

# **Introduction to Geoprocessing Scripts Using Python**

Copyright © 2007 ESRI

All rights reserved.

Course version 2.0. Revised December 2006.

Printed in the United States of America.

The information contained in this document is the exclusive property of ESRI. This work is protected under United States copyright law and the copyright laws of the given countries of origin and applicable international laws, treaties, and/or conventions. No part of this work may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying or recording, or by any information storage or retrieval system, except as expressly permitted in writing by ESRI. All requests should be sent to Attention: Contracts Manager, ESRI, 380 New York Street, Redlands, CA 92373-8100, USA.

The information contained in this document is subject to change without notice.

#### **U. S. GOVERNMENT RESTRICTED/LIMITED RIGHTS**

Any software, documentation, and/or data delivered hereunder is subject to the terms of the License Agreement. In no event shall the U.S. Government acquire greater than RESTRICTED/LIMITED RIGHTS. At a minimum, use, duplication, or disclosure by the U.S. Government is subject to restrictions as set forth in FAR §52.227-14 Alternates I, II, and III (JUN 1987); FAR §52.227-19 (JUN 1987) and/or FAR §12.211/12.212 (Commercial Technical Data/Computer Software); and DFARS §252.227-7015 (NOV 1995) (Technical Data) and/or DFARS §227.7202 (Computer Software), as applicable. Contractor/Manufacturer is ESRI, 380 New York Street, Redlands, CA 92373-8100, USA.

ESRI, ARC/INFO, ArcCAD, ArcGIS, ArcIMS, ArcPad, ArcSDE, ArcView, *BusinessMAP*, MapObjects, PC ARC/INFO, SDE, and the ESRI globe logo are trademarks of Environmental Systems Research Institute, Inc., registered in the United States and certain other countries; registration is pending in the European Community. 3D Analyst, ADF, ArcCOGO, the ArcCOGO logo, ArcGrid, the ArcGrid logo, the ARC/INFO logo, AML, ArcNetwork, the ArcNetwork logo, *ArcNews*, ArcTIN, the ArcTIN logo, ArcInfo, the ArcInfo logo, ArcInfo Librarian, ArcInfo—Professional GIS, ArcInfo—The World's GIS, ArcAtlas, the ArcAtlas logo, the ArcCAD logo, the ArcCAD WorkBench logo, ArcCatalog, the ArcData logo, the ArcData Online logo, ArcDoc, ArcEdit, the ArcEdit logo, ArcEurope, the ArcEurope logo, ArcEditor, ArcExplorer, the ArcExplorer logo, ArcExpress, the ArcExpress logo, ArcFM, the ArcFM logo, ArcFM Viewer, the ArcFM Viewer logo, ArcGlobe, the ArcIMS logo, ArcLocation, ArcLogistics, the ArcLogistics Route logo, ArcMap, ArcObjects, the ArcPad logo, Arcplot, the Arcplot logo, ArcPress, the ArcPress logo, the ArcPress for ArcView logo, ArcReader, ArcScan, the ArcScan logo, ArcScene, the ArcScene logo, ArcSchool, the ArcSDE logo, the ArcSDE CAD Client logo, ArcSdl, ArcStorm, the ArcStorm logo, ArcSurvey, ArcToolbox, ArcTools, the ArcTools logo, ArcUSA, the ArcUSA logo, *ArcUser*, the ArcView GIS logo, the ArcView 3D Analyst logo, the ArcView Business Analyst logo, the ArcView Data Publisher logo, the ArcView Image Analysis logo, the ArcView Internet Map Server logo, the ArcView Network Analyst logo, the ArcView Spatial Analyst logo, the ArcView StreetMap logo, the ArcView StreetMap 2000 logo, the ArcView Tracking Analyst logo, ArcVoyager, ArcWorld, the ArcWorld logo, Atlas GIS, the Atlas GIS logo, AtlasWare, Avenue, the Avenue logo, the *BusinessMAP* logo, DAK, the DAK logo, Database Integrator, DBI Kit, the Digital Chart of the World logo, the ESRI Data logo, the ESRI Press logo, ESRI—Team GIS, ESRI—The GIS People, FormEdit, Geographic Design System, Geography Matters, GIS by ESRI, GIS Day, the GIS Day logo, GIS for Everyone, GISData Server, *InsiteMAP*, MapBeans, MapCafé, the MapCafé logo, the MapObjects logo, the MapObjects Internet Map Server logo, ModelBuilder, MOLE, the MOLE logo, NetEngine, the NetEngine logo, the PC ARC/INFO logo, PC ARCEdit, PC ARCPLOT, PC ARCSHELL, PC DATA CONVERSION, PC NETWORK, PC OVERLAY, PC STARTER KIT, PC TABLES, the Production Line Tool Set logo, *RouteMAP*, the *RouteMAP* logo, the *RouteMAP* IMS logo, Spatial Database Engine, the SDE logo, SML, StreetEditor, StreetMap, TABLES, The World's Leading Desktop GIS, *Water Writes*, and Your Personal Geographic Information System are trademarks; and ArcData, ArcOpen, ArcQuest, *ArcWatch*, ArcWeb, Rent-a-Tech, Geography Network, the Geography Network logo, [www.geographynetwork.com](http://www.geographynetwork.com), [www.gisday.com](http://www.gisday.com), [@esri.com](mailto:@esri.com), and [www.esri.com](http://www.esri.com) are service marks of ESRI.

The names of other companies and products herein are trademarks or registered trademarks of their respective trademark owners.

ArcView GIS uses HCL Technologies Ltd. Presenter software under license.

# C O N T E N T S

## 1 Introduction

Course objectives	1-2
Day 1 course content	1-3
Day 2 course content	1-4
Course materials	1-5
Additional materials and resources	1-6
ESRI Support Center	1-7
ESRI Developer Network	1-8
ArcGIS: a complete GIS	1-9
Logistics	1-10
Introductions	1-11
Exercise goals	1-12
<i>Exercise 1: Install the class database (SBS)</i>	

## 2 The geoprocessing framework

Lesson 2 overview	2-2
What is geoprocessing?	2-3
Accessing geoprocessing tools	2-4
Inside ArcToolbox	2-5
Supported data types	2-6
System toolboxes	2-7
Tools with the same name	2-8
Tools and licensing	2-9
The geoprocessing framework	2-10
Environment settings	2-11
Class focus	2-12
Why write scripts?	2-13
Points of interest	2-14
The Python scripting language	2-15
Exercise 2 overview (SBS)	2-17
<i>Exercise 2: The geoprocessing framework (SBS)</i>	

## 3 *The basics of Python*

Lesson 3 overview	3-2
Where to write code	3-3
PythonWin interface	3-4
IDLE interface	3-5
Comments	3-6
Variables in Python	3-7
Strings	3-8
Numbers and lists	3-9
Variable naming conventions	3-10
Line continuation	3-11
Built-in functions	3-12
Accessing modules	3-13
Statements	3-14
Decision making syntax	3-15
Looping syntax	3-16
Case sensitive rules	3-17
Common shortcut keys for PythonWin	3-18
Python resources	3-19
Exercise 3 overview (SBS)	3-20
<i>Exercise 3: The basics of Python (SBS)</i>	

## 4 *Accessing tools and environment settings in scripts*

Lesson 4 overview	4-2
Common ArcObjects	4-3
Common ArcObjects	4-4
Interacting with ArcObjects	4-5
The Geoprocessor (GpDispatch) ArcObject	4-6
Creating the Geoprocessor	4-7
Syntax for properties and methods	4-8
Demonstration: Finding the scripting syntax	4-9
Toolbox aliases	4-10
The Select tool	4-11
The CreateFeatureClass tool	4-13
The (raster) Clip tool	4-14
The Buffer tool	4-15
The Union tool	4-16
Learning how to populate tool arguments	4-17

Running multiple tools	4-18
Exercise 4 overview	4-19
<i>Exercise 4A: Create a folder (ILD)</i>	
<i>Exercise 4B: Run geoprocessing tools (SBS/SD)</i>	

## 5 *The Geoprocessor Programming Model and Geoprocessor object*

Lesson 5 overview	5-2
What you know	5-3
What you may not know	5-4
The Geoprocessor Programming Model	5-5
Finding the model	5-6
Object symbol	5-7
Property and method symbols	5-8
Object colors	5-9
Methods and properties on the Geoprocessor	5-10
Adding and removing toolboxes	5-11
Refreshing ArcCatalog	5-12
Checking if data exists	5-13
Overwriting the output	5-14
Getting help	5-15
Exercise 5 overview	5-16
<i>Exercise 5A: Check if a folder exists (ILD)</i>	
<i>Exercise 5B: Run Geoprocessor methods (SD)</i>	

## 6 *The describe objects*

Lesson 6 overview	6-2
Returning standard data	6-3
Returning objects	6-4
The describe objects	6-5
The describe method	6-6
The describe objects	6-7
Dataset properties	6-8
Feature class properties	6-9
Raster dataset properties	6-10
Describe object properties	6-11
Demonstration: Help for describe objects	6-12
Activity: Describing geodatabases	6-13
Activity: Describing coverages	6-14

Activity: Describing rasters	6-15
Exercise 6 overview	6-16
<i>Exercise 6A: Describe a feature class (ILD)</i>	
<i>Exercise 6B: Describe data (SD)</i>	

## 7 *The enumeration objects*

Lesson 7 overview	7-2
The enumeration objects	7-3
The enumeration methods	7-4
The enumeration objects	7-5
The Enumeration object	7-6
List feature class example	7-7
List dataset example	7-8
Looping through a list of data	7-9
The Fields object	7-10
Activity: Complete the code	7-12
Exercise 7 overview	7-13
<i>Exercise 7A: List feature classes (ILD)</i>	
<i>Exercise 7B: List data (SD)</i>	

## 8 *The cursor objects*

Lesson 8 overview	8-2
The cursor objects	8-3
The cursor methods	8-4
The cursor objects	8-5
The SearchCursor object	8-6
Search cursor example	8-7
The UpdateCursor object	8-8
Update cursor example	8-9
The InsertCursor object	8-10
Insert cursor example	8-11
The Geometry object	8-12
Geometry example	8-13
Data locks	8-14
Exercise 8 overview	8-15
<i>Exercise 8A: Read values from fields (ILD)</i>	
<i>Exercise 8B: Add and update a field (SD)</i>	

## 9 *Running scripts from ArcToolbox*

Lesson 9 overview	9-2
Making scripts dynamic	9-3
Creating arguments: sys.argv[]	9-4
Creating arguments: GetParameterAsText()	9-5
Running scripts with arguments	9-6
Why attach a script to a tool?	9-7
Attaching a script to a tool	9-8
General settings	9-9
Setting the script source	9-10
Parameter properties	9-11
Final output	9-13
Domain property	9-14
Dependency property	9-15
Script tools and the geoprocessing framework	9-16
Demonstration: Show existing script tools	9-17
Exercise 9 overview	9-18
<i>Exercise 9A: Copy features (SBS)</i>	
<i>Exercise 9B: Buffer multiple feature classes (SBS)</i>	

## 10 *Debugging code and handling errors*

Lesson 10A overview	10-2
Step 1: Where to test code	10-3
Step 2: Check for syntax errors	10-4
Step 3: Understand the script	10-5
Step 4: Enter any arguments	10-6
Step 5: Narrow error to block or line of code	10-7
Interactive Window	10-8
Print statements	10-9
Comment code	10-10
Debugger toolbar	10-11
Step 6: Visually examine the line of code	10-12
Activity A: Find seven errors	10-13
Activity B: Find five errors	10-14
Activity C: Find four errors	10-15
Step 7: Check data in ArcCatalog	10-16
A note of caution	10-17