Lab Session 1
XML & JSON

University of Trento
Service Design and Engineering (2019-20)

Team Rocket

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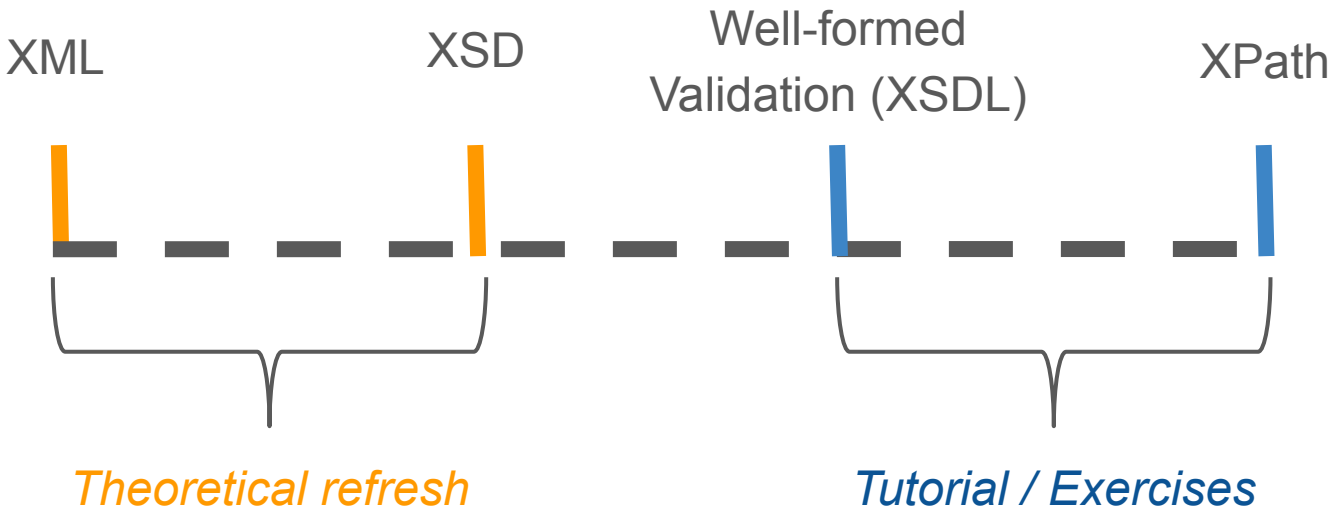
Summary for XML



XML - eXtensible Markup Language

Standard data representation and data **exchange** format

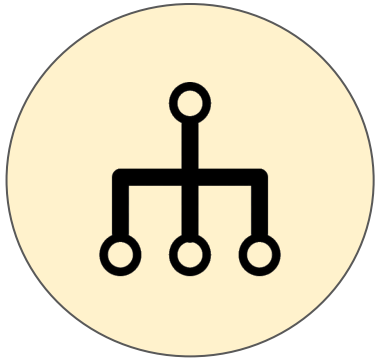
Framework to define markup languages (**meta-language**)

Tree-like structure

Platform independent

(UTF-8 compliant)

e.g. XML for Pokémon data to store them in your Pokédex



XML - Basic concepts

```xml
<?xml version="1.0" encoding="UTF-8" standalone="no" ?>

<!--THIS IS OUR POKEDEX-->
<Team>
    <Pokemon nickname="GreenRipper">
        <species>BULBASAUR</species>
        <dex>4</dex>
        <types>
            <type>GRASS</type>
            <type>POISON</type>
        </types>
        <experience>64</experience>
        <moves>
            <attack>
                <name>RAZOR LEAF</name>
                <type>GRASS</type>
                <power>55</power>
            </attack>
            <effect>
                <name>SLEEP POWDER</name>
                <type>GRASS</type>
            </effect>
        </moves>
    </Pokemon>
</Team>
```

- Element node

  (logical grouping of contents)

- Text node (actual content)
- Attribute node (name value pairs)
- Comment node
- Processing instruction

XML - Properties

Well Formed

Single root node

Appropriate tag nesting

`<a> <../> </a>`

No repetition in attributes per element

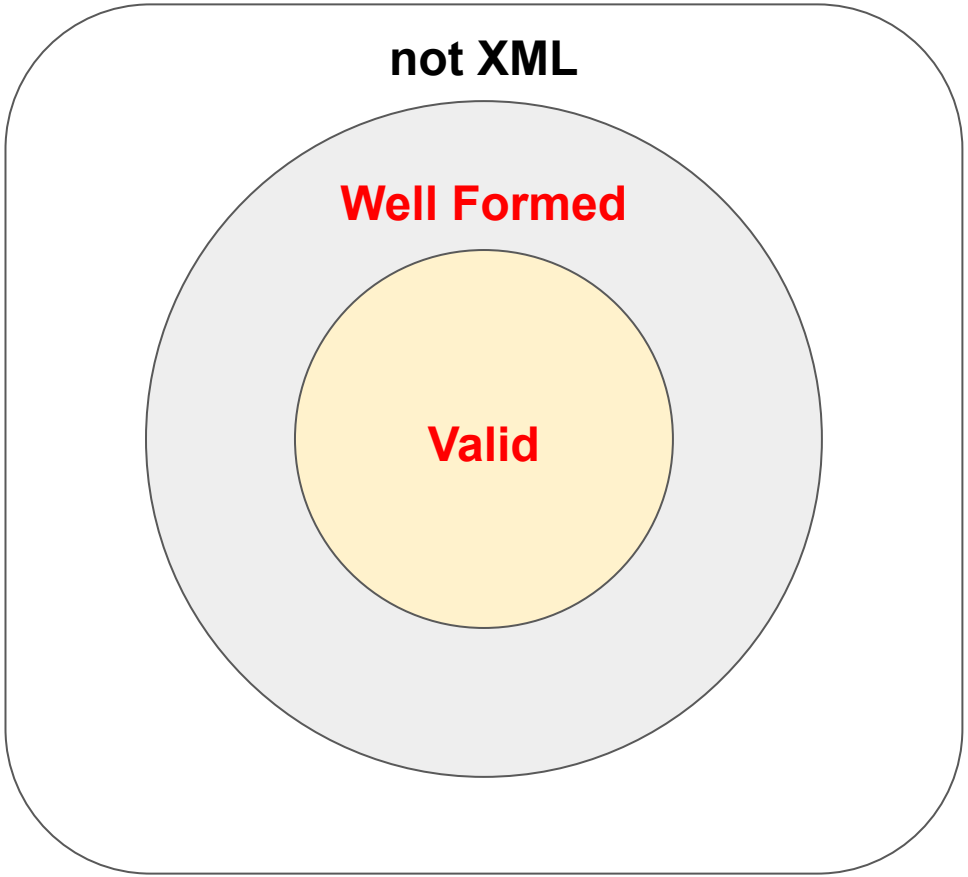
Validated

compliance
with an DTD/XSD (when defined)

XML - Properties

*An XML document **MUST** be well formed*

*If it's **NOT** well formed, it can't be valid either...*



XML Schema Definition (XSD)

XML file with a specific grammar to define new XML-based languages and validate its instances

Data types:
by using simple (e.g. string, integer,..) and defining complex (e.g. PokemonType, Move) data types, we can build the **elements** (with their **attributes**) of the XML-based language we're describing

Constraints:
declarative rules for data types and elements (e.g. min/max values and/or occurrences like "*a Pokèmon element must have 1 or two PokémonType assigned to it* ")

Relationships:
express associations between elements (e.g. "*a Pokémon has multiple moves and these could be attacks, effects, ..*")

XSD - Example

- Using the standard xsd schema
- Defining new complex type
  (elements in xml instances of this XML-based lang.)
- using XSD base types
  (string, decimal, integer, boolean, date, time)
- Indicators
  (all, choice, sequence)
- Possible attributes for a Pokémon
  (use=”required” if mandatory)

```
<xsd:schema xmlns:xsd="http://www.w3.org/2001/XMLSchema">
    <xsd:element name="Pokemon">
        <xsd:complexType>
            <xsd:all>
                <xsd:element name="species" type="xsd:string"/>

                <xsd:element name="types">
                    <xsd:complexType>
                        <xsd:sequence>
                            <xsd:element name="type" type="xsd:string"
                                         minOccurs="1" maxOccurs="2"/>
                        </xsd:sequence>
                    </xsd:complexType>
                </xsd:element>

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

                <xsd:element name="experience">
                    <xsd:simpleType>
                        <xsd:restriction base="xsd:integer">
                            <xsd:minInclusive value="0"/>
                            <xsd:maxInclusive value="100"/>
                        </xsd:restriction>
                    </xsd:simpleType>
                </xsd:element>
            </xsd:all>
            <xsd:attribute name="nickname" type="xsd:string"/>
        </xsd:complexType>
    </xsd:element>
</xsd:schema>
```

In order to avoid confusion,
we need to see some examples..

QUIZ TIME!

Is it well formed?

1

```
<Pokemon nickname="GreenRipper" species="BULBASAUR" dex="1">
    <types type="GRASS" type="POISON"></types>
</Pokemon>
```

2

```
<Team>
    <Pokemon>
        <species name="BULBASAUR" dex="1" />
        <type>GRASS</type>
        <experience>64</experience>
        <moves>
            <attack>
                <name>RAZOR LEAF</name>
                <type>GRASS</type>
                <power>55</power>
            </attack>
            <effect />
        </moves>
    </pokemon>
</Team>
```

Is it well formed?

1

```
<Pokemon nickname="GreenRipper" species="BULBASAUR" dex="1">
    <types type="GRASS" type="POISON"></types>
</Pokemon>
```

Duplicated attribute **`type`** in tag **`types`**

2

```
<Team>
    <Pokemon>
        <species name="BULBASAUR" dex="1" />
        <type>GRASS</type>
        <experience>64</experience>
        <moves>
            <attack>
                <name>RAZOR LEAF</name>
                <type>GRASS</type>
                <power>55</power>
            </attack>
            <effect />
        </moves>
    </pokemon>
</Team>
```

`<Pokemon>` is not closed
(XML is case sensitive)

Is it well formed?

3

```
<T3am>
    <Poké-mon>
        BULBASAUR
    </Poké-mon>
</T3am>
```

4

```
<Team>
    <Pokémon>
        <!-- BULBASAUR DATA -->
    </Pokémon>
    <Pokémon>
        <!-- PIKACHU DATA -->
    </Pokémon>
</Team>

<Team>
    <Pokémon>
        <!-- CHARMANDER DATA -->
    </Pokémon>
    <Pokémon>
        <!-- SQUIRTLE DATA -->
    </Pokémon>
</Team>
```

5

```
<team>
    <pokemon>
    <bulbasaur>
    </pokemon>
    </bulbasaur>
</team>
```

Is it well formed?

3

```
<T3am>
    <Poké-mon>
        BULBASAUR
    </Poké-mon>
</T3am>
```

Tag's name must start with a character, can contain any kind of letter, digit or hyphens
(avoid special chars)

4

```
<Team>
    <Pokémon>
        <!-- BULBASAUR DATA -->
    </Pokémon>
    <Pokémon>
        <!-- PIKACHU DATA -->
    </Pokémon>
</Team>

<Team>
    <Pokémon>
        <!-- CHARMANDER DATA -->
    </Pokémon>
    <Pokémon>
        <!-- SQUIRTLE DATA -->
    </Pokémon>
</Team>
```

Multiple root elements?

5

```
<team>
    <pokemon>
    <bulbasaur>
    </pokemon>
    </bulbasaur>
</team>
```

This is **NOT** proper nesting

1

Is it valid?

XML

```
<effect xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns="pokemonNamespace"
xsi:schemaLocation="pokemonNamespace pokemon.xsd">
    <id>5</id>
    <type>NORMAL</type>
    <name>CONFUSION</name>
</effect>
```

XSD

```
<xsd:element name="effect" type="pkm:effect" />

<!--Pokémon effect attack-->
<xsd:complexType name="effect">
    <xsd:sequence>
        <!--Id of the effect-->
        <xsd:element name="id" type="xsd:string"/>

        <!--Name of the effect-->
        <xsd:element name="name" type="xsd:string"/>

        <!--Type of the effect (e.g. WATER, ELECTRIC,...)-->
        <xsd:element name="type" type="xsd:string"/>
    </xsd:sequence>
</xsd:complexType>
```

Declaration in XML are going to be omitted in these examples, xsd namespace definition as well: don't count them as errors

1

Is it valid?

XML

```
<effect xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns="pokemonNamespace"
xsi:schemaLocation="pokemonNamespace pokemon.xsd">
    <id>5</id>
    <type>NORMAL</type>
    <name>CONFUSION</name>
</effect>
```

`<id /><name/><type/>` is the correct sequence

XSD

```
<xsd:element name="effect" type="pkm:effect" />

<!--Pokémon effect attack-->
<xsd:complexType name="effect">
    <xsd:sequence>
        <!--Id of the effect-->
        <xsd:element name="id" type="xsd:string"/>

        <!--Name of the effect-->
        <xsd:element name="name" type="xsd:string"/>

        <!--Type of the effect (e.g. WATER, ELECTRIC,...)-->
        <xsd:element name="type" type="xsd:string"/>
    </xsd:sequence>
</xsd:complexType>
```

Declaration in XML are going to be omitted in these examples, xsd namespace definition as well: don't count them as errors

2

Is it valid?

XML

```
<gender xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns="pokemonNamespace"
xsi:schemaLocation="pokemonNamespace pokemon.xsd">
    <female>1</female>
    <female>1</female>
</gender>
```

XSD

```
<xsd:element name="gender" type="pkm:gender" />

<!--Pokémon gender-->
<xsd:complexType name="gender">
    <xsd:choice>
        <xsd:element name="male" type="xsd:boolean" minOccurs="1"/>
        <xsd:element name="female" type="xsd:boolean" minOccurs="2"/>
    </xsd:choice>
</xsd:complexType>
```

Declaration in XML are going to be omitted in these examples, xsd namespace definition as well: don't count them as errors

2

Is it valid?

XML

```
<gender xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns="pokemonNamespace"
xsi:schemaLocation="pokemonNamespace pokemon.xsd">
    <female>1</female>
    <female>1</female>
</gender>
```

XSD

```
<xsd:element name="gender" type="pkm:gender" />

<!--Pokémon gender-->
<xsd:complexType name="gender">
    <xsd:choice>
        <xsd:element name="male" type="xsd:boolean" minOccurs="1"/>
        <xsd:element name="female" type="xsd:boolean" minOccurs="2"/>
    </xsd:choice>
</xsd:complexType>
```

Invalid XSD schema: `xsd:choice` cannot accept minOccurs value greater than 1, since `xsd:choice` implies by default a CHOICE...

Declaration in XML are going to be omitted in these examples, xsd namespace definition as well: don't count them as errors

Is it valid?

XML

```xml
<gender xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns="pokemonNamespace"
xsi:schemaLocation="pokemonNamespace pokemon.xsd">
    <male>1</male>
    <male>false</male>
</gender>
```

XSD

```xsd
<xsd:element name="gender" type="pkm:gender" />

<!--Pokémon gender-->
<xsd:complexType name="gender">
    <xsd:choice minOccurs="0">
        <xsd:element name="male" type="xsd:boolean" maxOccurs="2"/>
        <xsd:element name="female" type="xsd:boolean" maxOccurs="2"/>
    </xsd:choice>
</xsd:complexType>
```

Declaration in XML are going to be omitted in these examples, xsd namespace definition as well: don't count them as errors

Is it valid?

XML

```xml
<gender xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns="pokemonNamespace"
xsi:schemaLocation="pokemonNamespace pokemon.xsd">
    <male>1</male>
    <male>false</male>
</gender>
```

XSD

```xsd
<xsd:element name="gender" type="pkm:gender" />

<!--Pokémon gender-->
<xsd:complexType name="gender">
    <xsd:choice minOccurs="0">
        <xsd:element name="male" type="xsd:boolean" maxOccurs="2"/>
        <xsd:element name="female" type="xsd:boolean" maxOccurs="2"/>
    </xsd:choice>
</xsd:complexType>
```

Important thing while using XSD is to choose just one child element, while respecting the `maxOccurs` constraint (by default 1)

Declaration in XML are going to be omitted in these examples, xsd namespace definition as well: don't count them as errors

Is it valid?

You can also set `minOccurs` of `xsd:choice` to 0 and accept gender element with no child

XML

```
<gender xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns="pokemonNamespace"
xsi:schemaLocation="pokemonNamespace pokemon.xsd">
    <male>1</male>
    <male>false</male>
</gender>
```

XSD

```
<xsd:element name="gender" type="pkm:gender" />

<!--Pokémon gender-->
<xsd:complexType name="gender">
    <xsd:choice minOccurs="0">
        <xsd:element name="male" type="xsd:boolean" maxOccurs="2"/>
        <xsd:element name="female" type="xsd:boolean" maxOccurs="2"/>
    </xsd:choice>
</xsd:complexType>
```

✓

Important thing while using XSD is to choose just one child element, while respecting the `maxOccurs` constraint (by default 1)

Is it valid?

XML

```xml
<trainer xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns="pokemonNamespace"
xsi:schemaLocation="pokemonNamespace pokemon.xsd">
    <name>ASH</name>
    <exp>1</exp>
    <accessories>
        <pokeball>MEGABALL</pokeball>
        <tool>RADAR</tool>
        <pokeball>ULTRABALL</pokeball>
    </accessories>
</trainer>
```

XSD

```xsd
<xsd:element name="trainer">
    <xsd:complexType>
        <xsd:all>
            <xsd:element name="name" type="xsd:string"/>
            <xsd:element name="exp" type="xsd:integer"/>
            <xsd:element name="accessories">
                <xsd:complexType>
                    <xsd:choice minOccurs="0" maxOccurs="3">
                        <xsd:element name="pokeball" type="xsd:string" />
                        <xsd:element name="tool" type="xsd:string" />
                    </xsd:choice>
                </xsd:complexType>
            </xsd:element>
        </xsd:all>
    </xsd:complexType>
</xsd:element>
```

Declaration in XML are going to be omitted in these examples, xsd namespace definition as well: don't count them as errors

Is it valid?

XML

```xml
<trainer xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns="pokemonNamespace"
xsi:schemaLocation="pokemonNamespace pokemon.xsd">
    <name>ASH</name>
    <exp>1</exp>
    <accessories>
        <pokeball>MEGABALL</pokeball>
        <tool>RADAR</tool>
        <pokeball>ULTRABALL</pokeball>
    </accessories>
</trainer>
```

XSD

```xsd
<xsd:element name="trainer">
    <xsd:complexType>
        <xsd:all>
            <xsd:element name="name" type="xsd:string"/>
            <xsd:element name="exp" type="xsd:integer"/>
            <xsd:element name="accessories">
                <xsd:complexType>
                    <xsd:choice minOccurs="0" maxOccurs="3">
                        <xsd:element name="pokeball" type="xsd:string" />
                        <xsd:element name="tool" type="xsd:string" />
                    </xsd:choice>
                </xsd:complexType>
            </xsd:element>
        </xsd:all>
    </xsd:complexType>
</xsd:element>
```

`xsd:choice` by default has `maxOccurs` set to 1, but you can modify it!

Declaration in XML are going to be omitted in these examples, xsd namespace definition as well: don't count them as errors

Is it valid?

XML

```
<trainer xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns="pokemonNamespace"
xsi:schemaLocation="pokemonNamespace pokemon.xsd">
    <name>ASH</name>
    <exp>1</exp>
    <accessories></accessories>
</trainer>
```

XSD

```
<xsd:element name="trainer">
    <xsd:complexType>
        <xsd:all>
            <xsd:element name="name" type="xsd:string"/>
            <xsd:element name="exp" type="xsd:integer"/>
            <xsd:element name="accessories">
                <xsd:complexType>
                    <xsd:choice minOccurs="0" maxOccurs="2">
                        <xsd:element name="pokeball" type="xsd:string" />
                        <xsd:element name="tool" type="xsd:string" minOccurs="1" />
                    </xsd:choice>
                </xsd:complexType>
            </xsd:element>
        </xsd:all>
    </xsd:complexType>
</xsd:element>
```

Declaration in XML are going to be omitted in these examples, xsd namespace definition as well: don't count them as errors

Is it valid?

XML

```
<trainer xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns="pokemonNamespace"
xsi:schemaLocation="pokemonNamespace pokemon.xsd">
    <name>ASH</name>
    <exp>1</exp>
    <accessories></accessories>
</trainer>
```

XSD

```
<xsd:element name="trainer">
    <xsd:complexType>
        <xsd:all>
            <xsd:element name="name" type="xsd:string"/>
            <xsd:element name="exp" type="xsd:integer"/>
            <xsd:element name="accessories">
                <xsd:complexType>
                    <xsd:choice minOccurs="0" maxOccurs="2">
                        <xsd:element name="pokeball" type="xsd:string" />
                        <xsd:element name="tool" type="xsd:string" minOccurs="1" />
                    </xsd:choice>
                </xsd:complexType>
            </xsd:element>
        </xsd:all>
    </xsd:complexType>
</xsd:element>
```

The `minOccurs="0"` has a stronger significance than the one (`minOccurs="1"`) we put on `tool`

Declaration in XML are going to be omitted in these examples, xsd namespace definition as well: don't count them as errors

XML: is it well formed ? / is it valid?

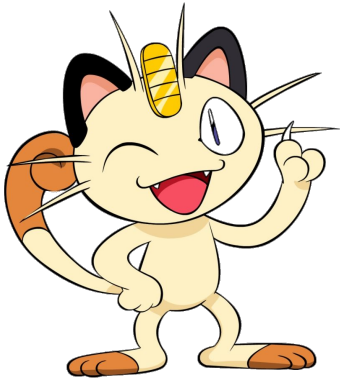
Go into the folder `Documents/json-xml-SDElab/xml/`.
The data of your team is going to be in the file `xmlInstances/myTeam.xml` *while the xsd definition is in* `xsdDefinitions/pokemonTeam.xsd`.

In order to call the validation script, you should open a terminal, move to the folder mentioned above and write: `node validate.js xmlInstances/myTeam.xml xsdDefinitions/pokemonTeam.xsd`

XPath

Addressing elements and attributes of an XML document

“Path-like” syntax to navigate through the “XML tree”



Select from the current node

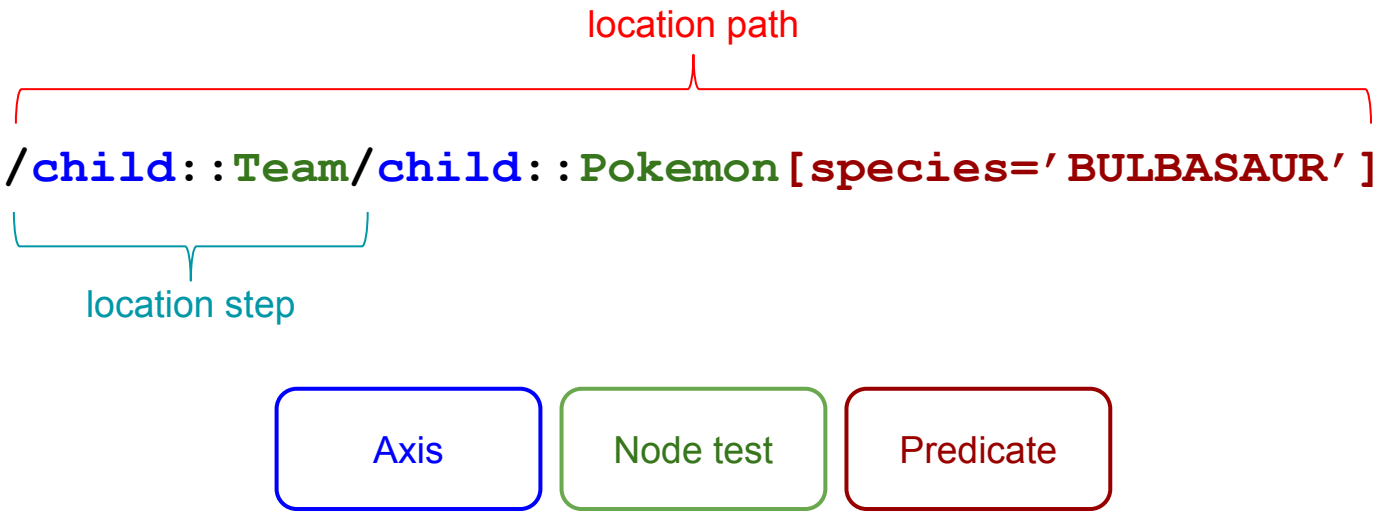
Filter by attribute

```
/tagname[@Attribute='Value']
```

Name of targeted tag

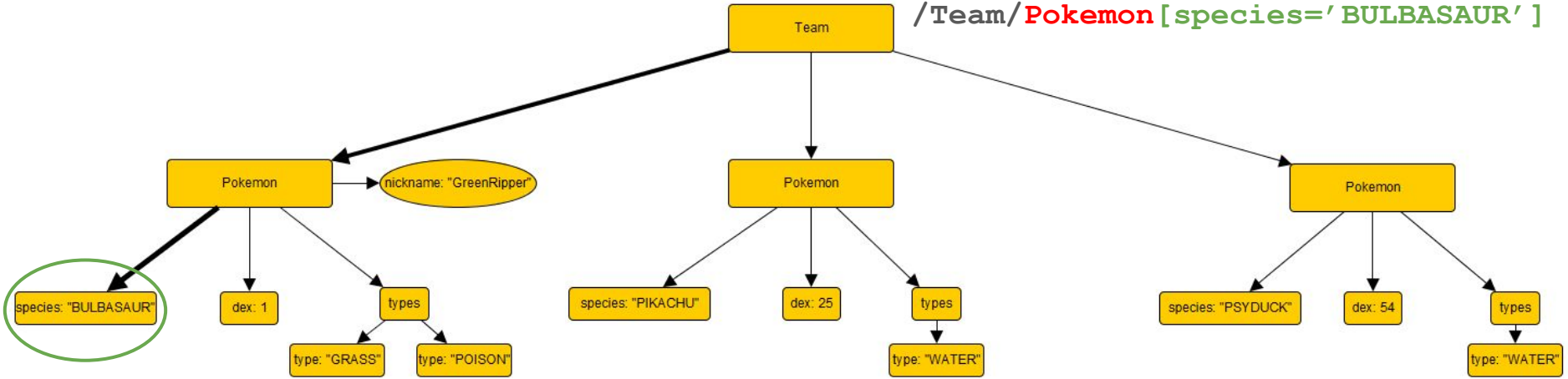
Location Path

XPath - Syntax



Note: there is also an abbreviated syntax: e.g. `/Team/Pokemon[species='BULBASAUR']`

XPath - Tree navigation



```
Element='<Pokemon xmlns="pokemonNamespace" nickname="GreenRipper">
                <species>BULBASAUR</species>
                <dex>1</dex>
                <types>
                        <type>GRASS</type>
                        <type>POISON</type>
                </types>
        </Pokemon>'
```

XPath

```
/Team/Pokemon[@nickname='GreenRipper']
```

SQL

```
SELECT *
FROM Pokemon P
WHERE nickname = "GreenRipper" AND
      P.team IN (SELECT id
                 FROM Team T
                 WHERE T.id = P.team)
```

Extracts all the pokemons that have GreenRipper as a nickname

XPath - Examples

`/Team/Pokemon`

Selects **the Pokemons**, which in the XML are **children** elements of the **root element Team**

`//moves/attack`

Selects **the attacks**, which in the XML are **children** elements of the **root or other deeper descendents** that in this case are **elements of type “moves”**

`//moves/attack[last()]`

Works just like above, then selects the **last attack** of each pokemon

`//Pokemon[@nickname='TopoGigio']`

Selects **the Pokemons**, which in the XML are **children** elements of the **root or other deeper descendents that has the nickname “TopoGigio”**

QUIZ TIME!

XPath - Quiz

```
/Team/Pokemon[dex>=2]
```

Take as a reference for the definition the document `xml/xsdDefinitions/pokemonTeam.xsd`

XPath - Quiz

```
/Team/Pokemon[dex>=2]
```

Selects **the Pokemons**, which in the XML are **children** elements of the **root element Team**, that have a **dex level higher or equal to 2**

Take as a reference for the definition the document `xml/xsdDefinitions/pokemonTeam.xsd`

XPath - Quiz

```
//moves/attack/*[last()]
```

Take as a reference for the definition the document `xml/xsdDefinitions/pokemonTeam.xsd`

XPath - Quiz

```
//moves/attack/*[last()]
```

Selects **the attacks**, which in the XML are **children** elements of the **root or other deeper descendents** that in this case are **elements of type "moves"**, then selects the **last children element of every attack** element picked up (in this case they are the `<power>` elements, since every `attack` is characterized by `name`, `type` and a `power` coefficient)

Take as a reference for the definition the document `xml/xsdDefinitions/pokemonTeam.xsd`

XPath - Exercises

Go into the folder `Documents/json-xml-SDElab/xml/`. *The data of your team is going to be in the file* `xmlInstances/myTeam.xml`
In order to call an xPath query on it, you should open a terminal, move to the folder mentioned above and write:
`node xPath.js xmlInstances/myTeam.xml "query"`

Note: YOU MUST USE APPROPRIATE NAMESPACE(s): e.g. //pkm:moves

1. Find all the pokemons in your team that have an experience level lower than 50
2. Find all the bulbasaur pokemons that have an attack with a power level higher than 40
3. Find the last pokemon in your team with sleep powder as an effect listed in the moves

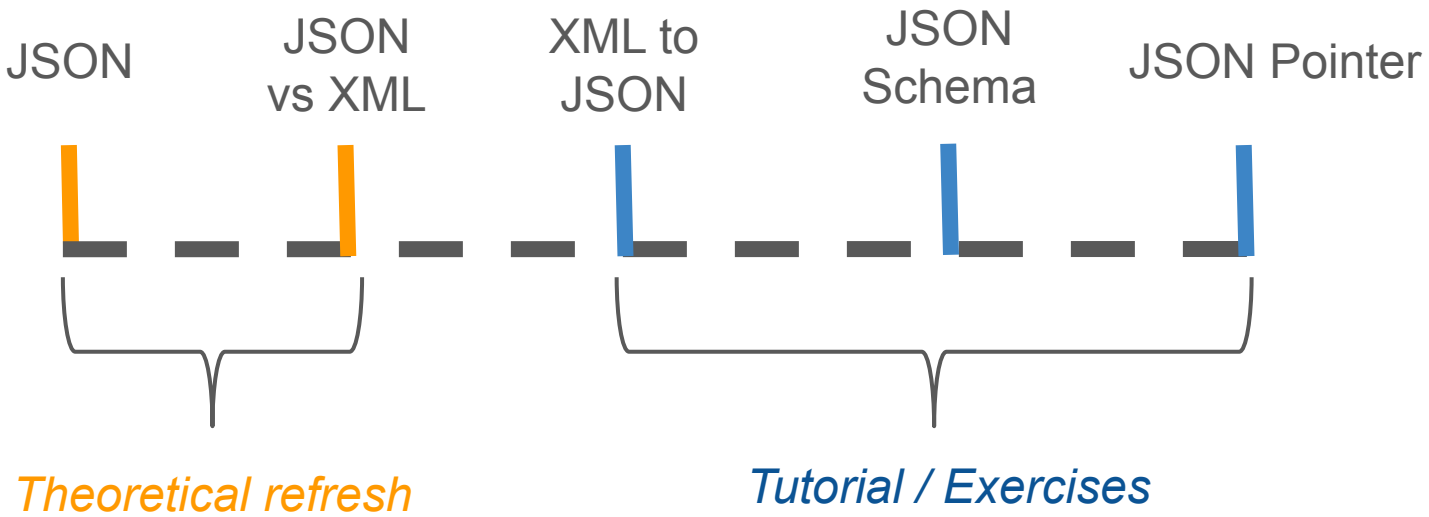
XPath - Solutions

1. `/Team/Pokemon[experience < 50] or //Pokemon[experience < 50]`

2. `/Team/Pokemon[species='BULBASAUR']/moves/attack[power > 40]/parent::*/parent::*`

3. `/Team/Pokemon/moves/effect[name='SLEEP POWDER']/ancestor::Pokemon[last()]`

Summary for JSON



JSON - JavaScript Object Notation[1]

Standard data representation and data **exchange** format

Easily generated and **readable** for both humans and machines

Data type defined in forms of **array**, **maps** (key value pairs) or both

Platform independent

(UTF-8 compliant)

Uses conventions present in other programming languages

Starting from primitive types (e.g. number, string, boolean)

1: Related/close to a JS object, but not completely the same (e.g. quotes, function type in js)

JSON - Basic concepts

```
{
 "Team":[
      {
            "@nickname": "GreenRipper",
            "species": "BULBASAUR",
            "dex": "4",
            "types": [
                "GRASS",
                "POISON"
            ],
            "experience": "64",
            "moves": [
                {
                    "name": "RAZOR LEAF",
                    "type": "GRASS",
                    "power": "55"
                },
                {
                    "name": "SLEEP POWDER",
                    "type": "GRASS"
                }
            ]
        }
    }

 ]

}
```

- **Property Name**
  (always between double quotes)
- Property Value
  (could be a number, a string, a boolean, an object or an array)
- Array
  (a list composed of all sort of elements: primitive or composite)
- Object
  (map of *"key":value* properties)

Is JSON better than XML?

every evolution comes with its pros & cons...

{ JSON }

Simple syntax (less verbose)

Easiness to use: time saving

Faster to transmit

<XML />

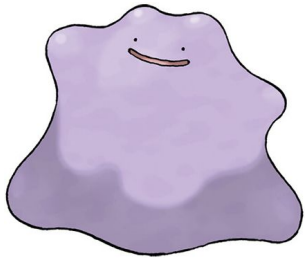
Established validation techniques (standard)

Strictness: more suitable to safety critical use cases

There are
MORE STANDARDs

*serialization/deserialization faster in …
(depends)*

From XML to JSON



Can be done in both ways using, for example, the **xml2json** library in js:

- Easy to use (just call the function)
- Customizable
- Conversion is lossy

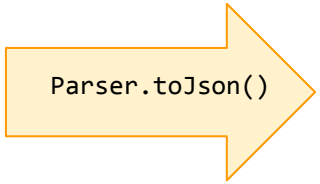
```
parser.toJson(xml, options);
```

```
parser.toXml(json);
```

Good results are not always guaranteed!

From XML to JSON

```xml
<Pokemon nickname="GreenRipper">
    <species>BULBASAUR</species>
    <dex>1</dex>
    <types>
        <type>GRASS</type>
        <type>POISON</type>
    </types>
</Pokemon>
```

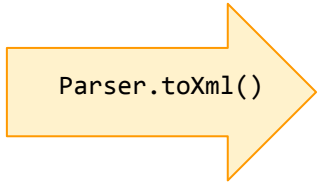



```json
{
  "Pokemon": {
    "nickname": "GreenRipper",
    "species": "BULBASAUR",
    "dex": 1,
    "types": [
      "GRASS",
      "POISON"
    ]
  }
}
```

Could be useful, but be aware you're going to **lose some information**
(e.g. XML attributes vs XML simple elements)

From JSON to XML

```json
{
  "Pokemon": {
    "nickname": "GreenRipper",
    "species": "BULBASAUR",
    "dex": 1,
    "types": [
      "GRASS",
      "POISON"
    ]
  }
}
```




```xml
<Pokemon    nickname="GreenRipper"
            species="BULBASAUR" dex="1"
            types="GRASS" types="POISON">
</Pokemon>
```

Every time there is an array of simple elements in JSON,
the converted XML will be **NOT WELL-FORMED!**

JSON ⟺ XML

When can I make “safe” conversions?

{ JSON }

There aren’t any arrays

⟺

<XML />

Leaf elements have just attributes and no content

JSON ⟺ XML (don't abuse!)

"Bulbasaur.xml"

```xml
<Pokemon nickname="GreenRipper">
    <species>BULBASAUR</species>
    <dex>1</dex>
    <types>
        <type>GRASS</type>
        <type>POISON</type>
    </types>
</Pokemon>
```

Parser.toJson();
Parser.toXml();

```xml
<Pokemon nickname="GreenRipper" species="BULBASAUR" dex="1">
    <types type="GRASS" type="POISON"></types>
</Pokemon>
```

XML not Well Formed!

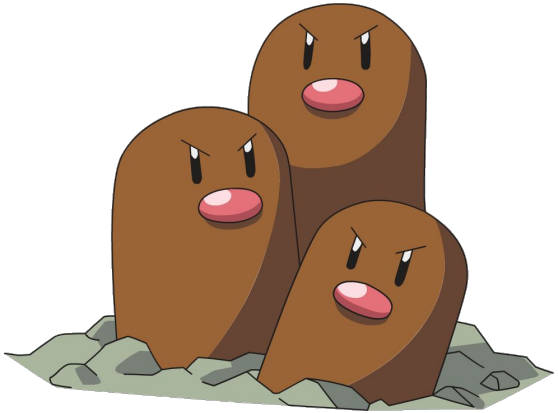
"Bulbasaur.json"

```json
{
    "Pokemon":{
        "nickname": "GreenRipper",
        "species": "BULBASAUR",
        "dex": 1,
        "types": ["GRASS", "POISON"]
    }
}
```

Parser.toXml();
Parser.toJson();

Error while parsing XML!
Duplicated attribute "types"

JSON ⟺ XML **(don’t abuse!)**



A few conversions later...

JSON - XML converter

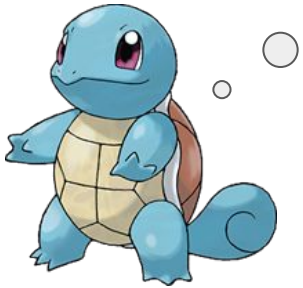
Go into the folder `Documents/json-xml-SDElab/json2xmlExamples/`.
In order to call the converter script, you should open a terminal, move to the folder mentioned above and write:

`node xml2json.js <xmlInstance.xml>` (from xml to json)
`node json2xml.js <jsonInstance.json>` (from json to xml)


JSON - Properties

Checking for appropriate nesting

In js, I can just call `JSON.parse()`

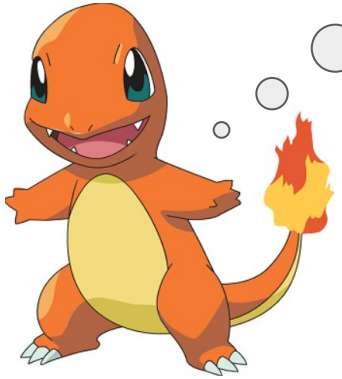


WELL-FORMED ✓

JSON - Properties

There are methods to do it, but **NO** actual **STANDARDS**

We can use JSON schema



VALIDATION

JSON Schema

Provides a huge variety of **constraints**

dependencies, max/minItems, requires, ...

Makes **combining schemas simpler**, implying smaller level of effort

anyOf, allOf, oneOf

Some **options** from XSD are **missing**

Doesn't provide sequence check

JSON Schema

- **Constraints**
  (# of items, required fields, additional properties,..)
- Schema declaration
  (draft version of JSON schema)
- **Reference to the definition**
  (modularity and reusability)
- Basic types
  (integer, number, boolean, string, object, array)

```
{
  "$id": "pokemonTeamJSONSchema",
  "$schema": "http://json-schema.org/draft-07/schema#",
  "description": "A representation of a pokemon team",
  "type": "array",
  "items": { "$ref": "#/definitions/Pokemon" },
  "maxItems": 6,

  "definitions": {
    "Pokemon": {
      "type": "object",
      "properties": {
          "@nickname":{ "type": "string" },
          //other properties[...]
          "experience":{ "type": "integer", "minimum": 1, "maximum": 100 },
          "moves":{
              "type" : "array",
              "items":
                  { "anyOf":
                      [   { "$ref": "#/definitions/attack" },
                          { "$ref": "#/definitions/effect" }]
                  },
              "minItems": 0, "maxItems": 4
          }
      },// other definitions[...]
      "required": ["experience", "moves", // other required properties*/]
    }
  }
}
```

Again...

we need to see some examples

QUIZ TIME!

Is it well formed?

1

```
{
    "Team":
    [
        {
            "nickname": 'GreenRipper',
            "species": 'BULBASAUR',
            "dex": 1,
            "types": ['GRASS', 'POISON'],
            "experience": 64,
            "moves":
                [
                    {
                        "name": 'RAZOR LEAF',
                        "type": 'GRASS',
                        "power": 55
                    }
                ]
        }
    ]
}
```

Is it well formed?

1

```
{
    "Team":
    [
        {
            "nickname": 'GreenRipper',
            "species": 'BULBASAUR',
            "dex": 1,
            "types": ['GRASS', 'POISON'],
            "experience": 64,
            "moves":
                [
                    {
                        "name": 'RAZOR LEAF',
                        "type": 'GRASS',
                        "power": 55
                    }
                ]
        }
    ]
}
```

JSON forbids the use of single-quotes for strings.

Is it well formed?

2

```
{
    "Team":
    {
        {
            "nickname": "GreenRipper",
            "species": "BULBASAUR",
            "dex": 1,
            "types": ["GRASS", "POISON"],
            "experience": 64,
            "moves":
                [
                    {
                        "name": "RAZOR LEAF",
                        "type": "GRASS",
                        "power": 55
                    }
                ]
        }
    }
}
```

Is it well formed?

2

```
{
    "Team":
    {
        {
            "nickname": "GreenRipper",
            "species": "BULBASAUR",
            "dex": 1,
            "types": ["GRASS", "POISON"],
            "experience": 64,
            "moves":
                [
                    {
                        "name": "RAZOR LEAF",
                        "type": "GRASS",
                        "power": 55
                    }
                ]
        }
    }
}
```

A JSON object is a map containing key value pairs; here "`Team`" is an object with another object nested inside of it (this is a just value with no key)

1

Is it valid?

JSON

```
{
  "nickname": "Bulby",
  "species": "BULBASAUR",
  "types": ["GRASS", "POISON"],
  "dex": 5
}
```

SCHEMA

```
{
    "$id": "pokemonJSONSchema",
    "$schema": "http://json-schema.org/draft-07/schema#",
    "type": "object",
    "properties": {
        "nickname":{"type": "string"},
        "species": {"type": "string"},
        "types":{
            "type": "array",
            "items": {"type": "string"},
            "minItems": 1,"maxItems": 2
        }
    },
    "required": ["nickname", "species", "types"],
    "dependencies": {},
    "definitions": {}
}
```

1

Is it valid?

JSON

```
{
  "nickname": "Bulby",
  "species": "BULBASAUR",
  "types": ["GRASS", "POISON"],
  "dex": 5
}
```

SCHEMA

```
{
    "$id": "pokemonJSONSchema",
    "$schema": "http://json-schema.org/draft-07/schema#",
    "type": "object",
    "properties": {
        "nickname":{"type": "string"},
        "species": {"type": "string"},
        "types":{
            "type": "array",
            "items": {"type": "string"},
            "minItems": 1,"maxItems": 2
        }
    },
    "required": ["nickname", "species", "types"],
    "dependencies": {},
    "definitions": {}
}
```

By default JSON Schema allows for additional properties. In order to avoid this "additionalProperties": false can be used

2

Is it valid?

JSON

```
[
  {
    "nickname": "GreenRipper",
    "species": "BULBASAUR",
    "types": ["GRASS", "POISON"]
  }
]
```

SCHEMA

```
{
    "$id": "pokemonJSONSchema",
    "$schema": "http://json-schema.org/draft-07/schema#",

    "Pokemon":{
        "type": "object",
        "properties": {
            "nickname":{"type": "string"},
            "species": {"type": "string"},
            "dex": {"type": "integer"},
            "types":{
                "type": "array",
                "items": {"type": "string"},
                "minItems": 1,"maxItems": 2
            }
        },
        "required": ["species", "dex", "types"]
    },
    "definitions": {}
}
```

2

Is it valid?

JSON

```
[
  {
    "nickname": "GreenRipper",
    "species": "BULBASAUR",
    "types": ["GRASS", "POISON"]
  }
]
```

SCHEMA

```
{
    "$id": "pokemonJSONSchema",
    "$schema": "http://json-schema.org/draft-07/schema#",

    "Pokemon":{
        "type": "object",
        "properties": {
            "nickname":{"type": "string"},
            "species": {"type": "string"},
            "dex": {"type": "integer"},
            "types":{
                "type": "array",
                "items": {"type": "string"},
                "minItems": 1,"maxItems": 2
            }
        },
        "required": ["species", "dex", "types"]
    },
    "definitions": {}
}
```

This schema allows everything, because a “root” type for the schema to validate the instance against of is not defined (missed property `type`)

3

Is it valid?

JSON

```
{
  "nickname": "GreenRipper",
  "species": "BULBASAUR",
  "types": ["GRASS", "POISON"],
  "dex": 1,
  "accessory": "Peculiar Spoon"
}
```

SCHEMA

```
{
  "$id": "pokemonJSONSchema",
  "$schema": "http://json-schema.org/draft-07/schema#",

  "type": "object",
  "properties": {
    "nickname":{ "type": "string" },
    "species": { "type": "string" },
    "dex": { "type": "integer" },
    "types":{
      "type": "array",
        "items": {"type": "string"},
        "minItems": 1,
        "maxItems": 2
    }
  },
  "required": ["species", "dex", "types", "accessory"]
}
```

3

Is it valid?

JSON

```
{
  "nickname": "GreenRipper",
  "species": "BULBASAUR",
  "types": ["GRASS", "POISON"],
  "dex": 1,
  "accessory": "Peculiar Spoon"
}
```

SCHEMA

```
{
  "$id": "pokemonJSONSchema",
  "$schema": "http://json-schema.org/draft-07/schema#",

  "type": "object",
  "properties": {
    "nickname":{ "type": "string" },
    "species": { "type": "string" },
    "dex": { "type": "integer" },
    "types":{
      "type": "array",
        "items": {"type": "string"},
        "minItems": 1,
        "maxItems": 2
    }
  },
  "required": ["species", "dex", "types", "accessory"]
}
```

The schema requires an accessory, but doesn't define it. Thus, the accessory can be anything, it only needs to be included in the JSON.

JSON: is it well formed ? / is it valid?

Go into the folder `Documents/json-xml-SDElab/json/`.
The data of your team is going to be in the file `jsonInstances/myTeam.json` *while the json schema definition is in* `jsonDefinitions/pokemonTeam.json`.

In order to call the validation script, you should open a terminal, move to the folder mentioned above and write:

```
node validate.js jsonInstances/myTeam.json jsonDefinitions/pokemonTeam.json
```

JSONata - Introduction

Query language for JSON

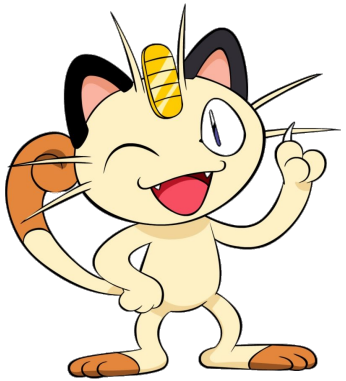
Similar to what XPath does for an XML document

Select from the current node

Filter by property value

```
.property[property=value]
```

Name of targeted property



Why JSONata?

There are different libraries, with more “normal” names, like **JSON Pointer** or **JSONPath**.

You could think they work, well.. **DON’T** use those libraries.

They are terrible, like Bidoof.

JSONata - Syntax

```
$.Team[species='BULBASAUR']
```

Simply extracting all the pokemons in the team which are of the BULBASAUR species

JSONata - Examples

`$.Team`

Selects the Pokemons, which in the JSON are elements of the array **Team** which is a child element of the **root**

`$.**.moves`

Selects **all the moves**, which in the JSON are **children** elements of the **root or other deeper descendents**

`$.Team[dex>4].moves[-1]`

Selects the **last move** of **all the pokemons** that **have a dex level greater than 4**

`$.Team['GRASS' in types]`

Selects the Pokemons, which are elements of the array **Team** (which is a child element of the **root**), **that have 'GRASS' as an element of the array types**

QUIZ TIME!

JSONata - Quiz

```
$.Team[moves[type="GRASS"][power<=110]]
```

JSONata - Quiz

```
$.Team[moves[type="GRASS"][power<=110]]
```

Selects **all the pokemons** that have at least **a move** of **type grass and a power level less than 110**

JSONata - Quiz

```
$.Team.moves[-2]
```

JSONata - Quiz

```
$.Team.moves[-2]
```

Selects the **penultimate** **move** of **each team's pokemon**

JSONata - Exercises

Go into the folder `Documents/json-xml-SDElab/json/`*. The data of your team is going to be in the file* `myTeam.json`
In order to call a JSONata query on it, you should open a terminal, move to the folder mentioned above and write:

```
node jsonata.js jsonInstances/myTeam.json query
```

1. Find all the pokemons in your team that have an experience level lower than 50
2. Find all the bulbasaur pokemons that have a move with a power level higher than 40
3. Find the last pokemon in your team with sleep powder listed in the moves

JSONata - Solutions

1. `$.Team[experience<50]`
2. `$.Team[species='BULBASAUR'][moves[power>40]]`
3. `$.Team[moves[name="SLEEP POWDER"]][-1]`

References

XML [https://www.w3.org/XML/Core/#Publications]

XSD [https://www.w3.org/TR/xmlschema11-1/]

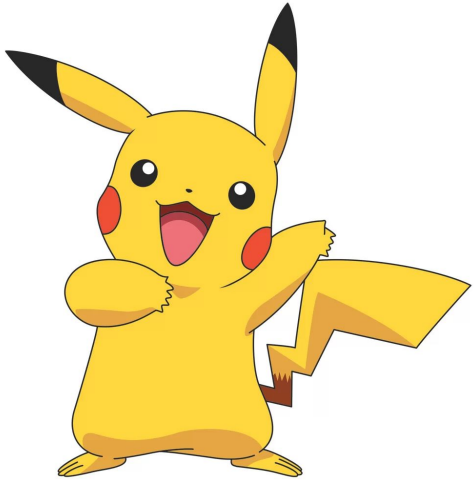
XPath [https://www.w3.org/TR/2017/REC-xpath-31-20170321/]

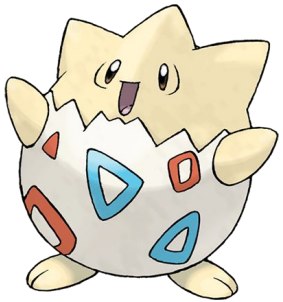
JSON [https://developer.mozilla.org/en-US/docs/Web/JavaScript/Reference/Global_Objects/JSON]

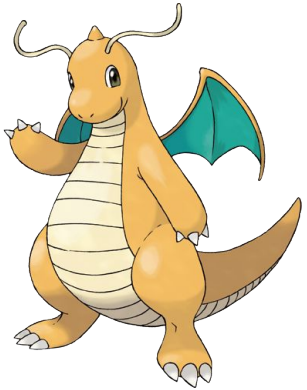
JSON Schema [https://json-schema.org/understanding-json-schema/]

JSONata [http://docs.jsonata.org/overview]

Thanks for your attention!







Hope you've had fun

(well... if by any chance you've learnt something, it's not bad either)