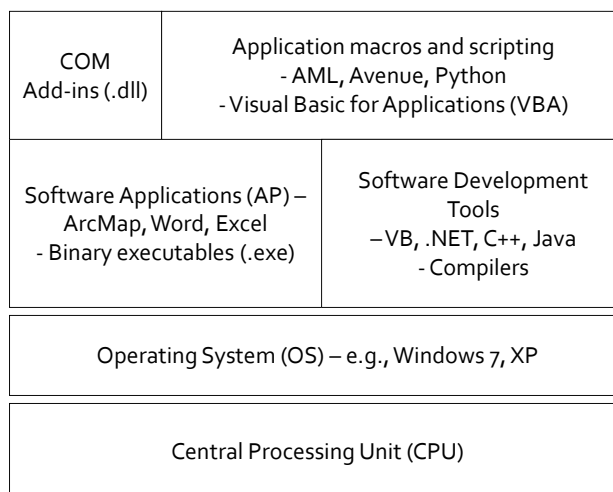* Course Overview
* Programming Environment
* Intro to object-oriented Programming (prototyping and pseudo code)

GEOG 4/590: GIS Programming

Computer Programming Components

- Computer hardware (CPU + memories + peripheries)
- Computer operating systems
- Programming environment
  - An editor for *source code* editing
  - A debugger for correcting "*bugs*"
  - A *compiler* (e.g., VB, C#) for generating machine code
- Execution environment
  - Interpreter (e.g., ArcPy, VBA)
  - Resources/references (libraries, element classes)
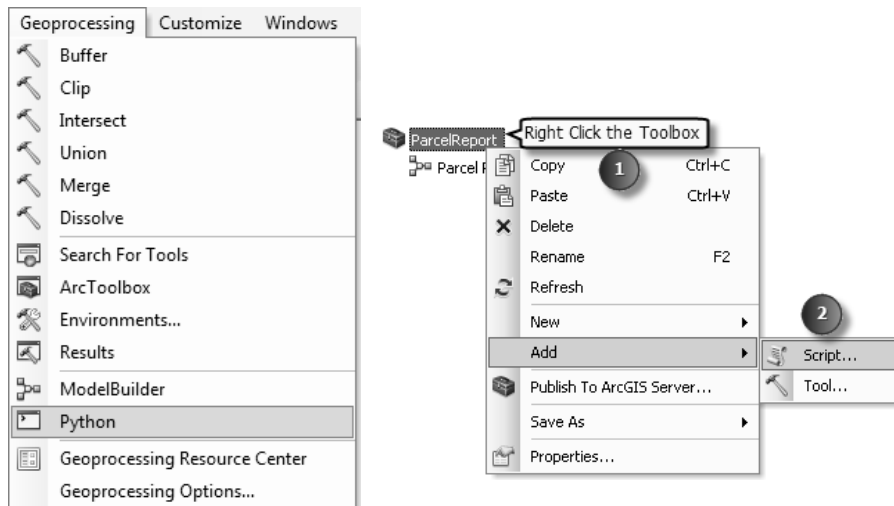
Computer Software Architecture

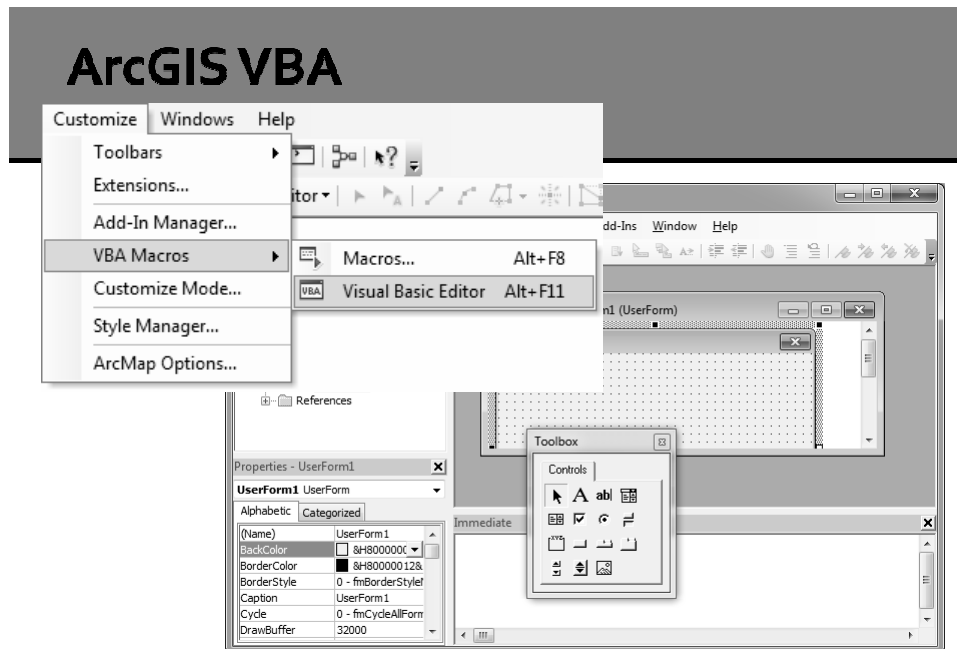| COM Add-ins (.dll)	Application macros and scripting - AML, Avenue, Python - Visual Basic for Applications (VBA)
Software Applications (AP) – ArcMap, Word, Excel - Binary executables (.exe)	Software Development Tools – VB, .NET, C++, Java - Compilers
Operating System (OS) – e.g., Windows 7, XP	
Central Processing Unit (CPU)	

ArcGIS Programming
http://help.arcgis.com/

- ArcGIS programming resources
  - Geoprocessing (GP) tools
  - ArcObjects (Dynamic Link Libraries)
  - ArcGIS Engine (ArcGIS Application Programming Interface)

- ArcGIS programming environment
  - ArcGIS Python and ArcPy
  - ArcGIS Modelbuilder + Python scripts
  - Visual Basic for Applications (VBA)
  - Software Development Kit (SDK for .NET Framework)
  - Other APIs for ArcGIS Server applications

Python (ArcPy) Scripts

Limitations of Python

- Not all components of ArcGIS are exposed to Python
- Editing and debugging is less sophisticated than more advanced programming environments such as Visual Studio
- Cannot listen for and respond to ArcGIS application events
- Cannot implement any Component Object Model (COM) interfaces including:
  - Buttons and tools
  - ComboBoxes
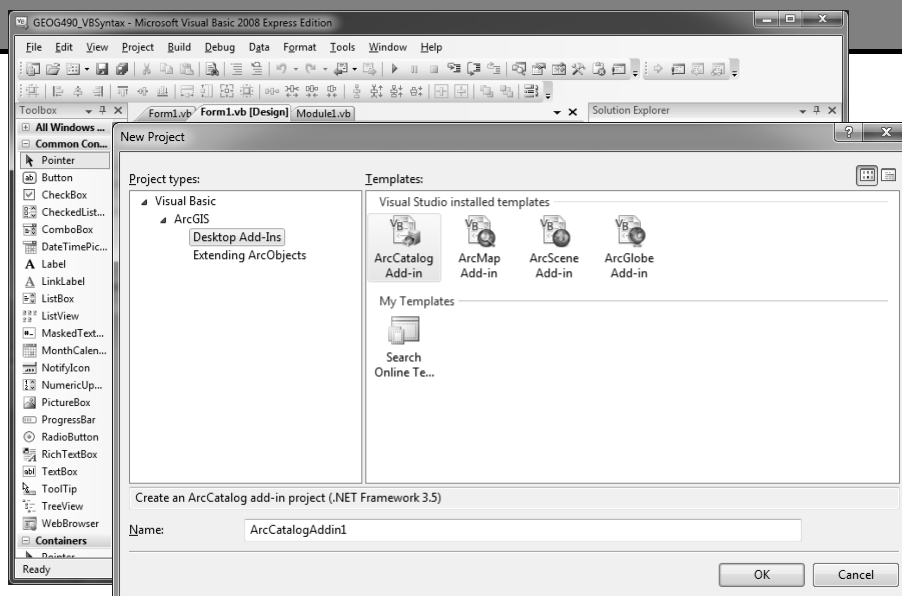 - Dockable windows (UserForms)

ArcGIS VBA

■ Separate installation and license required in ArcGIS 10 to use VBA

Limitations of VBA

- Microsoft has dropped support for VB6/VBA and is emphasizing a shift to .NET compliant languages (VB and C#)

- ESRI is removing the familiar VBA development environment from their products, discontinuing support, and promoting new alternatives
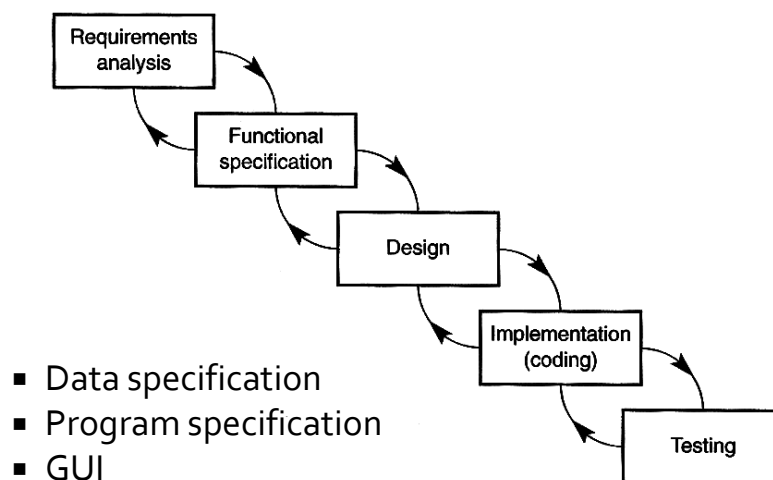
Microsoft .NET (VB .NET and C#)

Coding with VB.NET and C#

- Add-ins (new in ArcGIS 10)
- Application extensions
- Stand-alone application development

Add-ins for ArcGIS (.esriAddIn)

- The add-in model provides a declarative programming framework for creating customizations packaged within a compressed file
- Add-ins are easily shared between users: they do not require installation programs or COM registration
- Add-ins are added to a system by simply copying them to a well-known folder and removed by deleting them from this folder
- Add-ins can also be shared between users within an organization using a centralized network share.

Software Design Procedures (the big picture)

Requirements analysis → Functional specification → Design → Implementation (coding) → Testing

- Data specification
- Program specification
- GUI

The nitty-gritties...

- Algorithm
- Pseudo-code
- Source code
- Debugging
- Compiling

Algorithm

- A procedure for solving a problem in terms of the actions to be executed and the order in which those actions are to be executed.

- The sequence of steps taken to solve a problem. The steps are normally "sequence," "selection, " "iteration," and a case-type statement.

Pseudo-code

- An artificial and informal language that helps programmers develop algorithms. Pseudo-code is a "text-based" detail (algorithmic) design tool.

Pesudo-code Example

Set total to zero
Set student counter to one

While student counter is less than or equal to student number
   Input the next grade
   Add the grade into the total

Set the class average to the total divided by student number
Print the class average

VB .NET

- Object-oriented event-driven programming
- Integrated development environment (IDE)
  - Builder Wizards
  - Solution, file, project, item manager/explorer
  - Builder User Interface (GUI development)
  - Text editor (IntelliSense®, syntax coloring)
  - Resources and resource editors (e.g., image editing)
  - Add-in and add-in reference
  - Compiler and debugger

VB .NET Solutions, Projects, and Items