AutoCAD GUIDE
2022

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******* INTRO *******

CHAP 1 - INTRO

1.1 About AutoCAD

AutoCAD is probably the most ubiquitous engineering CAD (computer-aided design/drafting) software. It is the premiere CAD program for civil engineers and architects. Autodesk is the company that develops and sells AutoCAD. Autodesk also produces Civil 3D, Inventor, and REVIT. AutoCAD is mainly used for its impressive 2D drafting tools, but it is also capable of doing 3D modeling.

AutoCAD is mainly used in Windows, but it also has a version for Mac. Autodesk is probably the only major CAD software company that offers engineering CAD software that is written natively for Mac.

GETTING AUTOCAD

Autodesk allows students to download and use a student-version of AutoCAD for free (search: "AutoCAD student edition"). Generally, this involves downloading the program (> 8 Gb) and then registering with Autodesk as a student. They will generally email you some codes that allow you to open the software. If you are having problems, it is usually best to talk to your fellow students. Licenses are likely 1 year.

1.2   Starting AutoCAD & initial changes

Open AutoCAD by double-clicking its icon. Some initial settings changes include the following. You may turn off GRID and SNAP (see sections below on how to do that). AutoCAD defaults to a dark grey background but you can change that to black if you wish. (options > Display tab > Colors ... > background (set to black)).

1.3   AutoCAD inputs

Users will generally use the mouse or keyboard to operate AutoCAD.

TERMS

Click	push left mouse button & RELEASE
Drag	hold down left mouse button and move mouse
Right click	push the right mouse button and release
Scroll wheel	zooms in and out (can change this)
MMB	push scroll wheel (middle mouse button)
hold LMB	push left mouse button and hold it down
Snap to point	allow OSNAPS to "snap" the cursor to a specific location (e.g., endpoint or midpoint). (do NOT click the mouse unless specified).
Touch and pull	snap the cursor to a location and pause ("touch", NO mouse button pushes) Then move the cursor again ("pull").

KEYBOARD

\<space bar\> = \<space\>	The space bar
\<enter\>	The space bar and enter keys are the same in AutoCAD
\<delete\> = \<del\>	Delete
\<ctl\> = \<ctrl\>	control key
\<alt\>	Alt key

WINDOWS SHORTCUTS

\<ctl-A\>   select all   \<ctl-z\>   undo

<ctl-C>	copy	<ctl-p>	plot (or print)
<ctl-x>	cut	<ctl-y>	redo
<ctl-v>	paste		

1.4   AutoCAD Interface

1.5   Status Bar

Grid
Snap
Ortho
Polar tracking
Iso
auto snap or osnap tracking
osnap
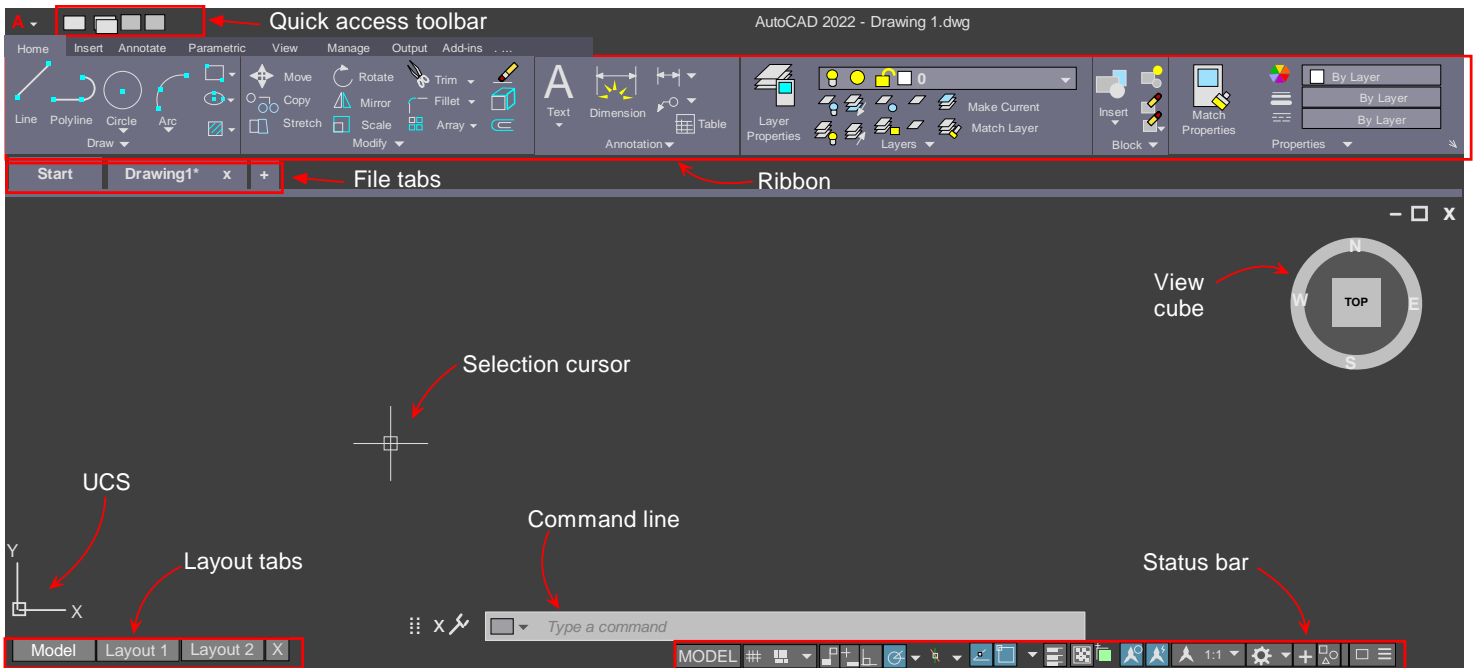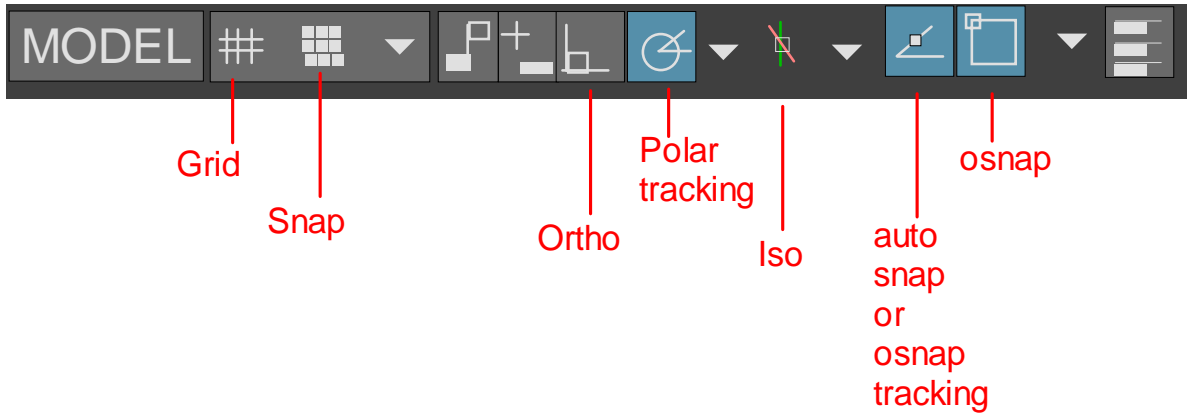
Here are some suggested settings for the status bar.

Infer constraints………… off   Dynamic Input (F12)……….......... ON
Snap mode………………. Off   Show lineweight…………………. ON
Grid……………………. Off   Show/hide transparency………... ON
Ortho mode (F8)………... off   Quick properties…………………. off
Polar tracking (F10)……. ON   Selection cycling…………………. off
Object snap (F3)……….. ON   Annotation monitor……………… off
3D Object snap (F4)…… off
Object snap tracking (F11) ON
Dynamic UCS…………... off

1.6   Commands

You may access various functions using either the RIBBON or by typing commands. AutoCAD remains a command-based program where functions may be typed into the command window (old-school users do this). Often this is faster than using the ribbon.

commandline   turns on command window
commandlinehide   closes command window (or click X)

< esc > exit a command.
<enter> or <space> repeats last command
<arrow up> (2x) to repeat command prior to last command (command window tracks history of commands)

AutoCAD saves the sequence of commands entered. Arrowing up allows you to access this command history.

1.7   Coordinates

AutoCAD uses a Cartesian system (x,y) and a POLAR system (r, θ).

CARTESIAN (X,Y) COORDINATES

(F6 = coordinates)

X axis is horizontal and (+) to the right, (-) to left.
Y axis is vertical and (+) up, (-) down
Origin – where X & Y axis intersect

POLAR SYSTEM (R, angle) COORDINATES

Another option when drawing lines is to use polar coordinates. With polar coordinates you specify an angle from your current position, where 0 degrees is horizontal to the right. 90 degrees is up. 180 degrees is left horizontal, etc. You then specify distance (or the radial coordinate).

Angles – 0 degrees points to the right horizontally. (+) angles are measured CCW.
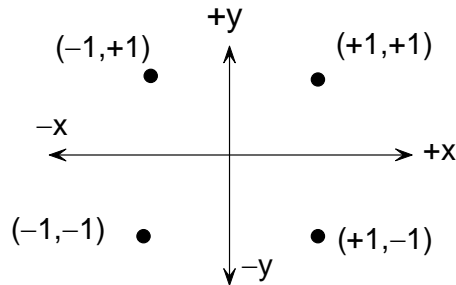
Cartesian (x,y) Coordinates
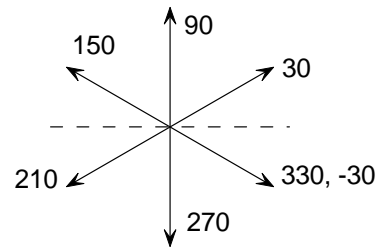
Polar (r, θ) coordinates

1.8   New Drawing

Creating a new drawing (settings)

Units	(Format/Units)
Drawing limits	(Format/Drawing limits)
Drawing size	<0,0> to <12, 9> (architectural size A) (virtual paper size)
Drafting settings	(ds, or tools/drafting settings)
Snap (F9)	Cursor snaps to grid or not
Grid (F7)	Toggle display of grid in drawing area. When shown, shows the drawing area

At this point you can start drawing items such as lines, arc, circles, and more. AutoCAD is VECTOR-BASED graphics program. This means that all objects are encoded mathematically, allow you to move, scale and do many other transformations to individual or groups of objects.
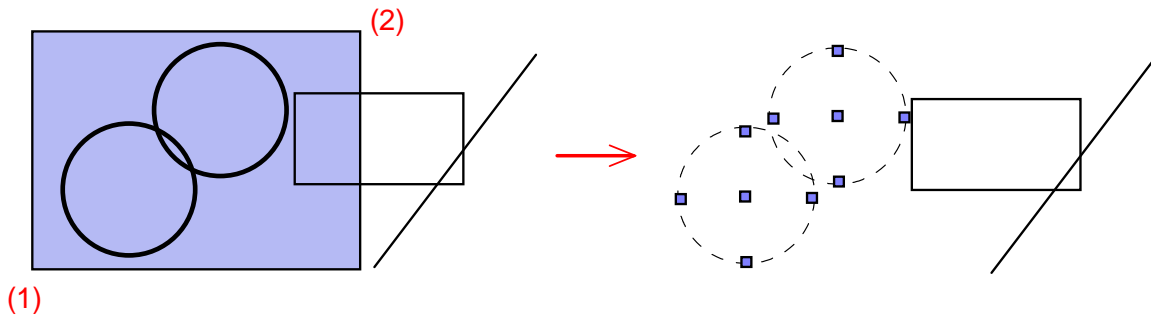
1.9   Selection

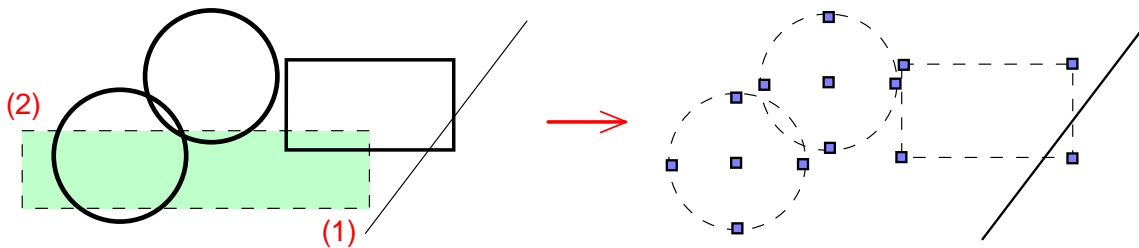There are 3 basic ways of selecting objects:

1. Pick box - pick individual objects (object is highlighted)
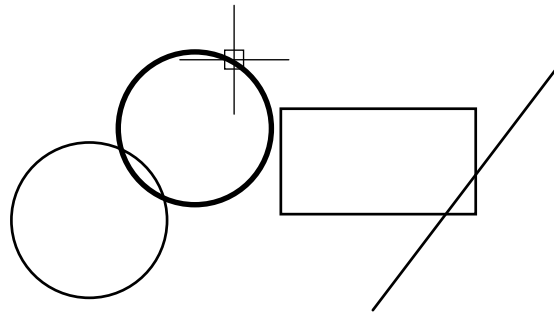
2. Window - drag a window left to right. Objects completely inside the blue window are selected

3. Crossing window - drag window right to left. Objects even partially inside green window are selected.

Selected objects have GRIPS (small blue squares) on them.
Accumulate selection by clicking other objects (no need to hold SHIFT, which is usually done in Windows programs). This can be altered (Options > Selection tab > [x] Use Shift to add to selection)

Unselect object by pressing SHIFT and clicking on the object.

1.10   Zoom (z) & Pan (p)

Zoom (command: z)

Zoom types
1.   Zoom ALL
2.   Zoom Window
3.   Zoom extents
4.   Zoom in/out - use scroll wheel (will zoom IN to the area where you hold the cursor)

PAN

Command: p (then drag mouse)
OR
Press MMB and drag
<Enter> or <es> to exit pan mode

1.11 Erase (e)

Select object. Press DELETE on keyboard. (command: "e")

1.12 Plot (p)

Plot = print.
Select printer
What to plot   extents
[x] Center the plot
[x] Fit to paper
Plot style pen   monochrome.ctb (to print everything in black)

1.13 Save (s)

Standard AutoCAD files are of the type *.dwg.
Use SAVE AS if you created something from a template file.

1.14 Object Snaps (OSNAPS)

OSNAPS are necessary for precise drawing. With OSNAPS on, if the cursor is moved close to a particular location (e.g., endpoint of line, midpoint of line), AutoCAD will snap the cursor to the exact location, assuming that is what the user intends.

Toggle Osnaps on and off using the status bar.

TRACKING

You can obtain exact alignments by touching off on a point (no mouse click) and then pulling the cursor. AutoCAD will present tracking lines that show alignment with the original point.

OSNAP "EXTENSION" HERE
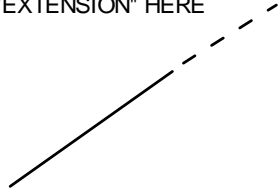
OBJECT SNAP TRACKING
IS SHOWN HERE

CHAP 2 - BASIC DRAWING

2.1   Line (L)

Command: "L"
Ribbon: (see figure, Home ribbon tab)

Select "Line".
Click to start line, move cursor
Click to end line.
Enter (or space) to end line creation.

Chain of lines - just keep clicking.

To create a line, and then another line (not connected)
Line > Click > Move Cursor > Click > Enter (end line command) > Move cursor > Enter (re-start line command) > Click > Move cursor > Click > Enter.

DYNAMIC ENTRY
Click, then move the cursor, then type the desired line length value.

POLAR ENTRY (setting in status bar)
Click to start the line, move the cursor.
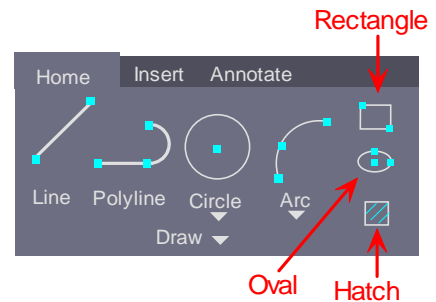A guide line will form at the nearest angle increment.

Change polar tracking settings by right clicking the button shown in status bar.
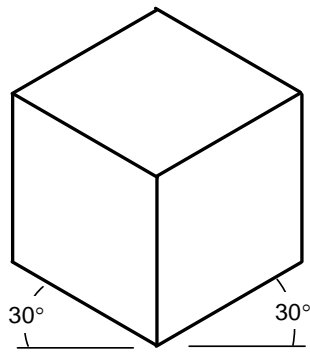You can change angular increments to any value you wish.
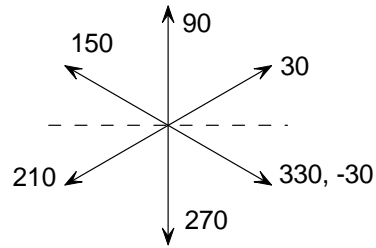
[x] Track using all polar angle settings

ISOMETRIC ANGLE

When drawing isometric views, the angles below are necessary.

Isometric cube

2.2 Circle (c)

Command: c
Ribbon: see figure

2.3 Rectangle (rec)

Command: rec
Ribbon: see figure

2.4 Arc (a)

Command: a
Ribbon: see figure

2.5 Hatch (bh)

Command: bh

CHAP 3 - MODIFY

3.1   Move (m)

Type m
Select objects to move
Select BASE (grabbing) point
Select new location
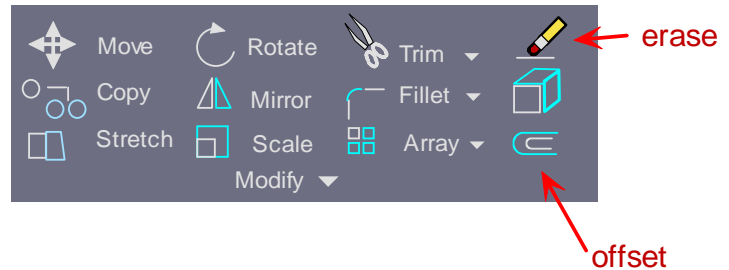
3.2   Copy (co)

Type co
Select objects to copy
Select BASE point.
Select new location

3.3   Trim (tr)

3.4   Extend (ex)

xx

3.5   Scale (sc)

Select objects to scale
Select BASE point
Type a value (> 1 increases size, < 1 decreases size)

3.6   Rotate (ro)

Select objects to rotate
Select BASE point
Type angle value

ROTATE TO A REFERENCE LINE
Select objects to rotate
Select BASE point
Type angle value

After picking base point, "r" (Reference)
Specify reference angle – pick 2 points to be the reference line (we will make the line joining those 2 points parallel to the line joining 2 other points)
Specify new angle or [Points]: "p"

3.7   Offset
xx

3.8   Fillet (f)
xx
xx

3.9   Array (ar)

This function makes copies of an entity and places them in either a rectangular or radial pattern.

Select objects
xx

3.10   Text

SINGLE LINE TEXT (dt)

Pick start point, type height, type angle, type TEXT

MULTI-LINE TEXT (mt)
Pull out boundary box
A whole menu & ruler appear, like MS Word.

CHAP 4 - LAYERS

Layers are used in AutoCAD as a collection of formatting. Objects on a particular layer will take on the formatting or attributes set up for that layer (e.g., line type, line weight, color, etc.).

Typical practice is to put related items on the same layer (e.g., dimensions).

Layer manager - you shouldn't have to get into this.

MY TEMPLATE
Dimensions (color = 143), hatch (color 31)
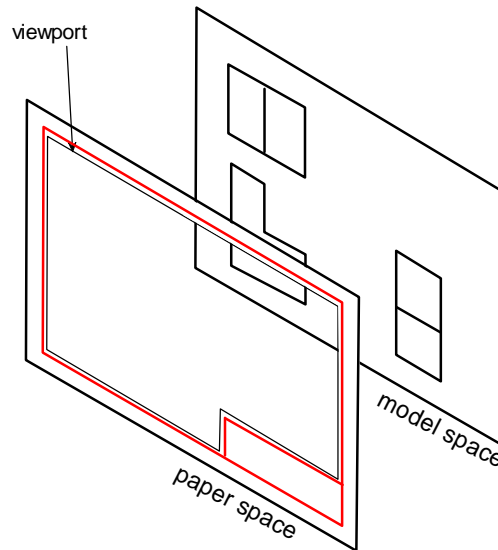
4.1   Initial Layer

As you create objects they will be placed on the current active layer.
It is best to select the current layer before creating objects.

4.2   Moving Objects Between Layers

Select the object. Select the layer it should be moved to.

CHAP 5 - VIEW PORTS

Until now we have only used MODEL SPACE. But there is also PAPER SPACE.
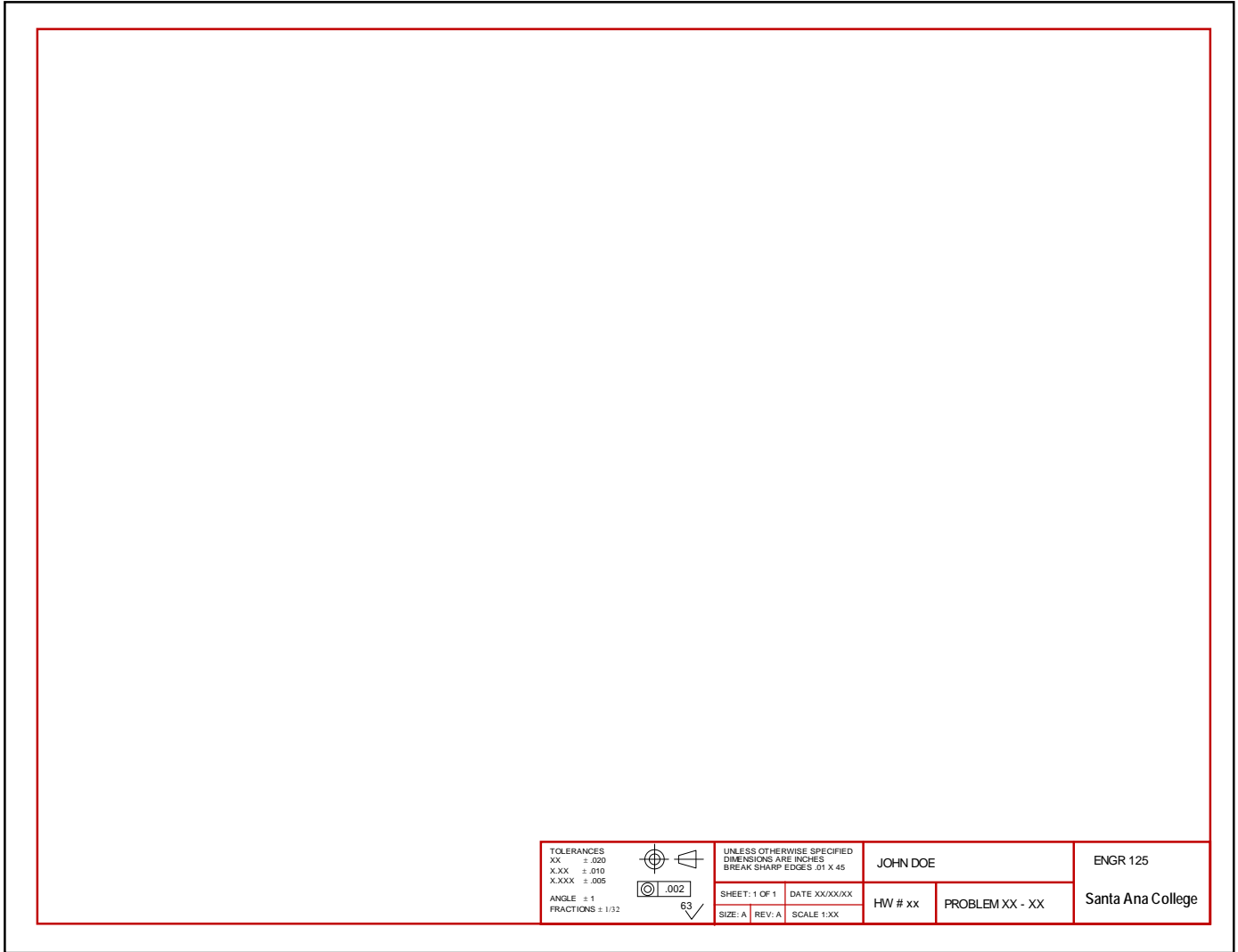
MODEL SPACE

This is the "space" where we draw all of our drawing entities (lines, curves, dimensions, text, etc.). We have been drawing everything in model space up until now.

PAPER SPACE

This is the space that holds the sheet format (border, title block).
It is also sometimes used to hold general notes, text, and dimensions.
It is also specified as one of the "Layout" tabs in the lower left of the interface.

Paper overlaps with model space (like 2 pieces of paper lines up with one another). Model space sits underneath paper space. The VIEWPORT is a hole cut thru paper space so that you can see thru to model space. The viewport scale allows magnifies or shrinks the model space items relative to the sheet format.

MOVING BETWEEN MODEL & PAPER SPACE
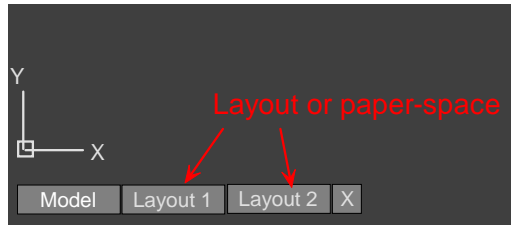
ENTER MODEL SPACE WHILE ON PAPERSPACE

While on a layout tab (paperspace), double-click in the middle white space. The viewport line (bright green) becomes thick, and the status bar indicates "model space".   You will see both the sheet format (which is on paper space) and the drawing entities (in model space) at the same time.

"Model" is indicated

Dynamic viewport scale

Viewport line is thick

TOLERANCES XX ± .020 X.XX ± .010 X.XXX ± .005 ANGLE ± 1 FRACTIONS ± 1/32	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES BREAK SHARP EDGES .01 X 45	JOHN DOE	ENGR 125
	SHEET: 1 OF 1	DATE XX/XX/XX	HW # xx	PROBLEM XX - XX	Santa Ana College
	SIZE: A	REV: A	SCALE 1:XX			

MODEL ⟋ 1.15483 1:1

Quick access toolbar

File tabs

Ribbon

View cube

Selection cursor

UCS

Layout tabs

Command line

Status bar

5.1 Create Viewport

Ribbon: Layout tab
Options: Rectangular, Polygonal

Get into paper-space first.

5.2 Viewport Scale

In mechanical drafting it is desirable to set the drawing scale to be in whole numbers (integers). The drawing scale in AutoCAD is tantamount to setting the viewport scale.

Steps for achieving this:

1. Display the Viewport toolbar
2. Dock the viewport toolbar (???)
3. Get into model space (double click white space)
4. The viewport will highlight as a thick bright green line.
5. Zoom extents. This will zoom to all of your drawn entities though it may be slightly too big
6. Observe the current viewport scale (it is likely a decimal number)
7. Reduce the scale. Eg - if it reads 1.115, change it to 1.00
8. Center your stuff in the viewport (pan)
9. Careful not to turn the scroll wheel while panning
10. Once you have what you want double-click in the grey area outside the sheet.

******* DIMENSIONING *******

CHAP 6 - DIMENSIONING

6.1   Dimension tools
6.2   Linear
6.3   Offset
6.4   Radius

Pick tool
Pick arc
Dimension placed on concave side of arc

6.5   Dimension scale
Dimensions are placed in model space.
Thus they will shrink/grow with adjustments to viewport scale.
Thus we must compensate for this by setting the dimension scale as RECIPROCAL of viewport scale.
Steps
1. Set viewport scale with enough space for views + dimensions.
2. Get into dimension style manager (command: d)
3. Class dim style is highlighted > Modify > Fit (tab) > Use overall scale of: > set as reciprocal

6.6   Dimension Style

6.7   Dimension tools

CHAP 7 - TECHNIQUES

7.1   Auxiliary Views

Create the view and dimensions FIRST. Then rotate everything.

7.2   Section Views

Draw the section view.
Get into the hatch layer.
Hatch BEFORE drawing centerlines.

ct_text1 - Interesting text goes **here**.
ct_text2

CHAP 8 - APPENDIX

ct_text1 - Interesting text goes **here**.
   ct_text2
       ct_text3
                   ct_text4
                     ct_text5

8.1   Section 1.1

```
 // ctz_programg
    // ctZ_programg2
```
we have some ct 2 text
   1.   Numbered list
   2.   list 2
   3.   list 3

8.2   Section 1.1

Here we have some ct 2 text

1. Numbered list
2. list 2
3. list 3