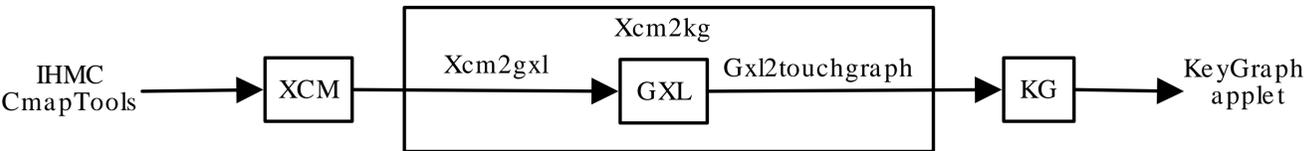


ONLINE MATHEMATICS WITH INTERACTIVE CONCEPT MAPS

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ABSTRACT

There has not been a free and easy-to-use utility to handle both authoring and presentation of large graphs online, especially with mathematical content. On one hand, concept map editors are ideal for authoring graphs, but publishing capabilities may be limited. On the other hand, numerous browsing and layout tools exist for publishing content generated elsewhere. We present a transformation tool Xcm2kg that tries to solve the problem by integrating authoring with IHMC CmapTools to publishing based on TouchGraph. GXL is used as an intermediate format to facilitate interoperability with other graph-based applications. The tool is demonstrated with concept maps drawn on an undergraduate mathematics course.

The problem with authoring and presentation of large graphs with mathematical content lies in the inability of the current concept mapping software to present conveniently anything else than textual data, and the lack of interoperability between them. Mathematical formulas may have to be converted manually to images, which is not practical with large texts. MathML helps, but needs software support both for editing and publishing. TeX-like concise formatting, supported by some publishing packages and wikis would be more efficient, especially for mathematically oriented users.

IHMC CMAPTOOLS

While CmapTools is adequate for authoring and has MathML support, its default HTML output has limitations, because concept map is exported as a single image. This can be impractical with large graphs – especially if the graph is not partitioned to subgraphs.

TOUCHGRAPH

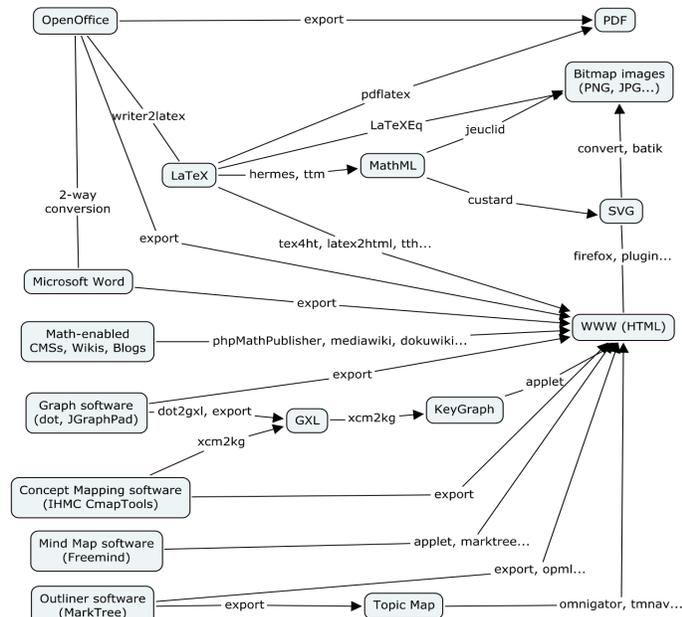
TouchGraph is an innovative, open source graph browsing component developed by Alex Shapiro. TouchGraph supports interactive browsing of large graphs, because the view can be restricted to a local portion of the graph. LinkBrowser is a graph browser based on TouchGraph.

XCM2KG

Xcm2kg is a conversion utility that converts concept maps from CmapTools XCM format to KeyGraph, a graph visualization component based on TouchGraph. The conversion is done with two separate filters, Xcm2gxl and Gxl2TouchGraph. External resources are shown as hints in LinkBrowser nodes. References to external concept maps are supported. MathML markup is converted to images and shown directly in TouchGraph nodes. Xcm2kg is published as a part of ConceptUtils transformation framework. KeyGraph includes a simple framework that eases publishing concept maps and linking between them.

DISCUSSION

Future work in Xcm2kg includes generalized support for GXL-KeyGraph -conversion. This would require a standard way to represent style in GXL files. The ConceptUtils framework should be extended to account new formats in transformation, such as FreeMind mind maps. Finally, the tool should be tested more extensively in different settings. Many online mathematics collections would benefit from visual representation of the context.



Potential transformations of mathematical/conceptual content. Transformations can be facilitated by ConceptUtils components. <http://conceptutils.sourceforge.net/>

CONCLUSION

Xcm2kg converts concept maps from IHMC CmapTools XCM format to KeyGraph, a graph user interface format based on TouchGraph.

GXL is used as an intermediate format, making the conversion framework extensible.

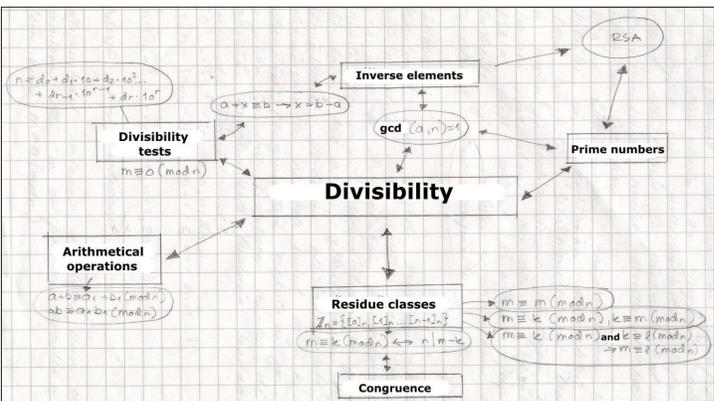
Xcm2kg's purpose is to simplify concept map authoring and web publishing, especially in the mathematics domain – both for learning material and general description of mathematical content.

While being a simple converter and a prototype, it integrates CmapTools and KeyGraph in a natural way.

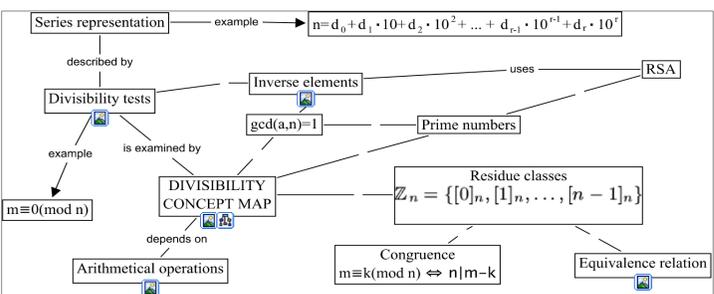
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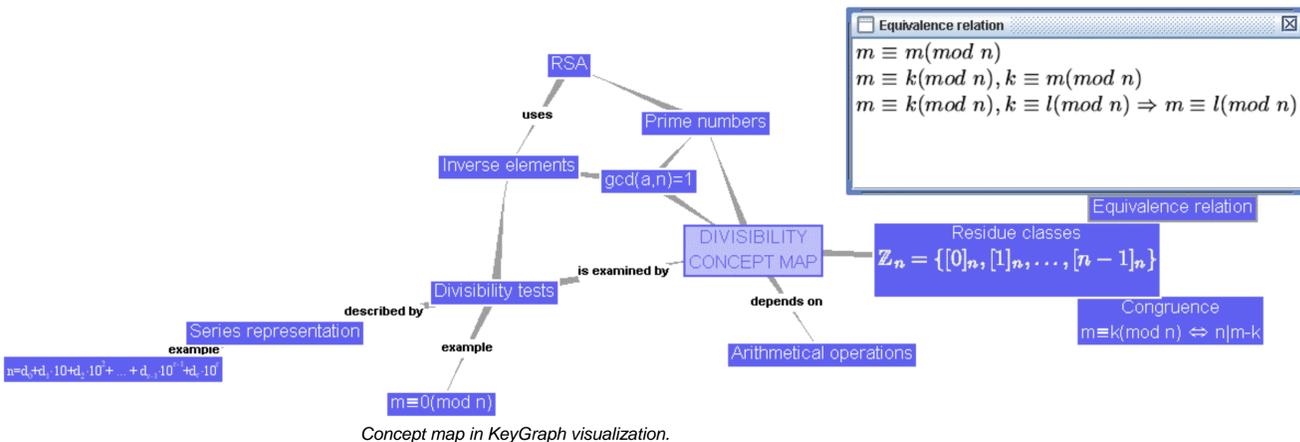
TRANSFORMATION EXAMPLE



Original, hand-drawn concept map (labels translated from Finnish) (Kujansuu, 2003).



Web page concept map generated by IHMC CmapTools.



Concept map in KeyGraph visualization.

