Consultingwerk
software architecture and development

Lists, Generics, Enumerators, Enumerations, Serialization

DIY: Closing the OO Gap

EMEAPUG CHALLENGE

Mike Fechner, Director, Consultingwerk Ltd.
mike.fechner@consultingwerk.de

Consultingwerk Ltd.

- Independent IT consulting organization
- Focusing on **OpenEdge** and **related technology**
- Located in Cologne, Germany
- Customers in Europe, North America, Australia and South Africa
- Vendor of tools and consulting programs
- 25 years of Progress experience (V5 … OE11)
- Specialized in GUI for .NET, OO, Software Architecture, Application Integration

Warning!

- If you believe include files should not be used with class files at all, you are probably in the wrong presentation
- You will see how include files can be used to enhance OO ABL usability and help focus on the real problem

Sample Code

- https://github.com/consultingwerk/ListsAndEnumSamples

Agenda

- **Introduction – OO ABL**
- OO ABL’s missing features
- Lists of Objects
- Generic Lists of Objects
- List Enumerators
- Enumerations
- Object Serialization

Introduction - OO ABL

- OOABL is not a separate language, it‘s a feature of the ABL (aka 4GL available since 1982)
- OO ABL and procedural cooperate
- Procedures can
  - create Object instances
  - Invoke methods of Objects
  - Get/Set properties
  - Subscribe to events from classes/events
- Procedures can use classes as parameters

```
DEFINE INPUT PARAMETER poParameter AS Sample01.CustomerReportParameter NO-UNDO .
```

OO ABL Timeline

- **10.1A first implementation**, classes, objects, methods
- 10.1B **Interfaces**, USING statement, properties
- 10.1C **Static members**, **structured error-handling**, properties in Interfaces, DYNAMIC-NEW
- 10.2A **GUI for .NET**, **garbage collection** for objects (anything reference by a WIDGET-HANDLE or COM-HANDLE is not an object)
- 10.2B **Abstract classes**, abstract members, .NET generic type definition, **strong typed events**, reflection part I

OO ABL Timeline

- 11.0 **DYNAMIC-PROPERTY**
- 11.0 **JSON Object Model** as classes
- 11.2 REST Adapter can call into class directly, singleton-run
- 11.4 **Serialization** between ABL Client and AppServer
- 11.4 Ability to THROW errors from AppServer to client
- 11.6 Enum's, Reflection
- Generally new language features are more often added as objects and not as new statements

OO ABL and AppServer

- The AppServer protocol only speaks procedural
- Every client needs to call into procedures (except the REST Adapter)
- Activate, Deactivate, Connect, Disconnect **procedures**
- AppServer may use objects from there on
- Can only pass an object as a parameter between AppServer and ABL Client from 11.4 on

OO ABL and AppServer

- Can‘t remotely call into an object like we can into a remote persistent procedure (not recommended anyway, but possible, unfortunately used a lot)

- OO ABL and AppServer limitation typically solved by OERA patterns:
  - Service Adapter on the client
  - Service Interface on the AppServer

Agenda

- Introduction – OO ABL
- **OO ABL’s missing features**
- Lists of Objects
- Generic Lists of Objects
- List Enumerators
- Enumerations
- Object Serialization

OO ABL‘s missing features

- Lists, Dictionaries
- Generic Lists and Dictionaries
- LINQ
- Enums (11.6)
- Reflection: Ability to query methods and properties of an object or a class (partly 11.6)
- Ability to query a classes, properties, methods annotations at runtime
- Serialization for non ABL clients
- Ability to store objects (structures) in DB

Risk with OO ABL‘s missing features

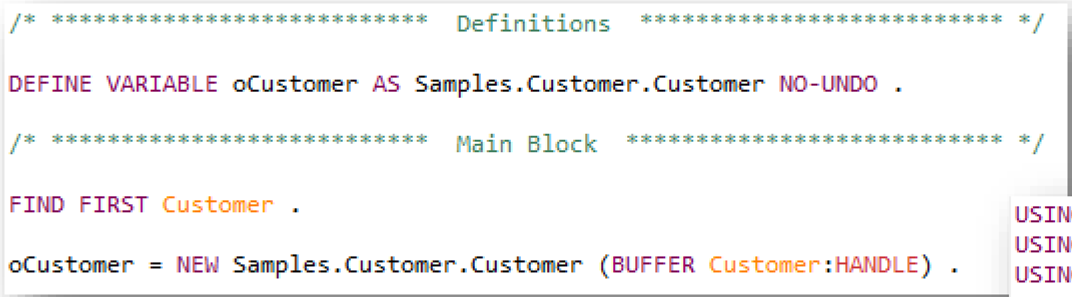
- Poor OO code …, too many workarounds
- ABL may be seen as a legacy code only language
- Difficulty adopting patterns or sample code form other OO languages to ABL
- Acceptance problems of OO ABL at young developers
- Modernization decisions may be based on missing OO features, ignoring the strength of the ABL in so many other aspects

Agenda

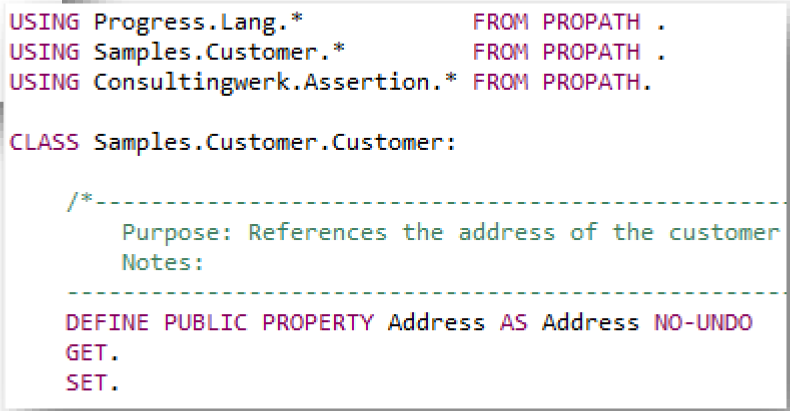
- Introduction – OO ABL
- OO ABL’s missing features
- **Lists of Objects**
- Generic Lists of Objects
- List Enumerators
- Enumerations
- Object Serialization

Lists of Objects

- ABL variable may reference a single object instance at a time
- ABL property may reference a single object at a time



```
/* ***************************  Definitions  ************************** */

DEFINE VARIABLE oCustomer AS Samples.Customer.Customer NO-UNDO .

/* ***************************  Main Block  *************************** */

FIND FIRST Customer .

oCustomer = NEW Samples.Customer.Customer (BUFFER Customer:HANDLE) .
```



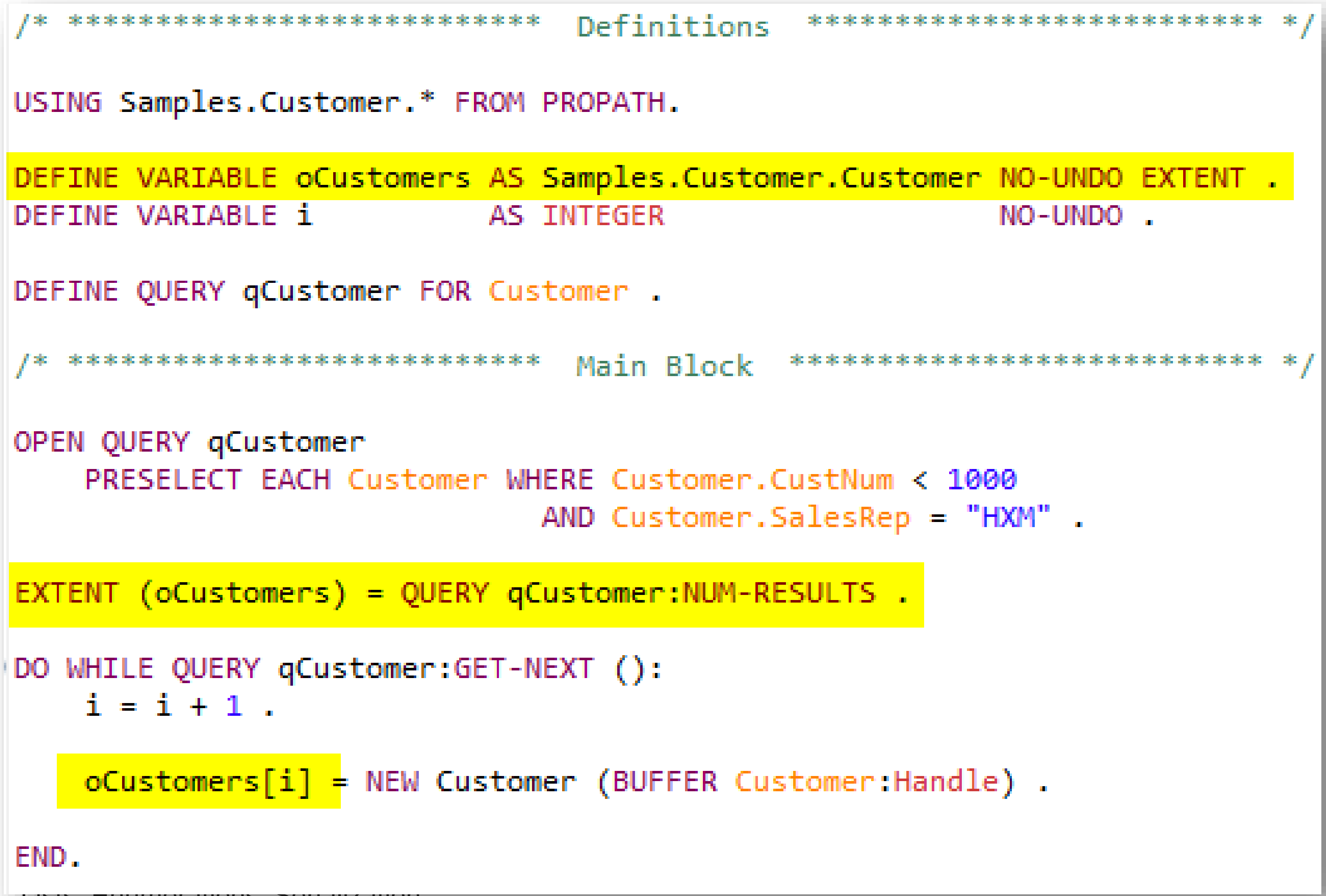
```
USING Progress.Lang.*             FROM PROPATH .
USING Samples.Customer.*          FROM PROPATH .
USING Consultingwerk.Assertion.*  FROM PROPATH.

CLASS Samples.Customer.Customer:

    /*------------------------------------------------------------------------
        Purpose: References the address of the customer
        Notes:
    ------------------------------------------------------------------------
    DEFINE PUBLIC PROPERTY Address AS Address NO-UNDO
    GET.
    SET.
```

List of Objects

- What if we are successful and win a second customer? Or a third? Or more?
- What if a customer may have multiple addresses?

- We can use arrays (EXTENT’s) of Objects

Referencing objects in an Array



```
/* ****************************  Definitions  *************************** */

USING Samples.Customer.* FROM PROPATH.

DEFINE VARIABLE oCustomers AS Samples.Customer.Customer NO-UNDO EXTENT .
DEFINE VARIABLE i          AS INTEGER                   NO-UNDO .

DEFINE QUERY qCustomer FOR Customer .

/* ****************************  Main Block  *************************** */

OPEN QUERY qCustomer
    PRESELECT EACH Customer WHERE Customer.CustNum < 1000
                              AND Customer.SalesRep = "HXM" .

EXTENT (oCustomers) = QUERY qCustomer:NUM-RESULTS .

DO WHILE QUERY qCustomer:GET-NEXT ():
    i = i + 1 .

    oCustomers[i] = NEW Customer (BUFFER Customer:Handle) .

END.
```

Demo

- Populating Array of Customers

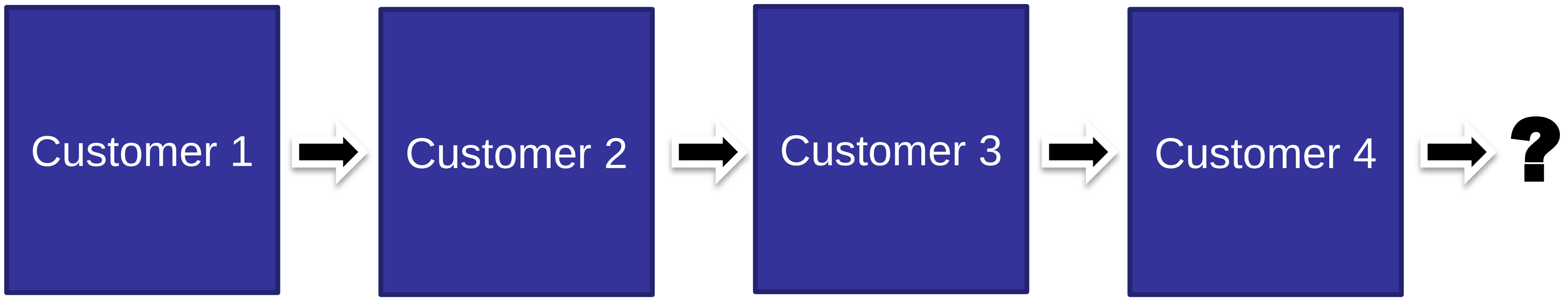
Array drawbacks

- Arrays are fixed in extent size once they contain data
- To re-size an Array (add another item or remove an item) you have to re-initialize the array causing the Array to loose all data (need to copy each element)
- An Array is considered a single variable – so all object references (pointers) are required to be within 32k
  - A rather theoretical limitation, I believe

Alternative variable length Lists

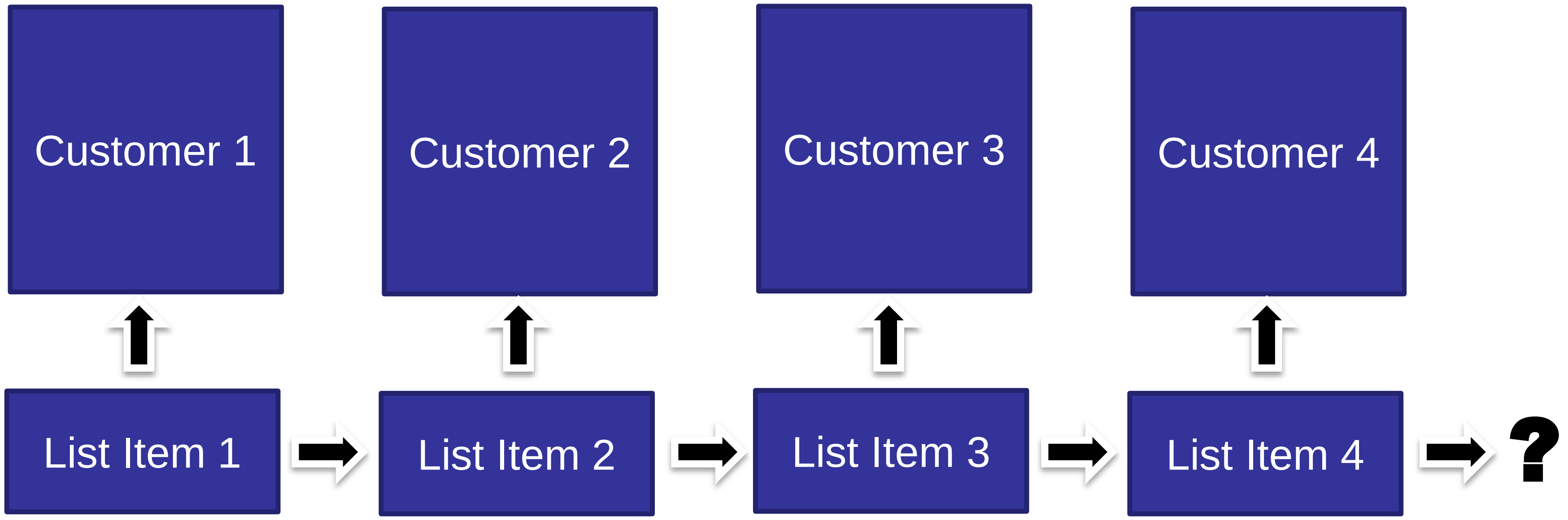
- Linked lists
- Temp-Table with Progress.Lang.Object field

Linked Lists



- Customer object needs additional property to reference next item in the list
- Disadvantage: Customer Object needs to manage list as well, no separation of concern

Linked lists



- Customer object kept as it
- Specialized “List Item” object instances that reference “their” customer instance and the next list item

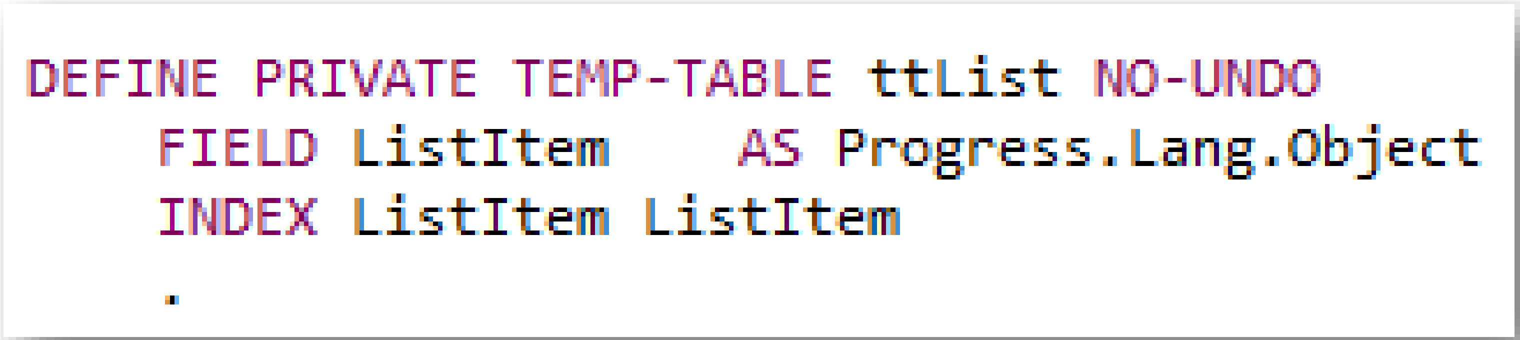
Linked Lists

- Allows all kind of List manipulations
- Add instance (at the end)
- Insert instance (anywhere in the list)
- Delete reference

- Requires additional object for list item
- Relatively complex implementation
  - not very ABL’ish – we don’t use ABL because we are keen to manipulate pointer values

List based on Temp-Table

- Temp-Tables may contain fields of type „Progress.Lang.Object“ to reference objects
- Temp-Tables may contain any number of records (0 .. n)
- Temp-Tables provide the “ABL”-ishst way of managing a variable set of object references



```
DEFINE PRIVATE TEMP-TABLE ttList NO-UNDO
    FIELD ListItem    AS Progress.Lang.Object
    INDEX ListItem ListItem
    .
```

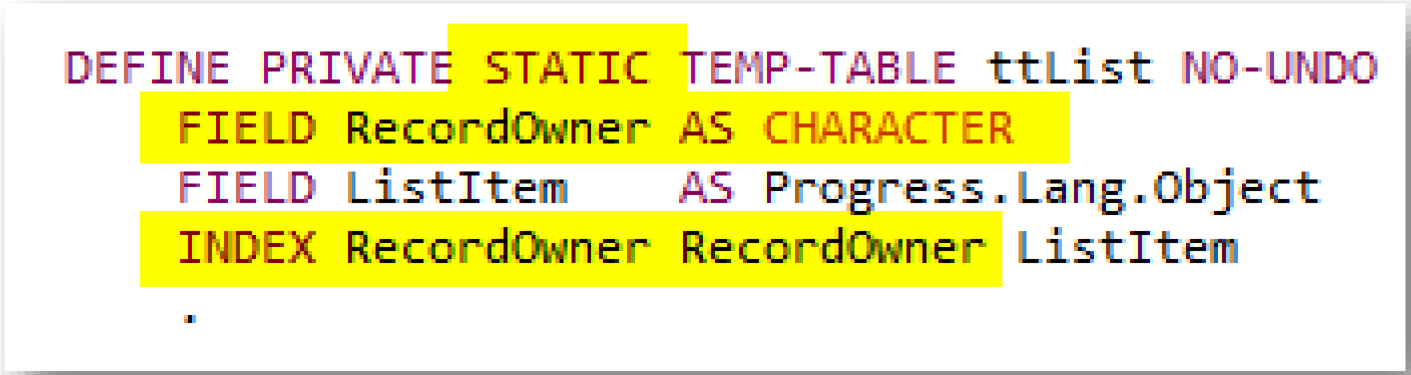
Typical List class methods

- Add (Progress.Lang.Object)
- Add (Progress.Lang.Object[])
- Clear ()
- LOGICAL Contains (Progress.Lang.Object)
- Progress.Lang.Object GetItem (INTEGER)
- Remove (Progress.Lang.Object)
- RemoveAt (INTEGER)
- Object[] ToArray ()

- PROPERTY: Count (INTEGER)

Reducing Temp-Table overhead

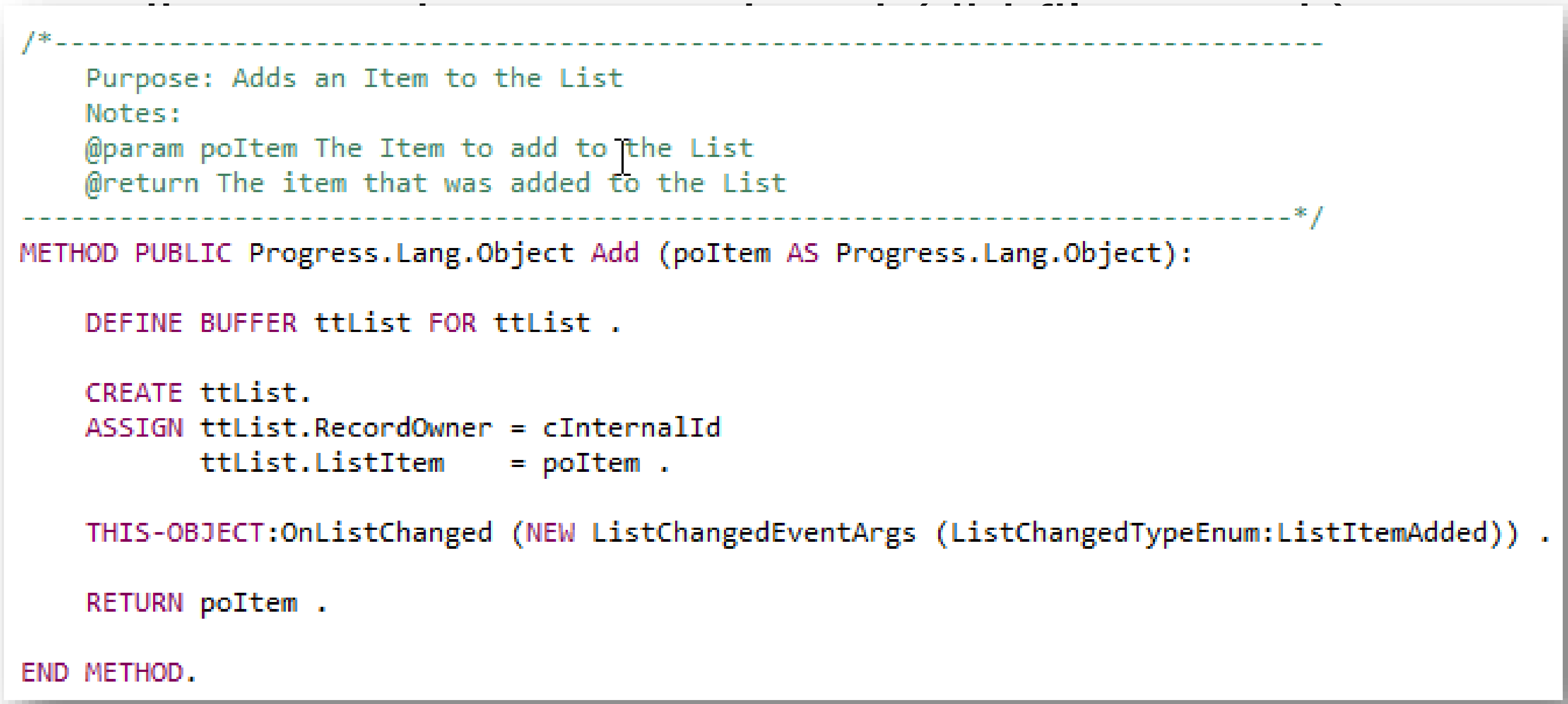
- OO may need lots of lists …
- Temp-Tables with small amount of records disproportionate overhead (dbi file growth)
- Issue relaxed for empty temp-tables in OE11
- Solution: break encapsulation – use shared temp-table



```
DEFINE PRIVATE STATIC TEMP-TABLE ttList NO-UNDO
    FIELD RecordOwner AS CHARACTER
    FIELD ListItem    AS Progress.Lang.Object
    INDEX RecordOwner RecordOwner ListItem
    .
```

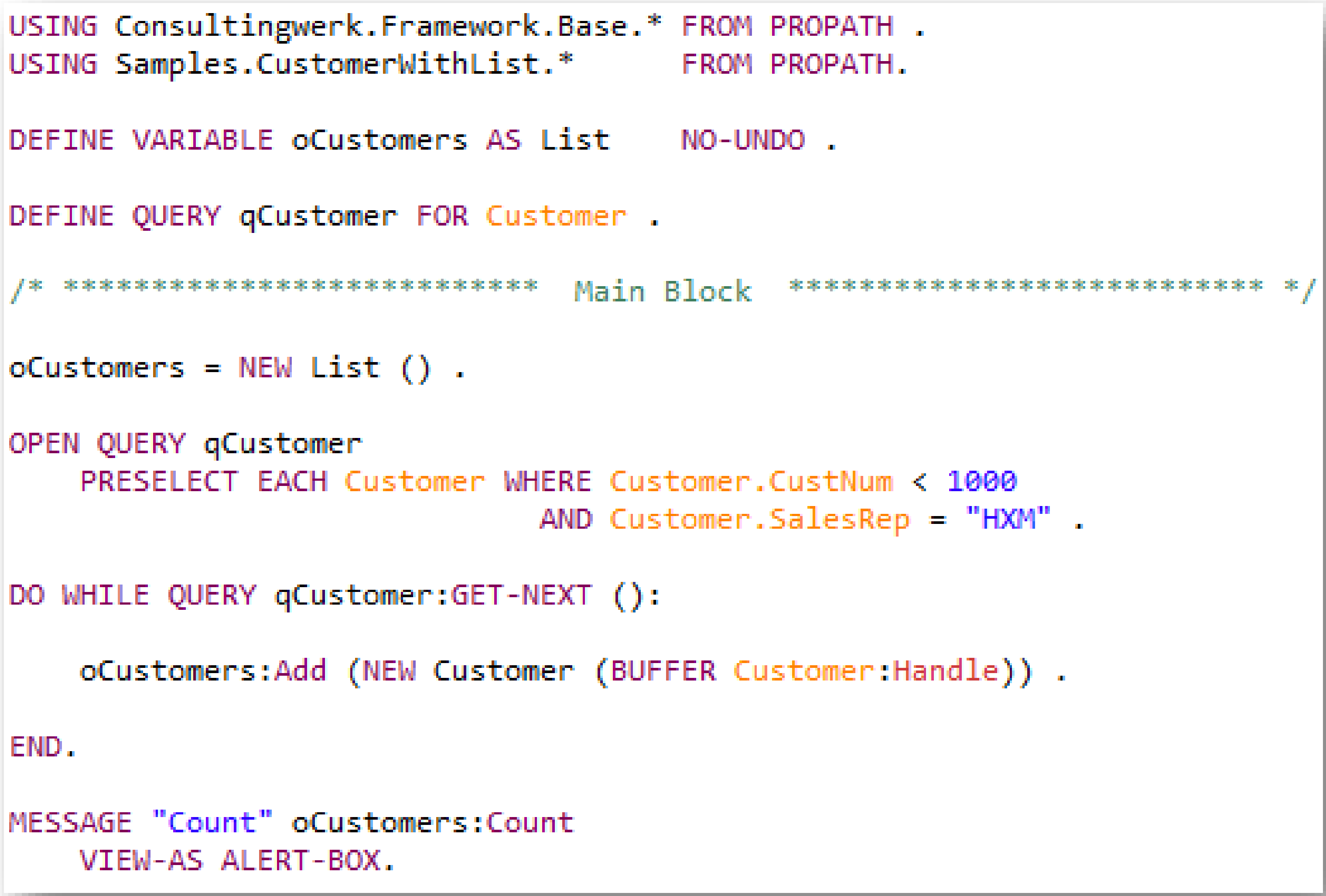
Reducing Temp-Table overhead

- OO may need lots of lists …
- Temp-Tables with small amount of records



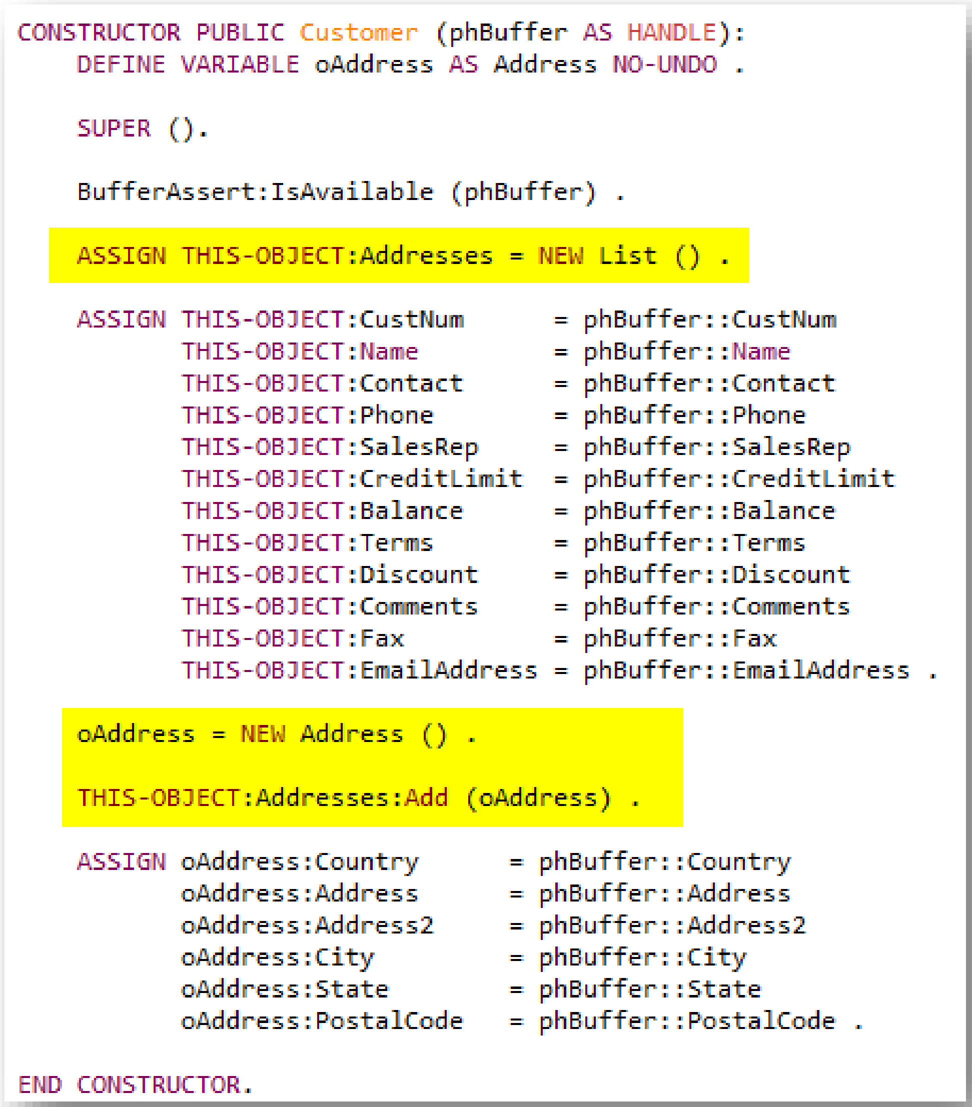
```
/*------------------------------------------------------------------------------
    Purpose: Adds an Item to the List
    Notes:
    @param poItem The Item to add to the List
    @return The item that was added to the List
------------------------------------------------------------------------------*/
METHOD PUBLIC Progress.Lang.Object Add (poItem AS Progress.Lang.Object):

    DEFINE BUFFER ttList FOR ttList .

    CREATE ttList.
    ASSIGN ttList.RecordOwner = cInternalId
           ttList.ListItem    = poItem .

    THIS-OBJECT:OnListChanged (NEW ListChangedEventArgs (ListChangedTypeEnum:ListItemAdded)) .

    RETURN poItem .

END METHOD.
```

Adding Customers to List class



```
USING Consultingwerk.Framework.Base.* FROM PROPATH .
USING Samples.CustomerWithList.*      FROM PROPATH.

DEFINE VARIABLE oCustomers AS List    NO-UNDO .

DEFINE QUERY qCustomer FOR Customer .

/* ***************************  Main Block  *************************** */

oCustomers = NEW List () .

OPEN QUERY qCustomer
    PRESELECT EACH Customer WHERE Customer.CustNum < 1000
                              AND Customer.SalesRep = "HXM" .

DO WHILE QUERY qCustomer:GET-NEXT ():

    oCustomers:Add (NEW Customer (BUFFER Customer:Handle)) .

END.

MESSAGE "Count" oCustomers:Count
    VIEW-AS ALERT-BOX.
```

Customer class with List of Addresses



```
CONSTRUCTOR PUBLIC Customer (phBuffer AS HANDLE):
    DEFINE VARIABLE oAddress AS Address NO-UNDO .

    SUPER ().

    BufferAssert:IsAvailable (phBuffer) .

    ASSIGN THIS-OBJECT:Addresses = NEW List () .

    ASSIGN THIS-OBJECT:CustNum      = phBuffer::CustNum
           THIS-OBJECT:Name         = phBuffer::Name
           THIS-OBJECT:Contact      = phBuffer::Contact
           THIS-OBJECT:Phone        = phBuffer::Phone
           THIS-OBJECT:SalesRep     = phBuffer::SalesRep
           THIS-OBJECT:CreditLimit  = phBuffer::CreditLimit
           THIS-OBJECT:Balance      = phBuffer::Balance
           THIS-OBJECT:Terms        = phBuffer::Terms
           THIS-OBJECT:Discount     = phBuffer::Discount
           THIS-OBJECT:Comments     = phBuffer::Comments
           THIS-OBJECT:Fax          = phBuffer::Fax
           THIS-OBJECT:EmailAddress = phBuffer::EmailAddress .

    oAddress = NEW Address () .

    THIS-OBJECT:Addresses:Add (oAddress) .

    ASSIGN oAddress:Country      = phBuffer::Country
           oAddress:Address      = phBuffer::Address
           oAddress:Address2     = phBuffer::Address2
           oAddress:City         = phBuffer::City
           oAddress:State        = phBuffer::State
           oAddress:PostalCode   = phBuffer::PostalCode .

END CONSTRUCTOR.
```

Sample

- Customer class with list of Addresses
- Loop through List of Customers
- Review List class methods

Agenda

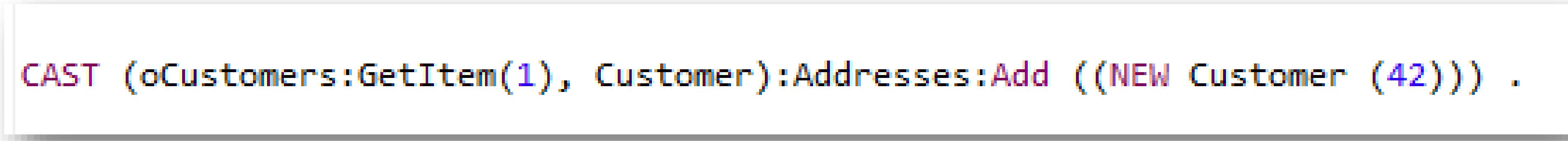
- Introduction – OO ABL
- OO ABL’s missing features
- Lists of Objects
- **Generic Lists of Objects**
- List Enumerators
- Enumerations
- Object Serialization

Generic Lists of Objects

- Standard List (of Progress.Lang.Object) has two main problems:
  - You can‘t enforce item type during Add
  - You have to cast to item type after GetItem()

Standard List can‘t enforce item type

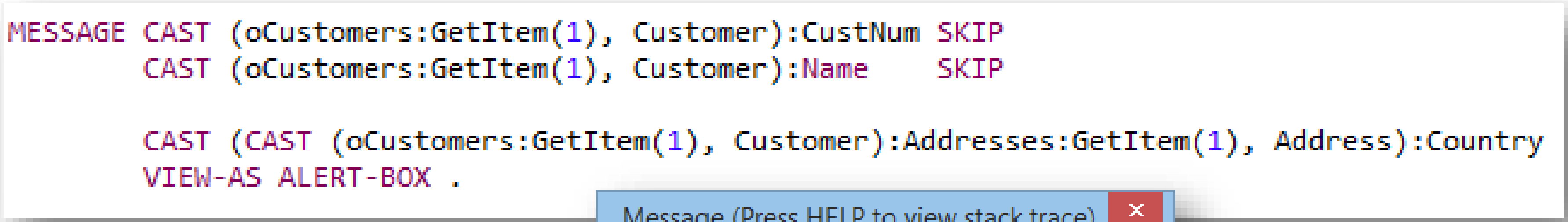
- Can add Address to oCustomers and add Customer to Addresses



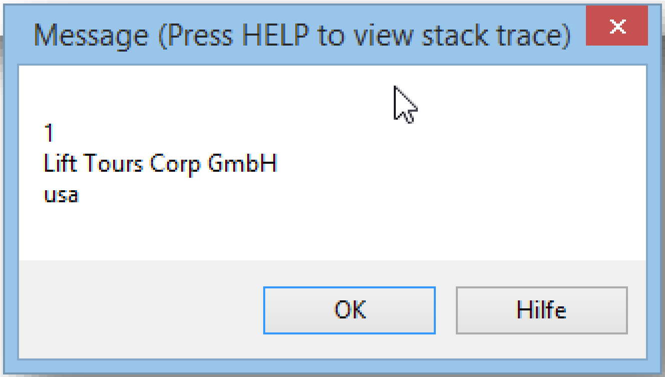
```
CAST (oCustomers:GetItem(1), Customer):Addresses:Add ((NEW Customer (42))) .
```

Standard List requires CAST on GetItem()

- Need to CAST GetItem(1) of oCustomers to Customer
- Need to CAST GetItem(1) of oCustomers:Addresses:GetItem(1) to Address



```
MESSAGE CAST (oCustomers:GetItem(1), Customer):CustNum SKIP
        CAST (oCustomers:GetItem(1), Customer):Name    SKIP

        CAST (CAST (oCustomers:GetItem(1), Customer):Addresses:GetItem(1), Address):Country
        VIEW-AS ALERT-BOX .
```



Message (Press HELP to view stack trace)

```
1
Lift Tours Corp GmbH
usa
```

Need for ListCustomer and ListAddress

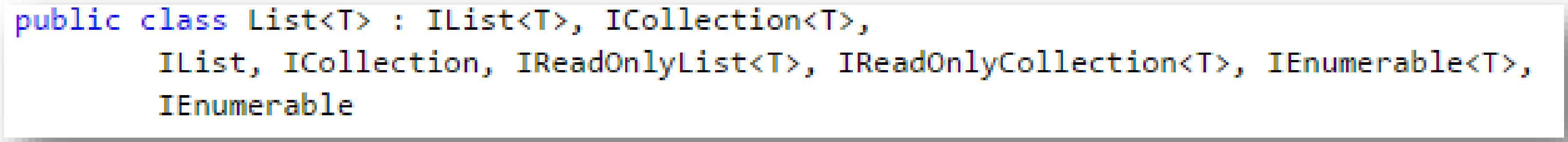
- Need specific List‘s for Customer and Address:

- ListCustomer
  - Add (Customer)
  - Customer GetItem (INTEGER)

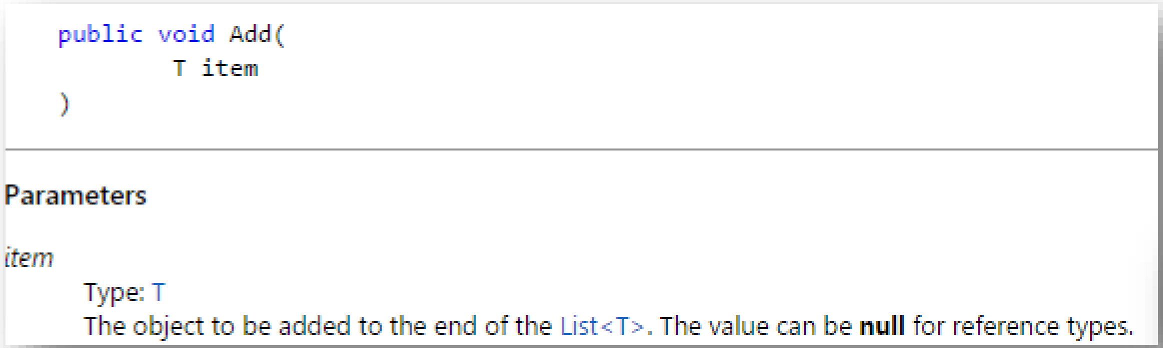
- ListAddress
  - Add (Address)
  - Address GetItem (INTEGER)

Generic Types in C#

- List<T>



```
public class List<T> : IList<T>, ICollection<T>,
        IList, ICollection, IReadOnlyList<T>, IReadOnlyCollection<T>, IEnumerable<T>,
        IEnumerable
```

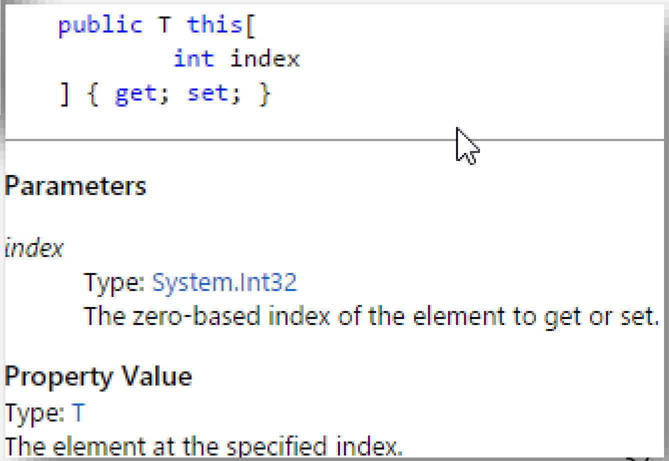


```
public void Add(
        T item
)
```

Parameters

item

Type: T
The object to be added to the end of the List<T>. The value can be **null** for reference types.



```
public T this[
        int index
] { get; set; }
```

Parameters

index

Type: System.Int32
The zero-based index of the element to get or set.

Property Value

Type: T
The element at the specified index.

Generic Types in C# (or GUI for .NET)

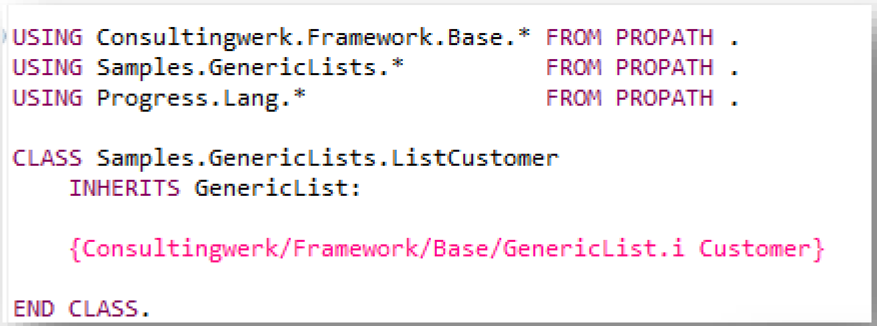
- DEFINE VARIABLE oList AS “List<Customer>” .
- On the fly defined …
- oList:Add (Customer)
- oList[0]:Name   -> no CAST required

- Add enforces list type
- GetItem does not require CAST to List Type

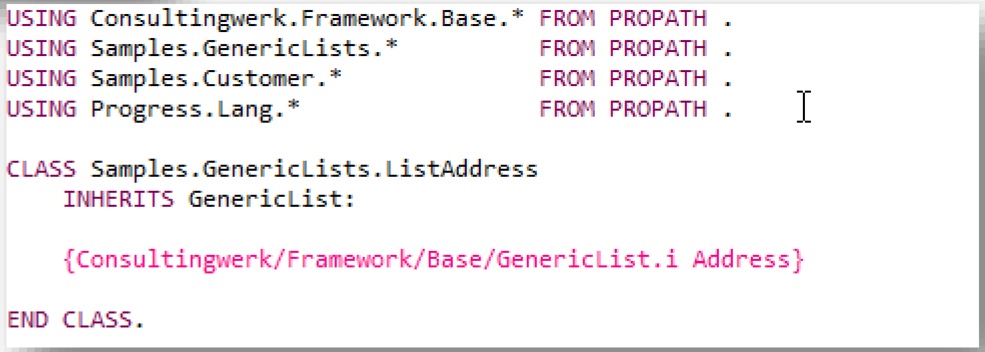
- **ABL lacks capabilities for ABL Generic Types**
- **.NET Generic Types only available for .NET classes, not available on UNIX**

Generic List in the ABL

- Generic List implementation using Include File …

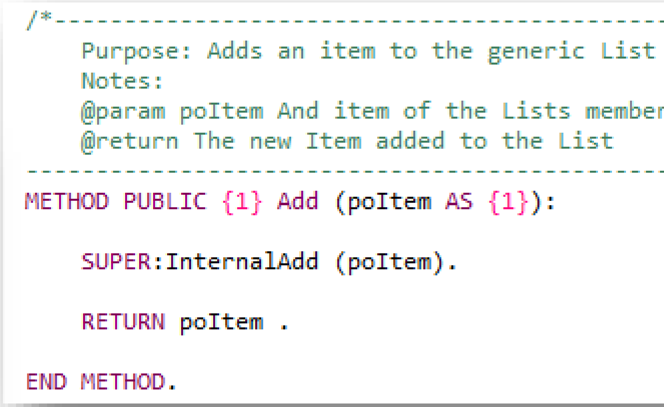


```
USING Consultingwerk.Framework.Base.* FROM PROPATH .
USING Samples.GenericLists.*          FROM PROPATH .
USING Progress.Lang.*                 FROM PROPATH .

CLASS Samples.GenericLists.ListCustomer
    INHERITS GenericList:

    {Consultingwerk/Framework/Base/GenericList.i Customer}

END CLASS.
```

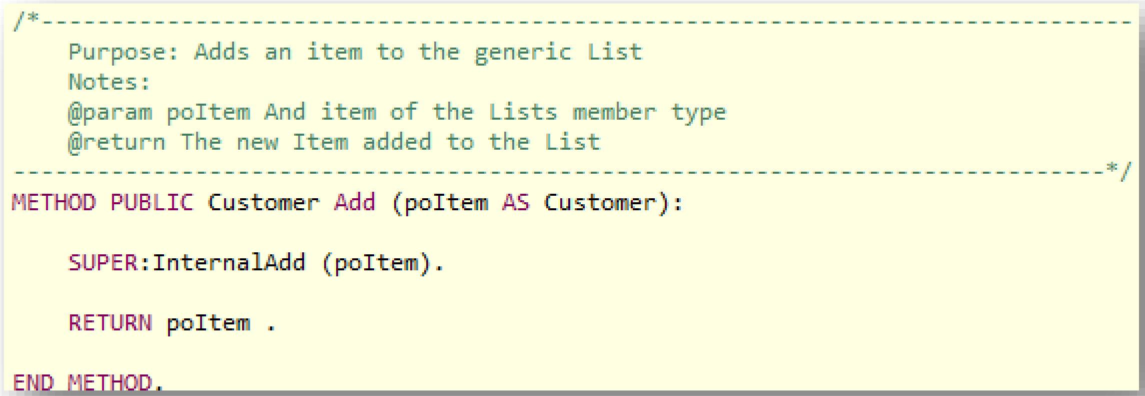


```
USING Consultingwerk.Framework.Base.* FROM PROPATH .
USING Samples.GenericLists.*          FROM PROPATH .
USING Samples.Customer.*              FROM PROPATH .
USING Progress.Lang.*                 FROM PROPATH .

CLASS Samples.GenericLists.ListAddress
    INHERITS GenericList:

    {Consultingwerk/Framework/Base/GenericList.i Address}

END CLASS.
```

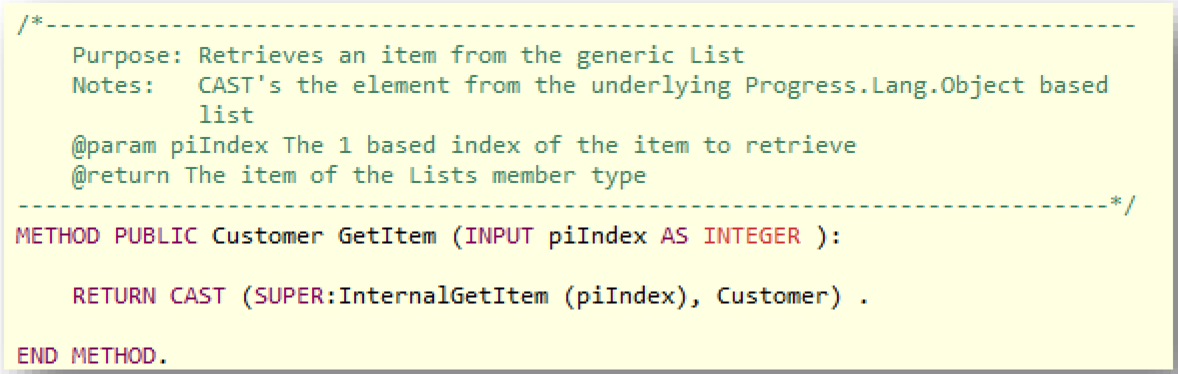
Preprocessor Listing



```
/*------------------------------------------------
    Purpose: Adds an item to the generic List
    Notes:
    @param poItem And item of the Lists membe
    @return The new Item added to the List
--------------------------------------------------
METHOD PUBLIC {1} Add (poItem AS {1}):

    SUPER:InternalAdd (poItem).

    RETURN poItem .

END METHOD.
```

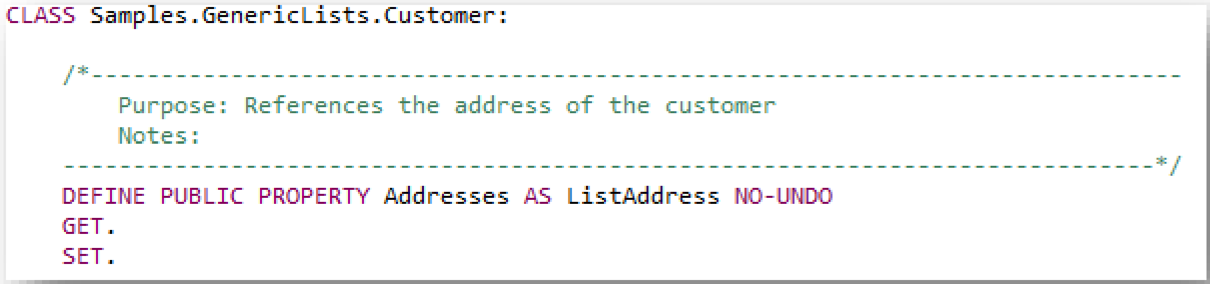


```
/*------------------------------------------------------------------------------
    Purpose: Adds an item to the generic List
    Notes:
    @param poItem And item of the Lists member type
    @return The new Item added to the List
------------------------------------------------------------------------------*/
METHOD PUBLIC Customer Add (poItem AS Customer):

    SUPER:InternalAdd (poItem).

    RETURN poItem .

END METHOD.
```

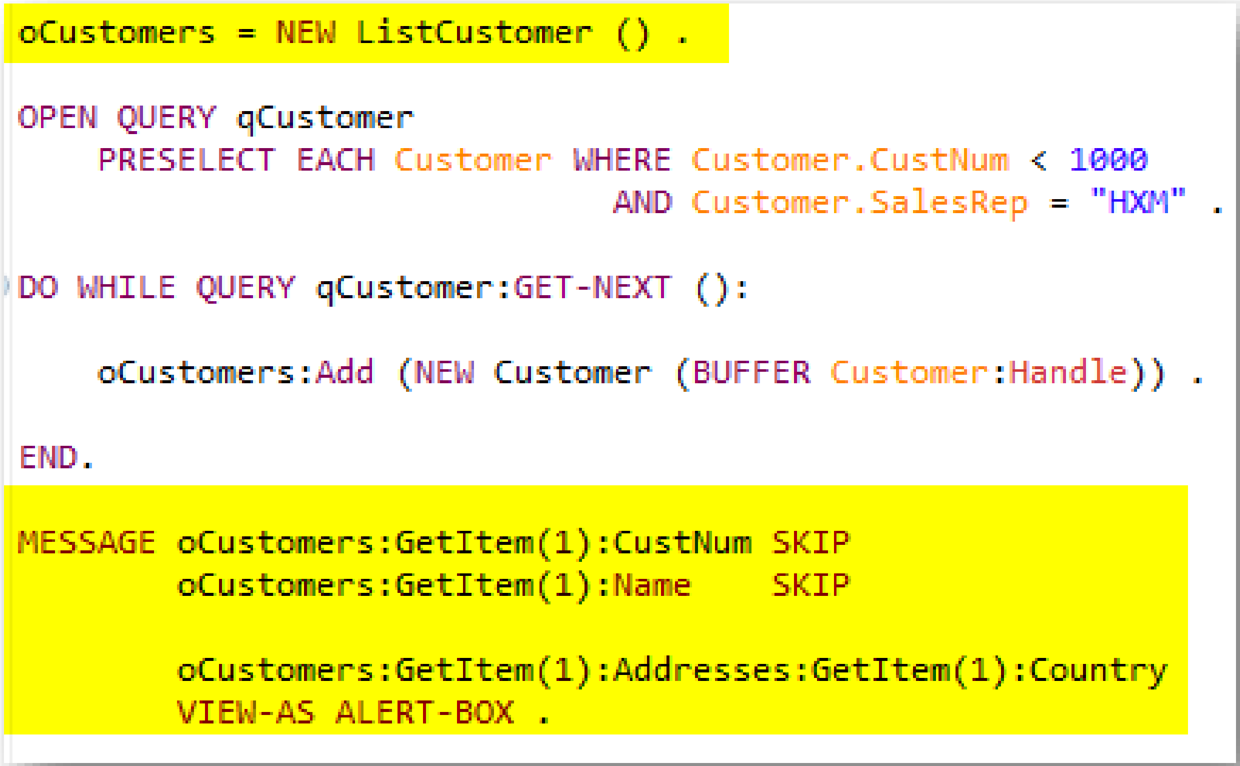


```
/*------------------------------------------------------------------------------
    Purpose: Retrieves an item from the generic List
    Notes:   CAST's the element from the underlying Progress.Lang.Object based
             list
    @param piIndex The 1 based index of the item to retrieve
    @return The item of the Lists member type
------------------------------------------------------------------------------*/
METHOD PUBLIC Customer GetItem (INPUT piIndex AS INTEGER ):

    RETURN CAST (SUPER:InternalGetItem (piIndex), Customer) .

END METHOD.
```

Access Customer and Address



```
CLASS Samples.GenericLists.Customer:

    /*------------------------------------------------------------------------------
        Purpose: References the address of the customer
        Notes:
    ------------------------------------------------------------------------------*/
    DEFINE PUBLIC PROPERTY Addresses AS ListAddress NO-UNDO
    GET.
    SET.
```



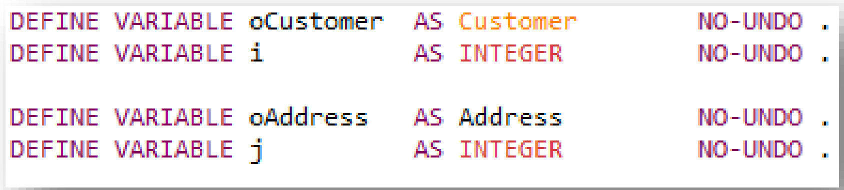
```
oCustomers = NEW ListCustomer () .

OPEN QUERY qCustomer
    PRESELECT EACH Customer WHERE Customer.CustNum < 1000
                              AND Customer.SalesRep = "HXM" .

DO WHILE QUERY qCustomer:GET-NEXT ():

    oCustomers:Add (NEW Customer (BUFFER Customer:Handle)) .

END.

MESSAGE oCustomers:GetItem(1):CustNum SKIP
        oCustomers:GetItem(1):Name    SKIP

        oCustomers:GetItem(1):Addresses:GetItem(1):Country
        VIEW-AS ALERT-BOX .
```

Agenda

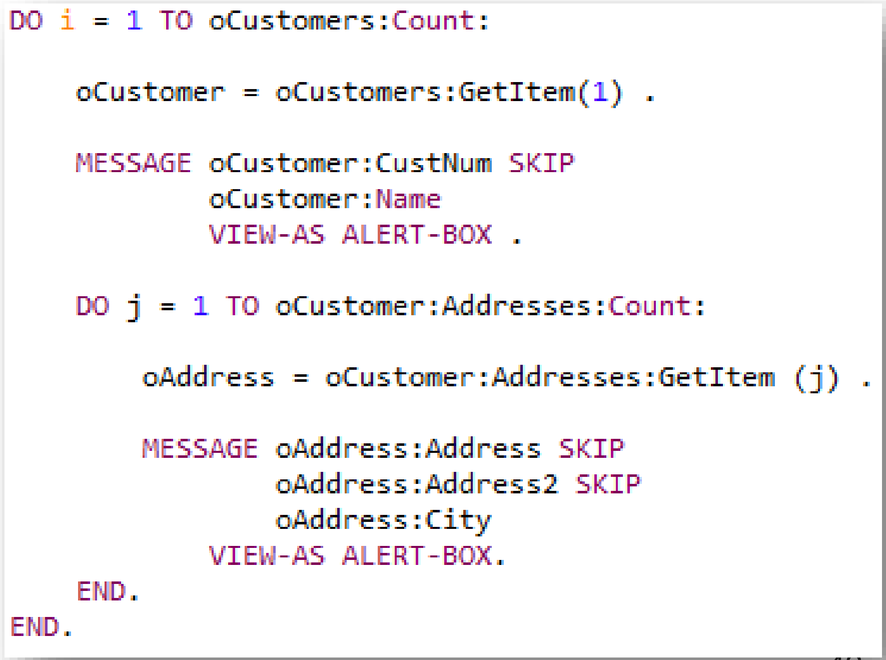
- Introduction – OO ABL
- OO ABL's missing features
- Lists of Objects
- Generic Lists of Objects
- **List Enumerators**
- Enumerations
- Object Serialization

List Enumerators

- Typical requirement to process all or some elements of the list in sequence
- One option to loop from 1 to oList:Count with a counter



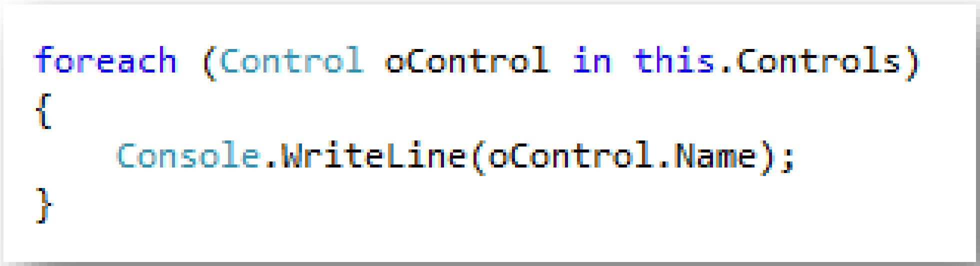
```
DEFINE VARIABLE oCustomer  AS Customer       NO-UNDO .
DEFINE VARIABLE i          AS INTEGER        NO-UNDO .

DEFINE VARIABLE oAddress   AS Address        NO-UNDO .
DEFINE VARIABLE j          AS INTEGER        NO-UNDO .
```



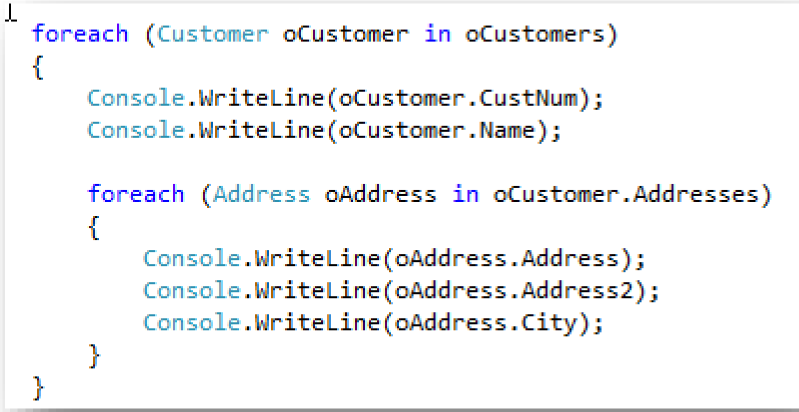
```
DO i = 1 TO oCustomers:Count:

    oCustomer = oCustomers:GetItem(1) .

    MESSAGE oCustomer:CustNum SKIP
            oCustomer:Name
            VIEW-AS ALERT-BOX .

    DO j = 1 TO oCustomer:Addresses:Count:

        oAddress = oCustomer:Addresses:GetItem (j) .

        MESSAGE oAddress:Address SKIP
                oAddress:Address2 SKIP
                oAddress:City
            VIEW-AS ALERT-BOX.
    END.
END.
```

Enumerator in C#

- C# allows to "foreach" a list or other sets that are IEnumerable



```
foreach (Control oControl in this.Controls)
{
    Console.WriteLine(oControl.Name);
}
```

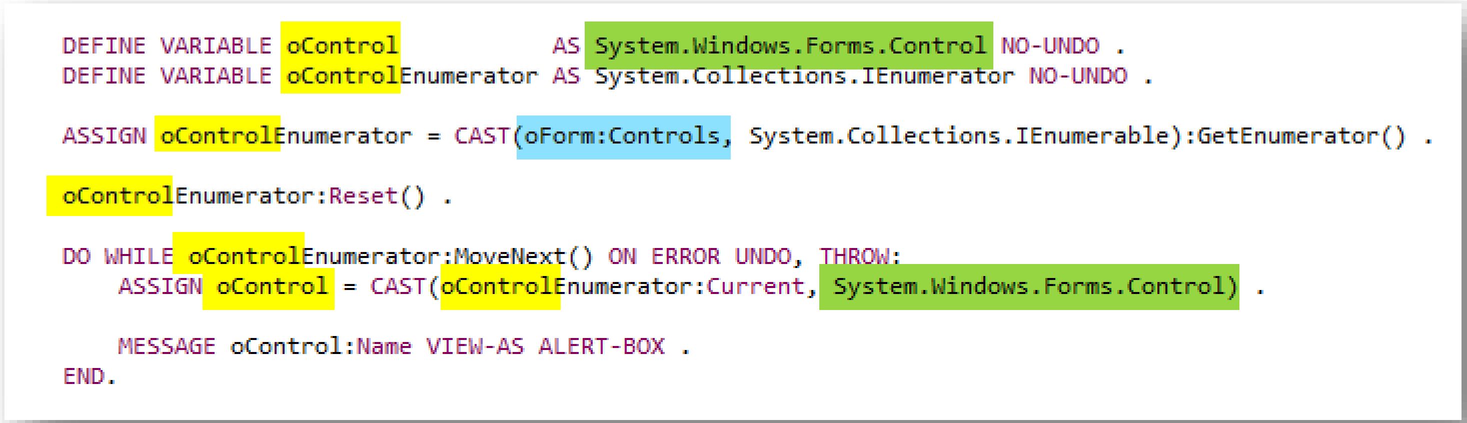


```
foreach (Customer oCustomer in oCustomers)
{
    Console.WriteLine(oCustomer.CustNum);
    Console.WriteLine(oCustomer.Name);

    foreach (Address oAddress in oCustomer.Addresses)
    {
        Console.WriteLine(oAddress.Address);
        Console.WriteLine(oAddress.Address2);
        Console.WriteLine(oAddress.City);
    }
}
```

- Loops through all Controls in this.Controls (List)
- http://msdn.microsoft.com/en-us/library/ttw7t8t6(v=vs.71).aspx

.NET Enumerator from ABL (GUI for .NET)

- This is the ABL code similar to the C# foreach

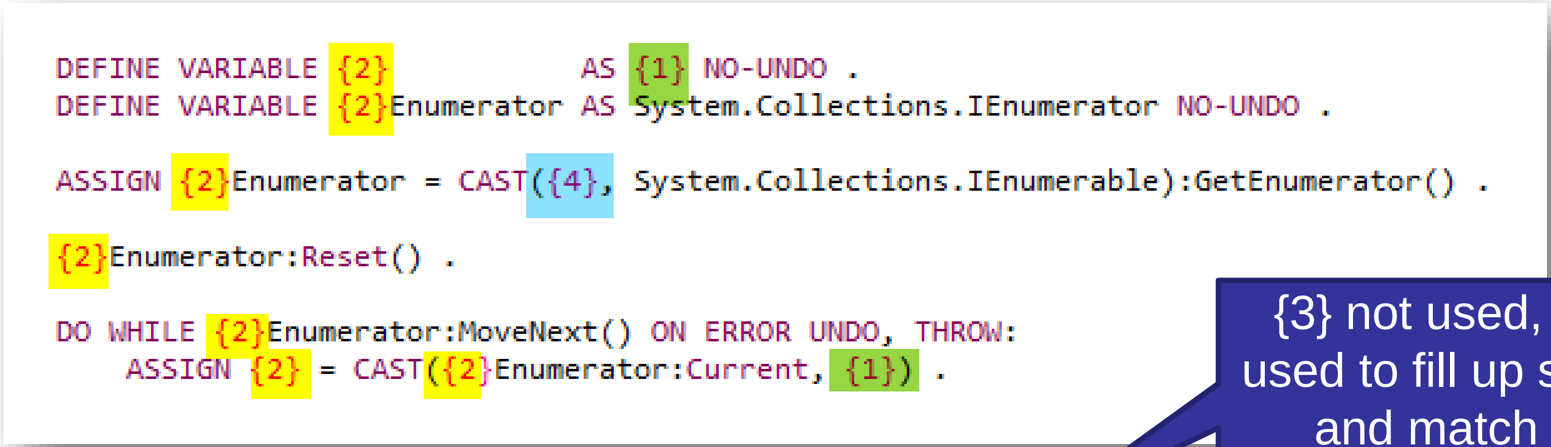


```
DEFINE VARIABLE oControl           AS System.Windows.Forms.Control NO-UNDO .
DEFINE VARIABLE oControlEnumerator AS System.Collections.IEnumerator NO-UNDO .

ASSIGN oControlEnumerator = CAST(oForm:Controls, System.Collections.IEnumerable):GetEnumerator() .

oControlEnumerator:Reset() .

DO WHILE oControlEnumerator:MoveNext() ON ERROR UNDO, THROW:
    ASSIGN oControl = CAST(oControlEnumerator:Current, System.Windows.Forms.Control) .

    MESSAGE oControl:Name VIEW-AS ALERT-BOX .
END.
```

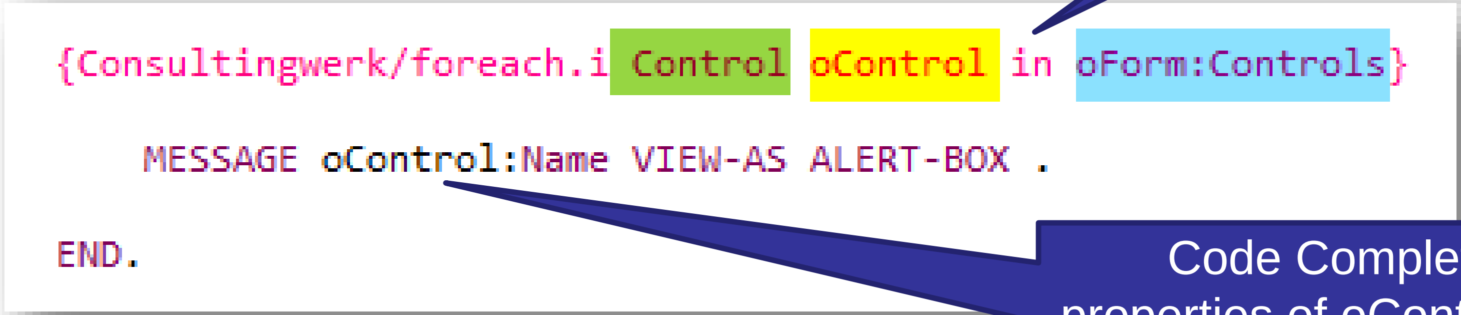
- First, we get the „Enumerator“ for the List
- That is an object, that provides a reference (Current) to an item and iterates over the items in the List
- Similar, to the ABL FOR EACH on a BUFFER

.NET Enumerator from ABL (GUI for .NET)

- Let‘s write Consultingwerk/foreach.i (Include)



```
DEFINE VARIABLE {2}           AS {1} NO-UNDO .
DEFINE VARIABLE {2}Enumerator AS System.Collections.IEnumerator NO-UNDO .

ASSIGN {2}Enumerator = CAST({4}, System.Collections.IEnumerable):GetEnumerator() .

{2}Enumerator:Reset() .

DO WHILE {2}Enumerator:MoveNext() ON ERROR UNDO, THROW:
    ASSIGN {2} = CAST({2}Enumerator:Current, {1}) .
```



```
{Consultingwerk/foreach.i Control oControl in oForm:Controls}

    MESSAGE oControl:Name VIEW-AS ALERT-BOX .

END.
```

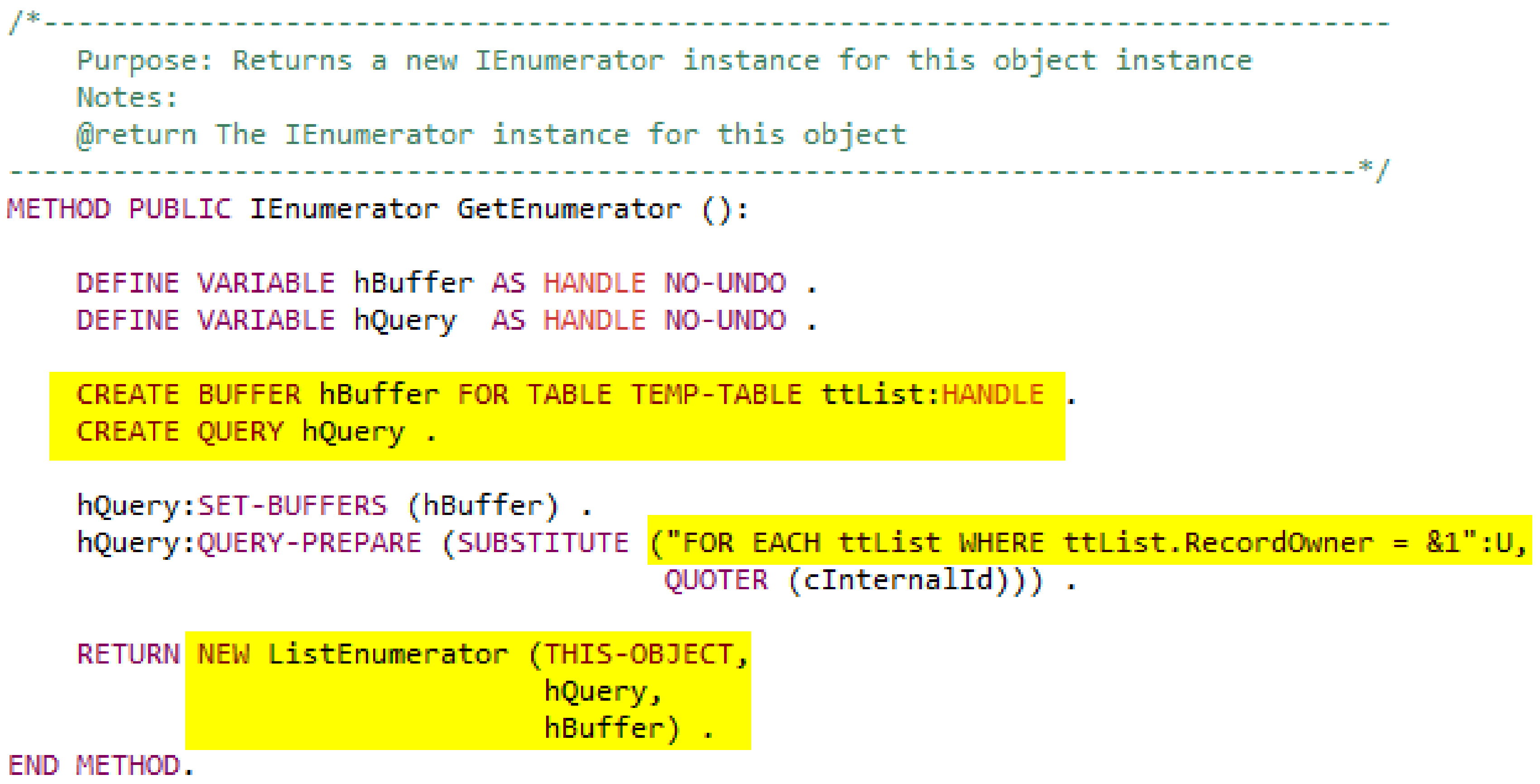
{3} not used, only used to fill up syntax and match c#

Code Completion on properties of oControl works in recent Versions of PDSOE, did not work in 10.2B

Enumerator implementation for ABL List

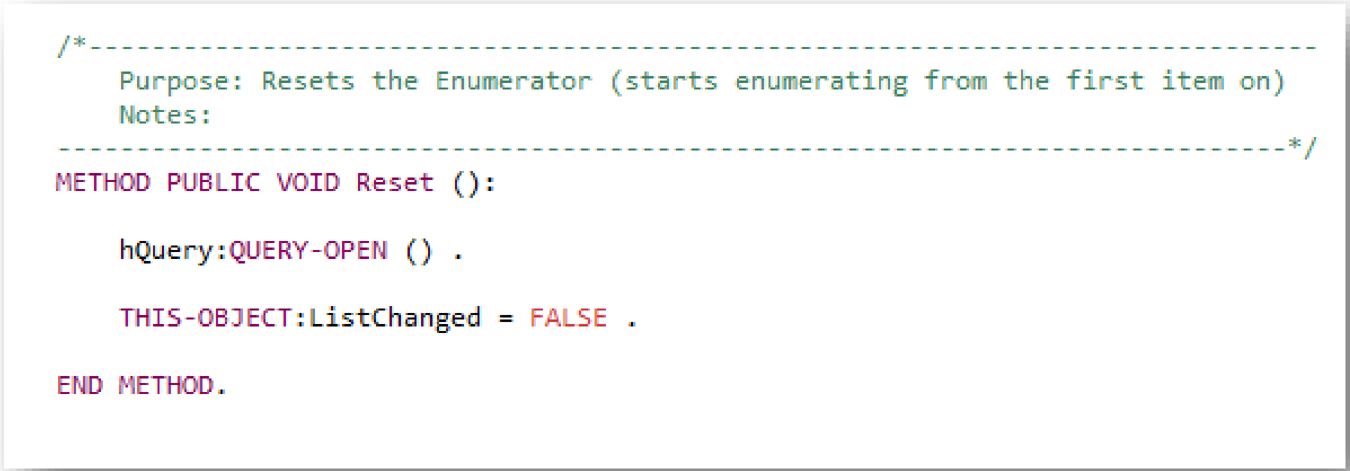
- IEnumerable Interface with GetEnumerator() method
- Enumerator instance needs to provide method to
  - Reset()
  - MoveNext()
- Property
  - Current
- As List is implemented using ABL Temp-Table, we can create BUFFER and QUERY

Lists GetEnumerator() method



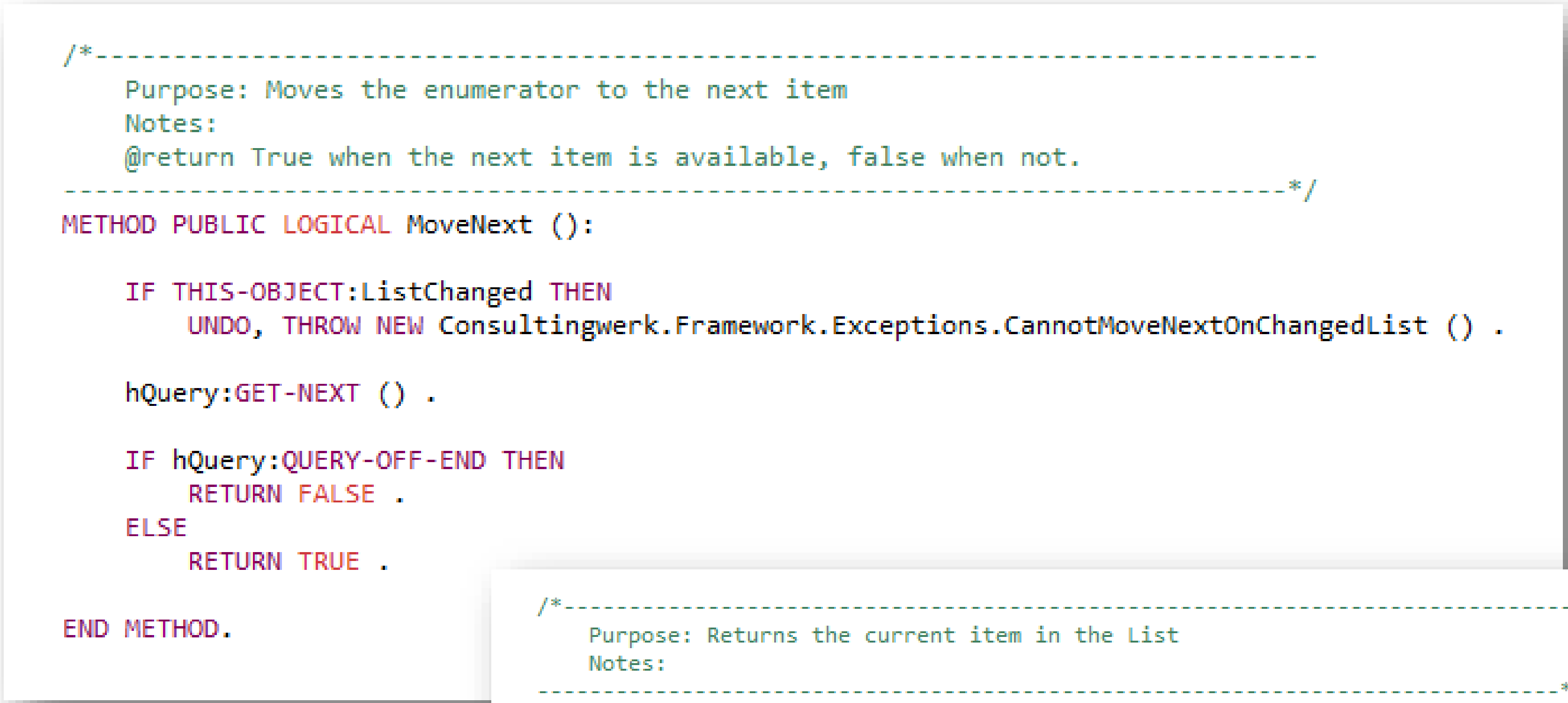
```
/*------------------------------------------------------------------------------
    Purpose: Returns a new IEnumerator instance for this object instance
    Notes:
    @return The IEnumerator instance for this object
------------------------------------------------------------------------------*/
METHOD PUBLIC IEnumerator GetEnumerator ():

    DEFINE VARIABLE hBuffer AS HANDLE NO-UNDO .
    DEFINE VARIABLE hQuery  AS HANDLE NO-UNDO .

    CREATE BUFFER hBuffer FOR TABLE TEMP-TABLE ttList:HANDLE .
    CREATE QUERY hQuery .

    hQuery:SET-BUFFERS (hBuffer) .
    hQuery:QUERY-PREPARE (SUBSTITUTE ("FOR EACH ttList WHERE ttList.RecordOwner = &1":U,
                                      QUOTER (cInternalId))) .

    RETURN NEW ListEnumerator (THIS-OBJECT,
                               hQuery,
                               hBuffer) .
END METHOD.
```

Enumerators Reset() method

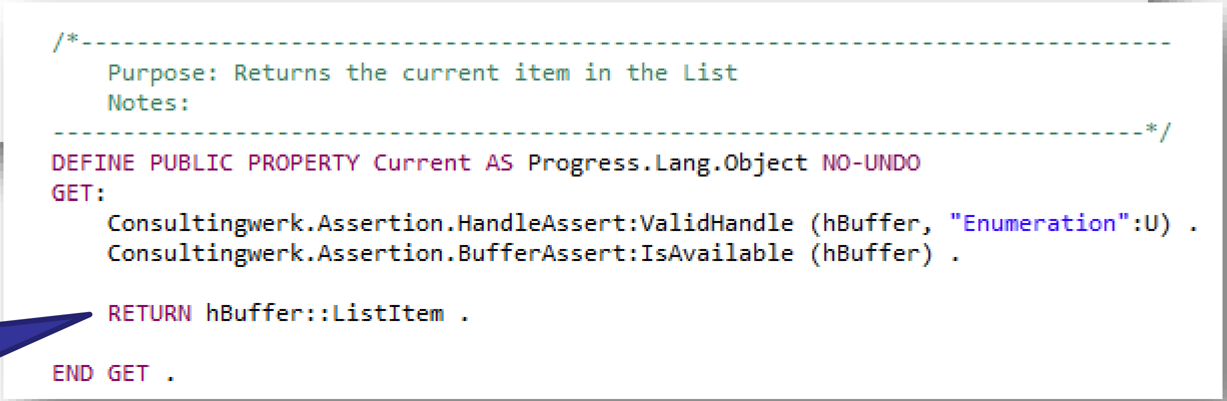


```
/*------------------------------------------------------------------------------
    Purpose: Resets the Enumerator (starts enumerating from the first item on)
    Notes:
------------------------------------------------------------------------------*/
METHOD PUBLIC VOID Reset ():

    hQuery:QUERY-OPEN () .

    THIS-OBJECT:ListChanged = FALSE .

END METHOD.
```

Enumerators MoveNext() method



```
/*------------------------------------------------------------------------------
    Purpose: Moves the enumerator to the next item
    Notes:
    @return True when the next item is available, false when not.
------------------------------------------------------------------------------*/
METHOD PUBLIC LOGICAL MoveNext ():

    IF THIS-OBJECT:ListChanged THEN
        UNDO, THROW NEW Consultingwerk.Framework.Exceptions.CannotMoveNextOnChangedList () .

    hQuery:GET-NEXT () .

    IF hQuery:QUERY-OFF-END THEN
        RETURN FALSE .
    ELSE
        RETURN TRUE .

END METHOD.
```



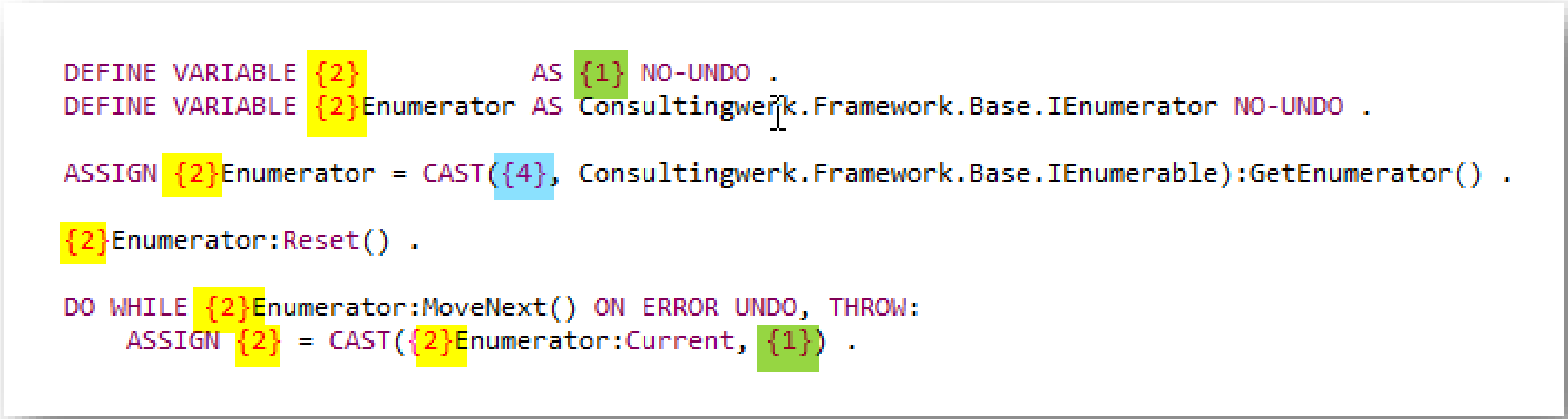
```
/*------------------------------------------------------------------------------
    Purpose: Returns the current item in the List
    Notes:
------------------------------------------------------------------------------*/
DEFINE PUBLIC PROPERTY Current AS Progress.Lang.Object NO-UNDO
GET:
    Consultingwerk.Assertion.HandleAssert:ValidHandle (hBuffer, "Enumeration":U) .
    Consultingwerk.Assertion.BufferAssert:IsAvailable (hBuffer) .

    RETURN hBuffer::ListItem .

END GET .
```

Object Reference from List Temp-Table

Consultingwerk
software architecture and development

foreachABL.i

- We need a special version of foreach.i – simply because we cannot use the same IEnumerator interface for pure ABL and ABL with GUI for .NET

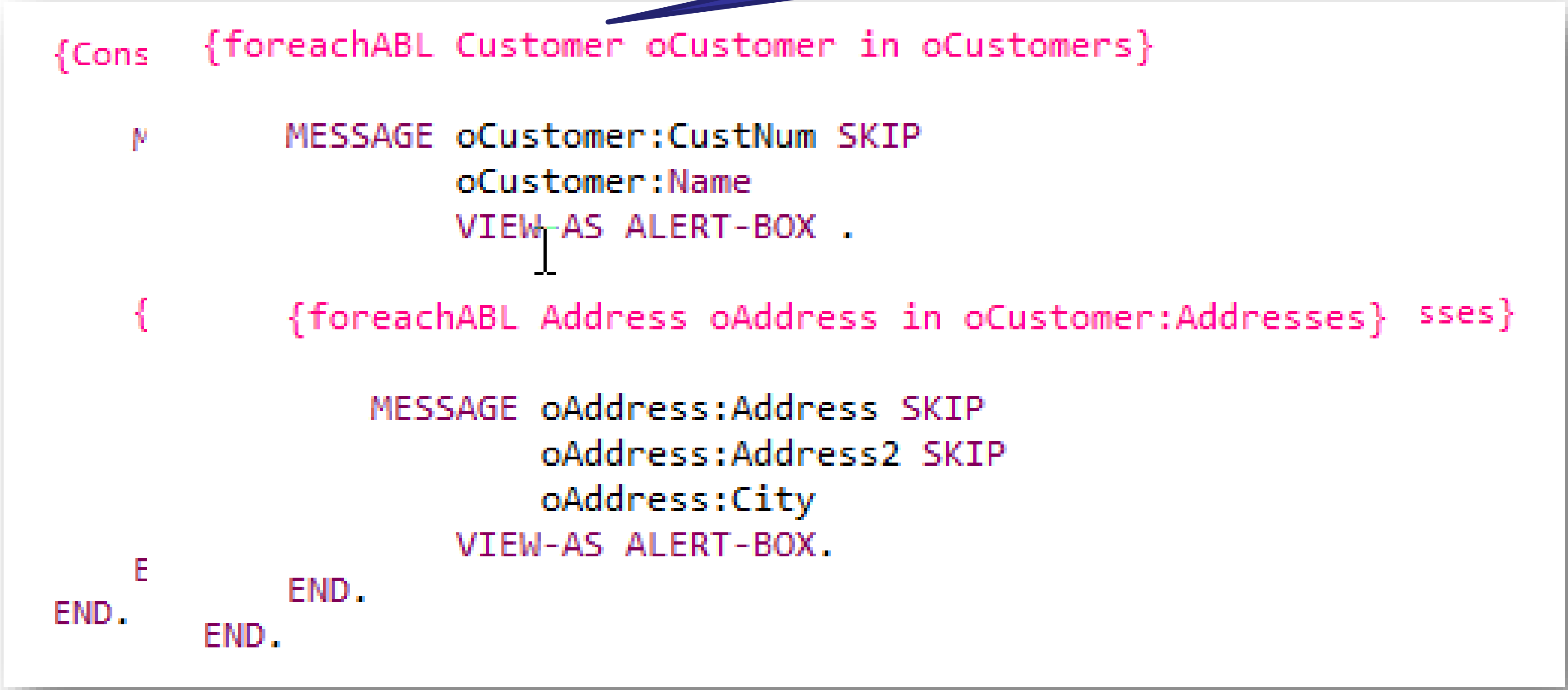


```
DEFINE VARIABLE {2}            AS {1} NO-UNDO .
DEFINE VARIABLE {2}Enumerator AS Consultingwerk.Framework.Base.IEnumerator NO-UNDO .

ASSIGN {2}Enumerator = CAST({4}, Consultingwerk.Framework.Base.IEnumerable):GetEnumerator() .

{2}Enumerator:Reset() .

DO WHILE {2}Enumerator:MoveNext() ON ERROR UNDO, THROW:
    ASSIGN {2} = CAST({2}Enumerator:Current, {1}) .
```

- But as we mimic .NET Enumerators, the code looks very similar

Enumerating Customers and

Include File in PROPATH, no .i extention



```
{Cons  {foreachABL Customer oCustomer in oCustomers}

   M       MESSAGE oCustomer:CustNum SKIP
                   oCustomer:Name
                   VIEW-AS ALERT-BOX .

   {       {foreachABL Address oAddress in oCustomer:Addresses}  sses}

               MESSAGE oAddress:Address SKIP
                       oAddress:Address2 SKIP
                       oAddress:City
                   VIEW-AS ALERT-BOX.
   E
END.       END.
       END.
```

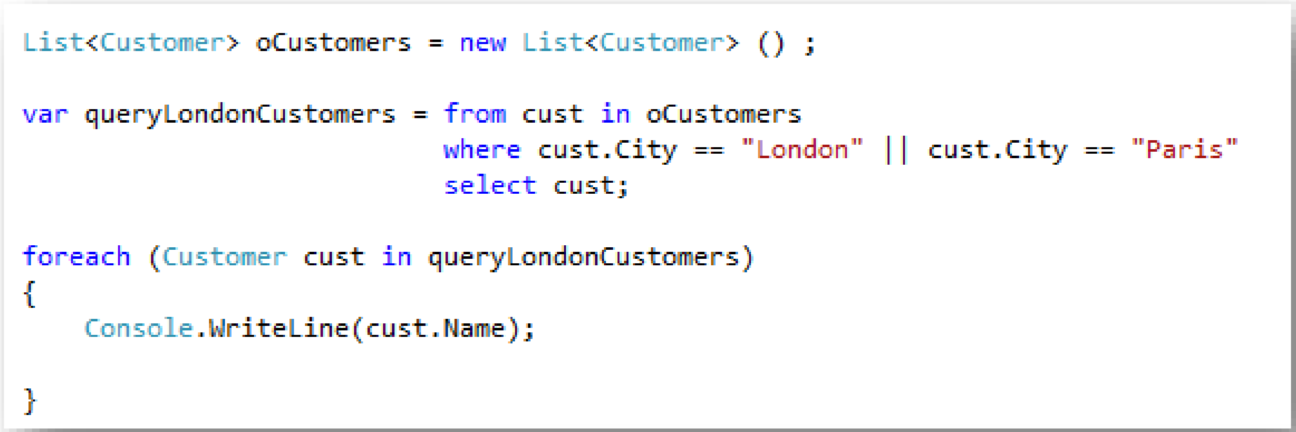
- No need to remember that ABL starts counting with 1 and .NET starts counting with 0

Querying while iterating List

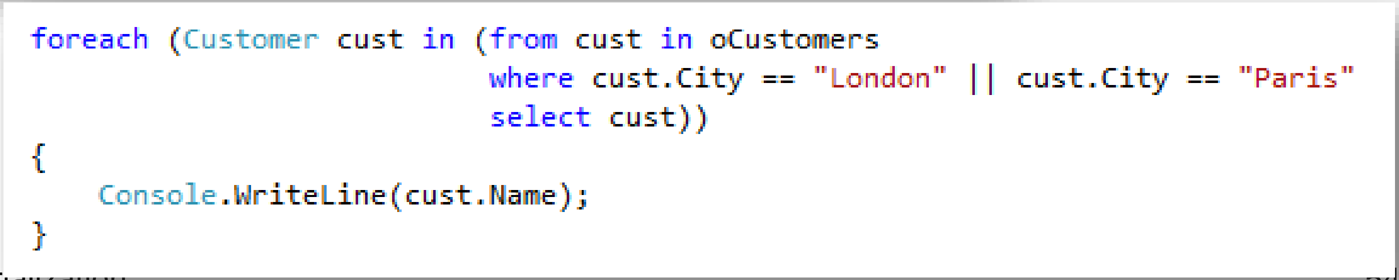
- ABL does not provide ability to Query objects
- Progress.Lang.Object field in Temp-Table can only be queried on object reference (same pointer)
- We could extend List implementation to include Filter criteria
- Probably would need multiple Filter criteria, would require to sync Filter criteria in List implementation with referenced objects
- Ultimately leads to redundancy of data in List temp-table, questioning the Object at all

LINQ in C#

- „**L**anguage **IN**tegrated **Q**uery“
- Set of object + language (compiler features to provide syntax)



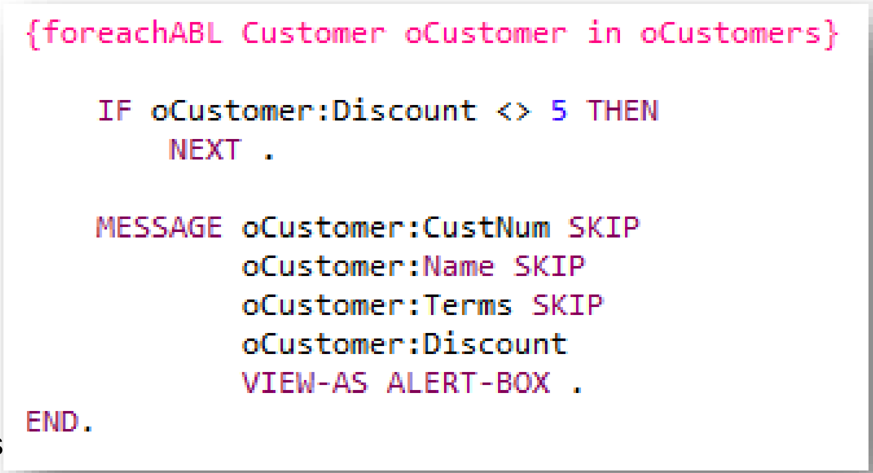
```
List<Customer> oCustomers = new List<Customer> () ;

var queryLondonCustomers = from cust in oCustomers
                           where cust.City == "London" || cust.City == "Paris"
                           select cust;

foreach (Customer cust in queryLondonCustomers)
{
    Console.WriteLine(cust.Name);

}
```



```
foreach (Customer cust in (from cust in oCustomers
                           where cust.City == "London" || cust.City == "Paris"
                           select cust))
{
    Console.WriteLine(cust.Name);
}
```

ABL version of LINQ?

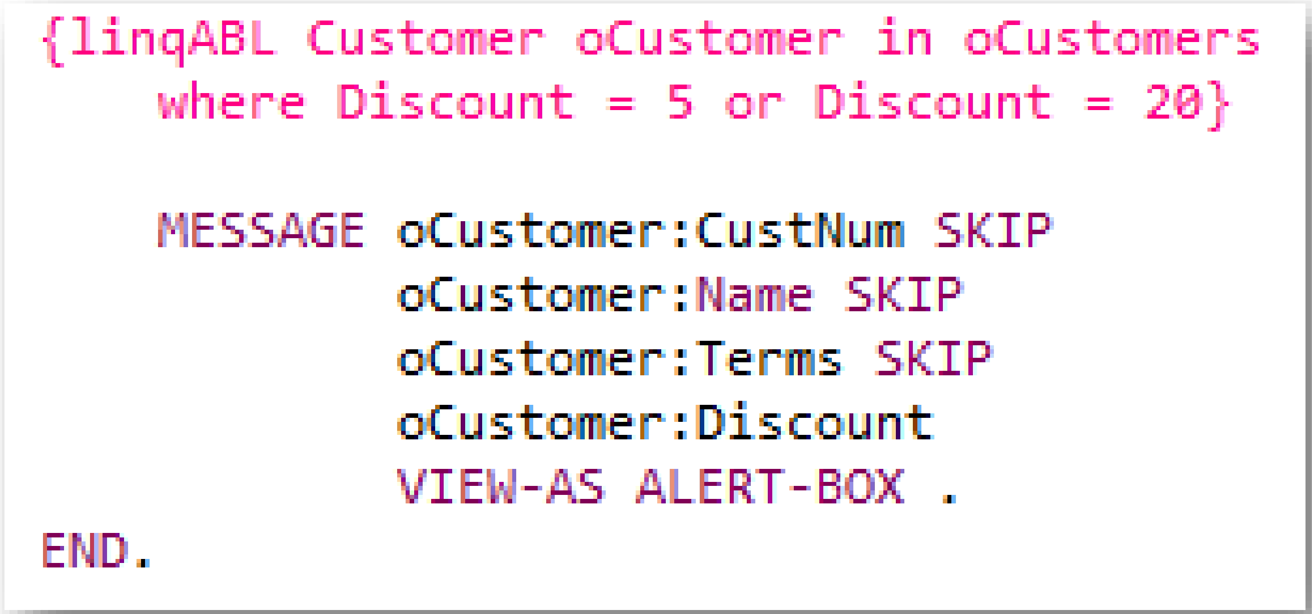
- As a matter of fact most lists will be rather small
- All data is in memory anyway (Objects not stored in DBI file as Temp-Tables are)
- It won’t cause significant overhead if we iterate the List and just NEXT those records that don’t match the selection criteria (negative filtering)



```
{foreachABL Customer oCustomer in oCustomers}

    IF oCustomer:Discount <> 5 THEN
        NEXT .

    MESSAGE oCustomer:CustNum SKIP
            oCustomer:Name SKIP
            oCustomer:Terms SKIP
            oCustomer:Discount
            VIEW-AS ALERT-BOX .
END.
```

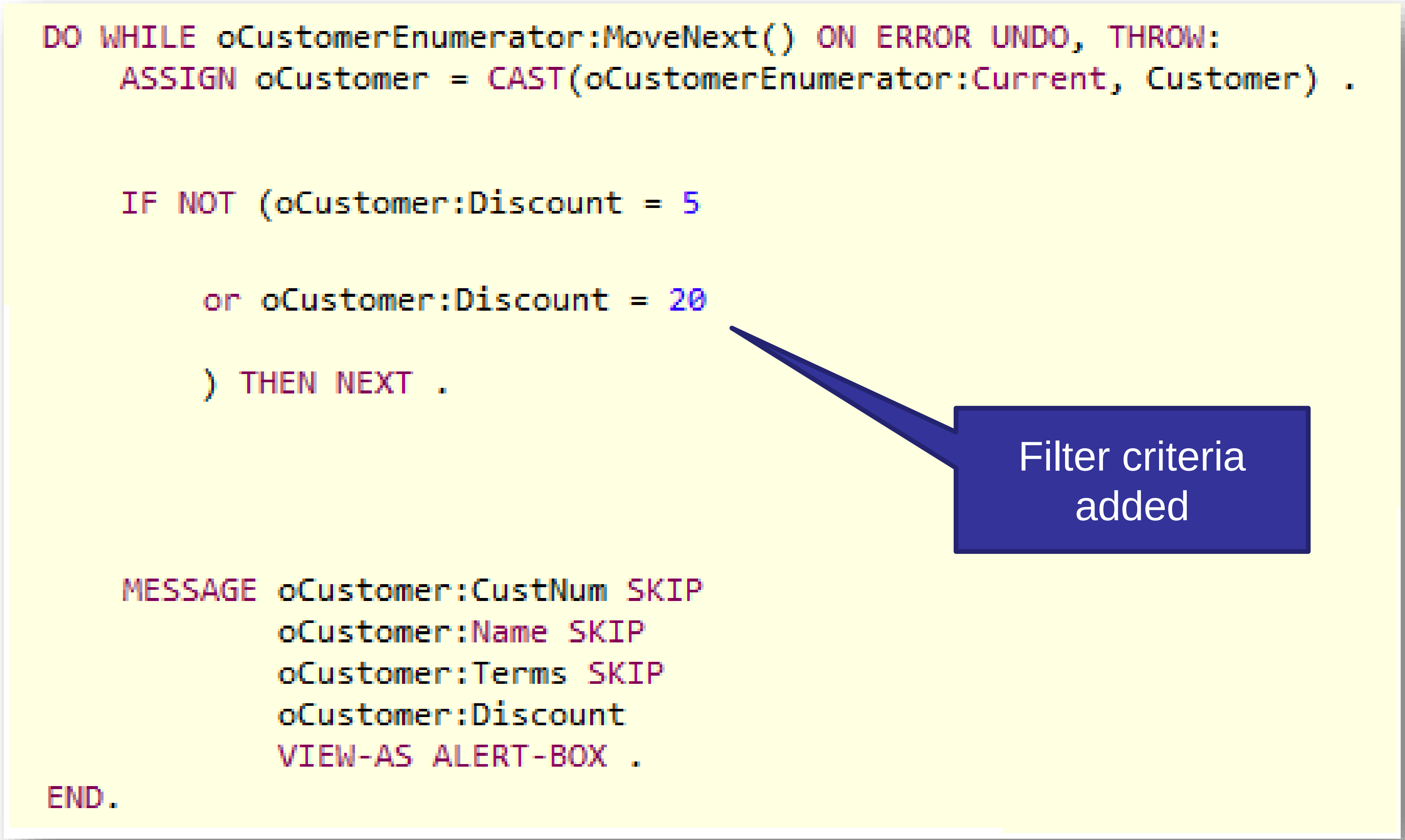
linqABL.i

- Combines the benefits of foreachABL.i with filtering using positive expressions



```
{linqABL Customer oCustomer in oCustomers
    where Discount = 5 or Discount = 20}

    MESSAGE oCustomer:CustNum SKIP
            oCustomer:Name SKIP
            oCustomer:Terms SKIP
            oCustomer:Discount
            VIEW-AS ALERT-BOX .
END.
```

Preprocessor view



```
DO WHILE oCustomerEnumerator:MoveNext() ON ERROR UNDO, THROW:
    ASSIGN oCustomer = CAST(oCustomerEnumerator:Current, Customer) .


    IF NOT (oCustomer:Discount = 5

        or oCustomer:Discount = 20

        ) THEN NEXT .



    MESSAGE oCustomer:CustNum SKIP
            oCustomer:Name SKIP
            oCustomer:Terms SKIP
            oCustomer:Discount
            VIEW-AS ALERT-BOX .
END.
```

Filter criteria added

Agenda

- Introduction – OO ABL
- OO ABL’s missing features
- Lists of Objects
- Generic Lists of Objects
- List Enumerators
- **Enumerations**
- Object Serialization

Enumeration

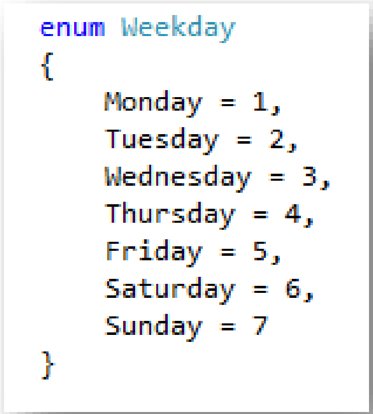
- Often named „Enum“ in other languages
- Set of related values of the same type
  - Weekdays
  - Months
  - Gender
  - AddressType
- Each entry is an object instance itself, it‘s a member of a set of "values"
- Enumeration may be Enumerable … do we start to exaggerate?

Enumeration

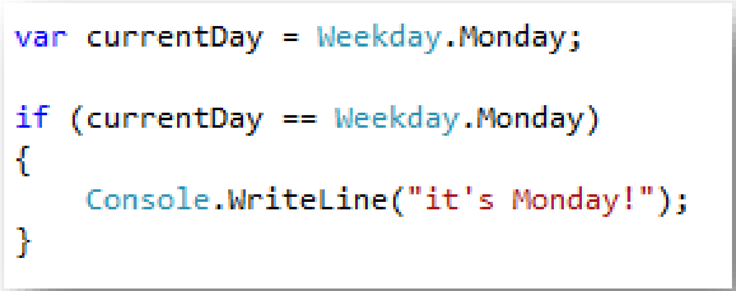
- Typically representing a Name (Text representation) and a number (for ordering and comparison)
- Enumeration itself typically set of static references to member instances
- Much safer than Weekday based on INTEGER or OrderStatus based on CHARACTER
- Compiler detects typos, no need to runtime test
- Represents a type of it’s own: strong typing of object properties or method parameters!

Enum in C#

- Enum represents a value type, each entry stands for a value



```
enum Weekday
{
    Monday = 1,
    Tuesday = 2,
    Wednesday = 3,
    Thursday = 4,
    Friday = 5,
    Saturday = 6,
    Sunday = 7
}
```

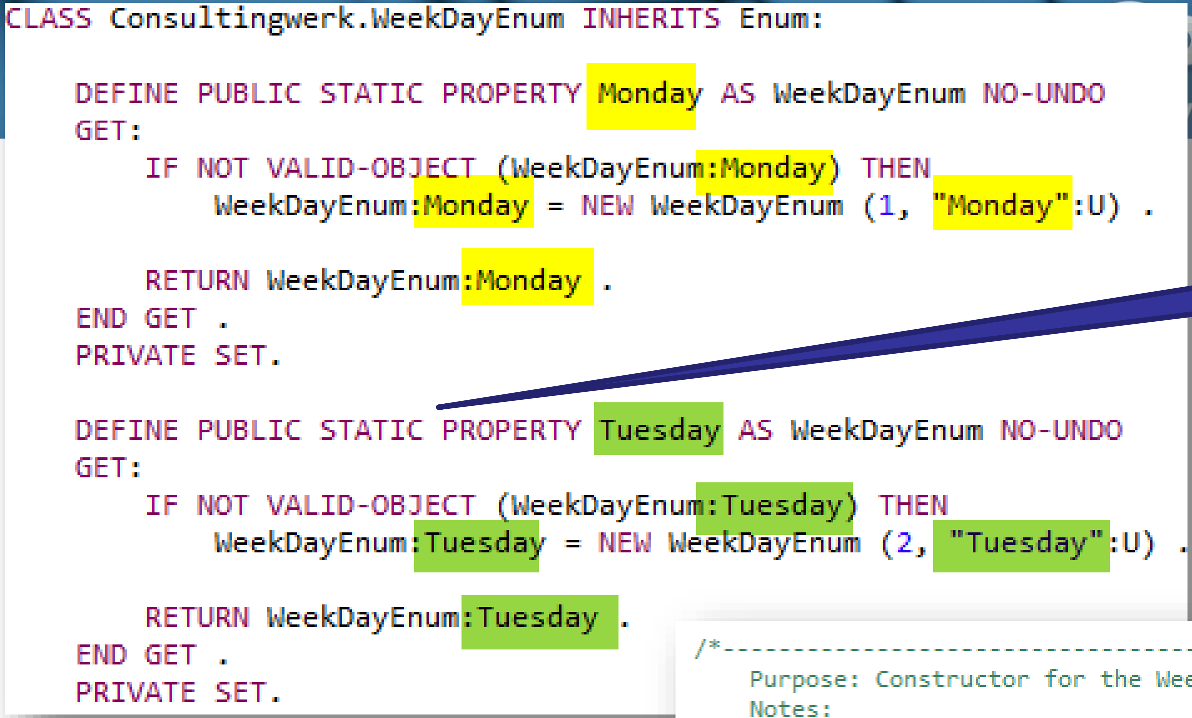


```
var currentDay = Weekday.Monday;

if (currentDay == Weekday.Monday)
{
    Console.WriteLine("it's Monday!");
}
```

- We can define variables of type Weekday
- Those can hold one of the Weekdays or null

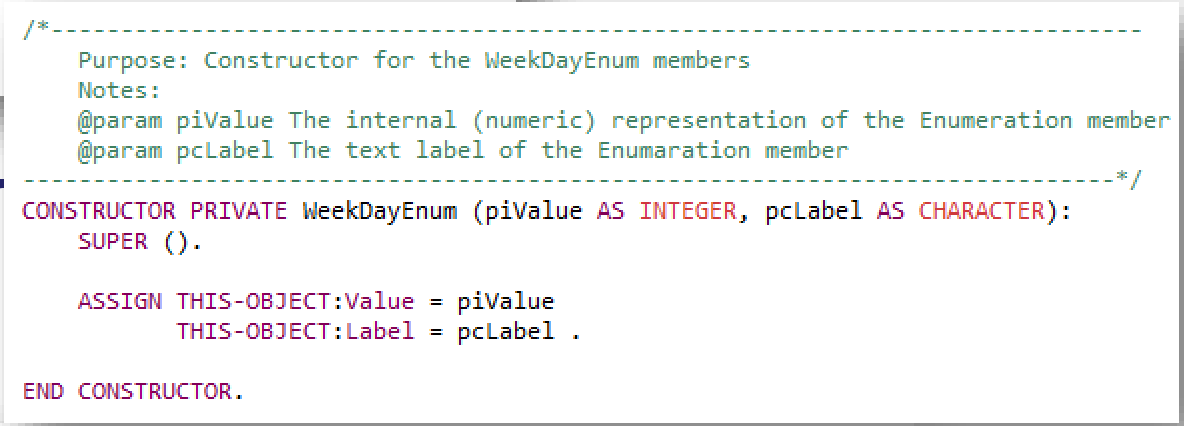
Enums in the ABL

- ABL has just added support for Enums in 11.6
- Enum can be build using single class for 10.1C..11.5
  - Static portion representing the Enumeration
  - Instance for each member
  - A single instance created for each member (singleton style) accessed via Properties of Enum
- Usage of Enums compatible



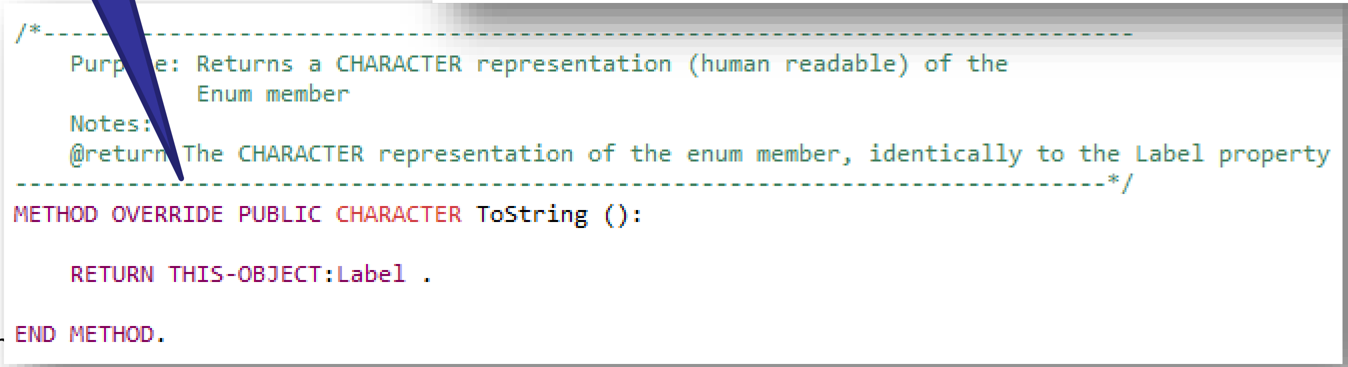
```
CLASS Consultingwerk.WeekDayEnum INHERITS Enum:

    DEFINE PUBLIC STATIC PROPERTY Monday AS WeekDayEnum NO-UNDO
    GET:
        IF NOT VALID-OBJECT (WeekDayEnum:Monday) THEN
            WeekDayEnum:Monday = NEW WeekDayEnum (1, "Monday":U) .

        RETURN WeekDayEnum:Monday .
    END GET .
    PRIVATE SET.

    DEFINE PUBLIC STATIC PROPERTY Tuesday AS WeekDayEnum NO-UNDO
    GET:
        IF NOT VALID-OBJECT (WeekDayEnum:Tuesday) THEN
            WeekDayEnum:Tuesday = NEW WeekDayEnum (2, "Tuesday":U) .

        RETURN WeekDayEnum:Tuesday .
    END GET .
    PRIVATE SET.
```

STATIC



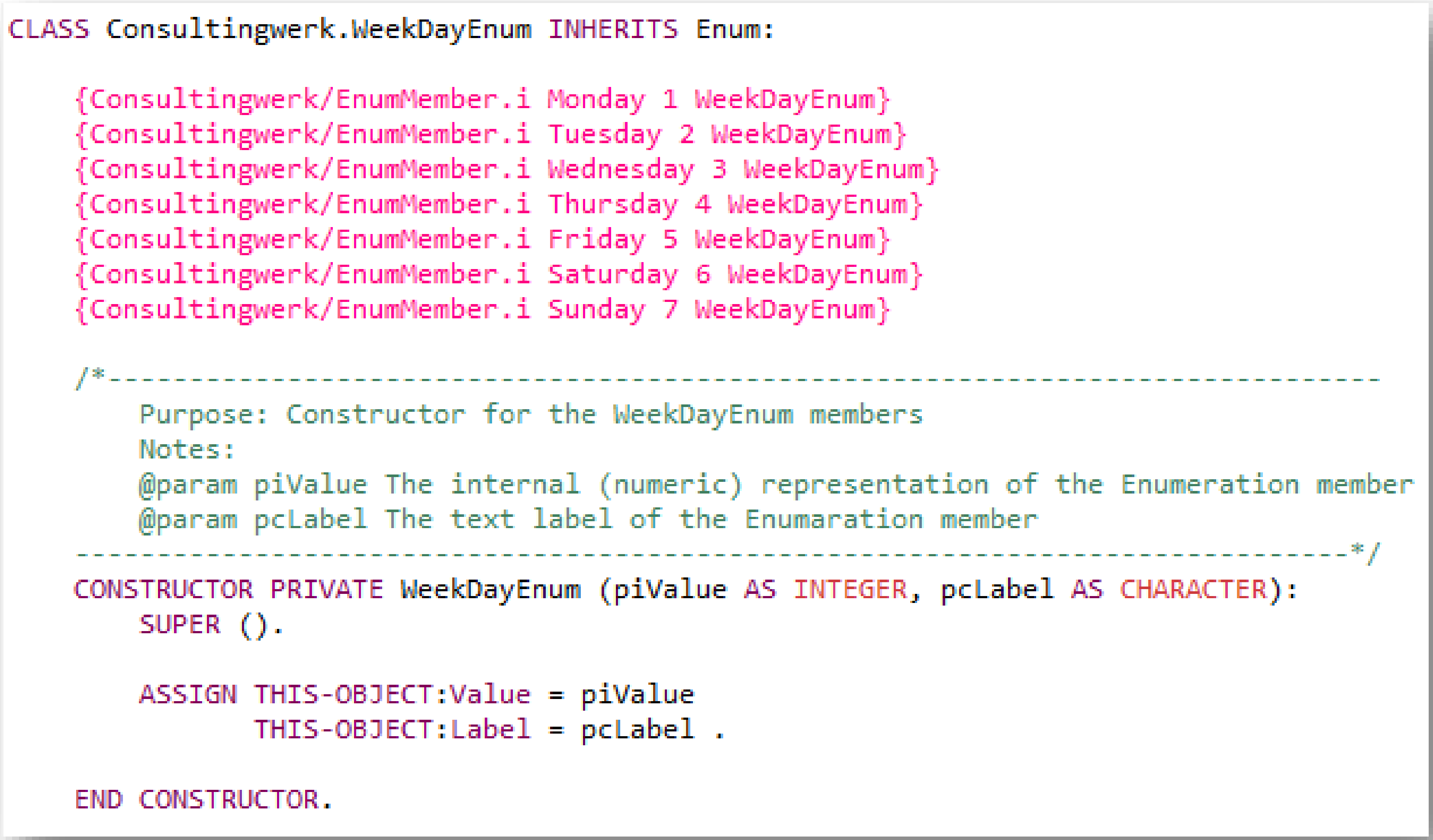
```
/*------------------------------------------------------------------------------
    Purpose: Constructor for the WeekDayEnum members
    Notes:
    @param piValue The internal (numeric) representation of the Enumeration member
    @param pcLabel The text label of the Enumaration member
------------------------------------------------------------------------------*/
CONSTRUCTOR PRIVATE WeekDayEnum (piValue AS INTEGER, pcLabel AS CHARACTER):
    SUPER ().

    ASSIGN THIS-OBJECT:Value = piValue
           THIS-OBJECT:Label = pcLabel .

END CONSTRUCTOR.
```

Instance members



```
/*------------------------------------------------------------------------------
    Purpose: Returns a CHARACTER representation (human readable) of the
             Enum member
    Notes:
    @return The CHARACTER representation of the enum member, identically to the Label property
------------------------------------------------------------------------------*/
METHOD OVERRIDE PUBLIC CHARACTER ToString ():

    RETURN THIS-OBJECT:Label .

END METHOD.
```

A task for another Include file ☺

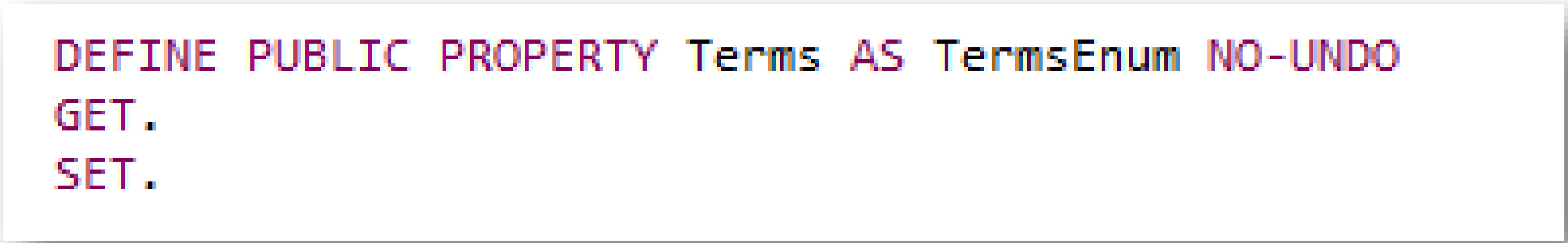


```
CLASS Consultingwerk.WeekDayEnum INHERITS Enum:

    {Consultingwerk/EnumMember.i Monday 1 WeekDayEnum}
    {Consultingwerk/EnumMember.i Tuesday 2 WeekDayEnum}
    {Consultingwerk/EnumMember.i Wednesday 3 WeekDayEnum}
    {Consultingwerk/EnumMember.i Thursday 4 WeekDayEnum}
    {Consultingwerk/EnumMember.i Friday 5 WeekDayEnum}
    {Consultingwerk/EnumMember.i Saturday 6 WeekDayEnum}
    {Consultingwerk/EnumMember.i Sunday 7 WeekDayEnum}

    /*------------------------------------------------------------------------------
        Purpose: Constructor for the WeekDayEnum members
        Notes:
        @param piValue The internal (numeric) representation of the Enumeration member
        @param pcLabel The text label of the Enumaration member
    ------------------------------------------------------------------------------*/
    CONSTRUCTOR PRIVATE WeekDayEnum (piValue AS INTEGER, pcLabel AS CHARACTER):
        SUPER ().

        ASSIGN THIS-OBJECT:Value = piValue
               THIS-OBJECT:Label = pcLabel .

    END CONSTRUCTOR.
```

Demo

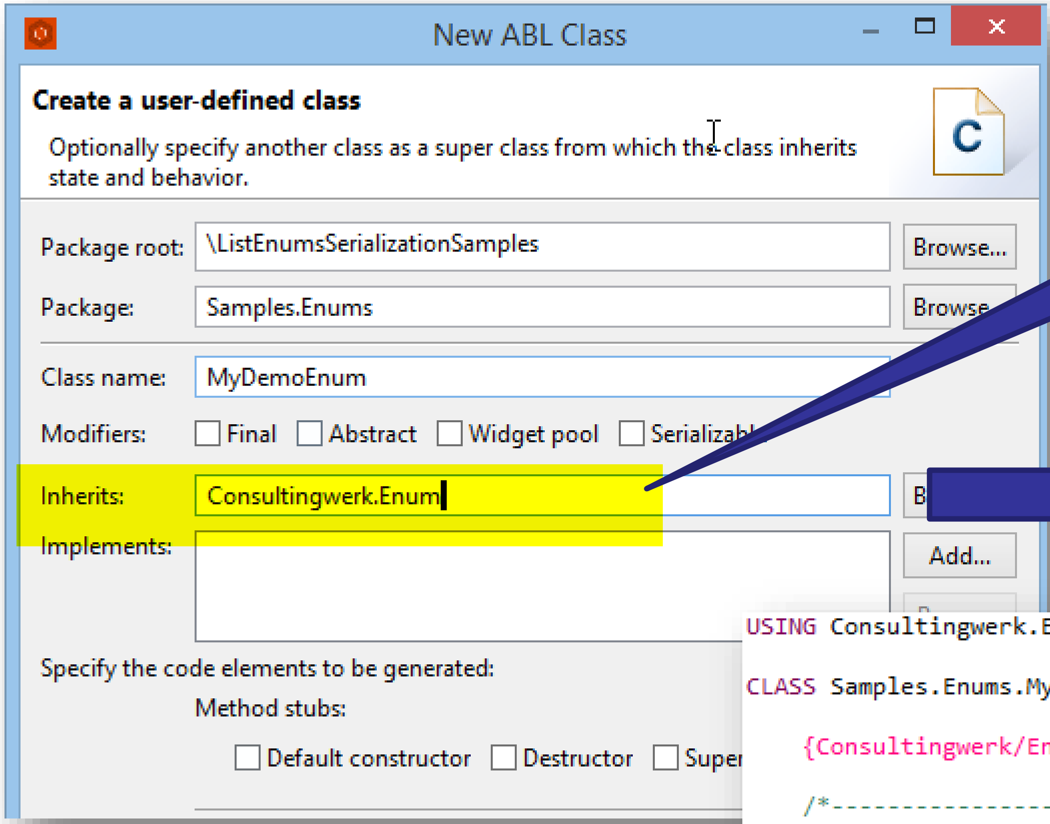
- Create a new Enum using Consultingwerk new Class Template in PDSOE

- Review TermsEnum in Customer
- Filter oCustomers on TermsEnum



```
DEFINE PUBLIC PROPERTY Terms AS TermsEnum NO-UNDO
GET.
SET.
```

PDSOE New Class Macro



New ABL Class

Create a user-defined class

Optionally specify another class as a super class from which the class inherits state and behavior.

Package root: \ListEnumsSerializationSamples

Package: Samples.Enums

Class name: MyDemoEnum

Modifiers: ☐ Final ☐ Abstract ☐ Widget pool ☐ Serializab

Inherits: Consultingwerk.Enum

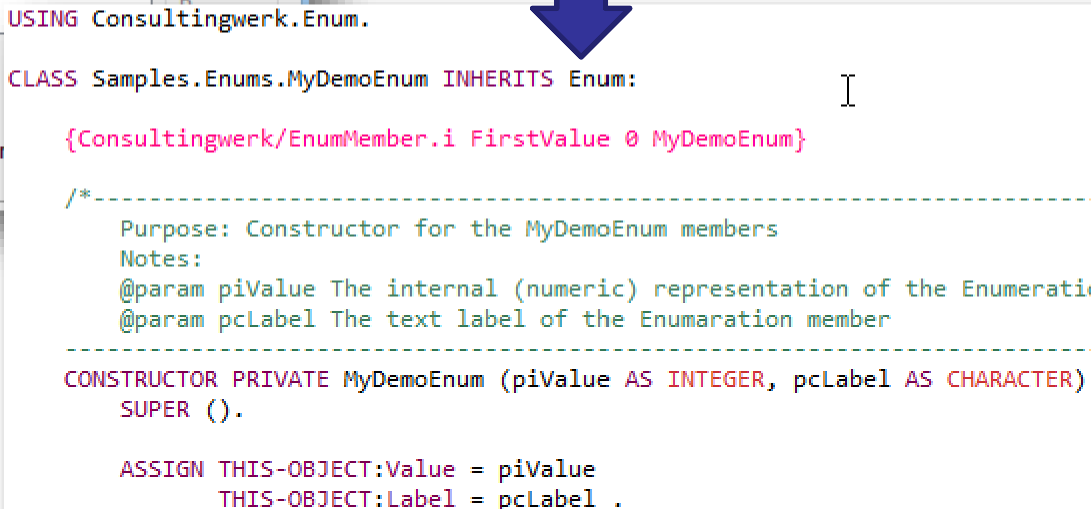
Implements:

Specify the code elements to be generated:

Method stubs:

☐ Default constructor ☐ Destructor ☐ Super

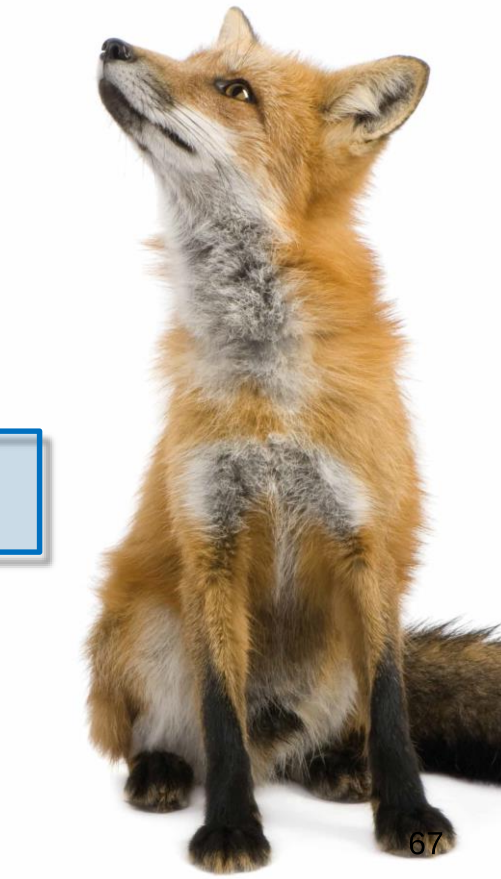
Custom Class Template triggered by base class name



```
USING Consultingwerk.Enum.

CLASS Samples.Enums.MyDemoEnum INHERITS Enum:

    {Consultingwerk/EnumMember.i FirstValue 0 MyDemoEnum}

    /*------------------------------------------------------------------------
        Purpose: Constructor for the MyDemoEnum members
        Notes:
        @param piValue The internal (numeric) representation of the Enumerati
        @param pcLabel The text label of the Enumaration member
    ------------------------------------------------------------------------
    CONSTRUCTOR PRIVATE MyDemoEnum (piValue AS INTEGER, pcLabel AS CHARACTER)
        SUPER ().

        ASSIGN THIS-OBJECT:Value = piValue
               THIS-OBJECT:Label = pcLabel .
```

Agenda

- Introduction – OO ABL
- OO ABL's missing features
- Lists of Objects
- Generic Lists of Objects
- List Enumerators
- Enumerations
- **Object Serialization**



Consultingwerk
software architecture and development

Object Serialization

- Transforming an object instance (or a set of objects) into a form that can be persisted (disk, database, etc.) or be send to another system (aka marshalling)
- Deserialization is the process of converting this form back into an object – typically a new object instance, eventually on a different system or a different time (aka unmarshalling)
- Systems involved may be AppServer and Client
- Serialization is about Data in an object, not the implementation

Serialization formats

- Need to be understood by sender and receiver
- Binary form
- Text based formats
  - XML
  - JSON (from OpenEdge 11 on)
  - CSV
  - …
- Morse code

OpenEdge Serialization in 11.4

- **Only supported between ABL Client and AppServer**
- Very well suited for parameter objects or throwing errors from the AppServer to the client
- Does not support serialization of objects to other clients types
  - XML serialization for .NET
  - JSON serialization for REST/Kendo UI/etc.
- So we are using Progress' serialization when it fits and our own when it does not

OpenEdge Serialization in 11.6

- Progress.IO.JsonSerializer
- Progress.IO.BinarySerializer

- Built in Serialization to MEMPTR, LONGCHAR, FILE

Walkthrough JSON Serializable object

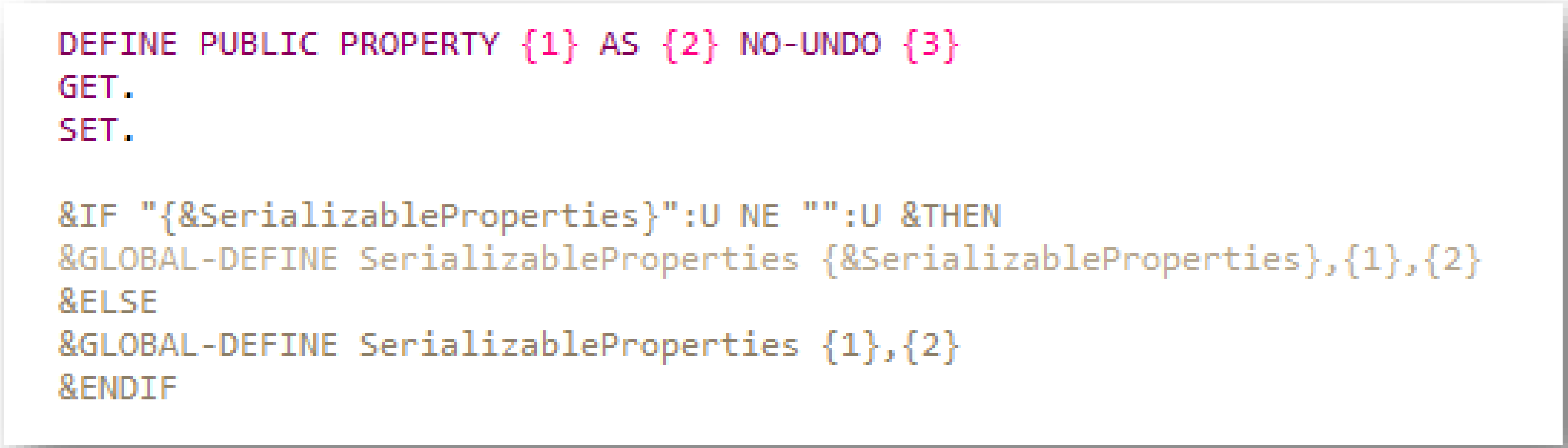
- OpenEdge 11 provides JSON Object Model, flexible way of parsing and generating JSON Strings
- JSON is a LONGCHAR String, so it can be stored and send to another system

Walkthrough JSON Serializable object

- We typically want to serialize properties of an object and when we can send them to another system, it's a fair assumption that those properties are PUBLIC – transport cannot hide privates
- Serializing other members (e.g. temp-table would be possible as well, but not required by us)
- OpenEdge 11 has DYNAMIC-PROPERTY – so we can query and assign properties dynamically
- But we don't know what properties are available
  - No reflection in ABL (***prior to 11.6***)

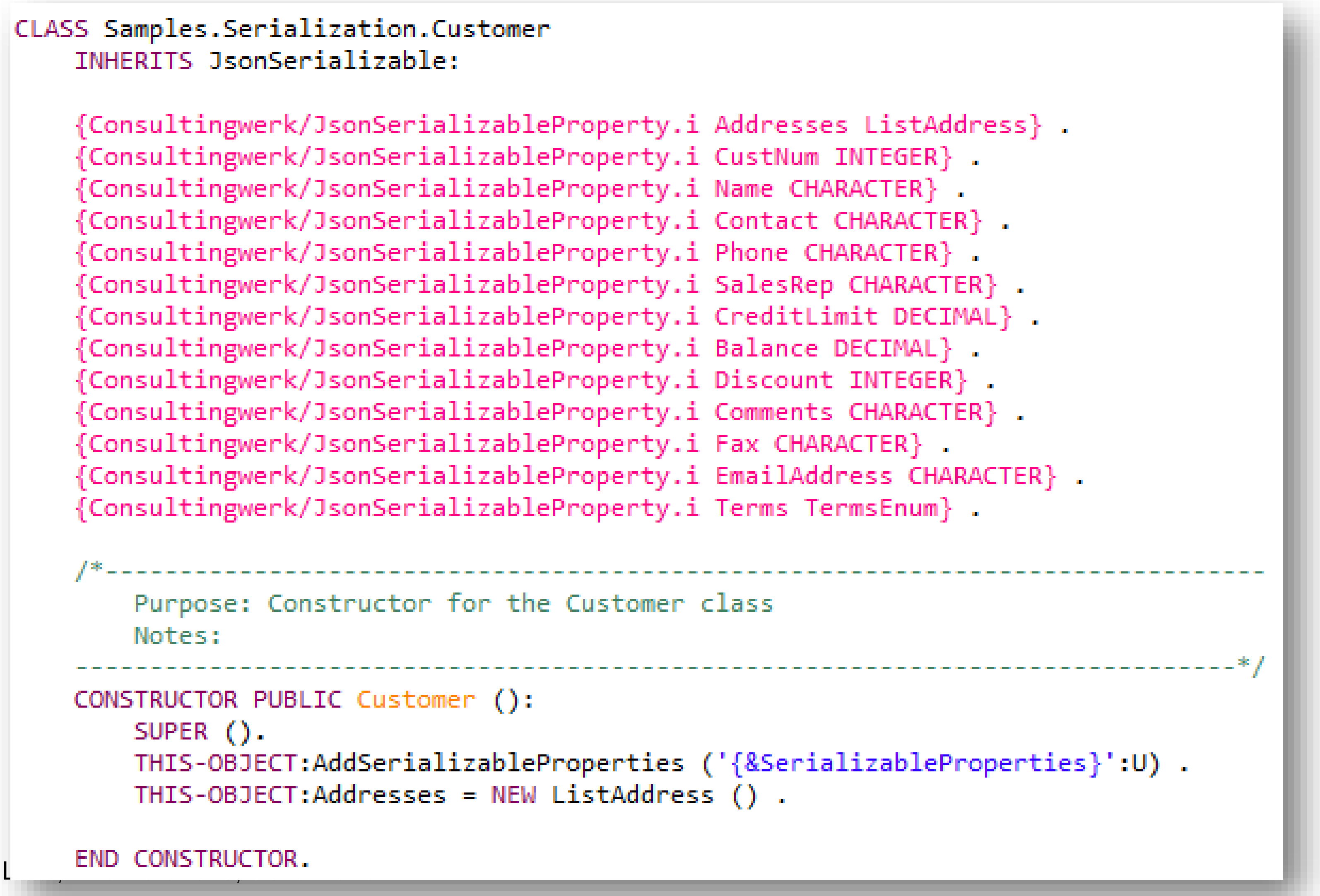
Serialization, again with an include file

- We maintain our own property specs – in a simple comma delimited list
- We use include file to consistently define property and property specs



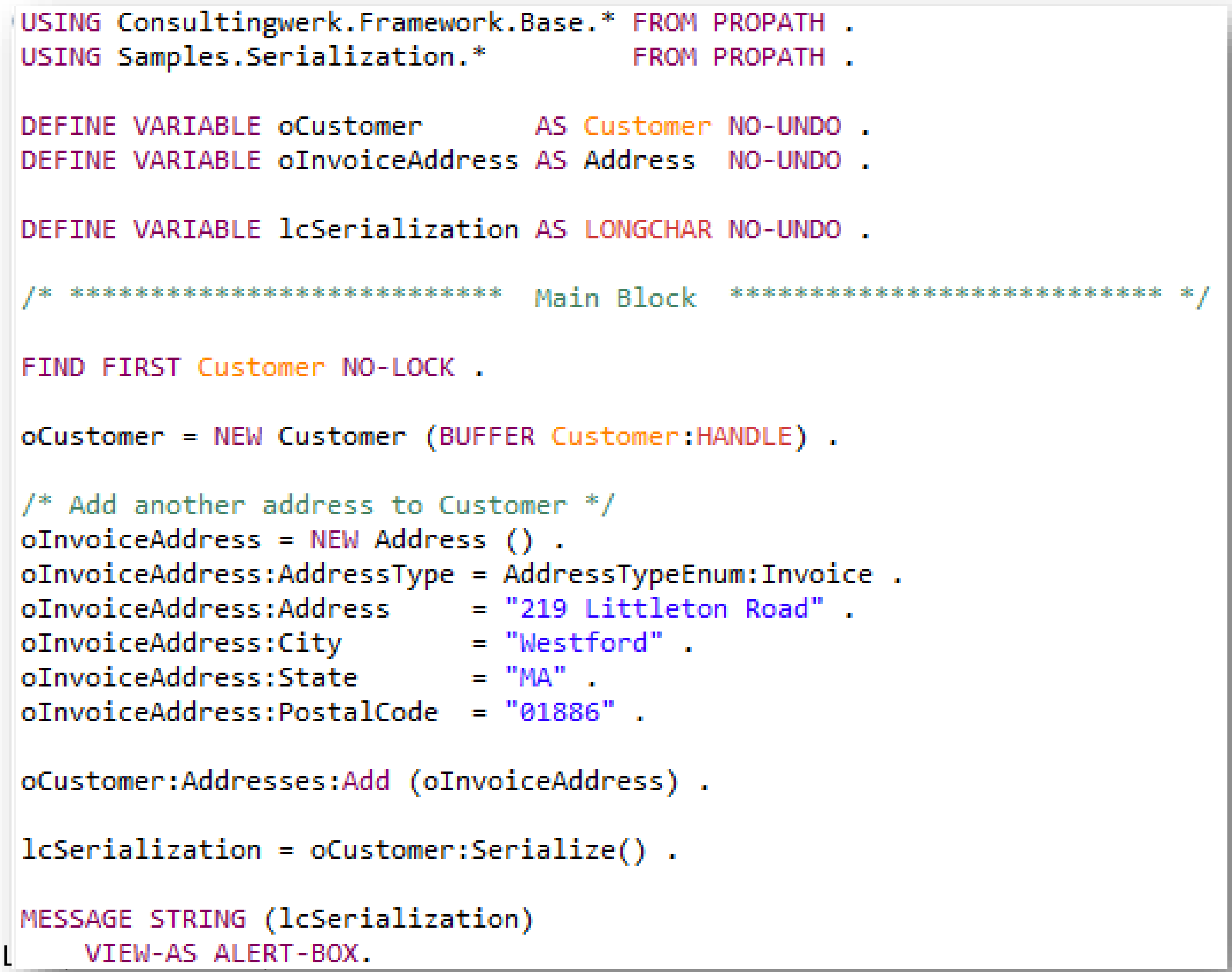
```
DEFINE PUBLIC PROPERTY {1} AS {2} NO-UNDO {3}
GET.
SET.

&IF "{&SerializableProperties}":U NE "":U &THEN
&GLOBAL-DEFINE SerializableProperties {&SerializableProperties},{1},{2}
&ELSE
&GLOBAL-DEFINE SerializableProperties {1},{2}
&ENDIF
```

Consultingwerk.JsonSerializable Customer

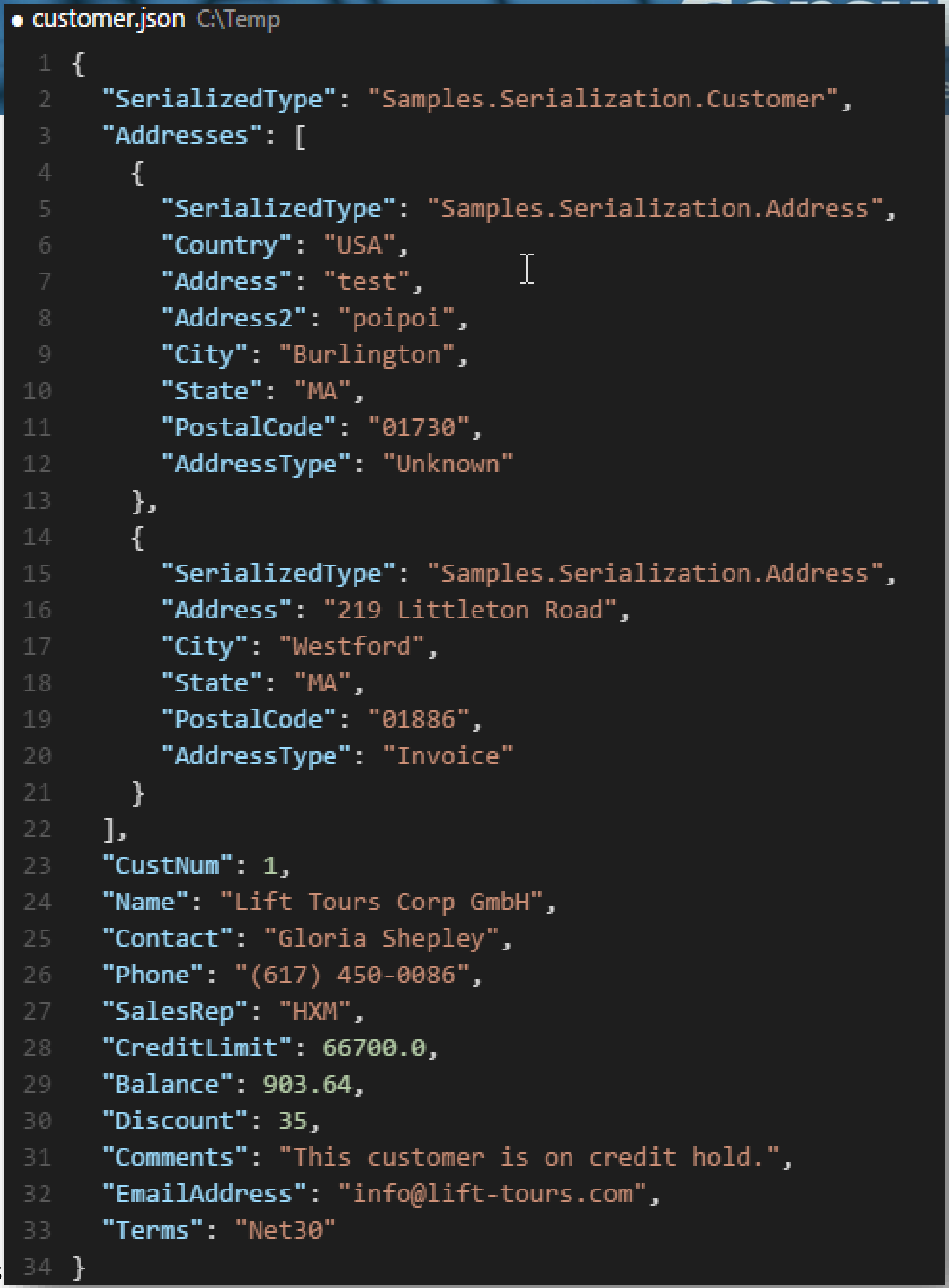


```
CLASS Samples.Serialization.Customer
    INHERITS JsonSerializable:

    {Consultingwerk/JsonSerializableProperty.i Addresses ListAddress} .
    {Consultingwerk/JsonSerializableProperty.i CustNum INTEGER} .
    {Consultingwerk/JsonSerializableProperty.i Name CHARACTER} .
    {Consultingwerk/JsonSerializableProperty.i Contact CHARACTER} .
    {Consultingwerk/JsonSerializableProperty.i Phone CHARACTER} .
    {Consultingwerk/JsonSerializableProperty.i SalesRep CHARACTER} .
    {Consultingwerk/JsonSerializableProperty.i CreditLimit DECIMAL} .
    {Consultingwerk/JsonSerializableProperty.i Balance DECIMAL} .
    {Consultingwerk/JsonSerializableProperty.i Discount INTEGER} .
    {Consultingwerk/JsonSerializableProperty.i Comments CHARACTER} .
    {Consultingwerk/JsonSerializableProperty.i Fax CHARACTER} .
    {Consultingwerk/JsonSerializableProperty.i EmailAddress CHARACTER} .
    {Consultingwerk/JsonSerializableProperty.i Terms TermsEnum} .

    /*------------------------------------------------------------------------------
        Purpose: Constructor for the Customer class
        Notes:
    ------------------------------------------------------------------------------*/
    CONSTRUCTOR PUBLIC Customer ():
        SUPER ().
        THIS-OBJECT:AddSerializableProperties ('{&SerializableProperties}':U) .
        THIS-OBJECT:Addresses = NEW ListAddress () .

    END CONSTRUCTOR.
```

Serializing Customer



```
USING Consultingwerk.Framework.Base.* FROM PROPATH .
USING Samples.Serialization.*         FROM PROPATH .

DEFINE VARIABLE oCustomer        AS Customer NO-UNDO .
DEFINE VARIABLE oInvoiceAddress AS Address  NO-UNDO .

DEFINE VARIABLE lcSerialization AS LONGCHAR NO-UNDO .

/* ***************************  Main Block  *************************** */

FIND FIRST Customer NO-LOCK .

oCustomer = NEW Customer (BUFFER Customer:HANDLE) .

/* Add another address to Customer */
oInvoiceAddress = NEW Address () .
oInvoiceAddress:AddressType = AddressTypeEnum:Invoice .
oInvoiceAddress:Address     = "219 Littleton Road" .
oInvoiceAddress:City        = "Westford" .
oInvoiceAddress:State       = "MA" .
oInvoiceAddress:PostalCode  = "01886" .

oCustomer:Addresses:Add (oInvoiceAddress) .

lcSerialization = oCustomer:Serialize() .

MESSAGE STRING (lcSerialization)
    VIEW-AS ALERT-BOX.
```

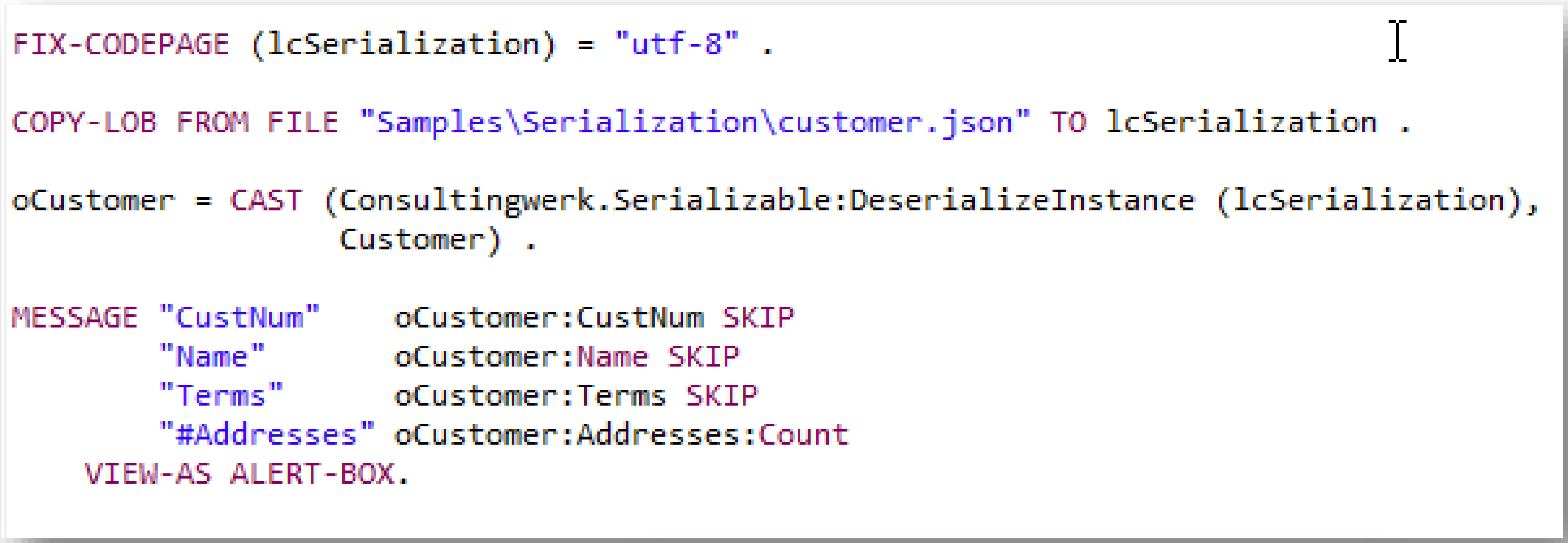

● customer.json C:\Temp

```
{
  "SerializedType": "Samples.Serialization.Customer",
  "Addresses": [
    {
      "SerializedType": "Samples.Serialization.Address",
      "Country": "USA",
      "Address": "test",
      "Address2": "poipoi",
      "City": "Burlington",
      "State": "MA",
      "PostalCode": "01730",
      "AddressType": "Unknown"
    },
    {
      "SerializedType": "Samples.Serialization.Address",
      "Address": "219 Littleton Road",
      "City": "Westford",
      "State": "MA",
      "PostalCode": "01886",
      "AddressType": "Invoice"
    }
  ],
  "CustNum": 1,
  "Name": "Lift Tours Corp GmbH",
  "Contact": "Gloria Shepley",
  "Phone": "(617) 450-0086",
  "SalesRep": "HXM",
  "CreditLimit": 66700.0,
  "Balance": 903.64,
  "Discount": 35,
  "Comments": "This customer is on credit hold.",
  "EmailAddress": "info@lift-tours.com",
  "Terms": "Net30"
}
```

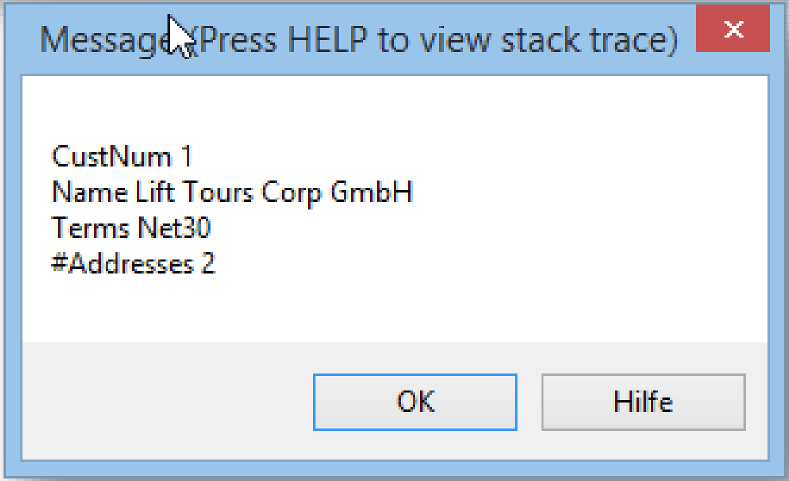
Demo

- Code Review Consultingwerk.JsonSerializable

Deserializing Customer



```
FIX-CODEPAGE (lcSerialization) = "utf-8" .

COPY-LOB FROM FILE "Samples\Serialization\customer.json" TO lcSerialization .

oCustomer = CAST (Consultingwerk.Serializable:DeserializeInstance (lcSerialization),
                  Customer) .

MESSAGE "CustNum"    oCustomer:CustNum SKIP
        "Name"       oCustomer:Name SKIP
        "Terms"      oCustomer:Terms SKIP
        "#Addresses" oCustomer:Addresses:Count
    VIEW-AS ALERT-BOX.
```



```
Message (Press HELP to view stack trace)

CustNum 1
Name Lift Tours Corp GmbH
Terms Net30
#Addresses 2
```

Questions

EMEAPUG
CHALLENGE