

W249/112

DUBLIN INSTITUTE OF TECHNOLOGY
KEVIN STREET, DUBLIN 8.

BSc Information Systems / Information Technology

Stage 1

SUMMER EXAMINATIONS 2009

INFORMATION STORAGE AND MANAGEMENT

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2 HOURS

ATTEMPT **3** QUESTIONS

ALL QUESTIONS CARRY EQUAL MARKS

Examine figures 1, 2 and 3 below.

- *Figure 1* shows an XML Schema for a radio schedule XML language.
- *Figure 2* shows an XML document which is valid according to the XML Schema from *Figure 1*.
- *Figure 3* shows a web page whose HTML was generated through an XSL transformation of the XML document from *Figure 2*. *Figure 3* is needed only for question 2.

```
<?xml version="1.0"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema">
  <xs:element name="presenter" type="xs:token"/>
  <xs:element name="starttime" type="xs:integer"/>
  <xs:element name="endtime" type="xs:integer"/>
  <xs:element name="day" type="xs:token"/>
  <xs:attribute name="name" type="xs:token"/>
  <xs:attribute name="title" type="xs:token"/>
  <xs:attribute name="minfrequency" type="xs:decimal"/>
  <xs:attribute name="maxfrequency" type="xs:decimal"/>
  <xs:element name="radioschedule">
    <xs:complexType>
      <xs:sequence>
        <xs:element ref="station"/>
      </xs:sequence>
    </xs:complexType>
  </xs:element>
  <xs:element name="station">
    <xs:complexType>
      <xs:sequence>
        <xs:element ref="show" minOccurs="1"
          maxOccurs="unbounded"/>
      </xs:sequence>
      <xs:attribute ref="name" use="required"/>
      <xs:attribute ref="minfrequency" use="required"/>
      <xs:attribute ref="maxfrequency" use="required"/>
    </xs:complexType>
  </xs:element>
  <xs:element name="show">
    <xs:complexType>
      <xs:sequence>
        <xs:element ref="presenter" minOccurs="1"
          maxOccurs="unbounded"/>
        <xs:element ref="starttime"/>
        <xs:element ref="endtime"/>
        <xs:element ref="day" minOccurs="1"
          maxOccurs="unbounded"/>
      </xs:sequence>
      <xs:attribute ref="title" use="required"/>
    </xs:complexType>
  </xs:element>
</xs:schema>
```

Figure 1: XML Schema for Radio Schedules

```

<radioschedule>

  <station name="Today FM" minfrequency="100" maxfrequency="102">

    <show title="The AM Kelly Show">
      <presenter>Ann Marie Kelly</presenter>
      <starttime>5</starttime>
      <endtime>7</endtime>
      <day>Monday</day>
      <day>Tuesday</day>
      <day>Wednesday</day>
      <day>Thursday</day>
      <day>Friday</day>
    </show>

    <show title="The Ian Dempsey Breakfast Show">
      <presenter>Ian Dempsey</presenter>
      <presenter>Mario Rosenstock</presenter>
      <starttime>7</starttime>
      <endtime>9</endtime>
      <day>Monday</day>
      <day>Tuesday</day>
      <day>Wednesday</day>
      <day>Thursday</day>
      <day>Friday</day>
    </show>

    <show title="The Ray D'Arcy Show">
      <presenter>Ray D'Arcy</presenter>
      <presenter>Jenny Kelly</presenter>
      <starttime>9</starttime>
      <endtime>12</endtime>
      <day>Monday</day>
      <day>Tuesday</day>
      <day>Wednesday</day>
      <day>Thursday</day>
      <day>Friday</day>
    </show>

    <show title="The Last Word">
      <presenter>Matt Cooper</presenter>
      <starttime>16</starttime>
      <endtime>19</endtime>
      <day>Monday</day>
      <day>Tuesday</day>
      <day>Wednesday</day>
      <day>Thursday</day>
      <day>Friday</day>
    </show>

    <show title="Paul McCloon Show">
      <presenter>Paul McCloon</presenter>
      <starttime>19</starttime>
      <endtime>22</endtime>
      <day>Monday</day>
      <day>Tuesday</day>
      <day>Wednesday</day>
      <day>Thursday</day>
    </show>

```

Continued on next page

```
<show title="The Saturday Breakfast">
  <presenter>Martin King</presenter>
  <starttime>7</starttime>
  <endtime>10</endtime>
  <day>Saturday</day>
</show>

<show title="Premier League Live">
  <presenter>Michael McMullan</presenter>
  <presenter>Mark Lawrenson</presenter>
  <starttime>14</starttime>
  <endtime>18</endtime>
  <day>Saturday</day>
</show>

<show title="Sunday Supplement">
  <presenter>Sam Smyth</presenter>
  <starttime>11</starttime>
  <endtime>13</endtime>
  <day>Sunday</day>
</show>

</station>
</radioschedule>
```

Figure 2: XML Document for Today FM Radio Schedule

Today FM

Shows (In alphabetical order)

- Paul McCloon Show
- Premier League Live
- Sunday Supplement
- The AM Kelly Show
- The Ian Dempsey Breakfast Show
- The Last Word
- The Ray D'Arcy Show
- The Saturday Breakfast

Shows that End no later than Mid-Day (12:00)

- The AM Kelly Show
- The Ian Dempsey Breakfast Show
- The Ray D'Arcy Show
- The Saturday Breakfast

All Shows

Shows with one presenter underlined

Shows with multiple presenters in *italics*

- The AM Kelly Show
- *The Ian Dempsey Breakfast Show*
- *The Ray D'Arcy Show*
- The Last Word
- Paul McCloon Show
- The Saturday Breakfast
- *Premier League Live*
- Sunday Supplement

Figure 3: HTML Generated through XSL Transformation of XML Document

1. (a) Explain clearly what is meant by *validity* with respect to XML documents and languages.

(5 marks)

- (b) Provide a DTD for the XML language whose XML Schema is shown in *Figure 1*, a sample document for which is provided in *Figure 2*.

(10 marks)

- (c) The XML Schema provided in *Figure 1* allows any integer to be provided for the `starttime` and `endtime` elements. It also allows any token to be provided for the `day` element.

Provide the code necessary to change the schema such that the `starttime` and `endtime` elements can only take integer values from 0 to 23 inclusive.

Provide the code necessary to change the schema such that `day` elements can only take the following values: *Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, Sunday*.

(18 marks)

2. (a) CSS and XSL are both style-sheet languages. Briefly discuss the role and importance of style-sheets in web development and elsewhere.

(5 marks)

- (b) Images are regularly used in web pages and elsewhere to present information and to improve appearance. Clearly distinguish between *raster images* and *vector images*, identifying the advantages and disadvantages of each.

Demonstrate using a small example how *vector images* can be created in XML.

(10 marks)

- (c) Provide the XSL code necessary to produce the output shown in *Figure 3* above. Note that your XSL code will take its data from the XML document shown in *Figure 2*.

(18 marks)

3. (a) Briefly compare and contrast *hierarchical data representation*, used in XML, and the *relational model*, as used in *relational databases*.

(5 marks)

- (b) Provide an entity-relationship diagram for a database to store information on a *radio schedule* according to the rules in *Figure 1*. Justify any decisions you make.

Note, you do not need to store information about the station (*name, frequencies* etc.), you only need to store information on the shows (*title, presenter, times, days* etc.).

You may **not** assume that each presenter only presents one show. State any other assumptions you make.

Comment on the strengths and weaknesses of your design.

(18 marks)

- (c) Provide SQL statements to perform the following operations on the database from part (b):

- i. Find the names of all shows which end no later than mid-day (12:00).
- ii. Find the name of the show presented by *Ann Marie Kelly*.
- iii. Add *Ray D'Arcy* as a co-presenter of *Premiership Live*.

(10 marks)

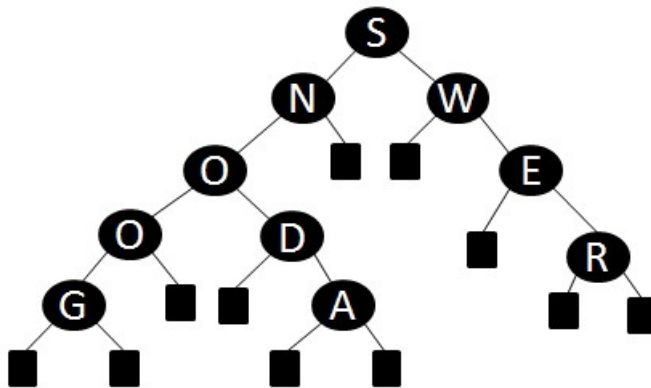
4. (a) Clearly define the following terms, with respect to tree data structures:

- i. Tree
- ii. Tree Path Length
- iii. Binary Tree

Use examples to help illustrate your answer.

(5 marks)

(b) Consider the tree shown below:



List the order with which each of the nodes in this tree are visited using each of the following tree traversal methods:

- i. Inorder Traversal
- ii. Preorder Traversal
- iii. Postorder Traversal

(10 marks)

(c) Regular expressions provide a very effective means of searching through text, and also validating text according to a given pattern.

The XML Schema provided in *Figure 1* allows any decimal to be provided for the minFrequency and maxFrequency elements.

Provide a regular expression which could be used by the XML Schema from *Figure 1* to limit the minFrequency and maxFrequency element values, such that the following values, and similar patterns, are the only values allowed:

- 100
- 100.2
- 85.3
- 99 FM
- 99.5 F.M.
- 104FM

State any assumptions you make. Note that you only need to provide the regular expression, you do not need to provide any further XML Schema code.

(18 marks)