

W249/112

DUBLIN INSTITUTE OF TECHNOLOGY  
KEVIN STREET, DUBLIN 8.

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# **BSc Information Systems / Information Technology**

**Stage 1**

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**SUMMER EXAMINATIONS 2008**

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**INFORMATION STORAGE AND MANAGEMENT**

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2 HOURS

ATTEMPT **3** QUESTIONS

ALL QUESTIONS CARRY EQUAL MARKS

Examine the following information. It will be needed for questions 1, 2 and 4.

The following describes the *Dublin Institute of Technology (DIT)*:

- The *DIT* is a college that has a name, an address, a url and a set of faculties.
- An address is comprised of a street, a town, a code and a country.
- Each faculty has a director and a set of schools.
- Each school has a number of staff.
- Each staff member is one of *Head of School, Assistant Head of School or Lecturer*.
- Each staff member and each director has a firstname, a surname and optionally a salutation (*Professor or Doctor*)

The XML document below describes the DIT according to the above rules.

```
<college name="Dublin Institute of Technology">
  <url>
    http://www.comp.dit.ie
  </url>
  <address>
    <street>Kevin St.</street>
    <town>Dublin</town>
    <code>8</code>
    <country>Ireland</country>
  </address>
  <faculty name="Science">
    <director>
      <salutation>Professor</salutation>
      <firstname>Michael</firstname>
      <surname>Deveraux</surname>
    </director>
    <school name="Computing">
      <staff position="Head of School">
        <salutation>Professor</salutation>
        <firstname>Brendan</firstname>
        <surname>O'Shea</surname>
      </staff>
      <staff position="Assistant Head of School">
        <salutation>Doctor</salutation>
        <firstname>Bing</firstname>
        <surname>Wu</surname>
      </staff>
      <staff position="Lecturer">
        <firstname>Ciaran</firstname>
        <surname>O'Leary</surname>
      </staff>
      <staff position="Lecturer">
        <firstname>Art</firstname>
        <surname>Sloan</surname>
      </staff>
      <staff position="Lecturer">
        <firstname>Pat</firstname>
        <surname>Browne</surname>
      </staff>
    </school>
  </faculty>
</college>
```

*XML Document continued on next page...*

```

        <staff position="Lecturer">
            <salutation>Doctor</salutation>
            <firstname>John</firstname>
            <surname>Kelleher</surname>
        </staff>
    </school>
    <school name="Mathematics">
        <staff position="Head of School">
            <salutation>Doctor</salutation>
            <firstname>Murrough</firstname>
            <surname>Golden</surname>
        </staff>
        <staff position="Assistant Head of School">
            <firstname>Maev</firstname>
            <surname>Maguire</surname>
        </staff>
        <staff position="Lecturer">
            <salutation>Doctor</salutation>
            <firstname>Dana</firstname>
            <surname>Ballard</surname>
        </staff>
    </school>
    <school name="Physics">
        <staff position="Head of School">
            <salutation>Doctor</salutation>
            <firstname>Vincent</firstname>
            <surname>Toal</surname>
        </staff>
    </school>
</faculty>
<faculty name="Engineering">
    <director>
        <salutation>Doctor</salutation>
        <firstname>Mike</firstname>
        <surname>Murphy</surname>
    </director>
    <school name="Mechanical and Transport Engineering">
        <staff position="Head of School">
            <salutation>Professor</salutation>
            <firstname>Jim</firstname>
            <surname>McGovern</surname>
        </staff>
        <staff position="Lecturer">
            <firstname>Lynette</firstname>
            <surname>Magee</surname>
        </staff>
    </school>
</faculty>
</college>

```

**Figure 1**

1. (a) *XML is a language for creating languages.*  
Briefly discuss this statement. **(5 marks)**
- (b) Provide *five* rules for well-formedness in XML, giving simple examples to illustrate your answer. **(10 marks)**
- (c) Consider the XML document shown in Figure 1 above (on pages 2 and 3). Use XSLT and XPath (where specified) to find the following information:
- i. The value of the name attribute for the first faculty element (using XPath).
  - ii. The number of staff elements appearing as child elements of the school element whose name is computing in the faculty whose name is science (using XPath).
  - iii. The number of staff elements which have a position attribute with value *lecturer* in the document as a whole (using XPath).
  - iv. The surnames of all staff who have a salutation child element (using XPath and XSLT).

**(18 marks)**

2. (a) Describe briefly the important differences between *XML Schema* and *Document Type Definitions (DTD)* with respect to enforcing validity in XML languages. **(5 marks)**

- (b) Provide a *DTD* for the XML document shown in Figure 1 (on pages 2 and 3).

State any assumptions you make.

**(12 marks)**

- (c) A URL (Uniform Resource Locator) is a unique address for a resource that is accessible over the internet. The rules for constructing a URL are as follows:

- The URL must start with the protocol identifier, which must be either `http` or `ftp`.
- The protocol identifier must be followed by the character sequence `://`
- This must be followed by the host identifier which is made up of a series of at least two words separated by dots e.g. `www.comp.dit.ie`
- This can optionally be followed by a forward slash `/`
- This can then optionally be followed by a path, which is a series of words separated by forward slashes `/`
- This can optionally be followed by an anchor, which is a hash symbol `#` followed by a word.

The following are example URLs:

- `http://dit.ie`
- `http://www.dit.ie`
- `http://comp.dit.ie`
- `ftp://comp.dit.ie`
- `http://www.dit.ie/home/computing/`
- `http://www.dit.ie/home/computing/file.html`
- `http://www.dit.ie/home/computing/file.html#top`

Provide a regular expression for URLs based on the above rules.

**(16 marks)**

3. (a) Define, and clearly distinguish between the terms *data*, *information*, *knowledge*, and *wisdom*.

**(8 marks)**

- (b) Alice and Bob are both from *Lilliput Island*. Bob is leaving Alice temporarily to fight *Blefuscu Island*, due to an ongoing disagreement over the manner in which to eat a boiled egg.

Both Alice and Bob are graduates of Computer Science degrees, and consequently understand binary. They decide, before Bob leaves, to share a secret key, which they will use to encrypt messages they will send to each other during the war.

The key they agree on is 10011110.

In order to reduce the amount of data they send to each other, they will compress their data using Huffman Coding before encrypting it.

The Lilliputian language consists only of 8 characters, and both Alice and Bob know the frequency with which those characters appear in Lilliputian text, as provided below:

- L 30%
- *space* 20%
- I 15%
- S 13%
- U 10%
- P 5%
- T 5%
- M 2%

You are required to:

- i. Provide the Huffman Tree for the Lilliputian Language.

**(7 marks)**

- ii. Encode the following message using the Huffman Tree:

I MISS U

**(5 marks)**

- iii. Encrypt the message, in some way, using the shared secret key.

**(8 marks)**

- iv. Provide a high level description of an encryption method Alice and Bob could have used if they had *not* agreed on the shared secret key.

**(5 marks)**

4. (a) Create an ERD for a database to store information on the Dublin Institute of Technology according to the rules in Figure 1 above (on pages 2 and 3).

Note that you do not need to include the name, address or URL for DIT in the database.

**(14 marks)**

- (b) Provide the SQL code needed to build the database from part (a).

**(10 marks)**

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

- i. Get the *saluation*, *firstname* and *surname* of all *heads of school*.
- ii. Ciaran O'Leary qualifies with a PhD and requires that his salutation gets updated to *Doctor*.
- iii. A *Faculty of Humanities* is established in the DIT, with Mr. Paul O'Sullivan as director. The database needs to be updated with this new faculty.

**(9 marks)**