



**Coláiste na Tríonóide, Baile Átha Cliath**  
**Trinity College Dublin**  
Ollscoil Átha Cliath | The University of Dublin

**Faculty of Engineering, Mathematics and Science**

**School of Computer Science & Statistics**

**Integrated Computer Science Programme**  
**B.A. (Mod.) Computer Science & Business**  
**Year 2 Annual Examinations**

**Trinity Term 2016**

**Information Management 1**

**Thursday 5<sup>th</sup> May 2016**

**Goldsmith Hall**

**09.30 – 11.00**

**Prof Declan O’Sullivan**

**Instructions to Candidates:**

Attempt **two** questions. All questions carry equal marks. Each question is scored out of a total of 25 marks.

You may not start this examination until you are instructed to do so by the invigilator.

**Materials Permitted for this examination:**

Non-programmable calculators are permitted for this examination – please indicate the make and model of your calculator on each answer book used.

## SOME QUESTIONS REFER TO THE FOLLOWING

FIGURE A:

```

<?xml version='1.0' encoding='UTF-8'?>
<collection>
  <description>
    Some recipes used in the XML tutorial.
  </description>
  <recipe>
    <title>Beef Parmesan with Garlic Angel Hair Pasta</title>
    <ingredient name='beef cube steak' amount='1.5' unit='pound' />
    <ingredient name='onion, sliced into thin rings' amount='1' />
  <preparation>
    <step>
      Preheat oven to 350 degrees F (175 degrees C).
    </step>
    <step>
      Cut cube steak into serving size pieces. Coat meat with the bread crumbs
      and parmesan cheese. Heat olive oil in a large frying pan, and saute 1
      teaspoon of the garlic for 3 minutes. Quick fry (brown quickly on both sides)
      meat. Place meat in a casserole baking dish, slightly overlapping edges.
      Place onion rings and peppers on top of meat, and pour marinara sauce
      over all.
    </step>
  </preparation>
  <comment>
    Cook the meat ahead of time, and refrigerate over night. </comment>
  <nutrition calories='1167' fat='23' carbohydrates='45' protein='32' />
</recipe>

<recipe>
  <title>Ricotta Pie</title>
  <ingredient name='filling'>
    <ingredient name='ricotta cheese' amount='3' unit='kilos' />
    <ingredient name='eggs' amount='12' />
  </ingredient>
<nutrition calories='349' fat='18' carbohydrates='64' protein='18' />
<comment> This is only part of the recipe </comment>
</recipe>
</collection>

```

SEE NEXT PAGE FOR QUESTIONS

1. Using UML, design an information system to support aspects of the operation of a **Hotel**.

(a) Model at least 6 UML classes (each with at least 2 attributes) representing your information with named associations and roles between the classes. Include at least one subclass and one aggregation association.

[8 marks]

(b) Model 2 UML use cases (include diagrams and standard textual descriptions (e.g. preconditions etc.)) that will be supported by these classes.

[6 marks]

(c) Provide a UML Activity diagram for each use case that indicates the flow of tasks that will implement the UML use cases designed in part (b) above.

[6 marks]

(d) Provide a detailed commentary on the design decisions you took during the modelling task.

[5 marks]

[Total 25 Marks]

2. (a) Explain how the number of elements in a XML document is described differently in DTDs and in XML Schema. Give example(s) to help your explanations.

[4 Marks]

(b) Use DTD notation to fully describe the XML document shown in Figure A. Provide explanations for your design decisions.

[8 Marks]

(c) Define and explain XQuery statements for each of the following queries posed over the document in Figure A. Show expected results and explain your design decisions.

I. Return within a single new element called 'Titles', all the titles in the document separated by semi-colons ";".

II. Return **just the** values of 'fat' attributes

III. Return only the ingredient names which have 'amount' value greater than 2.

IV. Return only the first comment in the document.

[13 Marks]

[Total 25 Marks]

3. (a) Describe in detail using an example and a diagram, one of the four approaches to adding structure to an information file.

[4 Marks]

(b) Describe the algorithm for inserting a key into a B-Tree. Use diagrams with examples to illustrate.

[8 Marks]

(c) Given the B-Tree in Figure B (with  $m=5$ ), show the growth of the B-Tree as you add the keys in the following order:

18, 20, 24, 6, 26, 28, 17, 33, 38, 44, 55, 25, 57, 69, 73

- I. Show the tree at each stage and provide an explanation for any splits
- II. What is the average number of node splits per new key inserted?
- III. What is the average search time?

[13 Marks]

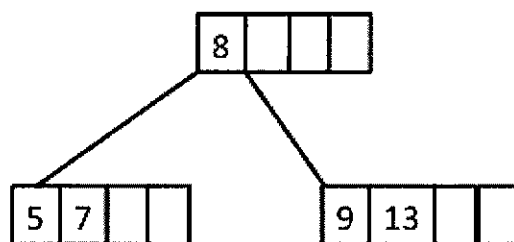


FIGURE B

[Total 25 Marks]

4. With recent advances that have been achieved in information storage and network technologies, there is no longer a need to worry about how information is structured. Discuss and use diagrams to illustrate.

Address at least the following points in your answer:

- How has storage media evolved over the years;
- What are the different types of storage media currently available, and how do they work;
- What are the key concerns of application developers when it comes to functional and non-functional requirements upon storage;
- What potential impact does the organisation of information within a file have upon application performance;
- What potential impact does storage performance have upon application performance;
- What solution trends are proposed to deal with the challenges of Volume, Velocity, Variety of information;
- What concerns still need to be addressed with future storage and information organisation solutions.

[Total 25 Marks]