Digital Systems

Things you should learn:

1. The concept of "analog"
2. How information is represented in analog
3. How physical processes and computation can be represented by analog devices
4. Some problems with analog representation—stability, resolution, etc.
5. The concept of "digital"
6. The implications of continuous vs. discrete information states
7. How digital representations of information eliminate problems associated with analog representations
8. The tradeoffs between analog and digital systems—including economic considerations
9. Why digital systems are almost always binary
10. Binary representation of information and the base-2 numbering system
11. Why octal (base-8) and hexadecimal (base-16) are useful numbering systems
12. What George Boole developed and why it's central to digital systems
13. The three primitive logic gates that, together) can carry out every possible operation—computational or logical—in binary systems
14. Truth tables, combinatorial logic, computation, and digital control
15. Addition, subtraction, and multiplication in binary; two's complement representation of negative numbers
16. Why NAND gates (or NOR gates) rule the digital world
17. John von Neumann's concept of a digital computer
18. Why this concept led to the digital revolution
19. The evolution of digital technology and Moore's Law
20. Digital technology today—CPUs, memory chips, communication

Things you should be able to do:

1. Identify and describe the operation of several everyday analog devices
2. Create/invent an analog device to represent a process or calculation
3. Convert quantities between binary, octal, and hexadecimal numbering systems
4. Convert verbal logic statements into truth tables into logic circuits into physical circuits
5. The inverse problem: Evaluate a logic circuit and deduce its truth table

Things you should lie awake thinking about:

1. Digital seems to be everywhere. Are there instances where analog is better?
2. Problems resulting in differential equations, integration, and differential—processes that are inherently continuous, must be "discretized" to be handled by digital systems.
3. If Moore's Law continues to hold for the foreseeable future, how long will it be before computers have the power/capacity of the human brain?