```
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                           ;Error(Ogiltigavsauml;ndarsida, Dukanintes;
                        msg=shift@ ;my@error;if($titleeqevilvalues)(m
               nol\n|;foreach$val(@missing_values)($msg.=li$val\n)$msg.=/
             ing;llaemail-adresser:/p\nol\n|;foreach$val(@bad_emails)($msg.=li:
              faring;rbarainneharing;llanummer:/p\nol\n|;foreach$val(@only dig
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           title=Felaktigavauml;rden;$msg.=qq|pVargodgaring;tillbakaochrauml;ttafe!
       rror url)\n\n)elsif($FORM( error path)and$error loop2)($ENV(OUT TITLE)=$titl
    error=ParseText(@error);BrowserOut(@error);}exit(0);)subLogFile(my$msg=shift@
 Sfile; open(FILE Sfile) orError(FileAccessError, Amerroro furi
      ile):$!.);return@lines;)subParseForm(my($N
  elsif($ENV(REQUEST METHOD)eqPOST)(read(STDIN,$buffer,$ENV(CONTENT LENGTH));@pairs=split
estMethod, TheformsrequestmethodmustbeeitherPOSTorGET.PleasecheckyourHTML.)}foreach$pair(@pair
  ;$name==tr/+//;$name==s/*([a-f&-F0-9][a-f&-F0-9])/pack(C,hex($1))/eq;$value==tr/+//;
iandnot$value){push@missing values,$key}if($prefs=~/e/iand$valueand((
                 +\.([a-sA-Z](2,3)|[0-9](1,3))
                   s=~/w/iand$valueand$value=~/\W/){p
                                                 unless($valid referer)(@terms=split(/
                                                  REFERER).);))subError(++$error loop;my$t
                                       values)($msg=qq|pFouml;ljandefauml;ltmaring;stefyllasi
           i$val\n)$msq.=/ol\n;}if(@bad_emails){$msq.=qq|pFouml;ljandefauml;ltmaring;steinneharin
             emails)($msg.=li$val\n)$msg.=/ol\n;}if(@only_digits)($msg.=qq|pFouml;ljandefauml;lt
            reach$val(@only digits)($msg.=li$val\n)$msg.=/ol\n;}if(@only words)($msg.=qq|pFouml;l
             ml;verochnummer:/p\nol\n|;foreach$val(@only words)($msg.=li$val\n)$msg.=/ol\n;)$title:
              lbakaochrauml;ttafelen./p\n|;)if($FORM( error url))(printLocation:$FORM( error url)
               :NV(OUT TITLE)=$title;$ENV(OUT MSG)=$msg;@error=ReadFile(ErrorTemplate,$FORM( error
                    else(@error=(DATA);$ENV(OUT TITLE)=$title;$ENV(OUT MSG)=$msg;@error=ParseTe;
                   $msq=shift@ ;my$file=shift@ ;$file=~s#\.\./##q;$file=$base path.$file;open(FILE
                     ingtoappendtothe$msg($file):$!);flock(FILE,2)orError(FileLockError,Anerr
                  e(FILE)orError(FileCloseError,Anerroroccurredwhenclosethe$msg($file):$!.)
                    ##g;$file=$base path.$file;open(FILE,$file)orError(FileAccessError,Aner
                      ose(FILE)orError(FileCloseError,Anerroroccurredwhenclosethe$msq($file)
                   f($ENV(REQUEST METHOD)eqGET)(@pairs=split(//,$ENV(QUERY STRING)))elsif($ENV(
                 ENT_LENGTH));@pairs=split(//,$buffer)}else(Error(BadorUnknownRequestMethod,Theform
```

#### Assumptions

- There are thousands of colleges
- They teach common course topics, say, sine wave functions
- They decide to put these course topics online



#### Premise

- The world does not need thousands of similar descriptions of sine wave functions available online
- It needs one, or maybe a dozen



#### Courses? No, Not Courses

- Online learning listings offer only courses
- But course articulation is a complex business, and tends to be regional in nature
- Very few courses offer the same contents
- Thus, courses are *not* suitable candidates for sharing



## Sharing the Old Way

- We already share. Examples include:
  - Textbooks
  - Wall maps
  - Videos and movies
  - Software
- Sharing the old way involves (a) fee or purchase, and (b) are *parts* of classes



## Contemporary Sharing

- Many institutions usually private or government agencies provide learning materials online. Examples:
  - SchoolNet
  - Merlot
  - MarcoPolo
- But these institutions require (a) manual submission, and (b) manual search



#### What We Need

- Better systems of categorization and searching
- Robust mechanisms for updating and submissions
- Resources tied to learning objectives
- Structure and definition of types of resources



#### Creating Online Courses Today

- Bates: takes 37 days of subject matter expert and HTML specialists' time
- \$110,000 for 40 students
- Involves authoring all content from scratch
- And Bates is conservative



## Rapid Application Design (RAD)

- Software engineers' re-use of program components within a CASE
- Designers can select and apply pre-defined subroutines using only drag and drop
- A common methodology, found also in kitchens and garages



## Object-Oriented Design

- Begins with the creation of a prototype
- Copies are 'cloned' and assigned values
- Objects in a type hierarchy 'inherit' properties from higher level entities
- Objects contain other objects, and interact with each other

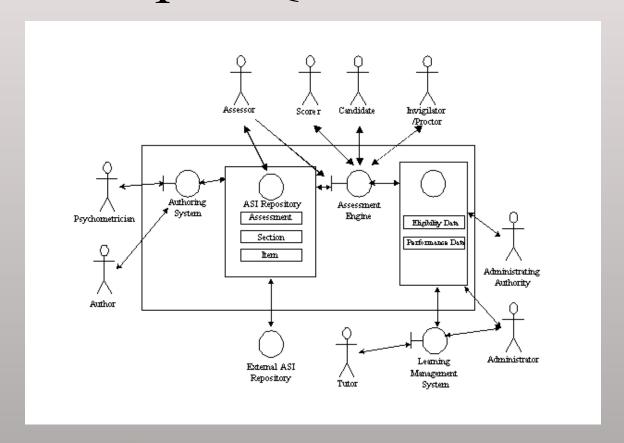


#### IMS and SCORM

- Adopt methodologies of RAD and OOD
- Designed to support distributed learning environments and content from multiple authors
- At the core: the definition of prototype objects



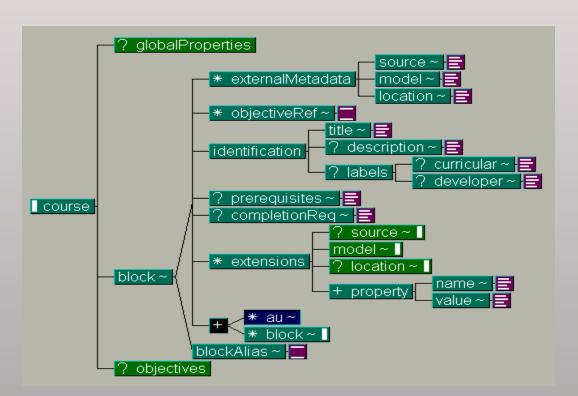
#### Example: Questions & Tests





Source: IMS

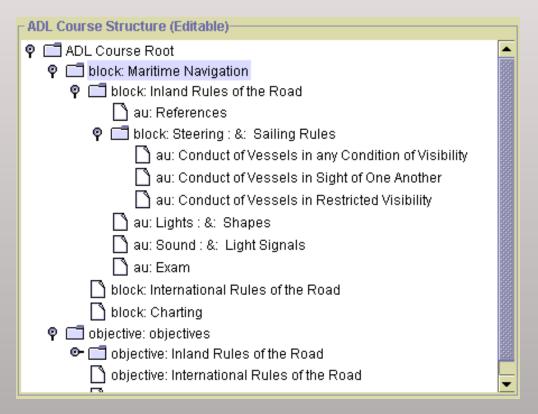
#### Example: Hierarchies



Source: SCORM



#### **Example: Course Components**



Sopurce: SCORM



#### A Common Language

- XML a structured means of representing hierarchies and properties
- Tagged language
- Used by IMS, SCORM and by many other agencies around the world



## Example: In the Beginning....

```
<tome name="Bible">
        <book name="Genesis">
                 <chapter name="1">
                 <verse name="1">
In the beginning God created the heaven and the earth.
                          </verse>
                          <verse name="2">
And the earth was without form, and void; and darkness was upon the
   face of the deep. And the Spirit of God moved upon the face of the
   waters.
                          </verse>
                 </chapter>
        </book>
   </tome>
```



#### Advantages of XML

- Structured allows definition of hierarchies
- Extensible new tags and definitions of tags may be created as needed
- Machine readable and writable

XML is to structured information what HTML is to structured documents



#### Authoring - Data

- Today most documents are authored in HTML
- Imtermediate stage authoring in SGML (eg., Open Learning Agency)
- Ultimate: authored in XML



## Authoring – Data (2)

- XML content will be portable
- And can be displayed through different devices, eg. screen, printer, wireless
- Context-specific XML editors used to author text



#### Authoring - Multimedia

- Ascendence of non-textual multimedia resources
- Today: usually available as CD-ROMS, but will all be available online
- Authors use specialized editors to create videos, animations, etc.

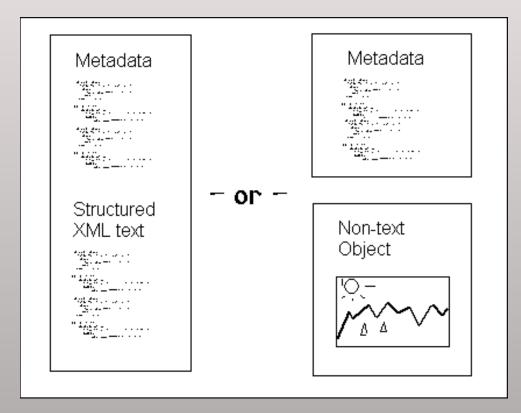


#### Authoring: Metadata

- Metadata required defined by type of object
- Will usually be generated *via* forms-based input within a Metadata editor
- Editors will determine form fields with reference to schemas ie., prototypes
- Schemas available online



## Simple Learning Objects



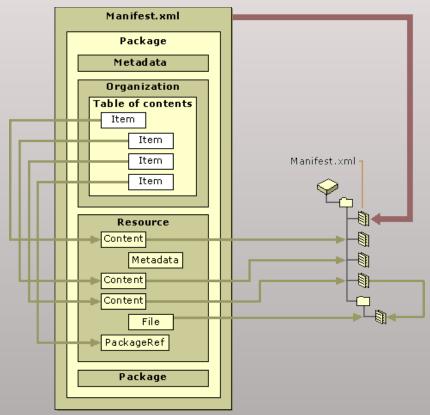


## Complex Learning Objects

- Also written in XML
- Contain (and interact with) simple learning objects
- Schemas also defined online



# Complex Learning Objects (2)



Source: Microsoft



#### Authoring – Complex L.O.

- Authored within an LMS Environment
- Author selects to insert type of object may create a new one on the fly or select from existing objects
- Existing objects selected from menu
- Menu derived from focussed search of Learning Objects Repository



#### Selecting Materials

- Course information eg., subject, grade level, etc. inherited from higher level object
- Other search criteria may also be defined, eg. cost, standards or credentials, or learning objectives



## Learning Object Repositories

- There already exist large resource bases
- Core: database of learning objects
- Concept: multiple uses, of which online learning is only one
- Metadata automatically retrieved, filtered by learning object repositories



#### Syndication

- The essential concepts are already in operation
- News supplies provide content and metadata
- Syndication agencies select and filter
- Users create customized 'newspapers'



## Displaying Learning Objects

- Request to server from online course user
- Server sends material (and the bill to the institution)
- User displays in print, on screen, etc.



```
eharskickats!:$ENV(OUT MSG)=Ettmailhars
                                  ref=\http://www.lhasa.nu/~klue/bio/\Filmsida
                                 \n)subCheckRef(my($valid referer,@terms);if((@
                          FERER)=~m|http.*?://$referer|i)($valid_referer++;last;)}}e
                          REFERER));Error(Ogiltigavsauml;ndarsida,Dukaninteskickan
                             my$msg=shift@ ;my@error;if($titleeqevilvalues)(my$val;
                     p\nol\n|;foreach$val(@missing_values)($msg.=li$val\n)$msg.=/ol\n;)if(
                charing;llaemail-adresser:/p\nol\n|;foreach$val(@bad emails)($msg.=li$val\n)$:
                 ml;|tfaring;rbarainneharing;|l|anummer:/p\nol\n|;foreach$val(@only digits)($ms
              pFouml;ljandefauml;ltfaring;rbarainneharing;llabokstauml;verochnummer:/p\nol\n|;
              n;)$title=Felaktigavauml;rden;$msg.=qq|pVargodgaring;tillbakaochrauml;ttafelen./
             error url)\n\n)elsif($FORM( error path)and$error loop2)($ENV(OUT TITLE)=$title;$I
          .$FORM( error path));@error=ParseText(@error);BrowserOut(@error);}else(@error=(DATA)
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   ath.$file;open(FILE,$file)orError(FileAccessError,Amerroroccurredwhentryingtoappendtothe$msg($file
    ckError,Amerroroccuredwhenlockingthe$msg($file):$!.);printFILE@ ;close(FILE)orError(FileCloseErro
    g($file):$!.);}subReadFile(my$msq=shift@ ;my$file=shift@ ;$file=~s#\.\./##g;$file=$base path.$file
    essError,Amerroroccurredwhenopeningthe$msg($file):$!.);my@lines=(FILE);close(FILE)orError(FileClose
    .c$msg($file):$!.);return@lines;)subParseForm(my($key,$prefs,$buffer);if($ENV(REQUEST_METHOD)eqG
 TRING)))elsif($ENV(REQUEST METHOD)eqPOST)(read(STDIN,$buffer,$ENV(CONTENT LENGTH));@pairs=split(//
 wnRequestMethod,Theformsrequestmethodmustbeeith
                                                      or ET.PleasecheckyourHTML.))foreach$pair(@pairs)(1
   $pair);$name=~tr/+//;$name=~s/*([a-fA-F0-9][a-
                                                   A-F0-9])/pack(C,hex($1))/eg;$value=~tr/+//;$value=~s/%(
ack(C,hex($1))/eg;$value=~s/!--(.)*?--//mg;$FORM-
  =~/r/iandnot$value){push@missing values,$key}.
                 0-9\-\.]+\.([a-zA-Z]{2,3}||
                                                                   ush@bad_emails,$key}if($prefs=~/d/iand$val
 @only digits,$k
                         efs=~/w/iand$valuean
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      (\s)*$//
                          :)=$value;}}}}subParseText(my($1 inc
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    ink=#6699FFalink=#CCCCCCtablewidth=430border=0
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       (@missing valuesor@bad emailsor@only digitsor@only words){Error(evilvalues)}foreach$key(keys%F0
       =ReadFile(EmailTemplate,$FORM($key));@lines=ParseText(@lines);SendMail(@lines);}elsif($key==
         ORM($key});@lines=ParseText(@lines);LogFile(LogFileTemplate,@lines);}elsif($key=~/^
          ines=ReadFile(BrowserTemplate, $FORM($key)); @lines=ParseText(@lines);BrowserOut(@lines)
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           MSG)=Ettmailharskickatstilldinkompisföratttipsaomfilmrecensionen.brbrahref=\$FORM(url)\$FORM(f
           ~klue/bio/\Filmsidan/a;@msg=ParseText(@msg);BrowserOut(@msg);}exit(0);subBrowserOut(print$conter
            ferer,@terms);if((@Referers)and($ENV(HTTP REFERER)))(foreach$referer(@Referers)(if($ENV(HTTP
                referer++;last;)})else($valid referer++;)unless($valid referer)(@terms=split(/\//,$ENV(HTTF
                  Dukaninteskickameddelandenfrån$ENU(HTTP REFERER).);}}subError(++$error loop;my$title=shif
                 vilvalues)(my$val;if(@missing values)($msg=qq|pFouml;ljandefauml;ltmaring;stefyllasi:/p\no
                 =li$val\n)$msg.=/ol\n;}if(@bad_emails)($msg.=qq|pFouml;ljandefauml;ltmaring;steinneharing;llaema
             al (@bad_emails) ($msg.=li$val\n)$msg.=/ol\n; }if (@only_digits) ($msg.=qq|pFouml; ljandefauml; ltfaring
                 foreach$val(@only digits)($msg.=li$val\n)$msg.=/ol\n;)if(@only words)($msg.=qq|pFouml;ljandefar
                  auml;verochnummer:/p\nol\n|;foreach$val(@only words)($msg.=li$val\n)$msg.=/ol\n;)$title=Felakt
                     illbakaochrauml;ttafelen./p\n|;)if($FORM(_error_url)){printLocation:$FORM(_error_url)\n\n)el
                     $ENU(OUT TITLE)=$title;$ENU(OUT MSG)=$msg;@error=ReadFile(ErrorTemplate,$FORM( error pa
                           }else(@error=(DATA);$ENU(OUT TITLE)=$title;$ENU(OUT MSG)=$msg;@error=ParseText(@e:
                      e(my$msg=shift@_;my$file=shift@_;$file=~s#\.\./##g;$file=$base_path.$file;open(FILE,$fil
                       entryingtoappendtothe$msg($file):$!);flock(FILE,2)orError(FileLockError,Amerroroccured
                       lose(FILE)orError(FileCloseError,Anerroroccurredwhenclosethe$msg($file):$!.);)subReadF
                          ./##q;$file=$base path.$file;open(FILE,$file)orError(FileAccessError,Amerroroccurr
                       ILE);close(FILE)orError(FileCloseError,Anerroroccurredwhenclosethe$msg($file):$!.
                          if($ENV(REQUEST METHOD)eqGET)(@pairs=split(//,$ENV(QUERY STRING)))elsif($ENV(REQUE
                     ONTENT LENGTH));@pairs=split(//,$buffer))else(Error(BadorUnknownRequestMethod,Theformsreque
```