Ein Kontrollflussüberwachungsdienst für KESO-Anwendungen

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System Software Group

Zuverlässigkeit

Zuverlässigkeit und Fehlertoleranz

Kontrollflussfehler | Datenfehler

Kontrollflussüberwachung

„We present a[n] [...] version [...] (ECCA) [...] targeted for the **detection of control flow-errors** with **low overhead** and **low detection latency** [...]“

- Alkhalifa et al.: Design and Evaluation of System-Level Checks for On-Line Control Flow Error Detection

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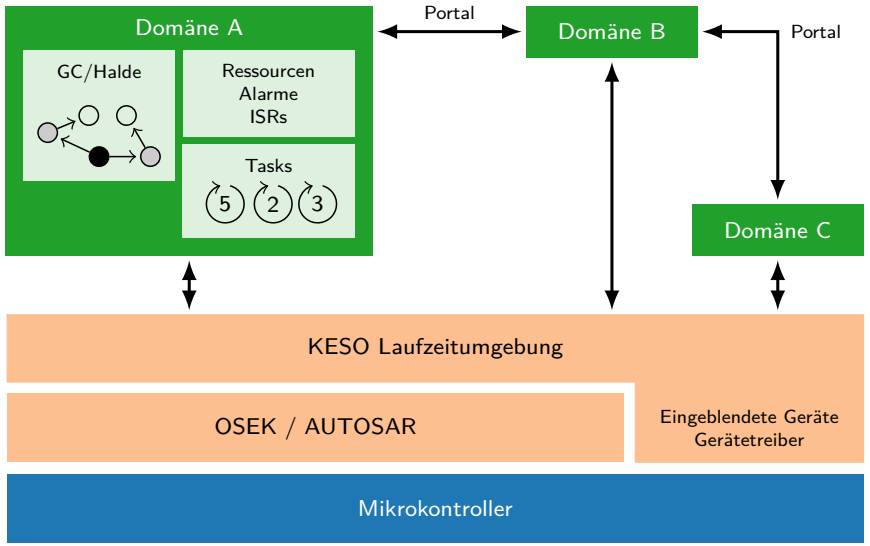
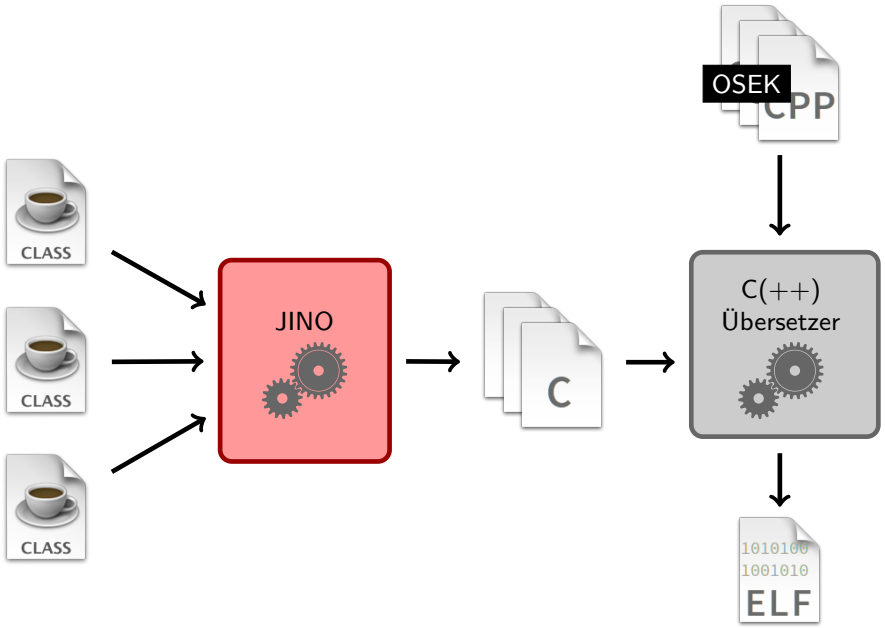
KESO-Aufbau



KESO-Bauprozess



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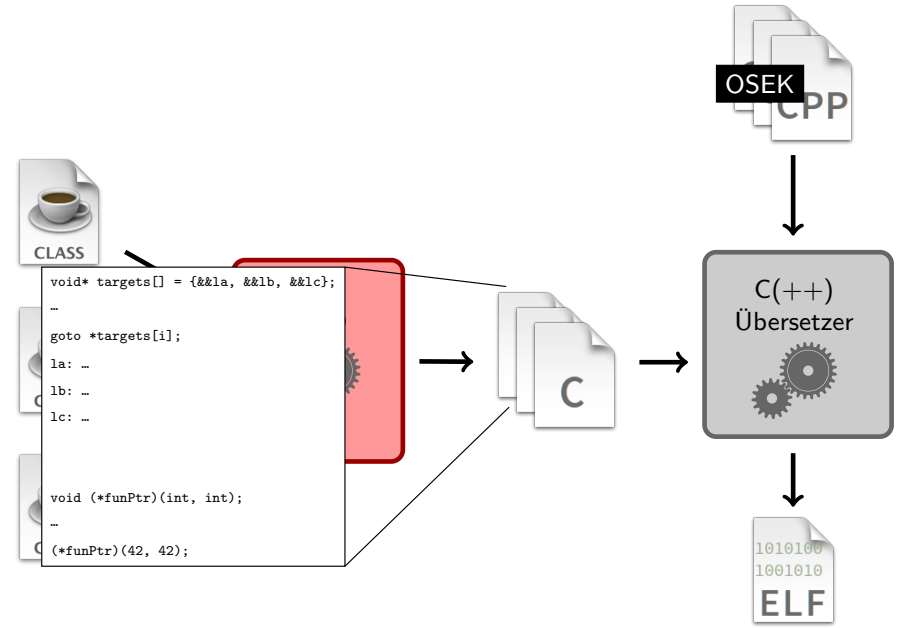

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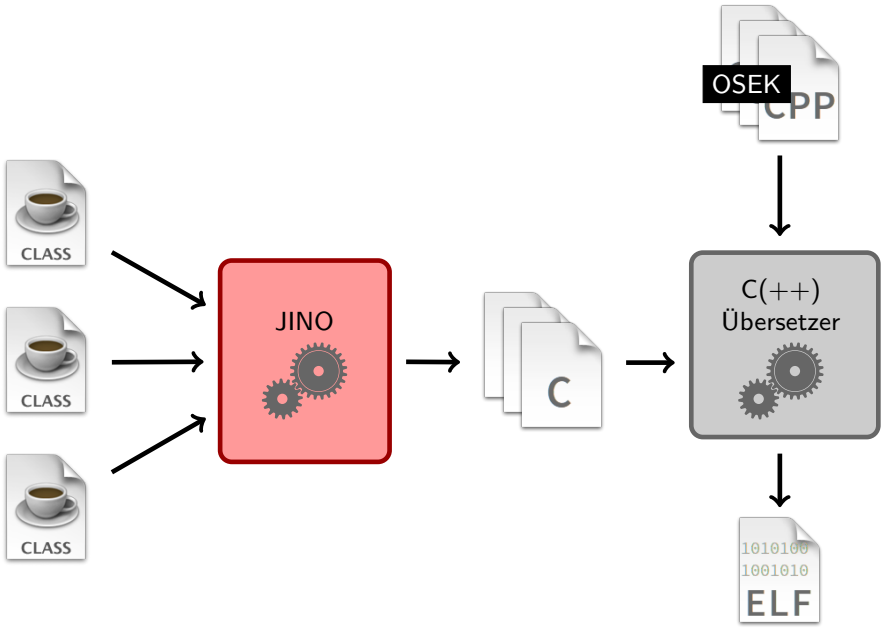

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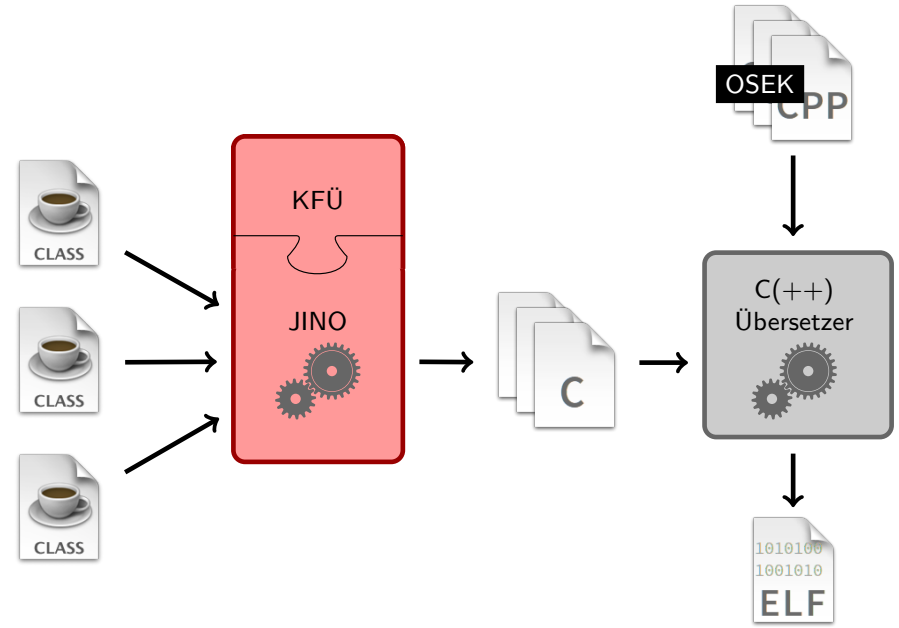

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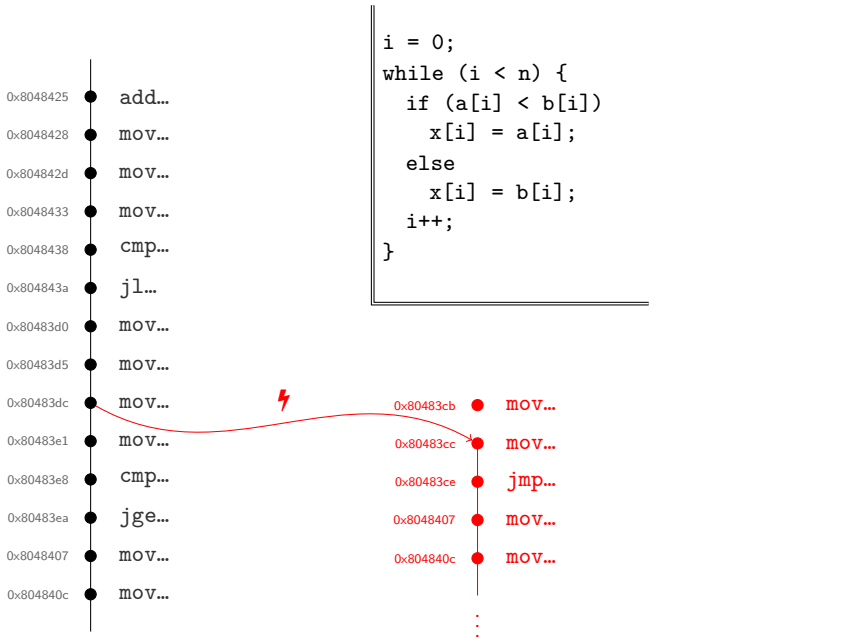

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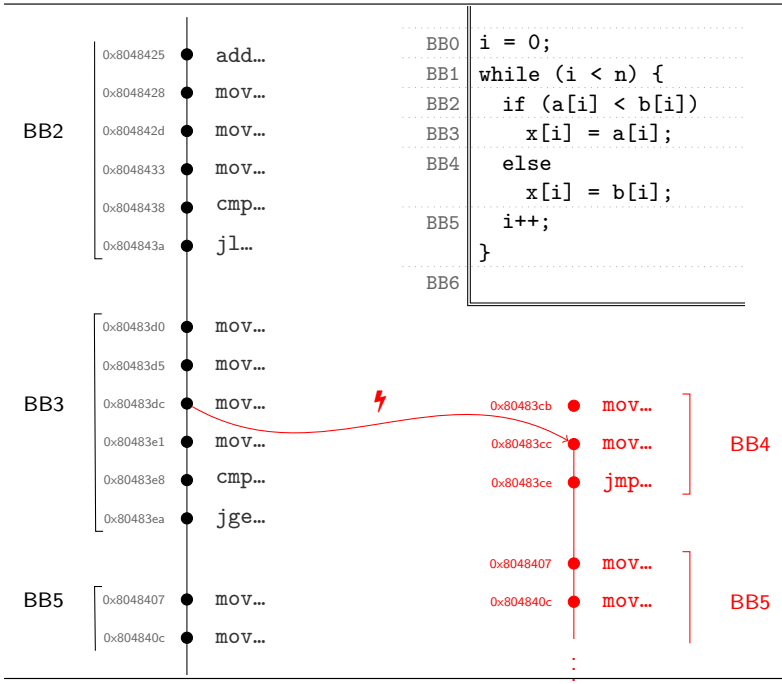

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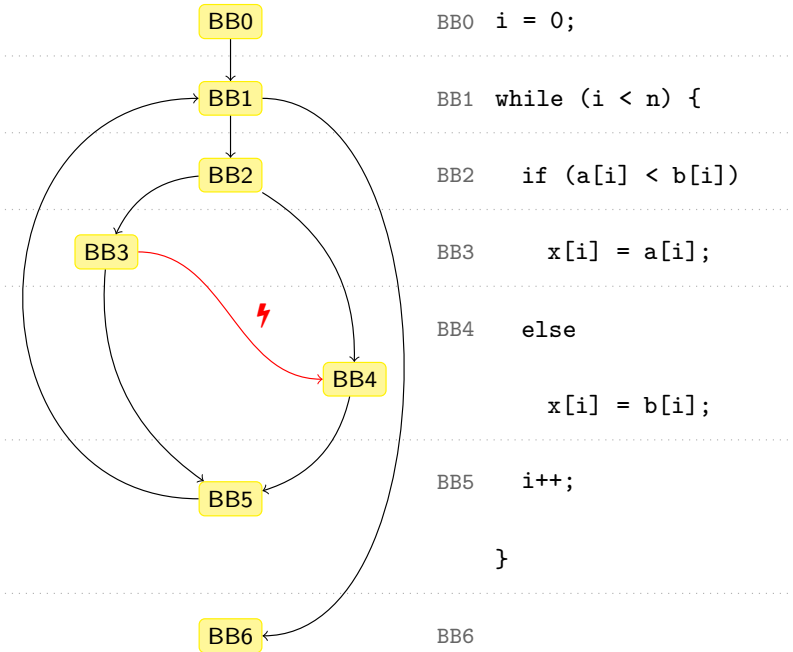

Umgesetzte Verfahren

Basisblockebene:

- Plain Interblock Error Detection [1], [2]
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- Yet Another Control-Flow Checking using Assertions (YACCA) [5], [6]

Dominanzregionsebene:

- Dominatorbasiertes Verfahren [7]
  - Vergabe-Strategien: „Kleinste“ und „Verteilung“
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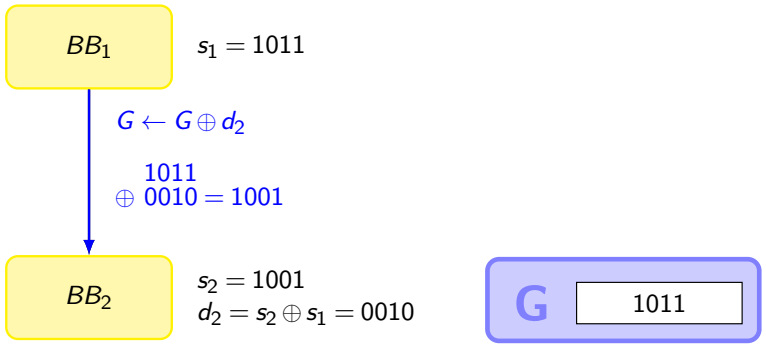
Control-Flow Checking by Software Signatures

CFCSS



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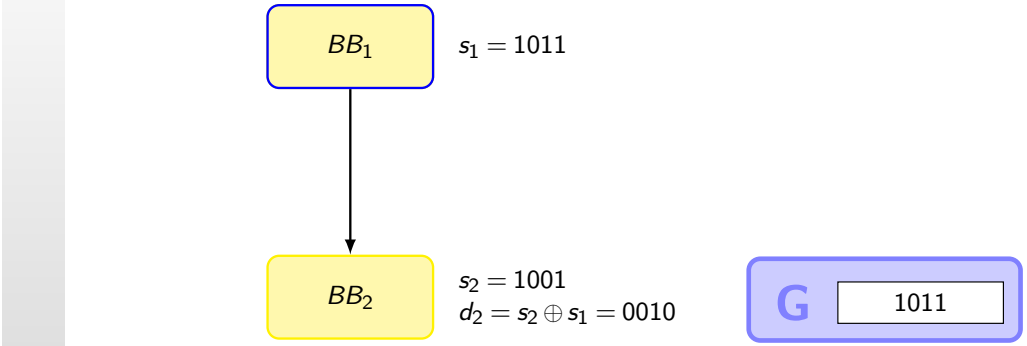

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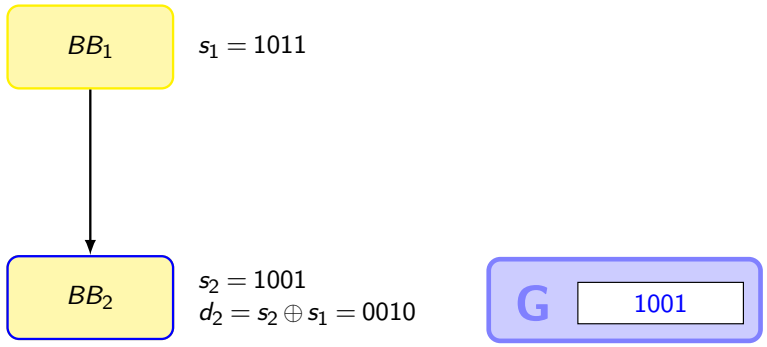
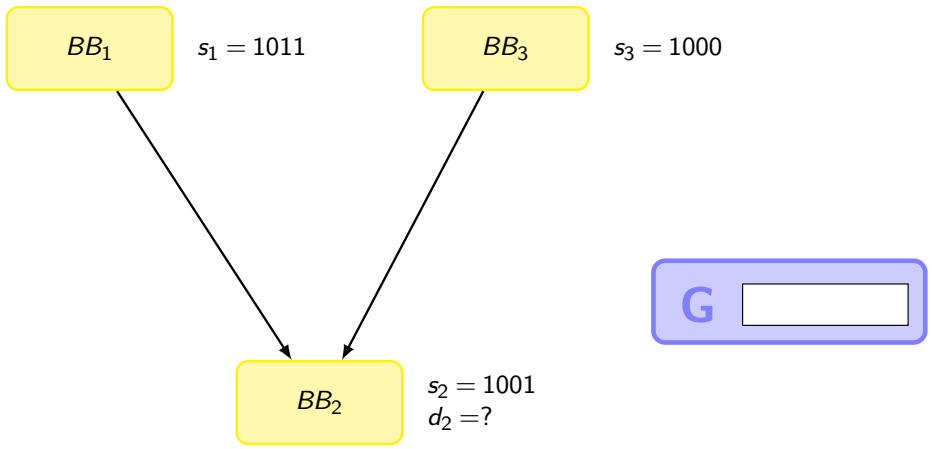
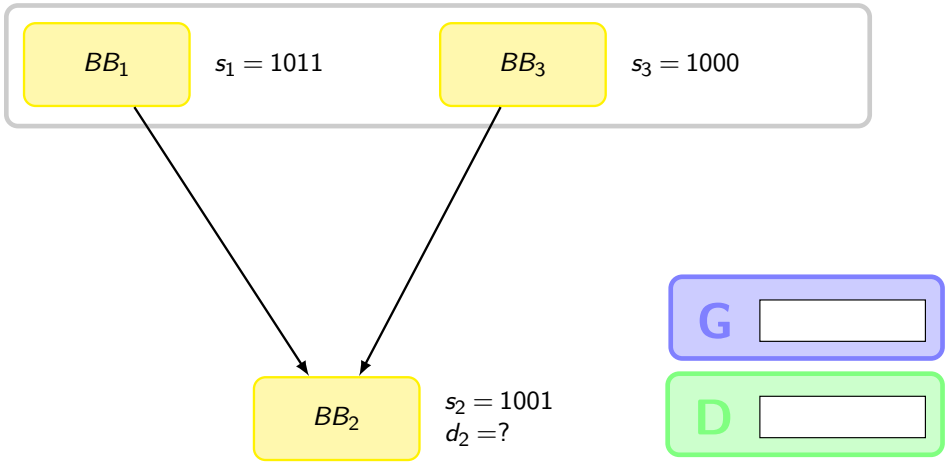
CFCSS




BB_1
$s_1 = 1011$
BB_3
$s_3 = 1000$
BB_2
$s_2 = 1001$
$d_2 = ?$
G


BB_1
$s_1 = 1011$
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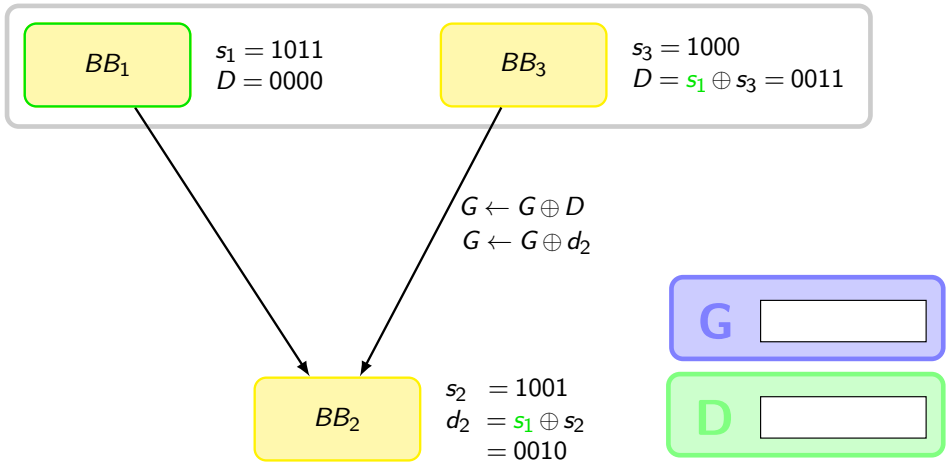
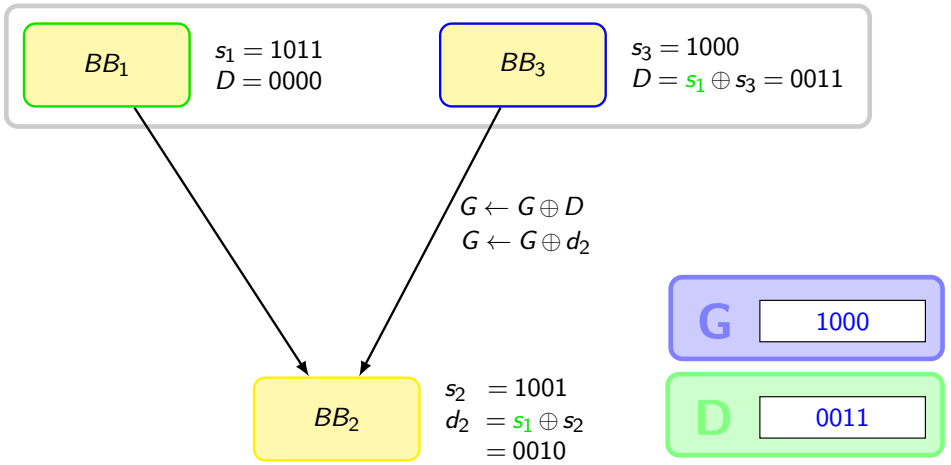
$s_3 = 1000$
BB_2
$s_2 = 1001$
$d_2 = ?$
G
D


BB_1
$s_1 = 1011$
$D = 0000$
BB_3
$s_3 = 1000$
$D = s_1 \oplus s_3 = 0011$
$G \leftarrow G \oplus D$
$G \leftarrow G \oplus d_2$
BB_2
$s_2 = 1001$
$d_2 = s_1 \oplus s_2$
$= 0010$
G
D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BB_3
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$G \leftarrow G \oplus d_2$
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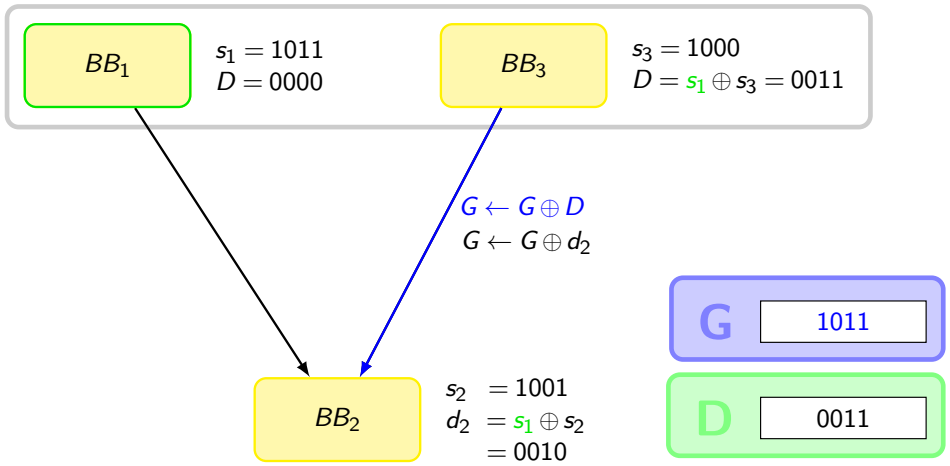
G
1000
D
0011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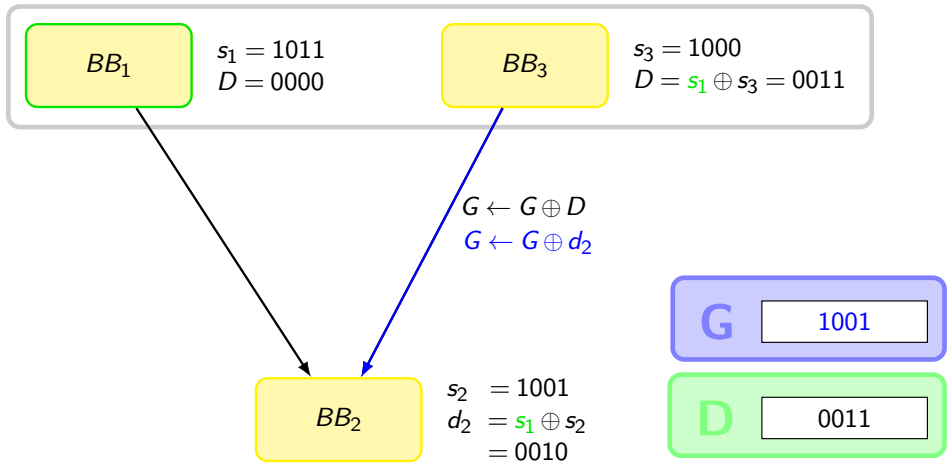
D
0011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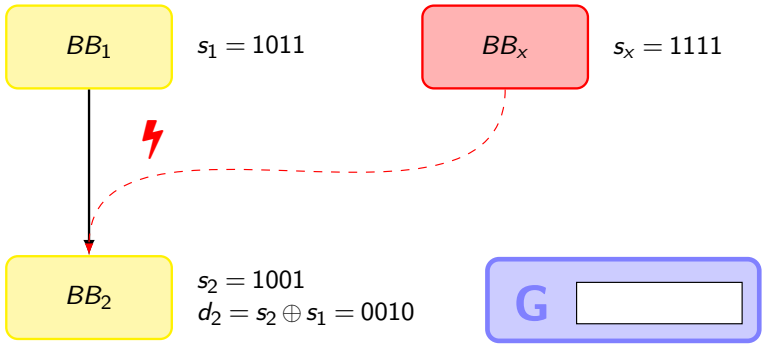
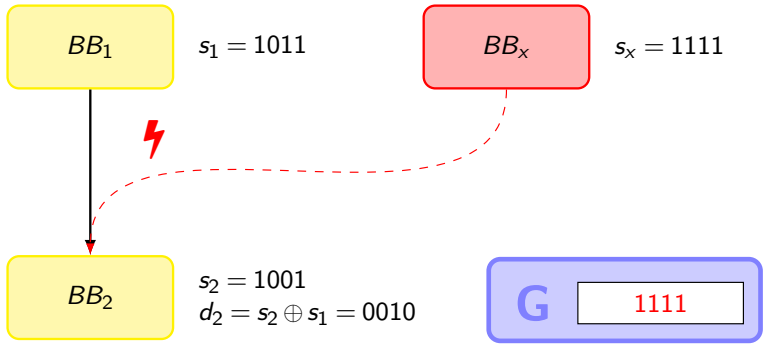
G
1001
D
0011


BB_1
$s_1 = 1011$
BB_x
$s_x = 1111$
BB_2
$s_2 = 1001$
$d_2 = s_2 \oplus s_1 = 0010$
G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$s_1 = 1011$
BB_x
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BB_2
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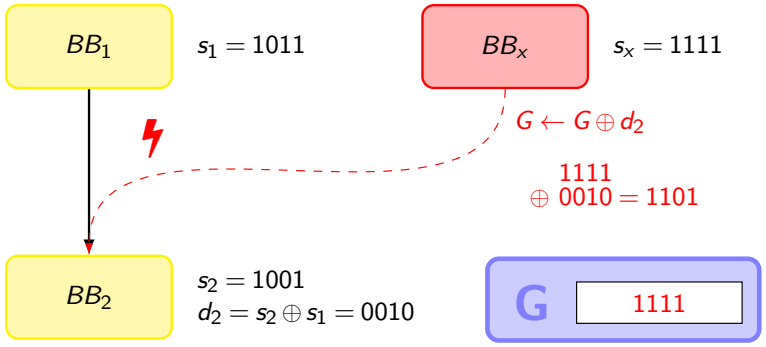
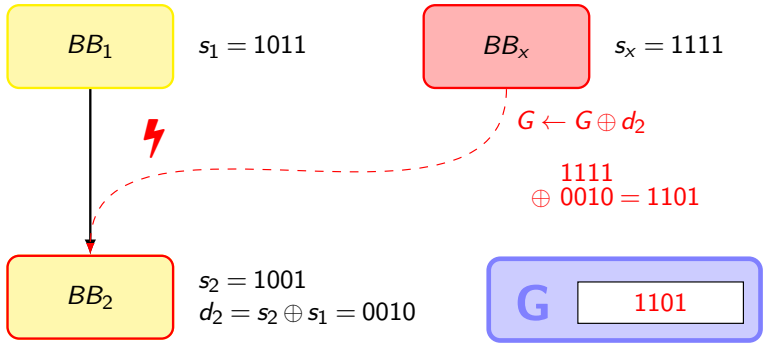
G
1111





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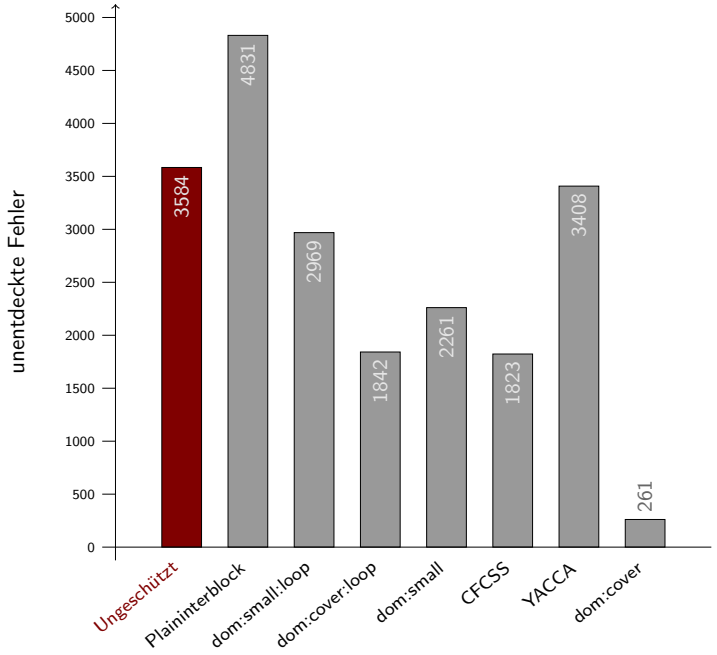

Unausgerichtete Sprünge

Ursprüngliche Instruktionsfolge

0x1014af	83	
0x1014b0	c2	add edx,0x1
0x1014b1	01	
0x1014b2	0f	
0x1014b3	af	
0x1014b4	4c	imul ecx,DWORD PTR
0x1014b5	ab	[ebx+ebp*4+0x8]
0x1014b6	08	
0x1014b7	01	
0x1014b8	ce	add esi,ecx
0x1014b9	0f	
0x1014ba	b7	movzx ecx,WORD PTR
0x1014bb	48	[eax+0xa]
0x1014bc	0a	
0x1014bd	83	
0x1014be	f1	xor ecx,0x7
0x1014bf	07	

Unausgerichtete Sprünge

	Ursprüngliche Instruktionsfolge	Unausgerichtete Instruktionsfolge
0x1014af 83		
0x1014b0 c2	add edx,0x1	
0x1014b1 01		
0x1014b2 0f		
0x1014b3 af		scas eax,DWORD PTR es:[edi]
0x1014b4 4c	imul ecx,DWORD PTR	dec esp
0x1014b5 ab	[ebx+ebp*4+0x8]	stos DWORD PTR es:[edi],eax
0x1014b6 08		or BYTE PTR [ecx],al
0x1014b7 01		
0x1014b8 ce	add esi,ecx	into
0x1014b9 0f		
0x1014ba b7	movzx ecx,WORD PTR	movzx ecx,WORD PTR
0x1014bb 48	[eax+0xa]	[eax+0xa]
0x1014bc 0a		
0x1014bd 83		
0x1014be f1	xor ecx,0x7	xor ecx,0x7
0x1014bf 07		

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0x1014af 83		
0x1014b0 c2	add edx,0x1	
0x1014b1 01		
0x1014b2 0f		
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0x1014b4 4c	imul ecx,DWORD PTR	dec esp
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0x1014bd 83		
0x1014be f1	xor ecx,0x7	xor ecx,0x7
0x1014bf 07		

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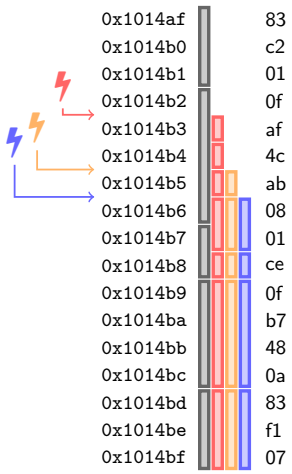

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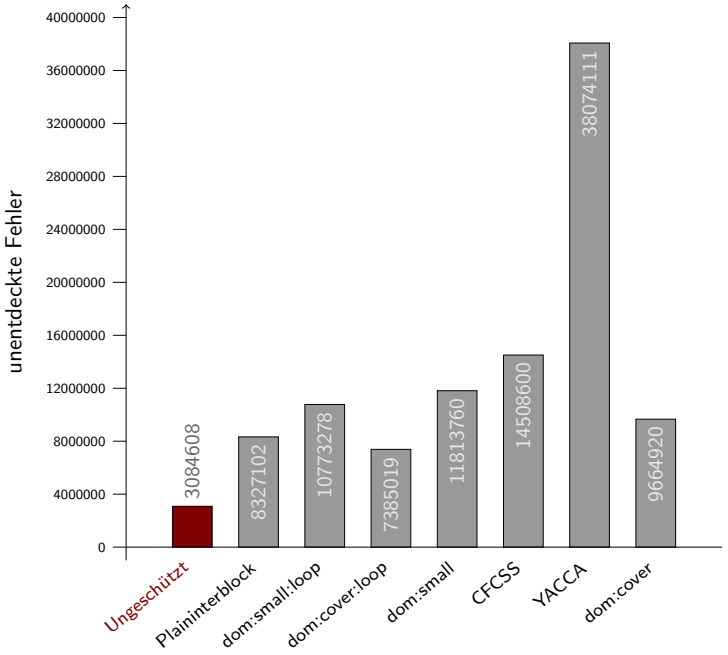
0x1014bc	0a		
0x1014bd	83		
0x1014be	f1	xor ecx,0x7	xor ecx,0x7
0x1014bf	07		

Allgemeine Einbitfehler



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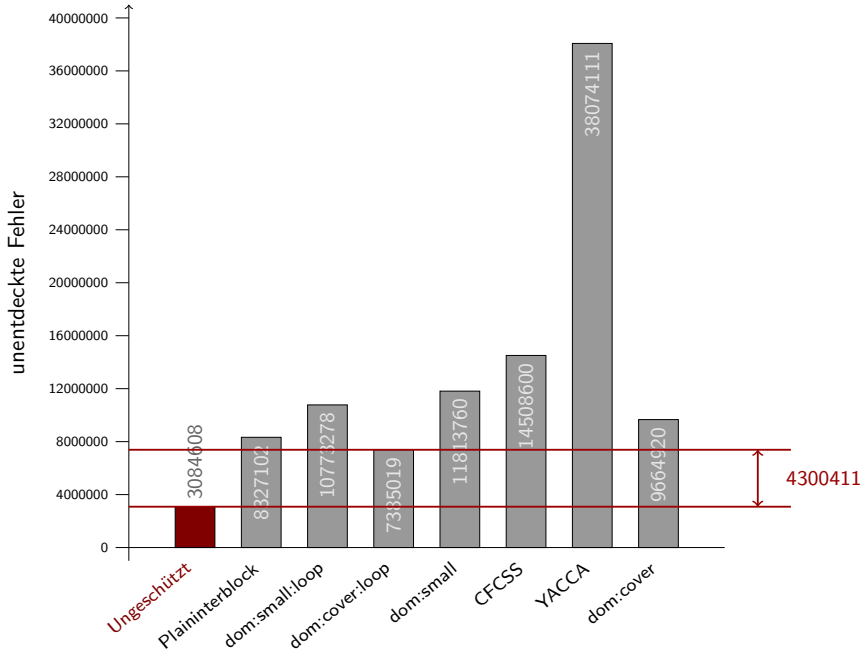
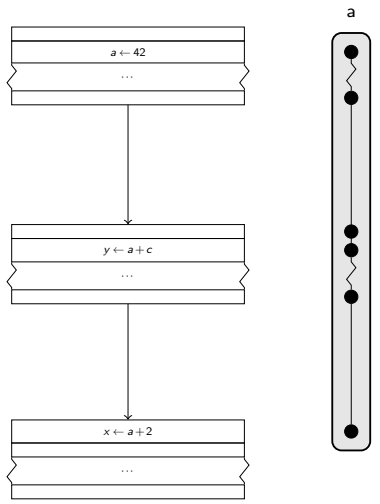


Datenfehler



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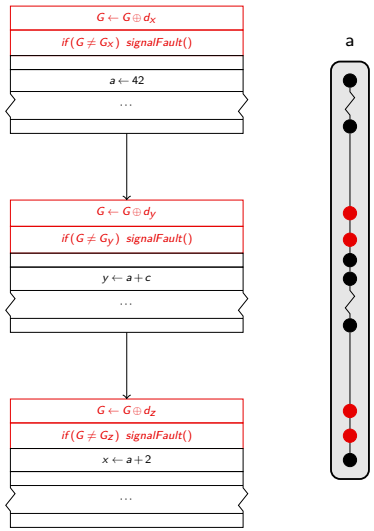

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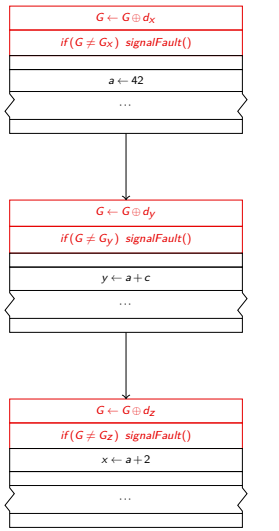
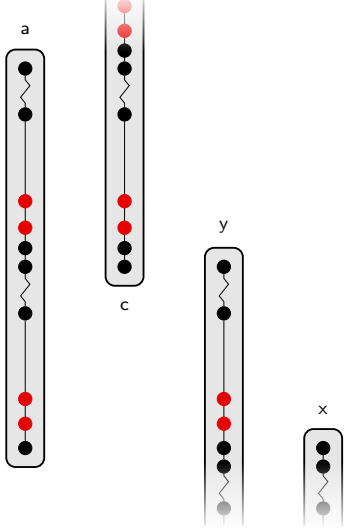
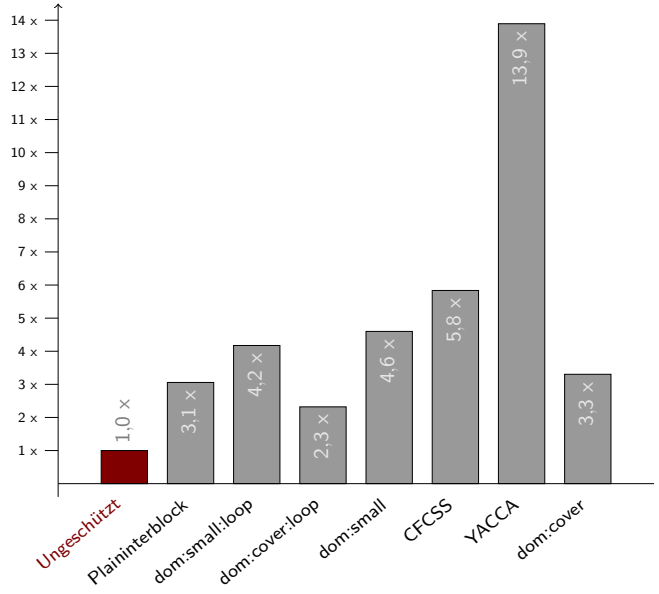
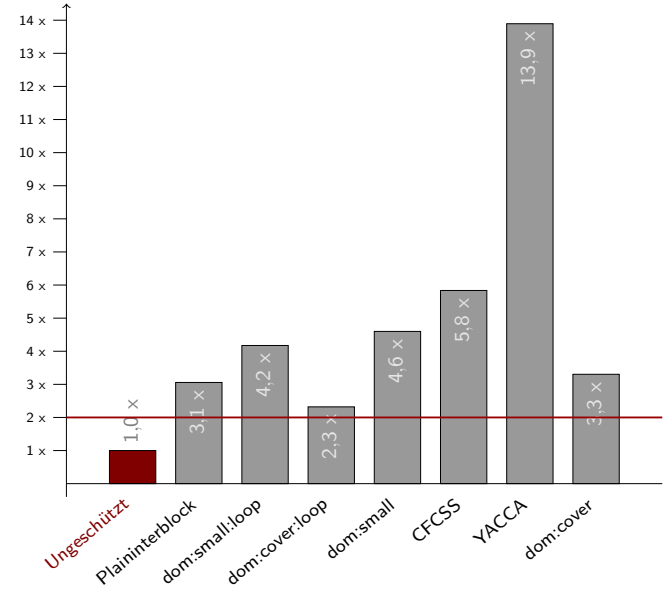




Laufzeit



Laufzeit

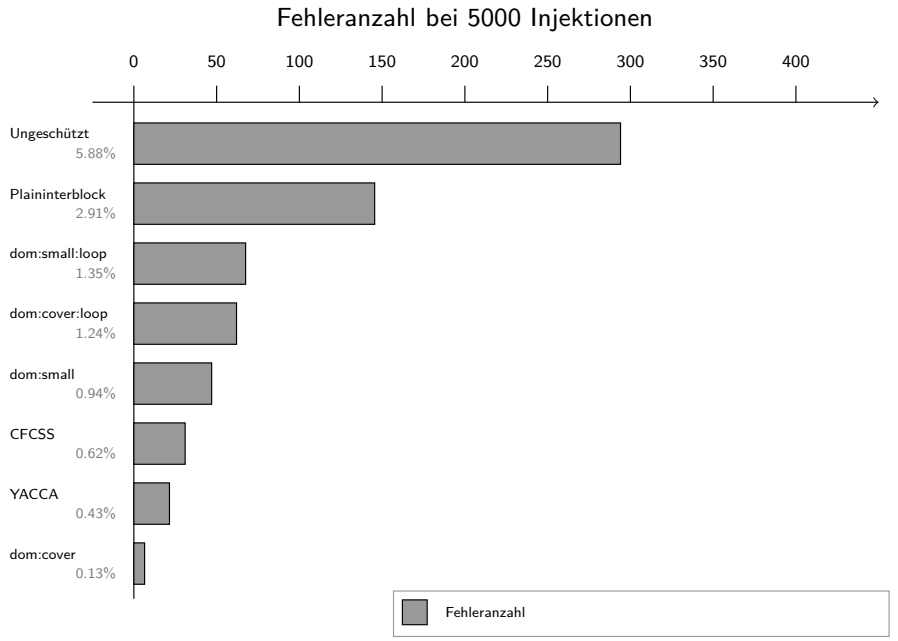


Literaturvergleich

- IA32 / TC1796
- g++, v4.9.1, v4.6.3
- Optionen: `-O2`
- Signatur als `volatile` Variable
- Speicherzugriff TC1796: 2 Zyklen
- ...

- R4400 (MIPS), Intel 8051, TIMA T225, ...
- ?
- ?
- ?
- ?
- ...

Fehlerrate und -abdeckung



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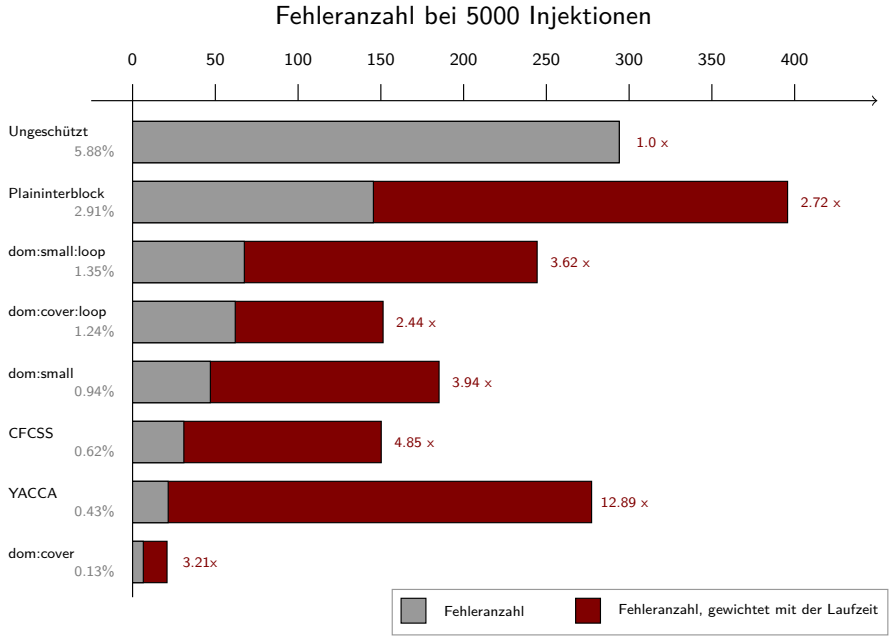

Fazit

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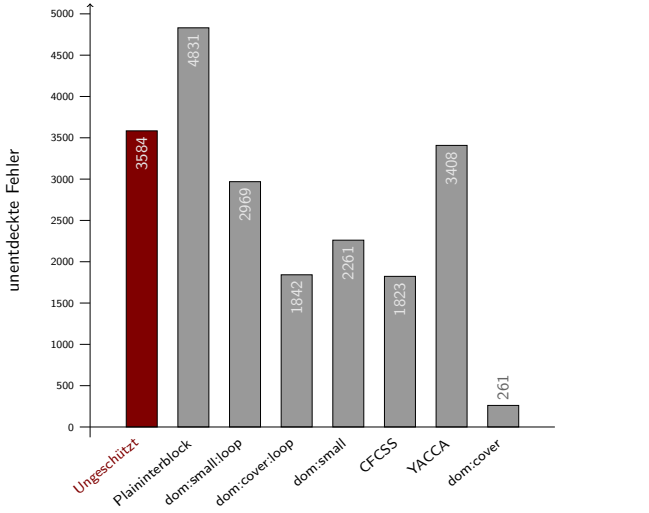

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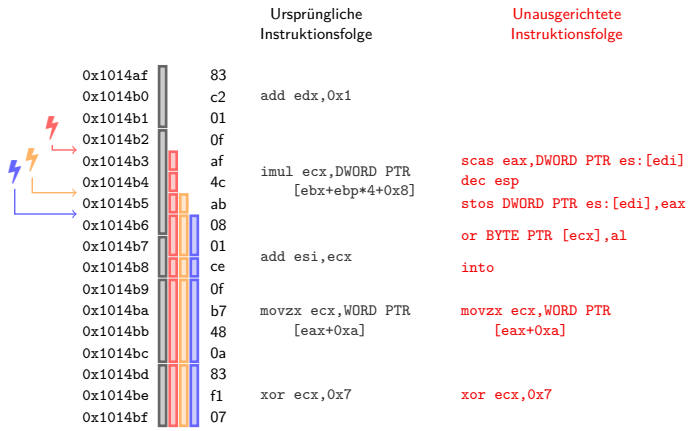
Unausgerichtete Sprünge



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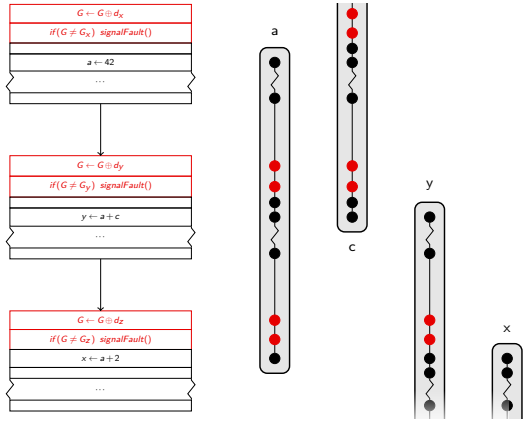

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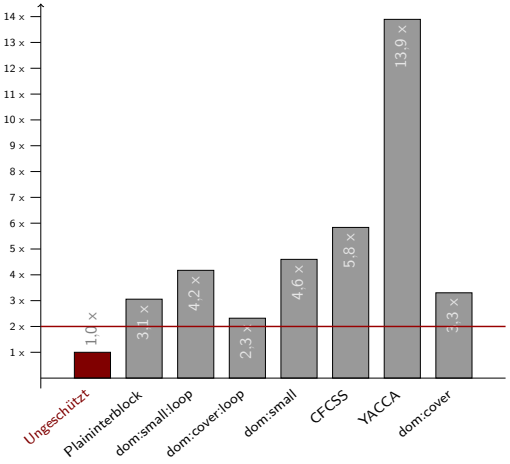

Referenzen

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