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 manually constructed using Adobe Flash (CmapTools), Visio, etc.
• Utilize vector graphics (mainly PDF, SVG) for visualization
• Are not typically used for collaborative authoring
• Can be exported to, e.g., PDF, SVG, or HTML (VSU).

Concept maps 2.0
• Can be created using dedicated web-based tools (CmapCloud).
• Utilize vector web (web 2.0) technology for facilitating sharing and collaboration.
• Are represented as open standards such as SVG (Scalable Vector Graphics).

Concept maps 3.0
• Utilize semantic web / web of data (web 3.0) technology to make content dynamic.
• Can make use of semantic metadata for meaningful integration of data from external sources.
• Can be annotated by metadata using “well known” and/or “well documented” vocabularies. (Johnsen, L. & Jensen, J., 2016).

Defining Five Fundamental Requirements for Concept Maps 3.0

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.

These recommendations state that Web Data should be:
• Linkable
• Parseable
• Documented, and supported by major search engines.
• Usable
• Usable

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 and 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).

We suggest representing concept maps in JSON (JavaScript Object Notation) as in the following example:

```json
{
   "name" : "The Battle of The Little Bighorn",
   "description" : "http://g.co/kg/m/0pzgm",
   "about" : [
      {
         "@type" : "Role",
         "additionalType" : "eo_A_1865_LC",
         "description" : "George Armstrong Custer",
         "sameAs" : "https://upload.wikimedia.org/ commons/1/16/cmap-1865-LC.png",
         "url" : "https://cmapscloud.ihmc.us/viewer/ 253bdCXL.html#concept-1PXQ8ZZHR"
      }
   ],
   "focusQuestion" : "What was General George Armstrong Custer famous for?"
}
```

2. “Concept map distributions should be represented in open formats that do not require proprietary software for processing and whose source code is open to inspection.” (Johnsen, L. & Jensen, J., 2016). SVG can be utilized to fulfill this requirement of concept maps being *parseable*, as SVG is an W3C (World Wide Web Consortium) endorsed open format and standard, supported by browsers, can be embedded in HTML (Hypertext Markup Language), and can be rendered as part of larger web pages.

3. “Concept maps should be annotated by metadata using ‘well known’ and/or ‘well documented’ vocabularies.” (Johnsen, L. & Jensen, J., 2016).

We prepare to use schema.org (https://schema.org/) in the main vocabulary to mark up concept maps because it is well known, well documented, and supported by major search engines. This allows concept maps to be *documented*, and thus discoverable and conductible to processing. Furthermore, we propose that the concept maps made to be in JSON-LD (JavaScript Object Notation for Linked Data) or RDFa (RDF as Microformats), in order to make them dynamic.

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

This can be achieved by providing links to Wikidata entities, which can act as unique identifiers in an as-pattern referencing web pages, which unambiguously indicate the meaning or identity of some concept.

5. “Concept maps should be labeled with a license to signify who, where, how and why they may be put to use and under what circumstances.” (Johnsen, L. & Jensen, J., 2016).

This can be achieved by linking to a Creative Commons license, which will allow the concept maps in question to signal how the code is open to inspection.” (Johnsen, L. & Jensen, J., 2016).

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.