# Predicting Memory Demands of BDD Operations using Maximum Graph Cuts

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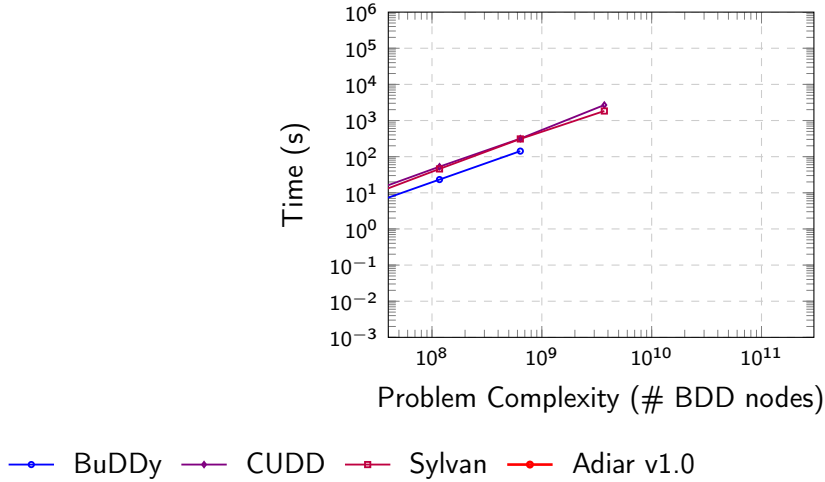
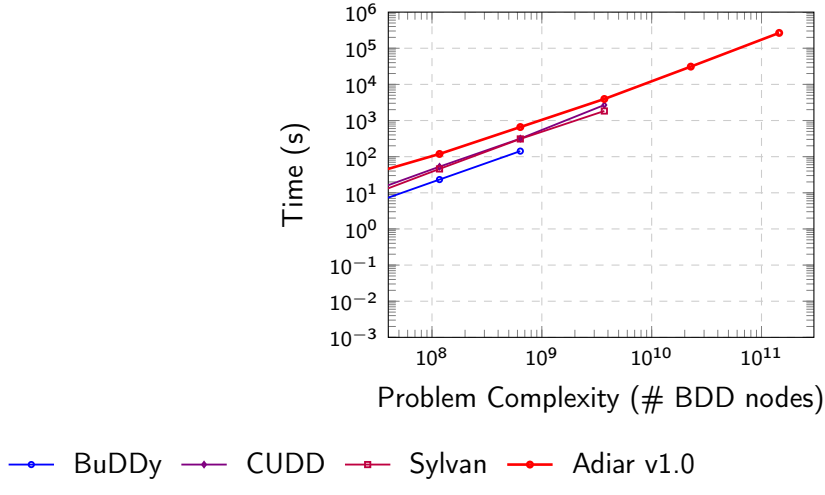
**Steffan Christ Sølvsten** and Jaco van de Pol

ATVA 2023




Running Time to solve *N-Queens* problems.

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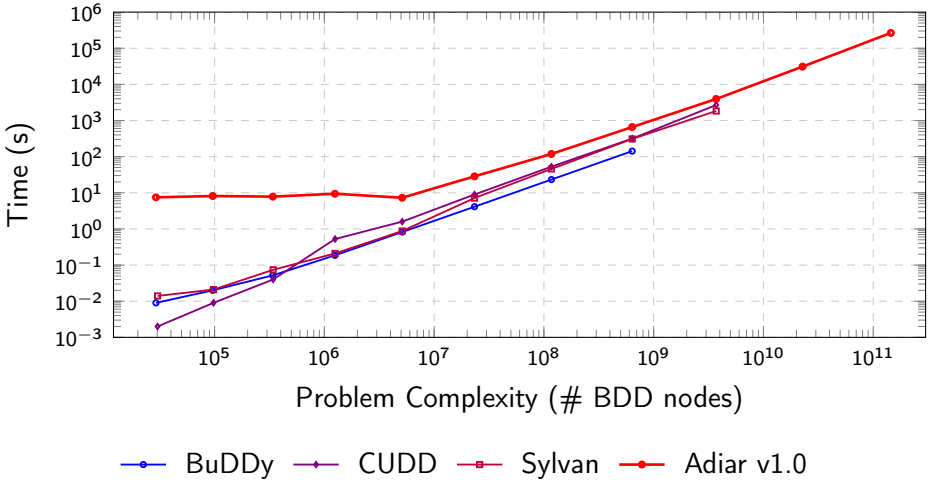


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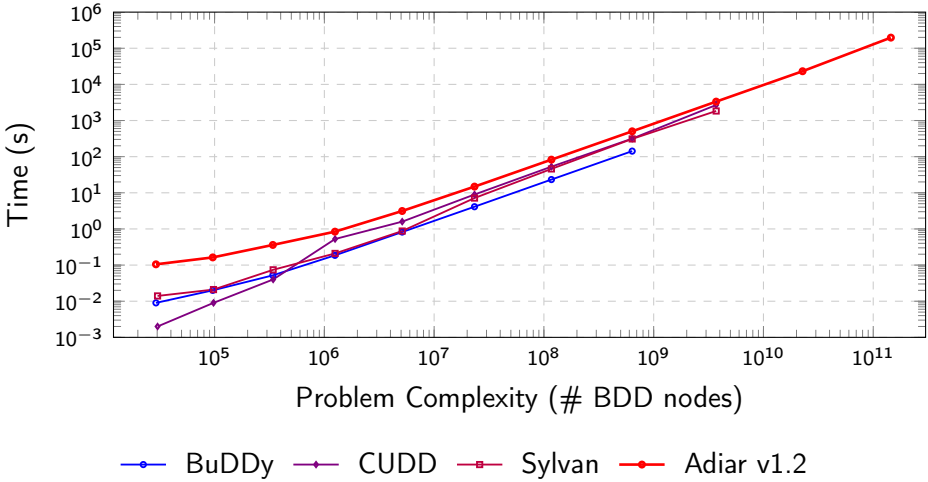


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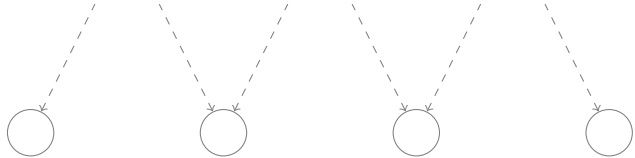
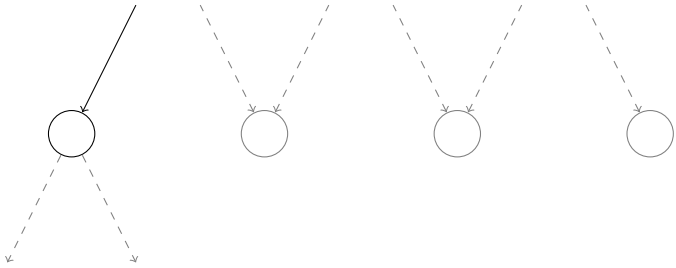
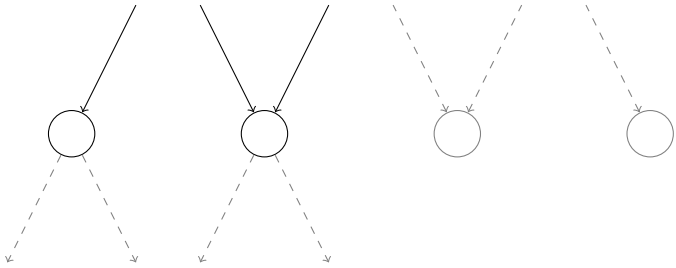
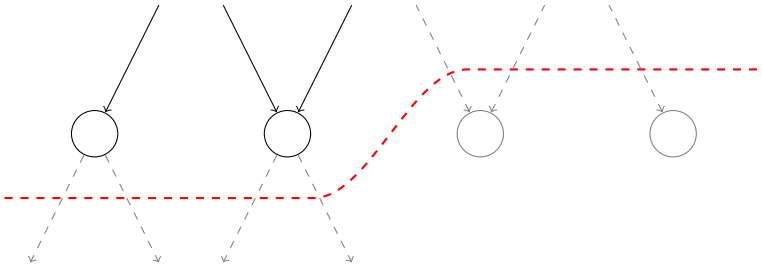
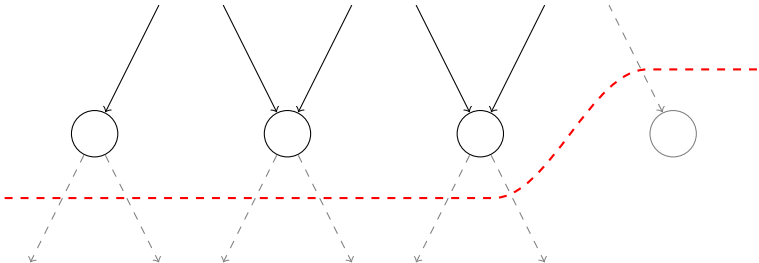
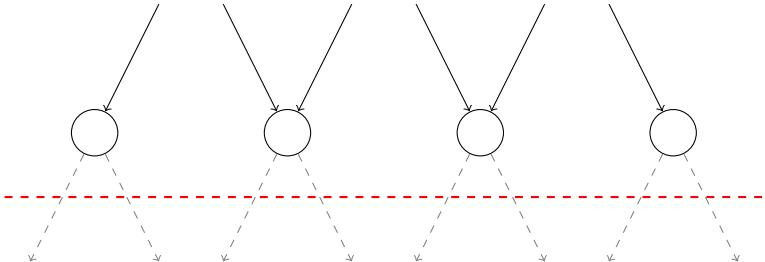




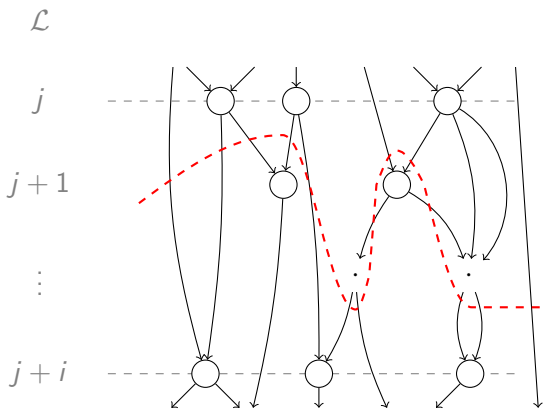








# $i$-level cut



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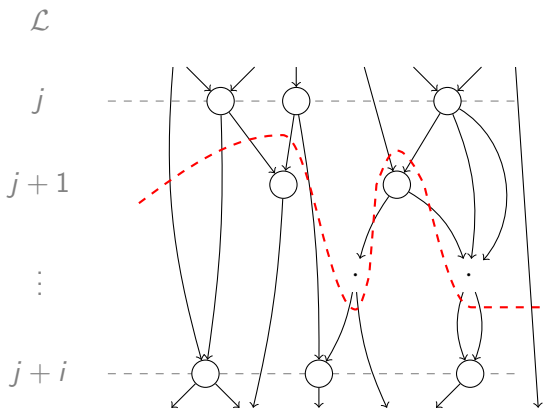
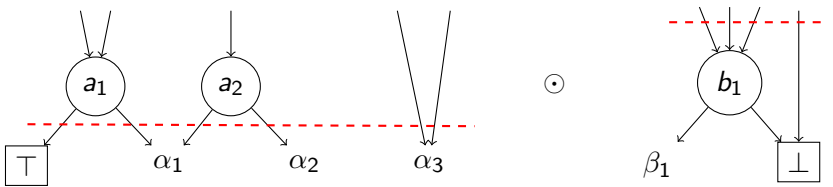



**Lemma** (**Sølvsten, Van de Pol 2023**)
*The maximum $i$-level cut problem is in $P$ for $i \in \{1, 2\}$.*

**Theorem** (**Lampis, Kaouri, Mitsou 2011**)
*The maximum $i$-level cut problem is NP-complete for $i \geq 4$.*

**Theorem** (**Sølvsten, Van de Pol 2023**)
*Given maximum 2-level cuts size $C_f$ for $f$ and $C_g$ for $g$, the maximum 2-level cut for $f \odot g$ is less than or equal to $C_f \cdot C_g$.*

**Proof.**

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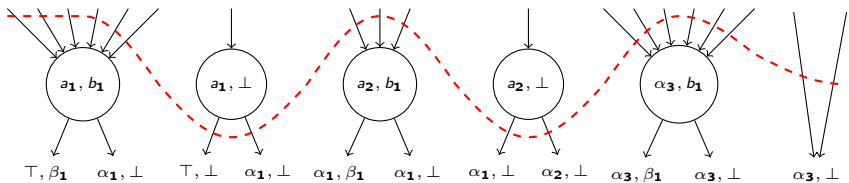


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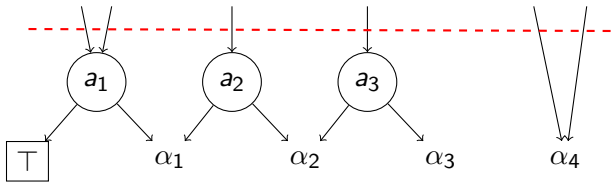
**Lemma (Sølvsten, Van de Pol 2023)**
*The maximum 2-level cut for $f$ is at most $\frac{3}{2}$ larger than its maximum 1-level cut.*

**Proof.**
The maximum 1-level cut bounds the number of available in-going and out-going edges.

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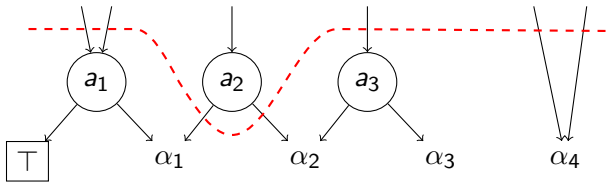


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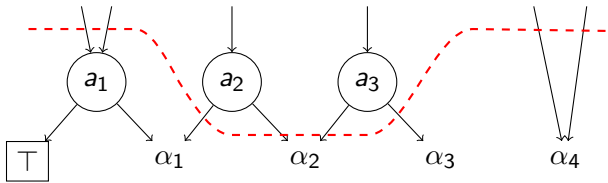


□

Possible to process a

# 1.1 GiB BDD

with only

## 128 MiB Memory

Adiar v1.0 : 56.5 hours

Running time to verify the 15 smallest EPFL instances.

Adiar v1.0 : 56.5 hours

Adiar v1.2 : 4.0 hours (−93%)[1]

Running time to verify the 15 smallest EPFL instances.

[1] 52.1 of these hours were saved on just verifying the `sin` circuit alone.

# Steffan Christ Sølvsten

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## Adiar

github.com/ssoelvsten/adiar

ssoelvsten.github.io/adiar


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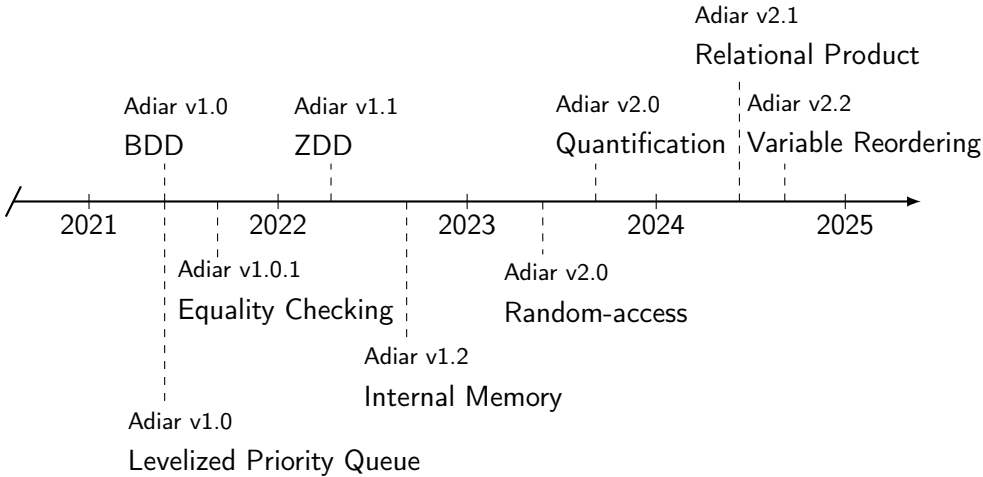
Adiar v2.1
Relational Product
Adiar v1.0
BDD
Adiar v1.1
ZDD
Adiar v2.0
Quantification
Adiar v2.2
Variable Reordering
2021
2022
2023
2024
2025
Adiar v1.0.1
Equality Checking
Adiar v2.0
Random-access
Adiar v1.2
Internal Memory
Adiar v1.0
Levelized Priority Queue

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