Technical Note

REP++ Serialization: Implementing the Undo Command

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Overview

REP++ RowsetTree and Rowset objects support the serialization/deserialization process of their content to or from a number of formats. This capability can be used to save the content of a RowsetTree or Rowset in a file or buffer for later retrieval. The serialized content is perfectly safe for interprocess and even internetwork communications. As a result, it can be retrieved and restored (i.e. deserialized) in the same or in a different application, which may or may not run on the same computer.

The capability to serialize and deserialize REP++ objects has created a number of possible uses:

- Use REP++ objects as Web services' parameters.
- Save data to and load data from the file system directly.
- Create standard data structures to send or receive a REP++ RowsetTree or Rowset to or from an application that is not REP++-aware.
- Keep and restore different snapshots of data to implement an **Undo** command.

This article describes how to use the REP++ serialization/deserialization capability to implement a simple **Undo** command.

Serializing and deserializing REP++ objects

You can serialize and deserialize RowsetTree and Rowset objects in a buffer or in a file using a binary or XML format. The objects provide the following serialization/deserialization methods.

Method	Description
LoadFromBuffer	Loads the content of a **RowsetTree** or **Rowset** object from a binary byte array.
LoadFromFile	Loads the content of a **RowsetTree** or **Rowset** object from a binary file.
LoadXMLFromBuffer	Loads the content of a **RowsetTree** or **Rowset** object from a string containing XML markup.
LoadXMLFromFile	Loads the content of a **RowsetTree** or **Rowset** object from an XML file.
SaveToBuffer	Saves the content of a **RowsetTree** or **Rowset** object to a byte array in binary format.
SaveToFile	Saves the content of a **RowsetTree** or **Rowset** object to a file in binary format.
SaveXMLToBuffer	Saves the content of a **RowsetTree** or **Rowset** object to a string in XML format.
SaveXMLToFile	Saves the content of a **RowsetTree** or **Rowset** object to an XML file.

The following parameters can be used when serializing/deserializing a binary format:

- **Compress** — When this parameter is not specified, its default value is *True*.
  - Set it to *True* when serializing to indicate that the binary content should be compressed.
  - Set it to *True* when deserializing to indicate that the binary content is compressed and thus needs to be decompressed before the deserialization.

- **ChangedOnly** — *True* to serialize only the new, deleted or modified lines. When this parameter is not specified, its default value is *False*.
- **LangNeutral** — *True* to serialize or deserialize content in a language-independent format. The meaning of this property is whether to serialize or deserialize the internal or external field values. When this parameter is not specified, its default value is *False*.

The following parameters can be used when serializing/deserializing the XML format:

- **ChangedOnly** — *True* to serialize only the new, deleted or modified lines. When this parameter is not specified, its default value is *False*.
- **RowsetTreePrefix** — String prefix for the XML element of a RowsetTreeDef.
- **RowsetPrefix** — String prefix for the XML element of a RowsetDef.
- **FieldPrefix** — String prefix for the XML element of a field.

Important

Please note that serializing or deserializing using the XML format is a lot slower than using the binary format.

Here is an example of an XML-serialized RowsetTree containing the list of clients in the contact management demo application.

```
- <CLIENT>
  - <CLIENT CurrentLine="1" DeletedLineCount="0" ChangedSinceReset="1">
    + <CLIENT LineState="0">
    + <CLIENT LineState="0">
    + <CLIENT LineState="0">
    + <CLIENT LineState="0">
    + <CLIENT LineState="0">
    + <CLIENT LineState="0">
    + <CLIENT LineState="0">
    + <CLIENT LineState="0">
    + <CLIENT LineState="0">
    + <CLIENT LineState="0">
    - <CLIENT LineState="0">
      - <Field>
          <CLIENTCODE FieldState="71">TREMPIER</CLIENTCODE>
          <CLIENTFIRSTNAME FieldState="71">Pierre</CLIENTFIRSTNAME>
          <CLIENTLASTNAME FieldState="71">Tremblay</CLIENTLASTNAME>
          <CLIENTTYPE FieldState="71">2</CLIENTTYPE>
          <CLIENTSALESTODATE FieldState="71">50000</CLIENTSALESTODATE>
          <CIECODE FieldState="71">MSFT</CIECODE>
          <CIENAME FieldState="71" />
          <CREATIONDATE FieldState="71">2006/11/20 13:43:26</CREATIONDATE>
          <MODIFICATIONDATE FieldState="71">2006/12/05 10:21:01</MODIFICATIONDATE>
          <DESCRIPTION FieldState="71" />
        </Field>
      - <Child>
        - <ADDRESS CurrentLine="1" DeletedLineCount="0" ChangedSinceReset="1">
          - <ADDRESS LineState="0">
            - <Field>
                <ADDRESSCODE FieldState="71">8</ADDRESSCODE>
                <ADDRESS_LINE1 FieldState="71">555 Rue Sainte-
                  Marie</ADDRESS_LINE1>
                <ADDRESS_LINE2 FieldState="71" />
                <CITY FieldState="71">Alma</CITY>
                <POSTALCODE FieldState="71">H8C1A5</POSTALCODE>
                <PROVINCE FieldState="71">PQ</PROVINCE>
              </Field>
            - <Child>
                <PHONE CurrentLine="0" DeletedLineCount="0" ChangedSinceReset="0" />
              </Child>
            </ADDRESS>
          </ADDRESS>
        </Child>
      </CLIENT>
    </CLIENT>
  </CLIENT>
```

The following Figure is a sample content of an XML-serialized Rowset that contains the address of the expanded client from the previous Figure.

```
- <ADDRESS CurrentLine="1" DeletedLineCount="0" ChangedSinceReset="1">
  - <ADDRESS LineState="0">
    - <Field>
        <ADDRESSCODE FieldState="71">8</ADDRESSCODE>
        <ADDRESS_LINE1 FieldState="71">555 Rue Sainte-Marie</ADDRESS_LINE1>
        <ADDRESS_LINE2 FieldState="71" />
        <CITY FieldState="71">Alma</CITY>
        <POSTALCODE FieldState="71">H8C1A5</POSTALCODE>
        <PROVINCE FieldState="71">PQ</PROVINCE>
      </Field>
    - <Child>
        <PHONE CurrentLine="0" DeletedLineCount="0" ChangedSinceReset="0" />
      </Child>
    </ADDRESS>
  </ADDRESS>
```

Implementing a simple Undo command

Undoing changes is a standard feature found in almost all commercial applications. The **Undo** command allows the end user to ignore recent changes and restore an older state by taking snapshots of the state while it is being modified. The principle is quite simple:

1. Take a snapshot of the original state.
2. Let the user make changes.
3. If the changes are saved, then overwrite the snapshot of the original state with a snapshot of the current state.
4. If the user clicks the **Undo** command, then overwrite the snapshot of the current state with the snapshot of the original state.

As you can see, the **Undo** command depends heavily on the presence of a mechanism to take and restore snapshots of an application's state. This can be achieved using the REP++ serialization and deserialization capability. REP++ enables you to:

1. Take a snapshot of a RowsetTree or Rowset by serializing its content to a buffer or file.
2. Restore a snapshot by deserializing a buffer or a file into a RowsetTree or Rowset.

The task of taking and restoring snapshots boils down to the following two methods:

```
private bool TakeSnapShot(RepPP.RowsetTree rsTree, out Byte[] arrSnapshot) {
  bool    bResult;

  arrSnapshot = null;
  bResult     = (rsTree.SaveToBuf(ref arrSnapshot) == (int)RepPP.ErrorCode.sdNoErr);
  return(bResult);
}

private bool RestoreSnapShot(RepPP.RowsetTree rsTree, Byte[] arrSnapshot) {
  bool bResult = false;

  if (arrSnapshot != null && arrSnapshot.Length != 0) {
    rsTree.Empty();
    bResult = (rsTree.LoadFromBuf(arrSnapshot) == (int)RepPP.ErrorCode.sdNoErr);
  }
  return(bResult);
}
```

To illustrate the implementation of your simple **Undo** command, you will use the contact management demo system to build an application that will:

1. Load the data.
2. Take a snapshot.
3. Change the data. The application will do the following:
   - Modify a client.
   - Delete a client.
   - Add an address for a client.
4. **Undo** your changes by restoring the snapshot taken in step 2.

Implementing the Undo command

1. Create a new Windows® project.
2. Add a reference to **RepPP.dll** (the REP++ class library for .NET).
3. Add the **TakeSnapShot** and **RestoreSnapShot** methods to the code of the default form.
4. Add the **DisplayData** helper method that will be used to display the state of the data at different stages:

```
private void DisplayData(string strTitle, RepPP.RowsetTree rsTreeClients) {
    RepPP.Application app;
    RepPP.Rowset      rowsetClients;
    RepPP.Rowset      rowsetAddresses;
    RepPP.Field       fldFirstName;
    string            strMessage;

    app = rsTreeClients.Application;
    rowsetClients = rsTreeClients.RootRowset;
    strMessage    = "The number of clients: ";
    strMessage   += rowsetClients.UndelLineCount;
    fldFirstName  = rowsetClients.Fields["ClientFirstName"];
    strMessage   += "\nThe first name of the first client: ";
    strMessage   += fldFirstName.GetValue(0, true);
    rowsetClients.SelectLine(1, true, true);
    rowsetAddresses = app.RowsetDefs["Address"].ActiveRowset;
    strMessage     += "\nThe number of addresses of the second client: ";
    strMessage     += rowsetAddresses.UndelLineCount;
    MessageBox.Show(strMessage, strTitle);
}
```

5. Add a button to the default form and handle its **Click** event to create the REP++ application object and load the list of clients:

```
private void button1_Click(object sender, EventArgs e) {
  RepPP.Application   app;
  RepPP.RowsetTreeDef rsTreeDef;
  RepPP.RowsetTree    rsTreeClients;
  RepPP.Rowset        rowsetClients;
  RepPP.Field         fldFirstName;

  using (app = RepPP.Application.CreateFromRes()) {
    rsTreeDef = app.RowsetTreeDefs["CLIENT"];
    rsTreeDef.BuildSqlCommand();
    using (rsTreeClients = rsTreeDef.RowsetTrees.Add()) {
      rsTreeClients.ReadFromDb();
      rowsetClients = rsTreeClients.RootRowset;
      fldFirstName  = rowsetClients.Fields["CLIENTFIRSTNAME"];

      DisplayData("Original data", rsTreeClients);
    }
  }
}
```

6. Add the following code to simulate different types of data modification:

```
private void button1_Click(object sender, EventArgs e) {
  RepPP.Application   app;
  RepPP.RowsetTreeDef rsTreeDef;
  RepPP.RowsetTree    rsTreeClients;
  RepPP.Rowset        rowsetClients;
  RepPP.Rowset        rowsetAddresses;
  RepPP.Field         fldFirstName;

  using (app = RepPP.Application.CreateFromRes()) {
    rsTreeDef = app.RowsetTreeDefs["CLIENT"];
    rsTreeDef.BuildSqlCommand();
    using (rsTreeClients = rsTreeDef.RowsetTrees.Add()) {
      rsTreeClients.ReadFromDb();
      rowsetClients = rsTreeClients.RootRowset;
      fldFirstName  = rowsetClients.Fields["CLIENTFIRSTNAME"];

      DisplayData("Original data", rsTreeClients);

      // Modify a Client
      fldFirstName.SetValue(0, true, "Modified");
      // Delete a Client
      rowsetClients.SelectLine(4);
      rowsetClients.DeleteLine();
      // Add an Address
      rowsetClients.SelectLine(1, true, false);
      rowsetAddresses = app.RowsetDefs["Address"].ActiveRowset;
      rowsetAddresses.AddBlankLine();

      DisplayData("Modified data", rsTreeClients);

    }
  }
}
```

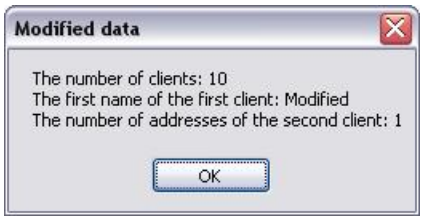
7. To simulate the implementation of an **Undo** command, take a snapshot of the original data (i.e. right after reading it from the database) and then restore the snapshot of the original data to ignore any intermediate changes:

```
private void button1_Click(object sender, EventArgs e) {
…
…
  DisplayData("Original data", rsTreeClients);

  // Take Client Snapshot
  if (!TakeSnapShot(rsTreeClients, out arrSnapshot)) {
    throw new ApplicationException("Cannot take Snapshot!");
  }

…
…
  DisplayData("Modified data", rsTreeClients);

  // Restoring Client Snapshot
  if (!RestoreSnapShot(rsTreeClients, arrSnapshot)) {
    throw new ApplicationException("Cannot restore Snapshot!");
  }

  DisplayData("Restored data", rsTreeClients);

…
…
}
```

8. Build the project and run the application. The following three message boxes indicate:

- The original data.

- The modified data.



- The restored data (to confirm that the **Undo** command was performed successfully).

Advanced Undo commands

The previous section described the basic building blocks of an **Undo** command. For instance, you have seen how to implement an **Undo** command that overwrites all changes made to the data since it was loaded from the database. The same basic building blocks will allow you to develop a number of sophisticated **Undo** commands. For example:

- You can take a snapshot after every change the user makes and thus implement a text editor-like **Undo** command.
- You can also take and restore a partial snapshot of data. For example, you can implement separate **Undo** commands for clients and addresses by using Rowset serialization instead of RowsetTree serialization.