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Layer Recipes

The Layer classes are in the **geoscript.layer** package.

A Layer is a collection of Features.

Getting a Layer's Properties

Get a Layer from a Workspace and it's name

```
Workspace workspace = new GeoPackage("src/main/resources/data.gpkg")
Layer layer = workspace.get("countries")
String name = layer.name
println "Name: ${name}"
```

```
Name: countries
```

The Layer's Format

```
String format = layer.format
println "Format: ${format}"
```

```
Format: GeoPackage
```

Count the number of Features

```
int count = layer.count
println "# of Features: ${count}"
```

```
# of Features: 177
```

Get the Layer's Projection

```
Projection proj = layer.proj
println "Projection: ${proj}"
```

```
Projection: EPSG:4326
```

Get the Bounds of the Layer

```
Bounds bounds = layer.bounds
println "Bounds: ${bounds}"
```

```
Bounds: (-179.99999999999997,-
90.00000000000003,180.00000000000014,83.64513000000002,EPSG:4326)
```

Getting a Layer's Features

Iterate over a Layer's Features

```
Workspace workspace = new GeoPackage("src/main/resources/data.gpkg")
Layer layer = workspace.get("states")
layer.eachFeature { Feature feature ->
    println feature["NAME_1"]
}
```

```
Minnesota
Montana
North Dakota
Hawaii
Idaho
Washington
Arizona
California
Colorado
Nevada
...
```

Iterate over a subset of a Layer's Features

```
Workspace workspace = new GeoPackage("src/main/resources/data.gpkg")
Layer layer = workspace.get("states")
layer.eachFeature("NAME_1 LIKE 'M%'") { Feature feature ->
    println feature["NAME_1"]
}
```

```
Minnesota
Montana
Missouri
Massachusetts
Mississippi
Maryland
Maine
Michigan
```

Iterate over a Layer's Features with parameters.

```
Workspace workspace = new GeoPackage("src/main/resources/data.gpkg")
Layer layer = workspace.get("states")
layer.eachFeature(sort: ["NAME_1"], start: 0, max: 5, fields: ["NAME_1"], filter:
"NAME_1 LIKE 'M%'") { Feature feature ->
    println feature["NAME_1"]
}
```

```
Maine
Maryland
Massachusetts
Michigan
Minnesota
```

Parameters

- filter: The Filter or Filter String to limit the Features. Defaults to null.

- sort: A List of Lists that define the sort order [[Field or Field name, "ASC" or "DESC"],...]. Not all
  Layers support sorting!

- max: The maximum number of Features to include

- start: The index of the record to start the cursor at. Together with maxFeatures this simulates
  paging. Not all Layers support the start index and paging!

- fields: A List of Fields or Field names to include. Used to select only a subset of Fields.

Read all Feature into a List

```
Workspace workspace = new GeoPackage("src/main/resources/data.gpkg")
Layer layer = workspace.get("states")
List<Feature> features = layer.features

println "# Features = ${features.size()}"
features.each { Feature feature ->
    println feature["NAME_1"]
}
```

```
# Features = 52
Minnesota
Montana
North Dakota
Hawaii
Idaho
Washington
Arizona
California
Colorado
Nevada
...
```

Collect values from a Layer's Features

```
Workspace workspace = new GeoPackage("src/main/resources/data.gpkg")
Layer layer = workspace.get("states")
List<String> names = layer.collectFromFeature { Feature f ->
    f["NAME_1"]
}.sort()

println "# Names = ${names.size()}"
names.each { String name ->
    println name
}
```

```
# Names = 52
Alabama
Alaska
Arizona
Arkansas
California
Colorado
Connecticut
Delaware
District of Columbia
Florida
...
```

Collect values from a Layer's Features with parameters.

```
Workspace workspace = new GeoPackage("src/main/resources/data.gpkg")
Layer layer = workspace.get("states")
List<String> names = layer.collectFromFeature(
    sort: ["NAME_1"],
    start: 0,
    max: 5,
    fields: ["NAME_1"],
    filter: "NAME_1 LIKE 'M%'") { Feature f ->
        f["NAME_1"]
    }

println "# Names = ${names.size()}"
names.each { String name ->
    println name
}
```

```
# Names = 5
Maine
Maryland
Massachusetts
Michigan
Minnesota
```

Get the first Feature that matches the Filter.

```
Workspace workspace = new GeoPackage("src/main/resources/data.gpkg")
Layer layer = workspace.get("states")
Feature feature = layer.first(filter: "NAME_1='Washington'")
println feature.get("NAME_1")
```

```
Washington
```

Get the first Feature sorted by name ascending and descending.

```
Workspace workspace = new GeoPackage("src/main/resources/data.gpkg")
Layer layer = workspace.get("states")

Feature featureAsc = layer.first(sort: "NAME_1 ASC")
println featureAsc.get("NAME_1")

Feature featureDesc = layer.first(sort: "NAME_1 DESC")
println featureDesc.get("NAME_1")
```

```
Alabama
Wyoming
```

Create a new Layer from an existing Layer with just the Features that match a Filter.

```
Workspace workspace = new Directory("target")
Layer layer = workspace.get("countries")
Layer disputedLayer = layer.filter("TYPE='Disputed'")
```


Adding, Updating, and Deleting

Add Features to a Layer

```
Workspace workspace = new Memory()
Schema schema = new Schema("cities", [
        new Field("geom", "Point", "EPSG:4326"),
        new Field("id", "Integer"),
        new Field("name", "String"),
        new Field("state", "String")
])
Layer layer = workspace.create(schema)

// Add a Feature with a Map
Map attributes = [
        geom: new Point(-122.333056, 47.609722),
        id: 1,
        name: "Seattle",
        state: "WA"
]
layer.add(attributes)

// Add a Feature with a List
List values = [
        new Point(-122.459444, 47.241389),
        2,
        "Tacoma",
```

```
            "WA"
    ]
    layer.add(values)

    // Add a Feature
    Feature feature = schema.feature([
            id:3,
            name: "Fargo",
            state: "ND",
            geom: new Point(-96.789444, 46.877222)
    ])
    layer.add(feature)

    // Add Features from a List of Maps
    List<Map> features = [
            [
                    geom: new Point(-100.778889, 46.813333),
                    id:4,
                    name: "Bismarck",
                    state: "ND"
            ],
            [
                    geom: new Point(-100.891111, 46.828889),
                    id: 5,
                    name: "Mandan",
                    state: "ND"
            ]
    ]
    layer.add(features)
```

id	name	state
1	Seattle	WA
2	Tacoma	WA
3	Fargo	ND
4	Bismarck	ND
5	Mandan	ND

Update Features in a Layer

```
Workspace workspace = new Memory()
Schema schema = new Schema("cities", [
        new Field("geom", "Point", "EPSG:4326"),
        new Field("id", "Integer"),
        new Field("name", "String"),
        new Field("state", "String")
])
Layer layer = workspace.create(schema)
List<Map> features = [
        [
                geom: new Point(-122.333056, 47.609722),
                id: 1,
                name: "Seattle",
                state: "WA"
        ],
        [
                geom: new Point(-122.459444, 47.241389),
                id: 2,
                name: "Tacoma",
                state: "WA"
        ],
        [
                id:3,
                name: "Fargo",
                state: "ND",
                geom: new Point(-96.789444, 46.877222)
        ],
        [
                geom: new Point(-100.778889, 46.813333),
                id:4,
                name: "Bismarck",
                state: "ND"
        ],
        [
                geom: new Point(-100.891111, 46.828889),
                id: 5,
                name: "Mandan",
                state: "ND"
        ]
]
layer.add(features)

layer.update(layer.schema.state, "North Dakota", "state='ND'")
layer.update(layer.schema.state, "Washington", "state='WA'")
```

id	name	state
1	Seattle	Washington

id	name	state
2	Tacoma	Washington
3	Fargo	North Dakota
4	Bismarck	North Dakota
5	Mandan	North Dakota

id	name	state
	Tacoma	Washington
	Fargo	North Dakota
	Bismarck	North Dakota
	Mandan	North Dakota

Delete Features from a Layer

```
Workspace workspace = new Memory()
Schema schema = new Schema("cities", [
        new Field("geom", "Point", "EPSG:4326"),
        new Field("id", "Integer"),
        new Field("name", "String"),
        new Field("state", "String")
])
Layer layer = workspace.create(schema)
List<Map> features = [
        [
                geom: new Point(-122.333056, 47.609722),
                id: 1,
                name: "Seattle",
                state: "WA"
        ],
        [
                geom: new Point(-122.459444, 47.241389),
                id: 2,
                name: "Tacoma",
                state: "WA"
        ],
        [
                id:3,
                name: "Fargo",
                state: "ND",
                geom: new Point(-96.789444, 46.877222)
        ],
        [
                geom: new Point(-100.778889, 46.813333),
                id:4,
                name: "Bismarck",
                state: "ND"
        ],
        [
                geom: new Point(-100.891111, 46.828889),
                id: 5,
                name: "Mandan",
                state: "ND"
        ]
]
layer.add(features)

layer.delete("state='ND'")
```

id	name	state
1	Seattle	WA
2	Tacoma	WA

Geoprocessing

Reproject

Reproject a Layer from it's source projection to a target projection

```
Workspace workspace = new GeoPackage('src/main/resources/data.gpkg')
Layer states = workspace.get("states")
println "States = ${states.proj}"

Projection projection = new Projection("EPSG:3857")
Workspace outputWorkspace = new Memory()
Layer statesInWebMercator = states.reproject(projection, outputWorkspace,
"states_3857")
println "Reprojected States = ${statesInWebMercator.proj}"
```

```
States = EPSG:4326
Reprojected States = EPSG:3857
```

Buffer

Buffer a Layer of populated places

```
Workspace workspace = new GeoPackage(new File("src/main/resources/data.gpkg"))
Layer places = workspace.get("places")
Layer buffer = places.buffer(5)
```


Dissolve

Dissolve a Layer by a Field

```
Workspace workspace = new Directory(new File("src/main/resources/data"))
Layer states = workspace.get("states")
Layer regions = states.dissolve(states.schema.get("SUB_REGION"))
```


Merge

Merge two Layer together

```
Workspace workspace = new Directory(new File("src/main/resources/data"))
Layer states = workspace.get("states")
Feature washington = states.first(filter: "STATE_NAME='Washington'")
Feature oregon = states.first(filter: "STATE_NAME='Oregon'")

Schema waSchema = new Schema("washington",[
        new Field("geom","Point","EPSG:4326"),
        new Field("id","int")
])
Layer waLayer = new Memory().create(waSchema)
waLayer.withWriter { geoscript.layer.Writer writer ->
    Geometry.createRandomPoints(washington.geom, 50).points.eachWithIndex { Point pt,
int index ->
        writer.add(waSchema.feature([geom: pt, id: index]))
    }
}
println "The Washington Layer  has ${waLayer.count} features"

Schema orSchema = new Schema("oregon",[
        new Field("geom","Point","EPSG:4326"),
        new Field("id","int")
])
Layer orLayer = new Memory().create(orSchema)
orLayer.withWriter { geoscript.layer.Writer writer ->
    Geometry.createRandomPoints(oregon.geom, 50).points.eachWithIndex { Point pt, int
index ->
        writer.add(orSchema.feature([geom: pt, id: index]))
    }
}
println "The Oregon Layer  has ${orLayer.count} features"

Layer mergedLayer = orLayer.merge(waLayer)
println "The merged Layer has ${mergedLayer.count} features"
```

```
The Washington Layer  has 50 features
The Oregon Layer  has 50 features
The merged Layer has 100 features
```
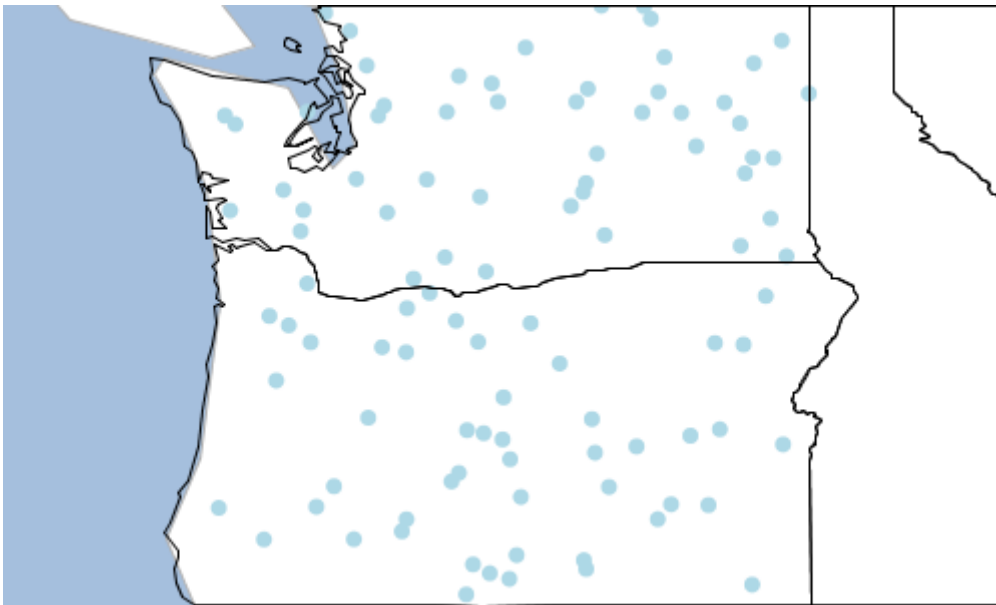
Split

Split a Layer into Layers based on the value from a Field

```
Workspace workspace = new GeoPackage(new File("src/main/resources/data.gpkg"))
Layer rivers = workspace.get("rivers")
Workspace outWorkspace = new Memory()
rivers.split(rivers.schema.get("scalerank"), outWorkspace)

outWorkspace.layers.each { Layer layer ->
    println "${layer.name} has ${layer.count} features"
}
```

```
rivers_0 has 1 features
rivers_1 has 27 features
rivers_2 has 35 features
rivers_3 has 53 features
rivers_4 has 71 features
rivers_5 has 67 features
rivers_6 has 206 features
```

Split a Layer into Layers based on another Layer

```
Schema schema = new Schema("grid",[
        new Field("geom","Polygon","EPSG:4326"),
        new Field("col","int"),
        new Field("row","int"),
        new Field("row_col","string")
])
Workspace gridWorkspace = new Directory("target")
Layer gridLayer = gridWorkspace.create(schema)
new Bounds(-180,-90,180,90,"EPSG:4326").generateGrid(2, 3, "polygon", {cell, col, row
->
    gridLayer.add([
            "geom": cell,
            "col": col,
            "row": row,
            "row_col": "${row} ${col}"
    ])
})

Workspace workspace = new GeoPackage(new File("src/main/resources/data.gpkg"))
Layer countries = workspace.get("countries")

Workspace outWorkspace = new Memory()
countries.split(gridLayer,gridLayer.schema.get("row_col"),outWorkspace)

outWorkspace.layers.each { Layer layer ->
    println "${layer.name} has ${layer.count} features"
}
```

```
countries_1_1 has 6 features
countries_1_2 has 6 features
countries_2_1 has 44 features
countries_2_2 has 74 features
countries_3_1 has 13 features
countries_3_2 has 70 features
```


Transform

Transform one Layer into another Layer

```
Workspace workspace = new Directory(new File("src/main/resources/data"))
Layer states = workspace.get("states")
Layer centroids = states.transform("centroids", [
    geom: "centroid(the_geom)",
    name: "strToUpperCase(STATE_NAME)",
    ratio: "FEMALE / MALE"
])
centroids.eachFeature(max: 5) {Feature f ->
    println "${f.geom} ${f['name']} = ${f['ratio']}"
}
```

```
ILLINOIS = 1.0587396098110435
DISTRICT OF COLUMBIA = 1.1447503268897763
DELAWARE = 1.0626439771122835
WEST VIRGINIA = 1.0817203227723509
MARYLAND = 1.0621588832568312
```

Layer Algebra

GeoScript can do layer algebra. All of the examples below use Layer A (red) and Layer B (green).
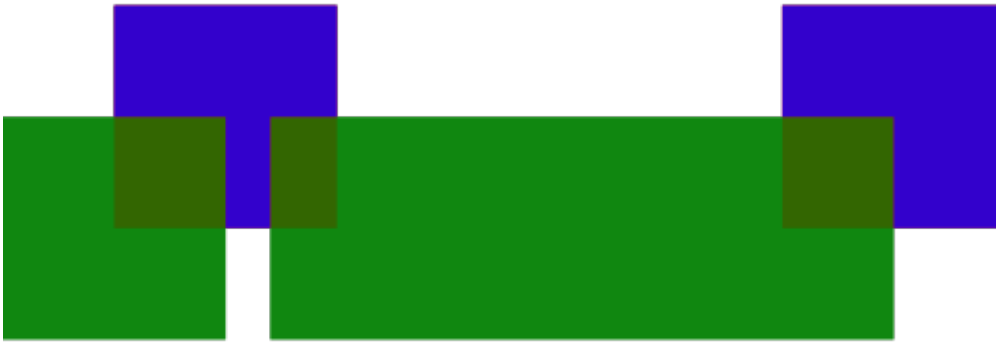

Clip

Clip Layer A with Layer B

```
Workspace workspace = new GeoPackage(new File("src/main/resources/layeralgebra.gpkg"))
Layer layerA = workspace.get("a")
Layer layerB = workspace.get("b")
Layer layerC = layerA.clip(layerB)
```

Clip Layer B with Layer A

```
Workspace workspace = new GeoPackage(new File("src/main/resources/layeralgebra.gpkg"))
Layer layerA = workspace.get("a")
Layer layerB = workspace.get("b")
Workspace outWorkspace = new Directory("target")
Layer layerC = layerB.clip(layerA, outWorkspace: outWorkspace, outLayer: "ba_clip")
```


Erase

Erase Layer A with Layer B

```
Workspace workspace = new GeoPackage(new File("src/main/resources/layeralgebra.gpkg"))
Layer layerA = workspace.get("a")
Layer layerB = workspace.get("b")
Layer layerC = layerA.erase(layerB)
```
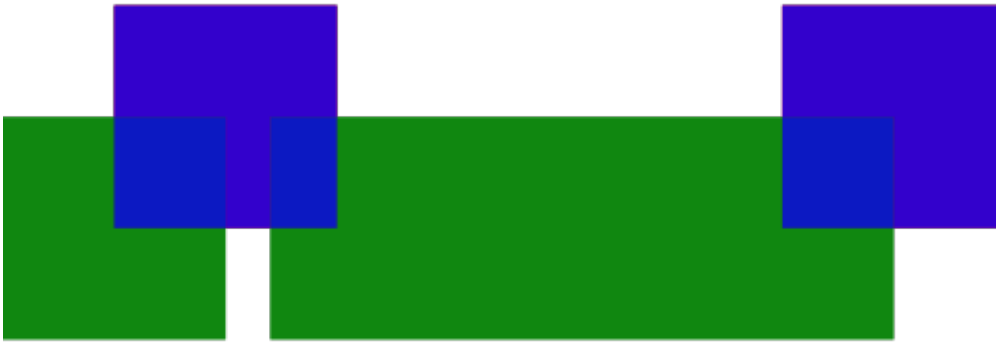
Erase Layer B with Layer A

```
Workspace workspace = new GeoPackage(new File("src/main/resources/layeralgebra.gpkg"))
Layer layerA = workspace.get("a")
Layer layerB = workspace.get("b")
Workspace outWorkspace = new Directory("target")
Layer layerC = layerB.erase(layerA, outWorkspace: outWorkspace, outLayer: "ba_erase")
```


Identity

Identity Layer A with Layer B

```
Workspace workspace = new GeoPackage(new File("src/main/resources/layeralgebra.gpkg"))
Layer layerA = workspace.get("a")
Layer layerB = workspace.get("b")
Layer layerC = layerA.identity(layerB)
```
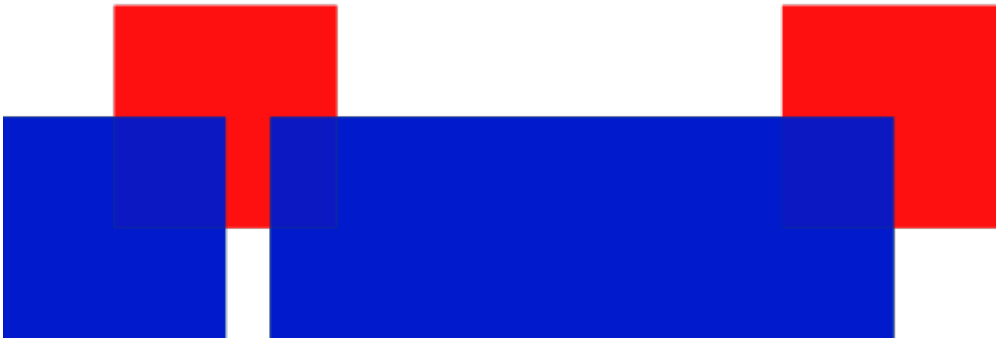
Identity Layer B with Layer A

```
Workspace workspace = new GeoPackage(new File("src/main/resources/layeralgebra.gpkg"))
Layer layerA = workspace.get("a")
Layer layerB = workspace.get("b")
Workspace outWorkspace = new Directory("target")
Layer layerC = layerB.identity(layerA, outWorkspace: outWorkspace, outLayer:
"ba_identity")
```


Intersection

Intersection Layer A with Layer B

```
Workspace workspace = new GeoPackage(new File("src/main/resources/layeralgebra.gpkg"))
Layer layerA = workspace.get("a")
Layer layerB = workspace.get("b")
Layer layerC = layerA.intersection(layerB)
```

Intersection Layer B with Layer A

```
Workspace workspace = new GeoPackage(new File("src/main/resources/layeralgebra.gpkg"))
Layer layerA = workspace.get("a")
Layer layerB = workspace.get("b")
Workspace outWorkspace = new Directory("target")
Layer layerC = layerB.intersection(layerA, outWorkspace: outWorkspace, outLayer:
"ba_intersection")
```


Symmetric Difference

Symmetric Difference Layer A with Layer B

```
Workspace workspace = new GeoPackage(new File("src/main/resources/layeralgebra.gpkg"))
Layer layerA = workspace.get("a")
Layer layerB = workspace.get("b")
Layer layerC = layerA.symDifference(layerB)
```

Symmetric Difference Layer B with Layer A

```
Workspace workspace = new GeoPackage(new File("src/main/resources/layeralgebra.gpkg"))
Layer layerA = workspace.get("a")
Layer layerB = workspace.get("b")
Workspace outWorkspace = new Directory("target")
Layer layerC = layerB.symDifference(layerA, outWorkspace: outWorkspace, outLayer:
"ba_symdifference")
```


Update

Update Layer A with Layer B

```
Workspace workspace = new GeoPackage(new File("src/main/resources/layeralgebra.gpkg"))
Layer layerA = workspace.get("a")
Layer layerB = workspace.get("b")
Layer layerC = layerA.update(layerB)
```

Update Layer B with Layer A

```
Workspace workspace = new GeoPackage(new File("src/main/resources/layeralgebra.gpkg"))
Layer layerA = workspace.get("a")
Layer layerB = workspace.get("b")
Workspace outWorkspace = new Directory("target")
Layer layerC = layerB.update(layerA, outWorkspace: outWorkspace, outLayer:
"ba_update")
```


Union

Union Layer A with Layer B

```
Workspace workspace = new GeoPackage(new File("src/main/resources/layeralgebra.gpkg"))
Layer layerA = workspace.get("a")
Layer layerB = workspace.get("b")
Layer layerC = layerA.union(layerB)
```

Union Layer B with Layer A

```
Workspace workspace = new GeoPackage(new File("src/main/resources/layeralgebra.gpkg"))
Layer layerA = workspace.get("a")
Layer layerB = workspace.get("b")
Workspace outWorkspace = new Directory("target")
Layer layerC = layerB.union(layerA, outWorkspace: outWorkspace, outLayer: "ba_union")
```


Reading and Writing Features

The Layer IO classes are in the **geoscript.layer.io** package.

Finding Layer Writer and Readers

List all Layer Writers

```
List<Writer> writers = Writers.list()
writers.each { Writer writer ->
    println writer.class.simpleName
}
```

```
CsvWriter
GeobufWriter
GeoJSONWriter
GeoRSSWriter
GmlWriter
GpxWriter
KmlWriter
MvtWriter
```

Find a Layer Writer

```
Workspace workspace = new Memory()
Schema schema = new Schema("cities", [
        new Field("geom", "Point", "EPSG:4326"),
        new Field("id", "Integer"),
        new Field("name", "String")
])
Layer layer = workspace.create(schema)
layer.add([
        geom: new Point(-122.3204, 47.6024),
        id: 1,
        name: "Seattle"
])
layer.add([
        geom: new Point(-122.48416, 47.2619),
        id: 2,
        name: "Tacoma"
])

Writer writer = Writers.find("csv")
String csv = writer.write(layer)
println csv
```

```
"geom:Point:EPSG:4326","id:Integer","name:String"
"POINT (-122.3204 47.6024)","1","Seattle"
"POINT (-122.48416 47.2619)","2","Tacoma"
```

List all Layer Readers

```
List<Reader> readers = Readers.list()
readers.each { Reader reader ->
    println reader.class.simpleName
}
```

```
CsvReader
GeobufReader
GeoJSONReader
GeoRSSReader
GmlReader
GpxReader
KmlReader
MvtReader
```

Find a Layer Reader

```
        Reader reader = Readers.find("csv")
        Layer layer = reader.read("""geom:Point:EPSG:4326","id:Integer","name:String"
"POINT (-122.3204 47.6024)","1","Seattle"
"POINT (-122.48416 47.2619)","2","Tacoma"
""")
        println "# features = ${layer.count}"
```

```
# features = 2
```

GeoJSON

Get GeoJSON String from a Layer

```
Workspace workspace = new Memory()
Schema schema = new Schema("cities", [
        new Field("geom", "Point", "EPSG:4326"),
        new Field("id", "Integer"),
        new Field("name", "String")
])
Layer layer = workspace.create(schema)
layer.add([
    geom: new Point(-122.3204, 47.6024),
    id: 1,
    name: "Seattle"
])
layer.add([
    geom: new Point(-122.48416, 47.2619),
    id: 2,
    name: "Tacoma"
])

String geojson = layer.toJSONString()
println geojson
```

```
{
    "type": "FeatureCollection",
    "features": [
        {
            "type": "Feature",
            "geometry": {
                "type": "Point",
                "coordinates": [
                    -122.3204,
                    47.6024
                ]
            },
            "properties": {
                "id": 1,
                "name": "Seattle"
            },
            "id": "fid-1294d00e_162b6dbbbfd_-6ad7"
        },
        {
            "type": "Feature",
            "geometry": {
                "type": "Point",
                "coordinates": [
                    -122.4842,
                    47.2619
                ]
            },
            "properties": {
                "id": 2,
                "name": "Tacoma"
            },
            "id": "fid-1294d00e_162b6dbbbfd_-6ad5"
        }
    ]
}
```

GeoBuf

Get GeoBuf String from a Layer

```
Workspace workspace = new Memory()
Schema schema = new Schema("cities", [
        new Field("geom", "Point", "EPSG:4326"),
        new Field("id", "Integer"),
        new Field("name", "String")
])
Layer layer = workspace.create(schema)
layer.add([
        geom: new Point(-122.3204, 47.6024),
        id: 1,
        name: "Seattle"
])
layer.add([
        geom: new Point(-122.48416, 47.2619),
        id: 2,
        name: "Tacoma"
])

String geobuf = layer.toGeobufString()
println geobuf
```

0a0269640a046e616d6510021806223d0a1d0a0c08001a089fd8d374c0ebb22d6a0218016a090a07536561
74746c650a1c0a0c08001a08ffd6e77498a3892d6a0218026a080a065461636f6d61

GML

Get GML String from a Layer

```
Workspace workspace = new Memory()
Schema schema = new Schema("cities", [
        new Field("geom", "Point", "EPSG:4326"),
        new Field("id", "Integer"),
        new Field("name", "String")
])
Layer layer = workspace.create(schema)
layer.add([
        geom: new Point(-122.3204, 47.6024),
        id: 1,
        name: "Seattle"
])
layer.add([
        geom: new Point(-122.48416, 47.2619),
        id: 2,
        name: "Tacoma"
])

String gml = layer.toGMLString()
println gml
```

```
<wfs:FeatureCollection xmlns:wfs="http://www.opengis.net/wfs">
  <gml:boundedBy xmlns:gml="http://www.opengis.net/gml">
    <gml:Box srsName="http://www.opengis.net/gml/srs/epsg.xml#4326">
      <gml:coord>
        <gml:X>
          -122.48416
        </gml:X>
        <gml:Y>
          47.2619
        </gml:Y>
      </gml:coord>
      <gml:coord>
        <gml:X>
          -122.3204
        </gml:X>
        <gml:Y>
          47.6024
        </gml:Y>
      </gml:coord>
    </gml:Box>
  </gml:boundedBy>
  <gml:featureMember xmlns:gml="http://www.opengis.net/gml">
    <gsf:cities xmlns:gsf="http://geoscript.org/feature" fid="fid-
1294d00e_162b6dbbbfd_-7489">
      <gml:name>
        Seattle
      </gml:name>
```

```
      <gsf:geom>
        <gml:Point>
          <gml:coord>
            <gml:X>
              -122.3204
            </gml:X>
            <gml:Y>
              47.6024
            </gml:Y>
          </gml:coord>
        </gml:Point>
      </gsf:geom>
      <gsf:id>
        1
      </gsf:id>
    </gsf:cities>
  </gml:featureMember>
  <gml:featureMember xmlns:gml="http://www.opengis.net/gml">
    <gsf:cities xmlns:gsf="http://geoscript.org/feature" fid="fid-
1294d00e_162b6dbbbfd_-7487">
      <gml:name>
        Tacoma
      </gml:name>
      <gsf:geom>
        <gml:Point>
          <gml:coord>
            <gml:X>
              -122.48416
            </gml:X>
            <gml:Y>
              47.2619
            </gml:Y>
          </gml:coord>
        </gml:Point>
      </gsf:geom>
      <gsf:id>
        2
      </gsf:id>
    </gsf:cities>
  </gml:featureMember>
</wfs:FeatureCollection>
```

KML

Get KML String from a Layer

```
Workspace workspace = new Memory()
Schema schema = new Schema("cities", [
        new Field("geom", "Point", "EPSG:4326"),
        new Field("id", "Integer"),
        new Field("name", "String")
])
Layer layer = workspace.create(schema)
layer.add([
    geom: new Point(-122.3204, 47.6024),
    id: 1,
    name: "Seattle"
])
layer.add([
    geom: new Point(-122.48416, 47.2619),
    id: 2,
    name: "Tacoma"
])

String kml = layer.toKMLString()
println kml
```

```
<kml:kml xmlns:kml="http://www.opengis.net/kml/2.2">
  <kml:Document>
    <kml:Folder>
      <kml:name>
        cities
      </kml:name>
      <kml:Schema kml:name="cities" kml:id="cities">
        <kml:SimpleField kml:name="id" kml:type="Integer"/>
        <kml:SimpleField kml:name="name" kml:type="String"/>
      </kml:Schema>
      <kml:Placemark>
        <kml:name>
          fid-1294d00e_162b6dbbbfd_-6b0c
        </kml:name>
        <kml:Style>
          <kml:IconStyle>
            <kml:color>
              ff0000ff
            </kml:color>
          </kml:IconStyle>
        </kml:Style>
        <kml:ExtendedData>
          <kml:SchemaData kml:schemaUrl="#cities">
            <kml:SimpleData kml:name="id">
              1
            </kml:SimpleData>
            <kml:SimpleData kml:name="name">
```

```
                Seattle
              </kml:SimpleData>
            </kml:SchemaData>
          </kml:ExtendedData>
          <kml:Point>
            <kml:coordinates>
              -122.3204,47.6024
            </kml:coordinates>
          </kml:Point>
        </kml:Placemark>
        <kml:Placemark>
          <kml:name>
            fid-1294d00e_162b6dbbbfd_-6b0a
          </kml:name>
          <kml:Style>
            <kml:IconStyle>
              <kml:color>
                ff0000ff
              </kml:color>
            </kml:IconStyle>
          </kml:Style>
          <kml:ExtendedData>
            <kml:SchemaData kml:schemaUrl="#cities">
              <kml:SimpleData kml:name="id">
                2
              </kml:SimpleData>
              <kml:SimpleData kml:name="name">
                Tacoma
              </kml:SimpleData>
            </kml:SchemaData>
          </kml:ExtendedData>
          <kml:Point>
            <kml:coordinates>
              -122.48416,47.2619
            </kml:coordinates>
          </kml:Point>
        </kml:Placemark>
      </kml:Folder>
    </kml:Document>
</kml:kml>
```

Graticules

Square

Create a square graticules Layer

```
Bounds bounds = new Bounds(-180,-90,180,90,"EPSG:4326")
double length = 20
double spacing = 5
Layer layer = Graticule.createSquares(bounds, length, spacing)
```


Create a square graticules Shapefile Layer

```
Bounds bounds = new Bounds(-180,-90,180,90,"EPSG:4326")
double length = 30
double spacing = -1
Workspace workspace = new Directory("target")
Layer layer = Graticule.createSquares(bounds, length, spacing, workspace: workspace,
layer: "squares")
```

Hexagon

Create a flat hexagon graticules Layer

```
Bounds bounds = new Bounds(-180,-90,180,90,"EPSG:4326")
double length = 20
double spacing = 5
String orientation = "flat"
Layer layer = Graticule.createHexagons(bounds, length, spacing, orientation)
```


Create a angled hexagon graticules Layer

```
Bounds bounds = new Bounds(-180,-90,180,90,"EPSG:4326")
double length = 10
double spacing = 5
String orientation = "angled"
Layer layer = Graticule.createHexagons(bounds, length, spacing, orientation)
```

Create a hexagon graticules Layer intersecting Washington States

```
Layer states = new Shapefile("src/main/resources/data/states.shp")
Feature feature = states.first(filter: "STATE_NAME = 'Washington'")
Layer layer = Graticule.createHexagons(feature.bounds.expandBy(1.0), 0.2, -1.0,
"flat", createFeature: { GridElement e ->
    new Point(e.center.x, e.center.y).buffer(0.2).intersects(feature.geom)
})
```


Create a hexagon graticules Layer with a custom schema

```
Layer states = new Shapefile("src/main/resources/data/states.shp")
Schema schema = new Schema("hexagon", [
        new Field("geom", "Polygon"),
        new Field("color", "java.awt.Color")
])
Bounds b = states.bounds.expandBy(1)
Layer layer = Graticule.createHexagons(b, 2.0, -1.0, "flat", schema: schema,
setAttributes: { GridElement e, Map attributes ->
    attributes["color"] = Color.randomPastel.asColor()
})
layer.style = new Fill(new Property("color"), 0.5)
```
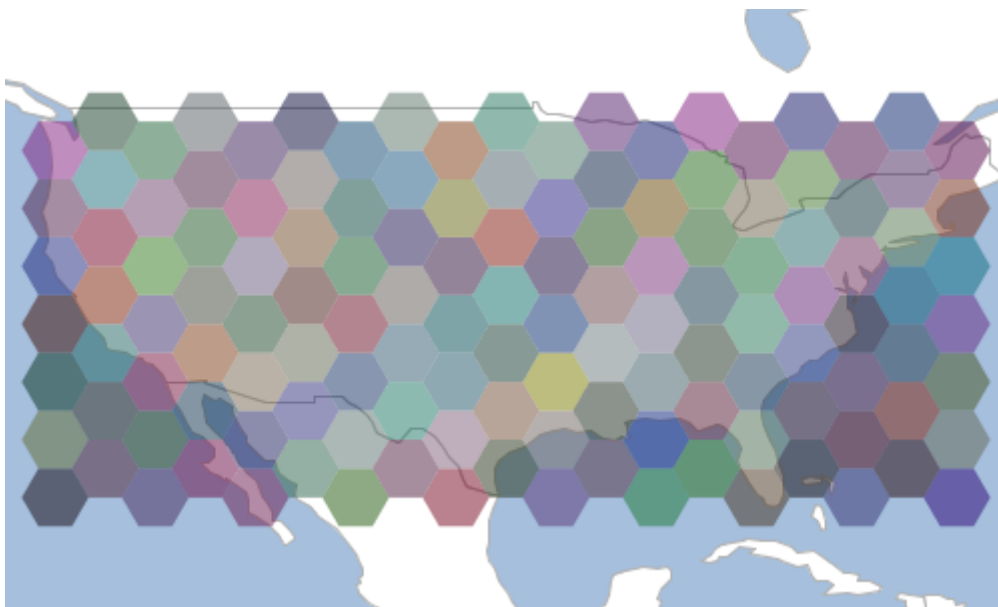
Line

Create a line graticules Layer

```
Bounds bounds = new Bounds(-180,-90,180,90,"EPSG:4326")
Layer layer = Graticule.createLines(bounds, [
        [orientation: 'vertical',   level: 2, spacing: 20],
        [orientation: 'vertical',   level: 1, spacing: 10 ],
        [orientation: 'horizontal', level: 2, spacing: 20],
        [orientation: 'horizontal', level: 1, spacing: 10 ]
], 2.0)
```


Rectangle

Create a rectangular graticules Layer

```
Bounds bounds = new Bounds(-180,-90,180,90,"EPSG:4326")
double width = 20
double height = 10
Layer layer = Graticule.createRectangles(bounds, width, height, -1)
```



```
Bounds bounds = new Bounds(-180,-90,180,90,"EPSG:4326")
double width = 20
double height = 10
Layer layer = Graticule.createRectangles(bounds, width, height, -1)
```