

# CS 484/504 HOMEWORK - 1

Fall 2022

Computer Science Department, New Mexico State University

*All questions have equal weight. Graduate problems are extra-credit when done by undergraduates.*

1. Assume there is a transmitter-receiver pair. The bit rate of the transmitter is 1,000 bits per second (1Kbps). There is a considerable amount of noise in the physical connection. So, we have chosen a line-coding scheme with error-correcting redundancy that uses 4 symbols for every useful bit transmitted. What must the Baud rate be to achieve this 1Kbps speed?
2. Under what conditions are the Bit rate and the Baud rate equal for a physical layer transmission?
3. Take your Aggie ID and convert it into binary format (8-bit ASCII). Assume you are to send these integer bits through a 2D-PAM4 signal with a Baud rate of 40 symbols per second. Answer the following questions:
  - How many bits long is your AggieID when encoded as 8-bit ASCII?
  - How many useful bits of information can a 2D-PAM4 signal carry per symbol?
  - How many bits/second can be sent at 40Bd on a 2D-PAM4 signal?
  - How many seconds does it take to send out the entire Aggie ID? Round to the nearest millisecond.
4. **Graduate Question:** Propose rules for a line coding scheme that uses 4 voltage levels (1D-PAM4). How many bits per symbol are carried by your line coding scheme? Is it self-clocking?
5. Sketch the Manchester encoding for 0001110101. The sketch must be drawn on a diagram of voltage over time like was shown in class:



Figure 1: Example

6. If a signal strength at 5 meters away from the transmitter is  $10^{-5}$  mW, what will the signal strength be at 10 meters? Explain how you made your estimate using the Inverse Square Law.
7. If the signal strength is  $10^{-6}$  mW at 20 meters, what will the signal strength be at 5 meters? Explain how you made your estimate using the Inverse Square Law.
8. **Graduate Question:** A signal is  $10^{-6}$  mW at a distance D. In terms of D, at what distance will it be  $10^{-8}$  mW? Show your work.

9. Imagine your employer just replaced the old cat5e cables running throughout the walls of your office to connect all the wifi access points to each other and to the Internet. They replaced the cable with fiber optic lines. Pulling the lines through the old cat5e conduit pipe tracks in the walls was difficult because of many tight bends. Unfortunately, you and your co-workers are not seeing any difference in your Internet speeds. In fact, they seem to be worse. What physical layer issues could be causing the problem? Give two distinct examples and explain how you could test for the problem.
10. Write a paragraph that answers each of these questions: Visit <https://x.company/projects/loon/> Why was Project Loon was discontinued? How could the problem they faced be overcome? Do you think Starlink is an effective alternative? Why or why not?