ArcGIS API for JavaScript: Using Arcade with your Apps

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Session Goals

Overview of Arcade
  What is Arcade
  Why use Arcade

Arcade Language
  Variables, Functions, Loops, Conditional Statements

Arcade and the ESRI JavaScript API
  Using Arcade in Custom Apps
What is Arcade?

• A new expression language for the ArcGIS Platform
  • ArcGIS Pro
  • Runtime SDKs
  • JavaScript API
  • Web apps

• Primarily designed for ArcGIS web maps and web scenes
Arcade Purpose

Arcade is NOT intended to be a Full Programming / Scripting Language
  • Goal: Lightweight and Simple
  • Equivalent to a Spreadsheet Cell Calculation

Embedded Expressions
  • Labeling, Rendering, Symbol Variation, ….
  • Sharing

Not a replacement for Python for geoprocessing and Automation
Hello World
Why is it called Arcade?
Why do I need another language?
ArcGIS: Make, Share, Anywhere
ArcGIS Environments and Platforms

- Desktop
- Tablets
- Smart Phones
- Web Sites
- Browsers
- Social Media
ArcGIS: Make, Share, Anywhere - Challenges

Mobile and Native Apps
- Size of Executable
- Security
  - Native Access

Browser based Apps
- Page Size
- Security
  - XSS
  - No Binaries

Traditional Development / Scripting Languages

Challenges:
- Mobile and Native Apps
- Browser based Apps
Arcade Goals

Portable
• Write an Expression in Pro, have it run in a Browser, or on a Device

Secure
• Ensure that Expressions or Scripting do not compromise Security

Lightweight
• Most requirements for Scripts and Expressions are Lightweight. The language should be small, and fast

Geospatial
• Scripts should treat Geospatial as First Class Members
What can I do with it?

```javascript
var tea = new tea();
if(tea.empty()){
  tea.refill();
} else {
  tea.drink();
}
```
Arcade Examples
Language Overview
Arcade: Language Features

Designed for Simple Expressions
- Single Line - Implicit Returns
- Case Insensitive Language
- Dictionary Syntax for Field Access

Has Language Features to Support more Complex Scripts
- Type System
- Implicit and Explicit Type Casting
- Flow Control Statements: IF, FOR
- Variable Declaration and Assignments
- User Defined Functions

Arcade Scripts run and return a value. They are self contained and cannot alter their environment.
Implicit Returns

- Last executable statement that is a value, will automatically be considered the return value.
- Enables very simple Single Line Expressions

\[(10 + 100) \times 30\]

Equivalent to:

```javascript
return (10 + 100) * 30;
```
Language is Case Insensitive

• Quicker to Author
• Simpler for working with Data, and Field Names
## Functions

### Data Functions
- Dictionary
- DomainCode
- DomainName
- Feature
- First
- HasKey
- IndexOf
- Reverse
- Sort
- TypeOf

### Date Functions
- Date
- DateAdd
- DateDiff
- Millisecond
- Minute
- Hour
- Month
- Weekday
- Year
- Day
- Now
- Today

### Logical Functions
- IsEmpty
- DefaultValue
- When
- Decode
- If
- Boolean

### Mathematical Functions
- Abs
- Acos
- Asin
- Atan
- Atan2
- Average
- Ceil
- Cos
- Count
- Exp
- Floor
- Log
- Min
- Max
- Number
- Pow
- Random
- Round
- Sin
- Sqrt
- Stdev
- Sum
- Tan
- Variance

### Text Functions
- Concatenate
- Console
- Find
- Lower
- Left
- Mid
- Proper
- Replace
- Right
- Split
- Text
- Trim
- Upper

"Functions are the Power of Arcade"
Functions : Geometry

Geometry Functions
- Geometry
- Multipoint
- Extent
- Polyline
- Polygon
- Area
- AreaGeodetic
- Buffer
- BufferGeodetic
- Centroid
- Clip
- Contains
- Crosses
- Cut
- Difference
- Disjoint
- Distance
- Equals
- Intersection
- Intersects
- Length
- LengthGeodetic
- MultiPartToSinglePart
- Overlaps
- Relate
- SymmetricDifference
- Touches
- Union
- Within

Functions are the Power of Arcade
Global Variables and Profiles

Rendering
• Use expressions to provide values required for different types of Renderers
  • Global Variables
    • $feature
    • $view

Labeling
• Use expressions to provide values required for different types of label classes
  • Global Variables
    • $feature
    • $view

Popup
• Use expressions to provide values for popup tables and other content elements
  • Global variables
    • $feature

Profiles provide the purpose for executing an Arcade Expression
Exploring Profiles and Functions in the Playground
Type System

Simple Types
- Numbers
- Booleans
- Dates
- Strings

Object Types
- Dictionary
- Feature
- Array
- Point
- Line
- Polygon
- Multipoint

Dates, Dictionary, Feature, Point, Line… all have overloaded constructors.

```javascript
var myNumber = 10;
var myText = "Hello";
var myDate = Date(2015,1,1);
var myBool = true;
var myDictionary = { "key1": 10 };
var myFeature = { "geometry": {"..."},
                 "attributes": {"key1": 10 }};
var myArray = [1,2,3];
var myPoint = Point({"..."});
```
Implicit and Explicit Type Casting

Implicit Casting
- For Function Parameters
- For Expressions

Explicit Casting
- Functions cast between types
- Number, Text, Date, Boolean

Implicit Casting
return 10 + “Hello”

Explicit Casting:
return text(10) + “Hello”
If Statement

• Traditional IF Statements are supported

• For simple single line expressions, consider using Functions
  • IIF
  • Decode
  • When

```java
if (myvalue==true) {
    return 1;
}
else {
    return 2;
}
```

Equivalent to:

```java
IIF(myvalue==true, 1, 2)
```
For Statement

For Statements
• Same syntax as JavaScript

For In Statements
• Iterates over indices of an array, or field names of a Dictionary or Feature

Break, Continue and Return Statements Supported inside Block

```javascript
for (var z=1; z<100; z++) {
    k+=z;
}

for(var k in myArray) {
    n+=myArray[k];
}
```
User Defined Functions

```javascript
function MultiplyNumber(thenumber) {
    return thenumber*10;
}

MultiplyNumber(10);
```

Function Keyword used to Declare Functions

- Must be Declared ahead of Use
- Variables defined inside of Function, have Local Scope
- Functions cannot be declared inside of Functions.
Variable Assignment

Variables can have their values reassigned.

- Objects Types maybe Immutable, if passed into Arcade.
- Arrays are not Sparse. They must be sequential.
- Geometry Types are immutable inside. You cannot change the points in a path of a line.

```cpp
++myNumber
i=i+1;
myArray[10]=11;
myFeature.Field1 = "ddd";
```
% population without formal education
Arcade and the ESRI JS API

Arcade Interpreter available in both 3.23 and 4.6 JavaScript API
ESRI JS API and Arcade Profiles

Arcade Expressions set as Properties

Classes that support Arcade Expressions

- ClassBreaksRenderer
- UniqueValueRenderer
- visualVariables
  - Color
  - Size
  - Opacity
  - Rotation

LabelClass
PopupTemplate

Supported for FeatureLayer and SceneLayer
Expression Properties are set as Literal Strings

Arcade Interpreter will Execute `valueExpression` for every Feature

```javascript
var renderer = {
    type: "class-breaks",
    valueExpression: "( $feature.TOT_VOTES / $feature.REG_VOTERS ) * 100",
    valueExpressionTitle: "Title to Display"
    classBreakInfos: [ ... ],
};
```
Arcade Expressions can be used for Labeling

```javascript
var labelClass = new LabelClass({
    labelExpressionInfo: {
        expression: "$feature.STATION_NAME",
    },
    labelPlacement: "below-right",
    minScale: 2500000
});
nameClass.symbol = new TextSymbol();
// set the label class to the feature layer
featureLayer.setLabelingInfo([ labelClass ]);`
```
Practicalities: Scripts in Script

<script type="text/plain" id="myScript">
    Proper($feature.CityName)
</script>
...

var arcadescript = document.getElementById("myScript").text;

Scripts within Scripts

• Lots of String Escaping.
• Embed Script in HTML using MIME type text/plain
Expression sharing
Future
More uses of Arcade

• Field Calculators
Adding Functions & Profiles

Identifying common operations and use cases

- Let us know what you need!
Finding Arcade Resources
Resources

For Arcade Documentation
https://developers.arcgis.com/arcade

Playground
https://developers.arcgis.com/arcade/playground/

Using Arcade with JS API

Blogs and Posts
https://blogs.esri.com/esri/arcgis/2016/12/19/introducing-arcade/
https://blogs.esri.com/esri/arcgis/2016/12/15/use-arcade-expressions-to-map-your-ideas/
http://odoe.net/blog/hello-arcade/
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