Exercises from van Drongelen:

- **Chapter 2:** 2.2 (see Ch2 page 24), 2.5
- **Chapter 4:** 4.5a,b
- **Chapter 6:** 6.4 (see page 109, 6.3.1), 6.5:

A note on the table for 6.4: I jumped the gun in lecture on this one, we derived in class that we cannot distinguish anything with frequency greater or equal to fs, with the last wave number corresponding to frequency (N-1)/T. So in Table 6.4, the answer you would give given your knowledge as of today would be fs (or s, from column 2).

However, what I tried to explain to you after bumbling on this is that we can actually only distinguish up to a frequency of fs/2, so the total range, F, is fs/2. This is the converse result of Nyquist rate (L3 slide 28).

Imagine the clock with wave number k=N/2. At each time step, it jumps to the opposite side of the clock, but we don't know which direction it took, and anything higher than that frequency gets interpreted as the negative of a smaller wave number. The bonus section in your lab should explain this more verbosely.

For the purpose of right now and your midterm, the answer to the last column in the table for exercise 6.4 should always be F = fs/2 (see provided answer)

(Some) Answers:
https://www.elsevier.com/books-and-journals/book-companion/9780128104828/answers-to-selected-exercises

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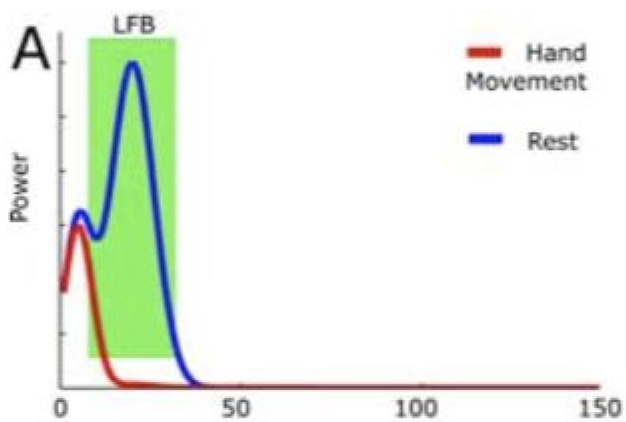
Study questions from slides:

- Know the macroscopic regions (lobes) of the brain, and their associated function.
    - **Example Q**: label where the cerebellum is, and what it's responsible for.
- Spatiotemporal scales of neural data (L2, slide 20).
    - **Example Q**: why is fMRI unsuitable for studying 10Hz oscillations in the brain?
- Different types of electrophysiological recordings, their physiological basis, and spatial scales.
- ADC resolution: given voltage range V, and # of bits n, compute the voltage resolution possible, or analogous computations.
    - **Example Q:** (L3, slide 12-14)
- Sampling rate, Nyquist rate.
    - **Example Q:** What is the minimum sampling rate you need to accurately measure an ERP, which happen on the order of ~50ms?

- Signal power (mean square, ms), root mean square (rms), signal to noise ratio (SNR), averaging over trials.
    - L4 slide 9-10, 24-26
    - **Example Q**: To get an SNR boost of 1dB, we can either increase signal power, or perform the experiment multiple times (trials). How can we accomplish either? I.e., how much do we have to increase signal power by, and how many more trials do we need?
- 3 categories of noises and examples of each, especially bolded ones.
- Applications of ERP, especially understanding the purpose and interpretation of the experiment in the Reading 1
- LTI systems:
    - **Example Q**: are the following functions linear and/or time-invariant, f(t) = abs(t), f(t) = t/5, f(t) = -1. Demonstrate this mathematically using the formulas given in lecture
- Simple computation for convolution, either using the delta decomposition table or by flip-and-slide. You can come up with arbitrary vectors to practice this.
- Fourier Transform, complex coefficients, power and phase
- Wave number to frequency conversion
- Interpreting a power spectrum:
    - **Example Q**: given this power spectrum, identify their significance



- 6 properties of power spectrum:
    - **Example Q**: given total signal power P, and a power spectrum with a distinct peak with power Q, compute the power of the remaining components
- **All non-coding computation questions from the lab are fair game!**