The Robber and the Speeder (version 2)

- An expanded version of the Robber and the Speeder example is shown on the following slides. This version was created by Ian Davis. Thanks Ian!

Robber drops gun while fleeing!

First of all a robbery takes place. The robber drops his gun while fleeing. This report is filed by the investigating officers:

```
<RobberyEvent>
   <date>...</date>
   <description>...</description>
   <evidence>
      <Gun>
         <serial>ABCD</serial>
      </Gun>
   </evidence>
   <robber>
      <Person /> <!-- an unknown person -->
   </robber>
</RobberyEvent>
```

Speeder stopped

Subsequently a car is pulled over for speeding. The traffic officer files this report electronically while issuing a ticket:

```
<SpeedingOffence>
   <date>...</date>
   <description>...</description>
   <speeder>
      <Person>
         <name>Fred Blogs</name>
         <driversLicenseNumber>ZXYZXY</driversLicenseNumber>
      </Person>
   </speeder>
</SpeedingOffence>
```

The speeder owns a gun with the same serial number as the robbery gun!

At police headquarters (HQ), a computer analyzes each report as it is filed. The computer uses the driver's license information to look up any other records it has about Fred Blogs (the speeder) and discovers this gun license:

```
<GunLicense>
   <registeredGun>
      <Gun>
         <serial>ABCD</serial>
      </Gun>
   </registeredGun>
   <holder>
      <Person>
         <driversLicenseNumber>ZXYZXY</driversLicenseNumber>
      </Person>
   </holder>
</GunLicense>
```

Case Solved?

- Not yet! These questions must be answered before the speeder can be arrested as the robbery suspect:
  - Can multiple guns have the same serial number?
    - If so, then just because Fred Blogs owns a gun with the same serial number as the robbery gun does not mean it was his gun that was used in the robbery.
  - Can multiple people have the same driver's license number?
    - If so, then the gun license information may be for someone else.
  - Can a gun be registered in multiple gun licenses?
    - If so, then the other gun licenses may show the holder of the gun to be someone other than Fred Blogs.
  - Can a gun license have multiple holders of a registered gun?
    - If so, then there may be another gun license document (not available at the police HQ) which shows the same registered gun but with a different holder.
- The OWL Ontology (Police.owl) provides the information needed to answer these questions!

Can multiple guns have the same serial number?

This OWL rule (in Police.owl) tells the computer at police HQ that *each gun is uniquely identified by its serial number*:

```
<owl:InverseFunctionalProperty rdf:ID="serial">
    <rdfs:domain rdf:resource="Gun"/>
    <rdfs:range  rdf:resource="http://www.w3.org/2000/01/rdf-schema#Literal"/>
</owl:InverseFunctionalProperty>
```

Can multiple people have the same driver's license number?

The following OWL rule tells the computer that *a driver's license number is unique to a Person*:

```
<owl:InverseFunctionalProperty rdf:ID="driversLicenseNumber">
    <rdfs:domain rdf:resource="Person"/>
    <rdfs:range  rdf:resource="http://www.w3.org/2000/01/rdf-schema#Literal"/>
</owl:InverseFunctionalProperty>
```

Can a gun be registered in multiple gun licenses?

The next OWL rule tells the computer that the registeredGun property uniquely identifies a GunLicense, i.e., *each gun is associated with only a single GunLicense*:

```
<owl:InverseFunctionalProperty rdf:ID="registeredGun">
    <rdfs:domain rdf:resource="GunLicense"/>
    <rdfs:range  rdf:resource="Gun"/>
</owl:InverseFunctionalProperty>
```

Can a gun license have multiple holders of a registered gun?

The police computer uses the following OWL rule to determine that the gun on the license is the same gun used in the robbery. This final rule seals the speeder's fate. It tells the computer that *each GunLicense applies to only one gun and one person*. So, there is no doubt that the speeder is the person who owns the gun:

```
<owl:Class rdf:ID="GunLicense">
   <owl:intersectionOf rdf:parseType="Collection">
      <owl:Restriction>
         <owl:onProperty rdf:resource="#registeredGun"/>
         <owl:cardinality>1</owl:cardinality>
      </owl:Restriction>
      <owl:Restriction>
         <owl:onProperty rdf:resource="#holder"/>
         <owl:cardinality>1</owl:cardinality>
      </owl:Restriction>
   </owl:intersectionOf>
</owl:Class>
```

Summary of information provided by the Police ontology

A gun license registers one gun to one person.

A gun can be registered in only one gun license.

```
<GunLicense>
   <registeredGun>
      <Gun>
         <serial>ABCD</serial>
      </Gun>
   </registeredGun>
   <holder>
      <Person>
         <driversLicenseNumber>ZXYZXY</driversLicenseNumber>
      </Person>
   </holder>
</GunLicense>
```

Only one gun can have this serial number.

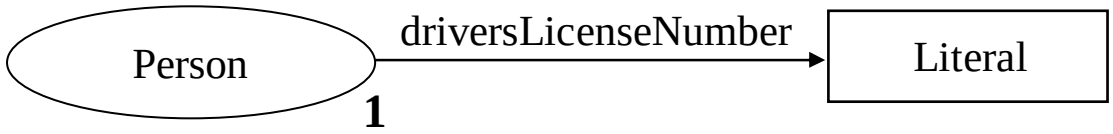
Only one person can have this driver's license number.

We now have overwhelming evidence that the speeder is the robber!

Notes

The example showed that a driver's license number applies to only one person:

```
<owl:InverseFunctionalProperty rdf:ID="driversLicenseNumber">
    <rdfs:domain rdf:resource="Person"/>
    <rdfs:range  rdf:resource="http://www.w3.org/2000/01/rdf-schema#Literal"/>
</owl:InverseFunctionalProperty>
```



"A driver's license number applies to only one person."

We can make an even stronger statement, because it's also true that a person has only one driver's license number:

"A driver's license number applies to only one person, and a person has only one driver's license number."

Continued ⟶

Notes (cont.)

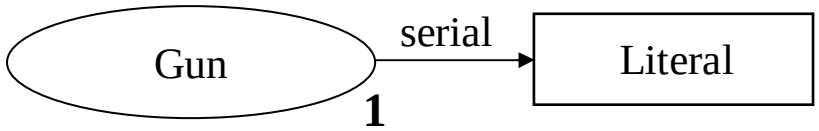
Thus, driversLicenseNumber is also a functional property:

```
<owl:DatatypeProperty rdf:ID="driversLicenseNumber">
    <rdf:type rdf:resource="http://www.w3.org/2002/07/owl#FunctionalProperty"/>
    <rdf:type rdf:resource="http://www.w3.org/2002/07/owl#InverseFunctionalProperty"/>
    <rdfs:domain rdf:resource="Person"/>
    <rdfs:range  rdf:resource="http://www.w3.org/2000/01/rdf-schema#Literal"/>
</owl:DatatypeProperty>
```

Notes (cont.)

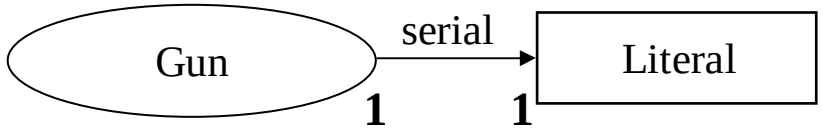
The example also showed that a serial number applies to only one gun:

```
<owl:InverseFunctionalProperty rdf:ID="serial">
    <rdfs:domain rdf:resource="Gun"/>
    <rdfs:range  rdf:resource="http://www.w3.org/2000/01/rdf-schema#Literal"/>
</owl:InverseFunctionalProperty>
```



"A serial number applies to only one gun."

We can make an even stronger statement, because it's also true that a gun has only one serial number:



"A serial number applies to only one gun, and a gun has only one serial number."

Continued ⟶

Notes (cont.)

Thus, serial is also a functional property:

```
<owl:DatatypeProperty rdf:ID="serial">
    <rdf:type rdf:resource="http://www.w3.org/2002/07/owl#FunctionalProperty"/>
    <rdf:type rdf:resource="http://www.w3.org/2002/07/owl#InverseFunctionalProperty"/>
    <rdfs:domain rdf:resource="Gun"/>
    <rdfs:range  rdf:resource="http://www.w3.org/2000/01/rdf-schema#Literal"/>
</owl:DatatypeProperty>
```