**DEFINING THE NOTION OF CONCEPT MAPS 3.0**

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Web based concept maps can be viewed as reflections of generations of web technology. Thus we define the following generations of concept maps:

- Concept maps 1.0
  - Can be created using dedicated tools (such as CmapTools, WebMaps).
  - Can be exported to other resources to enhance their informational or learning value.
  - Can be annotated by metadata using well-known vocabularies.
  - Can be used with two dimensional graphics that also makes it possible to understand the visual elements that constitute a concept map.

- Concept maps 2.0
  - Can be created using dedicated or non-dedicated tools (such as WordPress, wikis).
  - Can be linked to external resources to enhance their informational or learning value.
  - Can be annotated by metadata using well-known, documented vocabularies.

- Concept maps 3.0
  - Can be created using dedicated or non-dedicated tools (such as CmapTools, WebMaps).
  - Can be linked to external resources to enhance their informational or learning value.
  - Can be annotated by metadata using well-known, documented vocabularies.

Based on the Web Data Principles above, we propose five requirements for concept maps 3.0 as data sets:

1. "Concept maps should be linkable, that is accessible via persistent or stable identifiers. This obviously applies to the concept map as a whole but preferably also to its constituent parts. In this way, external resources can be linked to specific entities or subjects in the structure." (Johnsen, L. & Jensen, J., 2016)

2. "Concept maps should be annotated by metadata using well-known vocabularies that outline five recommendations for exposing data on the Web of Data / Semantic Web.

3. "Concept maps should be usable code is open to inspection." (Johnsen, L. & Jensen, J., 2016)

4. "Concept maps should belong to other resources to enhance their informational or learning value. Links should be typed if possible to signal their communicational purpose and/or the nature of their target and be made available for automatic processing. Individual concepts should be linked to external resources to better determine their identity." (Johnsen, L. & Jensen, J., 2016)

5. "Concept maps should be usable code is open to inspection." (Johnsen, L. & Jensen, J., 2016)

We have adopted the following Web Data Principles (Wilde, E., 2016, http://dret.github.io/webdata/), which outline five recommendations for exposing data on the Web of Data / Semantic Web.

- Linkable
- Parseable
- Usable
- Linked
- Scalable

We propose to use the JSON-LD vocabulary as the main vocabulary to mark up the concept maps. This allows concept maps to be mashup'd together to create new data sets. This obviously applies to the concept map as a whole but preferably also to its constituent parts.

A simple example of how a concept map 3.0 can be annotated and exposed as web data using the schema.org vocabulary and the format JSON-LD.

This particular example includes a snippet of code specifying metadata for a history concept map about the American general George Armstrong Custer.

```json
{ "@context" : "http://schema.org", 
  "@type" : "CreativeWork", 
  "url" : "https://www.wikidata.org/wiki/Q205422", 
  "mainEntity" : { 
    "@type" : "Event", 
    "about" : "https://www.wikidata.org/wiki/Q205422", 
    "@context" : "http://schema.org/", 
    "alternateName" : "Custer’s Last Stand", 
    "name" : "The Battle of The Little Bighorn", 
    "focusQuestion" : "Who was George Armstrong Custer famous for?", 
    "description" : "https://upload.wikimedia.org/wikipedia/commons/1/16/Custer_Bvt_MG_Geo_Armstrong_Custer.png", 
    "identifier" : "eo_A_1865_LC", 
    "learningResourceType" : "CreativeWork", 
    "inLanguage" : "en", 
    "learningResourceSize" : "800x600", 
    "copyrightYear" : "1865", 
    "isAccessibleForFree" : true, 
    "contentLocation" : "https://www.wikidata.org/wiki/Q205422", 
    "contributor" : "George Armstrong Custer", 
    "publisher" : "https://en.wikipedia.org/wiki/George_Armstrong_Custer", 
    "description" : "https://www.wikipedia.org/wiki/Custer\_Battle\_site\_national\_historic\_site\_battle\_of\_little\_bighorn\_1876", 
    "keywords" : [ 
      "Custer’s Last Stand", 
      "Battle of Little Bighorn." ] 
  }
}
```