

Hardware Description Language

Homework 3

Blizzard Finnegan

Author's note: All answers here are using the SI standard prefixes (that is, multiples of 1000). For more information, please see the [linked article](#).

1. An average audio CD can contain 650MB of data. Given that the audio is stored *in stereo* 16-bit samples at a rate of 44100Hz, how many minutes of audio can a CD contain?

$$\begin{aligned} \text{stereo} &= \frac{2 \times \text{bits}}{\text{sample}} \\ \frac{1 \text{ sample}}{4B} \times \frac{32 \text{ bit}}{1 \text{ sample}} \times \frac{44100 \text{ sample}}{1 \text{ sec}} \times \frac{1 \text{ sec}}{650 \text{ MB}} \times \frac{1 \text{ disc}}{1000 \text{ kB}} \times \frac{1 \text{ byte}}{8 \text{ bit}} \times \frac{1000 \text{ B}}{1 \text{ kB}} &= \frac{3684 \text{ sec}}{\text{disc}} \\ 3684 \text{ sec} &\approx 1 \text{ h}, 1 \text{ min}, 24 \text{ sec} \end{aligned}$$

2. It takes 10 bits to encode an **nxm** memory, where m is 8 bits. What is the size of the memory?

10 bit address size: $2^{10} = 1024$ addresses

Each address contains 8 bits (1byte).

Total memory contains 8096 bits, or 1024 bytes. This is 1.024kB or 1KiB.

3. How many bits does it take to encode a memory that contains 1 second of a mono, 16-bit audio snippet sampled at 8000 Hz?

$$\frac{16 \text{ bit}}{\text{sample}} \times \frac{8000 \text{ sample}}{\text{sec}} \times \frac{1 \text{ sec}}{1} = 128000 \text{ bit}$$

128kbit or 16kByte