ShEx:
Shape Expressions language

Kat Thornton, Tom Baker, Andra Waagmeester, Eric Prud'hommeaux

SWIB-2018

Bonn, 2018-11-26

XML Schema

```
<xsd:schema xmlns:xsd="http://www.w3.org/2001/XMLSchema">

  <xsd:annotation>
    <xsd:documentation xml:lang="en">
     Purchase order schema for Example.com.
     Copyright 2000 Example.com. All rights reserved.
    </xsd:documentation>
  </xsd:annotation>

<xsd:element name="purchaseOrder" type="PurchaseOrderType"/>

<xsd:element name="comment" type="xsd:string"/>

<xsd:complexType name="PurchaseOrderType">
  <xsd:sequence>
    <xsd:element name="shipTo" type="USAddress"/>
```

XML Data

```
<?xml version="1.0"?>
<purchaseOrder orderDate="1999-10-20">
  <shipTo country="US">
    <name>Alice Smith</name>
    <street>123 Maple Street</street>
    <city>Mill Valley</city>
    <state>CA</state>
    <zip>90952</zip>
  </shipTo>
  <billTo country="US">
    <name>Robert Smith</name>
    <street>8 Oak Avenue</street>
    <city>Old Town</city>
    <state>PA</state>
    <zip>95819</zip>
  </billTo>
```
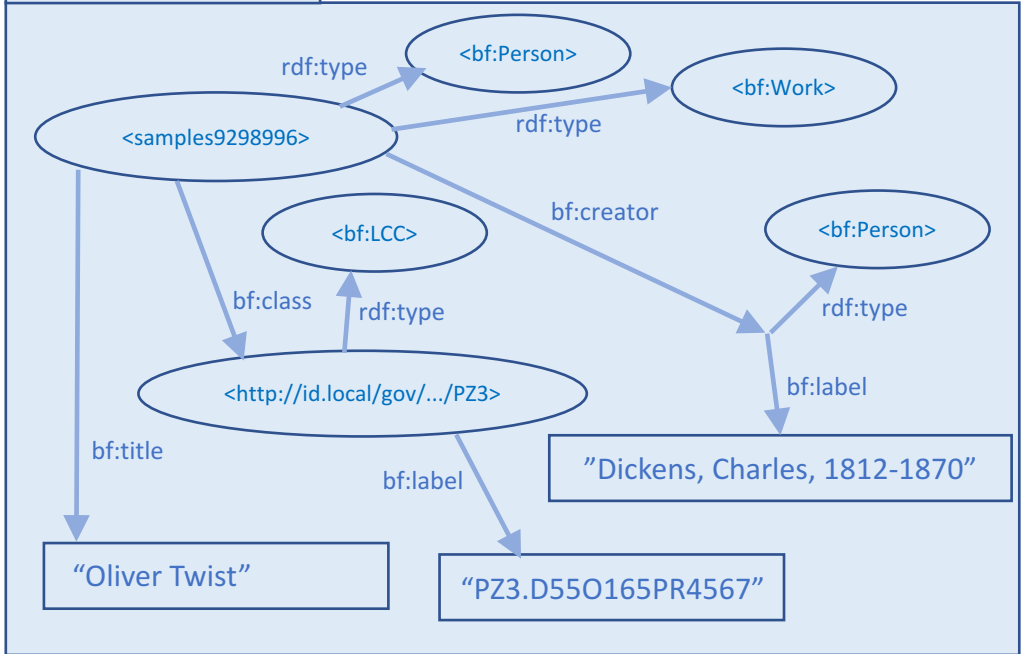
2. Against a schema.

1. Validate data.

Validation

XML Schema Definition language: schema prescribes conditions to which an XML document must conform to be considered valid.

3. To yield a validation result

D:\data\purchase_order23.xml is valid.

2

ShEx Schema [ShExC syntax]

```
<Work> EXTRA rdf:type {
  rdf:type [bf:Work] ? ;
  bf:title LITERAL ;
  bf:class @<Classification> * ;
  bf:creator @<Person> OR @<Organization> + ;
  bf:derivedFrom IRI * ;
}

<Classification>
  [<http://id.loc.gov/…/>~]
AND
  EXTRA rdf:type {
    rdf:type [bf:LCC] ? ;
    bf:label LITERAL ;
}
```

ShExC syntax is terse, ideal for editing by hand.

RDF Graph

Shape Expressions language (ShEx): schema prescribes conditions to which an RDF graph must conform to be considered valid.

2. Against a schema.

1. Validate graph.

Validation

3. To yield a validation result

```
✓<samples9298996>@<Work>

                    validating samples9298996bad as Work:
                        validating http://...oliverTwist:
                            Error validating http://...oliverTwist
                            as nodeKind literal:
✗<samples9298996bad>@!<Work>        iri found when literal expected
```

3

ShEx Schema [ShExC syntax]

```
<Work> EXTRA rdf:type {
  rdf:type [bf:Work] ? ;
  bf:title LITERAL ;
  bf:class @<Classification> * ;
  bf:creator @<Person> OR @<Organization> + ;
  bf:derivedFrom IRI * ;
}

<Classification>
  [<http://id.loc.gov/>~]
AND
  EXTRA rdf:type {
    rdf:type [bf:LCC] ? ;
    bf:label LITERAL ;
}
```

Labels and references to those labels...

RDF Data [Turtle syntax]

```
<samples9298996>
  rdf:type bf:Text ;
  rdf:type bf:Work ;
  bf:title "Oliver Twist." ;
  bf:class <id.loc.gov/.../PZ3> ;
  bf:creator [
    rdf:type bf:Person ;
    bf:label "Dickens, Charles, 1812-1870." ;
  ] .

<id.loc.gov/.../PZ3>
  rdf:type bf:LCC ;
  bf:label "PZ3.D55O165PR4567" .
```

2. Against a schema.

1. Validate data.

Validation

Shape Expressions language (ShEx): schema prescribes conditions to which RDF data must conform to be considered valid.

3. To yield a validation result

```
✓<samples9298996>@<Work>
                        validating samples9298996bad as Work:
                           validating http://...oliverTwist:
                              Error validating http://...oliverTwist
                              as nodeKind literal:
✗<samples9298996bad>@!<Work>        iri found when literal expected
```

5

ShEx Schema [ShExC syntax]

```
<Work> EXTRA rdf:type {
  rdf:type [bf:Work] ? ;
  bf:title LITERAL ;
  bf:class @<Classification> * ;
  bf:creator @<Person> OR @<Organization> + ;
  bf:derivedFrom IRI * ;
}

<Classification>
  [<http://id.loc.gov/>~]
AND
  EXTRA rdf:type {
    rdf:type [bf:LCC] ? ;
    bf:label LITERAL ;
}
```

Keywords, some with arguments.

RDF Data [Turtle syntax]

```
<samples9298996>
  rdf:type bf:Text ;
  rdf:type bf:Work ;
  bf:title "Oliver Twist." ;
  bf:class <id.loc.gov/.../PZ3> ;
  bf:creator [
    rdf:type bf:Person ;
    bf:label "Dickens, Charles, 1812-1870." ;
  ] .

<id.loc.gov/.../PZ3>
  rdf:type bf:LCC ;
  bf:label "PZ3.D55O165PR4567" .
```

2. Against a schema.

1. Validate data.

Validation

Shape Expressions language (ShEx): schema prescribes conditions to which RDF data must conform to be considered valid.

3. To yield a validation result

```
✓<samples9298996>@<Work>
                              validating samples9298996bad as Work:
                                validating http://...oliverTwist:
                                  Error validating http://...oliverTwist
                                  as nodeKind literal:
                                    iri found when literal expected
✗<samples9298996bad>@!<Work>
```

ShEx Schema [ShExC syntax]

```
<Work> EXTRA rdf:type {
  rdf:type [bf:Work] ? ;
  bf:title LITERAL ;
  bf:class @<Classification> * ;
  bf:creator @<Person> OR @<Organization> + ;
  bf:derivedFrom IRI * ;
}

<Classification>
  [<http://id.loc.gov/>~]
AND
  EXTRA rdf:type {
    rdf:type [bf:LCC] ? ;
    bf:label LITERAL ;
}
```

Value sets...

RDF Data [Turtle syntax]

```
<samples9298996>
  rdf:type bf:Text ;
  rdf:type bf:Work ;
  bf:title "Oliver Twist." ;
  bf:class <id.loc.gov/.../PZ3> ;
  bf:creator [
    rdf:type bf:Person ;
    bf:label "Dickens, Charles, 1812-1870." ;
  ] .

<id.loc.gov/.../PZ3>
  rdf:type bf:LCC ;
  bf:label "PZ3.D55O165PR4567" .
```

2. Against a schema.

1. Validate data.

Validation

Shape Expressions language (ShEx): schema prescribes conditions to which RDF data must conform to be considered valid.

3. To yield a validation result

```
✓<samples9298996>@<Work>

                    validating samples9298996bad as Work:
                      validating http://...oliverTwist:
                        Error validating http://...oliverTwist
                        as nodeKind literal:
✗<samples9298996bad>@!<Work>    iri found when literal expected
```

7

ShEx Schema [ShExC syntax]

```
<Work> EXTRA rdf:type {
  rdf:type [bf:Work] ? ;
  bf:title LITERAL ;
  bf:class @<Classification> * ;
  bf:creator @<Person> OR @<Organization> + ;
  bf:derivedFrom IRI * ;
}

<Classification>
  [<http://id.loc.gov/>~]
AND
  EXTRA rdf:type {
    rdf:type [bf:LCC] ? ;
    bf:label LITERAL ;
}
```

Cardinality markers.

RDF Data [Turtle syntax]

```
<samples9298996>
  rdf:type bf:Text ;
  rdf:type bf:Work ;
  bf:title "Oliver Twist." ;
  bf:class <id.loc.gov/.../PZ3> ;
  bf:creator [
    rdf:type bf:Person ;
    bf:label "Dickens, Charles, 1812-1870." ;
  ] .

<id.loc.gov/.../PZ3>
  rdf:type bf:LCC ;
  bf:label "PZ3.D55O165PR4567" .
```

2. Against a schema.

1. Validate data.

Validation

Shape Expressions language (ShEx): schema prescribes conditions to which RDF data must conform to be considered valid.

3. To yield a validation result

```
✓<samples9298996>@<Work>

                        validating samples9298996bad as Work:
                            validating http://...oliverTwist:
                                Error validating http://...oliverTwist
                                as nodeKind literal:
                                    iri found when literal expected
✗<samples9298996bad>@!<Work>
```

8

ShEx Schema [ShExJ syntax]

```
{
  "type": "Schema",
  "shapes": [
    {
      "id": "https://rawgit.com/shexSpec/shex.js/master/doc/Work",
      "type": "Shape",
      "expression": {
        "type": "EachOf",
        "expressions": [
          {
            "type": "TripleConstraint",
            "predicate": "http://www.w3.org/1999/02/22-rdf-syntax-ns#type",
            "valueExpr": {
              "type": "NodeConstraint",
              "values": [
                "http://bibframe.org/vocab/Work" ... ... ...
```

ShExJ syntax is verbose, ideal for processing by machines.

Helps in understanding structure of ShEx

RDF Data [Turtle syntax]

```
<samples9298996>
  rdf:type bf:Text ;
  rdf:type bf:Work ;
  bf:title "Oliver Twist." ;
  bf:class <id.loc.gov/.../PZ3> ;
  bf:creator [
    rdf:type bf:Person ;
    bf:label "Dickens, Charles, 1812-1870." ;
  ] .

<id.loc.gov/.../PZ3>
  rdf:type bf:LCC ;
  bf:label "PZ3.D55O165PR4567" .
```

2. Against a schema.

1. Validate data.

ShExJ syntax, interchangeable with ShExC.

Validation

3. To yield a validation result

```
✓<samples9298996>@<Work>

                      validating samples9298996bad as Work:
                          validating http://...oliverTwist:
                            Error validating http://...oliverTwist
                            as nodeKind literal:
✗<samples9298996bad>@!<Work>       iri found when literal expected
```

9

ShEx Schema [ShExC syntax]

```
<Work> EXTRA rdf:type {
  rdf:type [bf:Work] ? ;
  bf:title LITERAL ;
  bf:class @<Classification> * ;
  bf:creator @<Person> OR @<Organization> + ;
  bf:derivedFrom IRI * ;
}

<Classification>
  [<http://id.loc.gov/...>~]
AND
  EXTRA rdf:type {
    rdf:type [bf:LCC] ? ;
    bf:label LITERAL ;
}
```

RDF Data [Turtle syntax]

```
<samples9298996>
  rdf:type bf:Text ;
  rdf:type bf:Work ;
  bf:title "Oliver Twist." ;
  bf:class <id.loc.gov/.../PZ3> ;
  bf:creator [
    rdf:type bf:Person ;
    bf:label "Dickens, Charles, 1812-1870." ;
  ] .

<id.loc.gov/.../PZ3>
  rdf:type bf:LCC ;
  bf:label "PZ3.D55O165PR4567" .
```

2. Against a schema.

1. Validate data.

A resource in RDF data matching the "Work" shape[1]

Validation

[1] Note: a pre-processing step uses the ShEx ShapeMap language to associate an RDF nodes with ShEx shapes, here: **`<samples9298996>@<Work>`**. Associations can be enumerated (in "fixed shape maps") or generated automatically (in "query shape maps") depending on the degree of control desired.

3. To yield a validation result

```
✓<samples9298996>@<Work>
                          validating samples9298996bad as Work:
                            validating http://...oliverTwist:
                              Error validating http://...oliverTwist
                              as nodeKind literal:
✗<samples9298996bad>@!<Work>      iri found when literal expected
```

ShEx Schema [ShExC syntax]

```
<Work> EXTRA rdf:type {
  rdf:type [bf:Work] ? ;
  bf:title LITERAL ;
  bf:class @<Classification> * ;
  bf:creator @<Person> OR @<Organization> + ;
  bf:derivedFrom IRI * ;
}

<Classification>
  [<http://id.loc.gov/.../>~]
AND
  EXTRA rdf:type {
    rdf:type [bf:LCC] ? ;
    bf:label LITERAL ;
}
```

RDF Data [Turtle syntax]

```
<samples9298996>
  rdf:type bf:Text ;
  rdf:type bf:Work ;
  bf:title "Oliver Twist." ;
  bf:class <id.loc.gov/.../PZ3> ;
  bf:creator [
    rdf:type bf:Person ;
    bf:label "Dickens, Charles, 1812-1870." ;
  ] .

<id.loc.gov/.../PZ3>
  rdf:type bf:LCC ;
  bf:label "PZ3.D55O165PR4567" .
```

2. Against a schema.

1. Validate data.

A resource in RDF data matching the "Work" shape
Has zero or one "rdf:type bf:Work" statements

Validation

3. To yield a validation result

```
✓<samples9298996>@<Work>

                     validating samples9298996bad as Work:
                         validating http://...oliverTwist:
                             Error validating http://...oliverTwist
                             as nodeKind literal:
✗<samples9298996bad>@!<Work>     iri found when literal expected
```

11

ShEx Schema [ShExC syntax]

```
<Work> EXTRA rdf:type {
  rdf:type [bf:Work] ? ;
  bf:title LITERAL ;
  bf:class @<Classification> * ;
  bf:creator @<Person> OR @<Organization> + ;
  bf:derivedFrom IRI * ;
}

<Classification>
  [<http://id.loc.gov/.../>~]
AND
  EXTRA rdf:type {
    rdf:type [bf:LCC] ? ;
    bf:label LITERAL ;
}
```

RDF Data [Turtle syntax]

```
<samples9298996>
  rdf:type bf:Text ;
  rdf:type bf:Work ;
  bf:title "Oliver Twist." ;
  bf:class <id.loc.gov/.../PZ3> ;
  bf:creator [
    rdf:type bf:Person ;
    bf:label "Dickens, Charles, 1812-1870." ;
  ] .

<id.loc.gov/.../PZ3>
  rdf:type bf:LCC ;
  bf:label "PZ3.D55O165PR4567" .
```

2. Against a schema.

1. Validate data.

A resource in RDF data matching the "Work" shape:
Has zero or one "rdf:type bf:Work" statements
Optionally has an extra "rdf:type" statement

Validation

3. To yield a validation result

```
✓<samples9298996>@<Work>
                              validating samples9298996bad as Work:
                                  validating http://...oliverTwist:
                                     Error validating http://...oliverTwist
                                     as nodeKind literal:
✗<samples9298996bad>@!<Work>       iri found when literal expected
```

ShEx Schema [ShExC syntax]

```
<Work> EXTRA rdf:type {
  rdf:type [bf:Work] ? ;
  bf:title LITERAL ;
  bf:class @<Classification> * ;
  bf:creator @<Person> OR @<Organization> + ;
  bf:derivedFrom IRI * ;
}

<Classification>
  [<http://id.loc.gov/.../>~]
AND
  EXTRA rdf:type {
    rdf:type [bf:LCC] ? ;
    bf:label LITERAL ;
}
```

RDF Data [Turtle syntax]

```
<samples9298996>
  rdf:type bf:Text ;
  rdf:type bf:Work ;
  bf:title "Oliver Twist." ;
  bf:class <id.loc.gov/.../PZ3> ;
  bf:creator [
    rdf:type bf:Person ;
    bf:label "Dickens, Charles, 1812-1870." ;
  ] .

<id.loc.gov/.../PZ3>
  rdf:type bf:LCC ;
  bf:label "PZ3.D55O165PR4567" .
```

2. Against a schema.

1. Validate data.

Validation

A resource in RDF data matching the "Work" shape:
Has zero or one "rdf:type bf:Work" statements
Optionally has an extra "rdf:type" statement
Has exactly one "bf:title" statement with literal value

3. To yield a validation result

```
✓<samples9298996>@<Work>
                          validating samples9298996bad as Work:
                              validating http://...oliverTwist:
                                  Error validating http://...oliverTwist
                                  as nodeKind literal:
                                      iri found when literal expected
✗<samples9298996bad>@!<Work>
```

13

ShEx Schema [ShExC syntax]

```
<Work> EXTRA rdf:type {
  rdf:type [bf:Work] ? ;
  bf:title LITERAL ;
  bf:class @<Classification> * ;
  bf:creator @<Person> OR @<Organization> + ;
  bf:derivedFrom IRI * ;
}

<Classification>
  [<http://id.loc.gov/.../>~]
AND
  EXTRA rdf:type {
    rdf:type [bf:LCC] ? ;
    bf:label LITERAL ;
}
```

RDF Data [Turtle syntax]

```
<samples9298996>
  rdf:type bf:Text ;
  rdf:type bf:Work ;
  bf:title "Oliver Twist." ;
  bf:class <id.loc.gov/.../PZ3> ;
  bf:creator [
    rdf:type bf:Person ;
    bf:label "Dickens, Charles, 1812-1870." ;
  ] .

<id.loc.gov/.../PZ3>
  rdf:type bf:LCC ;
  bf:label "PZ3.D55O165PR4567" .
```

2. Against a schema.

1. Validate data.

Validation

A resource in RDF data matching the "Work" shape:
Has zero or one "rdf:type bf:Work" statements
Optionally has an extra "rdf:type" statement
Has exactly one "bf:title" statement with literal value
Has zero or more "bf:class" statements taking objects that match the "Classification" shape

3. To yield a validation result

```
✓<samples9298996>@<Work>

                    validating samples9298996bad as Work:
                        validating http://...oliverTwist:
                          Error validating http://...oliverTwist
                          as nodeKind literal:
✗<samples9298996bad>@!<Work>      iri found when literal expected
```

ShEx Schema [ShExC syntax]

```
<Work> EXTRA rdf:type {
  rdf:type [bf:Work] ? ;
  bf:title LITERAL ;
  bf:class @<Classification> * ;
  bf:creator @<Person> OR @<Organization> + ;
  bf:derivedFrom IRI * ;
}

<Classification>
  [<http://id.loc.gov/.../>~]
AND
  EXTRA rdf:type {
    rdf:type [bf:LCC] ? ;
    bf:label LITERAL ;
}
```

RDF Data [Turtle syntax]

```
<samples9298996>
  rdf:type bf:Text ;
  rdf:type bf:Work ;
  bf:title "Oliver Twist." ;
  bf:class <id.loc.gov/.../PZ3> ;
  bf:creator [
    rdf:type bf:Person ;
    bf:label "Dickens, Charles, 1812-1870." ;
  ] .

<id.loc.gov/.../PZ3>
  rdf:type bf:LCC ;
  bf:label "PZ3.D55O165PR4567" .
```

2. Against a schema.

1. Validate data.

Validation

A resource in RDF data matching the "Work" shape:
Has zero or one "rdf:type bf:Work" statements
Optionally has an extra "rdf:type" statement
Has exactly one "bf:title" statement with literal value
Has zero or more "bf:class" statements taking objects
that match the "Classification" shape
**Has one or more "bf:creator" statements taking objects
that match either the "Person" or the "Organization"
shape**

3. To yield a validation result

```
✓<samples9298996>@<Work>
                        validating samples9298996bad as Work:
                            validating http://...oliverTwist:
                                Error validating http://...oliverTwist
                                as nodeKind literal:
✗<samples9298996bad>@!<Work>        iri found when literal expected
```

ShEx Schema [ShExC syntax]

```
<Work> EXTRA rdf:type {
  rdf:type [bf:Work] ? ;
  bf:title LITERAL ;
  bf:class @<Classification> * ;
  bf:creator @<Person> OR @<Organization> + ;
  bf:derivedFrom IRI * ;
}

<Classification>
  [<http://id.loc.gov/…/>~]
AND
  EXTRA rdf:type {
    rdf:type [bf:LCC] ? ;
    bf:label LITERAL ;
}
```

RDF Data [Turtle syntax]

```
<samples9298996>
  rdf:type bf:Text ;
  rdf:type bf:Work ;
  bf:title "Oliver Twist." ;
  bf:class <id.loc.gov/…/PZ3> ;
  bf:creator [
    rdf:type bf:Person ;
    bf:label "Dickens, Charles, 1812-1870." ;
  ] .

<id.loc.gov/…/PZ3>
  rdf:type bf:LCC ;
  bf:label "PZ3.D55O165PR4567" .
```

2. Against a schema.

1. Validate data.

Validation

A resource in RDF data matching the "Work" shape:
Has zero or one "rdf:type bf:Work" statements
Optionally has an extra "rdf:type" statement
Has exactly one "bf:title" statement with literal value
Has zero or more "bf:class" statements taking objects
that match the "Classification" shape
Has one or more "bf:creator" statements taking objects
that match either the "Person" or the "Organization"
Shape
**And zero or more "bf:derivedFrom" statements taking
an IRI as object.**

3. To yield a validation result

```
✓<samples9298996>@<Work>



✗<samples9298996bad>@!<Work>
```

```
validating samples9298996bad as Work:
  validating http://...oliverTwist:
    Error validating http://...oliverTwist
    as nodeKind literal:
      iri found when literal expected
```

ShEx Schema [ShExC syntax]

```
<Work> EXTRA rdf:type {
  rdf:type [bf:Work] ? ;
  bf:title LITERAL ;
  bf:class @<Classification> * ;
  bf:creator @<Person> OR @<Organization> + ;
  bf:derivedFrom IRI * ;
}

<Classification>
  [<http://id.loc.gov/…/>~]
AND
  EXTRA rdf:type {
    rdf:type [bf:LCC] ? ;
    bf:label LITERAL ;
}
```

RDF Data [Turtle syntax]

```
<samples9298996>
  rdf:type bf:Text ;
  rdf:type bf:Work ;
  bf:title "Oliver Twist." ;
  bf:class <id.loc.gov/…/PZ3> ;
  bf:creator [
    rdf:type bf:Person ;
    bf:label "Dickens, Charles, 1812-1870." ;
  ] .

<id.loc.gov/…/PZ3>
  rdf:type bf:LCC ;
  bf:label "PZ3.D55O165PR4567" .
```

2. Against a schema.

1. Validate data.

A resource matching the "Classification" shape:

Validation

3. To yield a validation result

```
✓<samples9298996>@<Work>

              validating samples9298996bad as Work:
                validating http://...oliverTwist:
                  Error validating http://...oliverTwist
                  as nodeKind literal:
✗<samples9298996bad>@!<Work>    iri found when literal expected
```

17

ShEx Schema [ShExC syntax]

```
<Work> EXTRA rdf:type {
  rdf:type [bf:Work] ? ;
  bf:title LITERAL ;
  bf:class @<Classification> * ;
  bf:creator @<Person> OR @<Organization> + ;
  bf:derivedFrom IRI * ;
}

<Classification>
[<http://id.loc.gov/>~]
AND
  EXTRA rdf:type {
    rdf:type [bf:LCC] ? ;
    bf:label LITERAL ;
}
```

RDF Data [Turtle syntax]

```
<samples9298996>
  rdf:type bf:Text ;
  rdf:type bf:Work ;
  bf:title "Oliver Twist." ;
  bf:class <id.loc.gov/.../PZ3> ;
  bf:creator [
    rdf:type bf:Person ;
    bf:label "Dickens, Charles, 1812-1870." ;
  ] .

<https://id.loc.gov/authorities/classification/PZ3>
  rdf:type bf:LCC ;
  bf:label "PZ3.D55O165PR4567" .
```

2. Against a schema.

1. Validate data.

A resource matching the "Classification" shape:
is identified with an IRI starting with "id.loc.gov"

Validation

3. To yield a validation result

```
✓<samples9298996>@<Work>

                          validating samples9298996bad as Work:
                              validating http://...oliverTwist:
                                  Error validating http://...oliverTwist
                                  as nodeKind literal:
                                      iri found when literal expected
✗<samples9298996bad>@!<Work>
```

ShEx Schema [ShExC syntax]

```
<Work> EXTRA rdf:type {
  rdf:type [bf:Work] ? ;
  bf:title LITERAL ;
  bf:class @<Classification> * ;
  bf:creator @<Person> OR @<Organization> + ;
  bf:derivedFrom IRI * ;
}

<Classification>
  [<http://id.loc.gov/.../>~]
AND
  EXTRA rdf:type {
    rdf:type [bf:LCC] ? ;
    bf:label LITERAL ;
}
```

RDF Data [Turtle syntax]

```
<samples9298996>
  rdf:type bf:Text ;
  rdf:type bf:Work ;
  bf:title "Oliver Twist." ;
  bf:class <id.loc.gov/.../PZ3> ;
  bf:creator [
    rdf:type bf:Person ;
    bf:label "Dickens, Charles, 1812-1870." ;
  ] .

<id.loc.gov/.../PZ3>
  rdf:type bf:LCC ;
  bf:label "PZ3.D55O165PR4567" .
```

2. Against a schema.

1. Validate data.

A resource matching the "Classification" shape:
is identified with an IRI starting with "id.loc.gov"
has zero or one "rdf:type bf:LOC" statements

Validation

3. To yield a validation result

```
✓<samples9298996>@<Work>

                    validating samples9298996bad as Work:
                        validating http://...oliverTwist:
                            Error validating http://...oliverTwist
                            as nodeKind literal:
✗<samples9298996bad>@!<Work>    iri found when literal expected
```

19

ShEx Schema [ShExC syntax]

```
<Work> EXTRA rdf:type {
  rdf:type [bf:Work] ? ;
  bf:title LITERAL ;
  bf:class @<Classification> * ;
  bf:creator @<Person> OR @<Organization> + ;
  bf:derivedFrom IRI * ;
}

<Classification>
  [<http://id.loc.gov/.../>~]
AND
EXTRA rdf:type {
    rdf:type [bf:LCC] ? ;
    bf:label LITERAL ;
}
```

RDF Data [Turtle syntax]

```
<samples9298996>
  rdf:type bf:Text ;
  rdf:type bf:Work ;
  bf:title "Oliver Twist." ;
  bf:class <id.loc.gov/.../PZ3> ;
  bf:creator [
    rdf:type bf:Person ;
    bf:label "Dickens, Charles, 1812-1870." ;
  ] .

<id.loc.gov/.../PZ3>
  rdf:type bf:LCC ;
  bf:label "PZ3.D55O165PR4567" .
```

2. Against a schema.

1. Validate data.

A resource matching the "Classification" shape:
is identified with an IRI starting with "id.loc.gov"
has zero or one "rdf:type bf:LOC statements
optionally has an additional "rdf:type" statement

Validation

3. To yield a validation result

```
✓<samples9298996>@<Work>

                     validating samples9298996bad as Work:
                        validating http://...oliverTwist:
                          Error validating http://...oliverTwist
                          as nodeKind literal:
✗<samples9298996bad>@!<Work>        iri found when literal expected
```

ShEx Schema [ShExC syntax]

```
<Work> EXTRA rdf:type {
  rdf:type [bf:Work] ? ;
  bf:title LITERAL ;
  bf:class @<Classification> * ;
  bf:creator @<Person> OR @<Organization> + ;
  bf:derivedFrom IRI * ;
}

<Classification>
  [<http://id.loc.gov/.../>~]
AND
  EXTRA rdf:type {
    rdf:type [bf:LCC] ? ;
    bf:label LITERAL ;
}
```

RDF Data [Turtle syntax]

```
<samples9298996>
  rdf:type bf:Text ;
  rdf:type bf:Work ;
  bf:title "Oliver Twist." ;
  bf:class <id.loc.gov/.../PZ3> ;
  bf:creator [
    rdf:type bf:Person ;
    bf:label "Dickens, Charles, 1812-1870." ;
  ] .

<id.loc.gov/.../PZ3>
  rdf:type bf:LCC ;
  bf:label "PZ3.D55O165PR4567" .
```

2. Against a schema.

1. Validate data.

A resource matching the "Classification" shape:
is identified with an IRI starting with "id.loc.gov"
has zero or one "rdf:type bf:LOC statements
optionally has an additional "rdf:type" statement
has exactly one "bf:label" statement with a literal value

Validation

3. To yield a validation result

```
✓<samples9298996>@<Work>

                        validating samples9298996bad as Work:
                           validating http://...oliverTwist:
                              Error validating http://...oliverTwist
                              as nodeKind literal:
✗<samples9298996bad>@!<Work>    iri found when literal expected
```

ShEx Schema [ShExC syntax]

```
<Work> EXTRA rdf:type {
  rdf:type [bf:Work] ? ;
  bf:title LITERAL ;
  bf:class @<Classification> * ;
  bf:creator @<Person> OR @<Organization> + ;
  bf:derivedFrom IRI * ;
}

<Classification>
  [<http://id.loc.gov/.../>~]
AND
  EXTRA rdf:type {
    rdf:type [bf:LCC] ? ;
    bf:label LITERAL ;
}
```

RDF Data [Turtle syntax]

```
<samples9298996>
  rdf:type bf:Text ;
  rdf:type bf:Work ;
  bf:title "Oliver Twist." ;
  bf:class <id.loc.gov/.../PZ3> ;
  bf:creator [
    rdf:type bf:Person ;
    bf:label "Dickens, Charles, 1812-1870." ;
  ] .

<id.loc.gov/.../PZ3>
  rdf:type bf:LCC ;
  bf:label "PZ3.D55O165PR4567" .
```

2. Against a schema.

1. Validate data.

Shapes can combine constraints with AND, OR, NOT, and parentheses.

Validation

3. To yield a validation result

```
✓<samples9298996>@<Work>

                    validating samples9298996bad as Work:
                        validating http://...oliverTwist:
                            Error validating http://...oliverTwist
                            as nodeKind literal:
✗<samples9298996bad>@!<Work>        iri found when literal expected
```

Terminology summarized

- A **ShEx Schema** holds a collection of…
  - **Shape Expressions**, which logically combine…
    - **Node Constraints**, which match nodes in RDF Data, and…
    - **Shapes**, which match triples in RDF Data as specified in…
      - **Triple constraints**, which match triples touching a given node in RDF Data in terms of…
        - Predicates
        - Direction
        - Cardinality
        - Value

Active and friendly development community

- W3C Shape Expressions Community Group (ShEx CG)
    - https://www.w3.org/community/shex CG homepage
    - http://shex.io ShEx homepage
    - http://shex.io/shex-primer/ primer
    - http://shex.io/shex-semantics/ main specification
    - https://rawgit.com/shexSpec/shex.js/master/doc/shex-simple.html validator

Focus Node and Neighborhood of a Node

- **Focus Node**   = node that is being validated (here :alice)
- **Neighborhood of a node** = set of incoming/outgoing triples

```
:alice       schema:name      "Alice";
             schema:follows   :bob;
             schema:worksFor  :OurCompany .

:bob         foaf:name        "Robert" ;
             schema:worksFor  :OurCompany .

:carol       schema:name      "Carol" ;
             schema:follows   :alice .

:dave        schema:name       "Dave" .

:OurCompany  schema:founder  :dave ;
             schema:employee :alice , :bob .
```

```
Neighbourhood of :alice = {
    (:alice,       schema:name,     "Alice")
    (:alice,       schema:follows,  :bob),
    (:alice,       schema:worksFor, :OurCompany),
    (:carol,       schema:follows,  :alice),
    (:OurCompany,  schema:employee, :alice)
}
```