CMPT 334 **Spring 2021**

Assignment 3

Due: Friday April 02, 2021 – 8:00 AM

Submit a single pdf/word file in Moodle.

Provide short answers for the following question (100 points):

Q1. What are DRAMs and SRAMs mainly used for?

SRAM is used for cache memory (both on and off chip), and DRAM is used for main memory.

Q2. What is the difference between EPROM and EEPROM?

EPROM is read and written electrically; before a write operation, all the storage cells must be erased to the same initial state by exposure of the packaged chip to ultraviolet radiation. Erasure is performed by shining an intense ultraviolet light through a window that is designed into the memory chip. EEPROM is a read-mostly memory that can be written into at any time without erasing prior contents; only the byte or bytes addressed are updated.

Q3. Given the data word "11000010". Using the hamming code algorithm, show the word that will be stored in memory after calculating the check bits.

Position	12	11	10	9	8	7	6	5	4	3	2	1
Bits	D8	D7	D6	D5	C8	D4	D3	D2	C4	D1	C2	C1
Block	1	1	0	0		0	0	1		0		
Codes	1100	1011						0101				

The check bits are in bit numbers 8, 4, 2, and 1.
Check bit 8 calculated by values in bit numbers: 12, 11, 10 and 9
Check bit 4 calculated by values in bit numbers: 12, 7, 6, and 5
Check bit 2 calculated by values in bit numbers: 11, 10, 7, 6 and 3
Check bit 1 calculated by values in bit numbers: 11, 9, 7, 5 and 3
Thus, the check bits are: 0 0 1 0
The world will be stored as 1100 **0** 001 **1** 0 **1 0** **(check bits are bold)**

Q4. How many check bits are needed if the Hamming Code is used to detect single bit errors in 64-bit data word?

Need K check bits such that $64 + K \leq 2^k - 1$.
The minimum value of K that satisfies this condition is 7.

Q5. Define what is a sector, track and cylinder?

On a magnetic disk, data is organized on the platter in a concentric set of rings, called tracks. Data are transferred to and from the disk in sectors. For a disk with multiple platters, the set of all the tracks in the same relative position on the platter is referred to as a cylinder.

Q6. Explain the different between a CAV system and a multiple zone recording system.

For the constant angular velocity (CAV) system, the number of bits per track is constant. An increase in density is achieved with multiple zoned recording, in which the surface is divided into a number of zones, with zones farther from the center containing more bits than zones closer to the center. This means that outer zones are divided into more sectors than the inner zones; with all sectors having equal bit size.

Q7. What is striped data?

The disk is divided into strips; these strips may be physical blocks, sectors, or some other unit. The strips are mapped round robin to consecutive array members. A set of logically consecutive strips that maps exactly one strip to each array member is referred to as a stripe.

Q8. What are the common characteristics of the RAID levels?

(1) RAID is a set of physical disk drives viewed by the operating system as a single logical drive.
(2) Data are distributed across the physical drives of an array.
(3) Redundant disk capacity is used to store parity information, which guarantees data recoverability in case of a disk failure.

Q9. What is the available data storage capacity for each of the RAID levels 0, 1, 2, 3, 5 and 6, if you have 4-drives each with a 100GB capacity.

RAID 0: 400 GB
RAID 1: 200 GB
RAID 3: 300 GB
RAID 4: 300 GB
RAID 5: 300 GB
RAID 6: 200 GB

Q10. Consider a disk that rotates at 2600 rpm. The seek time to move the head between adjacent tracks is 3ms. Each track is divided into 16 sectors, stored linearly from sector 0 to 15. The head sees the sectors in an ascending order.

a. **Assuming the initial position of the head is at the start of sector 5 on track 1, how long (in milliseconds) will it take to position the head on sector 6 on track 2?**
b. **Assuming the initial position of the head is at the start of sector 5 on track 2, how long (in milliseconds) will it take to read sector 2 on track 2?**

The disk rotates at 2600 rpm, so reading an entire track takes 60000/2600 = ~23ms.
Each track includes 16 sectors, so reading a sector takes 23/16 = ~1.4ms.

(a) Moving the head from track 1 to 2 takes 3ms (seek time). Rotating the disk so that head is positioned from sector 5 to sector 6 takes 1.4ms (rotational time of 1 sector). The total time = 4.4ms. Most likely, seeking time and rotational time overlap, in this case, the total time = 3ms (the maximum of the two).

(b) No seeking time is required since the head is already positioned on track 2. Since the head sees the sectors in ascending order, accessing sector 2 when the head is currently positioned on sector 5 requires the disk to be rotated all the way to the end and then to sector 2. This means that the disk has to rotate through 12 sectors to position the head on at the start of sector 2, then rotate through sector 2 to read it. The total time requires is 12 * 1.4 + 1.4 = 18.2ms.