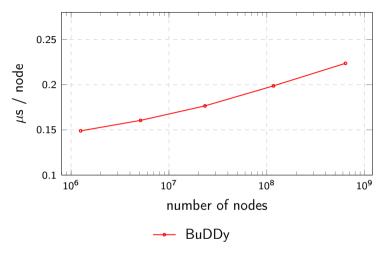
# Adiar:

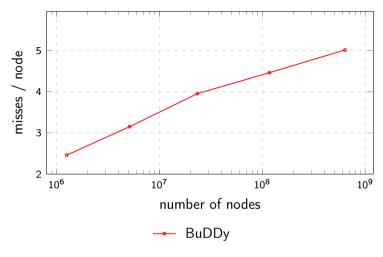
Binary Decision Diagrams in External Memory

**Steffan Christ Sølvsten**, Jaco van de Pol, Anna Blume Jakobsen, and Mathias Weller Berg Thomasen TACAS 2022

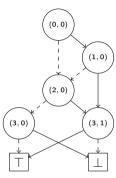




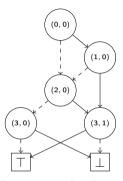
Minimal running time for the Queens problems.



Cache-misses for the Queens problems.



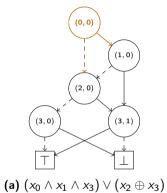
(a)  $(x_0 \land x_1 \land x_3) \lor (x_2 \oplus x_3)$ 



(a)  $(x_0 \land x_1 \land x_3) \lor (x_2 \oplus x_3)$ 

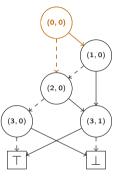
Priority Queue:  $Q_{count}$ :

3



⊕ x2)

Priority Queue:  $Q_{count}$ :

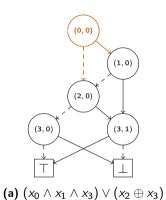


(a)  $(x_0 \land x_1 \land x_3) \lor (x_2 \oplus x_3)$ 

#### Priority Queue: Qcount:

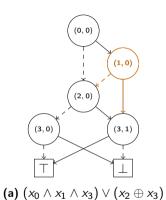
$$[ (0,0) \xrightarrow{\top} (1,0), 1) , (0,0) \xrightarrow{\bot} (2,0), 1) ,$$

]



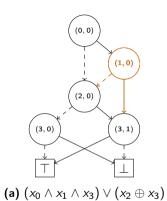
Seek	Sum	Result
(1,0)	0	0

Priority Queue: 
$$Q_{count}$$
:
$$[ ((0,0) \xrightarrow{\top} (1,0), 1) , ((0,0) \xrightarrow{\bot} (2,0), 1) ,$$

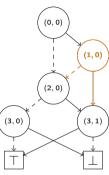


Seek	Sum	Result
(1,0)	0	0

Priority Queue: 
$$Q_{count}$$
:
$$[ ((0,0) \xrightarrow{\top} (1,0), 1) , ((0,0) \xrightarrow{\bot} (2,0), 1) ,$$

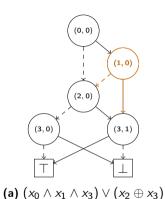


Seek (1, 0)	Sum 1	Result 0
]	Priority Queue: $Q_0$ $((0,0) \xrightarrow{\perp} (2,0),$	;
		1

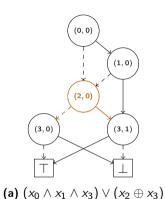


(0,0)	Seek
(1,0)	(1,0)
(2,0)	
(3,0) $(3,1)$	[
Ť	
(a) $(x_0 \wedge x_1 \wedge x_3) \vee (x_2 \oplus x_3)$	

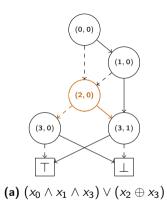
eek Sum Result ., 0) 1 0 ... 
$$((0,0) \xrightarrow{\top} (3,1), 1)$$
 ,  $((1,0) \xrightarrow{\top} (3,1), 1)$  ,  $(1,0) \xrightarrow{\top} (3,1), 1)$  ,  $(1,0) \xrightarrow{\top} (3,1), 1)$  ,  $(1,0) \xrightarrow{\top} (3,1), 1)$  ,



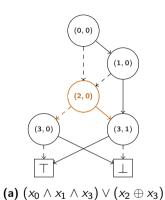
Seek Sum Result (2,0) 0 0 0  $(2,0) = \frac{\text{Priority Queue: } Q_{count}:}{((0,0) \xrightarrow{\bot} (2,0), \quad 1)} \cdot ((1,0) \xrightarrow{\top} (3,1), \quad 1) \cdot ((1,0) \xrightarrow{\top} (3,1), \quad 1) \cdot (1,0) \cdot (1,0)$ 

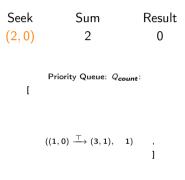


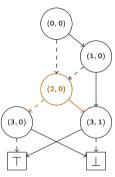
Seek Sum Result (2,0) 0 0 0  $(2,0) \quad 0 \quad 0$  Priority Queue:  $Q_{count}$ :  $[ \quad ((0,0) \xrightarrow{\bot} (2,0), \quad 1) \quad , \quad ((1,0) \xrightarrow{\top} (3,1), \quad 1) \quad , \quad ]$ 



Seek	Sum		Result
(2,0)	1		0
]	Priority Queue: Q	count	
	$((1,0) \xrightarrow{\perp} (2,0),$	1)	,
	$((1,0) \xrightarrow{\top} (3,1),$	1)	1

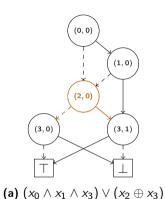




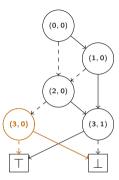


(a) 
$$(x_0 \wedge x_1 \wedge x_3) \vee (x_2 \oplus x_3)$$

Seek (2,0)	Sum 2		Result 0
]	Priority Queue: Q	count :	
	$((2,0) \xrightarrow{\perp} (3,0), ((1,0) \xrightarrow{\top} (3,1), ((2,0) \xrightarrow{\top} (3,1),$		, , 1

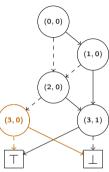


Seek Sum Result (3,0) 0 0 0 0



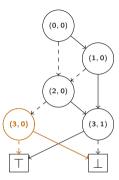
(a) 
$$(x_0 \land x_1 \land x_3) \lor (x_2 \oplus x_3)$$

Seek (3,0)	Sum 0	Res 0	ult
]	Priority Queue: Q	count:	
	$((2,0) \xrightarrow{\perp} (3,0), ((1,0) \xrightarrow{\top} (3,1), ((2,0) \xrightarrow{\top} (3,1),$		



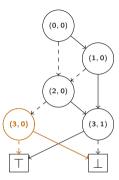
	_ '	
(a)	$(x_0 \wedge x_1$	$\wedge x_3) \vee (x_2 \oplus x_3)$

Seek (3, 0)	Sum 2	Result 0
]	Priority Queue: <i>Qcou</i>	nt:
	$((1,0) \xrightarrow{\top} (3,1), 1$ $((2,0) \xrightarrow{\top} (3,1), 2$	) , ) ]



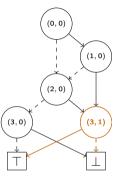
(a) 
$$(x_0 \land x_1 \land x_3) \lor (x_2 \oplus x_3)$$

Seek (3,0)	Sum 2	Result 2
]	Priority Queue: <i>Q<sub>cour</sub></i>	nt:
	$((1,0) \xrightarrow{\top} (3,1),  1)$ $((2,0) \xrightarrow{\top} (3,1),  2)$	, 1



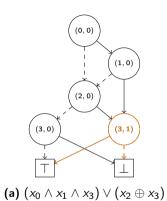
(a) 
$$(x_0 \land x_1 \land x_3) \lor (x_2 \oplus x_3)$$

Seek (3, 1)	Sum 0	Result 2
]	Priority Queue: <i>Qco</i>	unt:
	$((1,0) \xrightarrow{\top} (3,1), (2,0) \xrightarrow{\top} (3,1), (3,1), (1,0)$	1) , 2) ]

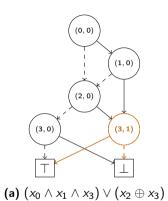


(a)  $(x_0 \wedge x_1 \wedge x_3) \vee (x_2 \oplus x_3)$ 

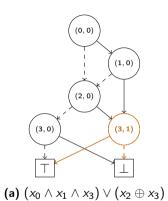
Seek (3, 1)	Sum 0	Result 2
]	Priority Queue: $Q_c$	count:
	$((1,0) \xrightarrow{\top} (3,1),$ $((2,0) \xrightarrow{\top} (3,1),$	1) , 2) ]



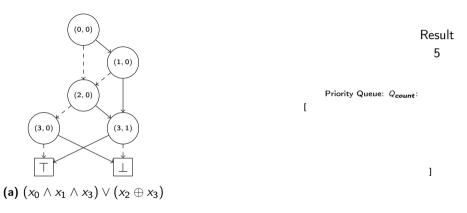
Seek	Sum	Result
(3, 1)	1	2
Į	Priority Queue: Q	count:
	$((2,0) \xrightarrow{\top} (3,1),$	2) ]



Seek (3, 1)	Sum 3	Result 2
]	Priority Queue:	Q <sub>count</sub> :
		1

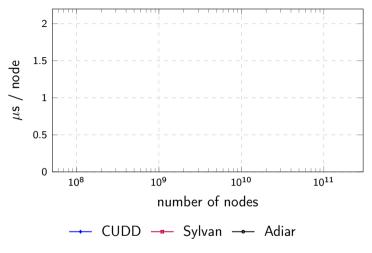


Seek (3, 1)	Sum 3	Result 5
]	Priority Queue:	Q <sub>count</sub> :
		1

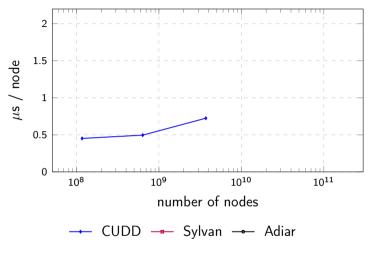


# **A**diar

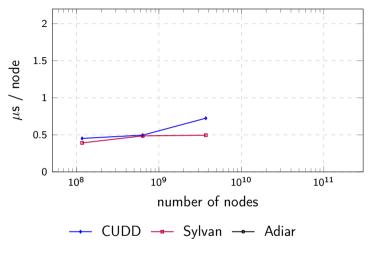
github.com/ssoelvsten/adiar



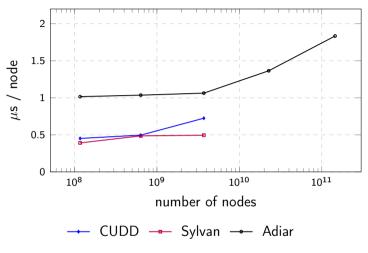
Minimal running time for the *Queens* problems.



Minimal running time for the *Queens* problems.



Minimal running time for the *Queens* problems.



Minimal running time for the *Queens* problems.

### Steffan Christ Sølvsten

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**y** @ssoelvsten

# **Adiar**

</> github.com/ssoelvsten/adiar

