CS 808
GMM
BTech 6th Sem
CSE

Graphics and Multimedia

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* Computer Graphics: It is an art of drawing pictures, lines, charts etc. on computer screen using programming language. In C.G., objects are presented as a collection of discrete picture elements called the pixel. Pixel is the smallest screen element.

* User can edit graphic objects with keyboard, mouse and touch sensitive panel on the screen, i.e, graphic devices are the combination of i/p devices and display devices.

* Advantages
  - High quality graphics display on PC
  - Provides tools to produce the picture.
  - Produces animations
  - Using motion dynamic tools, user can make object stationary and the viewer moving around them.
  - Using update dynamic, it is possible to change the shape, colour and other properties of the obj.

* Applications
  - Graphical User Interface
  - Educational Softwares
  - Multimedia
  - Biology Labs
  - Education and Training
  - Visualization
  - Computer Generated Maps
  - Computer Art
  - Printing Technology
  - Entertainment
  - Architecture
  - Presentation Graphics

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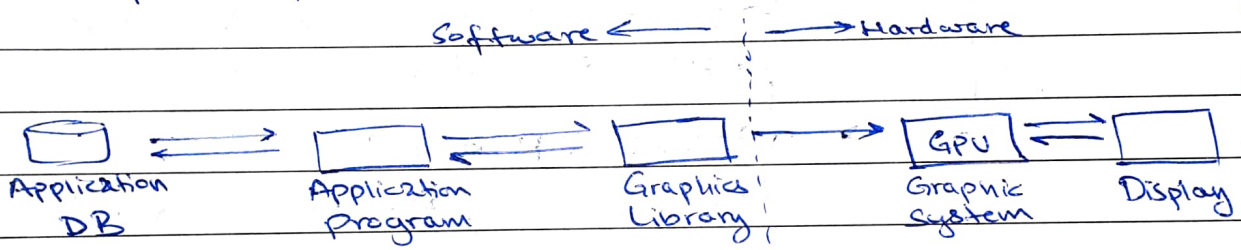
* Types of Computer Graphics:
  - Non-interactive (Passive) C.G. : User does not have any kind of control over the image. Eg: Screensaver.
  - Interactive C.G.: It involves two way communication between the user and the computer.

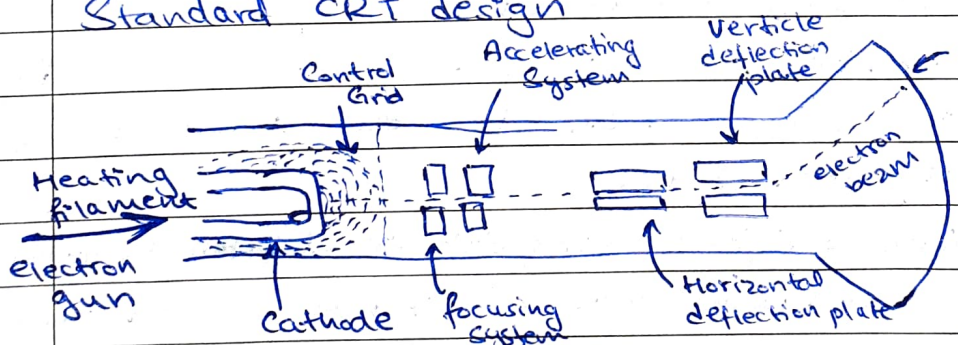
* Basic Components of Interactive Graphic System:
  - i/p
  - processing
  - (output) Display

* Conceptual framework for interactive Graphics.



* Cathode Ray Tube (CRT):
  - It is a video monitor - the primary o/p device in graphics.

Standard CRT design



1) Electron Gun (Heating filament)
2) Control Grid
3) Focusing System (Clean picture)
4) (Electric field, Magnetic field) Deflection System
5) Phosphorous Coated Screen (Glows)

∴ Periodic.

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* Random Scan Display:
  - Uses electron beam which operates like pencil to create line image on CRT Screen
  - Picture is constructed out of a sequence of straight line segments.
  - Random Scan Monitors are also known as Vector displays or Stroke-Writing display or Calligraphic display.
    - ADVANTAGES
      - CRT has the electron beam directed only to the parts of the screen where image is to be drawn
        - Produces smooth line drawings.
        - High Resolution.
    - DISADVANTAGES
      - Random Scan Monitors cannot display realistic shades scenes.

* Raster Scan Display:
  - Electron beam is swept across the screen, one row at a time from top to bottom.
  - Electron beam moves across each row, the beam intensity is turned on and off to create a pattern of illuminated spots.
  - Picture definition, along with set of intensity values for all the screen points, are stored in memory area called the refresh buffer or frame buffer.
  - TYPES OF SCANNING / TRAVELLING of BEAM:
    - Interlaced Scanning
      - PROS
        - → Realistic image
        - → Million different colours to be generated
      - CONS
        - → Low Resolution
    - Non-Interlaced Scanning

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* Direct View Storage Tubes (DVST)
  - Uses Random Scan approach to generate image on CRT Screen
  - Storage Tube refers to the ability of screen to retain the image which has been projected against it, thus avoiding the need to rewrite the image constantly.
  - Function of guns: Two guns are used in DVST.
    - Primary Gun: Used to store picture pattern
    - Secondary (Flood) Gun: Used to maintain picture display

ADVANTAGES	DISADVANTAGES
No refreshing needed	Not possible to erase selected part of picture
High Resolution	Not suitable for dynamic graphic applications
Very less cost	Time is consumed, if part of a picture is to be modified.

** Flat Panel Display:
- Refers to class of video devices that have reduced volume, weight and power requirement compared to CRT.
- TYPES :
  - Emissive Display. E.g.: Plasma Panels, LED
  - Non-emissive Display. E.g.: LCD

- Emissive Display : Converts electrical energy into light. E.g.: Plasma panel, LED,
- Non-emissive Display : Uses optical effects to convert sunlight or any source light into graphic patterns

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* **Line Drawing Algorithm:**
  - DDA Line Drawing Algo
  - Bresenham Line Drawing Algo.
  - Mid point Line Drawing Algo.

- **DDA : 3 Cases :**

c-1 → if, $m < 1$:
$x_{p+1} = \text{round off}\ (1 + x_p)$
$y_{p+1} = \text{round off}\ (M + y_p)$

c-2 → if, $m = 1$:
$x_{p+1} = \text{round off}\ (1 + x_p)$
$y_{p+1} = \text{round off}\ (1 + y_p)$

c-3 → if, $m > 1$:
$x_{p+1} = \text{round off}\ ((1/m) + x_p)$
$y_{p+1} = \text{round off}\ (1 + y_p)$

- **Bresenham : 2 cases :**

for m

c-1 → if $P_k < 0$;
$P_{k+1} = P_k + 2\Delta y$
$x_{k+1} = x_k + 1$
$y_{k+1} = y_k$

c-2 → if $P_k >= 0$;
$P_{k+1} = P_k + 2\Delta y - 2\Delta x$ (constant, let it be C, $\Delta p = 2(\Delta y - \Delta x)$)
$x_{k+1} = x_k + 1$
$y_{k+1} = y_k + 1$.

for $m >= 1$,
c-I, $P_{k+1} = P_k + 2\Delta x$
c-II, $P_{k+1} = P_k + 2\Delta x - 2\Delta y$

- **Mid Point : 2 Cases :**

c-1 → if, Dinit < 0 ;
$x_{k+1} = x_k + 1$
$y_{k+1} = y_k$
$D_{new} = D_{init} + 2\Delta y$

c-2 → if, Dinit >= 0 ;
$x_{k+1} = x_k + 1$
$y_{k+1} = y_k + 1$
$D_{new} = D_{init} + \Delta D$

→ **Solving Steps** (Starting coordinates = (x_0, y_0) ; Ending coordinates = (x_n, y_n))

STEP I: $\Delta x = x_n - x_0$; $\Delta y = y_n - y_0$; (for DDA and Bresenham) $M = \Delta y / \Delta x$

STEP II: (for DDA): if $|\Delta x| > |\Delta y|$; Steps = $|\Delta x|$; else, Steps = $|\Delta y|$

(for Bresenham): for m < 1, $P_k = 2\Delta y - \Delta x$; for m > 1, $P_k = 2\Delta x - \Delta y$ (Here, P_k is P_0)

(for Mid Point): $D_{init} = 2\Delta y - \Delta x$; $\Delta D = 2(\Delta y - \Delta x)$

STEP III: Use Cases for respective algo to find values for P_{k+1}, x_{k+1}, y_{k+1} until end point reached.

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✱ Circle Drawing Algorithm:

↳ Mid Point Circle Drawing Algorithm
↳ Bresenham's Circle Drawing Algorithm.

- **Mid Point: 2 Cases:**

c-1 ↳ if, $P_k < 0$:
$x_{k+1} = x_k + 1$
$y_{k+1} = y_k$
$P_{k+1} = P_k + 2x_{k+1} + 1$

c-2 ↳ if, $P_k >= 0$:
$x_{k+1} = x_k + 1$
$y_{k+1} = y_k - 1$
$P_{k+1} = P_k - 2y_{k+1} + 2x_{k+1} + 1$

- **Bresenham: 2 Cases:**

c-1 ↳ if, $P_k < 0$:
$x_{k+1} = x_k + 1$
$y_{k+1} = y_k$
$P_{k+1} = P_k + 4x_{k+1} + 6$

↳ if, $P_k >= 0$:
$x_{k+1} = x_k + 1$
$y_{k+1} = y_k - 1$
$P_{k+1} = P_k + 4(x_{k+1} - y_{k+1}) + 10$

→ **Solving Steps:**

Center point : (x_c, y_c)
Radius, = R

STEP I: $x_0 = 0$; $y_0 = R$

STEP II: (for Mid Point), $P_k = 1 - R$ (Here, $P_k = P_0$)
(for Bresenham), $P_k = 3 - 2R$ (Here, $P_k = P_0$)

STEP III: Use respective cases to find values for P_{k+1}, x_{k+1} and y_{k+1} until end point reached.

If, given Center point $\neq (0,0)$, then, follow step IV:
Let, Center Point : (x_c', y_c') ; $x_c' \neq 0$, $y_c' \neq 0$

Then plot values,

STEP IV: $x_{plot} = x_c + x_c'$; $y_{plot} = y_c + y_c'$

STEP V: Find Quadrant - I, II, III, IV values as final points of Circ
i.e. periodic.

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* 12 Principles of Animation
  - Squash and Stretch
  - Anticipation
  - Staging
  - Straight-Ahead action and Pose to Pose
  - Follow Through and Overlapping action.
  - Slow-in and Slow-out
  - Arc
  - Secondary Action
  - Timing
  - Exaggeration
  - Solid drawing
  - Appeal.

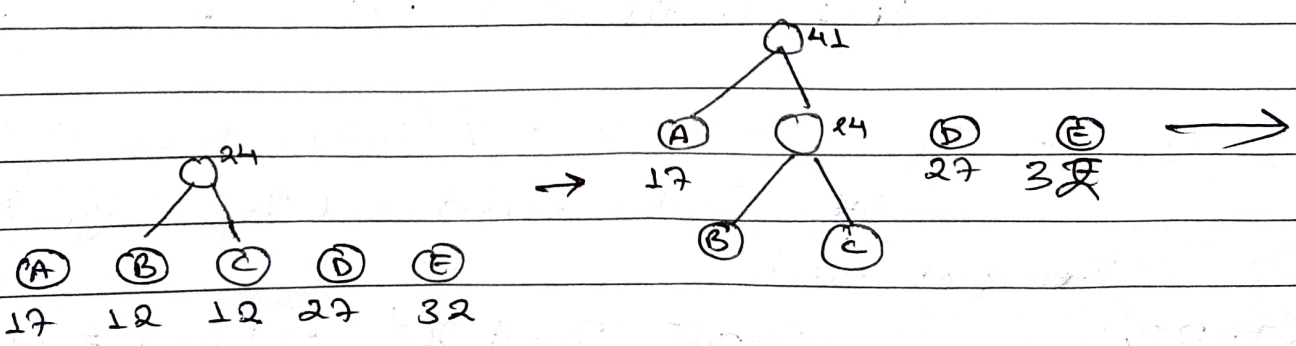
* Huffman Coding
  ↳ Lossless Encoding Method.

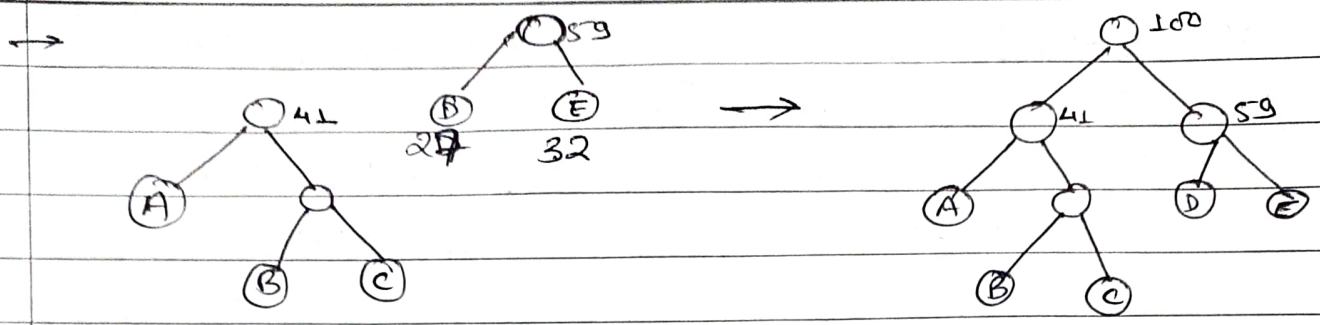
Make huffman tree by taking two least counts each step and assign 0 to left and 1 to right leaf nodes in the final huffman tree.

Example,

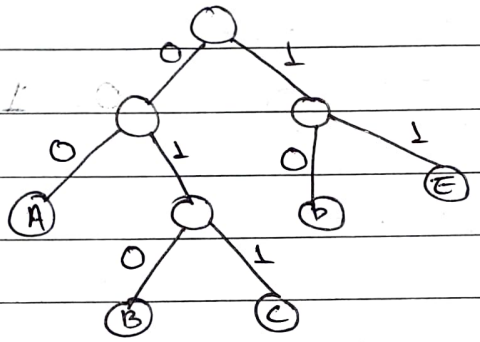
Given, Characters : A B C D E

Frequency : 17 12 12 27 32





So,



∴ A : 00
B : 010
C : 011
D : 10
E : 11

Encoders

Now, Encoding for Text : EAEBAECDEA.

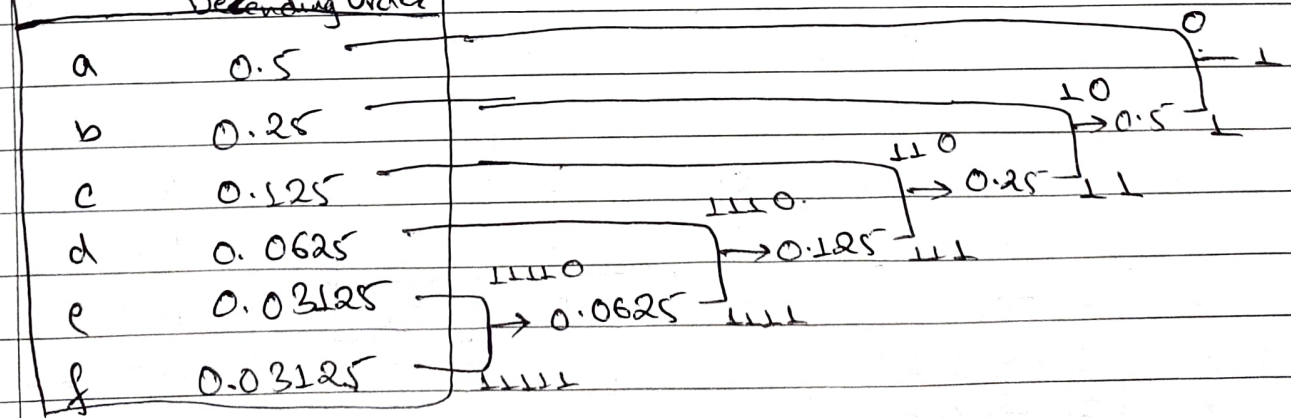
∴ Huffmann Code : 11001101000110111011100

* Huffman Coding : Variable Length Coding.

Symbol	a	b	c	d	e	f
~~Probability~~ Probability	0.5	0.25	0.125	0.0625	0.03125	0.03125

Descending Order

a	0.5
b	0.25
c	0.125
d	0.0625
e	0.03125
f	0.03125



	a	b	c	d	e	f
Codewords	0	10	110	1110	11110	11111

∴ Periodic.

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* Huffman Coding: Run-length Coding.
  └ simplest method of compression.

E.g.: Input: AAABBCDDDD
Encoded: 3A 2B 1C 4D

E.g.: Input: 25 bit
000000111111000111111111

Step I: 0:6 ; 1:7 ; 0:3 , 1:9

Step II: Convert to Resulting 5-bit bytes.

00110 , 10111 , 00011 , 11001
0 6 1 7 0 3 1 3

∴ Compressed bit stream:
00110101110001111001

20-bit

Originally 25-bit. Compressed: 20-bit.

* Shannan Fano Coding:

Arrange in desc. orders. Divide from the part where top half and bottom half are nearest to each other in added value. Give '0' to top part and '1' to bottom.

E.g.: A→0.22, B→0.28, C→0.15, D→0.30
E→0.05

D→0.30	0	0		∴ D→00 2
B→0.28	0	1		B→01 2
A→0.22	1	0		A→10 2
C→0.15	1	1	0	C→110 3
E→0.05	1	1	1	E→111 3

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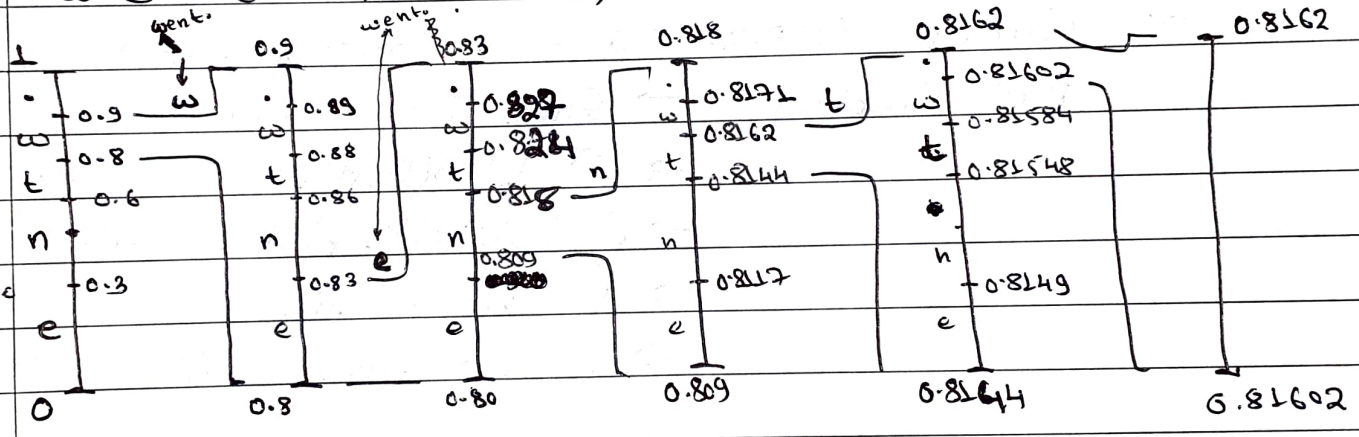
* Avg. code length = $\sum_{k=1}^{n} P_k L_k$
* Entropy = $\left| \sum_{k=1}^{n} P_k \log_2 P_k \right|$
* Efficiency = $\frac{\text{Entropy}}{\text{Avg. length}} \times 100\%$
* Redundancy = Avg. Length − Entropy.
* Arithmetic Coding.

Example. Input: "went."

e → 0.3 , n → 0.3, t → 0.2 , w → 0.1 , . → 0.1



Codeword = $\frac{0.8162 + 0.81602}{2} = 0.81611$

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* RAID : Redundant Array of Inexpensive Disks
  - RAID 0 : Data Striping } Run-length Coding
  - RAID 1 : Disk Mirroring
  - RAID 2 : Bit interleaving } Hamming Error Correction Code
  - RAID 3 : Byte interleaving
  - RAID 4 : Block Striping } Parity check.
  - RAID 5 : Block Striping
  - RAID 10 : RAID 1 + RAID 0
    (Data Striping + Disk Mirroring)

* Query SMDSs (Uniform Representation)

Basic functions :
- → Find Type (Obj)
- → FindObjWith Feature (f)
- → FindObjWith FeatureandAttr (f, a, v)
- → FindFeaturesin Obj (Obj)
- → FindFeaturesandAttrinObj (Obj)