



# Exercise: SKILL

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## Exercise A ('warmup'):

- Calculate  $1 + 1$
- What is  $\sin(1)$ ?
- Find a way to get  $\pi$
  
- Define two variables  $x$  and  $y$ , set them to 2 and 3 and multiply them
  
- Let  $p$  be a *list* of two float values
- Get the first and second element of the list  $p$
  
- Add the first and second element directly (in one command)
- Define a function which outputs the double of a (float) argument
- Define a function which takes a list argument and outputs the sum of the 1<sup>st</sup> and 2<sup>nd</sup> elements.



## Exercise B: Area of a Rectangle

- Calculate the area of a rectangle (a list of two points)
- Define a function **area** which does this

For the rectangle

- `(setq A list(1:2 3:4))`

your function

- `(area A)`

should return

- **4**



## Exercise C: Sum of Elements

- Define a function **sumup** which calculates the sum of all elements of a list
  - Assume all elements are numbers
  
- Write two different versions at least:
  - Using **foreach**
  - Explicitly picking the **nth** element (i.e. using an index)
  
- You could try two more versions:
  - Stepping through the list with **car / cdr**
  - A recursive version



## Exercise D: Objects in a Layout

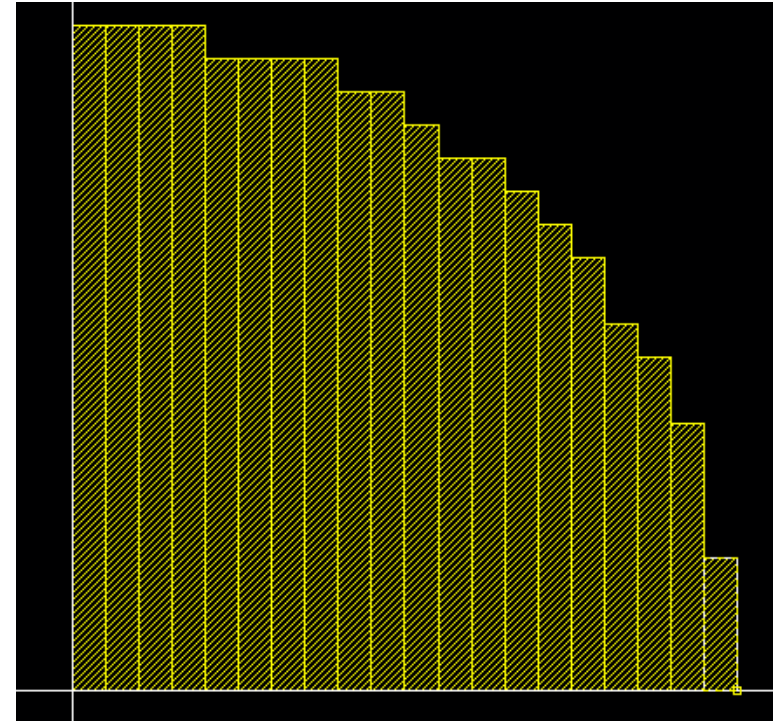
- Create a new layout. Create a rectangle on *metal1* and a path on *poly* by hand.
- From the CIW store the ID of the view in **myID**
- What is **myID~>shapes** ?
- Examine the two objects
  
- In the CIW: Assign a new value to the bounding box of the rectangle and check what happens in the open cell view.
  
- Create a new rectangle using the command from the lecture
- Search in the manual how to place a circle or a path.



## Exercise E: Making a Binned Circle

- Write a routine to create a circle (quadrant) from many small rectangular stripes

- Fix the layer to `\("ME2" "drawing")`
- Fix the origin at (0,0)
- Input parameters are
  - the outer **radius**
  - the (x) **step** size of the stripes
- It is sufficient to generate a quadrant, i.e. We define a procedure `'quadrant'` and call `(quadrant radius step)`



- For a start assume that **radius** is an integer multiple of **step**
- Make sure the y-coordinates are on 'some' grid, for instance multiples of **step**



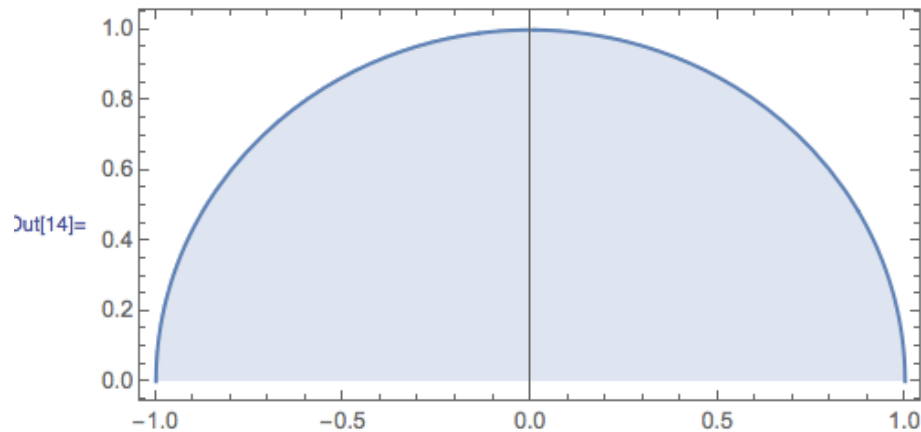
# Exercise E: Maths

- The formula for the 'ideal' area of a slice is obtained by integration:

$$\text{In[1]:= } f[R_, x_] = \sqrt{R^2 - x^2}$$

$$\text{Out[1]= } \sqrt{R^2 - x^2}$$

`In[14]:= Plot[f[1, x], {x, -1, 1}, AspectRatio -> 1/2, Frame -> True, Filling -> Axis]`



`In[11]:= $Assumptions = R > 0 && x1 > -R && x1 < R && x2 > -R && x2 < R && x1 < x2;`

`In[12]:= Integrate[f[R, x], {x, x1, x2}]`

$$\text{Out[12]= } \frac{1}{2} \left( \underbrace{-x1 \sqrt{R^2 - x1^2}}_{x1s} + \underbrace{x2 \sqrt{R^2 - x2^2}}_{x2s} + R^2 \left( -\text{ArcTan} \left[ \frac{x1}{\sqrt{R^2 - x1^2}} \right] + \text{ArcTan} \left[ \frac{x2}{\sqrt{R^2 - x2^2}} \right] \right) \right)$$



## Exercise F: Define a Key ShortCut

- Check in your `.cdsinit` file how the shortcuts for changing the grid are defined
  - Change the message that is printed
  - Add another key for a new grid
  
- Define a function which places a rectangle ( $1 \times 1 \text{ um}^2$ ) at the cursor position
  - You get the cursor position with  
`(hiGetPoint (hiGetCurrentWindow))`
- Associate the function to a bind key





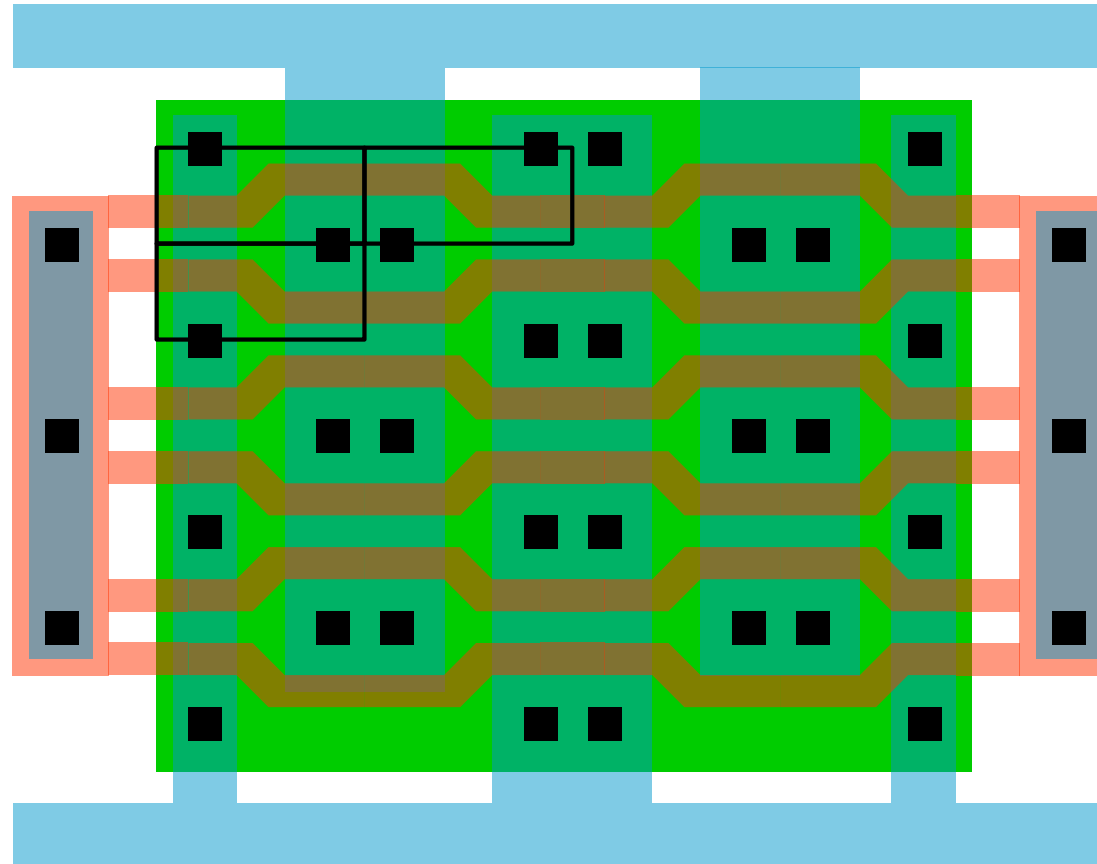
## Exercise G:

- Create a PCELL which generates the quarter circle from exercise E



## Exercise H:

- Make a PCELL which creates a Waffle transistor like this



- Make small unit layout cells (core/left/right/top/bottom).
- The PCELL just composes the layout from these elements