Knuth-Bendix Completion for Program Optimization

Thesis Proposal

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What Kind of Optimization?

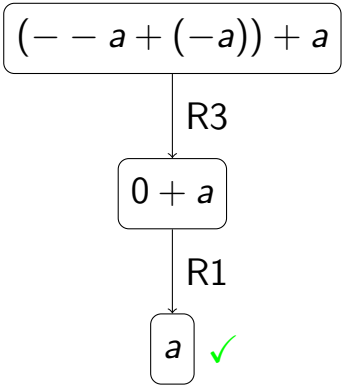
Rewrite rules:

R1: $0 + X \to X$

R2: $X + 0 \to X$

R3: $-X + X \to 0$

R4: $(X + Y) + Z \to X + (Y + Z)$



What's the Problem?

Rewrite rules:

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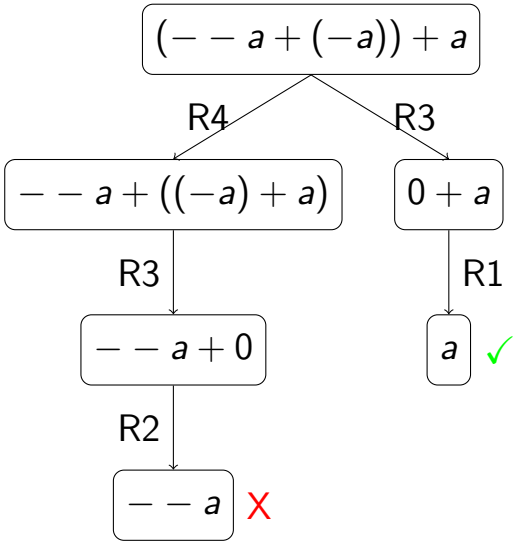
R2: $X + 0 \to X$

R3: $-X + X \to 0$

R4: $(X + Y) + Z \to X + (Y + Z)$



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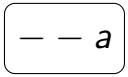


What's the Problem?

Rewrite rules:

R1: $0 + X \leftrightarrow X$

R2: $X + 0 \leftrightarrow X$

R3: $-X + X \leftrightarrow 0$

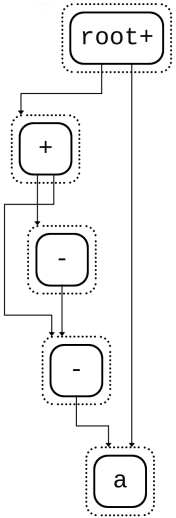
R4: $(X + Y) + Z \leftrightarrow X + (Y + Z)$

Turns our nice DAG into an infinite undirected graph

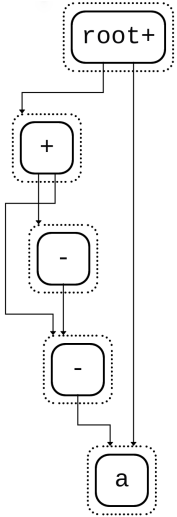
Equality Saturation

$$(- - a + (-a)) + a$$

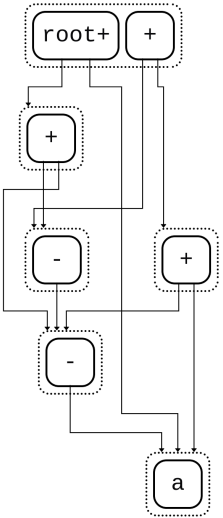
to e-graph



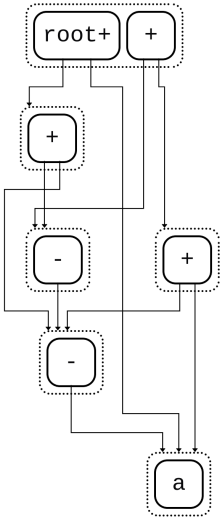
Equality Saturation



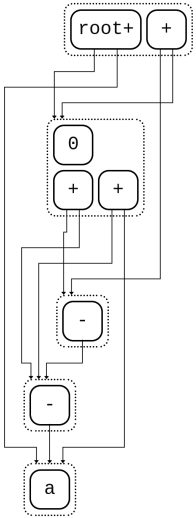
$$(X + Y) + Z \rightarrow X + (Y + Z)$$



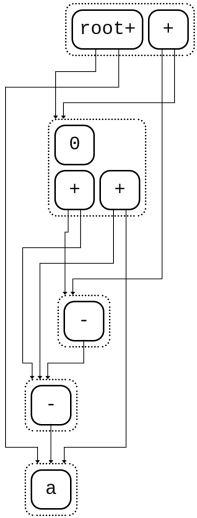
Equality Saturation



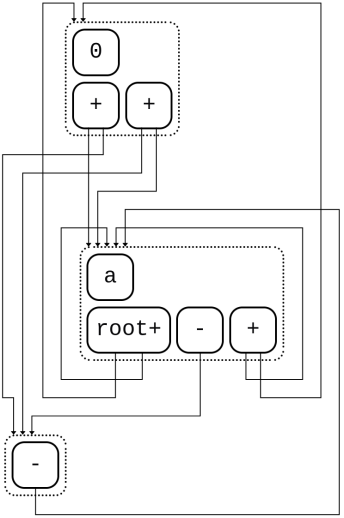
$$-X + X \rightarrow 0$$



Equality Saturation



$$0 + X \to X \text{ and } X + 0 \to X$$



Equality Saturation