Hamburg University of Science and Technology
Prof. Dr. Ralf Möller

28th July 2004

Written examination for the lecture Multimedia Content Management Systems in summer 2004.

Please fill in your name, student id, and the name of your curriculum. Note that readability is important.

Name:

Student Id:

Name of curriculum:

- At the end of the exam, please return all sheets including this one.
- If you receive additional pieces of paper from the supervisor, please write your name also on these pages, and add a page number.
- Please read every question carefully. Take care of the stated limitations for the length of your answer.
- You have 90 minutes for answering the questions.
- Additional resources are not allowed.

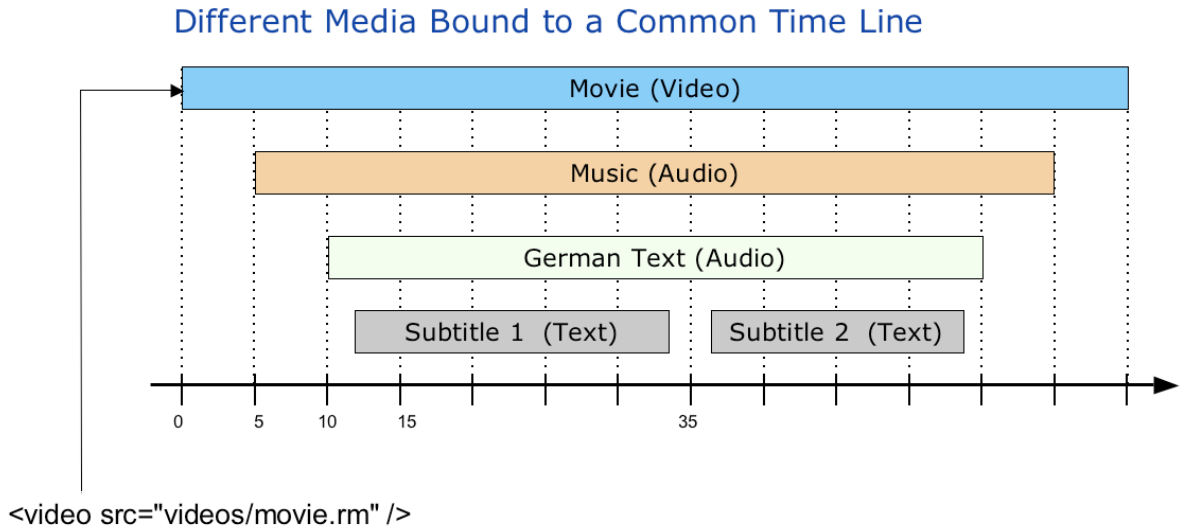
Good Luck!

Question 1 (12 points)

For synchronizing different media the language SMIL was discussed in the lecture. Briefly explain the main idea of how the synchronization is specified in SMIL.

How does SMIL compare to MPEG-4?

Let us consider a scenario with some media to be synchronized.



Correct the errors in the following SMIL specification for the media presentation scenario shown in the figure above:

```
<smil>
  <body>
    <vertical>
      <video src="videos/movie.avi" />
      <audio src="soundtracks/music.rm" begin="5s"/>
      <audio id="germ" src="rtsp://example.overdub.de/german.rm"
             begin="1s"/>
      <horizontal>
        <textstream src="rtsp://example.overdub.de/subtitles1.rt"
                    begin="40s"/>
        <textstream src="rtsp://example.overdub.de/subtitles2.rt"
                    begin="20s"/>
      </horizontal>
    </vertical>
  </body>
</smil>
```

Question 2 (4+4 points)

In order to deal with QoS specifications in multimedia systems, traffic shaping algorithms are used. Explain the main ideas of the leaky bucket and token bucket techniques.

Question 3 (10 points)

What is the purpose of ontologies in the context of metadata specifications for multimedia data?

For specifying ontologies, description logics were used as a theoretical foundation. Let us consider the following set of axioms (T-box).

$$\text{HUMAN} \sqsubseteq (\text{WOMAN} \sqcup \text{MAN})$$

$$\text{BROTHER} \equiv \text{MAN} \sqcap (\exists\ \textit{has-sibling}\ \text{HUMAN})$$

$$\text{PARENT} \equiv \text{HUMAN} \sqcap (\exists\ \textit{has-child}\ \text{HUMAN})$$

$$\text{UNCLE} \equiv \text{MAN} \sqcap (\exists\ \textit{has-sibling}\ \text{PARENT})$$

With $\sqsubseteq$ necessary conditions are indicated whereas with $\equiv$ necessary and sufficient conditions are specified.

For each of the names mentioned in the T-box, list the most specific concept names that subsume a concept name (parents). Draw a graph depicting the parent relation.

Question 4 (10 points)

Answering queries with reference to a T-box and an A-box involves certain basic assumptions.

What is meant with the Open World Assumption? You might want to discuss this using an example.

What is meant with the Active Domain Assumption with respect to the quantifiers used in retrieval queries?

Question 5 (10 points)

Multimedia data or metadata for multimedia data often contain two-dimensional regions. In this context, we have discussed 8 topological relations between two-dimensional regions. List and explain all of them. Are these relations also applicable to characterize topological relations between three-dimensional objects? Justify your answer.

Question 6 (10 points)

Explain the difference between compression with and without loss of data. Name two techniques for compressing still images, and briefly sketch the main ideas of the techniques. What is the reason for the development of additional compression techniques for video data (i.e., why are videos not compressed in a frame by frame way)?

Question 7 (20 points)

For efficiently answering many types of queries with respect to multidimensional data specific data structures were investigated. In particular, we have discussed k-d trees for determining whether a point is an element of a set of points.

Explain the k-d tree data structures and corresponding constraints on the values associated with tree nodes.

Sketch how the element test algorithm for points works on a k-d tree.

Why can’t we just use simple binary search trees for the element test if points are two- or three-dimensional objects?

Question 8 (10 points)

For describing image **content** we have discussed the MPEG-7 standard. Briefly explain the purpose of descriptions in MPEG-7. Give examples for descriptions about parts of content in still images as well as video images in the context of MPEG-7 (2 examples for each type are expected).

Question 9 (10 points)

Why do we distinguish between the notions of content descriptions and metadata descriptions in MPEG-7? What is the purpose of each type of information? Is it reasonable to try to automatically derive metadata description from content descriptions? Justify your answer.