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
Rapid Algorithmic Prototyping Tool for Ordered Reasoning

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RAPTOR

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

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

C# GUI (.exe) ↔ Interoperability DLL ↔ C++ COM (.dll)

Ada code (.dll)
Environments Used

- AdaGI DE
  - 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#

- AdaGI DE
  - 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
  ```csharp
  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

MasterConsole

Properties

Menu

Font

ForeColor

BackColor

BorderStyle

Text

Menu

Font

ForeColor

BackColor

BorderStyle

Text
VS GUI Designer

Windows Forms
- Pointer
- Label
- LinkLabel
- Button
- TextBox
- MainMenuStrip
- CheckListBox
- RadioButtons
- GroupBox
- PictureBox
- Panel
- DataGridView
- ListBox
- CheckedListBox
- ComboBox
- ListView
- TreeView
- TabControl
- DateTimePicker
- MonthCalendar
- HScrollBar
- VScrollBar
- Timer
- Splitter
- DomainUpDown
- NumericUpDown
- TrackBar
- ProgressBar
- RichTextBox
- ImageList
- HelpProvider
- ToolTip
- ContextMenuStrip
- ToolBar
- StatusBar
- NotifyIcon
- OpenFileDialog
- SaveFileDialog
- FolderBrowserDialog
- FontDialog
- ColorDialog
- PrintDialog
- PrintPreviewDialog
- PrintPreviewControl
- ErrorProvider
- PrintDocument
- PageSetupDialog
- CrystalReportViewer
RAPID GUI Designer
VS .NET Autocompletion
VS .NET Hints

Start.check_expansion_click(
bool Component.check_expansion_click(int x, int y) p11.SelectedTab).panel1;
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
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)
- MSI L2Ada (creates Ada specs for .NET files)
- AdaGIDE
- RAPID
European Mirror Sites

- AdaGI DE:
  - 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