

Yet another heuristic for
cograph editing

K. Hainke, N. Wieseke, M. Bernt

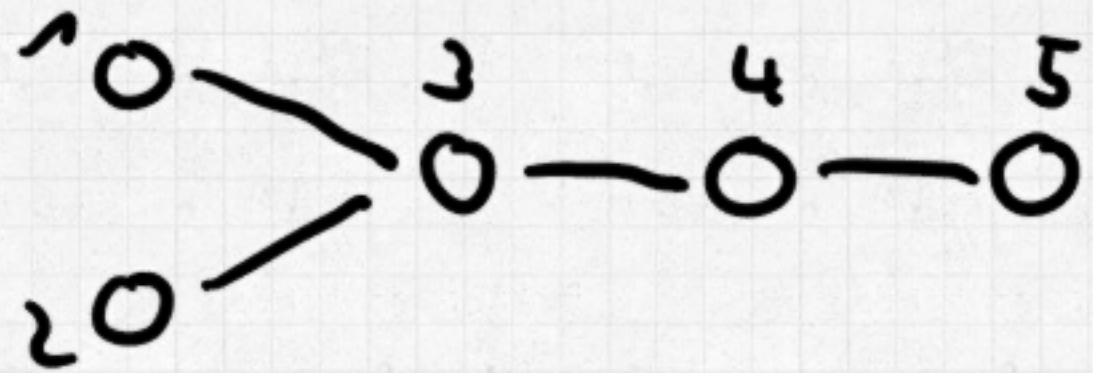
Parallel Algorithms Complex Systems Group
University of Leipzig

Intro ●○

Heuristic ○○○

Results ○○○○○○○○

Co-graph Editing



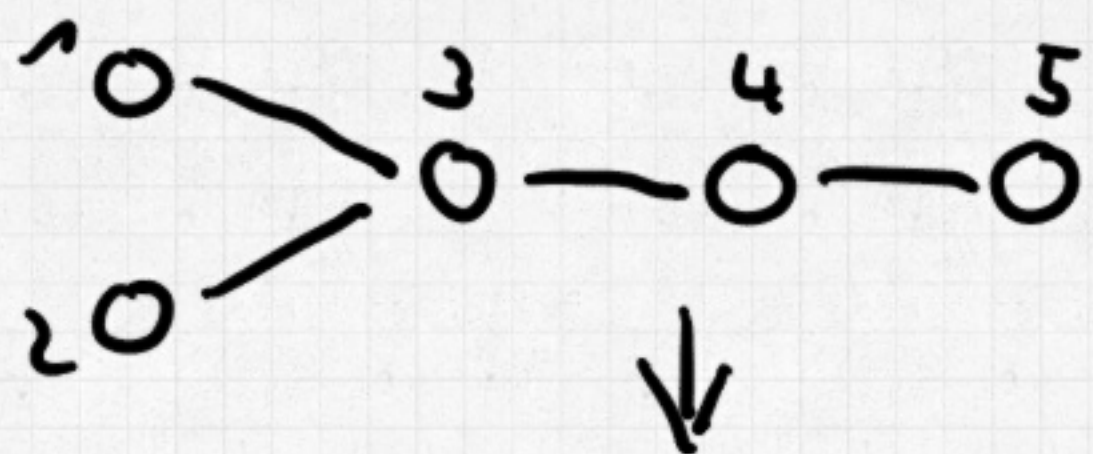
arbitrary graph

Intro ●○

Heuristic ○○○

Results ○○○○○○○○

Cograph Editing



$$\{(3,4)\} = S$$

arbitrary graph

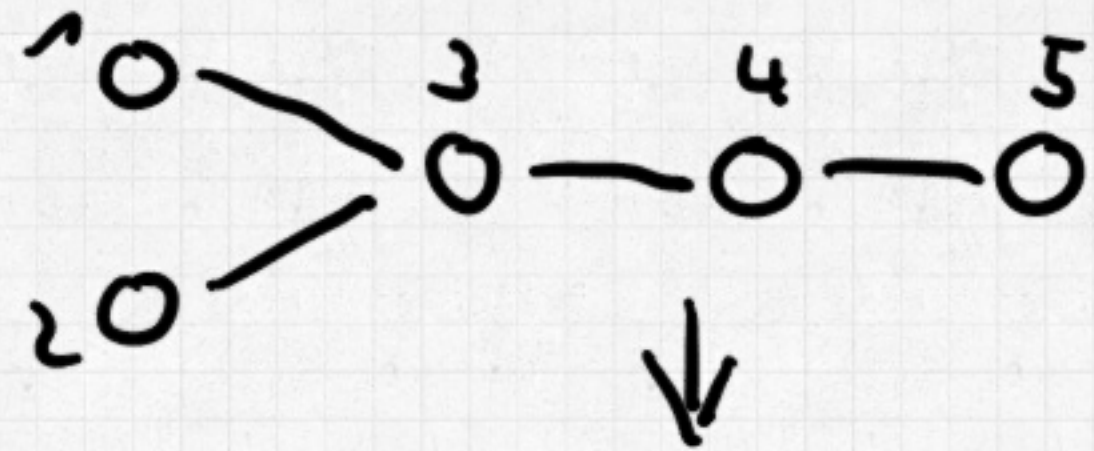
set of edge modifications

Intro ●○

Heuristic ○○○

Results ○○○○○○○○

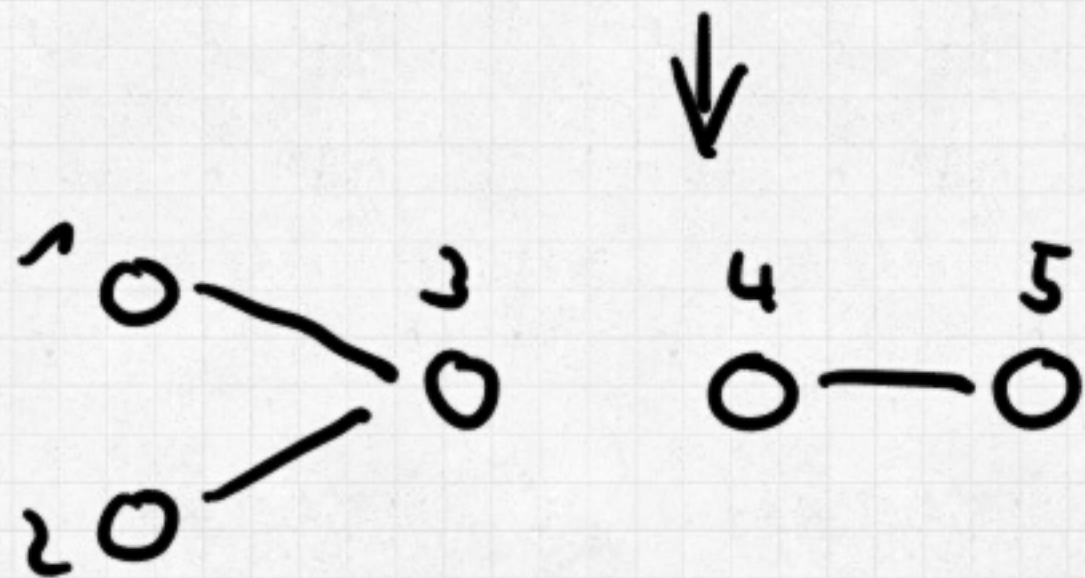
Cograph Editing



arbitrary graph

$$\{(3,4)\} = S$$

set of edge modifications



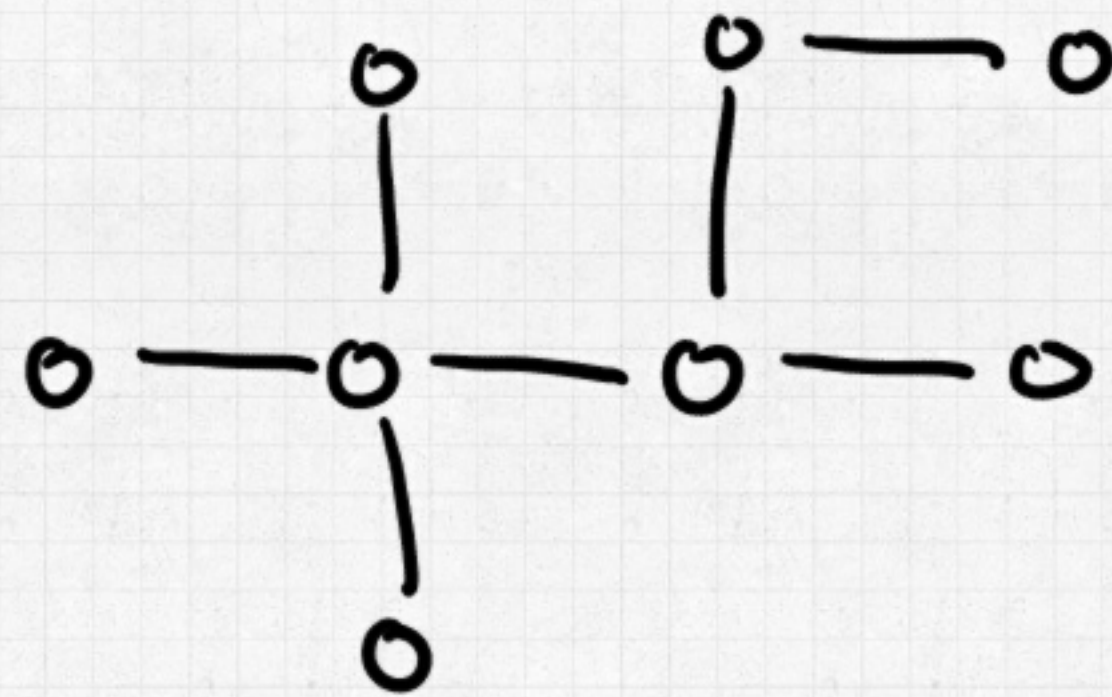
cograph

Intro ○●

Heuristic ○○○

Results ○○○○○○○○

Cographs did not contain induced paths of
length 4

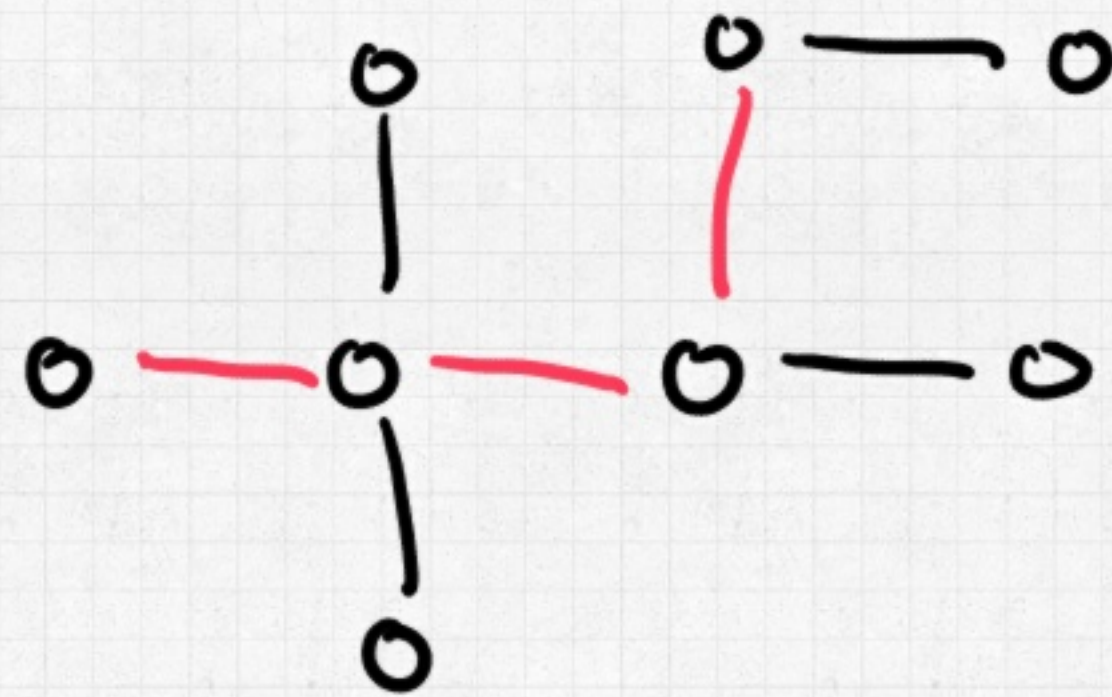


Intro ○●

Heuristic ○○○

Results ○○○○○○○○

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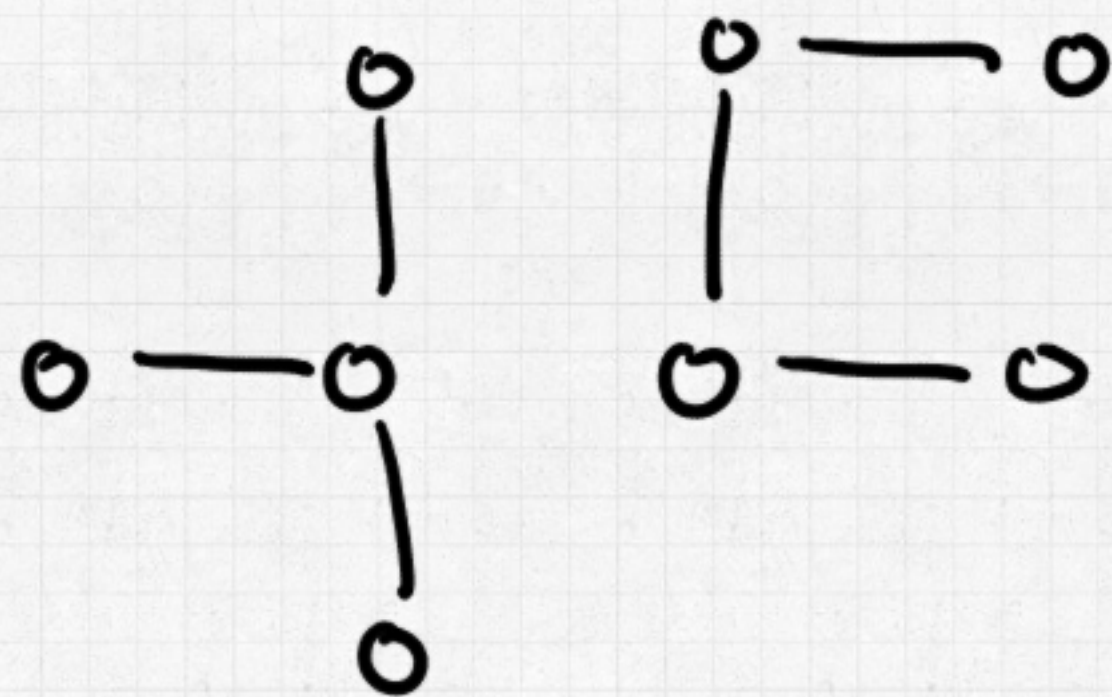


Intro ○●

Heuristic ○○○

Results ○○○○○○○○

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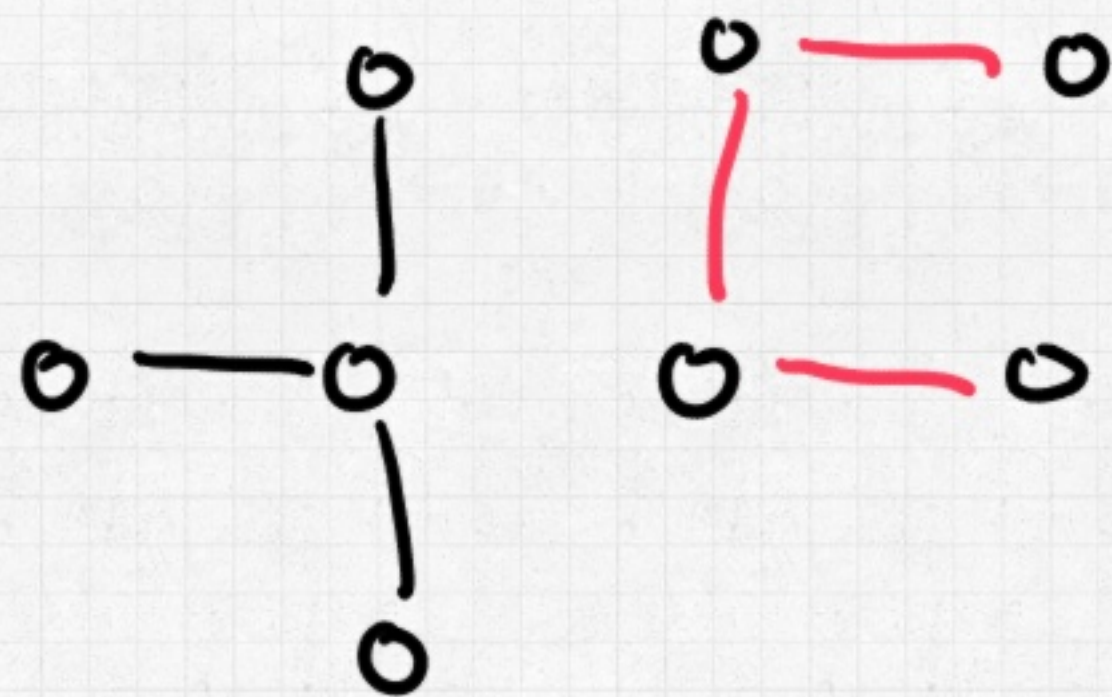


Intro ○●

Heuristic ○○○

Results ○○○○○○○○

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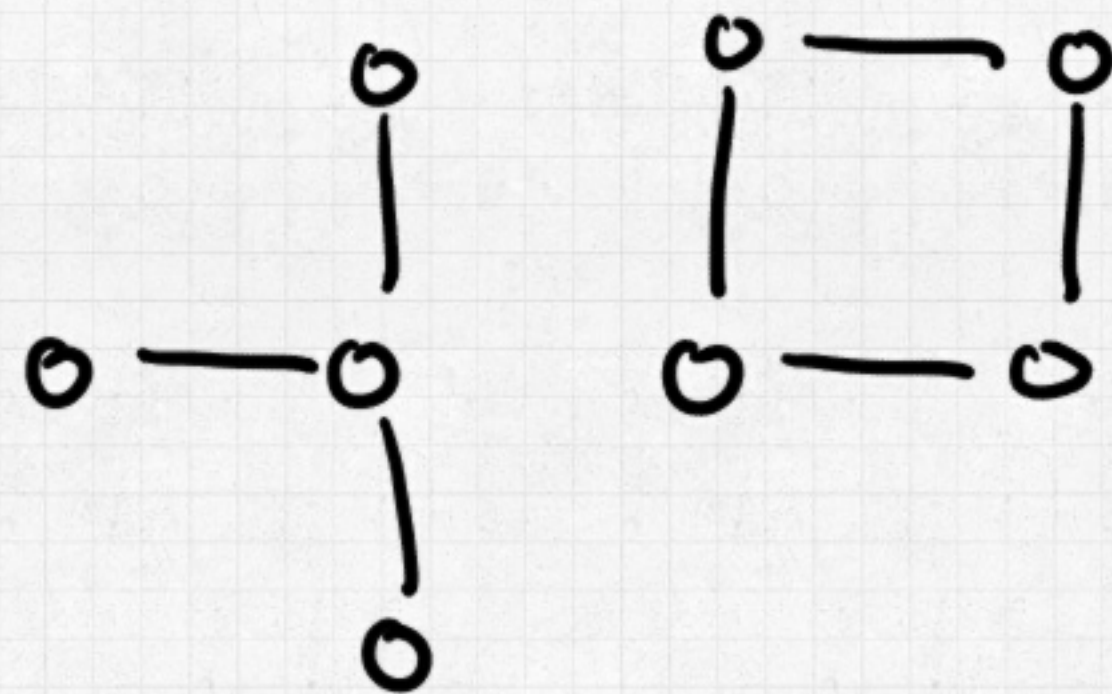


Intro ○●

Heuristic ○○○

Results ○○○○○○○○

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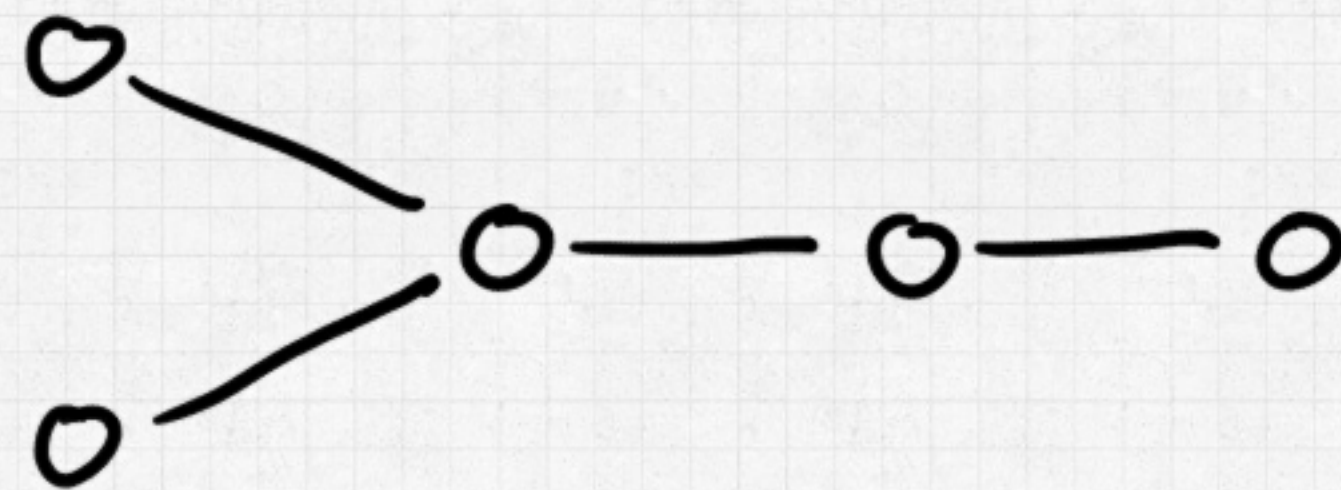
Intro ○○

Heuristic ●○○

Results ○○○○○○○○

Greedy Strategy

□ modify edges first that belong to many P_4 s



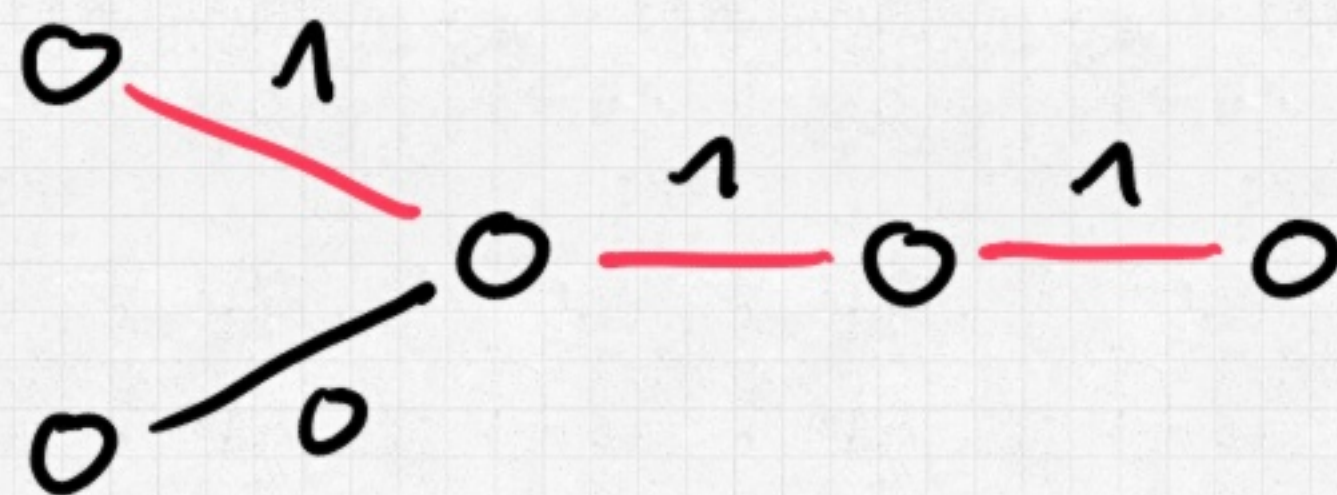
Intro OO

Heuristic ●OO

Results OOOOOOOOO

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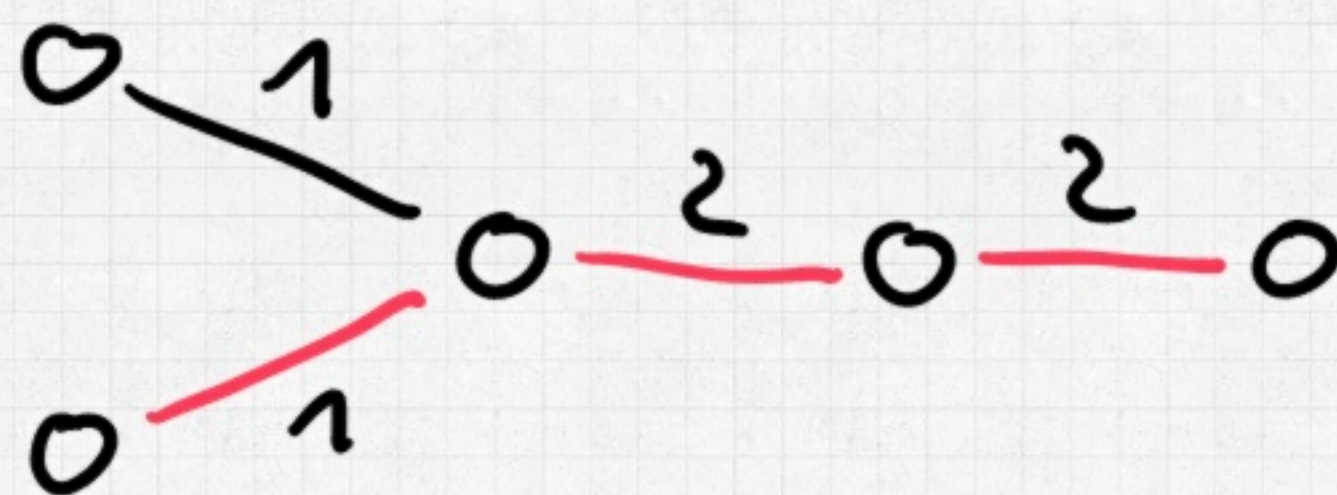
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Heuristic ●OO

Results OOOOOOOOO

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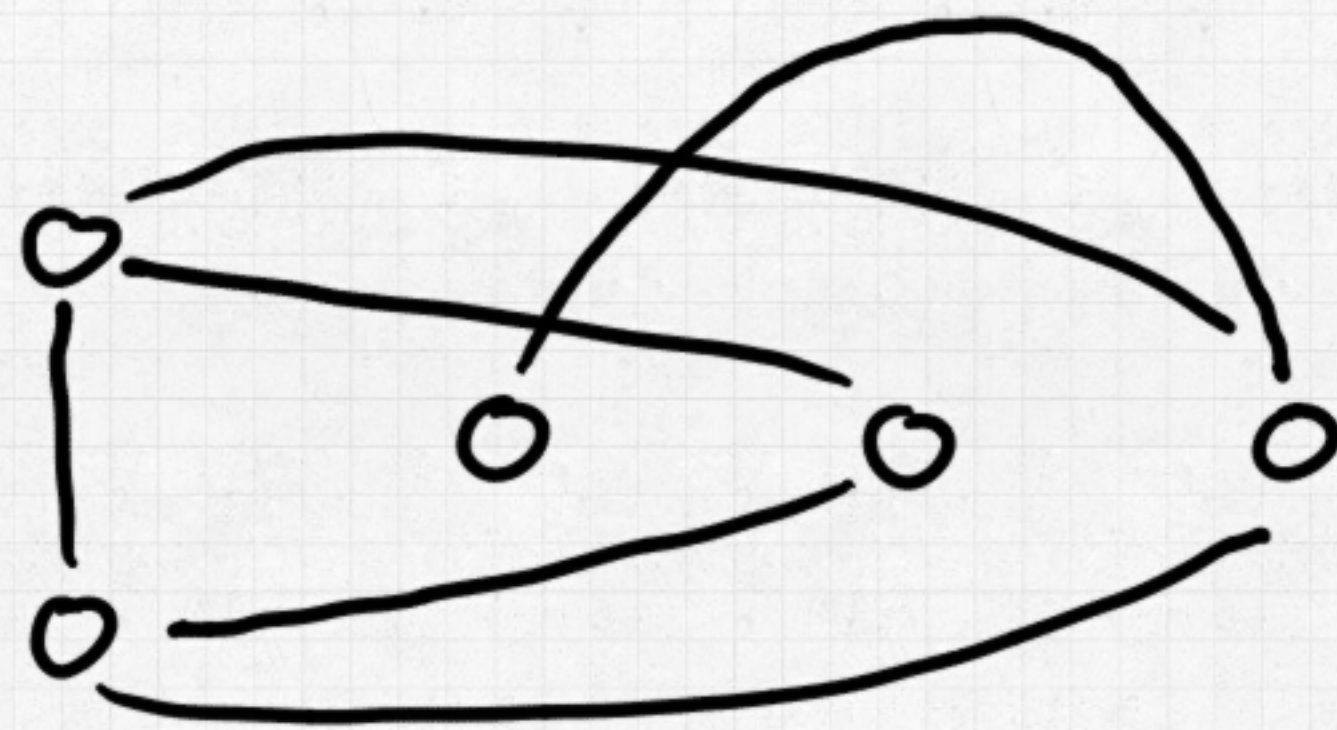
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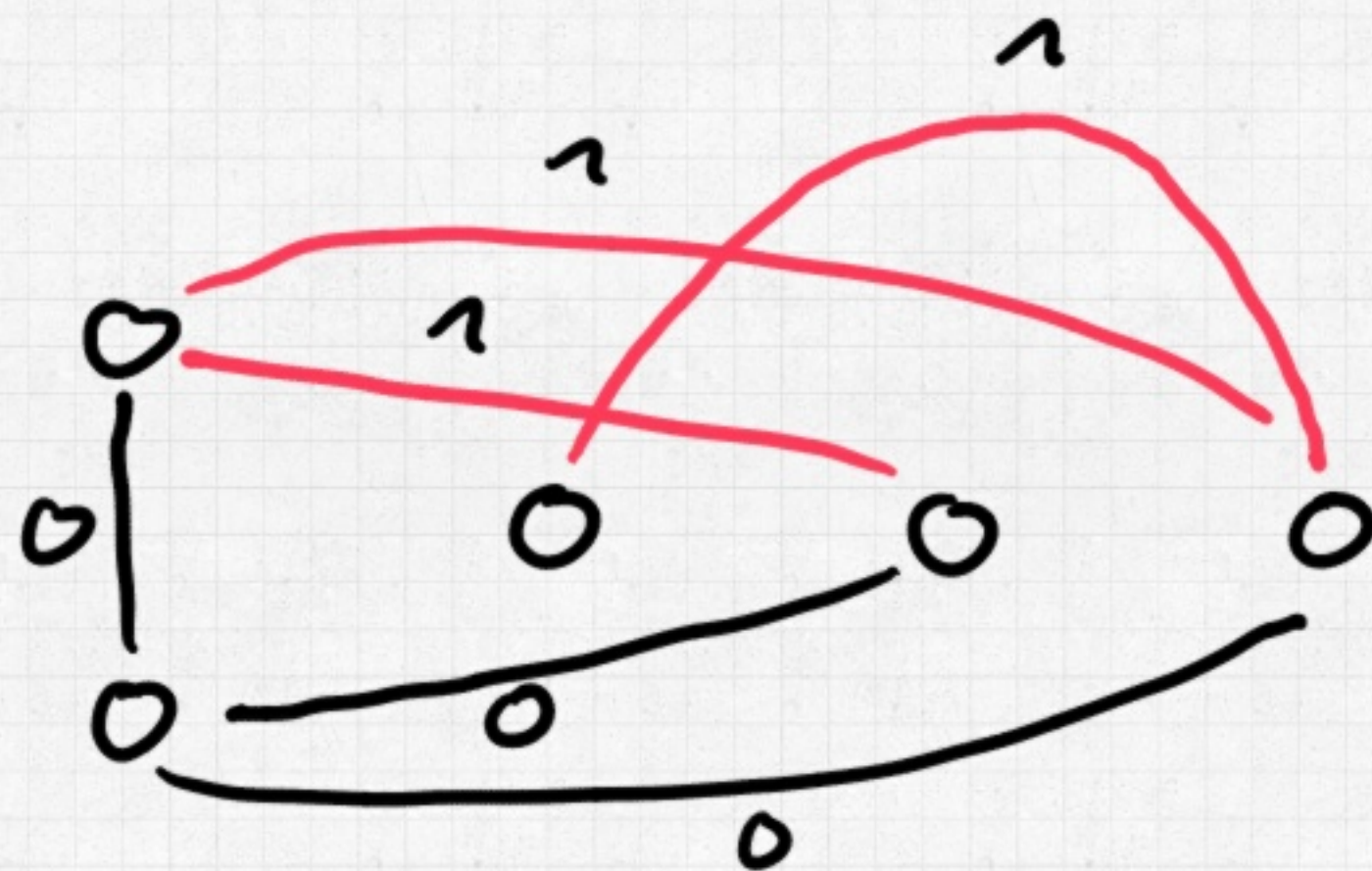
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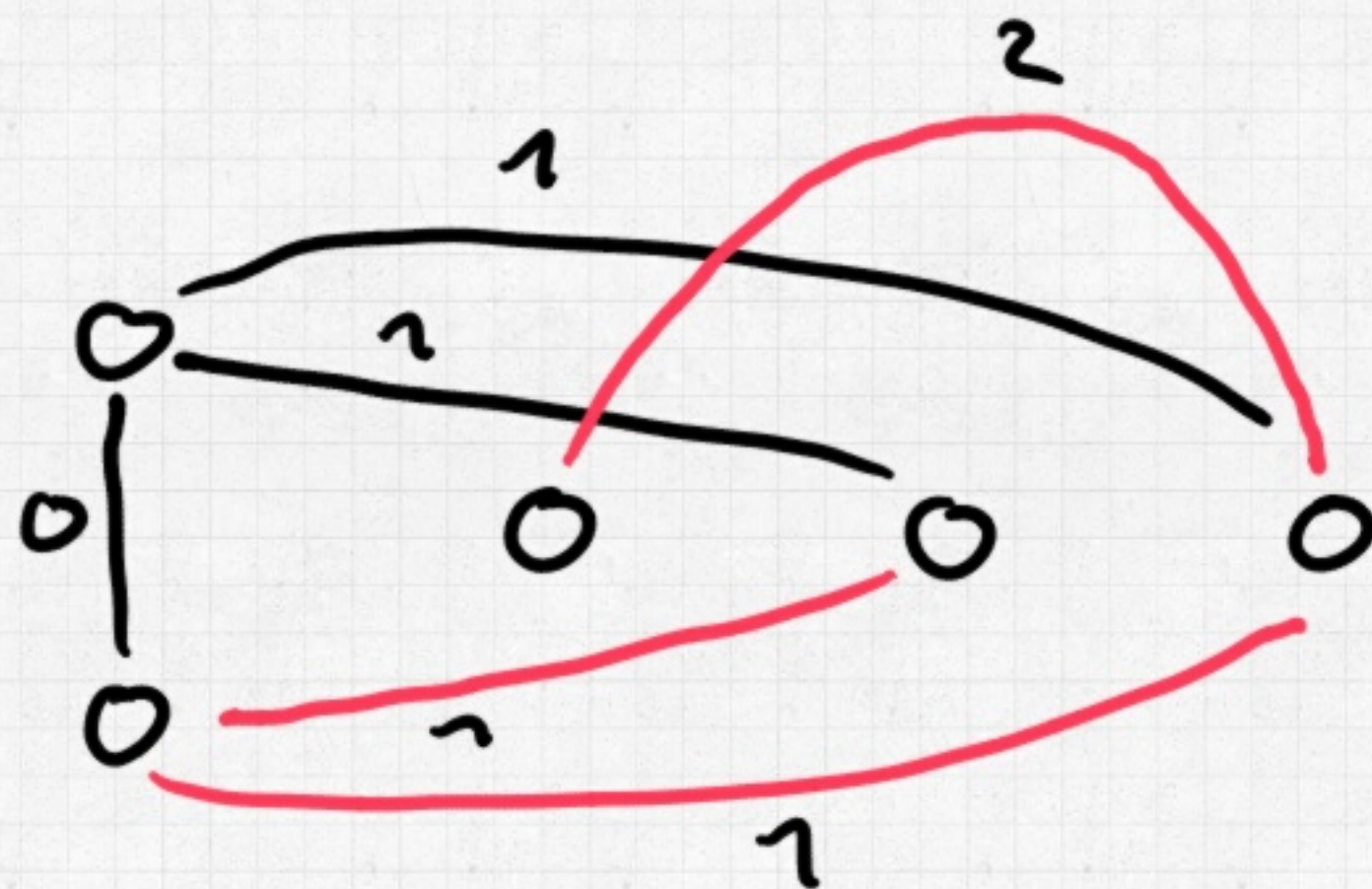
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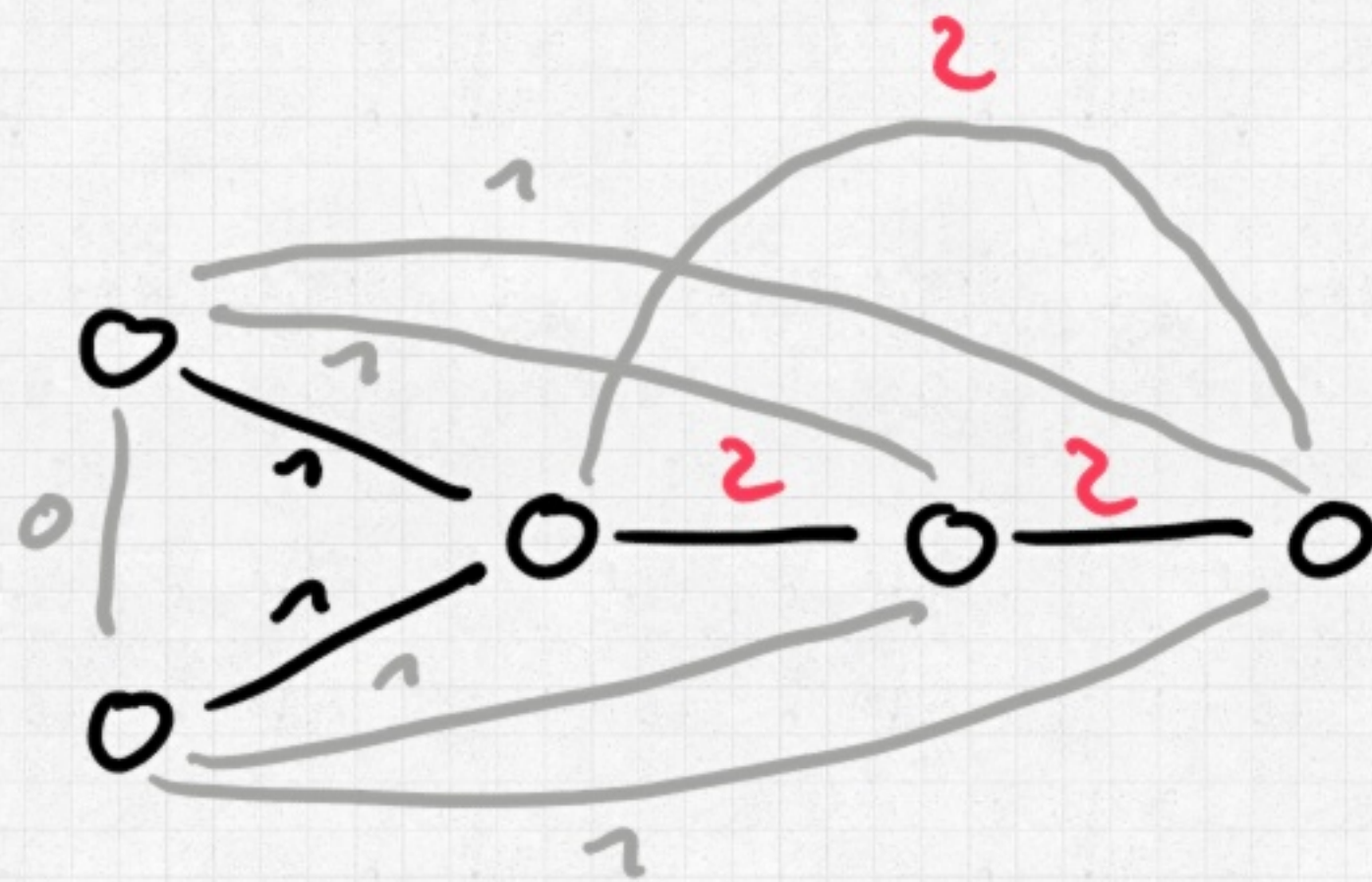
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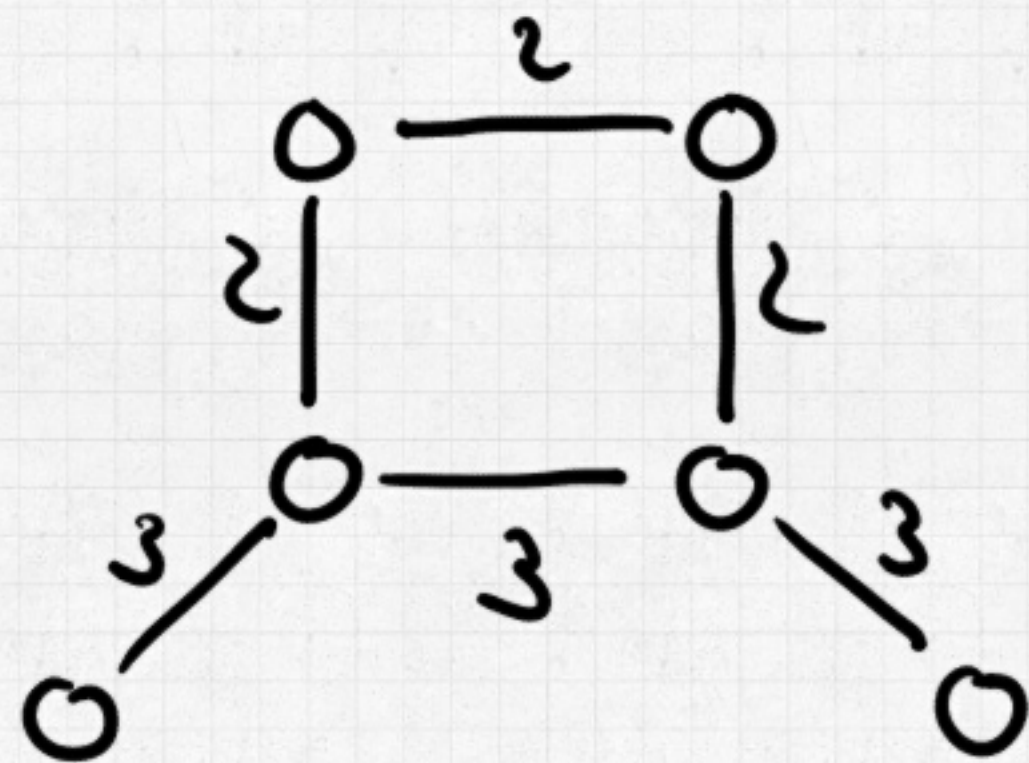
Intro ○○

Heuristic ○●○

Results ○○○○○○○○

Greedy Strategy

- modify edges first that belong to many P_4 s
- and that create few new P_4 s



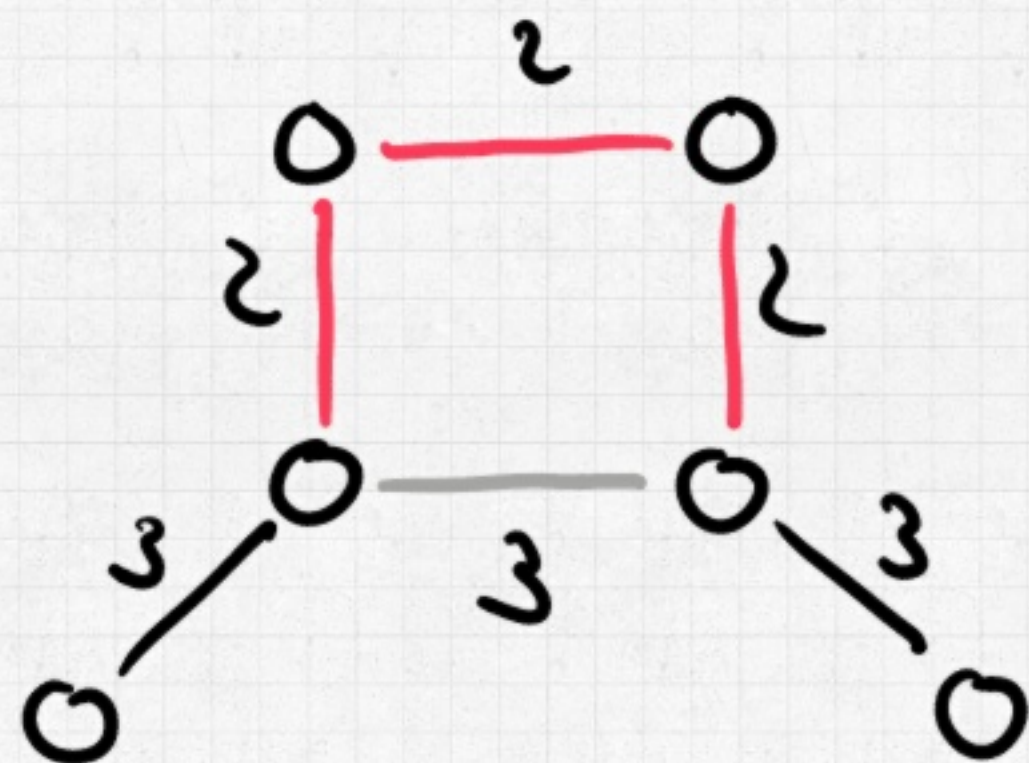
Intro ○○

Heuristic ○●○

Results ○○○○○○○○

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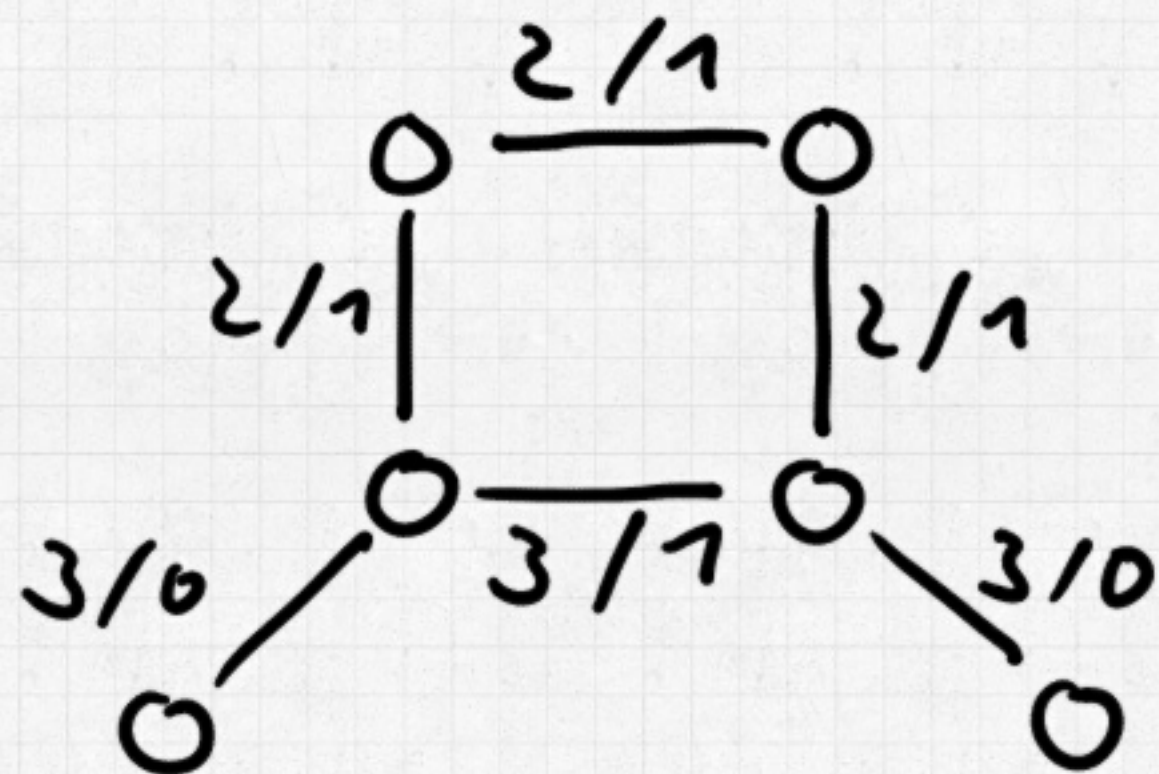
Intro ○○

Heuristic ○●○

Results ○○○○○○○○

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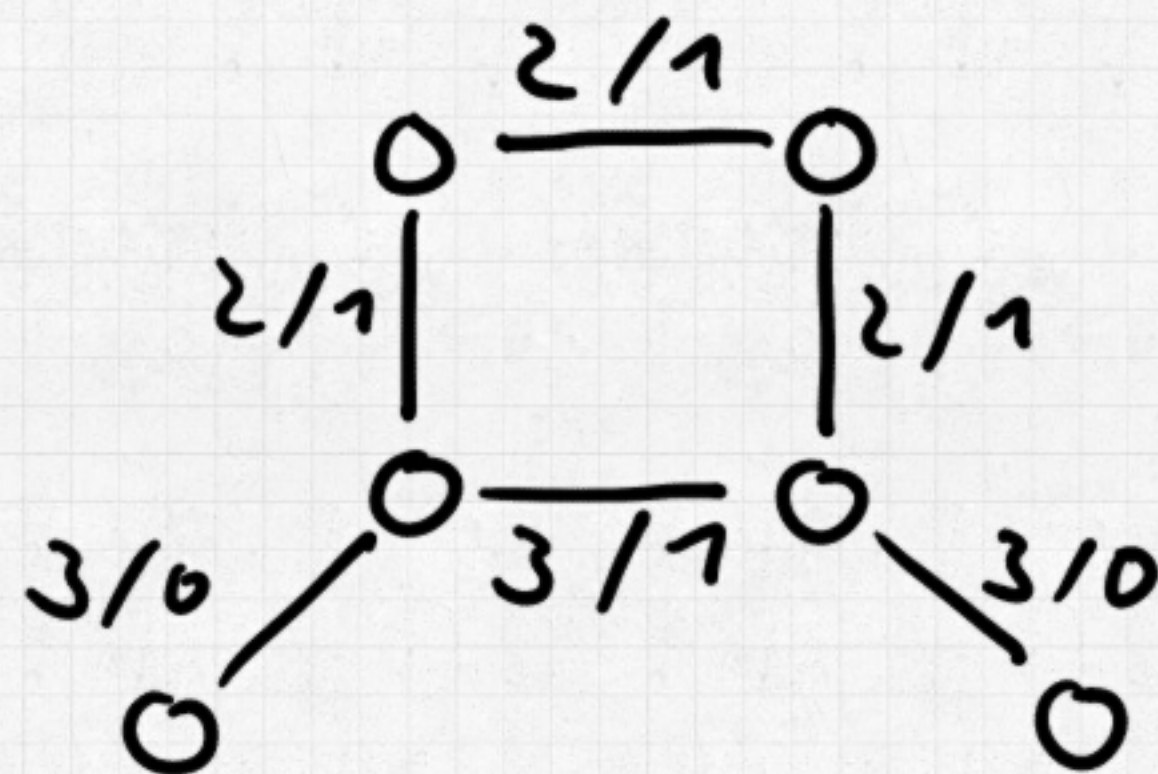
Intro OO

Heuristic O●O

Results OOOOOOOOO

Greedy Strategy

- modify edges first that belong to many P_4 s
- and that create few new P_4 s



$$\begin{aligned} \delta^-(x,y) &, x,y \in V \\ &= \# P_4s \text{ removed by } (x,y) \\ \delta^+(x,y) &, x,y \in V \\ &= \# P_4s \text{ created by } (x,y) \end{aligned}$$

Select (x,y) with maximum $\delta(x,y) = \delta^-(x,y) - \delta^+(x,y)$

Intro 00

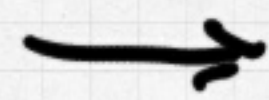
Heuristic 00●

Results 00000000

Runtime

□ Initialization: $O(n^4)$

□ Update: $O(n^2)$



$O(n^4 + k \cdot n^2)$

Intro 00

Heuristic 00●

Results 00000000

Runtime

□ Initialization: $O(n^4)$

□ Update: $O(n^2)$

→ $O(n^4 + k \cdot n^2)$

Drawbacks

□ did not terminate

□ restriction to 1 modification per edge

did not help

Intro 00

Heuristic 00●

Results 00000000

Runtime

□ Initialization: $O(n^4)$

□ Update: $O(n^2)$

→ $O(n^4 + k \cdot n^2)$

Drawbacks

□ did not terminate

□ restriction to 1 modification per edge

did not help

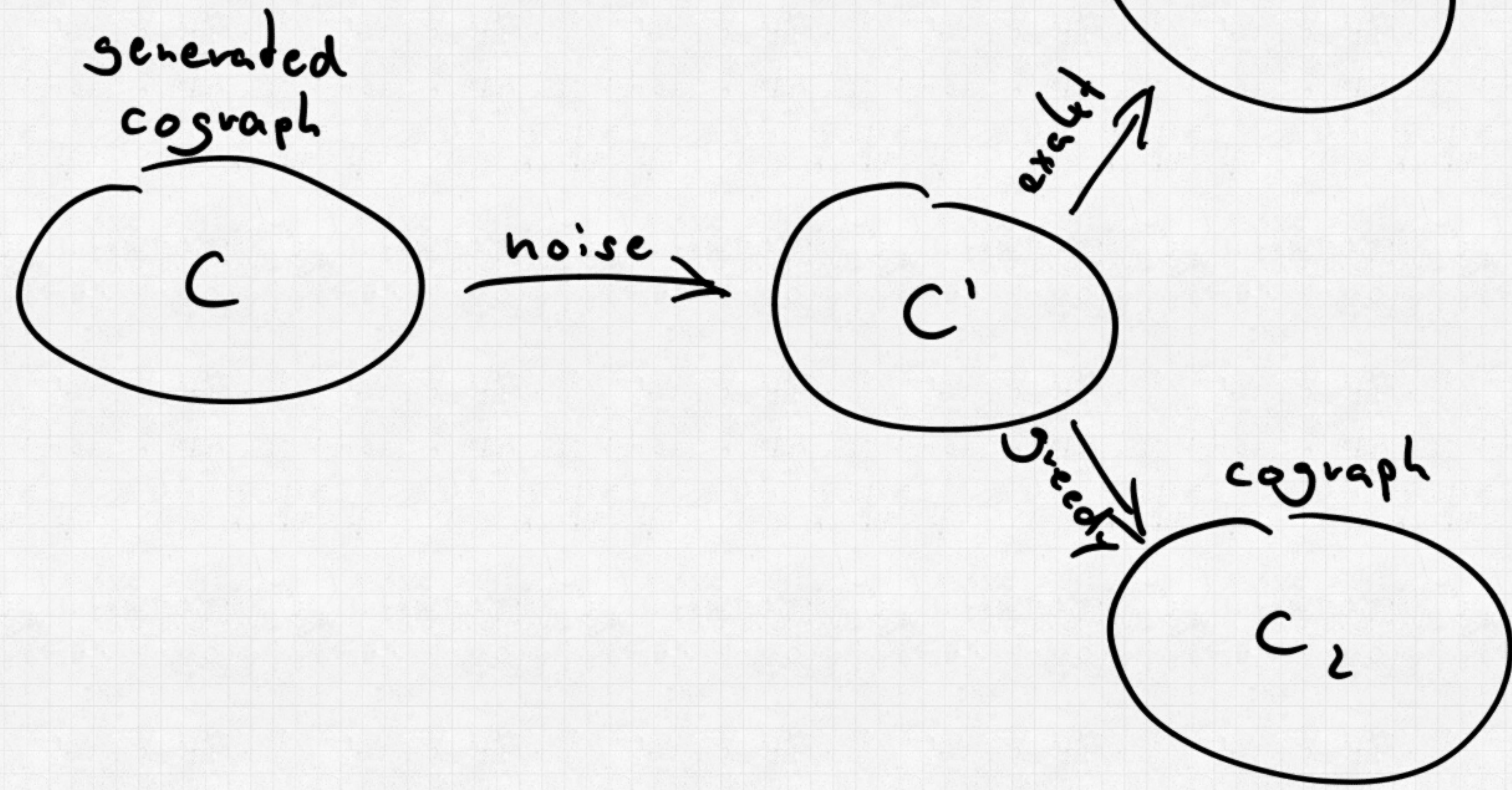
Workaround: allow 2nd modification of an edge

only if it is a deletion

Intro OO

Heuristic OOO

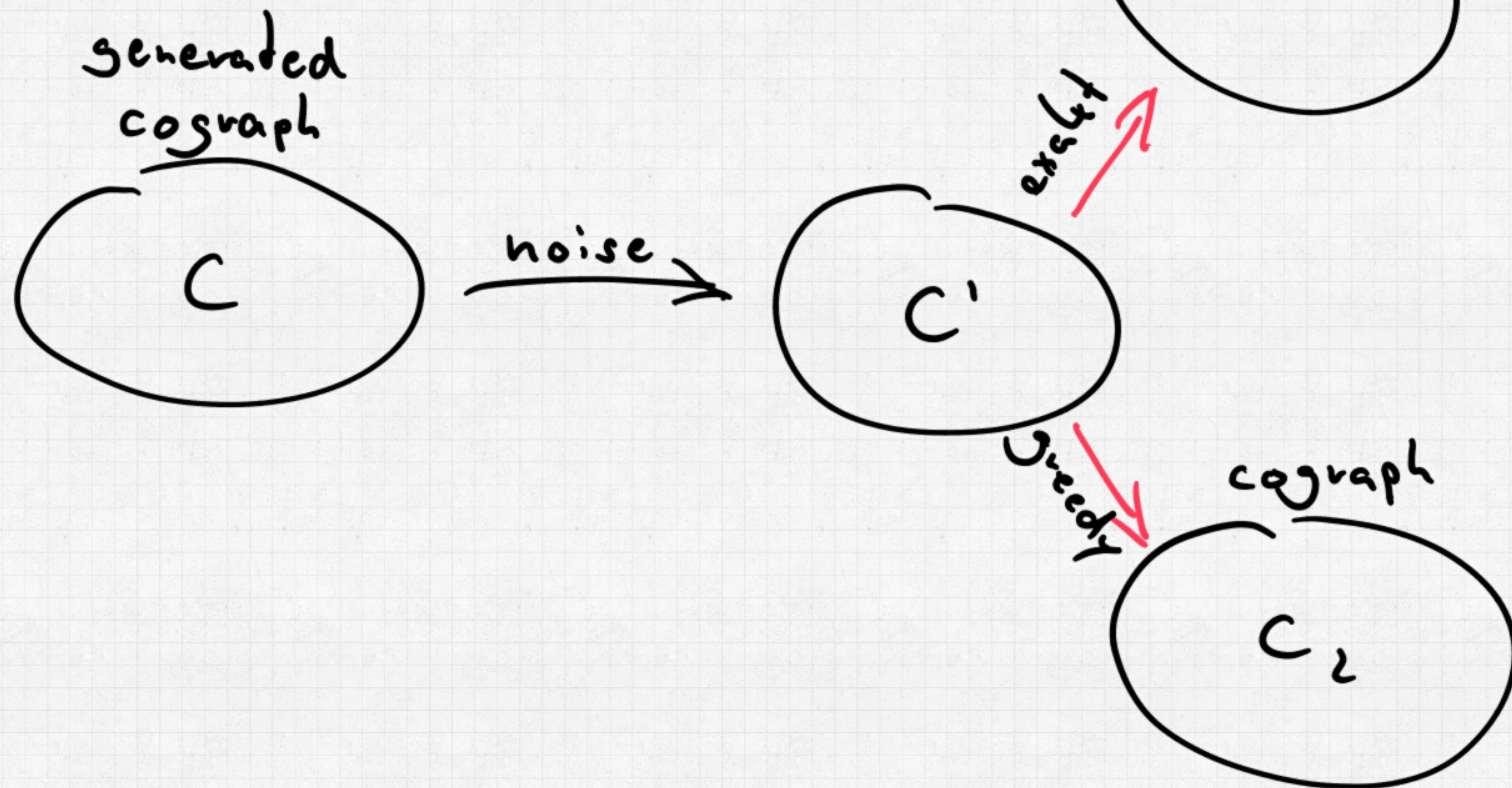
Results ●OOOOOOOO



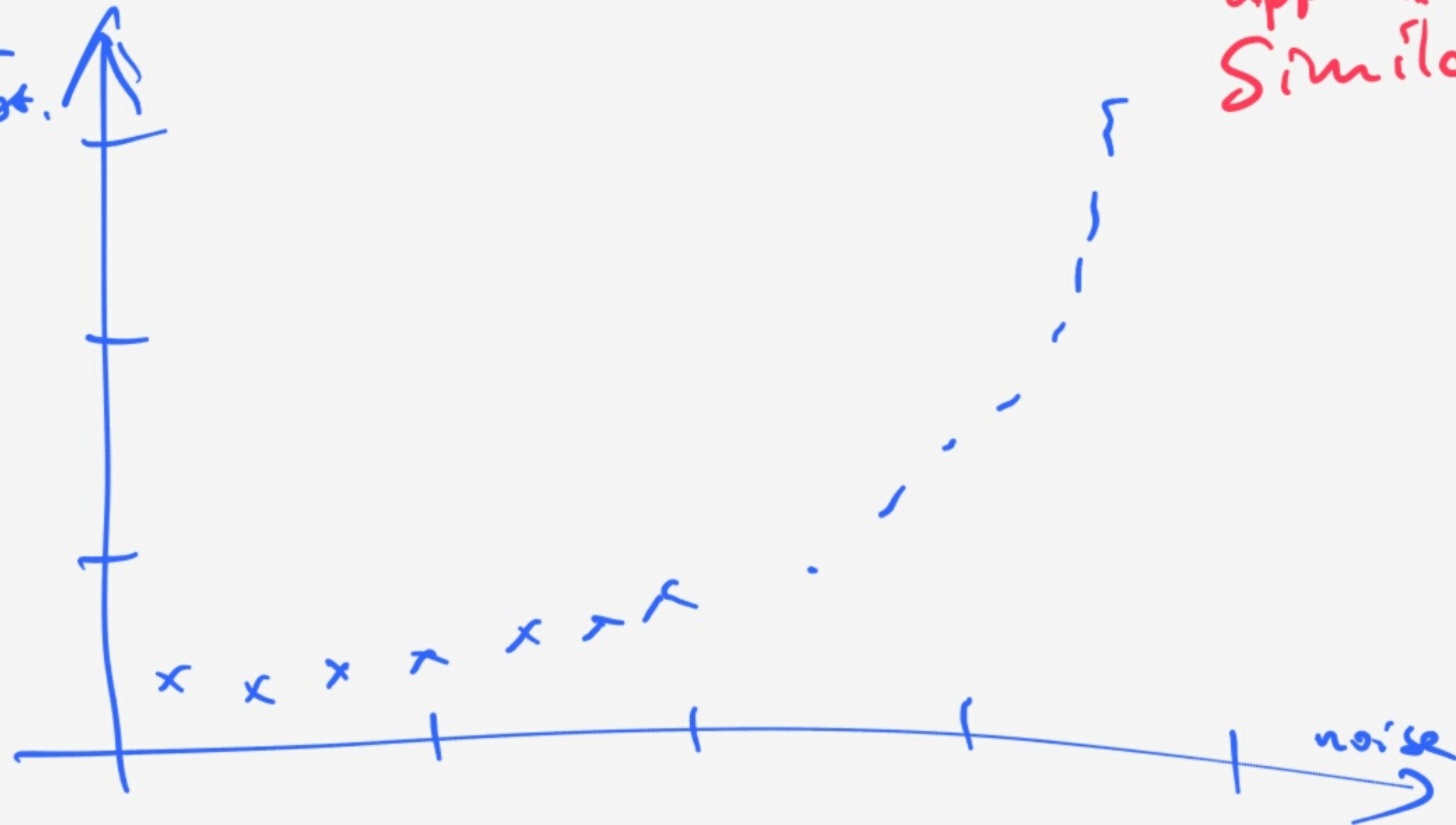
Intro OO

Heuristic OOO

Results ●OOOOOOOO



Diff
to opt.



approx.
Similar to original

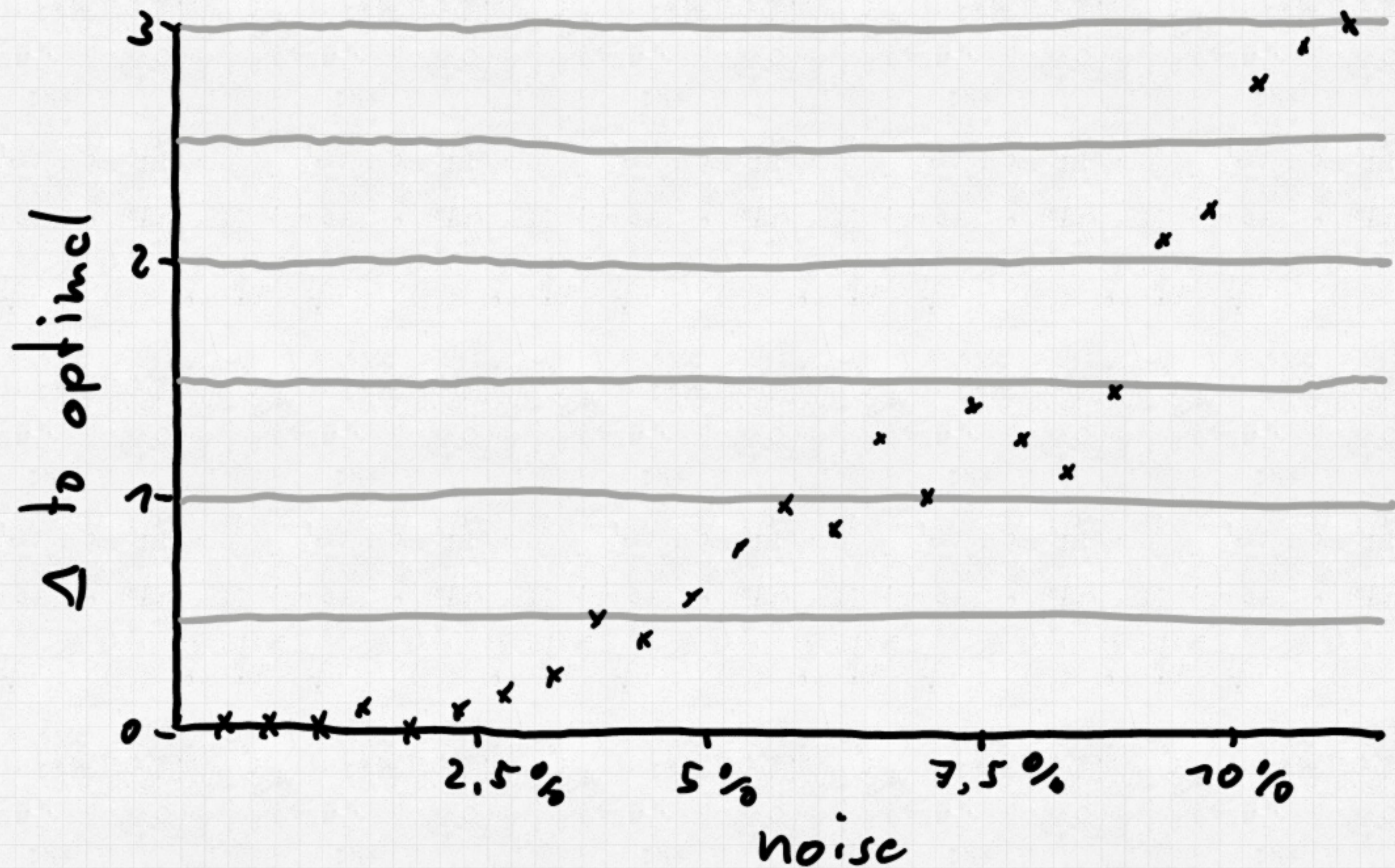


⚠ DONT FORGET THE CHALLENGE!

Intro OO

Heuristic OOO

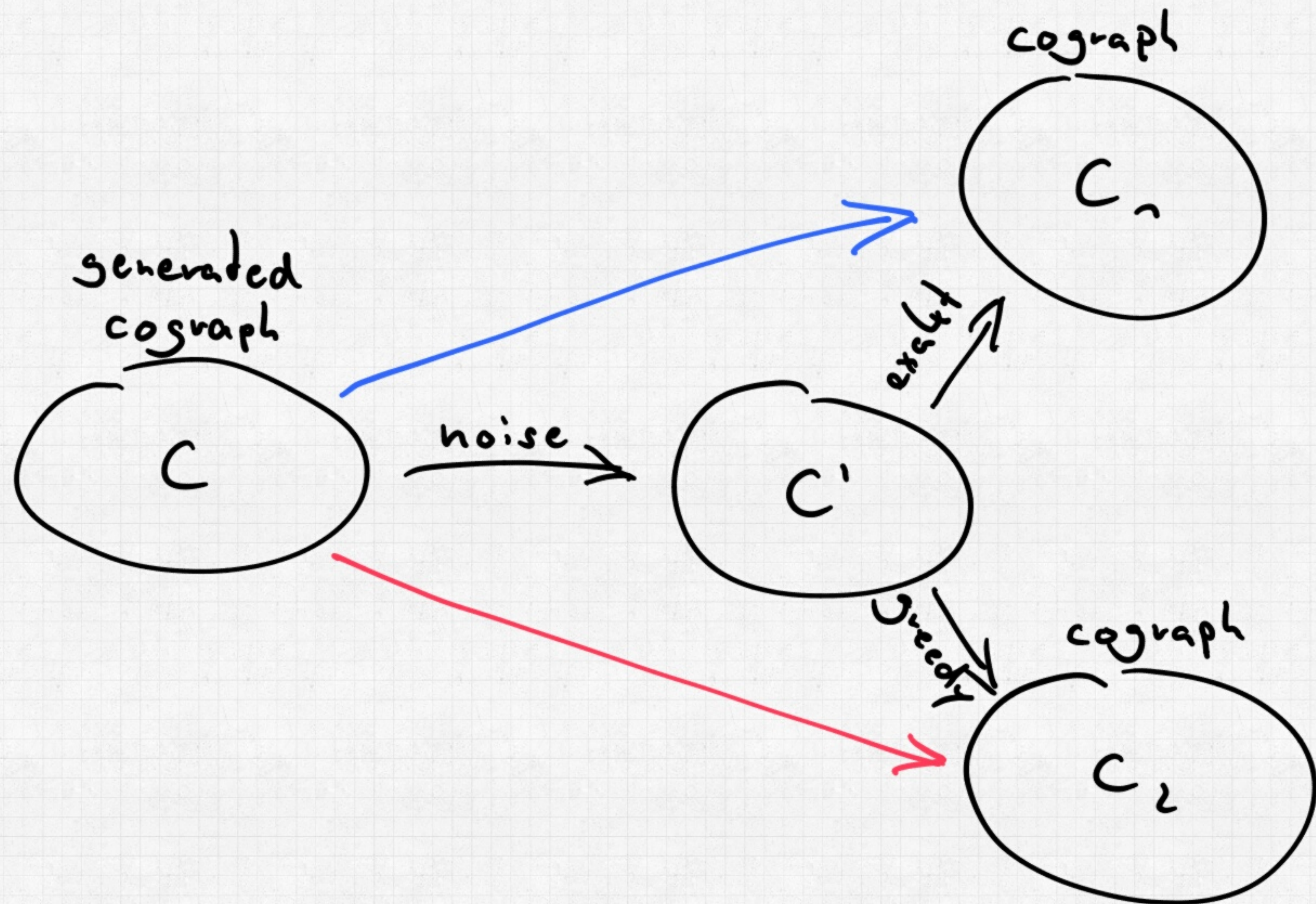
Results O●OOOOOO



Intro OO

Heuristic OOO

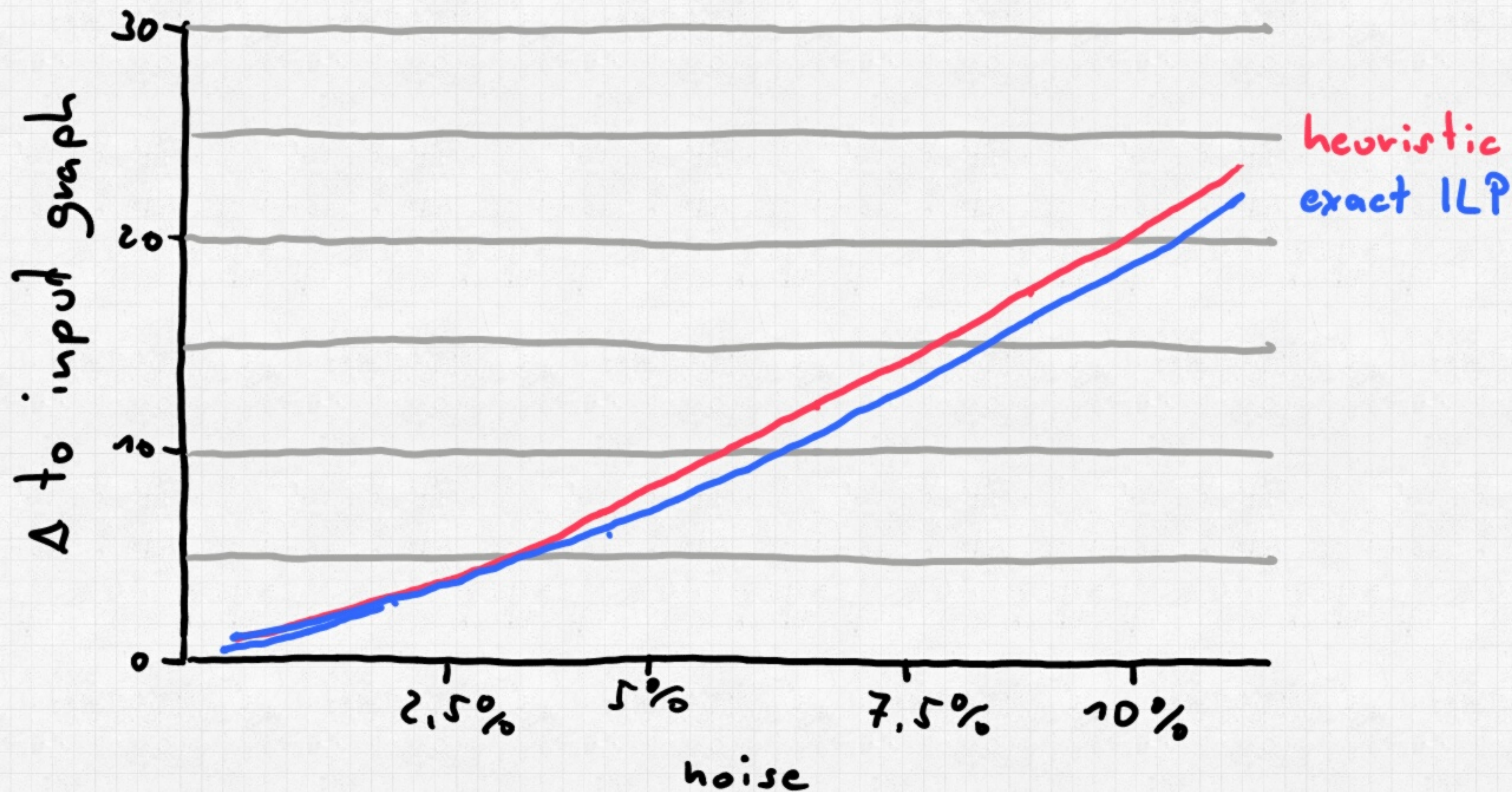
Results OO●OOOOO



Intro 00

Heuristic 000

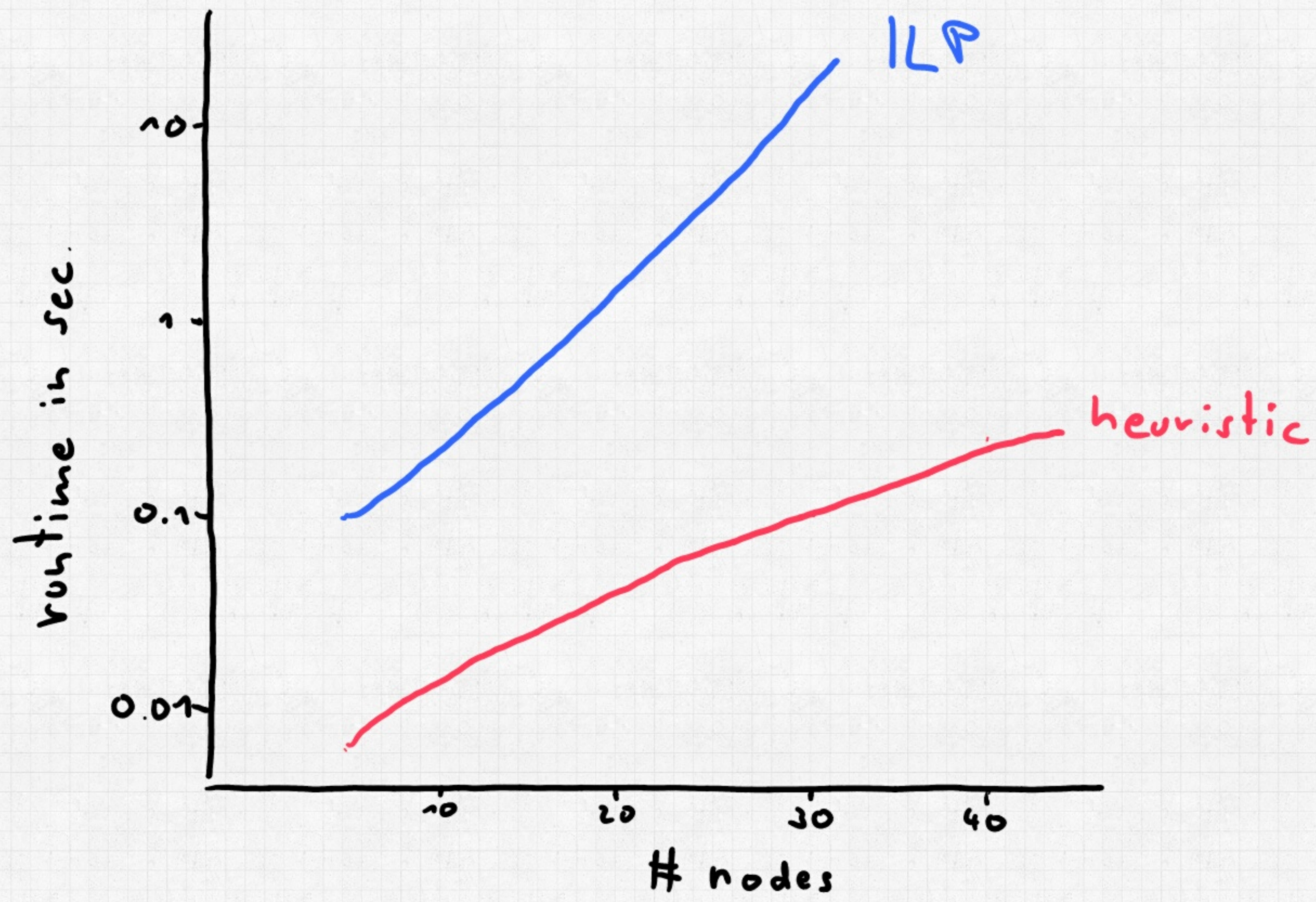
Results 000●00000



Intro OO

Heuristic OOO

Results OOOO●OOO

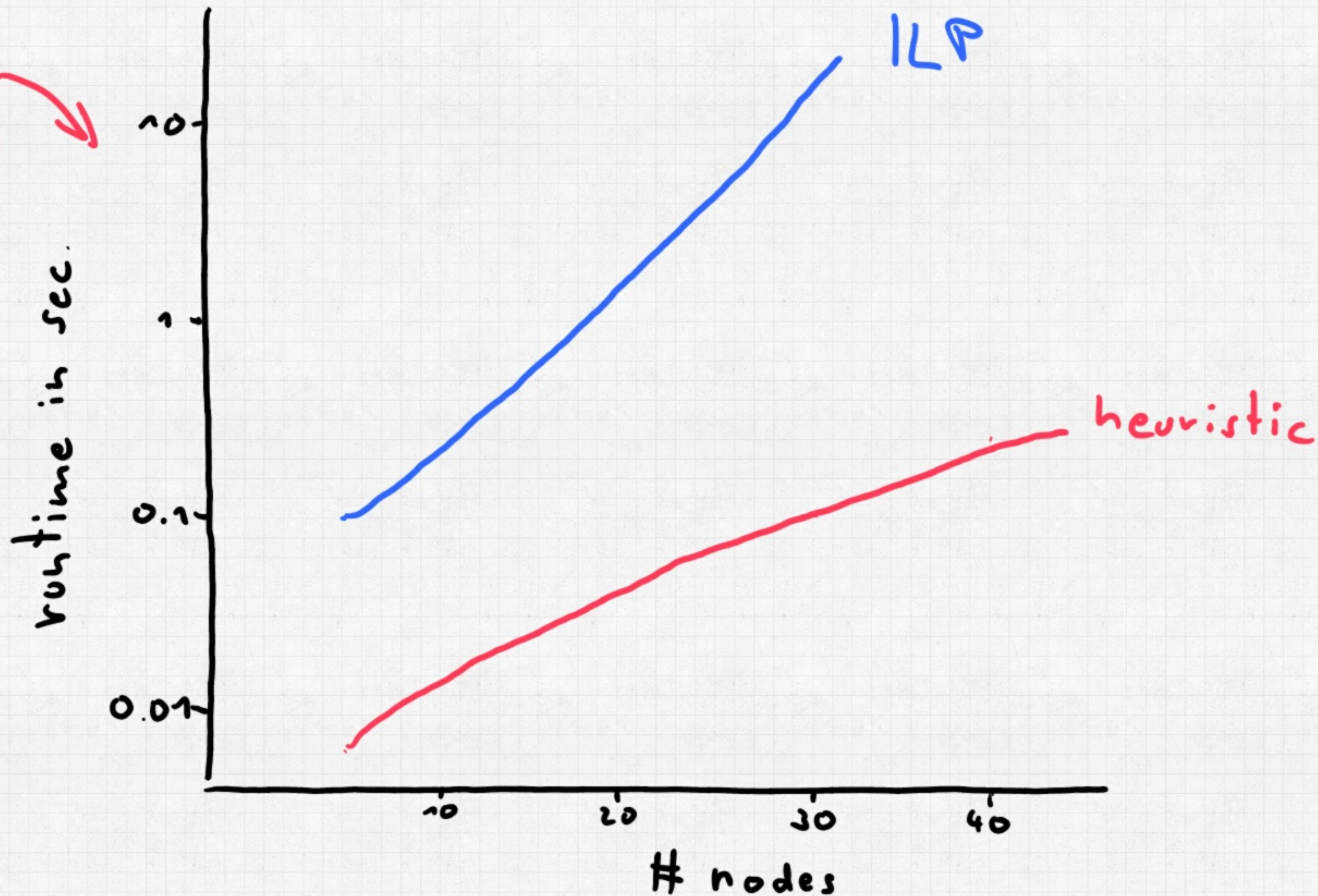


Intro OO

Heuristic OOO

Results OOOO●OOO

log
Scale



Intro 00

Heuristic 000

Results 00000●00

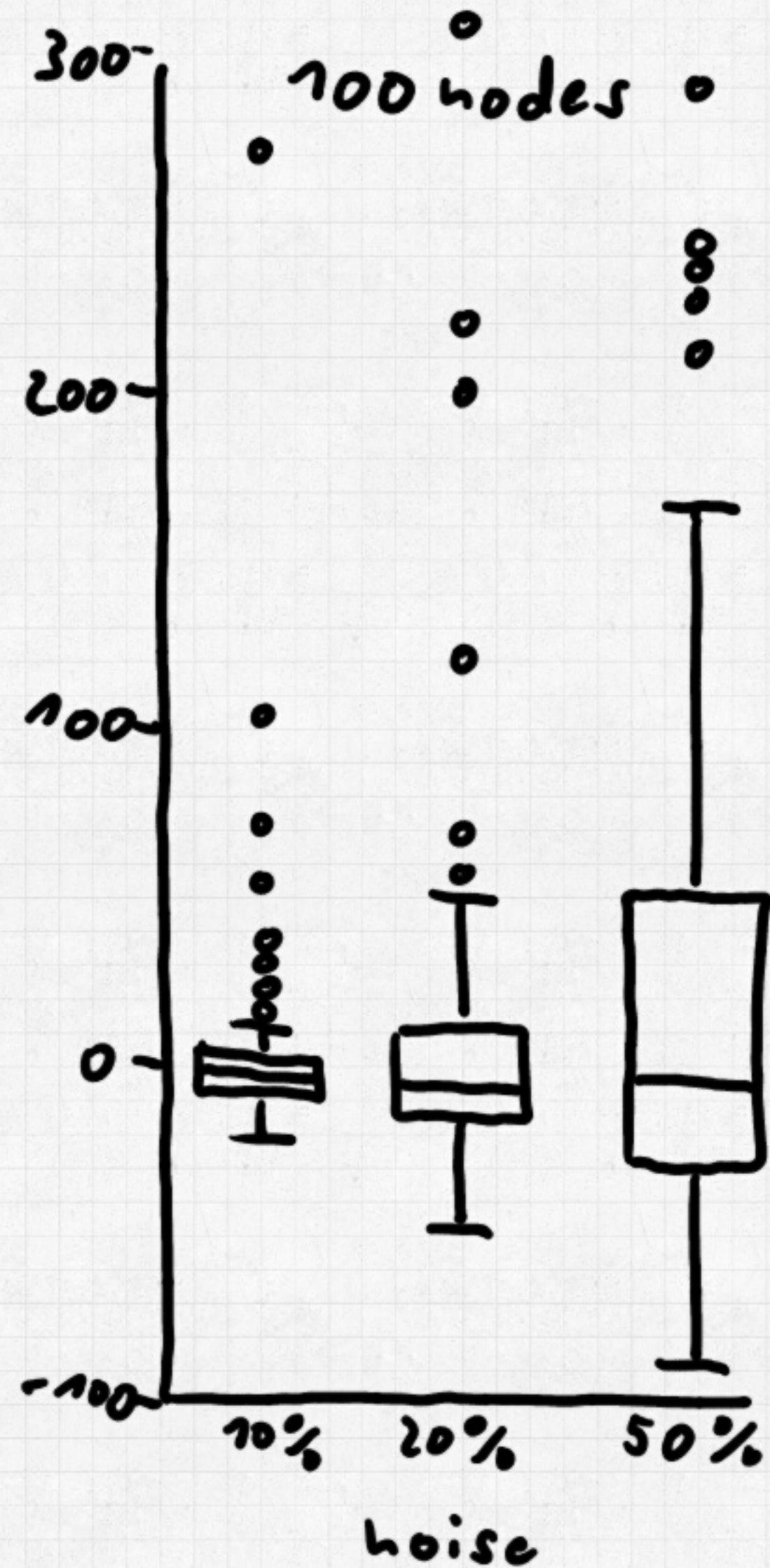
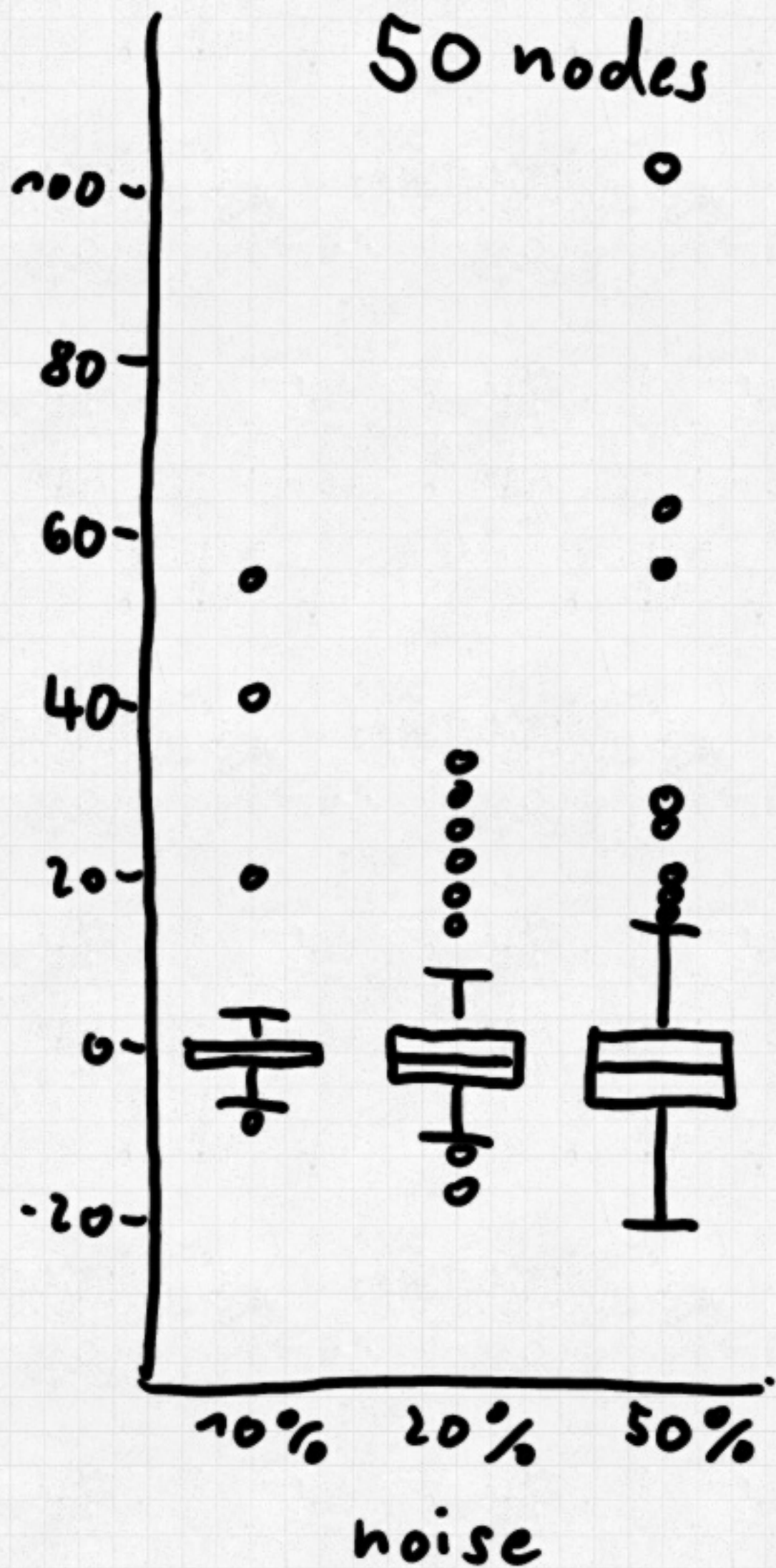
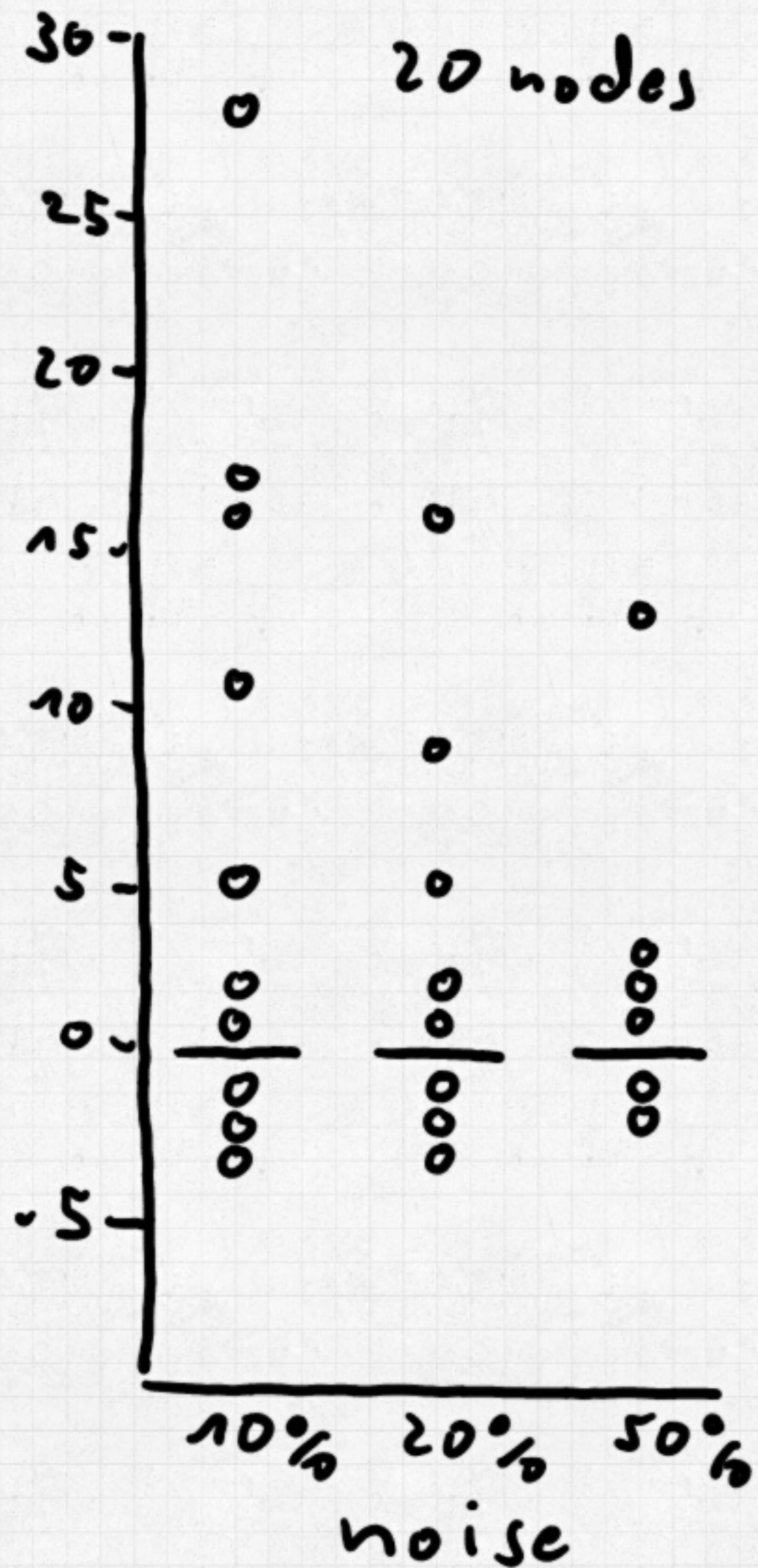
Leipzig vs. Saarbrücken

- 100 datasets of size 20, 50 and 100 nodes
- noise of 10%, 20% and 50%

Intro OO

Heuristic OOO

Results OOOOOOO●O



Intro 00

Heuristic 000

Results 00000000●

Runtime

method size	Leipzig	Saar- brücken	ILP
20 nodes	1,8 sec	≈ 6 sec	41 sec
50 nodes	7 sec	≈ 1 min	57 min
100 nodes	1 min	21 min	≥ 10 h

Thank You