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paper Computer Architecture

Q1 Part A:-

Word:-

The natural Unit of organization of memory. The size of word is typically equal to the no of bits used to represent an integer and to instructions length.

Addressable Units:-

As the word, however many systems allow addressing at the byte level in any case A=N.

Unit of transfer:-

For main memory, this is the number of bits read out of or written into memory at a time. The Unit of transfer need not equal a word or an addressable Unit.

Q1 B:-

Probably the most effective is least recently used (LRU): replace that block in the set that has been in the cache longest with no reference to it for two way set associative this is easily implemented. Each line includes a USE bit. When a line is referenced its USE bit is set to 1 and the USE bit of the other line in that set is set to 0.

(2)

When a block is to be read into the set, the line whose USE bit is 0 is used. Bcz we are assuming that more recently used memory location are more likely to be referenced LRU should give the best hit ratio. LRU is also relatively easy to implement for a fully associative cache.

* Another possibility is least frequently used (LFU): Replace that block in the set that has experienced the fewest reference LFU could be implemented by associating a counter with each line. A technique not based on usage (i.e FIFO, LFU,) is to pick a line at random from among the candidate lines. random replacement provides only slightly inferior performance to an algorithm based on usage.

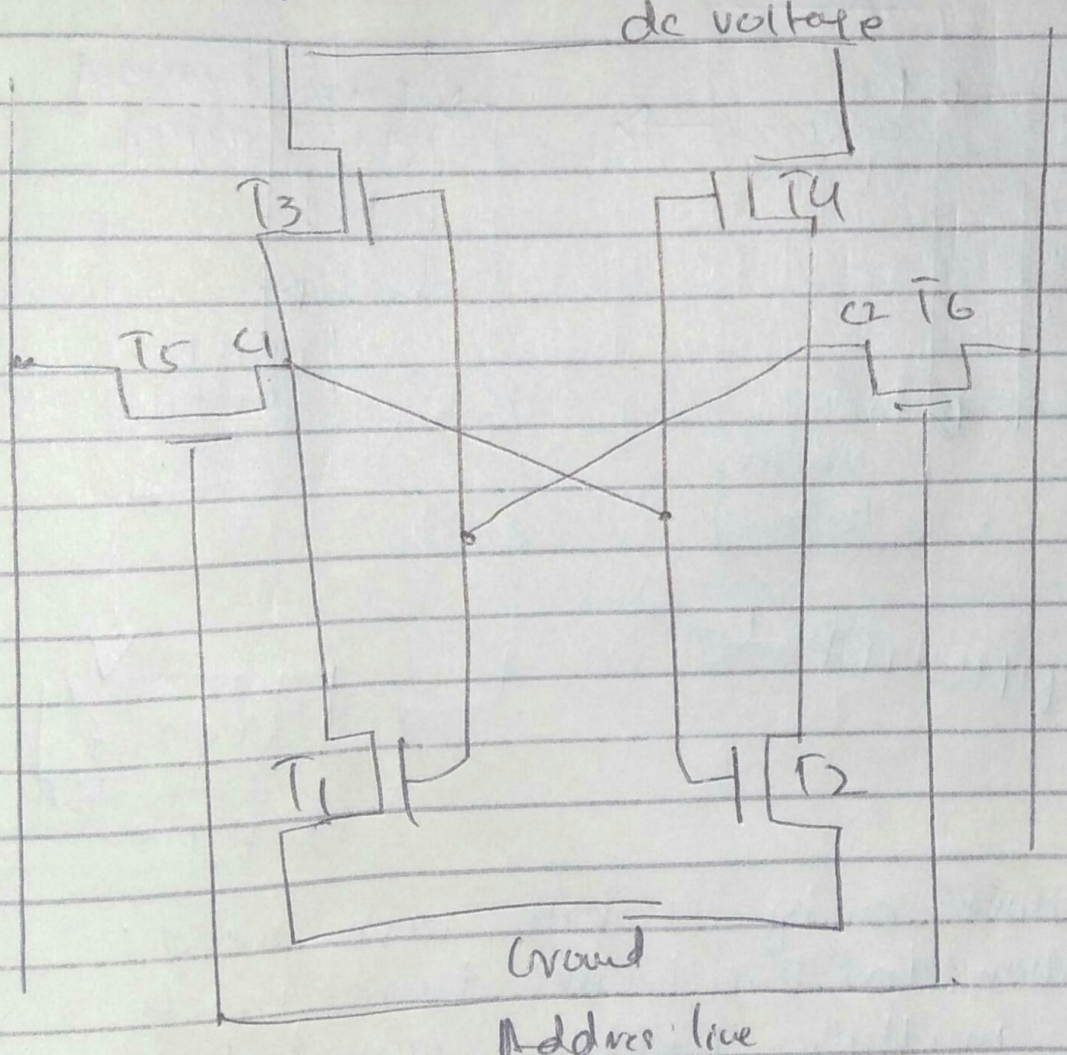
Q1 C:-

Read operation:-

An SRAM for only operation to be performed, the word line should be high to perform read operation.

write operation:-

consider the memory bits consists of Q = 0 and Q' = 1

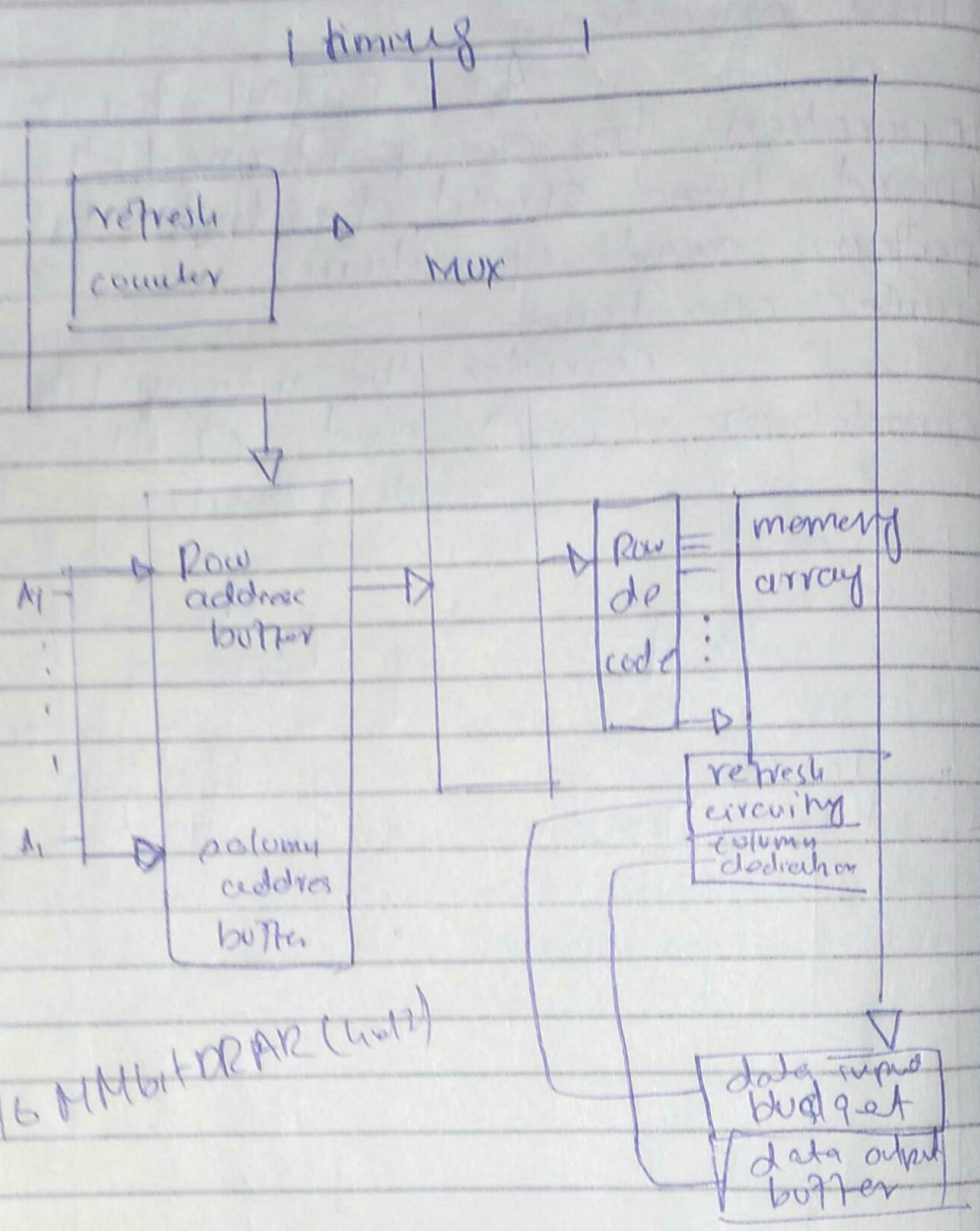


The SRAM address line is used to open or close a switch, the address line controls two transistors (T_5, T_6) when a single is applied to this line, the two transistors are switched on, allowing a read or write operation.

For write operation the desired bit value is applied to line B. while its complement is applied to line For a read operation the bit value is read from line B.

(4)

Q 1 D:-



Because only 4 bits are read/written to this DRAM there must be multiple DRAMs connected to the memory controller to read/write a word of data to the bus. All the DRAMs require a refresh operation. A simple technique for refreshing is in effect to

- disable the DRAM chip while all data cells are refreshed
the refresh counter steps through all of the row values the causes each cell in row to be refreshed.

Q1 E

The DVD's greater capacity is because
* Bits are packed more closely on a DVD. The spacing blw loops of a spiral on a CD is 1.6 μm and the minimum distance blw pits along the spiral is 0.834 μm. The DVD uses a laser with shorter wavelength, and achieves a loop spacing of 0.74 μm and a minimum distance blw pits of 0.4 μm. The result of these two improvements is about a seven fold increase in capacity to about 4.7 GB.
* The DVD employs a second layer of pits and lands on the top of the first layer. A dual-layer DVD has a semi-reflective layer on top of the reflective layer. and by adjusting focus the laser in DVD drives can read each layer separately. this technique double the capacity of the disk to about 8.5 GB.
* The DVD-ROM can be two sided, whereas data are ~~removed~~ recorded on only one side of a CD. This brings total capacity upto 17 GB.

(A)2 Ans

EEPROM and Flash memory?

Flash memory is one kind of non volatile random-access memory.

The main difference b/w EEPROM and Flash memory is that most EEPROM devices can erase any byte of memory at any time, Flash memory can only erase an entire chunk, or "sector" of memory at a time Flash memory is used primarily for storage, By their nature Flash memory and RAM are faster than storage alternatives such as hard disk and tape, An terms of Flash memory.

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Hard failure and soft error in semiconductor memories

1) Soft failure:

A soft failure is a temporary failure that may be corrected (or will correct itself) without replacing the failed component, Safety critical embedded systems. e.g Embedded system.

2 Hard failure:

Failure that require repair by a person with Specialized knowledge before the equipment can be put back into operation.

Difference:-

Hard failures are errors that occur through process defects and/or circuit bugs. hard failures are repeatable with the correct sequence of actions within the microcontroller, Soft errors occur through no failure of the circuit or defect ~~due~~ but due to an external source that causes the data to change.

Q2v

Read:

The traditional read mechanism exploits the facts that a magnetic field moving relative to a coil produces an electrical current in the coil, The structure of the head for reading is in this case essentially the same as for writing. Such single heads are used in floppy disk systems and in older rigid disk system.

Write:

The write mechanism exploits the fact that electricity flowing through a coil produces a magnetic field Electric pulses are sent to the write head, and the resulting magnetic patterns are recorded on the surface below, with diff patterns for positive and negative current The write head itself is made of easily magnetizable material and is in the shape of a rectangular doughnut with a gap along one side and a few turns of conducting wire along the opposite side.

Q2 D:-

Parallel Access RAID:-

All member disks participate in the execution of every I/O request typically the spindles of the individuals drives are synchronized so that each disk head is in the same position on each disk at any given time.

Independent Access RAID:-

Each member disk operates independently, so that separate I/O requests can be satisfied in parallel. Independent access are more suitable for applications that require high I/O request rates and are relatively less suited for applications that require high data transfer rates.

Q2 part E:-

HD DVD and blue ray DvD?

Explanation:-

Blue ray and HD DVD both Uses a blue laser, which has a shorter wavelength than red ones. In contrast, HD DVDs can hold 25 GB on one layer. Even more can be packed into Blue ray / HD DVD discs if they use more than one layer or one side of the disc.

	Difference:-	Blue Ray	HD DVD
1	Storage capacity	25 GB (single layer)	15 GB (single layer)
2	Laser Wavelength	405 nm (blue-violet laser)	405 nm (BVL)
3	Numerical Aperture	0.85	0.65
4	Maximum Bitrate	53.95 Mbits/s	36.55 Mbits/s
5	Max bitrate (Audio+video)	48 Mbits/s	30.24 Mbits/s
6	Interactivity	Blu-Ray disc java	HD format
7	Hardcoating of disc	Mandatory	optional
8	Block size.	64 KB ECC	4096 bytes
9	Dimensions	120 mm (4.7 in)	120 mm
	"	diameter, 1.2 mm	(4.7 in) diameter
	"	thickness	1.2 mm thickness
10	DTS - HD Master Audio codec and DTS X	optional " "	optional " "
11	Linear PCM audio codec	Mandatory "	Mandatory "
12	DTS - HD high Resolution audio codec	optional 6.0 Mbits/s "	optional " "

Q3 part A:-

Memory access methods:
There are 4 memory access methods.

1 Sequential access:
In this method, memory is accessed in a specific linear sequential manner, like accessing in a single linked list. The access time depends on the location of the data applications of the sequential memory accesses are magnetic tapes, magnetic disk and optical memories.

2 Random access:
In this method any location of the memory can be accessed randomly like accessing in array. physical locations are independant in this access method.

3 Direct access:-
In this method particular location of the memory can be accessed directly like accessing in array. This method is a combination of above two access methods. The access time depends on both the memory organization and characteristics of storage technology. The access is semi-random or direct.

4 Associate access:
A word is accessed rather than its address. This access method is a special type of random access method. Appli of this direct memory, access is cache memory.

Q3 B:-

Principle of locality:-

The principle of locality states that data in the vicinity of a refereuced word are likely to be refereuced in the near future. An implication of locality is that we can predict with reasonable accuracy what instructions and data a program will use in the near future based on its accesses in the recent pass.

Q3 part c:-

possible approaches to cashe coherency:

Possible approaches to cashe coherency include the following:

- Bus watching with write through:
  Each cashe controller monitors the address lines to detect write operations to memory by other bus masters. if another master writes to a location in shared memory that also resides in the cashe memory.
- Hardware transparency:
  Additional hardware is used to ensure that all updates to main memory via cashe are reflected in all cashes. Thus, if one processor modifies a word

in its cache, this update is written to main memory. An addition any matching words in other cache are similarly updated.

Non-cacheable memory:

Only a portion of main memory is shared by more than one processor, and this is designated as non-cacheable. An such a system all accesses to shared memory are cache misses, because the shared memory is never copied into the cache. The non cacheable memory can be identified using chip-select logic or high. address bits.

Q3 part D:-

There are two practicle issues to ssd's

* SSD performance has a tendency to slow down as the device is used.
  - The entire block must be read from the flash memory and placed in a RAM buffer.
  - Before the block can be written back to flash memory, the entire block of flash memory must be erased.
* Flash memory becomes unusable after a certain no of writes.
  - Front ending the flash with a cache to delay and group write operations.

Using Wear leaving algorithems that evenly distribute writes across block of cells. Bad blocks management techniques.

Q3 E E:-

Read:-

Information is retrieved from a CD-ROM by a low powered laser housed in an optical disk player, or drive Unit. The laser shines through the clear polycarbonate while a motor spins the disk past it. The intensity of the reflected light of the laser changes as it encounters a pit. The area blw pits are called lands.

Write:-

Recall that on a magnetic disk, info is recorded in concentric tracks with the simplest constant angular velocity system. The no of bit per track is constant. An increase in density is achieved with multiple zoned recording. In which the surface is divided into a no of zone with zones farther from the center containing more bits than zones closer to the center. Not optional but increase capacity.

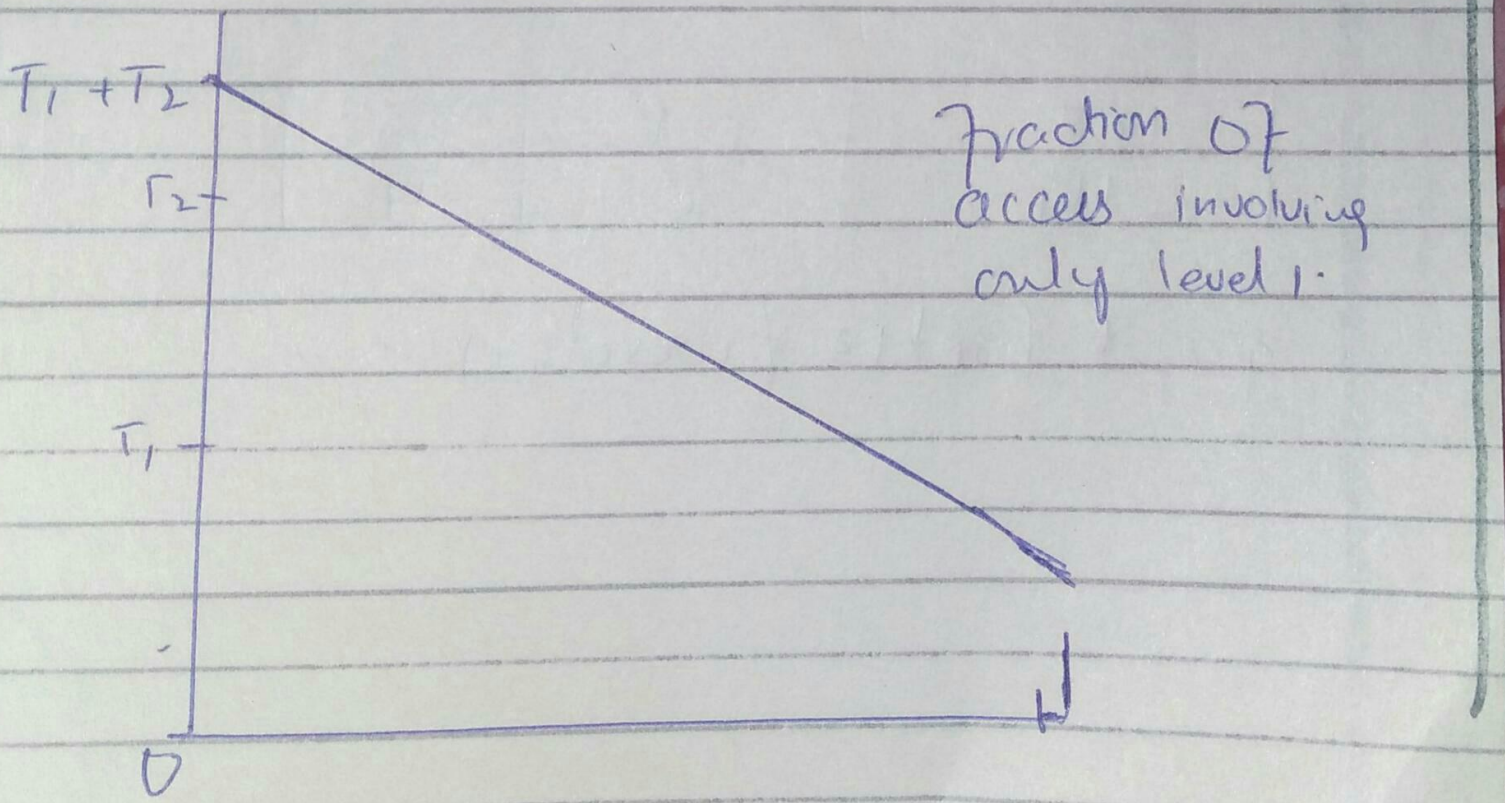
Q4 A:-

In example suppose 95% of the memory accesses are found in level 1. Then the average time to access a word can be expressed as

$$(0.95)(0.01\,\mu s) + (0.05)(0.01\,\mu s + 0.1\,\mu s)$$

$$= 0.0095 + 0.0055 = 0.015\,\mu s$$

The average access time is much closer to 0.01 μs than to 0.1 μs as desired



Q4 B.

Total block in the cashe =
8k byles / 16 byles = $2^3 \times 2^{10} / 2^4 = 2^9 = 512$

no of set = number of block in cashe / 2

no of set = 512/2

" " in cashe = 256

" " " $= 2^8$

" of set = 8

Size block = $16 = 2^4$

Size of memory = $2^6 \times 2^{20} = 2^{26}$

Tag = Size of memory - set size of block

Tag = 26 - 8 - 4

Tag = 14

Tag	Set	size of block
14	8	4

Tag (set13 / word(2)

Q4 c:

$m = 8$

$2^k - 1 >= k + m$

$2^4 - 1 >= 4 + 8$

$15 >= 12$

1	2	3	4	5	6	7	8	9	10	11	12
1	0	1	1	1	0	0	1	0	0	1	0

the check bits are in a bit number 1, 2, 4 & 8
check bit 8 calculated by values in bit numbers 9, 10, 11 and 12
check bit 4 calculated by values in bit numbers: 5, 6, 7 and 12
check bit 2 calculated by values in bit number: 3, 6, 7, 10 & 11
check bit 1 calculated by values in bit numbers: 3, 5, 7, 9, 10, 11
check bits are : 1011.

Q4 D

7200 revalution in 60 sec
1 revalution in 60/7200 or

1 revalution in 6ms
1 revalution = covering one entire track = 500 sector
500 Sector = 6ms
1 " = 8 ms
Now there are 2 diff things
(1) 2500 sectors, so time = 2500 x 8ms = 20ms
(2) 1.28 mB = 1342177.28 byles or 2621.44 sectors = 2622 sectors = 20.976 ms

Total time case:

case (1) 4+2+20 = 26ms
" (2) 4+2+20.976 = 26.976 ms