1. Co to je světlo? Co to je bílé světlo, čím je dána případná barva světla?

   "Light" is a form of electromagnetic radiation that is visible to the human eye. It enables us to see our surroundings.

   "White light" is a combination of all the colors of the visible spectrum. It can be split into various colors by a prism, demonstrating this spectrum of colors.

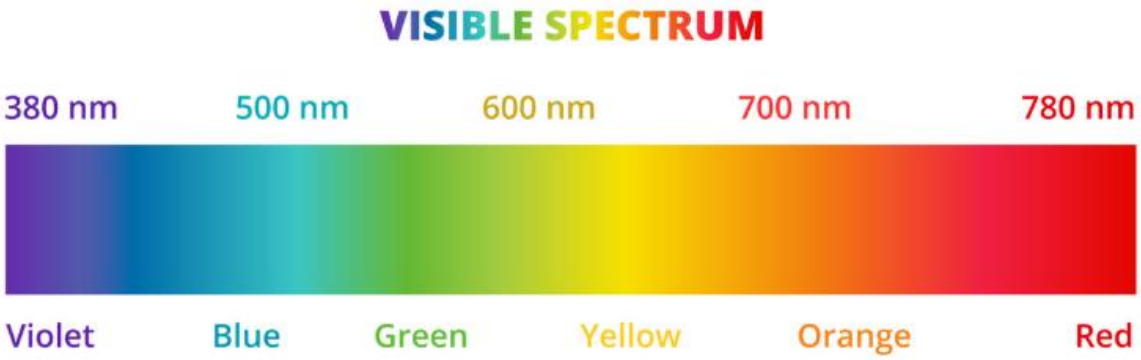
2. Jaké znáte základní charakteristiky světla? Co znamenají?

   - Wavelength: This is the distance between two consecutive peaks of a light wave. It determines the color of light. For example, red light has a longer wavelength than blue light.
   - Frequency: Number of repetitions per a given period of time. Higher frequency corresponds to shorter wavelengths and vice versa.
   - Amplitude: This refers to the height of the light wave from its average value.
   - luminosity (intensity) – more shining source = higher intensity
   - saturation – color purity
   - brightness – proportion of achromatic component in a light with some dominant frequency

3. Na jaké barvy je lidské oko nejcitlivější a nejméně citlivé?

   The human eye is most sensitive to green light, particularly around the wavelength of 555 nanometers in bright lighting conditions. This sensitivity is due to the high density of cone cells in the retina that are most responsive to green light.

   On the other hand, the human eye is least sensitive to blue and red light at the extreme ends of the visible spectrum. Blue light has a shorter wavelength, while red light has a longer wavelength



4. Podle jaké informace v obrazu zaostřuje lidské oko?

   The human eye focuses on an image primarily based on contrast and edges within the visual scene. Contrast refers to the difference in luminance or color that makes an object distinguishable from other objects and the background. Edges, or the points where there are significant changes in brightness or color, provide important information for the eye to focus.

   When looking at a scene, the eye is naturally drawn to areas with high contrast or sharp edges

5. Je vhodné do diagramu kreslit tenké čáry modrou barvou? Vysvětlete.

   Drawing thin lines in blue color in a diagram is typically not recommended. The reasons are related to the visual perception and clarity:

   - Low Contrast: Blue, especially lighter shades, tends to have low contrast against common backgrounds like white or light colors. This can make blue lines harder to see, especially if they are thin.

   - Eye Sensitivity: The human eye is less sensitive to blue, particularly at the peripheries of the visual field. As a result, thin blue lines might appear less distinct and can be easily overlooked.

   - Print Clarity: If the diagram is to be printed, blue lines, especially thin ones, might not reproduce well, leading to reduced visibility or clarity.

6. Je vhodné na pozadí prezentace použít červenou nebo zelenou barvu? Vysvětlete.

   Using red or green as background colors in presentations should be approached with caution, considering the following factors:

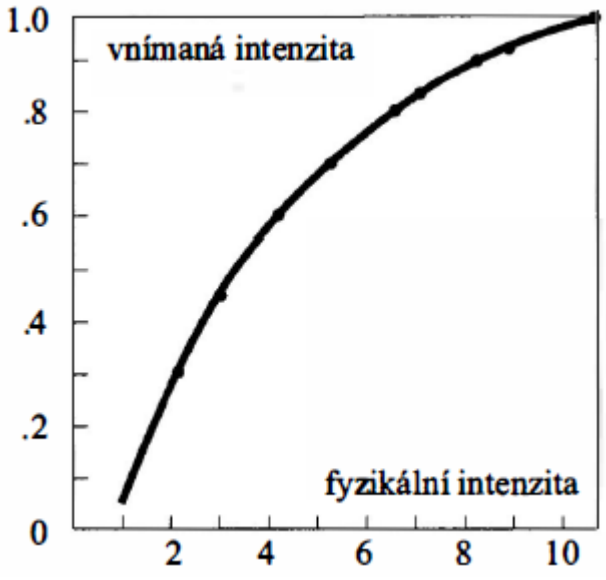
   - Visibility and Contrast: Both red and green can be intense and may overpower or clash with text and graphics, making them hard to see. It's important to ensure high contrast between the background and the content for readability. Light text on dark backgrounds or vice versa usually works best.

   - Color Blindness Considerations: A significant portion of the population has some form of color blindness, with red-green color blindness being the most common.

7. Jaká je závislost subjektivně vnímaného jasu a skutečné intenzity světla?

   The relationship between the subjectively perceived brightness of light and its actual intensity is described by the Weber-Fechner Law. This law states that the perceived brightness is proportional to the logarithm of the actual intensity of the light. In simpler terms, this means that the perceived brightness does not increase linearly with the intensity of the light.

   For example, if the intensity of a light source is doubled, the perceived brightness does not double; the increase in perceived brightness is less than the increase in actual intensity. This is because the human visual system is more sensitive to changes in light intensity at lower levels than at higher levels.



8. Co to je barevný prostor? Jmenujte aspoň tři barevné prostory

   A color space is a specific organization of colors, which helps in the reproduction of color in both physical and digital realms. It's a model for representing colors in terms of intensity values.

   - RGB (Red, Green, Blue): Used primarily in electronic displays like TVs, computer monitors, and cameras. Colors are created by combining red, green, and blue light in various intensities.

   - sRGB: standard RBG by HP and Microsoft

   - CMYK (Cyan, Magenta, Yellow, Key/Black): Used in color printing. This space is subtractive, meaning that colors are created by subtracting brightness from white. Cyan, magenta, yellow, and black inks are combined in various amounts to produce a wide range of colors.

   - HSB/HSV (Hue, Saturation, Brightness/Value): Often used in graphic design and digital art software. This model describes three fundamental characteristics of color: Hue (the type of color, like red or blue), Saturation (the intensity of the color), and Brightness/Value (how light or dark the color is).

9. Kde se používají barevné prostory YUV, YIQ, YCBCR? Co znamená souřadnice Y a k jaká je její hlavní výhoda ?

   The color spaces YUV, YIQ, and YCbCr are primarily used in video and television broadcasting. They are designed to be compatible with black-and-white television while adding color information.

   - YUV: Used in European color television and some computer graphics. It's common in PAL and SECAM television systems.

   - YIQ: Used by the NTSC television system

   - YCbCr: Widely used in digital video, including DVD, Blu-Ray, and digital television. It's a digital version of YUV used for video compression and transmission.

   The "Y" coordinate in these color spaces represents the luminance (brightness) component. The main advantage of separating luminance (Y) from chrominance (color information, represented in U/V, I/Q, or Cb/Cr components) is that it aligns with the human visual system's greater sensitivity to variations in brightness than in color. This separation allows for more efficient video processing and transmission:

10. Co to je obraz (příklady)? Co to je obrazová funkce? Popište.

    It can refer to a visual representation or depiction of a scene, object, or concept.

    - Photographs: Captured using cameras, they represent a real-life scene or subject.
    - Paintings: Artistic creations using paint on a surface like canvas or paper.
    - Digital Images: Created or edited using computer software, including both raster (pixel-based) and vector (path-based) graphics.
    - Drawings: Created with pencils, pens, or other drawing tools.
    - Prints: Produced through various printing techniques, like lithography or screen printing.

    image function, is a mathematical representation of an image. In digital image processing, an image is often represented as a function, $f(x, y)$, where x and y are spatial coordinates (representing the position of a pixel in the image), and the value of ***f*** at any point ***(x,y)*** represents the intensity or color of the image at that point.

11. Jaké znáte základní druhy reprezentace obrazu v počítači? Jaké jsou jejich výhody, nevýhody a typická použití?

    Basic types of image representation in computers include raster (bitmap) images and vector images.

    Raster (Bitmap) Images:

    - Characteristics: Composed of pixels, each with a specific color value.
    - Advantages: Capable of depicting complex, detailed images like photographs with subtle gradations in color and tone.
    - Disadvantages: Resolution-dependent; quality deteriorates when scaling up. Larger file sizes for high-resolution images.
    - Typical Uses: Digital photography, detailed artwork, web graphics, and any application where detailed or realistic images are required.

    Vector Images:

    - Characteristics: Made up of paths defined by mathematical equations. These paths are drawn using points, lines, and shapes.
    - Advantages: Scalable without loss of quality. Smaller file sizes for images with less complexity.
    - Disadvantages: Limited in representing more complex or detailed images like photographs. They can look less realistic compared to raster images.
    - Typical Uses: Logos, icons, typography, and any graphic design where scalability and manipulation of individual elements are important.

12. Co to je vektorová grafika? Jaké má výhody, jaké znáte základní formáty souborů?

    Vector graphics, involves the use of geometric shapes like lines, curves, and polygons to represent images in computer graphics. Unlike raster graphics, which are composed of pixels, vector graphics are based on mathematical equations to define the shapes in the image.

    (Advantages):
    - Scalability: Vector images can be scaled up or down infinitely without any loss of quality or resolution, as they are not made of pixels.
    - Smaller File Size: For less complex graphics, vector files are usually smaller than raster images.
    - Editability: Individual elements can be edited independently. You can change shapes, colors, and sizes of different components without affecting the rest of the image.
    - Print Quality: Vector graphics are ideal for print as they provide crisp and clear output, no matter the size.

    (Common File Formats):
    - SVG (Scalable Vector Graphics): Widely used for web graphics; supported by all modern web browsers and scalable for different screen sizes.
    - AI (Adobe Illustrator): A proprietary file format developed by Adobe Systems, primarily used in Adobe Illustrator.
    - PDF (Portable Document Format): While known for documents, PDFs can also effectively contain vector graphics.
    - CDR (CorelDRAW): Used in CorelDRAW software, a popular vector graphic editing tool.

13. Co představuje v rastrovém obrazu kvantování a vzorkování? Jaká vlastnost obrazu odpovídá vzorkovací frekvenci a jaká kvantovacímu kroku?

    In raster (bitmap) images, sampling and quantization are two key processes used in digital image processing:

    Sampling: This refers to the process of converting a continuous image into a discrete grid of pixels. Each pixel in the grid represents a small area of the image.

    - Sampling Frequency: Corresponds to the resolution of the image. Higher sampling frequency means more pixels are used to represent the image, leading to finer detail and higher resolution.

    Quantization: Once the image is divided into pixels, each pixel's color is recorded. Quantization is the process of mapping the continuous range of color values in the image to a discrete set of color levels. It's about how many colors you use to represent the image.

    - Quantization Step: Relates to the color depth of the image. A smaller quantization step means more available color levels and via versa.

14. Kdy a jak se v obrazu projevuje aliasing? Jak se tento jev v oblasti grafiky nazývá ?

    Aliasing in images occurs when the resolution of the image is not high enough to accurately capture the detail of the image, particularly at high frequencies (like sharp edges, fine textures, or patterns). This discrepancy leads to artifacts in the digital representation of the image.

    - Jagged Edges: When diagonal or curved lines appear as a series of steps or jags instead of smooth lines. This is commonly seen in low-resolution images or when a high-resolution image is scaled down.

    - Moire Patterns: When fine patterns or textures in the image are rendered incorrectly, resulting in a wavy appearance.

    - False Coloration: In color images, aliasing can sometimes lead to creation of unexpected colors

15. Omezujeme před digitalizací analogového obrazu frekvenční rozsah obrazové funkce tak, aby byl splněn vzorkovací teorém? Vysvětlete, uveďte příčiny a důsledky.

    Yes, before digitizing an analog image, it's important to limit the frequency range of the image function to satisfy the Sampling Theorem. This theorem states that in order to accurately capture a signal (in this case, an image), you must sample it at a rate that is at least twice the highest frequency present in the signal.

    Why Limit the Frequency Range:
    - Avoid Aliasing
    - Ensure Accurate Representation

    How It's Done:
    The process of limiting the frequency range is known as "pre-filtering" or "anti-aliasing filtering." This involves applying a low-pass filter to the analog image before sampling. The low-pass filter removes high-frequency components.

    Consequences:
    - Loss of Some Detail
    - Trade-Off Between Detail and Aliasing

16. Lze v praxi před převzorkováním rastrového obrazu omezit frekvenční rozsah obrazové funkce tak, aby byl splněn vzorkovací teorém? Vysvětlete.

    Yes, it is commonly done, especially in digital image processing. This process is known as anti-aliasing filtering and is crucial when changing the resolution of a raster image.

    How It's Done:

    - Anti-Aliasing Filter: This is a low-pass filter that removes high-frequency beyond the new, lower sampling rate's capability.

    - Resampling: After filtering, the image is resampled at a new resolution. This could be downsampling (reducing resolution) or upsampling (increasing resolution).

    Why It's Necessary:

    - Prevent Aliasing: Without this step, resampling could introduce aliasing artifacts, such as jagged edges or moiré patterns, especially when downsampling an image.

    - Maintain Image Quality

17. Jaké znáte způsoby reprezentace barev v rastrovém obrazu? Popište je

    In raster images, colors are typically represented through various color models.

    - RGB (Red, Green, Blue):
        - Description: Colors are created by combining red, green, and blue light. Each color channel (red, green, and blue) typically has a range from 0 to 255 in digital images, allowing for over 16 million possible colors in a 24-bit image.
        - Use: It's the standard model for electronic displays like monitors, TVs, and cameras.

    - CMYK (Cyan, Magenta, Yellow, Key/Black):
        - Description: This is a subtractive color model used in color printing. It works by subtracting brightness from white. Unlike RGB, where colors are added to black (no light), CMYK starts with white (all light) and subtracts colors.
        - Use: Primarily used in the printing industry.

    - HSV (Hue, Saturation, Value):
        - Description: Represents colors in terms of their Hue (color type), Saturation (intensity of the color), and Value (brightness).
        - Use: Often used in graphics software as it is more intuitive for humans to select colors based on shade, intensity, and brightness.

18. Jakým zařízením se realizuje digitalizace obrazu např. v kameře nebo fotoaparátu? Jakými způsoby se může řešit snímání barvy?

    image digitization, in devices such as cameras and digital cameras, is achieved through an image sensor. The two main types of image sensors are:

    - CCD (Charge-Coupled Device):
        - Light hitting the CCD is converted into an electrical charge. Each photodiode on the CCD corresponds to a pixel in the final image
    - CMOS (Complementary Metal-Oxide-Semiconductor):
        - Similar to CCD, CMOS sensors also convert light into electrons. However, the processing of these electrons into digital values is done by transistors at each pixel site.

    Color Capture:
    The capturing of color in these sensors is typically achieved through one of the following methods:

    - Bayer Filter:
        - The camera interpolates the data from these filters to produce full-color images, a process known as demosaicing.
    - Foveon X3 Sensor:
        - Captures all three primary colors at each pixel location, which is achieved by layering photodiodes.
    - Three-Sensor Camera Systems:
        - These systems use a beam splitter and direct light onto three separate sensors for red, green, and blue.

19. Co to je Bayerova maska, k čemu se používá? Jmenujte výhody a nevýhody.

    Bayer filter, is a color filter array for arranging RGB color filters on a square grid of photosensors. Its pattern comprises 50% green filters, 25% red, and 25% blue. This arrangement mimics the human eye's greater sensitivity to green light.

    It is used for digital imaging and it is simple and low-cost compare to more advance filters.

20. Čím se v rastrovém obrazu projevuje kvantování? Jak lze vliv kvantování omezit?

    In a raster image, quantization manifests as the limitation of the range of colors and intensities that can be represented. It's the process of mapping a large set of input values to a smaller set, like reducing the number of colors in an image.

    How Quantization Manifests:

    - Color Banding(páskování): In images with gradients, quantization can lead to noticeable bands of color, where smooth transitions should be.
    - Posterization: This effect occurs when the color depth is significantly reduced, leading to flat areas of color and loss of detail.
    - Increased Image Noise: In some cases, particularly in low light images, quantization can increase the appearance of noise.

    Limiting the Effects of Quantization:

    - Higher Bit Depth: Using a higher bit depth for each color channel increases the number of possible color values
    - Dithering: This technique adds noise to the image to mask the banding effects of quantization.
    - Noise Reduction Algorithms: Post-processing techniques can sometimes help in reducing the visual impact of quantization.
    - Careful Color Palette Selection: In indexed color images, selecting a color palette that matches the image content can reduce the visible effects of quantization.

21. K čemu dochází při podkvantování (omezení barevného prostoru) rastrového obrazu? Jakými technikami lze kompenzovat rušivost výsledných zkreslení?

    When under-quantization (limiting the color space) occurs in a raster image, several artifacts and distortions can appear. Under-quantization means reducing the number of colors or intensity levels that the image can display, leading to a less accurate representation of the original scene.

    Effects of Under-Quantization:
    - Color Banding
    - Posterization
    - Increased Noise and Artifacts

Techniques to Compensate for Distortions:

- Dithering:
- Noise Filtering Algorithm:
- Color Palette Optimization
- Bit Depth Increase
- Gradient Smoothing: Applying post-processing techniques that specifically target smoothing gradients can help in reducing banding effects.

22. Co to je dithering (rozptylování), k čemu se používá, jaké jsou základní metody ditheru?

Dithering is a digital image processing technique used to create the illusion of color depth in images with a limited color palette. By blending different colored pixels together, dithering simulates intermediate colors that are not actually present in the palette.

Purpose of Dithering:

- Minimize Color Banding
- Enhance Image Depth
- Artistic Effect: Sometimes used deliberately to create a specific artistic or retro look in digital art.

Basic Methods of Dithering:

- Ordered Dithering:
    - Description: Uses a fixed pattern (matrix) to determine how pixels are replaced or modified. Common patterns include Bayer matrices.
- Floyd-Steinberg Dithering (Error Diffusion):
    - Description: Spreads the quantization error of a pixel to its neighboring pixels. This method is more sophisticated and produces images that are closer to the original in appearance.
- Random Dithering (Noise):
    - Description: Applies noise randomly to pixels instead of using a fixed pattern or error diffusion. This can create a less structured and more natural-looking result.
- Blue Noise Dithering:
    - Description: Similar to random dithering but uses a blue noise pattern, which is less noticeable to the human eye than white noise.

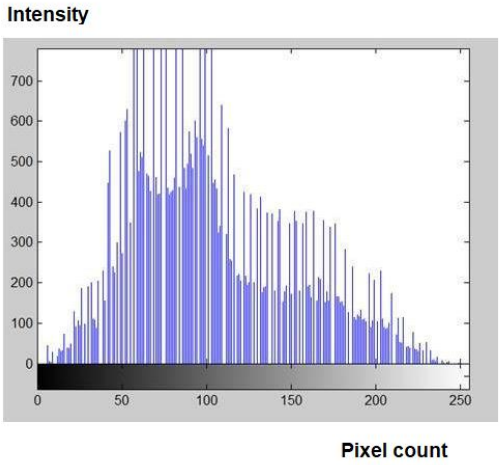
23. Při geometrických transformacích rastorvého obrazu se často používá tzv. zpětné mapování. Co to je?

    In raster image processing, "reverse mapping" or "inverse mapping" is a technique commonly used in geometric transformations, such as rotating, scaling, or skewing an image. This approach focuses on where to place the pixels of the transformed image back in the original image.

    Reverse mapping in geometric transformations of raster images ensures a more precise and often higher-quality result by calculating where each pixel in the transformed image should come from in the original image.

24. Co to je histogram? Jak vypadá histogram pro jasný obraz, tmavý obraz, vysoce kontrastní obraz?

    A histogram is a graphical representation of the distribution of pixel intensities (brightness levels) in an image. It typically has the intensity values on the horizontal axis and the number of pixels for each intensity level on the vertical axis.



    Histogram Types Based on Image Characteristics:

    - (Bright Image):
        - Characteristics: The image predominantly contains bright tones, with fewer mid-tones and shadows.
    - (Dark Image):
        - Characteristics: The image is mostly made up of darker tones, with fewer highlights and mid-tones.
    - (High-Contrast Image):
        - Characteristics: The image has a wide range of tones with stark differences between the lightest and darkest areas, resulting in a striking contrast.

25. Jaké znáte metody potlačení šumu v obrazu?
    - Averaging: Reduces random noise by averaging multiple frames or neighboring pixels. Effective but may blur the image.
    - Gaussian Filter: Applies a Gaussian blur to smooth the image and reduce noise while preserving edges, though it can slightly blur the image.
    - Median Filter: Replaces each pixel's value with the median of neighboring pixels. Highly effective for removing salt-and-pepper noise without blurring edges.
    - Bilateral Filter: Combines spatial and intensity similarities to preserve edges while reducing noise, ideal for keeping edge sharpness.
    - Wavelet Transform: Uses wavelet transforms for noise reduction, separating image details into different frequency components.
    - Non-Local Means: Averages the image over larger areas based on similarity of patches, effectively reducing noise while preserving details.
    - Adaptive Filtering: Adjusts the filter properties based on the local characteristics of the image, allowing for more targeted noise reduction.

26. Mějme přeexponovanou fotografii krajiny, kde má celá obloha bílou barvu a nelze rozlišit mraky. Provedeme softwarovou korekci expozice tak, aby fotografie měla lepší rozložení jasu. Jakou bude mít barvu obloha ? Budou na ní vidět mraky?

    When correcting an overexposed photo of a landscape where the sky appears completely white and clouds are indistinguishable, adjusting the exposure can potentially improve the overall tonal balance of the image. However, the outcome for the sky, particularly the visibility of clouds, depends on the level of overexposure and the data captured in the original image, but there is a possibility that the sky would be blue, and clouds are visible.

27. V kompresi JPEG a MPEG se používá redukce barev. Popište princip, důvody použití a jaká vlastnost lidského zraku redukci umožňuje tolerovat (ponechat bez povšimnutí).

    JPEG and MPEG compression methods use color reduction to shrink file sizes and save storage and bandwidth. They transform the image from RGB to YCbCr, where Y is brightness and Cb and Cr are color. They then lower the resolution of the color channels, since human vision is more attuned to brightness than color. This way, they preserve most of the visual quality while reducing the amount of data.

28. V kompresi JPEG se používá transformace barev do barevného prostoru YCBCR. Jaká je základní vlastnost tohoto barevného prostoru? Jaký je účel této tranformace?

    In JPEG compression, colors are transformed to the YCBCR color space. The basic property of this color space is luminance (Y), chroma (Cb) and chrominance (Cr). Luminance corresponds to the light intensity in a pixel, chroma corresponds to the color of the pixel and chrominance corresponds to the details of the pixel. The transformation reduces the resolution of these components and frees up space for storing luminance, which is less sensitive to color changes than to brightness changes.

29. Jaké jsou typické artefakty komprese JPEG?

    JPEG compression, while efficient in reducing file sizes, often introduces several types of artifacts due to its lossy compression technique. These artifacts become more noticeable as the level of compression increases.

    - Blockiness or Blocking Artifacts:
    - Ringing Artifacts:
    - Mosquito Noise:
    - Color Banding:
    - Chroma Subsampling Artifacts:
    - Loss of Fine Detail:
    - Quantization Artifacts:
    - The visibility and severity

30. Popište grafický formát JPEG zejména z hlediska následujících vlastností: komprese (ztrátová/bezeztrátová/algoritmus), reprezentace barev (barevná hloubka, režim, průhlednost), animace, vrstvy, uložení doplňkových informací (libovolný text, EXIF, ICC).

    The JPEG (Joint Photographic Experts Group)

    - Komprese:
        - Type: Lossy.
        - Algorithm: It primarily uses a discrete cosine transform (DCT) to convert spatial domain data into frequency domain data.

    - Color Representation:
        - Color Depth: Typically supports 24-bit color depth
        - Color Space: Commonly uses the YCbCr color space
        - Transparency: JPEG does not support transparency.

    - Animation:
        - JPEG does not natively support animation.
    - Layers:
        - JPEG does not support layers. Once a JPEG is saved, all layers are flattened into a single layer, making it impossible to separate them afterward.

    - Metadata Storage:
        - Arbitrary Text: Basic JPEG files do not support arbitrary text
        - EXIF (Exchangeable Image File Format): JPEG supports EXIF metadata
        - ICC Profiles: JPEGs can include ICC profiles

31. Popište grafický formát GIF zejména z hlediska následujících vlastností: komprese (ztrátová/bezeztrátová/algoritmus), reprezentace barev (barevná hloubka, režim, průhlednost), animace, vrstvy, uložení doplňkových informací (libovolný text, EXIF, ICC).

    - Komprese:
        - Type: Lossless.
        - Algorithm: GIF uses the Lempel-Ziv-Welch (LZW) compression algorithm.
    - Color Representation:
        - Color Depth: GIF supports up to 8 bits per pixel
        - Color Space: GIFs use an indexed color palette. Each color in the palette is defined in RGB color space.
        - Transparency: GIF supports simple binary transparency.
    - Animation:
        - GIFs are well-known for supporting animation.
    - Layers:
        - GIF does not support layers
    - Metadata Storage:
        - Libovolný Text (Arbitrary Text): GIF does not support arbitrary text
        - EXIF (Exchangeable Image File Format): GIF format does not natively support EXIF metadata.
        - ICC Profiles: GIFs do not support including ICC profiles

32. Popište grafický formát PNG zejména z hlediska následujících vlastností: komprese (ztrátová/bezeztrátová/algoritmus), reprezentace barev (barevná hloubka, režim, průhlednost), animace, vrstvy, uložení doplňkových informací (libovolný text, EXIF, ICC).

- Komprese:
  - Type: Lossless.
  - Algorithm: PNG uses combination of LZ77 and Huffman coding.
- Color Representation:
  - Color Depth: PNG supports a range of color depths, from 1-bit (black and white) to 16 bits per channel
  - Color Space: Primarily uses RGB color space but can also support indexed color, grayscale
  - Transparency: Supports full alpha channel transparency
- Animation:
  - The standard PNG format does not support animation. However, an unofficial extension known as APNG (Animated PNG) exists, which supports animation similar to GIFs but with better color support and alpha transparency.
- Layers:
  - PNG does not support layers.
- Metadata Storage:
  - Arbitrary Text: PNG supports the inclusion of text chunks within the file, which can contain arbitrary text metadata.
  - EXIF (Exchangeable Image File Format): While not commonly used with PNG, it is possible to include EXIF metadata in PNG files.
  - ICC Profiles: PNG supports including ICC profiles.

33. Popište grafický formát TIF zejména z hlediska následujících vlastností: komprese (ztrátová/bezeztrátová/algoritmus), reprezentace barev (barevná hloubka, režim, průhlednost), animace, vrstvy, uložení doplňkových informací (libovolný text, EXIF, ICC)

    - Komprese:
        - Type: TIFF supports both lossy and lossless compression.
        - Algorithm: For lossless compression, it commonly uses the LZW or Deflate algorithms. It can also use JPEG compression for lossy compression.
    - Color Representation:
        - Color Depth: TIFF supports a wide range of color depths, from 1-bit (black and white) up to 16 bits per channel, and even 32 bits for floating-point images.
        - Color Space: It can handle various color spaces, including RGB, CMYK, and Lab color, and supports color management through embedded ICC profiles.
        - Transparency: TIFF files can support transparency, but this feature is not as commonly used as in formats like PNG.
    - Animation:
        - TIFF is not typically used for animation. It is primarily designed for static images.
    - Layers:
        - TIFF supports layers, which makes it a preferred choice in fields like photography, graphic design, and publishing, where editing flexibility is crucial.
    - Metadata Storage:
        - Arbitrary Text: TIFF allows for the inclusion of various metadata fields.
        - EXIF (Exchangeable Image File Format): It can store extensive EXIF data.
        - ICC Profiles: TIFF supports including ICC profiles

34. Jaký byste zvolili grafický formát pro uložení digitální fotografie, pokud nepředpokládáte další úpravy? Zdůvodněte.

    The best format to choose is JPEG. Here are the reasons why:

    - Effective Compression Ratio: JPEG provides a good balance between image quality and file size.
    - Universal Compatibility: JPEG is one of the most popular formats and is compatible almost with all devices and software for viewing images.

    - Optimization for Sharing: Due to smaller file size, JPEG images are ideal for sharing via email or on social media.

    - Sufficient Image Quality: For common purposes, such as displaying on digital devices or standard printing, JPEG provides sufficient image quality.

35. Jaký byste zvolili grafický formát pro uložení digitální fotografie, pokud předpokládáte další úpravy? Zdůvodněte.

    Hello, this is Bing. I can help you with translating text from Czech to English. Here is a possible translation of the text you provided:

    If you expect further editing of digital photos, the best choice would be RAW or TIFF format. Here are the reasons for their selection:

    - RAW:
        - Maximum Quality and Flexibility: RAW format captures all the data from the camera sensor, which provides the highest possible image quality and the greatest flexibility in editing.
        - Uncompressed and Lossless
        - Wider Range for Editing: They allow better control over exposure, white balance, tones and overall dynamic range.
    - TIFF:
        - Lossless Quality: TIFF offers lossless compression, which means that there is no degradation of quality after editing and saving repeatedly.
        - Support for High Color Depth: TIFF supports high color depth, which is beneficial for detailed color and tone adjustments.
        - Compatibility with Editing Programs: TIFF is widely supported in professional editing programs, such as Adobe Photoshop.
        - Layer Support: It allows saving images with layers, which is useful for complex editing.

36. Jaký byste zvolili grafický formát pro uložení diagramu elektrického obvodu v rastrové reprezentaci? Zdůvodněte.

    PNG (Portable Network Graphics) format would be the most suitable choice. Here's why:

    - Clarity and Sharpness: Diagrams, particularly those with lines and text, benefit from the clear, sharp edges that PNG provides.
    - Lossless Compression: PNG uses lossless compression, meaning there is no quality loss.
    - Support for High Color Depth: Although diagrams don't typically require a wide color palette, PNG's support for high color depth ensures that any color coding in the diagram remains accurate and vibrant.
    - Transparency Support: If you need to overlay the diagram on different backgrounds, PNG's support for transparency is useful.
    - Widely Supported and Portable: PNG is widely supported across various software and platforms, making it a reliable choice for sharing and viewing on different systems.

37. Jaký byste zvolili grafický formát pro uložení textu v rastrové reprezentaci? Zdůvodněte.

    PNG (Portable Network Graphics) format is the most suitable choice. Here's why:

    - Sharpness and Clarity: Text requires clear, sharp edges to be legible. PNG is excellent for preserving sharp lines and edges, making it ideal for text.
    - Lossless Compression: PNG uses lossless compression, ensuring that the quality of the text is not degraded.
    - High Contrast and Color Accuracy: PNG's support for high color depth ensures that any color in the text or background is accurately represented, maintaining contrast and readability.
    - Transparency Support: If you need to overlay the text on different backgrounds or images, PNG’s support for transparency is beneficial.
    - File Size Efficiency: For images like text, where there are large areas of uniform color, PNG is efficient in terms of file size while still providing high-quality output.
    - Wide Compatibility: PNG is widely supported across various platforms and software, ensuring the text image can be viewed consistently across different devices and applications.

38. I klasický analogový film je v jedné dimenzi vzorkován. V které? Jaká je vzorkovací frekvence? Jak se toto vzorkování často projevuje?

    Traditional analog film is sampled in the time dimension. The sampling frequency, often referred to as the frame rate, is typically 24 frames per second (fps) for standard cinema. This sampling manifests as a series of discrete still images that, when played back at a sufficient speed, create the illusion of continuous motion. This frame rate can sometimes lead to motion blur in fast-moving scenes and a flickering effect known as the "wagon-wheel effect," where spinning objects can appear to rotate slowly or even backward.

39. Jaký je vztah mezi rozlišením a poměrem stran digitálního videa?

    Resolution: Resolution refers to the number of pixels that make up the video image, typically described by its width and height in pixels. Common resolutions include 1920x1080 (Full HD), 1280x720 (HD), 3840x2160 (4K)

    Aspect Ratio: The aspect ratio describes the proportional relationship between the width and height of the video. Common aspect ratios include 4:3 (traditional television format), 16:9 (widescreen, standard for HDTVs and online platforms), and 21:9 (cinematic widescreen).

    Relationship:
    Independence: Resolution and aspect ratio are independent of each other. A particular aspect ratio can be associated with various resolutions. For example, a 16:9 aspect ratio can be seen in 1280x720, 1920x1080, or 3840x2160 resolutions, but for example, for digital television, a common aspect ratio is 16:9 and together with a resolution of 1920 x 1080 pixels.

40. DVD video v normě PAL má rozlišení 720x576 pixelů. Jaký může mít takový film poměr stran?

    A 720x576 pixel PAL DVD video can have different aspect ratios depending on how the pixels and the screen are used, but the base resolution of 720x576 itself has an aspect ratio of 5:4.

41. Vysvětlete, co to je prokládání (interlacing). Uveďte důvody jeho používání a problémy, které způsobuje

    Interlacing is a technique used in video and television technology where each frame is split into two fields. Each field contains alternating lines of the image - one field contains the odd lines, and the other contains the even lines. These fields are displayed sequentially but at a rate fast enough that the human eye perceives them as a single image.

    - Reasons for Using Interlacing:
        - Bandwidth Efficiency(Šířka pásma): In the early days of television, bandwidth was limited. Interlacing allowed for smoother motion perception in video without increasing the bandwidth required for transmitting the signal.

- Reduce Flickering: On older CRT (Cathode Ray Tube) televisions, interlacing helped reduce flickering and improved the perception of motion.

- Problems Caused by Interlacing:
  - Motion Artifacts: When objects move quickly, the two fields can become misaligned, leading to "combing" artifacts - a jagged or serrated look to moving objects.
  - Reduced Image Quality on Modern Displays like LCDs, LEDs
  - Incompatibility with Digital Standards
  - Limitation in Resolution

42. Vysvětlete, co v oblasti digitálního videa znamená kontejner a stream a jaký je mezi nimi vztah.

    Video container, sometimes referred to as a file format, is a type of file format that holds various types of data (video, audio, and sometimes subtitles) together in a single file. Popular container formats include MP4, AVI, MOV, MKV.

    Stream refers to the individual sequence of encoded data – primarily video or audio. A video stream contains visual information, while an audio stream contains sound information.

    Relationship Between Container and Stream:
    Container contains one or more streams (video, audio, subtitles) into a single file.

43. Co znamená pojem postprodukce audiovizuálního díla a jaké má nejčastěji kroky?

    Digitization of analog recording (if necessary), loading of raw data into the computer, arrangement of shots and editing, transitions, color grading and effects(VFX), filters, sound track, finalization of subtitles, rendering and preparation for distribution.

44. Jaké znáte způsoby ukládání natočeného video materiálu v digitálních kamerách? Uveďte jejich přednosti a nevýhody

    - Internal Memory:
      - Advantages:
        - No need for external storage devices.
        - Often allows for a more compact camera design.
        - Less risk of connection issues compared to external storage.
      - Disadvantages:
        - Limited Capacity compared to external options.
        - Inflexibility: Can't swap out for more storage without transferring or deleting files.
        - Data Transfer Time: Requires connecting the camera to another device to transfer data.

- Removable Memory Cards (SD/CF Cards):
  - Advantages:
    - Flexibility: Easy to swap out when full, allowing for virtually unlimited storage.
    - Portability: Small and easy to carry multiple cards.
    - Speed: High-speed cards can quickly write data, suitable for high-resolution and high frame rate video.
  - Disadvantages:
    - Fragility: More susceptible to physical damage or data corruption than internal storage.
    - Cost: High-capacity, high-speed cards can be expensive.
- External Hard Drives or SSDs:
  - Advantages:
    - High Capacity: Suitable for long recordings and high-resolution formats like 4K or 8K.
    - Fast Data Transfer: Especially with SSDs, enabling rapid transfer of large video files.
    - Reusability: Can be erased and reused many times.
  - Disadvantages:
    - Size and Connectivity: More cumbersome than memory cards; requires cables or additional mounting hardware.
    - Power Requirements: Some external drives may need separate power.
    - Cost: High-capacity SSDs can be quite expensive.

- 4. Cloud Storage or Wireless Transfer:
  - Advantages:
    - Backup: Offers a way to back up footage immediately.
    - Accessibility: Footage can be accessed from various devices and locations.
    - Space-Saving: Reduces the need for physical storage space on the camera.
  - Disadvantages:
    - Dependence on Internet Connectivity: Requires a stable and fast internet connection.
    - Security Risks: Potential for data breaches or hacking.
    - Ongoing Costs: May involve subscription fees for sufficient storage space.

45. Vysvětlete, co je a co není kodek.

What a Codec Is:

- Codec is a term derived from "Compressor-Decompressor" or "Coder-Decoder." It refers to software or hardware that compresses (encodes) and decompresses (decodes) digital media, such as audio or video.

What a Codec Is Not:

- Not a File Format: A codec is not the same as a file format (like MP4, AVI, or WAV).
- Not a Media Player: A codec does not play media by itself.
- Not Exclusive to Video: While often associated with video, codecs are also essential for audio files.
- Not Always Software-Based: Although commonly software, codecs can also be hardware-based.

46. Vysvětlete, co v oblasti digitálního videa znamená renderování a jak souvisí se střihem videa.

Rendering refers to the process of generating a final video output from different elements like video clips, audio tracks, special effects, and transitions. This process is closely related to video editing.

- Rendering in Digital Video:
  - Process of Generating Final Video: Rendering is the process where your editing software processes the various components of your video project and combines them into a single, viewable video file.
  - Application of Effects and Transitions: During editing, various effects, transitions, text overlays, and color grading are applied. Rendering computes all these elements to produce the final, continuous video.
  - Encoding: Rendering also includes encoding the video into a desired format (like MP4, AVI, etc.), which involves compressing the video and audio tracks into a single file using codecs.
  - Quality and Resolution Adjustments: When rendering, you can select the desired quality, resolution, frame rate, and other output settings for your video.
- Relationship with Video Editing:
  - Part of the Editing Process: Rendering is a crucial step after the editing process. While you edit, you're arranging and modifying various components in a video editing software. However, these changes are not yet finalized.

47. Jaké znáte formáty audia používané u digitálního videa?

- AAC (Advanced Audio Coding):
    - Usage: Widely used in MP4 files and streaming platforms.
    - Pros: Offers good sound quality at lower bitrates compared to MP3, making it efficient for online streaming and storage.
    - Cons: Not as universally compatible as MP3.
- MP3 (MPEG-1 Audio Layer III):
    - Usage: Commonly used in digital media players and online.
    - Pros: Highly compatible with most devices and platforms, known for decent sound quality at a relatively small file size.
    - Cons: Lossy compression means some audio quality is sacrificed.
- WAV (Waveform Audio File Format):
    - Usage: Often used in professional settings for editing and recording.
    - Pros: Lossless format, meaning it retains all the audio data without compression, leading to high audio quality.
    - Cons: Large file sizes make it impractical for streaming or portable use.
- AIFF (Audio Interchange File Format):
    - Usage: Common in Apple systems and professional audio settings.
    - Pros: Similar to WAV, offers high-quality, lossless audio.
    - Cons: Large file size, similar to WAV.
- PCM (Pulse-Code Modulation):
    - Usage: Used in CDs and DVDs, often the raw form of digital audio.
    - Pros: Lossless and high-quality.
    - Cons: Very large file sizes.
- AC-3 (Dolby Digital):
    - Usage: Standard in DVDs, Blu-ray, and digital broadcast.
    - Pros: Supports multiple audio channels (surround sound) and is efficient in terms of file size.
    - Cons: Proprietary format requiring licensing for use.
- DTS (Digital Theater Systems):
    - Usage: Common in Blu-ray discs and home theater systems.
    - Pros: High-quality surround sound.
    - Cons: Larger file sizes than AC-3 and less common in consumer products.
- Opus:
    - Usage: Designed for interactive online applications.
    - Pros: High performance at low bitrates, good for streaming.
    - Cons: Not as widely supported as more established formats.

48. Je při změně snímkové frekvence digitálního videa nutno brát v potaz i prostorové umístění pixelů?

    When changing the frame rate of a digital video, the spatial placement of pixels (i.e., their position within each frame) typically does not need to be adjusted. Frame rate adjustments are more about the temporal aspect of video – how many frames are shown per second – rather than the spatial arrangement of pixels within each frame.

49. Mějme video o snímkové frekvenci 25 fps. Je na něm natočeno otáčející se loukoťové kolo s 25 loukotěmi. Jakou rychlostí (v otáčkách za sekundu) se musí otáčet ve skutečnosti kolo, aby to na filmu vypadalo, že stojí?

    To make the wheel with 25 spokes appear stationary in a video shot at 25 frames per second (fps), the wheel must complete an exact number of full rotations every second.

    Since there are 25 spokes and 25 fps, the wheel should complete one full rotation per second for it to appear stationary.

50. Lze prokládané video převzorkovávat v dimenzi prostoru? Vysvětlete.

    Yes, interlaced video can be resampled in the spatial dimension, but it requires careful handling due to the nature of interlacing.

    - Resampling Interlaced Video:
        - Deinterlacing: The first step is often to deinterlace the video. This process involves converting the interlaced video into a progressive format, where each frame contains all lines of the image.

    - Spatial Resampling: Once the video is deinterlaced and in a progressive format, it can be resampled in the spatial dimension. This can involve:

        - Upscaling or Downscaling: Changing the resolution of the video.
        - Aspect Ratio Conversion: Adjusting the video to fit different display aspect ratios.

51. Jaké dílčí operace zahrnuje převod z normy NTSC do normy PAL? Je tento převod jednoduchý nebo složitý? Vysvětlete

    Converting video from the NTSC standard to the PAL standard involves several complex steps, due to the inherent differences in frame rate, resolution, and color encoding between these two systems.

- Differences Between NTSC and PAL:
    - Frame Rate: NTSC uses a frame rate of approximately 29.97 fps (30 fps interlaced), while PAL uses 25 fps.
    - Resolution: NTSC standard resolution is 720x480 pixels, whereas PAL is 720x576 pixels.
    - Color Encoding: NTSC and PAL use different methods for color encoding.

- Conversion Operations:
    - Frame Rate Conversion:
    - Resolution Adjustment:
    - Color Encoding Conversion:

Converting from NTSC to PAL is a complex process that involves several technical challenges. It requires careful handling to ensure that the resultant video maintains as much of the original quality as possible, with minimal introduction of artifacts.

52. Vysvětlete, co to je časová a prostorová redundance u digitálního videa.

- Temporal Redundancy (Časová Redundance):
    - Definition: Temporal redundancy refers to the similarity or repetition of content across successive frames in a video. In other words, it's the redundant information present in the time dimension of a video.

    - Example: In a scene where the background remains static while only a small object moves, much of the frame does not change from one to the next. These unchanged areas represent temporal redundancy.

- Spatial Redundancy (Prostorová Redundance):
    - Definition: Spatial redundancy refers to the repetition or similarity of data within a single video frame. It's the redundant information present in the spatial dimension (within the frame itself).

    - Example: In a frame where a large portion of the scene is a single color, like a blue sky, the repeated blue pixels represent spatial redundancy.

53. Vysvětlete, čeho využívá interframe a intraframe komprese u digitálního videa

In digital video compression, interframe and intraframe compression are two methods used to reduce file size. Each targets different types of redundancies within the video.

Intraframe Compression:

- Intraframe compression, also known as spatial compression, focuses on reducing redundancy within a single frame (similar to still image compression). It does not consider the differences or similarities between successive frames.

- Generally results in larger file sizes compared to interframe compression as it doesn't take advantage of similarities between frames.

Interframe Compression:

- Interframe compression, also known as temporal compression, reduces redundancy across different frames. It's focused on the similarities or lack of change between successive frames.

54. Vysvětlete, co znamenají tzv. I-frame, P-frame a B-frame u komprese videa standardem MPEG. Co to je GOP?

In MPEG video compression, I-frames, P-frames, and B-frames are types of frames used to encode video data efficiently. They are part of a strategy known as interframe compression, which reduces file size by taking advantage of the similarities between successive frames. The concept of a GOP (Group of Pictures) is closely related to these frame types.

- I-frame (Intra-coded frame):
    - I-frames are self-contained. They are coded without reference to other frames and contain all the information needed to display that frame.
- P-frame (Predictive frame):
    - P-frames are coded relative to the nearest previous I-frame or P-frame.
    - They store only the changes in the image from the previous frame.
- B-frame (Bi-predictive frame):
    - B-frames are coded relative to the nearest I-frame, P-frame, or other B-frames before and after them.
    - They use information from both the past and future frames to encode.
- GOP (Group of Pictures):
    - A GOP is a sequence of frames that begins with an I-frame, followed by a series of P-frames and B-frames.
    - The length of a GOP can vary but is typically fixed within a single encoding session.

- GOP structure enables efficient video compression by balancing the need for quality (I-frames), storage efficiency (P-frames and B-frames), and the ability to seek within the video.

55. Mějme digitální videoklip ve formátu MPEG s GOP délky 18 snímků. Je tento videoklip vhodný pro střih? Vysvětlete.

While it's possible to edit an MPEG video with a GOP length of 18 frames, it may not be the most straightforward choice for complex editing due to the nature of MPEG compression, because there are too few frames. And it uses GOP, which wouldn't be good for applying effects to an entire video.

56. Mějme digitální video a chceme je uložit do formátu MPEG. Použitý SW umožňuje nastavit téměř libovolnou kombinaci I-snímků, P-snímků a B-snímků. Vysvětlete, v jaké situaci byste použili jakou kombinaci I/P/B snímků a proč?

- For High Quality and Easy Editing:
  - Use More I-Frames:
  - I-frames are self-contained and offer the highest quality, as they are not dependent on other frames.
  - Ideal for scenarios where you plan to do a lot of editing
- For Efficient Storage and Streaming:
  - Use More P-Frames and B-Frames:
  - P-frames and B-frames store only changes from previous or future frames, making them more efficient in terms of storage.
- For a Balanced Approach:
  - Moderate Use of All Frame Types:
  - A balanced approach uses a mix of I, P, and B frames in a manner that optimizes both file size and editing flexibility
- Fast-Moving or Complex Video:
  - For videos with a lot of action or complex scenes, using more I-frames can help maintain quality, as predictive frames (P and B) might struggle with too much motion or change.
- Static or Slow-Moving Video:
  - For static or slow-moving scenes, you can rely more on P and B frames, as the changes between frames are minimal.

57. Má prokládání nějaký vliv na kompresi digitálního videa? Vysvětlete.

    Yes, interlacing does have an impact on the compression of digital video. This impact is mainly due to the way interlaced video captures and displays motion, which affects how compression algorithms work. This can cause motion artifacts and loss of details.

58. Vysvětlete, co to je motion vector u komprese digitálního videa.

    Motion vectors are used to compress video by describing how blocks of pixels move between frames. They reduce the data needed to store a video by only saving the changes from a reference frame. They are used in many video standards like MPEG and H.264, and they improve the quality and smoothness of the video. However, they also have challenges like complexity and artifacts.

59. Jaké jsou typické artefakty digitálního videa? Jaký je vliv predikce snímků na trvání artefaktů?

    Typical artifacts in digital video arise from various factors, including compression techniques, transmission errors, and limitations in recording technology. The use of frame prediction in video compression, particularly interframe compression, can influence the duration and visibility of these artifacts.

    - Typical Digital Video Artifacts:
        - Blockiness (Blocking Artifact):
            - Often due to heavy compression, where the video is divided into blocks for encoding.
        - Banding:
            - Visible bands or stripes
            - Often results from limited color depth and compression.
        - Pixelation:
        - Mosquito Noise:
            - Small, flickering artifacts around edges.
        - Motion Artifacts:
            - Blur or ghosting in fast-moving objects, or a 'juddering' effect in panning shots.
            - Errors in compression or insufficient frame rate.
        - Artifacting from Lossy Compression:
            - General degradation of image quality.
            - Some data is discarded to reduce file size.

    - Influence of Frame Prediction on Artifacts:
        - Temporal Smearing:

            - Incorrect prediction in P-frames and B-frames can lead to smearing or ghosting effects

- Propagation of Errors:
    - If an I-frame (intra-coded frame) is encoded with errors or artifacts, these errors can propagate to subsequent P-frames and B-frames, prolonging the duration of the artifacts.
- Motion Estimation Errors:
    - Errors in motion estimation can cause artifacts in areas with complex motion, which might persist as long as the motion continues.

60. Co to je streamování? Jaké má základní typy?

Streaming is the process of transferring and playing audio and video content over the internet without downloading it to the user's device. It allows users to access media in real time. Streaming is a key part of the modern approach to digital content and has several basic types:

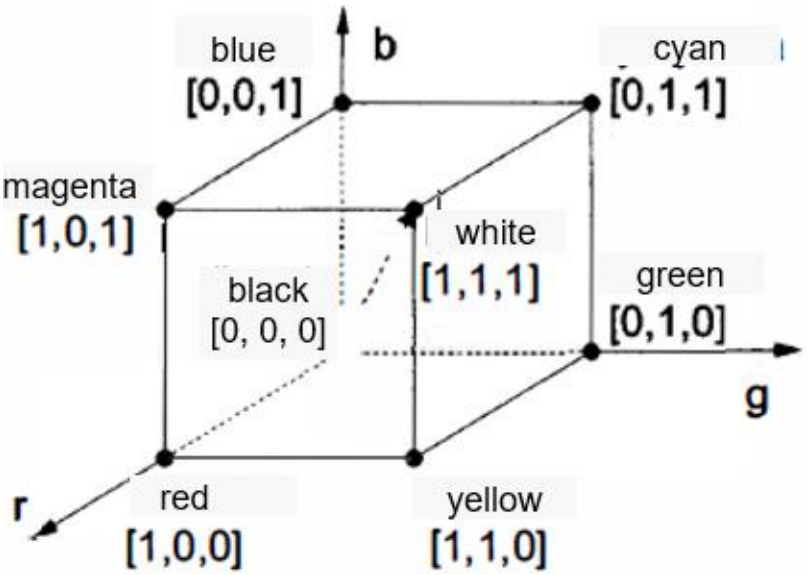
- Live Streaming
    - Transmits content as it is generated, such as live sports, concerts, or news. It is interactive, often with communication between the broadcaster and the viewers (e.g., chat). It is often used for special events, online education, webinars.
- On-Demand Streaming
    - Allows users to access audio and video content anytime. It is not live, but pre-recorded. It gives more flexibility to users, who can choose what and when to watch or listen. It is used by movie and TV services like Netflix, YouTube, Hulu.
- Adaptive bitrate streaming
    - Streams content in multiple qualities and adjusts the quality according to the internet speed and the device's capabilities. It minimizes interruptions and ensures smooth playback at different internet speeds. It is commonly used by services like Netflix, Amazon Prime Video, to provide a stable streaming experience.

61. Jaké tři typy procesů (filtrů) potřebujeme pro přehrání audiovizuálního souboru?

To play an audiovisual file, we need three processes: a decoder, a stream processor, and an output filter. They convert, synchronize, and present the audio and video data to the user. They are usually integrated in playback software and hardware.

- Decoder (Codec)
    - Decoders are necessary to convert compressed audio and video data back to a format that can be played.
- Stream Processing
    - Stream processing processes handle the manipulation of data streams, such as synchronizing sound and image, selecting audio channels or subtitles.
- Output Filters
    - Output filters ensure that the decoded data is properly passed to the audio and visual hardware of the device, such as speakers, headphones, or screens.

1. Popište barevný prostor RGB a jeho použití. Popište jeho vlastnosti – např. souřadnice černé a bílé a základních barev, princip skládání barev, princip převodu RGB na odstíny šedi, výpočet jasu z barevných složek apod.. Demonstrujte odpovídající vlastnosti na jednotkové krychli.

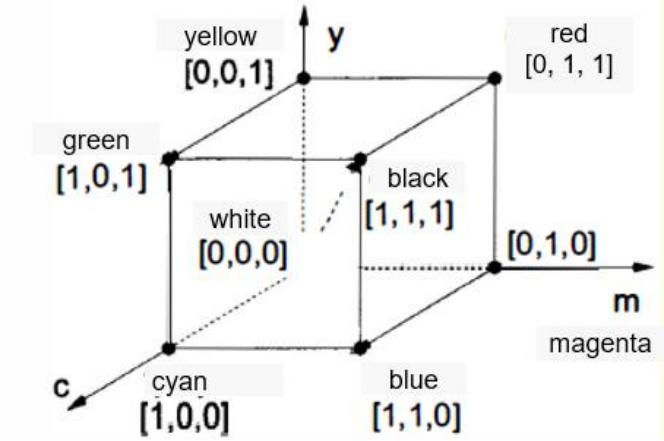


The RGB color space is a widely used additive color model in which red, green, and blue light are added together in various ways to reproduce a broad array of colors. This model is primarily used for sensing, representation, and display of images in electronic systems, such as televisions and computers.

- Properties of RGB Color Space:
  - Coordinates of Black, White, and Primary Colors:
    - Black: No color, represented as (0, 0, 0).
    - White: Full intensity of all colors, represented as (1, 1, 1).
    - Red: (1, 0, 0)
    - Green: (0, 1, 0)
    - Blue: (0, 0, 1)
  - Color Mixing Principle:
    - RGB uses additive color mixing, where colors are created by combining the light of the three primary colors.
    - The more you add of each color, the closer you get to white.
  - Conversion to Grayscale:
    - Grayscale can be achieved by using formula:
      $0.299 \cdot \text{Red} + 0.587 \cdot \text{Green} + 0.114 \cdot \text{Blue}$
  - Calculating Brightness:
    - A common method is to use a weighted average, giving more weight to green and less to blue, based on human perception. For instance, brightness = 0.299R + 0.587G + 0.114*B.

- Usage of RGB:
  - Digital Displays
  - Photography and Videography
  - Web and Graphic Design

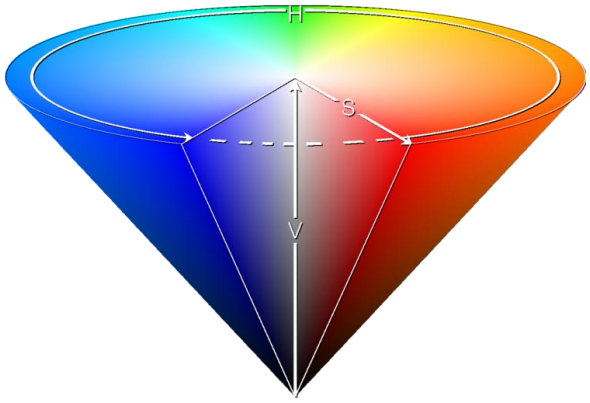
2. Popište barevný prostor CMY(K) a jeho použití. Popište jeho vlastnosti – např. souřadnice černé a bílé a základních barev, princip skládání barev, princip převodu CMY(K) na odstíny šedi, výpočet jasu z barevných složek apod.. Demonstrujte odpovídající vlastnosti na jednotkové krychli.



The CMY(K) color space is a subtractive color model used primarily in color printing. This model is based on the primary colors Cyan (C), Magenta (M), and Yellow (Y). The "K" stands for Key or Black and is added to improve the depth and density of black in prints.

- Properties of CMY(K) Color Space:
  - Coordinates of Black and White:
    - Black: In theory, combining 100% of C, M, and Y should produce black. In reality, this combination often results in a muddy dark brown or gray, so pure black (K) is added. The coordinates for black are (1, 1, 1, 1) in CMYK.
    - White: The absence of color, represented as (0, 0, 0, 0) in CMYK.
  - Primary Colors Coordinates:
    - Cyan (C): (1, 0, 0, 0)
    - Magenta (M): (0, 1, 0, 0)
    - Yellow (Y): (0, 0, 1, 0)
  - Color Mixing Principle:
    - It's a subtractive model, meaning colors are created by subtracting light. Combining C, M, and Y filters subtracts varying degrees of red, green, and blue from white light to produce different colors.
  - Conversion to Grayscale:
    - Grayscale images in CMY(K) are created by equal values of C, M, and Y, with K adjusted for brightness.
  - Brightness Calculation:
    - Brightness or luminance in CMY(K) isn't calculated directly from C, M, and Y but rather from the RGB values or through specialized formulas considering the printing process and ink characteristics.
- Usage of CMY(K):
  - Printing: CMY(K) is the standard model for full-color printing.
  - Graphic Design: It's crucial for designers to work in CMY(K) for printed materials to ensure color accuracy.

3. Popište barevný prostor HSV a jeho použití. Popište jeho vlastnosti – např. souřadnice černé a bílé a základních barev, vztah HSV a odstínů šedi apod.. Demonstrujte odpovídající vlastnosti na jednotkovém jehlanu



The HSV (Hue, Saturation, Value) color space represents colors in terms of their hue, saturation, and value, offering a more intuitive approach to color adjustment than RGB. It's especially useful in scenarios where these color aspects need to be modified or filtered.

- Properties of HSV Color Space:
  - Hue (H):
    - Represents the color type (like red, blue, green).
    - It's a circular value, an angle from 0° to 360°.
  - Saturation (S):
    - Represents the intensity or purity of the color.
    - Ranges from 0 (gray, no color) to 100% (full intensity).
  - Value (V):
    - Represents the brightness of the color.
    - Ranges from 0 (black) to 100% (full brightness).
  - Coordinates of Black, White, and Grayscale:
    - Black: Represented by V = 0, regardless of H or S values.
    - White: Represented by V = 100% and S = 0%.
    - Grayscale: Any point with S = 0% (no saturation), with V determining the shade of gray.
  - Primary Colors:
    - Red, green, blue, and other primary colors are located at specific angles around the hue circle (e.g., red at 0° or 360°).
- Use of HSV:
  - Image Processing and Editing: Allows for more intuitive adjustments of color brightness and saturation.
  - Graphics Design: Useful for selecting and modifying colors based on their characteristics.
  - Filtering and Effects: Facilitates operations like color thresholding or segmentation in computer vision.

4. Mějme barevný prostor RGB popsaný jednotkovou krychlí. Napište přibližné souřadnice následujících barev: černá, bílá, světle šedá, tmavě šedá, žlutá, oranžová, červená, fialová, zelená, modrá, tyrkysová. Jaké souřadnice budou mít tyto barvy v prostoru CMY

   In the RGB color space described by a unit cube, colors are represented by a combination of Red (R), Green (G), and Blue (B) values, each ranging from 0 to 1. Below are the approximate RGB coordinates for the specified colors:

   - Black: (0, 0, 0)
   - White: (1, 1, 1)
   - Light Gray: (0.75, 0.75, 0.75)
   - Dark Gray: (0.25, 0.25, 0.25)
   - Yellow: (1, 1, 0)
   - Orange: (1, 0.5, 0)
   - Red: (1, 0, 0)
   - Purple: (0.5, 0, 0.5)
   - Green: (0, 1, 0)
   - Blue: (0, 0, 1)
   - Turquoise: (0, 1, 1)

   In the CMY color space, which is a subtractive color model, the CMY values are typically the inverse of the RGB values. The CMY coordinates for the same colors would be:

   - Black: (1, 1, 1) - (subtracting all colors gives black)
   - White: (0, 0, 0)
   - Light Gray: (0.25, 0.25, 0.25)
   - Dark Gray: (0.75, 0.75, 0.75)
   - Yellow: (0, 0, 1)
   - Orange: (0, 0.5, 1)
   - Red: (0, 1, 1)
   - Purple: (0.5, 1, 0.5)
   - Green: (1, 0, 1)
   - Blue: (1, 1, 0)
   - Turquoise: (1, 0, 0)

conversion RGB – CMY

$$\begin{bmatrix} c \\ m \\ y \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} - \begin{bmatrix} r \\ g \\ b \end{bmatrix}$$

5. Mějme analogový obraz – černobílou šachovnici. Tento obraz chceme digitalizovat (např. scannerem). Popište (popř. nakreslete), jaký vliv má na výsledek: 1) velikost pixelu vzhledem k velikosti políčka šachovnice, 2) relativní poloha pixelu vůči políčku šachovnice, 3) úhel natočení vzorkovací mřížky vůči šachovnici.

   1 - Pixel Size Relative to Checkerboard Squares:

   - Small Pixels (High Resolution): If the pixel size is small compared to the checkerboard squares, the scanner captures more detail, and the digital image will closely resemble the original checkerboard pattern.
   - Large Pixels (Low Resolution): If the pixels are large relative to the checkerboard squares, there will be less detail. This might lead to a loss of the checkerboard pattern clarity, and some squares might not be accurately represented.

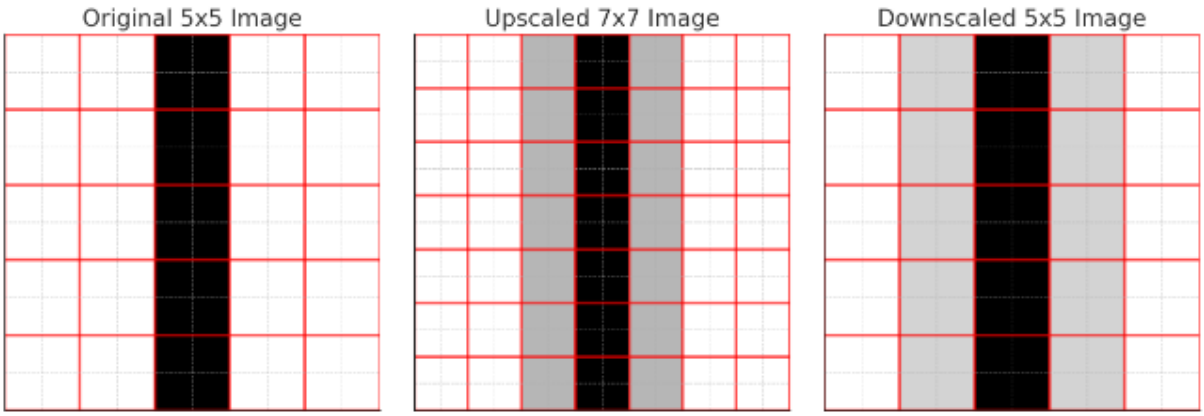
   2 - Relative Position of Pixel Grid to Checkerboard:

   - Aligned Grid: If the pixel grid is perfectly aligned with the checkerboard, each pixel will capture either a black or white area accurately.
   - Misaligned Grid: If the grid is misaligned (e.g., pixels overlap the edges of the checkerboard squares), pixels at the boundaries might capture mixed values, leading to grayish tones or unclear boundaries in the digital image.

   3 - Angle of the Sampling Grid Relative to Checkerboard:

   - No Rotation (Aligned): If the sampling grid aligns with the checkerboard (no rotation), the digital representation will be more accurate.
   - Rotation Applied: If the sampling grid is rotated relative to the checkerboard, it can cause a moiré pattern.

6. Mějme rastrový obraz – bílý čtverec o straně 5 pixelů, v němž je uprostřed svislá černá čára šířky 1 pixel. Převzorkujme tento obraz nejprve na velikost 7x7 pixelů a pak opět zpět na velikost 5x5 pixelů. Předpokládejte bilineární interpolaci. Bude se nový obraz lišit od původního? Pokud ano, jak ? Nakreslete. (Nápověda: nakreslete si obrazovou funkci v řezu a proveďte interpolaci a převzorkování).



The process of resampling the original 5x5 image (with a vertical black line in the center) to a 7x7 image and then back to 5x5 using bilinear interpolation (approximated in this case) results in changes to the final image.

In the final downscaled 5x5 image, you can observe that:

- Blurring of the Black Line: The original sharp black line becomes blurred. This is due to the averaging effect of the bilinear interpolation, which blends the black pixels with the surrounding white pixels during both upscaling and downscaling.

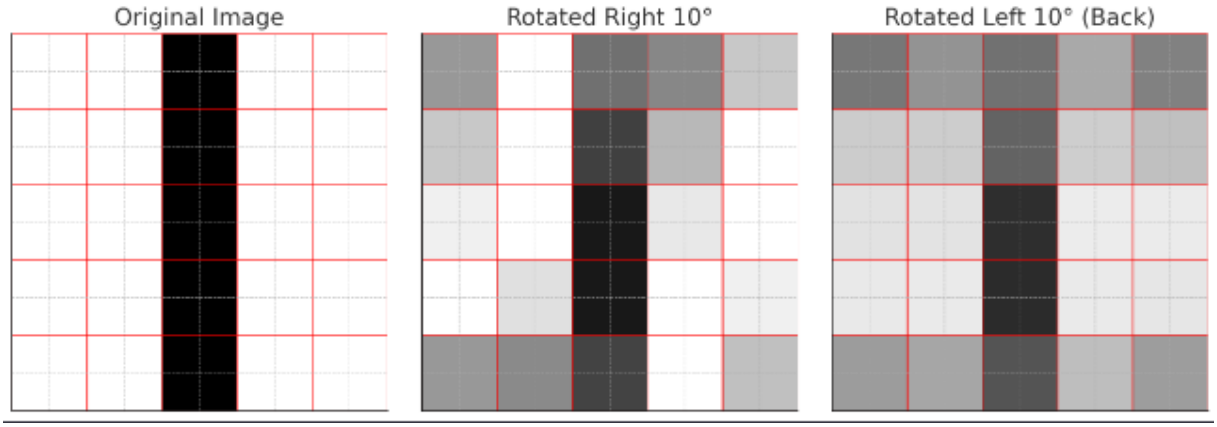
- Grayish Pixels Around the Line: The pixels adjacent to the black line are no longer purely white. They have taken on grayish values due to the interpolation process. This effect is more pronounced in areas immediately surrounding the black line.

- Loss of Original Sharpness: The original crisp edges of the black line are lost, and the line's contrast with the white background is reduced.

Summary:

- Original 5x5 Image: Displays the distinct vertical black line.
- Upscaled 7x7 Image: Shows the same black line across a larger pixel area.
- Downscaled 5x5 Image: Illustrates how the black line becomes blurred after downscaling, impacting the adjacent pixels.

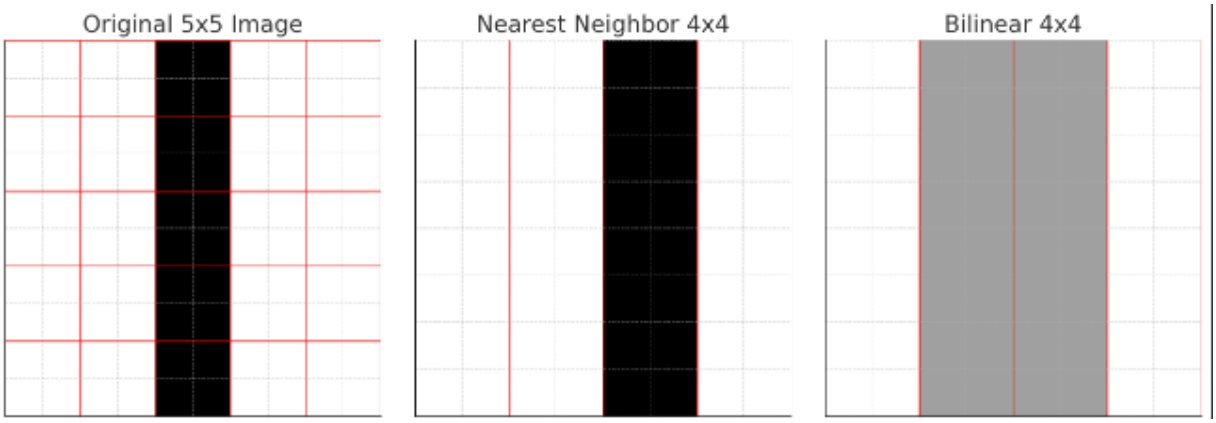
7. Mějme rastrový obraz – bílý čtverec o straně 5 pixelů, v němž je uprostřed svislá černá čára šířky 1 pixel. Otočme tento obraz o 10 stupňů doprava a poté o 10 stupňů doleva. Předpokládejte bilineární interpolaci. Bude se nový obraz lišit od původního? Pokud ano, jak? Nakreslete.



In the process of rotating the original 5x5 image first 10 degrees to the right and then 10 degrees back to the left using bilinear interpolation, changes occur in the image.

- Original Image: Shows a clear vertical black line in the center of the white square.
- Rotated Right 10°: After the first rotation, the black line becomes slightly blurred and skewed due to the rotation and interpolation. The image boundaries also become somewhat distorted as the image is rotated within its original dimensions.
- Rotated Left 10° (Back): After rotating the image back, the distortion and blurring are further accentuated. The black line is no longer perfectly vertical or sharply defined, and the white areas around it have grayish pixels due to the interpolation process.

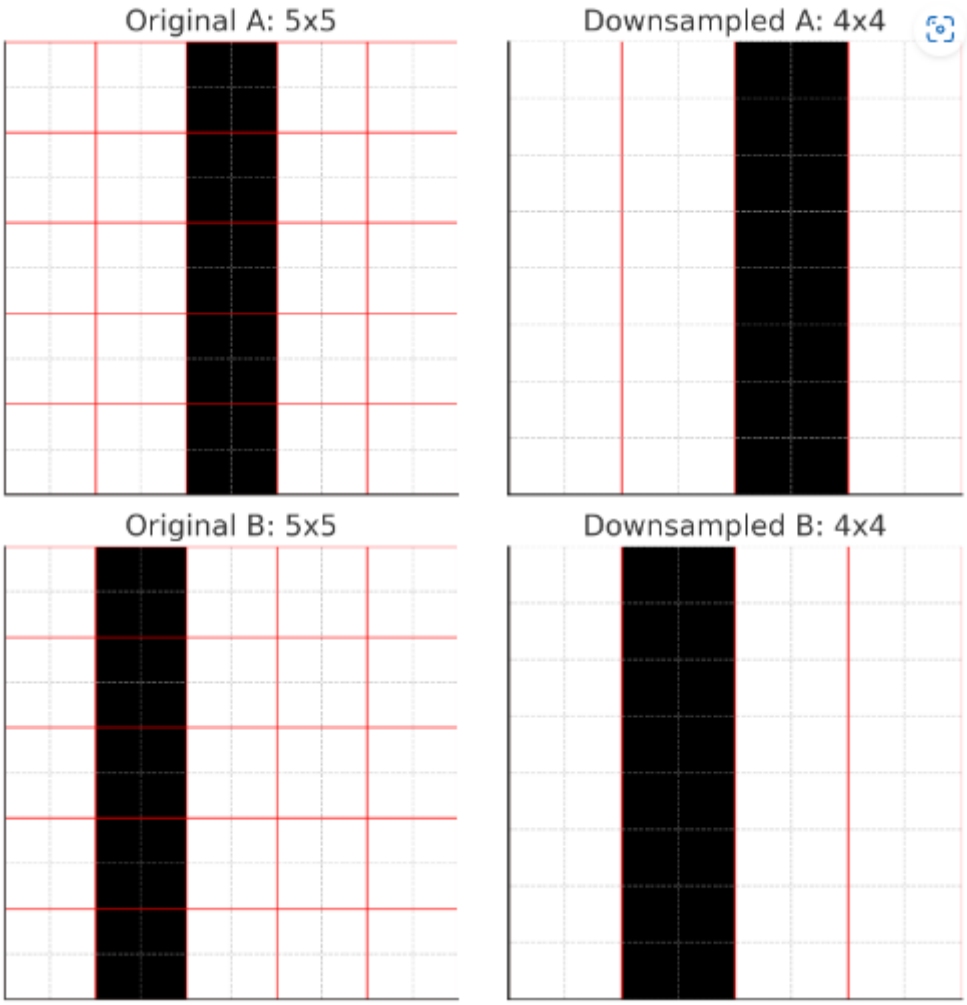
8. Mějme rastrový obraz – bílý čtverec o straně 5 pixelů, v němž je uprostřed svislá černá čára šířky 1 pixel. Převzorkujme tento obraz na velikost 4x4 pixely. Jak bude nový obraz vypadat při použití interpolace metodou nejbližšího souseda a jak při použití bilineární interpolace? Nakreslete. (Nápověda: nakreslete si obrazovou funkci v řezu a proveďte interpolaci a převzorkování).



Here are the downscaled 4x4 versions of the original 5x5 image with a vertical black line in the center, using two different interpolation methods:

- Original 5x5 Image: Shows a clear vertical black line in the center.
- Nearest Neighbor 4x4: This method simply picks the nearest pixel value from the original image. The result is a 4x4 image where the black line is still somewhat visible, but its position and thickness may appear slightly altered due to the reduced resolution and the method of choosing the nearest pixels.
- Bilinear 4x4: Bilinear interpolation averages the pixel values, which causes a blurring effect. In this downscaled image, the black line is less distinct than in the nearest neighbor method. The pixels around the black line have grayish tones due to the blending of black and white pixels.

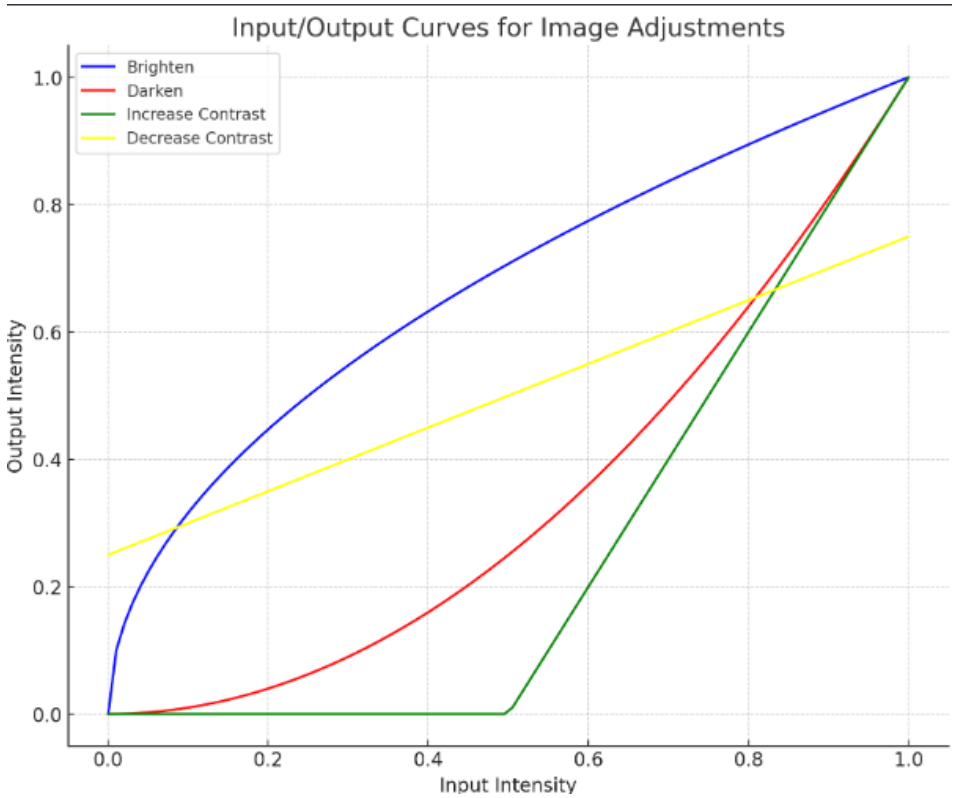
9. Mějme rastrový obraz – bílý čtverec o straně 5 pixelů, v němž je svislá černá čára šířky 1 pixel – v případě A je uprostřed (ve třetím sloupci), v případě B je v druhém sloupci. Převzorkujme tento obraz na velikost 4x4 pixely. Jak bude nový obraz vypadat při použití interpolace metodou nejbližšího souseda v případech A a B? Nakreslete. (Nápověda: nakreslete si obrazovou funkci v řezu a proveďte interpolaci a převzorkování).



- Case A (4x4 Downsample): The grid clearly shows the black vertical line in the center of the image, resulting from the nearest neighbor interpolation of the original line in the 3rd column of the 5x5 image.

- Case B (4x4 Downsample): The grid highlights how the black vertical line, originally in the 2nd column of the 5x5 image, has been shifted slightly towards the center in the downsampled image.

10. Mějme šedotónový rastrový obraz. Pomocí vstupně/výstupních křivek chceme provést následující operace: zesvětlit obraz, ztmavit obraz, zvýšit kontrast, snížit kontrast. Nakreslete, jak budou vypadat odpovídající křivky na jasové složce obrazu



11. Jaké znáte formáty pro ukládání rastrových obrazů? U každého jmenujte přednosti, nedostatky, pro co je vhodný a pro co není vhodný.

    - JPEG (Joint Photographic Experts Group)
        - Advantages: Efficient compression for reducing file size. Widely supported and used on the web and digital cameras.
        - Disadvantages: Lossy compression leads to quality degradation, especially after repeated saving. Does not support transparency.
        - Suitable for: Photographs, web images.
        - Unsuitable for: Graphics with transparency, images requiring high quality.

    - PNG (Portable Network Graphics)
        - Advantages: Supports transparency. Lossless compression. Good image quality.
        - Disadvantages: Larger files than JPEG. Not always ideal for very large images or photographs.
        - Suitable for: Web graphics, images with transparency, screenshots.
        - Unsuitable for: Large photographs, where file size is a priority.

    - GIF (Graphics Interchange Format)
        - Advantages: Supports animation. Supports simple transparency.
        - Disadvantages: Limited to 256 colors.
        - Suitable for: Simple animations, icons, logos.
        - Unsuitable for: Quality photographs, images with a large amount of colors.

    - BMP (Bitmap)
        - Advantages: Lossless quality. Simple format without complicated compression.
        - Disadvantages: Large files, lack of compression. Not efficient for sharing or web.
        - Suitable for: Storing uncompressed images in Windows.
        - Unsuitable for: Web, sharing, storing large image files.

    - TIFF (Tagged Image File Format)
        - Advantages: Supports lossless compression. Suitable for storing detailed images, e.g. in photography and scanning. Flexible format supporting various kinds of image data. Support layers.
        - Disadvantages: Large files. Not always supported in web browsers.
        - Suitable for: Printing, archiving photographs, professional photographic applications.
        - Unsuitable for: Common use on the web. Each of these formats has its specific use depending on the requirements for image quality, file size and other features, such as transparency or animation.

12. Vysvětlete základní princip, jak funguje algoritmus komprese obrazu ve formátu JPEG.

- Conversion to YCbCr Color Space:
  - An image in the RGB format is converted into the YCbCr color space. "Y" represents luminance (brightness), while "Cb" and "Cr" represent chrominance (color information).

- Reduction of Resolution of Color Components:
  - Due to the lower sensitivity of the eye to color, the resolution of the Cb and Cr components is often reduced (subsampling).

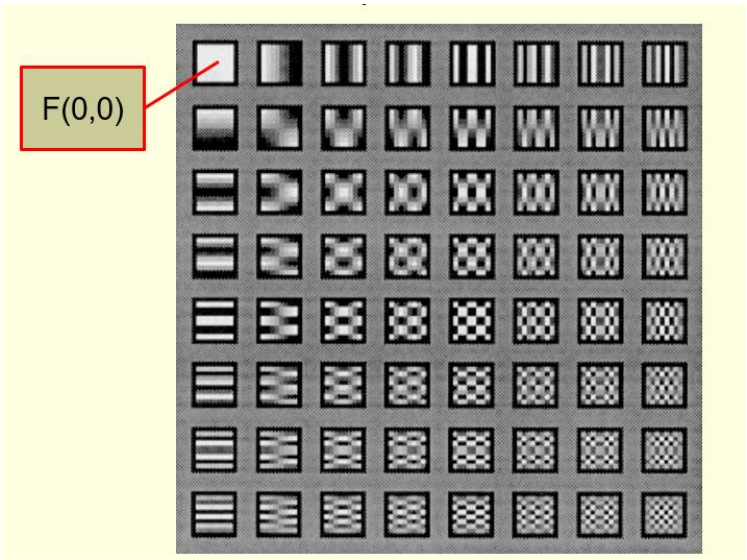
- Division into Blocks and DCT (Discrete Cosine Transform):
  - The image is divided into small blocks (typically 8x8 pixels).
  - Discrete Cosine Transform (DCT) is performed on each block. DCT converts the pixels of the block from the spatial domain to the frequency domain, revealing frequency patterns in the image.

- Quantization:
  - The results of the DCT are quantized. Quantization reduces the accuracy of the frequency coefficients, leading to the loss of some information. Higher frequencies (details, textures) are typically reduced more than lower frequencies (basic patterns).
  - This step is the primary source of lossiness in JPEG compression.

- Encoding:
  - The quantized blocks are encoded using techniques such as Huffman coding.

- Final File:
  - All steps are packaged into a single JPEG file, which contains all the necessary information for decoding and displaying the image.
  - JPEG compression is particularly effective for photographs and complex image scenes.

13. Jaká je základní myšlenka dvourozměrné diskrétní kosinové transformace, použité v kompresi JPEG? Nakreslete příklady bázových funkcí – kolik jich celkem ve formátu JPEG je?



Basic Idea of 2D DCT in JPEG Compression:

- Transformation: The DCT transforms an 8x8 block of pixel values from the spatial domain into the frequency domain. In this domain, the values represent the amplitude of frequencies in the image block.

- Basis Functions: Each of the 64 basis functions represents a different frequency. The (u,v) position in the grid indicates the frequency: (0,0) is the lowest frequency (DC component), and frequencies increase as u and v increase.

14. Předpokládejme, že komprese JPEG odstranila z obrazu všechny nenulové frekvence a ponechala pouze stejnosměrnou složku. Jak bude obecně vypadat výsledný obrázek? Pokud by byl původní obrázek tvořen pravidelnou šachovnicí černých a bílých pixelů, jak by vypadal výsledek po takovéto drastické kompresi?

    General Resulting Image:
    - Uniform Color: The resulting image will have a uniform color across the entire image. This is because the DC component represents the average color of the block of pixels.
    - Loss of Detail: All details, textures, and patterns will be lost, leaving only a single, flat color that represents the average of all the colors in the original image.

    Specific Case - Regular Checkerboard Pattern:
    - Original Image: A regular checkerboard of black and white pixels.
    - After Compression: Since the original image has an equal number of black and white pixels, the average color will be a shade of gray.
    - Resulting Image: The entire image will be converted into a uniform gray color, where each pixel has the same intensity. The intensity will be mid-way between black and white, effectively removing the checkerboard pattern entirely.

15. Mějme DVD video v normě PAL (rozlišení 720x576 pixelů) s poměrem stran 4:3. Chceme video přehrát na zařízení se čtvercovým pixelem. Jakou operaci musíme na videu provést?

For playing a PAL DVD video (resolution 720x576 pixels) with an aspect ratio of 4:3 on a device with square pixels, we need to adjust the video to accommodate the different pixel aspect ratios.

- Operation Required:
  - Aspect Ratio Correction
  - Resizing or Stretching the Image
- Resulting Resolution:
  - Calculating New Resolution:
    - The original resolution of the video is 720x576. This is designed for display on a screen where the pixels are taller than they are wide.
    - To maintain the 4:3 aspect ratio with square pixels, we need to increase the width of the image.
    - The height remains the same (576 pixels), but the width needs to be adjusted to keep the 4:3 ratio.
  - Width Calculation:
    - Aspect Ratio = Width / Height
    - For a 4:3 aspect ratio with a height of 576 pixels: Width = 4/3 * 576 = 768 pixels.
  - Final Resolution:
    - Therefore, the video should be resized to a resolution of 768x576 pixels for correct display on a device with square pixels.

This resizing ensures that the aspect ratio of the original content is preserved, and the video is displayed correctly without any distortion on a device with square pixels.

16. Jaké znáte standardy MPEG pro ukládání digitálního videa? U každého jmenujte jeho oblast použití, přednosti, nedostatky.

- MPEG-1:
  - Usage: Primarily used for Video CD (VCD) and lower-resolution video.
  - Advantages: Good at lower bitrates, making it suitable for CDs and early digital video applications.
  - Disadvantages: Limited support for high resolutions and advanced compression techniques.

- MPEG-2:
  - Usage: Widely used for DVD videos, digital television, and cable broadcasting.
  - Advantages: Better quality at higher resolutions compared to MPEG-1
  - Disadvantages: Requires more processing power than MPEG-1.

- MPEG-4 Part 2:
  - Usage: Early standard for digital rights management (DRM) and Internet streaming.
  - Advantages: Advanced video coding features compared to MPEG-2, efficient at lower bitrates.
  - Disadvantages: Less efficient than newer standards like MPEG-4 Part 10

- MPEG-4 Part 10 (AVC):
  - Usage: Broad application including Blu-ray discs, streaming media (like YouTube, Netflix), and broadcasting.
  - Advantages: High compression efficiency, excellent video quality at lower bitrates, wide compatibility.
  - Disadvantages: More computationally intensive for encoding.

- MPEG-H Part 2 (HEVC):
  - Usage: Next-generation standard for 4K and 8K video, used in streaming, broadcasting, and Blu-ray.
  - Advantages: Improved compression efficiency compared to AVC, supports higher resolutions and HDR.
  - Disadvantages: Even more computationally intensive than AVC

17. Jaké znáte formáty kontejnerů digitálního videa? U každého jmenujte přednosti, nedostatky, pro co je vhodný a pro co není vhodný.

1. MP4 (MPEG-4 Part14)
    - Advantages:
        - Wide compatibility with various devices and platforms.
        - Supports video, audio, subtitles, and still images.
        - Good for streaming over the internet.
    - Disadvantages:
        - Limited support for certain advanced codec options.
    - Suitable For: General-purpose digital video, online streaming.
    - Not Suitable For: Extremely high-quality video where a more sophisticated codec might be required.
2. AVI (Audio Video Interleave)
    - Advantages:
        - Compatibility with many older systems and software.
        - Can contain a variety of codecs.
    - Disadvantages:
        - Larger file sizes compared to newer formats.
        - Does not support modern features like subtitles or multiple audio tracks well.
    - Suitable For: Simple video playback on older systems.
    - Not Suitable For: Modern streaming applications, high-quality video.
3. MKV (Matroska)
    - Advantages:
        - Supports virtually any audio and video format.
        - Can include multiple audio tracks, subtitles, and metadata.
        - Good for high-quality video, including 4K and 3D content.
    - Disadvantages:
        - Not as widely supported on some devices and platforms.
    - Suitable For: High-quality video projects, multimedia content with multiple tracks.
    - Not Suitable For: Environments requiring universal playback compatibility, like basic streaming services.
4. MOV (Apple QuickTime)
    - Advantages:
        - High-quality video support.
        - Integration with Apple's ecosystem.
    - Disadvantages:
        - Less compatible with non-Apple devices and platforms.
    - Suitable For: Video editing and playback in Apple environments.
    - Not Suitable For: Universal playback across diverse platforms and devices.
5. WMV (Windows Media Video)
    - Advantages:
        - Good integration with Windows-based systems.
        - Efficient compression.
    - Disadvantages:
        - Limited compatibility with non-Windows platforms.

- Suitable For: Content primarily for playback on Windows systems.
- Not Suitable For: Cross-platform applications and web streaming.

6. FLV/F4V (Flash Video)
    - Advantages:
        - Once widely used for online streaming.
    - Disadvantages:
        - Declining support due to the obsolescence of Adobe Flash.
    - Suitable For: Legacy web content.
    - Not Suitable For: Modern web streaming and cross-platform video sharing.

18. Jaké znáte formáty digitálního videa (pro ukládání pohyblivého obrazu)? U každého jmenujte přednosti, nedostatky, pro co je vhodný a pro co není vhodný.

- MPEG-1:
  - Advantages: Universal playback compatibility across various devices and platforms.
  - Disadvantages: Outdated in terms of quality,
  - Suitable For: Basic video playback, especially for legacy content.
  - Not Suitable For: High-resolution or quality-demanding applications.
- MPEG-2:
  - Advantages: Supports interlaced video, widely used for DVDs and broadcasting.
  - Disadvantages: Limited to rectangular frames, can be inefficient in terms of data size.
  - Suitable For: Standard-definition TV, DVD production.
  - Not Suitable For: High-definition or efficient storage solutions.
- VC-1:
  - Advantages: Developed by Microsoft, optimized for Windows Media.
  - Disadvantages: Lower support compared to other codecs, may have quality limitations.
  - Suitable For: Content within the Microsoft ecosystem.
  - Not Suitable For: Broad, cross-platform applications.
- MJPEG (Motion JPEG):
  - Advantages: Beneficial for editing and processing each frame independently.
  - Disadvantages: Generates a high volume of data, leading to large file sizes.
  - Suitable For: Editing and frame-by-frame processing.
  - Not Suitable For: Efficient storage or streaming.
- DV (Digital Video):
  - Advantages: Widely used in digital camcorders, good for further processing.
  - Disadvantages: Produces a significant amount of data.
  - Suitable For: Consumer and semi-professional video recording.
  - Not Suitable For: Compact storage solutions.
- HDV (High Definition Video):
  - Advantages: Excellent quality for editing and post-production, higher resolution than DV.
  - Disadvantages: Generates more data than standard DV.
  - Suitable For: High-quality video production.
  - Not Suitable For: Situations where data storage is a constraint.

19. Popište specifické problémy převzorkování digitálního videa. Uvažujte jak převzorkování v dimenzi prostoru, tak převzorkování v dimenzi času.

- Spatial Resampling:
  - Loss of Detail:
    - Enlarging (upscaling) a video often leads to a loss of detail and sharpness, as new pixel values are interpolated from existing ones. Fine details can become blurred.
  - Artifacts:
    - Resampling can introduce visual artifacts like aliasing, where diagonal lines and curves appear jagged or pixelated. Moiré patterns can also occur in areas with fine patterns.
  - Aspect Ratio Distortion:
    - If the resampling doesn't maintain the original aspect ratio, the video can become stretched or squashed, leading to unnatural-looking images.
  - Color and Brightness Changes:
    - Some resampling algorithms can unintentionally alter color balance and brightness levels, especially if color space conversions are involved.

- Temporal Resampling:
  - Motion Blur:
    - Increasing the frame rate (frame interpolation) can create unnatural motion blur. This is because new frames are generated based on the motion in existing frames, which might not always accurately represent natural motion.
  - Judder:
    - Decreasing the frame rate can lead to judder, a jerky or stuttering movement, particularly noticeable in fast-moving scenes or panning shots.
  - Audio Synchronization Issues:
    - Changing the frame rate without adjusting the audio can lead to synchronization problems, where the audio no longer matches the video.
  - Frame Duplication or Skipping:
    - Simple methods of temporal resampling, like frame skipping or duplication, can disrupt the flow of motion, making the video appear choppy or uneven.

20. Mějme jednoduché video o rozlišení 5x5 pixelů a snímkové frevenci 25 fps. Video obsahuje pět snímků, které jsou celé bílé, pouze v prvním řádku postupuje rovnoměrně zleva doprava černý pixel a to tak, že na prvním snímku je zcela vlevo (v prvním sloupci), na druhém snímku je ve druhém sloupci, atd., až na posledním snímku je zcela vpravo (v pátém sloupci). Převzorkujme video na snímkovou frekvenci 20 fps. Které snímky převzorkovaného filmu budou celé bílé (předpokládejte lineární interpolaci)?

To resample the simple 5x5 pixel video from 25 fps to 20 fps using linear interpolation, we need to determine which frames from the original sequence are included in the new sequence at the reduced frame rate.

- Original Video at 25 fps:
  - Frame 1: Black pixel in the 1st column.
  - Frame 2: Black pixel in the 2nd column.
  - Frame 3: Black pixel in the 3rd column.
  - Frame 4: Black pixel in the 4th column.
  - Frame 5: Black pixel in the 5th column.
- Process of Resampling to 20 fps:
  - When reducing the frame rate from 25 fps to 20 fps, we're essentially reducing the number of frames by a factor of 25/20 (or 5/4). This means we need to select frames at regular intervals from the original 5 frames to create a sequence of 4 frames.
  - With linear interpolation, we would select frames based on evenly spaced intervals in the original sequence.
  - $$\text{Nový snímek} = \frac{\text{Stará snímková frekvence}}{\text{Nová snímková frekvence}} \times \text{Starý snímek}$$
- Selected Frames for 20 fps:
  - Tabulka

Nový snímek	Starý snímek	Výsledek
1	$\frac{25}{20} \times 1 = 1.25$	Interpolace mezi 1. a 2. snímkem
2	$\frac{25}{20} \times 2 = 2.5$	Interpolace mezi 2. a 3. snímkem
3	$\frac{25}{20} \times 3 = 3.75$	Interpolace mezi 3. a 4. snímkem
4	$\frac{25}{20} \times 4 = 5$	Stejný jako 5. snímek

- Conclusion:
  - In the resampled 20 fps video, none of the frames will be entirely white. All frames will contain the black pixel, either at its original position or at an interpolated position based on the closest frames in the original 25 fps sequence.

21. Mějme jednoduché video o rozlišení 5x5 pixelů a snímkové frevenci 25 fps. Video obsahuje pět snímků, které jsou celé bílé, pouze v levém horním rohu se ve třetím snímku objeví černý pixel. Převzorkujme video na snímkovou frekvenci 20 fps. Nakreslete a popište, jak bude přibližně vypadat druhý snímek převzorkovaného filmu (předpokládejte lineární interpolaci v čase).

- Original Video at 25 fps:
  - Frame 1: White.
  - Frame 2: White.
  - Frame 3: Black pixel in top left corner.
  - Frame 4: White.
  - Frame 5: White.
- Process of Resampling to 20 fps:
  - When reducing the frame rate from 25 fps to 20 fps, we're essentially reducing the number of frames by a factor of 25/20 (or 5/4). This means we need to select frames at regular intervals from the original 5 frames to create a sequence of 4 frames.
  - With linear interpolation, we would select frames based on evenly spaced intervals in the original sequence.
  - $$\text{Nový snímek} = \frac{\text{Stará snímková frekvence}}{\text{Nová snímková frekvence}} \times \text{Starý snímek}$$
- Selected Frames for 20 fps:

Tabulka

Nový snímek	Starý snímek	Výsledek
1	$\frac{25}{20} \times 1 = 1.25$	Interpolace mezi 1. a 2. snímkem
2	$\frac{25}{20} \times 2 = 2.5$	Interpolace mezi 2. a 3. snímkem
3	$\frac{25}{20} \times 3 = 3.75$	Interpolace mezi 3. a 4. snímkem
4	$\frac{25}{20} \times 4 = 5$	Stejný jako 5. snímek

- Conclusion:
  - Second frame will be interpolation between 2nd and 3rd frame so the black pixel will fade but not disappear

22. Mějme video o snímkové frekvenci 24 fps. Je na něm natočeno otáčející se loukoťové kolo s šesti loukotěmi. Jakou rychlostí (v otáčkách za sekundu) se musí otáčet ve skutečnosti kolo, aby to na filmu vypadalo, že se otáčí rychlostí jedna otáčka za sekundu v opačném směru?

1. **Calculation of Rotation per Frame:**
   - The wheel should rotate just under one full rotation in 24 frames to appear as though it's moving backwards.
   - In 24 frames, if the wheel rotates 360° (one full rotation), it would appear stationary. To appear as if it's rotating backwards, it should rotate slightly less than 360°.
   - If it rotates 60° less (300° in total) in 24 frames, then in each frame, it will rotate $\frac{300^\circ}{24} = 12.5^\circ$.
2. **Rotation Speed in Revolutions Per Second (rps):**
   - 300° in one second is $\frac{300^\circ}{360^\circ}$ of a full rotation.
   - This is approximately 83.3% of a full rotation, so the speed is $0.833 \times 1\,\text{rps} = 0.833\,\text{rps}$.

23. Vysvětlete, jak funguje algoritmus komprese videa ve formátu MPEG.

The MPEG (Moving Picture Experts Group) video compression algorithm reduces video file sizes while maintaining quality. It's a widely used standard with formats like MPEG-1, MPEG-2, MPEG-4

- Spatial Compression:
  - Discrete Cosine Transform (DCT): The image is divided into small blocks (e.g., 8x8 pixels), and DCT is applied to convert these pixels from spatial to frequency domain
  - Quantization: After DCT, the frequency coefficients are quantized, reducing precision, especially for less visually important high-frequency details.
- Temporal Compression:
  - Motion-Based Prediction: This technique reduces redundancy between frames by finding unchanged areas or small changes and encoding only the differences or movements.
  - Frame Types: MPEG uses different frame types for efficient compression:
    - I-frames are independent and fully encoded.
    - P-frames are encoded based on previous I or P frames.
    - B-frames use both previous and following frames for reference.
- Encoding and Data Processing:
  - After compression, data is further encoded using techniques like Huffman coding to reduce file size.
- Final File:
  - The resulting compressed file contains all necessary information for decoding and displaying the video.

24. Kolik zabere 1 sekunda nekomprimovaného videa v normě PAL fullHD se snímkovou frekvencí 25 fps a barevnou hloubkou 8 bitů na kanál?

```
sirka = 1920  # šířka v pixelech
vyska = 1080  # výška v pixelech
pocet_kanalu = 3  # RGB
bitova_hloubka = 8  # bitů na kanál
snimkova_frekvence = 25  # snímků za sekundu

# Výpočet celkové velikosti v bitech
velikost = (sirka * vyska * pocet_kanalu * bitova_hloubka * snimkova_frekvence)
velikost = velikost/8 # velikost v baitech
velikost = velikost/1000000 #velikost v megabaitech
```