Session Goals

• Overview of the Geometry Engine
  - Available operations

• Coding with the Geometry Engine
  - How to use the Geometry Engine

• Geometry Engine Internals
  - Sync/Async Architecture

• When to use the Geometry Engine
  - When does it make a difference?
Geometry
Points, lines, polygons, multipoints…
Operations: Geometry Operations

- Overlaps
- Crosses
- Intersects
- Within
- Touches
- Equals
Operations: Overlay

Union

Symmetric Difference

Clip

Intersection
Operations: Topological correctness

- **Polygon Simplify**
  - **Rings**
  - **Simplify**

- **Polyline Simplify**
  - **Paths**
  - **Simplify**
  - EndPoint @ Vertex

- **Point Simplify**
  - **Simplify**

**Simplify**

**isSimple**
Operations: Nearest vertices/coordinates
Operations: Measurement

- geodesicLength
- planarLength
- geodesicArea
- planarArea
Operations: Buffering

Planar and Geodesic Buffering
Other Operations

- Generalize
- Densify
- ConvexHull
- Rotate
- Flip

geodesicDensify
I can do this already…

It’s called the Geometry Service!
User Experience: Interactivity

Geometry Service REST Call

<table>
<thead>
<tr>
<th>Step</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Encoding Geometry as JSON</td>
<td>5ms</td>
</tr>
<tr>
<td>Sending Request over Network</td>
<td>200+ ms</td>
</tr>
<tr>
<td>Running Geometry Operation</td>
<td>100+ ms</td>
</tr>
<tr>
<td>Sending Response back over Network</td>
<td>200+ ms</td>
</tr>
<tr>
<td>Decoding Response</td>
<td>5ms</td>
</tr>
</tbody>
</table>
User Experience: Interactivity

Geometry Engine API Call

Running Geometry Operation

200+ ms
Demo

How many REST calls can I save?
Writing Apps with Geometry Engine
Geometry Engine : Writing Code

Calling the methods

```javascript
require( [ "esri/geometry/geometryEngine" ],
function( geometryEngine ) {

    var buffer = geometryEngine.buffer(mapPoint, 10, "miles");

});
```
require( [ "esri/tasks/GeometryService", "esri/tasks/BufferParameters" ],
function( GeometryService, BufferParameters ) {

  var geomService = new GeometryService("//.../GeometryServer");
  var bufferParams = new BufferParameters();
  bufferParams.geometries = [mapPoint]
  bufferParams.distances = [10]
  bufferParams.unit = GeometryService.UNIT_MILE;
  bufferParams.outSpatialReference = map.spatialReference;

  geomService.buffer( bufferParams, function(buffer) {

  });
});
Building Editing Apps
Building Analysis Apps
Synchronous versus Asynchronous

You can use Geometry Engine Async
Geometry Engine Async

• Asynchronous Geometry Engine
  - Uses Web Workers to perform Geometry Engine
  - Operations return Promises.

• Benefits
  - Browser is not blocked whilst operations run
  - Greater throughput. Operations can run in parallel
  - Easier substitution of existing GeometryService code

• Drawbacks
  - Older Browsers do not support WebWorkers
Asynchronous Patterns

- Uses Deferred Pattern

```javascript
require( [ "esri/geometry/geometryEngineAsync" ],
function( geometryEngineAsync ) {

  geometryEngineAsync.buffer(mapPoint, 10, "miles").then( function(buffer) {
    
  },
  function(err) {
    
  });
});
```
Geometry Engine internals

What is the Geometry Engine doing for me!
Spatial Tolerance

Spatial References have different Tolerances. GeometryEngine uses X/Y Tolerance in its calculations.

XY Tolerance = 0.001
Spatial Tolerance

Inside the Geometry Methods

```javascript
require( [ "esri/geometry/geometryEngine" ],
function( geometryEngine ) {

    var mapPointA = new esriPoint(1.22, 2.0, map.spatialReference);  
    var mapPointB = new esriPoint(1.22000000001, 2.0, map.spatialReference);

    var areequal = geometryEngine.equals(mapPointA, mapPointB);

    // Returns True
});
```
Geometry Engine Async

Architecture and Throughput

Buffer

Deferred

Resolved

geometryEngine Async

WebWorker SendMessage

Busy Web Worker

Busy Web Worker

Busy Web Worker

Busy Web Worker

Free Web Worker

Queued Geometry Operations
Coordinate Systems

- Projected and Geographic
- No Project Operation
- Certain methods will only work in WebMercator or Geographic Coordinate Systems
  - GeodesicArea
  - GeodesicLength
  - GeodesicBuffer
When to use the Geometry Engine

When will it make a difference in my app
Geometry Engine: Trade-offs

• Trade-off between Geometry Service and Geometry Engine
  - Large AMD download for Geometry Engine versus
  - Network latency and round trip cost of Geometry Service

• Other Considerations: Apps Requirements
  - Unsupported operations: projections
  - Frequency of calls: user interactivity
  - Offline or poor network connection
  - Ease of coding
GeometryEngine Resources
Documentation, Blogs, Samples
Resources

• Documentation

• Blogs
  - Testing spatial relationships and editing
  - Measurement
  - Overlay analysis

• Demos/samples
  - https://github.com/ekenes/esri-js-samples
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Select the session you attended

Scroll down to the “Feedback” section

Complete Answers, add a Comment, and Select “Submit”