# ICM – Computer Science Major

# M1 Cyber Physical and Social Systems

# Course unit on Data Interoperability and Semantics

# Tutorial 2

# 1) Delimiter-Separated Values

Time,Tel,Type,Message

1574431166,+33477421111,in,"Hey, let's get back to work on the project"

1574432836,+33477421111,out,"Let’s meet this evening?

FYI John suggests Zoom at 8."

1574432945,+33477421111,in,"What is ""FYI"" ?"

1574433477,+33477421111,out,"That means For Your Interest"

1574433477,+33477421111,in,"ah

...

ok"

What is the data format of this document? What would be its mediatype?

What is the cell separator character? **comma ,**

The field enclosing character? **double quote "**

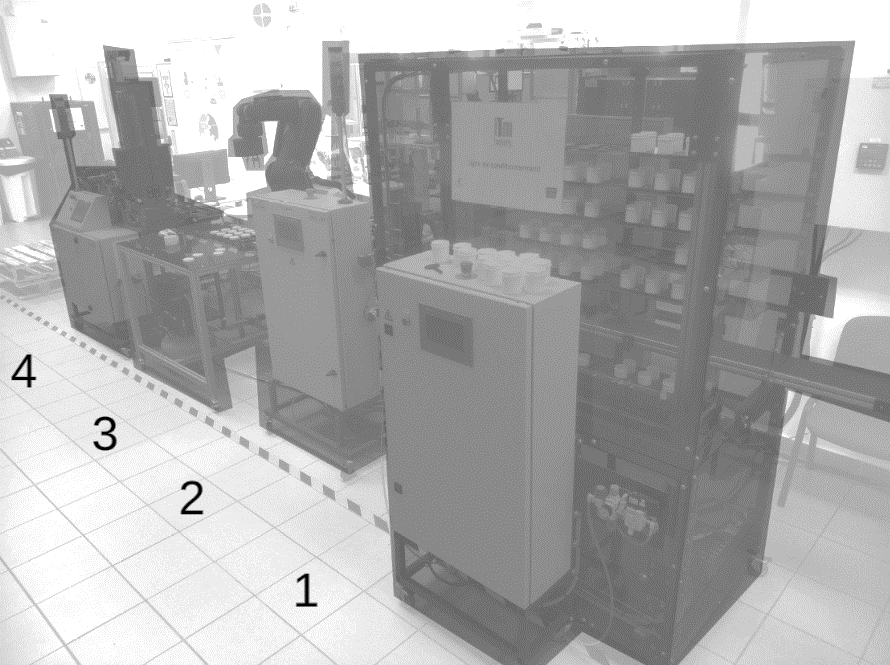
How many lines? **9 lines**

How many columns? **4 columns**

How many records? **5 records**

What is the text content of message 1574432945 ? **What is "FYI" ?**

# 2) JSON – IT’M Factory

The EMSE IT’M factory, inaugurated Sept. 24th 2018, simulates an industry 4.0 factory where containers (ex. pots of yoghurt) are filled with some product (ex. yoghurt), then packaged. As illustrated in the figure below, the production line is composed of a sequence of four workshops: 1) the “conveying workshop” (type VL10), 2) the “filling workshop” (type DX10), 3) the “potting workshop” (type APAS), 4) the packaging workshop (type XY10). Each workshop has an operating state (one of: running, paused, stopped, error)

Write a JSON document to describe this production line

**see document itmfactory.json**

# 3) YAML

Here is a simple YAML document

openapi: 3.0.0

info:

title: Sample API

description: |

Simple example

of an API

version: 0.1.9

servers:

- url: http://api.example.com/v1

description: main server

- url: http://staging-api.example.com

description: staging

Write an equivalent JSON document. **see document openapi.json**

# 4) XML - Sitemap

A sitemap is a file where you provide information about the pages, videos, and other files on your site, and the relationships between them. Search engines like Google read this file to crawl your website more efficiently. A sitemap tells Google which pages and files you think are important in your website, and also provides valuable information about these files. For example, when the page was last updated and any alternate language versions of the page. (Source: Google)

Below is an example of a sitemap in XML format (Source: [sitemaps.org](https://www.sitemaps.org/)) where I injected a few errors.

**Circle the 4 syntax errors and the 2 other errors. Explain below how to correct them.**

<?xml version=1.0 encoding="UTF-12"?>

<urlset xmlns="http://www.sitemaps.org/schemas/sitemap/0.9">

<url>

<loc>http://www.example.com/</loc>

<lastmod>2005-01-01</lastmod>

<changefreq>monthly</changefreq>

<priority>0.8</priority>

</url>

<url>

<loc>http://www.example.com/catalog?item=12&amp;desc=vacation\_hawaii</loc>

<changefreq>weekly</changefreq>

</url>

<url>

<loc>http://www.example.com/catalog?item=73&amp;desc=vacation\_new\_zealand</loc>

<lastmod>2004-12-23</modlast>>

<changefreq>weekly</changefreq>

</url>

<url>

<loc>http://www.example.com/catalog?item=74&amp;desc=vacation\_newfoundland

<lastmod>23-12-2004T18:00:15+00:00</loc></lastmod>

</url>

<url>

<priority>0.3</priority>

<url>

<loc>http://www.example.com/catalog?item=83&amp;desc=vacation\_usa</loc>

<lastmod>2004-11-23</lastmod>

</url>

**Syntax Errors:**

1. **Incorrect XML Declaration:**

<?xml version=1.0 encoding="UTF-12"?>

**Correction:** The correct syntax for the XML declaration requires double quotes around attribute values and should specify a valid encoding. Replace the line with:

<?xml version="1.0" encoding="UTF-8"?>

1. **Unclosed loc Tag:**

<loc>http://www.example.com/catalog?item=74&amp;desc=vacation\_newfoundland <lastmod>23-12-2004T18:00:15+00:00</loc></lastmod>

**Correction:** Close the **loc** tag before the **lastmod** tag:

<loc>http://www.example.com/catalog?item=74&amp;desc=vacation\_newfoundland</loc> <lastmod>23-12-2004T18:00:15+00:00</lastmod>

1. **Incorrect lastmod Closing Tag:**

<lastmod>2004-12-23</modlast>

**Correction:** Replace **</modlast>** with **</lastmod>**:

<lastmod>2004-12-23</lastmod>

1. **Unclosed url Tag:**

<priority>0.3</priority> <url>

**Correction:** Close the **url** tag before the **priority** tag or remove the unnecessary **url** tag:

</url> <priority>0.3</priority>

**Other Errors:**

1. **Misplaced url Tag:**

<url> <priority>0.3</priority> <url> <loc>http://www.example.com/catalog?item=83&amp;desc=vacation\_usa</loc> <lastmod>2004-11-23</lastmod> </url>

**Correction:** It seems like there's a misplaced **url** tag. Either remove it or correct the nesting:

<url> <loc>http://www.example.com/catalog?item=83&amp;desc=vacation\_usa</loc> <lastmod>2004-11-23</lastmod> </url>

1. **Invalid lastmod Format:**

<lastmod>23-12-2004T18:00:15+00:00</lastmod>

**Correction:** The **lastmod** date format is incorrect. Use a valid date-time format:

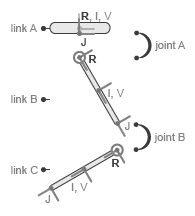
<lastmod>2004-12-23T18:00:15+00:00</lastmod>

After applying these corrections, the XML document should be well-formed and free from syntax errors.

see also documents sitemap.xml and sitemap\_corrected.xml

you should be able to identify the syntax errors with online applications, or in your IDE with some plugin

# 5) XML - URDF



Unified Robotics Description Format, URDF, is an XML specification used in academia and industry to model multibody systems such as robotic manipulator arms for manufacturing assembly lines and animatronic robots for amusement parks. URDF is especially popular with users of Robotics Operating System, ROS. (Source: MathWorks)

Below is an example of a urdf description of a Double-Pendulum Model in XML format where I injected a few errors.

1. **Find the 5 syntax errors. Explain how to correct them.**
2. **What color is** link C **?**

<?xml version="1.0" encoding="utf-8"?>

<link name="link A">

<inertial>

<origin xyz="0 0 0"/>

<mass value="0.5"/>

<inertia ixx="0.5" iyy="0.5" izz="0.5" ixy="0" ixz="0" iyz="0"/>

</inerital>

<visual>

<origin xyz="0 0 0"/>

<geometry>

<box size="0.5 0.5 0.1"/>

</geometry>

<material name="gray A">

<color rgba="0.1 0.1 0.1 1"/>

</material>

</visual>

</link>

<link name="link B">

<inertial>

<origin xyz="0 0 -0.5"/>

<mass value="0.5"/>

<inertia ixx="0.5" iyy="0.5" izz="0.5" ixy="0" ixz="0" iyz="0"/>

</inertial>

<visual>

<origin xyz="0 0 -0.5"/>

<geometry>

<cylinder radius="0.05" length="1"/>

<material name="gray B">

<color rgba="0.3 0.3 0.3 1"/>

</material>

</visual>

</link>

<link name="link C">

<inertial>

<origin xyz="0 0 -0.5"/>

<mass value="0.5"/>

<inertia ixx="0.5" iyy="0.5" izz="0.5" ixy="0" ixz="0" iyz="0"/>

</inertial>

<visual>

<origin xyz="0 0 -0.5"/>

<geometry>

<cylinder radius="0.05" length="1"/>

</geometry>

<material name="xxx C">

<color rgba="0.5 0.0 0.5 1"/>

</material>

</visual>

</link>

<joint name="joint A" type="continuous">

<parent link="link A"/>

<child link="link B"/>

<origin xyz="0 0 -0.05"/>

<axis xyz="0 1 0"/>

<joint>

<joint name="joint B" type="continuous">

<parent link="link B"/>

<child link= link C />

<origin xyz="0 0 -1"/>

<axis xyz="0 1 0"/>

<dynamics damping ="0.002"/>

</joint>

See also documents urdf.xml and urdf\_corrected.xml

you should be able to identify the syntax errors with online applications, or in your IDE with some plugin

a) Here are the syntax errors in the provided URDF XML document, along with explanations on how to correct them:

1. Missing root tag. Every XML document requires a root tag.

example: <robot> …. </robot>

1. Typo in the closing tag of <inertial> element of link A: </inerital> -> </inertial>:
2. Unclosed <geometry> element in link B: closing tag </geometry> should be place just after the <cylinder> element
3. Joint tag "joint A" is not closed property. <joint> -> </joint>
4. Attribute @link of element <child> inside "joint B" should be enclosed with double quotes:

<child link="link C" />

b) Color of Link C:

The color of Link C is specified in the material with the name "xxx C," and its RGBA values are "0.5 0.0 0.5 1." The color is a shade of purple, as the red (0.5) and blue (0.5) components are present, while the green component is set to 0.



# 6) FHIR

FHIR (Fast Healthcare Interoperability Resources) is designed to enable the exchange of healthcare-related information. This includes clinical data as well as healthcare-related administrative, public health and research data. It covers both human and veterinary medicine and is intended to be usable world-wide in a wide variety of contexts, including in-patient, ambulatory care, acute care, long-term care, community care, allied health, etc.

Many healthcare systems and technology vendors are already supporting the FHIR data standard, including the electronic medical record systems of the largest hospitals in the US, as well as major tech vendors such as Apple and Microsoft.

Below is a simple (modified) example of a document that describes a cholesterol diagnostic report.

{

"resourceType": "Observation",

"id": "cholesterol",

"status": "final",

"code": {

"system": "http://loinc.org",

"code": "35200-5",

"display": "Cholesterol [Moles/​volume] in Serum or Plasma"

},

"subject": {

"names": {

"official": {

"use": "official",

"family": "Chalmers",

"given": [ "Peter", "James"]

},

"usual": {

"given": "Jim"

}

},

"birthDate": "1974-12-25"

},

"performer": [

{

"reference": "Organization/1832473e-2fe0-452d-abe9-3cdb9879522f",

"display": "Acme Laboratory, Inc"

}

],

"valueQuantity": {

"value": 6.3,

"unit": "mmol/L",

"system": "http://unitsofmeasure.org",

"code": "mmol/L"

},

"referenceRange": [

{

"type": "high",

"value": 4.5,

"system": "http://unitsofmeasure.org",

"code": "mmol/L"

},

{ ... other objects with "type": "low" , "type": "reference", etc.}

]

}

1. What would be the media type for this document when exchanged on the web?

I would accept: → application/fhir+json , application/json, …

1. What is 1832473e-2fe0-452d-abe9-3cdb9879522f ?

This is a **universally unique identifier** ([UUID](https://en.wikipedia.org/wiki/Universally_unique_identifier)). A [128-bit](https://en.wikipedia.org/wiki/128-bit) [number](https://en.wikipedia.org/wiki/Nominal_number) designed to be unique [identifier](https://en.wikipedia.org/wiki/Identifier) for objects in a computer systems that use the standard but being also unique and large enough as to avoid random collisions with external number comparisons (Wikipedia)

1. What interest is there in using codes from LOINC, SNOMED, or unitsofmeasure.org?

These coding systems ensure **semantic interoperability** by providing standardized, machine-readable identifiers for clinical concepts and measurement units.

LOINC → standardized lab and clinical observation codes

SNOMED CT → standardized clinical terminology

unitsofmeasure.org → standardized units (e.g., mmol/L)

This allows different systems and organizations to understand and exchange data consistently.

1. What standard is the birth date expressed in?

**ISO 8601** date format (YYYY-MM-DD)

1. Write a JSONPath query to retrieve the usual given name of the patient

$.subject.names.usual.given

1. Write a JSONPath query to retrieve the high reference value

$.referenceRange[?(@.type == "high")].value

# Question 7: (/2)

Here is a JSONSchema document

{

"$id": "https://example.com/arrays.schema.json",

"$schema": "https://json-schema.org/draft/2020-12/schema",

"description": "A representation of a person, company, organization, or place",

"type": "object",

"properties": {

"fruits": {

"type": "array",

"items": {

"type": "string"

}

},

"vegetables": {

"type": "array",

"items": { "$ref": "#/$defs/veggie" }

}

},

"$defs": {

"veggie": {

"type": "object",

"required": [ "veggieName", "veggieLike" ],

"properties": {

"veggieName": {

"type": "string",

"description": "The name of the vegetable."

},

"veggieLike": {

"type": "boolean",

"description": "Do I like this vegetable?"

}

}

}

}

}

Write a simple JSON document that validates against this schema with 2 fruits and 2 veggies.

{

"fruits": [

"apple",

"banana"

],

"vegetables": [

{

"veggieName": "carrot",

"veggieLike": true

},

{

"veggieName": "broccoli",

"veggieLike": false

}

]

}

also check online at <https://www.jsonschemavalidator.net/> or in your IDE with the appropriate plugin

# Appendix A: JSONPath Cheat Sheet

**Syntax**

$.store.book[0].title

$['store']['book'][0]['title'] # Alternative notation

**Traversal**

$.parentNode.childNode.field # XPath: /parentNode/childNode/@field

$..anyChildNode # XPath: //anyChildNode   
 $.parentNode.\* # XPath: /parentNode/\*

Array Access

$.myList[0] # first element

$.myList[-1] # last element

$.myList[2:3] # range

$.myList[0,4,5] # selection

Filtering

$.customer[?(@.car)] # Only "customer"s that have attribute "car"

$.customer[?(@.car == 'Ford Fiesta')] # Only "customer"s with "Ford Fiesta"s

$.customer[?(@.age > 18)] # Only adults

Complex Conditions

$.customer[?(@.age > 18 || @.car == 'Ford Fiesta')] # logical or

$.customer[?(@.age < 18 && @.hobby == 'Biking' )] # logical and