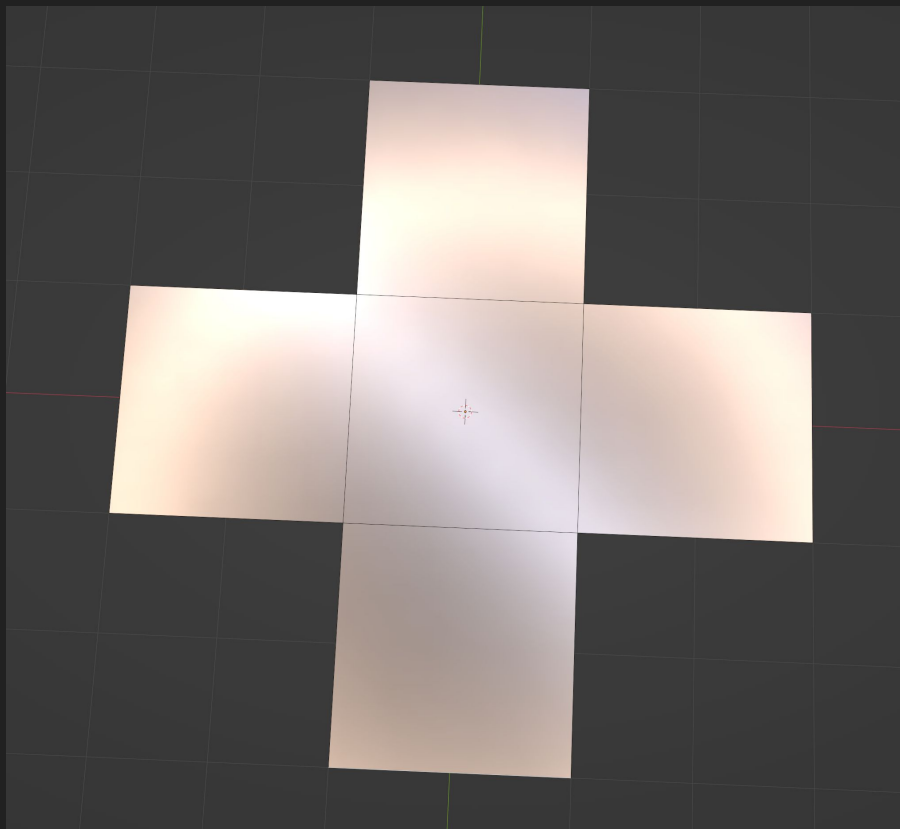


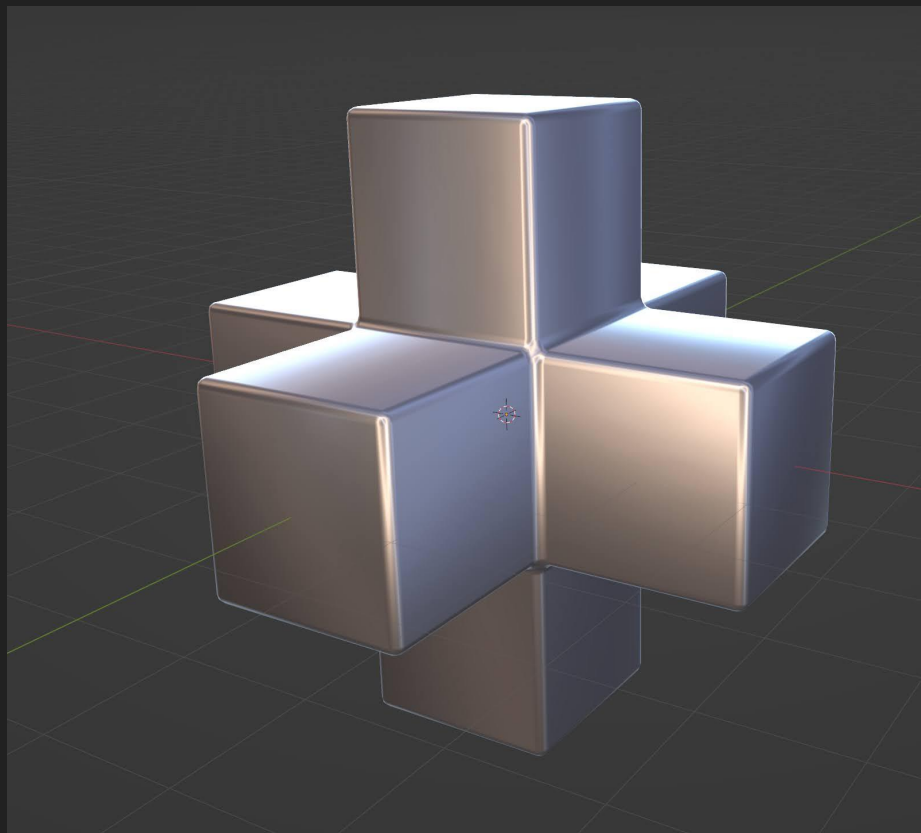
Mit 3D-Plussen den Raum füllen

Wie ein SAT solver mir half
den Raum mit 3D-Plussen zu füllen.

Ein Plus - ihr kennt das



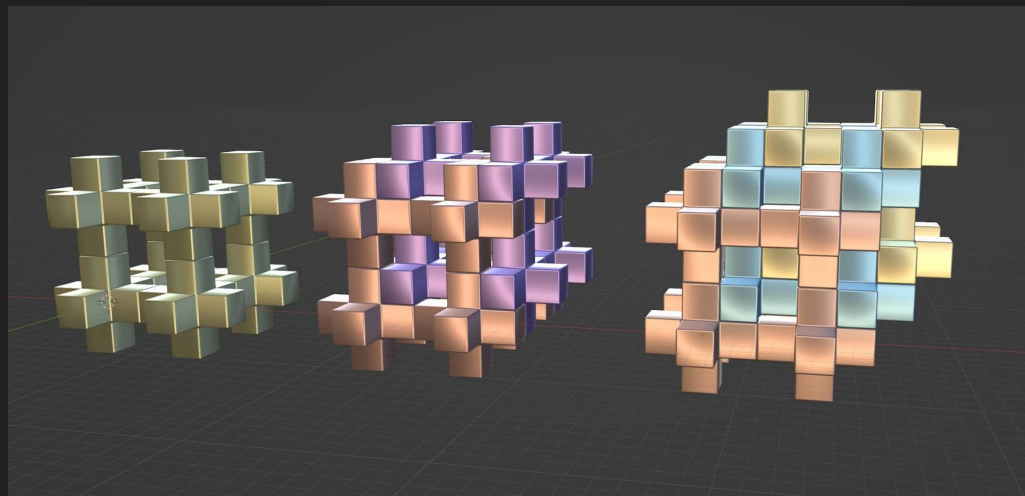
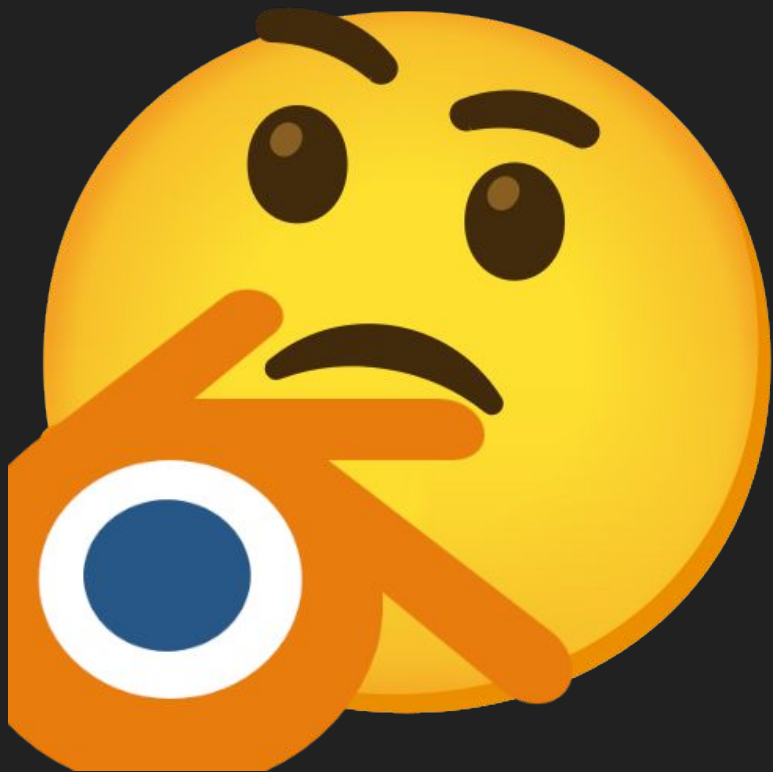
Ein Plus in 3D



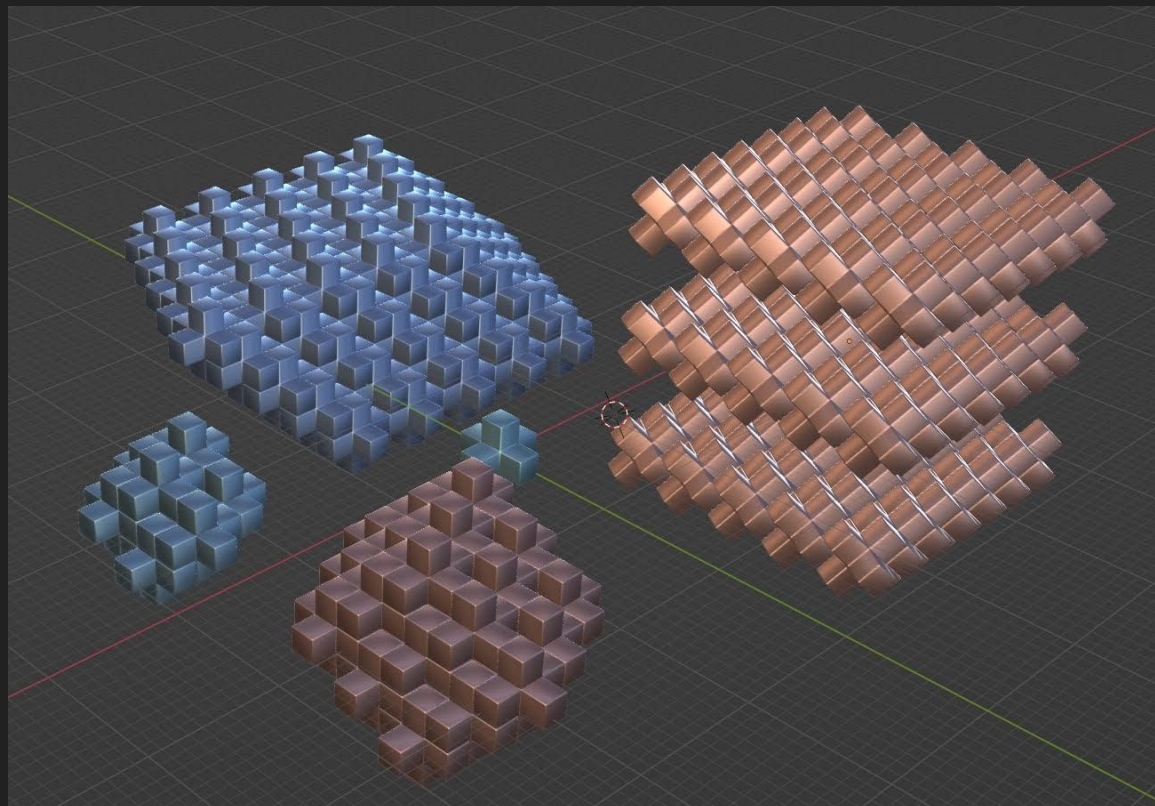
Der Raum



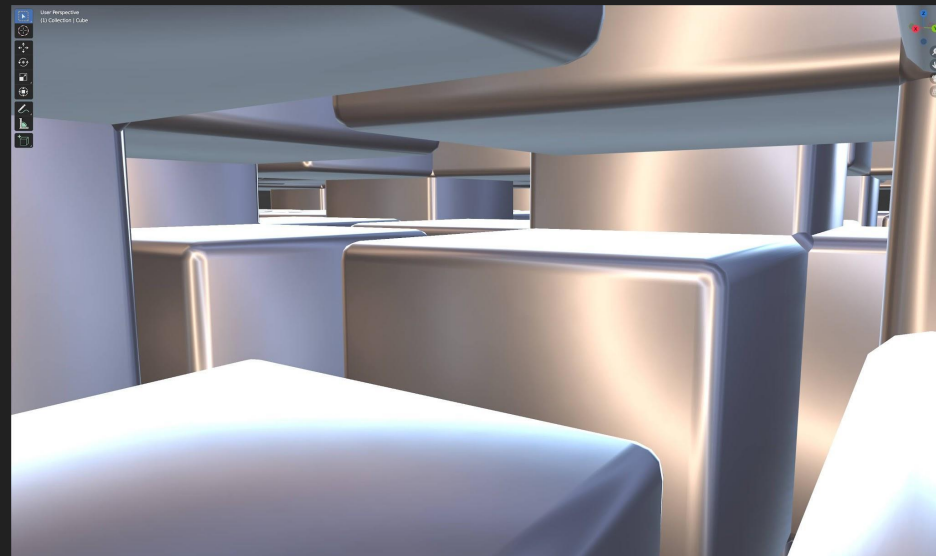
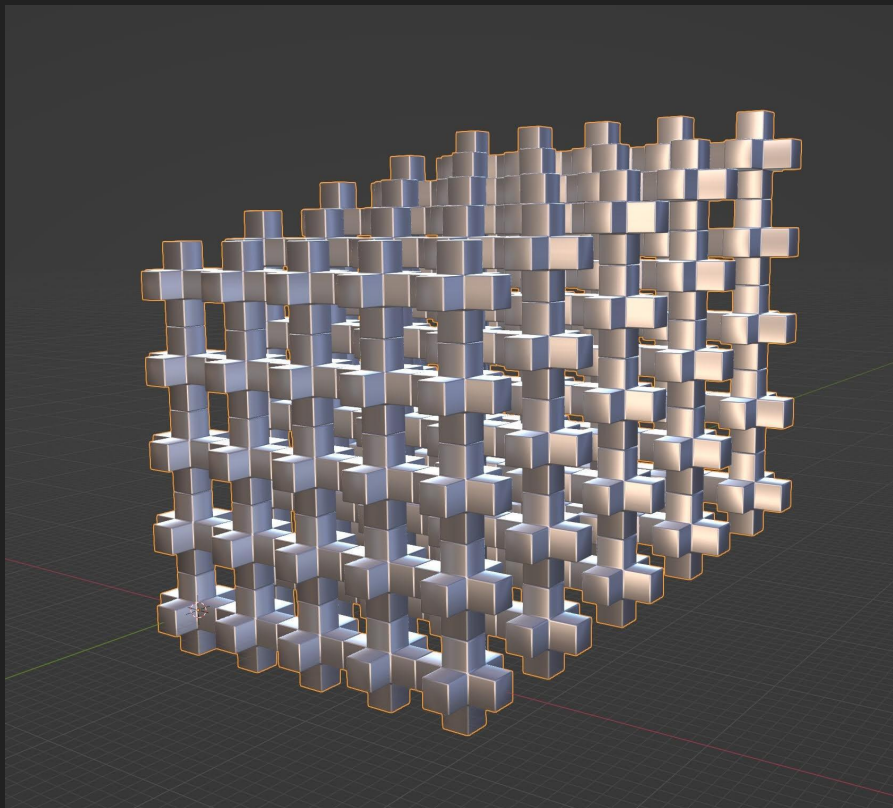
Herumprobieren



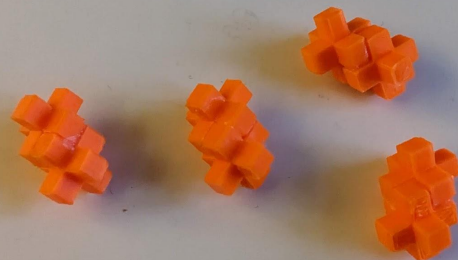
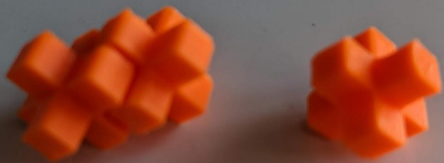
Herumprobieren



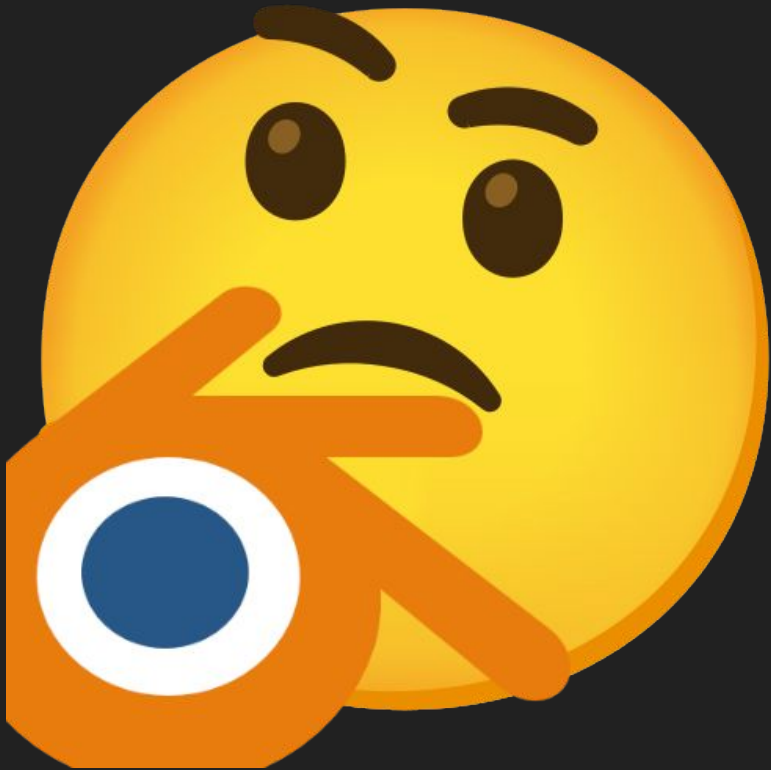
Herumprobierereeren



Hilft anfassen?

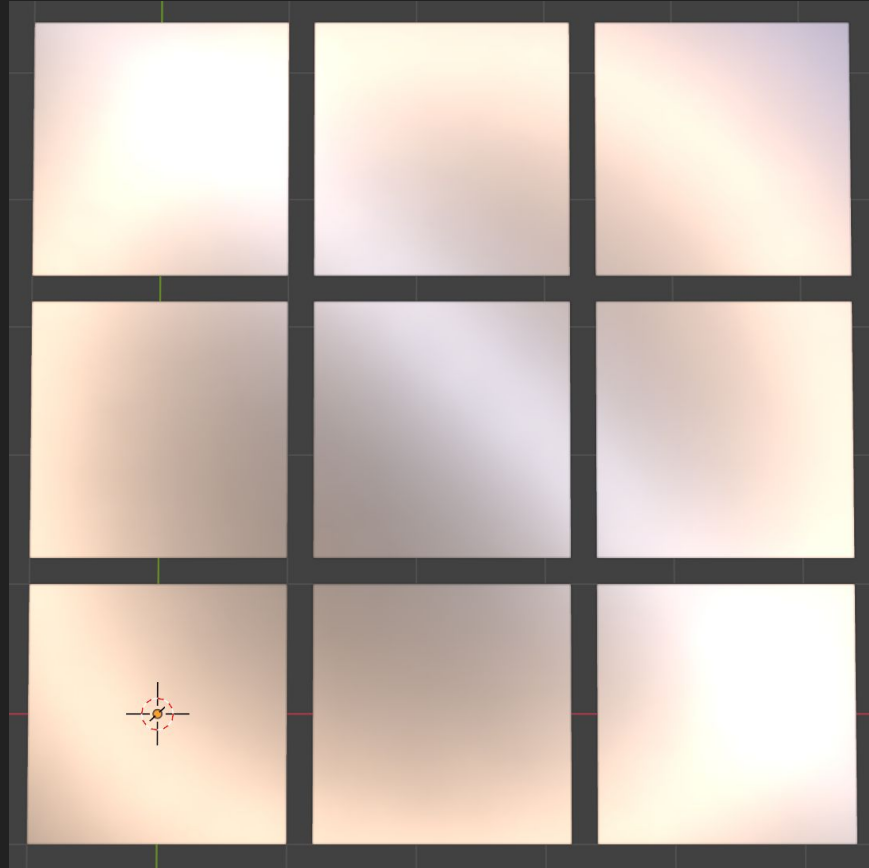


Beweisen?

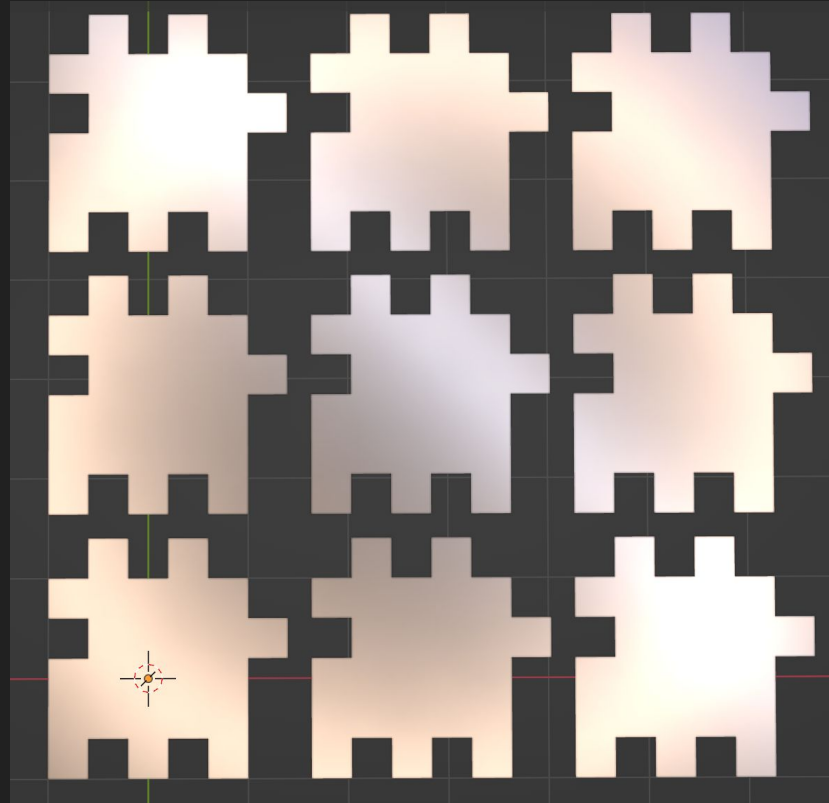


Quader teilen den Raum

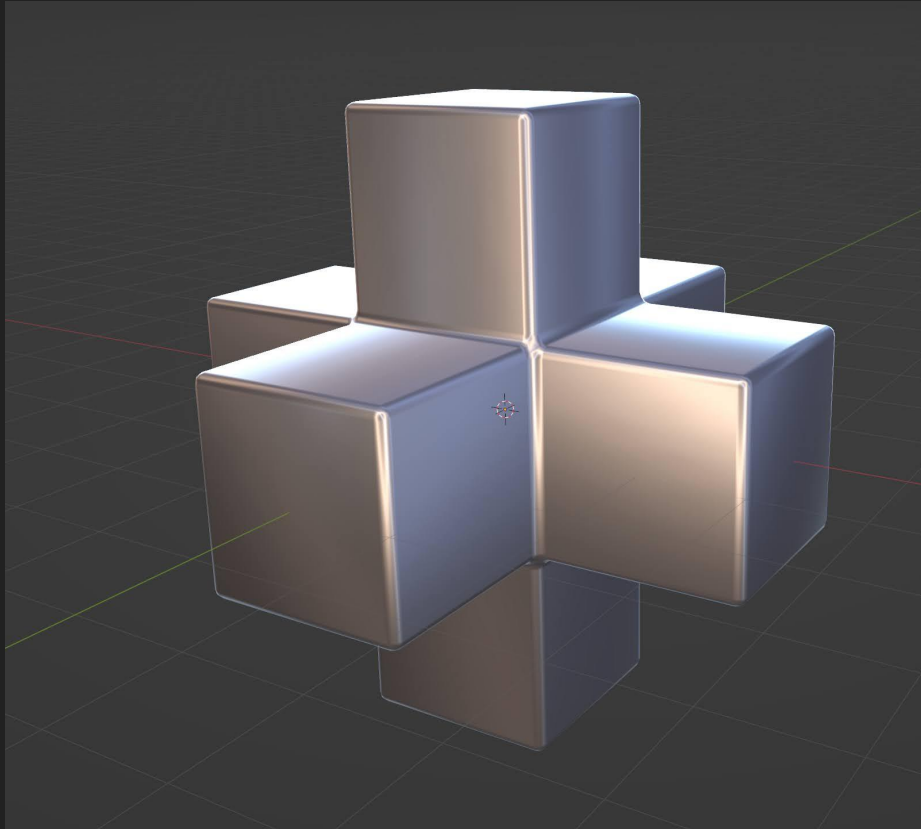
Quelle: Minecraft



Legosteine



Quader Kandidaten: Volumen



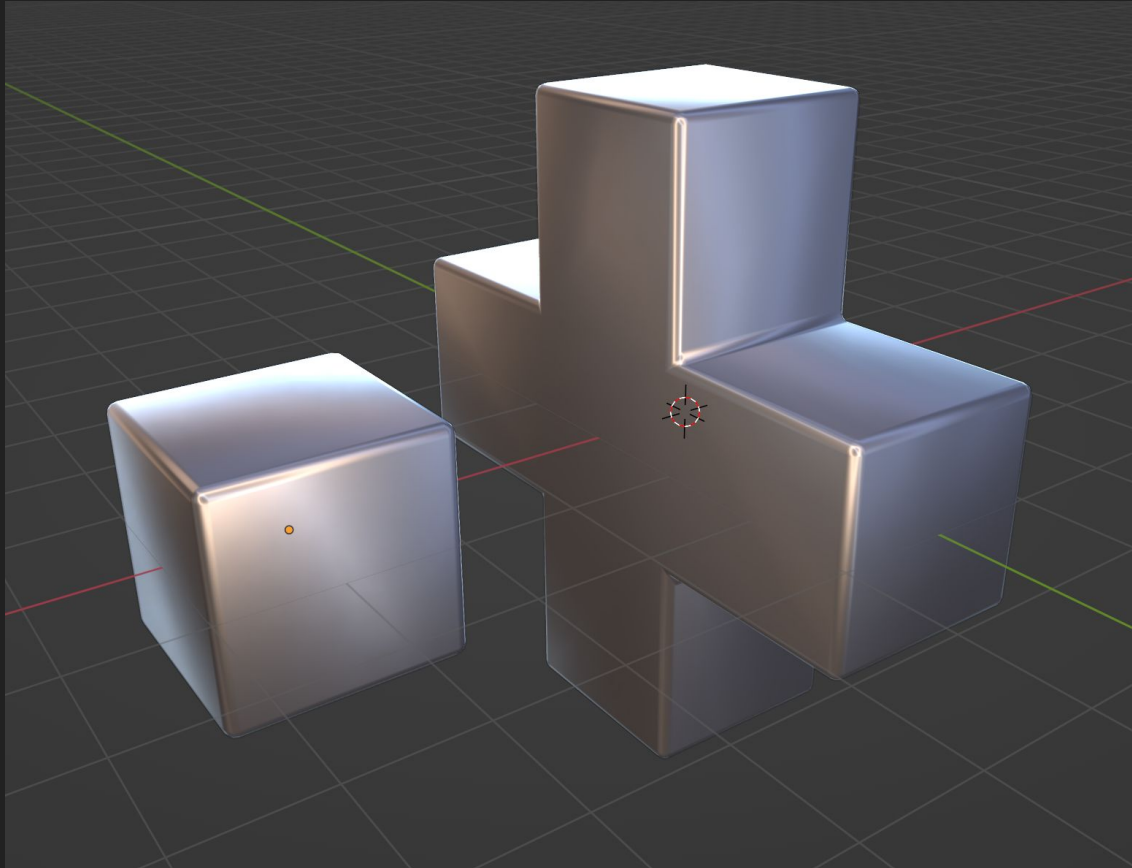
$$V = x * y * z$$

$$7 \mid V$$

7 is prime :)

$$\exists d \in \{x, y, z\} . 7 \mid d$$

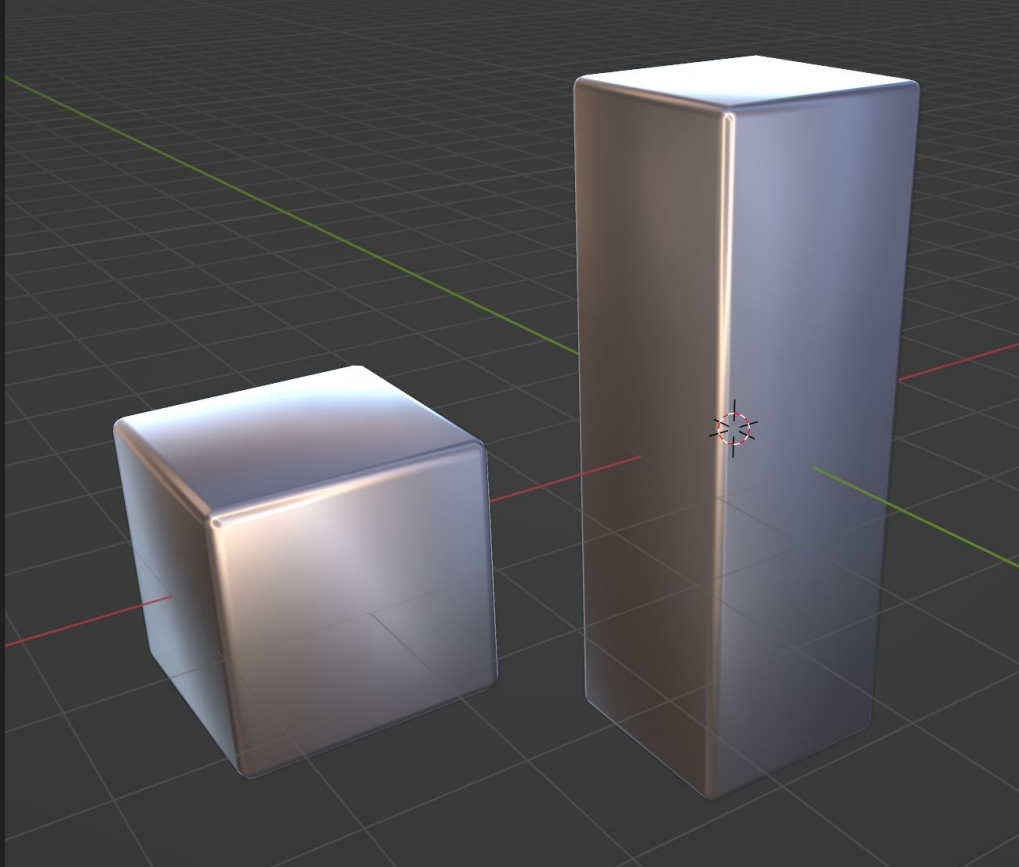
Quader Kandidaten: Schichten



$$A \in \{x * y, y * z, x * z\}$$

$$A \geq 5$$

Quader Kandidaten: Längen

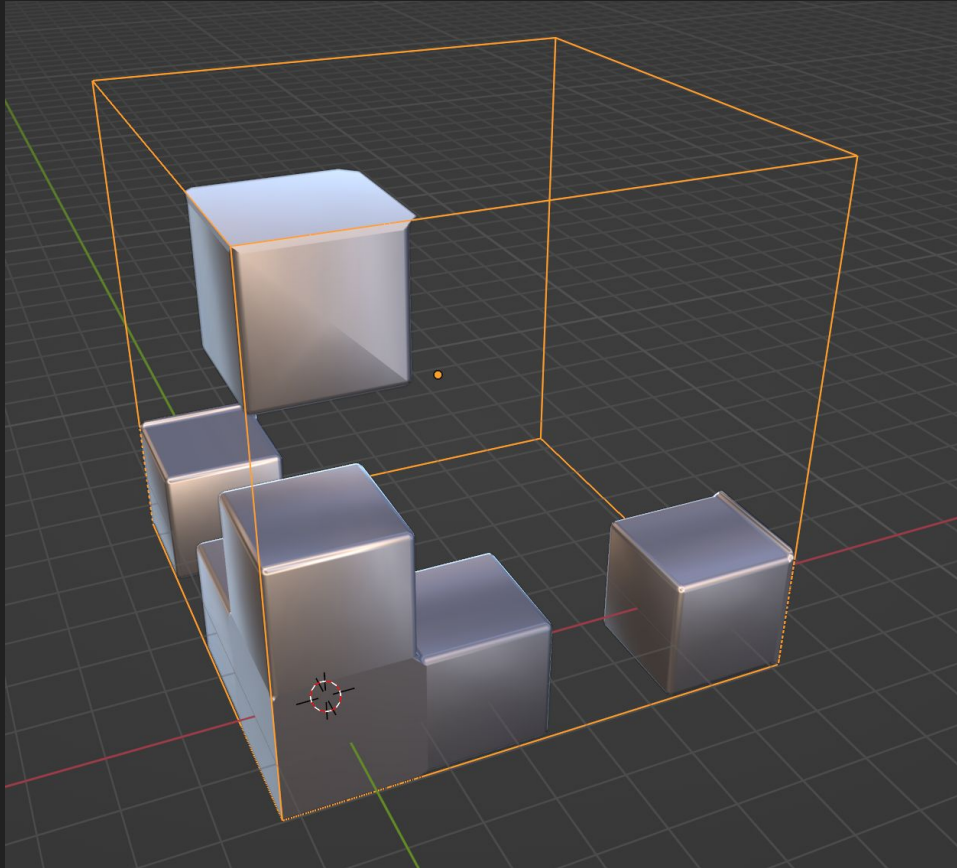


$$x, y, z \geq 3$$

Quader Kandidaten: Beispielwerte

```
[  
  [7, 3, 3],  
  [7, 4, 3], [7, 4, 4],  
  [7, 5, 3], [7, 5, 4], [7, 5, 5],  
  [7, 6, 3], [7, 6, 4], [7, 6, 5], [7, 6, 6],  
  [7, 7, 3], [7, 7, 4], [7, 7, 5], [7, 7, 6], [7, 7, 7],  
];
```

Beispielplatzierung im Quader



Beispiel: $4 * 4 * 4$

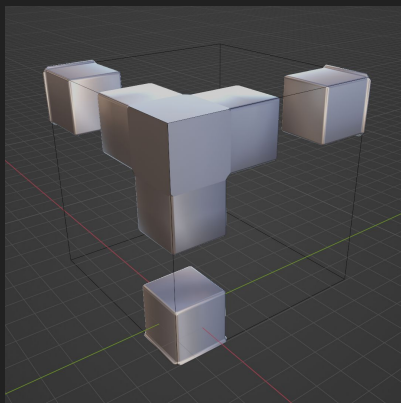
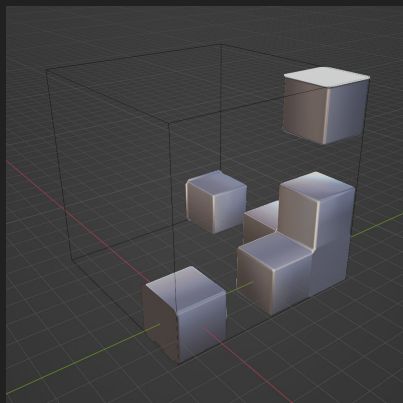
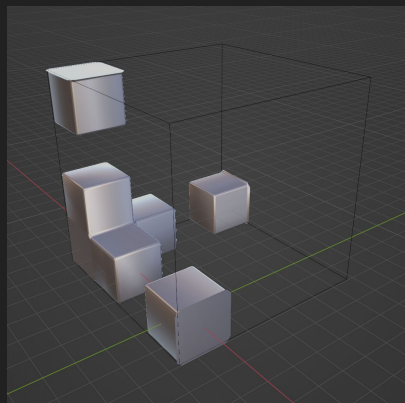
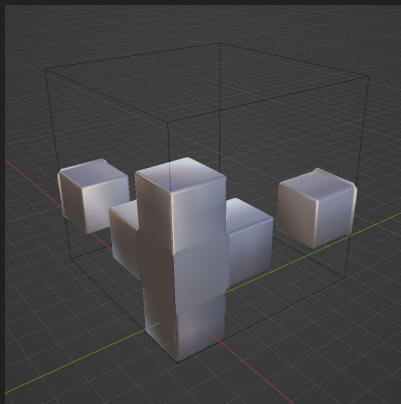
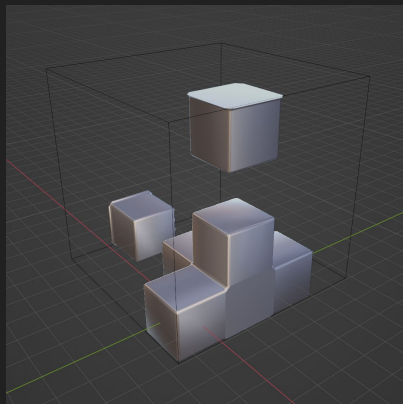
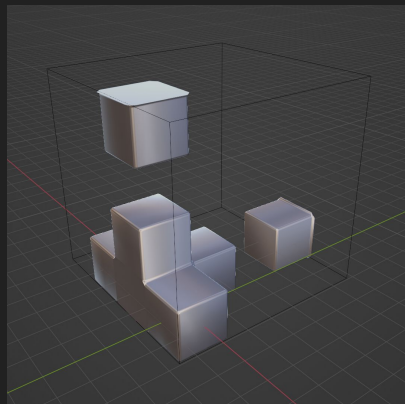
Plusmitte: $(0, 0, 0)$

Dazu belegte Zellen:

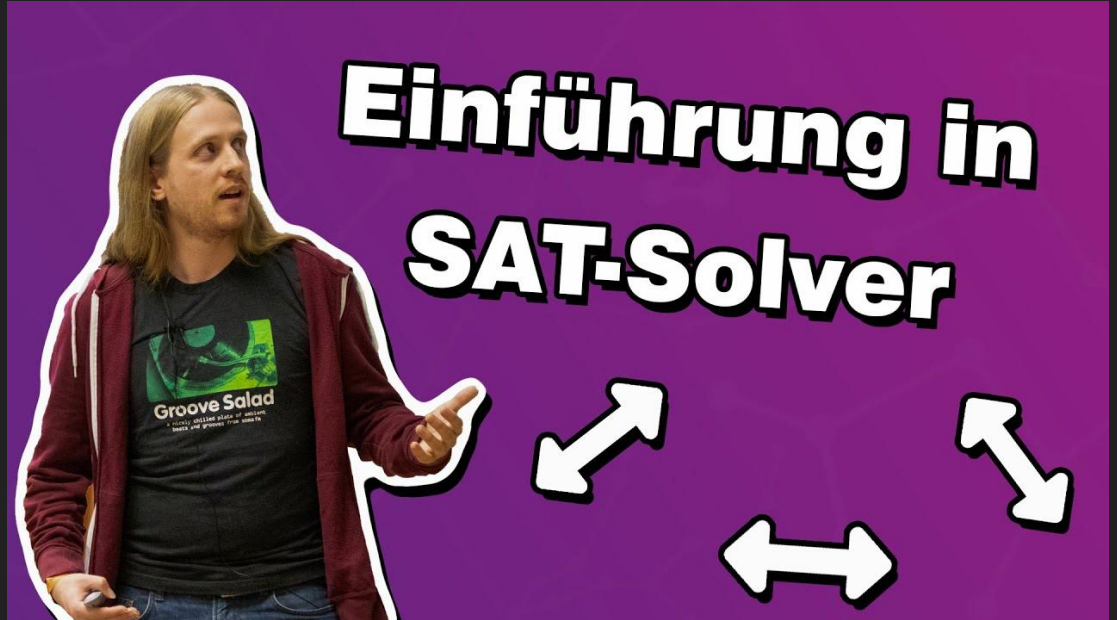
$(1,0,0), (0,1,0), (0,0,1),$

$(3,0,0), (0,3,0), (0,0,3)$

Beispielkollisionen zu $(0,0,0)$



Talkempfehlung



<https://media.ccc.de/v/einfuehrung-in-sat-solver-1>

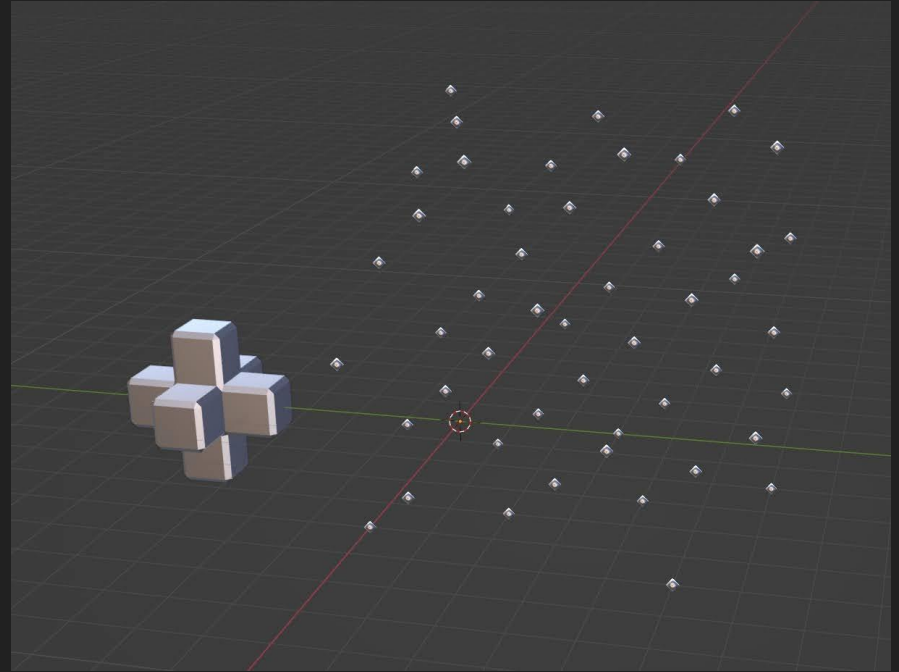
Wir brauchen genau eins

- Für SAT solver brauchen wir
 - eine Konjunktion (\wedge) von Disjunktionen (\vee) von Literalen ($a, \neg a$)
- Mindestens eins
 - $a \vee b \vee c$
- Höchstens eins
 - $a \rightarrow \neg b$
 - $\neg a \vee \neg b$

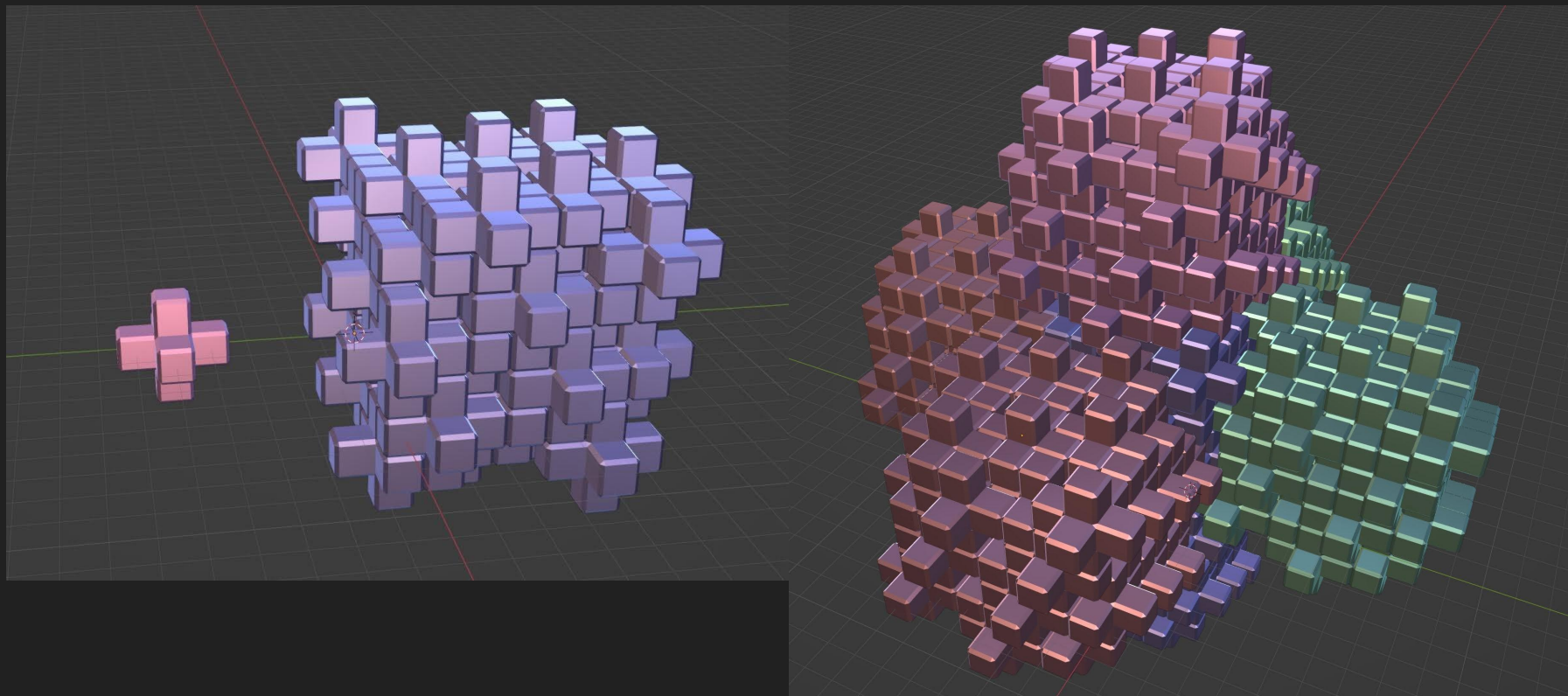
Was kommt raus?

```
{
  names: [
    '[0,0,6]', '[0,1,4]', '[0,2,2]', '[0,3,0]',
    '[0,4,5]', '[0,5,3]', '[0,6,1]', '[1,0,2]',
    '[1,1,0]', '[1,2,5]', '[1,3,3]', '[1,4,1]',
    '[1,5,6]', '[1,6,4]', '[2,0,5]', '[2,1,3]',
    '[2,2,1]', '[2,3,6]', '[2,4,4]', '[2,5,2]',
    '[2,6,0]', '[3,0,1]', '[3,1,6]', '[3,2,4]',
    '[3,3,2]', '[3,4,0]', '[3,5,5]', '[3,6,3]',
    '[4,0,4]', '[4,1,2]', '[4,2,0]', '[4,3,5]',
    '[4,4,3]', '[4,5,1]', '[4,6,6]', '[5,0,0]',
    '[5,1,5]', '[5,2,3]', '[5,3,1]', '[5,4,6]',
    '[5,5,4]', '[5,6,2]', '[6,0,3]', '[6,1,1]',
    '[6,2,6]', '[6,3,4]', '[6,4,2]', '[6,5,0]',
    '[6,6,5]'
  ]
}
```

mushu@flame-princess:~/dev/2023-01-06.sat-experiment\$



Was kommt raus?



Was kommt raus?

