

Study Guide

Working with AutoCAD, Part 2

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INSTRUCTIONS

INTRODUCTION

Welcome to Working with AutoCAD, Part 2. This course introduces you to this automated drafting tool in a logical, skill-building manner. As you progress through your studies, keep in mind that often, there's more than one way to accomplish a particular task in AutoCAD. (For example, there are several equally efficient ways to draw a circle.) The information presented in this study guide and in your textbook will introduce you to the drawing and editing commands, and the different ways that you can access these commands. You should learn all of the options that are available in the program, even if you come to prefer one method over another. Knowing a variety of options will allow you to choose the best option for the task at hand. Additional learning tools provided in your textbook are the "WWW Exercises" and the "Chapter Drawing Projects" that can be used to reinforce the new AutoCAD concepts and skills you've learned. These exercises are located at the ends of the chapters. As you progress through this course, your skill in using AutoCAD will increase, and you'll become proficient at using this powerful and versatile drafting software.

COURSE OBJECTIVES

When you complete this course, you'll be able to

- Explain how to create a drawing template in AutoCAD using various commands
- Describe how plot layouts are created, modified, and how to scale viewpoints by using commands

YOUR TEXTBOOK

Your textbook, *Discovering AutoCAD 2017*, by Mark Dix and Paul Riley, contains the material on which you'll be tested. You need to become familiar with this textbook prior to beginning your studies.

You'll want to begin by skimming the table of contents. This will give you an overview of the entire textbook. Then read the preface as a brief introduction to the textbook. A glossary, which provides definitions for terms you may or may not be familiar with. Following the glossary is an index.

COURSE MATERIALS

This course includes the following materials:

1. This study guide, which contains an introduction to your course, plus
 - A lesson assignments page with a schedule of study assignments as well as exam for the two lessons you'll complete during this course
 - Assignment lessons emphasizing the main points in the textbook
2. Self-checks and answers to help you assess your understanding of the material
 - Your course textbook, *Discovering AutoCAD 2017*, which contains the assignment reading material

A STUDY PLAN

Think of this study guide as a blueprint for your course. You should read it carefully. Using the following procedures should help you receive the maximum benefit from your studies:

- Read the lesson in the study guide to introduce yourself to concepts that are discussed in the textbook. The lesson emphasizes the important material discussed in the text and provides additional tips or examples to help you grasp the material.
- Note the pages for each assignment in the textbook and read the assignment in the textbook to get a general idea of its content. Then study the assignment, paying attention to all details, especially the main concepts.
- Answer the questions and problems provided in the self-checks in the study guide. This will serve as a review of the material covered.
- After answering the suggested questions, check your answers with those given in the back of the study guide. If you miss any questions, review the pages of the textbook covering those questions. The self-checks are designed to reveal weak points that you need to review. Don't send the self-check answers to the school. They're for you to evaluate your understanding of the material. Complete each assignment in this way.
- After you've completed and checked the self-checks for Lesson 1, go to your student portal and complete your first exam.
- Follow this procedure for both lessons. At any time, you can contact your instructor for information regarding the materials.

Now you're ready to begin Lesson 1.

Good luck!



Remember to regularly check your student portal. Additional resources to enhance your learning experience may be posted.

READING ASSIGNMENTS

Lesson 1: Templates, Copies, Arrays, Arcs, and Polar Arrays

Read in the study guide:

Read in the textbook:

Section 1

Chapter 4

Section 2

Chapter 5, pages 181–192

Examination 054712

Lesson 2: Mirror Images, Page Setups, and Object Snap

Read in the study guide:

Read in the textbook:

Section 3

Chapter 5, pages 192–202

Section 4

Chapter 6

Examination 054713

Note: To access and complete any of the examinations for this study guide, click on the appropriate **Take Exam** icon on your student portal page. You shouldn't have to enter the examination numbers. These numbers are for reference only if you have reason to contact Student CARE.

LESSON 1: TEMPLATES, COPIES, ARRAYS, ARCS, AND POLAR ARRAYS

Learning how to create and save drawing templates in AutoCAD will save you time by eliminating the need to redefine a setup that was already done for a previous drawing. Templates require you to specify limits that define the outer frame size of your drawing. Another practical skill covered in this lesson is copying and moving objects in a drawing. You'll learn how to use the **ARRAY** command to replicate an object many times within a drawing. You'll be introduced to methods for drawing and editing objects that are based on circles when you learn how to create polar arrays. AutoCAD provides a variety of ways to draw arcs by inputting various pieces of information, and a few methods for drawing arcs will be covered in this lesson. The **ROTATE** command is the final time-saver introduced here; it allows you to rotate a previously drawn object.

LESSON OBJECTIVES

When you complete this lesson, you'll be able to

- Utilize templates, copies, and arrays commands
- Create arcs and polar arrays

SECTION 1

Read the following section. Then read Chapter 4 in your textbook.

This section will introduce you to the processes involved in setting up a drawing's parameters and creating templates that can be saved to use for future drawings. You'll learn more about several different drawing commands, as well as some of the more commonly used **Modify** options.

As explained in your earlier studies, when you're formatting a drawing, you'll typically begin by choosing the units that will be used to create the objects. The next step is to set the *limits* of the drawing. The **LIMITS** command controls the area of your project. This command also determines the "size" of the grid that's displayed on the screen. Be sure that you choose a limits setting that's appropriate for your drawing. Keep in mind what the limits of a drawing really mean. The limits in AutoCAD don't "limit" you when you're drawing; rather, they're simply a representation of the required area of a drawing as it relates to the display area of your screen.

Although it isn't a typical procedure, you can set drawing limits that are much larger than the object you want to draw, and the object will just appear to be very small on your screen. This will require you to *zoom in* on the object to make it fill your display area. Conversely, you can set limits that are much smaller than the object you're drawing, and the object will extend out past your display screen. Then, you simply need to *zoom out* to bring the object into a workable display size.

You can also change the limits of a current drawing, if you want to. To change the limits, you can simply type the word **LIMITS** in the command window. At that time, you'll be prompted to enter two points. These points represent the corners of your paper. The first point will be the lower left corner of the paper, and the second point will be the upper right corner of the paper.

For example, suppose you want a drawing size of 11 units wide and 8 units high. You would reset your limits by first typing the word **LIMITS** at the command prompt. You would enter your lower left corner point, which is normally started at the origin. Thus, you would type in the point (0,0), and then press **Enter**. You would then enter your upper right corner point, which in this case is (11,8), and then press **Enter**.

Now, once your limits are set, you must change your viewing area to this new size. You can do this by clicking on the **View** menu, selecting **Zoom**, and then selecting the **All** option. The viewing area of the screen will now match your new limits.

Once a drawing is formatted and various drawing parameters have been set, it can be very beneficial to save that "setup" for use in other similar drawings. The AutoCAD software allows you to create and save your own templates for future use. You can incorporate various AutoCAD settings into a template as described earlier, and it's also common practice to include individual object elements (such as a title block drawing) in a template. This option can help you use your drawing time much more efficiently. It also enables you to have more than one drawing open at a time. In that way, you can copy objects from one file to another.

One of the outstanding features of the AutoCAD software is the ability to move or to make multiple copies of objects within one drawing, by using the **COPY** and **MOVE** commands. The copies of objects, which have all of the properties of the original, can be modified to create variations. This ability is one of AutoCAD's most useful features, because it considerably lessens the amount of time needed to create drawings. You need to draw an object only one time, and then you can arrange it on your drawing by moving and copying. You can also use the **ARRAY** command to place repeated objects in an ordered arrangement.

The concepts of *model space* and *paper space* (page 138 in the textbook) are introduced in this section to clarify the difference between a three-dimensional (3D) *modeling* environment and a two-dimensional (2D) *drawing* environment. The *modeling environment* is the imaginary space in AutoCAD where you build a 3D representation of an object. So far, you've only drawn 2D objects; however, 3D modeling will be explained in detail later in your studies.

Paper space, or *layout*, is a 2D environment. This environment is where you arrange the various views of a model. These views are sometimes called *floating viewports*. Paper space represents the sheet of paper on which the drawing will be plotted, or printed. Although it's easy to make changes using AutoCAD, you'll still need to plan the layout somewhat to get good results and to avoid wasting time and resources. You need to consider the full size (1:1 scale) of the objects and the finished size of the image plotted on paper.

The *plot style table* allows you to control how AutoCAD treats the objects in your drawing when it's translating the model to a paper image. Depending on the output you want, you can control the colors, line weights, and shades of gray, as well as other parameters.

AutoCAD allows you to create customized tools such as macros, or automated key sequences. You will read about these customized tools later in this course.



Self-Check 1

At the end of each section of *Working with AutoCad, Part 2*, you'll be asked to pause and check your understanding of what you've just read by completing a "Self-Check" exercise. Answering these questions will help you review what you've studied so far. Please complete *Self-Check 1* now.

Answer the "Chapter Test Questions" at the end of chapter 4 of your textbook, *Discovering AutoCAD 2017*. This includes the "Multiple Choice," "Matching," "True or False," and "Questions." You may also want to try the "Drawing Problems" on your own.

Check your answers with those in the back of this study guide.

SECTION 2

Read the following section. Then read pages 181–192 of Chapter 5 in your textbook.

In the last section, the **ARRAY** command was introduced, and you learned how to array objects in a rectangular arrangement. The **Polar Array** option allows objects to be arranged according to angular distances defined by a circle or an arc. Keep in mind that

an *arc* is simply one curved section of a circle. Both arcs and circles are located by their center points. A circle contains a span of 360 degrees. The span of an arc shouldn't be confused with its length when you're creating polar arrays. It's also important to remember that the default option of a **Polar Array** command is that the objects are rotated. In many cases, you'll want objects to maintain a horizontal/vertical orientation, and therefore, you'll need to turn off the **Rotate Items** function.

As you learned earlier, regardless of the hundreds of commands and options that are available in the AutoCAD software menu, you're ultimately drawing objects using lines, circles, and arcs. You've already learned the basics of the **LINE** and **CIRCLE** commands. In this section, you'll learn to draw arcs. Arcs are drawn according to the geometry you choose to define them. In AutoCAD, there are 11 different ways to draw an arc depending on the values that you have available or that you choose to use. In most cases when you're drawing an arc, you'll use the **3-Point** option and use a defined center.

Regardless of the method used, to draw an arc, you must input three values. These three values are the point where the arc begins, the point where it ends, and the point where its center is located. It's important to realize that the number of methods a command includes, or the variety of options it contains, doesn't necessarily mean it's the best drawing tool to use. In many cases, you may find it much easier to use the **CIRCLE** command to draw a circle, and then simply "trim off" the section of the circle you don't need to draw an arc.

Another example of a "simpler is better" drawing method involves the use of the **ROTATE** command. Typically, you'll view, position, and define distances of objects in a horizontal or vertical orientation. Therefore, it's often easier to draw them in this familiar orientation, and then simply "rotate" them to the angle you choose.



Self-Check 2

In the "Chapter Test Questions" at the end of chapter 5 of your textbook, *Discovering AutoCAD 2017*, complete "Multiple Choice" exercises 1–4; "Matching" exercises a, c, and d; "True or False" exercises 3–5; and "Questions" 1–3. You may also want to try the "Drawing Problems" on your own.

Check your answers with those in the back of this study guide.

LESSON 2: MIRROR IMAGES, PAGE SETUPS, AND OBJECT SNAP

Lesson 2 continues the discussion of how objects can be rotated in a drawing and introduces the concept of using polar tracking at angular increments other than 90°. Original objects can be copied across an imaginary mirror line with the **MIRROR** command. *Page setups* allow you to save plot settings by name so that they may be used again in other future drawings.

Some of the powerful tools that are introduced in this lesson include *object snap* and *object snap tracking*. These allow for the accurate drawing and editing of two-dimensional shapes in AutoCAD. The **OFFSET**, **TRIM**, **EXTEND**, and **STRETCH** commands continue to show you ways to save time by taking advantage of AutoCAD's object modifying capabilities. The lesson concludes with a discussion of layouts and multiple viewports as you learn how to switch from paper space to model space in your drawings.

LESSON OBJECTIVES

When you complete this lesson, you'll be able to

- Identify the ways in which page setups are used to capture plot settings
- Describe how object snap and object snap tracking are used to increase your level of drawing accuracy

SECTION 3

Read the following section. Then read pages 192–202 of Chapter 5 in your textbook.

You've already learned several different ways to modify objects in AutoCAD, and you'll be learning many more in this lesson. In most cases, two methods are involved: (1) one that defines parameters of size or movement using specified distances or angles, and (2) another method that uses selection grips to select predetermined points on the object.

Using grips to **Rotate** or **Mirror** objects is a common practice. You can also rotate objects using *polar tracking* or the Ortho option. You simply choose the angle of rotation from the **Drafting Settings** dialog box and move the cursor in the direction you want to rotate. If you want, you can then copy the rotated object at the same angle to create a pattern, similar to the array process.

The **MIRROR** command is very similar to the **COPY** command, except that it creates a mirror image of the object instead of an exact duplicate. The mirror image is defined according to an imaginary line that defines the points at which the object will be mirrored. Each point on the mirrored object will be the same distance from its corresponding original point as measured along the mirror line.

You've become familiar with the basic steps that are required to print drawings in model space. Another part of this process involves using the **Page Setup** dialog box, which is accessed through the **Page Setup Manager** to establish the page setup parameters of the drawing plot. The most common decisions that you'll need to make are choosing the plotter (which is another name for a printer), the paper size, and the orientation. The available paper sizes are determined by the printer/plotter that you're using. There are two orientation choices in AutoCAD: **Portrait** and **Landscape**. The **Page Setup Manager** allows you to create a new page setup, and it can also modify an existing page setup. Although **Page Setup** is similar to the expanded **Plot** dialog box, it's important to note that **Page Setup** doesn't include some of the features of plotting.



Self-Check 3

In the "Chapter Test Questions" at the end of chapter 5 of your textbook, *Discovering AutoCAD 2017*, complete "Multiple Choice" exercise 5, "Matching" exercises b and e, "True or False" exercises 1 and 2, and "Questions" 4 and 5.

Check your answers with those in the back of this study guide.

SECTION 4

Read the following section. Then read Chapter 6 in your textbook.

In this section, you'll be introduced to several more **Modify** command options, as well as the powerful object snap function of the software. The **OSNAP** command allows you to "snap" to a predetermined location on or near an object, instead of entering a distance value when you're drawing lines, circles, or arcs. It's a huge time-saving option when you're creating drawings. Numerous **OSNAP** setting modes are available, depending on the object you're "snapping" to. For example, for circles, arcs, and ellipses, the choices are **Center**, **Tangent**, or **Quadrant**. Other options that can be used with several types of lines as well as circular defined objects are **Endpoint**, **Midpoint**, **Intersection**, **Apparent Intersection**, **Perpendicular**, and **Nearest**.

When you're using the object snap **OSNAP** function, you should choose only the setting modes that you're currently using. Although it might seem convenient to enable all of the modes, that isn't advisable. When you're actually trying to "snap" to or from a point in a

complicated drawing, the cursor will lock on the closest possible option along its path, even though you're trying to choose another. You can, however, choose to keep a few *running object snap* modes enabled that you use frequently. In many cases, you can right-click to toggle the settings *ON* and *OFF* to select the correct mode for the current task. It's also very important to remember that the object snap option should be enabled only when you're actually snapping to create lines, circles, and so on. If you're entering actual coordinates or distances in the command line, **OSNAP** must be turned off.

The **OFFSET** command is one of the most useful editing commands in AutoCAD. As its name implies, it can be used to copy lines, circles, and arcs to a parallel location; you simply need to choose the object and enter an offset distance and direction. The **OFFSET** option can be very helpful when it's used in conjunction with construction lines (*xlines*) to lay out drawings, especially architectural floor plans.

As you develop your own techniques to create drawings, you'll find that many times, you'll need to modify objects by "trimming off" some portions. The **TRIM** command will be used frequently to shorten lines, circles, and arcs that intersect other lines, circles, or arcs. Naturally, this process involves two separate objects; however, the process isn't intuitive. That is, when you're using the **TRIM** command, you're first prompted to choose the object that you're "trimming to" before you choose the object that you're "trimming." This means that you must first select the cutting edge that you want to use to trim another object. Your textbook contains a detailed explanation of this process with good illustrations, so be sure to read it carefully.

You can also extend objects by using the **EXTEND** command option, or stretch objects that are connected to other objects by using the **STRETCH** command. However, both of these commands differ from the **TRIM** command in that when you're prompted, you must choose the object to be modified *first* and the trimming edge *second*. Two other modifying commands that you'll find helpful are the **LENGTHEN** and **BREAK** commands, which function as their names imply.

Earlier, you learned the basics of plotting from model space, and were introduced to the concepts of *paper space* and *viewports* when creating plot layouts. By using paper space, you're able to place multiple views of objects on the same paper and plot them at the same time. If you think of a drawing in model space as a "one viewport" drawing, the viewport scale would be the same as a typical model space scale. By adding viewports, you're simply dividing your paper into different areas that you can zoom in or out to view. The viewport scales depend on their relationship to the overall plotting scale of your "one viewport" drawing. You'll learn much more about scaling for text and dimensions when using viewports in a future lesson.



Self-Check 4

Answer the “Chapter Test Questions” at the end of chapter 6 on pages 219–249 of your textbook, *Discovering AutoCAD 2017*. This includes the “Multiple Choice,” “Matching,” “True or False,” and “Questions.” You may also want to try the “Drawing Problems” on your own.

Check your answers with those in the back of this study guide.

SELF-CHECK ANSWERS

Self-Check 1

Multiple Choice

1. a
2. c
3. b
4. d
5. a

Matching

- a. Polar array
- b. Rectangular array
- c. ANSI B
- d. Template
- e. Vertical

True or False

1. True
2. True
3. True
4. False
5. False

Questions

1. Grid, snap, layers, limits, and units
2. In the AutoCAD **Template** file folder. The complete path is *Documents and Settings/<user name>/Local Settings/Application Data/Autodesk/AutoCAD 2017/R18.0/enu/Template*. The extension is .dwt.
3. You create a new drawing with settings already defined in the template.

4. Select an object so that grips are displayed, and then right-click.
5. An *array* is a circular or rectangular pattern of objects. Therefore, in a *rectangular array*, the pattern is linear and defined by rows and columns at regular distances apart. In a *polar array*, the pattern is angular and is based on the repetition of objects around the circumference of an arc or circle. A *path array* is created by copying objects at evenly spaced intervals along any curve, line, or closed figure.

Self-Check 2

Multiple Choice

1. b
2. d
3. b
4. c

Matching

- a. ROTATE
- c. ARRAYPOLAR
- d. ARC

True or False

3. True
4. False
5. False

Questions

1. A *polar array* is defined by any combination of two of the following: a certain number of objects, an angle that these objects span, and an angle between each item and the next. Any two will completely define the array.
2. Every *arc* has a start point, a center point, an end point, and an included angle. A start point and any two other factors will define the arc.
3. Select the object, enter the **ROTATE** command, specify the reference option, type **60**, and then type **90**. Without using reference, select the object, enter the **ROTATE** command, and type **30**.

Self-Check 3

Multiple Choice

5. a

Matching

- b. MIRROR
- e. Plot

True or False

1. False
2. False

Questions

4. The option allows objects to be rotated around different points, either on or off the object.
5. If a drawing with 18 × 12 limits was printed with a 1:1 scale on an A-size printer, and since A-size paper is only 12 × 9, only part of the drawing would be printed. Use the **Plot Preview** feature to see the effect before plotting.

Self-Check 4

Multiple Choice

1. d
2. a
3. c
4. c
5. b

Matching

- a. Trim
- b. Extend
- c. Object snap
- d. Object snap tracking
- e. Stretch

True or False

- 1. False
- 2. False
- 3. True
- 4. False
- 5. True

Questions

- 1. Hold down **Shift** and right-click.
- 2. You've selected a point on the opposite half of the line from the direction of the extend boundary.
- 3. crossing
- 4. Because the purpose of paper space is to represent the drawing sheet you wish to plot to. A 1:1 representation of the drawing sheet on the screen facilitates this.
- 5. So that you can have precise information about the relationship between the size of objects in the viewport and the size of objects in paper space. This also gives you information about the relative sizes of objects shown in different viewports.