ArcGIS for Developers Part 1

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Options Building Custom Solutions

- Take existing ArcGIS Apps and configure
- Build custom web and mobile apps using builders
- Build custom apps using ArcGIS client APIs
- Extend ArcGIS Desktop
- A mixture of all of the above
  - ArcGIS system architecture designed to support this interoperability
Web GIS Is the Modern GIS Architecture
Helping Everyone Do Their Work Better

Leveraging Web Services

Engaging Everyone

Sharing and Collaboration

Distributed and Interconnected

Communities

Organizations

Departments

Teams

Individuals
Web Maps Engage and Interconnect . . . Everyone
Providing a Common Language

Supporting Communication and Real-Time Awareness

A Common Framework . . .
for Collaborating and Problem Solving
ArcGIS
A Comprehensive Geospatial Platform

Supporting Individuals, Teams, and Organizations
ArcGIS App Builders | Enable Everyone to Build Apps

Simple and Powerful

Web

3D

Web AppBuilder

Native Devices

AppStudio

Many Widgets

500,000+ Web Apps Created and Deployed

Build Once, Deploy on Any Device

No Programming Required
ArcGIS Developer Platform | Extending GIS and Creating New Apps

New and Improved
- Performance
- Usability
- Functionality

ArcGIS Developer Platform | Extending GIS and Creating New Apps

For Devices, Web, and Desktop

Supporting GIS, Enterprise, and Independent App Developers
ArcGIS Developer Platform | Apps Empower Your Users

The ArcGIS System

APIS

- Dashboards
- Story Maps
- Social Media
- Browser Apps
- Professional Desktop Apps
- Server Admin Apps
- Mobile Apps
- Story Maps
- Dashboards
ArcGIS APIs
Developer Experience
ArcGIS APIs

- Extension APIs for customizing and extending ArcGIS
  - Desktop
  - Server
- Client APIs for building Apps
  - Web
  - Mobile
  - Desktop
Extension SDKs
ArcGIS Extension SDKs

- Allow developers to customize ArcGIS for their specific workflows
- SDKs are designed and built specifically for this purpose
- ArcGIS Pro SDK for .NET
- ArcGIS Enterprise SDK
- ArcObjects SDK
ArcGIS Pro
Customizing and Extending ArcGIS Pro

- Configure UI through settings and workflows through tasks
- Automate using geoprocessing and Python
- Extend with your own custom tools and solutions using the Pro SDK for Microsoft .NET
ArcGIS Pro SDK for .NET
Customizing and Extending ArcGIS Pro

• Modern framework design specifically to support customization of Pro
• Microsoft .NET – develop with Visual Studio 2015 and 2017
• Three patterns:
  - **Add-Ins** – Develop new tools and functionality, and customize UI
  - **Configurations** – Deeper customization, branding, start-up experience, streamline UI
  - **Plug-in data sources** – Develop new data source formats
Pro SDK Resources

• **Landing page** – main resource page -
  Go to pro.argis.com and click on “SDK” tab

• **Community Samples** – ready to use code solutions categorized by functional area

• **Doc Wiki** – primary documentation site with concept and guide docs, and much more

• **GeoNet Pro SDK Group** – developer community
ArcGIS Pro SDK for .NET
Customizing the UI with Add-ins

• Easy to share and install
• Deployed as a single zipfile package, with .esriAddInX extension
• Can be secured and licensed
Pro Add-In Demo
ArcGIS Pro SDK
Taking Control with Solution Configurations

• Includes all functionality of an add-in plus
  - Change the application title and icon
  - Change the application splash screen, start page, and about page
  - Conditional customization of the UI

• Packaged within a single, compressed file with a .ProConfigX file extension
  - Built in a similar way to an add-in
  - Default install location in a dedicated folder with standard add-ins
Pro Configuration Demo
What can you do with the Pro SDK?

- **Framework** - customize the Pro UI and manage the ribbon with context, extend with solution configurations
- **Content** - manage Pro project items and connections to Portal to consume and integrate online data
- **Editing** - develop powerful editing tools and create and manage editing operations
- **Geodatabase** - access file and enterprise datasets, and manage queries, searches and selections, as well as versions
- **Geometry** - build and manage feature geometries and perform spatial operations
- **Geoprocessing** - run geoprocessing tools and python scripts from add-in tools and routines
What can you do with the Pro SDK?

- Layouts - build custom layouts and elements, manage layout views and selections
- Map Authoring - author maps, manage layers, define and set layer renderers
- Map Exploration - build and manage animations, control the camera and build new map tools
- Raster - work with raster datasets, layers and colorizers
- Sharing - access and search content, folders, and groups of a portal or online organization
- Tasks - access and manage Tasks within the UI
- Utility Network - create custom utility network tools, traces and workflows
ArcGIS Enterprise SDK
Extending ArcGIS Pro Compatible Services

- Extending ArcGIS Pro based services
  - Building Server Object Extensions (SOEs)
  - Building Server Object Interceptors (SOIs)
- Supports Feature and Image services
- SDK for Java and .NET developers
- IDE integration for Eclipse (Java) and Visual Studio 2015 and 2017 (.NET)
- Help documentation and API reference
ArcObjects SDK
Supporting ArcMap Based Development

• Customizing and Extending ArcMap
• Extending ArcMap based services
  - Building Server Object Extensions (SOEs)
  - Building Server Object Interceptors (SOIs)
• Supporting VS 2015 / 2017 and .NET 4.5
• ArcObjects continue to be supported
• ArcObjects resources available on GitHub
Client SDKs
ArcGIS Client APIs

- ArcGIS REST API
- ArcGIS API for Python
- ArcGIS API for JavaScript
- ArcGIS Runtime SDKs

- APIs architected to take full advantage of the Web GIS Pattern
ArcGIS Client APIs Designed for Web GIS

Working with the Geoinformation Model – ArcGIS Identity

- Users have a unique secure identity
- Content saved under user name
- Users can be assigned special privileges
- Users can share or keep content private
- Organize users, content and services
- Find, upload, share, configure, secure
ArcGIS REST API

- ArcGIS Online and ArcGIS Enterprise services are RESTful services
- Over 25 service types
- Grouped into 4 sub categories
  - Location based services
  - GIS services
  - Users, groups and items services
  - Enterprise administration services
- Higher level ArcGIS APIs wrap these REST services
  - Simplifies development
    - Presents capability in a more familiar environment
  - The underlying REST service can still be accessed directly if required

https://developers.arcgis.com/rest/
ArcGIS Python API
A Whole New Way to Experience and Leverage ArcGIS

- Analytics - Data Science
- Scripting and Automation
- System Administration

https://developers.arcgis.com/python/
ArcGIS Python API
Providing Answers to Questions Through Data Science

- What happened, where and when?
- Why did it happen?
- What will happen, where and when?
- What do we do about it?
ArcGIS Python API

The 3 Stages of Data Science

- Data preparation
- Analysis
- Dissemination
Python Notebook Demo
Notebooks with ArcGIS API for Python
Your Lab for Enterprise Data Science

- API Designed for Data Science
- Delivered via a familiar experience
- Brings Data Science to your Web GIS
- Designed for Machine Learning and Deep Learning workflows and models
  - Build, train, iterate, test, deploy, infer
- Create reproducible research, share and collaborate
Fine-tuning and differential learning rate annealing

Now that we have a good final layer trained, we can try fine-tuning the other layers. To tell the learner that we want to unfreeze the remaining layers, call `unfreeze()`.

```
In [33]: learn.unfreeze()
```

Note that the other layers have already been trained to recognize imagenet photos (whereas our final layers are fixed). So, we want to be careful of not destroying the carefully tuned weights that are already there.

Generally speaking, the earlier layers (as we’ve seen) have more general-purpose features. Therefore, we would expect them to need less fine-tuning for new datasets. For this reason, we will use different learning rates for different layers. The first few layers will be at $1e^{-4}$, the middle layers at $1e^{-3}$, and our FC layers will leave at $1e^{-2}$ as before. We refer to this as differential learning rates, although there’s no standard name for this technique in the literature that we’re aware of.

```
In [34]: lr=np.array([1e-4, 1e-3, 1e-2])
In [*]: learn.fit(lr, 3, cycle_len=1, cycle_mult=2)
    Epoch | Loss | acc  | lr
    -----+-----+------+-----+
    1/50 | 0.97 | [0.95, 0.97, 0.98] | 1e-3
    2/50 | 1/54 | [0.94, 0.96, 0.98] | 1e-3
```

Note that something plotted above is the learning rate of the final layers. The learning rates of the earlier layers are fixed at the same multiples of the final layer rates as we initially requested (i.e., the first layers have $100x$ smaller, and middle layers $10x$ smaller learning rates, since we set $lr=np.array([1e-4, 1e-3, 1e-2])$.)
Where is the Analysis Done?

Notebook Server

pandas
NumPy
XGBoost
TensorFlow
mxnet
Keras

Raster Analytics & Image Processing,
Geoanalytics
(Distributed Computing, Big Data)

Spatial Analysis,
Geocoding, Geoenrichment
DevOps with Chef and the Python API

- The lifecycle of the Web GIS from deployment to exploitation and growth
- Chef recipes for installing and administering ArcGIS Enterprise
- Python API used to manage users and content

Automation is no longer an option – it’s critical
Automate your ArcGIS Enterprise deployments…

Enterprise Builder

Cloud Builder CLI & Cloud Formation Templates

Cloud Builder & PowerShell DSC

Chef

Infrastructure as Code

AWS

Azure

Machine images, advanced cloud deployment options

For GIS Professionals

Automation for DevOps
Automate your ArcGIS Online and ArcGIS Enterprise workflows…

Your modern GIS, automated by the ArcGIS API for Python
Automating Your Web GIS - Demo
ArcGIS for Developers
A Complete Developer experience

• A comprehensive set of developer APIs and SDKs
• Full set of resources available to support your learning
• Business models covering all deployment options

https://developers.arcgis.com
Summary

• Extension APIs for customizing and extending ArcGIS
  - Desktop
  - Server

• Client APIs for building Apps
  - Web
  - Mobile
  - Desktop
Questions
Print Your Certificate of Attendance
Print Stations Located at L Street Bridge

**Tuesday**
12:30 pm – 6:30 pm  
GIS Solutions Expo  
Hall D

5:15 pm – 6:30 pm  
GIS Solutions Expo Social  
Hall D

**Wednesday**
10:45 am – 5:15 pm  
GIS Solutions Expo  
Hall D

6:30 pm – 9:00 pm  
Networking Reception  
National Museum of Natural History
Please Take Our Survey on the App

Download the Esri Events app and find your event

Select the session you attended

Scroll down to find the feedback section

Complete answers and select “Submit”