Windows Eiffel Library Tutorial

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The Windows Eiffel Library (WEL) has been designed to make Windows programming easier, more reliable, more convenient, and more powerful by using Eiffel principles. The most obvious definition of WEL is that it is an encapsulation of Windows primitives, making it possible for users of ISE's Graphical Eiffel for Windows to have direct access to the Windows graphical API.

This tutorial[1] requires some knowledge of Eiffel 3 (the language), EiffelBase (ISE's basic libraries) and EiffelBench (ISE's Programming Environment). Your knowledge of Windows Software Developers Kit will be helpful but not necessary.

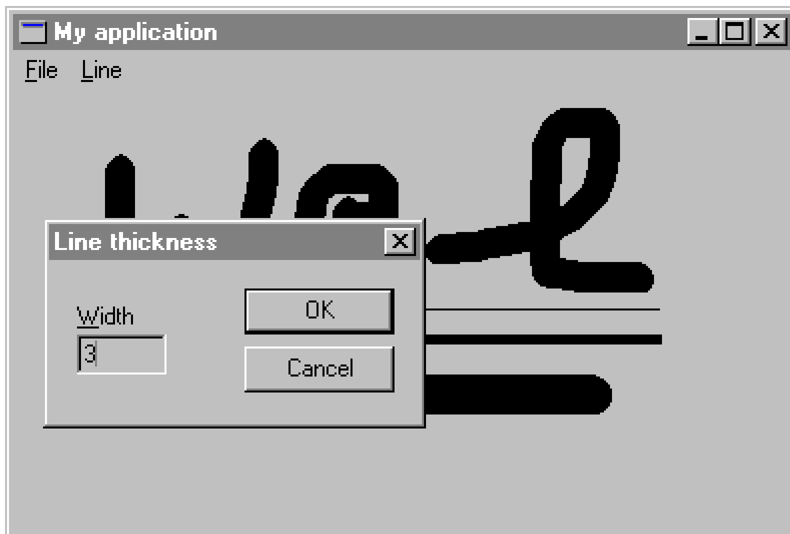
In the upcoming chapters, you will build a graphical, interactive Windows program, complete with menus, file saving and loading, graphic and text drawing. On the way, you will be introduced to the major principles of Windows application design, such as message processing, managing a device context, using dialog boxes, and automatic graphics redrawing.

This walk-through consists of eight steps:

- Step 1: Creating an application
- Step 2: Defining a main window class
- Step 3: Drawing text in a window
- Step 4: Drawing lines in a window
- Step 5: Changing line thickness
- Step 6: Repainting a window
- Step 7: Adding a menu
- Step 8: Storing the drawing in a file

Figure 1 shows the application you will have created at the end of this manual.

Figure 1



The source code for the application is provided at various stages on the distribution disk. The directories in $EIFFEL3\EXAMPLES\WEL\TUTORIAL are named STEP1, STEP2 and so on, corresponding to the steps in the tutorial.

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[1] This tutorial is also available on our WEB site at http://www.eiffel.com/doc/manuals/technology/wel/tutorial/index.html.

Step 1: Creating an application

All Windows programs have a window called main window that appears when the user starts the program. In WEL, this window is owned by the application which is responsible for creating and displaying the main window, processing Windows messages and terminating the application.

Every WEL application must define its own descendant of *WEL_APPLICATION* in order to define the deferred function *main_window* as follows:

```
class
	APPLICATION

inherit
	WEL_APPLICATION

creation
	make

feature

	main_window: WEL_FRAME_WINDOW is
			-- Create the application's main window.
		once
			!! Result.make_top ("My application")
		end ;

end -- class APPLICATION
```

This class is the minimal WEL application, if you run it you will get an empty frame window that can be moved, resized, maximized, minimized and closed. Figure 2 shows the appearance of the application.

Figure 2

Step 2: Defining a main window class

In this step, you will learn how to define your window type for the main window, including application-specific behavior and appearance. You will create a more specialized main window class which is descending from *WEL_FRAME_WINDOW*.

The quickest way to make a window useful is to explain it how to respond to Windows messages. For example, when the user clicks the left mouse button in the main window of *My application*, the corresponding window object receives a *Wm_lbuttondown* message from Windows. This tells the window object that the user clicked the mouse in it. It also passes the coordinates of the point where the user clicked. To intercept and respond to Windows messages, WEL defines several procedures corresponding to the most common Windows messages. For instance, *WEL_WINDOW* has a procedure named *on_left_button_down* corresponding to the *Wm_lbuttondown* message. To respond to the message, you just need to redefine this procedure as follows:

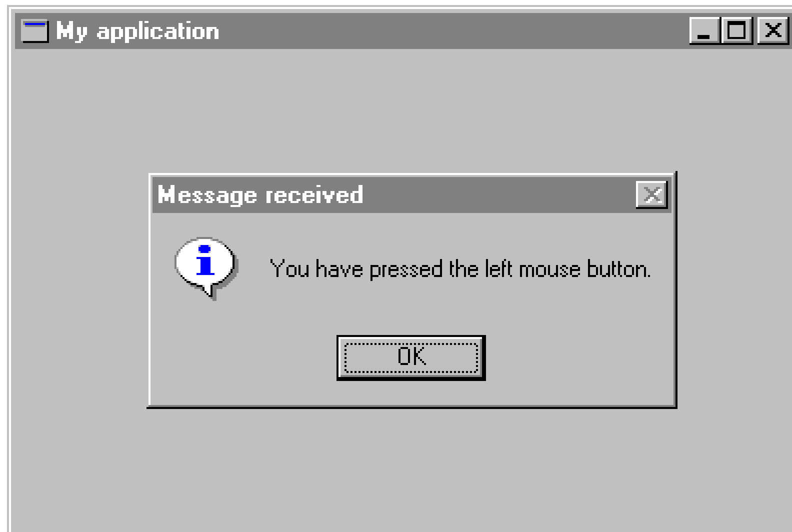
```
	on_left_button_down (keys, x_pos, y_pos: INTEGER) is
			-- Display a message box when the user presses the
			-- the left mouse button.
		do
			information_message_box ("You have pressed the left mouse button.",
				"Message received")
		end ;
```

Since you have defined a customized main window class, you have to change the *main_window* function in *APPLICATION* in order to return an instance of *MAIN_WINDOW*. Class *APPLICATION* must be defined as follows:

```
class
	APPLICATION

inherit
	WEL_APPLICATION

creation
	make

feature

	main_window: MAIN_WINDOW is
			-- Create the application's main window.
		once
			!! Result.make
		end ;

end  -- class APPLICATION
```

Figure 3 shows the message box displayed when the user clicks in the main window.

Figure 3



The program created here closes when the user clicks on the system close box. But in serious applications, you may want to change this default behavior, for instance, to ask the user if he wants to save his work. WEL provides an easy way to do that, you just need to redefine the boolean function *closeable* to perform tests and actions needed. If you return True (which is the default value) the user will be able to close the window, otherwise the user will be unable to close it. A possible implementation could be the following:

```
closeable: BOOLEAN is
            -- Does the user want to quit?
      do
            Result := question_message_box ("Do you want to quit?", "Quit")
      end ;
```

Here is the full source code of *MAIN_WINDOW*:

```
class
	MAIN_WINDOW

inherit
	WEL_FRAME_WINDOW
		redefine
			on_left_button_down, closeable
		end

creation
	make

feature {NONE} -- Initialization

	make is
			-- Make the main window.
		do
			make_top ("My application")
		end ;

feature {NONE} -- Implementation

	on_left_button_down (keys, x_pos, y_pos: INTEGER) is
			-- Display a message box when the user presses the
			-- the left mouse button.
		do
			information_message_box ("You have pressed the left mouse button.",
				"Message received")
		end ;

	closeable: BOOLEAN is
			-- Does the user want to quit?
		do
			Result := question_message_box ("Do you want to quit?", "Quit")
		end ;

end -- class MAIN_WINDOW
```

Step 3: Drawing text in a window

In the next sections, you will learn how to draw lines in the window, change the thickness of the lines, and finally save the contents of the window into a file for reloading later on. But first and to make things simple, you will learn to draw text in a window.

To provide applications with graphic functionality, Windows has a set of functions called the Graphic Device Interface, or GDI. The GDI is the graphic engine that Windows applications use to display and manipulate graphics. To draw text, lines, or figures in a window, you need to use a device context given by the GDI. A device context is a virtual surface with associated attributes, such as a pen, brush, font, background color, text color and current position. When you call GDI functions to draw on a device context, the device driver associated with that device context translates that drawing action into appropriate commands. These commands reproduce the drawing action as accurately as possible on the device context, regardless of the display's capabilities. The display might be a low-resolution monochrome screen, a two-million color screen or a printer. In other words, all devices supported by Windows.

To make things more interesting in your program, instead of bringing up a message box, you will respond by drawing text that shows the coordinates of the point where you clicked on the window. The new version of *on_left_button_down* will be defined as follows:

```
on_left_button_down (keys, x_pos, y_pos: INTEGER) is
            -- Write x_pos and y_pos when the user presses
            -- the left mouse button.
      local
            position: STRING
      do
            position := "(";
            position.append_integer (x_pos);
            position.append (", ");
            position.append_integer (y_pos);
            position.extend (')');
            dc.get;
            dc.text_out (x_pos, y_pos, position);
            dc.release
      end ;
```

You also need to add a new attribute in class *MAIN_WINDOW* which is:

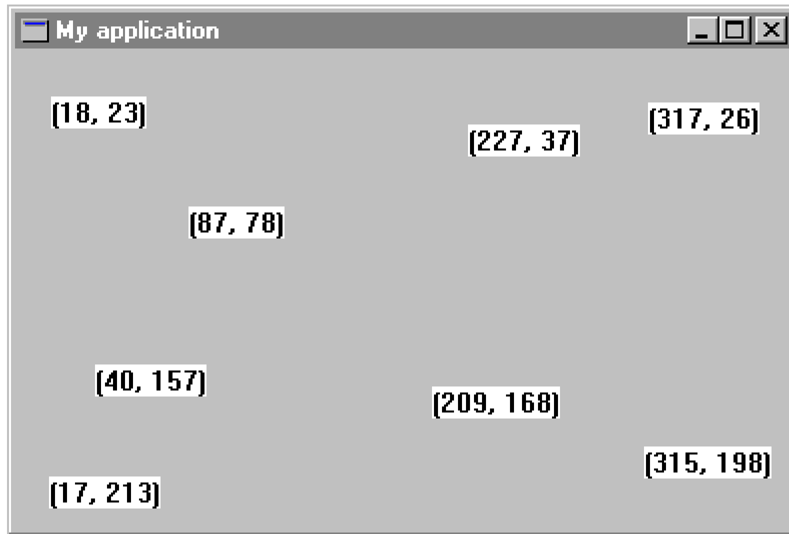
```
dc: WEL_CLIENT_DC;
            -- Device context associated to the current
            -- client window
```

The *make* routine needs to be modified in order to create *dc* as follows:

```
make is
            -- Make the main window.
      do
            make_top ("My application");
            !! dc.make (Current)
      end ;
```

Figure 4 shows the result after several clicks.

Figure 4



One more function you can add to the application is clearing the window. The window will be cleared when a right mouse button is clicked. To implement this, redefine *on_right_button* to call *invalidate* which causes the whole window to be repainted. Since your window does not yet know how to repaint itself, it just clears its client area.

```
on_right_button_down (keys, x_pos, y_pos: INTEGER) is
                -- Invalidate window.
        do
                invalidate
        end ;
```

The full code of *MAIN_WINDOW* is:

```
class
	MAIN_WINDOW

inherit
	WEL_FRAME_WINDOW
		redefine
			on_left_button_down, on_right_button_down, closeable
		end

creation
	make

feature {NONE} -- Initialization

	make is
			-- Make the main window.
		do
			make_top ("My application");
			!! dc.make (Current)
		end ;

feature  -- Access

	dc: WEL_CLIENT_DC;
			-- Device context associated to the current
			-- client window

feature {NONE} -- Implementation

	on_left_button_down (keys, x_pos, y_pos: INTEGER) is
			-- Write x_pos and y_pos when the user presses
			-- the left mouse button.
		local
			position: STRING
		do
			position := "(";
			position.append_integer (x_pos);
			position.append (", ");
			position.append_integer (y_pos);
			position.extend (')');
			dc.get;
			dc.text_out (x_pos, y_pos, position);
			dc.release
		end ;

	on_right_button_down (keys, x_pos, y_pos: INTEGER) is
			-- Invalidate window.
		do
			invalidate
		end ;

	closeable: BOOLEAN is
```

```
			-- Does the user want to quit?
		do
			Result := question_message_box ("Do you want to quit?", "Quit")
		end ;

end  -- class MAIN_WINDOW
```

Step 4: Drawing lines in a window

In the next few steps, you will build a simple painting program that lets the user draw on the main window. You will do the following steps:

1. Respond to left button clicks and drag by connecting the dots, resulting drawn lines.
2. Respond to the right click by bringing up an input dialog, allowing the user to change the thickness of the line.
3. Automatically redraw the window's contents by storing the points and redrawing them in response to a paint message.

Typically, a window will receive one left button down message, followed by a series of mouse move messages (one for each point dragged over), then followed by a single left button up message. The drawing model will be implemented as follows:

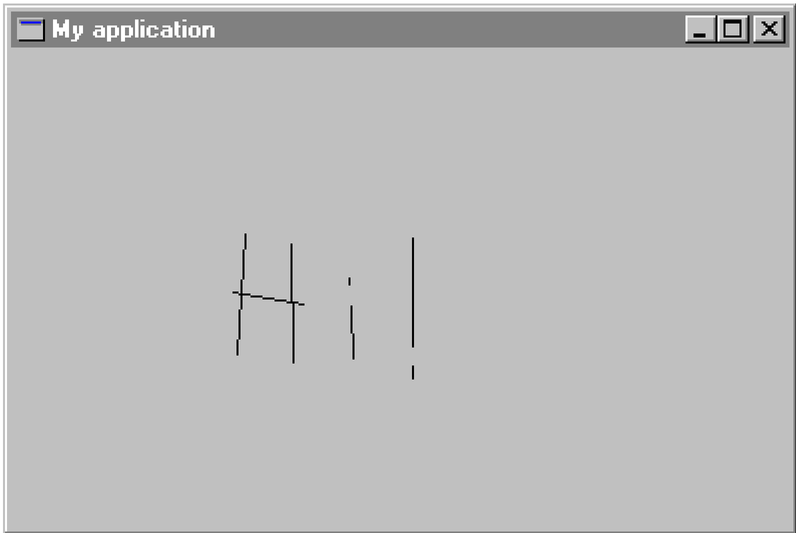
```
on_left_button_down (keys, x_pos, y_pos: INTEGER) is
                -- Initiate the drawing process.
        do
                if not button_down then
                        button_down := true ;
                        dc.get;
                        dc.move_to (x_pos, y_pos)
                end
        end ;

on_mouse_move (keys, x_pos, y_pos: INTEGER) is
                -- Connect the points to make lines.
        do
                if button_down then
                        dc.line_to (x_pos, y_pos)
                end
        end ;

on_left_button_up (keys, x_pos, y_pos: INTEGER) is
                -- Terminate the drawing process.
        do
                if button_down then
                        button_down := false ;
                        dc.release
                end
        end ;
```

Attribute *button_down* has been introduced to draw the lines only when the user moves the mouse while the button is down.

```
button_down: BOOLEAN;
                -- Is the left mouse button down?
```

Figure 5 shows what the application can do.

Figure 5



Here is the full text of *MAIN_WINDOW*:

```
class
	MAIN_WINDOW

inherit
	WEL_FRAME_WINDOW
		redefine
			on_left_button_down, on_left_button_up,
			on_right_button_down, on_mouse_move,
			closeable
		end

creation
	make

feature {NONE} -- Initialization

	make is
			-- Make the main window.
		do
			make_top ("My application");
			!! dc.make (Current)
		end ;

feature -- Access

	dc: WEL_CLIENT_DC;
			-- Device context associated to the current
			-- client window

	button_down: BOOLEAN;
			-- Is the left mouse button down?

feature {NONE} -- Implementation

	on_left_button_down (keys, x_pos, y_pos: INTEGER) is
			-- Initiate the drawing process.
		do
			if not button_down then
				button_down := true ;
				dc.get;
				dc.move_to (x_pos, y_pos)
			end
		end ;

	on_mouse_move (keys, x_pos, y_pos: INTEGER) is
			-- Connect the points to make lines.
		do
			if button_down then
				dc.line_to (x_pos, y_pos)
			end
		end ;
```

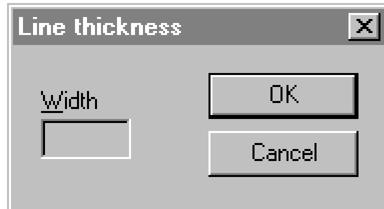
```
        on_left_button_up (keys, x_pos, y_pos: INTEGER) is
                        -- Terminate the drawing process.
                do
                        if  button_down then
                                button_down := false ;
                                dc.release
                        end
                end ;

        on_right_button_down (keys, x_pos, y_pos: INTEGER) is
                        -- Invalidate window.
                do
                        invalidate
                end ;

        closeable: BOOLEAN is
                        -- Does the user want to quit?
                do
                        Result := question_message_box ("Do you want to quit?", "Quit")
                end ;

end  -- class MAIN_WINDOW
```

Step 5: Changing line thickness

At this point, you can draw only thin lines. In order to change line thickness, you have to change the thickness of the pen the application use to draw lines. In this step, you will learn how to set new tools in a display context and how to create a dialog box.

You will use a dialog box to provide a mechanism for the user to change the line thickness. Figure 6 shows the dialog box.

Figure 6



There are 2 methods to include a dialog box in your application:

- Using resources
- Writing Eiffel code

The first method consists of using Windows resources capabilities works only with the Professional version of ISE Eiffel since resources are linked to the program's executable file. This solution needs a linker, a resource compiler and a resource editor which are shipped with your C-compiler. Resources compilation process is completely integrated to Professional ISE Eiffel 3 for Windows and fully transparent for the user. You just need to put a resource file in the project directory, start a Freeze (or Finalize) operation, and EiffelBench does the rest. In a nutshell, the freeze or finalization process will automatically copy the resource file from the project directory into the \EIFGEN\[W|F]_CODE directory and will link it to the executable file. Once the resource file is linked to your executable you can just Melt your project. You will need to Freeze again if you change or add any resources. This method is much easier and quicker than the second because it is usually easier to use a visual tool to design a dialog box or a menu instead of writing Eiffel code. One of the most important advantages of resources is that you can change them without touching Eiffel code. It is clear that this is the preferred method if you are a Professional ISE Eiffel 3 for Windows user. You will see later in details how to create and use a resource file in WEL.

The second method consists of writing an Eiffel class which creates each visual component of the dialog box with the right positions and dimensions. Typically, if you use Personal ISE Eiffel 3 for Windows you will choose this method since the Personal version does not allow to produce a stand-alone executable file.

Both methods will be explain in details in the following sections.

Method 1: Using resources

Resources are data stored in a program's executable file, but stored separately from the program's normal data segment. Typically, Windows leaves resources on disk when it loads an application into memory, and loads individual resources as it needs them during execution. You've probably noticed dynamic loading of resources when working with Windows programs. When you invoke a program's dialog box for the first time, Windows usually accesses the disk to copy the dialog box resource from the program's .EXE file into memory. Of course, if you want the resource to be loaded when the program is loaded, or if you don't want Windows to be able to discard the resource from memory, you can change its attributes (for more details, see your resource editor manual). These are the resources you will create and use most often:

- Menus
- Dialog boxes
- Icons
- Cursors
- Keyboard accelerators
- Bitmaps
- Character strings

You can create resources visually using a resource editor as Borland Resource Workshop, Microsoft Developer Studio, or Watcom resource editor. See your resource editor manual to learn how to create a resource file.

For instance, Figure 7 shows Borland Resource Workshop after the dialog box thickness has been created and Figure 8 shows the same with Microsoft Developer Studio.

Figure 7

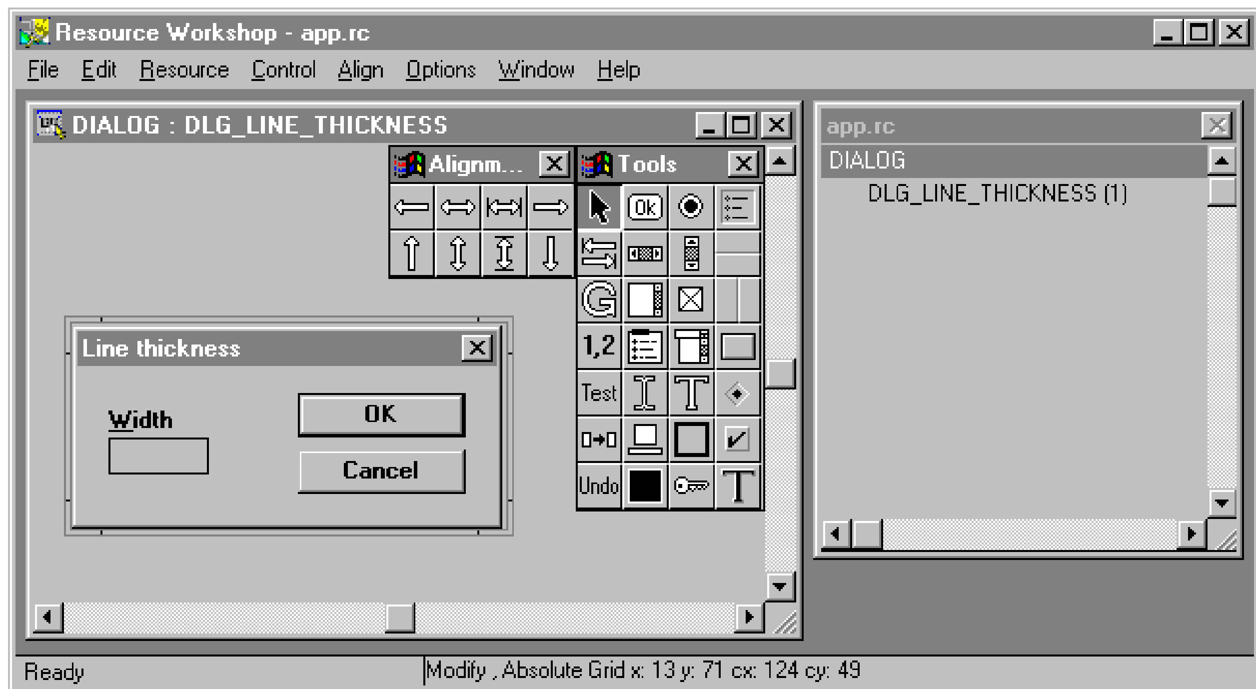
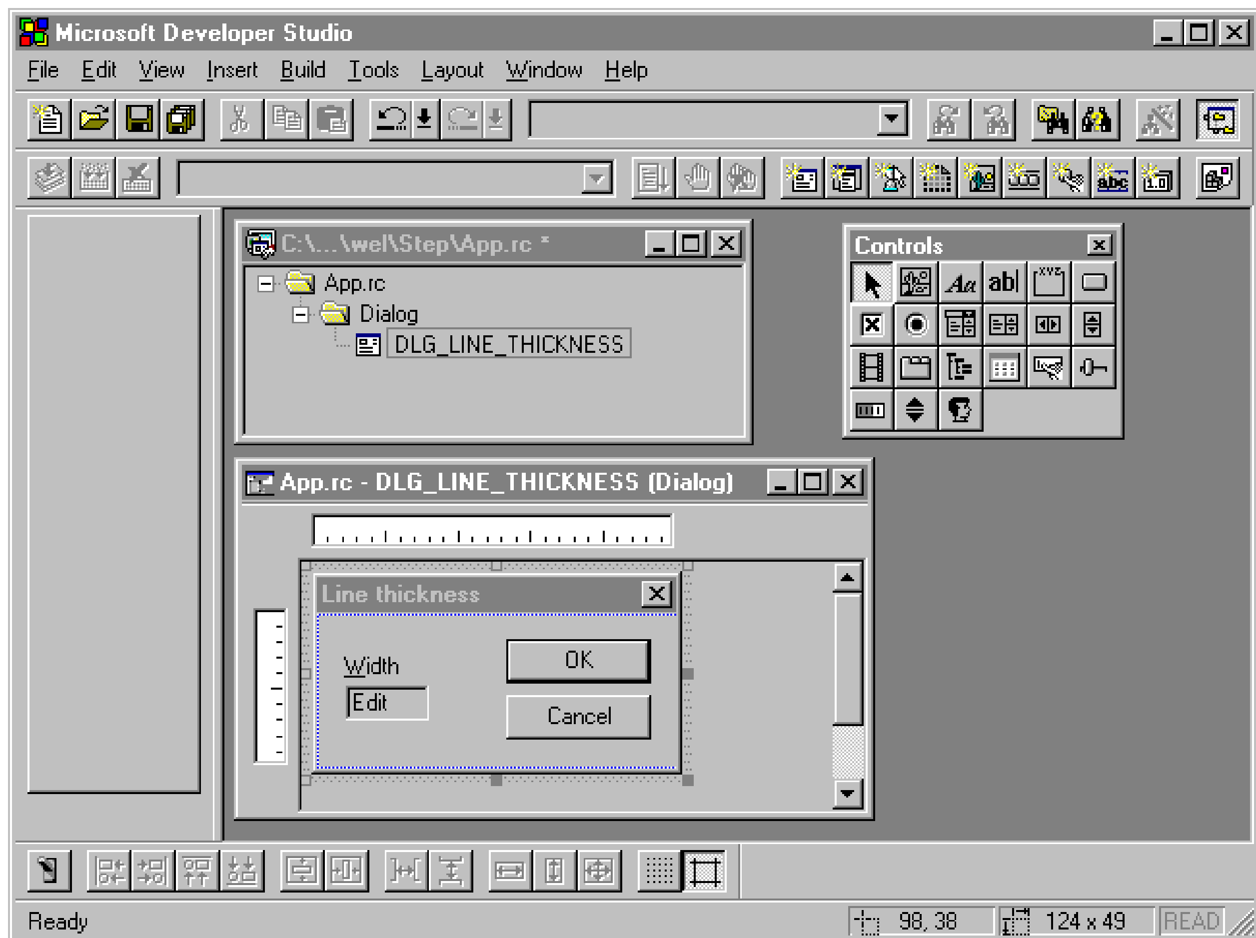


Figure 8



No matter what resource editor tool you want to use to design the line thickness dialog box, you should obtain a resource file like the following (app.rc).

```
#include <windows.h>

#define DLG_LINE_THICKNESS     1
#define IDC_EDIT_WIDTH         101

DLG_LINE_THICKNESS DIALOG 98, 38, 124, 49
STYLE DS_MODALFRAME | WS_POPUP | WS_VISIBLE | WS_CAPTION | WS_SYSMENU
CAPTION "Line thickness"
FONT 8, "MS Sans Serif"
{
        LTEXT "&Width", -1, 9, 12, 22, 8
        EDITTEXT IDC_EDIT_WIDTH, 9, 22, 30, 12, WS_BORDER | WS_GROUP | WS_TABSTOP
        DEFPUSHBUTTON "OK", IDOK, 65, 8, 50, 14, BS_DEFPUSHBUTTON | WS_GROUP | WS_TABSTOP
        PUSHBUTTON "Cancel", IDCANCEL, 65, 26, 50, 14, WS_GROUP | WS_TABSTOP
}
```

The **DIALOG** statement defines a window that an application can use to create dialog boxes. The statement defines the position and dimensions of the dialog box on the screen as well as the dialog box style. *control-statement* defines the controls of the dialog box.

```
nameID DIALOG [ load-mem] x, y, width, height
[optional-statements]
BEGIN
        control-statement
         . . .
END
```

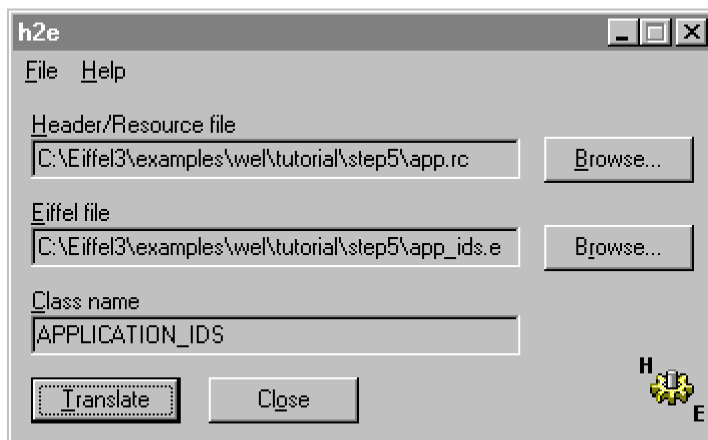
Important note: The resource file needs to be present in the project directory and its name must be the same as the system name specified in the Ace file with the .RC extension.

As you see at the beginning of the resource file, two identifiers (DLG_LINE_THICKNESS and IDC_EDIT_WIDTH) are declared. You will use them to identify the dialog box and the edit control since a resource file may contain several dialog boxes and one dialog box may contains several controls. WEL provides a simple tool to extract identifiers from a resource file (.RC) or a header file (.H) to make an Eiffel class which contains a set of constants. If you change or add any identifiers in the resource file, make sure to update your Eiffel class as well. After running this tool named H2E (available in $EIFFEL3\UTIL) with your resource file, you will obtain the following class:

```
indexing
        description: "Generated by h2e from the file C:\Eiffel3\examples\wel\tutorial\step5\app.rc."

class
        APPLICATION_IDS


feature   -- Access

        Dlg_line_thickness: INTEGER is  1;

        Idc_edit_width: INTEGER is  101;

end  -- class APPLICATION_IDS
```

Figure 9 shows the values entered in H2E in order to obtain the above file.

Figure 9



Note: If you use Microsoft Developer Studio, identifiers are saved in file `resource.h'. In this case, specify this file and not the resource file.

Now, you will learn how to make the connection between this dialog box specified in the resource file and your application. You will create a new class inherited from the class *WEL_MODAL_DIALOG* to load and use the line thickness dialog box. This class will do the following tasks:

- Load the dialog box from the resource and create an edit control. See *make* routine.
- Set the single line edit control Width with the value previously entered by the user (The first time, this value will be equal to 1). See *setup_dialog* routine.
- If the new width entered by the user is a valid integer, save the value in *pen_width* and terminate the dialog box. See *on_ok* routine.

The full text of this class is: (Note that the class *APPLICATION_IDS* generated by H2E is added in the inheritance clause.)

```
class
        LINE_THICKNESS_DIALOG

inherit
        WEL_MODAL_DIALOG
                redefine
                        on_ok, setup_dialog
                end ;
        APPLICATION_IDS
                export
                        {NONE} all
                end

creation
        make

feature {NONE} -- Initialization

        make (a_parent: WEL_COMPOSITE_WINDOW) is
                        -- Make the dialog box and create edit.
                do
                        make_by_id (a_parent, Dlg_line_thickness);
                        !! edit.make_by_id (Current, idc_edit_width);
                        pen_width := 1
                end ;

feature -- Access

        edit: WEL_SINGLE_LINE_EDIT;
                        -- Edit control to enter pen width

        pen_width: INTEGER;
                        -- Pen width entered

feature {NONE} -- Implementation

        setup_dialog is
                        -- Set the width previously entered.
                local
                        s: STRING
                do
                        !! s.make (0);
                        s.append_integer (pen_width);
                        edit.set_text (s)
                end ;

        on_ok is
                        -- Ensure edit value is an integer, save it in
                        -- pen_width and close the dialog box.
                do
                        if  edit.text.is_integer then
```

```
                    pen_width := edit.text.to_integer;
                    terminate (idok)
               end
          end ;

end  -- class LINE_THICKNESS_DIALOG
```

Method 2: Writing Eiffel code

If you use Personal ISE Eiffel, you need to create the following class:

```
class
        LINE_THICKNESS_WINDOW

inherit
        WEL_FRAME_WINDOW
                redefine
                        on_control_command
                end

creation
        make

feature {NONE} -- Initialization

        make (a_parent: WEL_COMPOSITE_WINDOW) is
                        -- Make the line thickness window.
                do
                        make_child (a_parent, "Line thickness");
                        move_and_resize (20, 20, 210, 104, true);
                        !! static.make (Current, "Width", 14, 18, 38, 13, - 1);
                        !! edit.make (Current, "", 14, 33, 52, 19, - 1);
                        !! ok_button.make (Current, "OK", 98, 12, 87, 23, - 1);
                        !! cancel_button.make (Current, "Cancel", 98, 45, 87, 23, - 1);
                        pen_width := 1
                end ;

feature  -- Access

        edit: WEL_SINGLE_LINE_EDIT;
                        -- Edit control to enter pen width

        ok_button: WEL_PUSH_BUTTON;
                        -- Button to validate the value

        cancel_button: WEL_PUSH_BUTTON;
                        -- Button to cancel the value

        static: WEL_STATIC;
                        -- "Width" static text

        pen_width: INTEGER;
                        -- Pen width entered

feature  -- Basic operations

        activate is
                        -- Activate the window
                local
                        s: STRING
```

```
        do
            !! s.make (0);
            s.append_integer (pen_width);
            edit.set_text (s);
            show
        end ;

feature {NONE} -- Implementation

    on_control_command (control: WEL_CONTROL) is
            -- Process ok_button and cancel_button selection.
        local
            p: MAIN_WINDOW
        do
            if control = ok_button then
                if edit.text.is_integer then
                    pen_width := edit.text.to_integer;
                    p ?= parent;
                    if p /= void then
                        p.set_pen_width (pen_width)
                    end ;
                    hide
                end
            elseif control = cancel_button then
                hide
            end
        end ;

end -- class LINE_THICKNESS_WINDOW
```

In order to be able to change line thickness in the device context, you need to add the following attribute:

```
    pen: WEL_PEN;
            -- Pen currently selected in dc
```

You also have to set the default pen width in the *make* routine:

```
    make is
            -- Make the main window.
        do
            make_top ("My application");
            !! dc.make (Current);
            set_pen_width (1)
        end ;
```

The implementation of *set_pen_width* is defined as follows:

```
    set_pen_width (new_width: INTEGER) is
            -- Set pen width with new_width.
        do
            !! pen.make_solid (new_width, black)
        end ;
```

The *black* color can be retrieved from the class *WEL_STANDARD_COLORS* which must be added in the inheritance clause.

You have to insert a call to *select_pen* in the routine *on_left_button_down* as follows. Selecting a pen for a device context will allow you to use a different pen than the default one.

```
on_left_button_down (keys, x_pos, y_pos: INTEGER) is
                -- Initiate the drawing process.
        do
                if not button_down then
                        button_down := true ;
                        dc.get;
                        dc.move_to (x_pos, y_pos);
                        dc.select_pen (pen)
                end
        end ;
```

The new version of *on_right_button* will now bring up the dialog box:

According the version you use, you need to update the *MAIN_WINDOW* class in order to bring up the line thickness dialog box or window when the user pushes on the right button. If you use Professional ISE Eiffel 3 for Windows, you need to add a new attribute *line_thickness_dialog* and change the body of *on_right_button_down* as follows:

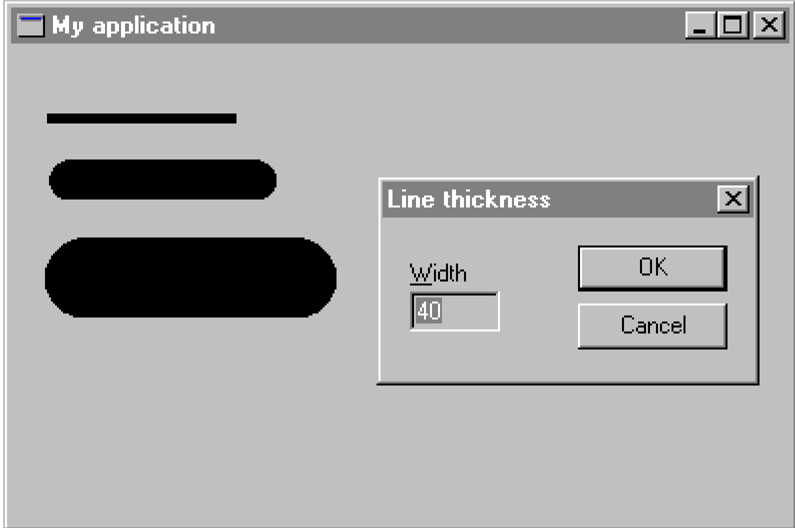
```
line_thickness_dialog: LINE_THICKNESS_DIALOG;
                -- Dialog box to change line thickness

on_right_button_down (keys, x_pos, y_pos: INTEGER) is
                -- Bring up line_thickness_dialog and set the
                -- new pen width.
        do
                if line_thickness_dialog = void then
                        !! line_thickness_dialog.make (Current)
                end ;
                line_thickness_dialog.activate;
                if line_thickness_dialog.ok_pushed then
                        set_pen_width (line_thickness_dialog.pen_width)
                end
        end ;
```

On the other hand, if you use Personal ISE Eiffel for Windows, you need to add a new attribute *line_thickness_dialog* and change the body of *on_right_button_down* as follows:

```
line_thickness_window: LINE_THICKNESS_WINDOW;
                -- Window to change line thickness

on_right_button_down (keys, x_pos, y_pos: INTEGER) is
                -- Bring up line_thickness_window and set the
                -- new pen width.
        do
                if line_thickness_window = void then
                        !! line_thickness_window.make (Current)
                end ;
                line_thickness_window.activate
        end ;
```

Figure 10 shows the new capabilities of your application:

Figure 10



This is the full text of *MAIN_WINDOW* (Professional version):

```
class
	MAIN_WINDOW

inherit
	WEL_FRAME_WINDOW
		redefine
			on_left_button_down, on_left_button_up,
			on_right_button_down, on_mouse_move,
			closeable
		end ;
	WEL_STANDARD_COLORS
		export
			{NONE} all
		end

creation
	make

feature {NONE} -- Initialization

	make is
			-- Make the main window.
		do
			make_top ("My application");
			!! dc.make (Current);
			set_pen_width (1)
		end ;

feature -- Access

	dc: WEL_CLIENT_DC;
			-- Device context associated to the current
			-- client window

	button_down: BOOLEAN;
			-- Is the left mouse button down?

	pen: WEL_PEN;
			-- Pen currently selected in dc

	line_thickness_dialog: LINE_THICKNESS_DIALOG;
			-- Dialog box to change line thickness

feature -- Element change

	set_pen_width (new_width: INTEGER) is
			-- Set pen width with new_width.
		do
			!! pen.make_solid (new_width, black)
		end ;

feature {NONE} -- Implementation
```

```
on_left_button_down (keys, x_pos, y_pos: INTEGER) is
        -- Initiate the drawing process.
    do
        if not button_down then
            button_down := true ;
            dc.get;
            dc.move_to (x_pos, y_pos);
            dc.select_pen (pen)
        end
    end ;

on_mouse_move (keys, x_pos, y_pos: INTEGER) is
        -- Connect the points to make lines.
    do
        if button_down then
            dc.line_to (x_pos, y_pos)
        end
    end ;

on_left_button_up (keys, x_pos, y_pos: INTEGER) is
        -- Terminate the drawing process.
    do
        if button_down then
            button_down := false ;
            dc.release
        end
    end ;

on_right_button_down (keys, x_pos, y_pos: INTEGER) is
        -- Bring up line_thickness_dialog and set the
        -- new pen width.
    do
        if line_thickness_dialog = void then
            !! line_thickness_dialog.make (Current)
        end ;
        line_thickness_dialog.activate;
        if line_thickness_dialog.ok_pushed then
            set_pen_width (line_thickness_dialog.pen_width)
        end
    end ;

closeable: BOOLEAN is
        -- Does the user want to quit?
    do
        Result := question_message_box ("Do you want to quit?", "Quit")
    end ;

end -- class MAIN_WINDOW
```

This is the full text of *MAIN_WINDOW* (Personal version):

```
class
	MAIN_WINDOW

inherit
	WEL_FRAME_WINDOW
		redefine
			on_left_button_down, on_left_button_up,
			on_right_button_down, on_mouse_move,
			closeable
		end ;
	WEL_STANDARD_COLORS
		export
			{NONE} all
		end

creation
	make

feature {NONE} -- Initialization

	make is
			-- Make the main window.
		do
			make_top ("My application");
			!! dc.make (Current);
			set_pen_width (1)
		end ;

feature -- Access

	dc: WEL_CLIENT_DC;
			-- Device context associated to the current
			-- client window.

	button_down: BOOLEAN;
			-- Is the left mouse button down?

	pen: WEL_PEN;
			-- Pen currently selected in dc.

	line_thickness_window: LINE_THICKNESS_WINDOW;
			-- Window to change line thickness.

feature -- Element change

	set_pen_width (new_width: INTEGER) is
			-- Set pen width with new_width.
		do
			!! pen.make_solid (new_width, black)
		end ;

feature {NONE} -- Implementation
```

```
on_left_button_down (keys, x_pos, y_pos: INTEGER) is
                -- Initiate the drawing process.
        do
                if not button_down then
                        button_down := true ;
                        dc.get;
                        dc.move_to (x_pos, y_pos);
                        dc.select_pen (pen)
                end
        end ;

on_mouse_move (keys, x_pos, y_pos: INTEGER) is
                -- Connect the points to make lines.
        do
                if button_down then
                        dc.line_to (x_pos, y_pos)
                end
        end ;

on_left_button_up (keys, x_pos, y_pos: INTEGER) is
                -- Terminate the drawing process.
        do
                if button_down then
                        button_down := false ;
                        dc.release
                end
        end ;

on_right_button_down (keys, x_pos, y_pos: INTEGER) is
                -- Bring up line_thickness_window and set the
                -- new pen width.
        do
                if line_thickness_window = void then
                        !! line_thickness_window.make (Current)
                end ;
                line_thickness_window.activate
        end ;

closeable: BOOLEAN is
                -- Does the user want to quit?
        do
                Result := question_message_box ("Do you want to quit?", "Quit")
        end ;

end -- class MAIN_WINDOW
```

Step 6: Repainting a window

As you have probably noticed, the graphics and text you draw in a window using device context functions (like *line_to* or *text_out*) disappear when you resize or uncover the window. Windows does not save the graphics that you draw in the device context, the application is in charge to refresh the window when it is necessary. In this step you will learn how to do that.

When the user of your application resizes or uncovers a window, it requires updating, or painting. WEL automatically calls the *on_paint* procedure (from *WEL_COMPOSITE_WINDOW*) when the window needs to be painted. Procedure *on_paint* is where you write the code to paint the contents of the window. There is one major difference between drawing graphics in the *on_paint* procedure and at other times, such as in response to mouse actions. The device context to be used for painting is passed in the *paint_dc* parameter, so your program does not need to get and release it. You will, however, need to select your drawing tools into the *paint_dc*.

To paint a window's contents, you are going to replay the actions that led to the original drawing on *dc*, but use *paint_dc* instead. But first, you need to store the graphic as objects, so you can paint them in the *on_paint* procedure.

Let's say that the window's contents is a set of lines, and each line is a set of points with a width. Then, you can simply define a line as follows:

```
class
        LINE

inherit
        LINKED_LIST [POINT]

creation
        make

feature   -- Access

        width: INTEGER;
                        -- Width of the line

feature   -- Element change

        set_width (a_width: INTEGER) is
                        -- Set width with a_width.
                require
                        positive_width: a_width >= 0
                do
                        width := a_width
                ensure
                        width_set: width = a_width
                end ;

        add (x, y: INTEGER) is
                        -- Add a point specified by x and y.
                local
                        p: POINT
                do
                        !! p.make (x, y);
                        extend (p)
                end ;

invariant
        positive_width: width >= 0;

end  -- class LINE
```

Class *POINT* is simply defined as follows:

```
class
	POINT

creation
	make

feature  -- Initialization

	make (a_x, a_y: INTEGER) is
			-- Make a point with a_x and a_y.
		do
			x := a_x;
			y := a_y
		ensure
			x_set: x = a_x;
			y_set: y = a_y
		end ;

feature  -- Access

	x: INTEGER;
			-- x position

	y: INTEGER;
			-- y position

end  -- class POINT
```

Using class *LINE*, the basic idea consists of saving mouse movements while the user draws. Then, you will use these data in the *on_paint* procedure to redraw window's contents. First, you need to add the following attributes in class *MAIN_WINDOW*.

```
	lines: LINKED_LIST [LINE];
			-- All lines drawn by the user

	current_line: LINE;
			-- Line currently drawn by the user
```

Attribute *lines* needs to be created in the *make* routine as follows:

```
	make is
			-- Make the main window.
		do
			make_top ("My application");
			!! dc.make (Current);
			set_pen_width (1);
			!! lines.make
		end ;
```

And finally, you have to change *on_left_button_down* and *on_mouse_move* to store the points in *lines*.

```
on_left_button_down (keys, x_pos, y_pos: INTEGER) is
                -- Initiate the drawing process.
        do
                if not button_down then
                        button_down := true ;
                        dc.get;
                        dc.move_to (x_pos, y_pos);
                        dc.select_pen (pen);
                        !! current_line.make;
                        current_line.set_width (pen.width);
                        lines.extend (current_line);
                        current_line.add (x_pos, y_pos)
                end
        end ;

on_mouse_move (keys, x_pos, y_pos: INTEGER) is
                -- Connect the points to make lines.
        do
                if button_down then
                        dc.line_to (x_pos, y_pos);
                        current_line.add (x_pos, y_pos)
                end
        end ;
```

At this point, *lines* has all the information needed to redraw the window's contents. Basically, you just need to redefine *on_paint* and iterate over the list to draw the lines as follows:

```
on_paint (paint_dc: WEL_PAINT_DC; invalid_rect: WEL_RECT) is
            -- Paint the lines.
        local
            a_line: LINE;
            a_pen: WEL_PEN;
            first_point: BOOLEAN
        do
            from
                lines.start
            until
                lines.off
            loop
                from
                    first_point := true ;
                    a_line := lines.item;
                    a_line.start;
                    !! a_pen.make_solid (a_line.width, black);
                    paint_dc.select_pen (a_pen)
                until
                    a_line.off
                loop
                    if  first_point then
                        first_point := false ;
                        paint_dc.move_to (a_line.item.x, a_line.item.y)
                    else
                        paint_dc.line_to (a_line.item.x, a_line.item.y)
                    end ;
                    a_line.forth
                end ;
                lines.forth
            end
        end ;
```

Now, if you minimize and restore the window, you will see that window's contents is restored.

Here is the full text of *MAIN_WINDOW* (Professional version):

```
class
	MAIN_WINDOW

inherit
	WEL_FRAME_WINDOW
		redefine
			on_left_button_down, on_left_button_up,
			on_right_button_down, on_mouse_move,
			on_paint, closeable
		end ;
	WEL_STANDARD_COLORS
		export
			{NONE} all
		end

creation
	make

feature {NONE} -- Initialization

	make is
			-- Make the main window.
		do
			make_top ("My application");
			!! dc.make (Current);
			set_pen_width (1);
			!! lines.make
		end ;

feature  -- Access

	dc: WEL_CLIENT_DC;
			-- Device context associated to the current
			-- client window

	button_down: BOOLEAN;
			-- Is the left mouse button down?

	pen: WEL_PEN;
			-- Pen currently selected in dc

	line_thickness_dialog: LINE_THICKNESS_DIALOG;
			-- Dialog box to change line thickness

	lines: LINKED_LIST [LINE];
			-- All lines drawn by the user

	current_line: LINE;
			-- Line currently drawn by the user

feature  -- Element change
```

```
set_pen_width (new_width: INTEGER) is
            -- Set pen width with new_width.
      do
            !! pen.make_solid (new_width, black)
      end ;

feature {NONE} -- Implementation

   on_left_button_down (keys, x_pos, y_pos: INTEGER) is
            -- Initiate the drawing process.
      do
            if not button_down then
                  button_down := true ;
                  dc.get;
                  dc.move_to (x_pos, y_pos);
                  dc.select_pen (pen);
                  !! current_line.make;
                  current_line.set_width (pen.width);
                  lines.extend (current_line);
                  current_line.add (x_pos, y_pos)
            end
      end ;

   on_mouse_move (keys, x_pos, y_pos: INTEGER) is
            -- Connect the points to make lines.
      do
            if button_down then
                  dc.line_to (x_pos, y_pos);
                  current_line.add (x_pos, y_pos)
            end
      end ;

   on_left_button_up (keys, x_pos, y_pos: INTEGER) is
            -- Terminate the drawing process.
      do
            if button_down then
                  button_down := false ;
                  dc.release
            end
      end ;

   on_right_button_down (keys, x_pos, y_pos: INTEGER) is
            -- Bring up line_thickness_dialog and set the
            -- new pen width.
      do
            if line_thickness_dialog = void then
                  !! line_thickness_dialog.make (Current)
            end ;
            line_thickness_dialog.activate;
            if line_thickness_dialog.ok_pushed then
                  set_pen_width (line_thickness_dialog.pen_width)
            end
      end ;
```

```
on_paint (paint_dc: WEL_PAINT_DC; invalid_rect: WEL_RECT) is
                -- Paint the lines.
        local
                a_line: LINE;
                a_pen: WEL_PEN;
                first_point: BOOLEAN
        do
                from
                        lines.start
                until
                        lines.off
                loop
                        from
                                first_point := true ;
                                a_line := lines.item;
                                a_line.start;
                                !! a_pen.make_solid (a_line.width, black);
                                paint_dc.select_pen (a_pen)
                        until
                                a_line.off
                        loop
                                if  first_point then
                                        first_point := false ;
                                        paint_dc.move_to (a_line.item.x, a_line.item.y)
                                else
                                        paint_dc.line_to (a_line.item.x, a_line.item.y)
                                end ;
                                a_line.forth
                        end ;
                        lines.forth
                end
        end ;

    closeable: BOOLEAN is
                -- Does the user want to quit?
        do
                Result := question_message_box ("Do you want to quit?", "Quit")
        end ;

end  -- class MAIN_WINDOW
```

Here is the full text of *MAIN_WINDOW* (Personal version):

```
class
    MAIN_WINDOW

inherit
    WEL_FRAME_WINDOW
        redefine
            on_left_button_down, on_left_button_up,
            on_right_button_down, on_mouse_move,
            on_paint, closeable
        end ;
    WEL_STANDARD_COLORS
        export
            {NONE} all
        end

creation
    make

feature {NONE} -- Initialization

    make is
            -- Make the main window.
        do
            make_top ("My application");
            !! dc.make (Current);
            set_pen_width (1);
            !! lines.make
        end ;

feature -- Access

    dc: WEL_CLIENT_DC;
            -- Device context associated to the current
            -- client window

    button_down: BOOLEAN;
            -- Is the left mouse button down?

    pen: WEL_PEN;
            -- Pen currently selected in dc

    line_thickness_window: LINE_THICKNESS_WINDOW;
            -- Window to change line thickness

    lines: LINKED_LIST [LINE];
            -- All lines drawn by the user

    current_line: LINE;
            -- Line currently drawn by the user

feature -- Element change
```

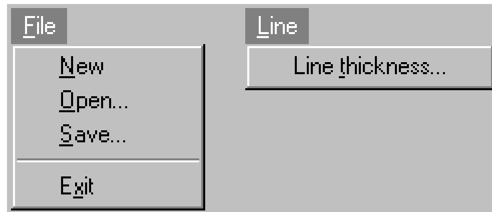
```
		set_pen_width (new_width: INTEGER) is
				-- Set pen width with new_width.
			do
				!! pen.make_solid (new_width, black)
			end ;

	feature {NONE} -- Implementation

		on_left_button_down (keys, x_pos, y_pos: INTEGER) is
				-- Initiate the drawing process.
			do
				if not button_down then
					button_down := true ;
					dc.get;
					dc.move_to (x_pos, y_pos);
					dc.select_pen (pen);
					!! current_line.make;
					current_line.set_width (pen.width);
					lines.extend (current_line);
					current_line.add (x_pos, y_pos)
				end
			end ;

		on_mouse_move (keys, x_pos, y_pos: INTEGER) is
				-- Connect the points to make lines.
			do
				if button_down then
					dc.line_to (x_pos, y_pos);
					current_line.add (x_pos, y_pos)
				end
			end ;

		on_left_button_up (keys, x_pos, y_pos: INTEGER) is
				-- Terminate the drawing process.
			do
				if button_down then
					button_down := false ;
					dc.release
				end
			end ;

		on_right_button_down (keys, x_pos, y_pos: INTEGER) is
				-- Bring up line_thickness_window and set the
				-- new pen width.
			do
				if line_thickness_window = void then
					!! line_thickness_window.make (Current)
				end ;
				line_thickness_window.activate
			end ;

		on_paint (paint_dc: WEL_PAINT_DC; invalid_rect: WEL_RECT) is
				-- Paint the lines.
			local
```

```
            a_line: LINE;
            a_pen: WEL_PEN;
            first_point: BOOLEAN
        do
            from
                lines.start
            until
                lines.off
            loop
                from
                    first_point := true ;
                    a_line := lines.item;
                    a_line.start;
                    !! a_pen.make_solid (a_line.width, black);
                    paint_dc.select_pen (a_pen)
                until
                    a_line.off
                loop
                    if  first_point then
                        first_point := false ;
                        paint_dc.move_to (a_line.item.x, a_line.item.y)
                    else
                        paint_dc.line_to (a_line.item.x, a_line.item.y)
                    end ;
                    a_line.forth
                end ;
                lines.forth
            end
        end ;

    closeable: BOOLEAN is
            -- Does the user want to quit?
        do
            Result := question_message_box ("Do you want to quit?", "Quit")
        end ;

end  -- class MAIN_WINDOW
```

Step 7: Adding a menu

Most Windows applications have a menu on their main window to provide a variety of selections for the user. In this section, you will add a menu to the program. Figure 11 shows the menus that you will add.

Figure 11

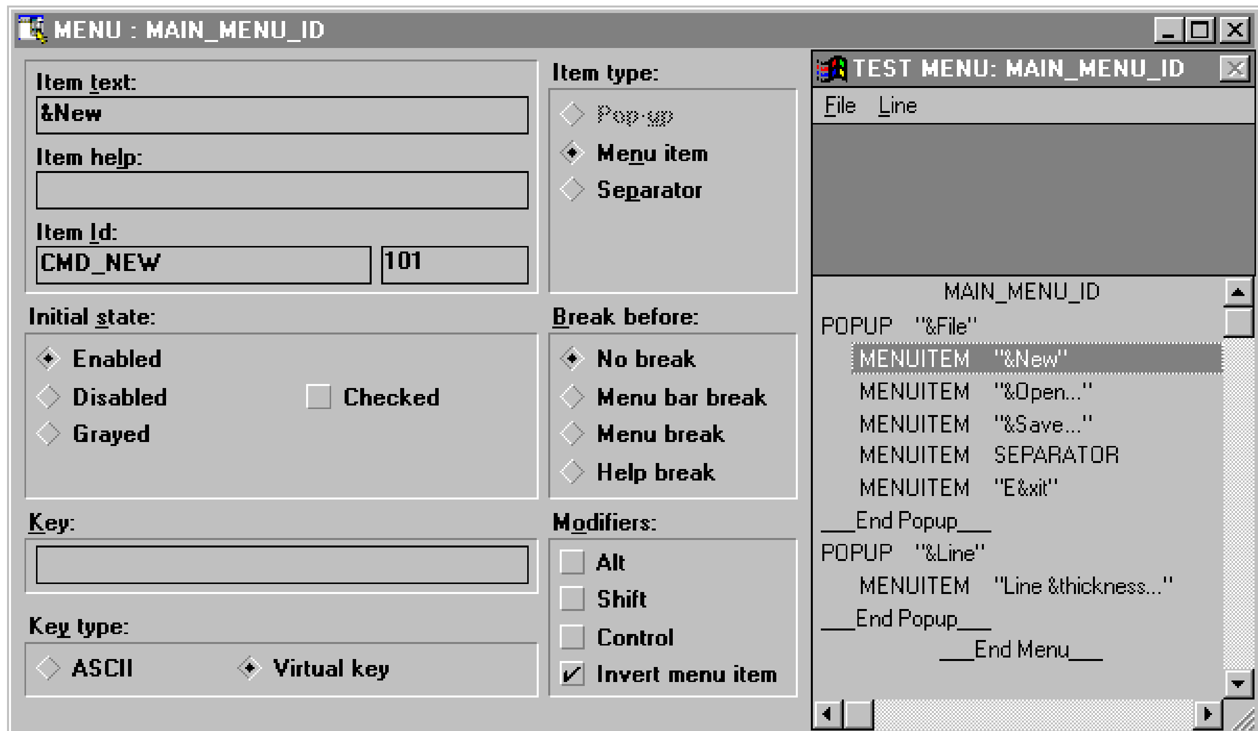


Like dialog boxes, you have two ways to add a menu: using resources or writing Eiffel code. Once again, both solutions will be presented for the Professional and Personal users.

Method 1: Using resources

Resource editors provide a very easy way to design menus visually. For instance, Figure 12 shows Borland Resource Workshop's menu module.

Figure 12



After adding the menus in app.rc, the following text will be added to the file.

```
#define MAIN_MENU_ID          1
#define CMD_NEW               101
#define CMD_OPEN              102
#define CMD_SAVE              103
#define CMD_EXIT              104
#define CMD_LINE_THICKNESS    105

MAIN_MENU_ID MENU
{
        POPUP "&File"
        {
                MENUITEM "&New", CMD_NEW
                MENUITEM "&Open...", CMD_OPEN
                MENUITEM "&Save...", CMD_SAVE
                MENUITEM SEPARATOR
                MENUITEM "E&xit", CMD_EXIT
        }
        POPUP "&Line"
        {
                MENUITEM "Line &thickness...", CMD_LINE_THICKNESS
        }
}
```

The value of MAIN_MENU_ID, which identifies the menu, will be used in Eiffel to load the menu. Menu item identifiers (as CMD_NEW, CMD_OPEN) will be used to identify options selected by the user. Don't forget to update class *APPLICATION_IDS* using H2E since new identifiers have been added in the resource file.

Now, you need to add the following once function to load the menu:

```
main_menu: WEL_MENU is
                -- Window's menu
        once
                !! Result.make_by_id (Main_menu_id)
        end ;
```

Class *APPLICATION_IDS* needs to be added in the inheritance clause of *MAIN_WINDOW* to use *Main_menu_id*.

Method 2: Writing Eiffel code

If you can't use a resource editor, you have to create the menu using WEL_MENU's procedures as follows:

```
main_menu: WEL_MENU is
            -- Window's menu
      local
            file, line: WEL_MENU
      once
            !! file.make;
            file.append_string ("&New", Cmd_new);
            file.append_string ("&Open...", Cmd_open);
            file.append_string ("&Save...", Cmd_save);
            file.append_separator;
            file.append_string ("E&xit", Cmd_exit);
            !! line.make;
            line.append_string ("Line &thickness...", Cmd_line_thickness);
            !! Result.make;
            Result.append_popup (file, "&File");
            Result.append_popup (line, "&Line")
      end ;

Cmd_new: INTEGER is  101;
Cmd_open: INTEGER is  102;
Cmd_save: INTEGER is  103;
Cmd_exit: INTEGER is  104;
Cmd_line_thickness: INTEGER is  105;
```

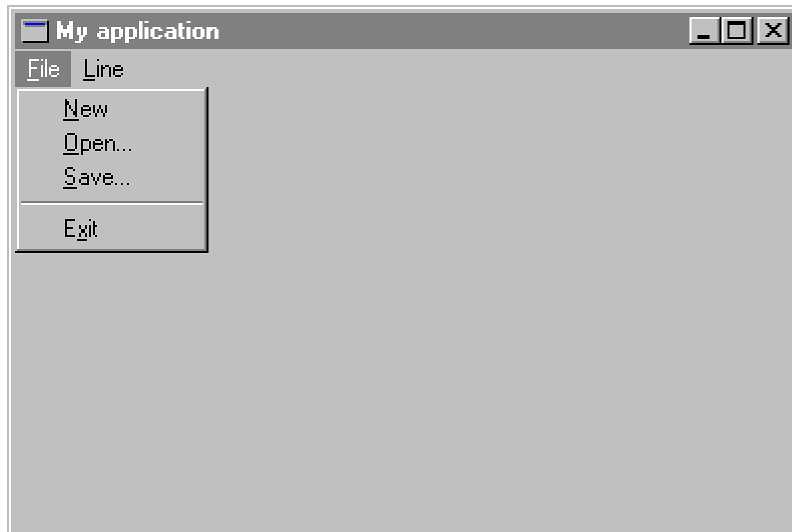
Basically, the function creates two popup menus (File and Line) and add them to the main menu. Procedure *append_string* expects two arguments which are an item name (*STRING*) and an unique identifier (*INTEGER*). Optional character "&" identifies the hot key of the option.

No matter which method you use, now you need to set the menu for the window in the *MAIN_WINDOW*'s make routine as follows:

```
set_menu (main_menu)
```

Figure 13 shows the menu how it appears in the menu window.

Figure 13



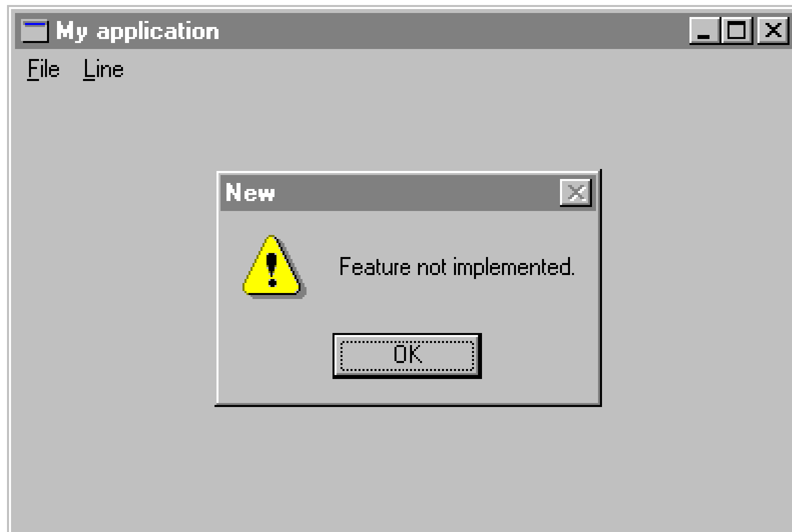
At this point, choosing an option in the menu does not perform any task. In order to process menu commands, you have to redefine *on_menu_command* from *WEL_COMPOSITE_WINDOW*. This procedure has an *INTEGER* argument which identifies the option selected by the user (the same as you have specified in the resources or in *main_menu* function).

A very basic implementation of *on_menu_command* could be the following:

```
on_menu_command (menu_id: INTEGER) is
            -- menu_id has been selected.
        do
            inspect
                menu_id
            when  Cmd_new then
                warning_message_box ("Feature not implemented.", "New")
            when  Cmd_open then
                warning_message_box ("Feature not implemented.", "Open")
            when  Cmd_save then
                warning_message_box ("Feature not implemented.", "Save")
            when  Cmd_exit then
                warning_message_box ("Feature not implemented.", "Exit")
            when  Cmd_line_thickness then
                warning_message_box ("Feature not implemented.", "Line thickness")
            end
        end ;
```

For instance, if you choose option New in the File menu, Figure 14 shows what you will get.

Figure 14



To make things more interesting, the application will process New option as it should be: Delete all the lines and forces a repainting of the screen. Since there are no lines to redraw, the screen becomes blank. Replace the call to *warning_message_box* by the following code:

```
when  Cmd_new then
        lines.wipe_out;
        invalidate
```

It is easy to respond to the Exit selection by destroying the main window as follows:

```
when  Cmd_exit then
        if  closeable then
                destroy
        end
```

You can also move the code from *on_right_button_down* which brings up line thickness dialog box to *on_menu_command* to respond to the Line thickness selection (identifier *Cmd_line_thickness*).

Step 8: Storing the drawing in a file

Since that you have got a data representation of the drawing, you should be able to transfer that data into a file and read it back. You will also use standard dialog boxes to get file names from the user.

You are going to use class *STORABLE* from EiffelBase to save and read data of the drawing. But first, you need to create the following abstraction in order to be able to save the linked list of points.

```
class
	LINES

inherit
	LINKED_LIST [LINE];
	STORABLE

creation
	make

end -- class LINES
```

In *MAIN_WINDOW* you need to change the definition of *lines* from:

```
	lines: LINKED_LIST [LINE];
```

into:

```
	lines: LINES;
```

The application will show standard dialog boxes in response to the user's selection of Open and Save to get the file name which will be used for the operation. The following attributes need to be added in *MAIN_WINDOW*:

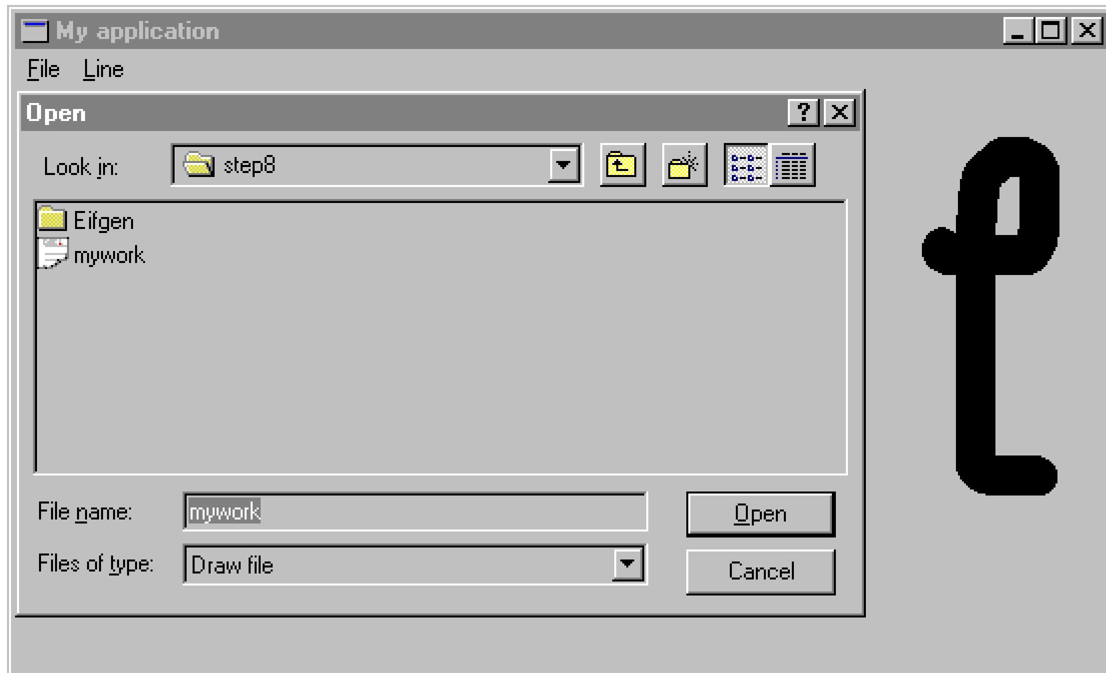
```
	open_dialog: WEL_OPEN_FILE_DIALOG;
			-- Standard dialog box to open a file.

	save_dialog: WEL_SAVE_FILE_DIALOG;
			-- Standard dialog box to save a file.
```

Now, you are ready to implement Open and Save options in *on_menu_command*. Basically, the file name is retrieved from the standard dialog box and used to save (*store_by_name*) or read (*retrieve_by_name*) the data. Extension .DRW is adopted for the files (procedures *set_filter* and *set_default_extension*).

```
on_menu_command (menu_id: INTEGER) is
            -- menu_id has been selected.
      do
            inspect
                  menu_id
            ...

            when  Cmd_open then
                  if  open_dialog = void then
                        !! open_dialog.make;
                        open_dialog.set_filter (<<"Draw file">>, <<"*.drw">>);
                        open_dialog.set_default_extension ("drw")
                  end ;
                  open_dialog.activate (Current);
                  if  open_dialog.selected then
                        lines ?= lines.retrieve_by_name (open_dialog.file_name);
                        invalidate
                  end
            when  Cmd_save then
                  if  save_dialog = void then
                        !! save_dialog.make;
                        save_dialog.set_filter (<<"Draw file">>, <<"*.drw">>);
                        save_dialog.set_default_extension ("drw")
                  end ;
                  save_dialog.activate (Current);
                  if  save_dialog.selected then
                        lines.store_by_name (save_dialog.file_name)
                  end
            end

            ...

      end ;
```

Figure 15 shows the standard open dialog box as it appears when the user chooses the Open option.

Figure 15



Here is the end of the tutorial, we hope that you have plenty of ideas to improve your application!