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SUMMARY OF RECENT ONLINE TECHNICAL – A System's View of Communications From Signals to Packets, Using MATLAB and Wireshark – see my Linked In Project Section for details and github links to files:

- **Parts 1 and 2 of this course focused on the physical layer, where as Part 3 focused on the rest of the communication stack layers, link, network, transport and application.**

- **Part 1 for Point to Point Links:** Basic engineering tools used and tradeoffs encountered in the design of communication systems like mobile phones for a point-to-point link, which communicates information from a single transmitter to a single receiver.
  - **Topics:**
    - Error Correction Coding for sending a waveform (adding bits)
    - Bits-to-waveforms (sent on channel)
    - Encoding bits to send
    - Continuous verses discrete waveforms representation
    - Discrete time channel step response
    - Communication protocols
    - Inter-symbol interference
    - Recursive channel model
    - Performance evaluation
    - Equalization
    - Additive noise
    - Bit error rate
    - From a received waveform on channel, convert waveforms-to-bits
    - Error Correction on Received Waveform
    - bit errors
    - parity bit code
    - repetition code
    - channel coding
    - eye diagrams
- **Part 2 - examines how multiple transmitters can share the same physical channel**
  - **Analysis Tool: MATLAB for these topics:**
    - lossless and lossy source coding compression
    - sequence of yes/no questions
    - entropy of a bit and a discrete random variable (lossless compression)
    - entropy and the average code length
    - Huffman source code for a set of symbols (lossless compression)
    - parameters that control the shape of continuous and discrete time sinusoids
    - signals as sums of sinusoids
    - reconstruct a signal given its Fourier coefficients
    - MP3 encoding used to compress our music files (lossy compression) - why frequency

domain analysis of signals is needed
    - lossy source coding: perceptual, time/frequency analysis, masking, non-uniform quantization
    - frequency response of linear time invariant system
    - different types of filters from their frequency response (low-pass, band-pass, high-pass)
    - predict the output of a filter given the Fourier coefficients of its input and its frequency response
    - complex exponential (numbers, exponentials, aliasing, discrete Fourier transform)
    - relationship between the discrete Fourier series and the discrete Fourier transform
    - frequency division multiplexing (to share channel, move signals in and out of freq. Ranges)
    - modulation and demodulation shifts signals from one part of the frequency spectrum to another
    - Analyze modulation and demodulation using sine waves and complex exponentials
    - Signal Transmission - Modulation: Radio Spectrum, Modulation
    - Modulation with Complex Exponentials and Demodulation
    - mixing using cosines
    - mixing using complex exponentials
    - Filtering
    - Non-ideal effects
    - effect of frequency and phase mismatches between the transmitter and receiver
    - how digital data can be transmitted wirelessly using binary phase shift keying (BPSK)
    - understand how quadrature phase shift keying can be used to double the rate information sent over the same channel - better efficiency
    - I/Q modulation
    - Quadrature phase shift keying (QPSK)
    - interpret eye and constellation diagrams for performance analysis of channel
- **Part 3 - discusses how information can be transmitted reliably from one station to another over a network that connects multiple stations.**
    - **Analysis Tools: MATLAB and for the application layer, Wireshark, for these topics:**
    - **Link Layer Topics:**
        - understanding the difference between circuit switching and packet switching
        - the use of layering in organizing network functionality
        - multiple access protocols
        - how the Aloha protocol operates
        - analyzing the efficiency of the slotted variant of the Aloha protocol
    - **Network Layer Topics:**
        - descriptions of the different functions of the network layer, including addressing, encapsulation, routing and forwarding
        - identifying differences between the distance vector and link state algorithms for routing
        - applying the distance vector algorithm to estimate forwarding tables at nodes in a network iteratively
        - calculating the best path in a network from one node to every other node using Dijkstra’s algorithm
    - **Transport Layer Topics:**
        - the transport layer's functions

    - descriptions of UDP and the TCP, and identifying differences between them
    - explanations of how the stop-and-wait protocol ensures in-order packet transfer
    - derivations of the throughput of the stop-and-wait protocol
    - analyzing the increase in throughput enabled by the sliding window protocol.
- **Application Layer Topics:**
    - understanding the internet hourglass
    - descriptions of different application architectures
    - such as client-server and peer to peer
    - Illustrations of how the hypertext transfer protocol is used to retrieve information on webpages
    - explanations of how the domain name system maps host names to IP addresses