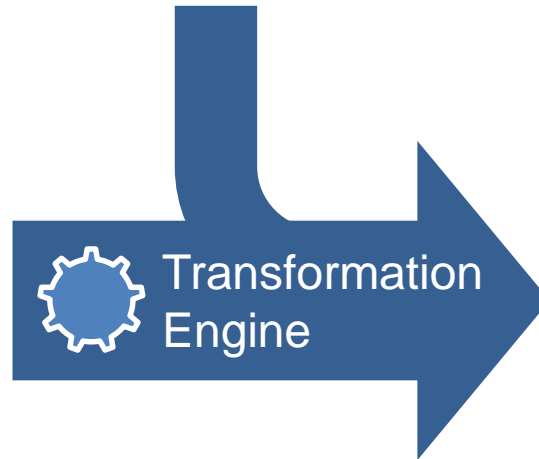


# Monitoring the Execution of Declarative Model Transformations

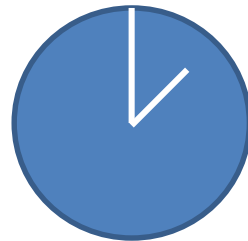
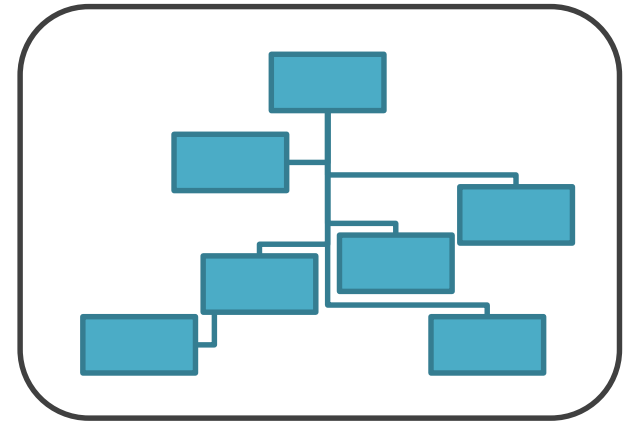
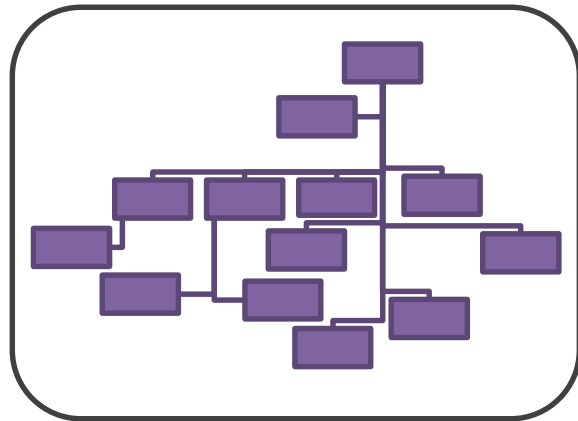
Model of an  
Electronic Control Unit  
(170 000 elements)



Transformation  
Script



Transformed Model

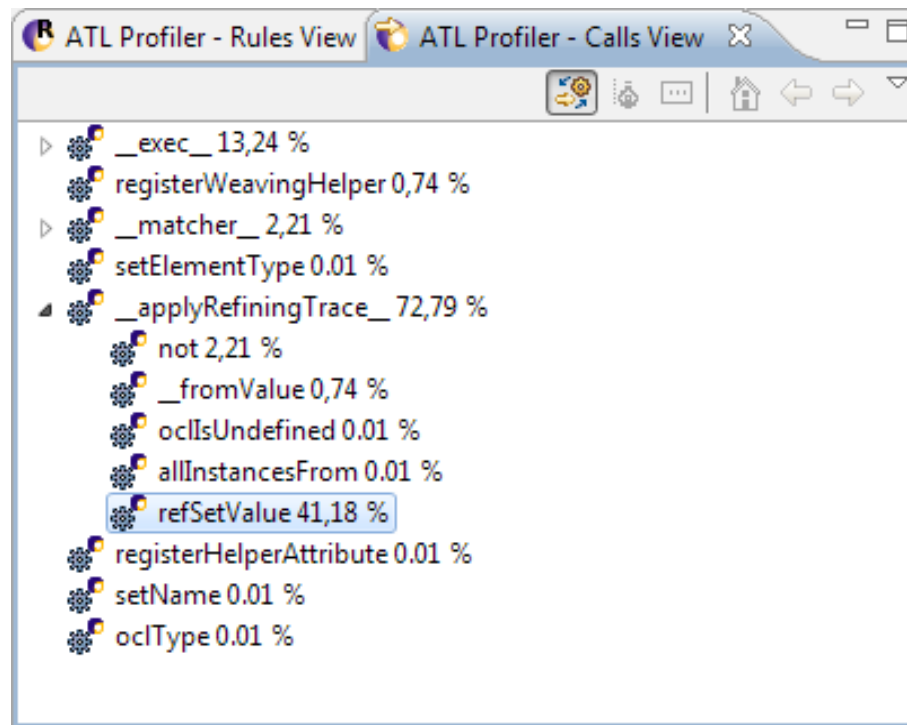


12 hours!

**We need monitoring to understand why a transformation takes so long**

## Related Work

- Piers, W. (2010). ATL 3.1–Industrialization improvements. In *Proceedings of the 2nd International Workshop on Model Transformation with ATL*.



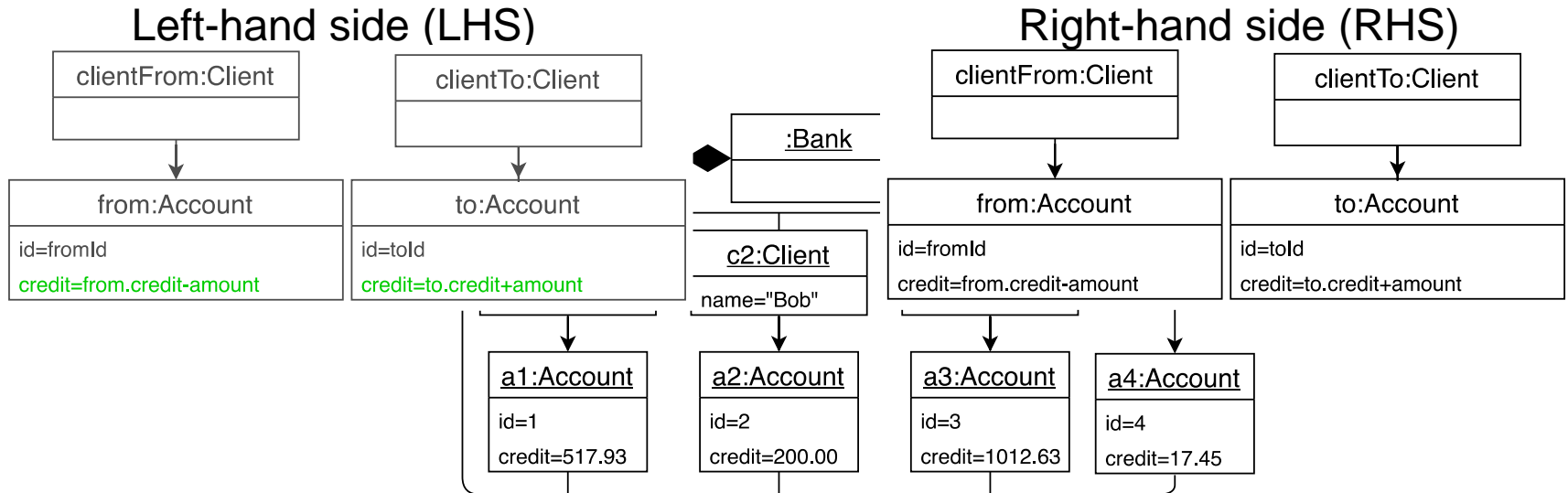
## We need monitoring to understand why a transformation takes so long

- We implemented monitoring for the declarative transformation language Henshin with Kieker



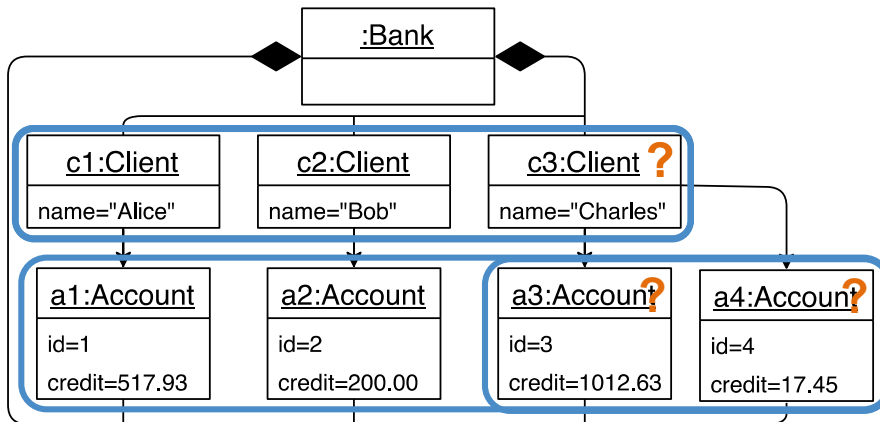
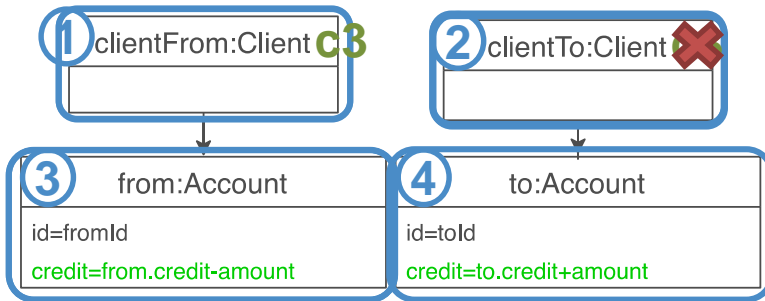
# Henshin


transferMoney(in amount, in fromId, in told)



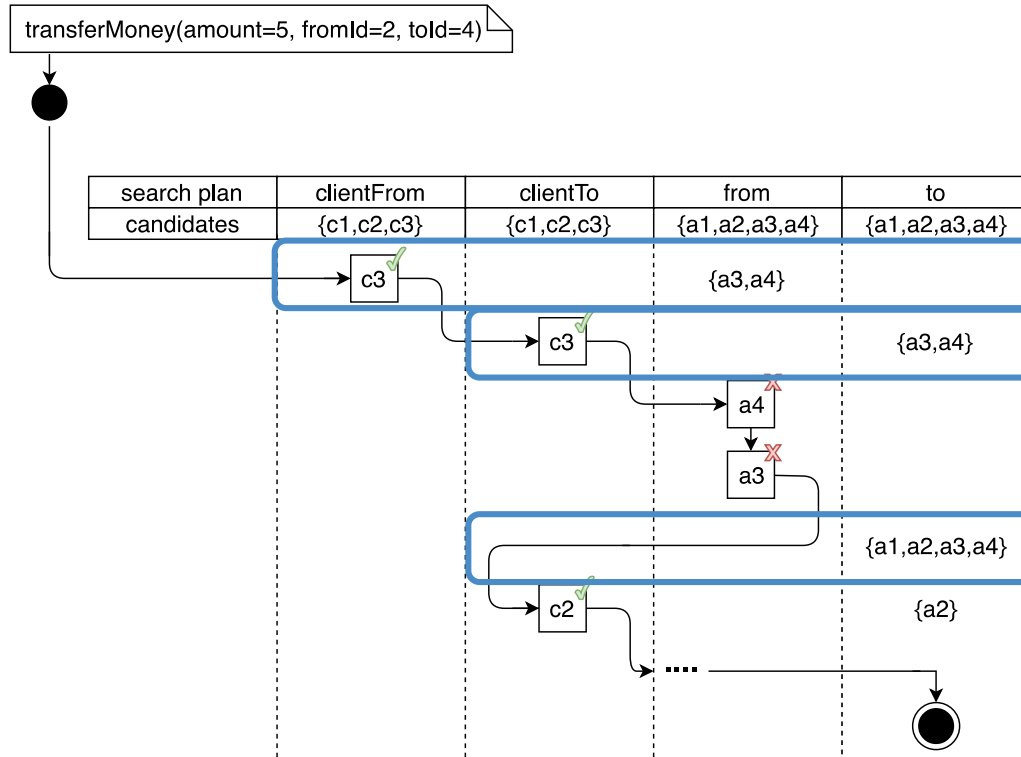
# Henshin

transferMoney(in amount=5, in fromId=2, in told=4)



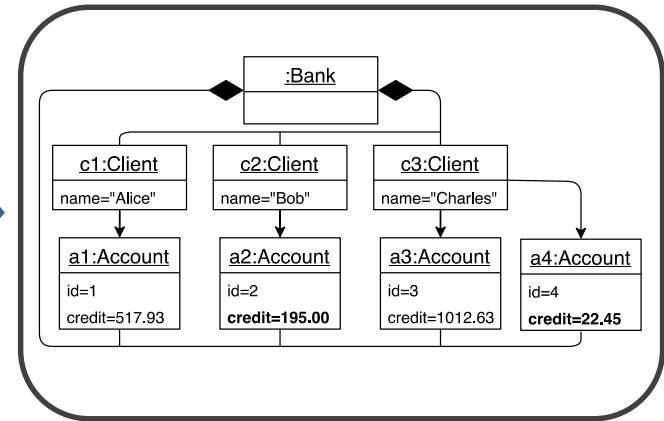
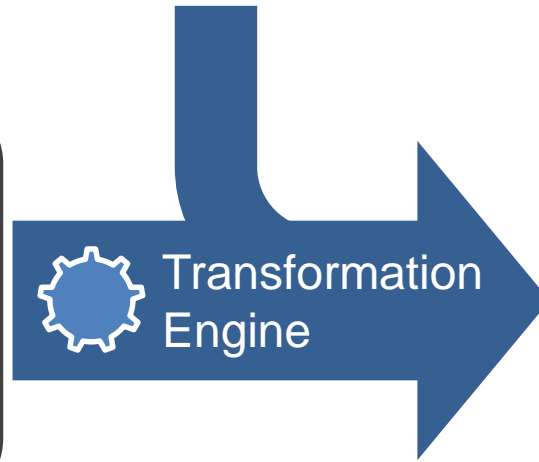
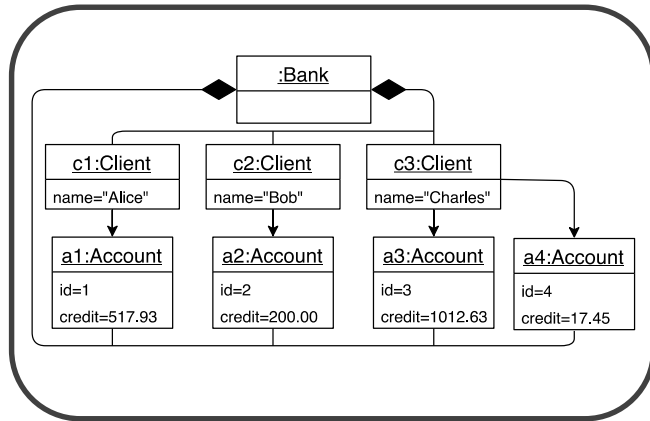
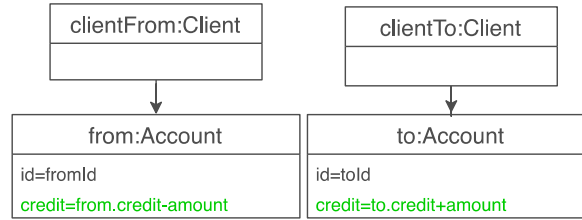
1. Search plan 
  - {clientFrom,clientTo,from,to}
2. Domains
  - clientFrom={c1,c2,c3}
  - clientTo={c1,c2,c3}
  - ~~from={a1,a2,a3,a4}~~
  - ~~to={a1,a2,a3,a4}~~
3. clientFrom → c3
  - from={a3,a4}
4. clientTo → ~~c3~~
  - ~~to={c3,a4}~~
5. from
6. Backtracking
7. clientTo

# Henshin





transferMoney(in amount=5, in fromId=2, in told=4)



## Related Work

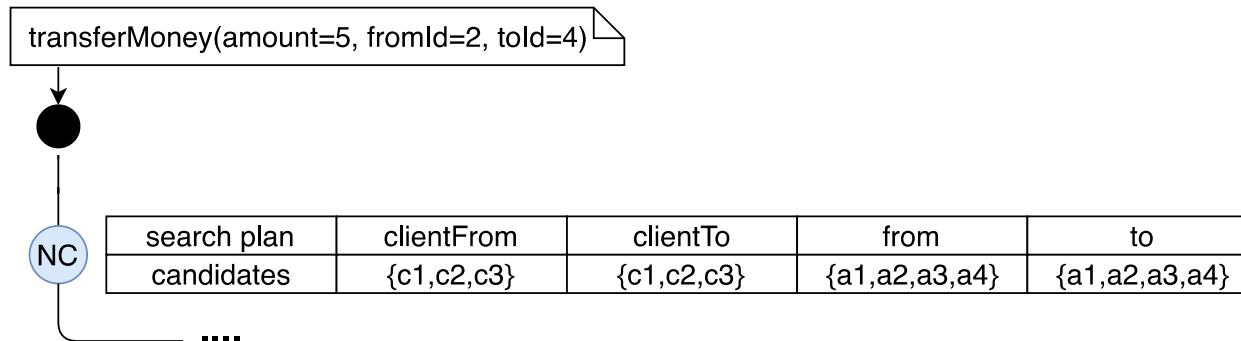
- Debray, S. K. (1988). Profiling prolog programs. *Software: Practice and Experience*, 18(9), 821-839.
  - Prolog is a declarative programming language
  - Prolog uses a similar concept of backtracking during program execution

# Relevant Execution Information

- Search plan
- Number of investigated model elements
- Changes in the domains
- Backtracking
- Execution duration

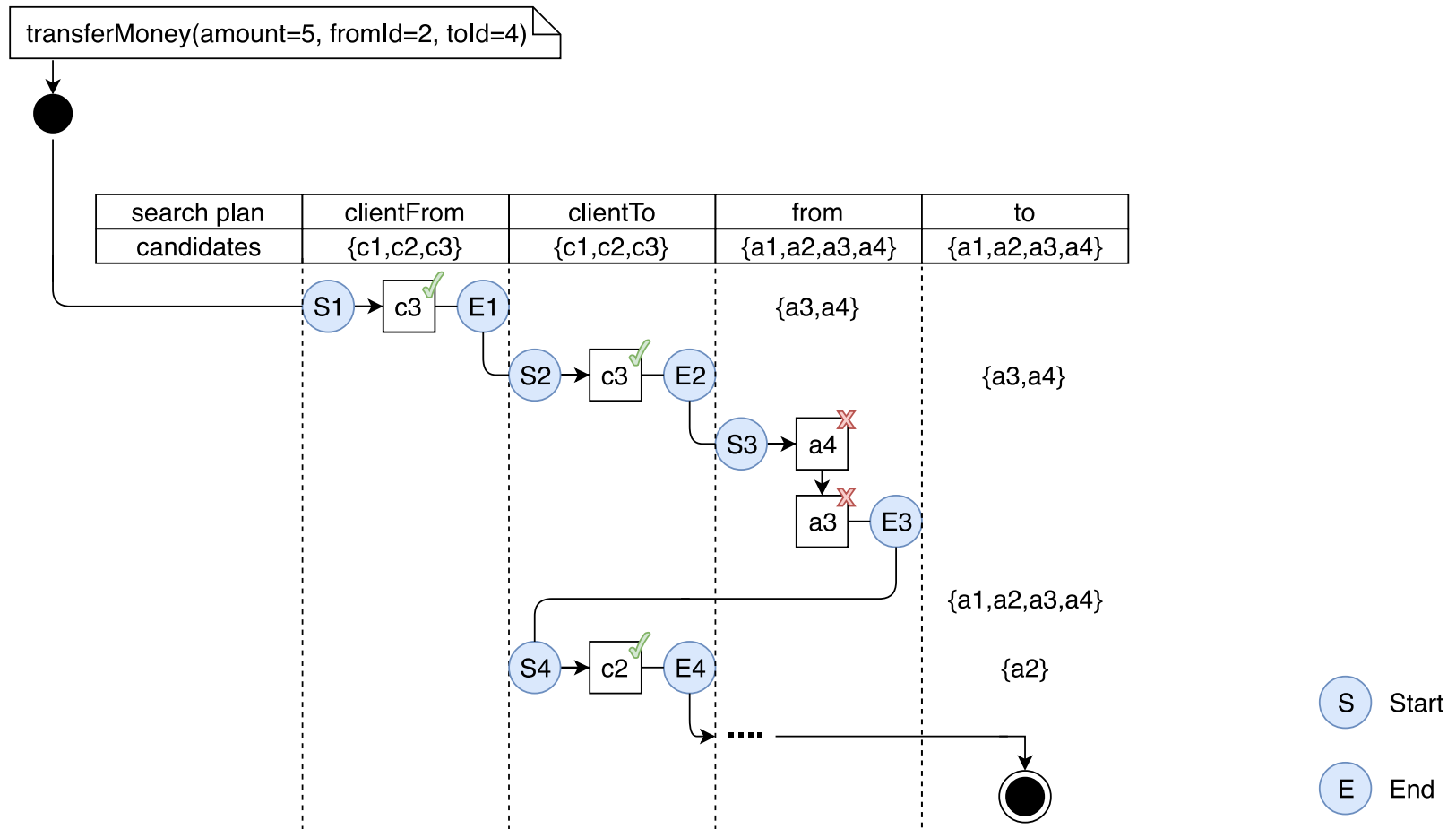
# Search Plan

- **Q1** How do we receive the order in which the elements of the LHS are chosen to find an isomorphic node in the input model?



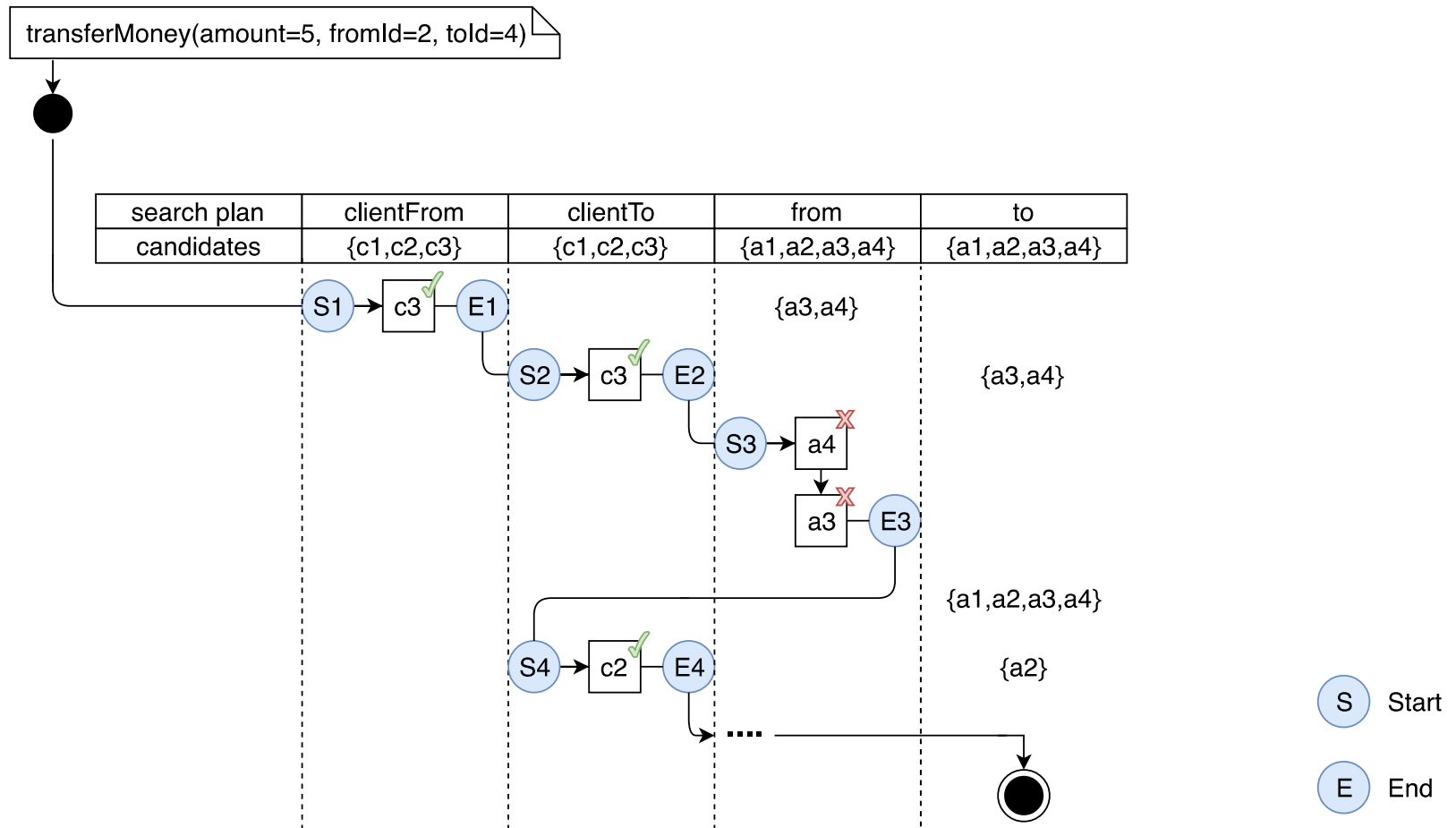
# Number of investigated Model Elements

- Q2** How do we get the number of model elements examined for each element in the LHS?



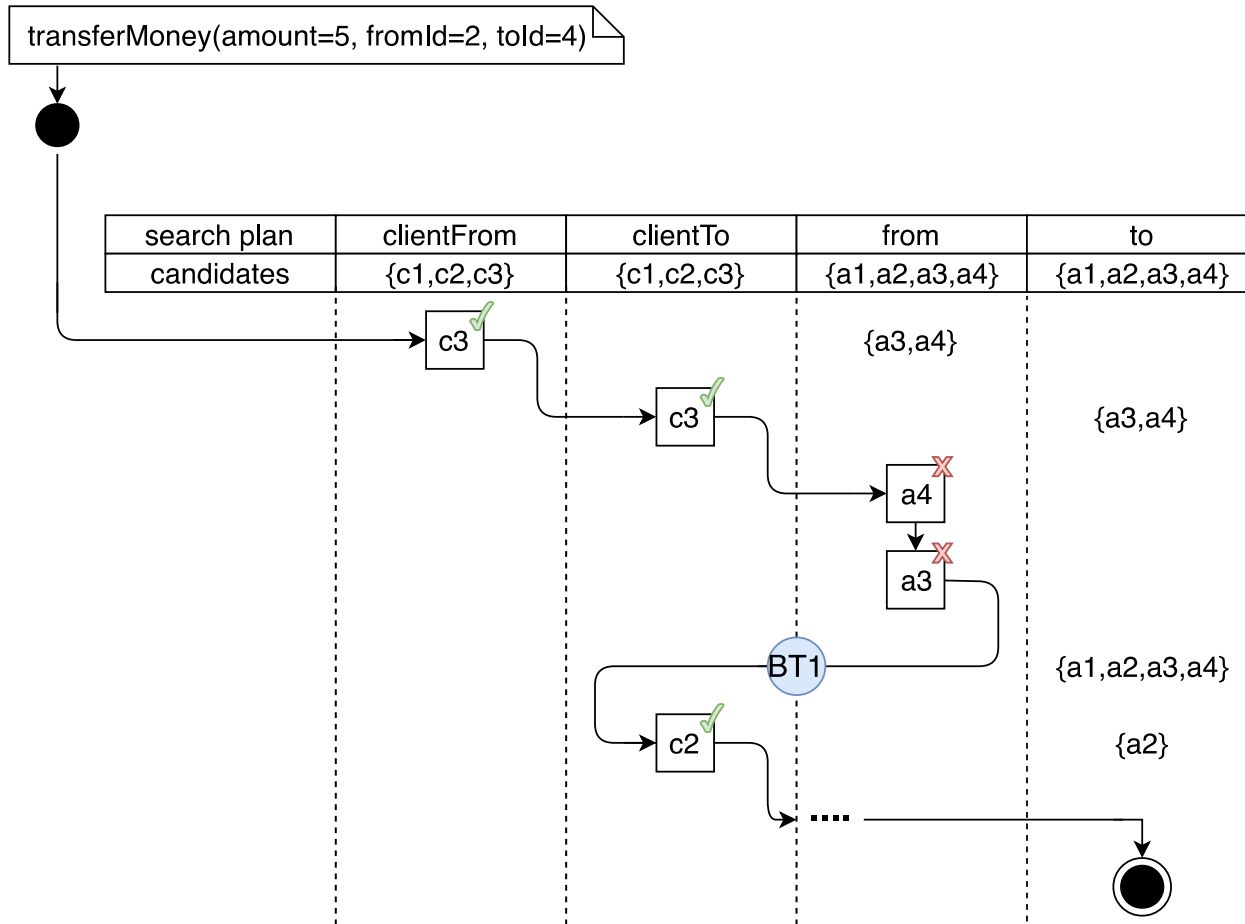
# Changes in the Domains

- Q3** How can we monitor how binding decisions of a model element to an element of the LHS affect candidate sets for other LHS elements?



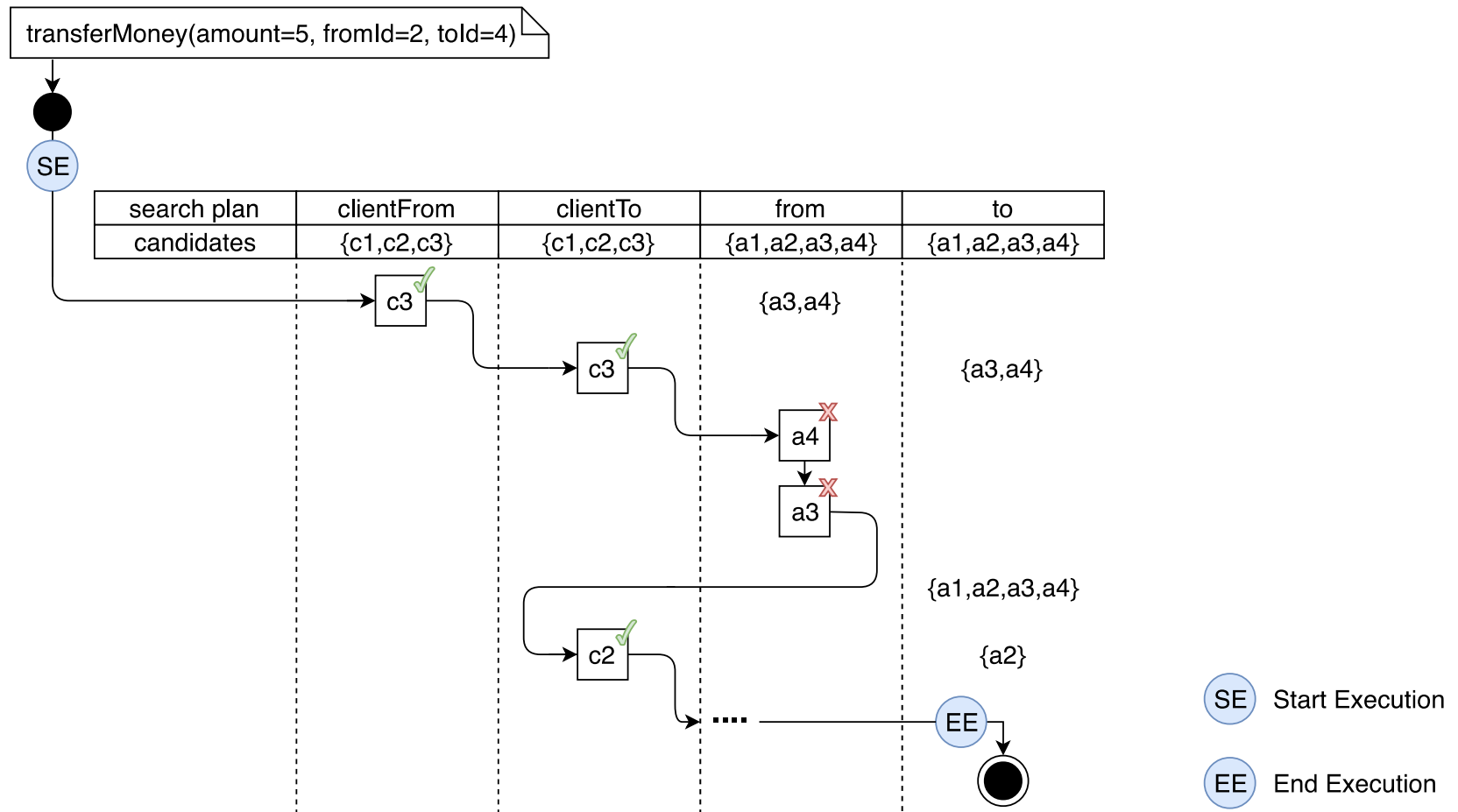
# Backtracking

- **Q4** How can we monitor where and when backtracking occurs?



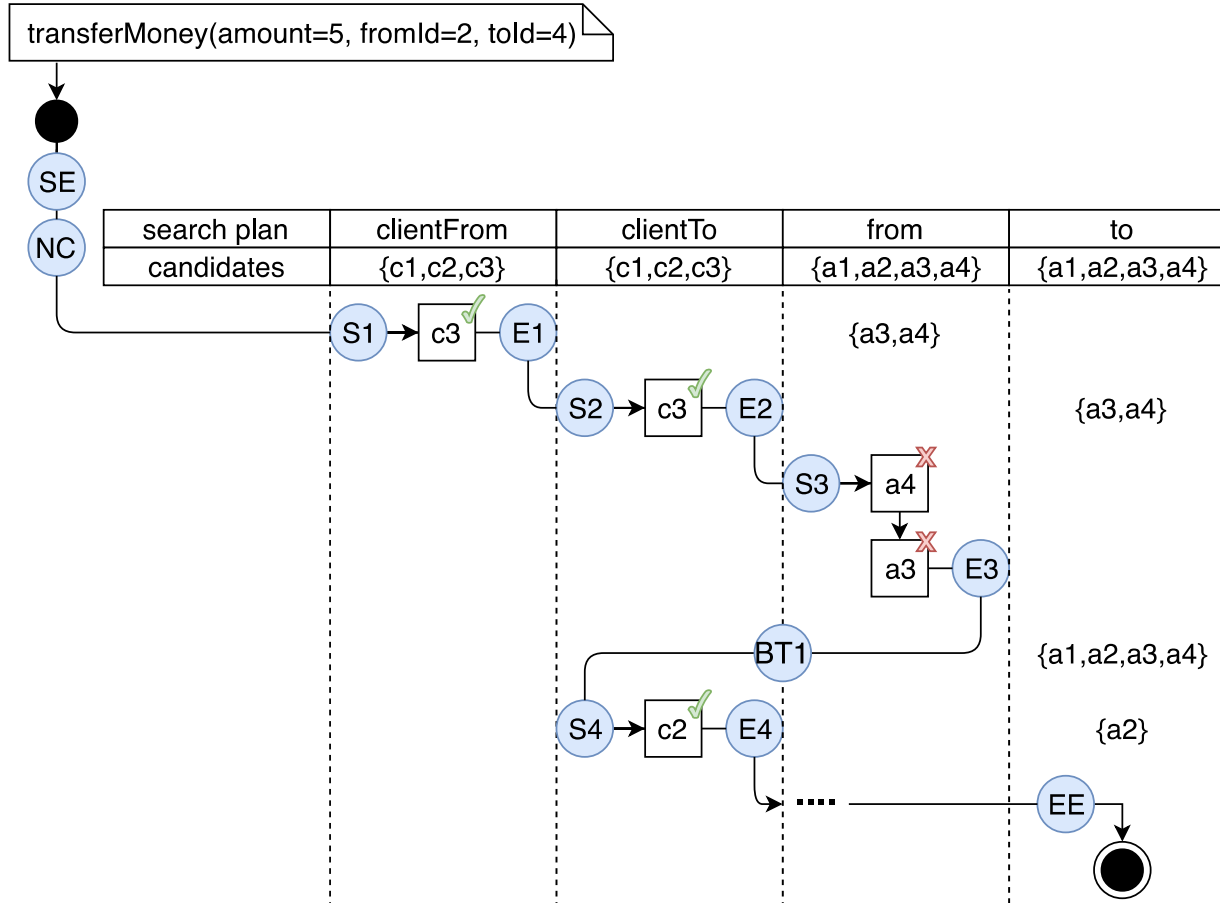
# Execution Duration

- **Q5** How can we measure how long the transformation execution takes?



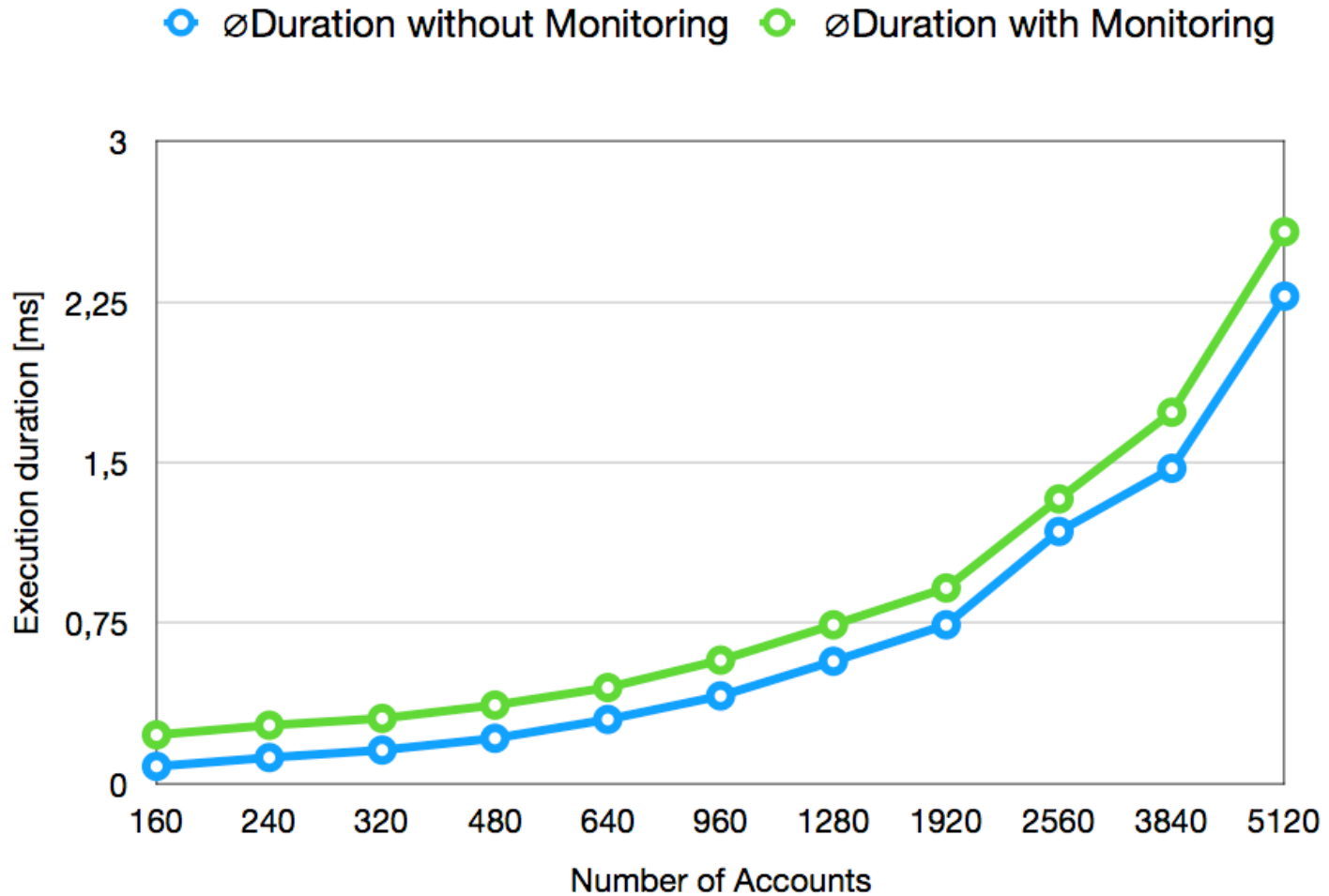


# Measuring Points

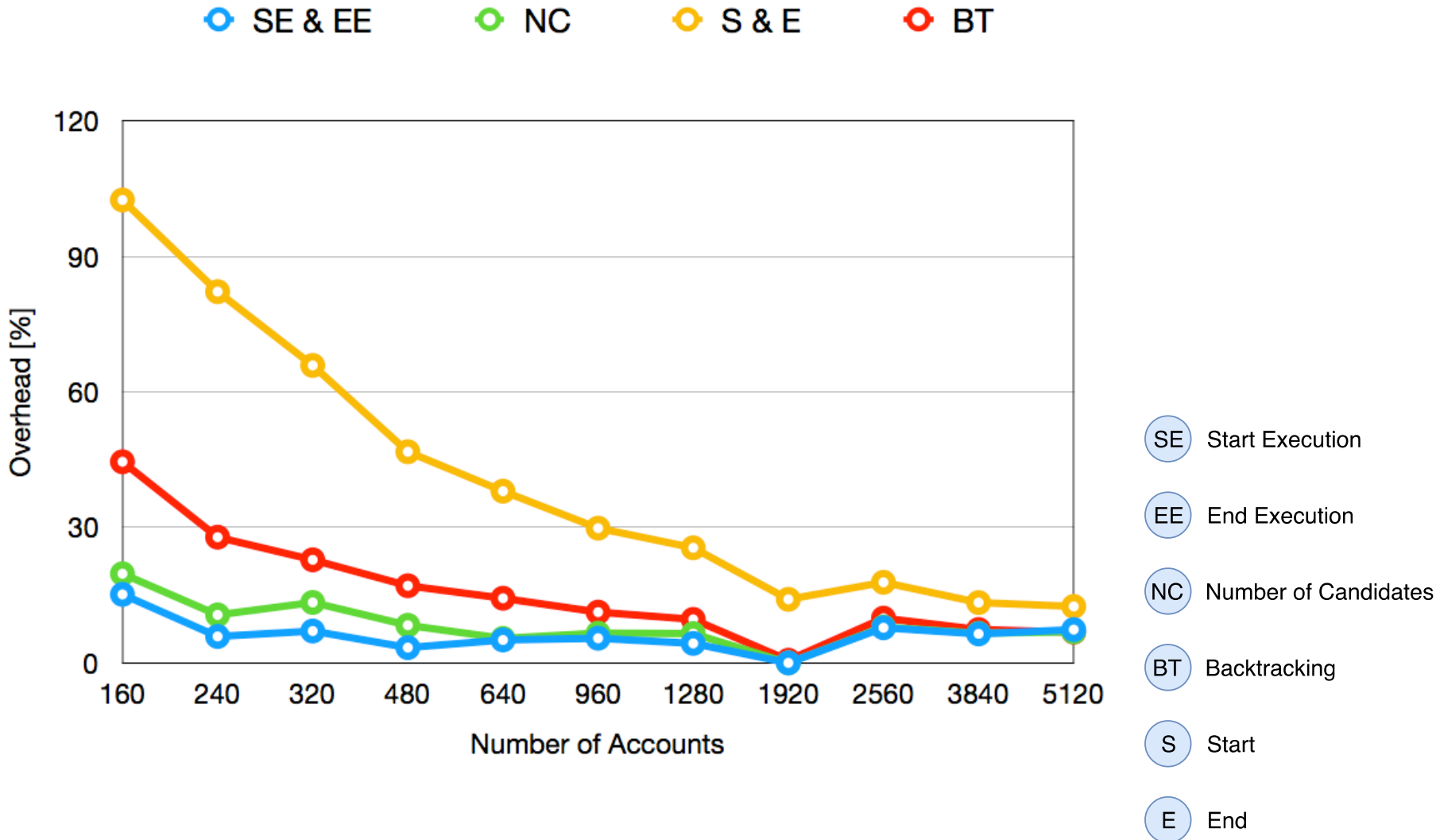


- SE Start Execution
- EE End Execution
- NC Number of Candidates
- BT Backtracking
- S Start
- E End

# Overhead



# Overhead

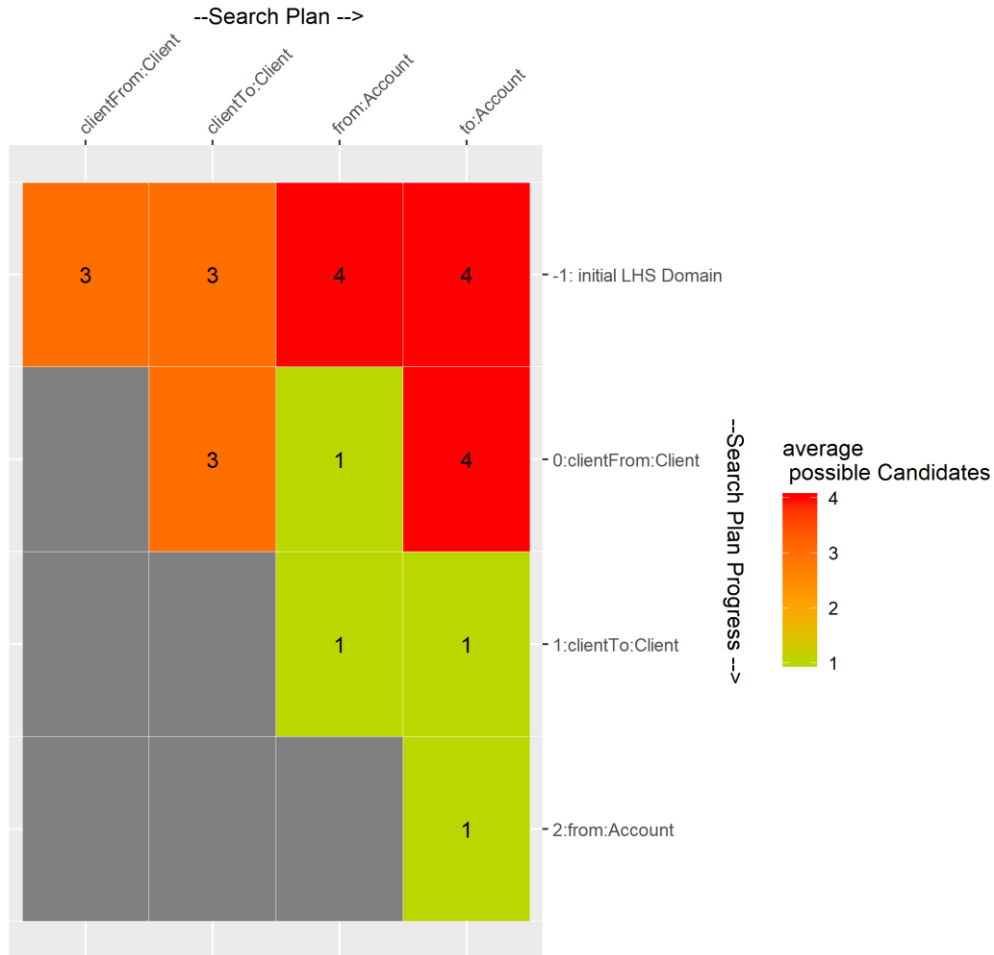


## Related Work

- Batz, G. V., Kroll, M., & Geiß, R. (2007, October). A first experimental evaluation of search plan driven graph pattern matching. In *International Symposium on Applications of Graph Transformations with Industrial Relevance* (pp. 471-486). Springer, Berlin, Heidelberg.



# Usage



## Future Work

- Extend our monitoring to support also control structures
- Investigate the monitoring overhead with bigger examples

# Summary

