

Automation (21-541)

*Advanced Manufacturing Laboratory
Department of Industrial Engineering
Sharif University of Technology*

Session # 6



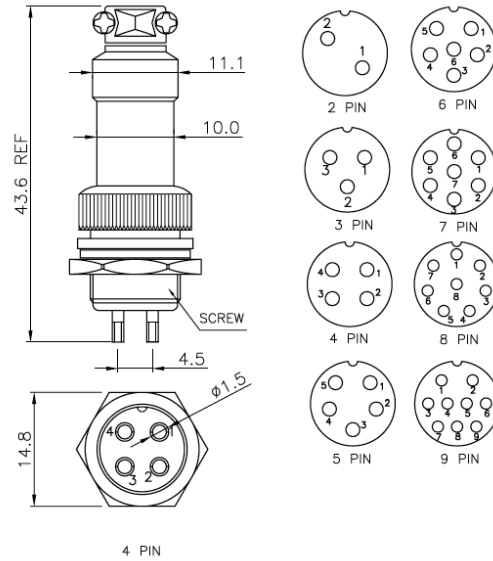
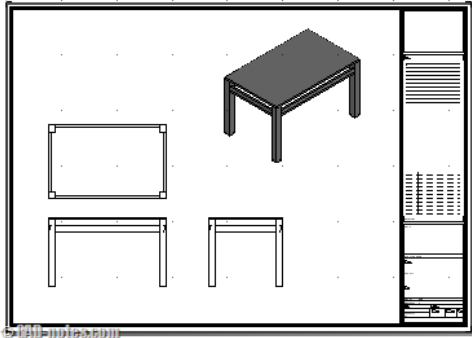
Session Schedule

- *Computer-Aided Design (CAD)*
 - *Introduction*
 - *Graphic primitives*

Computer-Aided Design (CAD)

Introduction:

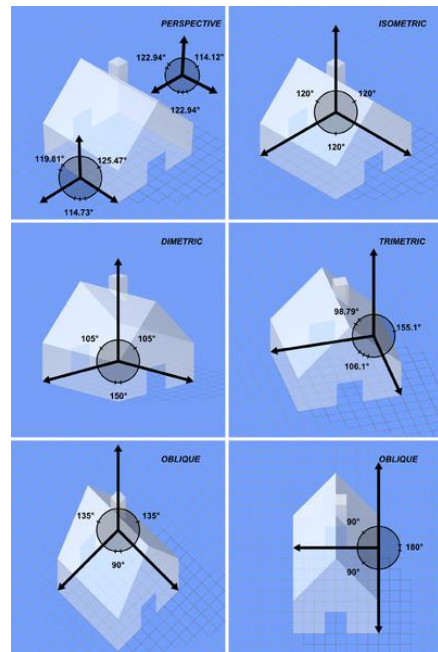
- Traditionally drawings are prepared on plane drawing sheets.



Computer-Aided Design (CAD)

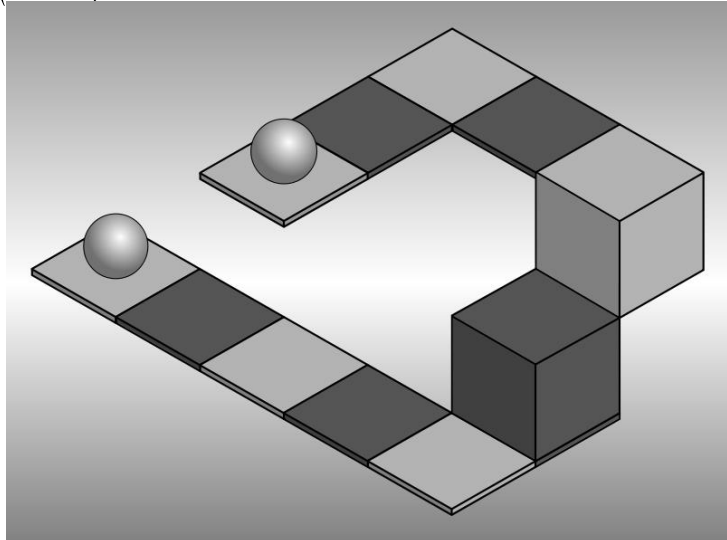
Introduction:

- Plane drawing sheets have several limitations:
 - The sketches have to be made only in two dimensions
 - Though the depth can be represented by pictorial projections like:
 - isometric and perspective projections,
 the projections have to be necessarily reduced to two dimensions.



Computer-Aided Design (CAD)

- *Introduction:*
 - *Plane drawing sheets have several limitations:*



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Computer-Aided Design (CAD)

- *Introduction:*
 - *Use of computer graphics has opened up tremendous possibilities for the designer:*
 - *The object is represented by its geometric model in three dimensions (X, Y and Z)*
 - *The mathematical representation reduces creation of views like orthographic, isometric, axonometric or perspective projections into simple viewing transformations*
 - *Sections can be automatically created.*
 - *Revision and revision control are easy.*
 - *Drawings (geometric models) can be modified easily.*

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Computer-Aided Design (CAD)

- *Graphic primitives:*

- *Modern computer graphics displays consist of basically three components.*
 - *Monitor*
 - *Digital Memory or Frame Buffer*
 - *Display Controller*



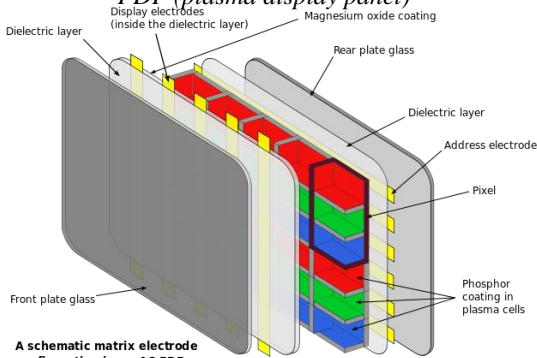
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Computer-Aided Design (CAD)

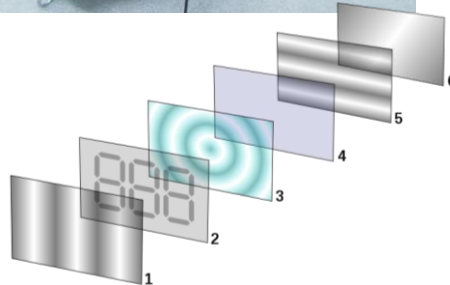
- *Graphic primitives:*

- *CRT (Cathode ray tube)*
- *LCD (liquid crystal display)*
- *PDP (plasma display panel)*



A schematic matrix electrode configuration in an AC PDP

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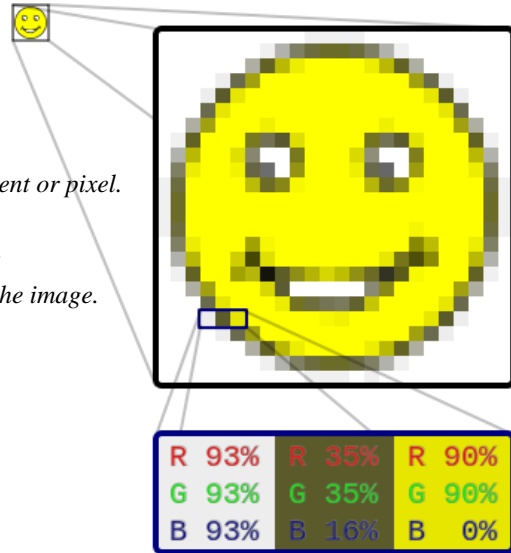


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Computer-Aided Design (CAD)

Graphic primitives:

- The video display screen is divided into very small rectangular elements called a picture element or pixel.
- Graphic images are formed by setting suitable intensity and color to the pixels which compose the image.



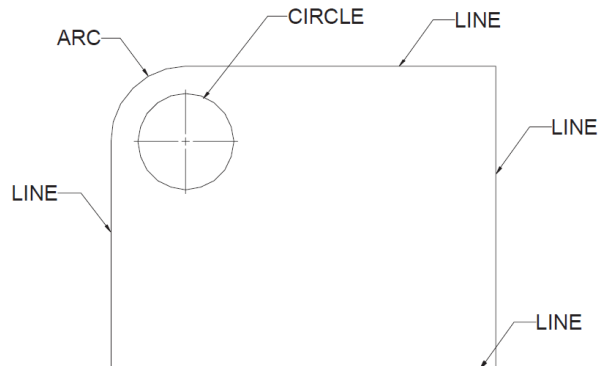
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Computer-Aided Design (CAD)

Graphic primitives:

- A drawing is created by an assembly of points, lines, arcs, circles.
- The drawing entities that a user may find in a typical CAD package include :
 - point
 - line
 - construction line, multi-line, polyline
 - circle
 - spline
 - arc
 - ellipse
 - polygon
 - rectangle



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Computer-Aided Design (CAD)

- *Graphic primitives:*
 - *Line*
 - *Straight line segments are used a great deal in computer generated pictures.*
 - *The following criteria have been stipulated for line drawing displays :*
 - *Lines should appear straight*
 - *Lines should terminate accurately*
 - *Lines should have constant density*
 - *Line density should be independent of length and angle*
 - *Line should be drawn rapidly*

Computer-Aided Design (CAD)

- *Graphic primitives:*
 - *DDA algorithm (Digital Differential Analyzer)*
 - *The digital differential analyzer generates lines from their differential equations.*
 - *The DDA works on the principle that X and Y are simultaneously incremented by small steps proportional to the first derivatives of X and Y.*
 - *In the real world of limited precision displays, addressable pixels only must be generated.*

Computer-Aided Design (CAD)

Graphic primitives:

- Procedure DDA ($x1, y1, x2, y2$: integer) ;
- As begin:
- $STEP = \max \{ \text{abs}(x2-x1), \text{abs}(y2-y1) \}$
- $Dx = (x2-x1)/STEP$; $Dy = (y2-y1)/STEP$;
- $X = x1$; $Y = y1$;
- For (int $i=0$; $i \leq STEP$; $i++$)
- {
- $\text{plot}(\text{truncate}(X+0.5), \text{truncate}(Y+0.5))$;
- $X = X + Dx$;
- $Y = Y + Dy$;
- }

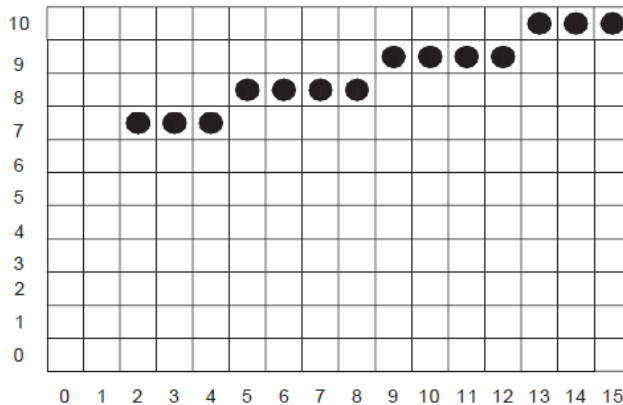
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Computer-Aided Design (CAD)

Graphic primitives:

- Procedure DDA (2,7, 15, 10)



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X	Y	trunc (X)	trunc (Y)
2.5	7.50	2	7
3.5	7.73	3	7
4.5	7.96	4	7
5.5	8.19	5	8
6.5	8.42	6	8
7.5	8.65	7	8
8.5	8.88	8	8
9.5	9.11	9	9
10.5	9.34	10	9
11.5	9.57	11	9
12.5	9.80	12	9
13.5	10.23	13	10
14.5	10.46	14	10
15.5	10.69	15	10

Computer-Aided Design (CAD)

- *Graphic primitives:*
 - $P=(1-t)P_0+(t)P_1 \quad 0 \leq t \leq 1$
 - *Procedure DDA* ($x1, y1, x2, y2 : integer$);
 - *As begin:*
 - $STEP = \max \{ \text{abs}(x2-x1), \text{abs}(y2-y1) \}$
 - $dt = 1/STEP;$
 - $(Dx, Dy) = dt(P1 - P0);$
 - $X = x1; Y = y1;$
 - *For* ($int \ i = 0; i <= STEP; i++$)
 - {
 - $plot(\text{truncate}(X+0.5), \text{truncate}(Y+0.5));$
 - $X = X + Dx;$
 - $Y = Y + Dy;$
 - }

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Homework: AT-G-02-#

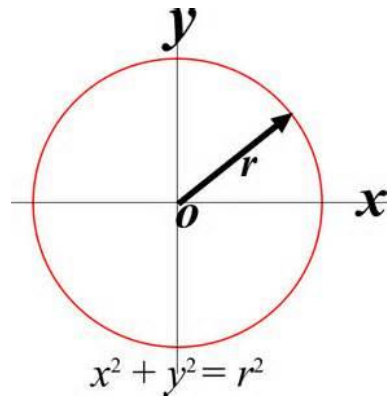
- *Provide a simple program to plot geometric objects. You should use your CIM data base structure to maintain the geometric data.*
 - *A simple interface can be applied to plot the geometric objects.*
 - *You should provide your first module/procedure to plot a line by getting the required Cartesian locations in a 2D space.*
- *The HW should be sent to Evalilai@sharif.edu till Saturday, 23rd of Farvardin (April, 12th, 2014)*
- *Email subject: "AT-G-02-#"*

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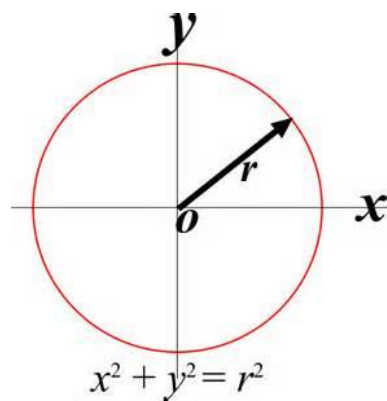
Computer-Aided Design (CAD)

- *Graphic primitives:*
 - *Procedure DDA (X1, Y1, R : integer) ;*



Computer-Aided Design (CAD)

- *Graphic primitives:*
 - *Procedure DDA (X1, Y1, R : integer) ;*
 - *As begin*
 - *For(int tetha=0;tetha<360;tetha++)*
 - {*
 - Plot(X1+R*cos(tetha),Y1+R*sin(tetha))*
 - }*



Computer-Aided Design (CAD)

Graphic primitives:

- Procedure DDA ($X1, Y1, R : \text{integer}$);
- As begin
- $DTetha = 1$
- For(int tetha = 0; tetha <= 2 * π ; tetha += $DTetha$)
- {
- $Plot(X1 + R * \cos(tetha), Y1 + R * \sin(tetha))$
- }

