COGUI TUTORIAL
Facts
FACT GRAPHS
A BG FACT IS COMPOSED OF:

- The **concept nodes** representing entities labeled by
  - *Concept types* (vocabulary) and
  - Either the *generic marker* (*) or an *individual marker*
- The **relation nodes** representing relationships between these entities labeled by *relation types* (vocabulary)
There are entities (represented by rectangles): Mary, who is a Woman, Alice who is a Girl and Bob who is a Man.

There are relations (represented by ovals) between the entities: a relation asserting that Mary is the motherOf Alice and a relation asserting that Mary is marriedTo Bob.
SUMMING AND NORMALIZING BGS

- The sum of two BGs comes down to summing two graphs (the resulting graph has the union set of vertices and edges).
- Two concept nodes having the same individual marker represent the same entity and then can be merged into one concept (normalization):
  - A BG is called normal if there is at most one individual concept with a given marker.
THE BG MODEL - SEMANTICS

- **Vocabulary:**
  - A predicate is assigned to each type (unary predicate to a concept type and a k-ary predicate to a k-ary relation type)
  - A constant is assigned to each individual marker
  - Translating the specialization relation:
    \[ \forall x (\text{Girl}(x) \rightarrow \text{Child}(x)), \forall x \forall y (\text{sisterOf}(x, y) \rightarrow \text{relativeOf}(x, y)) \]

- **Facts** being assigned the existentially closed formulae:
  \[ \exists x \exists y (\text{Girl}(x) \land \text{Boy}(y) \land \text{sisterOf}(x, y)) \]
HOMOMORPHISM ("PROJECTION")

- A homomorphism from a BG G to a BG H is a mapping from the nodes of G to the nodes of H, which preserves the relationships between the entities of G and may specialize the labels of entities and relationships.
HOMOMORPHISM

- **Sound and complete** with respect to **logical deduction**
- If there is a **homomorphism** from G to H we say that \( H \text{ entails } G \)
- Basic Conceptual Graphs correspond to the **existential, positive and conjunctive** fragment of **First Order Logic**
QUERY ANSWERING

- A knowledge base composed of a vocabulary and set of BGs
- A query: itself a BG
- Elements answering the query: elements of the knowledge base that entail the query:
  - Yes/No question: Is the knowledge represented by the query asserted by the Knowledge Base?
  - Pattern allowing to extract knowledge from the Knowledge Base: each homomorphism from the query to the knowledge base defines an answer to the query
IRREDUNDANT GRAPHS

- Two graphs $G$ and $H$ are hom-equivalent if there is a hom from $G$ to $H$ and a hom from $H$ to $G$.
- A BG is called redundant if it is hom-equivalent to one of its strict subgraphs. Otherwise it is called irredundant.
EDITING FACT GRAPHS IN COGUI
Open the tutorial-step2.cogxml file and select facts under project.
UNDER DEFAULT_SET OF FACTS THERE IS ALREADY A _G1 FACT THAT CAN BE EDITED
To insert a concept node in a fact use the graph editor and click on concept.
THE TYPE OF A ADDED CONCEPT IS BY DEFAULT THE UPPER MOST TYPE IN THE HIERARCHY – TO MODIFY RIGHT CLICK AND EDIT
VIEW AND SELECT THE APPROPRIATE CONCEPT TYPE IN THE HIERARCHY
To add an individual marker to a concept, just type the name of the individual.
A CONCEPT NODE PART OF A FACT
To add a concept node with an individual marker, alternatively, drag and drop from the individuals view to the fact editor.
TO ENTER A CONCEPT NODE OF A GIVEN TYPE
DRAG AND DROP THE CONCEPT FROM THE TREE
VIEW OF THE VOCABULARY
To add an individual marker to a concept node you can also select the individual from the individuals list.
IF THE INDIVIDUAL IS NOT IN THE LIST DO NOT PANIC!
EDIT CONCEPT TO ENTER THE INDIVIDUAL BY HAND
SIMPLY WRITE THE NAME OF THE INDIVIDUAL
Once you write the name of the individual in the concept node, the individual will appear in the individual list too.
TO ADD A RELATION DRAG AND DROP THE RELATION FROM THE TREE VIEW OF THE VOCABULARY
To link the relation to desired concepts, click the middle of the relation node then drag and drop the edge towards concepts.
TO CHANGE THE APPEARANCE OF EDGES IN THE FACT GRAPH GO TO PREFERENCES
In general options select fact graphs editor preferences.
Unselect Hide Edge Numbers
To apply the changes to your graph you have to refresh the graph view.
The edges are now numbered.
ADD A NEW RELATION TO THE GRAPH AND DRAG AND DROP FROM THE MIDDLE OF THE RELATION TO THE EMPTY SCREEN TO CREATE CONCEPTS
The added concept will have the type corresponding to the relation signature – refine it by right click and edit concept.
WHEN YOU ARE HAPPY WITH YOUR FACT RIGHT CLICK ON THE NAME BY DEFAULT OF THE FACT
RENAME YOUR FACT GRAPH ACCORDINGLY
DO NOT FORGET TO VALIDATE YOUR FACT GRAPHS
FOLLOW THE INSTRUCTIONS AFTER YOU VALIDATED YOUR GRAPH
TO CREATE A NEW FACT RIGHT CLICK ON DEFAULT SET AND SELECT NEW FACT
YOU CAN NAME YOUR GRAPH AFTER YOU CREATED IT
A fact graph can consist of a single concept node (but not a single relation node).
Click on reasoning for operations on the facts
TO CLASSIFY FACTS SELECT CLASSIFY FACTS
THE GRAPH CLASSIFICATION WINDOW IS OPEN
SELECT ALL YOUR FACT GRAPHS FOR CLASSIFICATION
WHEN THE FACT GRAPHS YOU WANT TO CLASSIFY ARE SELECTED CLICK NEXT
THE GRAPHS ARE SHOWN IN THEIR GENERALIZATION / SPECIALIZATION HIERARCHY
TO CLOSE THE GRAPH CLASSIFICATION WINDOW, RIGHT CLICK THEN SELECT CLOSE
TO ANALYZE FACTS SELECT REASONING THEN ANALYZE FACTS
THE ANALYZE FACTS WINDOW IS NOW OPEN
SELECT EACH GRAPH YOU WANT TO ANALYZE ONE BY ONE AND FIND THE REQUIRED INFORMATION ON THE RIGHT
YOU CAN ALSO CHECK IF A GRAPH IS REDUNDANT
ATTENTION: THE REDUNDANCY CHECKING IS DIFFERENT IN THE NEW VERSION
To sum (and normalize) facts select reasoning then sum and normalize facts.
THE SUM AND NORMALIZE WINDOW IS OPEN
SELECT ALL THE GRAPHS YOU WANT TO SUM
KEEP NORMALIZED CHECKED WHEN DOING THE SUM
CLICK ON SUM
The result graph is displayed in the results window.
DOUBLE CLICK ON THE RESULT GRAPH
In order to better visualize the graph, click on 'Arrange Graph'.
BECAUSE YOU NORMALIZED THE SUM GRAPH THE NODES WOMAN:MARY HAVE BEEN MERGED
IF YOU DO NOT CHECK NORMALIZE
AND THEN CLICK SUM
SIMILARLY THE RESULT GRAPH IS SHOWED IN THE RESULTS WINDOW
Since the graph was not normalized after the sum there are two concepts
Woman: Mary
To query the knowledge base select reasoning, query facts
THE QUERY FACTS WINDOW IS OPEN
To query you will need to create a new query.
To create a query go to Project > Queries and right click on the default query set.
THE QUERY IS A BG – IS BUILT JUST LIKE A FACT GRAPH
AFTER WRITING THE QUERY SELECT THE QUERY FACTS WINDOW
SELECT THE QUERY YOU WANT TO ASK
SELECT THE FACTS THAT YOU WANT TO USE TO ANSWER THE QUERY
Click next to find the homomorphisms of the query in the selected facts
IN THE RESULTS WINDOW YOU CAN SEE THE HOMOMORPHISMS (PROJECTIONS) OF THE QUERY IN THE FACT GRAPHS
SELECT ONE RESULT TO VIEW THE PROJECTION
If you only interested to see the image of the query use the visual navigator.
The visual navigator only allows you to see the images of the projection.