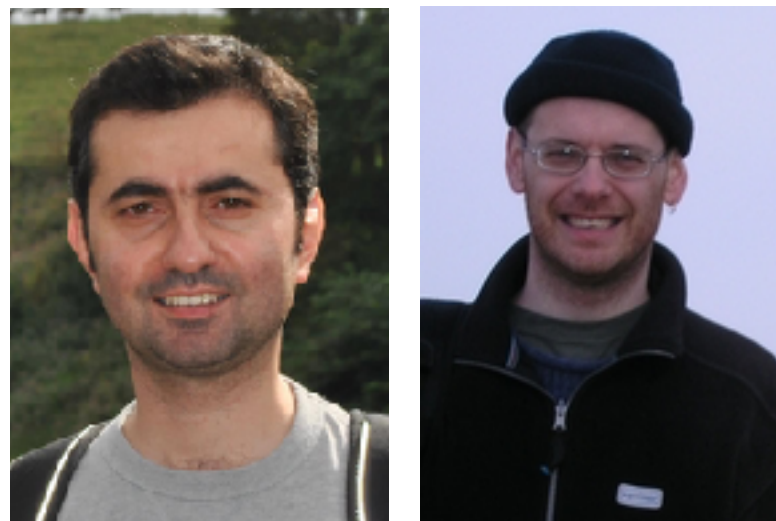
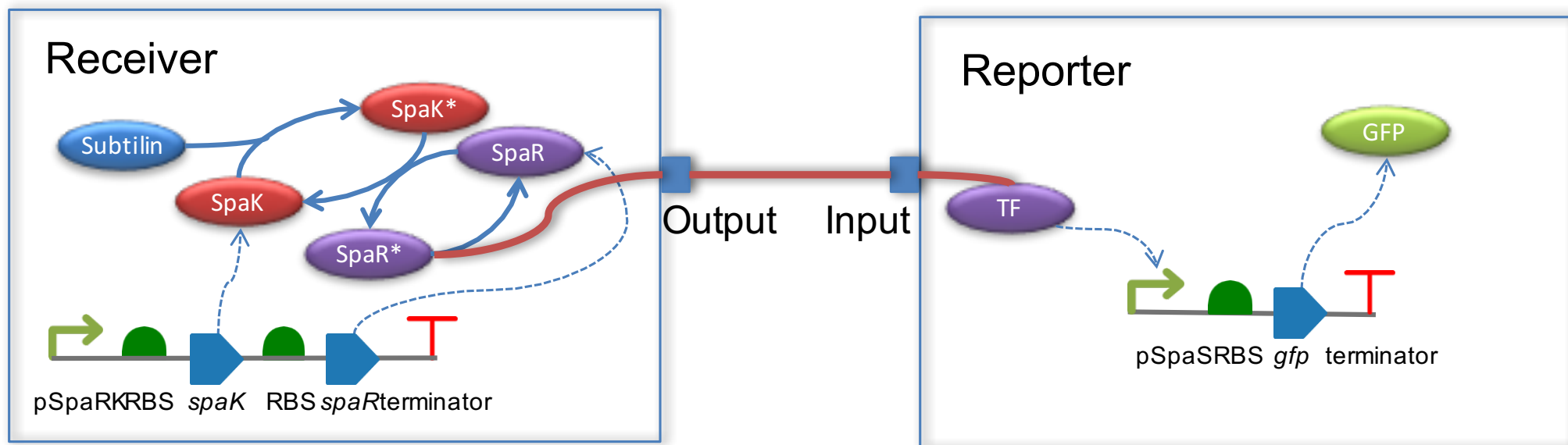
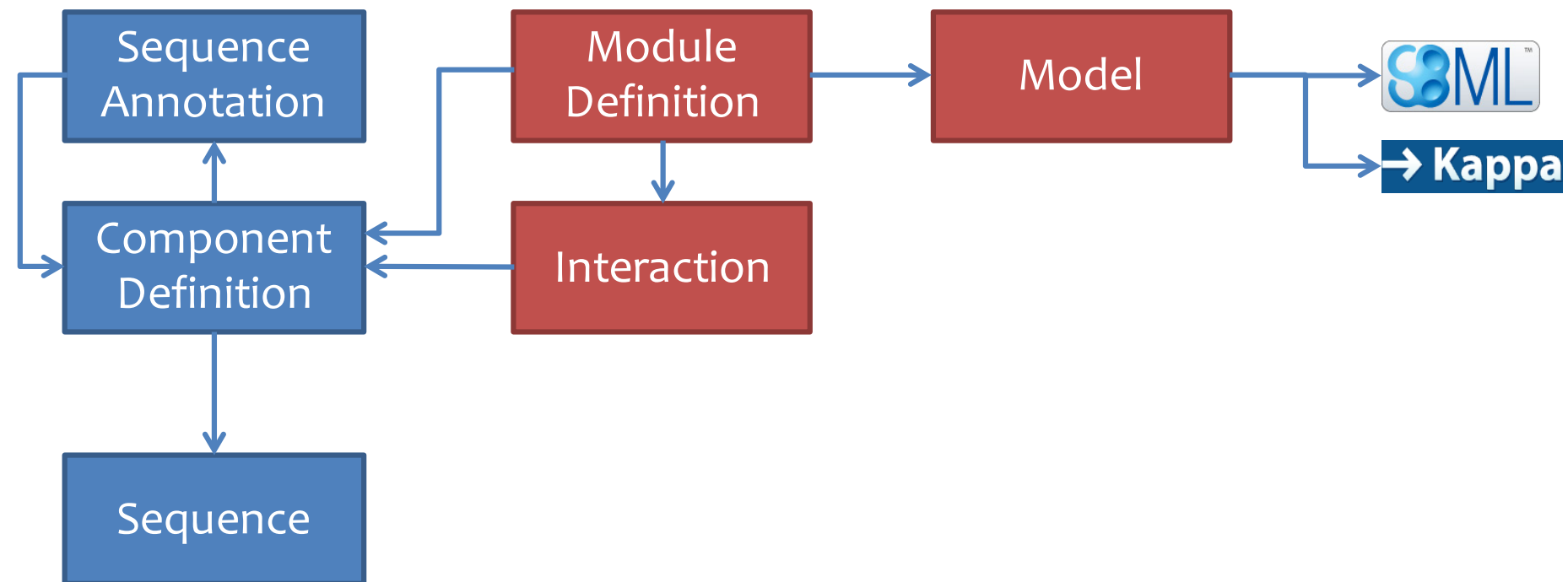


Tawny-SBOL: Using ontologies to design and constrain genetic circuits

Goksel Misirli; **James McLaughlin**; Angel Goni-Moreno; Anil Wipat; Phillip Lord



The Synthetic Biology Open Language



SBOL Vocabulary

- As a community we already started defining SBOL specific terms
- These terms are available in free text inside PDF documents
- Relationships between these terms are available via UML diagrams
 - Mainly used to convey the meaning of terms for humans
 - Not directly machine accessible
- As SBOL is based on Semantic Web technologies, it is ideal that these terms come from a formal ontology

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What is an ontology?

The representation of the entities of a domain is consistent and unambiguous

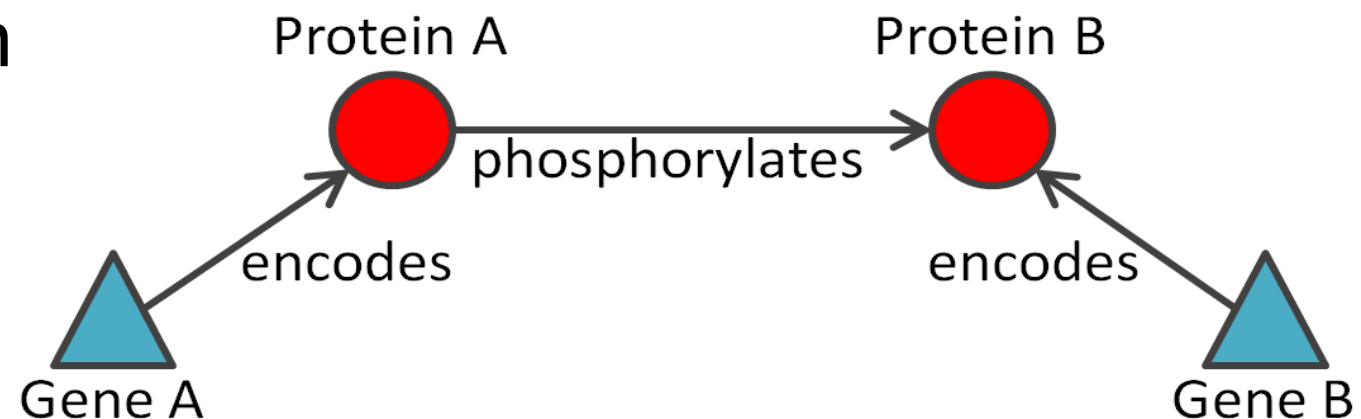
An abstract and simplified view of a domain being modelled

“An explicit and formal specification of a conceptualisation”
Gruber

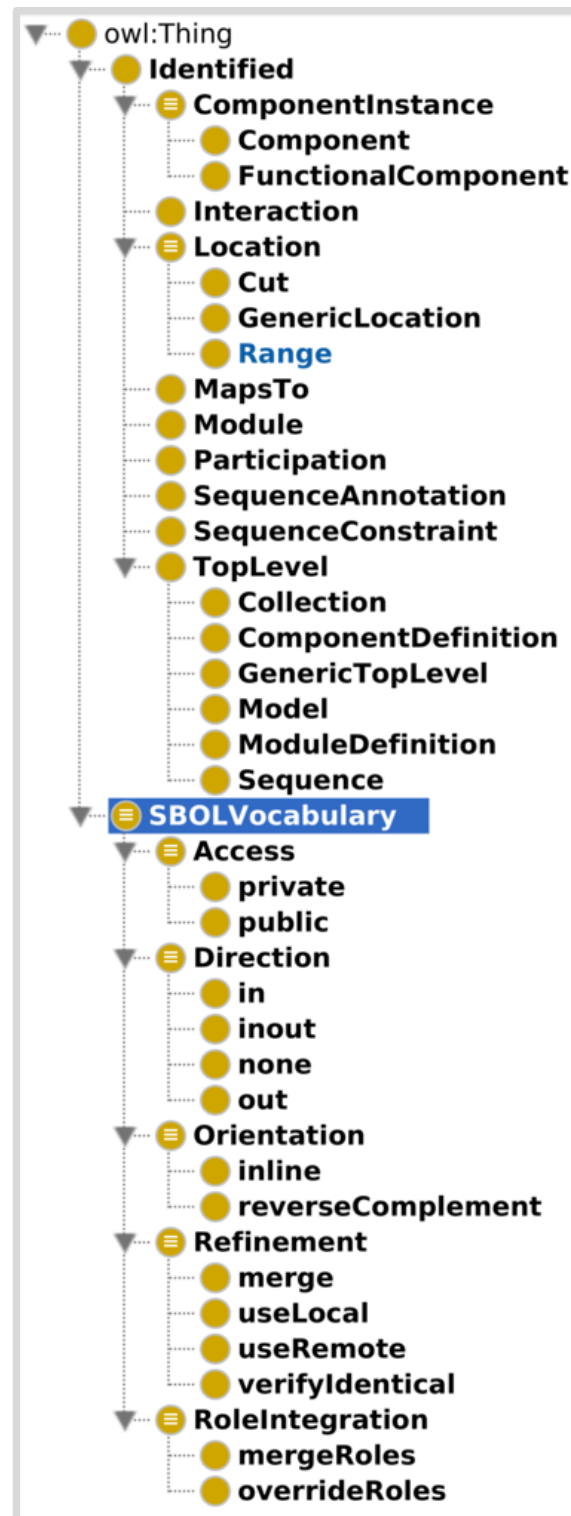
uses

captures

Shared understanding
of a domain



The SBOL ontology



- We defined an SBOL ontology
- Classes include:
 - Top-level entities such as
ComponentDefinition and
Sequence
 - Interfaces that are not directly serialised.
E.g. Identified and TopLevel
 - Terms for Access, Direction,
Orientation, Refinement and
RoleIntegration types

Testing the ontology with competency questions

- How can I retrieve promoter parts
- How can I retrieve all uses of a component in other components or complex designs
- ...
- The list can be extended

Tawny-OWL



“Tawny-OWL allows construction of OWL ontologies, in a evaluative, functional and fully programmatic environment. Think of it as the ontology engineering equivalent of [R](#).”

<https://github.com/phillord/tawny-owl>

- An interactive shell or REPL to explore and create ontologies.
- Source code, with comments, editable using any of a range of IDEs.
- Fully extensible -- new syntaxes, new data sources can be added by users
- Patterns can be created for individual ontologies; related classes can be built easily, accurately and maintainably.
- A unit test framework with fully reasoning.
- A clean syntax for versioning with any VCS, integrated with the IDE
- Support for packaging, dependency resolution and publication
- Enabled continuous integration with both ontology and software dependencies

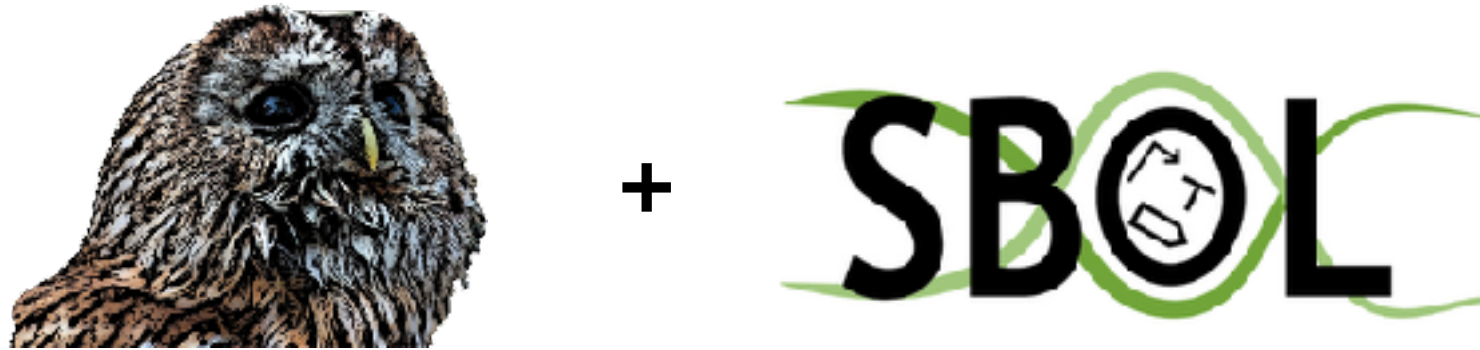

```
(owl-class Pizza
  :super
  (owl-some hasCalorificContentValue :XSD_INTEGER)
  (owl-some hasTopping PizzaTopping)
  (owl-some hasBase PizzaBase))

;; define a set of subclasses which are all mutually disjoint
(as-disjoint-subclasses
 PizzaBase

 (defclass ThinAndCrispyBase
   :super (cal 150)
   :annotation (label "BaseFinaEQuebradica" "pt"))

 (defclass DeepPanBase
   :super (cal 250)
   :annotation (label "BaseEspessa" "pt")))
```

Tawny-SBOL

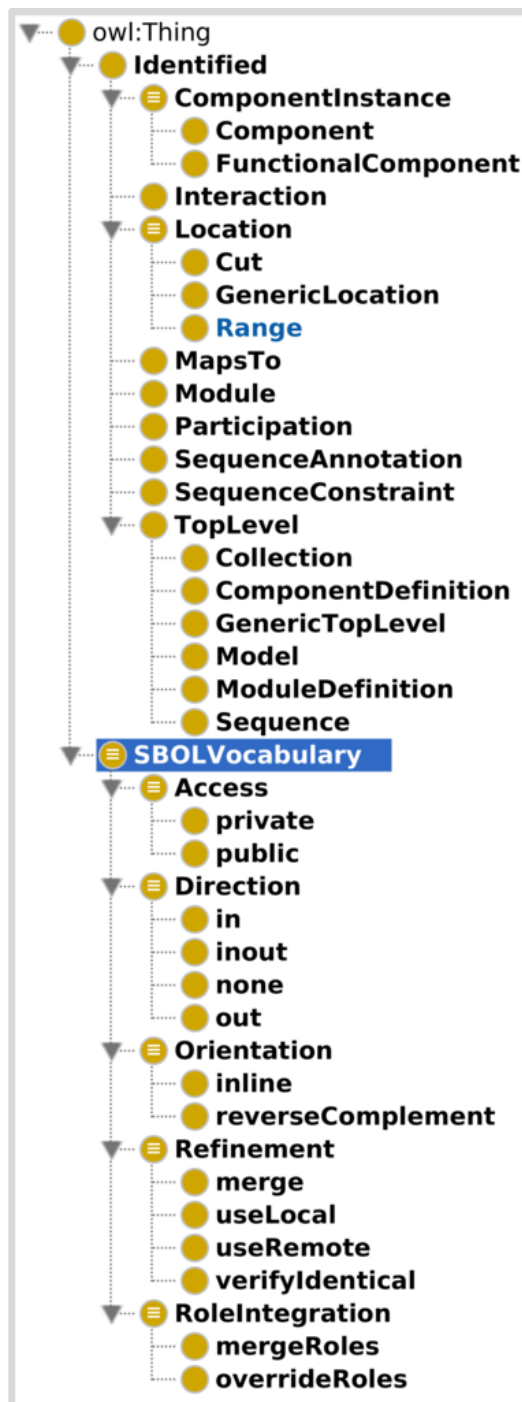


To facilitate semantic querying of the underlying data we defined a simple domain specific language called Tawny-SBOL, based on the Tawny-OWL ontology framework

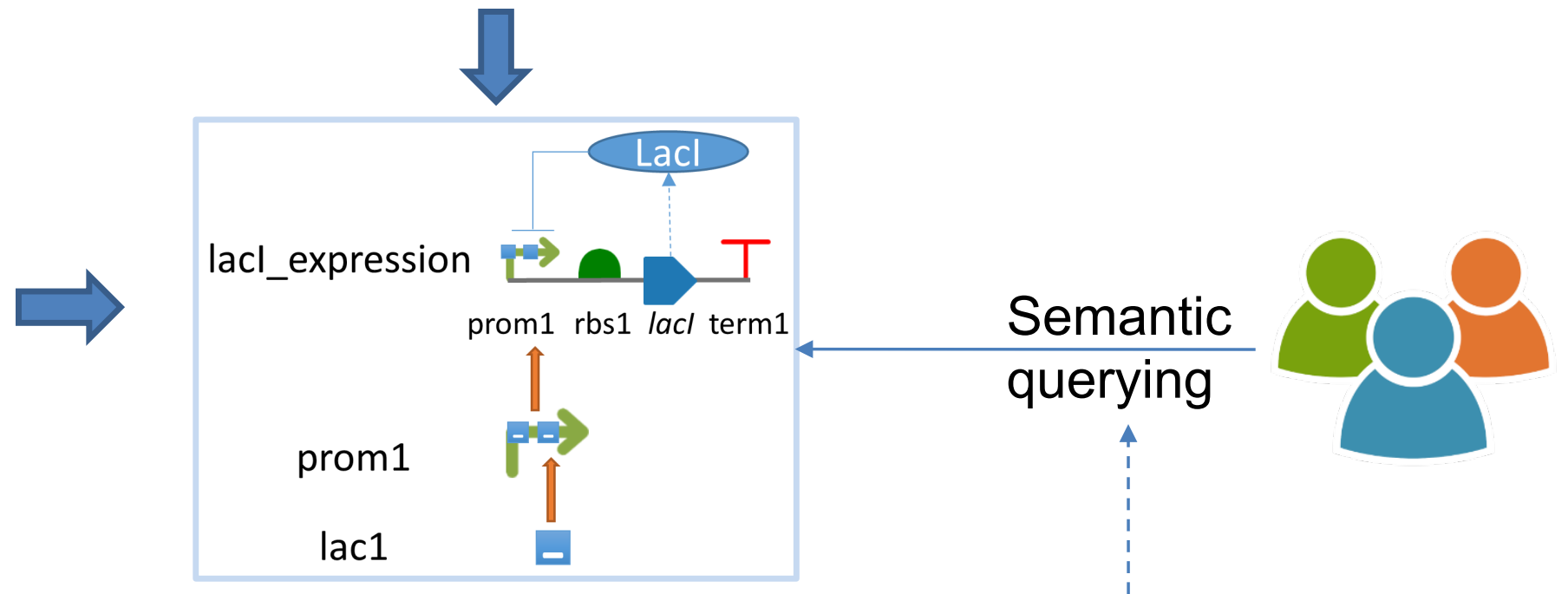
Tawny-SBOL is a simple language

- To create RDF/XML for SBOL
- To inject OWL classes which are useful for semantic querying

Tawny-SBOL: Using ontologies to design and constrain genetic circuits



```
(sboldocument "http://virtualparts.org/v2#" "v2")
...
(cds "lacI"
  {name "lacI",
   description "lacI coding sequence"
  })
...
(design "lacI_expression prom1 1..40:+ rbs1 41..50:+ lacI
51..800:+ term1 801..850:+")
(design "prom1 lac1 1..10:+ lac2 30..40:+")
(save "lacI_expression")
```



```
ComponentDefinition and
  ((component some lac1) or
   (component some lac1Parent))
```

Misirli and Lord, ICBO 2017

Summary

- The SBOL ontology is a useful resource for the community
- Tawny-SBOL is an OWL library for SBOL in addition to other APIs that we have for the community
- Through its simple syntax, Tawny-SBOL
 - Simplifies building SBOL documents
 - Facilitates writing human-readable queries



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