1 Task 1

1. What is a framebus and why is it used?

A framebus is a high-speed data bus used to transfer complete frames of data (such as video or image frames) between system components. It is used because frame data is large and requires high bandwidth and low latency for real-time processing. Framebuses also support efficient, synchronized data transfer, reducing overhead compared to general-purpose buses.

2. A high-color framebus with a color depth of 16 bits typically uses 5 bits each to represent red and blue, and 6 bits to represent green. Why is green preferred?

Green is preferred because the human eye is more sensitive to green light than to red or blue. Using more bits for green improves perceived brightness and detail without increasing total color depth. This results in better visual quality while keeping memory and bandwidth requirements low.

3. How much storage space is required for an uncompressed movie in 4K resolution (3840 x 2160), 36-bit color depth, and a duration of one hour at 24 frames per second?

$$\text{Resolution per frame} = 3840 \times 2160 = 8{,}294{,}400 \text{ pixels}$$

$$\text{Color depth} = 36 \text{ bits} = 4.5 \text{ bytes per pixel}$$

$$\text{Frames in 1 hour} = 24 \times 3600 = 86{,}400 \text{ frames}$$

$$\text{Total storage} = 8{,}294{,}400 \times 4.5 \times 86{,}400 = 3{,}224{,}862{,}720{,}000 \text{ bytes}$$

$$\approx 3.22 \text{ TB (decimal)} \quad \text{or} \quad 2.93 \text{ TiB (binary)}$$

2 Task 2

1. Why is aliasing an inherent problem with raster graphics?

Aliasing is inherent in raster graphics because they represent images using a finite grid of pixels. When continuous shapes, curves, or diagonal lines are mapped onto this discrete grid, the pixels can only approximate the shapes, resulting in jagged or stair-step edges. Since raster graphics are fundamentally pixel-based, this problem cannot be completely eliminated, though higher resolutions or anti-aliasing techniques can reduce its visibility.

2. How does aliasing occur and how can it be counteracted?

Aliasing occurs when continuous shapes or fine details are sampled onto a finite pixel grid, causing jagged edges or distortions. It can be counteracted by techniques like anti-aliasing, which smooths edges, higher resolutions to capture more detail, or supersampling and filtering to reduce high-frequency artifacts before display.

3. Name three different types of aliasing; consider discretization in general.

Spatial aliasing – occurs when continuous spatial details (like edges or patterns) are undersampled, causing jagged or moiré patterns.

Temporal aliasing – occurs when continuous motion is sampled too slowly in time, leading to strobing or "wagon-wheel" effects.

Quantization aliasing – occurs when continuous signal values are rounded to discrete levels, introducing distortion or noise.