Geospatial_analysis - DataDriven.md

An Introduction to Geospatial Analysis Using the Google Earth Engine Platform

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https://github.com/TC25/Geospatial_workshop_EE

https://signup.earthengine.google.com

Agenda

Introduction to Geospatial Analysis

Data Types

The Google Earth Engine platform

Basic functions

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Operations on Features

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Operations on Image Collections

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Introduction

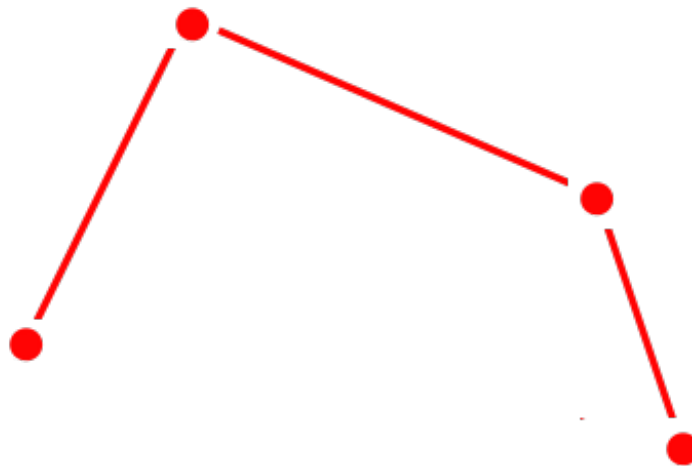Collection, visualization, and analysis of geographical or spatial data.

Data types

- Vector data represent lat-long coordinates
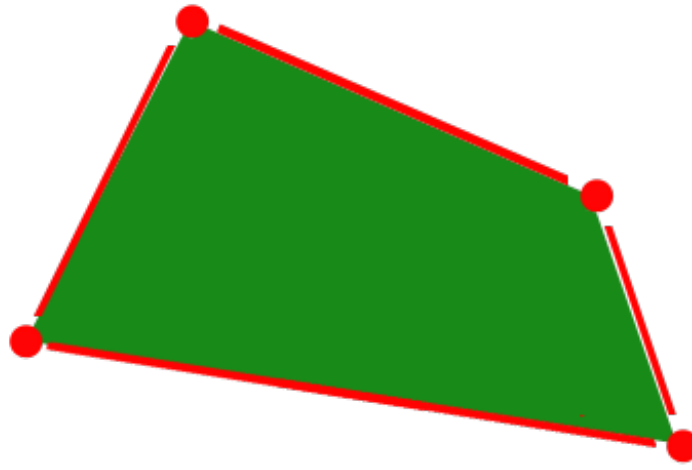- Raster data comprises of pixels with associated values
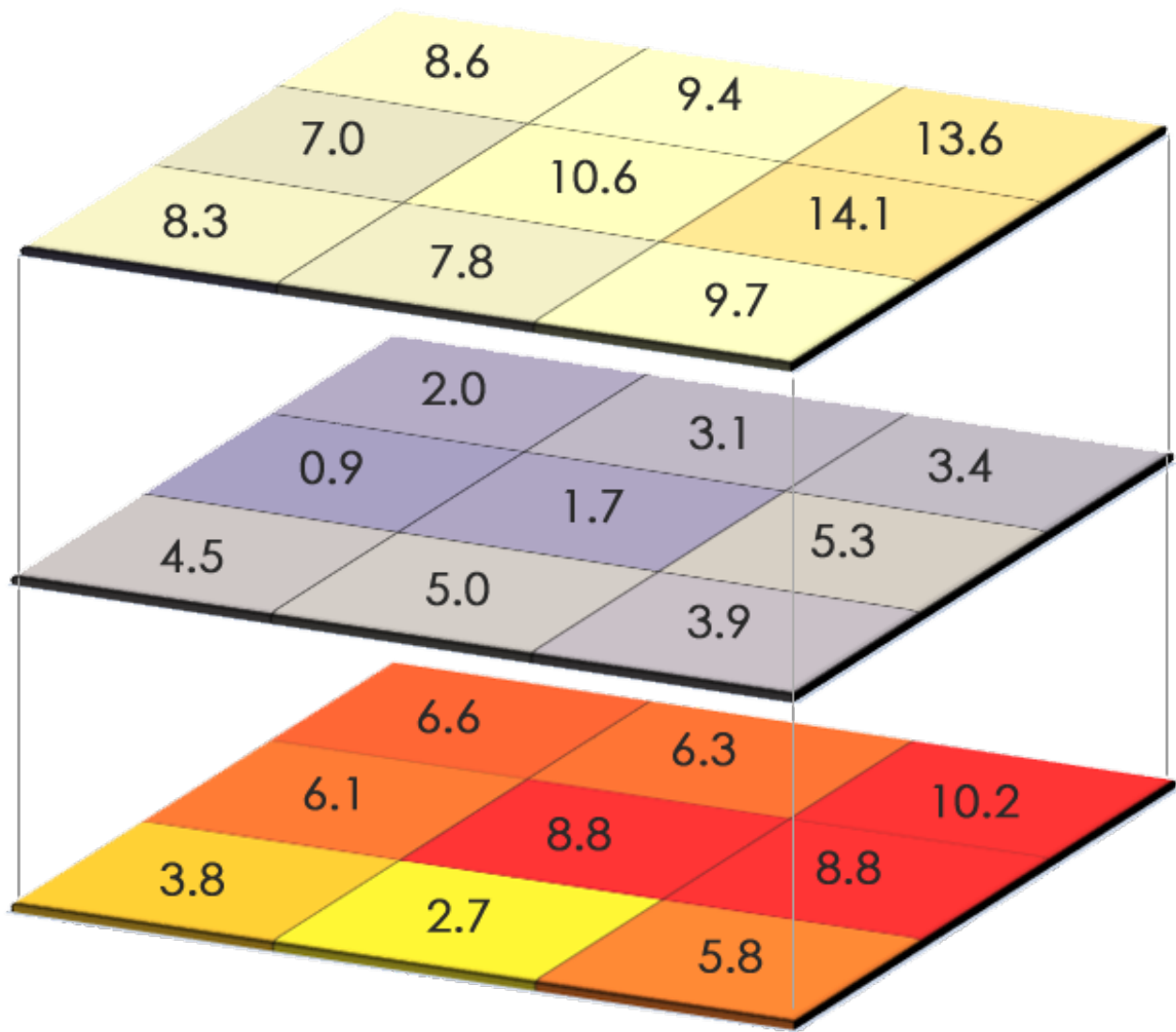
Points

Lines


Polygons

Raster layers/bands

Google Earth Engine platform

Introductory video

Code Editor

- Cloud-based platform for planetary scale geospatial analysis
- Uses Google's computational resources to reduce processing time
- Massive archive of remote sensing data
- 200 public datasets
- greater than 4000 new images every day
- greater than 5 million images
- greater than 5 petabytes of data

Source: Google Earth Engine User summit
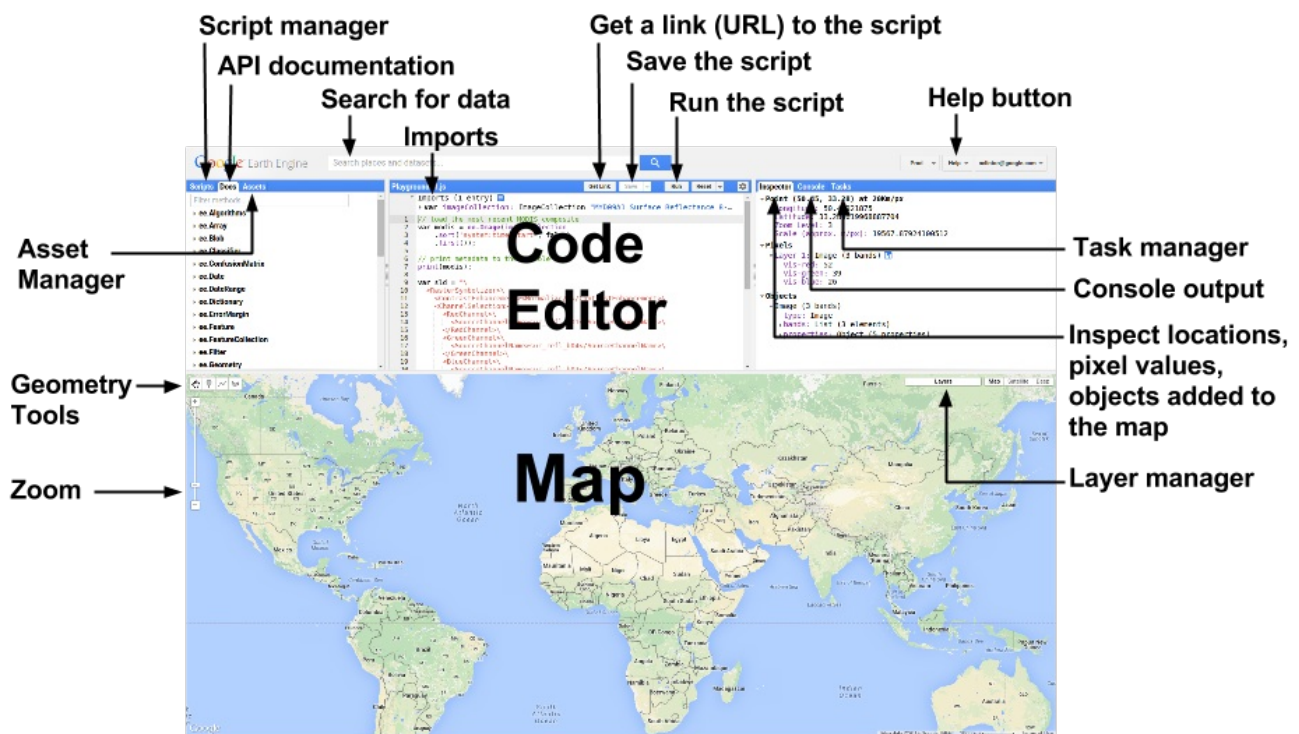
Basic Functions

Declaring variables

```
var varname = Containerforvariabletype(variable name);
```

Centering map

```
Map.setCenter(long, lat, zoom level);
```

> Zoom level varies from 0 (no zoom) to 20 (highest zoom level)

Displaying metadata

```
print(variable name)
```

Adding a layer to the map

```
Map.addLayer(VARIABLENAME);
```

Variable types in Earth Engine

Strings

```
var var_String = ee.String("This is a string. Or is it? It is.");
```

Numbers

```
var var_Numbers = ee.Number(5);
```

Arrays

```
var var_Array = ee.Array([[5, 2, 3],  [-2, 7, 10],  [6, 6, 9]]);
```

Lists

```
var var_List = ee.List([5, "five" , 6, "six"]);
```

Dictionaries

```
var var_Dictionary = ee.Dictionary({five: 5 , six: 6});
```

And the fun stuff

- Geometries
- Features
- Feature Collections
- Images
- Image Collections

Geometries – declaration and types

Points

```
var var_Point = ee.Geometry.Point(0, 45);
```

Multi Points

```
var var_MultiPoint = ee.Geometry.MultiPoint(0, 45, 5,6, 70,-56);
```

Line String

```
var var_LineString = ee.Geometry.LineString([[0, 45], [5,6], [70,-56]]);
```

Multi Line String

```
var var_MultiLineString = ee.Geometry.MultiLineString([[[0, 45], [5,6], [70,-56]], [[0,
-45], [-5,-6], [-70,56]]]);
```

Linear Ring

```
var var_LinearRing = ee.Geometry.LinearRing(0, 45, 5,6, 70,-56, 0,45);
```

Rectangle

```
var var_Rectangle = ee.Geometry.Rectangle(0, 0, 60,30);
```
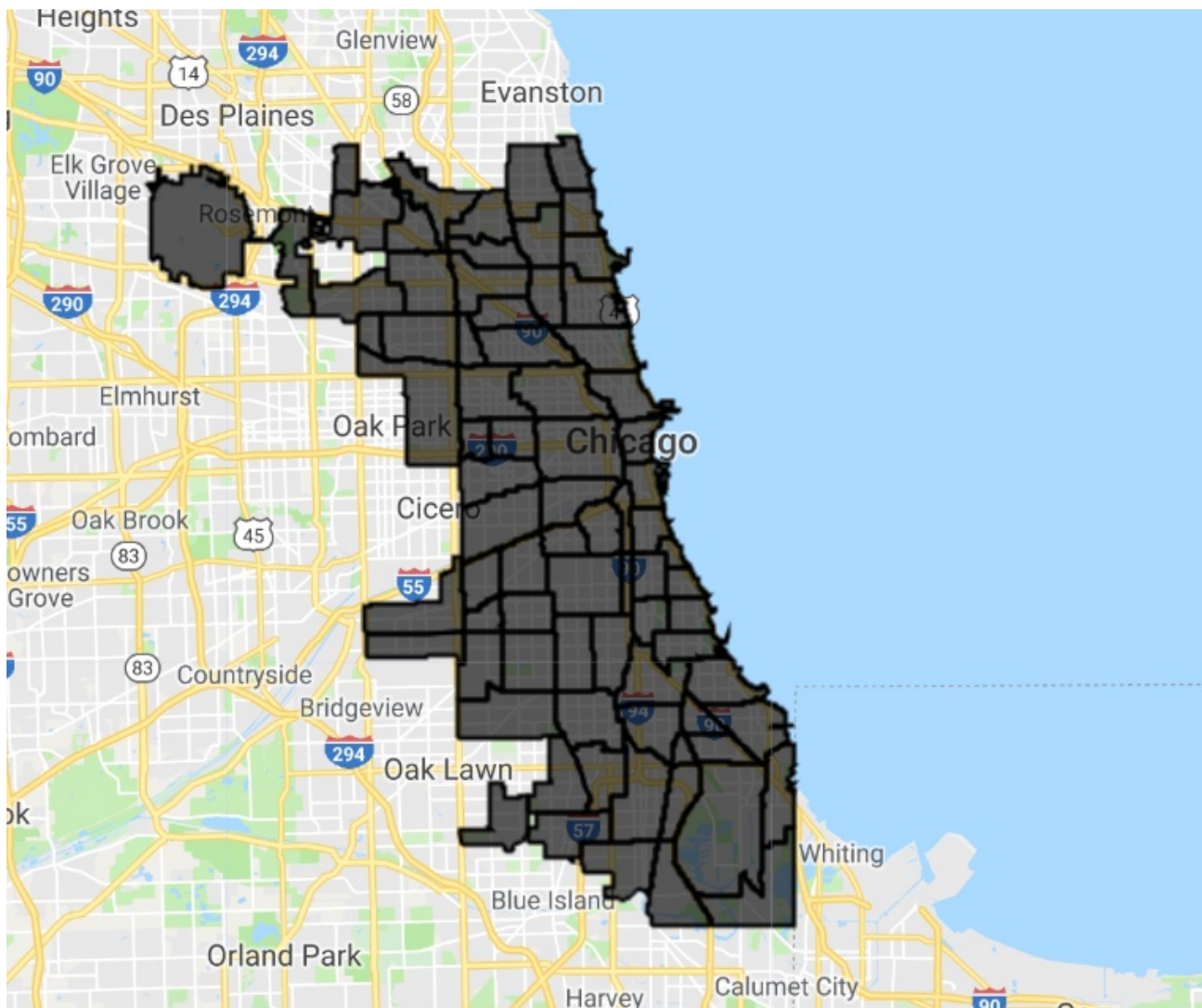
Polygon

```
var var_Polygon = ee.Geometry.Polygon([[[0, 0], [6,3], [5, 5], [-30,2], [0,0]]]);
```

Multi Polygon

```
var var_MultiPolygon = ee.Geometry.MultiPolygon([ee.Geometry.Polygon([[0, 0], [6, 3],
[5, 5], [-30, 2], [0,0]]), ee.Geometry.Polygon([[0, 0], [-6, -3], [-5, -5], [30, -2], [0,
0]])]);
```

Features and Feature Collections

- Features are geometries associated with specific properties
- Feature Collections are groups of features

Functions and mapping

A set of instructions to perform a specific task

```
function  function_Name(Arguments) {statements};
```

Call function

```
var result = function_Name(Input);
```

Map function over Feature or Image Collection

```
var result = Input.map(function_Name);
```

Operations on Geometries

Geometry operations

Find area of geometry

```
var Geometry_area = var_Geometry.area();
```

Find length of line

```
var Line_length = var_LineString.length();
```

Find perimeter of geometry

```
var Geometry_perimeter = var_Geometry.perimeter();
```

Reduce number of vertices in geometry

```
var SimplifiedGeometry = var_Geometry.simplify(100);
```

Find centroid of geometry

```
var Centroid = var_Geometry.centroid();
```

Create buffer around geometry

```
var Buffer = var_Geometry.buffer(100);
```

Find bounded rectangle of the Geometry

```
var BoundedGeometry = var_Geometry.bounds();
```

Find the smallest envelope that can envelop the Geometry

```
var Convexhull_Geometry = var_Geometry.convexHull();
```

Find common area between two or more geometries

```
var Inter_geometry = var_Geometry1.intersection(var_Geometry2);
```

Find area that includes two or more geometries

```
var Union_geometry = var_Geometry1.union(var_Geometry2);
```

Operations on Features

Feature operations

Set property name and value of geometry to create a feature

```
var var_Feature = ee.Feature(var_Geometry, {Name: "Feature name", Size: 500};
```

Create a new feature from existing feature while renaming a property

```
var var_Featurenew = var_Feature.select(["Name"], ["Descriptor"]);
```

Extract values of a property from a Feature

```
var values = var_Feature.get(''Size'');
```

Filters

Creator a filter for values of a property

```
var BFilter = ee.Filter.eq(Property_name, Value);
```

> or .neq , .gt , .gte , .lt , and .lte

Create a filter based on maximum difference from a threshold

```
var DiffFilter = ee.Filter.maxDifference(threshold, Property_name, Value);
```

Create a text filter

```
var TxtFilter = ee.Filter.stringContains( Property_name, StringValue);
```

> or .stringStartsWith, and .stringEndsWith

Create a range filter

```
var RangeFilter = ee.Filter.rangeContains( Property_name, StringValue, MinValue,
MaxValue);
```

Create a list filter to check for certain values

```
var ListFilter = ee.Filter.listContains(Property_name, Value1, Property_name2, Value2);
```

> .inList to test against list of values

Create a filter of dates

```
var DateFilter = ee.Filter.calendarRange(StartDate, StopDate);
```

Create a filter for particular days of the year

```
var DayFilter = ee.Filter.dayOfYear(startDay, StopDay);
```

Create a filter to subset geospatial data

```
var BoundsFilter= ee.Filter.bounds(GeometryorFeature);
```

Combining and inversing filters

```
var NewFilter=ee.Filter.and(Listoffilters);
var NewFilter=ee.Filter.or(Listoffilters);
var inverseFilter = ee.Filter.not(filter);
```

Operations on Images

Image operations

Selecting the bands of an image

```
var band = var_Image.select(band name);
```

Creating masks

```
var mask =var_Image.eq(value);
```

> or .neq or .gt or .gte or .lt or .lte

Applying masks

```
var masked =var_Image.mask(mask);
```

Pixelwise calculation

```
var results =var_Image.sum(value);
```

> or .subtract , .multiply , .divide , .max , .min , .abs , .round , .floor , .ceil , .sqrt , .exp, .log,
> .log10, .sin , .cos , .tan , .sinh , .cosh , .tanh , .acos, .asin

Shift pixels of an image

```
newImage = oldImage.leftShift(valueofshift);
```

> or .rightShift

Create a single value from an image by applying a reducer based on regions of interest

```
var outputDictionary = var_Image.reduceRegion(Reducer, var_Geometry, scale);
```

Operations on Image Collections

Select the first n numbers of images in a collection (based on property)

```
var SelectedImages =var_ImCollection.limit (n, Property_name, Order);
```

Select images in collection based on particular properties

```
var SelectedImages = var_ImCollection.filterMetadata (Property_name, Relation , Value);
```

> Relations could be "equals", "less_than", "greater_than", "starts_with", "ends_with", and "contains"

Select images within date range

```
var SelectedImages = var_ImCollection.filterDate (StartDate, StopDate);
```

Select images within Geometry

```
var SelectedImages = var_ImCollection.filterBounds (var_Geometry);
```

Perform pixelwise calculations for all images in collection

```
var sumofimages = var_ImCollection.sum();
```

> or .product, .max, .min, .mean, .mode, .median, and .count

Create composite of images in collection with the last image on top

```
var mosaicofimages = var_ImCollection.mosaic();
```

Importing and exporting data

Image to table example

Timelapse example

Dubai timelapse

Export image, video or table to Google Drive, Asset, or Google Cloud

```
Export.image.toDrive({
  collection: var_Image, description: 'FileName', region: var_Geometry, scale: 1000}
});
```

> or image.toCloudStorage, image.toAsset, table.toDrive, table.toCloudStorage,
> video.toCloudStorage, and video.toDrive

Example Applications

What can you do with Google Earth Engine?

EE Population Explorer

EE Ocean Time Series Investigator

Global Surface UHI Explorer

Stratifi - cloud-based stratification

Resources

Geospatial Software Design

Google Earth Engine API documentation

Google Earth Engine Developers forum

Example scripts from Prof. Dana Tomlin's handouts for his course on Geospatial Software Design

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