Multi-agent and Semantic Web Systems: Web Services: Part 2

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  - a binding for each operation which specifies the allowed protocol and the service endpoints.

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- OWL-S builds on OWL to provide OWL descriptions of Services.

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  - provides a limited form of quantification.

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Definitional Equivalence

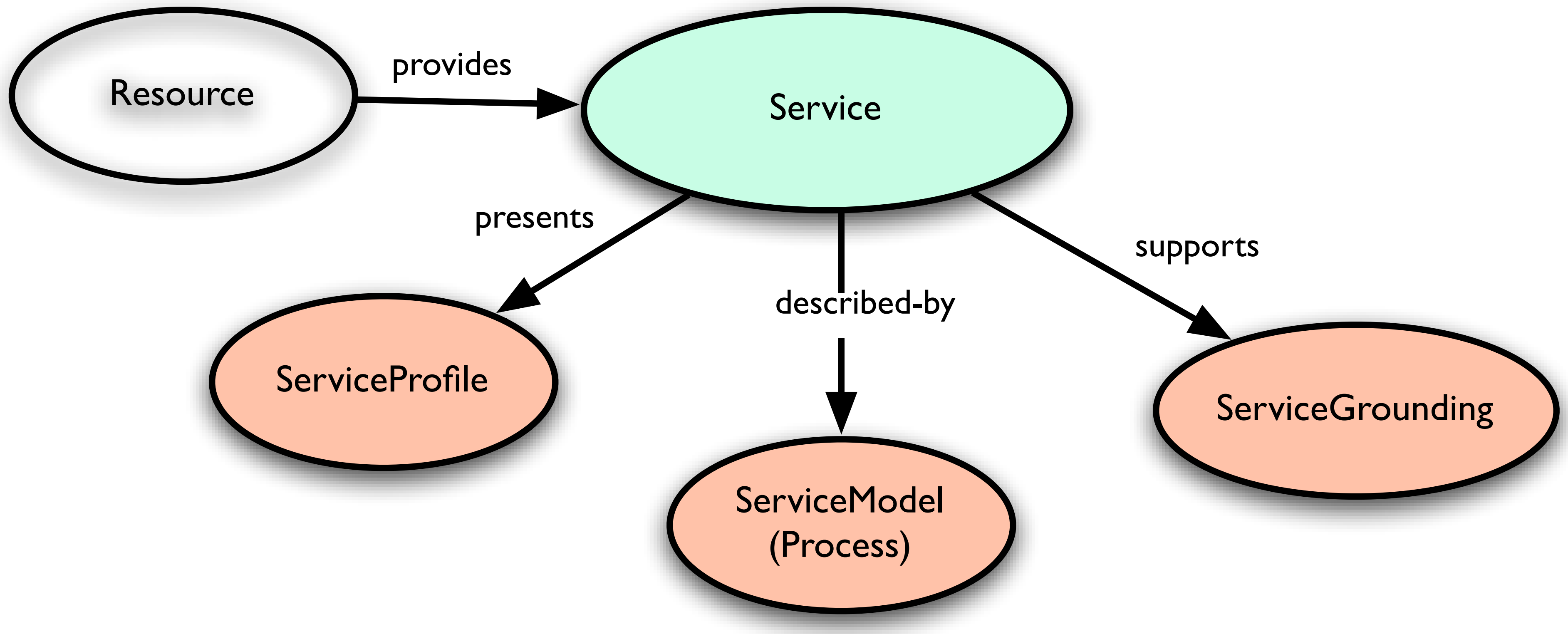
$\text{Sibling} \doteq \text{Brother} \sqcup \text{Sister}$	$\forall x(\text{Sibling}(x) \leftrightarrow \text{Brother}(x) \vee \text{Sister}(x))$

OWL-S View of Services

- Based on DAML (Darpa Agent Markup Language) and DAML-S.
- Provides an ontology for web services that consists of three sub-ontologies.

Service Profile:	How the service presents itself to the external world.
Service Model:	What the service does, and how the client interacts with it.
Service Grounding:	How the service is realised — analogous to WSDL binding.

OWL-S Service Ontology



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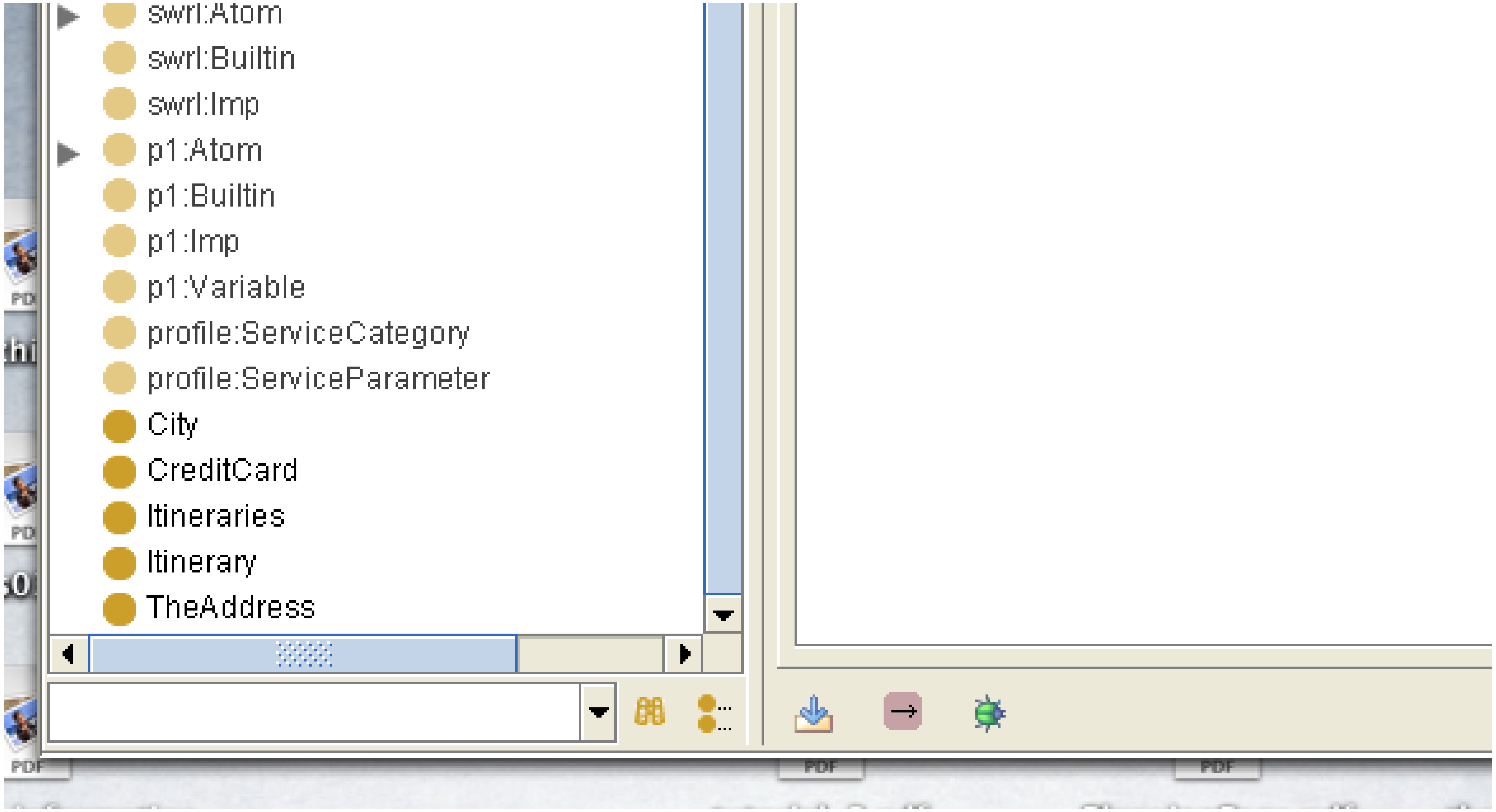
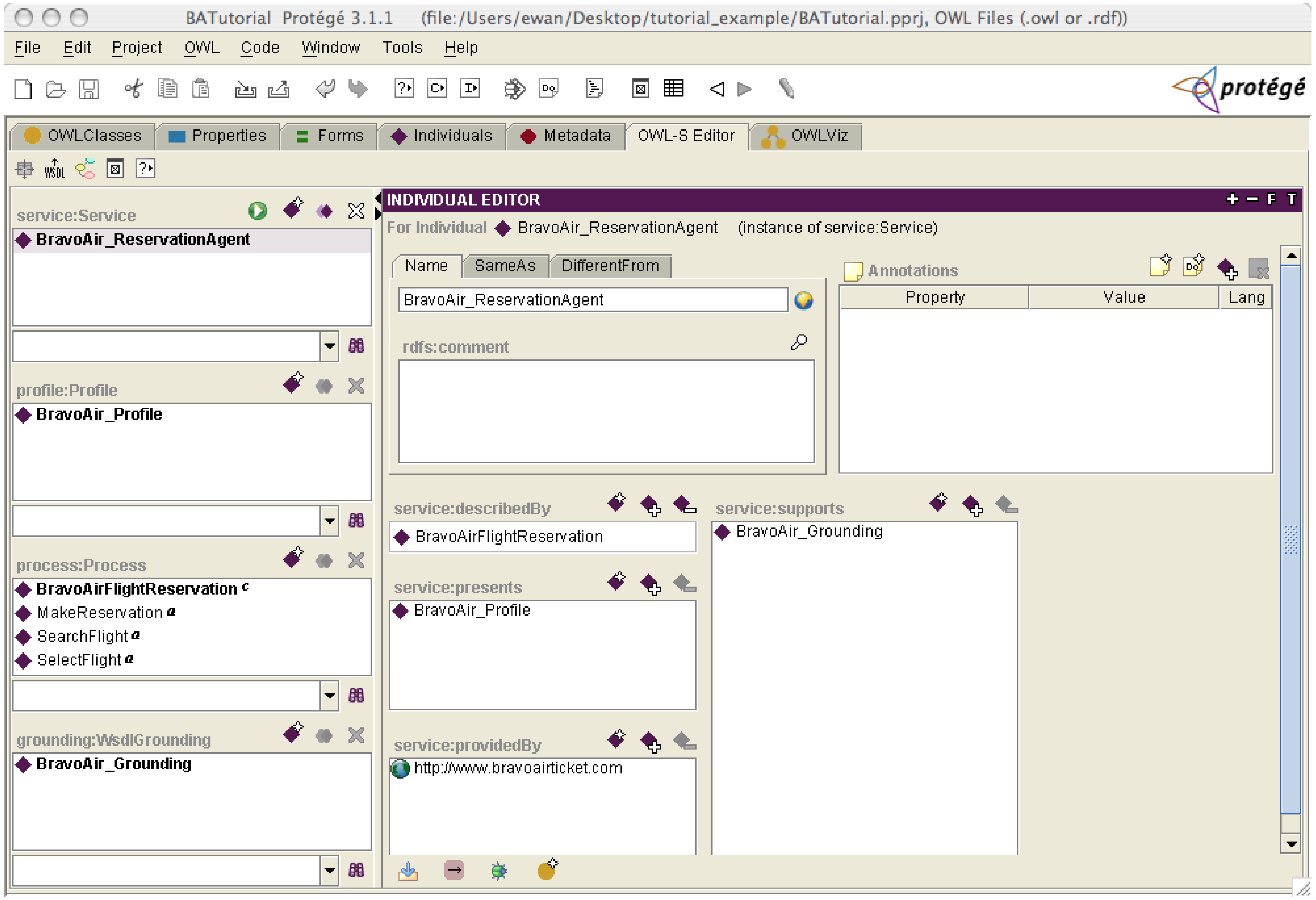
- Typically, this will be a pointer to an OWL class in a domain ontology.
  - `Input`,`Output` $\sqsubset$ `Parameter`
- Parameters are associated with services via property `hasParameter`:
  - `hasInput`, `hasOutput` sub-properties of `hasParameter`

OWL-S Plugin for Protégé: Domain Ontology


swrl:Atom
swrl:Builtin
swrl:Imp
p1:Atom
p1:Builtin
p1:Imp
p1:Variable
profile:ServiceCategory
profile:ServiceParameter
City
CreditCard
Itineraries
Itinerary
TheAddress

OWL-S Plugin for Protégé: OWL-S Service


BATutorial Protégé 3.1.1 (file:/Users/ewan/Desktop/tutorial_example/BATutorial.pprj, OWL Files (.owl or .rdf))
File Edit Project OWL Code Window Tools Help
protégé
OWLClasses Properties Forms Individuals Metadata OWL-S Editor OWLViz
INDIVIDUAL EDITOR
Name SameAs DifferentFrom
Annotations
Property Value Lang
rdfs:comment

service:Service
- BravoAir_ReservationAgent

profile:Profile
- BravoAir_Profile

process:Process
- BravoAirFlightReservation c
- MakeReservation a
- SearchFlight a
- SelectFlight a

grounding:WsdlGrounding
- BravoAir_Grounding

For Individual BravoAir_ReservationAgent (instance of service:Service)

Name: BravoAir_ReservationAgent

service:describedBy: BravoAirFlightReservation

service:presents: BravoAir_Profile

service:providedBy: http://www.bravoairticket.com

service:supports: BravoAir_Grounding

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  - `TheServer`—principal element of the service that the client deals with.

State Transformations

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Changing the world with WS

Before invoking Amazon: your net assets are £999.00.
After invoking Amazon: your net assets are £000.00, but you are now the proud owner of a Widescreen Plasma TV.

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IOPEs

IOPE = Input, Output, Precondition and Effect.

Expressing Preconditions and Effects

Expressing Truths about the World

Preconditions and effects need to be stated in terms of a reasonably expressive logical language. By themselves, RDF and OWL do not provide a good basis for such a language. (Why?)

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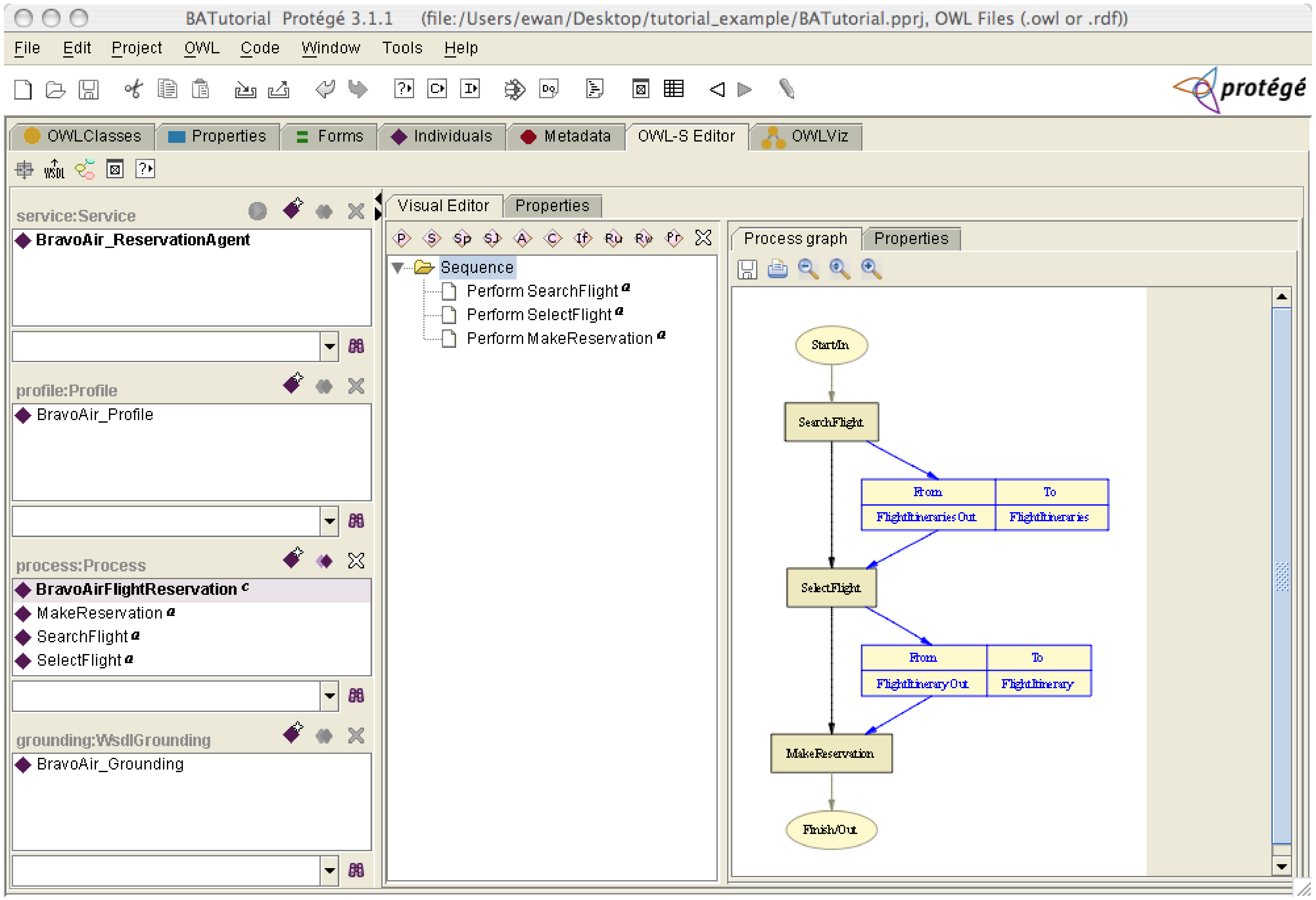
- In OWL-S, expressions from these languages can be embedded as RDF literals.

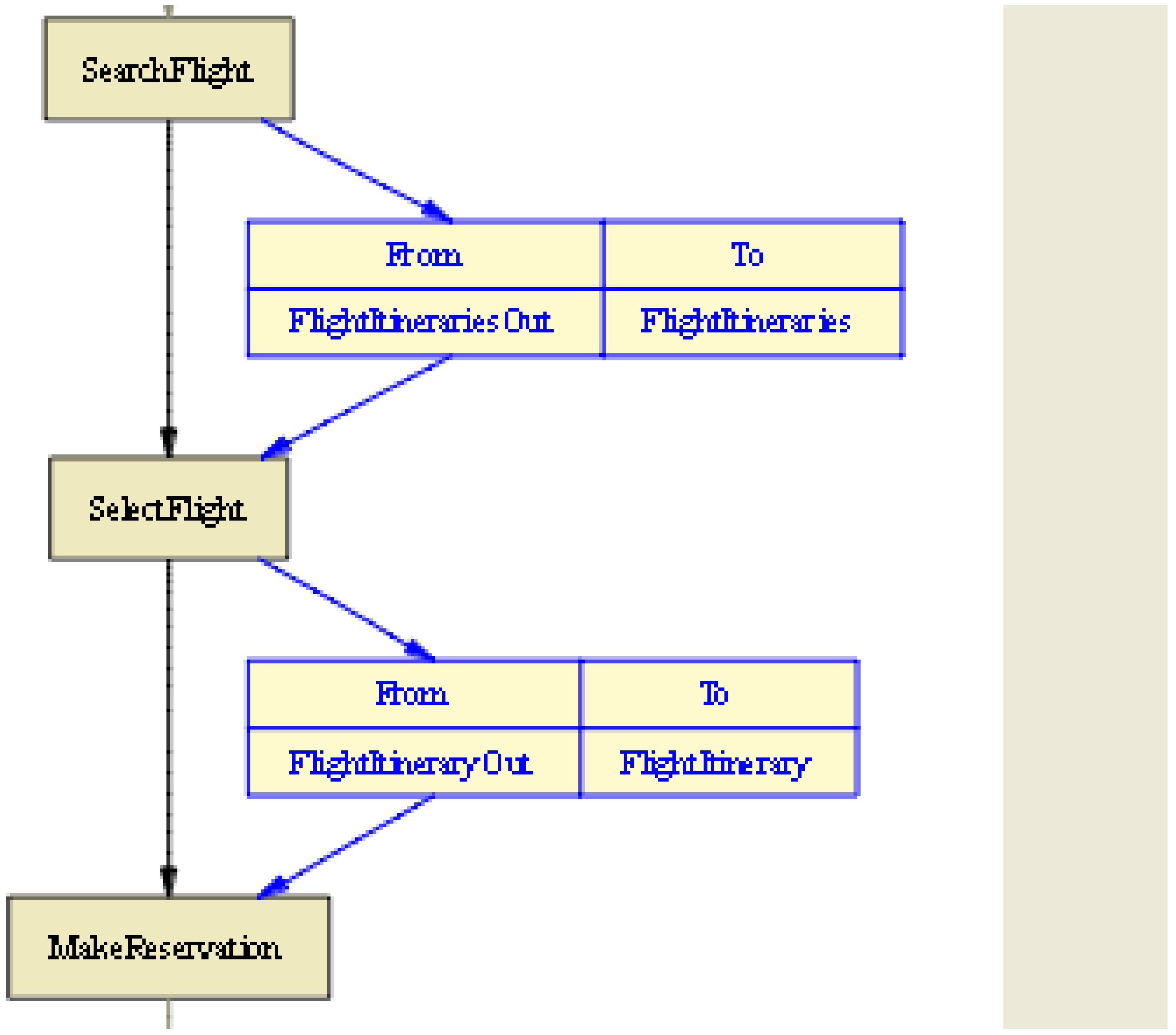
The Process Ontology

- OWL-S divides processes into
  - atomic, and
  - composite.
- Various constructors are provided for assembling composite processes out of component ones, e.g.,
  - sequence,
  - choice,
  - iterate, etc.
- A composite process represents behaviour a client can perform by sending and receiving messages.
- Inputs of an standalone atomic process must come directly from client;
- Inputs of components of a composite process may come from preceding steps.

OWL-S Plugin for Protégé: Process I


BATutorial Protégé 3.1.1 (file:/Users/ewan/Desktop/tutorial_example/BATutorial.pprj, OWL Files (.owl or .rdf))
File Edit Project OWL Code Window Tools Help
OWLClasses Properties Forms Individuals Metadata OWL-S Editor OWLViz
service:Service
BravoAir_ReservationAgent
profile:Profile
BravoAir_Profile
process:Process
BravoAirFlightReservation
MakeReservation
SearchFlight
SelectFlight
grounding:WsdlGrounding
BravoAir_Grounding
Visual Editor Properties
Sequence
Perform SearchFlight
Perform SelectFlight
Perform MakeReservation
Process graph Properties
Start/In
SearchFlight
From To
FlightItinerariesOut FlightItineraries
SelectFlight
From To
FlightItineraryOut FlightItinerary
MakeReservation
Finish/Out

OWL-S Plugin for Protégé: Process 2



Abstracting over Composite Processes

- Composite processes can be viewed at a higher level of abstraction, as simple processes.
- Allows layering, i.e. composite processes can be incorporated as simple processes into further composites.

Service Profile

- Description of the service that can be used by registry or broker.
- Once a client has chosen to engage with a service, uses the Service Model, not the Profile.
- By default, Profile uses same IOPEs as the Model, but this is not mandatory.
- Can also include information such as Service Category and Quality of Service (QoS).

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- referenced from within a WSDL `operation` definition using an `owl-s-parameter` attribute.

Reading

- http://www.w3.org/Submission/OWL-S
- http://www.daml.org/services/owl-s/1.0/

Bringing Semantics to Web Services with OWL-S
David Martin et al. (2007) *2007 World Wide Web Journal*, Volume 10, Number 3, pp. 243–277.

Unifying Reasoning and Search to Web Scale
Dieter Fensel and Frank van Harmelen (2007) *Internet Computing*, IEEE Volume 11, Issue 2, March-April, pp. 96–95

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- Service Grounding is realised in terms of a mapping to WSDL.