

Assignment #4R: OData REST services

Introduction

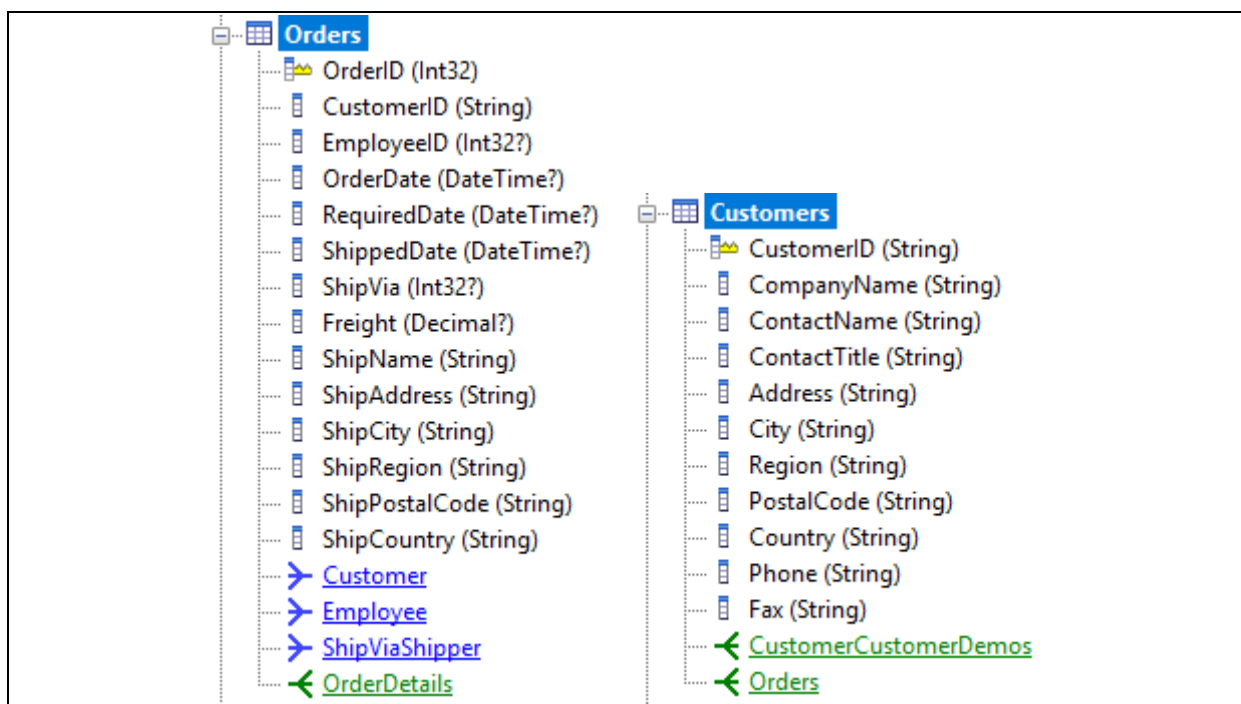
This assignment requires you to create two **OData REST** services that accept **GET** requests, in order to retrieve data from two **XML** “table” documents: **XOrders.xml** and **XCustomers.xml**, in **ATOM+XML** or **JSON** formats.

These XML documents are trimmed (and slightly modified) versions of the similarly named tables – **Orders** and **Customers** – from the public and well-known **Northwind SQL** database sample.

The service must be written in two versions, written (1) in **C#** and (2) in **F#**, starting with the provided **skeletons**. These two projects will be compiled with their command-line compilers, **CSC** and **FSC**, respectively, via given **batch** files. The services will be tested by running **IISExpress** via another given **batch** file (we’ll typically run this on port 8181, which is available in the labs). The marking will be performed by **scripts**, so exact matches are essential.

Server data

Our XML documents are not schema based. Therefore, let’s also have a look the original SQL types, as Linqpad sees these. This will allow us to properly identify the types.



Note the several **Orders** properties that are **nullable (?)** – We keep three of these (see below)!

Note the following **primary keys**: **OrderID** for **Orders** and **CustomerID** for **Customers**. Note also the **foreign key CustomerID** in **Orders**. Together, these define the following “duck’s paw” one-to-many and many-to-one relationships:

- **Customer**: from **Orders** to **Customers**
- **Orders**: from **Customers** to **Orders**

Our XML documents keep only part of the actual SQL columns

- **XOrders** keeps, in order: **OrderID**, **CustomerID**, **OrderDate** , **ShippedDate**, **Freight** , **ShipName**, **ShipCity**, and **ShipCountry** – also *EmployeeID*, but this will be ignored.
- **XCustomers** keeps, in order: **CustomerID**, **CompanyName**, and **ContactName**.
- The “ducks’ paw” relationships must be rebuilt by the program.

Here follow the first few lines of each of our XML documents:

XCategories

```
<Customers>
  <Customer>
    <CustomerID>ALFKI</CustomerID>
    <CompanyName>Alfreds Futterkiste</CompanyName>
    <ContactName>Maria Anders</ContactName>
  </Customer>
  ...
>
```

XOrders

```
<Orders>
  <Order>
    <OrderID>10248</OrderID>
    <CustomerID>VINET</CustomerID>
    <EmployeeID>5</EmployeeID>                                <!--ignore this -->
    <OrderDate>1996-07-04T00:00:00</OrderDate>
    <ShippedDate>1996-07-16T00:00:00</ShippedDate>
    <Freight>32.3800</Freight>
    <ShipName>Vins et alcools Chevalier</ShipName>
    <ShipCity>Reims</ShipCity>
    <ShipCountry>France</ShipCountry>
  </Order>
  ...
>
```

The three **nullable** properties may appear in three different ways, e.g.:

```
<Freight />
<Freight> </Freight>
<!-- <Freight>32.3800</Freight> -->
```

Sample GET URL queries and expected results for C# (for F# replace A4CS => A4FS); slightly reformatted (added readability spaces), and assuming the service is listening on port 8081.

odata_xml_0

[http://localhost:8181/A4CS.svc/?\\$format=json](http://localhost:8181/A4CS.svc/?$format=json)

```
{"odata.metadata":"http://localhost:8181/A4CS.svc/$metadata","value":[
{"name":"Customers","url":"Customers"},
{"name":"Orders","url":"Orders"}]}
```

odata_xml_1

[http://localhost:8181/A4CS.svc/Orders\(\)?\\$format=json&\\$top=0&\\$inlinecount=allpages](http://localhost:8181/A4CS.svc/Orders()?$format=json&$top=0&$inlinecount=allpages)

```
{"odata.metadata":"http://localhost:8181/A4CS.svc/$metadata#Orders","odata.count":"830",
"value":[]}
```

odata_xml_2

[http://localhost:8181/A4CS.svc/Customers\(\)?\\$format=json&\\$orderby=CustomerID&\\$top=3&\\$select=CustomerID,ContactName,CompanyName](http://localhost:8181/A4CS.svc/Customers()?$format=json&$orderby=CustomerID&$top=3&$select=CustomerID,ContactName,CompanyName)

```
{"odata.metadata":"http://localhost:8181/A4CS.svc/$metadata#Customers&
$select=CustomerID,ContactName,CompanyName","value":[
{"CustomerID":"ALFKI","CompanyName":"Alfreds Futterkiste",
"ContactName":"Maria Anders"},
{"CustomerID":"ANATR","CompanyName":"Ana Trujillo Emparedados y helados",
"ContactName":"Ana Trujillo"},
{"CustomerID":"ANTON","CompanyName":"Antonio Moreno Taquer\u00eda",
"ContactName":"Antonio Moreno"}]}
```

odata_xml_3

[http://localhost:8181/A4CS.svc/Orders\(\)?\\$format=json&\\$orderby=OrderID desc&\\$top=3&\\$select=OrderID,CustomerID,ShipName,ShipCity,ShipCountry](http://localhost:8181/A4CS.svc/Orders()?$format=json&$orderby=OrderID desc&$top=3&$select=OrderID,CustomerID,ShipName,ShipCity,ShipCountry)

```
{"odata.metadata":"http://localhost:8181/A4CS.svc/$metadata#Orders&
$select=OrderID,CustomerID,ShipName,ShipCity,ShipCountry","value":[
{"OrderID":11077,"CustomerID":"RATTC","ShipName":"Rattlesnake Canyon Grocery",
"ShipCity":"Albuquerque","ShipCountry":"USA"},
{"OrderID":11076,"CustomerID":"BONAP","ShipName":"Bon app'",
"ShipCity":"Marseille","ShipCountry":"France"},
{"OrderID":11075,"CustomerID":"RICSU","ShipName":"Richter Supermarkt",
"ShipCity":"Gen\u00e8ve","ShipCountry":"Switzerland"}]}
```

odata_xml_4

[http://localhost:8181/A4CS.svc/Orders\(\)?format=json&\\$orderby=OrderID&\\$filter=OrderDate eq null&\\$expand=Customer&\\$select=OrderID,CustomerID,OrderDate,ShippedDate,Freight](http://localhost:8181/A4CS.svc/Orders()?format=json&$orderby=OrderID&$filter=OrderDate eq null&$expand=Customer&$select=OrderID,CustomerID,OrderDate,ShippedDate,Freight)

```
{"odata.metadata":"http://localhost:8181/A4CS.svc/$metadata#Orders&$select=OrderID,CustomerID,OrderDate,ShippedDate,Freight","value":[{"OrderID":10249,"CustomerID":"TOMSP","OrderDate":null,"ShippedDate":"1996-07-10T00:00:00","Freight":"11.6100"}, {"OrderID":10250,"CustomerID":"HANAR","OrderDate":null,"ShippedDate":"1996-07-12T00:00:00","Freight":"65.8300"}]}
```

odata_xml_5

[http://localhost:8181/A4CS.svc/Orders\(\)?format=json&\\$orderby=OrderID&\\$filter=ShippedDate eq null&\\$expand=Customer&\\$select=OrderID,CustomerID,OrderDate,ShippedDate,Freight](http://localhost:8181/A4CS.svc/Orders()?format=json&$orderby=OrderID&$filter=ShippedDate eq null&$expand=Customer&$select=OrderID,CustomerID,OrderDate,ShippedDate,Freight)

```
{"odata.metadata":"http://localhost:8181/A4CS.svc/$metadata#Orders&$select=OrderID,CustomerID,OrderDate,ShippedDate,Freight","value":[{"OrderID":11008,"CustomerID":"ERNSH","OrderDate":"1998-04-08T00:00:00","ShippedDate":null,"Freight":"79.4600"}, {"OrderID":11009,"CustomerID":"GODOS","OrderDate":"1998-04-08T00:00:00","ShippedDate":null,"Freight":"59.1100"}, {"OrderID":11010,"CustomerID":"REGGC","OrderDate":"1998-04-09T00:00:00","ShippedDate":null,"Freight":"28.7100"}, {"OrderID":11019,"CustomerID":"RANCH","OrderDate":"1998-04-13T00:00:00","ShippedDate":null,"Freight":"3.1700"}, {"OrderID":11039,"CustomerID":"LINOD","OrderDate":"1998-04-21T00:00:00","ShippedDate":null,"Freight":"65.0000"}, {"OrderID":11040,"CustomerID":"GREAL","OrderDate":"1998-04-22T00:00:00","ShippedDate":null,"Freight":"18.8400"}, {"OrderID":11045,"CustomerID":"BOTTM","OrderDate":"1998-04-23T00:00:00","ShippedDate":null,"Freight":"70.5800"}, {"OrderID":11051,"CustomerID":"LAMAI","OrderDate":"1998-04-27T00:00:00","ShippedDate":null,"Freight":"2.7900"}, {"OrderID":11054,"CustomerID":"CACTU","OrderDate":"1998-04-28T00:00:00","ShippedDate":null,"Freight":"0.3300"}, {"OrderID":11058,"CustomerID":"BLAUS","OrderDate":"1998-04-29T00:00:00","ShippedDate":null,"Freight":"31.1400"}, {"OrderID":11059,"CustomerID":"RICAR","OrderDate":"1998-04-29T00:00:00","ShippedDate":null,"Freight":"85.8000"}, {"OrderID":11061,"CustomerID":"GREAL","OrderDate":"1998-04-30T00:00:00","ShippedDate":null,"Freight":"14.0100"}]}
```

```
{
  "OrderID":11062,"CustomerID":"REGGC","OrderDate":"1998-04-30T00:00:00",
  "ShippedDate":null,"Freight":"29.9300"},
  {"OrderID":11065,"CustomerID":"LILAS","OrderDate":"1998-05-01T00:00:00",
  "ShippedDate":null,"Freight":"12.9100"},
  {"OrderID":11068,"CustomerID":"QUEEN","OrderDate":"1998-05-04T00:00:00",
  "ShippedDate":null,"Freight":"81.7500"},
  {"OrderID":11070,"CustomerID":"LEHMS","OrderDate":"1998-05-05T00:00:00",
  "ShippedDate":null,"Freight":"136.0000"},
  {"OrderID":11071,"CustomerID":"LILAS","OrderDate":"1998-05-05T00:00:00",
  "ShippedDate":null,"Freight":"0.9300"},
  {"OrderID":11072,"CustomerID":"ERNSH","OrderDate":"1998-05-05T00:00:00",
  "ShippedDate":null,"Freight":"258.6400"},
  {"OrderID":11073,"CustomerID":"PERIC","OrderDate":"1998-05-05T00:00:00",
  "ShippedDate":null,"Freight":"24.9500"},
  {"OrderID":11074,"CustomerID":"SIMOB","OrderDate":"1998-05-06T00:00:00",
  "ShippedDate":null,"Freight":"18.4400"},
  {"OrderID":11075,"CustomerID":"RICSU","OrderDate":"1998-05-06T00:00:00",
  "ShippedDate":null,"Freight":null},
  {"OrderID":11076,"CustomerID":"BONAP","OrderDate":"1998-05-06T00:00:00",
  "ShippedDate":null,"Freight":null},
  {"OrderID":11077,"CustomerID":"RATTC","OrderDate":"1998-05-06T00:00:00",
  "ShippedDate":null,"Freight":null}}}
```

odata_xml_6

[http://localhost:8181/A4CS.svc/Orders\(\)?format=json&\\$orderby=OrderID&\\$filter=Freight eq null&\\$expand=Customer&\\$select=OrderID,CustomerID,OrderDate,ShippedDate,Freight](http://localhost:8181/A4CS.svc/Orders()?format=json&$orderby=OrderID&$filter=Freight eq null&$expand=Customer&$select=OrderID,CustomerID,OrderDate,ShippedDate,Freight)

```
{
  "odata.metadata":"http://localhost:8181/A4CS.svc/$metadata#Orders&
  $select=OrderID,CustomerID,OrderDate,ShippedDate,Freight","value":[
    {"OrderID":11075,"CustomerID":"RICSU","OrderDate":"1998-05-06T00:00:00",
    "ShippedDate":null,"Freight":null},
    {"OrderID":11076,"CustomerID":"BONAP","OrderDate":"1998-05-06T00:00:00",
    "ShippedDate":null,"Freight":null},
    {"OrderID":11077,"CustomerID":"RATTC","OrderDate":"1998-05-06T00:00:00",
    "ShippedDate":null,"Freight":null}}}
```

odata_xml_7

[http://localhost:8181/A4CS.svc/Customers\('ALFKI'\)?\\$format=json&\\$expand=Orders&\\$select=CustomerID,ContactName,CompanyName,Orders/OrderID,Orders/ShipName,Orders/ShipCity,Orders/ShipCountry](http://localhost:8181/A4CS.svc/Customers('ALFKI')?$format=json&$expand=Orders&$select=CustomerID,ContactName,CompanyName,Orders/OrderID,Orders/ShipName,Orders/ShipCity,Orders/ShipCountry)

```
{
  "odata.metadata": "http://localhost:8181/A4CS.svc/$metadata#Customers/@Element&$select=CustomerID,ContactName,CompanyName,Orders/OrderID,Orders/ShipName,Orders/ShipCity,Orders/ShipCountry",
  "Orders": [
    {
      "OrderID": 10643,
      "ShipName": "Alfreds Futterkiste",
      "ShipCity": "Berlin",
      "ShipCountry": "Germany"
    },
    {
      "OrderID": 10692,
      "ShipName": "Alfred's Futterkiste",
      "ShipCity": "Berlin",
      "ShipCountry": "Germany"
    },
    {
      "OrderID": 10702,
      "ShipName": "Alfred's Futterkiste",
      "ShipCity": "Berlin",
      "ShipCountry": "Germany"
    },
    {
      "OrderID": 10835,
      "ShipName": "Alfred's Futterkiste",
      "ShipCity": "Berlin",
      "ShipCountry": "Germany"
    },
    {
      "OrderID": 10952,
      "ShipName": "Alfred's Futterkiste",
      "ShipCity": "Berlin",
      "ShipCountry": "Germany"
    },
    {
      "OrderID": 11011,
      "ShipName": "Alfred's Futterkiste",
      "ShipCity": "Berlin",
      "ShipCountry": "Germany"
    }
  ],
  "CustomerID": "ALFKI",
  "CompanyName": "Alfreds Futterkiste",
  "ContactName": "Maria Anders"
}
```

odata_xml_8

[http://localhost:8181/A4CS.svc/Orders\(\)?\\$format=json&\\$orderby=OrderID&\\$top=3&\\$expand=Customer&\\$select=OrderID,CustomerID,Customer/ContactName,Customer/CompanyName](http://localhost:8181/A4CS.svc/Orders()?$format=json&$orderby=OrderID&$top=3&$expand=Customer&$select=OrderID,CustomerID,Customer/ContactName,Customer/CompanyName)

```
{
  "odata.metadata": "http://localhost:8181/A4CS.svc/$metadata#Orders&$select=OrderID,CustomerID,Customer/ContactName,Customer/CompanyName",
  "value": [
    {
      "Customer": {
        "CompanyName": "Vins et alcools Chevalier",
        "ContactName": "Paul Henriot *****",
        "OrderID": 10248,
        "CustomerID": "VINET"
      }
    },
    {
      "Customer": {
        "CompanyName": "Toms Spezialit\u00e4ten",
        "ContactName": "Karin Josephs",
        "OrderID": 10249,
        "CustomerID": "TOMSP"
      }
    },
    {
      "Customer": {
        "CompanyName": "Hanari Carnes",
        "ContactName": "Mario Pontes",
        "OrderID": 10250,
        "CustomerID": "HANAR"
      }
    }
  ]
}
```

odata_xml_9

[http://localhost:8181/A4CS.svc/Orders\(\)?\\$format=json&\\$orderby=OrderID&\\$top=3&\\$expand=Customer&\\$select=OrderID,CustomerID,Customer/ContactName,Customer/CompanyName](http://localhost:8181/A4CS.svc/Orders()?$format=json&$orderby=OrderID&$top=3&$expand=Customer&$select=OrderID,CustomerID,Customer/ContactName,Customer/CompanyName)

```
{
  "odata.metadata": "http://localhost:8181/A4CS.svc/$metadata#Orders&$select=OrderID,CustomerID,Customer/ContactName,Customer/CompanyName",
  "value": [
    {
      "Customer": {
        "CompanyName": "Vins et alcools Chevalier",
        "ContactName": "Paul Henriot *****",
        "OrderID": 10248,
        "CustomerID": "VINET"
      }
    },
    {
      "Customer": {
        "CompanyName": "Toms Spezialit\u00e4ten",
        "ContactName": "Karin Josephs",
        "OrderID": 10249,
        "CustomerID": "TOMSP"
      }
    },
    {
      "Customer": {
        "CompanyName": "Hanari Carnes",
        "ContactName": "Mario Pontes",
        "OrderID": 10250,
        "CustomerID": "HANAR"
      }
    }
  ]
}
```

Project folder structure

Your ODATA projects should keep the given skeleton structure!

In fact, **you must NOT change anything else except the jbon007 source files!**

- **bin** : compiler output, **A4Y.dll**, plus copies of the required libraries
- **lib** : required libraries
- **data** : XML documents
- **_Compile A4XS.bat** : compilation batch, **jbon.svc.XS** => **.\bin\A4XS.dll**
- **_localhost-8181-A4XS.svc** : URL shortcut to test if the service is running
- **_Service_IISExpress_x64_8181.bat** : starts IISExpress on port 8181 (64 bits)
- **_Service_IISExpress_x86_8181.bat** : starts IISExpress on port 8181 (32 bits)
- **A4XS.svc** : WCF processing directive, pointing to **A4XS,A4XS** (namespace,class)
- **jbon007.svc.XS** : source file – for you to write and **rename** (following the demo model)
 - to test this, you also need to edit the source name in the compile batch (but you do not need to submit the modified batch), e.g.

```
< set SOURCE=jbon007  
> set SOURCE=apow001
```

- **Web.config** : service config file

Where **X** is either **C** (for **C#**) or **F** (for **F#**).

Running and testing

To run and test your service, you must follow the following steps:

1. Compile your source file with the given **_Compile A4XS.bat**; the resulting **A4XS.dll** will be stored in the **bin** folder (together with all required libraries)
2. Start **IISExpress** with the appropriate **batch**
3. Optionally, double click on the **_localhost-8181-A4XS.svc** URL shortcut (which will start the **browser** and display the two entities)
4. Continue testing, using your favourite WCF client: a **browser**, a browser **add-on** (such as **RESTClient** in Firefox), **Linqpad**, ...

Development

Of course, we will NOT attempt to develop an ODATA service from scratch, even such a simple service restricted to GET queries. Instead, we will “piggy-back” on extant libraries, which allow us to fill in just our specific business requests – using various flavours of **LINQ**, i.e. in a crisp **functional way!**

For development, we suggest the following tools: **Notepad++**, **Linqpad** or other light weight editors. You are free to use **VS**, but your submitted project must NOT contain any trace of this and must still have the indicated structure and behaviour!

Note that the model solution has about 100 well-spaced lines, so you probably do not need to write more – much more than this may be a sign of a wrong approach.

Assignment Marks, Deliverables and Submission

This assignment is worth **5 total course marks**. Please note the strict COMPSCI policy on **plagiarism**.

Submit electronically, to the COMPSCI web assignment dropbox, your **two source files**, named after your UPI, e.g. **jbon077.svc.cs** and **jbon007.svc.fs**. The submission size will be **limited to 20 KB** per student.

Please recheck your projects before submitting, starting from the archive prepared for submission (which is the only thing that the marker will receive from you)!

You can submit several times, but only the **last submission** will be assessed. Please keep your electronic dropbox **receipt!**

Deadline

Monday 1 Oct 2018, 18:00! Please do not leave it for the last minute. Remember that you can resubmit and, by default, we only consider your **last submission**.

After this deadline, submissions will be still accepted for 4 more days, with gradually increasing penalties, of 0.5% for each hour late. For example:

Monday 1 Oct 2018, 20:00:	-1%,	Tuesday 2 Oct 2017, 18:00:	-12%
Tuesday 2 Oct 2018, 20:00:	-13%,	Wednesday 3 Oct 2017, 18:00:	-24%
Thursday 4 Oct 2018, 18:00:	-36%,	Friday 5 Oct 2017, 18:00:	-48%

After this, no more submissions are accepted!