



Signal and Image Processing Roadmap (12 Weeks)



Week 1: Introduction to Signal and Image Processing

- What is signal processing? What is image processing?
 - Analog vs Digital signals and images.
 - Applications in communication, medical, computer vision.
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Week 2: Signals and Systems Basics

- Types of signals: continuous, discrete, periodic.
 - System properties: linearity, time invariance, causality.
 - Convolution, correlation, and basic transforms.
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Week 3: Sampling and Quantization

- Nyquist theorem and aliasing.
 - A/D and D/A conversion.
 - Image sampling, quantization, and resolution.
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Week 4: Fourier Transform in Signal and Image Processing

- DTFT, DFT, FFT for signals.
 - 2D Fourier Transform for images.
 - Frequency domain analysis and filtering.
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Week 5: Filtering Techniques

- FIR and IIR filters for signals.
 - Low-pass, high-pass, band-pass, and notch filters.
 - Image smoothing, sharpening (Laplacian, Sobel, Gaussian).
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Week 6: Noise and Denoising

- Types of noise: Gaussian, Salt-and-Pepper.
- Signal noise reduction: moving average, Wiener filter.

- Image denoising techniques (Median filter, wavelets).
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Week 7: Z-Transform and Applications

- Definition and properties of Z-transform.
 - System stability and frequency response.
 - Pole-zero analysis and filter design.
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Week 8: Image Enhancement Techniques

- Histogram equalization.
 - Contrast stretching.
 - Adaptive enhancement methods.
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Week 9: Image Segmentation and Edge Detection

- Thresholding, Region growing, Watershed.
 - Edge detection: Canny, Prewitt, Sobel, Laplacian.
 - Morphological operations: dilation, erosion.
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Week 10: Image Compression Techniques

- Lossless (Huffman, Run-Length Encoding) vs. Lossy (JPEG, DCT).
 - Transform-based compression: Wavelets.
 - Compression standards and applications.
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Week 11: Feature Extraction and Object Recognition

- Features: corners, edges, blobs.
 - Algorithms: SIFT, SURF, HOG.
 - Basics of image classification and object detection.
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Week 12: Mini Project / Case Study

- Implement an application like:
 - ECG signal analysis
 - Face recognition system

- Noise removal from audio/image
- Use tools like MATLAB, Python (OpenCV, NumPy, SciPy).