

Hardware Description Language

Homework 3

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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?

$$\frac{1\text{sample}}{4B} \times \frac{32\text{bit}}{1\text{sample}} \times \frac{44100\text{sample}}{1\text{sec}} \times \frac{1\text{sec}}{650\text{MB}} \times \frac{2 \times \text{bits}}{\text{sample}} \times \frac{1\text{byte}}{8\text{bit}} \times \frac{1000B}{1\text{kB}} \times \frac{1\text{disc}}{1000\text{kB}} \times \frac{650\text{MB}}{1\text{MB}} = \frac{3684\text{sec}}{\text{disc}}$$

$3684\text{sec} \approx 1\text{h}, 1\text{min}, 24\text{sec}$

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?

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

$128\text{kbit or } 16\text{kByte}$