System identification and decomposition, and concept formalization

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Lecture goals

- Understand the second and third steps of the method

- System identification and decomposition
- Concept formalization

System identification and decomposition

- Given the identified problem and actors :
  - How does the system look like?
  - Who/what is in/out?
- Highly iterative process consisting of :
  - Inventory
  - Structuring
  - Iteration

Inventory

- Collect data
  - Literature, surveys, interviews and brainstorm sessions with domain experts,stakeholders, and relevant actors.
  - Inventory of all relevant elements, issues, factors, worries and explanations that come up.
- Choose a time frame that is important.
  - Select the longest and shortest time periods that are relevant for the system.
- identify:
  - Relevant concepts
  - Actors or objects
  - Relevant behaviours
  - Interactions or flows (continuous or discrete)
  - States or properties
-

Structuring

- Given the information from the braindump, start by
- Structuring of agents and interactions;
  - Who is relevant
  - What do they know / have
  - What to the do and to whom
  - Using which decision processes?
- Iteration
- Identifying the external world.
  - Everything that is relevant, but can not be logically placed in one of the agents

Structuring guiding questions

- Agent vs Objects
  - Consider actors and objects with useful boundaries (physical, organisational and functional).
  - Entities that are capable of independent decision making will be the agents, all others are considered to be objects.
- Agents can contain or interact with objects (such as companies owning facilities, or a postman processing a letter).
- Identify states/properties of both
- Identify interactions with agents or object outside, both incoming and outgoing.
- Identify the decision making processes that lead to state changes and/or actions
- If necessary, organise agents hierarchically
-

Example inventory and structuring

- SPREE mindmap
- PoR Mindmap

Step 3 - Concept formalization

- Once we know what is in the system, we need to think about how to describe it to the computer!
  - Computers are much dumber than you might think!
  - They understand a very limited set of things
- Formalization means that we must be very clear what the concept is, and how do we express it.
- Choices here is have large effects on the way we write our model algorithms

How to formalize

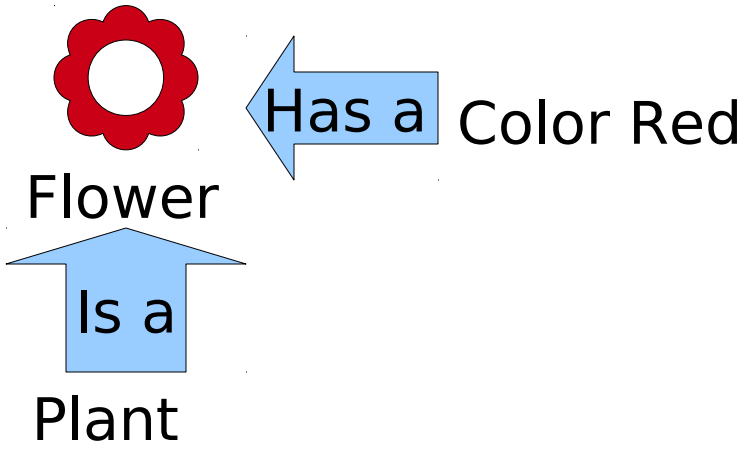
- Two main approaches we use at TPM
  - Language primitives
    - Dependent on the language we use
    - Relatively limited set of things
    - “Easy” to do
  - Formal ontologies
    - language independent
    - very powerful
    - “Difficult” to use

Language primitives in NetLogo

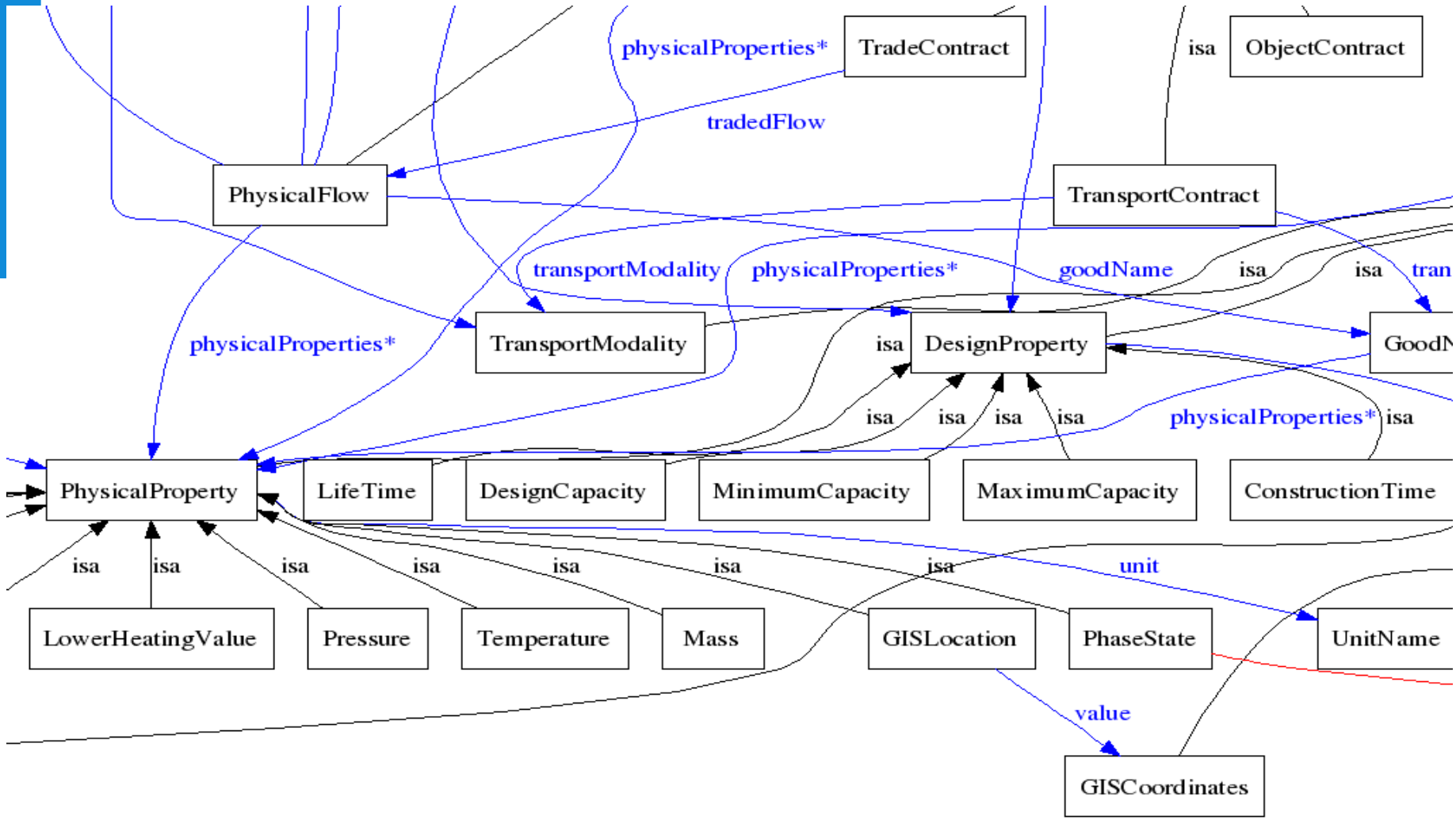
- Numbers
  - Integer, floating point
- Strings
  - (a set of characters, essentially text)
- Booleans
  - (representing truth values in logic, TRUE or FALSE)
- Turtles,patches,nodes,edges and breeds thereof
  - Agents and agent types
- Agent/patch sets
  - Collections of agents and/or pathes
- Lists
  - containing any of the above
- Matrices and tables
  - As extensions to NetLogo

This is a good moment to read the NetLogo manual !

An ontology is



- A (shared) formalization of a conceptualization of a knowledge domain
- A collection of ***is a*** and ***has a*** relationships between concepts relevant to the case
- An inventory of the relevant system components
- Can be difficult to make because many concepts are :
  - Ambiguous
  - Overloaded
  - Disagreed upon


physicalProperties*
TradeContract
isa
ObjectContract
tradedFlow
PhysicalFlow
TransportContract
transportModality
physicalProperties*
goodName
isa
isa
tran
physicalProperties*
TransportModality
isa
DesignProperty
GoodN
isa
isa
isa
isa
physicalProperties*
isa
PhysicalProperty
LifeTime
DesignCapacity
MinimumCapacity
MaximumCapacity
ConstructionTime
isa
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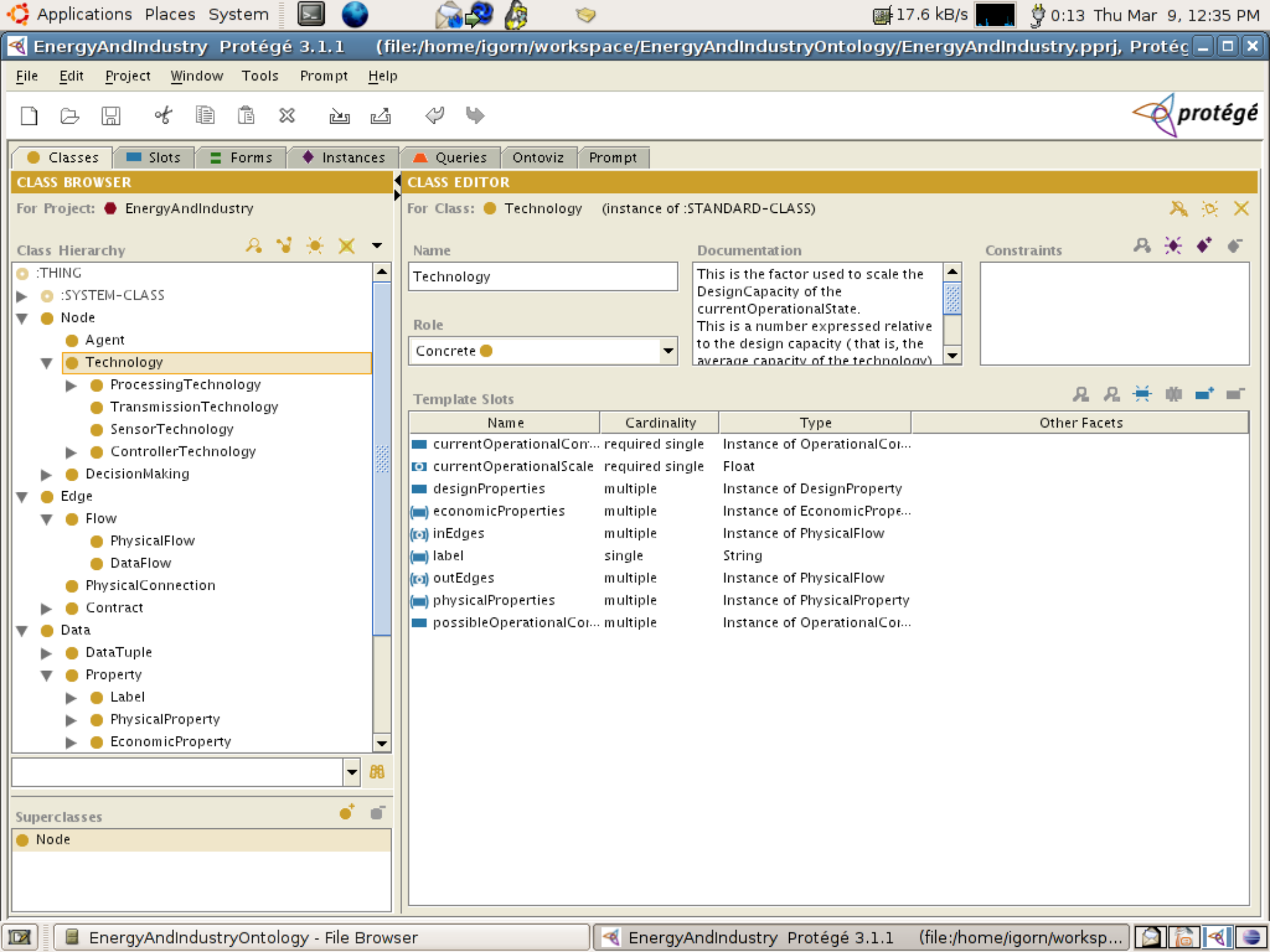
unit
LowerHeatingValue
Pressure
Temperature
Mass
GISLocation
PhaseState
UnitName
value
GISCoordinates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Classes Slots Forms Instances Queries Ontoviz Prompt
CLASS BROWSER
For Project: EnergyAndIndustry
Class Hierarchy
:THING
:SYSTEM-CLASS
Node
Agent
Technology
ProcessingTechnology
TransmissionTechnology
SensorTechnology
ControllerTechnology
DecisionMaking
Edge
Flow
PhysicalFlow
DataFlow
PhysicalConnection
Contract
Data
DataTuple
Property
Label
PhysicalProperty
EconomicProperty
Superclasses
Node
CLASS EDITOR
For Class: Technology (instance of :STANDARD-CLASS)
Name
Technology
Role
Concrete
Documentation
This is the factor used to scale the DesignCapacity of the currentOperationalState.
This is a number expressed relative to the design capacity (that is, the average capacity of the technology)
Constraints
Template Slots
Name
Cardinality
Type
Other Facets
currentOperationalCon... required single Instance of OperationalCo...
currentOperationalScale required single Float
designProperties multiple Instance of DesignProperty
economicProperties multiple Instance of EconomicPrope...
inEdges multiple Instance of PhysicalFlow
label single String
outEdges multiple Instance of PhysicalFlow
physicalProperties multiple Instance of PhysicalProperty
possibleOperationalCon... multiple Instance of OperationalCo...
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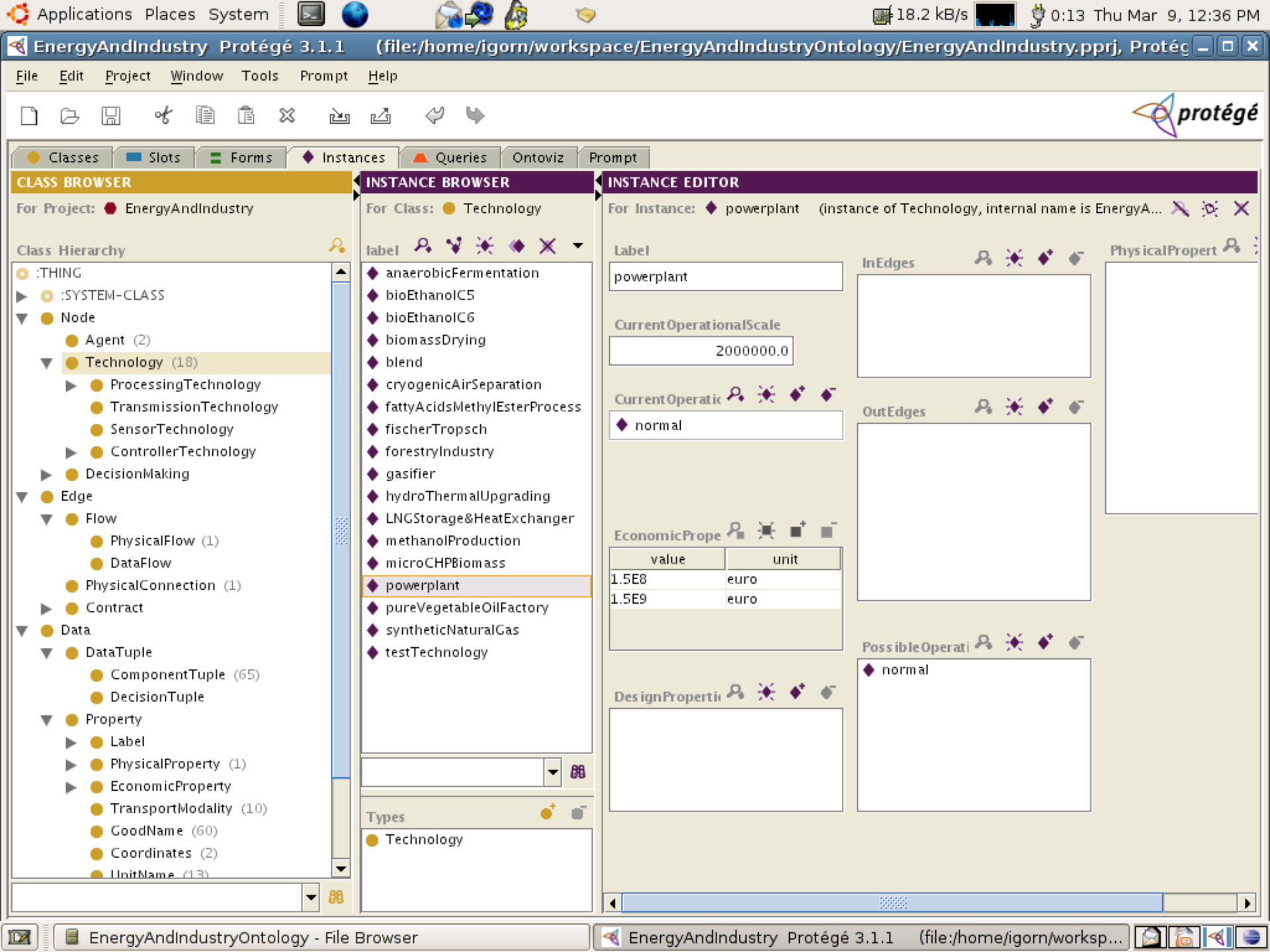
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protégé
Classes Slots Forms Instances Queries Ontoviz Prompt
CLASS BROWSER
For Project: EnergyAndIndustry
Class Hierarchy
:THING
:SYSTEM-CLASS
Node
Agent (2)
Technology (18)
ProcessingTechnology
TransmissionTechnology
SensorTechnology
ControllerTechnology
DecisionMaking
Edge
Flow
PhysicalFlow (1)
DataFlow
PhysicalConnection (1)
Contract
Data
DataTuple
ComponentTuple (65)
DecisionTuple
Property
Label
PhysicalProperty (1)
EconomicProperty
TransportModality (10)
GoodName (60)
Coordinates (2)
UnitName (13)
INSTANCE BROWSER
For Class: Technology
label
anaerobicFermentation
bioEthanolC5
bioEthanolC6
biomassDrying
blend
cryogenicAirSeparation
fattyAcidsMethylEsterProcess
fischerTropsch
forestryIndustry
gasifier
hydroThermalUpgrading
LNGStorage&HeatExchanger
methanolProduction
microCHPBiomass
powerplant
pureVegetableOilFactory
syntheticNaturalGas
testTechnology
Types
Technology
INSTANCE EDITOR
For Instance: powerplant (instance of Technology, internal name is EnergyA...
Label
powerplant
CurrentOperationalScale
2000000.0
CurrentOperatic
normal
EconomicPrope
value
unit
1.5E8
euro
1.5E9
euro
DesignPropertie
InEdges
OutEdges
PhysicalPropert
PossibleOperati
normal
EnergyAndIndustryOntology - File Browser
EnergyAndIndustry Protégé 3.1.1 (file:/home/igorn/worksp...

Ontology demo

- Enipedia
- Frame based ontologies

Break

Group progress