Informatics 1: Data & Analysis

Lecture 21: Exam Practice

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Semester 2 Week 11

THE UNIVERSITY
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https://blog.inf.ed.ac.uk/da18

Homework From Friday

Follow These Instructions

- Locate and download the Inf1-DA exam paper from May 2017.
- Read Question 1 and Question 2.
- Work through and write out answers to both questions.

  When doing this it's fine to look at past lectures, read your notes, look things up, and ask for help from others. This is about practising to write exam answers that are as good as you can make them.

- Bring your solutions along to the lecture on Tuesday.

In the lecture I shall explain some sample solutions and guide you through marking your own.

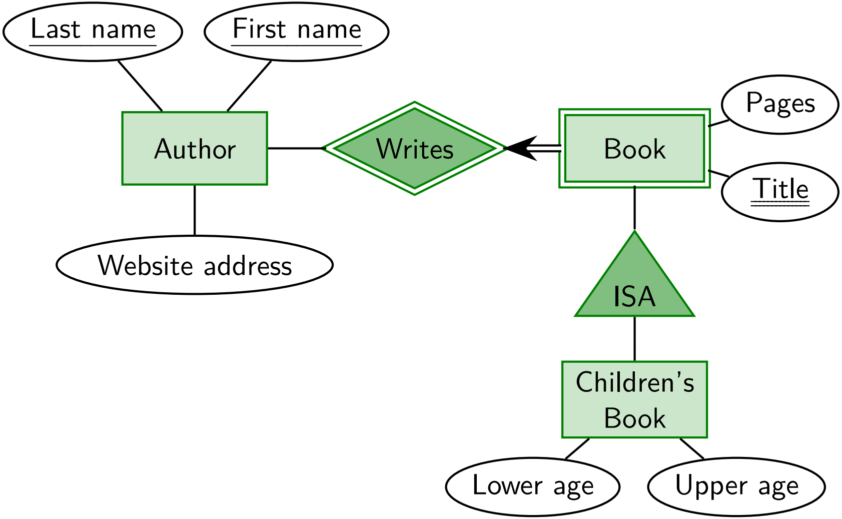
May 2017 Question 1 Section (a)

A small library is planning a database to record details of the books it holds. The following are some requirements they have established.

- The database should include information about books, about authors, and about which authors wrote which books.
- For this library, it's safe to assume that each book has exactly one author.
- Some of the books are specifically for children.
- The library want to record for every book its title, author, and how many pages it has.
- Children's books also have a lower and upper age guideline for readers.
- For each author, the database should identify their first name, last name, and a website address.
- Authors are uniquely identified by their first and last name. Books can be identified by their title and author.

Design and draw an entity-relationship diagram to model these requirements. [20 marks]

May 2017 Question 1 Section (a)



May 2017 Question 1 Section (a)

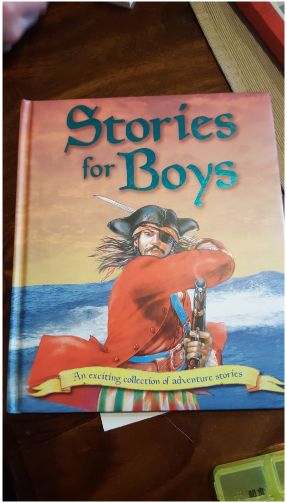
Note the use of a *weak entity* for books, with the Writes identifying relationship to Author. As usual, a weak entity needs total participation (double line) and a key constraint (arrowhead pointing to relationship). All these need to be in the right place.

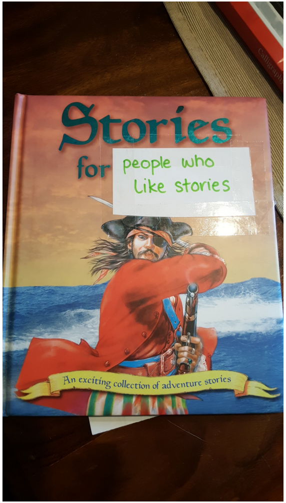
There is no need for any other subclasses beyond Children's Book. You could put in Adult's Book or Book for All, but the scenario doesn't ask for it.

The diagram alone is enough for the marks, if correct. Additional observations in supporting text may help a less-than-perfect diagram, though. "Correct" here includes avoiding unnecessary constraints as much as putting in the required ones.

Book Classification

http://katy-ereira.co.uk/





https://is.gd/storiesfor

May 2017 Question 1 Section (b)

The library issues tickets to borrowers which they can exchange for books. Each ticket has a unique code number and allows the borrower to take out one book for a certain number of weeks. The library assigns a unique identifier to each borrower, and keeps a record of their name and address. Here are the first few rows of two tables used in the database to capture this information.

Borrower

id	name	address
LEW	Abigail Lewis	14 Mill Lane
THO	Scott Thomas	31 Trivet Park
. . .	. . .	. . .

Ticket

owner	number	weeks
LEW	412	3
LEW	413	3
THO	501	2
. . .	. . .	. . .

May 2017 Question 1 Section (b)

(i) Write an expression in *tuple relational calculus* for “information about library tickets with code number 500 or higher”.

(ii) Write a tuple relational calculus expression for the set of names of all borrowers holding at least one 3-week ticket.

(iii) Write a term in *relational algebra* to compute the name and address of the owner of ticket number 623.

(iv) Write an *SQL query* to find the highest ticket number held by “Karen Parker”.

[12 marks]

May 2017 Question 1 Section (b)

Each expression has a range of legitimate variants, with one or two of each shown here.

(i) $\{ \mathsf{T} \in \mathsf{Tickets} \mid \mathsf{T.number} \geqslant 500 \}$ or $\{ \mathsf{T} \mid \mathsf{T} \in \mathsf{Tickets} \wedge \mathsf{T.number} \geqslant 500 \}$

(ii) $\{ R \mid \exists B \in \mathsf{Borrowers}, \mathsf{T} \in \mathsf{Tickets} \,.\, \mathsf{T.owner} = B.\mathsf{id} \wedge B.\mathsf{name} = R.\mathsf{name} \wedge \mathsf{T.weeks} = 3 \}$

Not $\{ B.\mathsf{name} \mid \exists B \in \mathsf{Borrowers} \ldots \}$

Because B is not in scope! B.name is not a record, it's a field! Partial marks at best.

(iii) $\pi_{\mathsf{name,address}}(\mathsf{Borrower} \bowtie_{\mathsf{id=owner}} (\sigma_{\mathsf{number}=623}(\mathsf{Ticket})))$

$\pi_{\mathsf{name,address}}(\sigma_{\mathsf{id=owner} \wedge \mathsf{number}=623}(\mathsf{Borrower} \times \mathsf{Ticket}))$

(iv)
```
select max(T.number)
from Borrower B, Ticket T
where B.id = T.owner and B.name = "Karen Parker"
```

May 2017 Question 1 Section (c)

For any database system with multiple simultaneous users, it can be important to guarantee the *ACID* properties for every transaction. These can help ensure reliable and robust service.

Each of the letters *A*, *C*, *I* and *D* stands for a different property. For each property:

(i) Give its name;

(ii) Explain in a sentence or two what it means for a transaction to have that property.

[8 marks]

May 2017 Question 1 Section (c)

A: Atomicity All-or-nothing: a transaction either runs to completion, or fails and leaves the database unchanged.

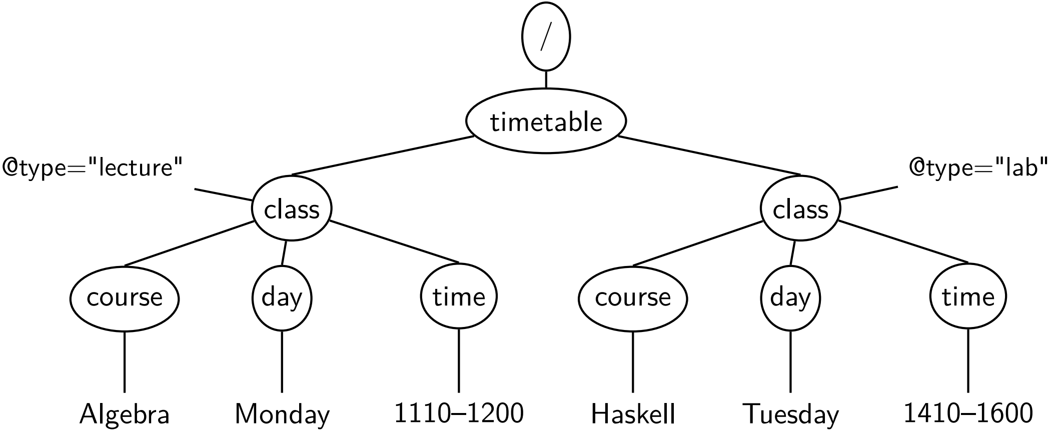
C: Consistency Applying a transaction in a valid state of the database will always give a valid result state.

I: Isolation Concurrent transactions have the same effect as sequential ones: the outcome is as if they were done in order.

D: Durability Once a transaction is committed, it will not be rolled back.

May 2017 Question 2

This is the *XPath data tree* for a small document describing a student timetable.



May 2017 Question 2 Section (a)

The XML text document for this tree starts as follows.

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE timetable SYSTEM "timetable.dtd">
...
```

Write out the rest of the document. [10 marks]

May 2017 Question 2 Section (a)

Here is the complete XML document. The order of lines matters, but indentation doesn't.

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE timetable SYSTEM "timetable.dtd">
<timetable>
    <class type="lecture">
        <course>Algebra</course>
        <day>Monday</day>
        <time>1110-1200</time>
    </class>
    <class type="lab">
        <course>Haskell</course>
        <day>Tuesday</day>
        <time>1410-1600</time>
    </class>
</timetable>
```

It's not essential to include the first two lines, which are already given in the question.

May 2017 Question 2 Section (b)

Here is an example of a DTD for validating timetables like the one above.

```
<!ELEMENT timetable (class)+ >
<!ELEMENT class    (course,day,time) >
<!ELEMENT course   (#PCDATA) >
<!ELEMENT day      (#PCDATA) >
<!ELEMENT time     (#PCDATA) >
<!ATTLIST class type CDATA "lecture">
```

For each of the first three lines of the DTD, give a brief explanation of its meaning. [5 marks]

May 2017 Question 2 Section (b)

Taking the lines in order:

<!**ELEMENT** timetable (class)+ >

A timetable contains one or more class elements.

<!**ELEMENT** class (course,day,time) >

A class contains a course, a date and a time, *in that order*.

<!**ELEMENT** course (#**PCDATA**) >

A course element contains just text.

Including information about attributes of class would be an error, as that doesn't appear in these lines.

May 2017 Question 2 Sections (c)–(e)

Write XPath expressions to extract the following from any XML timetable document that matches this DTD.

(c) All days of the week when there is an Algebra class.

(d) The time of Tuesday's Haskell lab.

(e) What types of class there are for Algebra in the timetable.

[9 marks]

May 2017 Question 2 Sections (c)–(e)

Each of the following can be stated in several different ways; these are just a few examples.

(c) //class[course="Algebra"]/day/text()

//course[text()="Algebra"]/../day/text()

(d) /timetable/class[@type="lab"][day="Tuesday"][course="Haskell"]/time/text()

//class[day="Tuesday" and @type="lab" and course="Haskell"]/time/text()

//class[@type="lab"]/day[text()="Tuesday"]/../course[text()="Haskell"]/../time/text()

(e) //class[course="Algebra"]/@type

//course[text()="Algebra"]/../@type

May 2017 Question 2 Sections (f)–(g)

The following give alternative constraints for the timetable XML: for each one say which entry in the DTD would need to change and write out the revision.

(f) A timetabled class can only be a lecture, tutorial, lab or workshop, and one of these choices must always be given.

(g) Each class entry may list multiple day/time occurrences through the week.

[6 marks]

May 2017 Question 2 Sections (f)–(g)

(f) The ATTLIST line would need to change, from

```
<!ATTLIST class type CDATA "lecture">
```

to

```
<!ATTLIST class type (lecture|tutorial|lab|workshop) \#REQUIRED >
```

(g) The ELEMENT class line would need to change, from

```
<!ELEMENT class (course,day,time) >
```

to

```
<!ELEMENT class (course,(day,time)+) >
```

Written answers only need to identify the line that changes and write out the new version.

Adding it all up

Question 1 was out of 40 marks, Question 2 out of 30 marks. You can add these up and convert them into grades with the following table.

Mark out of						
30	40	70	100	Grade	Description	Degree Class
27	36	63	90	A1	Excellent	1st
24	32	56	80	A2	Excellent	1st
21	28	49	70	A3	Excellent	1st
18	24	42	60	B	Very Good	2:1
15	20	35	50	C	Good	2:2
12	16	28	40	D	Pass	3rd
9	12	21	30	E	Marginal Fail	
6	8	14	20	F	Clear Fail	
3	4	7	10	G	Bad Fail	
0	0	0	0	H	Bad Fail	

Homework

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Student Course Feedback !

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MyEd ⟶ Studies ⟶ Course Enhancement Questionnaire

You can also reach the questionnaires in the following ways.

- Direct link **http://edin.ac/CEQ**
- Find survey email titled "Course Enhancement Questionnaires"

There are feedback forms for every course where you are enrolled. For all Informatics courses there are questions where can give feedback to staff and also offer your own advice to future students. We publish these comments online so you can find out yourself about courses you plan to take: http://www.inf.ed.ac.uk/teaching/student-feedback