

RS249/112

DUBLIN INSTITUTE OF TECHNOLOGY
KEVIN STREET, DUBLIN 8.

BSc Information Systems / Information Technology

Stage 1

SUPPLEMENTAL EXAMINATIONS 2009

INFORMATION STORAGE AND MANAGEMENT

MR. C. O'LEARY
DR. D. LILLIS

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 *country* XML language. It shows that countries are divided into sub-divisions, which can in turn each also be divided into sub-divisions. Each sub-division either has a population element, or has a set of further sub-divisions.
- *Figure 2* shows an XML document which is valid according to the XML Schema from *Figure 1*. It shows that Ireland is divided into sub-divisions called *provinces*, each of which are then divided into sub-divisions called *counties*, each of which has a *population*.
- *Figure 3* shows a web page whose HTML was generated through an XSL transformation of the XML document from *Figure 2*.

```
<?xml version="1.0"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema">

  <xs:attribute name="male" type="xs:positiveInteger"/>
  <xs:attribute name="female" type="xs:positiveInteger"/>
  <xs:attribute name="total" type="xs:positiveInteger"/>
  <xs:attribute name="name" type="xs:token"/>
  <xs:attribute name="type" type="xs:token"/>

  <xs:element name="country">
    <xs:complexType>
      <xs:sequence>
        <xs:element ref="subdivision" minOccurs="1"
          maxOccurs="unbounded"/>
      </xs:sequence>
      <xs:attribute ref="name" use="required"/>
    </xs:complexType>
  </xs:element>

  <xs:element name="subdivision">
    <xs:complexType>
      <xs:choice>
        <xs:sequence>
          <xs:element ref="subdivision" minOccurs="1"
            maxOccurs="unbounded"/>
        </xs:sequence>
        <xs:element ref="population"/>
      </xs:choice>
      <xs:attribute ref="type" use="required"/>
      <xs:attribute ref="name" use="required"/>
    </xs:complexType>
  </xs:element>

  <xs:element name="population">
    <xs:complexType>
      <xs:attribute ref="male" use="required"/>
      <xs:attribute ref="female" use="required"/>
      <xs:attribute ref="total" use="required"/>
    </xs:complexType>
  </xs:element>
</xs:schema>
```

Figure 1: XML Schema for Countries

```

<country name="Ireland">

  <subdivision type="province" name="Leinster">
    <subdivision type="county" name="Carlow">
      <population male="25611" female="24738" total="50349"/>
    </subdivision>
    <subdivision type="county" name="Dublin">
      <population male="582557" female="604619" total="1187176"/>
    </subdivision>
    <subdivision type="county" name="Kildare">
      <population male="94190" female="92145" total="186335"/>
    </subdivision>
    <subdivision type="county" name="Kilkenny">
      <population male="44263" female="43295" total="87558"/>
    </subdivision>
    <subdivision type="county" name="Laois">
      <population male="34409" female="32650" total="67059"/>
    </subdivision>
    <subdivision type="county" name="Longford">
      <population male="17573" female="16818" total="34391"/>
    </subdivision>
    <subdivision type="county" name="Louth">
      <population male="55335" female="55932" total="111267"/>
    </subdivision>
    <subdivision type="county" name="Meath">
      <population male="82651" female="80180" total="162831"/>
    </subdivision>
    <subdivision type="county" name="Offaly">
      <population male="35937" female="34931" total="70868"/>
    </subdivision>
    <subdivision type="county" name="Westmeath">
      <population male="39819" female="39527" total="79346"/>
    </subdivision>
    <subdivision type="county" name="Wexford">
      <population male="66070" female="65679" total="131749"/>
    </subdivision>
    <subdivision type="county" name="Wicklow">
      <population male="62905" female="63289" total="126194"/>
    </subdivision>
  </subdivision>

  <subdivision type="province" name="Connacht">
    <subdivision type="county" name="Galway">
      <population male="116476" female="115194" total="231670"/>
    </subdivision>
    <subdivision type="county" name="Leitrim">
      <population male="14903" female="14047" total="28950"/>
    </subdivision>
    <subdivision type="county" name="Mayo">
      <population male="62636" female="61203" total="123839"/>
    </subdivision>
    <subdivision type="county" name="Roscommon">
      <population male="30178" female="28590" total="58768"/>
    </subdivision>
    <subdivision type="county" name="Sligo">
      <population male="30257" female="30637" total="60894"/>
    </subdivision>
  </subdivision>

```

XML Document. Document is continued on next page.

```

<subdivision type="province" name="Munster">
  <subdivision type="county" name="Clare">
    <population male="56048" female="54902" total="110950"/>
  </subdivision>
  <subdivision type="county" name="Cork">
    <population male="240814" female="240481" total="481295"/>
  </subdivision>
  <subdivision type="county" name="Kerry">
    <population male="70641" female="69194" total="139835"/>
  </subdivision>
  <subdivision type="county" name="Limerick">
    <population male="92680" female="91375" total="184055"/>
  </subdivision>
  <subdivision type="county" name="Tipperary">
    <population male="75818" female="73426" total="149244"/>
  </subdivision>
  <subdivision type="county" name="Waterford">
    <population male="53932" female="54029" total="107961"/>
  </subdivision>
</subdivision>

<subdivision type="province" name="Ulster">
  <subdivision type="county" name="Cavan">
    <population male="32915" female="31088" total="64003"/>
  </subdivision>
  <subdivision type="county" name="Donegal">
    <population male="73970" female="73294" total="147264"/>
  </subdivision>
  <subdivision type="county" name="Monaghan">
    <population male="28583" female="27414" total="55997"/>
  </subdivision>
</subdivision>

</country>

```

Figure 2: XML Document for the country of Ireland

Counties in Ireland (in alphabetical order)

Carlow, Cavan, Clare, Cork, Donegal, Dublin, Galway, Kerry, Kildare, Kilkenny, Laois, Leitrim, Limerick, Longford, Louth, Mayo, Meath, Monaghan, Offaly, Roscommon, Sligo, Tipperary, Waterford, Westmeath, Wexford, Wicklow,

Least populous county in Ireland

Leitrim (Population: 28950)

Total Population in Ireland

4239848

Provinces in Ireland

- Leinster (Population: 2295123)
- Connacht (Population: 504121)
- Munster (Population: 1173340)
- Ulster (Population: 267264)

Figure 3: HTML Generated through XSL Transformation of XML Document

1. (a) Explain clearly what is meant by *well-formedness* with respect to XML. (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 in *Figure 1* allows for a deep nesting of sub-divisions. Show how to change the schema so that it is only possible to have a depth of two sub-divisions in any country. (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. Your XSL code will take its data from the XML document shown in *Figure 2*. (18 marks)
3. (a) Distinguish between the terms *data*, *information*, *knowledge* and *wisdom*. (5 marks)
- (b) Provide an entity-relationship diagram for a database to store information on a *country* according to the rules in *Figure 1*. Justify any decisions you make. (10 marks)
- (c) Provide SQL statements to retrieve the same information as is presented in *Figure 3* above from the database designed in part (b). (18 marks)
4. (a) Distinguish between *symmetric* and *asymmetric* forms of encryption. (5 marks)
- (b) Using the following simple sentence, build a Huffman Tree and provide the encoding for the word *thereby*: Betty bought butter (10 marks)
- (c) Using an example of your choice, illustrate the important differences between sequential search and hashing. What important considerations must always be taken into account when using hashing? (18 marks)