CC7220-1
La Web de Datos
Primavera 2025

Lecture 9: Shapes

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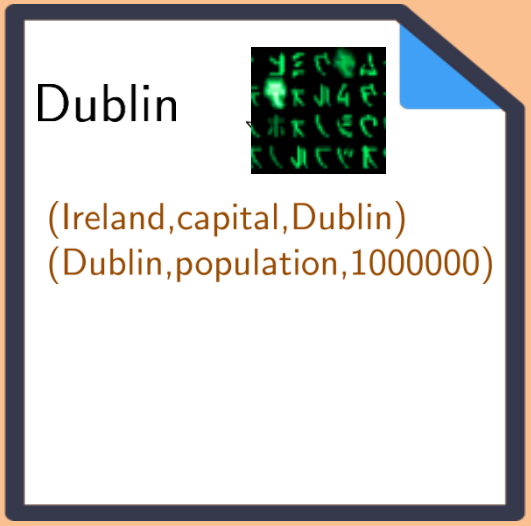
Previously …

* More or less

Semantic Web: Data, Logic, Query

Data:



Logic: “$(b$,capital,$a)$ $\rightarrow$ $(a$,partOf,$b)$”

“$(a$,partOf,$b)$, $(b$,partOf,$c)$ $\rightarrow$ $(a$,partOf,$c)$”

Query: “$(x$,partOf,$y)$?”

Output: $\{(x \mapsto \text{Ireland}, y \mapsto \text{Europe}),$
$(x \mapsto \text{Dublin}, y \mapsto \text{Ireland}),$
$(x \mapsto \text{Dublin}, y \mapsto \text{Europe})\}$

* More or less

Semantic Web: Data, Logic, Query

Data:

But what about Data Quality?

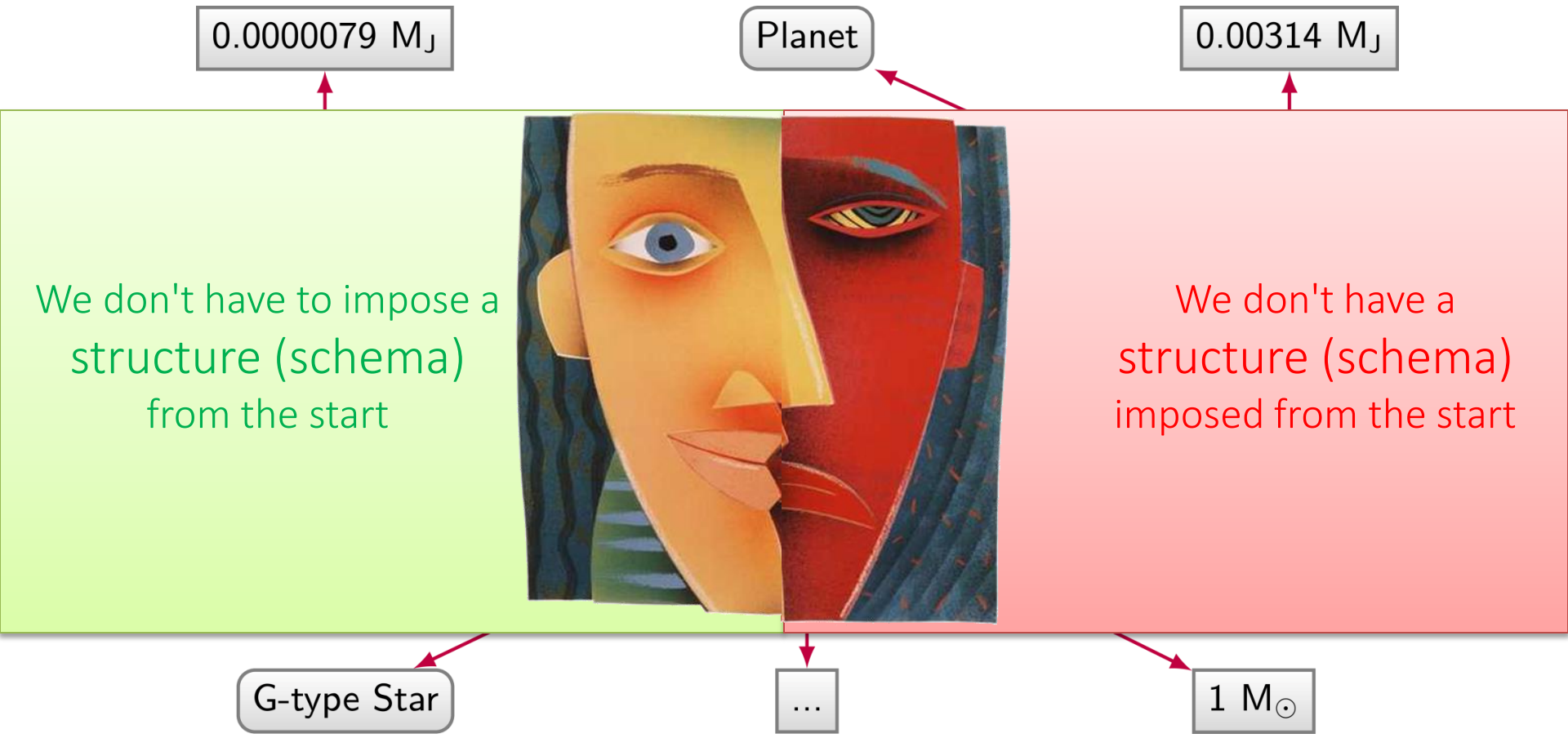
Logic: "$(b,\text{capital},a) \rightarrow (a,\text{partOf},b)$"
"$(a,\text{partOf},b),\ (b,\text{partOf},c) \rightarrow (a,\text{partOf},c)$"

Query: "(x,partOf,y)?"

Output: $\{(x \mapsto \text{Ireland}, y \mapsto \text{Europe}),$
$(x \mapsto \text{Dublin}, y \mapsto \text{Ireland}),$
$(x \mapsto \text{Dublin}, y \mapsto \text{Europe})\}$

Graphs ...

Graph Data: Pros and Cons



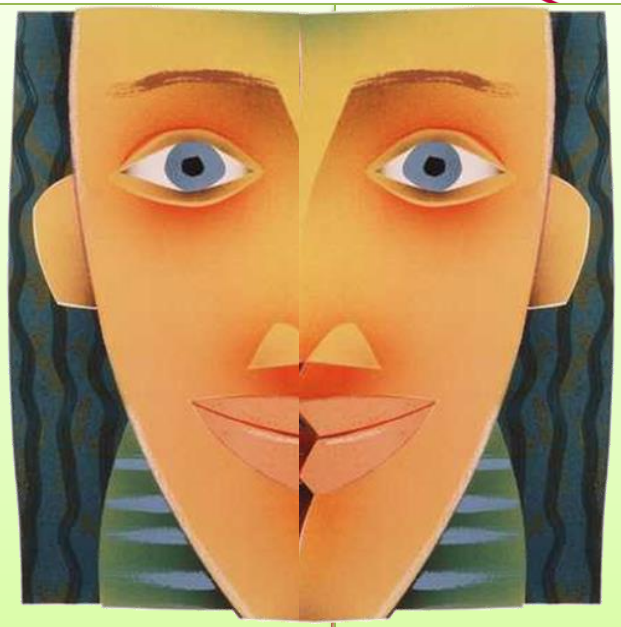
Graph Data: Pros and Pros

0.0000079 M_J

Planet

0.00314 M_J

We don't have to impose a structure (schema) from the start



... and we can impose a schema any time we like

G-type Star

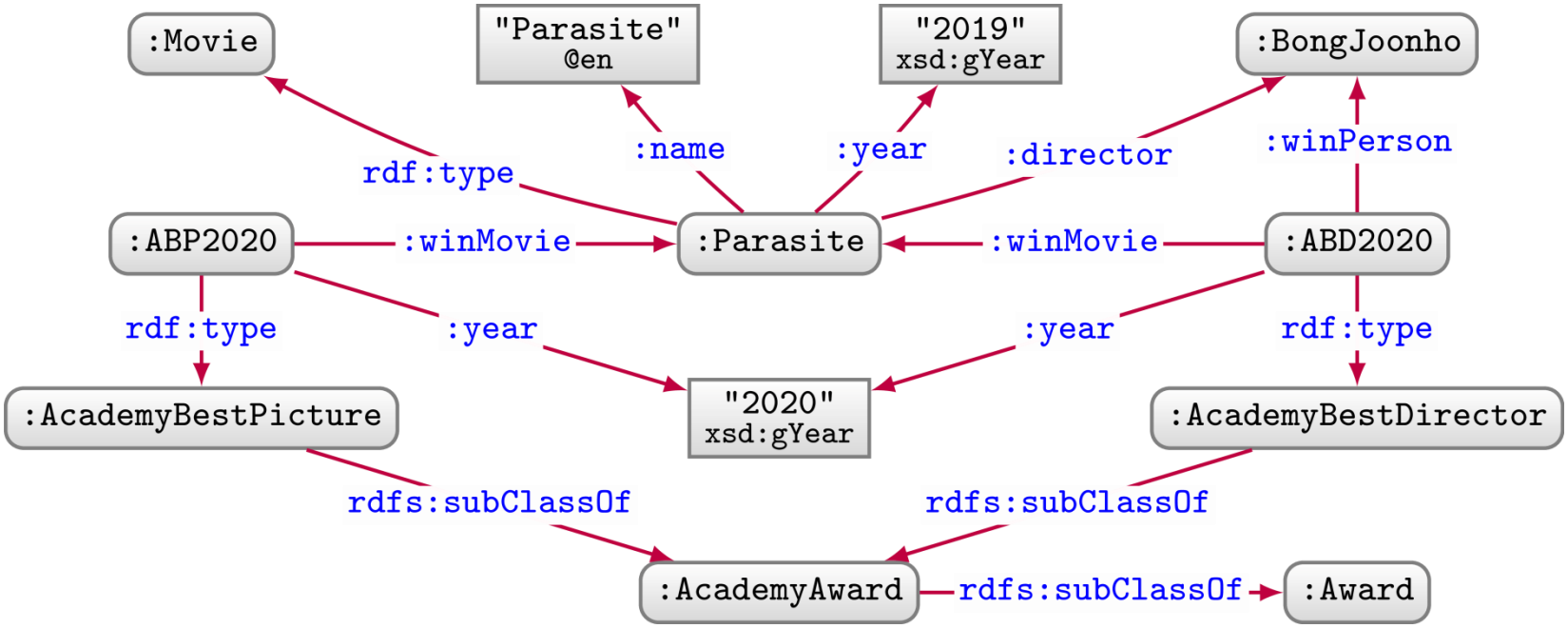
...

1 $M_\odot$

So how can we define and impose a schema for graphs?

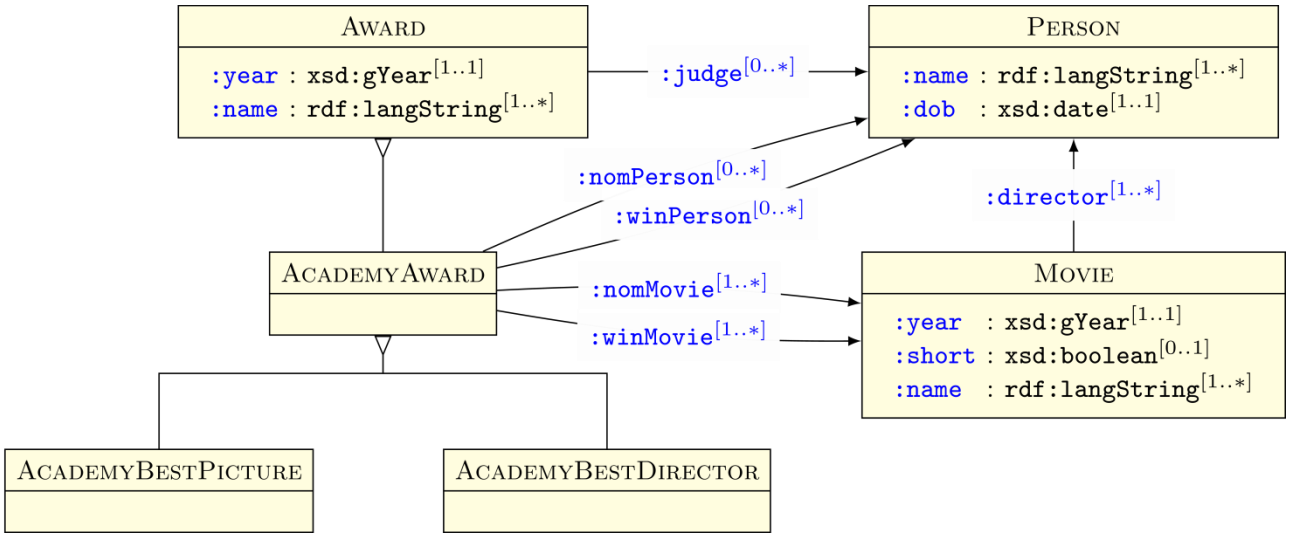
Shapes

Graph data: Validation

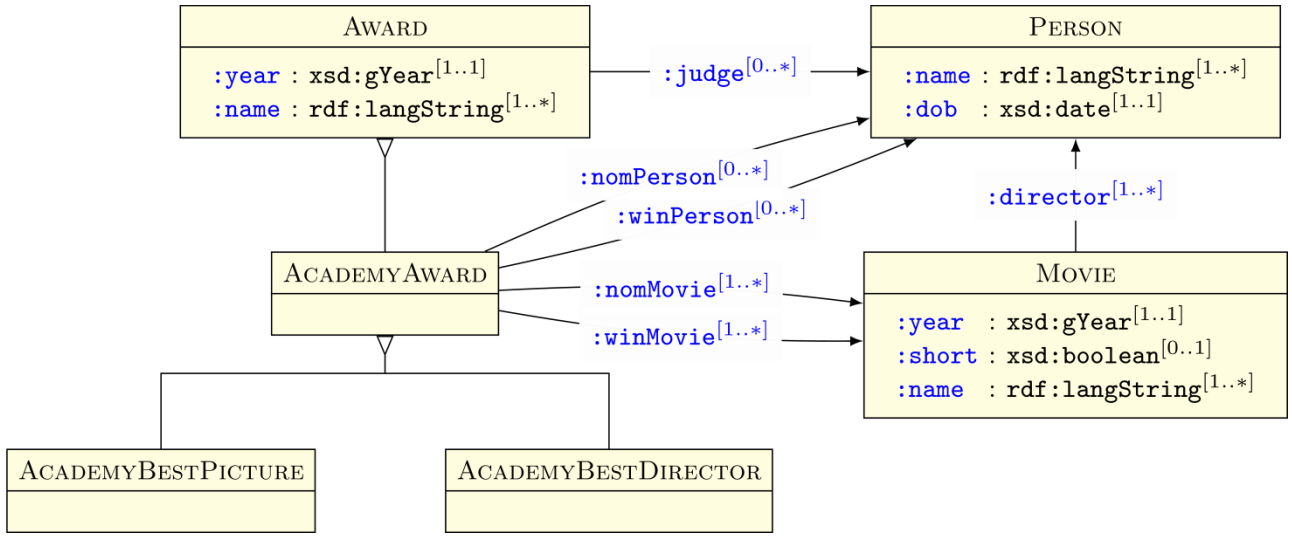


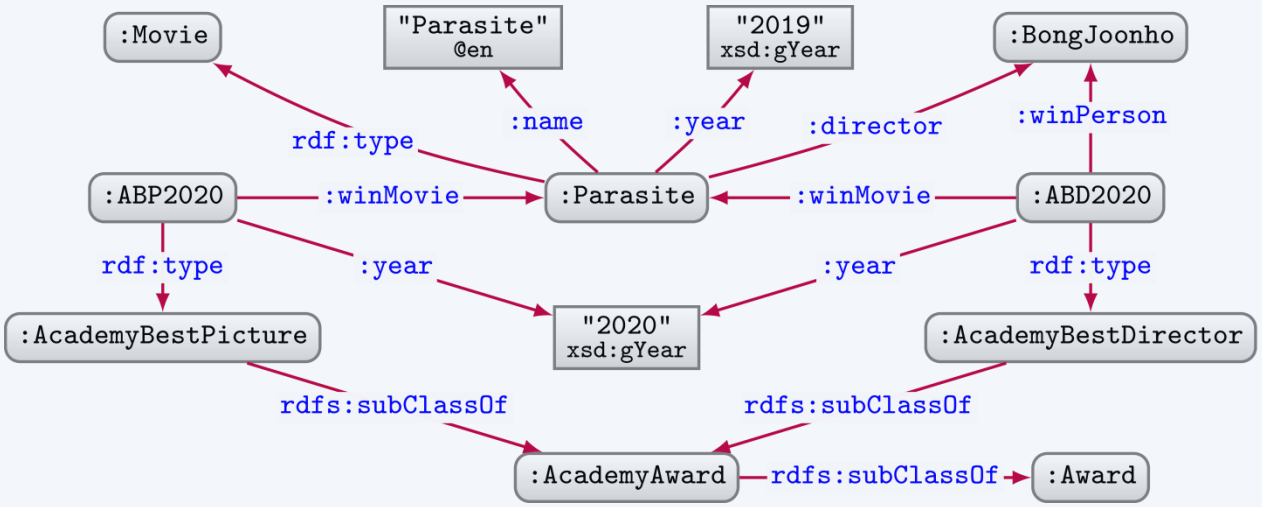
Is this graph "complete"?
Does it have "errors"?
How do we define "completeness" and "errors"?

Shapes Graph: Validating schema



Shapes Graph: Validate RDF graphs



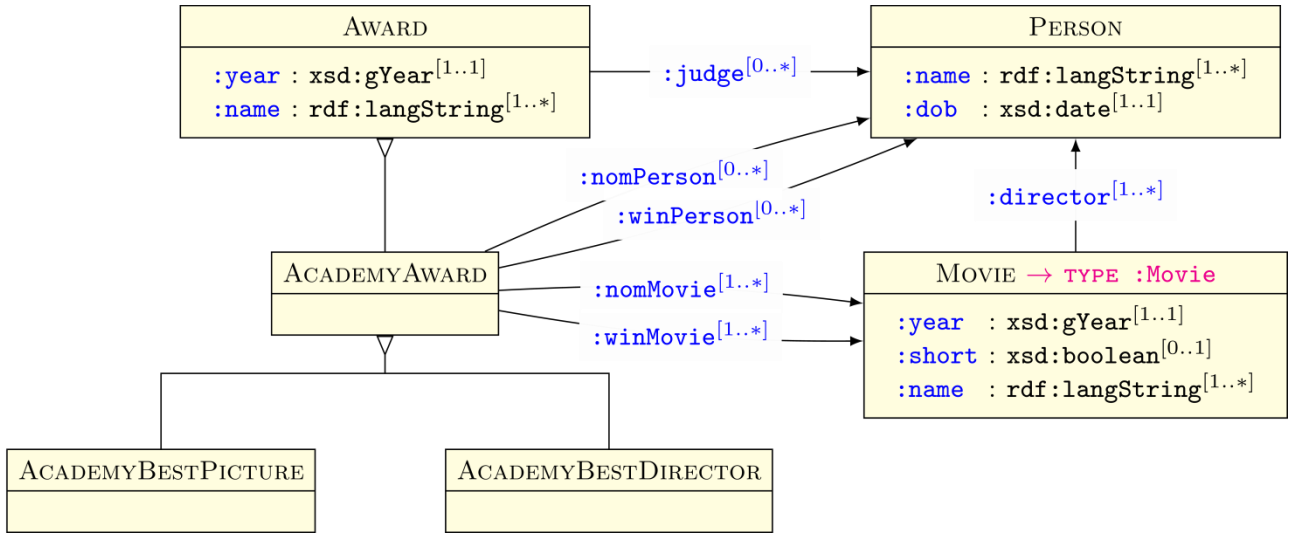


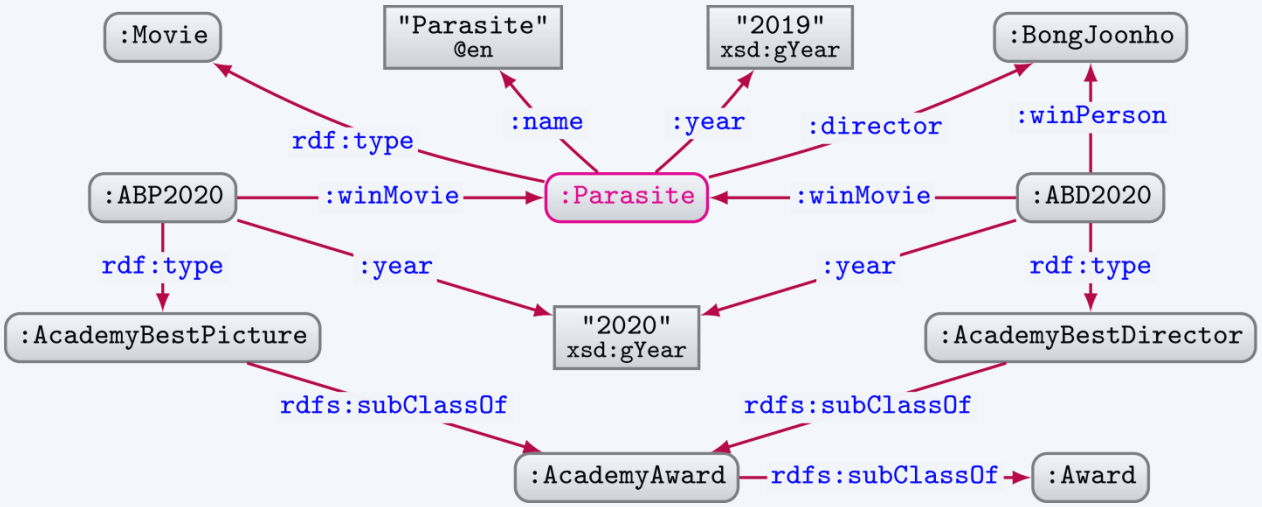
Does it pass?

Yes!

We have not yet defined a **target** for a shape, so we don't know which shape applies to which node in the data

Shapes Graph: Define a target



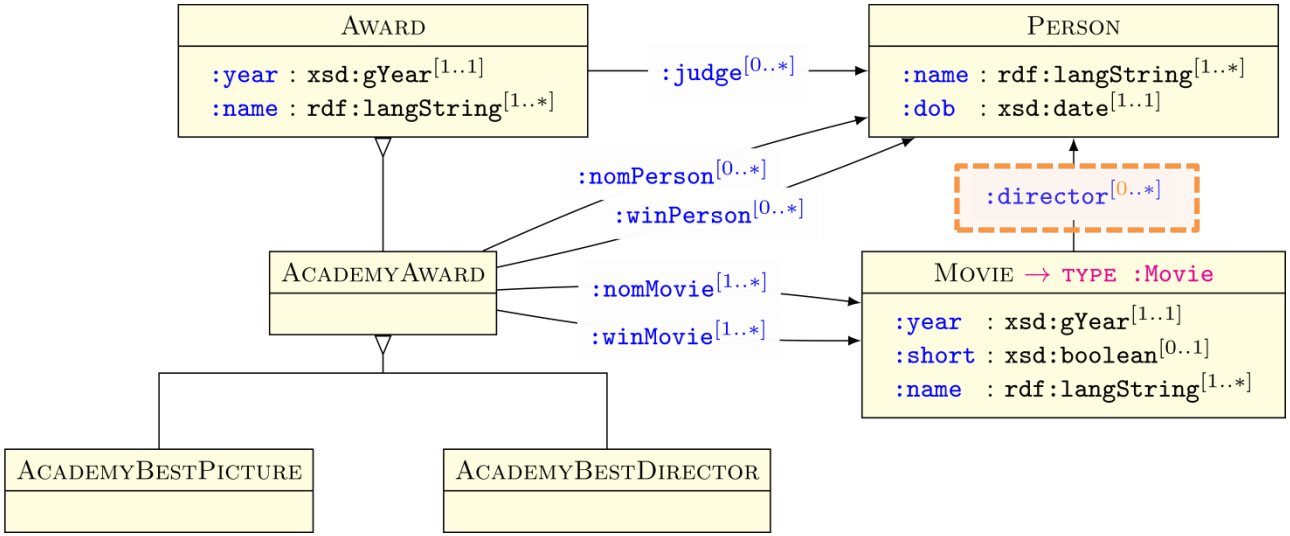


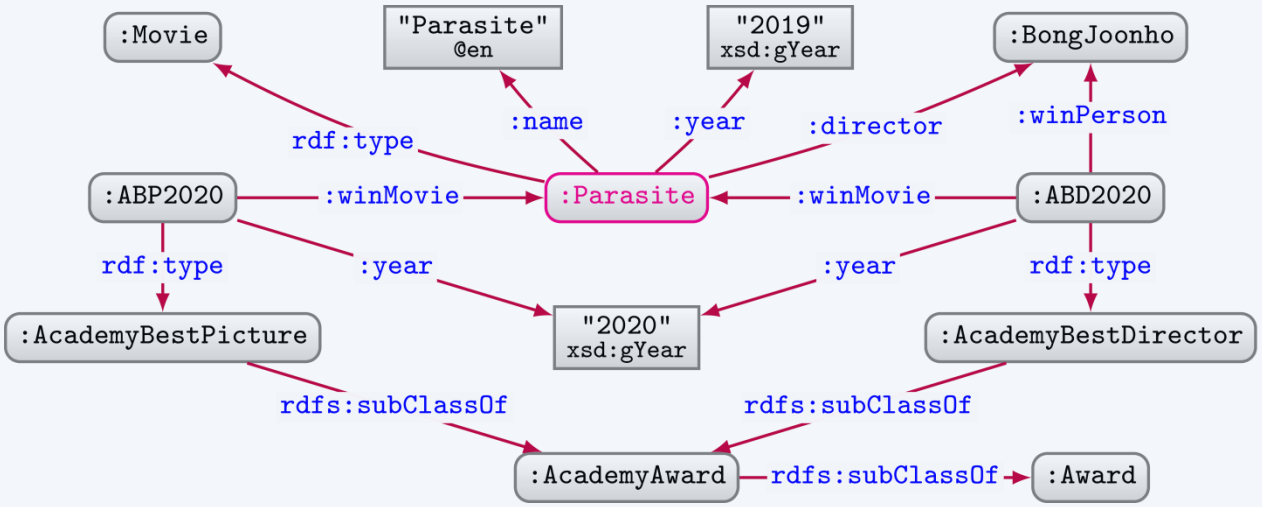
Does it pass?

No. `:Parasite` does not have a director satisfying **Person**.

We are missing a name and a date of birth for Bong Joon-ho!

Shapes Graph: Multiplicity



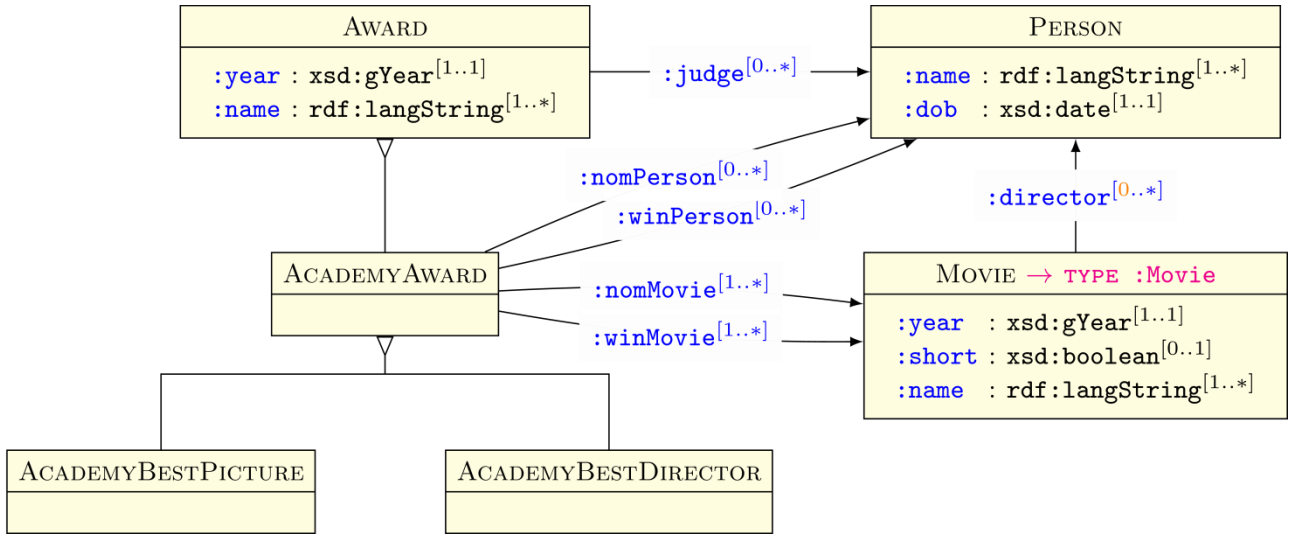


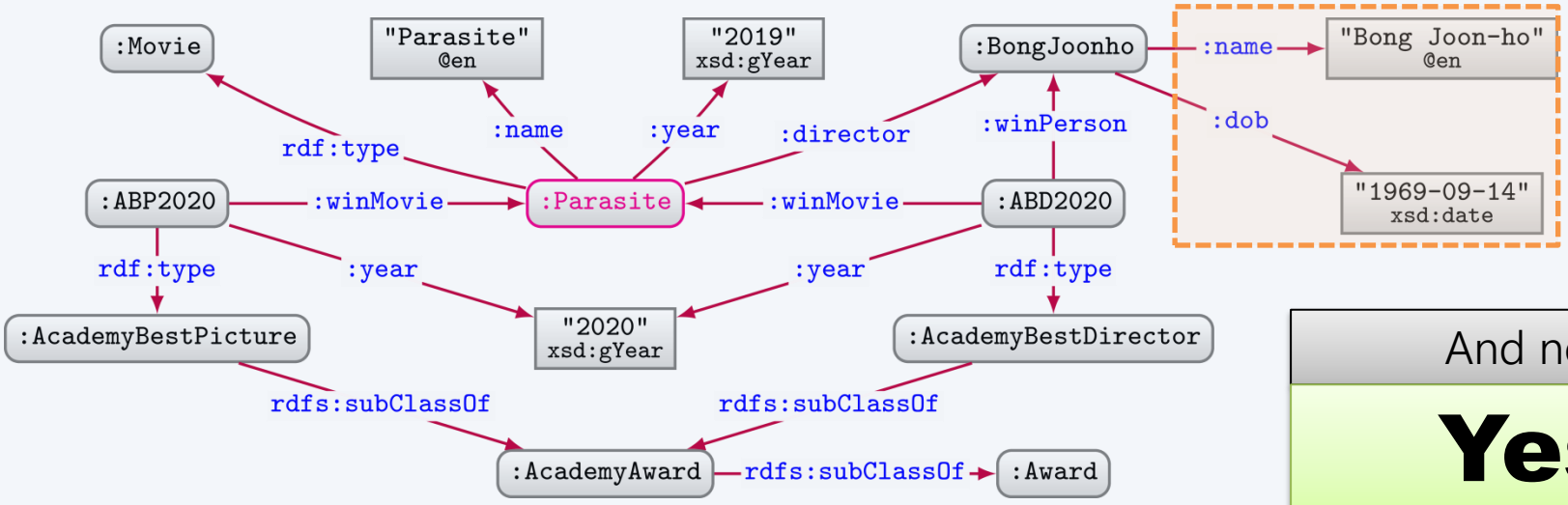
How about now?

No. Any director of `:Parasite` must still satisfy **Person**.

We are missing a name and a date of birth for Bong Joon-ho!

Shapes Graph: Validation



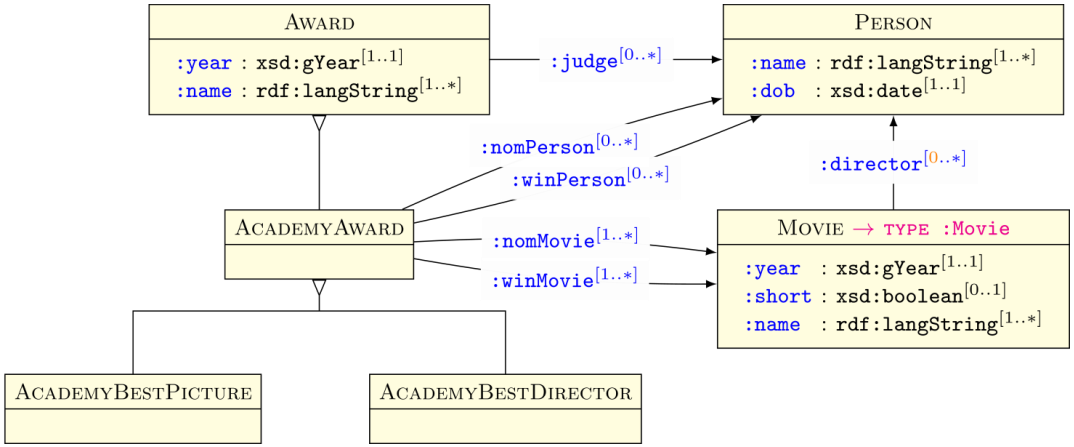


And now?

Yes!

Shapes vs. RDFS/OWL and SPARQL

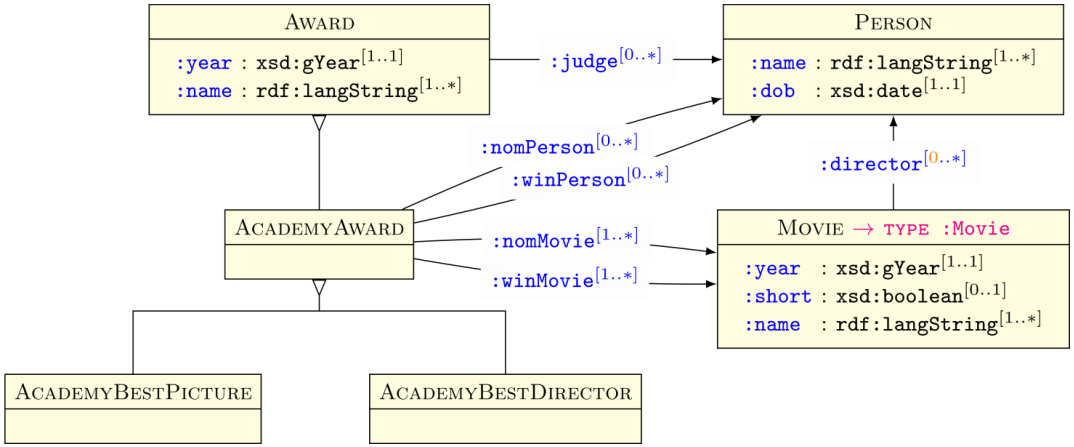
Shapes vs. RDFS/OWL




```
#[...]
:Award rdfs:subClassOf
  [ owl:allValuesFrom xsd:gYear ; owl:onProperty :year ] ,
  [ owl:cardinality 1 ; owl:onProperty :year ] ,
  [ owl:allValuesFrom rdf:langString ; owl:onProperty :name ] ,
  [ owl:minCardinality 1 ; owl:onProperty :name ] ,
  [ owl:allValuesFrom :Person ; owl:onProperty :judge ] .

AcademyAward rdfs:subClassOf :Award ,
  [ owl:allValuesFrom :Person ; owl:onProperty :nomPerson ] ,
  [ owl:allValuesFrom :Person ; owl:onProperty :winPerson ] ,
  [ owl:allValuesFrom :Movie ; owl:onProperty :nomMovie ] ,
  [ owl:minCardinality 1 ; owl:onProperty :nomMovie ] ,
  [ owl:minCardinality 1 ; owl:onProperty :winMovie ] .
#[...]
```

OWL assumes OWA and no UNA. Cannot easily detect missing data or duplicated values!

Shapes vs. SPARQL

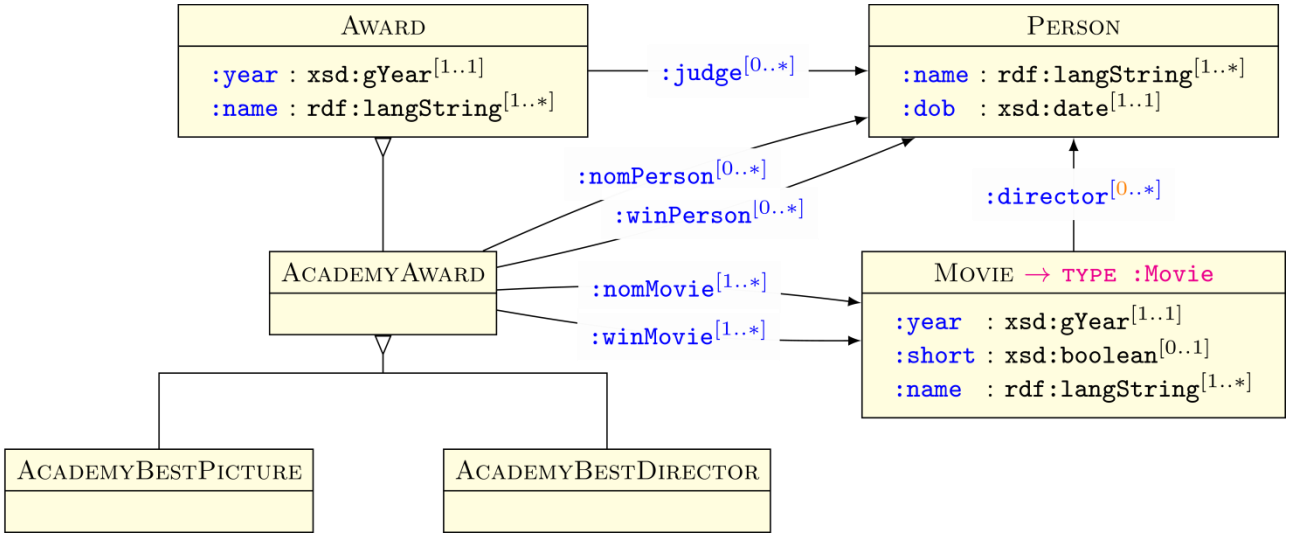



```
#[...]

# finds constraint violations
SELECT DISTINCT ?movie WHERE {
  ?movie a :Movie .
  OPTIONAL { ?movie :year ?year1 . }
  OPTIONAL { ?movie :year ?year2 . }
  FILTER(!bound(?year1) || datatype(?year1)!=xsd:gYear || ?year1 != ?year2)
  OPTIONAL { ?movie :short ?short1 . }
  OPTIONAL { ?movie :short ?short2 . }
  FILTER(bound(?short1) && (datatype(?short1)!=xsd:boolean || ?short1 != ?short2))
  OPTIONAL { ?movie :name ?name . }
  FILTER(!bound(?name) || lang(?name)="")
  OPTIONAL { ?movie :director ?director . }
  # check that ?director satisfies Person shape
}
```

Correct semantics, but difficult to express these types of constraints.

SHACL:
Shapes Constraint Language

Shapes Graph: How do we define them?



So how do we define shapes graphs?

Shapes Constraint Language (SHACL)

W3C Recommendation 20 July 2017

This version:

https://www.w3.org/TR/2017/REC-shacl-20170720/

Latest published version:

https://www.w3.org/TR/shacl/

Latest editor's draft:

https://w3c.github.io/data-shapes/shacl/

Implementation report:

https://w3c.github.io/data-shapes/data-shapes-test-suite/

Previous version:

https://www.w3.org/TR/2017/PR-shacl-20170608/

Editors:

Holger Knublauch, TopQuadrant, Inc.

Dimitris Kontokostas, University of Leipzig

Repository:

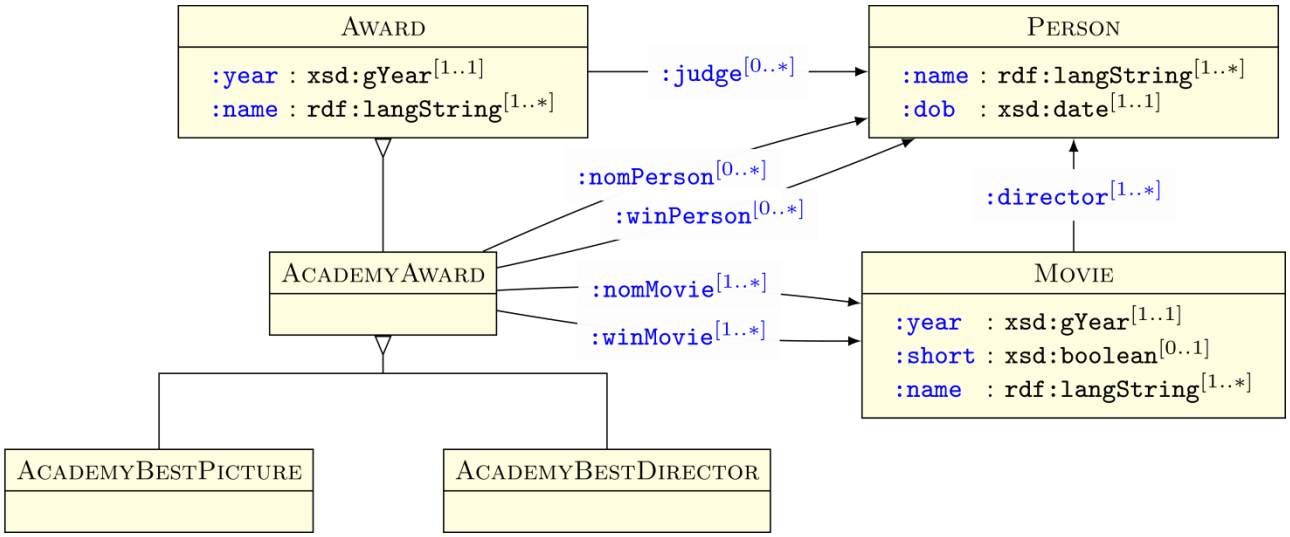
GitHub

Issues

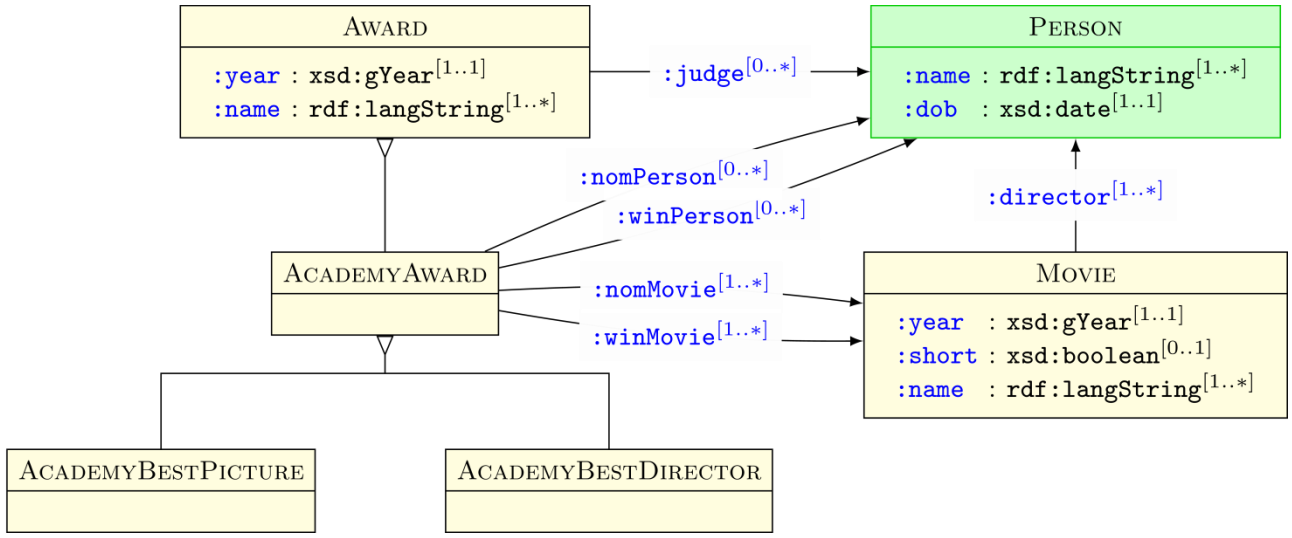
Test Suite:

SHACL Test Suite

SHACL: Shapes graph

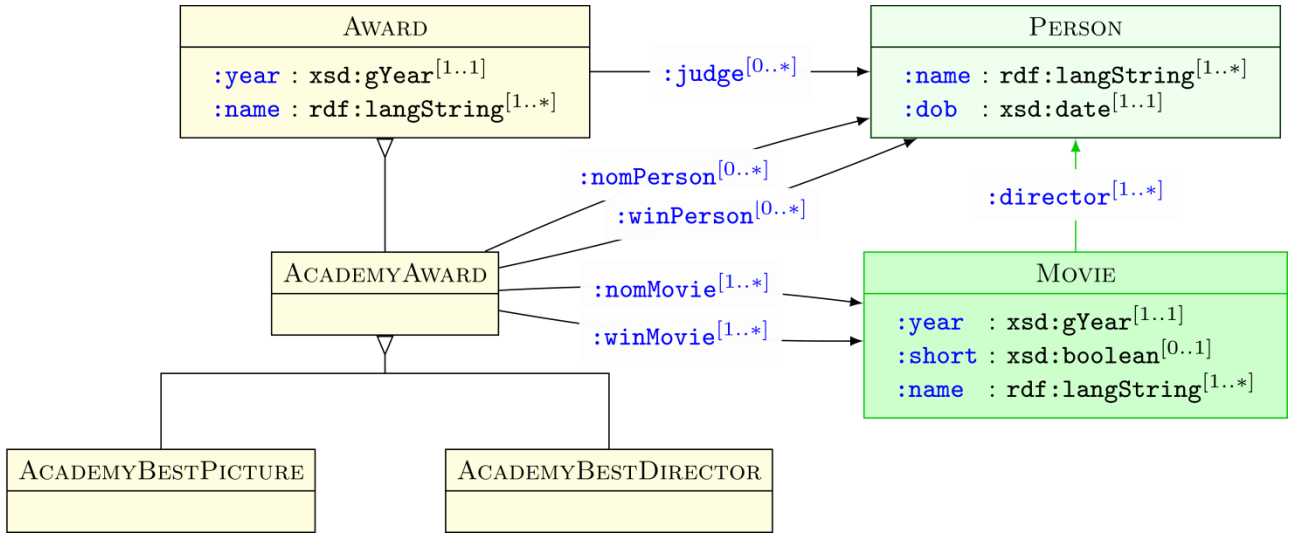


SHACL: Node and Property Shapes



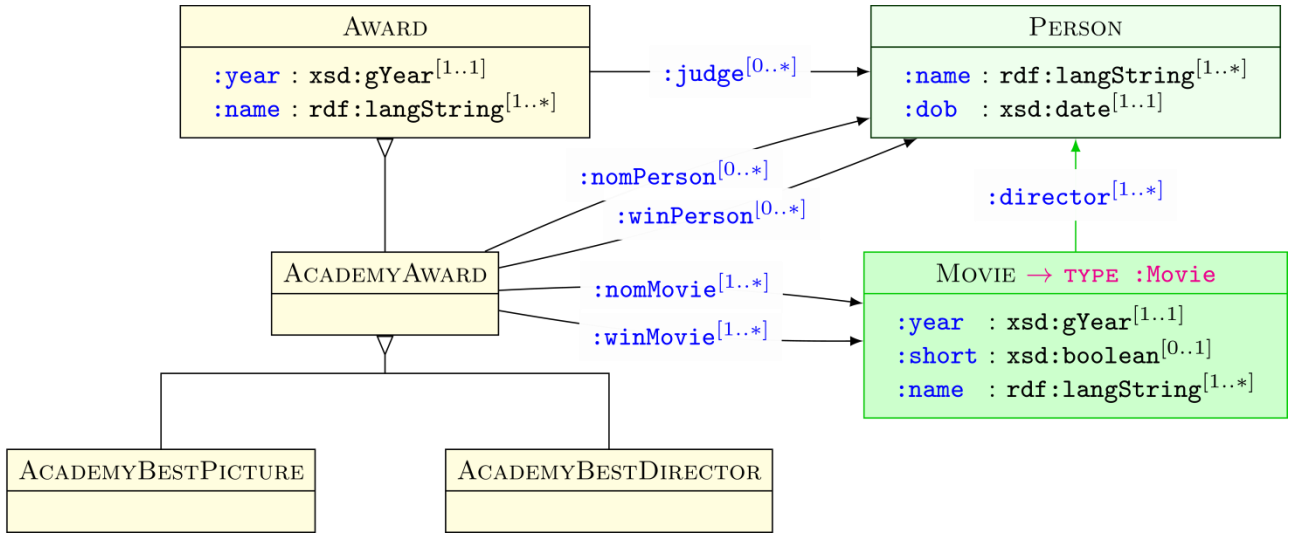

```
@prefix : <http://ex.org/data/> .
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>.
@prefix s: <http://ex.org/shapes/> .
@prefix sh: <http://www.w3.org/ns/shacl#> .
@prefix xsd: <http://www.w3.org/2001/XMLSchema#>.

s:Person a sh:NodeShape ;
  sh:property [ sh:path :name ; sh:datatype rdf:langString ; sh:minCount 1 ] ;
  sh:property [ sh:path :dob ; sh:datatype xsd:date ; sh:minCount 1 ; sh:maxCount 1 ] .
```

SHACL: Referencing node shapes



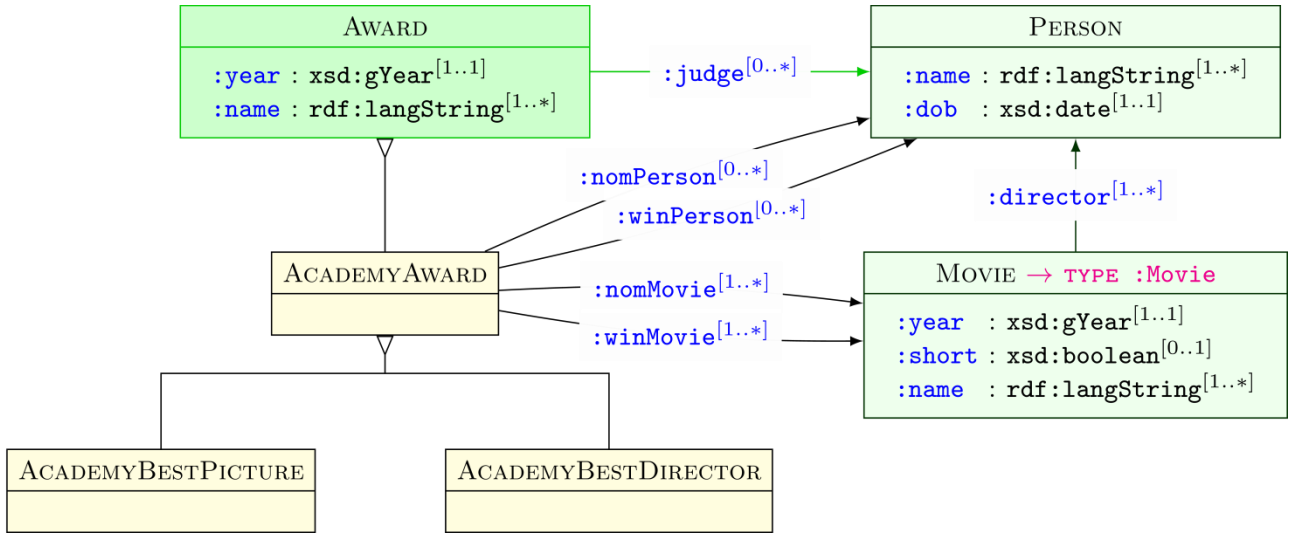

```
#[...]
s:Person a sh:NodeShape ; #[...]

s:Movie a sh:NodeShape ;
  sh:property [ sh:path :year ; sh:datatype xsd:gYear ; sh:maxCount 1 ; sh:minCount 1 ] ;
  sh:property [ sh:path :short ; sh:datatype xsd:boolean ; sh:maxCount 1 ] ;
  sh:property [ sh:path :name ; sh:datatype rdf:langString ; sh:minCount 1 ] ;
  sh:property [ sh:path :director ; sh:node s:Person ; sh:minCount 1 ] .
```

SHACL: Targets



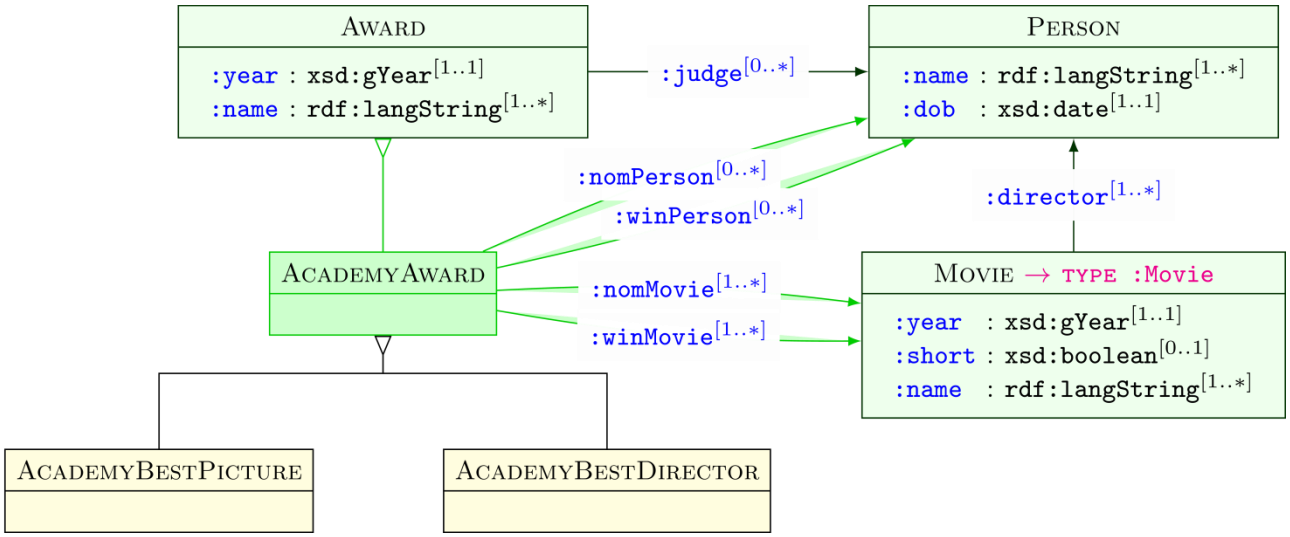

```
#[...]
s:Person a sh:NodeShape ; #[...]

s:Movie a sh:NodeShape ;
  sh:targetClass :Movie ;
  sh:property [ sh:path :year ; sh:datatype xsd:gYear ; sh:maxCount 1 ; sh:minCount 1 ] ;
  sh:property [ sh:path :short ; sh:datatype xsd:boolean ; sh:maxCount 1 ] ;
  sh:property [ sh:path :name ; sh:datatype rdf:langString ; sh:minCount 1 ] ;
  sh:property [ sh:path :director ; sh:node s:Person ; sh:minCount 1 ] .
```

SHACL: Inheritance



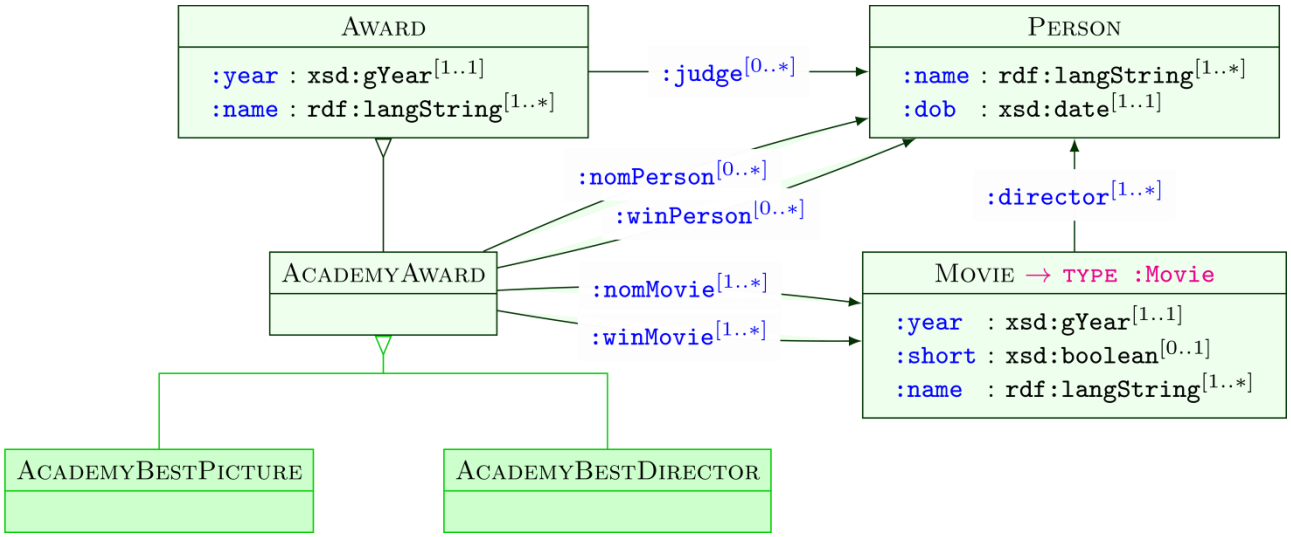

```
#[...]
s:Person a sh:NodeShape ; #[...]
s:Movie a sh:NodeShape ; #[...]

s:Award a sh:NodeShape ;
  sh:property [ sh:path :year ; sh:datatype xsd:gYear ; sh:maxCount 1 ; sh:minCount 1 ] ;
  sh:property [ sh:path :name ; sh:datatype rdf:langString ; sh:minCount 1 ] ;
  sh:property [ sh:path :judge ; sh:node s:Person ] .
```

SHACL: Inheritance




```
#[...]
s:Person a sh:NodeShape ; #[...]
s:Movie a sh:NodeShape ; #[...]
s:Award a sh:NodeShape ; #[...]

s:AcademyAward a sh:NodeShape ;
  sh:node s:Award ;
  sh:property [ sh:path :nomPerson ; sh:node s:Person ] ;
  sh:property [ sh:path :winPerson ; sh:node s:Person ] ;
  sh:property [ sh:path :nomMovie ; sh:node s:Movie ; sh:minCount 1 ] ;
  sh:property [ sh:path :winMovie ; sh:node s:Movie ; sh:minCount 1 ] .
```

SHACL: Inheritance



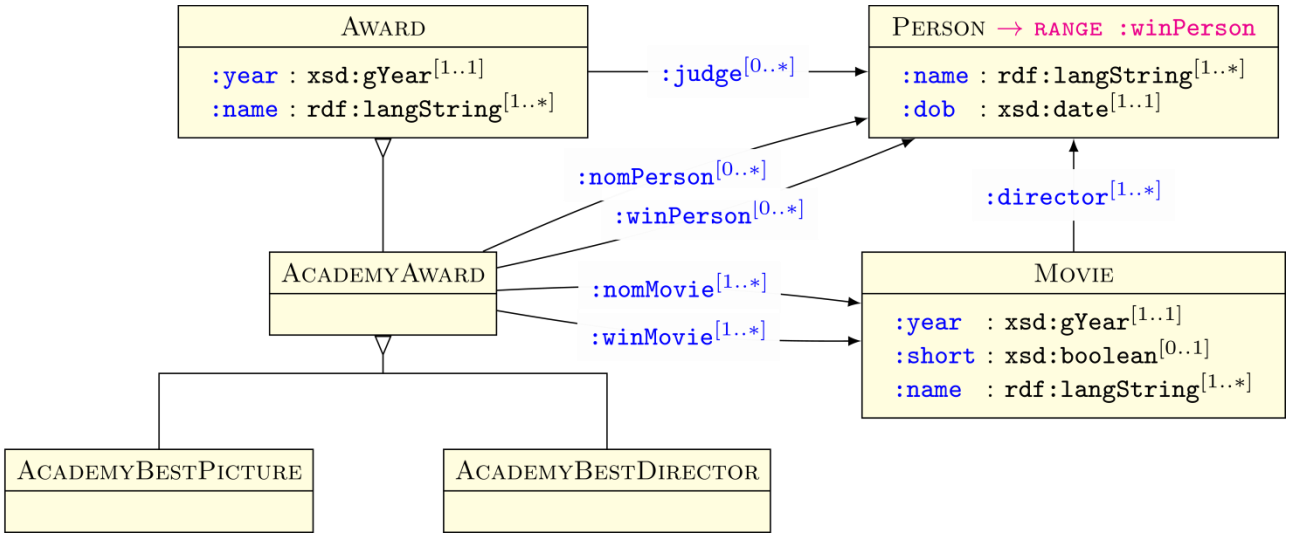

```
#[...]
s:Person a sh:NodeShape ; #[...]
s:Movie a sh:NodeShape ; #[...]
s:Award a sh:NodeShape ; #[...]
s:AcademyAward a sh:NodeShape ; #[...]

s:AcademyBestPicture a sh:NodeShape ;
  sh:node s:AcademyAward .

s:AcademyBestDirector a sh:NodeShape ;
  sh:node s:AcademyAward .
```

SHACL:
Targets

SHACL: Targets

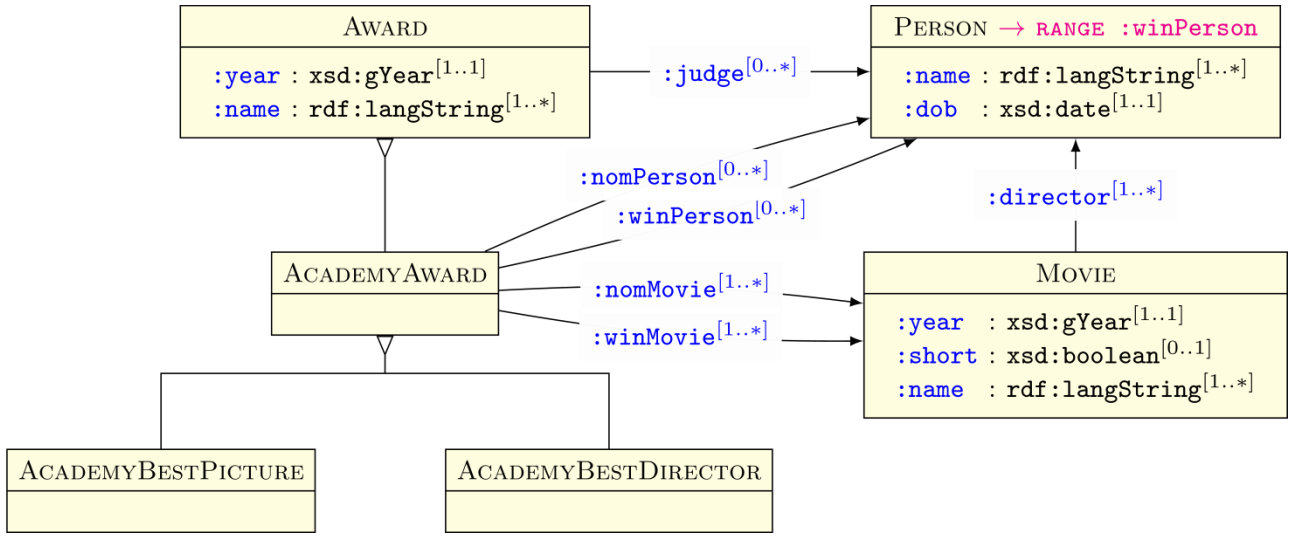
- `sh:targetClass` instances of a class
- `sh:targetSubjectsOf` domain of a property
- `sh:targetObjectsOf` range of a property
- `sh:targetNode` a specific node

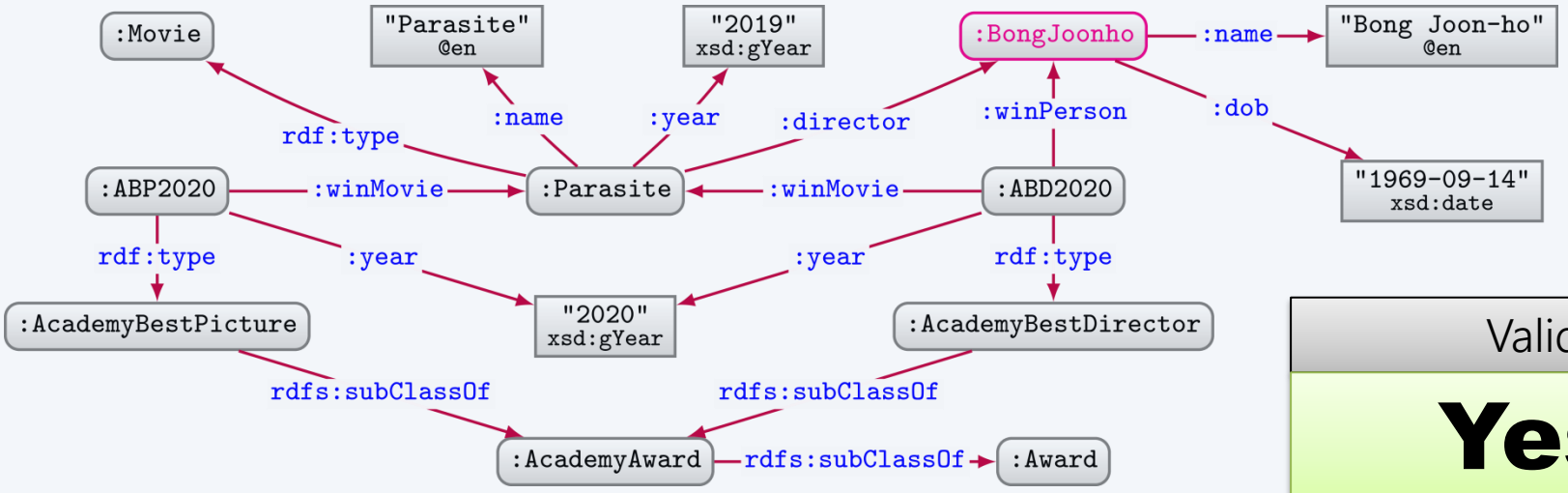
SHACL: Targeting range




```
@prefix : <http://ex.org/data/> .
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>.
@prefix s: <http://ex.org/shapes/> .
@prefix sh: <http://www.w3.org/ns/shacl#> .
@prefix xsd: <http://www.w3.org/2001/XMLSchema#>.

s:Person a sh:NodeShape ;
  sh:targetObjectsOf :winPerson ;
  sh:property [ sh:path :name ; sh:datatype rdf:langString ; sh:minCount 1 ] ;
  sh:property [ sh:path :dob ; sh:datatype xsd:date ; sh:minCount 1 ; sh:maxCount 1 ] .

#[...]
```

SHACL: Targeting range

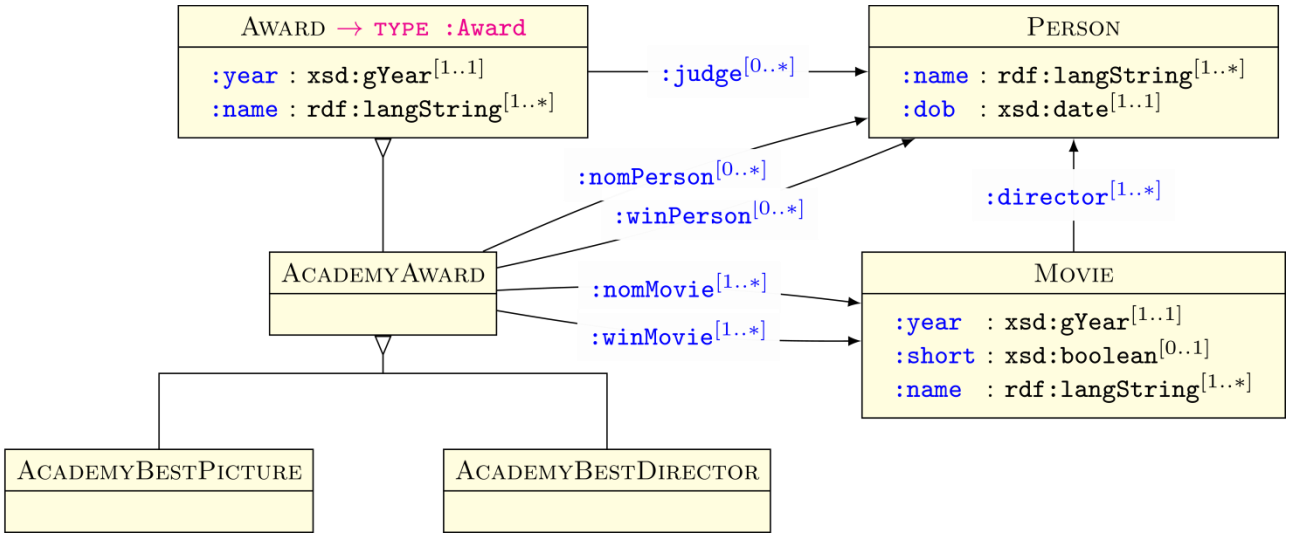




Valid?

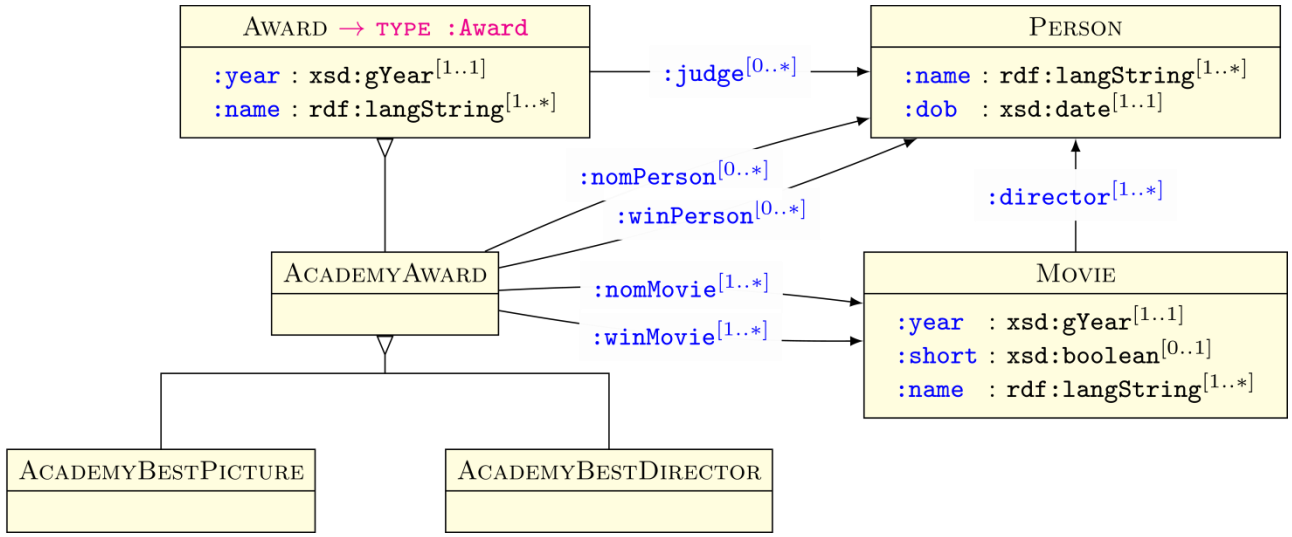
Yes!

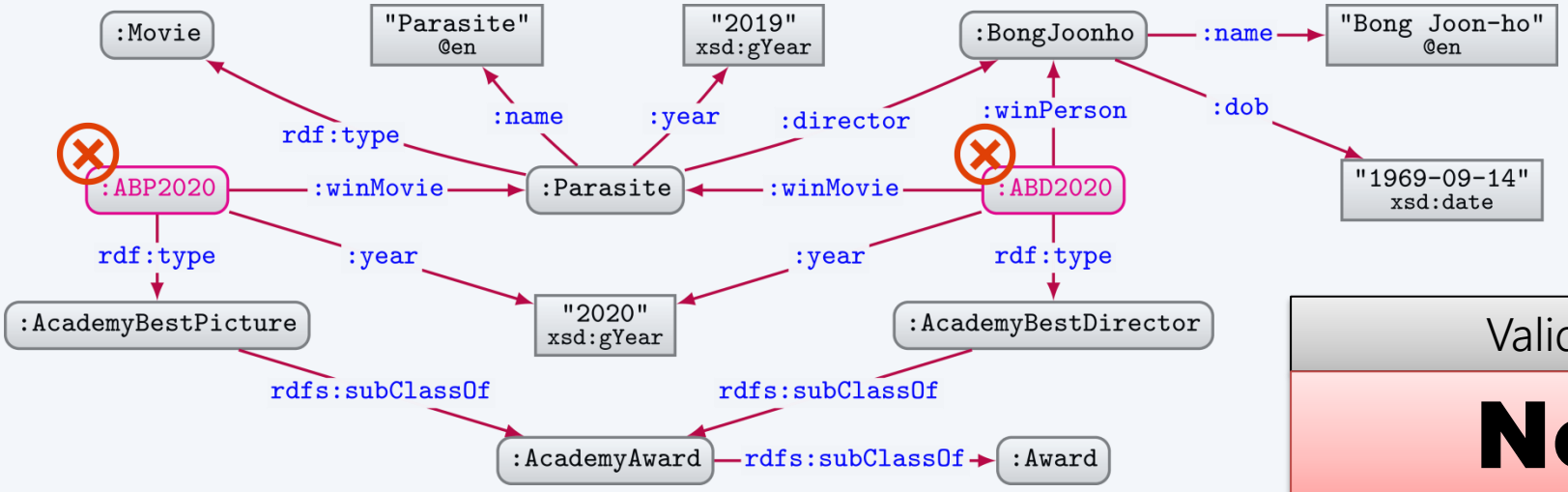
SHACL: Targeting subclasses




```
#[...]
s:Person a sh:NodeShape ; #[...]
s:Movie a sh:NodeShape ; #[...]

s:Award a sh:NodeShape ;
  sh:targetClass :Award ;
  sh:property [ sh:path :year ; sh:datatype xsd:gYear ; sh:maxCount 1 ; sh:minCount 1 ] ;
  sh:property [ sh:path :name ; sh:datatype rdf:langString ; sh:minCount 1 ] ;
  sh:property [ sh:path :judge ; sh:node s:Person ] .

#[...]
```

SHACL: Targets subclasses



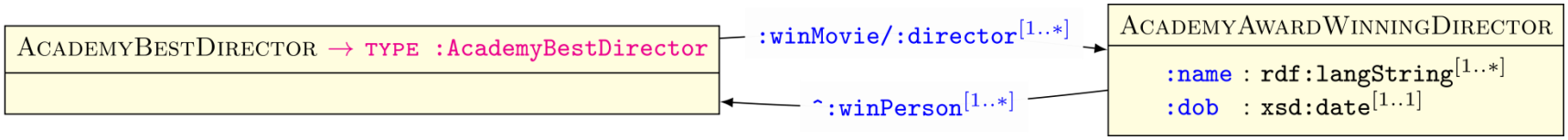


SHACL: Paths

SHACL: Paths

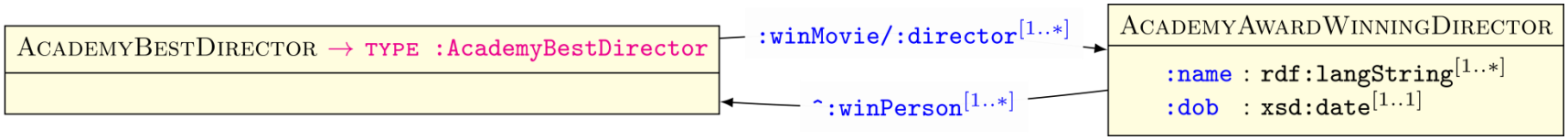
• `:p`	property	(`:p`)
• `[ sh:inversePath` *e* `]`	inverse of *e*	(^*e*)
• `(` *e f* `)`	*e* then *f*	(*e*/*f*)
• `[ sh:alternativePath (` *e f* `) ]`	*e* or *f*	(*e*|*f*)
• `[ sh:zeroOrMorePath` *e* `]`	recursive *e*	(*e**)
• `[ sh:oneOrMorePath` *e* `]`	recursive+ *e*	(*e*+)
• `[ sh:zeroOrOnePath` *e* `]`	optional *e*	(*e*?)

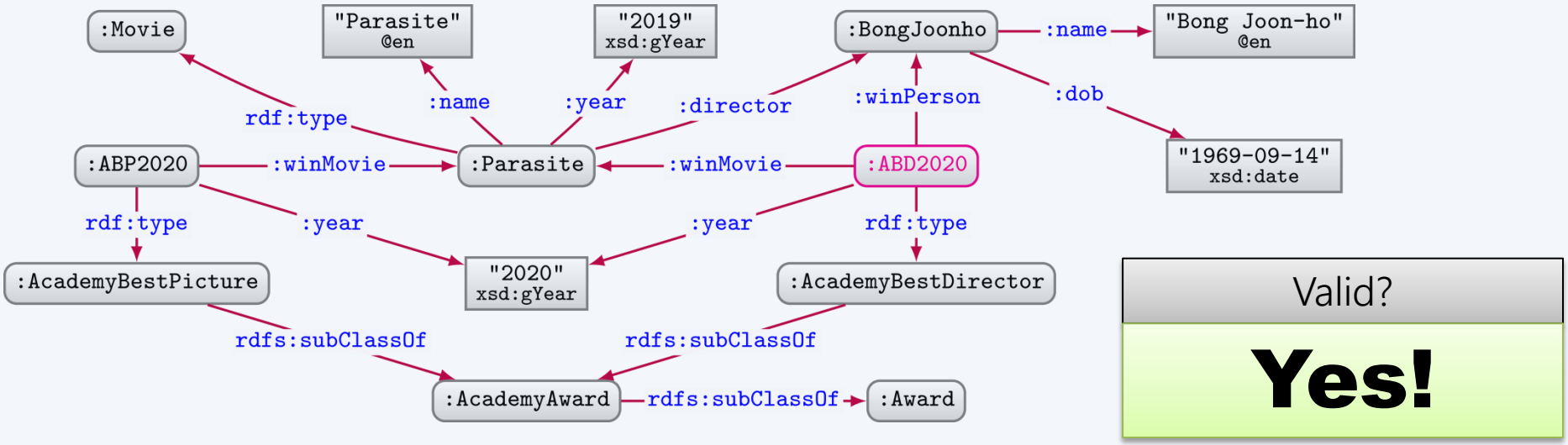
SHACL: Paths



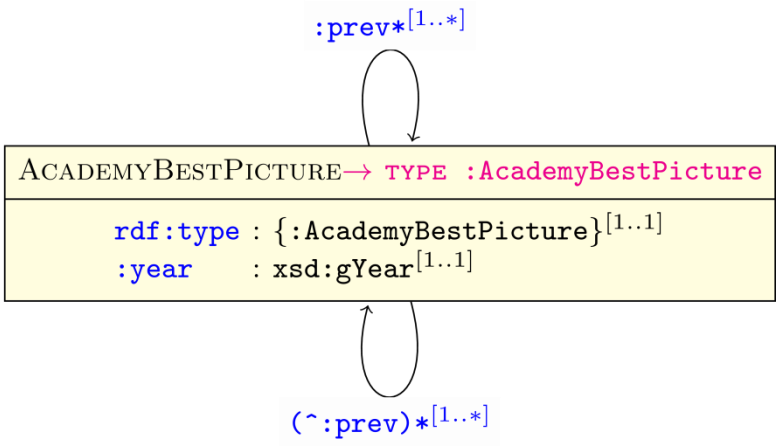

```
#[...]

s:AcademyBestDirector a sh:NodeShape ;
  sh:targetClass :AcademyBestDirector .
  sh:property [
    sh:path ( :winMovie :director ) ;
    sh:node s:AcademyAwardWinningDirector ; sh:minCount 1
  ] .

s:AcademyAwardWinningDirector a sh:NodeShape ;
  sh:property [ sh:path :name ; sh:datatype rdf:langString ; sh:minCount 1 ] ;
  sh:property [ sh:path :dob ; sh:datatype xsd:date ; sh:minCount 1 ; sh:maxCount 1 ] ;
  sh:property [
    sh:path [ sh:inversePath :winPerson ] ;
    sh:node s:AcademyBestDirector ; sh:minCount 1
  ] .

#[...]
```

SHACL: Paths


AcademyBestDirector → type :AcademyBestDirector
:winMovie/:director[1..*]
^:winPerson[1..*]
AcademyAwardWinningDirector
:name : rdf:langString[1..*]
:dob : xsd:date[1..1]

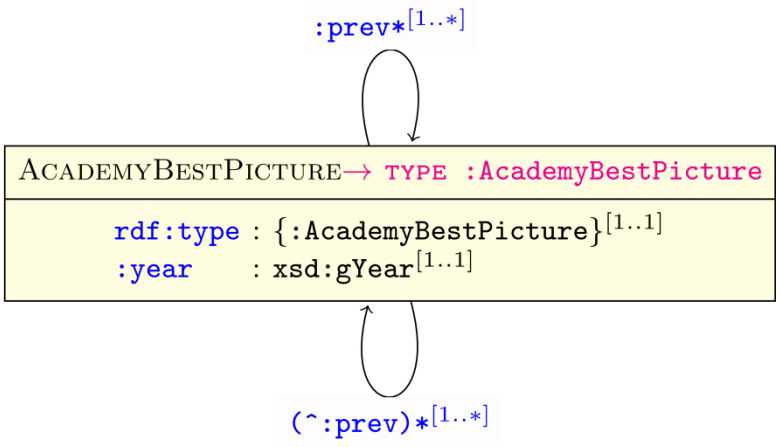

:Movie
"Parasite" @en
"2019" xsd:gYear
:BongJoonho
:name
"Bong Joon-ho" @en
rdf:type
:name
:year
:director
:winPerson
:dob
:ABP2020
:winMovie
:Parasite
:winMovie
:ABD2020
"1969-09-14" xsd:date
rdf:type
:year
:year
rdf:type
:AcademyBestPicture
"2020" xsd:gYear
:AcademyBestDirector
rdfs:subClassOf
rdfs:subClassOf
:AcademyAward
rdfs:subClassOf
:Award
Valid?
Yes!

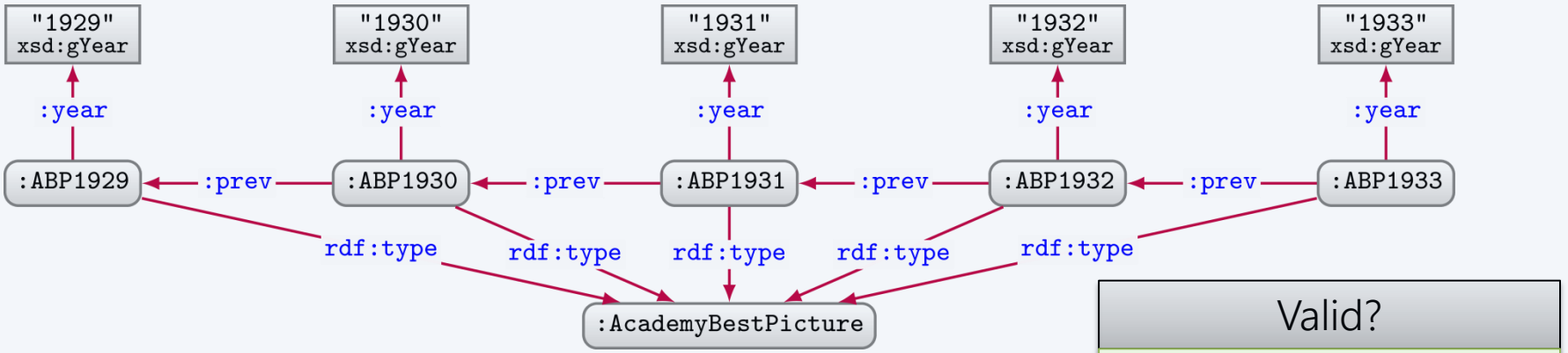
SHACL: Paths




```
#[...]

s:AcademyBestPicture a sh:NodeShape ;
  sh:targetClass :AcademyBestPicture ;
  sh:class :AcademyBestPicture ;
  sh:property [ sh:path :year ; sh:datatype xsd:gYear ] ;
  sh:property [
    sh:path [ sh:zeroOrMorePath :prev ] ;
    sh:node s:AcademyBestPicture ; sh:minCount 1
  ] ;
  sh:property [
    sh:path [ sh:zeroOrMorePath [ sh:inversePath :prev ] ] ;
    sh:node s:AcademyBestPicture ; sh:minCount 1
  ] .

#[...]
```

SHACL: Paths





Valid?

Yes!

SHACL:

Core Constraints

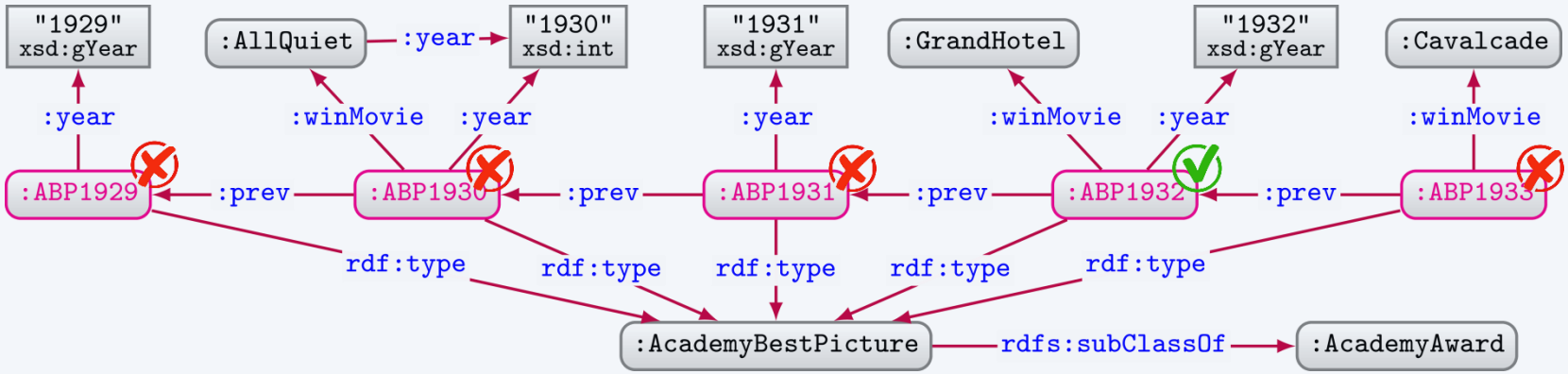
SHACL: Shape Constraints

Given ϕ a shape and e a path …

- `sh:node` ϕ — all target nodes in N satisfy shape ϕ
- `sh:property` ϕ, e — all value nodes V_n^e connected by path e from each target node $n \in N$ satisfy shape ϕ

```
#[...]
s:Movie a sh:NodeShape ;
  sh:property [ sh:path :year ; sh:datatype xsd:gYear ] .

s:Award a sh:NodeShape ;
  sh:property [ sh:path :year ; sh:datatype xsd:gYear ; sh:minCount 1 ] .

s:AcademyAward a sh:NodeShape ;
  sh:targetClass :AcademyAward ;
  sh:node s:Award ;
  sh:property [ sh:path :winMovie ; sh:node s:Movie ; sh:minCount 1 ] .
```

SHACL: Shape Constraints




```
#[...]
s:Movie a sh:NodeShape ;
  sh:property [ sh:path :year ; sh:datatype xsd:gYear ] .

s:Award a sh:NodeShape ;
  sh:property [ sh:path :year ; sh:datatype xsd:gYear ; sh:minCount 1 ] .

s:AcademyAward a sh:NodeShape ;
  sh:targetClass :AcademyAward ;
  sh:node s:Award ;
  sh:property [ sh:path :winMovie ; sh:node s:Movie ; sh:minCount 1 ] .
```

SHACL: Boolean Constraints

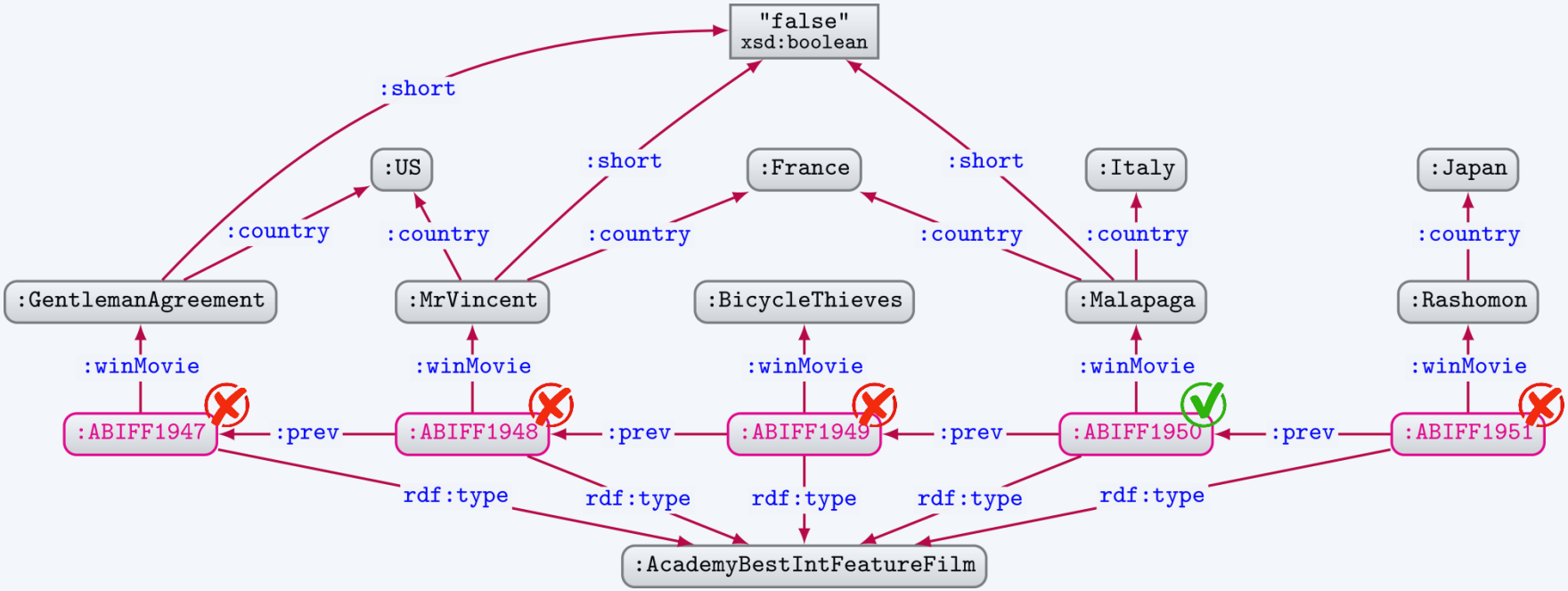
Assuming that $\phi, \phi_1, \ldots, \phi_n$ are shapes then …

- `sh:not` ϕ — negation — $(\neg\phi)$
- `sh:or (` $\phi_1 \ldots \phi_n$ `)` — disjunction — $(\phi_1 \vee \cdots \vee \phi_n)$
- `sh:and (` $\phi_1 \ldots \phi_n$ `)` — conjunction — $(\phi_1 \wedge \cdots \wedge \phi_n)$
- `sh:xone (` $\phi_1 \ldots \phi_n$ `)` — excl. disjunction — $(\phi_1 \oplus \cdots \oplus \phi_n)$

… are also shapes.

```
#[...]
s:FromUS a sh:NodeShape ; sh:property [ sh:path :country ; sh:hasValue :US ] .
s:FeatureMovie a sh:NodeShape ; sh:property [ sh:path :short ; sh:hasValue false ] .

s:AcademyBestIntFeatureFilm a sh:NodeShape ;
  sh:targetClass :AcademyBestIntFeatureFilm ;
  sh:property [
    sh:path :winMovie ;
    sh:and ( [ sh:not s:FromUS ] s:FeatureMovie ) ;
    sh:minCount 1 ; sh:maxCount 1
  ] .
```

SHACL: Boolean Constraints




```
#[...]
s:FromUS a sh:NodeShape ; sh:property [ sh:path :country ; sh:hasValue :US ] .
s:FeatureMovie a sh:NodeShape ; sh:property [ sh:path :short ; sh:hasValue false ] .

s:AcademyBestIntFeatureFilm a sh:NodeShape ;
  sh:targetClass :AcademyBestIntFeatureFilm ;
  sh:property [
    sh:path :winMovie ;
    sh:and ( [ sh:not s:FromUS ] s:FeatureMovie ) ;
    sh:minCount 1 ; sh:maxCount 1
  ] .
```

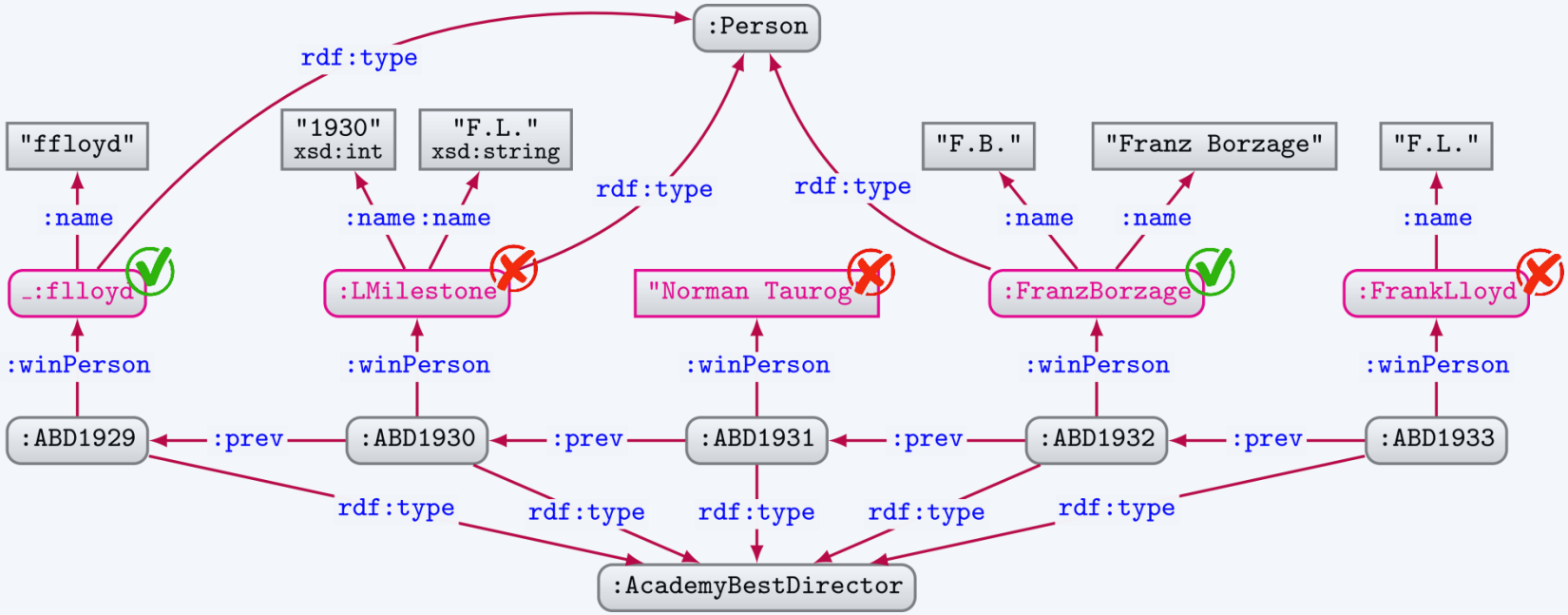
SHACL: Value Type Constraints

For each node $n \in N$ it holds that:

- `sh:class` C — n is an instance of class C
- `sh:datatype` D — n has the datatype D
- `sh:nodeKind` K — n is of kind K
  - K can be: `sh:BlankNode`, `sh:IRI`, `sh:Literal`, `sh:BlankNodeOrIRI`, `sh:BlankNodeOrLiteral`, `sh:IRIOrLiteral`

```
#[...]

s:Person a sh:NodeShape ;
  sh:targetObjectsOf :winPerson ;
  sh:class :Person ;
  sh:nodeKind sh:BlankNodeOrIRI ;
  sh:property [ sh:path :name ; sh:datatype xsd:string ; sh:minCount 1 ] .
```

SHACL: Value Type Constraints




```
#[...]

s:Person a sh:NodeShape ;
  sh:targetObjectsOf :winPerson ;
  sh:class :Person ;
  sh:nodeKind sh:BlankNodeOrIRI ;
  sh:property [ sh:path :name ; sh:datatype xsd:string ; sh:minCount 1 ] .
```

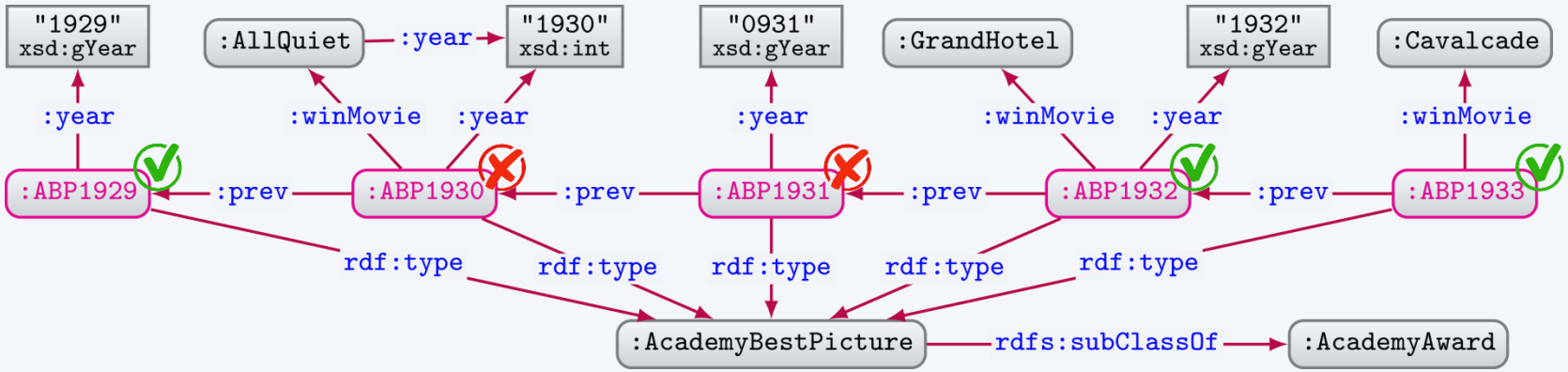
SHACL: Value Range Constraints

For each node $n \in N$ it holds that:

- `sh:minInclusive` m $\quad n \geq m$
- `sh:maxInclusive` m $\quad n \leq m$
- `sh:minExclusive` m $\quad n > m$
- `sh:maxExclusive` m $\quad n < m$

```
#[...]

s:AcademyBestPicture a sh:NodeShape ;
  sh:targetClass :AcademyBestPicture ;
  sh:property [ sh:path :year ; sh:datatype xsd:gYear ; sh:minInclusive "1929"^^xsd:gYear ] .
```

SHACL: Value Range Constraints




```
#[...]

s:AcademyBestPicture a sh:NodeShape ;
  sh:targetClass :AcademyBestPicture ;
  sh:property [ sh:path :year ; sh:datatype xsd:gYear ; sh:minInclusive "1929"^^xsd:gYear ] .
```

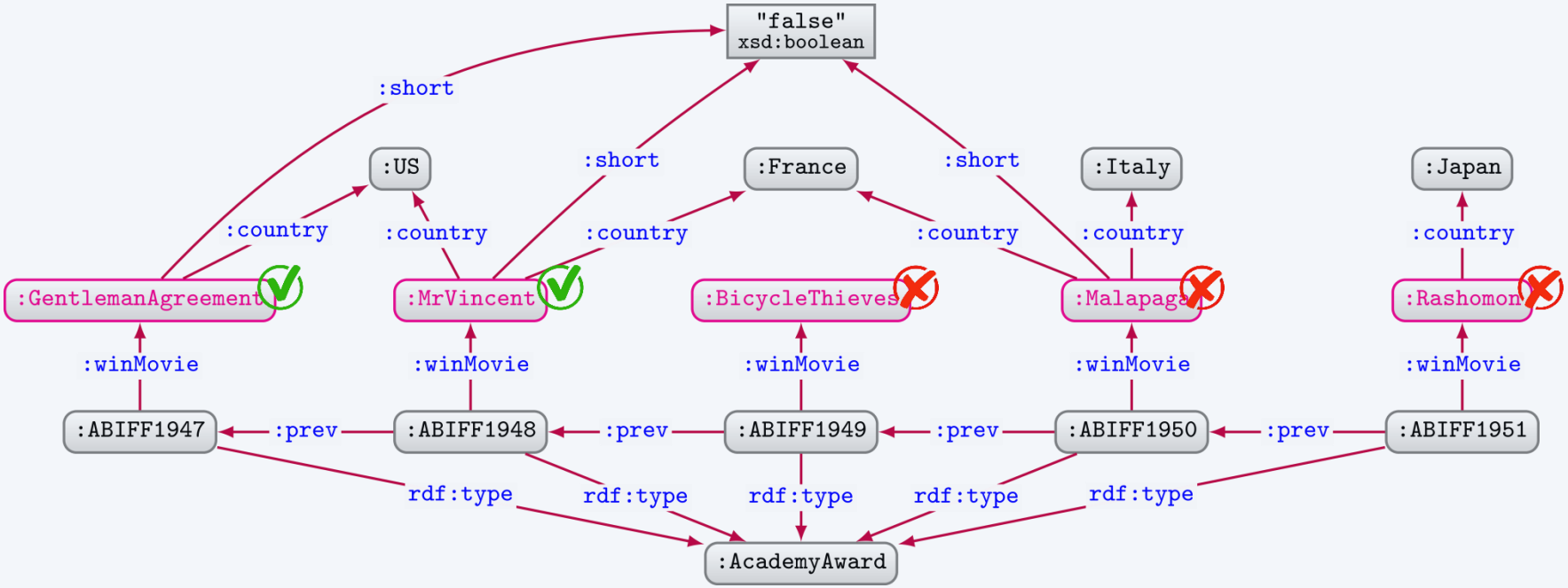
SHACL: Value Range Constraints

For the set of nodes N it holds that:

- `sh:hasValue` v $\quad\quad$ $v \in N$
- `sh:in ( ` $v_1 \ldots v_n$ `)` $\quad\quad$ $N \subseteq \{ v_1, \ldots, v_n \}$

```
#[...]

s:USMovie a sh:NodeShape ;
  sh:targetObjectsOf :winMovie ;
  sh:property [ sh:path :country ; sh:hasValue :US ] .
```

SHACL: Value Range Constraints




```
#[...]

s:USMovie a sh:NodeShape ;
  sh:targetObjectsOf :winMovie ;
  sh:property [ sh:path :country ; sh:hasValue :US ] .
```

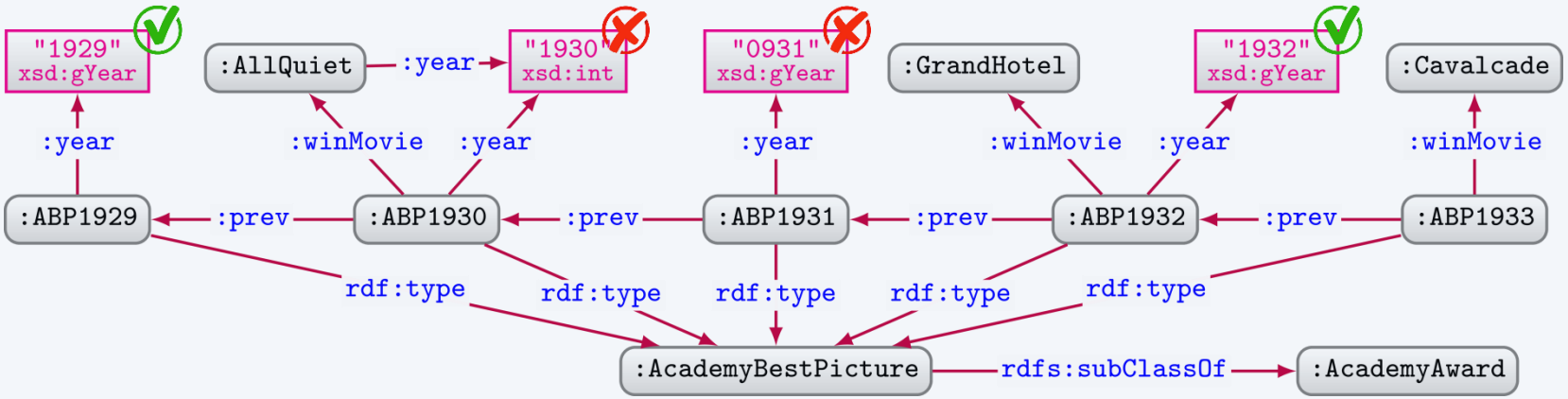
SHACL: String-based Constraints

Each node $n \in N$ is not a blank node and:

- `sh:minLength` m — has string length $\geq m$
- `sh:maxLength` m — has string length $\leq m$
- `sh:pattern` p, f — matches regex p with flags f

```
#[...]

s:ModernYear a sh:NodeShape ;
  sh:targetObjectsOf :year ;
  sh:datatype xsd:gYear ;
  sh:minLength 4 ;
  sh:maxLength 4 ;
  sh:pattern "(19|20)[0-9][0-9]" ;
  sh:flags "i" . # case insensitive pattern (just for the example)
```

SHACL: String-based Constraints




```
#[...]

s:ModernYear a sh:NodeShape ;
  sh:targetObjectsOf :year ;
  sh:datatype xsd:gYear ;
  sh:minLength 4 ;
  sh:maxLength 4 ;
  sh:pattern "(19|20)[0-9][0-9]" ;
  sh:flags "i" . # case insensitive pattern (just for the example)
```

SHACL: String-based Constraints

Each node $n \in N$ is a literal and:

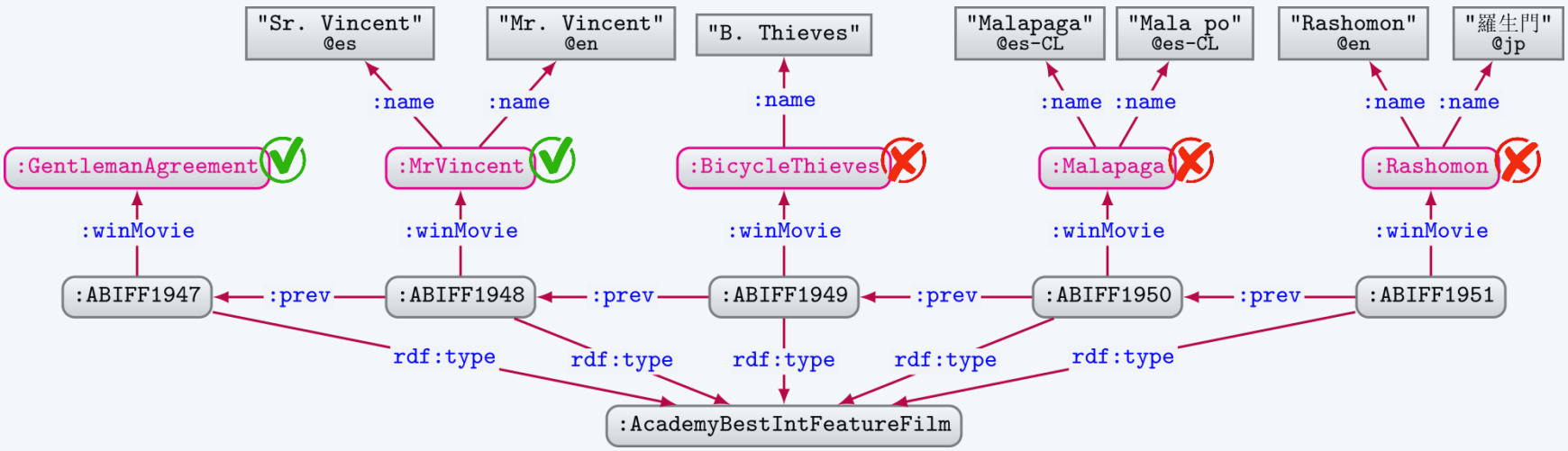
- `sh:languageIn ( ` $l_1 \ldots l_n$ `)` has a lang. tag matching $l \in \{ l_1, \ldots, l_n \}$

Each node $n \in N$:

- `sh:uniqueLang true` has no lang. tag, an empty lang. tag or or a lang. tag unique in N

```
#[...]

s:MovieHasUniqueEnglishSpanishName a sh:NodeShape ;
  sh:targetObjectsOf :winMovie ;
  sh:property [
    sh:path :name ;
    sh:languageIn ( "es" "en" ) ; # will also match "es-CL", etc.
    sh:uniqueLang true
  ] .
```

SHACL: String-based Constraints




```
#[...]

s:MovieHasUniqueEnglishSpanishName a sh:NodeShape ;
  sh:targetObjectsOf :winMovie ;
  sh:property [
    sh:path :name ;
    sh:languageIn ( "es" "en" ) ; # will also match "es-CL", etc.
    sh:uniqueLang true
  ] .
```

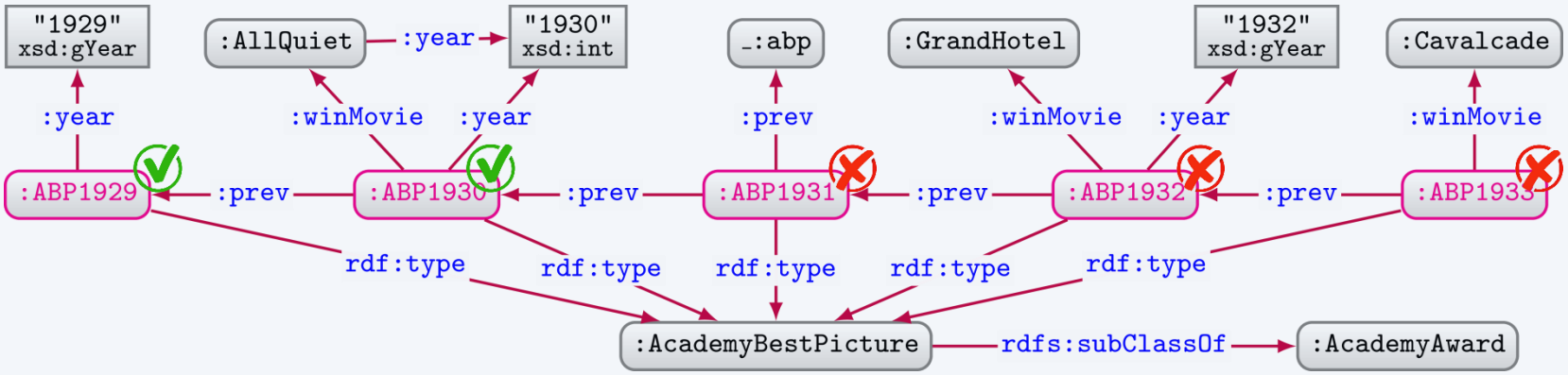
SHACL: Cardinality Constraints

Given a path e, for each node $n \in N$, there are …

- `sh:maxCount` m — at most m nodes in V_n^e
- `sh:minCount` m — at least m nodes in V_n^e
- `sh:qualifiedMinCount` m, ϕ — at least m nodes in V_n^e that satisfy ϕ
- `sh:qualifiedMaxCount` m, ϕ — at most m nodes in V_n^e that satisfy ϕ

```
#[...]

s:FirstInSeries a sh:NodeShape ;
  sh:property [ sh:path :prev ; sh:maxCount 0 ] .

s:AcademyBestPicture a sh:NodeShape ;
  sh:targetClass :AcademyBestPicture ;
  sh:property [
    sh:path [ sh:zeroOrMorePath :prev ] ;
    sh:qualifiedMaxCount 1 ;
    sh:qualifiedMinCount 1 ;
    sh:qualifiedValueShape s:FirstInSeries
  ] .
```

SHACL: Cardinality Constraints




```
#[...]

s:FirstInSeries a sh:NodeShape ;
  sh:property [ sh:path :prev ; sh:maxCount 0 ] .

s:AcademyBestPicture a sh:NodeShape ;
  sh:targetClass :AcademyBestPicture ;
  sh:property [
    sh:path [ sh:zeroOrMorePath :prev ] ;
    sh:qualifiedMaxCount 1 ;
    sh:qualifiedMinCount 1 ;
    sh:qualifiedValueShape s:FirstInSeries
  ] .
```

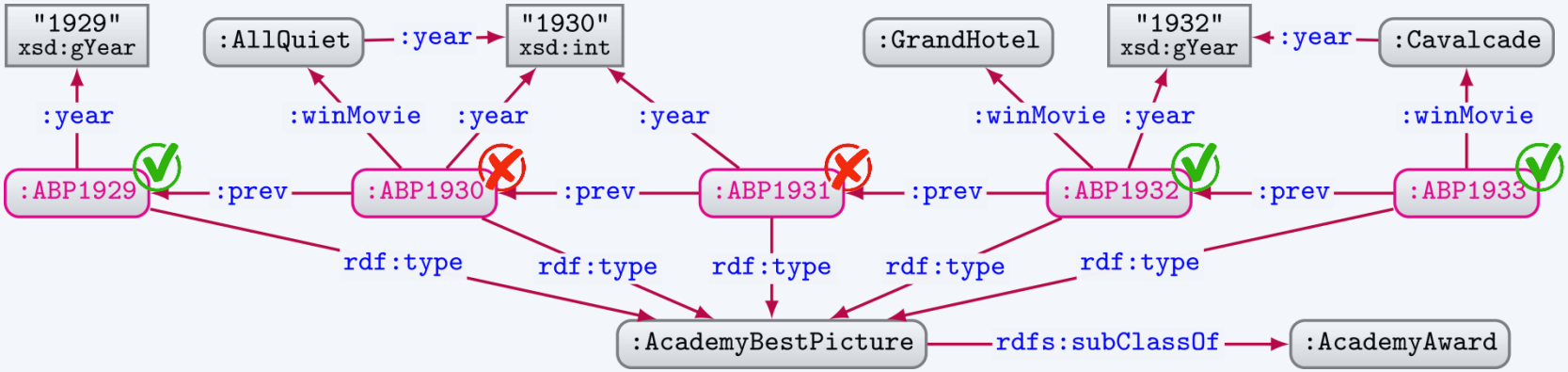
SHACL: Property-pair Constraints

Given a path e, for each target node $n \in N$, it holds that …

- `sh:equals` p $\quad V_n^e = V_n^f$
- `sh:disjoint` p $\quad V_n^e \cap V_n^f = \emptyset$
- `sh:lessThan` p $\quad \max(V_n^e) < \min(V_n^f)$
- `sh:lessThanOrEquals` p $\quad \max(V_n^e) \leq \min(V_n^f)$

```
#[...]

s:AcademyBestPicture a sh:NodeShape ;
  sh:targetClass :AcademyBestPicture ;
  sh:property [
    sh:path ( :winMovie :year ) ;
    sh:lessThan :year
  ] ;
  sh:property [
    sh:path [
       [ sh:alternativePath (
          [ sh:oneOrMorePath [ sh:inversePath :prev ] ] [ sh:oneOrMorePath :prev ]
        ) ]
       :year
    ] ;
    sh:disjoint :year
  ] .
```

SHACL: Property-pair Constraints



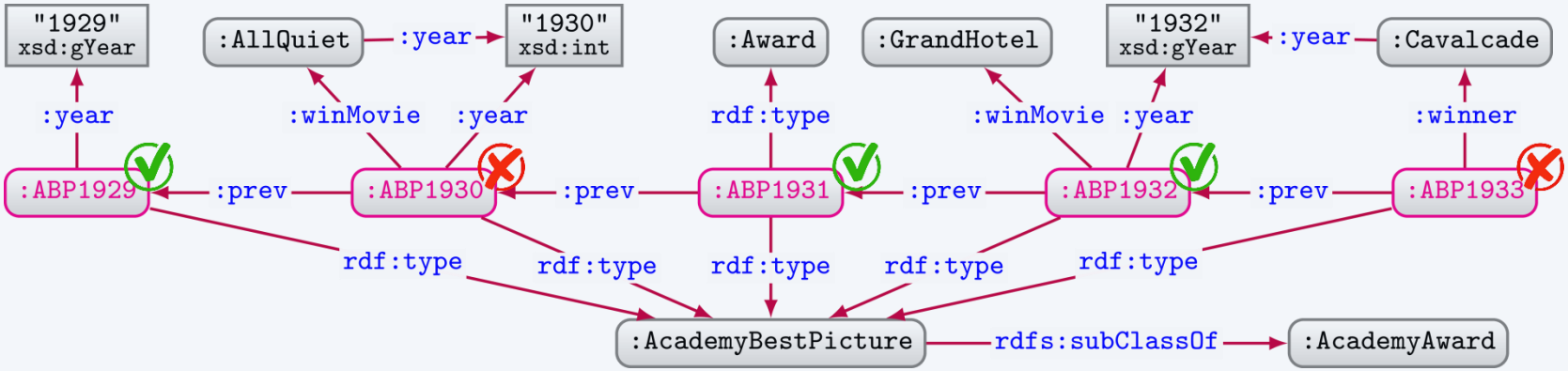

```
#[...]

s:AcademyBestPicture a sh:NodeShape ;
  sh:targetClass :AcademyBestPicture ;
  sh:property [
    sh:path ( :winMovie :year ) ;
    sh:lessThan :year
  ] ;
  sh:property [
    sh:path [
       [ sh:alternativePath (
          [ sh:oneOrMorePath [ sh:inversePath :prev ] ] [ sh:oneOrMorePath :prev ]
        ) ]
       :year
    ] ;
    sh:disjoint :year
  ] .
```

SHACL: Closed Constraints

- `sh:closed true` only properties in shapes graph allowed
  - `sh:ignoredProperties` optional list of exceptions

```
#[...]
s:AcademyAward a sh:NodeShape ;
  sh:targetClass :AcademyAward ;
  sh:property [ sh:path :winMovie ; sh:nodeKind sh:IRI ] ;
  sh:property [ sh:path :year ; sh:datatype xsd:gYear ] ;
  sh:closed true ; sh:ignoredProperties ( :prev rdf:type ) .
```

SHACL: Closed Constraints

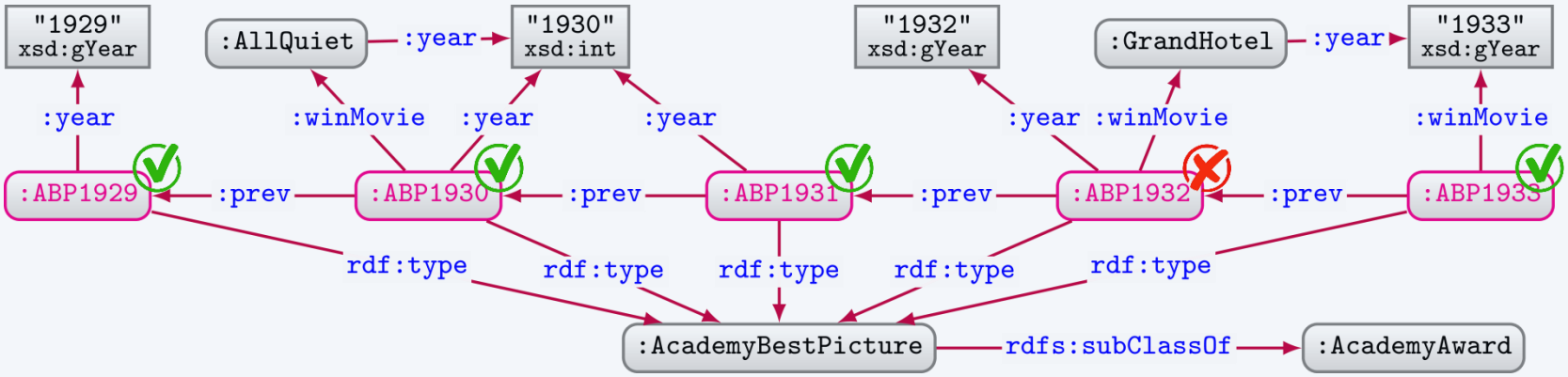



```
#[...]
s:AcademyAward a sh:NodeShape ;
  sh:targetClass :AcademyAward ;
  sh:property [ sh:path :winMovie ; sh:nodeKind sh:IRI ] ;
  sh:property [ sh:path :year ; sh:datatype xsd:gYear ] ;
  sh:closed true ; sh:ignoredProperties ( :prev rdf:type ) .
```

SHACL:

SPARQL Constraints

SHACL: SPARQL Constraints




```
#[...]
s:AcademyBestPicture a sh:NodeShape ;
  sh:targetClass :AcademyBestPicture ;
  sh:sparql [
    a sh:SPARQLConstraint ;
    sh:select """
       PREFIX : <http://ex.org/data/>
       PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
       SELECT $this (:year AS ?path) ?value
       WHERE {
          $this :year ?value .
          $this :winMovie/:year ?yearM .
          FILTER(xsd:int(str(?yearM))+1 != xsd:int(str(?value))
            && xsd:int(str(?yearM)) != xsd:int(str(?value)))
       }
    """
 ] .
```

Results indicate constraint violations.

`$this` will be replaced with target nodes.

ShEx:
Shape Expressions Language

Shape Expressions Language 2.1

Final Community Group Report 8 October 2019

This version:

http://shex.io/shex-semantics-20191008/

Latest published version:

http://shex.io/shex-semantics/

Editor's draft:

https://shexspec.github.io/spec/

Previous version:

http://shex.io/shex-semantics-20181122/

Test suite:

https://github.com/shexSpec/shexTest

Bug tracker:

File a bug (open bugs)

Editors:

Eric Prud'hommeaux (W3C/MIT)

Iovka Boneva (University of Lille)

Jose Emilio Labra Gayo (University of Oviedo)

Gregg Kellogg (Spec-Ops)

Participate:

GitHub shexSpec/spec

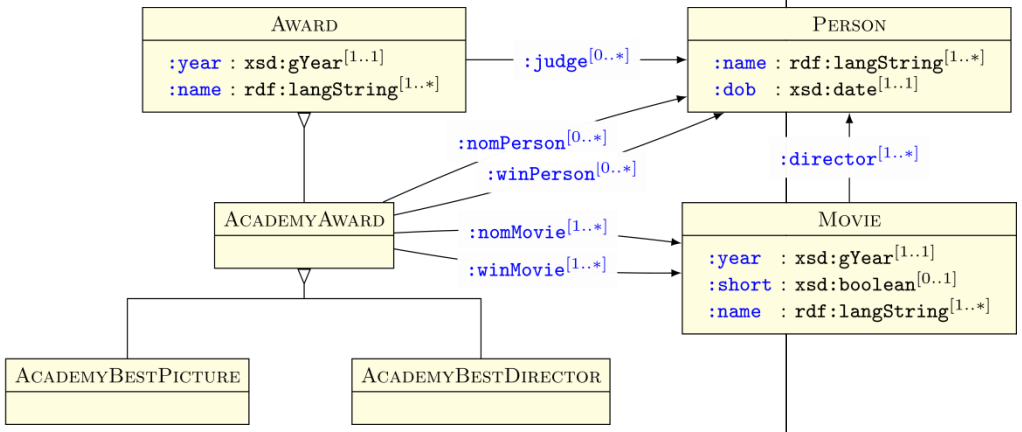
File a bug

Commit history

Pull requests

ShEx: Shape Expressions Language

```
prefix : <http://ex.org/data/>
prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
prefix xsd: <http://www.w3.org/2001/XMLSchema#>

:Award {
    :year     xsd:gYear ;
    :name     rdf:langString + ;
    :judge    @:Person *
}

:AcademyAward @:Award AND {
    :winMovie @:Movie  + ;
    :nomMovie @:Movie  + ;
    :winPerson @:Person * ;
    :nomPerson @:Person *
}

:AcademyBestDirector @:AcademyAward

:AcademyBestPicture @:AcademyAward

:Person {
    :name     rdf:langString + ;
    :dob      xsd:date
}

:Movie {
    :year     xsd:gYear ;
    :short    xsd:boolean ? ;
    :name     rdf:langString + ;
    :director @:Person +
}
```



ShEx: Used by Wikidata

EntitySchema | Discussion | Read | View history

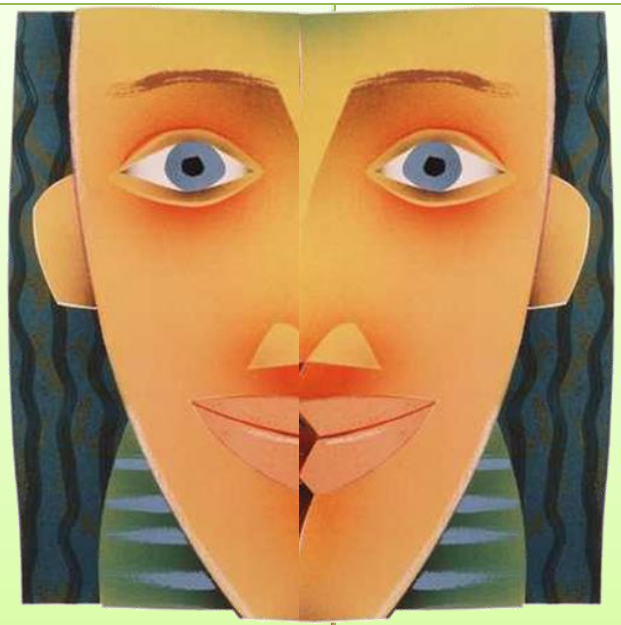
actor (E25)

```
PREFIX p: <http://www.wikidata.org/prop/>
PREFIX wd: <http://www.wikidata.org/entity/>
PREFIX wdt: <http://www.wikidata.org/prop/direct/>

start = @<actor>

<actor> {
        wdt:P31 [wd:Q5] ;
        wdt:P21 .  ;
        wdt:P106 . *  ;
  wdt:P106 [ wd:Q33999 wd:Q21169216]
}
```

Shapes:

(Optional) validating schema!

We don't have to impose a structure (schema) from the start



... and we can impose a schema any time we like **using shapes!**

Questions?