

PAPER CODE NO.
COMP311

EXAMINER : Dr Vladimir Sazonov
DEPARTMENT : Computer Science Tel. No. 5-4270



THE UNIVERSITY
of LIVERPOOL

JANUARY 2007 EXAMINATIONS

Bachelor of Arts : Year 3
Bachelor of Science : Year 3
Bachelor of Science : Year 4
Master of Science : Year 1
No qualification aimed for: Year 1

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).



THE UNIVERSITY
of LIVERPOOL

SECTION A

Answer **ALL** Questions in this section.

1. Graphs, bracket expressions and systems of hyperset equations.

(a) "Unnest" the following system of set equations

```
book1 = {title:"XML", chapters:{ch1, ch2}}
book2 = {title:"RDB", chapters:{ch3, ch4, ch5, ch6}}
ch1    = {refers-to:{ch5, ch6}}
ch4    = {refers-to:{ch1, ch2, ch3}}
```

Then transform it into the corresponding graph.

7 marks

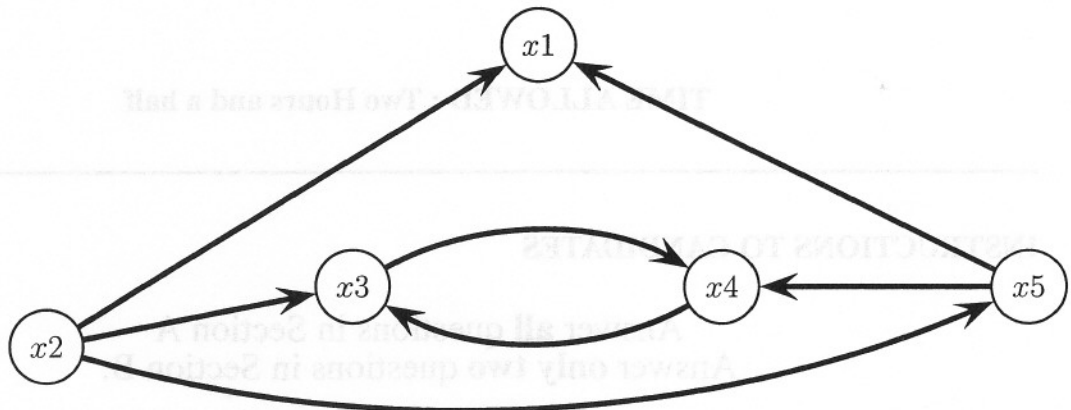
(b) Represent straightforwardly the following bracket expression as an XML document.

4 marks

```
BibDB:{book:{title:"XML",
             contents:{chapt:"XML Introduction", chapt:"XSL"}
       },
       book:{title:"RDB",
             contents:{chapt:"Relations",
                       chapt:"Queries",
                       chapt:"ER Diagrams"}
       }
}
```

(c) Transform the following graph to an equivalent system of set equations.

4 marks



(d) Derive which of the above hypersets x_1, x_2, x_3, x_4, x_5 are equal and which are not.

9 marks

(e) Simplify the system of equations obtained in 1 (c) by using 1 (d). Draw the resulting graph

5 marks



THE UNIVERSITY
of LIVERPOOL

2. WWW, HTML, XML and DTD.

- (a) Describe the *four* stages that a Web query system might use to execute general queries to the WWW or WDB, and compare this with traditional search engines. **5 marks**
- (b) What features do XML and HTML have in common, and what are their main differences? **6 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> <L> 1 </L> </B>
    <C> <L> 2 </L> <L> 2 </L> </C>
  </A>
  <B>
    <M> 2 </M>
    <L> 1 </L>
  </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? **6 marks**
- (e) Construct any XML document which is valid with respect to the following DTD. Give necessary comments explaining the way you achieved validity.

```
<!DOCTYPE staff [
  <!ELEMENT staff (person, person, person, person+)>
  <!ELEMENT person (name)>
  <!ELEMENT name (#PCDATA)>
  <!ATTLIST person staff-Id ID #REQUIRED
                chief IDREF #REQUIRED
                subordinates IDREFS #IMPLIED
                cooperateswith IDREFS #IMPLIED>
]>
```

8 marks



THE UNIVERSITY of LIVERPOOL

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

Consider the following XML document

```
<staff>
  <woman>
    <fstName> Janet </fstName>
    <surname> Lowry </surname>
  </woman>
  <man>
    <fstName> Michael </fstName>
    <surname> Fisher </surname>
  </man>
  <woman>
    <fstName> Clare </fstName>
    <surname> Dixon </surname>
  </woman>
</staff>
```

and XSL query

```
1  <xsl:template match="/">
2    <HTML><BODY><xsl:apply-templates/></BODY></HTML>
3  </xsl:template>
4  <xsl:template match="fstName">
5    <TD><xsl:value-of/></TD>
6  </xsl:template>
7  <xsl:template match="surname">
8    <TD><xsl:value-of/></TD>
9  </xsl:template>
10 <xsl:template match="man">
11   <TR>
12     <xsl:apply-templates select="fstName"/>
13     <xsl:apply-templates select="surname"/>
14   </TR>
15 </xsl:template>
16 <xsl:template match="woman">
17   <TR>
18     <xsl:apply-templates select="fstName"/>
19     <xsl:apply-templates select="surname"/>
20   </TR>
21 </xsl:template>
22 <xsl:template match="staff">
23   <TABLE BORDER="1">
24     <TBODY>
25       <xsl:apply-templates select="man"/>
26       <xsl:apply-templates select="woman"/>
27     </TBODY>
28   </TABLE>
29 </xsl:template>
```



THE UNIVERSITY
of LIVERPOOL

- (a) Is it true that this XSL query will produce the following table visible in an IE browser? Explain why, and correct the result if necessary.

| | |
|---------|--------|
| Janet | Lowry |
| Michael | Fisher |
| Clare | Dixon |

4 marks

- (b) Explain how to change this XSL query so that man rows will follow woman rows in the HTML table. 5 marks
- (c) Explain how to change this XSL query so that firstName columns will follow surname columns in the HTML table. 5 marks
- (d) Explain how to change this XSL query so that each row in this table will start with the additional table cell with the word MALE or FEMALE according to the data in the XML document. 5 marks
- (e) Explain how to change this XSL query so that first names will be in **boldface** and surnames will be in *italic*. 5 marks



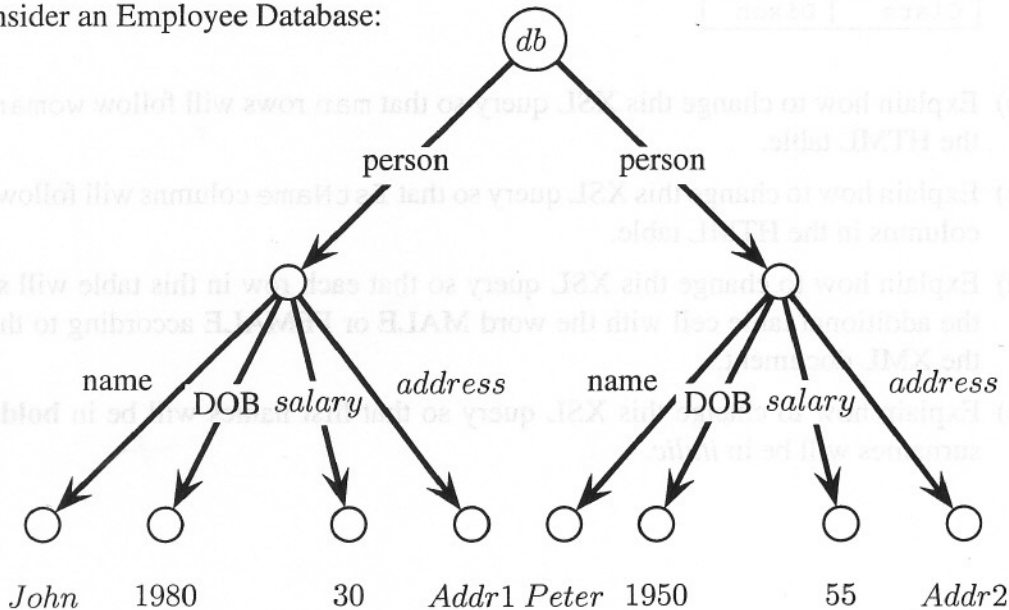
THE UNIVERSITY
of LIVERPOOL

SECTION B

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

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

4. Consider an Employee Database:



Express (i) in English and (ii) set-theoretically, the following query in the *core query language* and draw the corresponding answer first as a bracket expression and then as a graph.

```

select person: (select L: Y
                from X.L Y
                where not (L = salary)), not (L = address))
from db.person X
not X.name = John
  
```

8 marks

5. Define the syntax of the basic language Δ^* and explain its set-theoretic semantics. What role does this language play in the set-theoretic approach to Web-like Databases. **8 marks**

6. Which extension of the language Δ^* 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**



THE UNIVERSITY
of LIVERPOOL

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

```
<bib>
  <book>
    <author> L. Tolstoy </author>
    <title> War and Peace </title>
  </book>
  <book>
    <author> L. Tolstoy </author>
    <title> Anna Karenina </title>
  </book>
  <book>
    <author> Abiteboul </author>
    <author> Buneman </author>
    <author> Suciu </author>
    <title> Semistrucrued Databases </title>
  </book>
</bib>
```

Describe the informal meaning in English and give XML result of the following query in XML-QL:

```
<newbib>
where <book> <author> $A </> </> in "www.a.b.c/bib.xml"
construct <row>
  <author> $A </>
  where <book> <author> $A </author>
    <title> $T </title>
  <\book> in "www.a.b.c/bib.xml"
  construct <title> $T </>
</>
</newbib>
```

8 marks