Multilanguage Programming with Ada in .NET

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.NET Framework

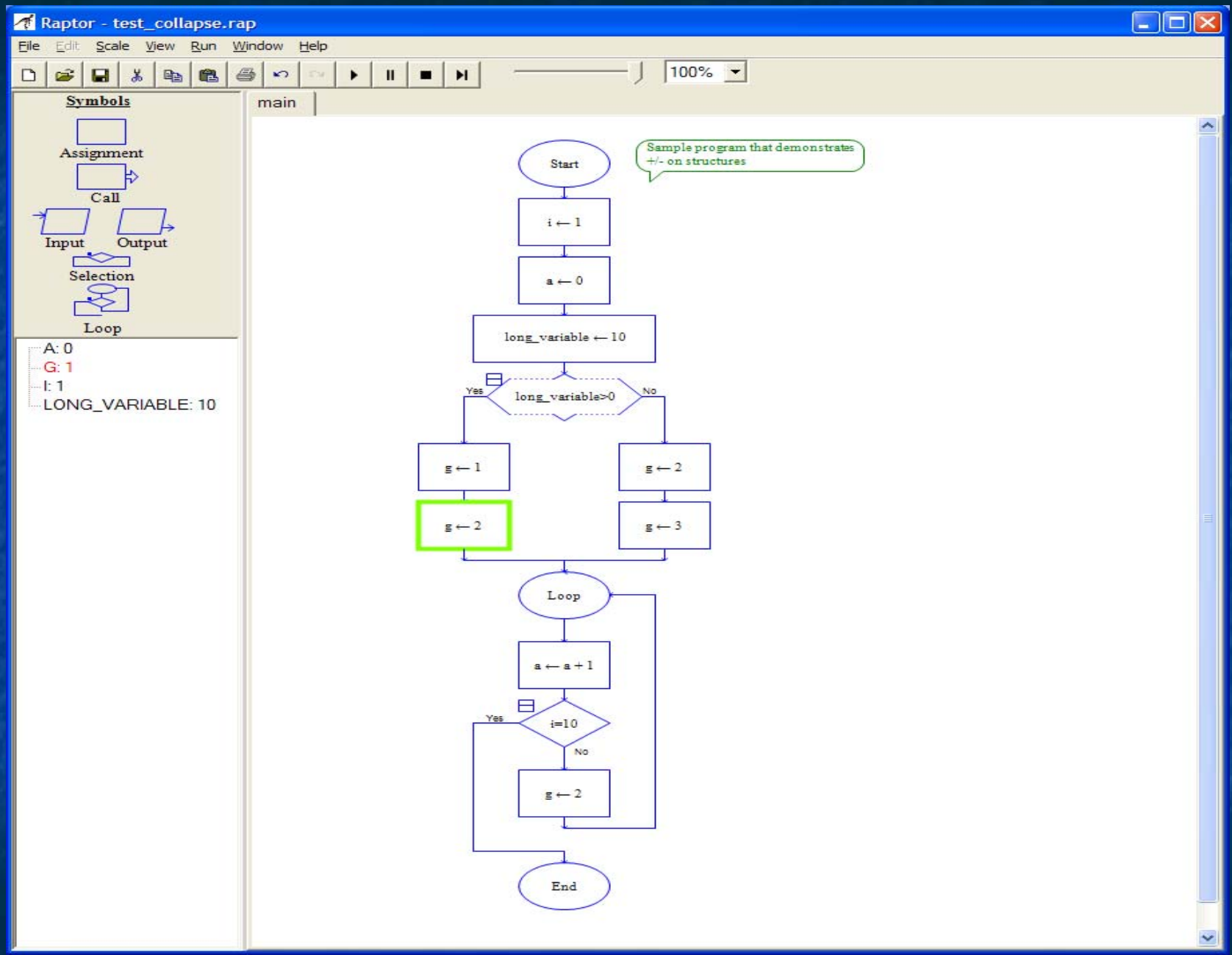
- Microsoft's answer to Java
  - Common Language Runtime
    - Seeks language independence– provides large library of core routines
  - C# is flagship programming language
    - Syntax very similar to Java
  - Platform independence
    - Java has advantage here, but Linux Mono version of .NET in works

RAPTOR


About Raptor
Raptor
Rapid Algorithmic Prototyping Tool for
Ordered Reasoning
Terry A. Wilson
Martin C. Carlisle
Jeffrey W. Humphries
Version 2.00
December 1, 2003
Ada
...inside
OK

RAPTOR

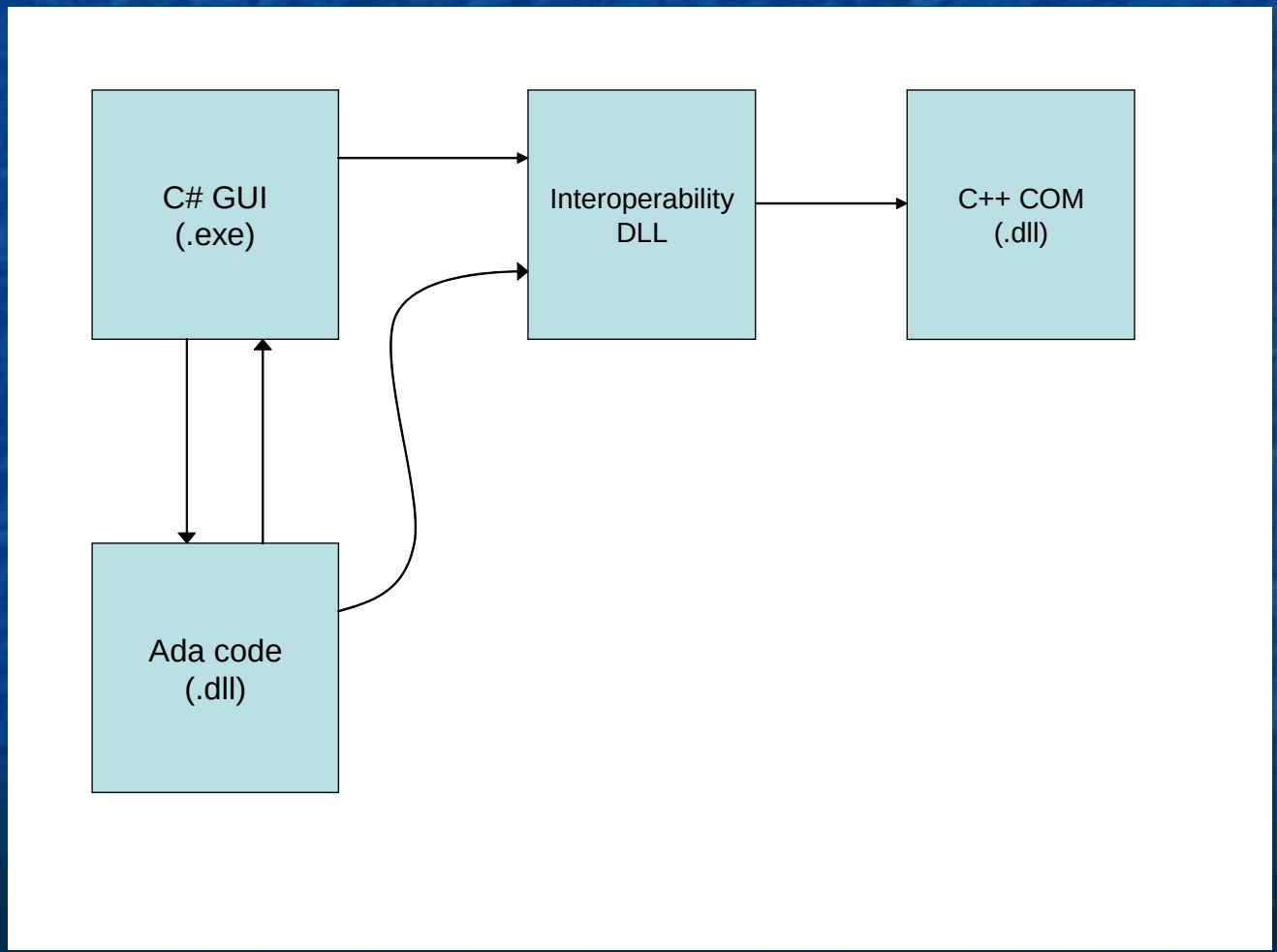
- Simple problem solving tool
- Used in CS 110, required of all cadets (including non-majors)
- Create programs visually
- Very little syntax


Raptor - test_collapse.rap
File Edit Scale View Run Window Help
100%
Symbols
Assignment
Call
Input
Output
Selection
Loop
A: 0
G: 1
I: 1
LONG_VARIABLE: 10
main
Sample program that demonstrates +/- on structures
Start
i ← 1
a ← 0
long_variable ← 10
Yes
long_variable>0
No
g ← 1
g ← 2
g ← 2
g ← 3
Loop
a ← a + 1
Yes
i=10
No
g ← 2
End

Languages Used

- Ada (A#)
  - Parsing input, execution
- C#
  - GUI
- C++
  - Legacy COM object of AdaGraph routines

RAPTOR Interoperability



Environments Used

- AdaGIDE
  - Used to build .NET DLL via MGNAT (A#)
- Visual Studio 7.0
  - Used to build COM object (DLL)
- Visual Studio .NET
  - Included A# DLL and COM object as references
  - Created .NET EXE

Implementing Interoperability

- Visual Studio .NET
  - Add COM object and Ada DLL as references
  - Can then call Ada and COM procedures/functions as if written in C#
- AdaGIDE
  - Use MSIL2Ada to generate Ada specs
  - Can call C# methods as if written in Ada

Implementing Interoperability

- Strings
  - C# strings are like Ada's Unbounded_String
  - Conversion is done with unary "+" operator
  - Ada routines calling .NET routines will automatically typecast Standard.String to C#'s System.String

Additional A# Syntax

- Object.method syntax added (proposed for Ada 0Y)
- Pragmas for importing .NET types

Language Advantages

- A# (language)
  - Enumeration types
  - Generics
  - Subtypes
  - Modular types
  - Decimal types
  - Can call routine stored in separate EXE

C# enumerations

- Really named constants

```
public enum FontStyle {Bold, Italic, Underline...};

System.Drawing.FontStyle fs;

fs = FontStyle.Bold;
// Writes Bold
Console.WriteLine(Enum.GetName(fs.GetType(),fs));

fs = FontStyle.Bold | FontStyle.Italic;
// Writes a blank line
Console.WriteLine(Enum.GetName(fs.GetType(),fs));
```

Ada enumerations

- Adding to an enumeration type cause compiler to report error on all case statements that need a new “when” clause
- Also, all assignments to arrays indexed by enumeration types are flagged.

Example use of enumeration

```
type Token is (...
   -- adagraph procedures
   Clear_Window,Close_Graph_Window,Display_Number,
   Display_Text,Draw_Arc,
   Draw_Box,Draw_Circle,Draw_Ellipse,Draw_Line,
   Flood_Fill,Open_Graph_Window,Wait_For_Key,
   Wait_For_Mouse_Button,
   Get_Mouse_Button,
   Set_Font_Size,
   Put_Pixel,Set_Window_Title,...);

subtype Adagraph_Procedure is Token range
   Clear_Window..Set_Window_Title;
```

Example enumeration (pt 2)

```
type Parameter_Count_Array is array(Adagraph_Procedure) of Natural;
Parameter_Count : constant Parameter_Count_Array :=
    (Clear_Window => 1,
    Close_Graph_Window => 0,
    Display_Number => 4,
    Display_Text => 4,
    Draw_Box => 6,
    Draw_Arc => 9,
    Draw_Circle => 5,
    Draw_Ellipse => 6,
    Draw_Line => 5,
    Flood_Fill => 3,
    Get_Mouse_Button => 3,
    Open_Graph_Window => 2,
    Wait_For_Key => 0,
    Wait_For_Mouse_Button => 1,
    Put_Pixel => 3,
    Set_Font_Size => 1,
    Set_Window_Title => 1);
```

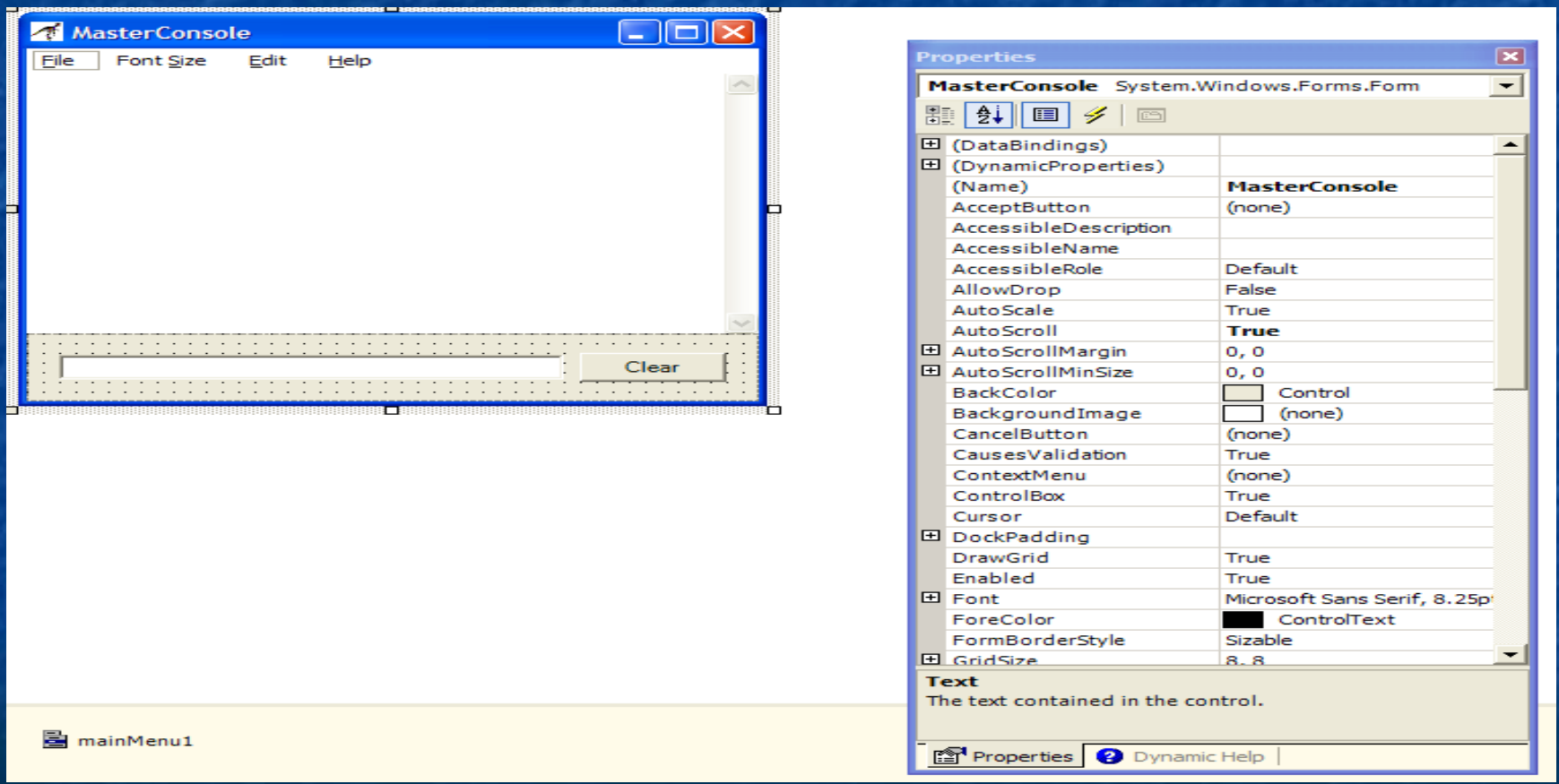
Example enumeration (pt 3)

```
   Kind : Adagraph_Procedure;
begin
   case Kind is
      when Clear_Window =>
         Dotnetgraph.Clear_Window(
            Color_Type.ValueType'Val(
            Numbers.Integer_Of(
               Check_Parameter_Number(
                  This.Param_List.
                  Parameter))));
```

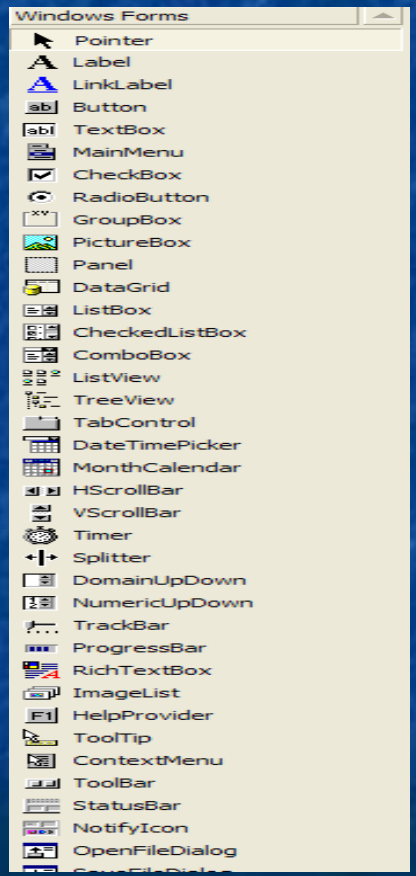
Language Advantages

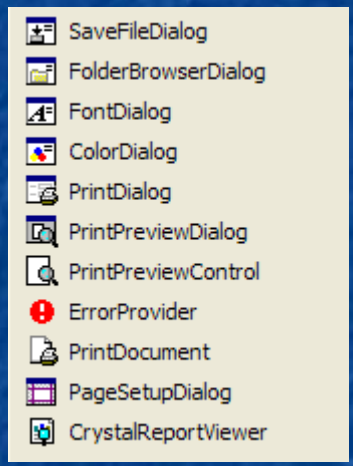
- C# (environment)
  - More sophisticated GUI Design Tool (VS .NET vs RAPID)
  - Automatic import of COM objects
  - Sophisticated auto-completion

VS GUI Designer

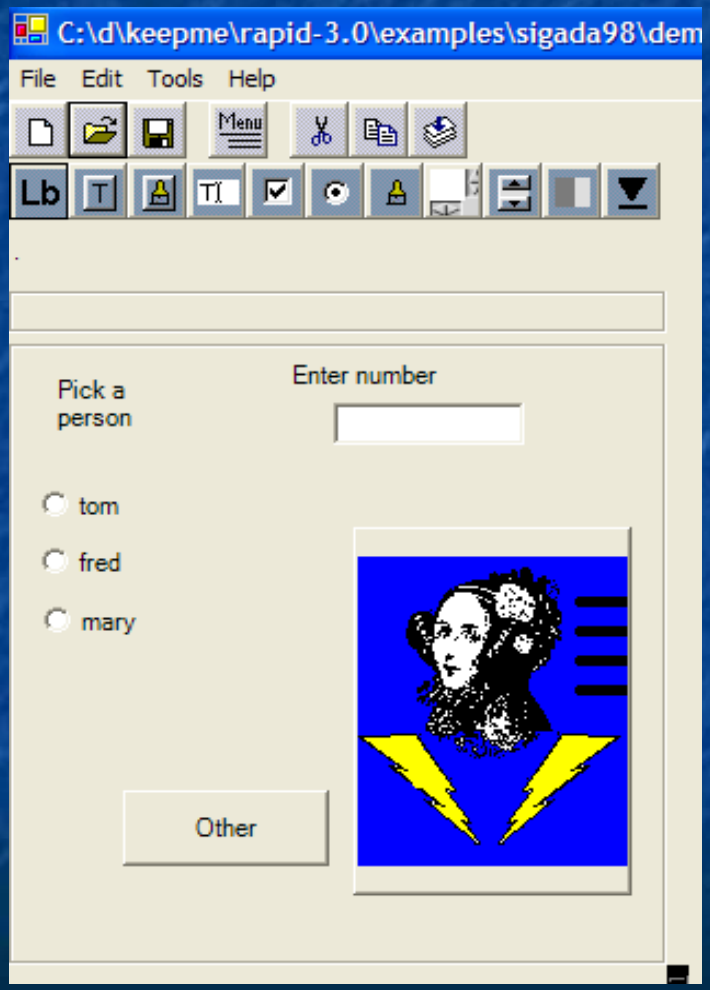


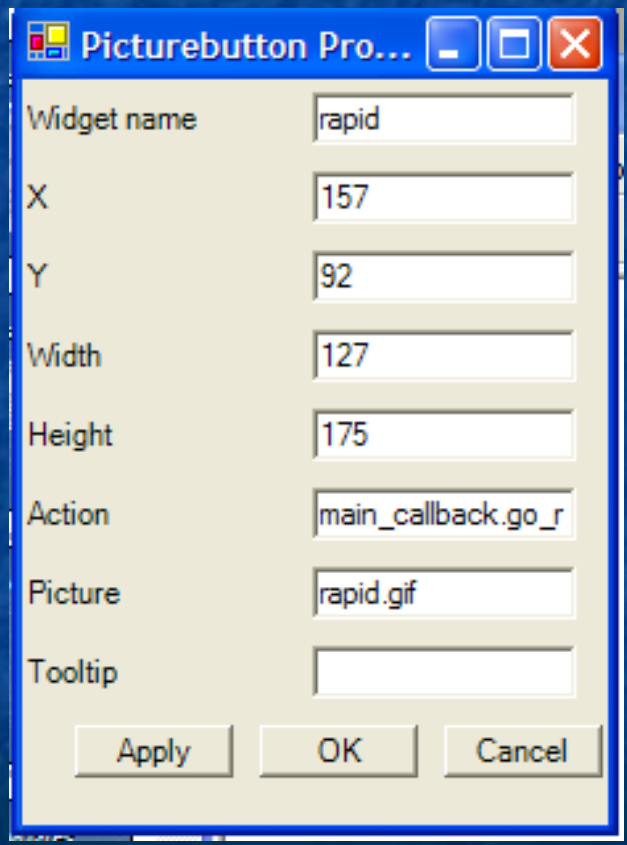
VS GUI Designer



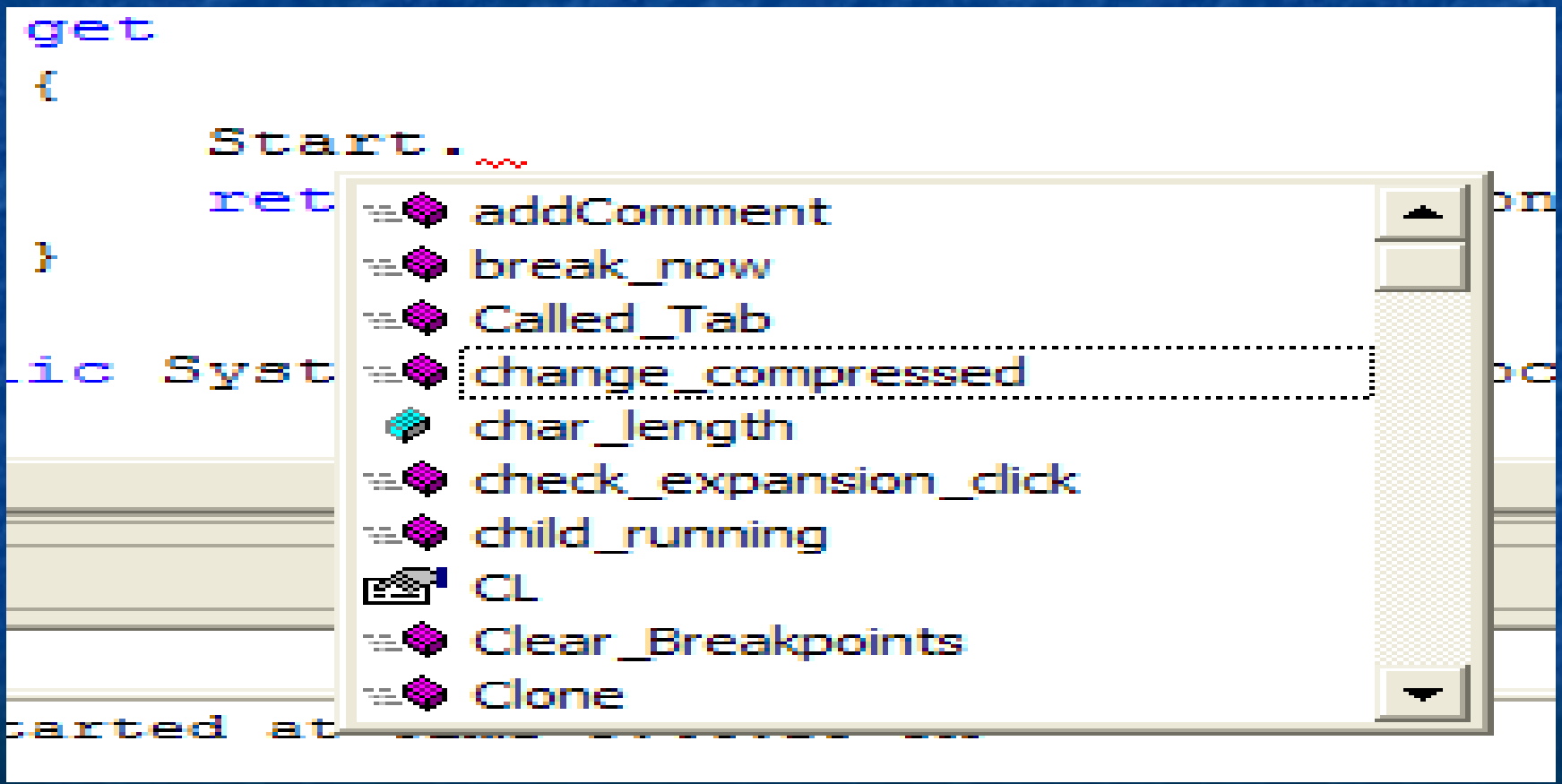


RAPID GUI Designer

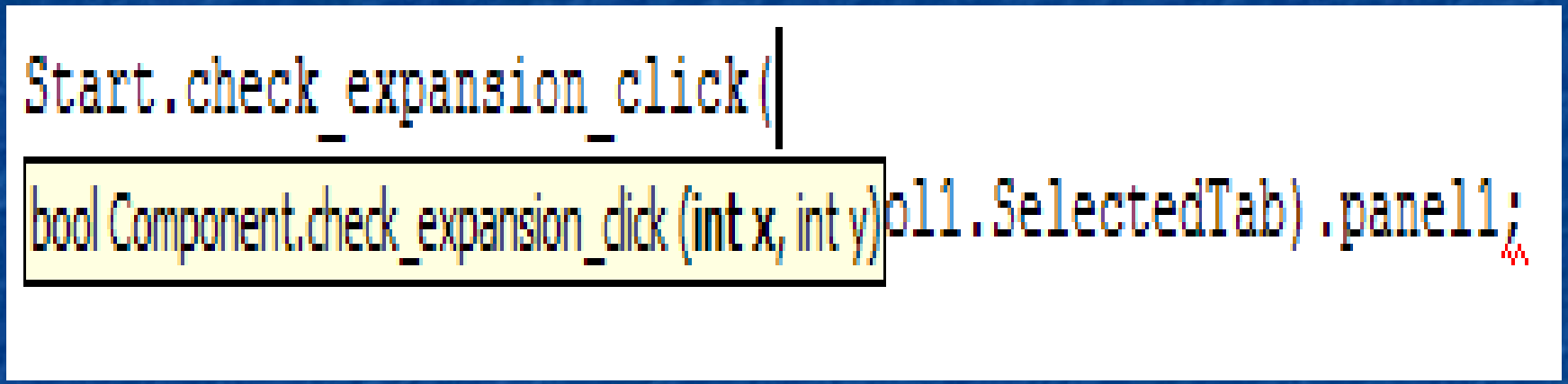




VS .NET Autocompletion



VS .NET Hints


Start.check_expansion_click(
bool Component.check_expansion_click (int x, int y)
o11.SelectedTab).panel1;

Language Advantages

- C++
  - Umm, well, ... it was already written ☺
  - Interface Definition Language (IDL) was awkward to use, especially when passing strings
  - Did provide relatively easy mechanism for calling native Win32 methods

A# tools

- MGNAT
  - Based on JGNAT, Ada to JVM compiler
  - Generates Microsoft Intermediate Language (MSIL)
  - Not full implementation of Ada 95
    - E.g. no representation clauses, nested controlled types not working

A# tools

- MSIL2Ada
  - Takes in MSIL and generates Ada specification files
- RAPID
  - Multi-platform, multi-implementation GUI Design Tool
    - .NET, Tcl/Tk, Gtk and JVM implementations
    - Recompile with different library to port to different implementation

A# tools

- AdaGIDE
  - Target button allows selection of different compiler (GNAT for Windows, JGNAT, MGNAT)

Download Locations

- MGNAT (Ada compiler for .NET)
- MSIL2Ada (creates Ada specs for .NET files)
  - http://www.usafa.af.mil/dfcs/bios/mcc_html/a_sharp.html
- AdaGIDE
  - http://www.usafa.af.mil/dfcs/bios/mcc_html/adagide.html
- RAPID
  - ftp://ftp.usafa.af.mil/pub/dfcs/carlisle/usafa/rapid/index.html

European Mirror Sites

- AdaGIDE:
  - ftp://sunsite.informatik.rwth-aachen.de/pub/mirror/ftp.usafa.af.mil/pub/dfcs/carlisle/adagide/
- A#
  - ftp://sunsite.informatik.rwth-aachen.de/pub/mirror/ftp.usafa.af.mil/pub/dfcs/carlisle/asharp/
- RAPID
  - ftp://sunsite.informatik.rwth-aachen.de/pub/mirror/ftp.usafa.af.mil/pub/dfcs/carlisle/usafa/rapid