৻ৎ GRAPHICS AND MULTIMEDIA TECHNOLOGY FORMULAS ৻ৎ

IMAGE EXERCISES

Size of Image $= \frac{no.\ of\ pixels\ (w)}{no.\ of\ pixels\ per\ inch} * \frac{no.\ of\ pixels\ (l)}{no.\ of\ pixels\ per\ inch}$

Resolution of Image $= \frac{total\ no.\ of\ pixels}{inches}$

Height of Resized Image $= \frac{H1}{W1}\ (W2)$

Width of Image $= \frac{H}{AR}$ *// given* ***Aspect Ratio*** $= \frac{H}{W}$

Amount of Memory
*= total pixels * requirement of each pixel //always 24 bits*
(to bytes → bits/8 | to KB → bytes/1024 | to MB → KB/1024)

Refresh Rate *(given batch)*
*= no. of groups * access time*
where: no. of groups $= \frac{total\ no.\ of\ pixels}{no.\ of\ pixels\ per\ group}$
(to seconds → ns/10^9 | to Hz → reciprocal of seconds)

Number of Colors produced by frame buffer
*= R * G * B = 256 * 256 * 256*

DIFFERENTIAL DIGITAL ANALYZER (DDA)

Slope (m) $= \frac{y2 - y1}{x2 - x1}$

Cases:

- 1.1: |m| <1 and m is positive, solve for y:
  - $y_{k+1} = y_k + m$
- 1.2: |m|< 1 and m is negative, solve for y:
  - $y_{k+1} = y_k - m$
- 2.1: |m| > 1 and m is positive, solve for x:
  - $x_{k+1} = x_k + 1/m$
- 2.2: |m| > 1 and m is negative, solve for x:
  - $x_{k+1} = x_k - 1/m$

| **x** | **y** | ***y(round)*** | or | **x(round)** | **x** | ***y*** |

MIDPOINT CIRCLE ALGORITHM

Initial Decision parameter

- $r_0 = (5/4) - r$

For each position thereafter starting at p=0:

- if $r_p < 0$
  - $r_{p+1} = r_p + 2x_{p+1} + 1$
  - (x_{p+1}, y_p) // retain y
- if $r_p \geq 0$
  - $r_{p+1} = r_p + 2x_{p+1} - 2y_{p+1} + 1$
  - (x_{p+1}, y_{p-1}) // decrease y

X and Y based on given Center at (x_c, y_c)

- $X = x_p + x_c$
- $Y = y_p + y_c$

| $\mathbf{r_p}$ | x | y | ***X*** | ***Y*** |

BRESENHAM'S LINE ALGORITHM

Slope (m) $= \frac{\Delta y}{\Delta x} = \frac{y2 - y1}{x2 - x1}$

for |m| < 1 (case 1):

- initial
  - $r_0 = 2\triangle y - \triangle x$
- if previous rp < 0 (negative)
  - $r_{p+1} = r_p + 2\triangle y$
  - (x_{p+1}, y) // retain y
- if previous rp ≥ 0 (positive)
  - $r_{p+1} = r_p + 2\triangle y - 2\triangle x$
  - (x_{p+1}, y_{p+1}) // increase y

For |m| > 1 (case 2):

- initial
  - $r_0 = 2\triangle x - \triangle y$
- if previous rp < 0
  - $r_{p+1} = r_p + 2\triangle x$
  - (x, y_{p+1}) // retain x
- if previous rp ≥ 0
  - $r_{p+1} = r_p + 2\triangle x - 2\triangle y$
  - (x_{p+1}, y_{p+1}) // increase x

| $\mathbf{r_p}$ | ***x*** | ***y*** |

CIRCLE GENERATING ALGORITHM

Solve for:

- dθ = 45/r

Formulas: θ = 0

- $x_1 = r\cos\theta$
- $y_1 = r\sin\theta$
- $x_2 = r\cos(\theta + d\theta)$
- $y_2 = r\sin(\theta + d\theta)$
- $x_3 = x_2\cos(d\theta) - y_2\sin(d\theta)$
- $y_3 = y_2\cos(d\theta) + x_2\sin(d\theta)$
- $x_n = x_{n-1}\cos(d\theta) - y_{n-1}\sin(d\theta)$
- $y_n = y_{n-1}\cos(d\theta) + x_{n-1}\sin(d\theta)$

| x | y | ***X*** | ***Y*** |

GEOMETRIC TRANSFORMATIONS

Scaling

$$\begin{pmatrix} x' \\ y' \end{pmatrix} = \begin{pmatrix} s_x \cdot x \\ s_y \cdot y \end{pmatrix} = \begin{pmatrix} s_x & 0 \\ 0 & s_y \end{pmatrix} \cdot \begin{pmatrix} x \\ y \end{pmatrix}$$

Rotation

$$\begin{pmatrix} x' \\ y' \end{pmatrix} = \begin{pmatrix} x \cdot \cos(\theta) - y \cdot \sin(\theta) \\ x \cdot \sin(\theta) + y \cdot \cos(\theta) \end{pmatrix} = \begin{pmatrix} \cos(\theta) & -\sin(\theta) \\ \sin(\theta) & \cos(\theta) \end{pmatrix} \cdot \begin{pmatrix} x \\ y \end{pmatrix}$$

Shearing

$$\begin{pmatrix} x' \\ y' \end{pmatrix} = \begin{pmatrix} x + s_x \cdot y \\ y + s_y \cdot x \end{pmatrix} = \begin{pmatrix} 1 & s_x \\ s_y & 1 \end{pmatrix} \cdot \begin{pmatrix} x \\ y \end{pmatrix}$$

Translation

$$\begin{pmatrix} x' \\ y' \end{pmatrix} = \begin{pmatrix} x + d_x \\ y + d_y \end{pmatrix} = \begin{pmatrix} x \\ y \end{pmatrix} + \begin{pmatrix} d_x \\ d_y \end{pmatrix}$$