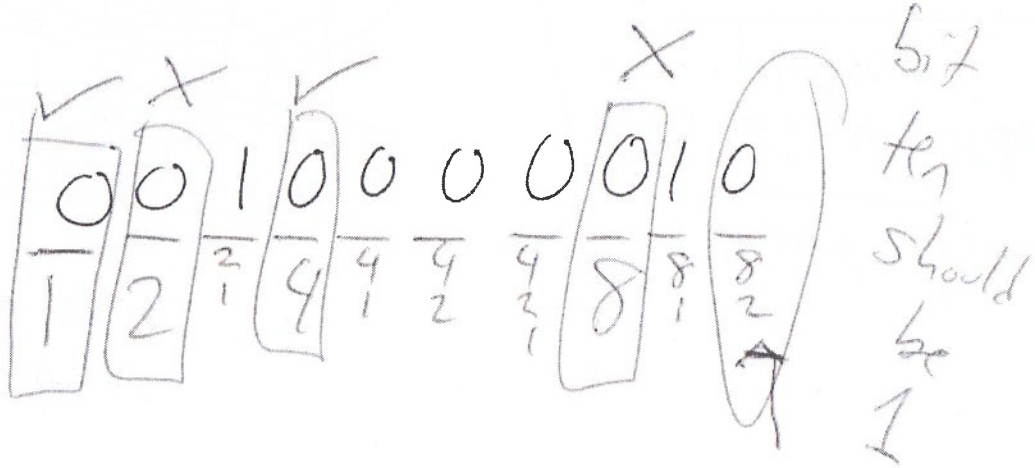
COMP 2721 Lesson Six

Hamming Code:

- show your work
- clearly label parity bits
- error detection capability
  for HD of 8
  up to 7

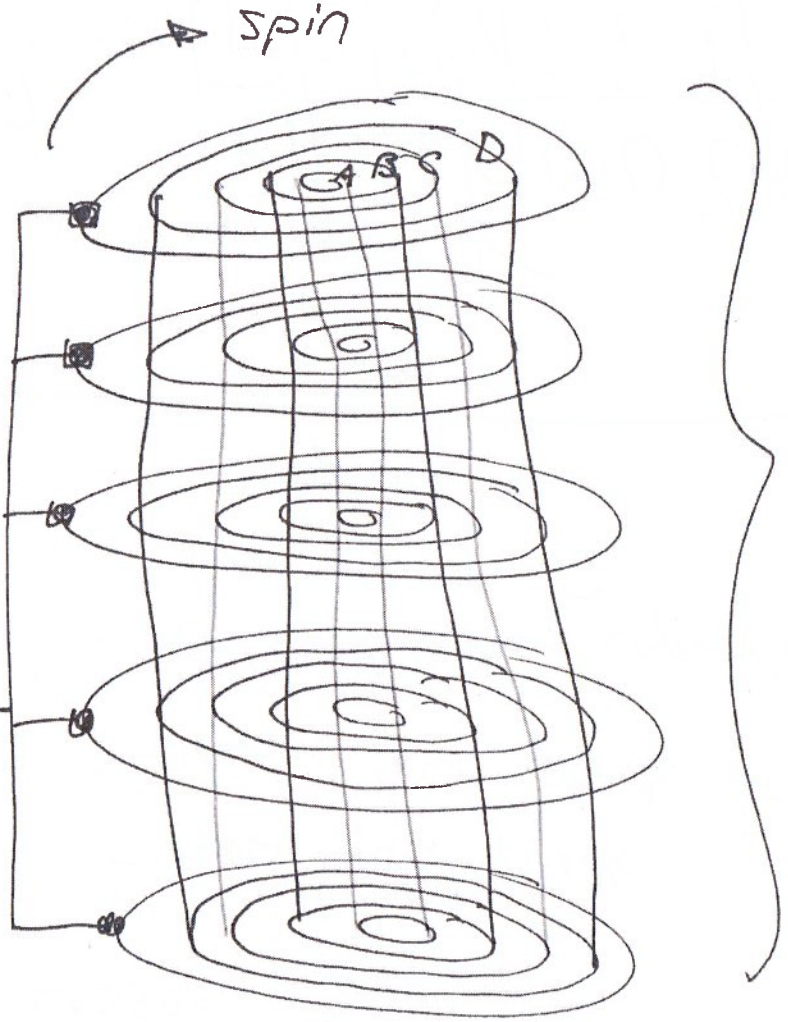
Codeword:
even
errors? where?



Hard-disk drive  (magnetic)

Not optical drives 

Homework! read solid state drives



track: ring of magnetic bits

cylinder: made of the same track on each platter

Read/write heads

1 hard drive

5 single-sided platters

4 tracks (A, B, C, D)

4 cylinders (A, B, C, D)

To read a HDD:

① move the RW head to the desired track } seek time

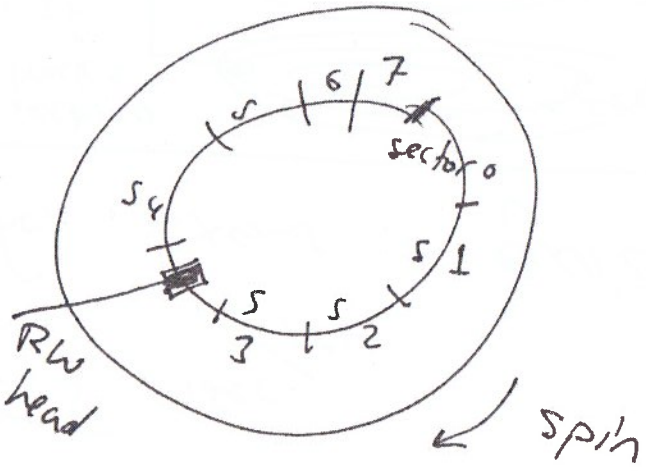
② wait for the desired sector to spin to the RW head } rotational latency

on avg, wait half a rotation after arriving

A track consists of sectors.

A sector contains the actual data plus:

- inter-sector gaps
- header (ecc)
- footer (meta)



7200 RPM => 120 RPS => $\frac{1}{120}$ th $\frac{\text{sec}}{\text{rev}}$ => 8.3 ms/rev

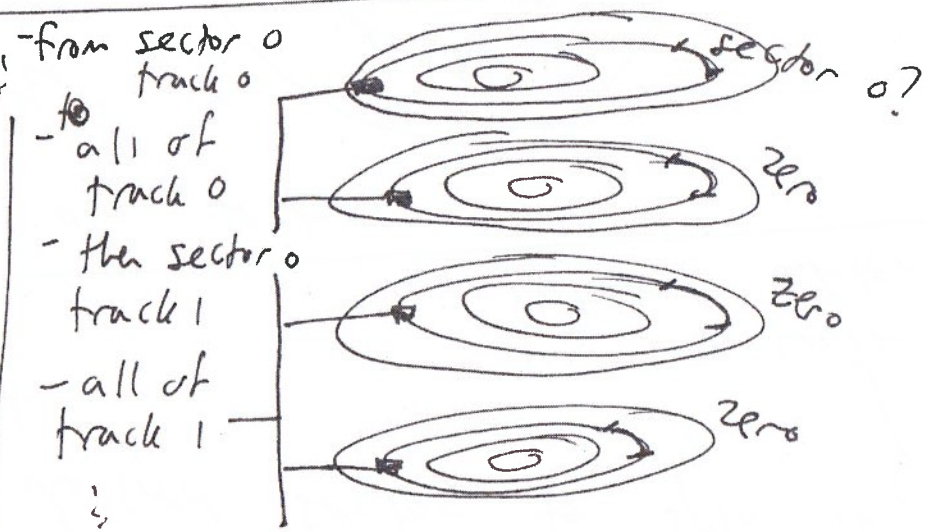
5400 RPM => 11.1 msec/rev

10 800 RPM => 5.5̄ msec/rev

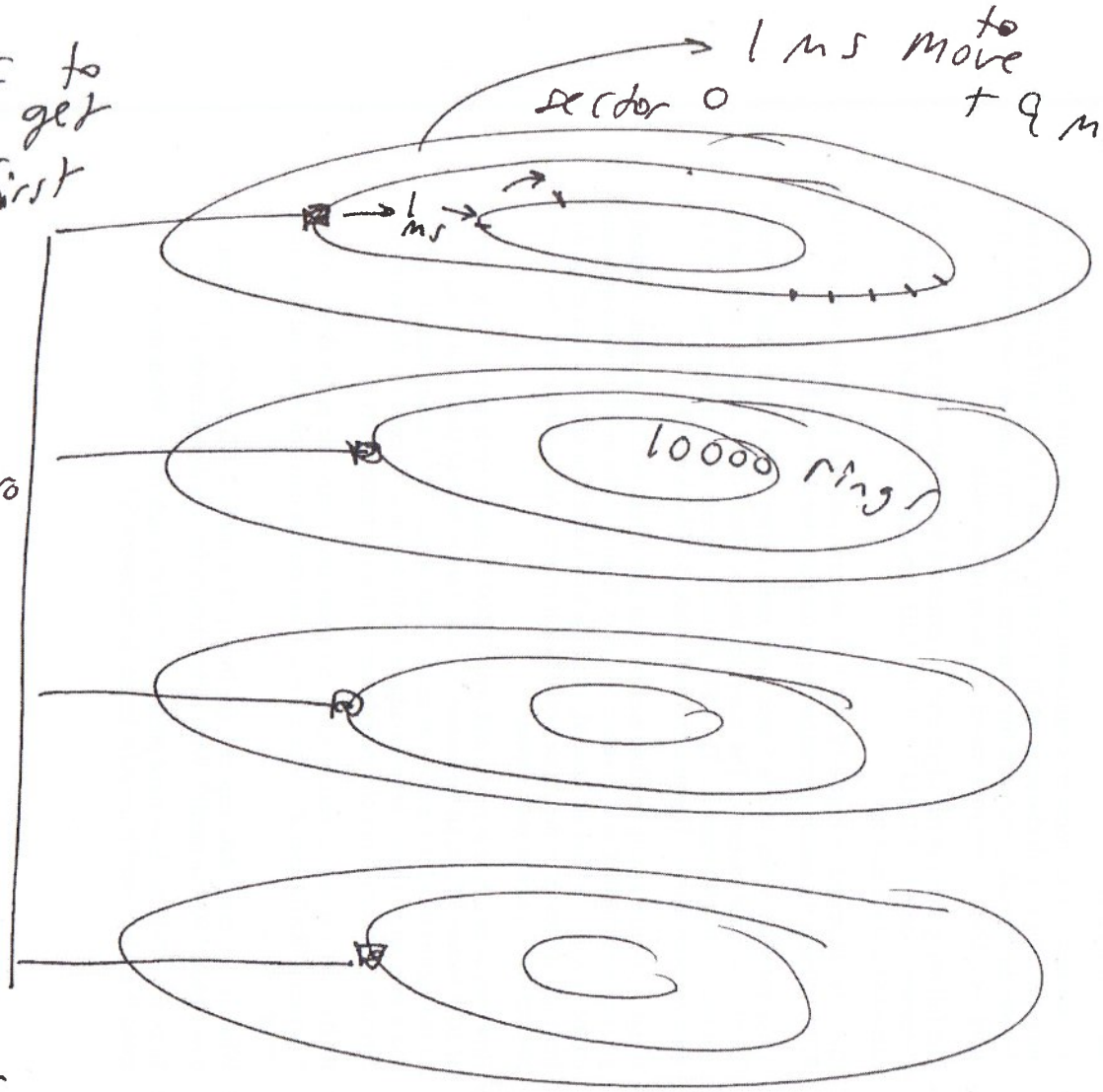
☆ Remember these for exams + quizzes

To read a HDD:

1. find the first track
   - "avg case seek time"
2. wait for sector 0
3. read one track (one rotation)
4. read that track on the other 3 platters (three rotations)
5. Move to next track ~~and wait for sector zero~~
6. Repeat steps 2-5 for each track that is remaining



4 platters
3 tracks



① 10 msec to get to first track

② wait for sector zero (5 msec on avg)

③ 10 msec × 4 platters = 40 msec to read a cylinder

④ takes 1 ms to move to next track
now must wait 10-1 = 9 ms for sector zero to return

⑤ Repeat step 3-4 9999 times

-5-
-5-

ANSWER
500,005 msec

10000 x
50 msec
+ ① 10
× ② 5
- 10 msec
(no need
to move
+ wait @ end)

is the total information capacity (in bits) of the human genome? What is the maximum information capacity (in bits) of the average gene?

11. A certain computer can be equipped with 1,073,741,824 bytes of memory. Why would a manufacturer choose such a peculiar number, instead of an easy-to-remember number like 1,000,000,000?

12. Devise a 7-bit even-parity Hamming code for the digits 0 to 9.

13. Devise a code for the digits 0 to 9 whose Hamming distance is 2.

14. In a Hamming code, some bits are "wasted" in the sense that they are used for checking and not information. What is the percentage of wasted bits for messages whose total length (data + check bits) is $2^n - 1$? Evaluate this expression numerically for values of n from 3 to 10.

15. An extended ASCII character is represented by an 8-bit quantity. The associated Hamming encoding of each character can then be represented by a string of three hex digits. Encode the following extended five-character ASCII text using an even-parity Hamming code: Earth. Show your answer as a string of hex digits.

16. The following string of hex digits encodes extended ASCII characters in an even-parity Hamming code: 0D3 DD3 0F2 5C1 1C5 CE3. Decode this string and write down the characters that are encoded.

17. The disk illustrated in Fig. 2-19 has 1024 sectors/track and a rotation rate of 7200 RPM. What is the sustained transfer rate of the disk over one track?

18. A computer has a bus with a 5-nsec cycle time, during which it can read or write a 32-bit word from memory. The computer has an Ultra4-SCSI disk that uses the bus and runs at 160 Mbytes/sec. The CPU normally fetches and executes one 32-bit instruction every 1 nsec. How much does the disk slow down the CPU?

19. Imagine you are writing the disk-management part of an operating system. Logically, you represent the disk as a sequence of blocks, from 0 on the inside to some maximum on the outside. As files are created, you have to allocate free sectors. You could do it from the outside in or the inside out. Does it matter which strategy you choose on a modern disk? Explain your answer.

20. How long does it take to read a disk with 10,000 cylinders, each containing four tracks of 2048 sectors? First, all the sectors of track 0 are to be read starting at sector 0, then all the sectors of track 1 starting at sector 0, and so on. The rotation time is 10 msec, and a seek takes 1 msec between adjacent cylinders and 20 msec for the worst case. Switching between tracks of a cylinder can be done instantaneously.

21. RAID level 3 is able to correct single-bit errors using only one parity drive. What is the point of RAID level 2? After all, it also can correct only one error and takes more drives to do so.

22. What is the exact data capacity (in bytes) of a mode-2 CD-ROM containing the now-standard 80-min media? What is the capacity for user data in mode 1?

23. To burn a CD-R, the laser must pulse on and off at a high speed. When running at 10x speed in mode 1, what is the pulse length, in nanoseconds?