

## **GIS Learning Objects: Approach to Content Aggregation**

Michael Govorov

Advanced Diploma Program in GIS, Vancouver Island University, Nanaimo, BC, V9R5S5, Canada,

E-mail: govorovm@viu.ca

### **ABSTRACT**

The objectives of this study are to examine how to organize and implement learning components, and apply findings for content's modeling of the Geographic Information Science (GIS) courses developed by the author. Such organization and implementation of learning components have to support a discovery, update and reuse of shared content fragments in courses delivered in different academic programs.

### **OBJECTIVES**

The author took part in the development and delivery of more than dozen courses in GIS (VIU, 2010, UoT, 2010, Projektas "Lietuvos ...", 2007). These courses were developed for delivery in different institutions and for national educational programs in on-line, face-to-face or blended delivery modes. The courses were built into a virtual learning environment by using a learning activities management system such as Moodle, Blackboard, or WebCT.

For courses' design, same content fragments were re-used to design lessons, which were included in different courses. Thus, few times in a year, the courses and their lessons have to be updated before a delivery. An issue occurs how to maintain consistency of courses' lessons, which include shared fragments, in different courses. The objective of this study is to examine aspects of organization and implementation of shared learning components (LC), and apply findings for content modeling of the GIS courses developed by the author.

### **LEARNING CONTENT PYRAMID OF THE GIS COURSES**

Different aspects of learning object's (LO) content modeling for instructional design and software engineering were intensively researched during the last decade in academic studies and industrial projects (Wiley, 2006, Wagner, 2002, Dodds, 2001 etc.). The review of studies related to instructional design based on learning objects may bring a discomfort in understanding what learning objects are. In spite of such statements as "whether learning objects are dead or not" (Wiley, 2006), many constructive methodological aspects and technological components of the LO modeling were developed, and which can be applied for LO organization of the GIS courses.

In this paper, mutated LO, which can be re-purposed, changed and re-used, are considered as components of courses' content organization. These objects can be active or passive (Mills, 2009), and can be represented in various media formats (Barrit, 1999). However, the main interest in this study is textual content's component, which is exposed to frequent modifications, can be used in different lessons and therefore its modifications should be synchronized within different courses.

Analysis of the main learning object content models, such as the Learnativity content model (Wagner, 2002), the ADL academic co-lab model (Brown, 2002), the SCORM content aggregation model (Dodds, 2001), the CISCO Reusable Learning Object (RLO)/Reusable Information Objects (RIO) model (Barrit, 1999), the IEEE LTSC LOM aggregation metadata model (IEEE, 2010) etc., shows that a LO content model can be represented as a pyramid, which consists of aggregation learning components levels or levels of functional granularity.

The developed GIS related courses include a course introduction module, a series of weekly modules (or lessons), exam modules, and course wrap-up/review module. Typical structure of weekly module is shown in Figure 1. It may include links to learning components such as a lecture text-document, topic learning activities (Figure 2), lab assignment document etc.

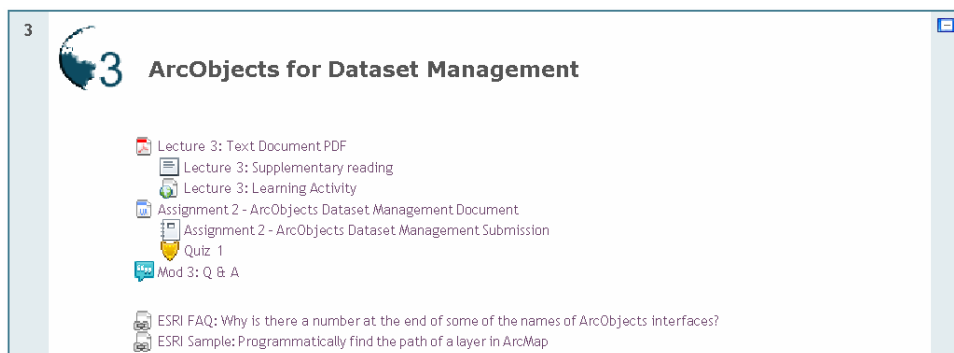


Figure 1: Weekly Module 3 from GIS Programming course



Check Your Understanding!!

Before you continue, why not check your understanding of what you have just learned.

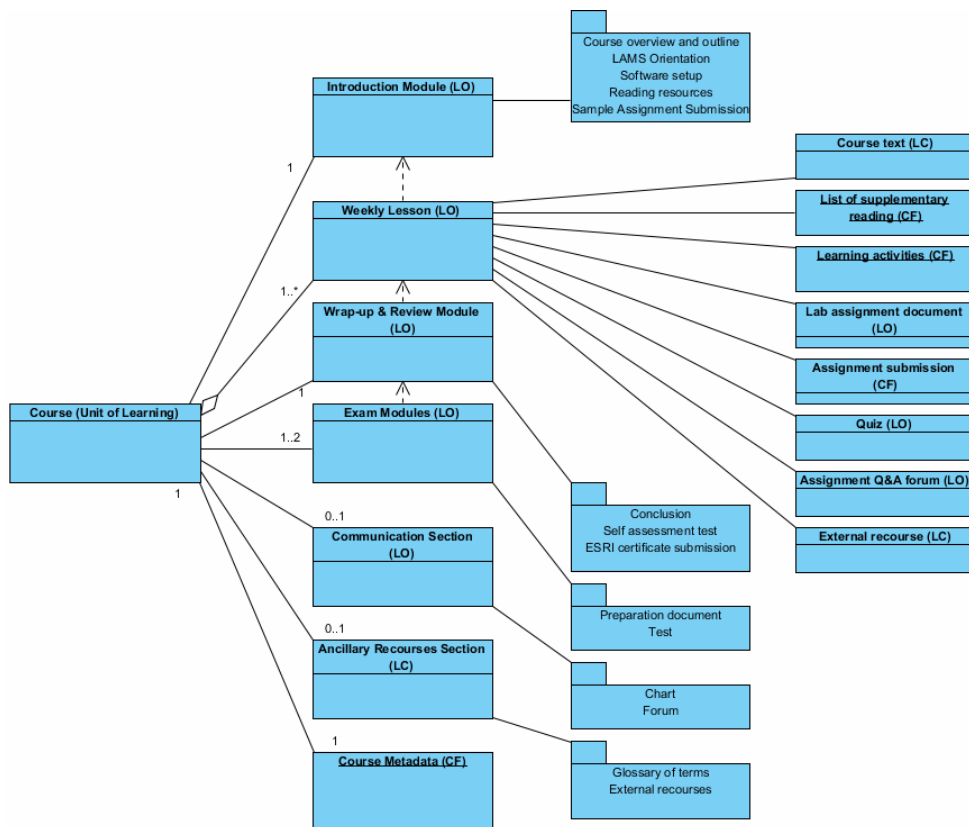
Match the code lines on the left with the respective comment on the right:

Code Lines	Comment
'Declare variables to pointer at specific ArcObjects	'Comment
Dim pFeatureLayer as IFeatureLayer Set pFeatureLayer = pMap.Layer(2)	'Get reference to a specific layer
Dim pFeatureClass as IFeatureClass Set pFeatureClass = pFeatureLayer.FeatureClass	'Get pointer to the current ArcMap document (.MXD)
Dim pMxdDoc as IMxdDocument Set pMxdDoc = ThisDocument	'Get reference to the data source (feature class) for the current layer
Dim pWorkspace as IWorkspace Set pWorkspace = pWorkspaceFactory.OpenFromFile("c:\geog531", 0)	'Get the Workspace for the class
Dim pMap as IMap Set pMap = pMxdDoc.FocusMap	'Get the IDataset interface for the feature class
Dim pDataset as IDataset Set pDataset =	'Get pointer to the current dataframe

Continue

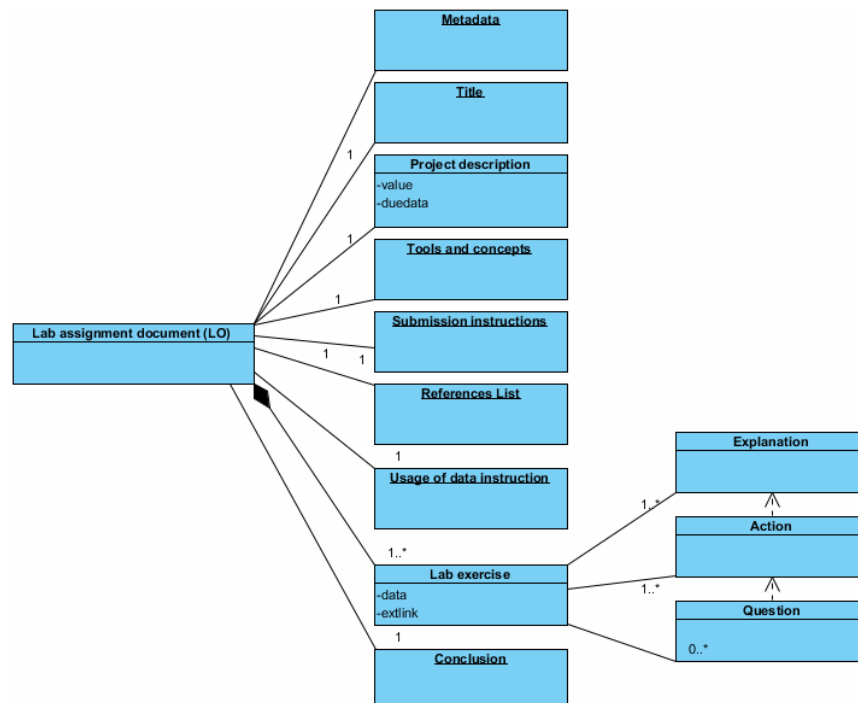
Figure 2: Check Your Understanding activity from Module 3 of GIS Programming course

UML object model diagrams were used to formalize and visually present the proposed structure of GIS courses' content pyramid. Figure 3 shows the class model diagram of abstract learning components (LC) of developed course.



**Figure 3:** Class diagram (including the packages) of abstract components (LO and LC) and Content Fragments (CF) instances of the GIS Programming course

Next, the abstract learning components were granulated into content fragments. Figure 4 illustrates the structure of CF's instances of lab assignment notes from the GIS Programming course. It was assumed that there are no overlaps among related context fragments.



**Figure 4:** Object diagram of the CF instances of lab assignment notes for the GIS Programming course

## IMPLEMENTATION OF THE LEARNING CONTENT PYRAMID

Few concepts from the learning object packaging and learning object metadata specifications (SCORM, 2004, IMS, 2009, IEEE, 2010) were considered and used to implement a prototype of the proposed learning content pyramid. The main concepts are:

- CF have to include not only “pure” contents (e.g., plain text), but also formatting elements of content media;
- A package of LC has to include information on structural content organization of LC and LF;
- A package of LC have to be associated with metadata, which are describing the content package as a whole, and at the same time, each package’s component have to have their own metadata.

A prototype of the learning component pyramid was designed in the form of database with metadata repository. The following steps of design and implementation were accomplished:

- UML CASE tool was used to design a schema of an object model diagram for one course. This diagram was saved as a template and reused to model other courses.
- The courses’ model schemas were converted into XML Metadata Interchange (XMI) files.
- The XMI files were used to created database schemas in a propriety database.
- Instances of CF were prepared as a set of data files, which contain chunks of formatted text of instructional, assessment, and communication documents, as well as other multimedia contents.
- The files with CF were uploaded into the respective instances of LO database. Large object’s data types (BLOB and CLOB) were used to store the files with fragments.

- The metadata repository was generated for the LO database. The metadata elements from the IEEE LOM standard were used to describe the LC and LF.
- A custom user interface was implemented to search, discover, manage, and generate lessons from LO, CO and CF.

This implementation approach of the learning content pyramid is cumbersome, but can be used to automate management of proposed GIS LO content pyramid.

## CONCLUSIONS AND FUTURE WORK

Development of specialized tools is required in order to implement a flexible architecture of integrated LO database including a metadata repository, which can enable on-the-fly search and discovery LC and the aggregation of them into lessons. Such tools may inherit the functionality of document management systems, which provide discovery, storage, versioning, metadata creation and support, security, indexing, and retrieval capabilities to manage electronic documents. At the same time, such tools have to support GUI that implements the visual management of learning objects in the form of model object diagram. CF can be implemented as object's instances with data and code members that support updating of content fragment elements. Thus, the most frequent changeable elements (or data members) of content fragment can be updated directly from the GUI without use of external media editors. In addition, a content fragment object may support few objects' interfaces.

## REFERENCES

- Barrit, C., Lewis, D., and Wieseler, W., 1999 CISCO Systems Reusable Information Object Strategy Version 3.0.  
[http://www.cisco.com/warp/public/779/ibs/solutions/learning/whitepapers/el\\_cisco\\_rio.pdf](http://www.cisco.com/warp/public/779/ibs/solutions/learning/whitepapers/el_cisco_rio.pdf).
- Brown J., 2002 Academic ADL Co-lab: <http://www.adlnet.org>.
- Dodds, P., 2001 Advanced Distributed Learning Sharable Content Object Reference Model Version 1.2. The SCORM Content Aggregation Model: <http://www.adlnet.gov/Technologies/scorm/SCORMSDocuments/2004%204th%20Edition/Overview.aspx>.
- IEEE Learning Technology Standards Committee (LTSC), 2010: <http://www.ieeeltsc.org:8080/Plone>.
- IMS specifications, 2009: <http://www.imsglobal.org/specifications.html>.
- Mills, S., 2009 Learning about Learning Objects with Learning Objects, AliveTek, Inc.: [http://www.alivetek.com/learningobjects/site\\_paper.htm](http://www.alivetek.com/learningobjects/site_paper.htm).
- Projektas "Lietuvos geografinės informacijos valdytojų kvalifikacijos kėlimas", 2007: <http://www.gismokymai.lt/>.
- SCORM 2004: <http://www.adlnet.gov/Technologies/scorm/SCORMSDocuments/2004%204th%20Edition/Documentation.aspx> <http://www.scorm.com/>.
- University of Toronto, 2010 Certificate in GIS for Environmental Management: <http://learn.environment.utoronto.ca/distance-education/programs/certificate-in-gis-for-environmental-management.aspx>.
- Vancouver Island University, SDI and ADGISA, 2010 Course Descriptions: <http://www.viu.ca/sdi/courses.asp> and <http://www.mala.ca/adgisa/courses.asp>.
- Wagner, E. D., 2002 Steps to Creating a Content Strategy for Your Organization. The e-Learning Developers' Journal.
- Wiley, D., 2006 RIP-ping on learning objects: <http://opencontent.org/blog/archives/230>.