Learn the OpenAccess API

Using Python

Initial Contribution By

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Section 3 OA Basic Classes

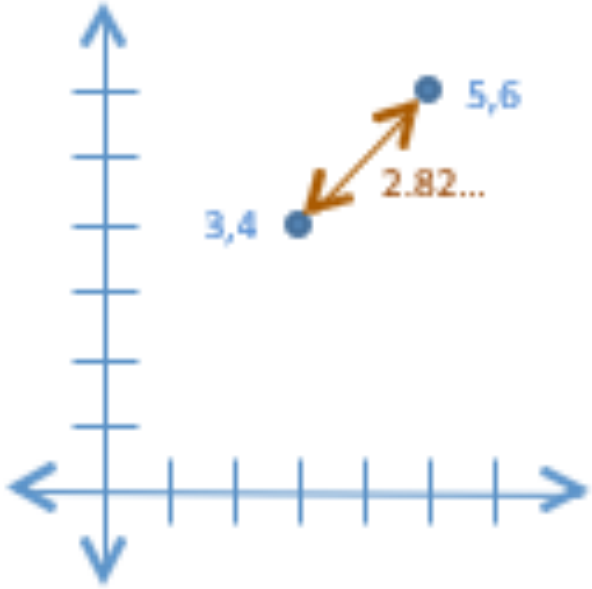
- OpenAccess models just about everything as an object; including basic concepts like: point, box, array of points, etc.
- It is important to understand these basic concepts before working with design data
- All coordinate values are specified in Database Units (DBU)
  - **Integer only values (no floating-point allowed)**
  - DBU is what is stored on disk; conversion to user units is done by the application (you)

  Note: For now, we will use integer values only for coordinates. This will be explained later in more detail.

oaPoint

- Points are represented in the oaPoint class:

```
point1 = oa.oaPoint(3, 4)
point1.x() #=> 3
point1.y() #=> 4
point2 = oa.oaPoint(5, 6)
```

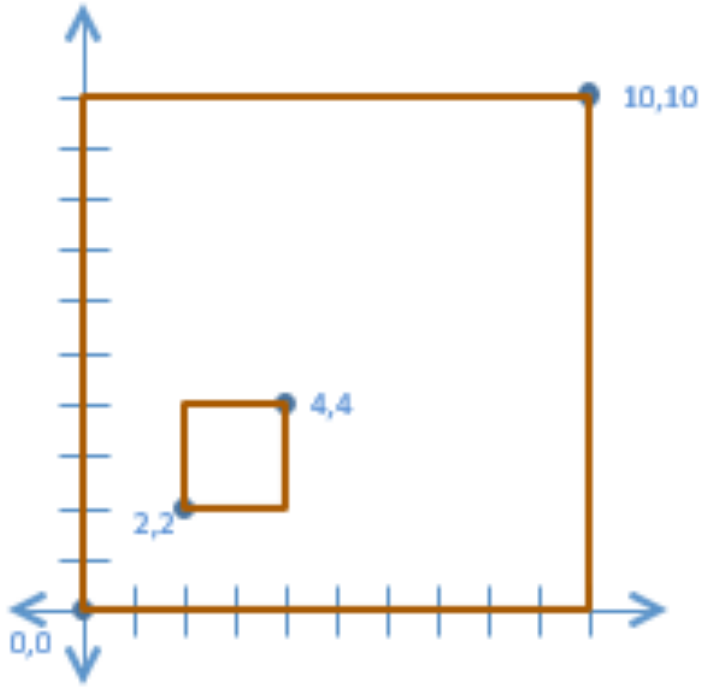



```
math.sqrt(point1.distanceFrom2(point2))
#=> 2.8284271247461903
```

- As a convenience in oaScript, any func,on that accepts an oaPoint as an argument will also accept an array of exactly two integers which represent a x/y point:

```
math.sqrt(point1.distanceFrom2([9,2]))
#=> 6.324555320336759
```

oaBox



- Boxes are represented in the oaBox class:

```
box = oa.oaBox(0, 0, 10, 10)
  box.lowerLeft() #=> oa.oaPoint(0, 0)
  box.upperRight() #=> oa.oaPoint(10, 10)
  box.getCenter() #=> oa.oaPoint(5, 5)
```

- As a convenience in oaScript, any function that accepts an oaBox as an argument will also accept an array of exactly four integers (left, bottom, right, top):

```
box.contains([2, 2, 4, 4]) #=> True
```

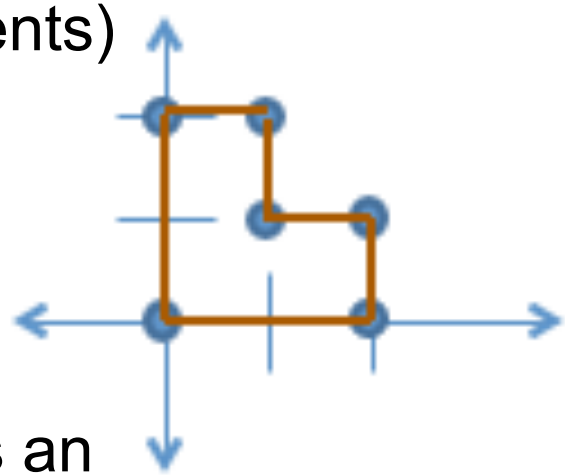
Lab 3.1

- Goal - Become familiar with coordinates, points, and boxes
- Create a script to:
  1. Create two boxes in different locations
  2. Scale one of the boxes by 2X
  3. See if the boxes are touching each other
  4. See if a point is completely inside one of the boxes
     - Not outside or on an edge
- compare your script to labs/3.1/boxes.py

oaPointArray

- Arrays of points are represented in the oaPointArray class. This is used to represent either a **closed set** of points (polygonal object) or an **open set** of points (line segments)

```
poly = oa.oaPointArray([[0,0], [0,10],
[5,10], [5,5], [10,5], [10,0]])
poly.getNumElements() #=> 6
poly.getArea() #=> 75.0
```



- As a convenience in oaScript, any func,on that accepts an oaPointArray as an argument will also accept an array of two element arrays of integers (points)
  - This is shown in the example above for the oa.oaPointArray() constructor where an existing set of points (array of arrays) is an oaPointArray to be copied and created into a new object

oaPointArray in other languages

- oaPointArray introduces a new concept, so we'll show it in all of the different languages
- **Perl**

```
$ptarr = new oa::oaPointArray( [[1,1], [1,2]] );
foreach $point (@$ptarr) {
  printf("(%d, %d)\n", $$point[0], $$point[1]);
}
```

- **Python**

```
ptarr = oa.oaPointArray(((1,1), (1,2)))
for point in ptarr:
  print "(%d, %d)" % (point.x(), point.y())
```

- **Ruby**

```
ptarr = Oa::OaPointArray.new([[1,1], [1,2]])
ptarr.each do |point|
  printf("(%d, %d)\n", point.x, point.y)
end
```

- **Tcl**

```
oa::foreach point $ptarr {
  puts [format "(%d, %d)" [$point x] [$point y]]
}
```

oaTransform

- In OA, objects can be transformed using the oaTransform class
  - Shifted by an x and y offset
  - Rotated about a reference point
  - Mirrored about the x or y axis
- See “Using Transforms” sec,on of the API doc for details (Programmers Guide->Physical Design->Using Transforms)
- Example:

```
point = oa.oaPoint(1,1)
xform  =  oa.oaTransform(oa.oacR90)
  point.transform(xform) #=> oaPoint(-1,1)
xform2 = oa.oaTransform(oa.oacR90, 2, 2)
  point.transform(xform2) #=> oaPoint(2,1)
```

Lab 3.2

- Goal - Become familiar with polygons and transforms
- Create a script to:
  - Create a polygon
  - Transform it in some way (rotate, mirror, and/or shift)
  - Print the resulting points to the screen
- compare your script to labs/3.2/points.py

oa*Name

- The oa*Name class provides a way to **store and translate** between different naming conventions
- Namespaces are used to manage handling of special characters or restrictions in naming
- The oaName concept is used for names like on nets and instances
- See “Name Mapping” sec,on of the API doc for details
  - Programmers Guide->Names->Name Mapping
- Name classes:
  - **oaName** – wrapper to represent any of the oa*Name types
  - **oaScalarName** – represents a non-bit name (e.g. “foo”)
  - **oaVectorName** – represents a name with many bits (e.g. “foo[0:7]”)
  - **oaVectorBitName** – represents a name with a single bit (e.g. “foo[1]”)
  - oaBundleName – represents potentially repeated simple names
  - oaSimpleName – wrapper to represent scalar, vector, or vector bit

Bold = covered in this training

oaScalarName

- The oaScalarName class is for single non-bit names
  - The most used out of all of the oa*Name classes
- Example conversion between CDBA->Verilog
  - To highlight conversion, the special hierarchy character is used
    - Grave symbol for CDBA `
    - Period for Verilog .

```
cdba_ns =  oa.oaCdbaNS()
v_ns =  oa.oaVerilogNS()
name = oa.oaScalarName(cdba_ns, "a`b")
name.get(v_ns) #=> "a.b"
```

oaVectorName

- The oaVectorName class is for a range of bits
  - Bus bits separation character(s) are abstracted until a name is needed in a given namespace
- Example:

```
vname = oa.oaVectorName("bit", 0, 7) vname.getBaseName() #=>
  "bit"
vname.getStart() #=> 0
vname.getStop() #=> 7
vname.getStep() #=> 1
vname.getNumBits() #=> 8
  vname.get(oa.oaCdbaNS())#=>"bit<0:7>"
vname.get(oa.oaVerilogNS()) #=> "bit[0:7]"
```

oaVectorBitName

- The oaVectorBitName class is for a single bit
  - Bus bits separation character(s) are abstracted until a name is needed in a given namespace
- Example:

```
bname   =  oa.oaVectorBitName("bit", 0)
  bname.getBaseName() #=> "bit"
bname.getIndex() #=> 0
bname.get(oa.oaCdbaNS()) #=> "bit<0>"
bname.get(oa.oaVerilogNS()) #=> "bit[0]"
```

oaName

- The oaName class is used to wrap any of the oa*Name classes
- The type of wrapped name can be found with the getType() method call
- Examples:

```
name = oa.oaName(oa.oaCdbaNS(), "foo")
  name.getType().getName() #=> "scalarName"

name = oa.oaName("foo[0]")  name.getType().getName()
  #=> "vectorBitName"

name = oa.oaName("foo[0:7]")  name.getType().getName()
  #=> "vectorName"  name.get(oa.oaVerilogNS()) #=>
  "foo[0:7]"
```

Lab 3.3

- Goal - Become familiar with OA Namespaces
- Create a script to:
  - Accept a single argument from the command line
  - Store it as a CDBA oaName (oaCdbaNS)
  - Show the oaName type
  - Show the unpacked string in the following namespaces:
    - Spice (oaSpiceNS)
    - Verilog (oaVerilogNS)
    - LEF (oaLefNS)
- Try using various inputs to see if they fail
  - ‘foo’, ‘bit<0>’, ‘bit<0:7>’, ‘a`b’
- Compare your script with labs/3.3/names.py

Section 3 Summary

- OpenAccess models just about everything as an object
- Geometric objects: point, point array, box
- Geometric actions: transform, comparisons (contains, overlaps)
- Names and namespaces
- Some types: not comprehensive, there are more

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