

Nemo/Neu User Study - Task Description

Before we start

- Informed consent
- Demographics questionnaire

Please speak your thoughts out loud and explain what you try to do while solving the tasks.

0. The Setting

You are assigned to work on the draft of a Datalog program that a former colleague left behind. Predicates only consist of single letters and their meaning might not be clear. Also, there are some errors in the program reported by the IDE.

```
e(1,2,7).e(1,4,2).e(1,7,15).e(2,3,17).e(2,9,3).e(3,5,9).e(3,8,14).e(4,2,6).e(4,6,1).  
e(5,1,8).e(5,10,2).e(6,3,13).e(6,9,3).e(7,5,5).e(8,2,4).e(9,7,2).e(9,10,9).  
t(#sum(?c, ?f, ?t)) :- e(?f, ?t, ?c).
```

```
r(?f, ?t, ?d) :- e(?f, ?t, ?c).  
r(?f, ?t, ?c1+?c2) :- r(?f, ?m, ?c1), r(?m, ?t, ?c3), t(?x), ?c1 + ?c3 < ?x.
```

```
m(?t, #min(?c)) :- r(1, ?t, ?c), ?t != 1.
```

[Use Link 1 from Appendix]

1. Fixing the Program

The first task is to get the program to work. Fix the errors reported by the IDE, without caring about the predicate names yet! Now see if the program executes successfully.

Assessment

- Discuss
- SEQ (with and without syntax highlighting)
- UEQ-S

2. Tracing a simple derivation

Maybe you can also already guess what the program is supposed to do after executing it. But don't worry if not! Let's investigate one of the outputs in more detail to get a better understanding.

- Can you already tell what the program computes?
- Open the trace for fact `m(6,3)` (by clicking the magnifying glass).
- Note that you can see an interactive overview of the tree on the left.
- Check which facts directly contribute to the rule where the `min` aggregate is applied by opening the relevant node.
- Trace the fact from this node that corresponds to the minimal value.
- Check if there are other facts following the same derivation pattern by unrestrictedly the query. Can you explain what you are seeing?
- Undo the latest change.
- Which facts contribute to the rules initializing the `r` predicate? *Answer: e(1,4,2), e(4,6,1)*
- Focus on the rule initializing `r`.
- Open the tables of the nodes going in and out of the rule side by side. What do you notice?
- Close the tables.

- Don't undo the changes but instead add rules to the tree manually to reproduce the tree shape from the previous state!
- What is shown now compared to the tree that only had $r(1,6,3)$ at it's root? (You can use undo and redo to see the difference again.)
- Try to figure out the intuitive meaning of $r(?f, ?t, ?c1+?c2) :- r(?f, ?m, ?c1), r(?m, ?t, ?c2), t(?x), ?c1 + ?c2 < ?x$. by picking some example facts from the root node (and using undo in between).
- In case you did not know already: What is the program computing, i.e. what is the content of table m ?
- Give meaningful names to the predicates in the program! Feel free to use the renaming feature by pressing "F2" after marking a predicate.

Assessment

- Discuss
- SEQ (before and after using Nev)
- UEQ-S

3. Finding shortest paths

Now we know what the program is doing! Can we exploit this to read off shortest paths from the information provided in Nev?

- Using only the features of nev (i.e. without changing the program), find the lowest cost path from 1 to 10! *Answer: 1,4,6,9,10*
- In Nev, try to exchange the rule below $r(1,6,3)$ to check if there is a shorter path (with fewer nodes) from 1 to 10 (with potentially higher cost). *Answer: 1,2,9,10*

Assessment

- Discuss
- SEQ (with and without Nemo/Nev)
- UEQ-S

4. Performance issue

Now that we know what the program can do, we can improve it a bit further. Unfortunately, your former colleague was not very well-versed in Datalog. So even on the rather small input, the program takes over a second to execute (which is a lot)!

- Use nev to check the execution times of the rules to see which one is slowest. The times are only for the visible facts, so you have to increase the number of facts per page to get a good enough estimate.
- Maybe there are too many possible combinations of r with r . Can you imagine a way to write the critical rule more efficiently?
- Also, we only want to compute the transitive closure starting at 1. Take this into account!
- Close nev and execute the reasoning again.
- Check the execution time for the rule again in nev. Is there a significant gain?
- Consider the proof trees where a single application of the critical rule is performed after the initialization of r . How many facts are derived in total?
- Query for a similar tree shape for the original program. How does the number of derived facts compare?

Assessment

- Discuss
- SEQ (with and without Nemo/Nev)
- UEQ-S

5. Findings a path of a specific length with the new program.

Now the program is much faster! You may also realize that all derivations have a quite specific shape now.

- Try to exploit the specific shape of the derivation trees to find a path from 1 to 10 of length 10 (*not cost 10*).
- What is the lowest cost of such a path?

Assessment

Take into account your answers from task 3 here.

- Discuss
- SEQ (with and without Nemo/Nev)
- UEQ-S

6. A medium-sized graph.

Since performance is good now, we can also consider a bigger graph.

[Use Link 2 from Appendix]

The program is the same, only the facts in the beginning differ.

- Find the lowest cost path from node 1 to 100!

Assessment

Assess how hard this task was, compared to only 10 nodes! Take into account your answers from task 3 here.

- Discuss
- SEQ (with and without Nemo/Nev)
- UEQ-S

7. A big graph.

Let's consider an even bigger graph for our last task.

[Use link 3 from Appendix]

The program is the same, only the facts in the beginning differ.

- Find the lowest cost path from node 1 to 500!

Assessment

Assess how hard this task was, compared to the previous ones! Take into account your answers from the previous tasks.

- Discuss
- SEQ (with and without Nemo/Nev)
- UEQ-S

You are all done with the tasks!

For the last bit, we have a standard demographic survey for you that we ask you to fill. This concludes the user study. Thank you for your participation!

Appendix

Link 1:

<https://tools.iccl.inf.tu-dresden.de/nemo/next/#ZSgxLDIsNykuZSgxLDQsMikuZSgxLDcsMTUplmUoMiwzLDE3KS5lKDIsoSwzKS5lKDMsNSw5KS5lKDMs0CwxNCKuZSg0LDIsNikuZSg0LDYsMSkuCmUoNSwxLDgplmUoNSwxMCwyKS5lKDYsMywxMykuZSg2LDksMykuZSg3LDUsNSkuZSg4LDIsNCKuZSg5LDcsMikuZSg5LDEwLDkpLgp0KCNzdW0oP2MsID9mLCA/dCkpIDotIGUoP2YsID90LCA/YykuCgpyKD9mLCA/dCwgP2QpIDotIGUoP2YsID90LCA/YykuCnIoP2YsID90LCA/YzErP2MyKSA6LSByKD9mLCA/bSwgP2MxKSwgcig/bSwgP3QsID9jMyksIHQoP3gpLCA/YzEgKyA/YzMgPCA/eC4KCM0oP3QsICNtaW4oP2MpKSA6LSByKDEsID90LCA/YyksID90ICE9IDEuCuG==>

Link 2:

<https://tools.iccl.inf.tu-dresden.de/nemo/next/#JSUlIFNob3J0ZXN0IHhhdGhzaW4uIGluIHdlaWdodGVkIGRpcmVjdGVkIGdyYXBoIChpLmUuIGVhY2g2ZW50ZSg0LDIsNikuZSg0LDYsMSkuCmUoNSwxLDgplmUoNSwxMCwyKS5lKDYsMywxMykuZSg2LDksMykuZSg3LDUsNSkuZSg4LDIsNCKuZSg5LDcsMikuZSg5LDEwLDkpLgp0KCNzdW0oP2MsID9mLCA/dCkpIDotIGUoP2YsID90LCA/YykuCgpyKD9mLCA/dCwgP2QpIDotIGUoP2YsID90LCA/YykuCnIoP2YsID90LCA/YzErP2MyKSA6LSByKD9mLCA/bSwgP2MxKSwgcig/bSwgP3QsID9jMyksIHQoP3gpLCA/YzEgKyA/YzMgPCA/eC4KCM0oP3QsICNtaW4oP2MpKSA6LSByKDEsID90LCA/YyksID90ICE9IDEuCuG==>

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Link 3:

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