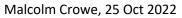
Demo 3: Updatable Views



[Slide 78 @ 36:05 of the video]

This demonstration explores the operation of RowSets, by considering the implementation of Views. [The process has been greatly streamlined in version 7.01, so that there are fewer stages in the account below than in the tutorial video, although the overall approach is similar. A more detailed account of this example is contained in the SourceIntro document in section 6.6.]

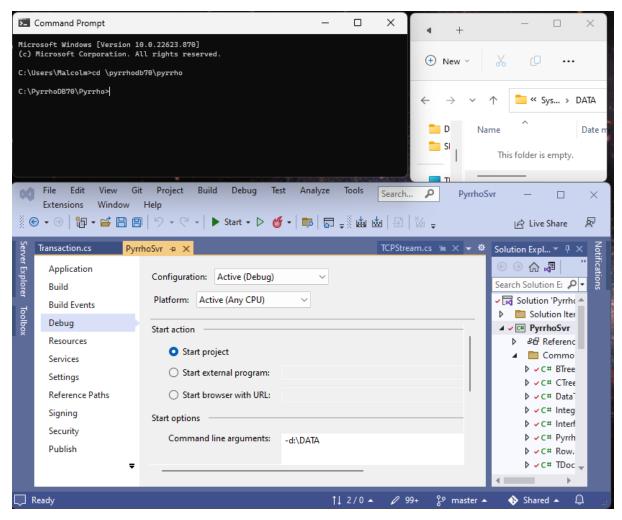
We will see that RowSets can be used for update, insert and delete actions in addition to queries

We will see the use of precompilation of complex database objects

We will see that RowSet analysis helps ensure that operations on Views are implemented as operations on the (possibly remote) base tables, but only if the user has the right permissions. (We consider remote data sets in Demo 4.)

[78 @ 36:37]

This demonstration traces through part of test12 of the PyrrhoTest program using the Visual Studio debugger. In Visual Studio, open the PyrrhoSvr solution in the src\Shared folder of the distribution. Set the debug properties of the PyrrhoSvr project to have -d:\DATA in the Command line arguments.



[79 @ 37:11]

From the Debug menu, select Options.. and ensure that the "Step over properties and operators (Managed only)" in Debugging/General is checked. Click OK.

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[80 @ 37:26]

Now click Start in the debugger, and in the popup command window, click Enter. We hide this window because it is not going to do anything interesting during this demo.

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We want to ensure that the database folder that we are using for our databases is currently empty before we start the demonstration.

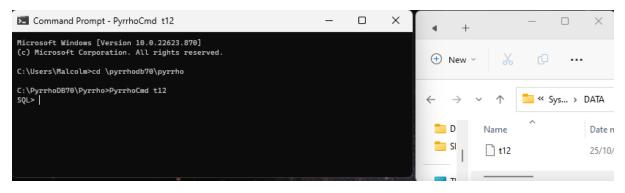
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Creating a View

[81 @ 37:48]

In a command window set to the distribution folder, start the command line client PyrrhoCmd for database t12. We see that the database is created by the server.

PyrrhoCmd t12



[82 @ 38:00]

In the command window, enter commands to create a table P with three columns, and a View which uses this table, renaming a column.

```
create table p(q int primary key,r char,a int)
create view v as select q,r as s,a from p
table "Log$"
```

We also want to look at the transaction log.

[83 @ 382:21]

Command Prompt - PyrrhoCmd t12	—		\times	+		—		×
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51 PIndex P on 23(29) PrimaryKey	PIndex	51						
67 PColumn3 R for 23(1)[CHAR]	PColumn3	67				~		
90 PColumn3 A for 23(2)[INTEGER]	PColumn3	90		D	Name			Date n
113 PTransaction for 1 Role=-502 User=-501 Time=25/10/2022 10:48:06	PTransaction	113						
131 PView V 131 view v as select q,r as s,a from p	PView	131		SI,	1 t12			25/10/
								23/10/
QL>								

In the log file, we see that the View definition in the database file is just recorded as the source of the select definition of the view.

When the server processes this, on load or on definition, it creates some compiled components, so that this statement doesn't have to be parsed every time it is used.

[84 @ 38:44]

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Security Publish Code Analysis	Start options	P ✓ C* Pyrmo.cs P ✓ C* Row.cs P ✓ C* Row.cs P ✓ C* TDocume P ✓ C* Tree.cs ■ Level1 P ✓ C* Crypt.cs

Let's pause the server so we can look at the precompiled objects.

Notice I have docked the Watch window.

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1312 CONSOLE WITCHING DALADASE TOLDER + PALIN); 1313 int cid = 0;	A	h Solution Explor P -
1314 for (; ;) 1315 = try		
1316 {		Solution 'PyrrhoSvr'
Socket client = tcp.AcceptSocket(); 1318 var t = new Thread(new ThreadStart(new PyrrhoServer(client).Server))		External Sources
1318 istantian 1319 istantian		Solution Items
1320 Name = "T" + (++cid)	2 🔹 🔺 🗸	C# PyrrhoSvr
1321 }; 1322 t.Start():		Pat References
1322 t.Start(); 1323 }		🗖 Common
1324 catch (Exception)		↓ ✓ C # BTree.cs
1325 { }		↓ ✓ C# CTree.cs
1326 } 1327 /// <summary></summary>		↓ C # DataType.
1328 /// The main entry point for the application. Process arguments and create the mai	in servid	
1329 ///	-	C# Integer.cs
1330 [STAThread] 0 references		C# Interfaces
1331 static void Main(string[] args)	*	👂 🗸 C# Pyrrho.cs 🔻
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[85 @ 38:54]

In the Watch window, examine Database.databases["t12"].objects[131] the View position.

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We see that there is a View defined in the Value.

[86 @ 39:11]

Let's expand that (it takes the server a moment to do it),

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and we see that there is a Framing field, and this contains the compiled components of the definition.

[87 @ 39:25]

Expand the framing, Right click on obs, and Copy its value.

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[88 @ 39:33]

Open a Notepad window, and click Paste. We see there is a fair bit in the framing field. We don't need to look at all this detail.

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	4=SelectR 7=SqlCopy 13=SqlCop 20=SqlCop 24=Domain 26=TableR 30=Domain	TABLE (29,67,90)[29,135],[owSet`4:`24 key (`7) targ `7 135 Q From:`26 copy fr y `13 CHAR R From:`26 Alia: y `20 135 A From:`26 copy TABLE (`7,`13,`20) Display owSet`26:`30 Indexes=[(`7 TABLE (`7,`13,`20) Display Statement`32 Union=`4)}	ets: 23=`26 From: `: om 29, s=S copy from 67, from 90, y=3[`7,135],[`13,CH)51] key (`7) targe	AR],[`20,135], ts: 23=`26 From: `	26 Target=23 SRow:(29,6	7,90) Tar	get:23	Ρ,
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We notice straightaway that the Domain `24 of the View and the domain `2 of the table don't match. There is a relationship, as the types of the columns match, but the uids are all different. In the table, they are of the columns, but in the View `7, `13, and `20 are some of the compiled objects. These positions (like file positions) are assigned when the database is loaded. However, a view might be referenced in more than one place in a complex SQL statement, so each reference will be instanced, to use per-reference uids in the heap uid range.

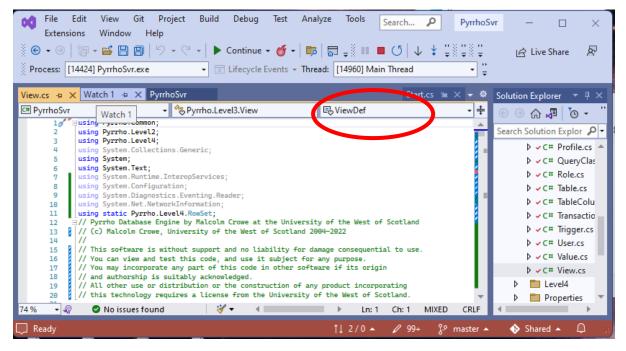
[92 @ 40:41]

Now, in Solution Explorer, scroll down to the end of the Level 3 folder, (I have collapsed the View object in the Watch window to make space for the next bit.)

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Double-click View.cs

[93 @ 40:54]



Find the Instance() method in the Targets list, and click on it,

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39	2 🔄 operator + (View v, (long, object) x)			♦ 🗸 C# TableC	olu

[94 @ 40:59]

and set breakpoints in Visual Studio at the start and end of the View.Instance() method (line 95 and of View.cs):

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	90	/// <param name="cx"/>	
	91	/// <pre>/// <pre>Search Solution Explor </pre></pre>	-
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:	93 💅 日	<pre>>> internal override DBObject Instance(long lp, Context cx, BList<ident> cs = null) </ident></pre>	
	94		
-	95 96	var od = cx.done; cx.done = ObTree.Empty;	
	97	var st = framing.result; Var st = framing.result;	
	98	cx.instDFirst = (cx.parse == ExecuteStatus.Obey) ? cx.nextHeap : cx.db.nextStmt; > <pre></pre>	
	99	cx.instSFirst = (framing.obs.PositionAt(Transaction.Executables)?.key() ?? 0L) = 1; v instSinct = forming.obs.PositionAt(22 = all:	
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	101	cx uids += (defoos _ pi):	11
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	104	var fo = (Framing)framing.Fix(cx); ▷ ✓ C# Value.cs	- F
	105	var ns = cx.Fix(st); var dt = cx.Fix(domain); ▷ ✓C# View.cs	
	106	var vi = (View/Relocate(ni) + (ViewResult, ns) + (_From,lp);	
	108	vi = (View)vi.Fix(cx):	
_	109	cx.Add(vi):	× 1
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[95 @ 41:09]

and line 161:

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	<pre>>= cx.nextHeap)</pre>			▷ ✓ C # Profile.cs ▲
153 cx.	.nextHeap = t + 1;		2	◊ ✓ C# QueryClas
	>= cx.db.nextStmt)		1	▷ ✓ C# Role.cs
	+= (Database.NextStmt,t + 1);			
157 vi += (_Dom	main,dt);		1	↓ ✓ C # Table.cs
158 // cx.defs =				Þ ✓ C# TableColu
159 cx.done = 0				♦ ✓ C# Transactio —
-	RowSets(vn, cx, (Domain)cxOb(dt), vi.	/iewTable);		,
● 161				▷ ✓ C # Trigger.cs
	on the complete set if a view is refere	nced.		♦ ✓ C# User.cs
	ing tasks should get carried out by App			▷ ✓ C # Value.cs
	column can be dropped from the request		es it.	
166 /// 4. If a vi	iew column is used as a simple filter,	-		▷ ✓ C# View.cs
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at the end of the Instance method. The View.Instance() method responds to a reference to the View.

[96 @ 41:22]

Allow the server to Continue execution.

[97 @ 41:29]

Let us use the following insert statement to add some rows to the table P:

```
insert into v(s) values('Twenty'),('Thirty')
```

Pos	Desc	Туре	Affects	/
5	PTransaction for 5 Role=-502 User=-501 Time=11/05/2021 20:32:48	PTransaction	5	
23	PTable P	PTable	23	
29	Domain INTEGER	PDomain	29	
13	PColumn3 Q for 23(0)[29]	PColumn3	43	
54	PIndex P on 23(43) PrimaryKey	PIndex	64	
30	Domain CHAR	PDomain	80	
93	PColumn3 R for 23(1)[80]	PColumn3	93	
115	PColumn3 A for 23(2)[29]	PColumn3	115	
137	PTransaction for 1 Role=-502 User=-501 Time=11/05/2021 20:32:48	PTransaction	137	
155	PView V 155 select g,r as s,a from p	PView	155	

This is obviously not what views are normally used for, but in this demonstration, we show that we have updatable views. Views can be used, provided the permissions are set correctly, to make modifications to the underlying tables.

[98 @ 41:52]

When we click Enter for this insert statement, Visual Studio stops at the break point.

	'iew v as select q,r as s,a from p 	ا 	PView 	131 	\rightarrow .	~ ^	🚞 « Sys	> DATA
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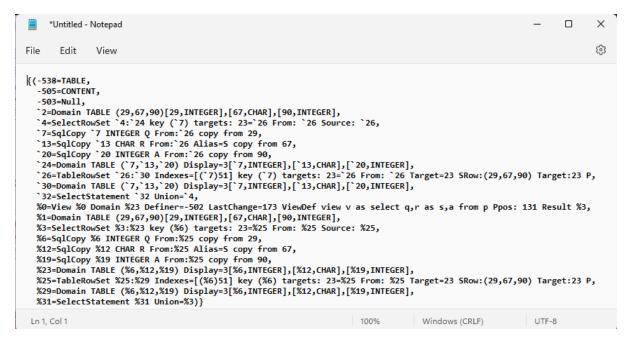
[99 @ 42:11]

As implied above, instancing of the view occurs when the Parser encounters a reference to the view. The only interesting parameter here is lp, the lexical position of the reference. Selecting hexadecimal display in the right-click menu on lp, we see it is 0x500000000000000 which we write as #15. The reference to v in the insert statement occurred at character position 15.

It is the very first object encountered by the parser, so the context is currently empty (cx.obs is {}). We will use the Watch window to see what objects the parser constructs during the Instance method: click continue:

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154 } 155 else if (t ≻= cx.db.nextStmt)	Search Solution Explor 👂 -		
156 cx.db += (Database.NextStmt,t + 1); 157 vi += (_Domain,dt);	♦ ✓ C# Profile.cs ▲		
158 // cx.defs = on; 159 cx.done = od;	Þ ✓C# QueryClas		
160 return vi.RowSets(vn, cx, (Domain)cxOb(dt), vi.viewTable);	↓ ✓ C# Role.cs		
162 - 7// <summary></summary>	↓ ✓ C # Table.cs		
163 /// Triggered on the complete set if a view is referenced.	◊ ✓ C# TableColu		
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Right-click the cx.obs value, and copy the value to replace the contents of our Notepad:



In addition to the compiled objects we now have the instanced view. %0 and %1 are 0x70000000000000 and 0x7000000000001 respectively. (We will soon see !0 which is 0x400000000000000.) These are long integers unlikely to clash with file positions. It appears so far that everything has been set up for a SELECT operation. We are performing an insert on V, but the above work makes it easy to insert directly into the TableRowSet %25, as we will see.

[100 @ 42:24] move on in the video to slide 112!

Place a breakpoint in Executable.cs at line 3175: in SqlInsert.Obey().

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Bit 3172 public override Context Obey(Context cx) 3173 { 3174 (cx.result = 0; 3175 var tg = (RowSet)cx.obs[source]; 3176 var data = (RowSet)cx.obs[value]; 3177 if (provenance!=null) xar ts = Bree <long, targetactivation="">.Empty; 3180 for (var it = tn rargetActivation>.Empty; 3180 ImagetActivation>.Empty; 74% ImagetActivation>.Empty; State ImagetActivation>.Empty; State<</long,>	 Level3 C# Check.cs C# Database. C# DBObject. C# Domain.c C# Executable C# Index.cs C# Method.c
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Again copy the value of cx.obs to replace the contents of our Notepad: the new lines are

#1=SqlInsert #1 Target: %3 Value: %33 Columns: [%12], #18=#24,#35, #24=SqlRow #24 Domain %34 , #25=Twenty, #35=SqlRow #35 Domain %35 , #36=Thirty,

```
%32=Domain TABLE (%12) Display=1[%6,INTEGER],[%12,CHAR],[%19,INTEGER],
%33=SqlRowSet %33:%36 targets: 23=%25 SqlRows [#24,#35],
%34=Domain ROW (#25)[#25,CHAR],
%35=Domain ROW (#36)[#36,CHAR],
%36=Domain TABLE (%12) Display=1[%6,INTEGER],[%12,CHAR],[%19,INTEGER])}
It is not hard to see that the SqlInsert statement targets the SelectRowSet %3 from before, and has
two SqlRows to insert into it.
```

[113 @ 45:25]

StepOver to line 3177. We see that tg is the SelectRowSet %3, and data is the SqlRowSet %33. In case the trigger machinery is needed, a TableActivation is constructed at line 3183 which we will see in action at line 3192. So set the next breakpoint at line 3192.

[117 @ 46:18]

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ib is a cursor in the data rowset, and the TableActivation ta calls EachRow to insert a row into the target. StepInto this, and step over to line 497 in Activation.cs:

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The TableActivation uses a thing called a TransitionRowSet, a concept defined in the SQL standard. Here trs is a cursor for a TransitionRowSet %37, which has a TargetCursor tgc:

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[114 @ 45:35]

The TargetCursor has the column uids for the target table P, and column 67 holds the value Twenty from the SQL insert command. The server has supplied an autokey value 1 for the primary key column 29. At line 517 the new Record is constructed:

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From now on it is all about installing this record in the Transaction. We are at line 518, where Add() adds the new record r to the TableActivation, so that when we Step Out to line 3193 of Executable.cx we can see in the Watch window that that the physicals now include the new Record, awaiting a future Commit().

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But the Record has already been Installed in the table and its index in transaction ta.db, and the new table is also installed in the transaction as object[23]. Remember that this does not alter the Database t12, which will only be updated on commit. Line 3193 gets the context to adopt the new transaction value.

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[135 @ 49:26]

We are still in the loop in SqlInsert, and the next tiume around the loop we will add the second new Record, to the physicals, and the transaction's structures. Continue to Step over as you wish, or just click Continue;

[149 @ 52:05]

The successful commit is reported to the client. Check the new entries in the transaction log with

table "Log"

Command Prompt - PyrrhoCmd t12	_		×
SQL> insert into v(s) values('Twenty'),('Thirty')		•••	
2 records affected in t12			
QL> table "Log\$"			
		 Affects	
	Туре 		
5 PTransaction for 5 Role=-502 User=-501 Time=25/10/2022 10:48:05	PTransaction	5	
23 PTable P	PTable	23	
29 PColumn3 Q for 23(θ)[INTEGER]	PColumn3	29	
51 PIndex P on 23(29) PrimaryKey	PIndex	51	
67 PColumn3 R for 23(1)[CHAR]	PColumn3	67	
90 PColumn3 A for 23(2)[INTEGER]	PColumn3	90	
113 PTransaction for 1 Role=-502 User=-501 Time=25/10/2022 10:48:06	PTransaction	113	
131 PView V 131 view v as select q,r as s,a from p	PView	131	
173 PTransaction for 2 Role=-502 User=-501 Time=25/10/2022 15:01:19	PTransaction	173	
191 Record 191[23]: 29=1,67=Twenty	Record	191	
218 Record 218[23]: 29=13,67=Thirty	Record	218	
SQL>			

The important aspect in the above is that the changes are made to the Table, not the View. The View contains no data.

[150 @ 52:12]

Confirm the new contents of the table P (this is the real target of the INSERT statement, not V!)

table P

Command Prompt - PyrrhoCmd t12	_	- 🗆	×
<pre> 131 PView V 131 view v as select q,r as s,a from p 173 PTransaction for 2 Role=-502 User=-501 Time=25/10/2022 15:01:19 191 Record 191[23]: 29=1,67=Twenty 218 Record 218[23]: 29=13,67=Thirty </pre>	PView PTransact Record Record	131 ion 173 191 218	

This concludes the demonstration.

As an exercise, trace through the operation of updating a join.