

Two hours - online

EXAM PAPER MUST NOT BE REMOVED FROM THE EXAM ROOM

**UNIVERSITY OF MANCHESTER  
DEPARTMENT OF COMPUTER SCIENCE**

Modelling Data on the Web

Date: Tuesday 14th January 2020

Time: 09:45 - 11:45

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**This is an online examination. Please answer ALL Questions  
The examination is worth a total of 54 marks**

**The running example provided as a print out is to be used in conjunction with the online exam  
and is provided for students to make notes only. This will NOT be marked**

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This is a CLOSED book examination

The use of electronic calculators is NOT permitted

**Question 1 to Question 26 contains  
restricted multiple choice questions  
(MCQs) and are NOT published**

27. In 4-5 sentences, explain the main similarities and differences between CSVs, JSON, and XML relevant for their use to share data on the web. You do *not* need to describe or define them - we know what they are. (5 marks)

28. Sketch out a RelaxNG schema for XML documents to record recipes (minor syntax errors will be ignored) as exemplified by the following document (which you have seen in an earlier question). For this sketch, please concentrate on elements and *ignore all attributes* apart from `takesTime`.

```
<?xml version="1.0" encoding="UTF-8"?>
<RecipeBook>
  <Ingredients>
    <Ingredient name="Flour" alternativeName="White Flour"
      unitOfMeasure="grams" caloriesPerUnitOfMeasure="3.61"
      isVegetarian="true" isVegan="true" isAllergen="true"/>
    <Ingredient name="Egg" alternativeName="Chicken Egg"
      unitOfMeasure="count" caloriesPerUnitOfMeasure="67"
      isVegetarian="true" isVegan="false" isAllergen="true"/>
    <Ingredient name="Sugar" unitOfMeasure="grams"
      caloriesPerUnitOfMeasure="3.87" isVegetarian="true"
      isVegan="true" isAllergen="false"/>
    <Ingredient name="Tomato" unitOfMeasure="grams"
      caloriesPerUnitOfMeasure="0.18" isVegetarian="true"
      isVegan="true" isAllergen="false"/>
    <Ingredient name="Milk" unitOfMeasure="liter"
      caloriesPerUnitOfMeasure="520" isVegetarian="true"
      isVegan="false" isAllergen="true"/>
  </Ingredients>
  <Recipes>
    <Recipe name="Pancake" healthy="no" allergy-free="no"
      serves="4 people"
      takesTime="7 minutes">
      <usesIngredient name="Egg" quantity="4"/>
      <usesIngredient name="Flour" quantity="220"/>
      <usesIngredient name="Milk" quantity="0.25"/>
      <usesIngredient name="Sugar" quantity="75"/>
      <step time="4 minutes">Mix flour, eggs, sugar, milk.</step>
      <step time="1 minute">Heat pan.</step>
      <step time="1 minute">Fry pancakes.</step>
    </Recipe>
    <Recipe name="TomOmelette" healthy="yes" allergy-free="no"
      serves="2 people">
      <usesIngredient name="Egg" quantity="5"/>
      <usesIngredient name="Tomato" quantity="450"/>
      <usesIngredient name="Milk" quantity="0.1"/>
      <step time="3 minutes">Chop tomatoes.</step>
      <step time="1 minute">Mix eggs, milk.</step>
      <step time="1 minute">Heat pan.</step>
      <step time="3 minutes">Fry tomatoes.</step>
      <step time="3 minutes">Lower heat and add milky eggs.</step>
    </Recipe>
  </Recipes>
</RecipeBook>
```

29. Consider again the XML-based format for documents to record recipes as exemplified by the following document (which you have seen in an earlier question): sketch out a similar JSON-based format for a recipe (i.e., ignore the ingredients for this question).

```
<?xml version="1.0" encoding="UTF-8"?>
<RecipeBook>
  <Ingredients>
    <Ingredient name="Flour" alternativeName="White Flour"
      unitOfMeasure="grams" caloriesPerUnitOfMeasure="3.61"
      isVegetarian="true" isVegan="true" isAllergen="true"/>
    <Ingredient name="Egg" alternativeName="Chicken Egg"
      unitOfMeasure="count" caloriesPerUnitOfMeasure="67"
      isVegetarian="true" isVegan="false" isAllergen="true"/>
    <Ingredient name="Sugar" unitOfMeasure="grams"
      caloriesPerUnitOfMeasure="3.87" isVegetarian="true"
      isVegan="true" isAllergen="false"/>
    <Ingredient name="Tomato" unitOfMeasure="grams"
      caloriesPerUnitOfMeasure="0.18" isVegetarian="true"
      isVegan="true" isAllergen="false"/>
    <Ingredient name="Milk" unitOfMeasure="liter"
      caloriesPerUnitOfMeasure="520" isVegetarian="true"
      isVegan="false" isAllergen="true"/>
  </Ingredients>
  <Recipes>
    <Recipe name="Pancake" healthy="no" allergy-free="no"
      serves="4 people"
      takesTime="7 minutes">
      <usesIngredient name="Egg" quantity="4"/>
      <usesIngredient name="Flour" quantity="220"/>
      <usesIngredient name="Milk" quantity="0.25"/>
      <usesIngredient name="Sugar" quantity="75"/>
      <step time="4 minutes">Mix flour, eggs, sugar, milk.</step>
      <step time="1 minute">Heat pan.</step>
      <step time="1 minute">Fry pancakes.</step>
    </Recipe>
    <Recipe name="TomOmelette" healthy="yes" allergy-free="no"
      serves="2 people">
      <usesIngredient name="Egg" quantity="5"/>
      <usesIngredient name="Tomato" quantity="450"/>
      <usesIngredient name="Milk" quantity="0.1"/>
      <step time="3 minutes">Chop tomatoes.</step>
      <step time="1 minute">Mix eggs, milk.</step>
      <step time="1 minute">Heat pan.</step>
      <step time="3 minutes">Fry tomatoes.</step>
      <step time="3 minutes">Lower heat and add milky eggs.</step>
    </Recipe>
  </Recipes>
</RecipeBook>
```

30. Consider again the XML-based format for documents to record recipes as exemplified by the following document (which you have seen in an earlier question) and the RelaxNG schema that was designed in response to an earlier question: in 2-3 sentences, explain where and how XML Schema (XSD) datatypes could be used your schema.

```
<?xml version="1.0" encoding="UTF-8"?>
<RecipeBook>
  <Ingredients>
    <Ingredient name="Flour" alternativeName="White Flour"
      unitOfMeasure="grams" caloriesPerUnitOfMeasure="3.61"
      isVegetarian="true" isVegan="true" isAllergen="true"/>
    <Ingredient name="Egg" alternativeName="Chicken Egg"
      unitOfMeasure="count" caloriesPerUnitOfMeasure="67"
      isVegetarian="true" isVegan="false" isAllergen="true"/>
    <Ingredient name="Sugar" unitOfMeasure="grams"
      caloriesPerUnitOfMeasure="3.87" isVegetarian="true"
      isVegan="true" isAllergen="false"/>
    <Ingredient name="Tomato" unitOfMeasure="grams"
      caloriesPerUnitOfMeasure="0.18" isVegetarian="true"
      isVegan="true" isAllergen="false"/>
    <Ingredient name="Milk" unitOfMeasure="liter"
      caloriesPerUnitOfMeasure="520" isVegetarian="true"
      isVegan="false" isAllergen="true"/>
  </Ingredients>
  <Recipes>
    <Recipe name="Pancake" healthy="no" allergy-free="no"
      serves="4 people"
      takesTime="7 minutes">
      <usesIngredient name="Egg" quantity="4"/>
      <usesIngredient name="Flour" quantity="220"/>
      <usesIngredient name="Milk" quantity="0.25"/>
      <usesIngredient name="Sugar" quantity="75"/>
      <step time="4 minutes">Mix flour, eggs, sugar, milk.</step>
      <step time="1 minute">Heat pan.</step>
      <step time="1 minute">Fry pancakes.</step>
    </Recipe>
    <Recipe name="TomOmelette" healthy="yes" allergy-free="no"
      serves="2 people">
      <usesIngredient name="Egg" quantity="5"/>
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      <usesIngredient name="Milk" quantity="0.1"/>
      <step time="3 minutes">Chop tomatoes.</step>
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      <step time="1 minute">Heat pan.</step>
      <step time="3 minutes">Fry tomatoes.</step>
      <step time="3 minutes">Lower heat and add milky eggs.</step>
    </Recipe>
  </Recipes>
</RecipeBook>
```

31. Consider again the XML-based format for documents to record recipes as exemplified by the following document (which you have seen in an earlier question): in 4-5 sentences, explain two major weaknesses of this format and how to improve it.

```
<?xml version="1.0" encoding="UTF-8"?>
<RecipeBook>
  <Ingredients>
    <Ingredient name="Flour" alternativeName="White Flour"
      unitOfMeasure="grams" caloriesPerUnitOfMeasure="3.61"
      isVegetarian="true" isVegan="true" isAllergen="true"/>
    <Ingredient name="Egg" alternativeName="Chicken Egg"
      unitOfMeasure="count" caloriesPerUnitOfMeasure="67"
      isVegetarian="true" isVegan="false" isAllergen="true"/>
    <Ingredient name="Sugar" unitOfMeasure="grams"
      caloriesPerUnitOfMeasure="3.87" isVegetarian="true"
      isVegan="true" isAllergen="false"/>
    <Ingredient name="Tomato" unitOfMeasure="grams"
      caloriesPerUnitOfMeasure="0.18" isVegetarian="true"
      isVegan="true" isAllergen="false"/>
    <Ingredient name="Milk" unitOfMeasure="liter"
      caloriesPerUnitOfMeasure="520" isVegetarian="true"
      isVegan="false" isAllergen="true"/>
  </Ingredients>
  <Recipes>
    <Recipe name="Pancake" healthy="no" allergy-free="no"
      serves="4 people"
      takesTime="7 minutes">
      <usesIngredient name="Egg" quantity="4"/>
      <usesIngredient name="Flour" quantity="220"/>
      <usesIngredient name="Milk" quantity="0.25"/>
      <usesIngredient name="Sugar" quantity="75"/>
      <step time="4 minutes">Mix flour, eggs, sugar, milk.</step>
      <step time="1 minute">Heat pan.</step>
      <step time="1 minute">Fry pancakes.</step>
    </Recipe>
    <Recipe name="TomOmelette" healthy="yes" allergy-free="no"
      serves="2 people">
      <usesIngredient name="Egg" quantity="5"/>
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      <step time="3 minutes">Chop tomatoes.</step>
      <step time="1 minute">Mix eggs, milk.</step>
      <step time="1 minute">Heat pan.</step>
      <step time="3 minutes">Fry tomatoes.</step>
      <step time="3 minutes">Lower heat and add milky eggs.</step>
    </Recipe>
  </Recipes>
</RecipeBook>
```

32. In 2-4 sentences, describe how you can use schemas to follow Postel's law in a robust application that produces and consumes data shared on the web. (4 marks)

## Handout example

```
<?xml version="1.0" encoding="UTF-8"?>
<RecipeBook>
  <Ingredients>
    <Ingredient name="Flour" alternativeName="White Flour"
      unitOfMeasure="grams" caloriesPerUnitOfMeasure="3.61"
      isVegetarian="true" isVegan="true" isAllergen="true"/>
    <Ingredient name="Egg" alternativeName="Chicken Egg"
      unitOfMeasure="count" caloriesPerUnitOfMeasure="67"
      isVegetarian="true" isVegan="false" isAllergen="true"/>
    <Ingredient name="Sugar" unitOfMeasure="grams"
      caloriesPerUnitOfMeasure="3.87" isVegetarian="true"
      isVegan="true" isAllergen="false"/>
    <Ingredient name="Tomato" unitOfMeasure="grams"
      caloriesPerUnitOfMeasure="0.18" isVegetarian="true"
      isVegan="true" isAllergen="false"/>
    <Ingredient name="Milk" unitOfMeasure="liter"
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      <usesIngredient name="Egg" quantity="4"/>
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      <usesIngredient name="Sugar" quantity="75"/>
      <step time="4 minutes">Mix flour, eggs, sugar, milk.</step>
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      <step time="3 minutes">Lower heat and add milky eggs.</step>
    </Recipe>
  </Recipes>
</RecipeBook>
```