1) **What are some digital image sources?**
    - Digital cameras
    - Scanned film & photograph
    - Digitalized TV signals
    - Computer graphics
    - The internet

2) **Explain what is meant by a pixel and how pixel values are being store inside the computer.**

    A pixel, short for "picture element," is the smallest unit of a digital image. It is a tiny square or rectangle that contains a single color or shade of gray. Pixels are arranged in a grid pattern to form an image, with each pixel's color or tone contributing to the overall appearance of the image.

    In a digital image, pixel values are typically stored as binary data. Each pixel is assigned a numerical value that corresponds to its color or tone. For example, in a grayscale image, each pixel might be assigned a value between 0 and 255, where 0 represents black and 255 represents white. In a color image, each pixel might be assigned three values, one for each primary color (red, green, and blue), which are combined to create the final color of the pixel.

    The pixel values are stored in memory as a sequence of binary digits, or bits. The number of bits used to represent each pixel depends on the color depth of the image. For example, an 8-bit grayscale image uses 8 bits per pixel, while a 24-bit color image uses 8 bits for each of the three primary colors, for a total of 24 bits per pixel.

    The binary data for an image is typically stored in a file on a computer or other digital device, such as a camera or smartphone. When the image is displayed on a screen or printed on paper, the pixel values are used to generate the corresponding colors or tones for each pixel, resulting in the final image.

3) **Explain the process of digitalizing an image inside the computer**

    Digitalizing an image involves converting a physical image, such as a photograph or a printed page, into a digital format that can be stored, edited, and displayed on a computer or other digital device. Here's a general overview of the process of digitalizing an image:

    - **Capture the Image:** The first step is to capture the image using a digital camera, scanner, or other device that can convert the image into a digital format. This involves shining light on the image and capturing the reflections or shadows using sensors, which then convert the information into digital data.
    - **Sampling:** Once the image is captured, it needs to be divided into a grid of tiny squares or rectangles called pixels. Each pixel contains a single color or tone. The resolution of the image, or the number of pixels per unit area, determines the level of detail and quality of the image.
    - **Quantization:** Each pixel is then assigned a numerical value that corresponds to its color or tone. This involves quantizing the color or tone information into a set number of levels. For example, a grayscale image might use 256 levels of gray, while a color image might use 256 levels for each primary color (red, green, and blue).

- **Encoding:** The pixel values are then encoded as binary data, which is a sequence of 0s and 1s. The binary data is stored in a file on a computer or other digital device, along with metadata that describes the image's properties such as size, resolution, color space, and compression.
- **Display or Print:** Once the image is digitalized, it can be displayed on a computer screen or printed on paper using a printer. The pixel values are used to generate the corresponding colors or tones for each pixel, resulting in the final image.

This process may vary depending on the specific device and software used, but this general overview provides a good idea of how an image can be digitalized inside a computer.

4) What are some Digitalizing methods?

There are several methods of digitizing various types of information. Here are some common digitalizing methods:

- **Scanning:** Scanning involves using a device called a scanner to capture an image or document and convert it into a digital format. The scanner typically has a flat glass surface where the image or document is placed, and a light source and sensor that move across the surface to capture the image or document.
- **Digital photography:** Digital photography involves capturing an image using a digital camera. The camera uses an electronic sensor to capture the image and convert it into a digital format.
- **Optical Character Recognition (OCR):** OCR is a method of digitizing printed text. It involves scanning the text using a scanner or camera, and then using software to recognize and convert the text into digital characters that can be edited and searched.
- **Audio digitization:** Audio digitization involves converting analog audio recordings, such as vinyl records or cassette tapes, into a digital format. This can be done using a turntable or cassette player connected to a computer, or using specialized equipment.
- **Video digitization:** Video digitization involves converting analog video recordings, such as VHS tapes or film reels, into a digital format. This can be done using a video cassette player or film projector connected to a computer, or using specialized equipment.
- **3D scanning:** 3D scanning involves capturing the physical shape and geometry of an object and converting it into a digital 3D model. This can be done using specialized 3D scanners that use lasers or structured light to capture the shape and dimensions of the object.

Overall, the method used for digitization depends on the type of information being captured and the desired level of quality and resolution.

5) What are the digital images' 2D array of values?

- **Binary images-** contains pixel values 0,1

  Each pixel is one bit

- **Grayscale images-** contain pixel values 0 to 255

  Each pixel contains 8 bits (1 byte)

- **Color images-** each pixel has three color components (RGB) each color component is from 0 to 255

Each pixel contains 24 bits (3 bytes)

6) Compare and contrast characteristics of grayscale image and color image.

Grayscale images and color images are both types of digital images, but there are some important differences between them. Here are some characteristics of grayscale images and color images:

Grayscale Images:

- **Monochromatic**: Grayscale images are monochromatic, meaning they use only shades of gray to represent the image. Each pixel is assigned a numerical value between 0 and 255 that corresponds to a shade of gray, with 0 representing black and 255 representing white.
- **One Channel:** Grayscale images use only one channel of information, which means that the pixel values represent only the brightness of the image.
- **Smaller File Size**: Because grayscale images use only one channel of information, they typically have a smaller file size than color images.
- **Limited Information**: Grayscale images have limited information compared to color images, because they do not contain information about color or hue.

Color Images:

- **Polychromatic:** Color images use multiple colors to represent the image. Each pixel is assigned three numerical values, one for each primary color (red, green, and blue), which are combined to create the final color of the pixel.
- **Three Channels:** Color images use three channels of information, which means that the pixel values represent not only brightness, but also color and hue.
- **Larger File Size:** Because color images use three channels of information, they typically have a larger file size than grayscale images.
- **More Information:** Color images contain more information than grayscale images, because they include information about color and hue in addition to brightness.

In summary, grayscale images are monochromatic, use only one channel of information, have a smaller file size, and contain limited information compared to color images. Color images are polychromatic, use three channels of information, have a larger file size, and contain more information than grayscale images.

7) What does a screen with 200x350 pixels mean?

A screen with 200x350 pixels means that the screen has a total of 200 pixels in the horizontal direction (also known as width) and 350 pixels in the vertical direction (also known as height). This indicates the resolution of the screen, which is the total number of pixels that can be displayed on the screen. In this case, the screen can display a total of 70,000 pixels (200 x 350). The actual physical size of the screen cannot be determined from this information alone, as the pixel density (pixels per inch or pixels per centimeter) can vary depending on the size of the screen.

8) What is image resolution?

Image resolution refers to the amount of detail or information present in an image, typically measured in pixels per inch (PPI) or dots per inch (DPI). The higher the resolution, the more detail an image contains.

For digital images, resolution is determined by the number of pixels that make up the image. For example, an image that is 1000 pixels wide and 1000 pixels tall has a resolution of 1000x1000 pixels. When printed or displayed on a screen, this image will appear sharper and more detailed if it has a higher resolution.

In general, higher resolutions are better for printing, while lower resolutions may be suitable for digital displays. The appropriate resolution for an image depends on its intended use and the size at which it will be viewed.

9) How are digital images stored

Digital images are converted to files for storage and transfer. The file types Is a special format for ordering and storing the bytes that make up the image. File types or formats are not necessarily compatible. You must often match the file type with the application.

Digital images are stored as binary data, which is a sequence of 0s and 1s. This data represents the colors and tones of the image, which are typically stored as pixels.

The most common format for storing digital images is the JPEG format, which uses lossy compression to reduce the file size of the image. This compression algorithm works by discarding some of the image data that is deemed less important or visually irrelevant. However, this can result in a loss of quality and detail.

Other popular image formats include PNG, BMP, GIF, and TIFF. Each of these formats has its own strengths and weaknesses, and the choice of format depends on the intended use of the image.

Regardless of the format, the data that makes up a digital image is stored in a file on a computer or other digital device. The file contains the binary data for each pixel of the image, along with metadata that describes the image's properties such as size, resolution, color space, and compression.

10) How many bytes to store an image. Assume that we have two images that is 500 x 500 pixels in size and 400 x 600 in size

a) Total resolution
b) Binary image
c) Greyscale image
d) Color image

11) Assume that there are two screens one with 200x350 pixels and second screen with 560x780 pixels. Which screen has clear footages. Explain your answer in your own words

The clarity of a screen's footage depends on its pixel density, which is measured in pixels per inch (PPI) or dots per inch (DPI). Generally, the higher the pixel density, the clearer and sharper the image will appear.

Assuming the screens have the same physical size, we can calculate the pixel density by dividing the number of pixels by the size of the screen. However, since we don't know the physical size of the screens, we cannot determine their exact pixel densities.

However, we can make an educated guess based on the number of pixels. The screen with 560x780 pixels has a higher number of pixels than the screen with 200x350 pixels, which suggests that it has a higher pixel density. This means that the footage on the screen with 560x780 pixels is likely to be clearer and sharper than the footage on the screen with 200x350 pixels.

Of course, other factors such as the quality of the display panel and the color accuracy also play a role in determining the clarity of the footage. But based on the information given, it is likely that the screen with 560x780 pixels has clearer footage.

12) Assume that image contains 240x860 pixels. If the image stores inside the computer as Binary image how much memory it will consume? Explain your answer

If an image with 240x860 pixels is stored as a binary image, each pixel will be represented by a single bit (either 0 or 1) indicating whether the pixel is black or white. Since 1 byte contains 8 bits, we can calculate the total memory consumption as follows:

Total number of pixels = 240 x 860 = 206,400 Total number of bits = 206,400 x 1 = 206,400 Total number of bytes = 206,400 / 8 = 25,800

Therefore, the image will consume 25,800 bytes of memory if stored as a binary image. This assumes that there is no additional metadata or compression applied to the image file. In practice, the actual file size may be larger due to additional information such as file headers, color profiles, and compression algorithms.

13) Explain how a computer stores picture in its memory

A computer stores pictures in its memory in the form of digital image files. The process of storing a picture involves converting it into a digital format that can be understood by the computer. Here are the general steps involved in storing a picture in a computer's memory:

Acquisition: The first step is to acquire the picture, either by scanning a physical image or capturing it with a digital camera.

Digitization: The picture is then digitized, which involves converting it into a series of numerical values that represent the colors and brightness levels of each pixel in the image. This is done by sampling the image at regular intervals to capture the color and brightness values at each pixel location. The values are typically represented using binary code, which consists of 0s and 1s.

Compression: In some cases, the digitized image may be compressed to reduce its file size. Compression algorithms can be lossless or lossy, meaning that they either preserve all of the original information or sacrifice some information to achieve a smaller file size.

Encoding: Once the image has been digitized and compressed, it is encoded in a specific file format such as JPEG, PNG, or BMP. The file format specifies how the image data is organized and how it should be interpreted by software applications.

Storage: Finally, the encoded image file is stored in the computer's memory, either on a hard drive, solid-state drive, or other storage device. The file can then be accessed and displayed by software applications that can interpret the file format.

Overall, storing a picture in a computer's memory involves digitizing, compressing, encoding, and storing the image data in a specific file format. The process may vary depending on the specific image and the software and hardware being used.