Theme 3: XML Schema

Complex Types

Defining Complex Types

- Simple type elements **may not** be empty, and...
- ...they **may not** contain child elements or attributes.

- For those, you must define a **complex type** element.

- There are no built-in complex types. You must create one.

- A complex type may be **anonymous** or **named**.

Defining Complex Types

- **An element rule with an anonymous complex type:**

```
<xs:element name=“tagName”>
          <xs:complexType>
                <!-- The content model -->
          </xs:complexType>
</xs:element>
```

Defining Complex Types

- **A named complex type and a rule using it:**

```
<xs:complexType name=“typeName”>
          <!-- The content model -->
</xs:complexType>
...
<xs:element name=“tagName” type=“typeName”/>
```

The Content Model

- A complex type’s **content model** can consist of:
    1. The **content type**;
    2. A **model group** if there are child elements, and
    3. Any attribute rules.

- The **content type** of a complex type can be either:
    - Simple content, or
    - Complex content.

Content Types

- **Simple content** refers to text.

- **Complex content** refers to child elements.

- By default, the content type is **complex content**…
- …so you must only explicitly specify the content type…
- …if the content type is **simple content**.

Text-Only Complex Types

- A **simple type** element can contain **only text**, but…
- …a **complex type** element with **simple content**…
- …can contain **text and attributes**.

- For the abovementioned complex type, you must specify:
  - What type of text it must contain (i.t.o. a **simple type**), then
  - Extend it with one or more **attribute rules**.

eg: you have only text (so simple type) so you have to define it as such, but it has an attribute (which automatically makes it complex, and it's complex by defautl so you have to create it a simple type explicitly

Text-Only Complex Types

- **E.g. an element that contains a string and one attribute:**

```
<xs:element name=“username”>
          <xs:complexType>
                <xs:simpleContent>
                      <xs:extension base=“xs:string”>
                            <xs:attribute name=“id”type=“xs:string”/>
                      </xs:extension>
                </xs:simpleContent>
          </xs:complexType>
</xs:element>
```

Model Group

Child Elements

- **To define element with child elements:**

```
<xs:element name=“elName”>
          <xs:complexType>
                    <!-- Model group -->
                    <!-- Attribute rules -->
          </xs:complexType>
</xs:element>
```

Child Elements

- You will use a **model group** to dictate…
- …the structure and order of the child elements.

- Then, you will define attributes for the element, if any.
  - Attribute rules must **always** appear **after** the model group.

Model Groups

- The **model group** can be one of the following:
  - **xs:sequence** far an ordered sequence of children;
  - **xs:choice** for a choice between children;
  - **xs:all** for an unordered list of children, or
  - A nest combination of **xs:sequence** and **xs:choice**.

  - E.g. a sequence of choices, or a choice between sequences.

Model Groups

- **E.g. a sequence of children to appear in that order:**

```
<xs:complexType name="typeName“>
    <xs:sequence>
          <xs:element name="child1" type="xs:string"/>
          <xs:element name="child2" type="xs:decimal"/>
    </xs:sequence>
          <!--Attribute rules -->
</xs:complexType>
```

Model Groups

- **Note**: An element rule within a complex type…
- …can also define an anonymous type…
  (within the **xs:element** tags)
- …or refer to an existing named type.

Model Groups (Continued)

In a complex type definition that allows child elements...

- ...you can use **xs:choice** as the model group...
- ...to allow the XML author to choose between children.

Model Groups (Continued)

- **E.g. an element with either an** A **child, or a** B **child:**

```
<xs:element name="tagName">
          <xs:complexType>
                <xs:choice>
                      <xs:element name="A" type="xs:string"/>
                      <xs:element name="B" type="xs:string"/>
                </xs:choice>
                <!-- Attribute rules, if any -->
          </xs:complexType>
</xs:element>
```

Model Groups (Continued)

- Use **xs:all** to allow an unordered list of child elements:

```
<xs:complexType name="typeName">
    <xs:all>
          <xs:element name="A" type="xs:string"/>
          <xs:element name="B" type="xs:string"/>
    </xs:all>
          <!-- Attribute rules, if any -->
</xs:complexType>
```

Model Groups (Continued)

- In the example on the previous slide...
- ...the author must add both **A** and **B**...
- ...but they may be in any order.

- **Note:** You may not nest **xs:all** with other model groups.

Nesting Model Groups

- **You can nest** xs:sequence **and** xs:choice **in many combinations:**

```
<xs:complexType name="typeName">
          <xs:sequence>
                <xs:choice>
                      <xs:element name="A" type="xs:string"/>
                      <xs:element name="a" type="xs:string"/>
                </xs:choice>
                <xs:element name="B" type="xs:string"/>
          </xs:sequence>
</xs:complexType>
```

Empty Elements

- You must define an empty element as a **complex type**...
- ...but you don't define a model group for it.
- **E.g.:**

```
<xs:element name="tagName">
      <xs:complexType>
            <!-- Attribute rules, if any -->
      </xs:complexType>
</xs:element>
```

Mixed Content Elements

- To define a mixed content element…
- …you must set **mixed="true"** (default: **false**).

```
<xs:element name="tagName">
      <xs:complexType mixed="true">
            <!-- Model group -->
            <!-- Attribute rules, if any -->
      </xs:complexType>
</xs:element>
```

allow you to mix plain text and elements embeded together

Mixed Content Elements

- **Note:** You cannot use the **xs:all** model group...
- ...in the complex type of a mixed content element.

- **Mixed content** means that the element so defined...
- ...can contain a mixture of text and the defined children.

Deriving New Types

Restrict and Extend

Deriving New Complex Types

- You can derive new complex types from existing ones.

- You will either **extend** or **restrict** the existing type.

- **Extend:** Extends the range of values provided by an existing **type**
  - E.g., adding child elements or attributes.

- **Restrict:** Creating a new **type** from existing **type** based on criteria
  - E.g., setting a default/fixed value for something.

Deriving New Complex Types

- **Creating a new type by** extending **an existing one:**

```
<xs:complexType name="newType">
    <xs:complexContent> <!-- required in this case -->
        <xs:extension base="existingType">
            <xs:sequence>
                <xs:element name="C" type="xs:string"/>
            </xs:sequence>
        </xs:extension>
    </xs:complexContent>
</xs:complexType>
```

Deriving New Complex Types

- The **newType** in the previous example...
- ...will have the same content model as **existingType**...
- ...but it adds the element, **C**, to the end...
- ...of the existing **xs:sequence** model group.

Deriving New Complex Types

In some cases when applying restrictions…

- You need to simply reference the existing type, or…
- …you need to duplicate the existing type's content model to add the refinement (e.g. **fixed** attribute).

- This is purely depandant on what type of restriction you are adding to an existing type.

Deriving New Complex Types

- **E.g. if this is the existing type:**

```
<xs:complexType name="existingType">
          <xs:sequence>
                <xs:element name="A" type="xs:string"/>
                <xs:element name="B" type="xs:string"/>
          </xs:sequence>
</xs:complexType>
```

Deriving New Complex Types

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- **…then it can be restricted like this:**

```
<xs:complexType name="newType">
    <xs:complexContent> <!-- required in this case -->
          <xs:restriction base="existingType">
                <xs:sequence>
          <xs:element name="A" type="xs:string" fixed="blah"/>
          <xs:element name="B" type="xs:string"/>
                </xs:sequence>
          </xs:restriction>
    </xs:complexContent>
</xs:complexType>
```

Attributes

Attributes

- An attribute is always defined in terms of a **simple type**.
- **E.g. an attribute rule:**

```
<xs:attribute name="attName" type="xs:decimal"/>
```

- By default, the XML author need not use the attribute.

- Add the **use** attribute to set it to be **required**.

Attributes

- **E.g. an attribute that the author MUST use:**

```
<xs:attribute name="attName" type="xs:decimal“ use="required"/>
```

- Just like with elements, you can add…
- …a **fixed** or **default** attribute to the attribute rule…
- …to set a fixed or default value for it.

Occurrences

- You can control how many times an **element**…
- …or **model group** may appear in the XML doc.

- Use the attributes, **minOccurs** and/or **maxOccurs**.

- If left out, both attributes default to the value, **1**.

- Thus, by default, all items must appear once only.

Occurrences

- Both attributes must contain a non-negative integer...
- ...but **maxOccurs** may contain the keyword, **unbounded**.

- **unbounded** = as many times as you want.

- You may add one or the other, or both.

- Whichever one is left out defaults to **1**.

Occurrences

- **E.g. allowing an element to appear without restrictions:**

```
<xs:element name="A" type="xs:string" maxOccurs="unbounded"/>
```

- **E.g. allowing a model group to occur three times:**

```
<xs:sequence maxOccurs="3">
      <!-- element rules -->
</xs:sequence>
```

Occurrences

Note:

- You may not set an **xs:all** nor any elements inside it...
- ...to appear more than **once**.

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Occurrences

- Now we can define a mixed content type...
- ...in which the children can occur in any order:

```
<xs:complexType name="typeName" mixed="true">
          <xs:choice minOccurs="0" maxOccurs="unbounded">
                <!-- element rules -->
          </xs:choice>
</xs:complexType>
```

Named Model Groups

- You can create model groups outside of complex types…
- …that you can then reference in multiple complex types.

- **E.g. creating a named** xs:sequence **group:**

```
<xs:group name="groupName">
          <xs:sequence>
                <!-- element rules -->
          </xs:sequence>
</xs:group>
```

Named Model Groups

- **xs:group** must be a child of **xs:schema** (i.e. global).

- Now you can reference it like this:

```
<xs:complexType name="typeName">
          <xs:group ref="groupName"/>
          <!-- Attribute rules, if any -->
</xs:complexType>
```

Named Attribute Groups

- You can group reusable attribute rules together as well.

```
<xs:attributeGroup name="attGroupName"> <!-- global -->
          <!-- Attribute rules -->
</xs:attributeGroup>
```

- Then, to reference it anywhere you can put attribute rules:

```
<xs:attributeGroup ref="attGroupName"/>
```

Global and Local definition

Local vs. Global Definitions

- These are defined **globally** (as children of **xs:schema**):
  - The element definition of the **root element**;
  - **Named** types (as opposed to anonymous types);
  - Named model and attribute groups.

- All other items are defined **locally** (within something).

- You can, however, define other elements or attributes globally, if you want.

Local vs. Global Definitions

- **To define an element globally:**

first level

```
<xs:schema>
          ...
          <xs:element name="A" type="xs:string"/>
          ...
</xs:schema>
```

Local vs. Global Definitions

- **You must then reference it locally:**

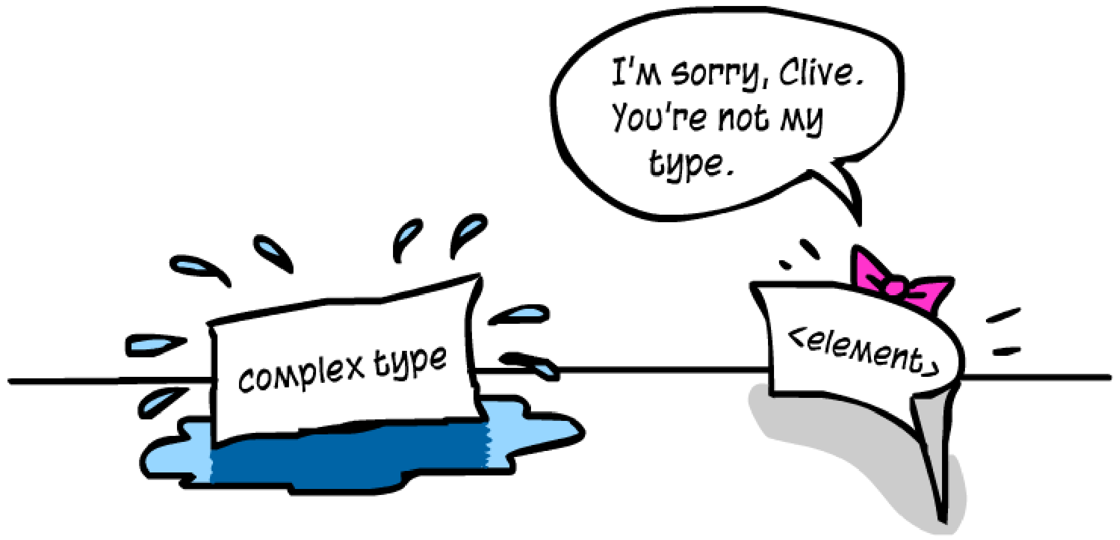
```
<xs:complexType name="typeName">
          <xs:sequence>
                <xs:element ref="A"/>
          </xs:sequence>
</xs:complexType>
```

Local vs. Global Definitions

- Global element/attribute definitions...
- ...except for the root element's definition...
- ...are **ignored** unless they are referenced locally.

- Place **minOccurs** and **maxOccurs** in the reference...
- ...instead of in the global definition.

Theme 3: XML Schema



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