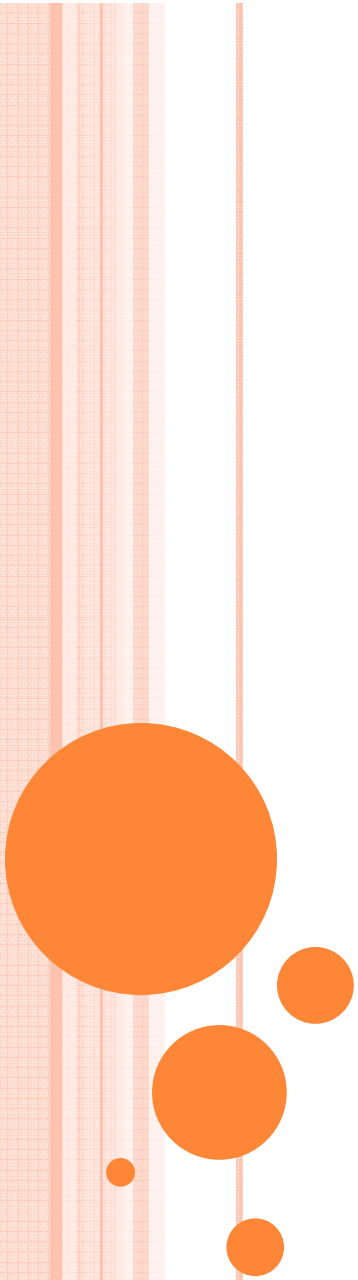
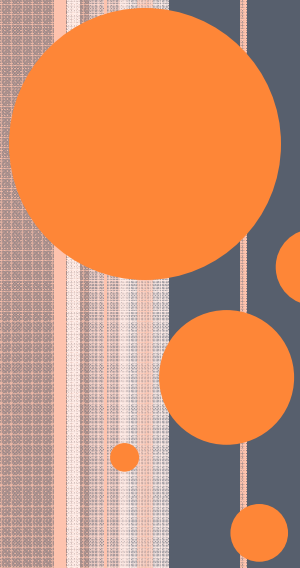


COGUI TUTORIAL

Rules



RULES

Basic Model

Rules to enhance expressivness

- The vocabulary can be seen as a *lightweight* ontology
- We can enrich it with rules expressing properties of relations and concepts
  - parentOf and childOf are inverse relations

    For all x and y, if parentOf(x,y) then childOf(y,x)

    For all x and y, if childOf(x,y) then parentOf(y,x)
  - ancesterOf is a transitive relation

    For all x, y and z, if ancesterOf(x,y) and ancesterOf(y,z) then ancesterOf(x,z)
  - siblingOf is a symmetrical relation

    For all x and y, if siblingOf(x,y) then siblingOf(y,x)

More rules

- **The vocabulary already encodes some kinds of rules**

  Definition of motherOf from parentOf

  - **For all x and y, if motherOf(x,y) then parentOf(x,y) and Woman(x)**

    already encoded in the vocabulary by subtyping and the signature of motherOf

  - **For all x and y, if parentOf(x,y) and Woman(x) then motherOf(x,y)**

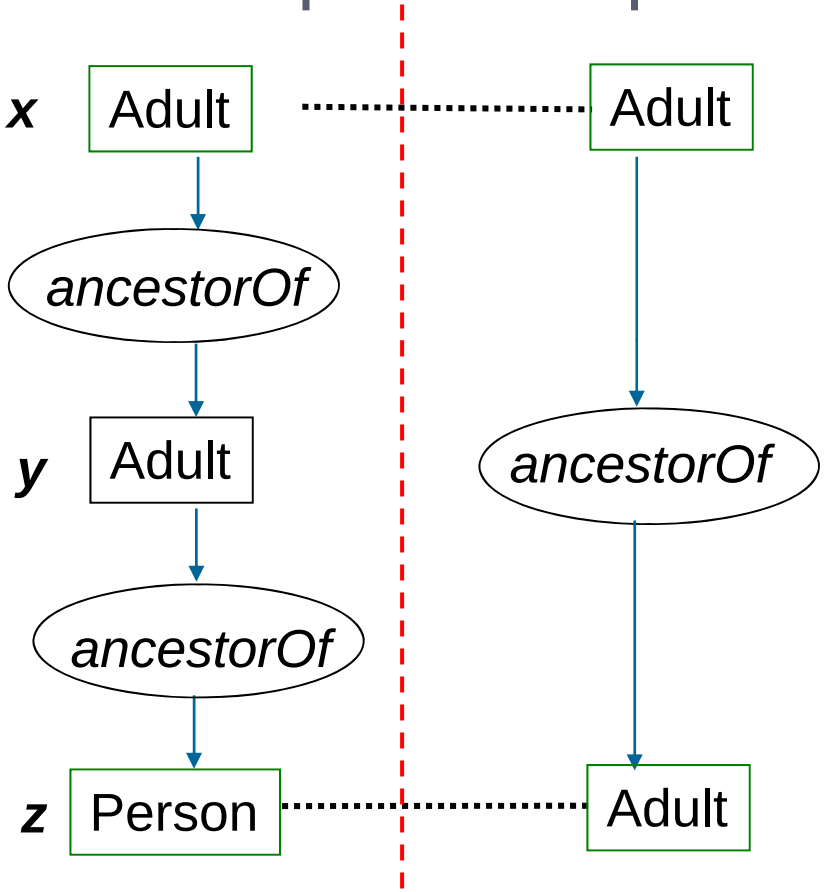
    not encoded in the vocabulary

- **Rules may introduce new unknown individuals**

  Definition of SiblingOf from parentOf

  - **For all x, y and z, if parentOf(z,x) and parentOf(z,y) then siblingOf(x,y)**
  - **For all x and y, if siblingOf(x,y) then there exists z such that parentOf(z,x) and parentOf(z,y)**

Conceptual Graph Rule: « ancestorOf » is transitive



Hypothesis
(any basic CG)

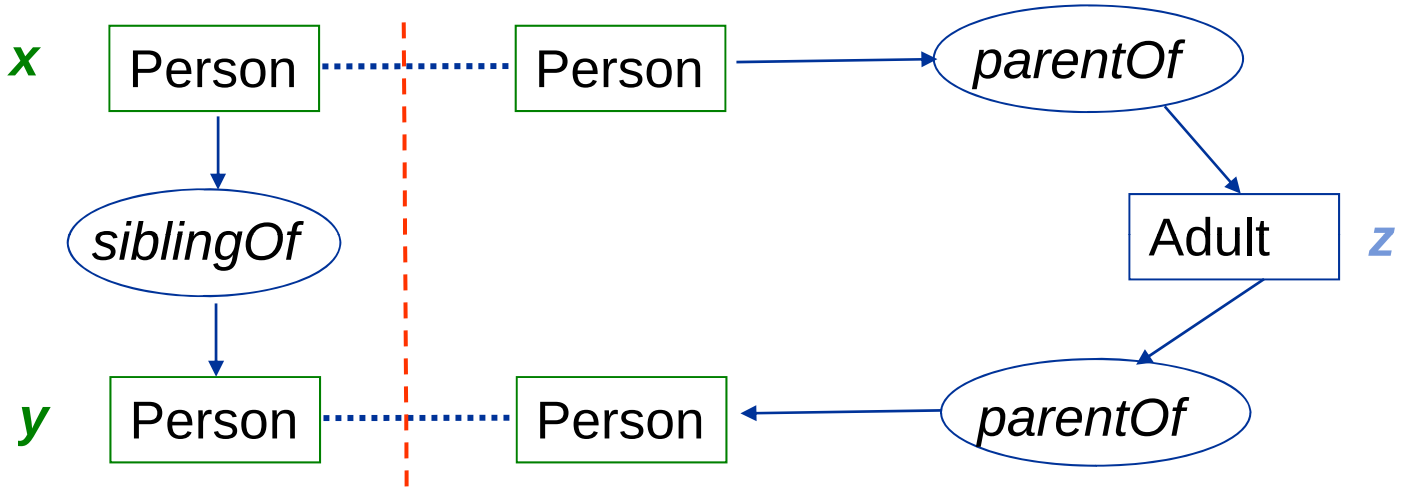
Conclusion
(any basic CG)

Frontier nodes : in green

Logical translation:

$$\forall x\ \forall y\ \forall z($$
$$(\ \mathbf{Adult(x)} \wedge \mathbf{Adult(y)} \wedge \mathbf{Person(z)}$$
$$\wedge\ \mathbf{ancestorOf(x, y)} \wedge \mathbf{ancestorOf(y,z)})$$
$$\rightarrow\ \mathbf{ancestor(x,z)}\ )$$

Another Conceptual Graph Rule

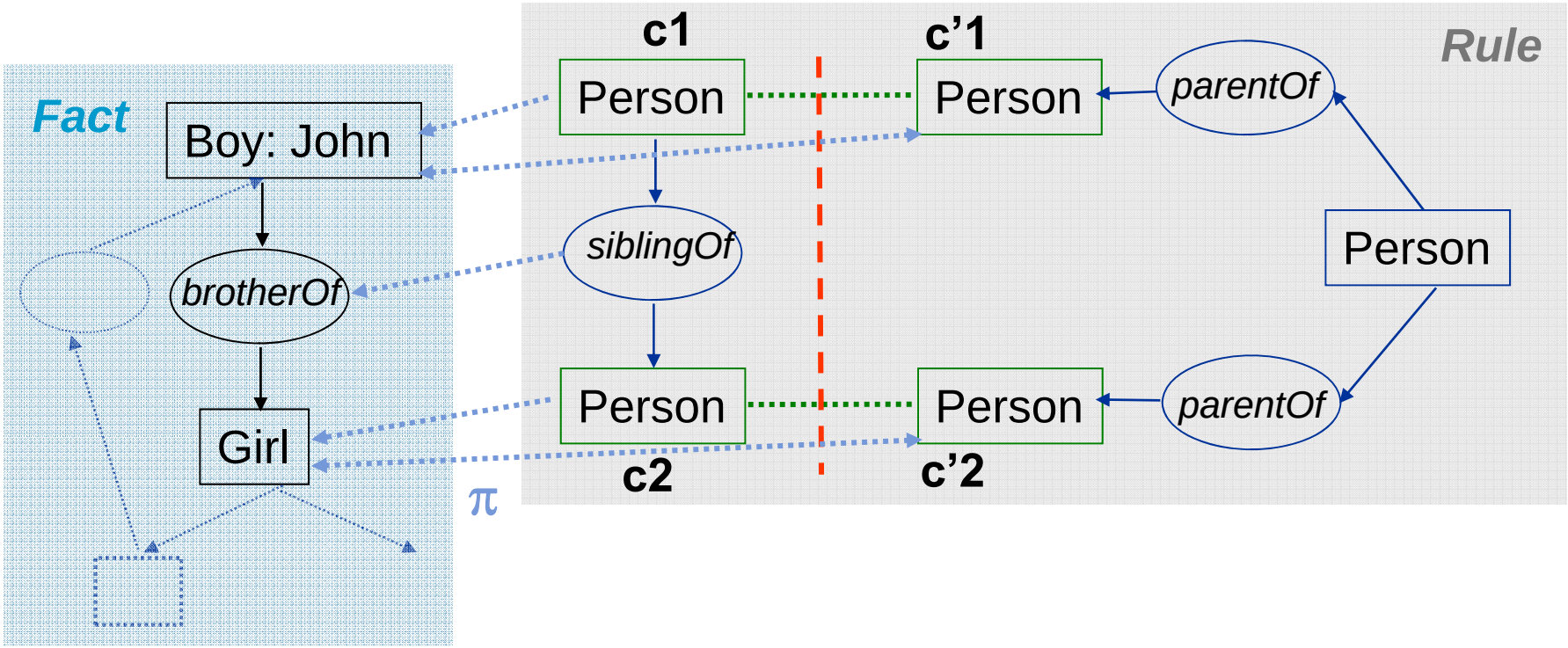


$$\forall x\ \forall y\ (\ (Person(x) \wedge Person(y) \wedge siblingOf(x,y)) \rightarrow \exists z\ (Person(z) \wedge parentOf(z,x) \wedge parentOf(z,y))\ )$$

Frontier nodes : in green

Rule application

- A rule *H* → *C* is applicable to a fact *F* if *H* projects to *F*



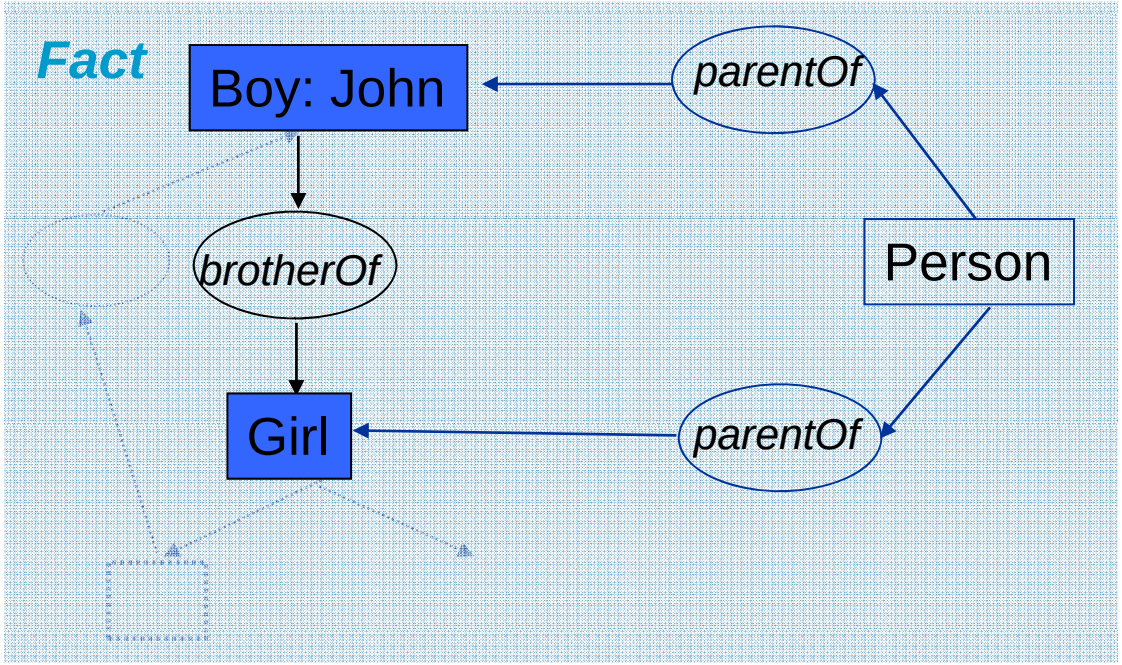
- Given a projection π from *H* to *F,* applying the rule consists in:

  (1) adding *C* to *F*

  (2) merging each frontier node c'_i of *C* with $\pi(c_i)$ in *F*

Rule application

- A rule *H* → *C* is applicable to a fact *F* if *H* projects to *F*



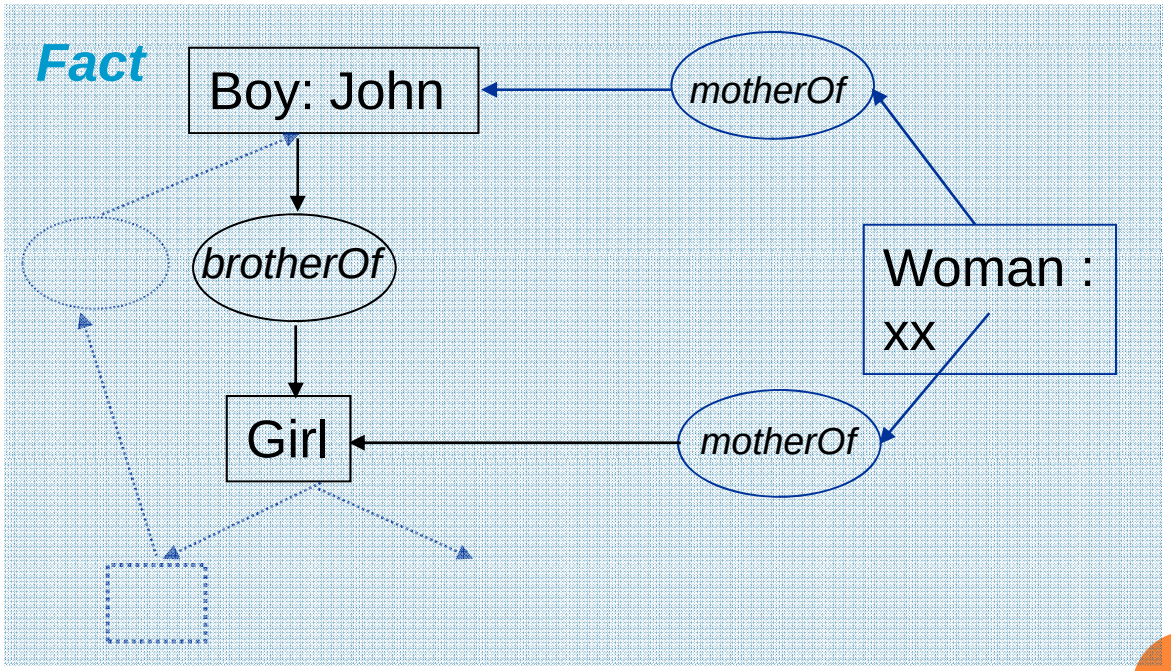
- Given a projection π from *H* to *F,* applying the rule consists in:

  (1) adding *C* to *F*

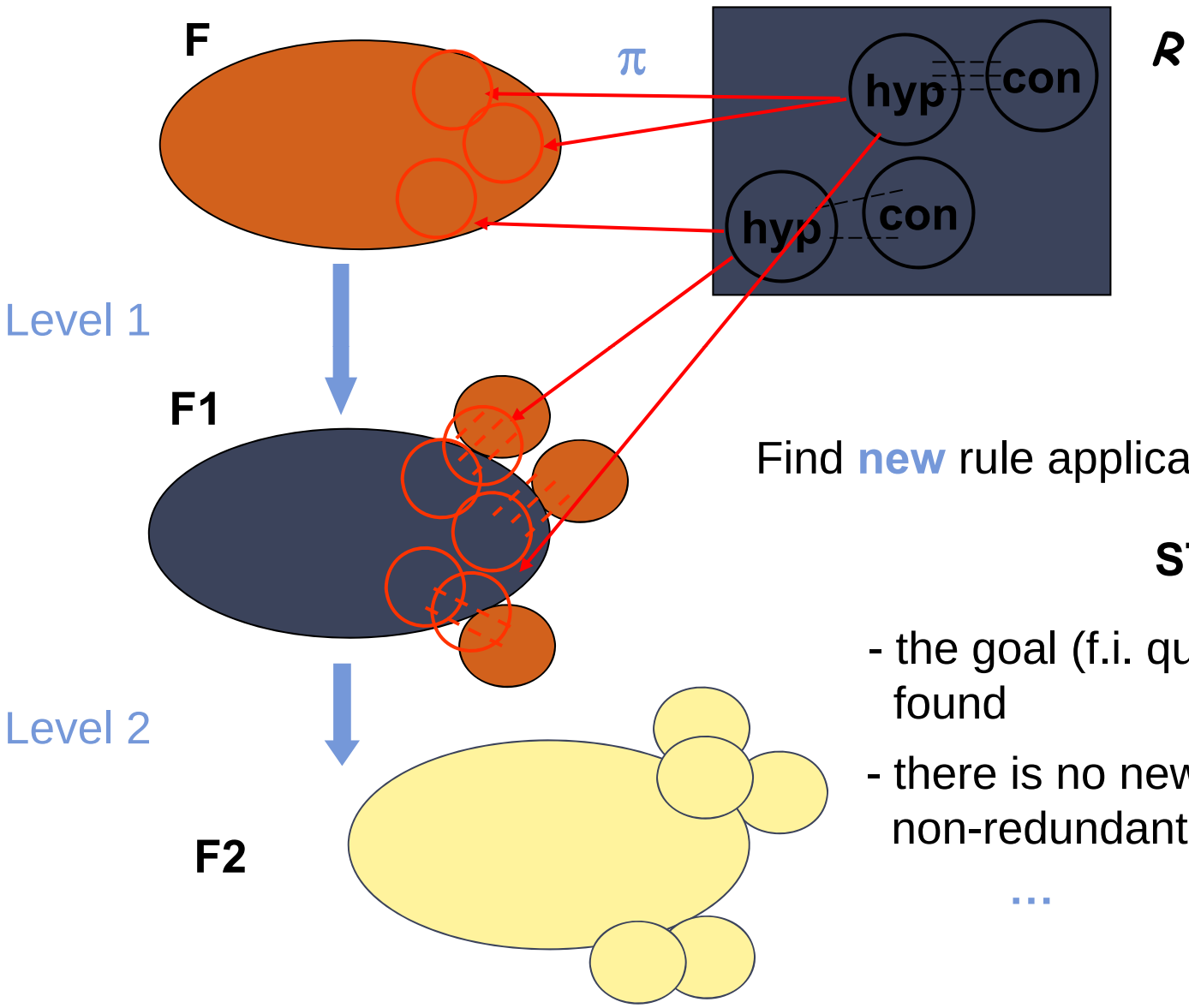
  (2) merging each frontier node c'_i of *C* with $\pi(c_i)$ in *F*

Redundant rule application

- Example: trying to apply the previous sibbling rule to this fact



Forward Chaining (FC) Scheme



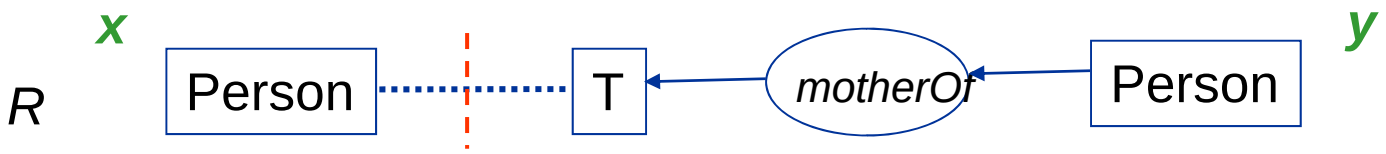
Find **new** rule applications

STOP when ?

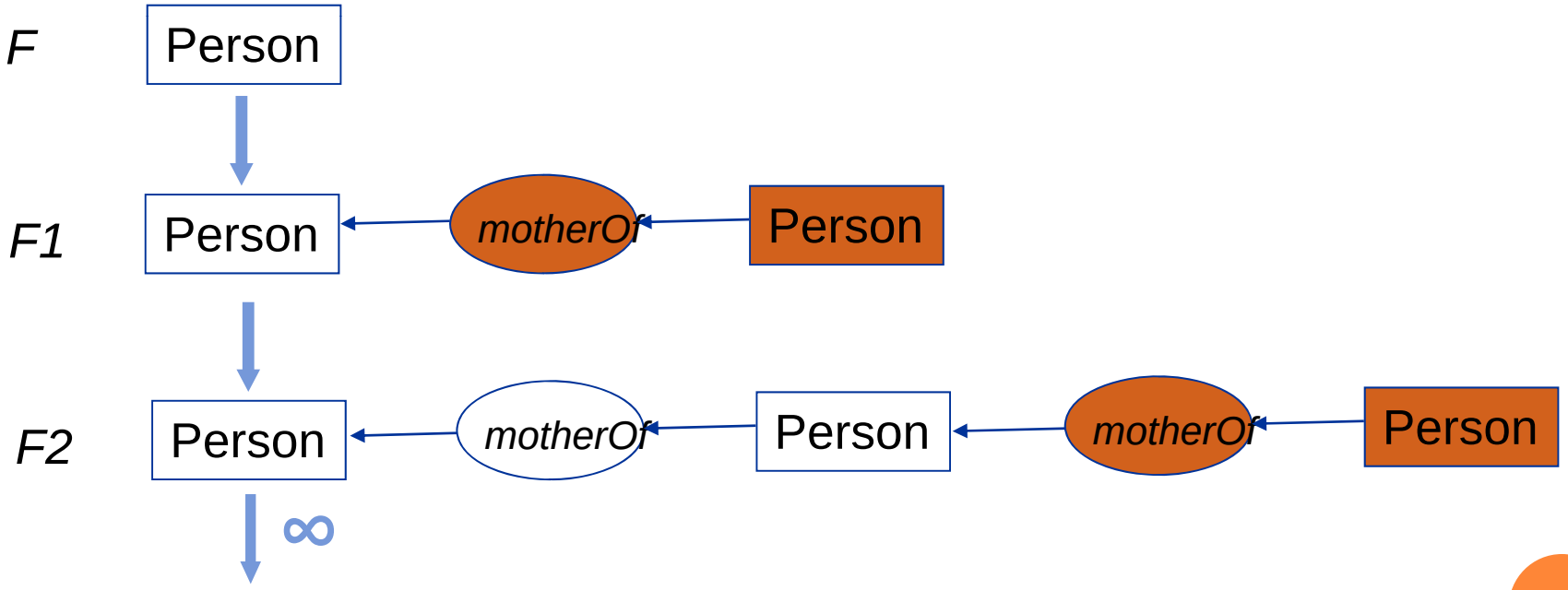
- the goal (f.i. query) has been found
- there is no new and non-redundant rule application

...

Forward Chaining (FC) may not halt

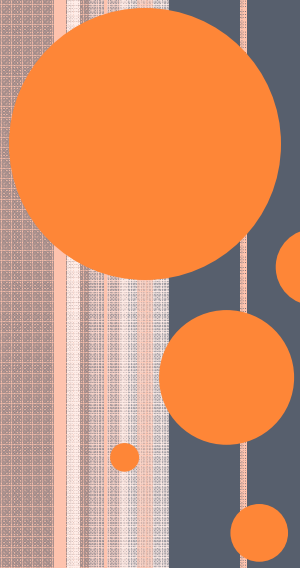


$\forall x\ (Person(x) \rightarrow \exists y\ (Person(y) \wedge motherOf(y,x))$



Forward chaining soundness and completeness

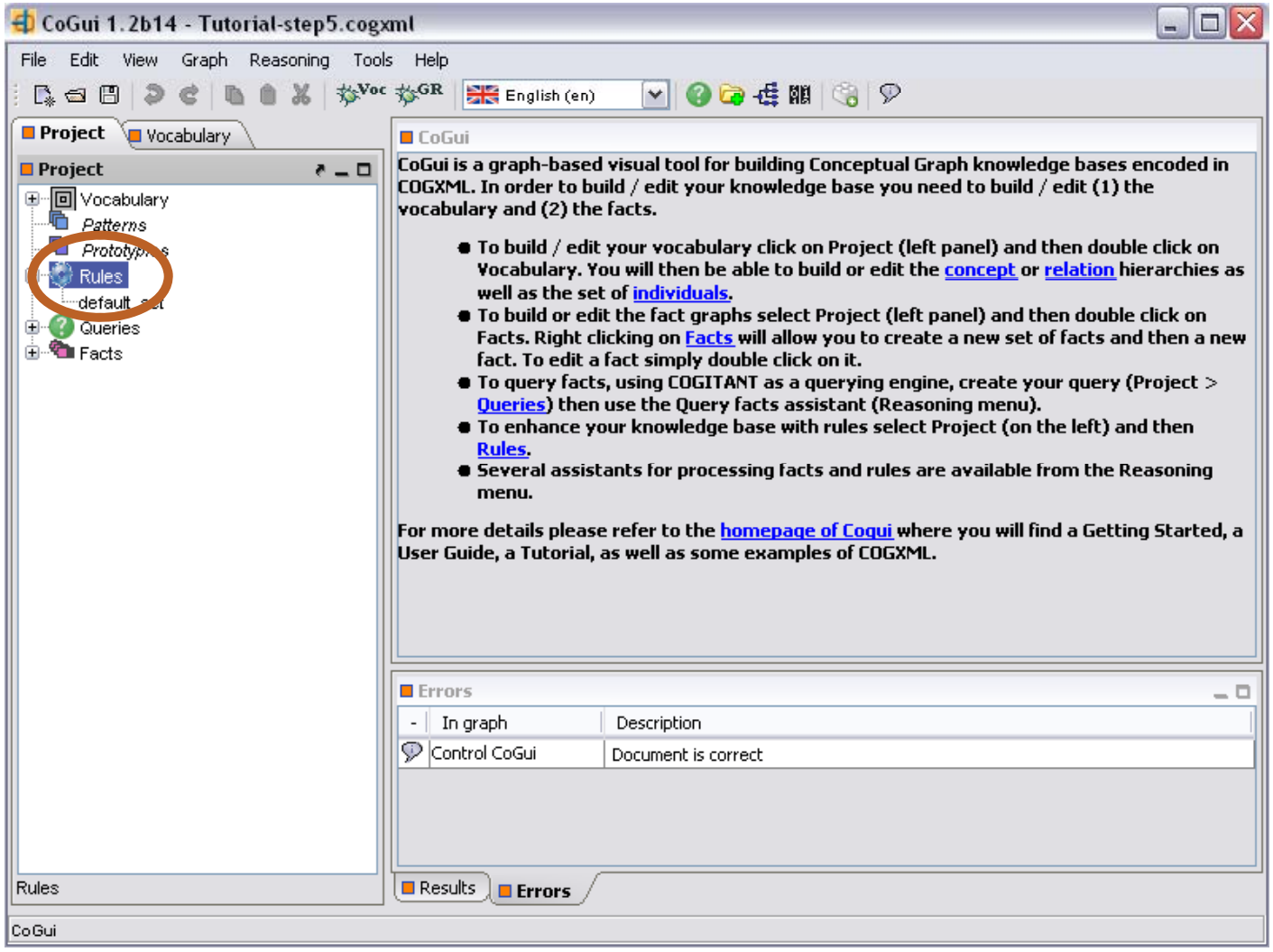
- Knowledge base K with a set of facts F and a set of rules R
- Query Q
- Q is logically deducible from K if and only if there is a projection from Q to a fact produced by FC (K)



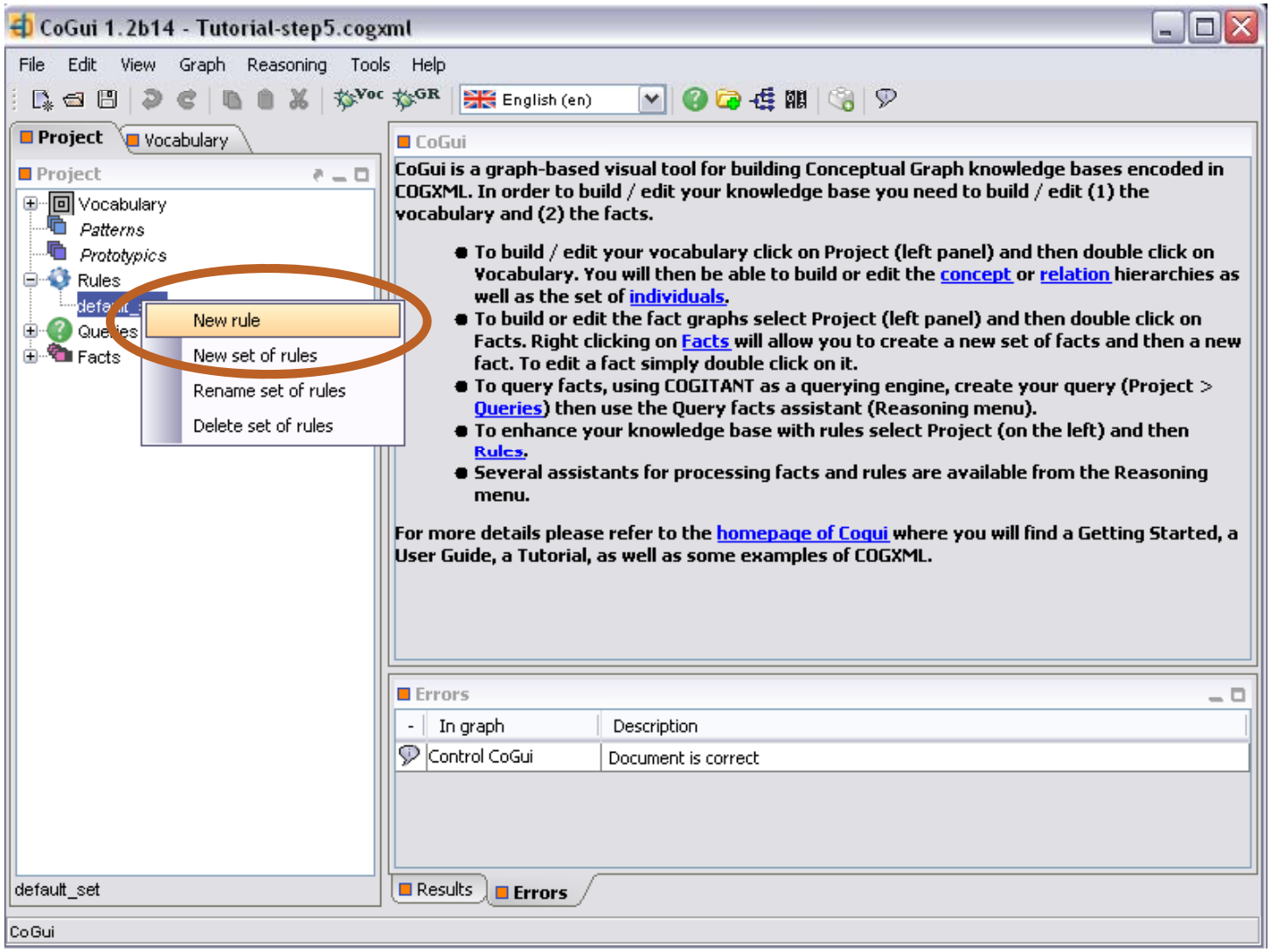
RULES

USING COGUI

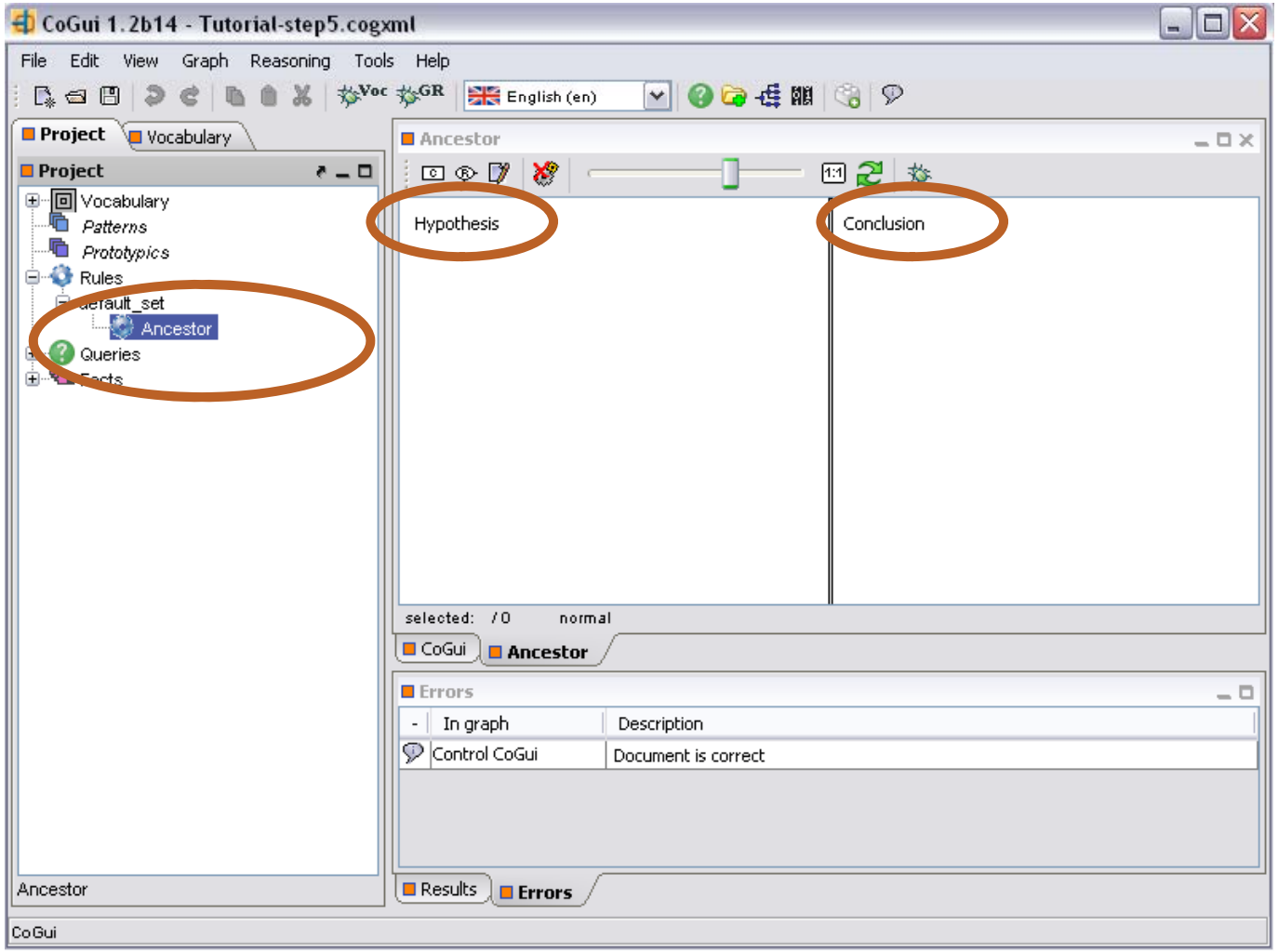
Go to Rules in the project menu



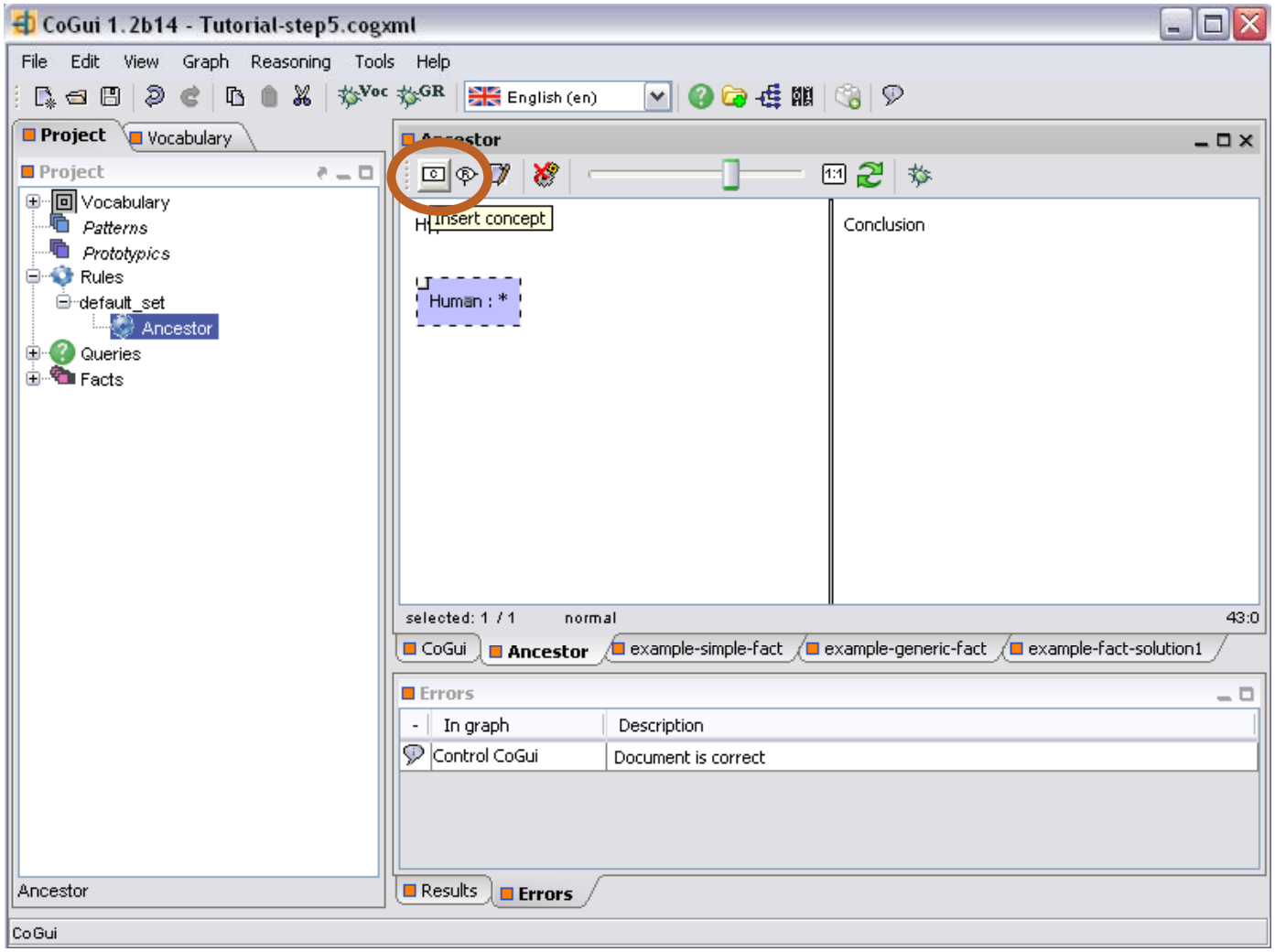
RIGHT CLICK ON DEFAULT SET AND SELECT NEW RULE



Name your rule and edit the hypothesis and the conclusion



To edit your rule do the same as for editing facts



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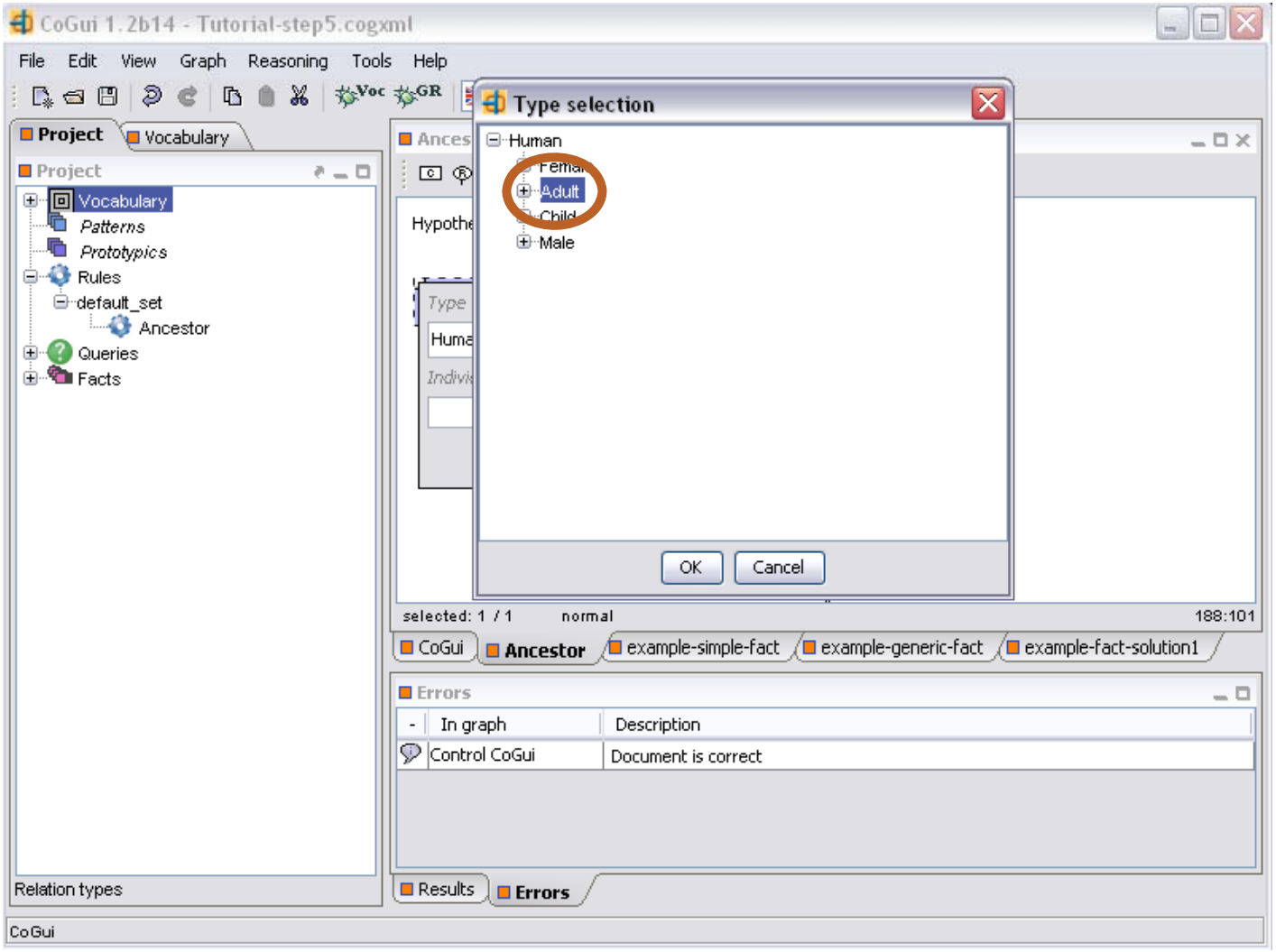
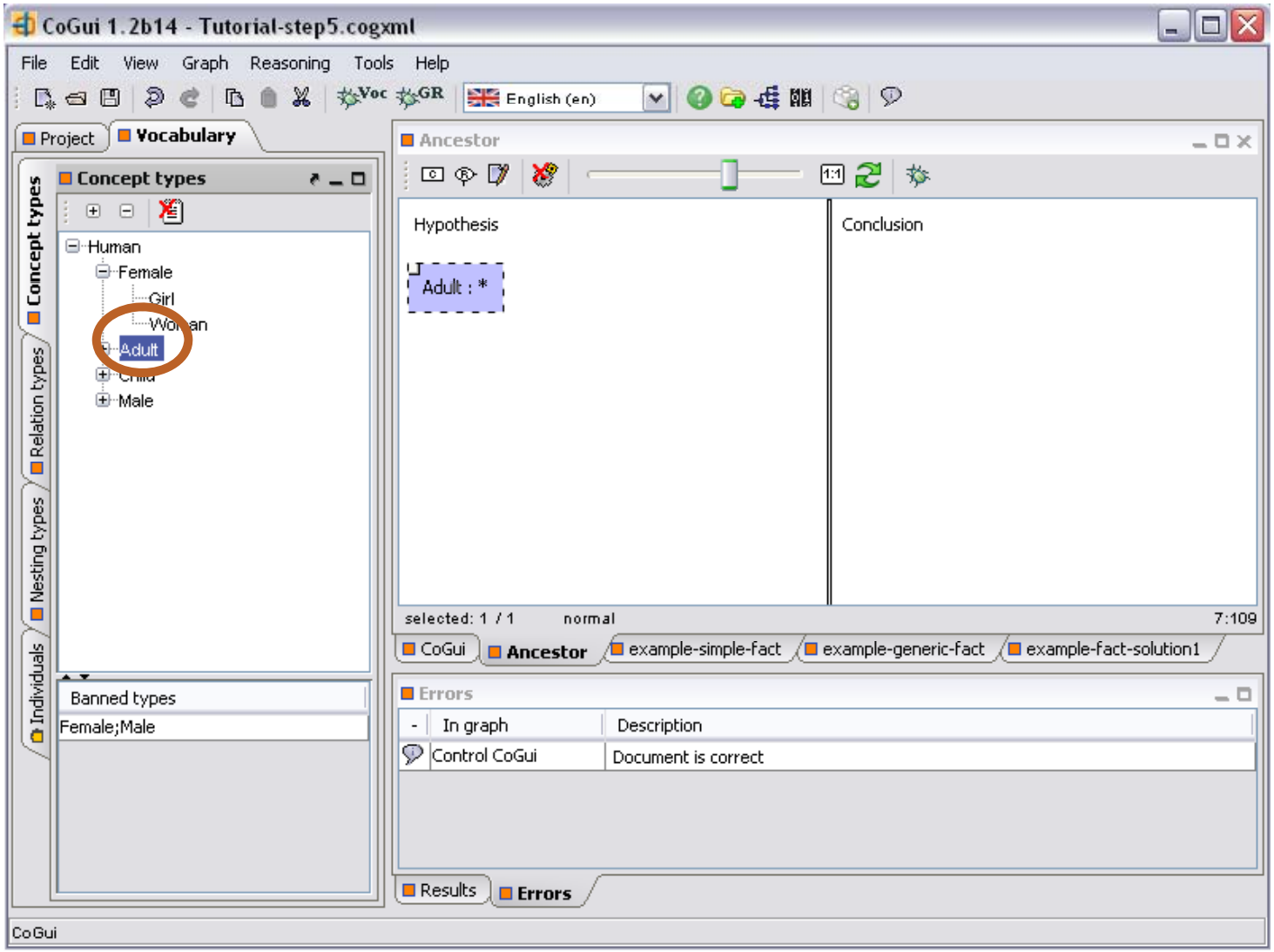
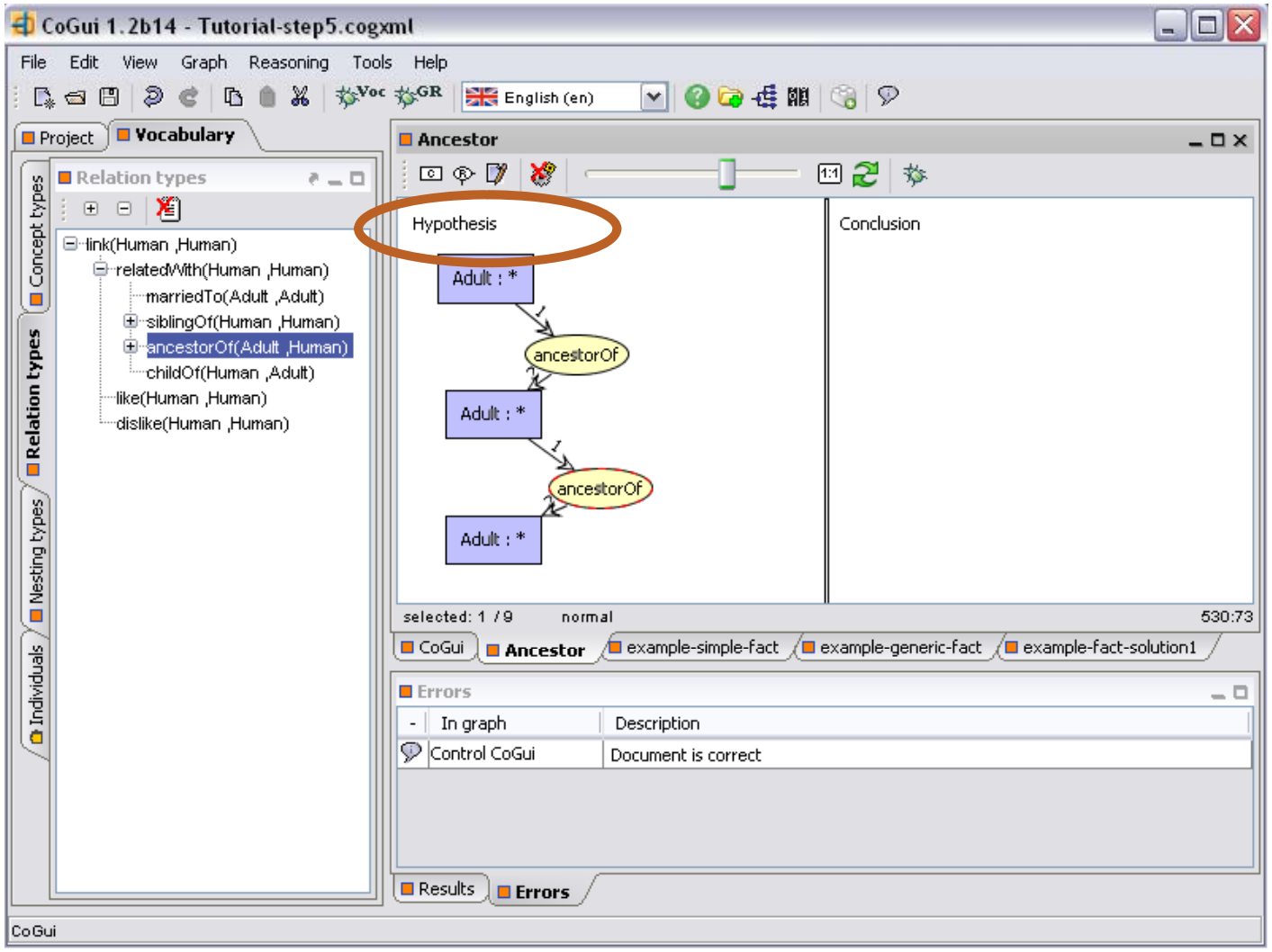


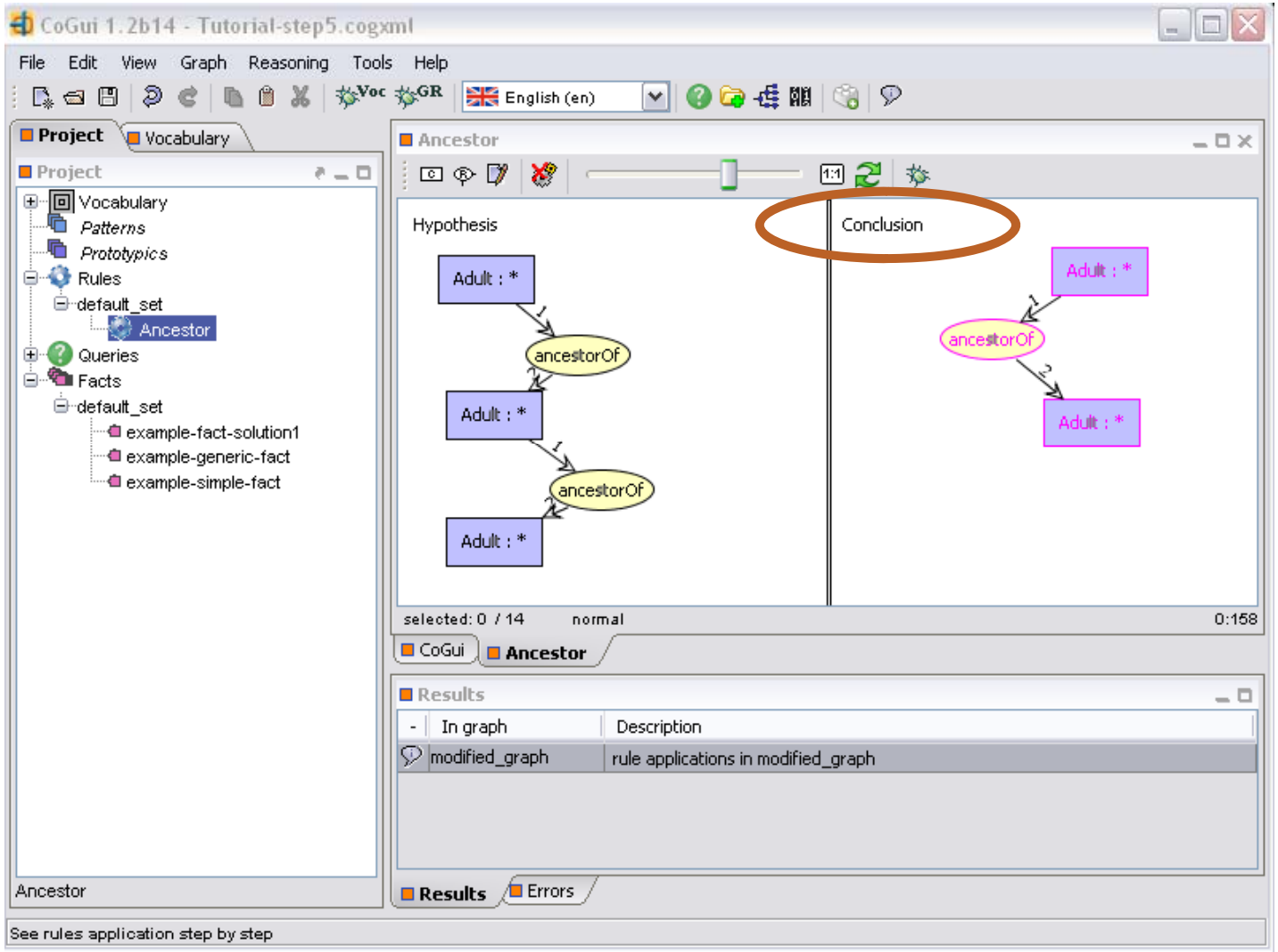
To edit your rule do the same as for editing facts



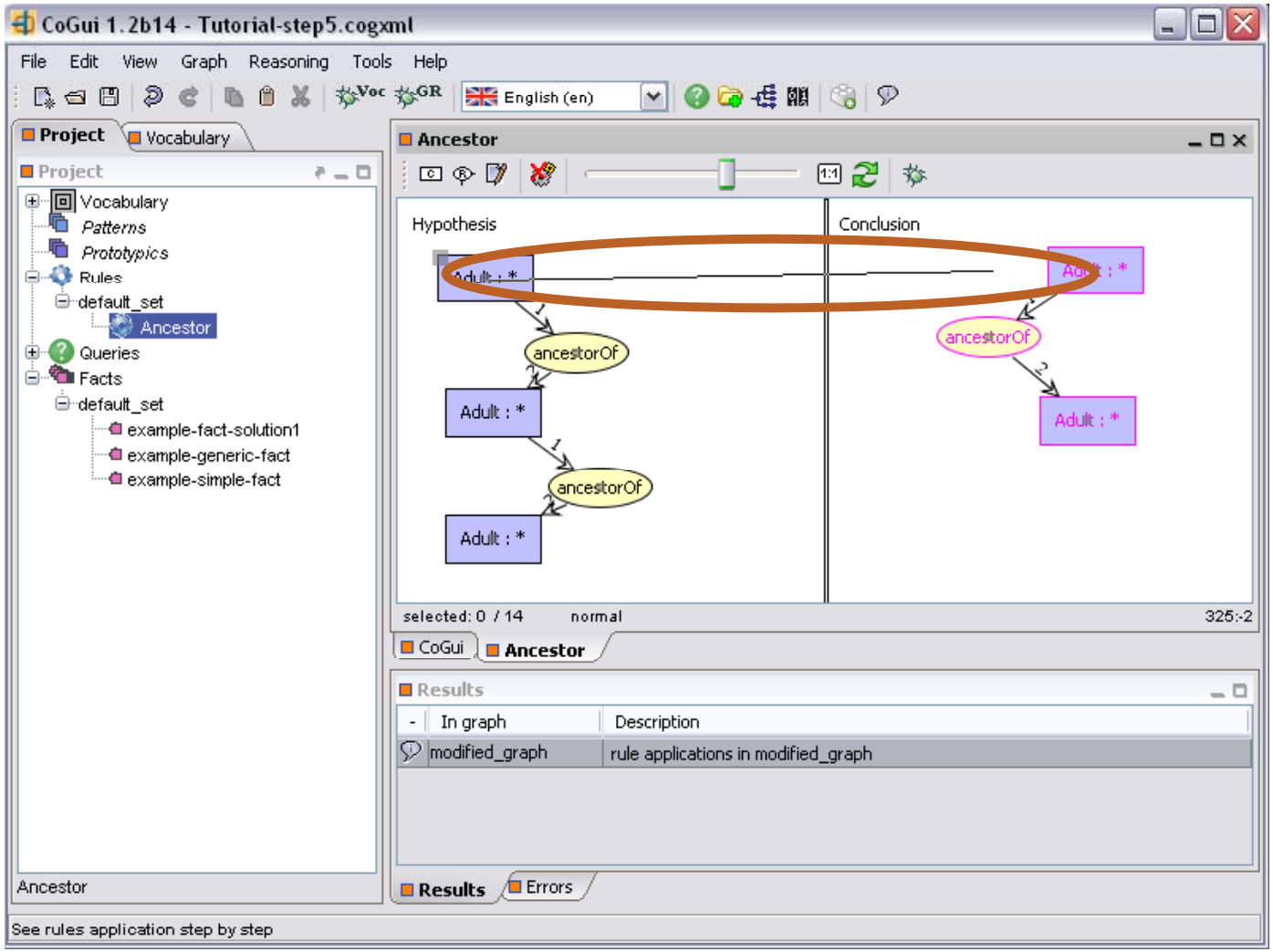
To edit your rule do the same as for editing facts



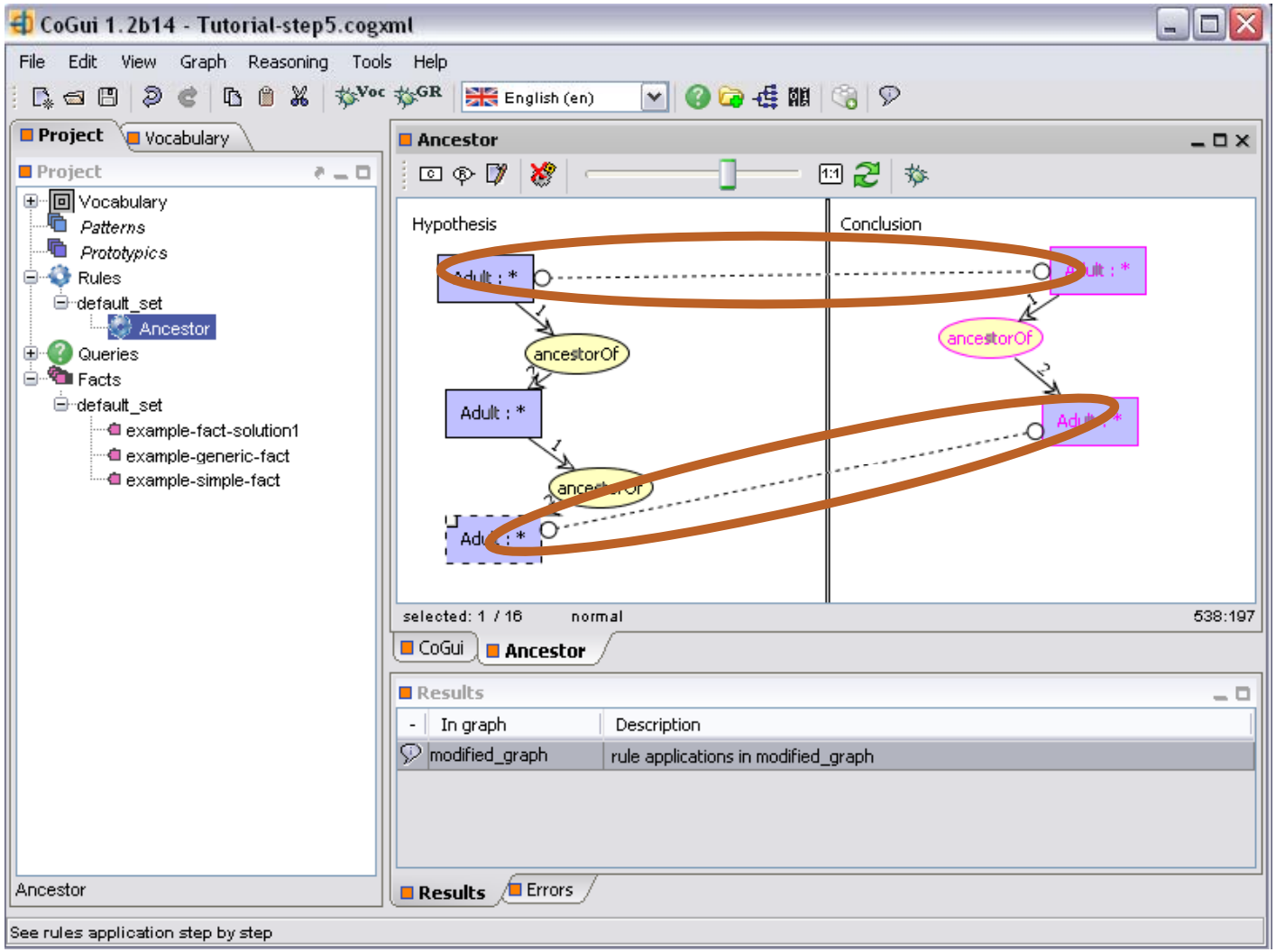
To edit your rule do the same as for editing facts



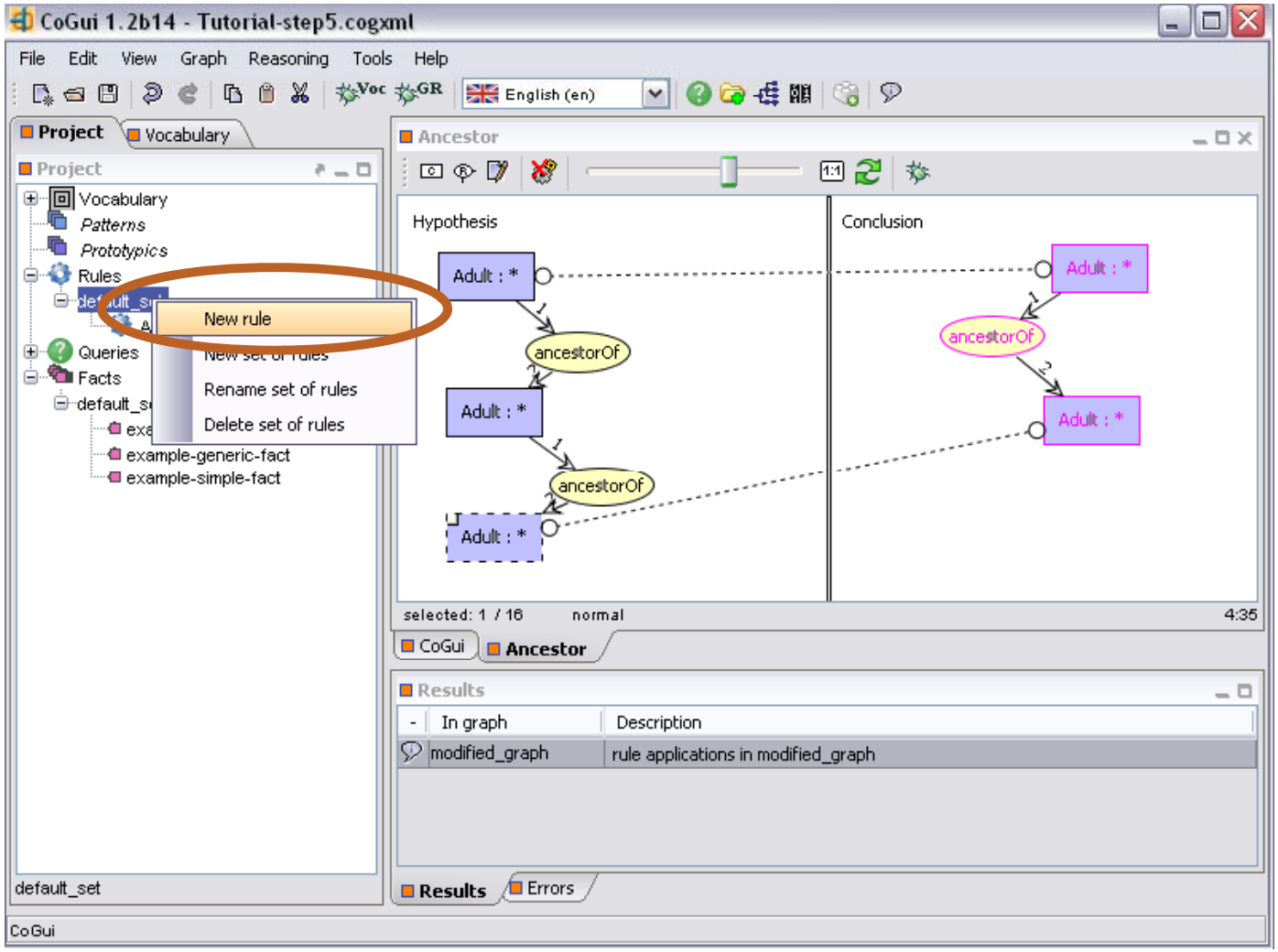
To express that two concept nodes design the same entity add a coref relation



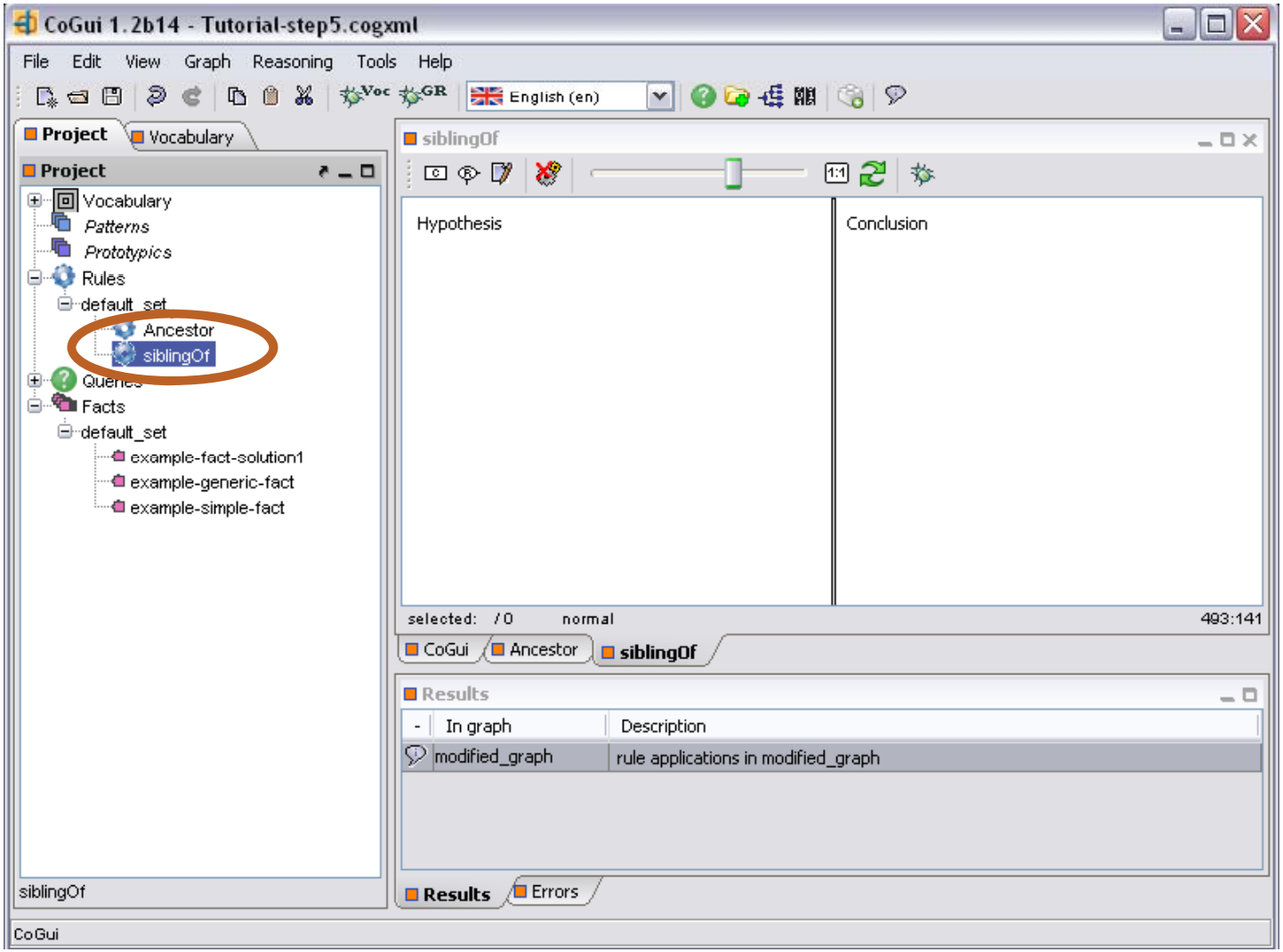
DO NOT FORGET TO ADD THE COREF RELATIONS BETWEEN ALL CONCEPTS



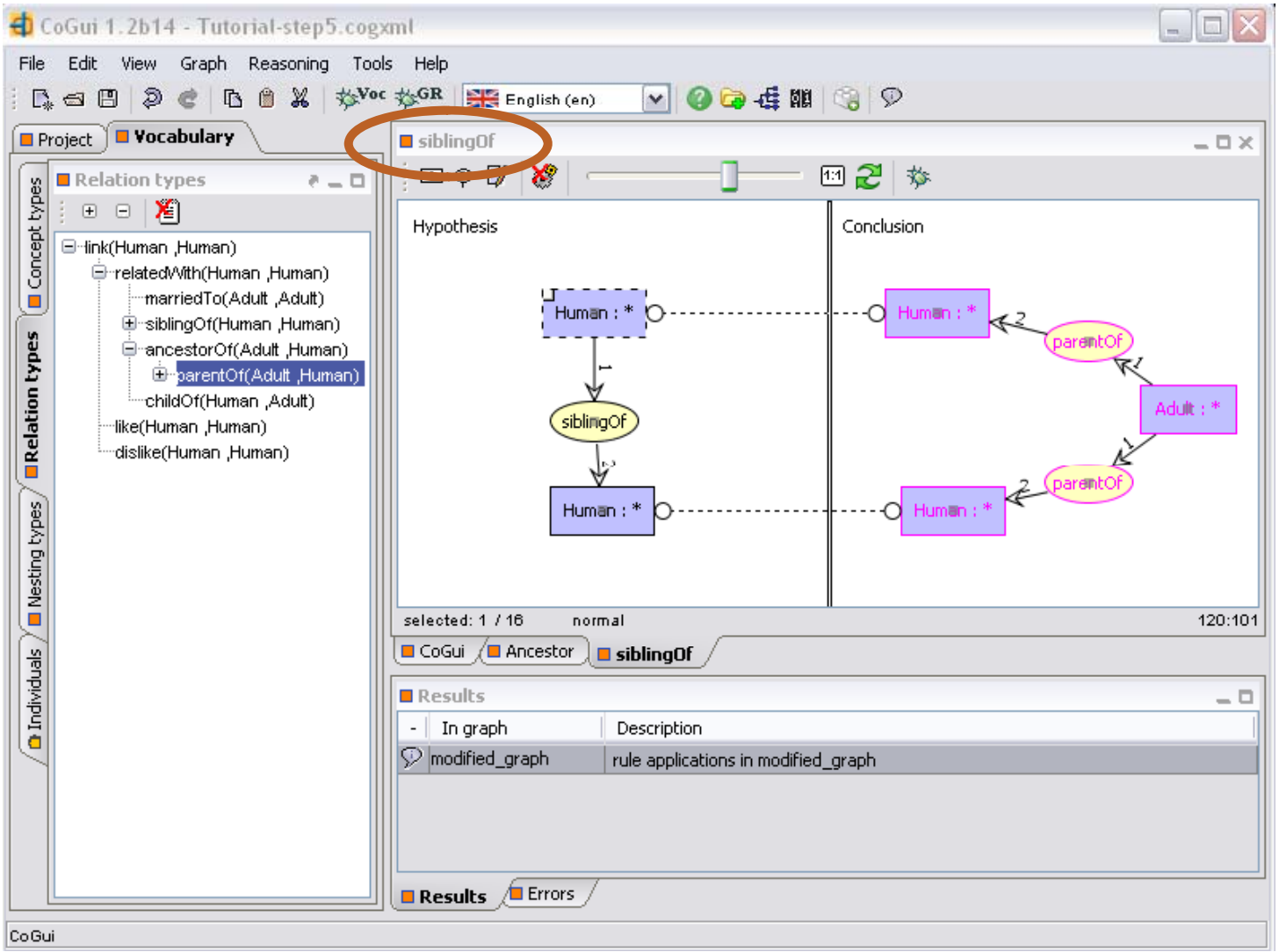
To construct a new rule right click on default_set of rules



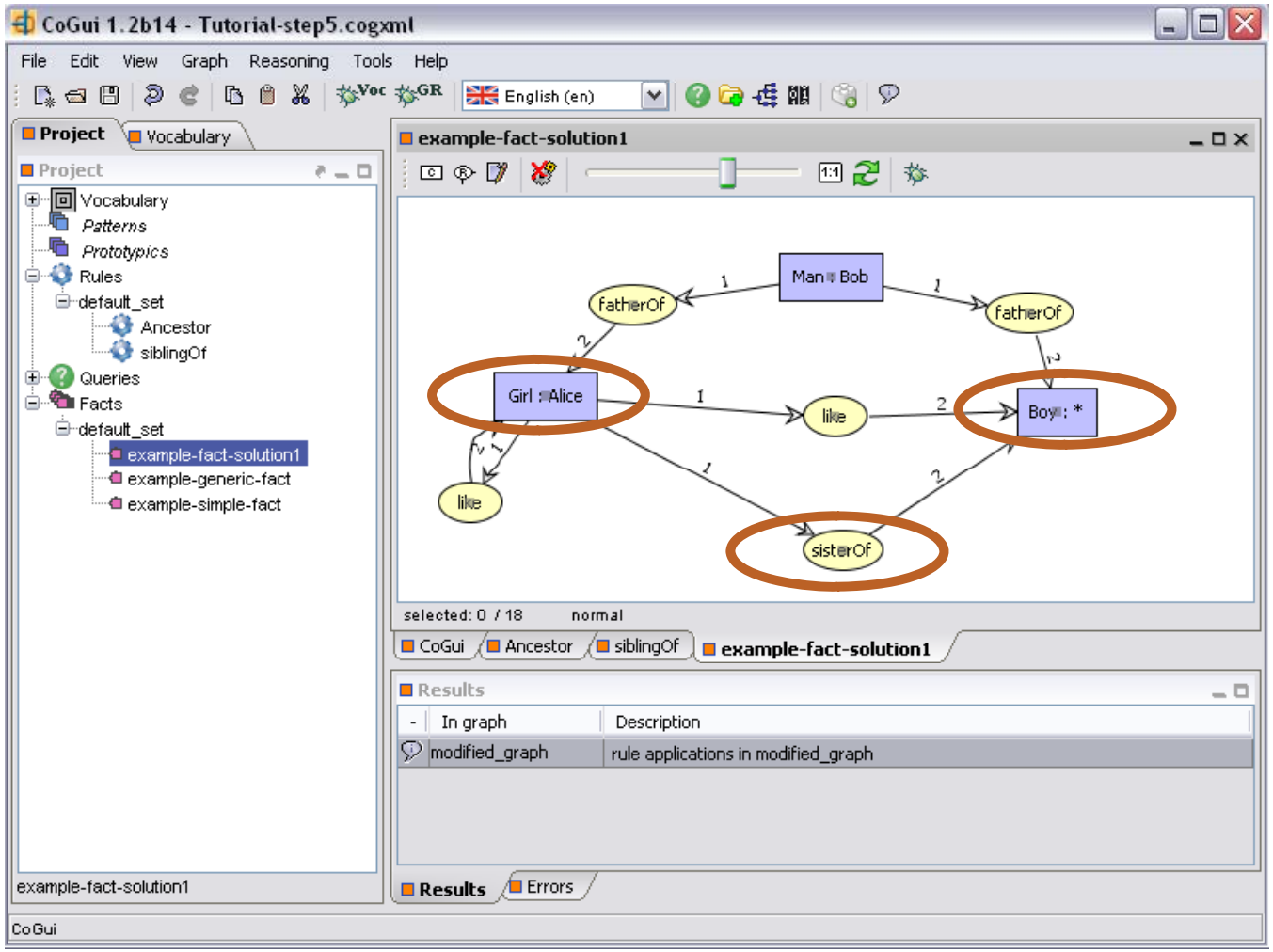
We will edit the siblingOf rule described earlier in the tutorial



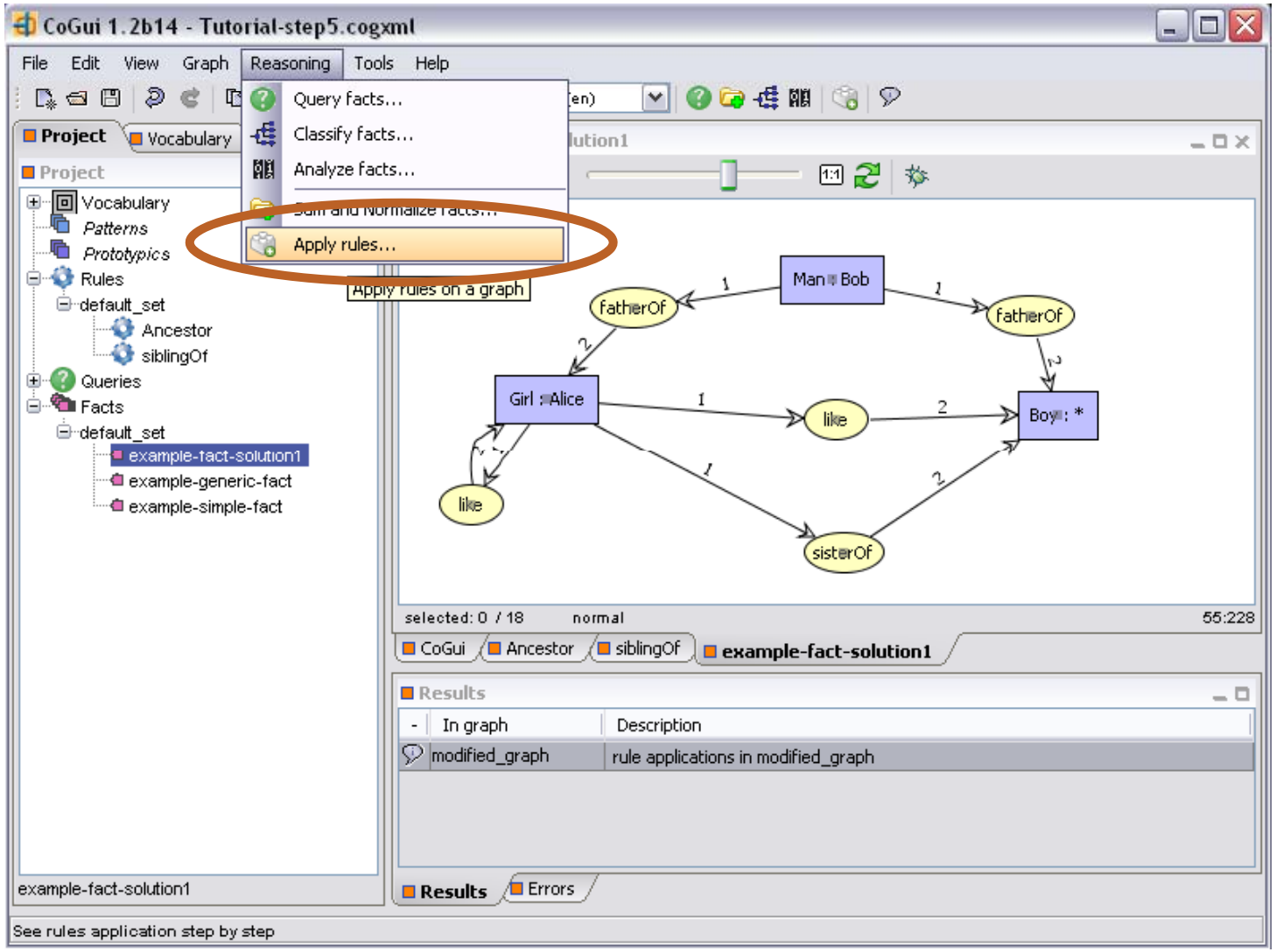
THE RULE: IF A HUMAN IS THE SIBLING OF ANOTHER HUMAN THEN THERE EXISTS AN ADULT WHO IS THE PARENT OF THE TWO HUMANS



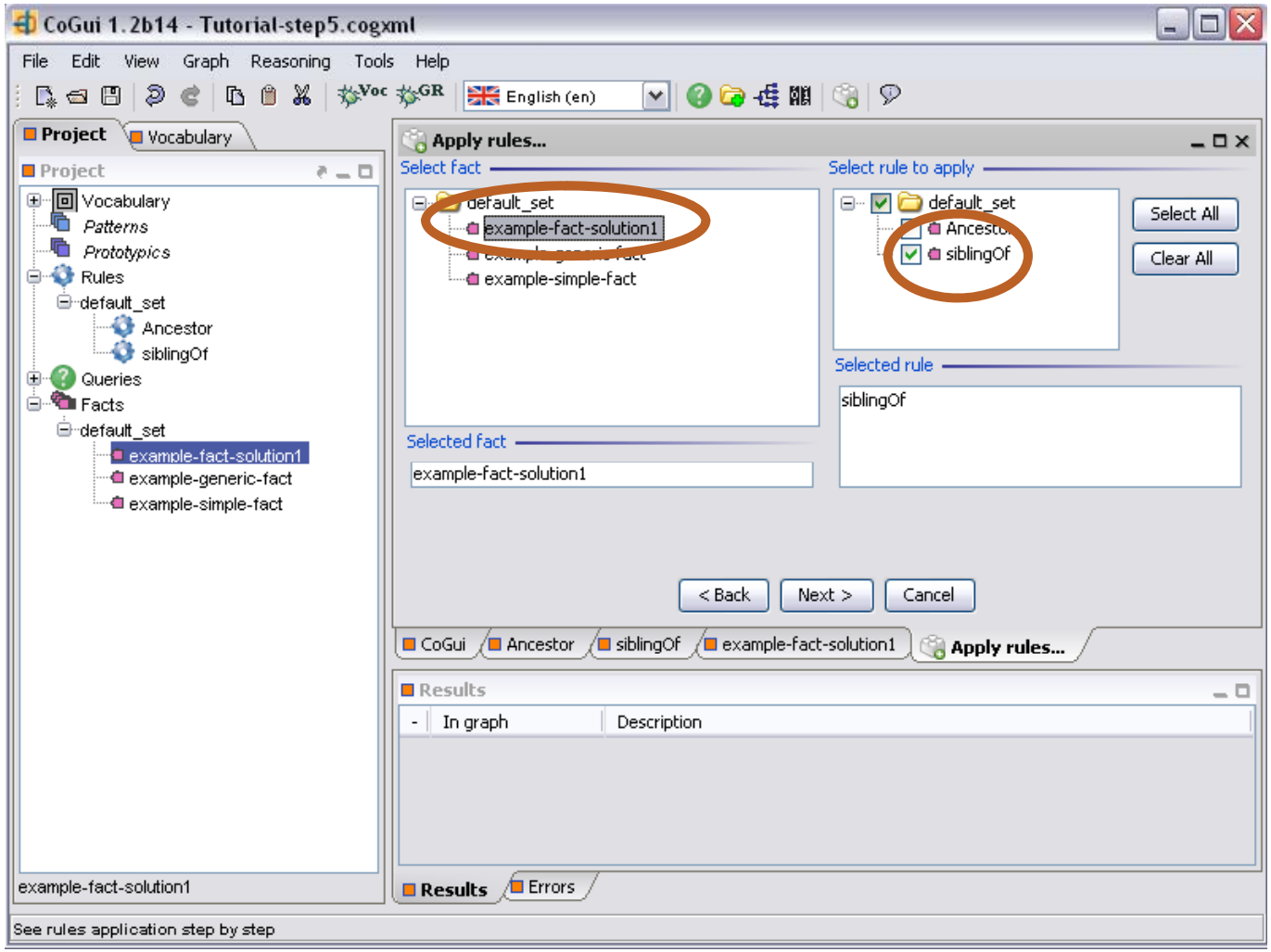
Let us try to apply this rule on the fact example-fact-solution1



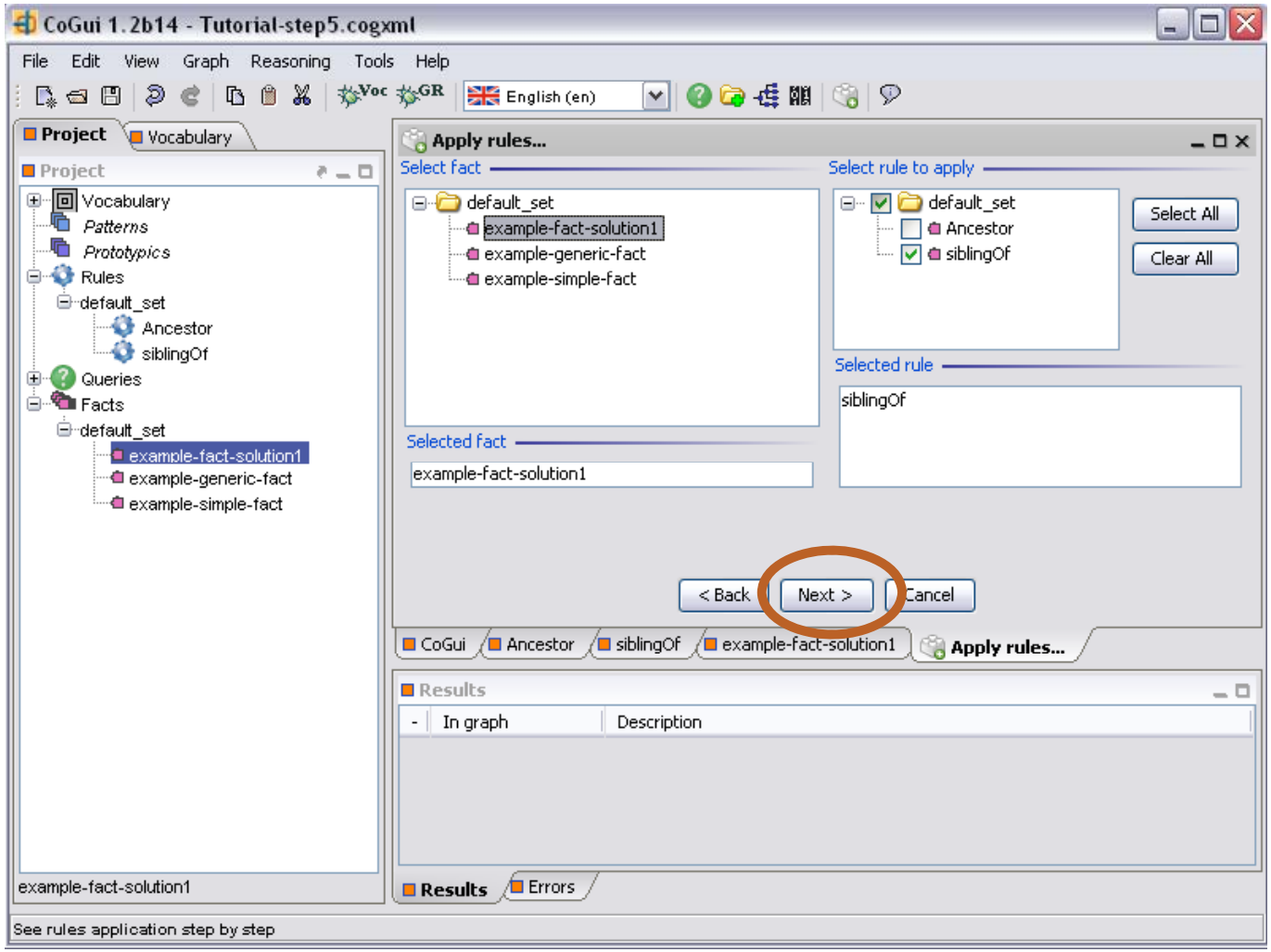
To apply rules, click on reasoning then select apply rules



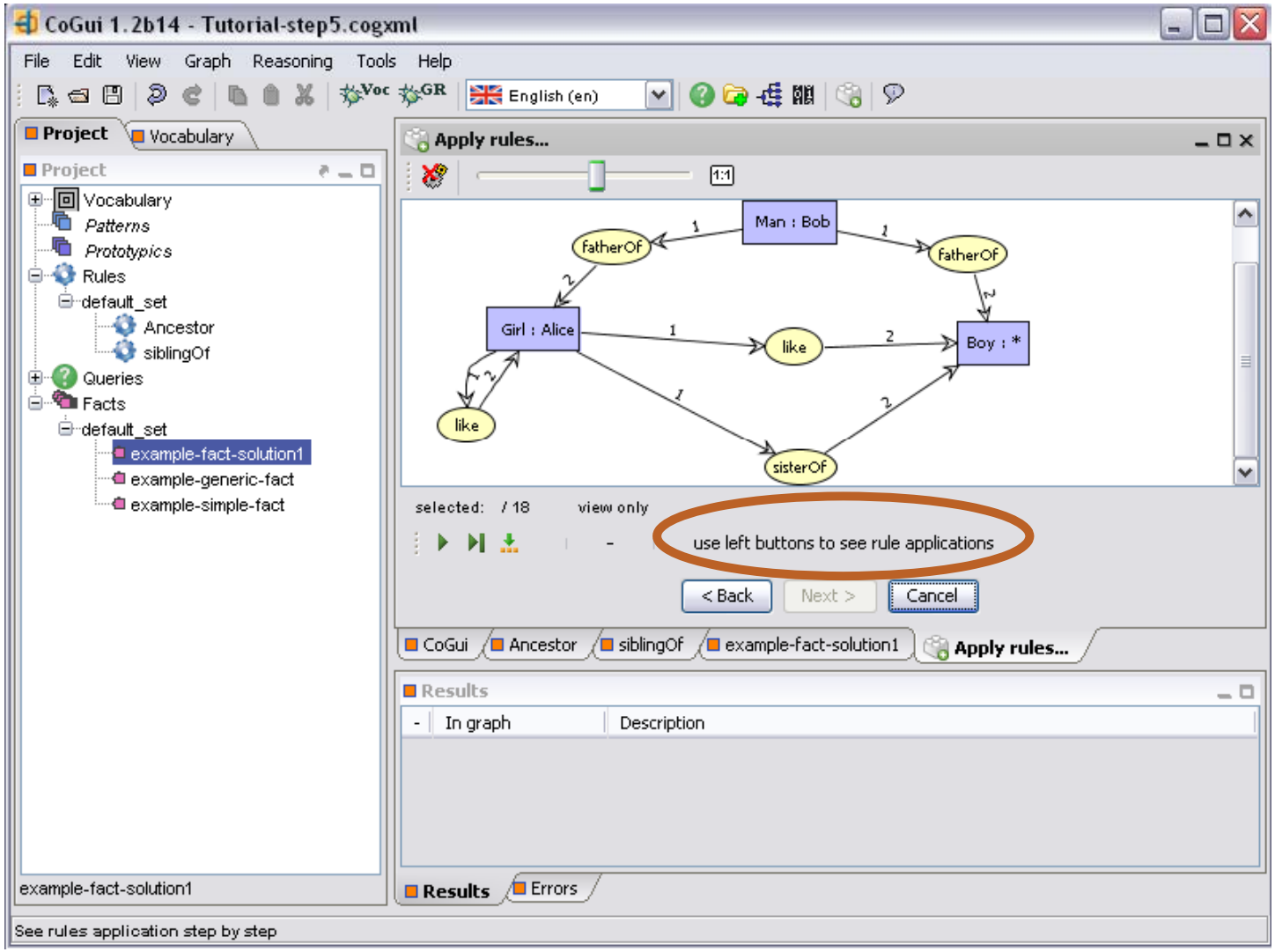
SELECT THE FACT ON WHICH YOU WANT TO APPLY THE RULE AND THE DESIRED RULE



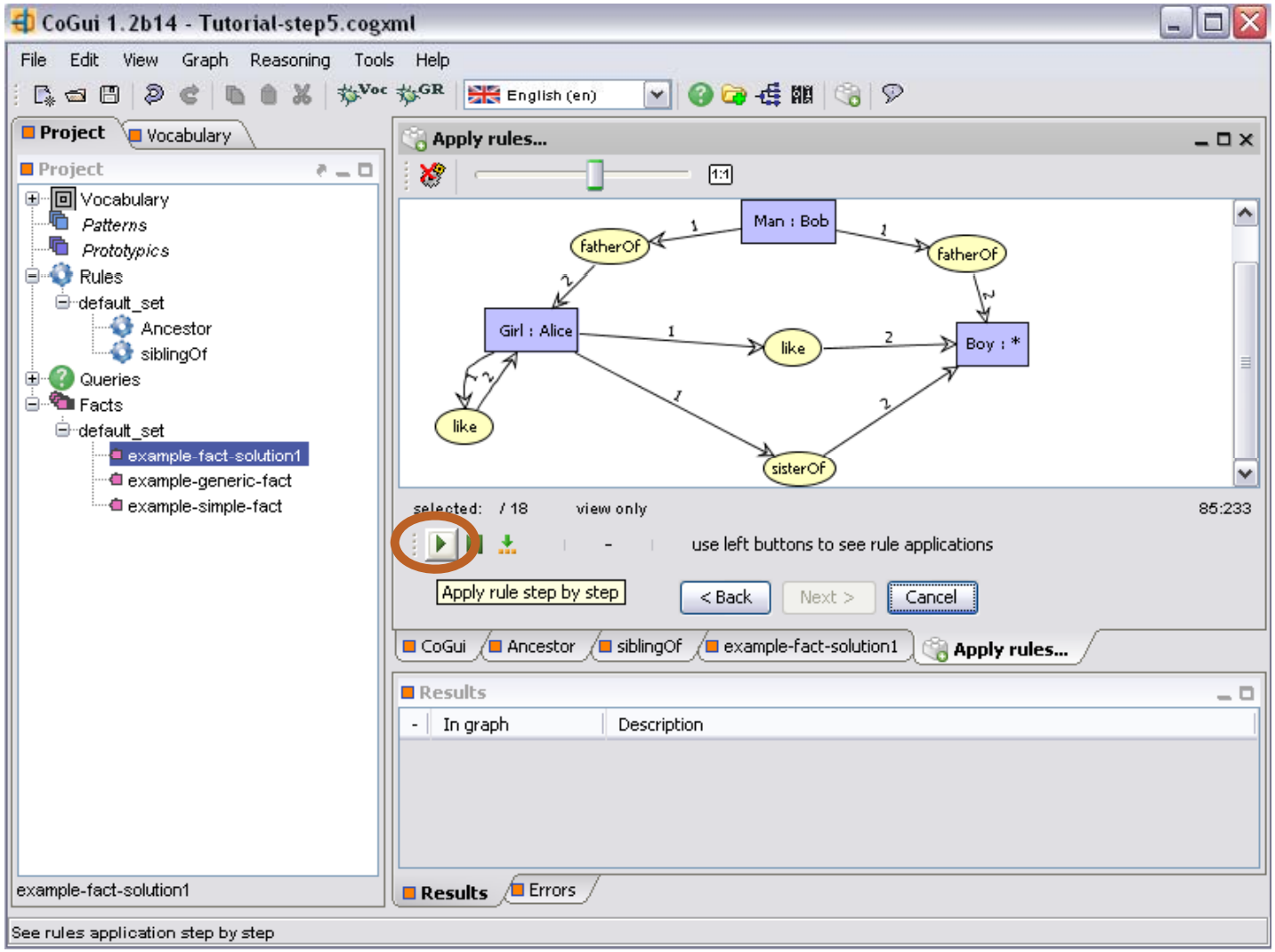
TO APPLY THE RULE CLICK NEXT



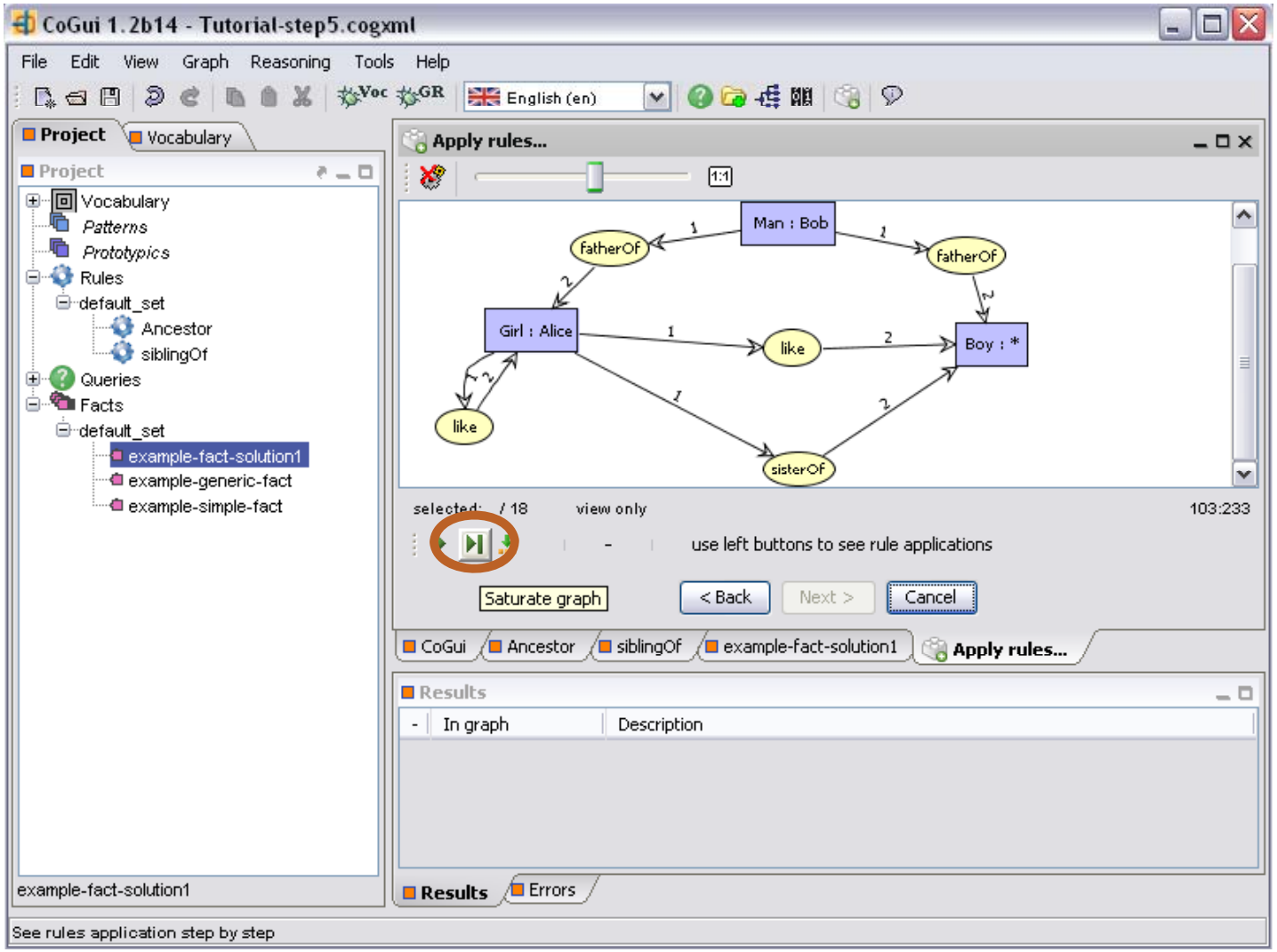
The rules assistant provides three buttons



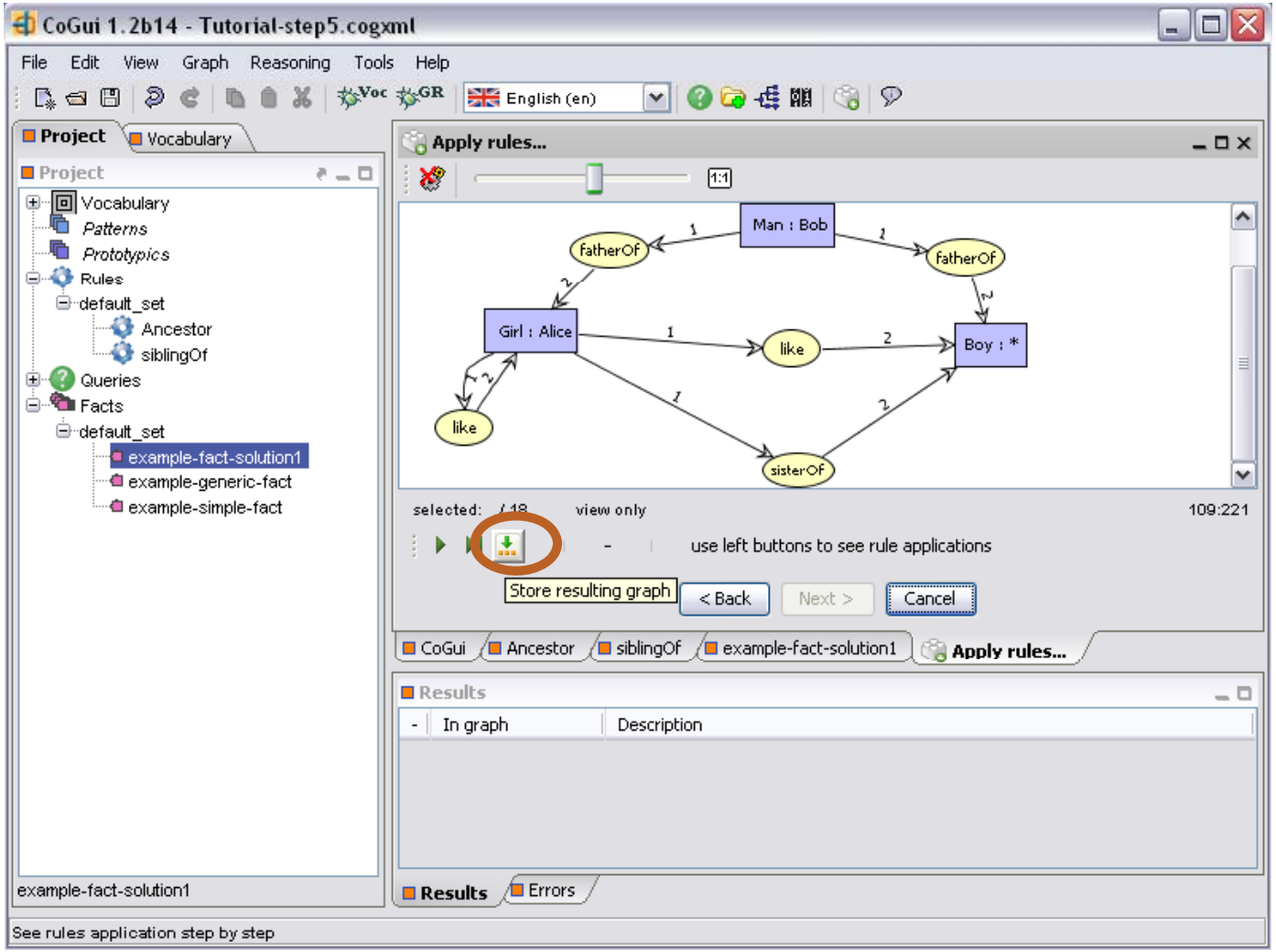
THE FIRST BUTTON ALLOWS THE STEP BY STEP APPLICATION OF THE RULE



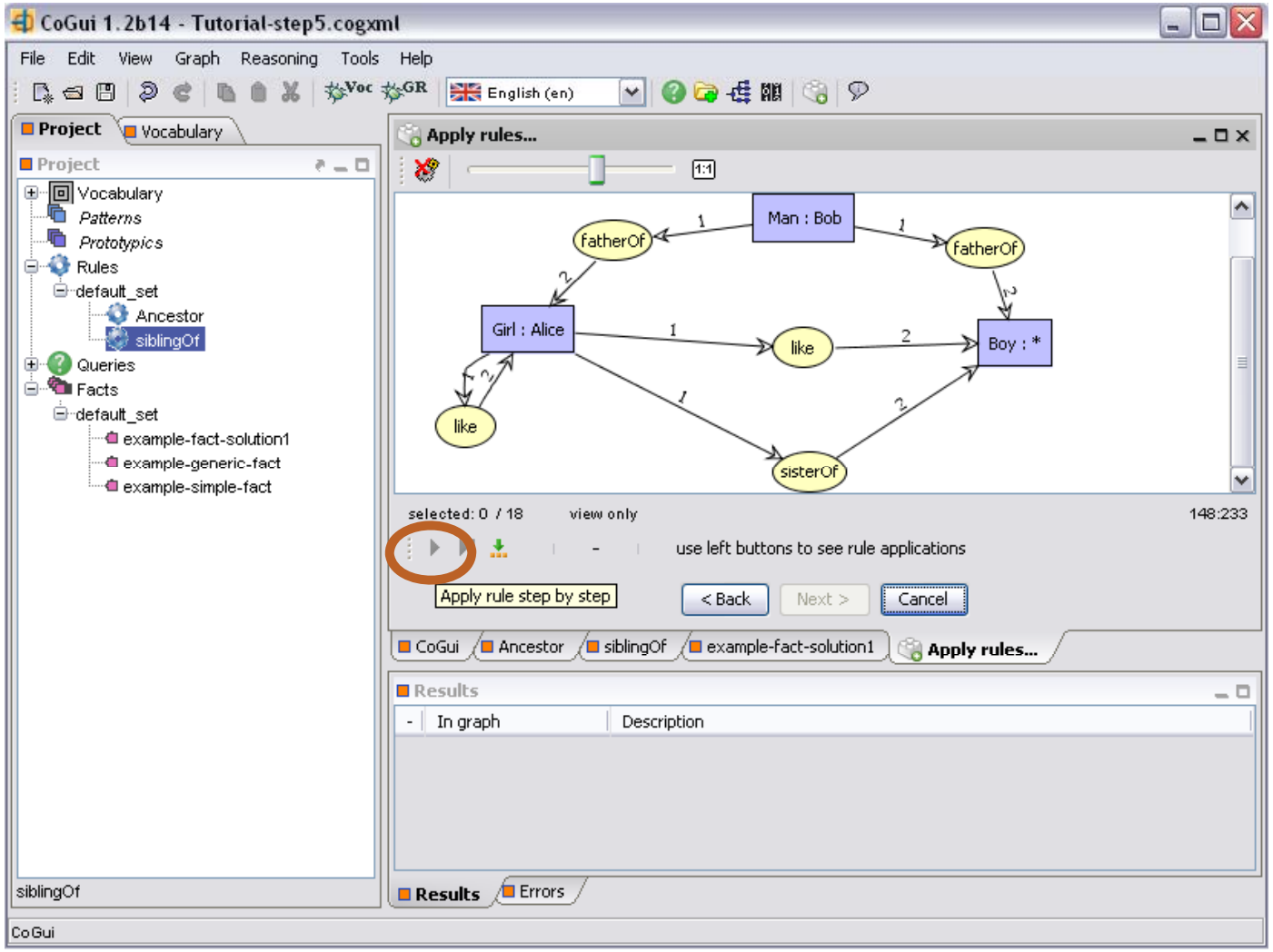
THE SECOND BUTTON ALLOWS THE SATURATION OF THE GRAPH WITH THE SELECTED RULE



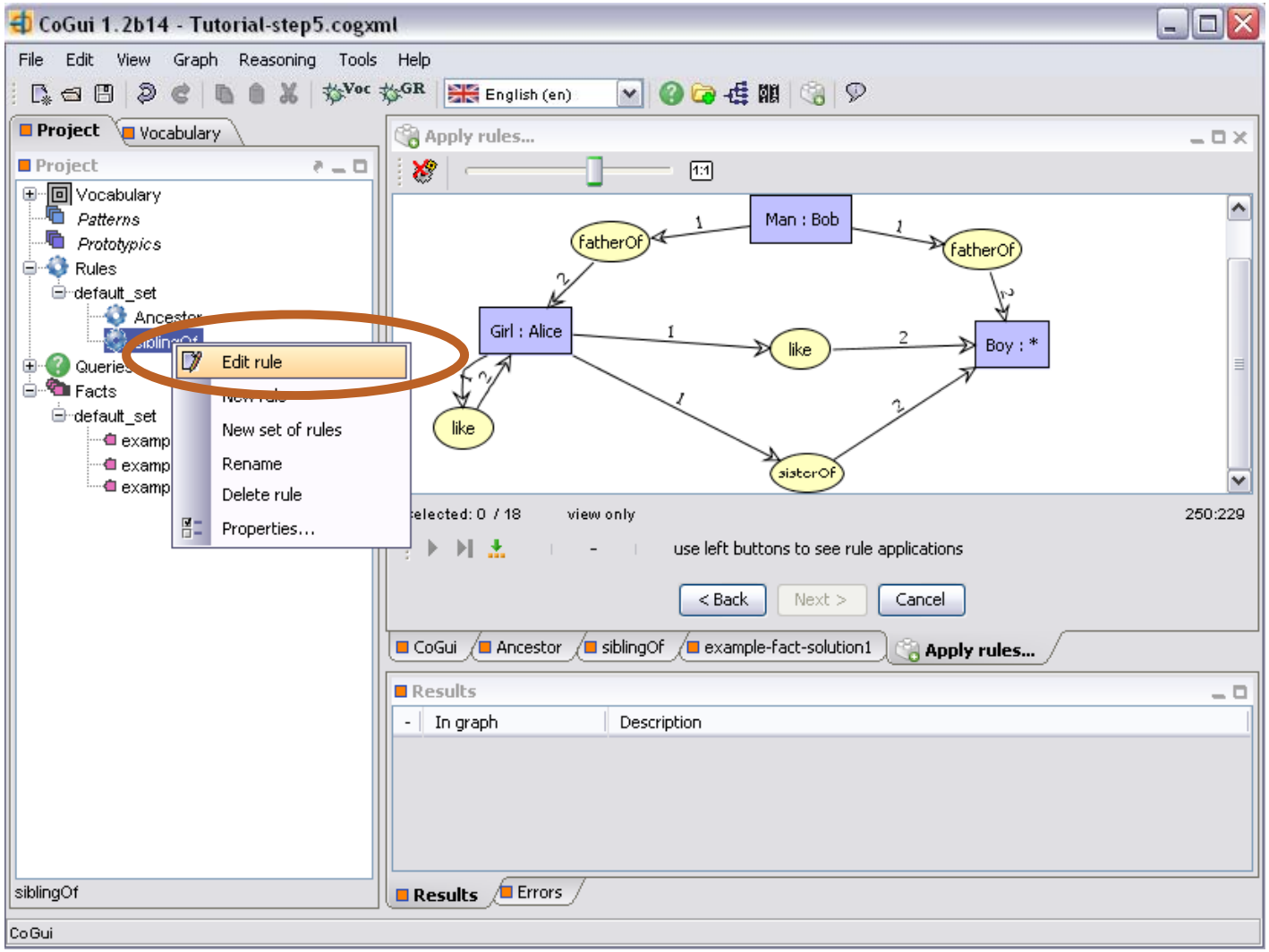
THE THIRD BUTTON ALLOWS THE STORAGE OF THE GRAPH ENRICHED AFTER RULE APPLICATION



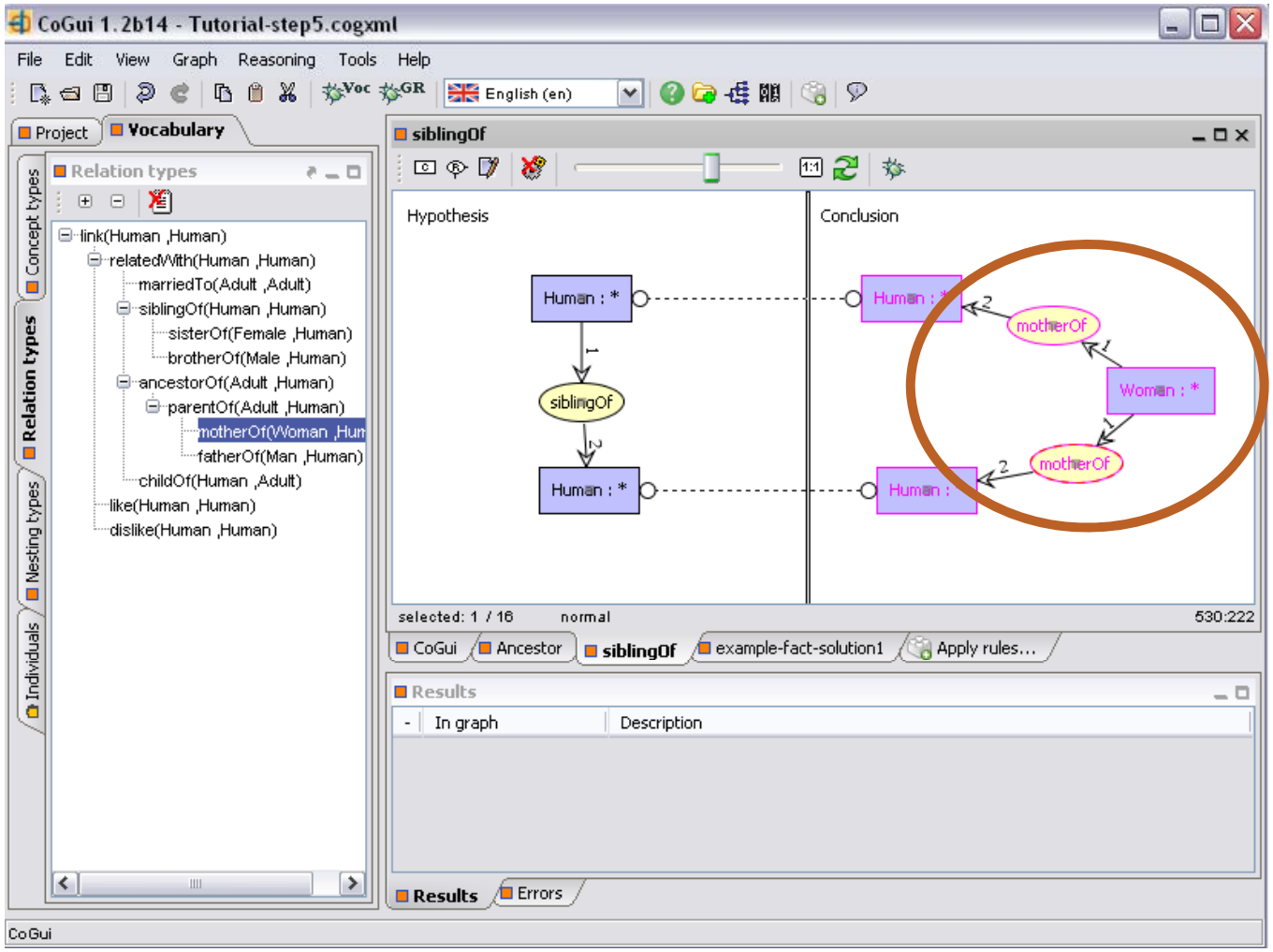
GOING BACK TO THE EXAMPLE WHEN WE CLICK ON APPLY RULE NOTHING HAPPENS!! WHY?



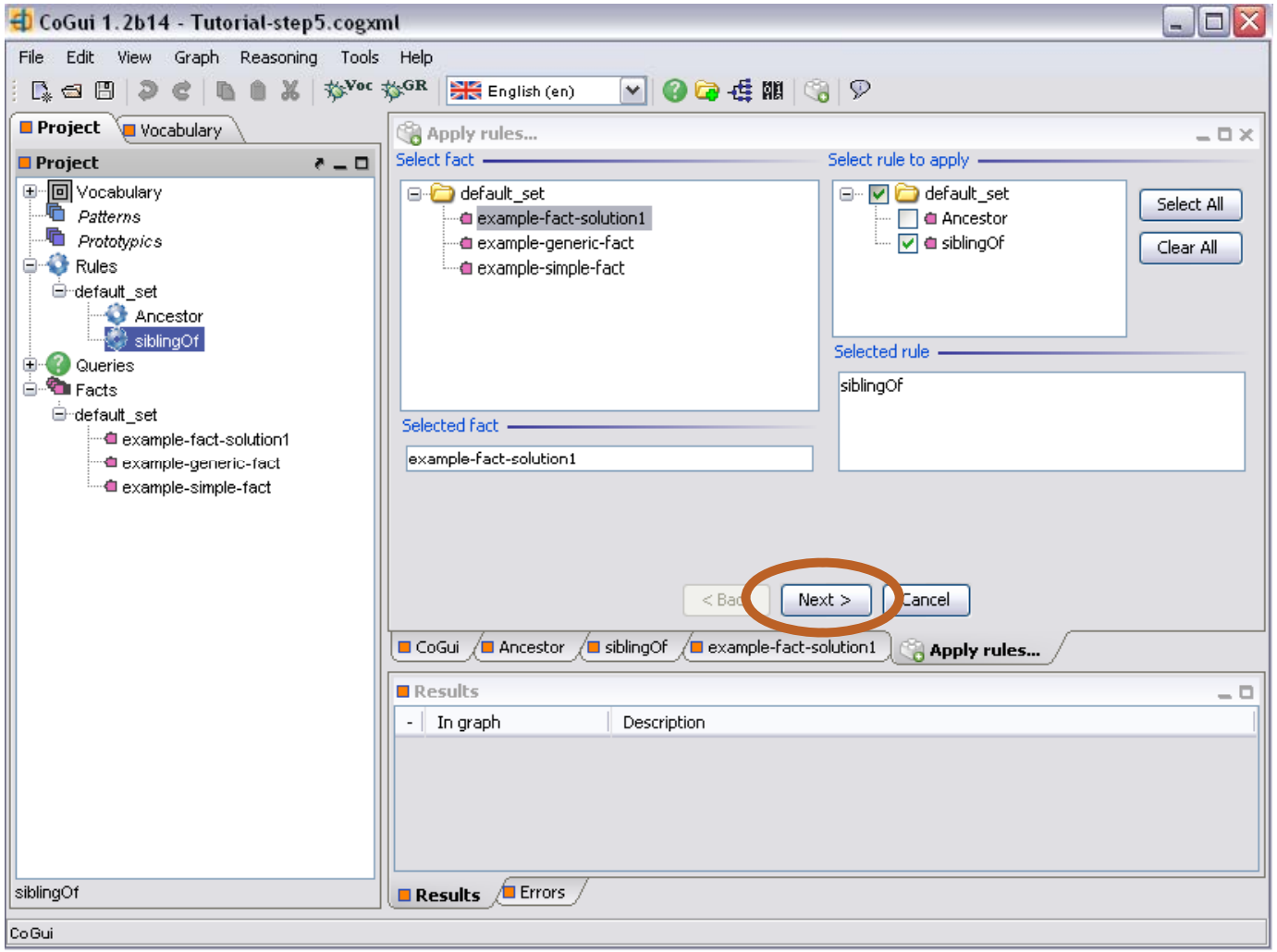
We edit the siblingOf rule



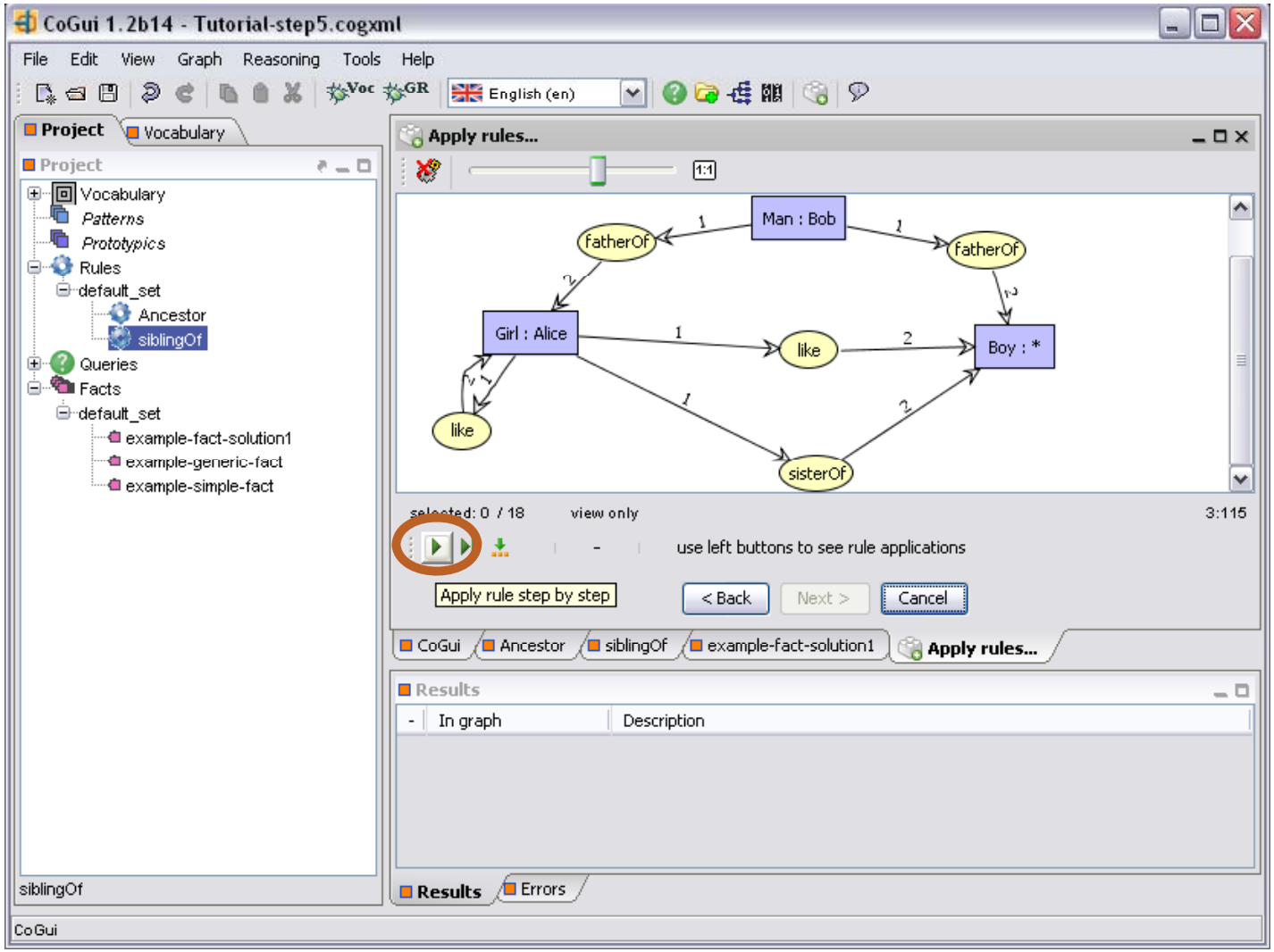
The siblingOf rule edited so that the added information concerns the mother of the two humans in the hypothesis



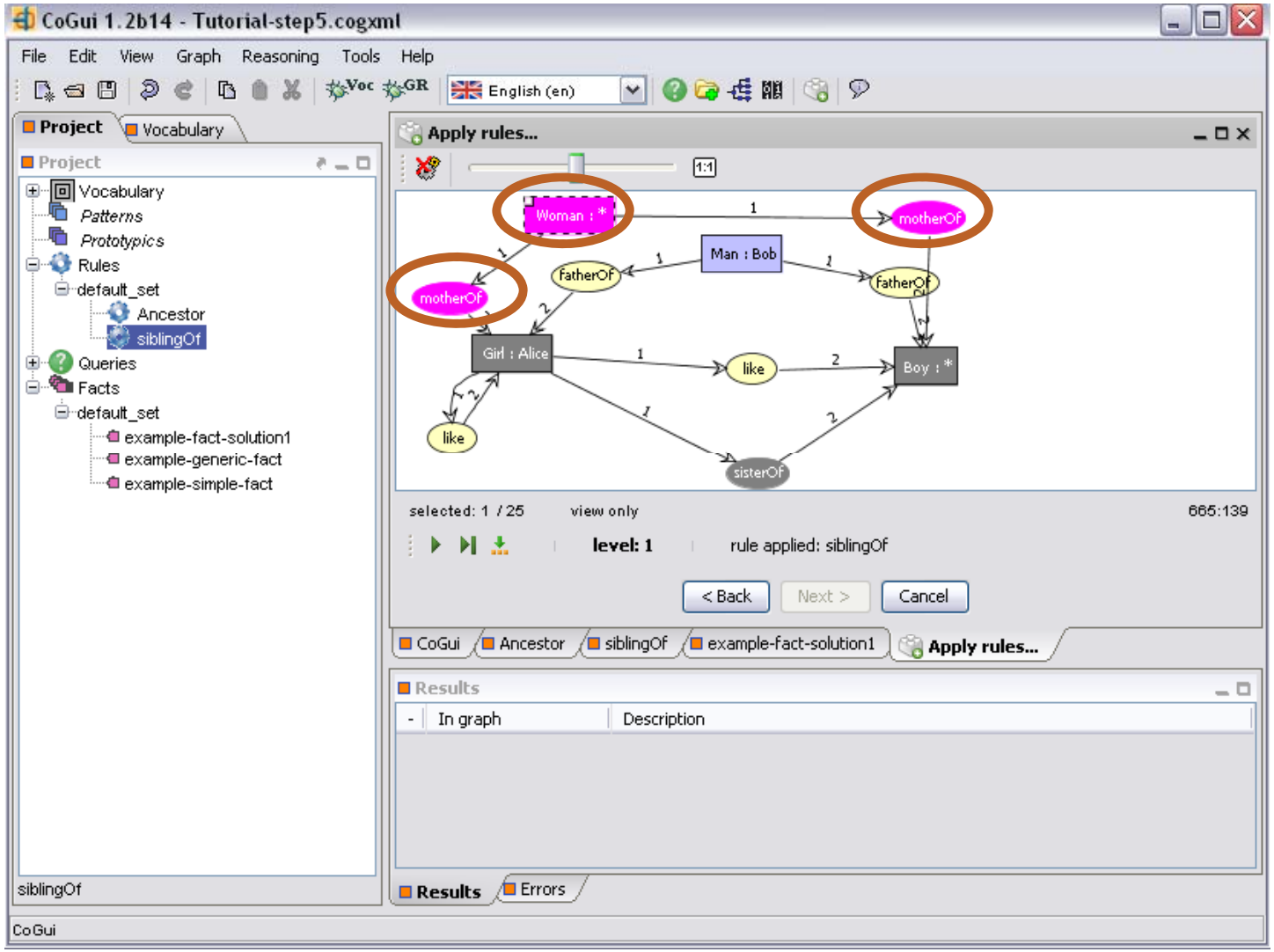
We apply the newly edited rule



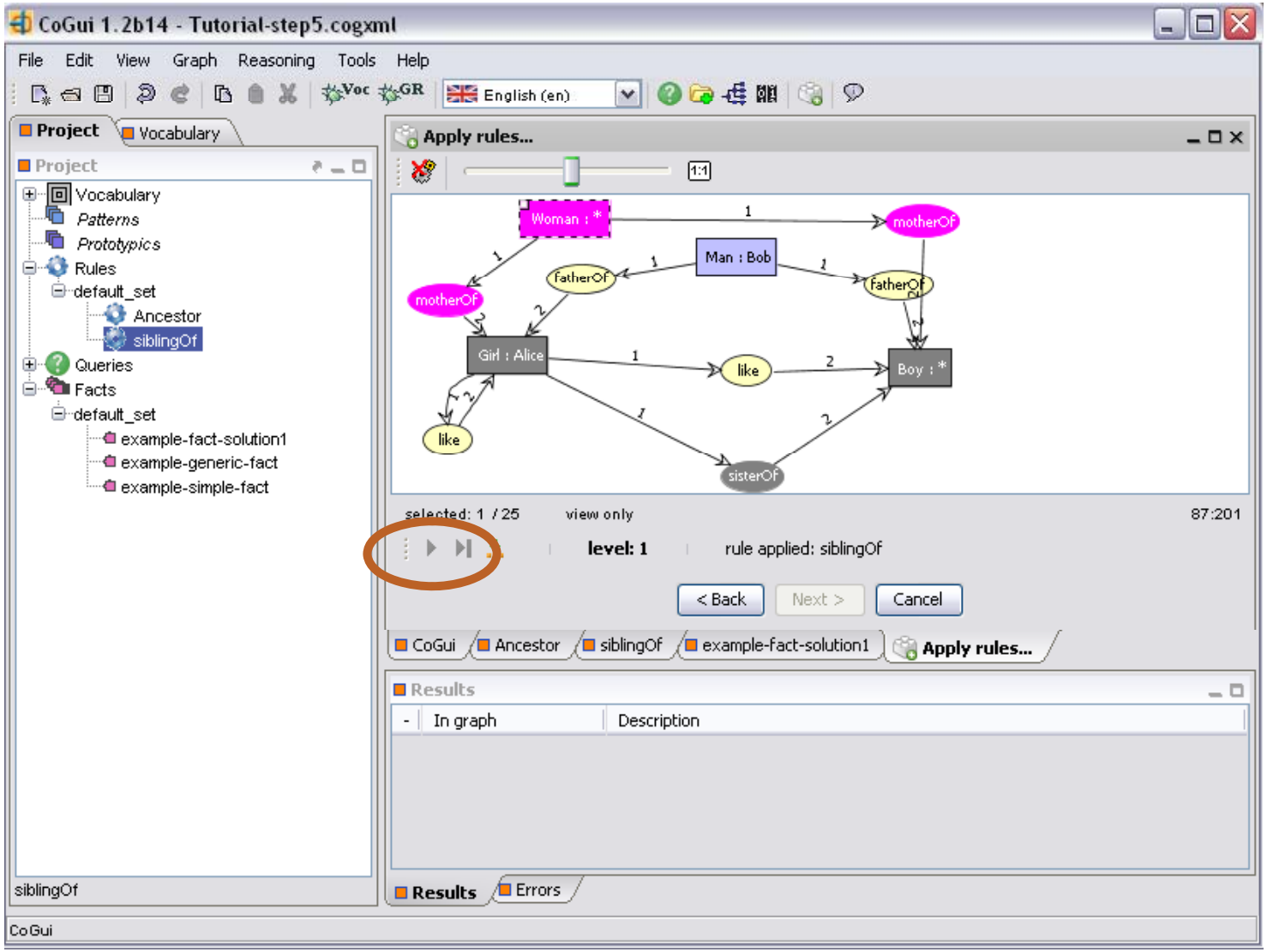
We select the step by step application of the rule



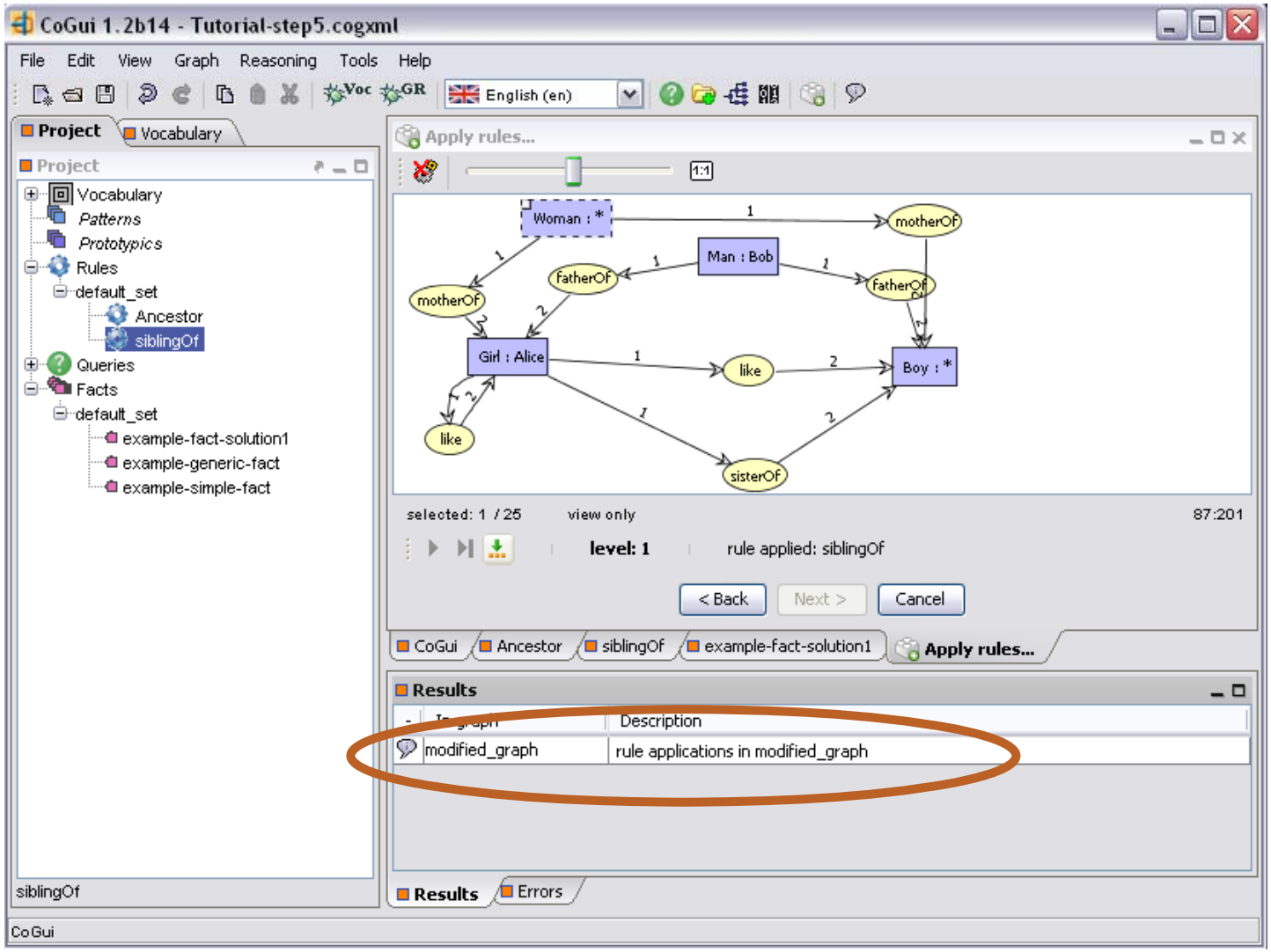
THE THREE NODES IN THE CONCLUSION HAVE BEEN ADDED IN PINK ON THE FACT



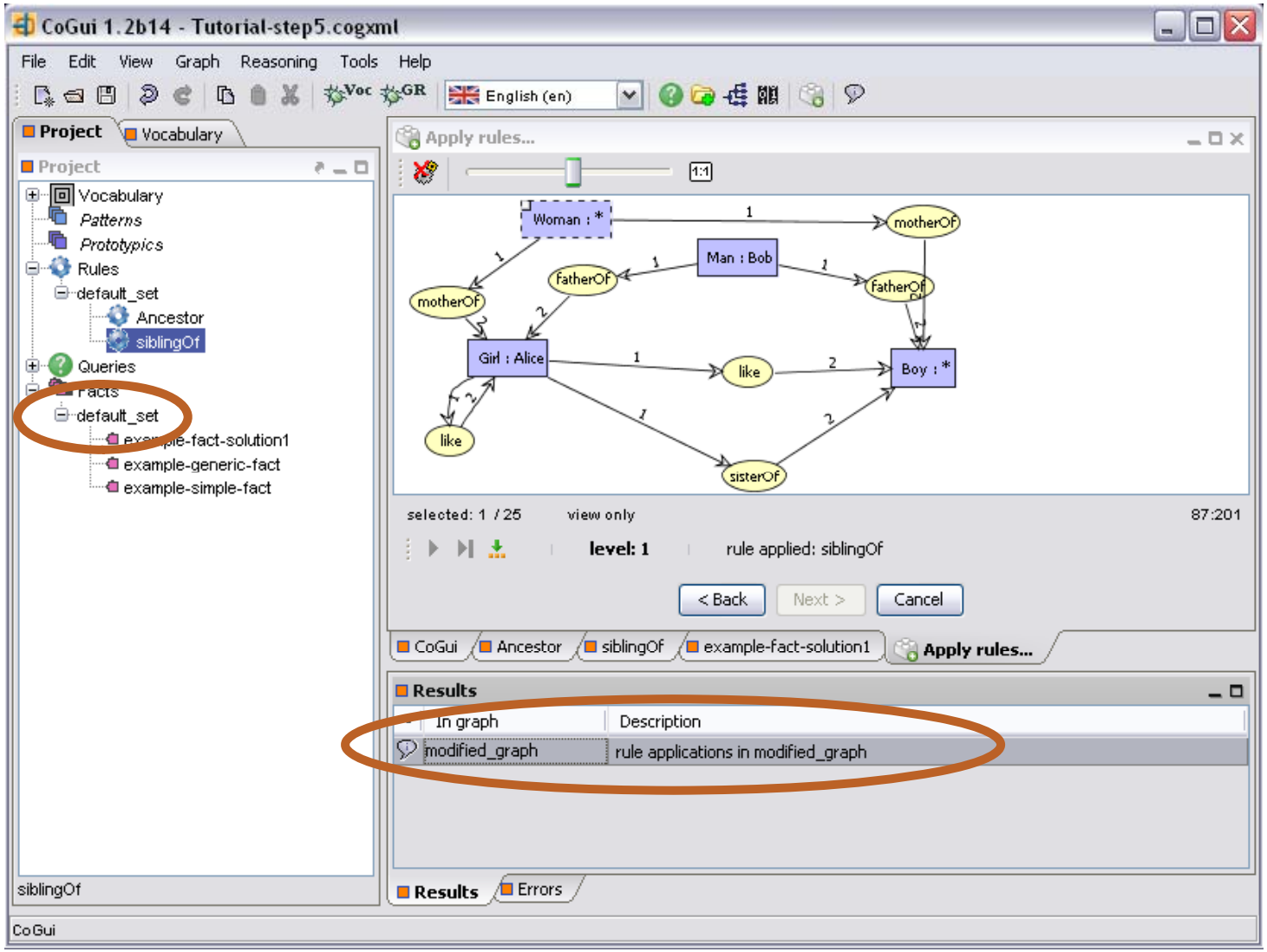
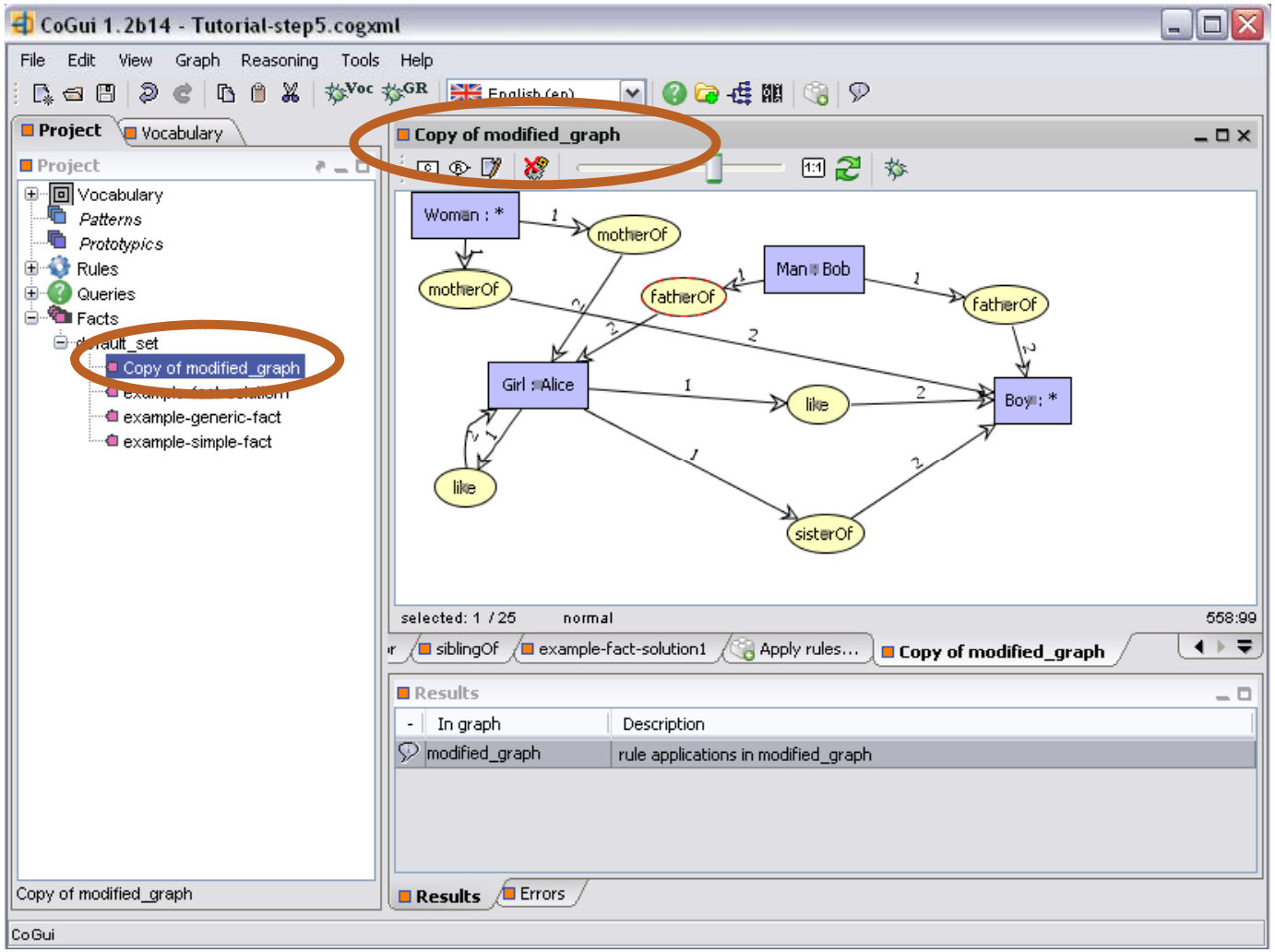
The rule cannot be re-applied without causing redundancy



You can store the resulting graph



To store the graph drag and drop



THE NEW GRAPH IS VISIBLE IN THE FACTS SET