# Game Programming for Introductory Computer Science

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at
Microsoft Academic
Days on Game
Development in
Computer Science
Education

The Phrogram Company
www.phrogram.com
www.k-p-l.org

Alans_3D_Project - Powered by Phrogram

# Agenda

- How I got here

- Pedagogical goals

- Demo of Phrogram's capabilities

- Phrogram in academia to date

- Available curriculum and supporting materials

# Introduction

- **Kid's Programming Language (7/05)**
  - 130,000 downloads of the IDE
  - 17 volunteer translations of the IDE

- **Phrogram (10/06)**
  - Academic partners: OSU, UW, PUC-Rio, Lakeside School
  - Industry partnerships: XNA, GarageGames, Weatherbug

- **Publications**
  - Academic Days on Gaming Keynote, Jan 2006
  - SIGGRAPH paper and panel representation, Aug 2006
  - Microsoft Research presentation, Oct 2006
  - SBGames Keynote, Nov 2006
  - Addison-Wesley eBook: *Learn to Program with Phrogram!*, Feb 2007

# Pedagogical Goals

- **Fun:** learning is best when learning is fun
- **Accessible:** easy to get started
- **Engaging:** games, graphics, sounds
- **Simple:** resist CS tendency toward increasing complexity
- **Rewarding:** see quick, fun results from one's work
- **Highly leveraged:** maximum function, minimum code

- **Progressive:** lots of concepts to learn, step by step
- **Preparatory:** easy 'graduation' to professional IDEs
- **Modern:** consistent with current software design standards
- **Publishable:** as open source or executables
- **State of the art:** extensible use of current technology
- **International:** IDE language versions available
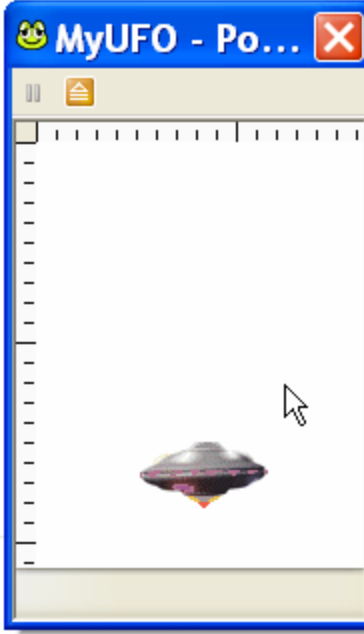
# First Contact = Red Herring
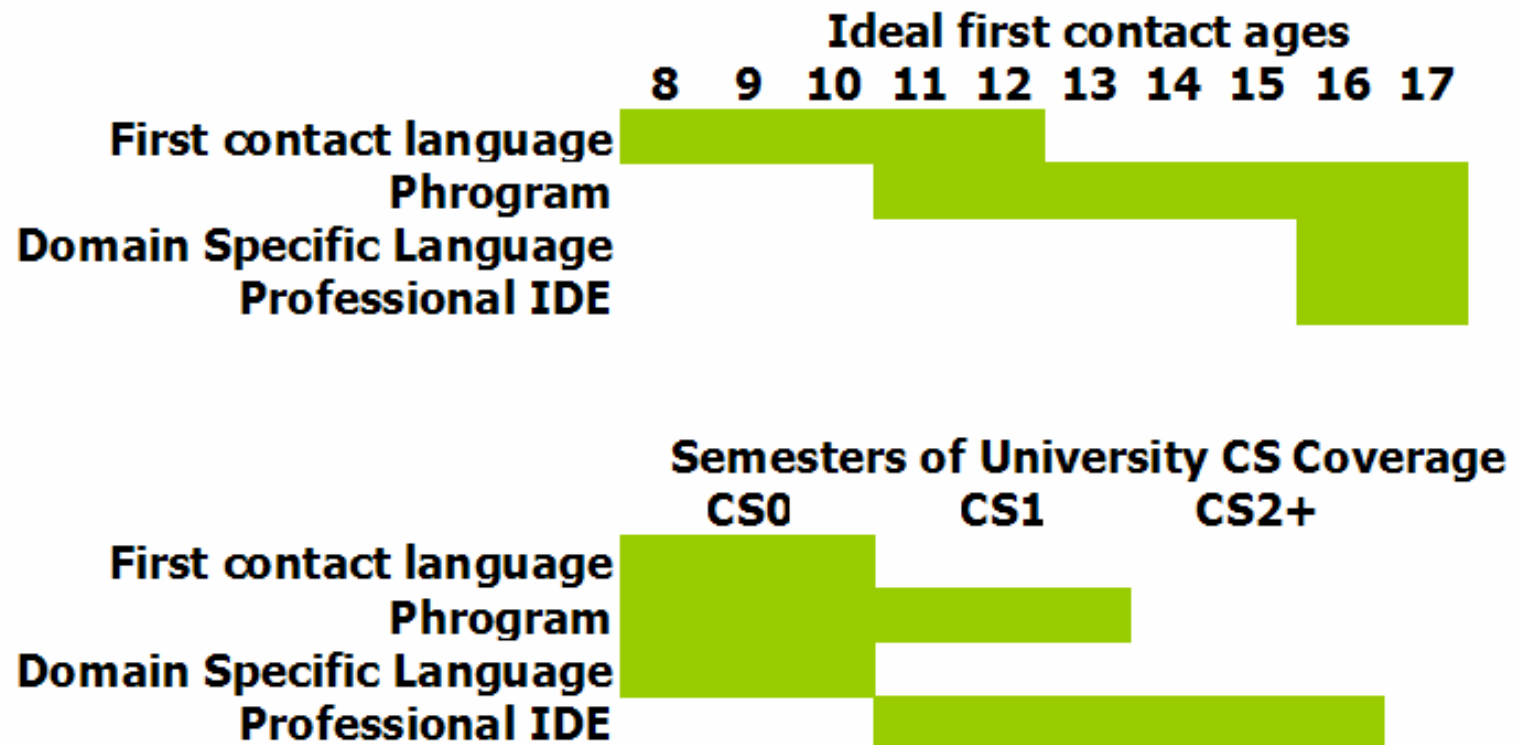
# Programming is Hard

We respectfully disagree.  And we think this assumption prevents the thinking that will make it easier.

If you can read and you can type, you can program.

```
1  Program MyUFO
2
3      Method Main()
4
5          Define myUFO As Sprite
6          myUFO.Load( "ufo.gif" )
7          myUFO.MoveTo( 200, 200 )
8          myUFO.Show()
9
10         Define ufoY As Integer
11         For ufoY = 1 To 150
12             Delay(10)
13             myUFO.MoveTo(50, ufoY)
14         Next
15
16     End Method
17
18  End Program
```
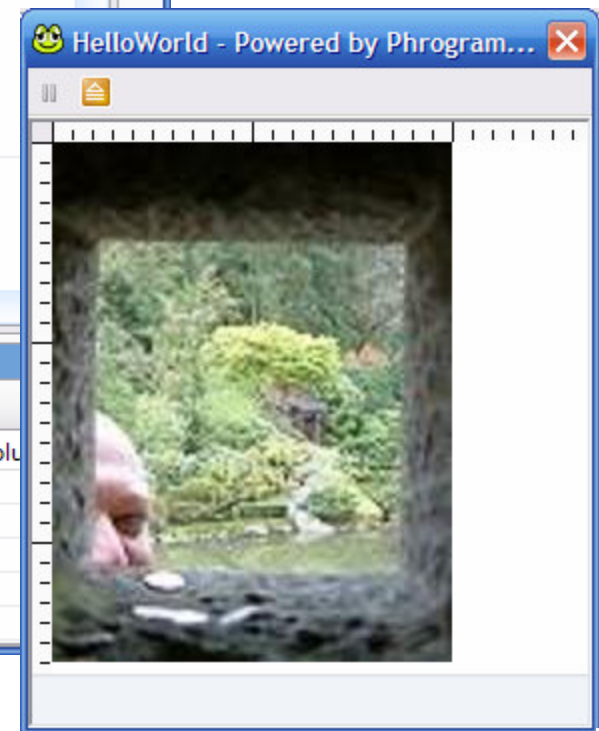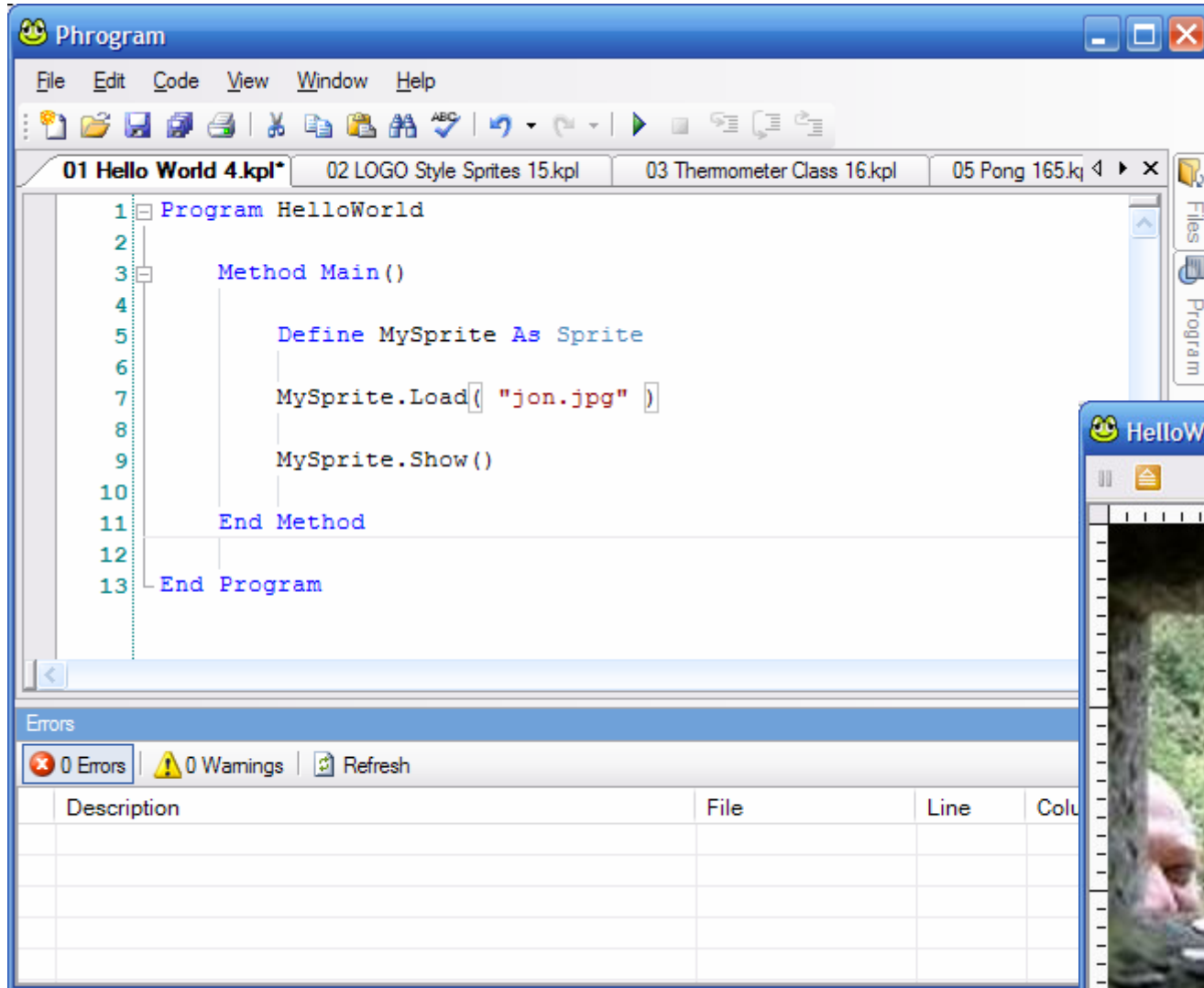
# Demo!
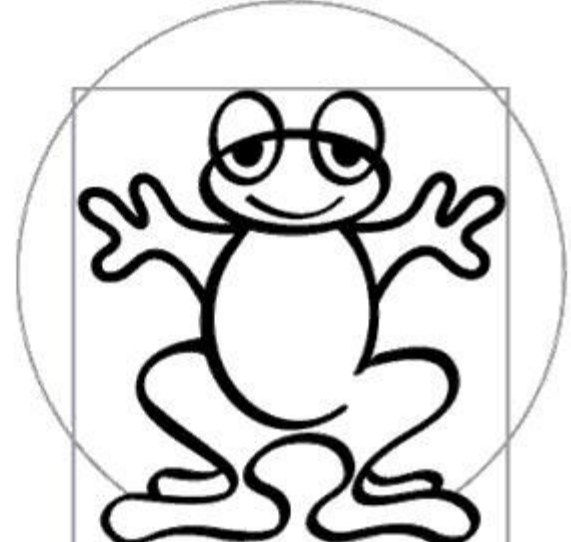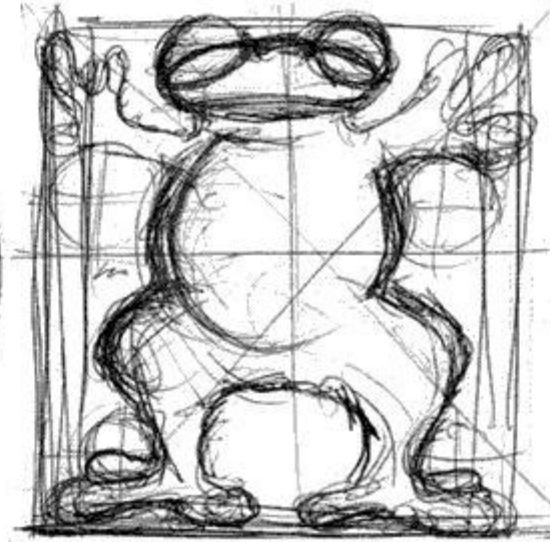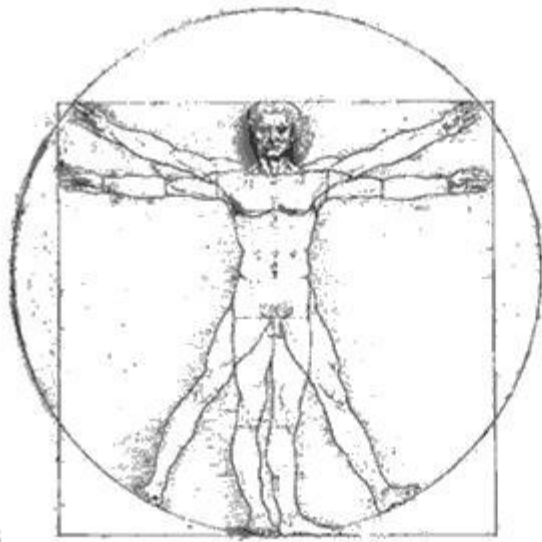


**Spoiler: Phrogram programs run on XNA on the Xbox 360!**

# Phrogram's version of Hello World!  Much more fun, yes?

# Phrogram's Logo-style sprite movement: Forward, TurnLeft, TurnRight. Also, key input handling:

```
Define Spider As Sprite = LoadSprite( "Spider", "SpiderDown.png" )

Spider.MoveTo( 275, 0 )
Spider.Visible = True

Define speed As Decimal = 5 // Demo Class Library Browser here

While Not Keyboard.IsKeyDown( Keys.Escape )

    If Keyboard.IsKeyDown( Keys.Up ) Then
        Spider.Forward( speed )
    End If

    If Keyboard.IsKeyDown( Keys.Left ) Then
        Spider.TurnLeft( speed / 2 )
    Else If Keyboard.IsKeyDown( Keys.Right ) Then
        Spider.TurnRight( speed / 2 )
    End If

    Delay(1)

End While
```

## Phrogram's class-based programming model also allows for *user-defined* classes and structures:

```
Class FahrenheitThermometer

    Define Temperature As Decimal

    Function CurrentReading() As String
        Return FormatString("#.# °F", This.Temperature)
    End Function

    Function CelsiusReading() As String
        Define ConvertedTemperature As Decimal
        ConvertedTemperature = (This.Temperature - 32) * 5 / 9
        Return FormatString("#.# °C", ConvertedTemperature)
    End Function

End Class

Method Main()

    Define MyThermometer As FahrenheitThermometer

    MyThermometer.Temperature = 100

    PrintLine("Fahrenheit temperature is " + MyThermometer.CurrentReading() )
    PrintLine("This is equal to " + MyThermometer.CelsiusReading() )
```
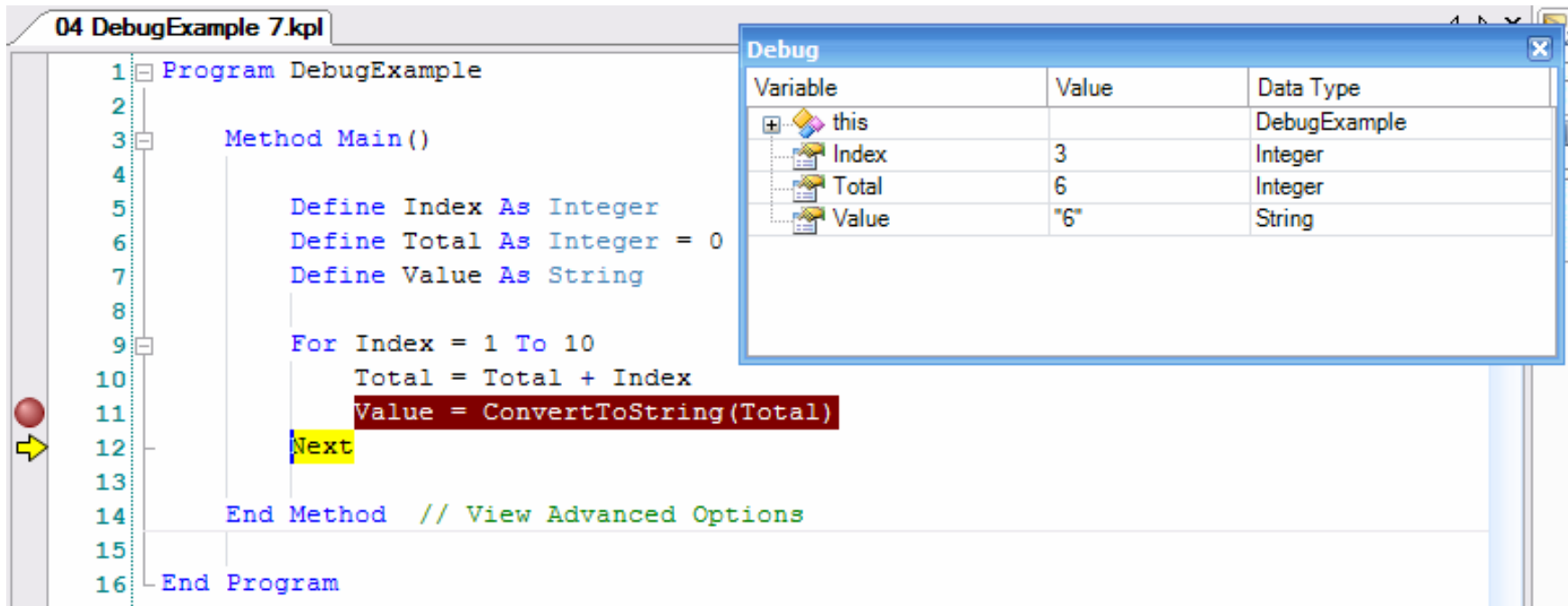
**Interactive debugging is a very useful pedagogical tool for teaching the flow of program instructions - especially how loops and conditional statements work:**

```
04 DebugExample 7.kpl

 1  Program DebugExample
 2
 3      Method Main()
 4
 5          Define Index As Integer
 6          Define Total As Integer = 0
 7          Define Value As String
 8
 9          For Index = 1 To 10
10              Total = Total + Index
11              Value = ConvertToString(Total)
12          Next
13
14      End Method   // View Advanced Options
15
16  End Program
```

**Debug**

| Variable | Value | Data Type |
|----------|-------|-----------|
| ⊞ ◆ this |  | DebugExample |
| Index | 3 | Integer |
| Total | 6 | Integer |
| Value | "6" | String |

**The Debug panel can be docked or floating, and *always* shows *all* in-scope variables. This feature teaches the rules of variable scoping in a very simple but clear way.**

**Pong – first console game ever sold – implemented in 165 instructions.  The first Phrogram book, published by Addison-Wesley, teaches a *novice* programmer to do this.  How's that for proof of how easy and powerful Phrogram is?**
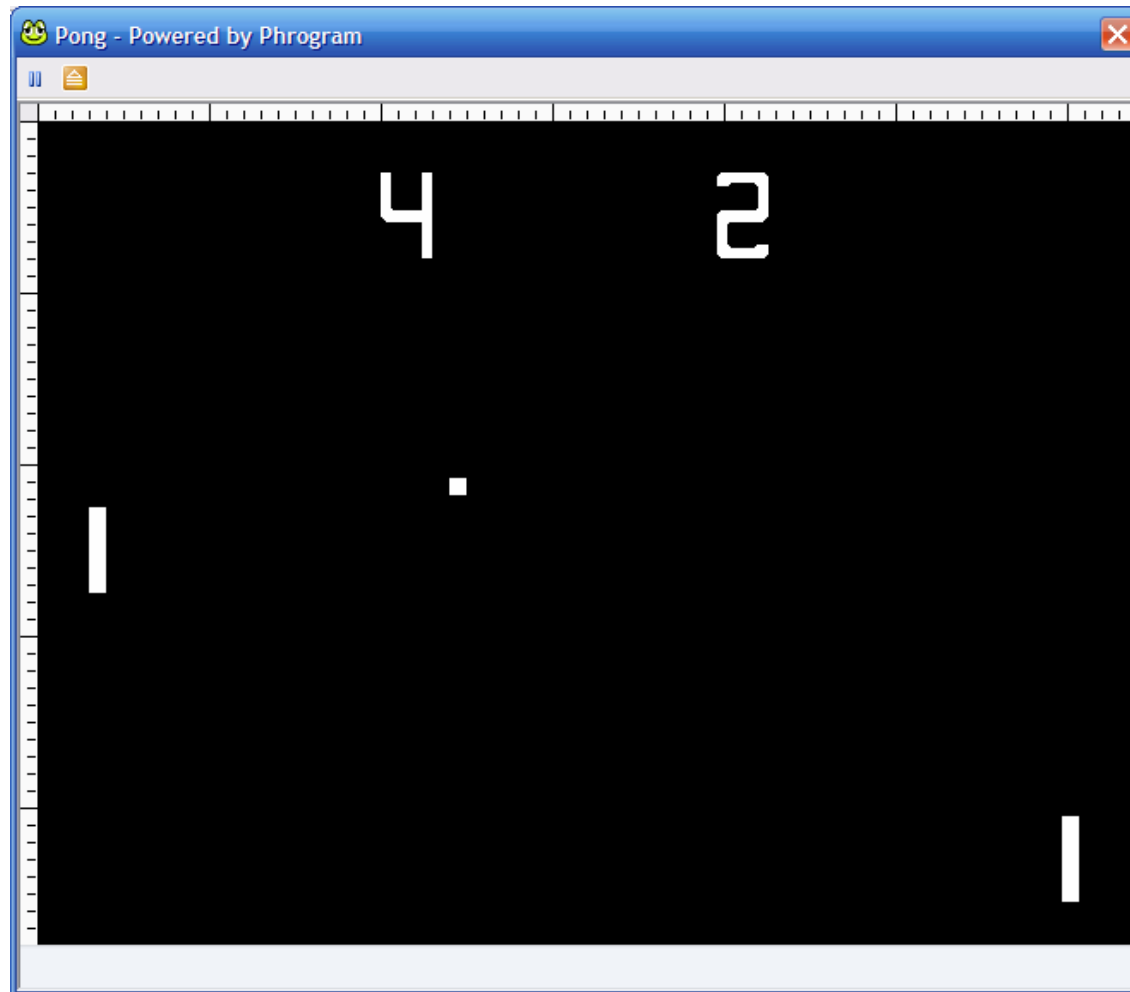
This multi-player pinball simulator, programmed by a volunteer in France, includes realistic behavior of ball, lights, bumpers and paddles – plus voice instructions.

This example demonstrates that Phrogram is capable of much more than just beginning programming.

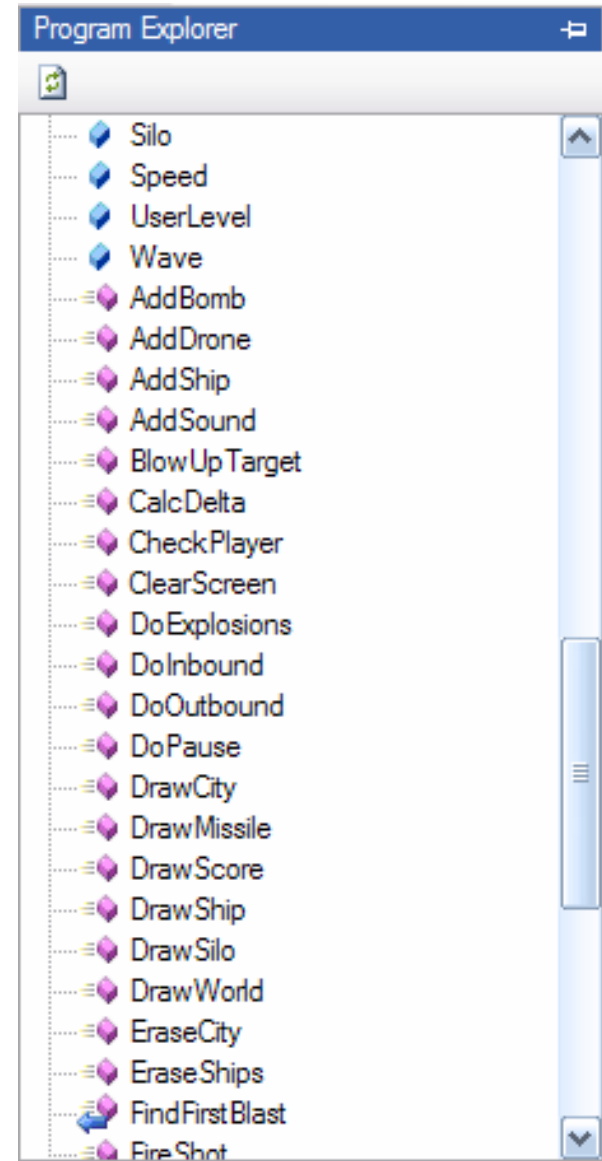As with all Phrogram examples, source code is available, to be studied, modified and reused.

# Missile Command in Phrogram – just as cool and just as fun as it was in the arcades 25 years ago:
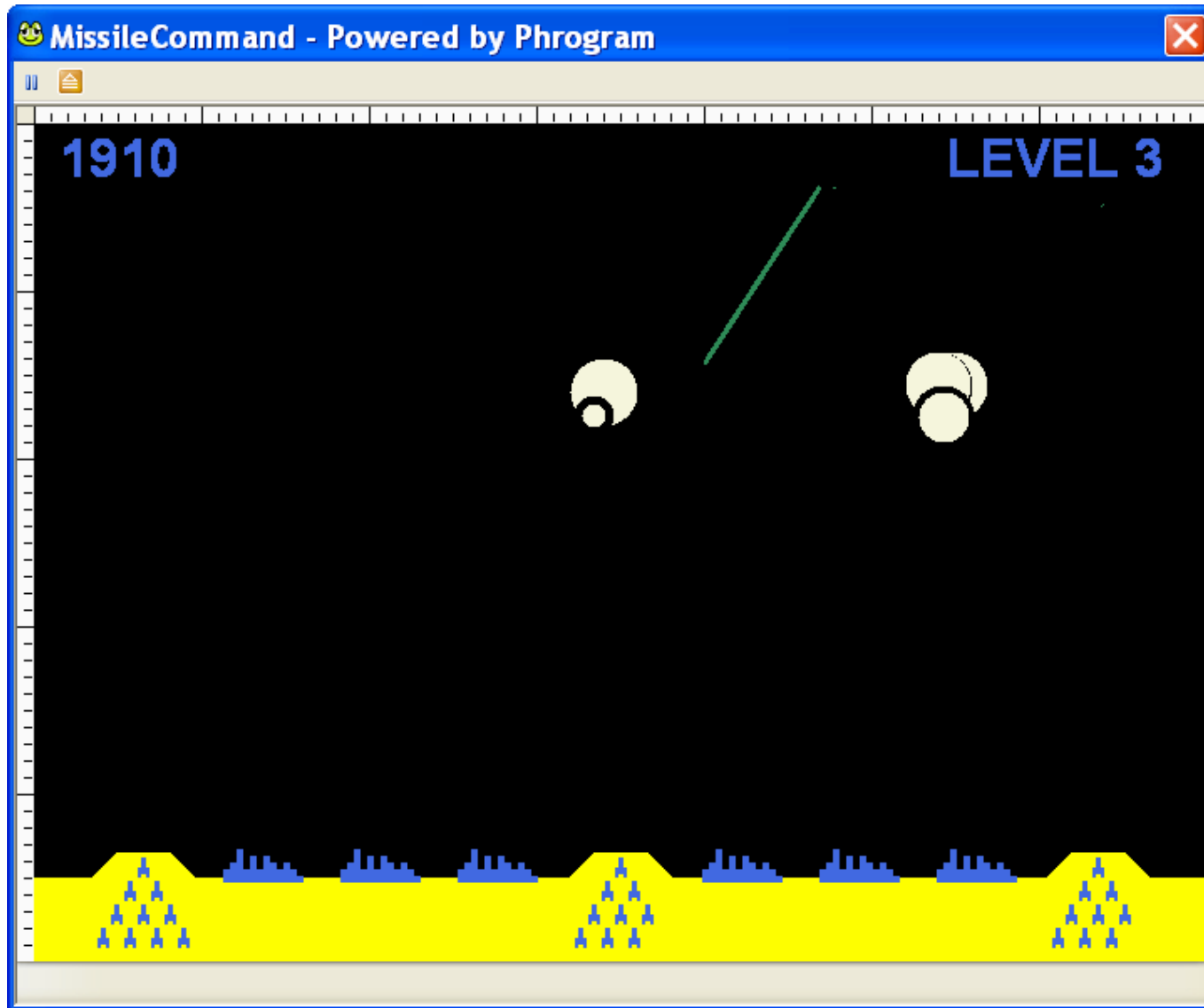
**The Program Explorer pane is shown here, presenting a view of some of the variables, methods and functions used in the Missile Command game.**

**This UI is very useful for learning or remembering how the program is organized, and is also useful for navigation.  A double-click on any item in the Explorer tree will open the matching line of code in the code editor.  The larger the program is, of course, the more valuable the Program Explorer.**

Program Explorer

- Silo
- Speed
- UserLevel
- Wave
- AddBomb
- AddDrone
- AddShip
- AddSound
- BlowUpTarget
- CalcDelta
- CheckPlayer
- ClearScreen
- DoExplosions
- DoInbound
- DoOutbound
- DoPause
- DrawCity
- DrawMissile
- DrawScore
- DrawShip
- DrawSilo
- DrawWorld
- EraseCity
- EraseShips
- FindFirstBlast
- FireShot

**"The Boy Who Cried Wolf" told in Phrogram. The volunteer who wrote this example is a lady with the specific goal of creating story-telling, art and other programs that are interesting to young girls.**



ShepherdBoy - Powered by Phrogram

Page 2

He rushed down towards the village calling out "Wolf, Wolf," and the villagers came out to meet him, and some of them stopped with him for a considerable time.

Type C to continue
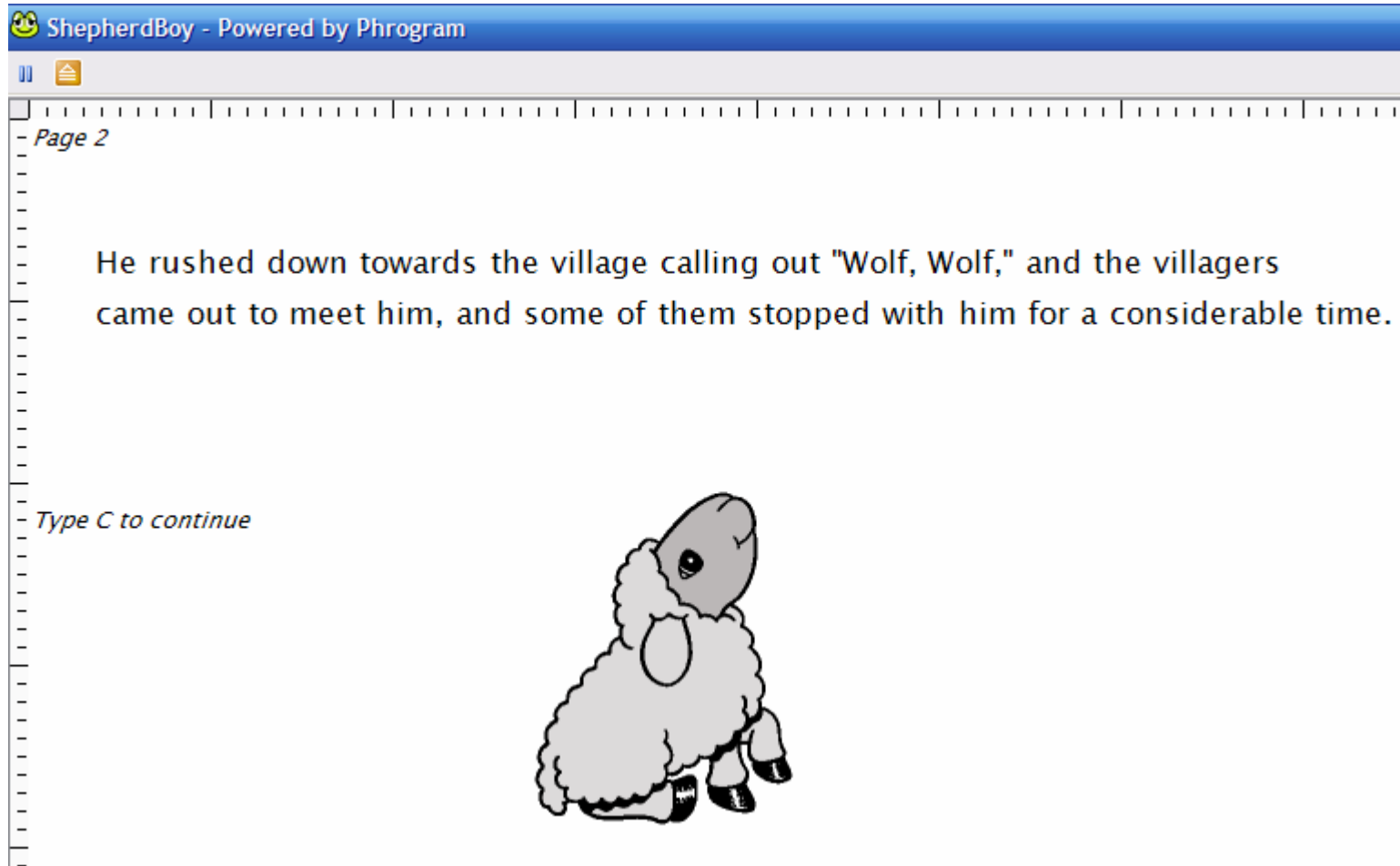
**Conway's Game of Life – Phrogram is simply the easiest available way to create educational software, so can be used to teach *many* topics, not just programming itself:**
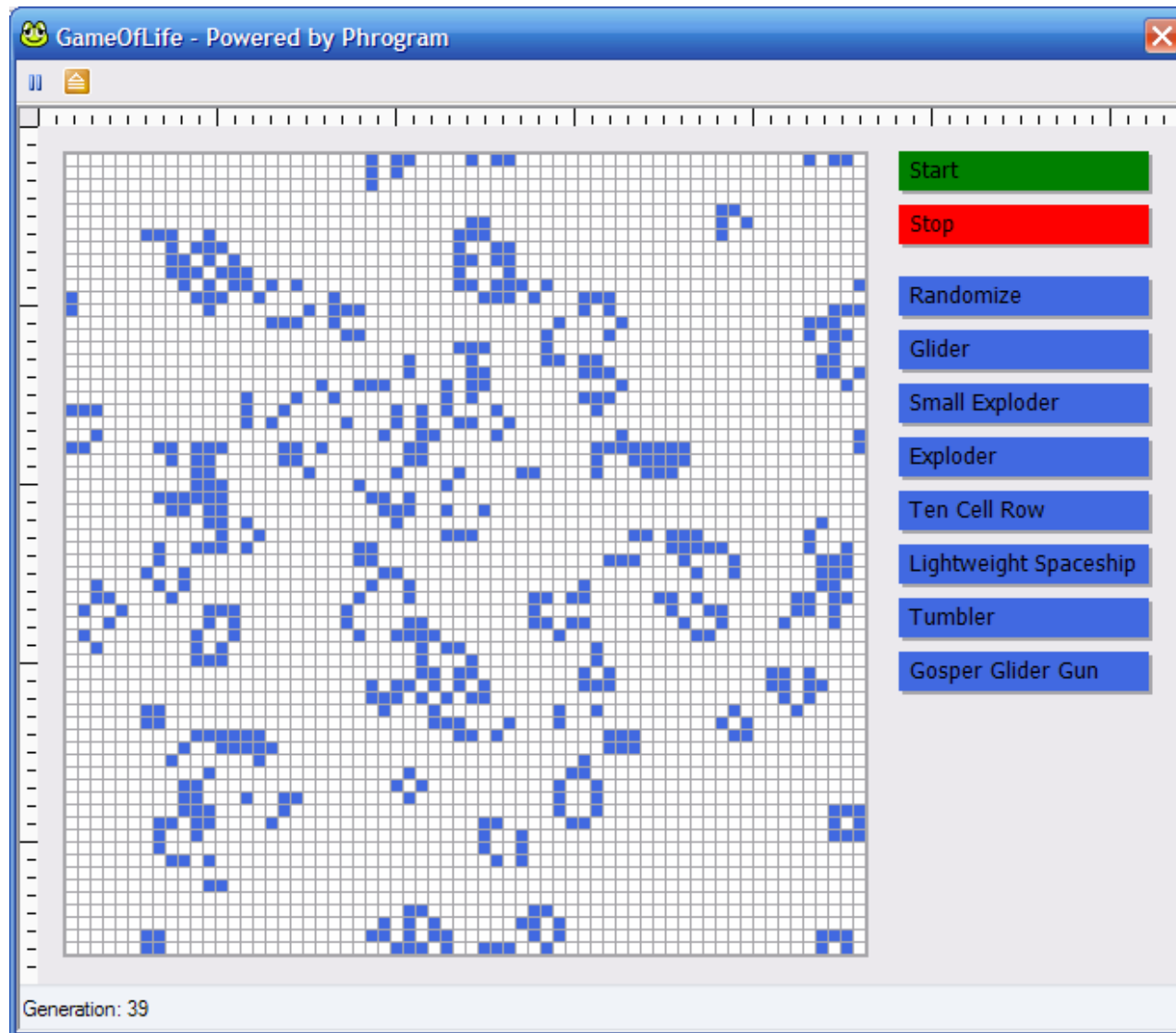
**Phrogram implementation of a bitwise AND operator for use with Integer variables – excellent programming exercise! – and Sierpinski triangle example using it:**

```
Function AndInteger( a As Integer, b As Integer ) As Integer
    Define a1   As Integer
    Define b1   As Integer
    Define c    As Integer = 0
    Define d    As Integer = 1
    While Not ( a = 0 Or b = 0 )
        a1 = a
        a  = a / 2
        b1 = b
        b  = b / 2
        If a1 <> 2 * a Then
            If b1 <> 2 * b Then
                c = c + d
            End If
        End If
        d = d * 2
    End While
    Return c
End Function
```
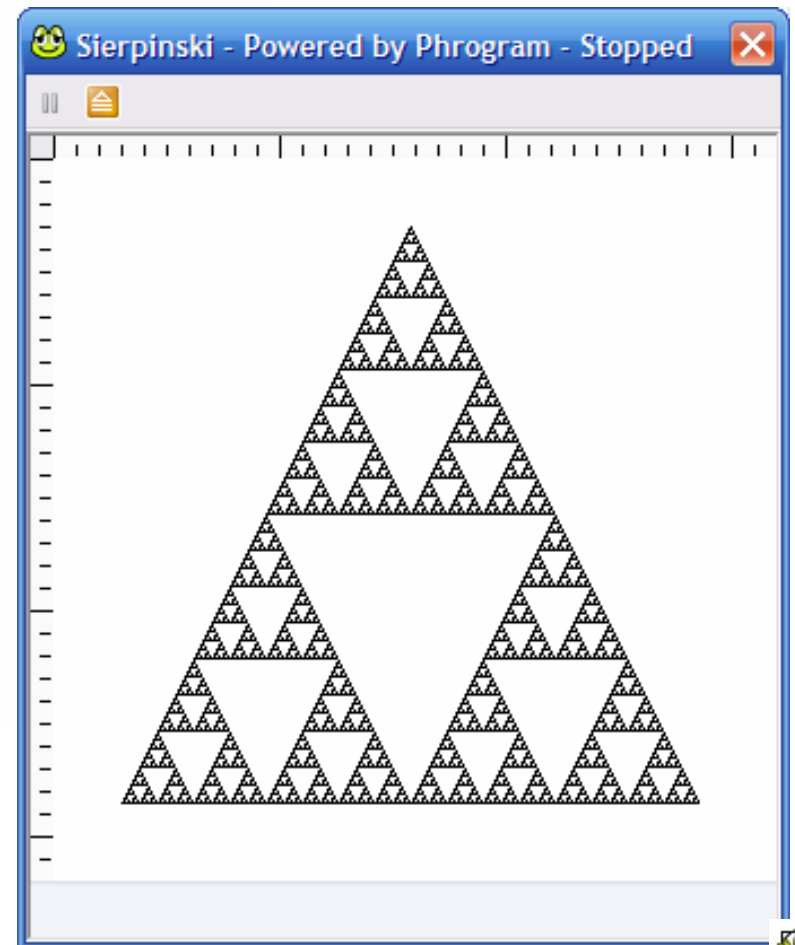
```
Define ship As Model3D
ship.LoadMesh( "fighter.x" ) // dwarf
ship.MoveTo( 10, 10, 10 )

While Not IsKeyDown( Escape )

    Define startTime As Decimal = TickCount()
    Define moveAmount As Decimal = 5 * frameTime

    If IsKeyDown( Left ) Then
        ship.TurnLeft( moveAmount )
    End If

    If IsKeyDown( Right ) Then
        ship.TurnRight( moveAmount )
    End If

    If IsKeyDown( Up ) Then
        Ship.TiltUP( moveAmount )
    End If
```
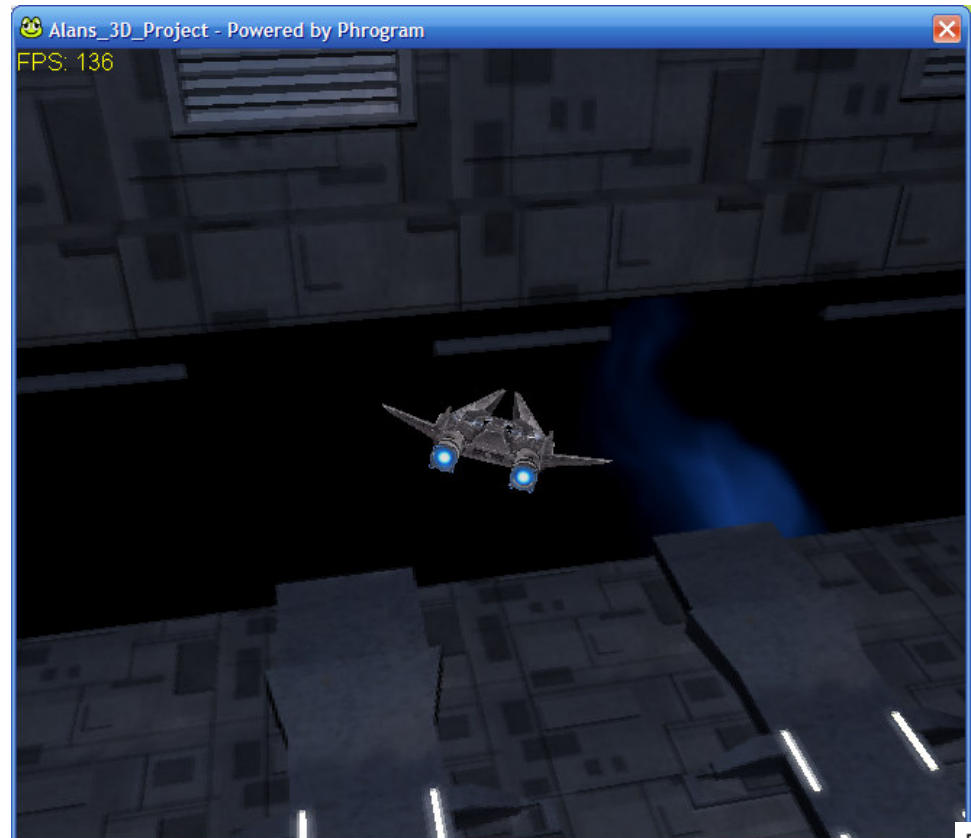
**When we release Phrogram's XNA support this spring, programs like these will run on the Xbox 360!**



**These are about half of the 35 simple instructions that allow a programmer to display and control a 3D model!**

# Things I didn't demo

- XNA compatibility: beta next month!
- Extensible class libraries:
  - Peer-to-peer Internet-based data exchange, for **multiplayer games**, **chat** and other **multi-user apps**
  - Extended file I/O library
  - Advanced math library (128 bit precision)
  - Weatherbug library for processing and visualization of weather data from live Internet feeds
- XML-based IDE translation: Spanish, Portuguese, French, Italian, German, Czechoslovakian so far

# Ohio State University

"I'm excited and very pleased to be using Phrogram in this introductory course.  The environment is truly as simple and easy to use as advertised.  The students, mostly art majors, are excitedly and happily creating scenes, scenes with moving objects, and scenes with user interaction.  The high speed of the executables is very gratifying.  The immediate red-underlining feedback on syntax errors seems to keep student frustration with syntax down to a minimum."

Wayne Heym, Ph.D, Computer Science and Engineering, Ohio State University

# PUC-Rio

- Focus on teaching CS concepts using game technology
- Esteban found 3DGame Studio, Unreal and other engines were not ideal for teaching beginning programming
- He adopted KPL after being introduced to it at last year's Academic Days on Gaming conference
- "Excellent learning process and student motivation"
- "Good preparation for compiled languages"
- "At the end of the first semester of 2006 many students were developing applications and more powerful games in .NET, using C#, even though this was not "officially" presented in the classes."

Esteban Clua, Ph.D, Departamento de Informática, Pontifícia Universidade Católica do Rio de Janeiro

# **Lakeside School, Seattle**

- Academically acclaimed independent school
- 4$^{th}$ and 5$^{th}$ grade: Logo
- 6$^{th}$ and 7$^{th}$ grade: Phrogram
- 8$^{th}$ grade and on: Java

# Available Materials

- 150-page User Guide and 30-page Beginner's Tutorial

- 110-page Addison-Wesley eBook, ***Learn to Program with Phrogram!***

- Active online community: www.phrogram.com

- Ohio State: full CS0 course curriculum

- Lakeside: curriculum published end of term

- 3 more book proposals in progress, one of them a textbook by a published CS teacher/author

# Join the fun?

- You are all invited to work with the beta of our XNA support, and with our SDK

- We will actively support any teacher or professor who wants to work on new curriculum or materials around Phrogram

- We will actively support any student project producing content for use with Phrogram – which might be media content, example content, or extensions of the class library

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