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# Bounds Recipes

## Creating Bounds

Create a *Bounds* from four coordinates (*minx*, *miny*, *maxx*, *maxy*) and a projection.

```
Bounds bounds = new Bounds(-127.265, 43.068, -113.554, 50.289, "EPSG:4326")
```



Create a *Bounds* from four coordinates (*minx*, *miny*, *maxx*, *maxy*) without a projection. The projection can be set later.

```
Bounds bounds = new Bounds(-127.265, 43.068, -113.554, 50.289)  
bounds.proj = new Projection("EPSG:4326")
```



Create a *Bounds* from a string with commas delimiting *minx*, *miny*, *maxx*, *maxy* and projection values.

```
Bounds bounds = Bounds.fromString("-127.265,43.068,-113.554,50.289,EPSG:4326")
```



Create a *Bounds* from a string with spaces delimiting minx, miny, maxx, maxy and projection values.

```
Bounds bounds = Bounds.fromString("12.919921874999998 40.84706035607122 15.99609375  
41.77131167976407 EPSG:4326")
```



## Getting Bounds Properties

Create a *Bounds* and view it's string representation

```
Bounds bounds = new Bounds(-127.265, 43.068, -113.554, 50.289, "EPSG:4326")  
String boundsStr = bounds.toString()  
println boundsStr
```

```
(-127.265,43.068,-113.554,50.289,EPG:4326)
```

Get the minimum x coordinate

```
double minX = bounds.minX  
println minX
```

```
-127.265
```

*Get the minimum y coordinate*

```
double minY = bounds.minY  
println minY
```

43.068

*Get the maximum x coordinate*

```
double maxX = bounds.maxX  
println maxX
```

-113.554

*Get the maximum y coordinate*

```
double maxY = bounds.maxY  
println maxY
```

50.289

*Get the Projection*

```
Projection proj = bounds.proj  
println proj.id
```

EPSG:4326

*Get the area*

```
double area = bounds.area  
println area
```

99.00713100000004

*Get the width*

```
double width = bounds.width  
println width
```

```
13.710999999999999
```

*Get the height*

```
double height = bounds.height  
println height
```

```
7.2210000000000004
```

*Get the aspect ratio*

```
double aspect = bounds.aspect  
println aspect
```

```
1.8987674837280144
```

*A Bounds is not a Geometry but you can get a Geometry from a Bounds*

```
Bounds bounds = new Bounds(-122.485, 47.246, -122.452, 47.267, "EPSG:4326")  
Geometry geometry = bounds.geometry
```



*You can also get a Polygon from a Bounds*

```
Bounds bounds = new Bounds(-122.485, 47.246, -122.452, 47.267, "EPSG:4326")  
Polygon polygon = bounds.polygon
```



*Get the four corners from a Bounds as a List of Points*

```
Bounds bounds = new Bounds(-122.485, 47.246, -122.452, 47.267, "EPSG:4326")
List<Point> points = bounds.corners
```



## Processing Bounds

*Reproject a Bounds from one Projection to another.*

```
Bounds bounds = new Bounds(-122.485, 47.246, -122.452, 47.267, "EPSG:4326")
println bounds
```

```
(-122.485,47.246,-122.452,47.267,EPSG:4326)
```

```
Bounds reprojectedBounds = bounds.reproject("EPSG:2927")
println reprojectedBounds
```

```
(1147444.7684517875,703506.223164177,1155828.120242509,711367.9403610165,EPSG:2927)
```

### *Expand a Bounds by a given distance*

```
Bounds bounds1 = new Bounds(-127.265, 43.068, -113.554, 50.289, "EPSG:4326")
Bounds bounds2 = new Bounds(-127.265, 43.068, -113.554, 50.289, "EPSG:4326")
bounds2.expandBy(10.1)
```



### *Expand a Bounds to include another Bounds*

```
Bounds bounds1 = new Bounds(8.4375, 37.996162679728116, 19.6875, 46.07323062540835,
"EPSG:4326")
Bounds bounds2 = new Bounds(22.5, 31.952162238024975, 30.937499999999996,
37.43997405227057, "EPSG:4326")
bounds1.expand(bounds2)
```



### *Scale an existing Bounds some distance to create a new Bounds*

```
Bounds bounds1 = new Bounds(-127.265, 43.068, -113.554, 50.289, "EPSG:4326")
Bounds bounds2 = bounds1.scale(2)
```



*Divide a Bounds into smaller tiles or Bounds*

```
Bounds bounds = new Bounds(-122.485, 47.246, -122.452, 47.267, "EPSG:4326")
List<Bounds> subBounds = bounds.tile(0.25)
```



*Calculate a quad tree for this Bounds between the start and stop levels. A Closure is called for each new Bounds generated.*

```
Bounds bounds = new Bounds(-180, -90, 180, 90, "EPSG:4326")
bounds.quadTree(0,2) { Bounds b ->
    println b
}
```

```
(-180.0,-90.0,180.0,90.0,EPSG:4326)
(-180.0,-90.0,0.0,0.0,EPSG:4326)
(-180.0,0.0,0.0,90.0,EPSG:4326)
(0.0,-90.0,180.0,0.0,EPSG:4326)
(0.0,0.0,180.0,90.0,EPSG:4326)
```

*Determine whether a Bounds is empty or not. A Bounds is empty if it is null or it's area is 0.*

```
Bounds bounds = new Bounds(0,10,10,20)
println bounds.isEmpty()
```



false

```
Bounds emptyBounds = new Bounds(0,10,10,10)
println emptyBounds.isEmpty()
```

true

*Determine if a Bounds contains another Bounds*

```
Bounds bounds1 = new Bounds(-107.226, 34.597, -92.812, 43.068)
Bounds bounds2 = new Bounds(-104.326, 37.857, -98.349, 40.913)
println bounds1.contains(bounds2)
```



true

```
Bounds bounds3 = new Bounds(-112.412, 36.809, -99.316, 44.777)
println bounds1.contains(bounds3)
```



false

### Determine if a Bounds contains a Point

```
Bounds bounds = new Bounds(-107.226, 34.597, -92.812, 43.068)
Point point1 = new Point(-95.976, 39.639)
println bounds.contains(point1)
```



true

```
Point point2 = new Point(-89.384, 38.959)
println bounds.contains(point2)
```



true

### Determine if two Bounds intersect

```
Bounds bounds1 = new Bounds(-95.885, 46.765, -95.788, 46.811)
Bounds bounds2 = new Bounds(-95.847, 46.818, -95.810, 46.839)
println bounds1.intersects(bounds2)
```



false

```
Bounds bounds3 = new Bounds(-95.904, 46.747, -95.839, 46.792)
println bounds1.intersects(bounds3)
```



true

*Calculate the intersection between two Bounds*

```
Bounds bounds1 = new Bounds(-95.885, 46.765, -95.788, 46.811)
Bounds bounds2 = new Bounds(-95.904, 46.747, -95.839, 46.792)
Bounds bounds3 = bounds1.intersection(bounds2)
```



Generate a grid from a Bounds with a given number of columns and rows and the polygon shape. Other shapes include: polygon, point, circle/ellipse, hexagon, hexagon-inv).

```
Bounds bounds = new Bounds(-180,-90,180,90,"EPSG:4326")
Geometry geometry = bounds.getGrid(5,4,"polygon")
```



Generate a grid from a Bounds with a given number of columns and rows and a point shape. A Closure that is called with a geometry, column, and row for each grid cell that is created.

```
Bounds bounds = new Bounds(-180,-90,180,90,"EPSG:4326")
List geometries = []
Geometry geometry = bounds.generateGrid(10,8,"point") { Geometry g, int col, int row
->
    geometries.add(g)
}
```



Generate a grid from a Bounds with a given cell width and height and a circle/ellipse shape.

```
Bounds bounds = new Bounds(-180,-90,180,90,"EPSG:4326")
Geometry geometry = bounds.getGrid(72.0,72.0,"circle")
```



*Generate a grid from a Bounds with a given cell width and height and a hexagon shape. A Closure is called with a geometry, column, and row for each grid cell generated.*

```
Bounds bounds = new Bounds(-180,-90,180,90,"EPSG:4326")
List geometries = []
Geometry geometry = bounds.generateGrid(72.0,72.0,"hexagon") { Geometry g, int col,
int row ->
    geometries.add(g)
}
```



*Generate a grid from a Bounds with a given cell width and height and an inverted hexagon shape.*

```
Bounds bounds = new Bounds(-180,-90,180,90,"EPSG:4326")
Geometry geometry = bounds.getGrid(5,5,"hexagon-inv")
```



Create a rectangle from a Bounds with a given number of Points and a rotation angle in radians.

```
Bounds bounds = new Bounds(0,0,20,20)
Polygon polygon = bounds.createRectangle(20,Math.toRadians(45))
```



Create an ellipse from a Bounds. The default number of points is 20 and the default rotation angle in radians is 0.

```
Bounds bounds = new Bounds(0,0,20,20)
Polygon polygon = bounds.createEllipse()
```



Create a squircle from a Bounds. The default number of points is 20 and the default rotation angle in radians is 0.

```
Bounds bounds = new Bounds(0,0,20,20)
Polygon polygon = bounds.createSquircle()
```



Create a super circle from a Bounds with a given power. The default number of points is 20 and the default rotation angle in radians is 0.

```
Bounds bounds = new Bounds(0,0,20,20)
Polygon polygon = bounds.createSuperCircle(1.75)
```



Create an arc from a Bounds with a start angle and angle extent. The default number of points is 20 and the default rotation angle in radians is 0.

```
Bounds bounds = new Bounds(0,0,20,20)
LineString lineString = bounds.createArc(Math.toRadians(45), Math.toRadians(90))
```



Create an arc polygon from a Bounds with a start angle and angle extent. The default number of points is 20 and the default rotation angle in radians is 0.

```
Bounds bounds = new Bounds(0,0,20,20)
Polygon polygon = bounds.createArcPolygon(Math.toRadians(45), Math.toRadians(90))
```



Create a sine star from a *Bounds* with a number of arms and an arm length ratio. The default number of points is 20 and the default rotation angle in radians is 0.

```
Bounds bounds = new Bounds(0,0,20,20)
Polygon polygon = bounds.createSineStar(5, 2.3)
```



Create a hexagon from a *Bounds* that is either inverted (*false*) or not (*true*).

```
Bounds bounds = new Bounds(0,0,20,20)
Polygon polygon = bounds.createHexagon(false)
```

