Learn the OpenAccess API

Using Python

Initial Contribution By

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Section 9:
oaNet, oaTerm, oaPin, oaPinFig

- Any oaShape can have a net attached to it to establish connectivity
- Different connectivity models can be established by using oaTerm, oaPin, and oaPinFig

oaNet

- Any oaShape can have connectivity associated with it using an a type of oaNet:
  - oaNet – wrapper to represent any of the oa*Net types
  - oaScalarNet – represents a non-bit net (e.g. “foo”)
  - oaBusNet – represents a net with many bits (e.g. “foo[0:7]”)
  - oaBusNetBit – represents a net with a single bit (e.g. “foo[1]”)
  - oaBundleNet – represents potentially repeated simple nets
- Most nets are oaScalarNet – single net name
- Can create a net in a block by just using oaNet and the right net type will automatically be detected by the name
  - A created net by itself does not involve any shapes until shapes are added to the net

```
net = oa.oaNet.create(block, "mynet")
  shape.addToNet(net)
...
shape.getNet(net) # to get later on
```

Lab 9.1: Add Shapes to Net

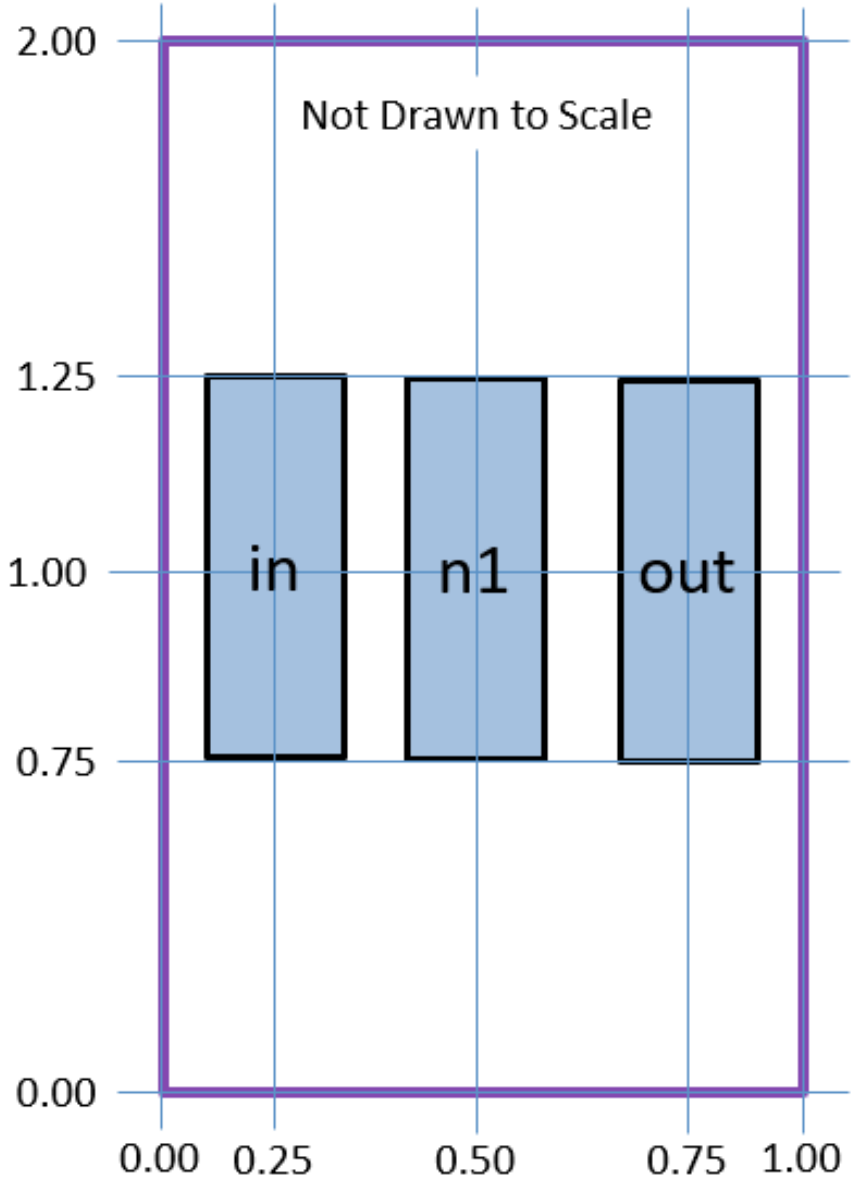
- Goal - Become familiar with creating oaNets inside of an oaBlock and adding shapes to those nets

- Write a script to create oaBlock and add shapes to an oaNet
  - Pretend that we're creating a "buffer" cell with three nets: "in", "out", and "n1" (between the inverters)
    - Will only draw rectangles as an abstract view – not all shapes
  - Create layout oaDesign called "buffer" under library "mylib"
  - Refer to the picture on the next slide to show rectangle locations, cell boundary dimensions, and net names
  - See next page

Compare your script to labs/9.1/buffer.py

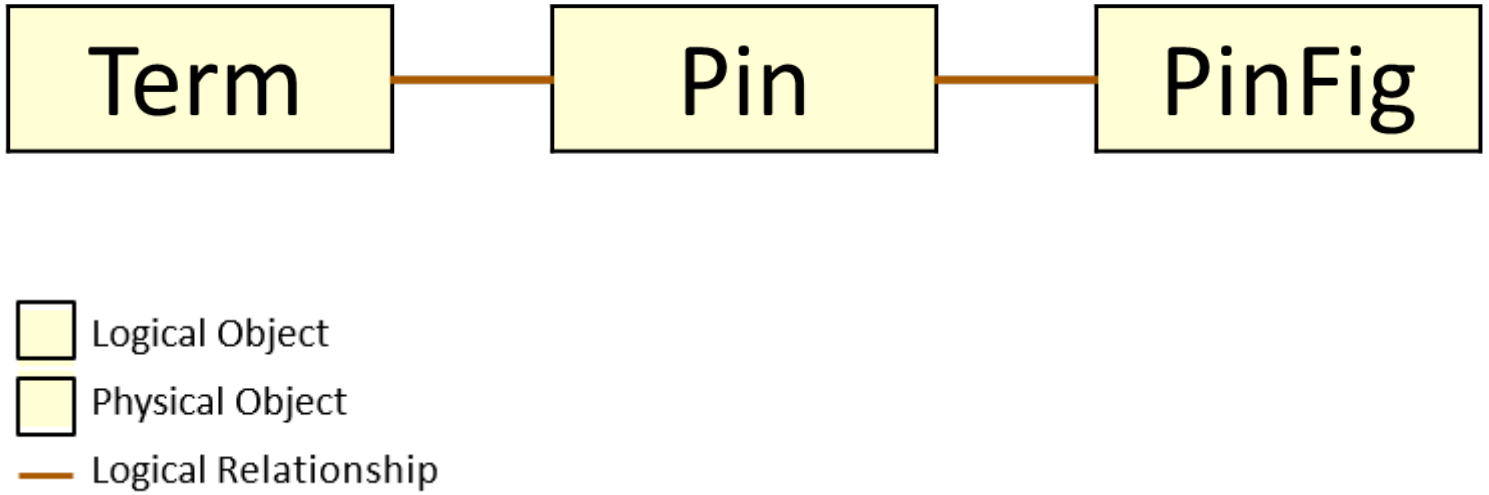
Buffer Shapes (Lab 9.1)

- Cell name: buffer/layout
- Rectangle attributes:
  - Layer = m1/drawing
  - Net Name = as shown
  - Width = 0.10
  - Height = 0.50



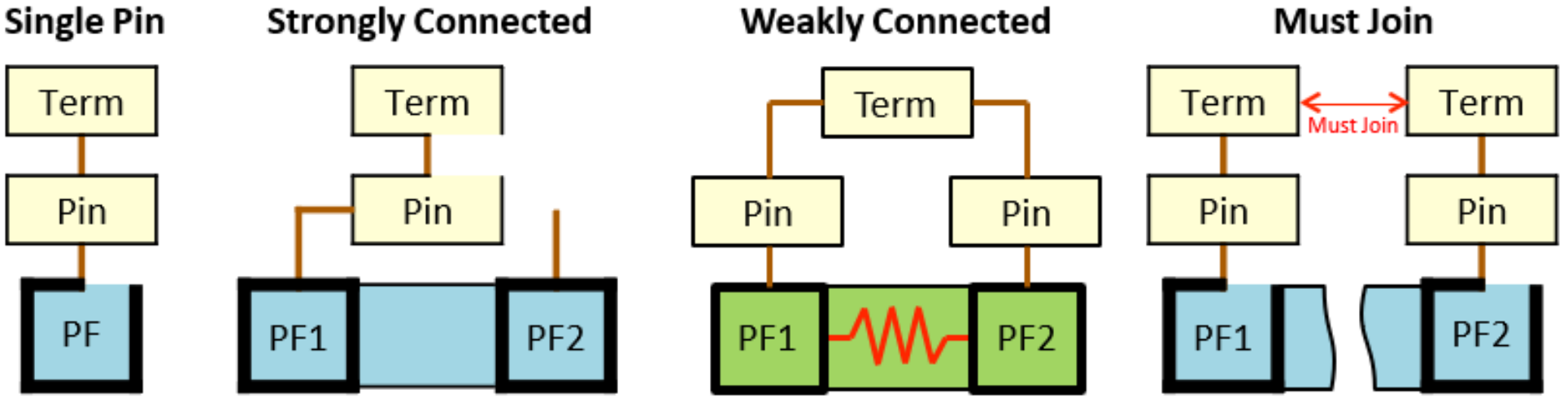
oaTerm, oaPin, oaPinFig

- **oaTerm:** A logical object joining oaPins and exporting nets outside of the block to be connected at a higher level of hierarchy
- **oaPin:** A logical object joining oaPinFigs in a way that indicates a desired connectivity model (see next slide for details)
- **oaPinFig:** A physical attribute that is attached to an oaShape that is intended to be a connection point outside of the current block level



OA Connectivity Models

- Different oaTerm, oaPin, and oaPinFig (PF) combinations indicate the type of connectivity to export to the next hierarchical level
- **Single Pin:** Single pin to be connected
- **Strongly Connected:** Can route into either pin and out the other
- **Weakly Connected:** High resistance connection; can route to one or another pin, but not through
- **Must Join:** Must connect to <u>both</u> pins at the next hierarchical level (open circuit in the subcell)



Creating oaTerm, oaPin, oaPinFig

- oaTerm and oaPin have names, but they just need to be unique names and otherwise aren't immediately exposed to users in a design
- Example creating single pin:

```
term = oa.oaTerm.create(net, net.getName())
pin = oa.oaPin.create(term)
shape.addToPin(pin)
```

- Example creating strongly connected pins (i.e. feedthrough)

```
term = oa.oaTerm.create(net, net.getName())
pin = oa.oaPin.create(term)
shape1.addToPin(pin)
shape2.addToPin(pin)
```

Pin Layers to Use

- You can create a pin on any layer; however:
  - Pins on primitive components are usually the physical layer (e.g. poly/drawing)
  - Pins at the block design are usually on a “pin” purpose (e.g. m1/pin)
  - Pins on the “pin” purpose have an advantage of having different visibility in an editor and also can export to a separate GDSII layer/ datatype number than the “drawing” purpose
  - Pins on a “pin” purpose are placed on top of existing shapes on the “drawing” purpose – **they are not placed alone**

m1/drawing
(as pin)

m1/drawing &
m1/pin (as pin)

m1/pin (as pin)
No m1/drawing

Copying OA Shapes

- In the next lab, you will edit your “buffer” design from the previous lab and promote “in” and “out” shapes to pins
- OA provides a built--in mechanism for copying shapes to avoid having to create a new shape
  - Copy into the same block or into another block
  - Transform the copy (move location, rotate)
- In this case, we will simply copy into the same block at the same location/rotation and change the purpose type to “pin”

```
ppin  =  oa.oaPurpose.find(tech, "pin").getNumber()
...
newshape =  shape.copy(oa.oaTransform())
  newshape.setPurposeNum(ppin)
```

Lab 9.2: Creating Pins

- Goal - Become familiar with creating terminals, pins, and pin figures

- Write a script to:
  - Open existing “buffer” design **in “a” mode (edit)**

```
design = oa.oaDesign.open("mylib", "buffer", "layout", "a")  block
   = design.getTopBlock()
```

  - Loop through all m1/drawing shapes and copy the shapes on “in” and “out” nets to be on m1/pin layer and as single pins (one oaTerm, one oaPin, one oaPinFig)

```
net = shape.getNet()
if net:
    if net.getName() in ("in", "out"):
    # copy to m1/pin, create term, pin
```

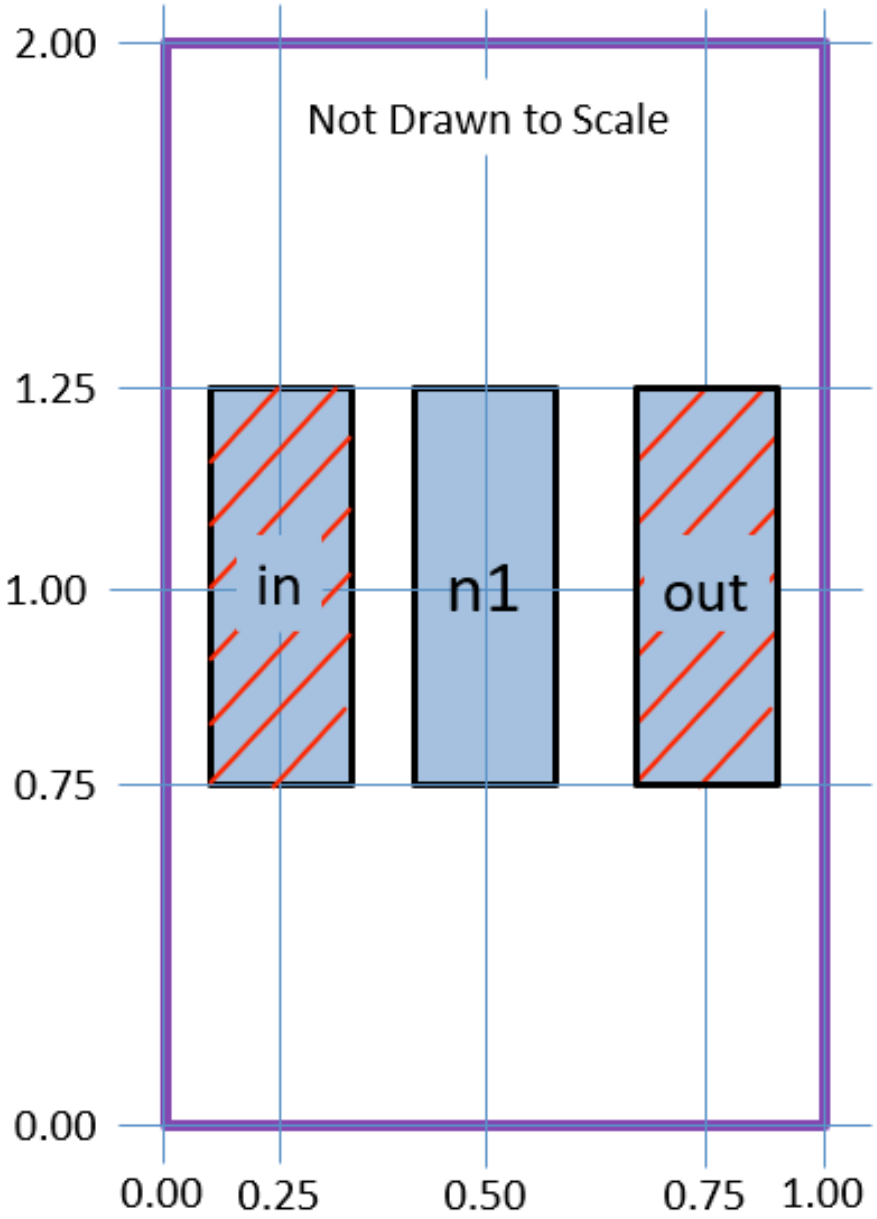
  - Use design.saveAs() to save to a different view to avoid constantly copying into the same design as you run multiple times

```
design.saveAs("mylib", "buffer", "layout1")
```

See next page
compare your script with labs/9.2/pins.py

Buffer Shapes (Lab 9.2)

- Rectangle attributes:
  - Layer = m1/drawing
  - Net Name = as shown
  - Width = 0.10
  - Height = 0.50
- Create two pins labeled “in” and “out” as shown
  - Create m1/pin shape on top of the existing pin also with the same net name (each pin has m1/drawing and m1/pin superimposed)
  - Add m1/pin shapes to their own respective oaTerm



- [in] Term → Pin → PinFig
- [out] Term → Pin → PinFig

Section 9 Summary

- Learned about the relationship between nets and shapes
- Understood the relationship between oaTerm, oaPin, and oaPinFig
- Investigated the connectivity model for pin connections
  - Must Join, Strongly Connected, and Weakly Connected
- Discussed advantages of using the pin purpose
- Used oaTransform to copy existing shapes

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