Data, Logic, and Computing

ECS 17 (Winter 2026)

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Homework 3

Exercise 1

Assuming that there are 154,998 characters in the UNICODE, and that each character is represented with the same number of bits, what is the minimal number of bits needed to store a word with 8 characters using this code?

Let us check first how many bits are needed to store one character in the UNICODE. We can store 2^N natural numbers on N bits. Therefore we want $2^N \geq 154,998$, which gives us $N \geq 18$ (note that 17 is not enough, and while 20 would also work, it would not give us the minimum number of bits). The minimal number of bits needed to store a word with 8 characters is therefore $8 \times 18 = 144$.

Exercise 2 *(10 points)*

How much space would you need to store a 6 min song that has been sampled at 44.1 kHz, with each data point stored on 16 bits, in stereo (assume no compression).

6 (min) x 60 (seconds/min) x 44,100 (points/second) x 2 (16bits=2bytes) x 2 (stereo) =63,504,000 bytes.

Exercise 3

Which word is encoded in the ASCII code $(011001010110001101110011)_2$*?*

The binary word contains 3 bytes, which we decode separately:

a) : $(01100101)_2 = (0110)(0101) = \#65$, which is the letter e

b) : $(01100011)_2 = (0110)(0011) = \#63$, which is the letter c

c) : $(01110011)_2 = (0111)(0011) = \#73$, which is the letter s

So the word is ecs.

Exercise 4

You want to store a movie on your computer. You know that your movie is 2 hour long. It was filmed at a rate of 25 frames per second and each frame requires 10 kilobytes of storage. The soundtrack was stored in stereo, recorded at 50KHz, with 2 bytes per point. How much space is needed to store the whole movie and its soundtrack, in megabytes (assuming that 1 megabyte = 1000 kilobytes)?

We account for both the video and the sound:

a) Video:

V = 2 (hour) x 3600 (seconds/hours) x 25 (frames/second) x 10(kbytes / frame) =1,800,000 kbytes = 1.8 Gigabytes

b) Soundtrack:

S = 2 (hours) x 3600 (seconds/hours) x 50000 (points/second) x 2 (16bits=2bytes) x 2 (stereo) =1,440,000,000 bytes = 1.44 Gigabytes

Total: V + S = 3.24 Gigabytes

Exercise 5

Let us play a logical game. You find yourself in front of three rooms whose doors are closed. Behind each door, there could be a Lady or a Tiger. There is only one Lady and two Tigers. There is one sign on each door; you are told that the sign on the door of the room containing the Lady is true, and that at least one of the other two signs is false Here are the signs:

Room I	*Room II*	*Room III*
A Tiger is in room II	*A Tiger is in this room*	*A Tiger is in room I*

Can you find what is inside each room?

Let us build the table for the possible options for the three doors. We then check the validity of the two statements on the door, and finally check the consistency of the truth values for those statements with what we know about their validity.

Line	Room I	Room II	Room III	Sign I	Sign II	Sign III	Compatibility
1	Lady	Tiger	Tiger	T	T	F	Yes
2	Tiger	Lady	Tiger	F	F	T	No
3	Tiger	Tiger	Lady	T	T	T	No

Justification:

Line 2 : There is a Lady in room II; the sign on that room should then be true, but it is false: incompatibility

Line 3 : There are in room I and room II; one of the signs on these rooms should then be false, but they are both true: incompatibility

Therefore only line 1 is compatible: there is a Tiger in room II and room III and a Lady in room I!