



Lab III

AutoCAD Editing (1)

Objectives

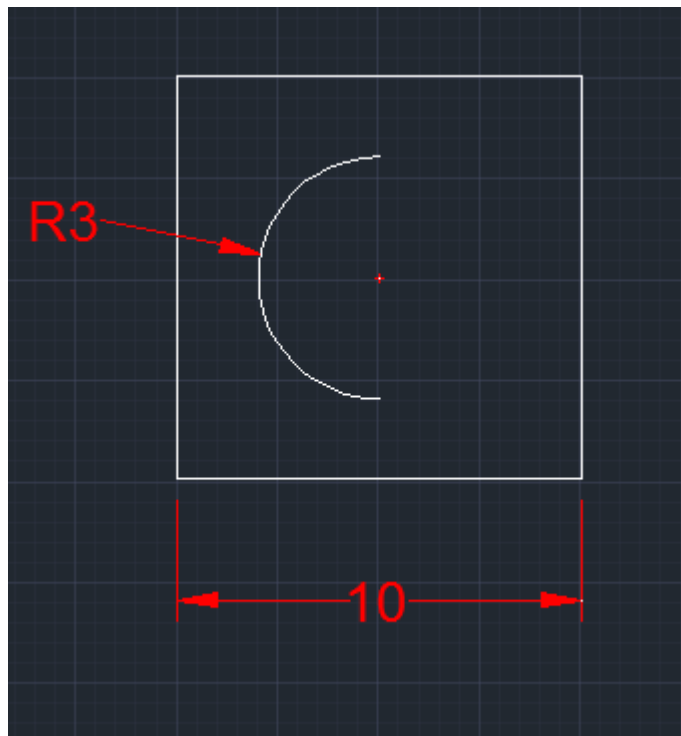
After learning the basic AutoCAD commands now it's time to focus on the editing commands:

- Trim
- Extend
- Scale
- Offset
- Copy
- Move
- Mirror
- Rotate
- Array (rectangular/polar)

1 Introduction

In this lab you will be adding some more common commands to your collection. All of these commands are ones that you will use on a regular basis and that will take your drawings to higher levels of complexities.


Draw a polygon of 4 sides and an edge of 10. From the midpoint draw a vertical line. Then, from the midpoint of that line, draw a circle of radius 3. Trim the object you drew as shown in the below figure.



2 Theoretical Background

2.1 Modify (editing) commands

2.1.1 Trim

Command	PDM	TB	Shortcut
trim	Modify → Trim		tr

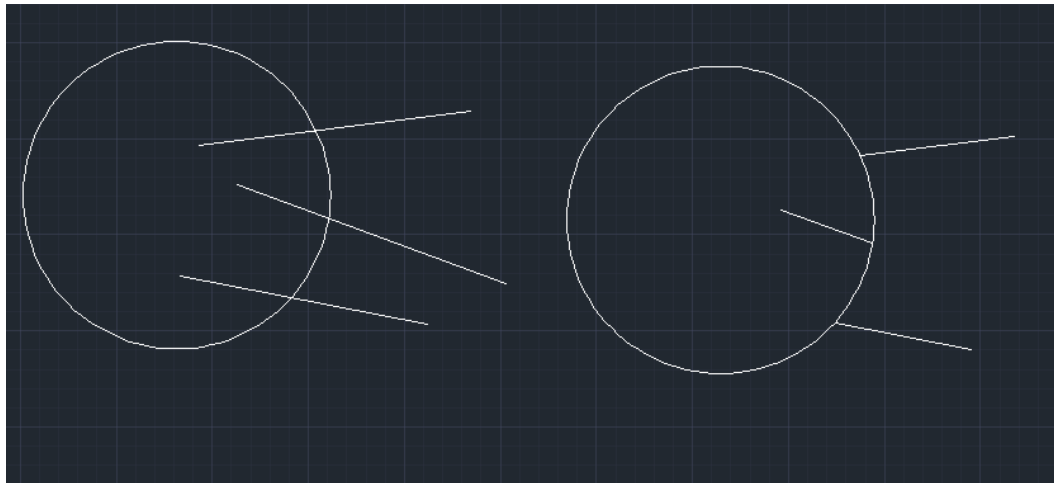
First, you need to select the objects that define the cutting edges to which you want

to trim an object then press ENTER or right click; or press ENTER to select all displayed objects as potential cutting edges.

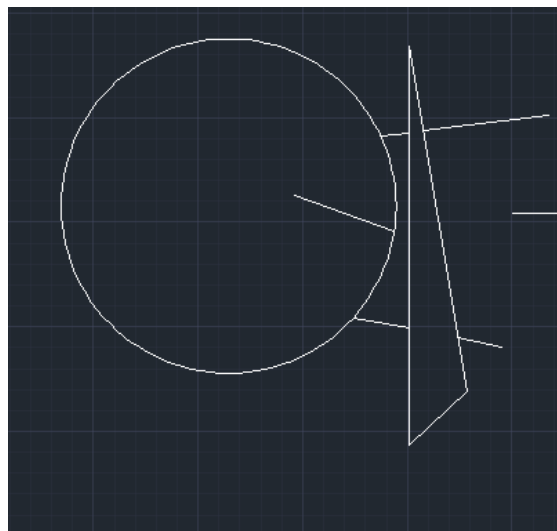
Then, you need to specify the object to trim. The prompt for selecting the object to trim repeats so you can trim multiple objects. Press ENTER to exit the command.

Example:

- 1) Draw a circle with three lines originating from within the circle and extending beyond its boundary. Then use the trim command with the circle as the cutting edge and the lines are the object to trim. See the below figure.



- 2) Draw a triangle on the above trimmed object. Select all the drawing as cutting edges and then trim the lines inside the triangle.



2.1.2 Extend

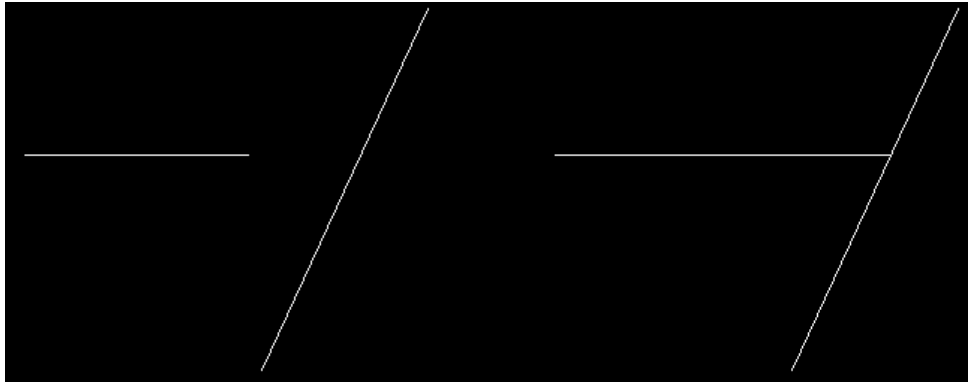
Command	PDM	TB	Shortcut
extend	Modify→extend		ex

First, you need to select the objects that define the boundary edges beyond which you do not want to extend then press ENTER or right click.

Then, you need to specify the object to extend. Press ENTER to exit the command.

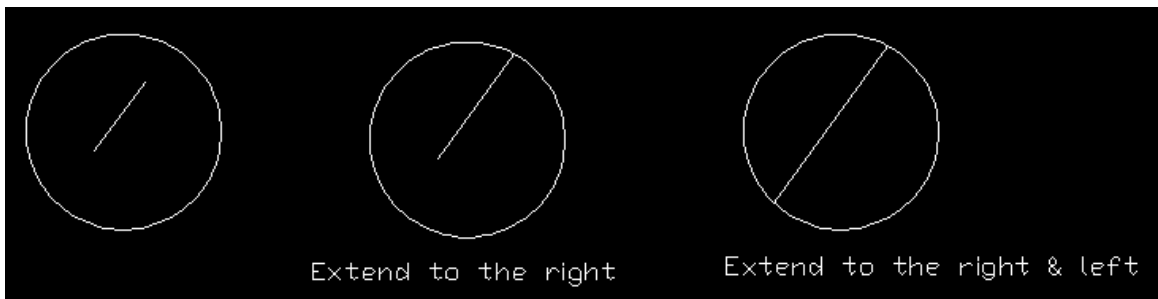
Example:

- 1) Draw two lines apart from each other. The oblique line is the boundary edge and the horizontal line is the object to extend.




- 2) Draw a circle and a line in the middle. Then choose the circle as the boundary edge and extend the line.

Note: If you press on the line but to the left, the line will be extended to the left. If you press to the right, it will be extended to the right



2.1.3 Scale

Command	PDM	TB	Shortcut
Scale	Modify→scale		sc

First, you need to select the objects then press ENTER or right click. Then, you need to specify a base point.

The base point you specify identifies the point that remains in the same location as the selected objects change size.

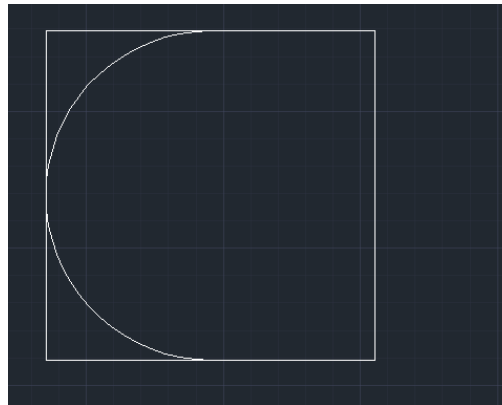
Finally, you need to specify a scale factor or [Copy/Reference]: Specify a scale, enter c, or enter r

Copy would actually copy the object before scaling it, while reference would use a

reference scale (i.e. specifying the reference to be 0.5 and then choosing a scale of 0.6 would be as if the object was scaled with a scale factor of $0.6/0.5=1.2$)

Example:

In the figure drawn before, scale the rectangle with a factor of $3/5$ using both the regular scale factor and the reference scale factor method (choose the center of the circle as the base point). You are supposed to obtain the following figure:

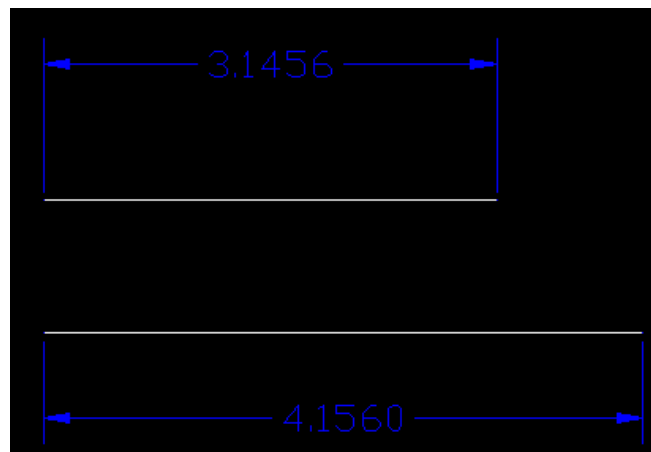


Note: Draw a line with a length of 3.1456


Now you need to scale this line to a new length of 4.156.

Instead of calculating the required scale factor, you can use scale **Reference** which scales the selected objects based on a reference length and a specified new length. The base point is the starting point of the line.

The reference length is 3.1456 and the new length is 4.156.



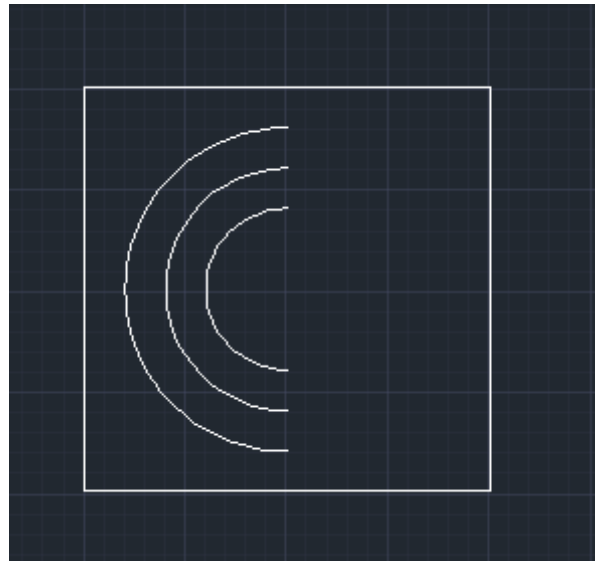
2.1.4 Offset

Command	PDM	TB	Shortcut
Offset	Modify→Offset		o

This command allows creating an object at a specified distance from an existing object.

First, you need to specify the offset distance (i.e. distance between the two objects) and then you need to click outside or inside the object in order to choose the offset direction.

Going back to the figure drawn in the beginning, perform an offset to the inside and outside of the half circle and of distance 1. Similar to the figure below

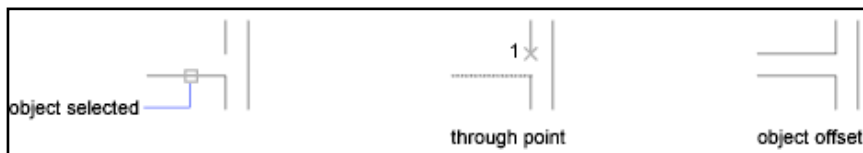


Note: You can enter the **Multiple** offset mode, which repeats the offset operation using the current offset distance. That is, once you select the object to offset, input “m” for multiple, and you will be able to do multiple offsets of the object at the same offset distance.

```
Select object to offset or [Exit/Undo] <Exit>:
Specify point on side to offset or [Exit/Multiple/Undo] <Exit>: m
```

Note: Offset **Through** creates an object passing through a specified point.

```
Specify offset distance or [Through/Erase/Layer] <5.0000>:
```



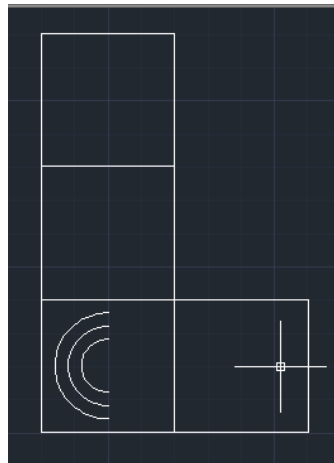
2.1.5 Copy

Command	PDM	TB	Shortcut
Copy	Modify → Copy		co

First, you need to select the objects that you want to copy then press ENTER or right click. Then, you need to specify the base point with respect to which you want to copy. Finally, you need to specify the point of insertion of your copied object (you

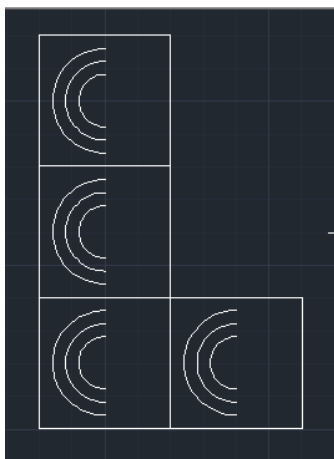
can either select the point or feed AutoCAD its coordinates). Press ENTER to exit the command.

Note: The two points you specify define a vector that indicates how far the copied objects are to be moved and in what direction.




Now copy the square **only** with the left lower corner being the base point, and the right lower corner being the insertion point (to make a copy to the right of our objects); or the left upper corner being the insertion point (to make a copy and place it above our existing objects).

Now you need to copy the half circles **only** and place them in the center of the copied squares. In order to do so, you need to take the left lower corner of the square as your base point and the right lower corner as your insertion point (to place the half circle in the center of the copied square on the right side); or the left upper corner of the square as your insertion point (to place the half circle in the center of the copied square on the top side).



Note: If you do not consider the left lower corner as your base point, i.e. you take your base point to be any point on the half circle, you will not be able to place the half circle in the center of the copied squares UNLESS you have the exact coordinates to feed them to AutoCAD.

2.1.6 Move

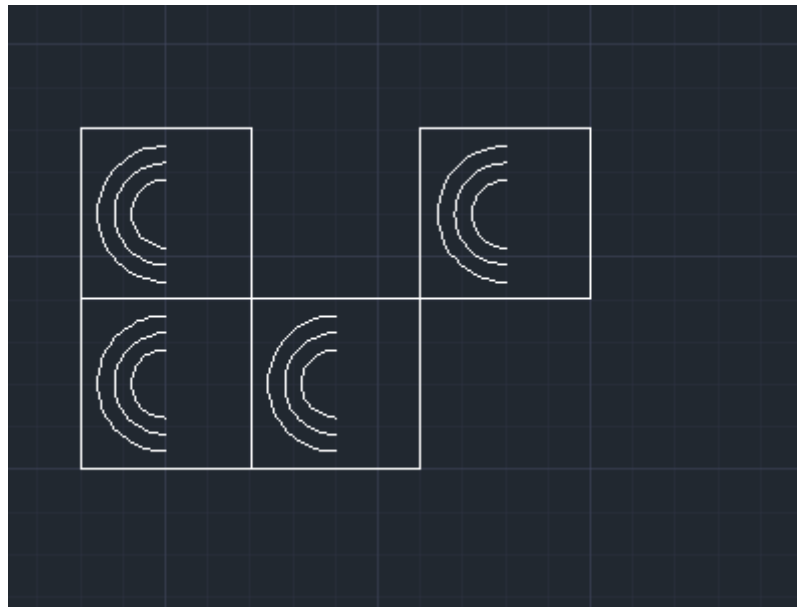
Command	PDM	TB	Shortcut
move	Modify→Move		m

First, you need to select the objects that you want to move then press ENTER or right click. Then, you need to specify the base point with respect to which you want to move. Finally, you need to specify the point of insertion of your moved object (you can either select the point or feed AutoCAD its coordinates). Press ENTER to exit the command.

Note: The two points you specify define a vector that indicates how far the selected objects are to be moved and in what direction.


Example:

Use the same drawing as the one used to demonstrate the **copy** command. Move the first square including the half circles to the right of the drawing. Note that you need to specify the base point (for example, the lower left corner of the square), and the insertion point (the upper right corner of the first square).



Note: The **Move** command changes the coordinates of the objects while the **Pan** command moves the whole paper, i.e. without altering the coordinates of the drawn objects.

2.1.7 Mirror

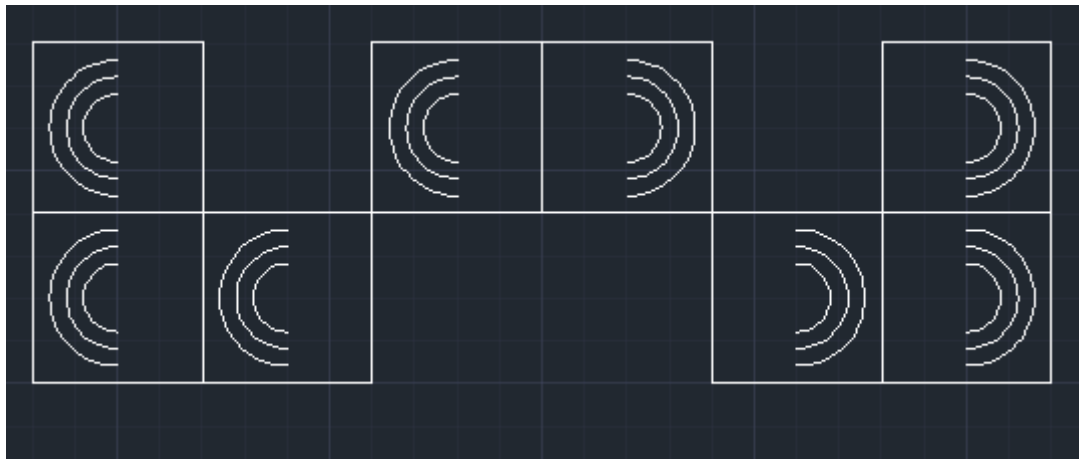
Command	PDM	TB	Shortcut
Mirror	Modify→Mirror		mi

First, you need to select the objects then press ENTER or right click. Then, you need to specify the mirror line by identifying the first point of the mirror line and the second point. The two specified points become the endpoints of a line about which the selected objects are mirrored. Finally, you need to specify whether you want to keep the source objects or not:


- **Yes:** Places the mirrored image into the drawing and erases the original objects.
- **No:** Places the mirrored image into the drawing and retains the original objects.

Example:

Use the same drawing as the one used to demonstrate the **copy and move** command and perform a mirror, using the right edge of the rightmost rectangle as the mirror line.



2.1.8 Rotate

Command	PDM	TB	Shortcut
Rotate	Modify→Rotate		ro

First, you need to select the objects to rotate, then press ENTER or right click. Then, you need to specify the base line with respect to which you want to rotate. Finally, you need to specify the rotation angle.

Example:

- 1) Use the same drawing as the one used to demonstrate the **mirror** command. Select all objects to be rotated and then specify the base point to be the left lower corner of the square. Finally, set the rotation angle to 45° .
- 2) Use the same drawing as the one used to demonstrate the **mirror** command. Select all objects to be rotated and then specify the base point to be the left lower corner of the square. Set the rotation angle to 23.156° .

Afterward, change the rotation angle using the **Reference** with a reference angle of 58.365° .

```
Specify rotation angle or [Copy/Reference] <0>:
```


Note: Reference rotates objects from a specified angle to a new, absolute angle.

- 3) Use the same drawing as the one used to demonstrate the **mirror** command. Select all objects to be rotated and then specify the base point to be the left lower corner of the square. Finally, use **Copy** and specify the rotation angle to be -90° .

```
Specify rotation angle or [Copy/Reference] <0>:
```

Note: Copy creates a copy of the selected objects for rotation, i.e. keeps the original objects.

2.1.9 Array

Command	PDM	TB	Shortcut
Array	Modify → Array		ar

We have three types of arrays: Rectangular, Polar and Path. If you select multiple objects, the objects are treated as one item to be copied and arrayed.

```
Enter array type [Rectangular/PATh/POLar] <Rectangular>:
```

Rectangular array

It creates an array of rows and columns of copies of the selected object. Therefore, you need to specify the number of columns and the number of rows that you need to generate.

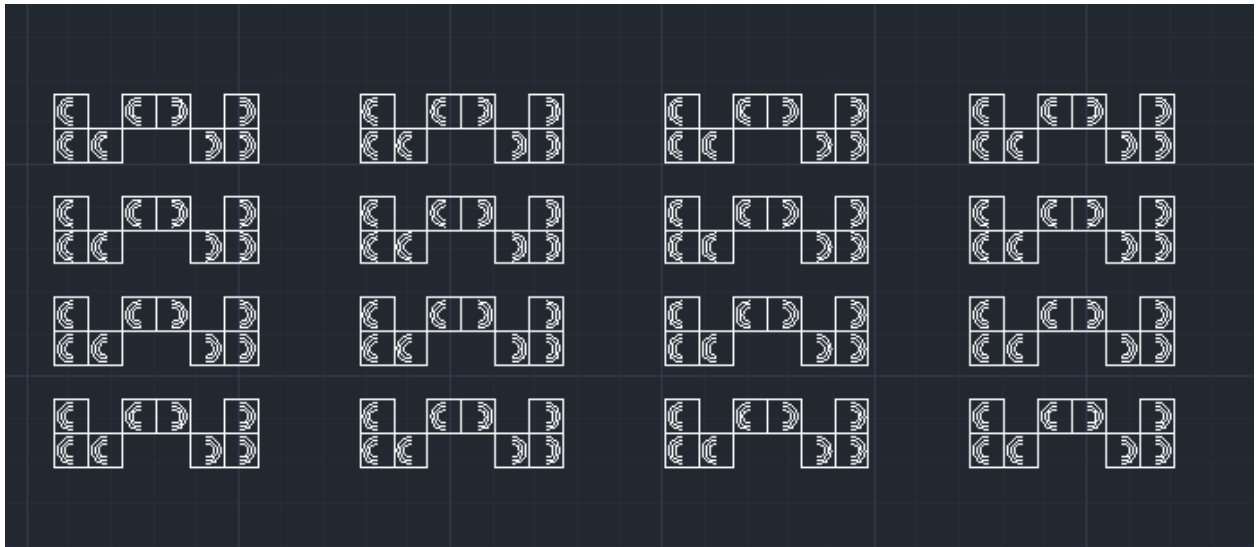
Also, you need to input either the distance of opposite corners in the array or the spacing between the rows (row offset) and columns (column offset).

In addition, you have the option to specify an angle of rotation for your array.

Example:

Use the same drawing as the one used to demonstrate the **mirror** command.

Select all the objects on your drawing. Specify the number of rows and columns to be 4. Choose the spacing option and specify the row spacing be 30 and column spacing to be 90.



Note: Notice how the entire array is set as one object. In order to separate the back you need to use the Explode command.

Polar array

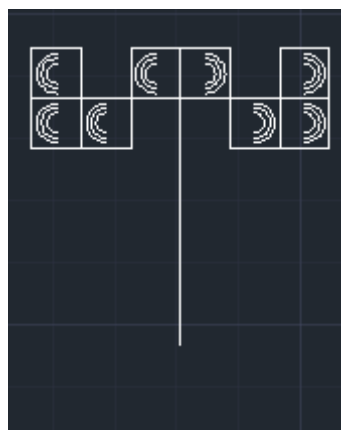
It creates an array by copying the selected objects around a specified center point.

Therefore, you need to specify the coordinates of the center point (X,Y) or select a point using the select box.

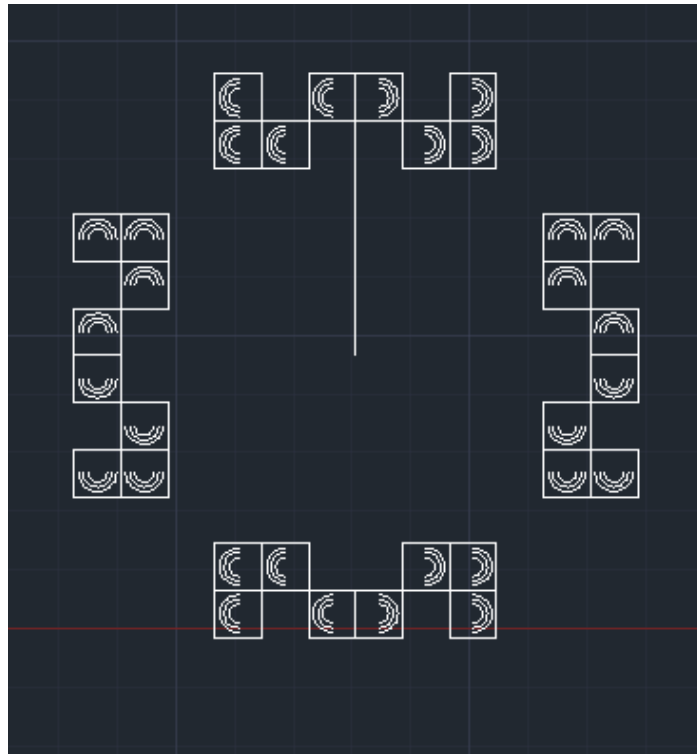
Also, you need to input the angle to fill and the number of items you want to create

Example:

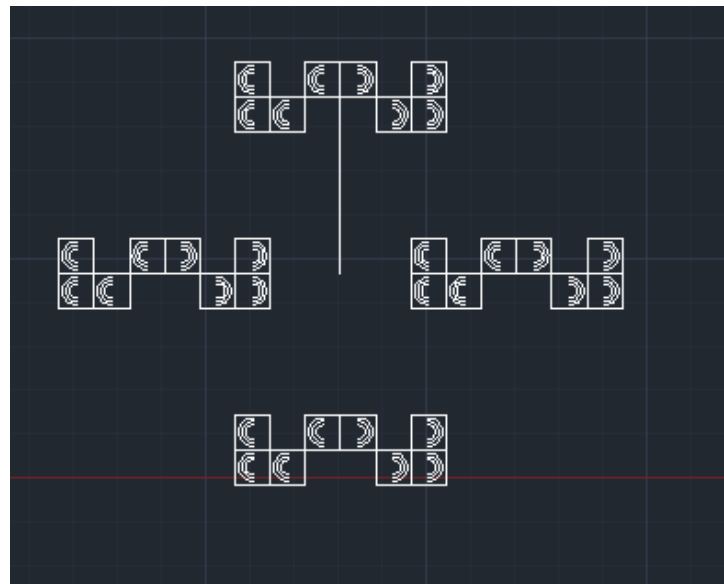
Use the same drawing as the one used to demonstrate the **mirror** command. However, add a vertical line of length 50 originating from the mirror line that was used previously.



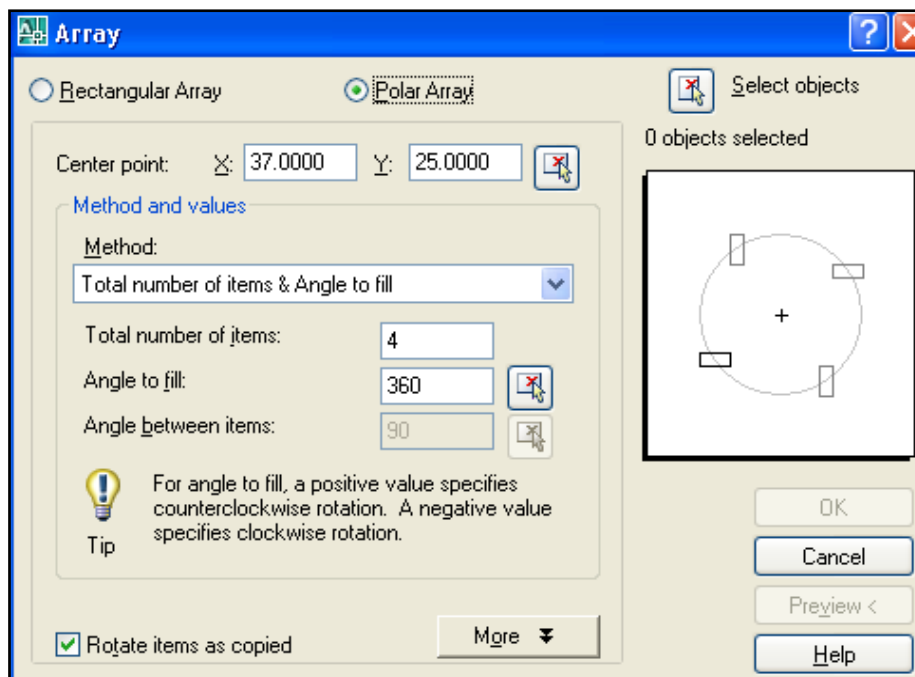
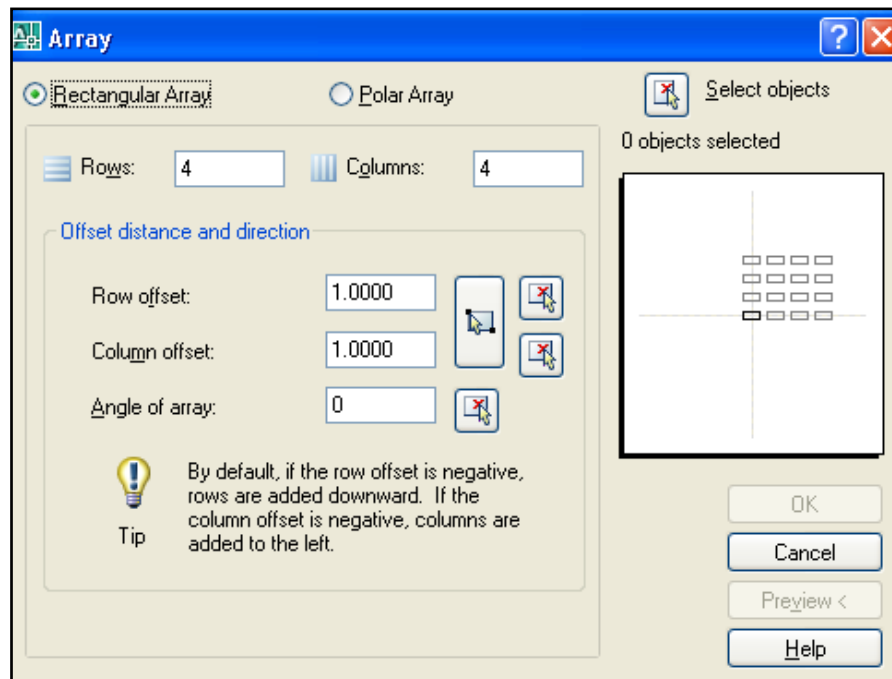
Select all the objects on your drawing without the line, i.e. use the blue pick box. Choose the array command and select polar array. Specify the lower end point of the line as the center point. Specify the total number of items to be equal to 4, the angle to fill to be $+360^\circ$.



Note: At the end, before accepting the array, you will have an option menu. In this menu you have the option to Rotate Items. It is set to yes by default, you can disable it and you will obtain the following figure:



Note: You can download an add-on for “array classic” to be able to input the array properties in a table form (similar to AUTOCAD 2007).



References

- [1] www.autodesk.com
- [2] <http://www.we-r-here.com/cad/tutorials/>
- [3] <http://www.cadtutor.net/tutorials/autocad/>