Chapter III

Topic Maps
Topic Maps

- ISO standard (ISO/IEC 13250) for an implementation-independent representation of knowledge about resources, their subjects and interrelationships
- Topic maps consist of topics (concepts), associations (relationships) and occurrences (relevant information resources)
- As opposed to RDF that aims at machine-processable metadata, topic maps are used to structure knowledge for human readers, with an emphasis on the findability of information
- Stem from glossaries, classification systems and thesauri, but provide more expressiveness
- Can be used to develop ontologies which may be even mapped to RDF, but are not part of the semantic web effort of the W3C
Fundamental Concepts

- **topic** -> fundamental entity in the context of the modeled knowledge domain
- **topic name** -> topic identifier (base name, display name and sort name)
- **topic occurrence** -> instances and roles (occurrence role type)
- **public subject descriptor** -> unique topic descriptor
- **associations** -> relationships between topics and their roles (association role)
- **scope** -> specifies the extent of the validity
- **facet** -> attribute-value-pair that describes a topic in more detail
Topic Maps – Example (I)
Topic Maps – Example (II)
Topic Maps – Example (III)
Topic Maps – Example (IV)

- Homepage
- Person
- Work
- Author
- Publication
- Publisher
- Publishing
- XML Recommendation
- World Wide Web Consortium
- Standards body
- Tim Bray
- Authorship
- Instance-of
- Is-author-of
- Role: work
- Role: author

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Topic Maps – Example (V)
Topic Maps – Example (VI)
Topic Maps – Example (VII)

URI

Homepage
Author
Authorship

Person
Publication
Publishing

Work
Publisher

occurrence

XML Recommendation
Standards body

World Wide Web Consortium

Tim Bray
Standard
Topic Maps – Example (VIII)

URI

instance-of

Homepage

Author

Authorship

Work

Person

Publication

Publishing

Standard

XML Recommendation

Publisher

Standards body

Tim Bray

World Wide Web Consortium
Topic Maps – Example (X)
Topic Maps – Example (XI)
Topic Maps – Example (XII)
Topic Maps – Example (XIII)
XTM – XML Topic Maps

- are an abstract model and XML grammar for the exchange of web-based topic maps created by the TopicMaps.Org Authoring Group (2001)

- design goals:
  - ease of use
  - support for a wide range of applications
  - standards compatible
  - ideally no optional features
  - short and concise specification
  - XTM documents shall be easy to create, read and understand
XTM Syntax Overview (I)

- **topicRef**: reference to a topic element
- **subjectIndicatorRef**: reference to a subject indicator
- **scope**: reference to topic(s) that comprise the scope
- **instanceOf**: points to a topic representing a class
- **topicMap**: topic map document element
- **topic**: topic element
- **subjectIdentity**: subject reified by topic
- **baseName**: base name of a topic
- **baseNameString**: base name string container
- **variant**: alternate forms of base name
XTM Syntax Overview (II)

- `variantName`: container for variant name
- `parameters`: processing context for variant
- `association`: topic association
- `member`: member in topic association
- `roleSpec`: points to a topic serving as an association role
- `occurrence`: resources regarded as an occurrence
- `resourceRef`: reference to a resource
- `resourceData`: container for resource data
- `mergeMap`: merge with another topic map
XTM - topicRef

- **Synopsis:**
  - The `<topicRef>` element provides a URI reference to a topic. The target of a `<topicRef>` link must resolve to a `<topic>` element child of a `<topicMap>` document that conforms to this XTM specification. The target `<topic>` need not be in the document entity of origin.

- **Content Model:**
  - `<!ELEMENT topicRef EMPTY>`

- **Attributes:**
  - `<!ATTLIST topicRef`
    - `id ID #IMPLIED`
    - `xlink:type NMTOKEN #FIXED 'simple'`
    - `xlink:href CDATA #REQUIRED>`

- **Example:**
  - `<topicRef xlink:href="http://www.topicmaps.org/xtm/1.0/language.xtm#en"/>"
XTM - subjectIndicatorRef

• Synopsis:
  – The `<subjectIndicatorRef>` element provides a URI reference to a resource that acts as a subject indicator.

• Content Model:
  – `<!ELEMENT subjectIndicatorRef EMPTY>`

• Attributes:
  – `<!ATTLIST subjectIndicatorRef`
    id ID #IMPLIED
    xlink:type NMTOKEN #FIXED ‘simple’
    xlink:href CDATA #REQUIRED>

• Example:
  – `<subjectIndicatorRef`
    xlink:href="http://www.shakespeare.org/plays.html#hamlet"/>
XTM - scope

• Synopsis:
  - The `<scope>` element consists of one or more `<topicRef>`, `<resourceRef>`, or `<subjectIndicatorRef>` elements. The union of the subjects corresponding to these elements specifies the context in which the assignment of the topic characteristic is considered to be valid.

• Content Model:
  - `<!ELEMENT scope (topicRef | resourceRef | subjectIndicatorRef)+>`

• Attributes:
  - `<!ATTLIST scope
    id ID #IMPLIED>`

• Example:
  - `<scope>
    <topicRef xlink:href="#tragedy"/>
    <topicRef xlink:href="#theatre"/>
  </scope>`
XTM - `instanceOf`

- **Synopsis:**
  - The `<instanceOf>` element specifies the class to which its parent belongs, via a `<topicRef>` or `<subjectIndicatorRef>` child element.

- **Content Model:**
  - `<!ELEMENT instanceOf (topicRef | subjectIndicatorRef) >`

- **Attributes:**
  - `<!ATTLIST instanceOf id ID #IMPLIED>`

- **Example:**
  - `<topic id="hamlet">
    <instanceOf>
      <subjectIndicatorRef xlink:href="http://www.shakespeare.org/plays.html"/>
    </instanceOf>
  </topic>`
XTM – topicMap (I)

• Synopsis:
  – The <topicMap> element is the parent of all <topic>, <association>, and <mergeMap> elements in the topic map document.

• Content Model:
  – <!ELEMENT topicMap (topic | association | mergeMap)*>  

• Attributes:
  – <!ATTLIST topicMap
    id ID #IMPLIED
    xmlns CDATA #FIXED 'http://www.topicmaps.org/xtm/1.0/'
    xmlns:xlink CDATA #FIXED 'http://www.w3.org/1999/xlink'
    xml:base CDATA #IMPLIED>
XTM - topicMap (II)

- Example:
  
  ```xml
  <?xml version="1.0"?>

  <!DOCTYPE topicMap
    PUBLIC "-//TopicMaps.Org//DTD XML Topic Map (XTM) 1.0//EN"
    "file://usr/local/home/gromit/xml/xtm/xtm1.dtd">

  <topicMap xmlns='http://www.topicmaps.org/xtm/1.0/'
    xmlns:xlink='http://www.w3.org/1999/xlink'
    xml:base='http://www.shakespeare.org/hamlet'/>

  <!-- topics, associations, and merge map directives go here -->

  </topicMap>
  ```
XTM - topic

- **Synopsis:**
  - The `<topic>` element specifies the name and occurrence characteristics of a single topic.

- **Content Model:**
  - `<!ELEMENT topic (instanceOf*, subjectIdentity?, (baseName | occurrence)*)>`

- **Attributes:**
  - `<!ATTLIST topic
      id ID #REQUIRED>`

- **Example:**
  - `<topic id="hamlet">
      <instanceOf>
        <topicRef xlink:href="#play"/>
      </instanceOf>
    <!-- base names and occurrences go here -->
  </topic>`
XTM - subjectIdentity

- **Synopsis:**
  - The `<subjectIdentity>` element specifies the subject that is reified by a topic, via `<resourceRef>`, `<subjectIndicatorRef>`, and/or `<topicRef>` child elements.

- **Content Model:**
  - `<!ELEMENT subjectIdentity (resourceRef?, (topicRef | subjectIndicatorRef)*)>`

- **Attributes:**
  - `<!ATTLIST subjectIdentity id ID #IMPLIED>`

- **Example:**
  - `<topic id="dk">
    <subjectIdentity>
      <subjectIndicatorRef>
        xlink:href="http://www.topicmaps.org/xtm/1.0/country.xtm#dk"/
      </subjectIndicatorRef>
    </subjectIdentity>
  </topic>`
XTM - baseName

- **Synopsis:**
  - The `<baseName>` element specifies a topic name in form of a `<baseNameString>` child element.

- **Content Model:**
  - `<!ELEMENT baseName (scope?, baseNameString, variant*)>`

- **Attributes:**
  - `<!ATTLIST baseName`  
    `id ID #IMPLIED>`

- **Example:**
  ```xml
  <topic id="shakespeare">
    <baseName>
      <baseNameString>William Shakespeare</baseNameString>
    </baseName>
  </topic>
  ```
XTM – **baseNameString** (I)

- **Synopsis:**
  - The `<baseNameString>` element is a string that represents the base name of its ancestor `<topic>` parent.

- **Content Model:**
  - `<!ELEMENT baseNameString (#PCDATA)>`

- **Attributes:**
  - `<!ATTLIST baseNameString id ID #IMPLIED>`
XTM – baseNameString (II)

• Example:
  - <topic id="written-by">
    <baseName>
      <baseNameString>written by</baseNameString>
      <topicRef xlink:href="#author"/>
    </scope>
    <baseNameString>author of</baseNameString>
  </baseName>
</topic>
XTM – variant (I)

• Synopsis:
  – The `<variant>` element is an alternate form of a topic’s base name appropriate for a processing context specified by the variant’s `<parameters>` child element. Among these contexts may be sorting and display.

• Content Model:
  – `<!ELEMENT variant (parameters, variantName?, variant*)>`

• Attributes:
  – `<!ATTLIST variant
id ID #IMPLIED>`
XTM – variant (II)

- Example:
  - `<topic id="shakespeare">
    <baseName>
    <baseNameString>William Shakespeare</baseNameString><!-- form for sorting (sort name) -->
    <!-- form for sorting (sort name) -->
    <variant>
    <parameters>
    <topicRef xlink:href="#sort"/>
    </parameters>
    <variantName>
    <resourceData>shakespeare,william</resourceData>
    </variantName>
    </variant>
    </baseName>
    </topic>
XTM - variantName

• Synopsis:
  – The <variantName> element provides the resource to be used as a variant of a base name.

• Content Model:
  – <!ELEMENT variantName (resourceRef | resourceData)>

• Attributes:
  – <!ATTLIST variantName
    id ID #IMPLIED>

• Example:
  – <variantName>
    <resourceData>shakespeare,william</resourceData>
  </variantName>
Synopsis:
- The `<parameters>` element consists of one or more `<topicRef>` or `<subjectIndicatorRef>` elements. The union of the subjects corresponding to these elements specifies an additional processing context in which variant names in the variant’s subtree are considered to be appropriate.

Content Model:
- `<!ELEMENT parameters (topicRef | subjectIndicatorRef)+>`

Attributes:
- `<!ATTLIST parameters id ID #IMPLIED>`
XTM – parameters (II)

- Example:
  - `<topic id="shakespeare">
        <baseName>
          <baseNameString>William Shakespeare</baseNameString><!-- form for sorting (sort name) -->
          <!-- form for sorting (sort name) -->
        </baseName>
        <variant>
          <parameters>
            <topicRef xlink:href="#sort"/>
          </parameters>
          <variantName>
            <resourceData>shakespeare,william</resourceData>
          </variantName>
        </variant>
    </topic>`
XTM - association (I)

- Synopsis:
  - The `<association>` element asserts a relationship among topics that play roles as members of the association.

- Content Model:
  - `<!ELEMENT association (instanceOf?, scope?, member+)>`

- Attributes:
  - `<!ATTLIST association id ID #IMPLIED>`
Example:

```xml
<association id="will-wrote-hamlet">
  <instanceOf>
    <topicRef xlink:href="#written-by"/>
  </instanceOf>
  <member>
    <roleSpec><topicRef xlink:href="#author"/></roleSpec>
    <topicRef xlink:href="#shakespeare"/>
  </member>
  <member>
    <roleSpec><topicRef xlink:href="#work"/></roleSpec>
    <topicRef xlink:href="#hamlet"/>
  </member>
</association>
```
Synopsis:
- The `<member>` element specifies all topics that play a given role in an association. The `<roleSpec>` element specifies the role played by these topics.

Content Model:
- `<!ELEMENT member (roleSpec?, (topicRef | resourceRef | subjectIndicatorRef)+)>`

Attributes:
- `<!ATTLIST member id ID #IMPLIED>`

Example:
```xml
<member>
  <roleSpec>
    <topicRef xlink:href="#work"/>
  </roleSpec>
  <topicRef xlink:href="#hamlet"/>
</member>
```
XTM - roleSpec

• Synopsis:
  – The <roleSpec> element specifies the role played by a member in an association.

• Content Model:
  – <!ELEMENT roleSpec (topicRef | subjectIndicatorRef)>

• Attributes:
  – <!ATTLIST roleSpec
       id ID #IMPLIED>

• Example:
  – <roleSpec>
    <topicRef xlink:href="#work"/>
  </roleSpec>
XTM – occurrence (I)

• Synopsis:
  – The `<occurrence>` element specifies a resource supplying information relevant to a topic.

• Content Model:
  – `<!ELEMENT occurrence (instanceOf?, scope?, (resourceRef | resourceData))>`

• Attributes:
  – `<!ATTLIST occurrence id ID #IMPLIED>`
XTM – occurrence (II)

- Example:
  - `<topic id="hamlet">
      <occurrence id="hamlet-in-xml">
        <instanceOf>
          <topicRef xlink:href="#xml-version"/>
        </instanceOf>
      </occurrence>
    </topic>`
Synopsis:
- The `<resourceRef>` element provides a URI reference to a resource:
  1. as occurrences of topics (in `<occurrence>` elements)
  2. as addressable subjects (in `<member>`, `<mergeMap>`, `<scope>`, and `<subjectIdentity>` elements)
  3. as variant names of topics (in `<variantName>` elements)

Content Model:
- `<!ELEMENT resourceRef EMPTY>`

Attributes:
- `<!ATTLIST resourceRef`
  id ID #IMPLIED
  xlink:type NMTOKEN #FIXED 'simple'
  xlink:href CDATA #REQUIRED>`
XTM – resourceRef (II)

- Example:
  - <occurrence id="hamlet-in-xml">
    <instanceOf>
      <topicRef xlink:href="#xml-version"/>
    </instanceOf>
  </occurrence>
XTM – resourceData (I)

- **Synopsis:**
  - The `<resourceData>` element contains information in the form of character data that may be
    - 1. an occurrence of a topic, or
    - 2. a variant form of a base name.

- **Content Model:**
  - `<!ELEMENT resourceData (#PCDATA)>`

- **Attributes:**
  - `<!ATTLIST resourceData`
    - `id ID #IMPLIED>`
• Example:
  
  - <topic id="hamlet">
    
    <occurrence>
      
      <instanceOf>
        
        <topicRef xlink:href="#date-of-composition"/>
        
      </instanceOf>
      
    </occurrence>
      
    <resourceData>1600-01</resourceData>
      
  </topic>
XTM – mergeMap (I)

• Synopsis:
  - A <mergeMap> element references an external <topicMap> element through an xlink:href attribute containing a URI. It is a directive to merge the containing topic map and the referenced topic map.

• Content Model:
  - `<!ELEMENT mergeMap (topicRef | resourceRef | subjectIndicatorRef)*>`

• Attributes:
  - `<!ATTLIST mergeMap
    id ID #IMPLIED
    xlink:type NMTOKEN #FIXED 'simple'
    xlink:href CDATA #REQUIRED>`
**Example:**

- `<mergeMap xlink:href="http://www.shakespeare.org/plays.xtm">`
  
  `<topicRef xlink:href="#shakespeare"/>`
  
  `<topicRef xlink:href="#drama"/>
  
  `</mergeMap>`

- `<mergeMap xlink:href="http://www.shakespeare.org/biography.xtm">`
  
  `<resourceRef xlink:href="http://www.shakespeare.org/biography.xtm"/>
  
  `</mergeMap>`
Resources

- XTM 1.0 specification
- XTM 2.0 draft
  - http://www.isotopicmaps.org/sam/sam-xtm/
- Topic Map Data Model
  - http://www.isotopicmaps.org/sam/sam-model/
- Topic Map Designer – free editor and graph viewer
  - http://www.topicmap-design.com/
- more tools
Summary

- **XML**
  - basics (syntax, structure, well-formedness, entities, namespaces, notations)
  - DTDs
  - XML schema
  - CSS, data binding, DOM, XSL and XSLT

- **Semantic Web**
  - basics, meta data, classification systems, taxonomies, thesauri
  - RDF and RDFS (RDF graph, RDF syntax, classes, resources, properties, objects)
  - Dublin Core
  - XBRL
  - Ontologies, OWL (basics, sublanguages, vocabulary)

- **Topic Maps and XTM** (basics, vocabulary)