The Case for Ada at the USAF Academy

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Overview

- Academy Background
- Using Ada at the Academy
- Language Features
- Compiler Features
- Development Experience
- Conclusions

Cadet Parade

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US Air Force Academy

Mission

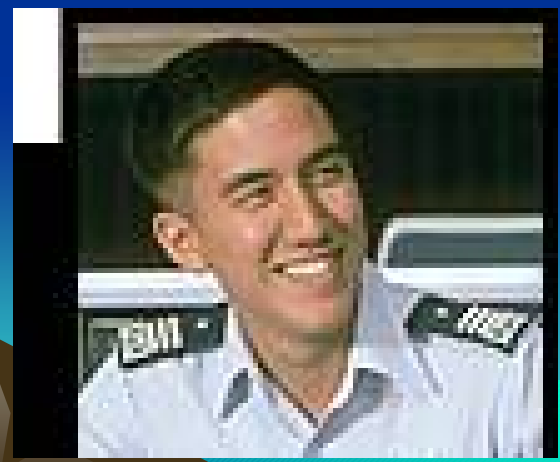
“Inspire and develop outstanding young men and women to become Air Force officers with knowledge, character and discipline; motivated to lead the world's greatest aerospace-force in service to the nation.”

US Air Force Academy

- Graduates enter Air Force as 2nd Lts
- Pilots, navigators, missile/space ops, computer, communications officers
- Typically five year commitment
- Our majors will lead other programmers

US Air Force Academy

- 500 Faculty – 25% civilian, 75% military
- Military normal tour around 3 years
- Military with PhD’s can stay longer
- Most civilian faculty have PhD



US Air Force Academy

- Every cadet takes 30 core courses in engineering, physics, chemistry, computer science, etc.
- Average course load is 6 courses over 18-week semesters
- Computer Science, Computer Engineering degrees compressed to three years

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Using Ada at the Academy

- Ada used in core course
  - 1996 – 2001 programming intensive course
  - 2001 – 2003 Information Technology focus
  - Fall 2003 using visual flow charting tool
- Ada in major's courses
  - Primary programming language
  - Computer Science and Computer Engineering
  - Used in first three courses of majors

Using Ada at the Academy

- We will continue to use Ada
- Curriculum Committee debate
- Choice was based on the following criteria
  - Language features
  - Compiler features
  - Development experience
- Re-examine this choice every few years

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Language Features

- Strong typing
  - Errors found at compile time, not run time
- Case insensitivity
- Lack of single character errors
- Subtypes and enumeration types
  - Superior to Java, C++ and C#
- Mixed-language pragmas
- Ada port to .NET framework

Language Features

- Support for Imperative paradigm
  - Essential for teaching introductory programming
  - Learn control flow, assignment and modularization
  - Not possible in Java, since OO required from start
- Support for Object-Oriented paradigm
  - Builds on imperative fundamentals
  - Easy transition using ADT concepts
  - Learn OO gradually when intellectually ready
- Helps our majors succeed in limited time

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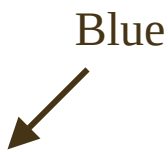
Compiler Features

- Compile time error messages
  - Useful and accurate
  - Steer students in right direction
  - More helpful than run time errors
- Strong typing and good compiler error messages help our students succeed

Compiler Features

```
with Ada.Text_Io;
use Ada.Text_Io;
procedure Color_Prog is
   type Colors is ( Red, White );
   C : Colors := White;
begin
   case C is
      when Red =>
         Put("Red");
      when White =>
         Put("White");
   end case;
end Color_Prog;
```



- Compiler error message if “Blue” added

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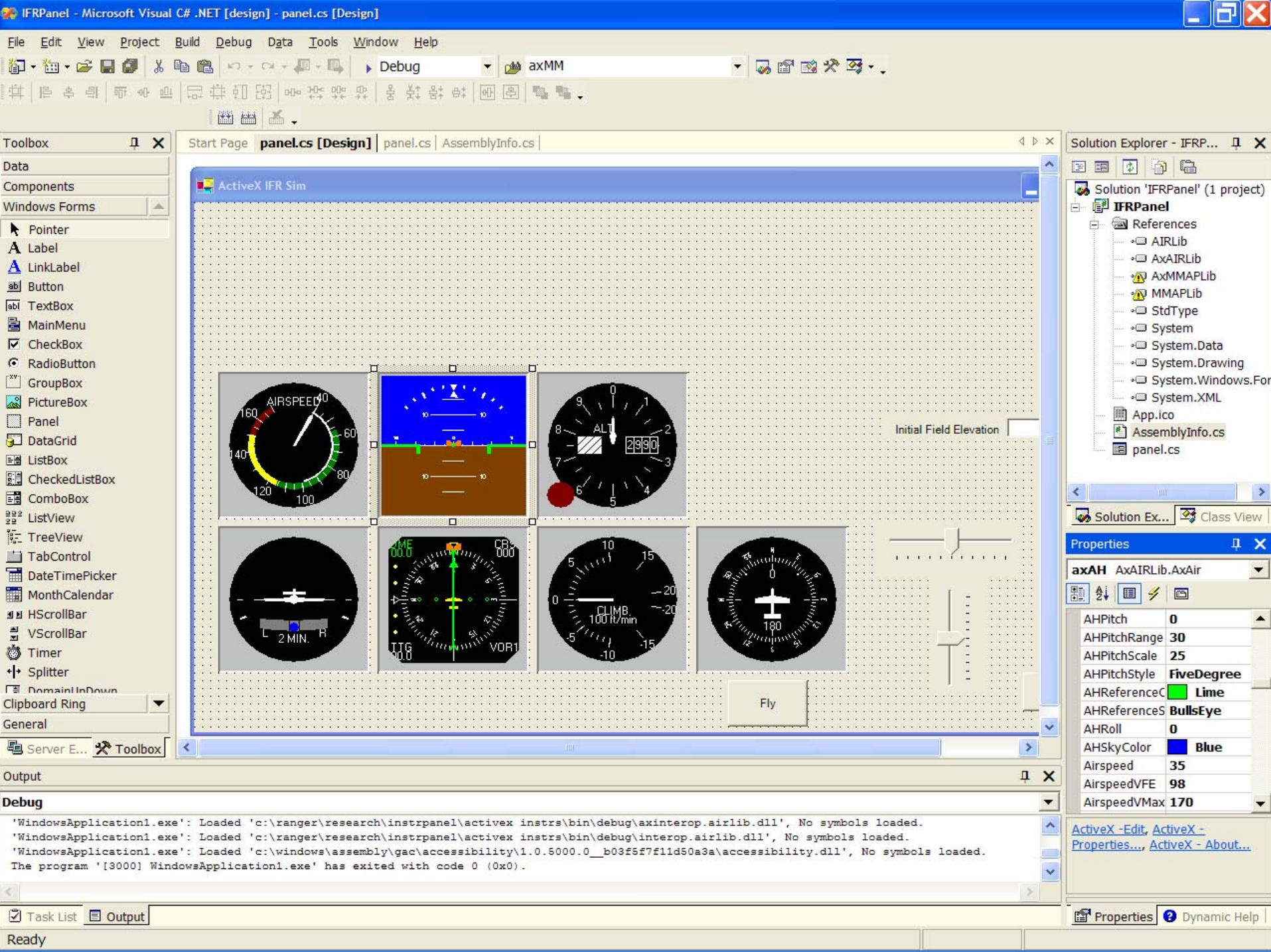
Development Experience

- Industry acceptance
  - Our majors will lead, not program
  - Can focus on education, not training of programmers
- Support for both Imperative and Object-Oriented
  - Decided against Java because OO must be first
  - Possible in C#, so we considered in more detail
- Textbook support
  - Currently no CS-2 textbooks available for C#
  - Major drawback of using C# as primary language

Development Experience

- Development environment considerations
- Visual Studio .NET for C#
  - Very powerful and complicated tool
  - Touch and feel including “intelli-sense”
  - Easy, rapid development of code
  - Graphical User Interface (GUI) builder outstanding


IFRPanel - Microsoft Visual C# .NET [design] - panel.cs [Design]
File Edit View Project Build Debug Data Tools Window Help
Debug
axMM
Toolbox
Data
Components
Windows Forms
Pointer
Label
LinkLabel
Button
TextBox
MainMenu
CheckBox
RadioButton
GroupBox
PictureBox
Panel
DataGrid
ListBox
CheckedListBox
ComboBox
ListView
TreeView
TabControl
DateTimePicker
MonthCalendar
HScrollBar
VScrollBar
Timer
Splitter
Clipboard Ring
General
Server E...
Toolbox
Start Page
panel.cs [Design]
panel.cs
AssemblyInfo.cs
ActiveX IFR Sim
AIRSPEED
ALT
2990
Initial Field Elevation
2 MIN.
CLIMB
100 ft/min
180
Fly
Solution Explorer - IFRP...
Solution 'IFRPanel' (1 project)
IFRPanel
References
AIRLib
AxAIRLib
AxMMAPLib
MMAPLib
StdType
System
System.Data
System.Drawing
System.Windows.For
System.XML
App.ico
AssemblyInfo.cs
panel.cs
Solution Ex...
Class View
Properties
axAH AxAIRLib.AxAir
AHPitch 0
AHPitchRange 30
AHPitchScale 25
AHPitchStyle FiveDegree
AHReferenceC Lime
AHReferenceS BullsEye
AHRoll 0
AHSkyColor Blue
Airspeed 35
AirspeedVFE 98
AirspeedVMax 170
ActiveX -Edit, ActiveX - Properties..., ActiveX - About...
Output
Debug
'WindowsApplication1.exe': Loaded 'c:\ranger\research\instrpanel\activex instrs\bin\debug\axinterop.airlib.dll', No symbols loaded.
'WindowsApplication1.exe': Loaded 'c:\ranger\research\instrpanel\activex instrs\bin\debug\interop.airlib.dll', No symbols loaded.
'WindowsApplication1.exe': Loaded 'c:\windows\assembly\gac\accessibility\1.0.5000.0__b03f5f7f11d50a3a\accessibility.dll', No symbols loaded.
The program '[3000] WindowsApplication1.exe' has exited with code 0 (0x0).
Task List
Output
Properties
Dynamic Help
Ready

Development Experience

- AdaGIDE for Ada 95
  - Excellent tool easily understood by novice programmer
  - Powerful enough for senior level capstone design courses
  - We control the look and feel of the environment
  - GUI support from Rapid is not as good as Visual Studios

AdaGIDE - [color_prog.adb]

File Edit Compile Run Tools Window Help

```
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procedure Color_Prog is
   type Colors is
         (Red,
          White, blue);
   C : Colors := White;
begin
   case C is
      when Red =>
         Put("Red");
      when White =>
         Put("White");
   end case;
end Color_Prog;
```

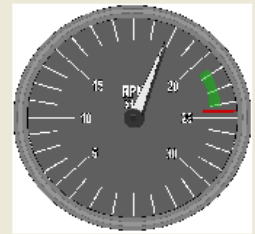
Line: 15, Col: 16 INS

C:/Ranger Alternate/courses/CS 210 spr 03/Assignments/pex 4/pex 4 demo/panel.gui

File Edit Tools Help

main

File Data Help



Error Output:

Rewind Data | Step Back | Step Forward | Exit

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Conclusions

- We will continue to use Ada
- Objections to Ada not technical
  - Appear to be sociological
  - Due to lack of widespread acceptance
- We are educating leaders, not programmers
- Languages are adopting desirable Ada features
  - Strong typing, generics, software engineering support
- We will continue to examine our choice