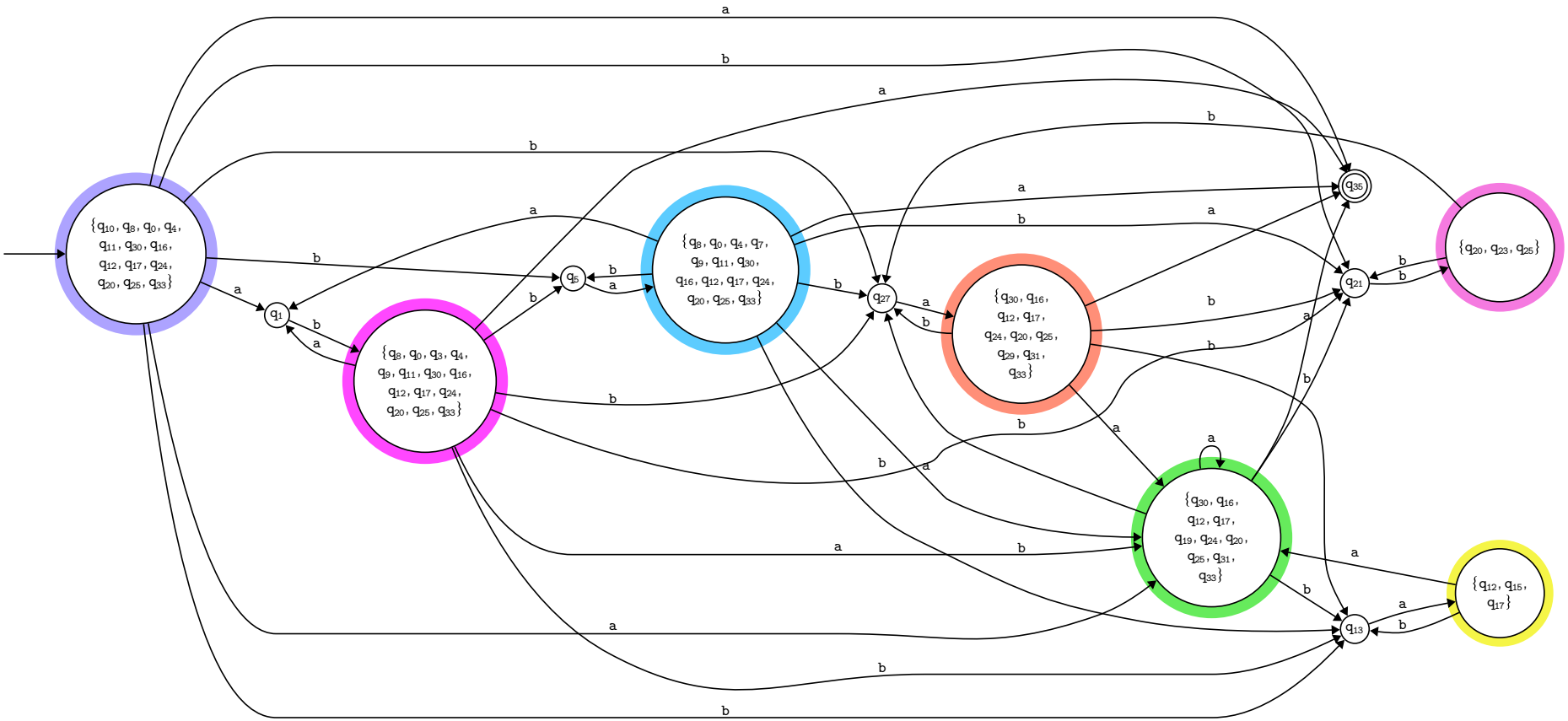
$\{\{\{\{q_{11}, q_{31}\}, q_8, \{q_{16}, q_{15}\}, \{q_{24}, q_{23}\}, \{q_{10}, q_9\}, q_{30}, q_{33}, q_0, \{q_{17}, q_{27}\}, q_{12}, q_{25}, q_4, q_{20}\}, \{\{q_{11}, q_{31}\}, q_8, \{q_{16}, q_{15}\}, \{q_{24}, q_{23}\}, \{q_{10}, q_9\}, q_{30}, \{q_3, q_7\}, \{q_{19}, q_{29}\}, q_{33}, q_0, \{q_{17}, q_{27}\}, q_{12}, q_{25}, q_4, q_{20}\}\}\}; \{\{\{\{q_{17}, q_{27}\}, q_{21}\}, \{q_{13}, \{q_{17}, q_{27}\}, q_{21}\}\}\}; \{\{q_{35}, \{q_{11}, q_{31}\}, \{q_{16}, q_{15}\}, \{q_{24}, q_{23}\}, q_{30}, \{q_{19}, q_{29}\}, q_{33}, \{q_{17}, q_{27}\}, q_{12}, q_{25}, q_{20}, q_1\}\}; \{\{q_{13}, q_5, \{q_{17}, q_{27}\}, q_{21}\}\}; \{\{\{q_{24}, q_{23}\}, q_{25}, q_{20}\}\}; \{\}; \{\{\{q_{11}, q_{31}\}, \{q_{16}, q_{15}\}, \{q_{24}, q_{23}\}, q_{30}, \{q_{19}, q_{29}\}, q_{33}, \{q_{17}, q_{27}\}, q_{12}, q_{25}, q_{20}\}\}; \{\{q_{35}, \{q_{11}, q_{31}\}, \{q_{16}, q_{15}\}, \{q_{24}, q_{23}\}, q_{30}, \{q_{19}, q_{29}\}, q_{33}, \{q_{17}, q_{27}\}, q_{12}, q_{25}, q_{20}\}\}; \{\{\{q_{11}, q_{31}\}, q_8, \{q_{16}, q_{15}\}, \{q_{24}, q_{23}\}, \{q_{10}, q_9\}, q_{30}, \{q_3, q_7\}, q_{33}, q_0, q_{13}, \{q_{17}, q_{27}\}, q_{12}, q_{25}, q_4, q_{20}, q_{21}\}\}; \{\{\{q_{24}, q_{23}\}, q_{13}, q_5, \{q_{17}, q_{27}\}, q_{25}, q_{20}, q_{21}\}\}; \{\{\{q_{24}, q_{23}\}, \{q_{17}, q_{27}\}, q_{25}, q_{20}, q_{21}\}\};$

Преобразование `RemEps :: NFA → NFA`

Автомат до преобразования:



Автомат после преобразования:



Преобразование `Linearize :: Regex → Regex`

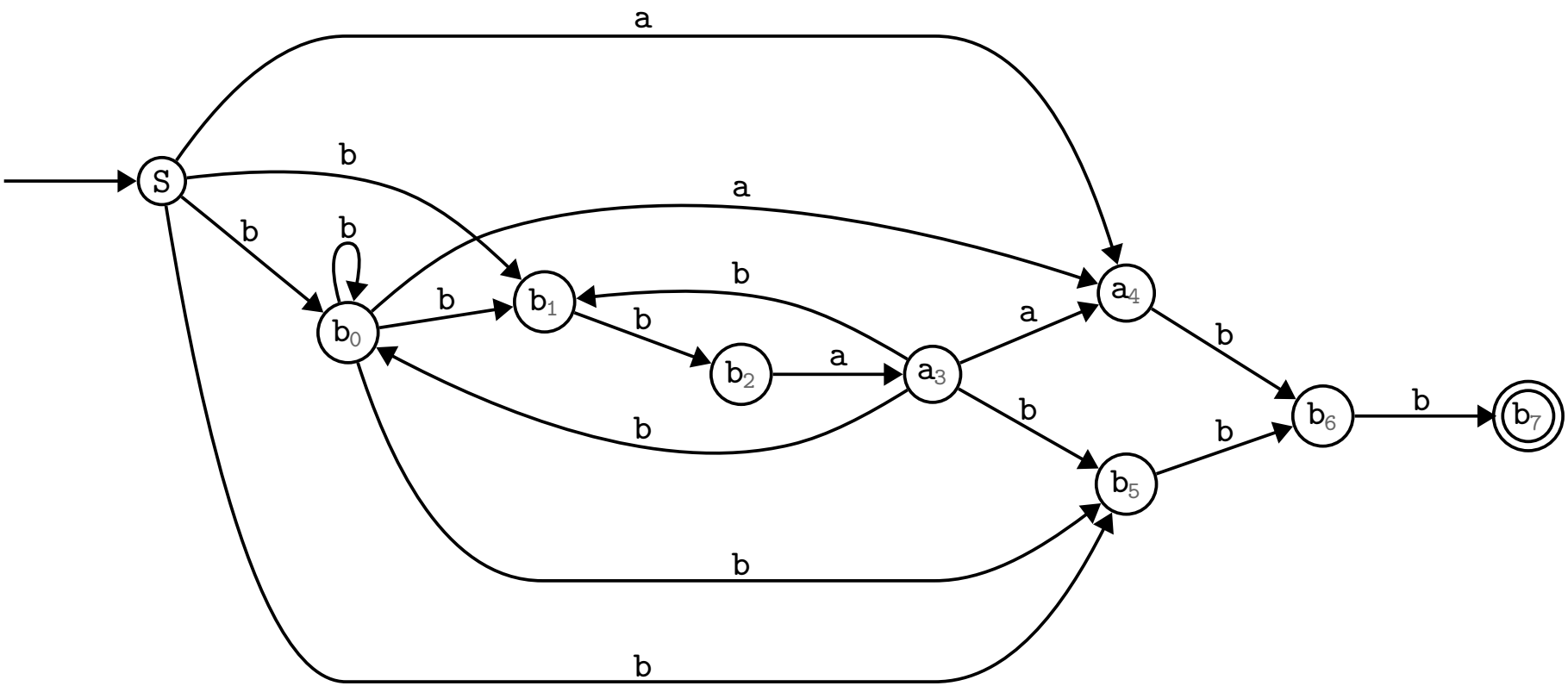
Регулярное выражение до преобразования: $(\mathtt{b} \mid \mathtt{bba})^*(\mathtt{a} \mid \mathtt{b})\mathtt{bb}$

Линеаризованное регулярное выражение: $(\mathtt{b}_0 \mid \mathtt{b}_1\mathtt{b}_2\mathtt{a}_3)^*(\mathtt{a}_4 \mid \mathtt{b}_5)\mathtt{b}_6\mathtt{b}_7$

Построение `Glushkov :: Regex → NFA`

Регулярное выражение: `(b | bba)*(a | b)bb`

Автомат:



Множество First:

$b_0\ b_1\ a_4\ b_5$

Множество Last:

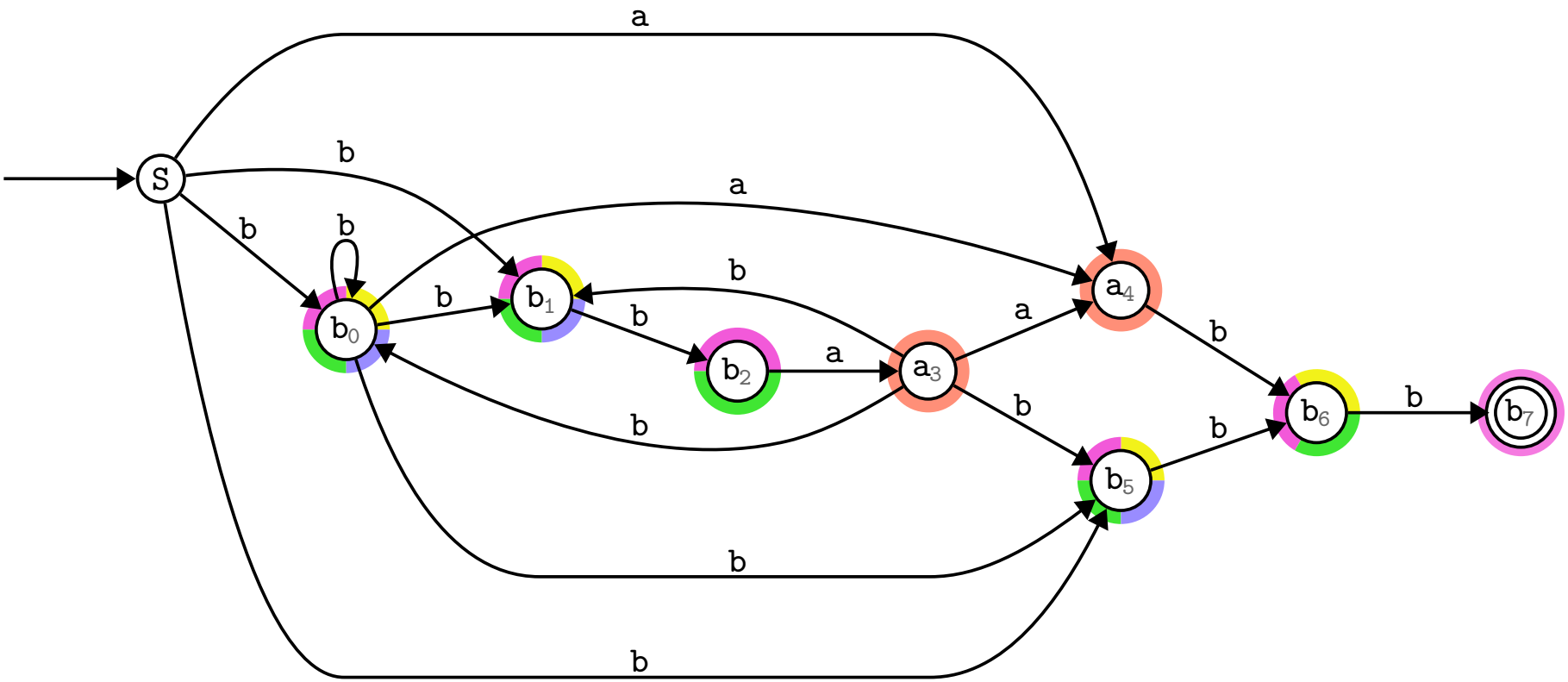
b_7

Множество Follow:

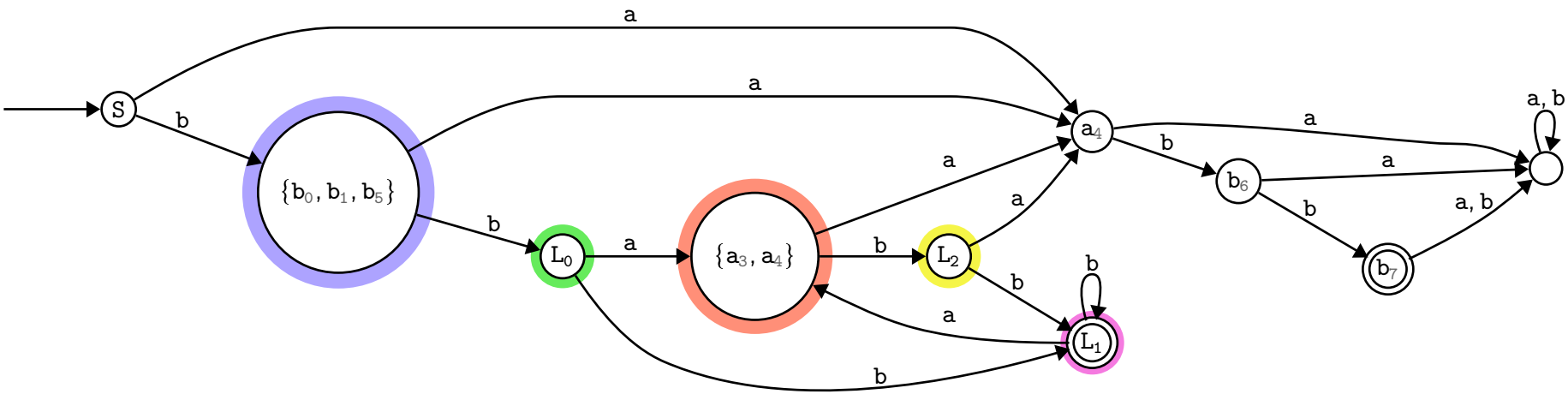
$(b_0, b_0)\ (b_0, b_1)\ (b_0, a_4)\ (b_0, b_5)\ (b_1, b_2)\ (b_2, a_3)\ (a_3, b_0)\ (a_3, b_1)\ (a_3, a_4)\ (a_3, b_5)\ (a_4, b_6)$
$(b_5, b_6)\ (b_6, b_7)$

Преобразование `Determinize :: NFA → DFA`

Автомат до преобразования:



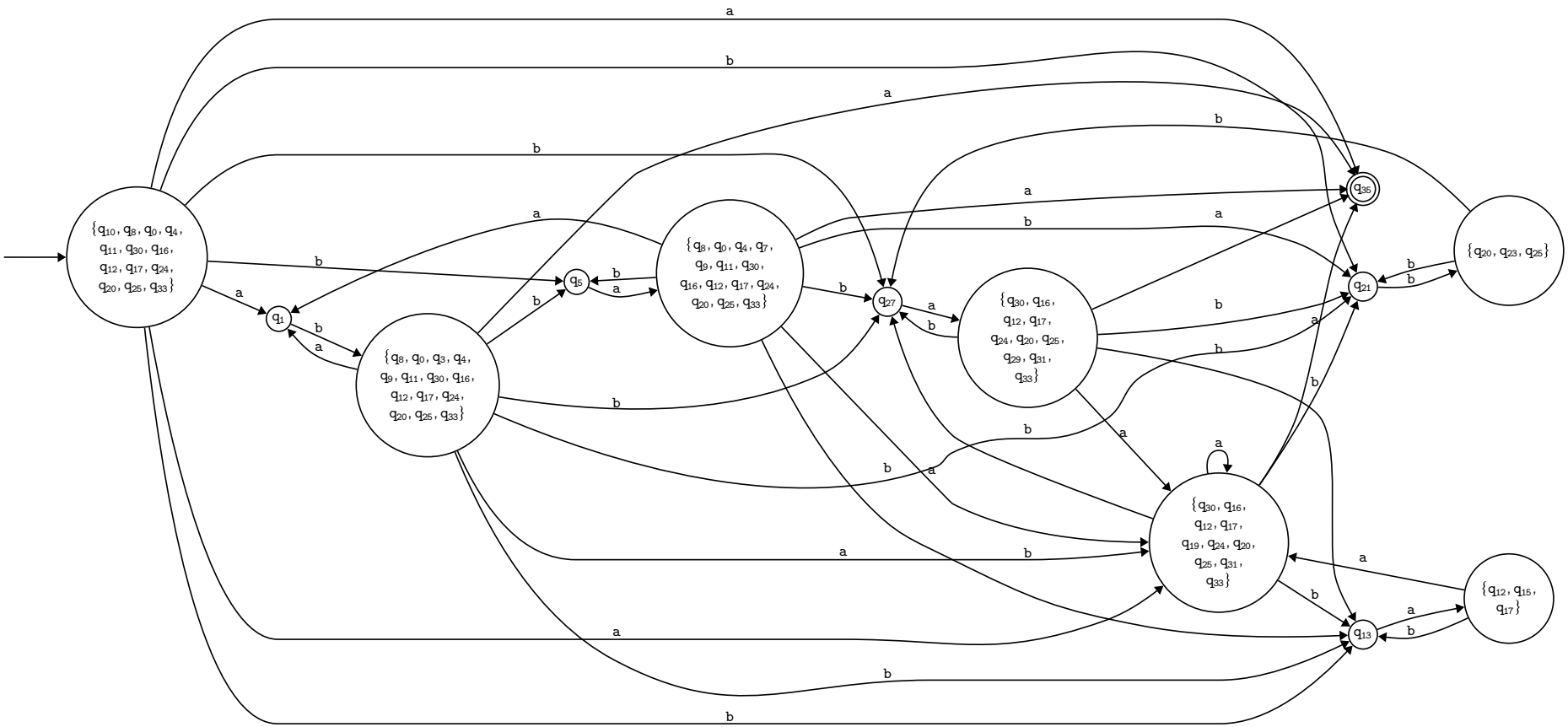
Автомат после преобразования:



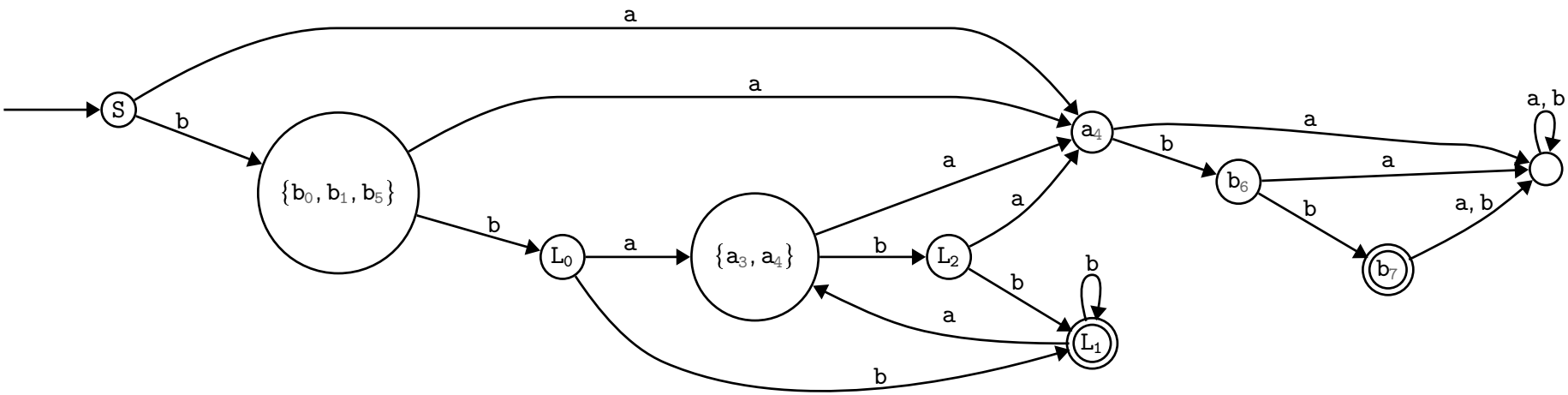
Имя	Подробная метка состояния
L_0	$\{b_0, b_1, b_2, b_5, b_6\}$
L_1	$\{b_0, b_1, b_2, b_5, b_6, b_7\}$
L_2	$\{b_0, b_1, b_5, b_6\}$

Построение `Intersect` :: $\langle$`NFA, NFA`$\rangle \to$ `NFA`

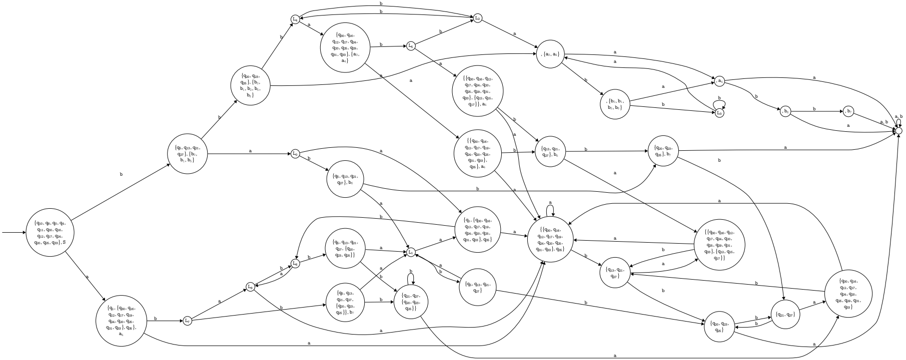
Первый автомат:



Второй автомат:



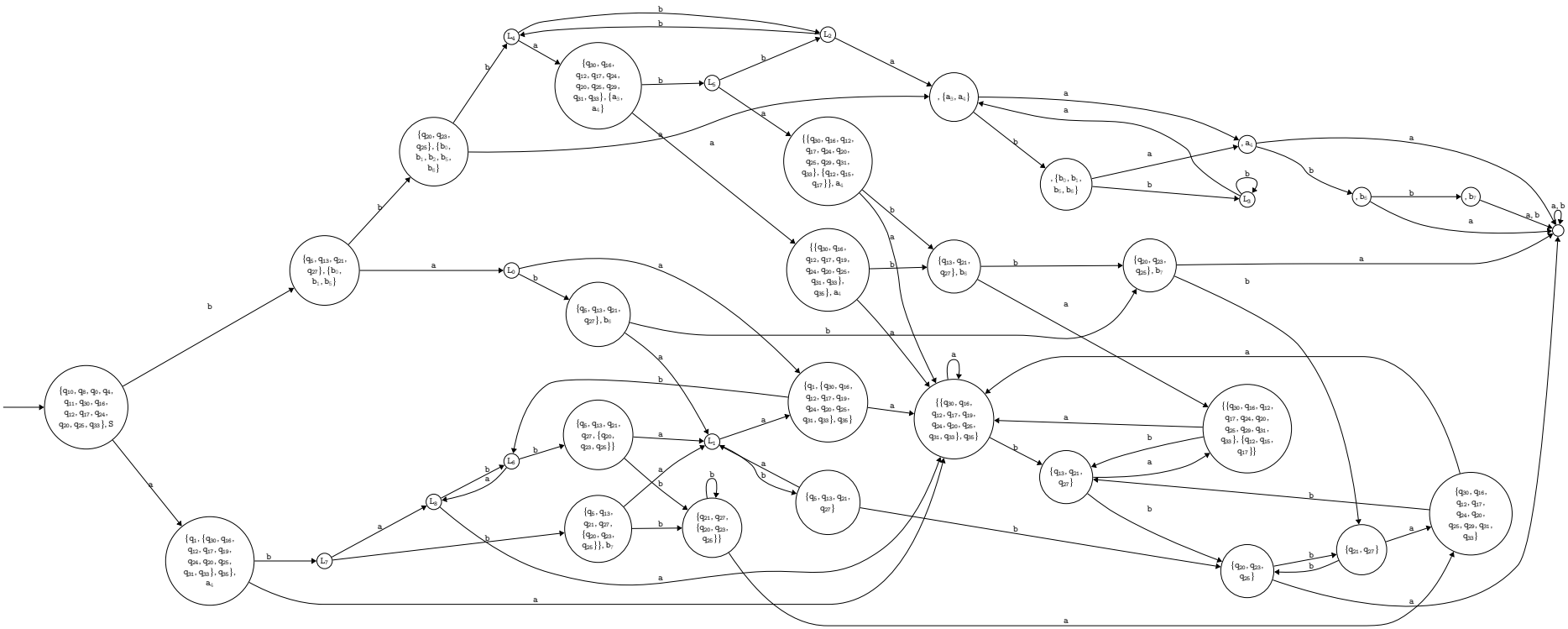
Автомат:



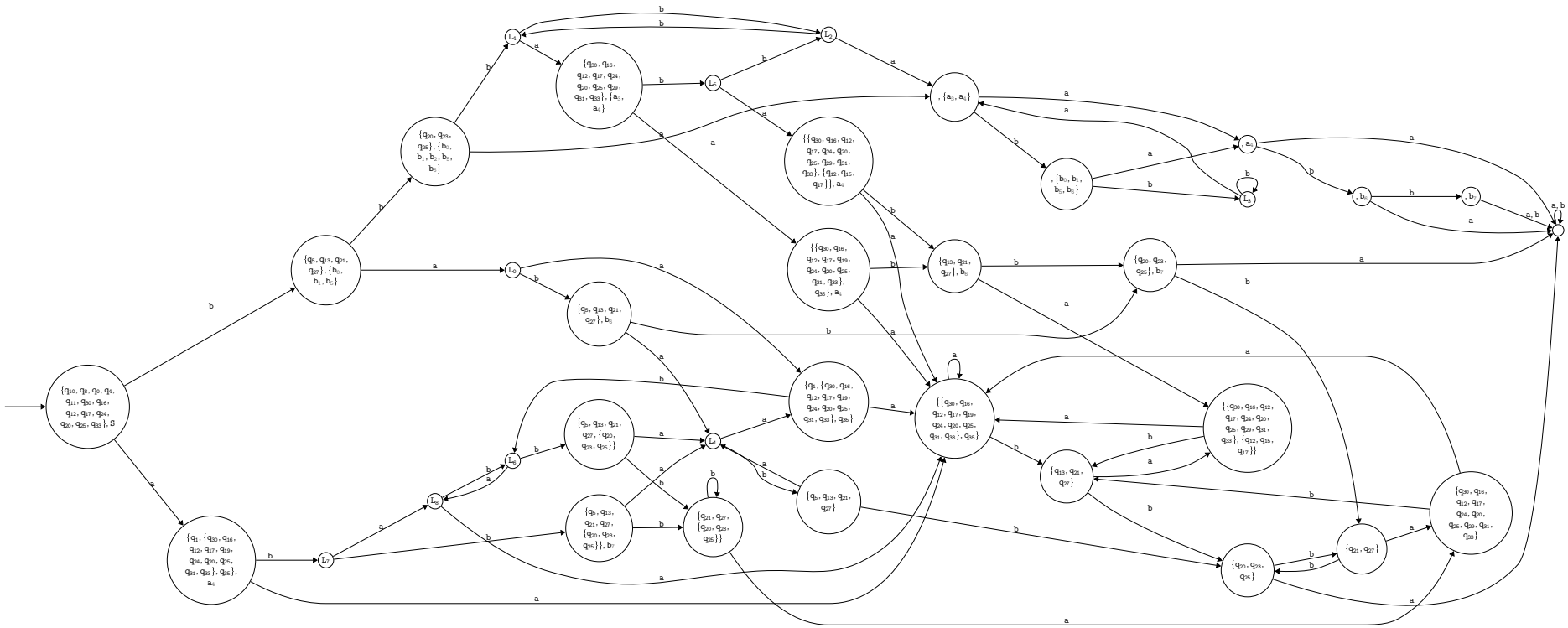
Имя	Подробная метка состояния
L_0	$\{\{q_{30}, q_{16}, q_{12}, q_{17}, q_{24}, q_{20}, q_{25}, q_{29}, q_{31}, q_{33}\}, \{q_{12}, q_{15}, q_{17}\}, \{q_8, q_0, q_4, q_7, q_9, q_{11}, q_{30}, q_{16}, q_{12}, q_{17}, q_{24}, q_{20}, q_{25}, q_{33}\}\}, a_4$
L_1	$\{\{q_{30}, q_{16}, q_{12}, q_{17}, q_{24}, q_{20}, q_{25}, q_{29}, q_{31}, q_{33}\}, \{q_{12}, q_{15}, q_{17}\}, \{q_8, q_0, q_4, q_7, q_9, q_{11}, q_{30}, q_{16}, q_{12}, q_{17}, q_{24}, q_{20}, q_{25}, q_{33}\}\}$
L_2	$\{q_{20}, q_{23}, q_{25}\}, \{b_0, b_1, b_2, b_5, b_6, b_7\}$
L_3	$, \{b_0, b_1, b_2, b_5, b_6, b_7\}$
L_4	$\{q_{21}, q_{27}\}, \{b_0, b_1, b_2, b_5, b_6, b_7\}$
L_5	$\{q_{13}, q_{21}, q_{27}\}, \{b_0, b_1, b_5, b_6\}$
L_6	$\{q_{13}, q_{21}, q_{27}, \{q_8, q_0, q_3, q_4, q_9, q_{11}, q_{30}, q_{16}, q_{12}, q_{17}, q_{24}, q_{20}, q_{25}, q_{33}\}\}$
L_7	$\{q_{13}, q_{21}, q_{27}, \{q_8, q_0, q_3, q_4, q_9, q_{11}, q_{30}, q_{16}, q_{12}, q_{17}, q_{24}, q_{20}, q_{25}, q_{33}\}\}, b_6$
L_8	$\{q_1, \{q_{30}, q_{16}, q_{12}, q_{17}, q_{19}, q_{24}, q_{20}, q_{25}, q_{31}, q_{33}\}, q_{35}, \{q_{30}, q_{16}, q_{12}, q_{17}, q_{24}, q_{20}, q_{25}, q_{29}, q_{31}, q_{33}\}, \{q_{12}, q_{15}, q_{17}\}\}$

Преобразование `Annote` :: `NFA` → `DFA`

Исходный автомат:

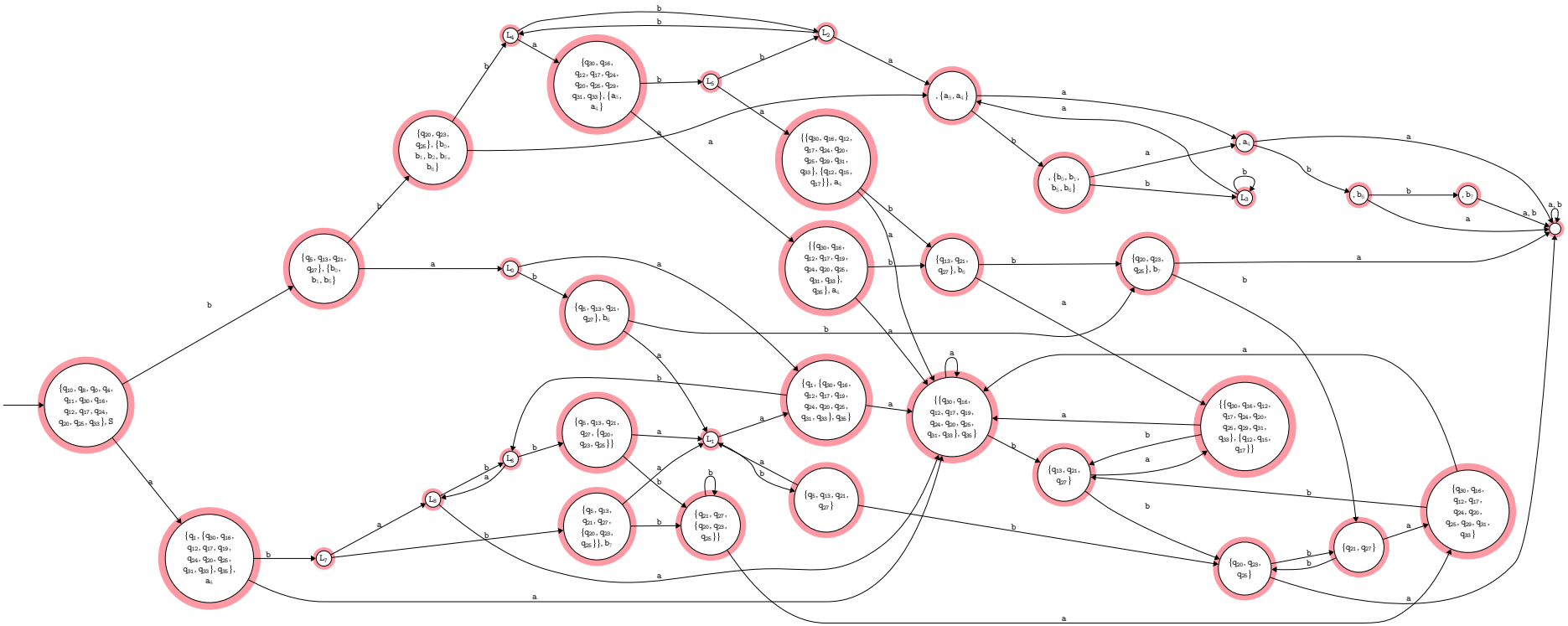


Автомат после навешивания детерминирующей разметки:

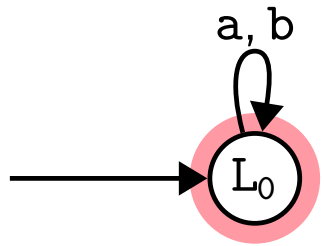


Преобразование `RemoveTrap :: DFA → DFA`

Автомат до преобразования:



Автомат после преобразования:



Имя	Подробная метка состояния
L_0	$\{\{q_{10}, q_8, q_0, q_4, q_{11}, q_{30}, q_{16}, q_{12}, q_{17}, q_{24}, q_{20}, q_{25}, q_{33}\}, S, \{q_1, \{q_{30}, q_{16}, q_{12}, q_{17}, q_{19}, q_{24}, q_{20}, q_{25}, q_{31}, q_{33}\}, q_{35}\}, a_4, \{q_5, q_{13}, q_{21}, q_{27}\}, \{b_0, b_1, b_5\}, \{\{q_{30}, q_{16}, q_{12}, q_{17}, q_{24}, q_{20}, q_{25}, q_{29}, q_{31}, q_{33}\}, \{q_{12}, q_{15}, q_{17}\}, \{q_8, q_0, q_4, q_7, q_9, q_{11}, q_{30}, q_{16}, q_{12}, q_{17}, q_{24}, q_{20}, q_{25}, q_{33}\}\}, a_4, \{q_{20}, q_{23}, q_{25}\}, \{b_0, b_1, b_2, b_5, b_6\}, , \{a_3, a_4\}, \{q_{21}, q_{27}\}, \{b_0, b_1, b_2, b_5, b_6, b_7\}, \{q_{30}, q_{16}, q_{12}, q_{17}, q_{24}, q_{20}, q_{25}, q_{29}, q_{31}, q_{33}\}, \{a_3, a_4\}, \{q_{20}, q_{23}, q_{25}\}, \{b_0, b_1, b_2, b_5, b_6, b_7\}, \{\{q_{30}, q_{16}, q_{12}, q_{17}, q_{19}, q_{24}, q_{20}, q_{25}, q_{31}, q_{33}\}, q_{35}\}, a_4, \{q_{13}, q_{21}, q_{27}\}, \{b_0, b_1, b_5, b_6\}, \{\{q_{30}, q_{16}, q_{12}, q_{17}, q_{24}, q_{20}, q_{25}, q_{29}, q_{31}, q_{33}\}, \{q_{12}, q_{15}, q_{17}\}\}, a_4, \{\{q_{30}, q_{16}, q_{12}, q_{17}, q_{19}, q_{24}, q_{20}, q_{25}, q_{31}, q_{33}\}, q_{35}\}, \{q_{13}, q_{21}, q_{27}\}, b_6, \{\{q_{30}, q_{16}, q_{12}, q_{17}, q_{24}, q_{20}, q_{25}, q_{29}, q_{31}, q_{33}\}, \{q_{12}, q_{15}, q_{17}\}\}, \{q_{20}, q_{23}, q_{25}\}, b_7, \{q_{21}, q_{27}\}, \{q_{30}, q_{16}, q_{12}, q_{17}, q_{24}, q_{20}, q_{25}, q_{29}, q_{31}, q_{33}\}, \{q_{20}, q_{23}, q_{25}\}, \{q_{13}, q_{21}, q_{27}\}, , a_4, , \{b_0, b_1, b_5, b_6\}, , \{b_0, b_1, b_2, b_5, b_6, b_7\}, , b_6, , b_7, \{q_1, \{q_{30}, q_{16}, q_{12}, q_{17}, q_{19}, q_{24}, q_{20}, q_{25}, q_{31}, q_{33}\}, q_{35}\}, \{q_5, q_{13}, q_{21}, q_{27}\}, b_6, \{\{q_{30}, q_{16}, q_{12}, q_{17}, q_{24}, q_{20}, q_{25}, q_{29}, q_{31}, q_{33}\}, \{q_{12}, q_{15}, q_{17}\}, \{q_8, q_0, q_4, q_7, q_9, q_{11}, q_{30}, q_{16}, q_{12}, q_{17}, q_{24}, q_{20}, q_{25}, q_{33}\}\}, \{q_5, q_{13}, q_{21}, q_{27}\}, \{q_{13}, q_{21}, q_{27}, \{q_8, q_0, q_3, q_4, q_9, q_{11}, q_{30}, q_{16}, q_{12}, q_{17}, q_{24}, q_{20}, q_{25}, q_{33}\}\}, \{q_1, \{q_{30}, q_{16}, q_{12}, q_{17}, q_{19}, q_{24}, q_{20}, q_{25}, q_{31}, q_{33}\}, q_{35}, \{q_{30}, q_{16}, q_{12}, q_{17}, q_{24}, q_{20}, q_{25}, q_{29}, q_{31}, q_{33}\}, \{q_{12}, q_{15}, q_{17}\}\}, \{q_5, q_{13}, q_{21}, q_{27}, \{q_{20}, q_{23}, q_{25}\}\}, \{q_{21}, q_{27}, \{q_{20}, q_{23}, q_{25}\}\}, \{q_{13}, q_{21}, q_{27}, \{q_8, q_0, q_3, q_4, q_9, q_{11}, q_{30}, q_{16}, q_{12}, q_{17}, q_{24}, q_{20}, q_{25}, q_{33}\}\}, b_6, \{q_5, q_{13}, q_{21}, q_{27}, \{q_{20}, q_{23}, q_{25}\}\}, b_7\}$