SAT problémát eldöntő aktív membrános P rendszer

Legyen $C = C_1 \wedge C_2 \wedge \ldots \wedge C_m$ egy m klózból álló zérusrendű konjunktív normálformájú formula, ahol a klózok összesen n különböző változót tartalmaznak ($C_i = y_{i,1} \vee \ldots \vee y_{i,p_i}$ $1 \leq i \leq m$, $1 \leq p_i \leq n$, $y_{i,j} \in \{x_k, \neg x_k \,|\, 1 \leq k \leq n\}$, $1 \leq j \leq p_i$).
Ekkor az alábbi aktív membrános P rendszer $(m+n)$-ben lineáris idő alatt eldönti, hogy a formula kielégíthető-e.

$\Pi_C = (O, H, \mu, w_1, w_2, R)$, ahol
$O = \{a_i, t_i, f_i \,|\, 1 \leq i \leq n\} \cup \{r_i, c_i \,|\, 0 \leq i \leq m\} \cup \{d_i \,|\, 0 \leq i \leq n\} \cup \{e_i \,|\, 0 \leq i \leq 2m+3\} \cup \{yes, no\}$,
$H = \{1, 2\}$, $\mu = [_1[_2\ ]_2^0]_1^0$, $w_1 = \varepsilon$, $w_2 = a_1 \ldots a_n d_0$,
R pedig az alábbi szabály-csoportokat tartalmazza:

1. $[a_i]_2^0 \to [t_i]_2^0\,[f_i]_2^0$ $(1 \leq i \leq n)$
2. $[d_k \to d_{k+1}]_2^0$ $(0 \leq k \leq n-2)$
3. $[d_{n-1} \to d_n c_0]_2^0$
4. $[d_n]_2^0 \to [\ ]_2^+ e_0$
5. $[e_j \to e_{j+1}]_1^0$ $(0 \leq j \leq 2m+2)$
6. $[t_i \to r_{h_{i,1}} \ldots r_{h_{i,j_i}}]_2^+$ $(1 \leq i \leq n,\ C_{h_{i,1}}, \ldots C_{h_{i,j_i}}$ klózok tartalmazzák x_i-t)
7. $[f_i \to r_{h_{i,1}} \ldots r_{h_{i,j_i}}]_2^+$ $(1 \leq i \leq n,\ C_{h_{i,1}}, \ldots C_{h_{i,j_i}}$ klózok tartalmazzák $\neg x_i$-t)
8. $[r_1]_2^+ \to [\ ]_2^- r_1$
9. $[r_k \to r_{k-1}]_2^-$ $(1 \leq k \leq m)$
10. $[c_j \to c_{j+1}]_2^-$ $(0 \leq j \leq m-1)$

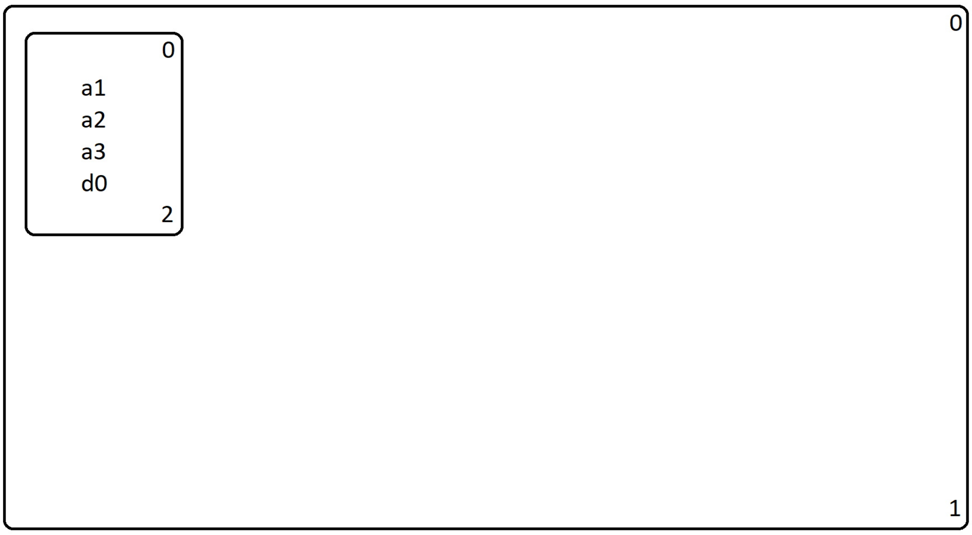
11. $r_1[\,]_2^- \rightarrow [r_0]_2^+$

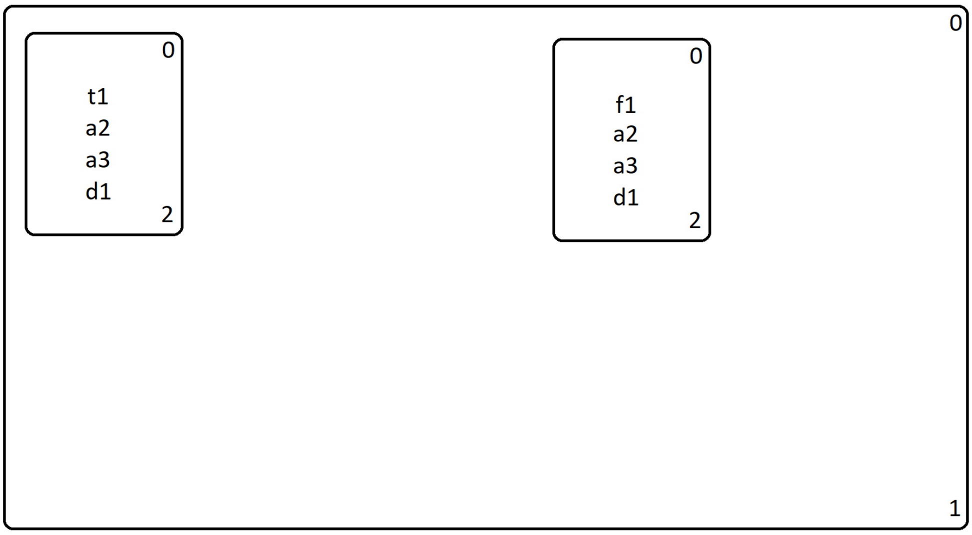
12. $[c_m]_2^+ \rightarrow [\,]_2^+ yes$

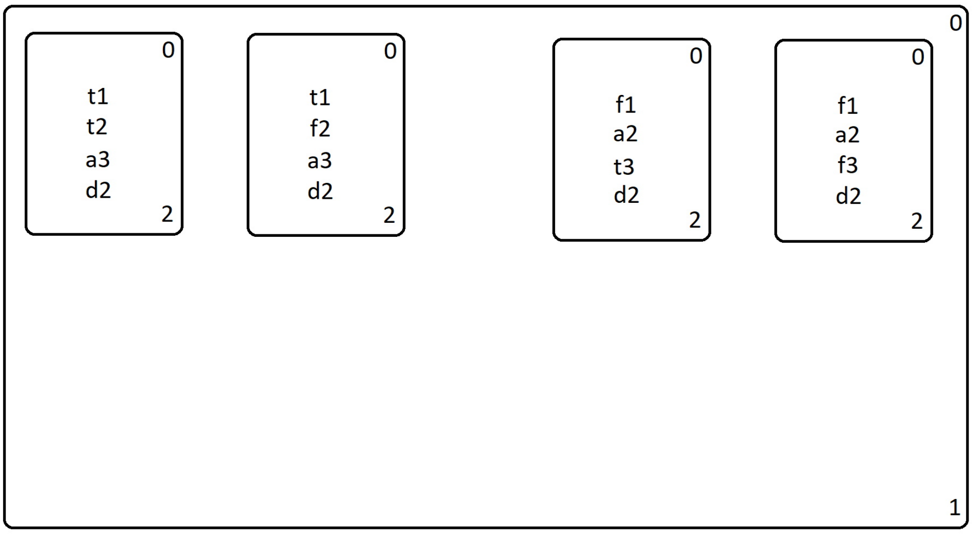
13. $[yes]_1^0 \rightarrow [\,]_1^+ yes$

14. $[e_{2m+3}]_1^0 \rightarrow [\,]_1^- no$

Pl.: $C = (x \vee y \vee z) \wedge (x \vee \neg y) \wedge (\neg x \vee z) \wedge (\neg y \vee \neg z)$ (ezt például az (i, h, i) és a (h, h, i) interpretációk elégítik ki). Ekkor $m = 4, n = 3$.







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f2
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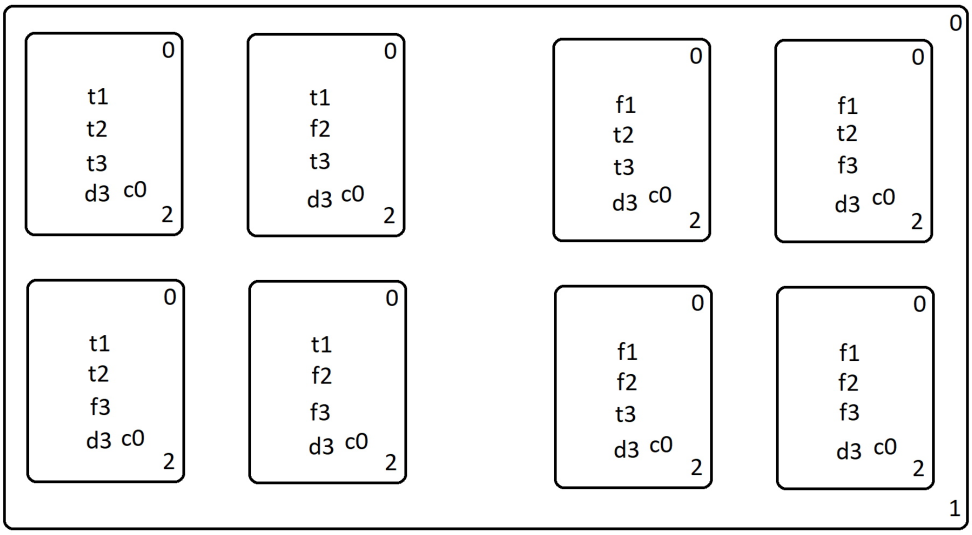

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t2
f3
d3 c0
t1
t2
f3
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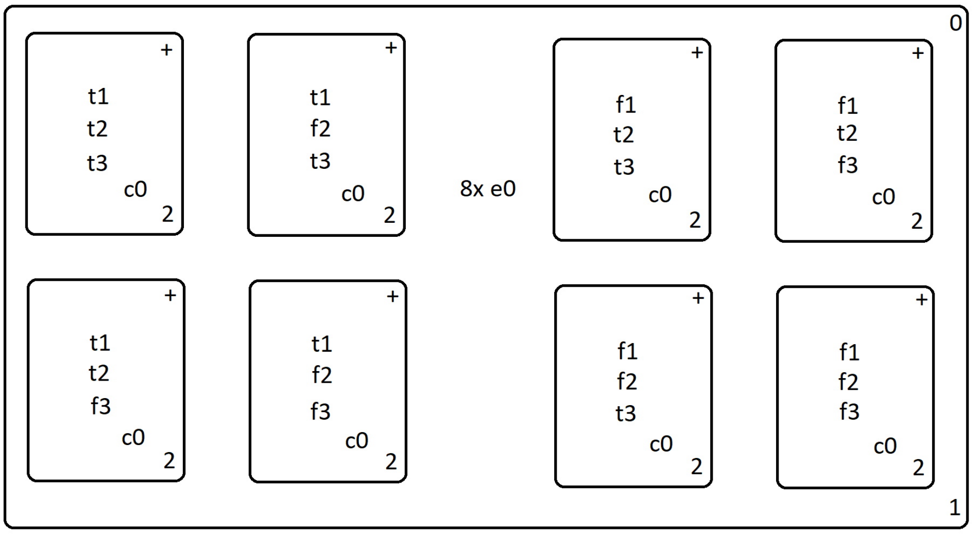
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t3
c0
2
+
f1
t2
f3
c0
2
+
t1
t2
f3
c0
2
+
t1
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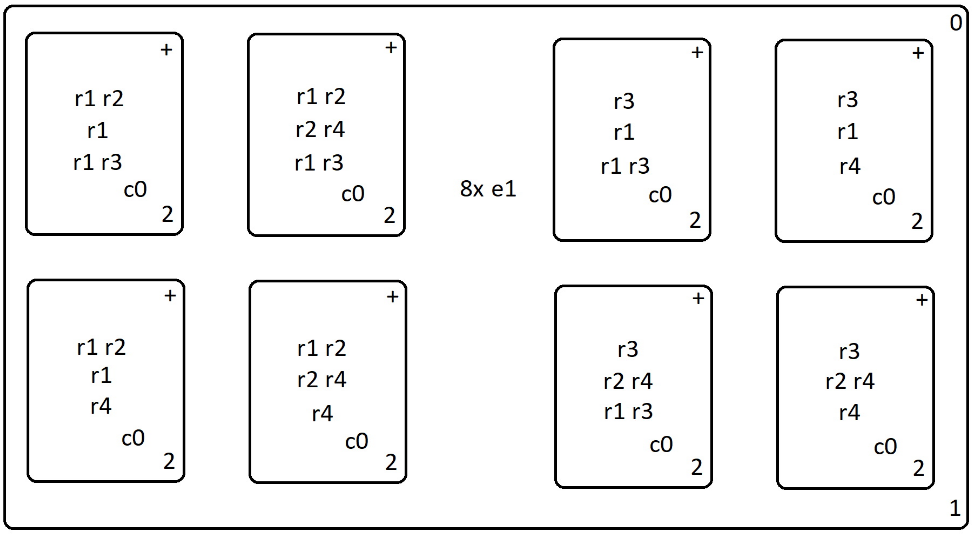
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r3
r1
r1 r3
c0
2
+
r3
r1
r4
c0
2
+
r1 r2
r1
r4
c0
2
+
r1 r2
r2 r4
r4
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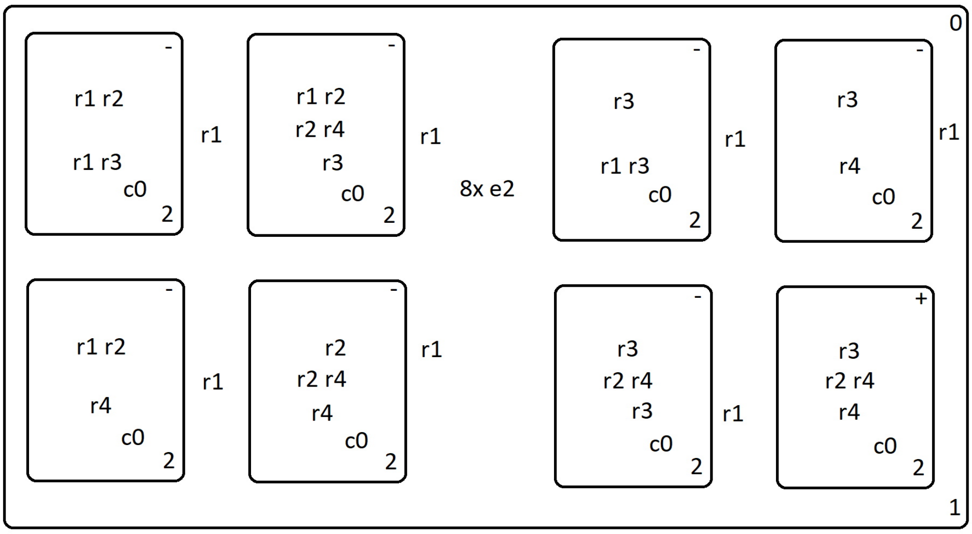
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2
r1
r3
r4
c0
2
r1
r1 r2
r4
c0
2
r1
r2
r2 r4
r4
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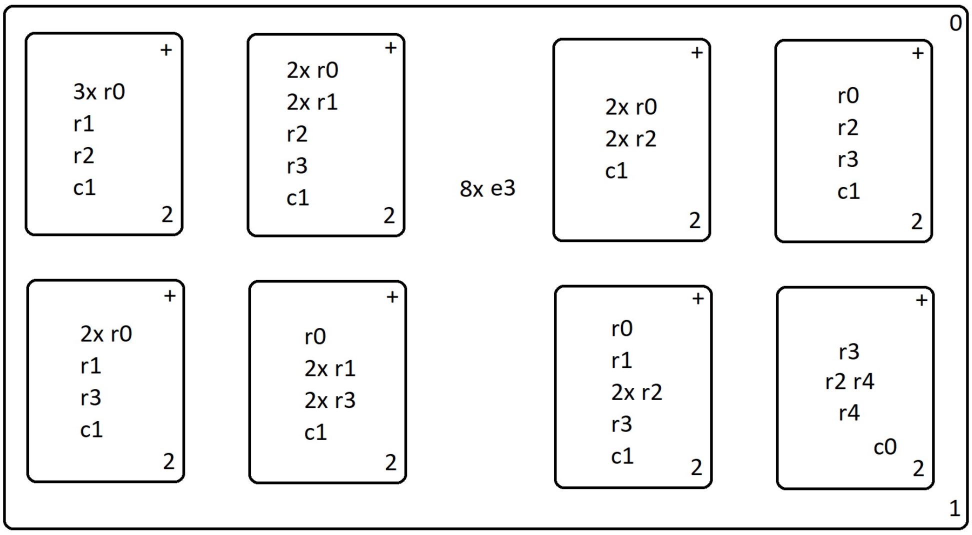
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c1
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r0
r2
r3
c1
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r1
r3
c1
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r0
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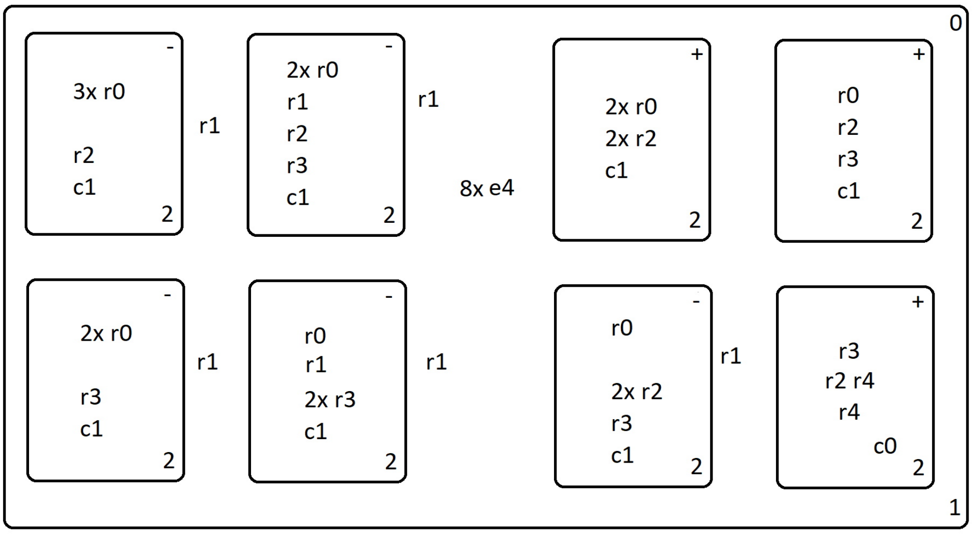
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r2
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2x r0
2x r2
c1
2
+
r0
r2
r3
c1
2
+
2x r0
r3
c1
2
-
r1
r0
r1
2x r3
c1
2
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r2 r4
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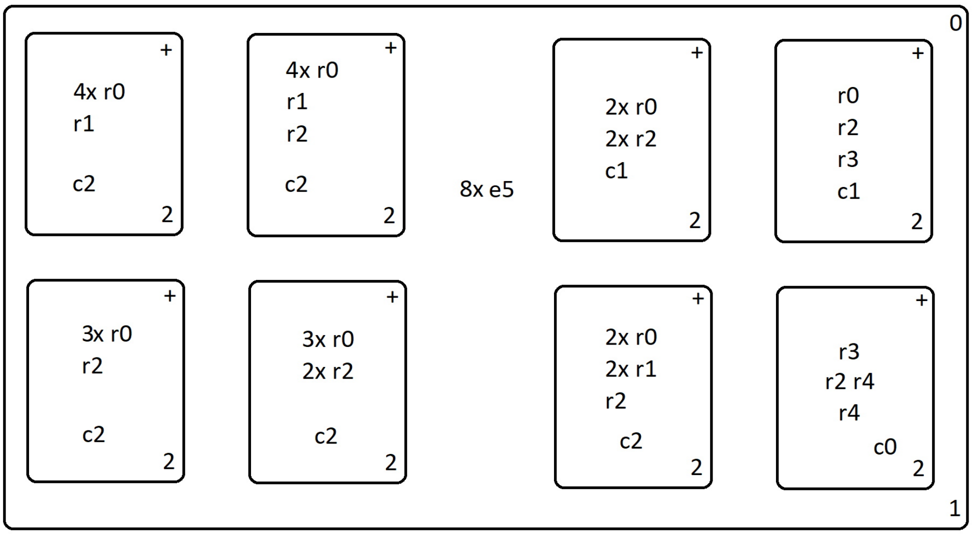
c0
2
+
1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r2
c2
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+
3x r0
2x r2
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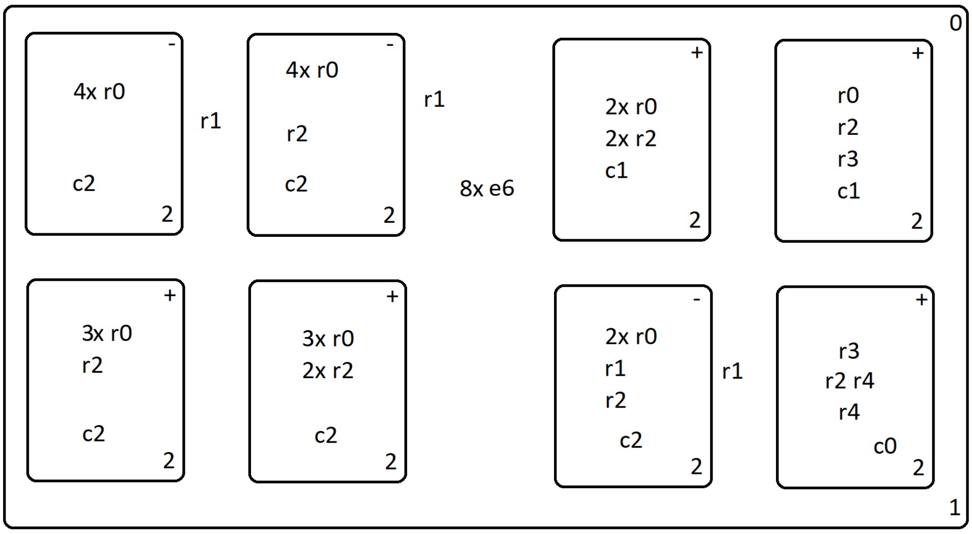
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c1
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+
r0
r2
r3
c1
2
+
3x r0
r2
c2
2
+
3x r0
2x r2
c2
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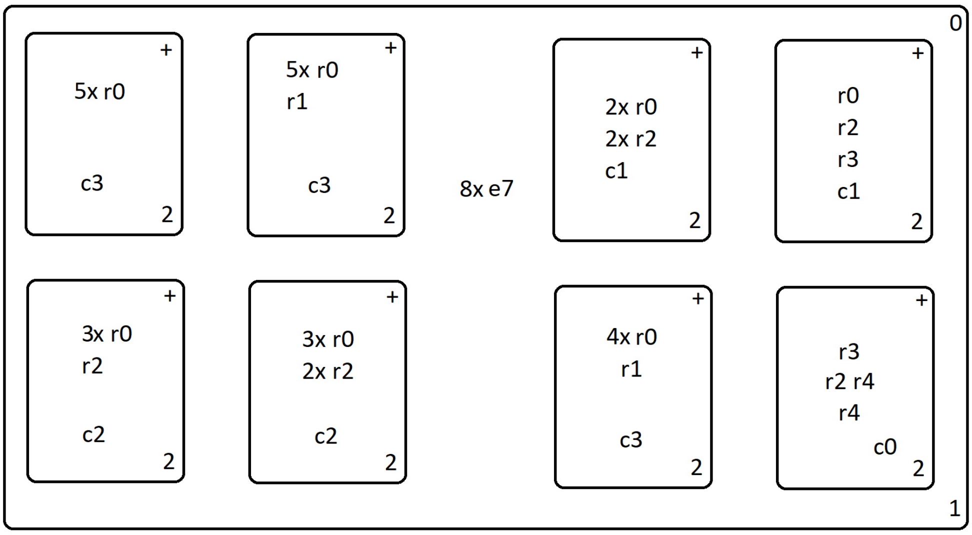
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c1
2
+
r0
r2
r3
c1
2
+
3x r0
r2
c2
2
+
3x r0
2x r2
c2
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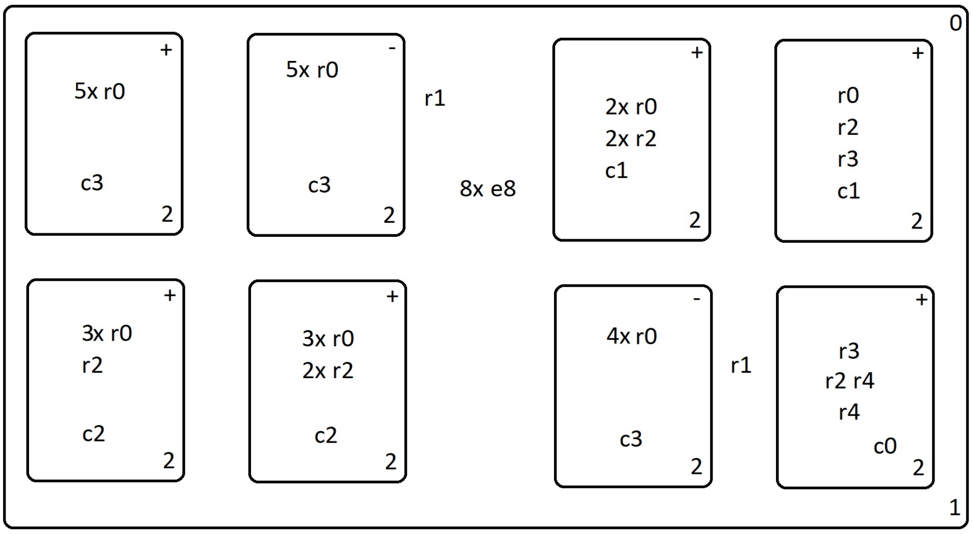
r1
c3
2
+
r3
r2 r4
r4
c0
2
+
1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5x r0
c3
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r1
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2x r2
c1
2
r0
r2
r3
c1
2
3x r0
r2
c2
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r3
r2 r4
r4
c0
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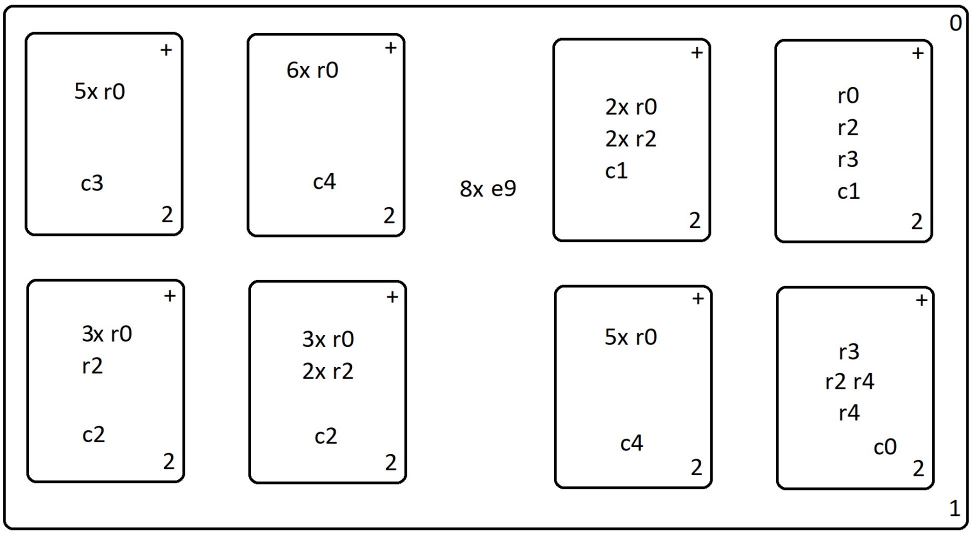
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r0
r2
r3
c1
2
3x r0
r2
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r3
r2 r4
r4
c0
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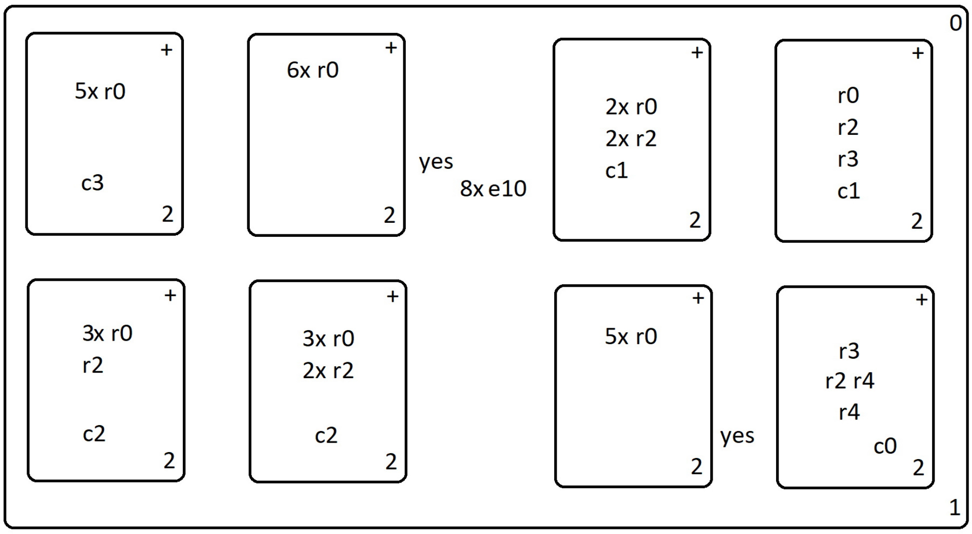
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+
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2
+
r0
r2
r3
c1
2
+
3x r0
r2
c2
2
+
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c2
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r3
r2 r4
r4
c0
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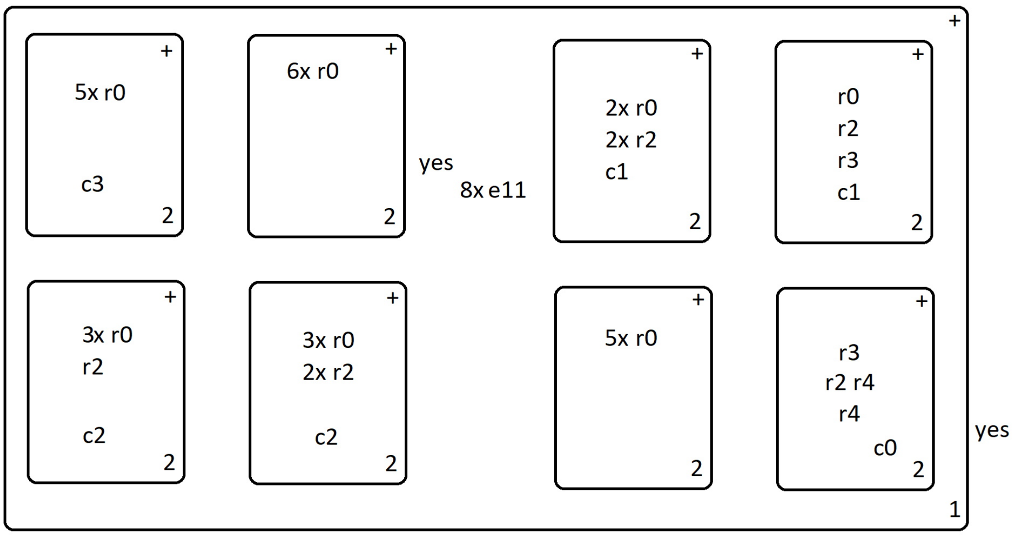
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r0
r2
r3
c1
2
+
3x r0
r2
c2
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3x r0
2x r2
c2
2
+
5x r0
2
+
r3
r2 r4
r4
c0
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