IntelligenceLab 7.5

Quick Start

Delphi 7 - Project1
File Edit Search View Project Run Component Database Tools Window MySQL Help
Standard Video Lab OpenWire Signal Lab Audio Lab Additional Win32 System
Unit1
SLScope1

www.openwire.org
www.mitov.com

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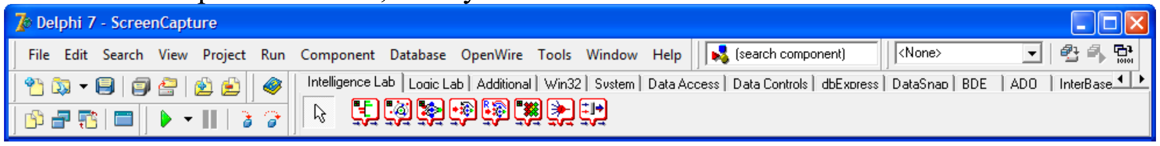
Installation

InstrumentLab comes with an installation program. Just start the installation by double-clicking on the Setup.exe file and follow the installation instructions.

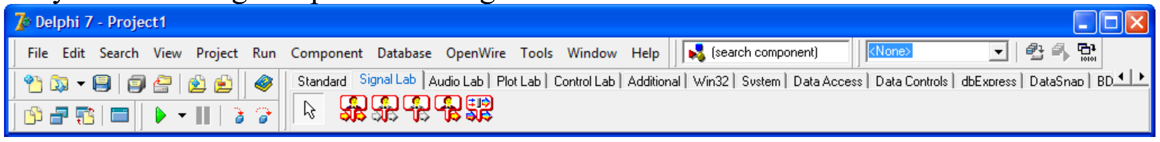
Where is InstrumentLab?

After the installation, start your Delphi or C++ Builder.
Scroll the Component Palette, until you see the last three tabs:


Delphi 7 - ScreenCapture
File Edit Search View Project Run Component Database OpenWire Tools Window Help
(search component)
<None>
Intelligence Lab | Logic Lab | Additional | Win32 | System | Data Access | Data Controls | dbExpress | DataSnap | BDE | ADO | InterBase

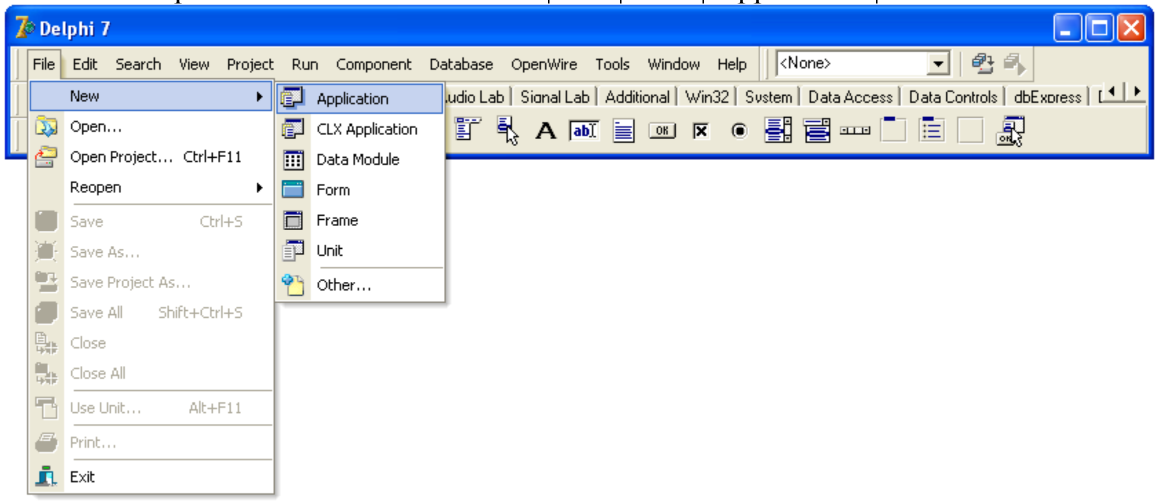
If the installation was successful, they should be named “Signal Lab”, “UserLab”, and “InstrumentLab”. On the SignalLab palette you will have only a subset of the SignalLab components. SignalLab is a separated product, and will not be shipped as full with InstrumentLab.

Only the following components of SignalLab will be available:


Delphi 7 - Project1
File Edit Search View Project Run Component Database OpenWire Tools Window Help
(search component)
<None>
Standard | Signal Lab | Audio Lab | Plot Lab | Control Lab | Additional | Win32 | System | Data Access | Data Controls | dbExpress | DataSnap | BD

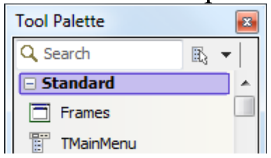
Creating classifier application

From the Delphi/C++Builder menu select | File | New | Application |.



An empty form will appear on the screen.

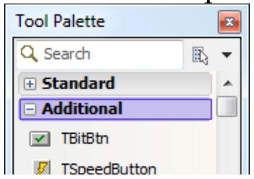
From the “Component Palette” select the “Standard” tab:



From the tab select and drop on the form a TButton component.

- TButton

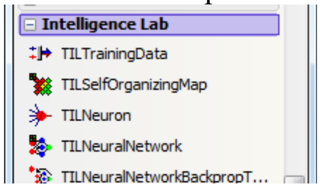
From the “Component Palette” select the “Additional” tab:



select and drop on the form a TImage:

- TImage

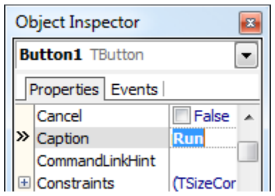
From the “Component Palette” select the “Intelligence Lab” tab:



From the tab select and drop on the form a TILNaiveBayes component.

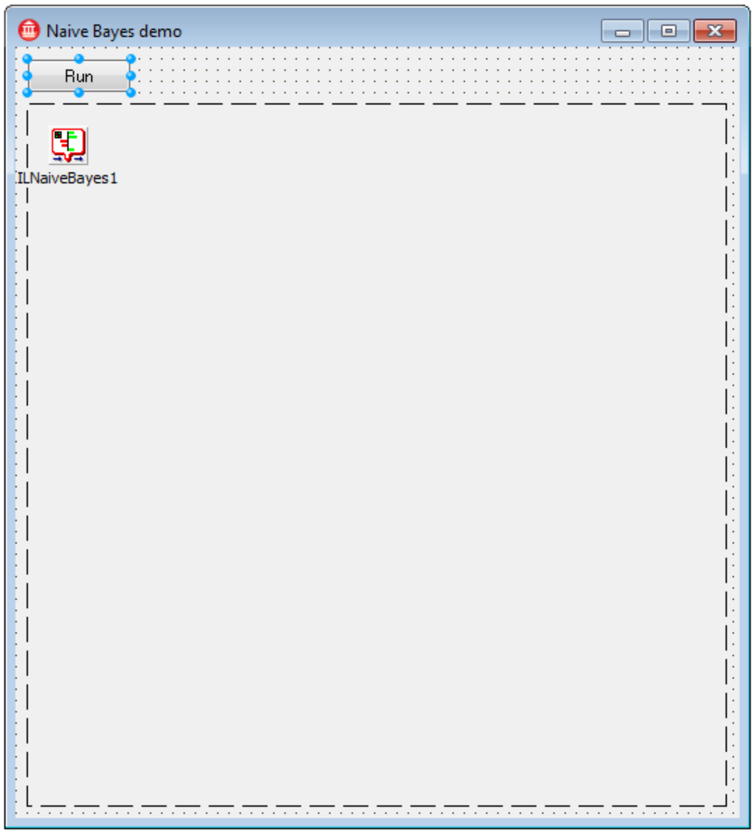
- TILNaiveBayes

Select the Button1 and in the “Object Inspector” change the Caption of the Button1 to “Run”:



Cancel	False
Caption	Run
CommandLinkHint	
Constraints	(TSizeCor

Double-click on the Button1:



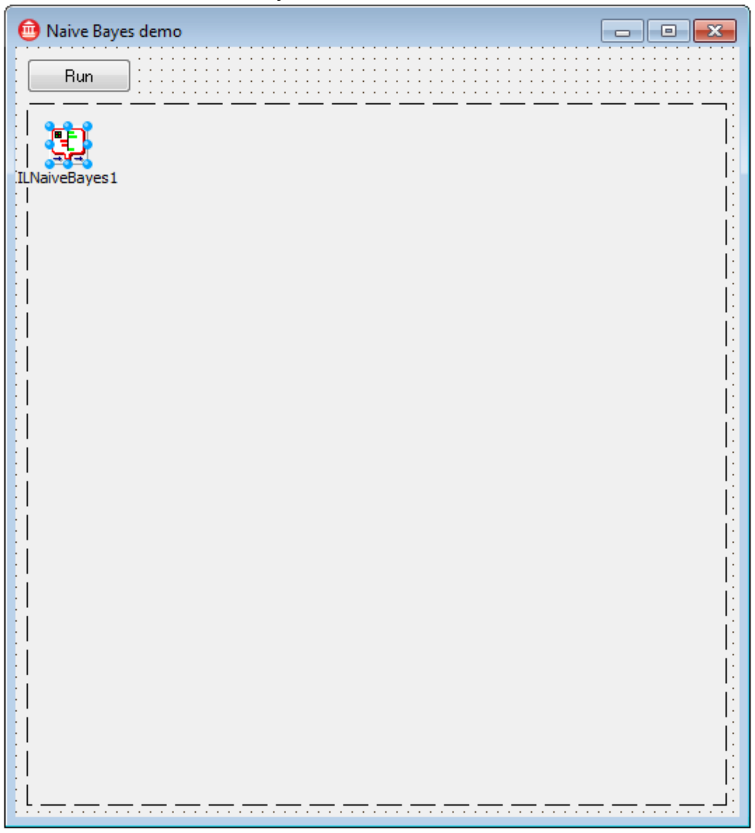
If you are using Delphi add the highlighted code to the Button1Click event in the Unit1.pas file:

```
procedure TForm1.Button1Click(Sender: Tobject);
var
  ATrainingData : ISLRealMatrixBuffer;
  AResposes     : ISLRealBuffer;
  ATestData     : ISLRealBuffer;
  I             : Integer;
  J             : Integer;
  pt            : Tpoint;

begin
  ATrainingData  := TSLRealMatrixBuffer.CreateSize( 150, 2 );
  AResposes := TSLRealBuffer.CreateSize( 150 );

  Image1.Picture.Bitmap.Width  := 500;
  Image1.Picture.Bitmap.Height := 500;

  for I := 0 to 50 - 1 do
    begin
    AResposes[ I ] := 1;
    ATrainingData[ I, 0 ] := Random( 250 );
    ATrainingData[ I, 1 ] := Random( 200 );
    end;

  for I := 50 to 100 - 1 do
    begin
    AResposes[ I ] := 2;
    ATrainingData[ I, 0 ] := 300 + Random( 199 );
    ATrainingData[ I, 1 ] := 100 + Random( 200 );
    end;

  for I := 100 to 150 - 1 do
    begin
    AResposes[ I ] := 3;
    ATrainingData[ I, 0 ] := Random( 300 );
    ATrainingData[ I, 1 ] := 300 + Random( 199 );
    end;

  ILNaiveBayes1.Train( ATrainingData, AResposes, False );

  ATestData := TSLRealBuffer.CreateSize( 2 );
  for I := 0 to 500 - 1 do
    for J := 0 to 500 - 1 do
      begin
      ATestData[ 1 ] := I;
      ATestData[ 0 ] := J;
      ILNaiveBayes1.Predict( ATestData );
      end;

  // display the original training samples
  for i := 0 to 150 div 3 - 1 do
    begin
    pt.x := Round( ATrainingData[ I, 0 ]);
    pt.y := Round( ATrainingData[ I, 1 ]);

    Image1.Picture.Bitmap.Canvas.Pen.Color := clRed;
    Image1.Picture.Bitmap.Canvas.Brush.Color := clRed;
    Image1.Picture.Bitmap.Canvas.Ellipse( pt.x - 2, pt.y - 2, pt.x +
2, pt.y + 2 );

    pt.x := Round( ATrainingData[ I + 50, 0 ]);
    pt.y := Round( ATrainingData[ I + 50, 1 ]);

    Image1.Picture.Bitmap.Canvas.Pen.Color := clLime;
    Image1.Picture.Bitmap.Canvas.Brush.Color := clLime;
    Image1.Picture.Bitmap.Canvas.Ellipse( pt.x - 2, pt.y - 2, pt.x +
2, pt.y + 2 );

    pt.x := Round( ATrainingData[ I + 100, 0 ]);
    pt.y := Round( ATrainingData[ I + 100, 1 ]);

    Image1.Picture.Bitmap.Canvas.Pen.Color := clBlue;
    Image1.Picture.Bitmap.Canvas.Brush.Color := clBlue;
    Image1.Picture.Bitmap.Canvas.Ellipse( pt.x - 2, pt.y - 2, pt.x +
2, pt.y + 2 );
    end;

end;
```

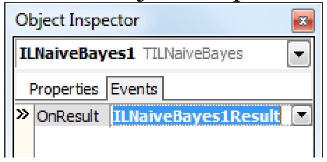
If you are using C++ Builder add the highlighted code to the Button1Click event in the Unit1.cpp file:

```
void __fastcall TForm1::Button1Click(TObject *Sender)
{
  TSLCRealMatrixBuffer ATrainingData( 150, 2 );
  TSLCRealBuffer AResposes( 150 );

  Image1->Picture->Bitmap->Width = 500;
  Image1->Picture->Bitmap->Height = 500;

  for( int i = 0; i < 50; i ++ )
    {
    AResposes[ i ] = 1;
    ATrainingData[ i ][ 0 ] = rand() % 250;
    ATrainingData[ i ][ 1 ] = rand() % 200;
    }

  for( int i = 50; i < 100; i ++ )
    {
    AResposes[ i ] = 2;
    ATrainingData[ i ][ 0 ] = 300 + rand() % 200;
    ATrainingData[ i ][ 1 ] = 100 + rand() % 200;
    }

  for( int i = 100; i < 150; i ++ )
    {
    AResposes[ i ] = 3;
    ATrainingData[ i ][ 0 ] = rand() % 300;
    ATrainingData[ i ][ 1 ] = 300 + rand() % 200;
    }

  ILNaiveBayes1->Train( ATrainingData, AResposes, false );

  TSLCRealBuffer ATestData( 2 );

  for( int i = 0; i < 500; i ++ )
    for( int j = 0; j < 500; j ++ )
      {
      ATestData[ 1 ] = i;
      ATestData[ 0 ] = j;
      ILNaiveBayes1->Predict( ATestData );
      }

  // display the original training samples
  for( int i = 0; i < 150 / 3; i ++ )
    {
    TPoint pt;
    pt.x = ATrainingData[ i ][ 0 ] + 0.5;
    pt.y = ATrainingData[ i ][ 1 ] + 0.5;

    Image1->Picture->Bitmap->Canvas->Pen->Color = clRed;
    Image1->Picture->Bitmap->Canvas->Brush->Color = clRed;
    Image1->Picture->Bitmap->Canvas->Ellipse( pt.x - 2, pt.y - 2,
pt.x + 2, pt.y + 2 );

    pt.x = ATrainingData[ i + 50 ][ 0 ] + 0.5;
    pt.y = ATrainingData[ i + 50 ][ 1 ] + 0.5;

    Image1->Picture->Bitmap->Canvas->Pen->Color = clLime;
    Image1->Picture->Bitmap->Canvas->Brush->Color = clLime;
    Image1->Picture->Bitmap->Canvas->Ellipse( pt.x - 2, pt.y - 2,
pt.x + 2, pt.y + 2 );

    pt.x = ATrainingData[ i + 100 ][ 0 ] + 0.5;
    pt.y = ATrainingData[ i + 100 ][ 1 ] + 0.5;

    Image1->Picture->Bitmap->Canvas->Pen->Color = clBlue;
    Image1->Picture->Bitmap->Canvas->Brush->Color = clBlue;
    Image1->Picture->Bitmap->Canvas->Ellipse( pt.x - 2, pt.y - 2,
pt.x + 2, pt.y + 2 );
    }

}
```

Select the ILNaiveBayes1 on the form:



In the "Object Inspector" select the events tab and double click on the OnResult event:



OnResult ILNaiveBayes1Result

If you are using Delphi add the highlighted code to the ILNaiveBayes1Result event in the Unit1.pas file:

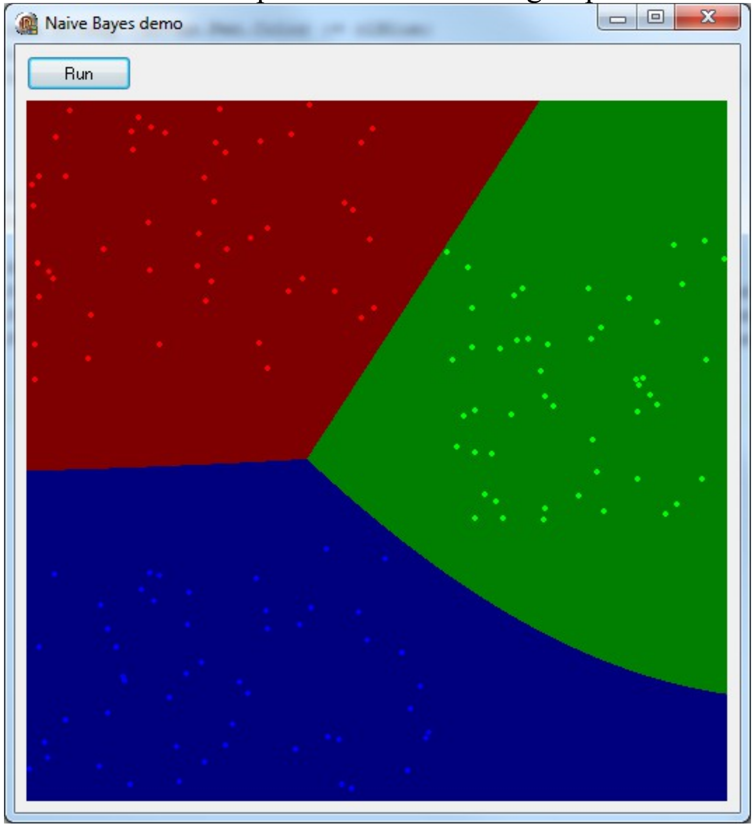
```
procedure TForm1.ILNaiveBayes1Result(ASender: TObject; AFeatures:
ISLRealBuffer; AResult: TILNaiveBayesResult);
begin
  case( Round( AResult.ResultClass )) of
    1 : Image1.Picture.Bitmap.Canvas.Pixels[ Round( AFeatures[ 0 ] ),
Round( AFeatures[ 1 ] ) ] := RGB( 127, 0, 0 );
    2 : Image1.Picture.Bitmap.Canvas.Pixels[ Round( AFeatures[ 0 ] ),
Round( AFeatures[ 1 ] ) ] := RGB( 0, 127, 0 );
    3 : Image1.Picture.Bitmap.Canvas.Pixels[ Round( AFeatures[ 0 ] ),
Round( AFeatures[ 1 ] ) ] := RGB( 0, 0, 127 );
    end;

end;
```

If you are using C++ Builder add the highlighted code to the ILNaiveBayes1Result event in the Unit1.cpp file:

```
void __fastcall TForm1::ILNaiveBayes1Result(TObject *ASender, ISLRe-
alBuffer *AFeatures, TILNaiveBayesResult *AResult)
{
  switch( (int)( AResult->ResultClass + 0.5 ))
    {
    case 1 : Image1->Picture->Bitmap->Canvas->Pixels[ AFeatures-
>Items[ 0 ] ][ AFeatures->Items[ 1 ] ] = (TColor)RGB( 127, 0, 0 );
break;
    case 2 : Image1->Picture->Bitmap->Canvas->Pixels[ AFeatures-
>Items[ 0 ] ][ AFeatures->Items[ 1 ] ] = (TColor)RGB( 0, 127, 0 );
break;
    case 3 : Image1->Picture->Bitmap->Canvas->Pixels[ AFeatures-
>Items[ 0 ] ][ AFeatures->Items[ 1 ] ] = (TColor)RGB( 0, 0, 127 );
break;
    }
}
```

Compile and run the application.

Click on the "Run" button.
You should see the pixels classified in 3 groups:



You have just learned how to use IntelligenceLab classifier.

Using the TSLCRealBuffer in C++ Builder and Visual C++

The C++ Builder version of the library comes with a powerful data buffer class, called TSLCRealBuffer.
The TSLCRealBuffer is capable of performing basic math operations over the data as well as some basic signal processing functions. The data buffer also uses copy on write algorithm improving dramatically the application performance.
The TSLCRealBuffer is an essential part of the SignalLab generators and filters, but it can be used independently in your code.
You have seen already some examples of using TSLCRealBuffer in the previous chapters. Here we will go into a little bit more details about how TSLCRealBuffer can be used.
In order to use TSLCRealBuffer you must include SLCRealBuffer.h directly or indirectly (trough another include file):

```
#include <SLCRealBuffer.h>
```

Once the file is included you can declare a buffer:
Here is how you can declare a 1024 samples buffer:

```
TSLCRealBuffer Buffer( 1024 );
```

Version 4.0 and up does not require the usage of data access objects. The data objects are now obsolete and have been removed from the library.

You can obtain the current size of a buffer by calling the GetSize method:

```
Int ASize = Buffer.GetSize(); // Obtains the size of the buffers
```

You can resize (change the size of) a buffer:

```
Buffer.Resize( 2048 ); // Changes the size to 2048
```

You can set all of the elements (samples) of the buffer to a value:

```
Buffer.Set( 30 ); // Sets all of the elements to 30.
```

You can access individual elements (samples) in the buffer:

```
Buffer [ 5 ] = 3.7; // Sets the fifth elment to 3.7

Double AValue = Buffer [ 5 ]; // Assigns the fifth element to a vari-
able
```

You can obtain read, write or modify pointer to the buffer data:

```
const double *data = Buffer.Read() // Starts reading only
double *data = Buffer.Write()// Starts writing only
double *data = Buffer.Modify()// Starts reading and writing
```

Sometimes you need a very fast way of accessing the buffer items. In this case, you can obtain a direct pointer to the internal data buffer. The buffer is based on copy on write technology for high performance. The mechanism is encapsulated inside the buffer, so when working with individual items you don't have to worry about it. If you want to access the internal buffer for speed however, you will have to specify up front if you are planning to modify the data or just to read it. The TSLCRealBuffer has 3 methods for accessing the data Read(), Write(), and Modify (). Read() will return a constant pointer to the data. You should use this method when you don't intend to modify the data and just need to read it. If you want to create new data from scratch and don't intend to preserve the existing buffer data, use Write(). If you need to modify the data you should use Modify (). Modify () returns a non constant pointer to the data, but often works slower than Read() or Write(). Here are some examples:

```
const double *pcData = Buffer.Read(); // read only data pointer

double Value = *pcData; // OK!
*pcData = 3.5; // Wrong!


double *pData = Buffer.Write(); // generic data pointer

double Value = *pData; // OK!
*pData = 3.5; // OK!
```

You can assign one buffer to another:

```
Buffer1 = Buffer2;
```

You can do basic buffer arithmetic:

```
TSLCRealBuffer Buffer1( 1024 );
TSLCRealBuffer Buffer2( 1024 );
TSLCRealBuffer Buffer3( 1024 );

Buffer1.Set( 20.5 );
Buffer2.Set( 5 );

Buffer3 = Buffer1 + Buffer2;
Buffer3 = Buffer1 - Buffer2;
Buffer3 = Buffer1 * Buffer2;
Buffer3 = Buffer1 / Buffer2;
```

In this example the elements of the Buffer3 will be result of the operation (+,-,* or /) between the corresponding elements of Buffer1 and Buffer2.
You can add, subtract, multiply or divide by constant:

```
// Adds 4.5 to each element of the buffer
Buffer1 = Buffer2 + 4.5;

// Subtracts 4.5 to each element of the buffer
Buffer1 = Buffer2 - 4.5;

// Multiplies the elements by 4.5
Buffer1 = Buffer2 * 4.5;

// Divides the elements by 4.5
Buffer1 = Buffer2 / 4.5;
```

You can do “in place” operations as well:

```
Buffer1 += Buffer2;
Buffer1 += 4.5;

Buffer1 -= Buffer2;
Buffer1 -= 4.5;

Buffer1 *= Buffer2;
Buffer1 *= 4.5;

Buffer1 /= Buffer2;
Buffer1 /= 4.5;
```

Those are just some of the basic buffer operations provided by SignalLab.
If you are planning to use some of the more advanced features of TSLCRealBuffer please refer to the online help.
SignalLab also provides TSLCComplexBuffer and TSLCIntegerBuffer. They work similar to the TSLCRealBuffer but are intended to be used with Complex and Integer data. For more information on TSLCComplexBuffer and TSLCIntegerBuffer please refer to the online help.

Distributing your application

Once you have finished the development of your application you most likely will need to distribute it to other systems. In order for some IntelligenceLab built application to work, you will have to include a set of DLL files together with the distribution. The necessary files can be found under the [install path]\DLL directory([install path] is the location where the IntelligenceLab was installed). You can distribute them to the [Windows]\System32 ([Windows]\SysWOW64 in 64 bit Windows) directory, or to the distribution directory of your application([Windows] is the Windows directory - usually C:\WINNT or C:\WINDOWS).
Not all of the components in the library require additional DLLs. Please check if the DLLs are needed by the application before including them in the install.

Deploying your 32 bit application with the IPP DLLs

The compiled applications can be deployed to the target system by simply copying the executable. The application will work, however the performance can be improved by also copying the Intel IPP DLLs provided with the library.
The DLLs are under the [install path]\LabPacks\IppDLL\Win32 directory([install path] is the location where the library was installed).
In 32 bit Windows to deploy IPP, copy the files to the [Windows]\System32 directory on the target system.
In 64 bit Windows to deploy IPP, copy the files to the [Windows]\SysWOW64 directory on the target system.
[Windows] is the Windows directory - usually C:\WINNT or C:\WINDOWS
This will improve the performance of your application on the target system.

Deploying your 64 bit application

The current version of the library requires when deploying 64 bit applications, the Intel IPP DLLs to be deployed as well.

The DLLs are under the [install path]\LabPacks\IppDLL\Win64 directory([install path] is the location where the library was installed).

To deploy IPP, copy the files to the [Windows]\System32 directory on the target system.
[Windows] is the Windows directory - usually C:\WINNT or C:\WINDOWS
This will improve the performance of your application on the target system.