



THE UNIVERSITY
of LIVERPOOL

JANUARY 2004 EXAMINATIONS

Bachelor of Arts : Year 3
Bachelor of Science : Year 3

Semi-structured or Web-like Databases

TIME ALLOWED : Two Hours and a half

INSTRUCTIONS TO CANDIDATES

Answer **all** questions in Section A
Answer **only two** questions in Section B.

If you attempt to answer more questions than the required number of questions (in any section), the marks awarded for the excess questions will be discarded (starting with your lowest mark).



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SECTION A

Answer **ALL** Questions in this section.

1. Graphs, bracket expressions and systems of hyper set equations.

(a) Transform the following system of set equations (first “unnesting” them) into the corresponding graph.

```
ST1 = {DEPT:CS, NAME:D.Beckham},
MW = {DEPT:CS, POS:HOD, NAME:M.Wooldridge},
VS = {DEPT:CS, POS:lect, NAME:V.Sazonov},
CS = {HOD:MW, RESEARCH-GROUPS:{RG:LoCo, RG:CTAG, ...},
      LECTURERS:{MW, MF, TBC, VS, ...},
      STUDENTS:{ST1, ST2, ...}
},
LoCo = {MF, VS, ...}
```

7 marks

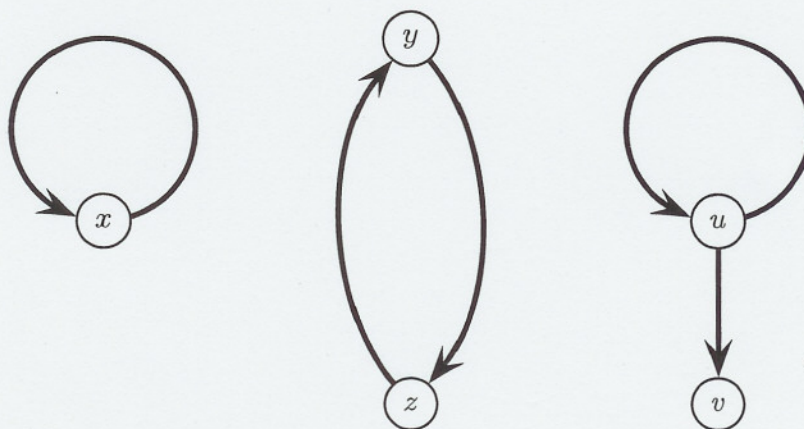
(b) Represent the following bracket expression as an XML document.

5 marks

```
CS : {HOD:MW,
      RESEARCH-GROUPS:{LoCo:{MF, VS}, CTAG:{MW}},
      STAFF:{POS:HOD, NAME:M.Wooldridge, INITIALS:MW},
      STAFF:{POS:Prof, NAME:M.Fisher, INITIALS:MF},
      STAFF:{POS:Lect, NAME:V.Sazonov, INITIALS:VS},
      STUDENTS:{D.Beckham, A.Ferguson, R.Ferdinand}
}.
```

(c) Transform the following graphs to equivalent systems of set equations.

5 marks



(d) What is the Anti-Foundation Axiom (AFA)?

3 marks

(e) Derive which of the above hypersets x, y, z, u, v are equal and which are not. You can use either (i) AFA and elementary properties of sets, or (ii) only the iterative process for deriving non-bisimulation.

8 marks



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2. WWW, HTML, XML and DTD.

(a) Give an example of a restructuring, rather than a searching, query to the WWW which the ordinary Web search engines cannot manage. **5 marks**

(b) What features do XML and HTML have in common, and what are their main differences? **5 marks**

(c) Draw this XML document as a tree in two forms: (i) with labels on edges and (ii) with labels on vertices. **6 marks**

```
<A>
  <A>
    <B> <leaf> 1 </leaf> </B>
    <C> <leaf> 2 </leaf> </C>
    <D> <leaf> 2 </leaf> </D>
  </A>
  <B>
    <leaf> 1 </leaf>
  </B>
</A>
```

(d) What is the difference between the concepts of a *well-formed* and *valid* XML document with respect to a document type definition DTD? **5 marks**

(e) Construct any XML document which is valid with respect to the following DTD:

```
<!ELEMENT family (person*)>
<!ELEMENT person (name)>
<!ELEMENT name (#PCDATA)>
<!ATTLIST person id ID #REQUIRED
                 mother IDREF #IMPLIED
                 father IDREF #IMPLIED
                 children IDREFS #IMPLIED>
```

Give necessary comments explaining the way you achieved validity.

7 marks



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3. Transformation of XML to HTML documents by using XSL queries.

(a) Consider the following XML document

```
<bib> <book> <title> title1 </title> <author> author1 </author>
      </book>
      <paper> <title> title2 </title> <author> author3 </author>
              <author> author4 </author>
      </paper>
      <book> <title> title3 </title> <author> author5 </author>
              <author> author6 </author>
      </book>
</bib>
```

and XSL query

```
<xsl:template match="/">
  <HTML><BODY><xsl:apply-templates/></BODY></HTML>
</xsl:template>
<xsl:template match="title">
  <TD><xsl:value-of/></TD>
</xsl:template>
<xsl:template match="author">
  <TD><xsl:value-of/></TD>
</xsl:template>
<xsl:template match="book">
  <TR>
    <xsl:apply-templates select="title"/>
    <xsl:apply-templates select="author"/>
  </TR>
</xsl:template>
<xsl:template match="paper">
  <TR>
    <xsl:apply-templates select="title"/>
    <xsl:apply-templates select="author"/>
  </TR>
</xsl:template>
<xsl:template match="bib">
  <TABLE>
    <TBODY>
      <xsl:apply-templates select="book"/>
      <xsl:apply-templates select="paper"/>
    </TBODY>
  </TABLE>
</xsl:template>
```

Is it true that this XSL query will produce the following HTML table visible in an IE browser? Correct the result, if necessary.

```
title1 author1
title2 author3 author4
title3 author5 author6
```

4 marks



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- (b) Explain how to change this XSL query so that book rows will follow paper rows in the HTML table. **4 marks**
- (c) Explain how to change this XSL query so that each row in this table will start with the word Book or Paper according to the data in the XML document. **7 marks**
- (d) Explain how to change this XSL query so that titles will be in **boldface** and authors will be in *italic*. **7 marks**
- (e) Explain how to change this XSL query to add title, heading and some text at the end of the table. **6 marks**



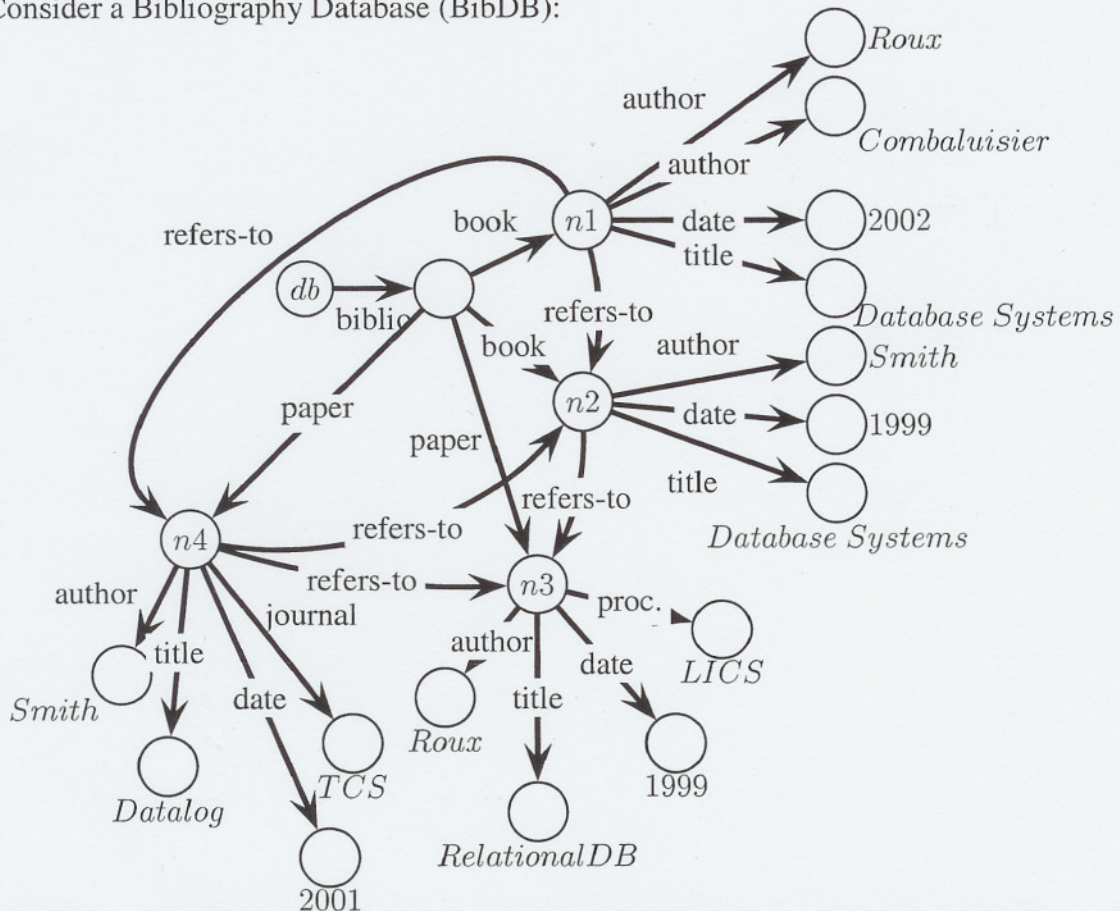
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SECTION B

Answer only **TWO** Questions from this section.

Credit will be given for the best two answers in Section B.

4. Consider a Bibliography Database (BibDB):



Express (i) in English and (ii) set-theoretically, the following query in the *core query language* and draw the corresponding answer graph.

```
select L: {title:T, date:D}
from biblio.L X,
      X.refers-to P,
      X.refers-to Q,
      X.title T
      X.date D
      P.journal J
where not (P = Q)
```

8 marks

- Define the syntax of the basic language Δ^* and explain its set-theoretic semantics. Which role does this language play in the set-theoretic approach to Web-like Databases? **8 marks**
- Which extension of the language Δ^* from the previous question has a precise description of its expressive power in terms of complexity theory? Give this description and also definitions and formulations for the concepts in your answer. **8 marks**



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7. Consider a bibliography database in `www.a.b./bib.xml` of the form

```
<bib>
  <authorandpublications>
    <authors>
      L. Tolstoy
    </authors>
    <book>
      War and Peace
    </book>
    <book>
      Anna Karenina
    </book>
  </authorandpublications>
  <authorandpublications>
    <authors>
      Abiteboul, Buneman, Suciu
    </authors>
    <book>
      Semistrucured Databases
    </book>
  </authorandpublications>
</bib>
```

What is the informal meaning and the precise result of the following query in XML-QL:

```
<newbib>
where <authorandpublications> <authors> $A </> <book> $B </> </>
  in "www.a.b./bib.xml"
construct <book>
  <authors> $A </>
  <title> $B </>
  </>
</newbib>
```

8 marks