ANSWERS CM1205 Main Exam SPRING 2015

Question 1

a) SCASB = Scan destination string for a byte.
This instruction scans a string by comparing each string element against a value stored in AL. The string to be searched is pointed to by the address stored in the EDI register.

b) The D- flag is the Direction flag. Its status specifies what direction the ESI and EDI registers are adjusted i.e. either incremented or decremented. If set (with instruction STD) the ESI and EDI registers auto-decrement. Clearing the flag (CLD) auto-increments ESI and EDI.

c) A subroutine is a collection of instructions that are *called* from one or many other different locations within a program. At the end of a subroutine there should be a RET instruction to tell the processor how to get back to the where it was called from.

```
convert  proc  near
                    .. Code to perform some task
                    RET
convert     ENDP
```

To use the routine your program would issue the following command:

```
CALL    convert
```

d) The two principle instructions to place or retrieve data from the stack are:
push (Puts data onto the top or the stack)
pop (Retrieves data from the top of the stack)

e) AND

0	0	0
0	1	0
1	0	0
1	1	1

OR

0	0	0
0	1	1
1	0	1
1	1	1

XOR

0	0	0
0	1	1
1	0	1
1	1	0

f) Little Endian/Big Endian is a reference to how data is stored in memory.
Little endian is stored Low Byte then High Byte (Byte Swapped)
Big endian is stored High Byte Low Byte

g) After a memory request, the CPU will not get the word for several cycles
Two simple solutions:

Continue execution, but stall CPU if an instruction references the word before it has arrived (hardware)
Require compiler to fetch words before they are needed (software)

h)
Cache memory is fast memory built into the microprocessor chip.
Sometimes systems are built with more than one cache.
The cache closest to the CPU is called level 1 cache, the next is level 2 etc.
Level 1 cache will be faster than level 2, but smaller in capacity.
The CPU will always look for data in level 1 first. If it gets a cache miss, it looks in level 2 if it also gets a miss it goes to main memory. On currently available desktop processors, i5 CPUs have L3 cache.

Question 2

a) When a file is deleted the File Allocation table entry is altered to 0 to indicate that the area on the disk is now free. The first letter of the file name in the directory entry is set to E5. Other than that the file contents still exist, the Data modification, Creation and Access (MAC) Times are preserved. [10]

b) Slack space consists of space on a disk drive between the end of a file and the allocated space for a file. E.g if the cluster size is 4 sectors then as a sector is 512 bytes. The minimum size allocated to a file is 2k. If a files size is 1280 bytes then there is space at the end (768 bytes) that are not accessible this is slack space. [1]

A cluster is the smallest number of sectors that are allocated to a file. [1]

Disk drives are divided in sectors. Sectors are the smallest units on a disk and usually hold 512 bytes of data. [1]

Unallocated space on a disk is either an area of disk that has never been allocated to a file yet, or space that has been freed up after a file has been deleted.

c)

i) 006B the values are byte swapped.

ii) 1024 bytes (1K)

a. Each sector holds 512 bytes. There are two sectors in a cluster hence 1024.
In the file allocation table the entry pointed to has the value (eof) end of file.
MSDOS.SYS therefore is only been allocated 1 cluster (1024 bytes).

Question 3

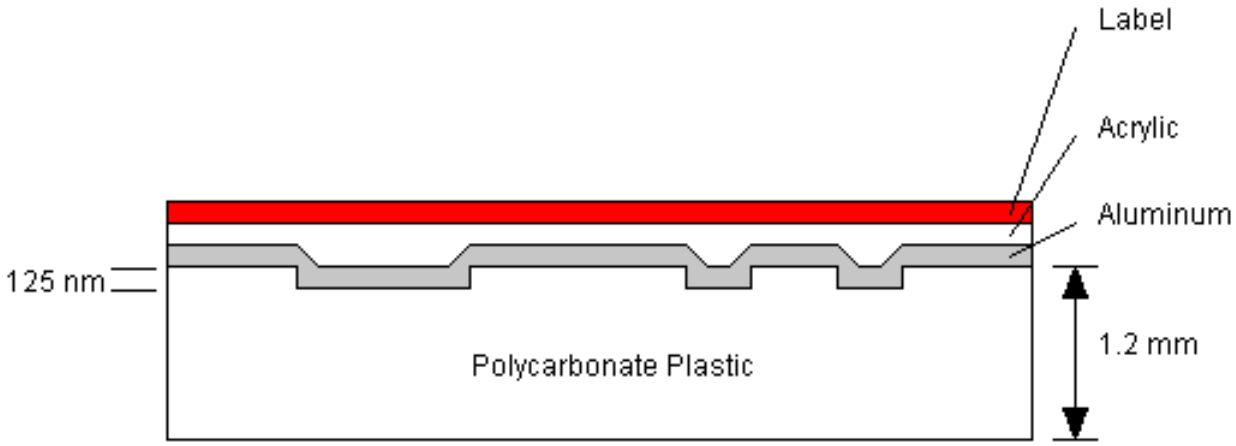
a) ATA disks (i.e. IDE/SATA drives) can have a reserved area at the end of the disk.

This area is known as the Host Protected Area. A user cannot normally write

or read from this area, and usually unaware of its existence. But anyone can

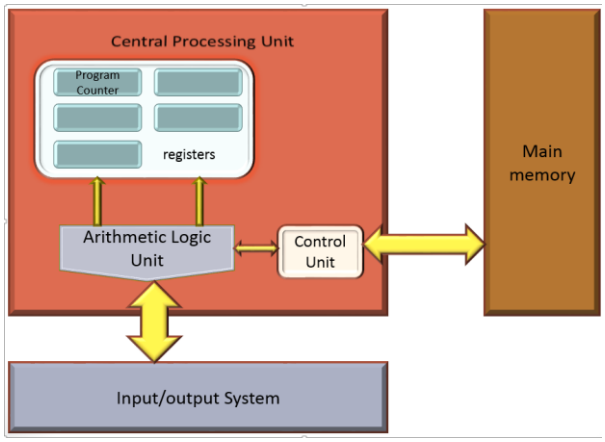
create this area if they wish. The original purpose was for OEM's to put restore files and data in there so that the user could not delete it.

a) A CDROM Drive uses a small plastic-encapsulated disk that can store data. This information is retrieved using a Laser Beam. It consists of 4 layers:
The biggest part is clear polycarbonate (nominally 1.2mm)
There is a very thin layer of reflective metal (usually aluminum) on top of the polycarbonate
Then a thin layer of some protective material covering the reflective metal
A label or some screened lettering on top of protective material



d)

Central Processing Unit, Main Memory, Arithmetic Logic Unit, Control Unit and I/O



Question 4

a) What happens if two devices want to use the bus at the same time?
The *Bus Arbitrator* decides who gets the bus in case of a conflict
Two main types of arbitrator
Centralised
Decentralised

b)

Problem: Regulate access to the critical section.

Any solution must satisfy the following conditions:

a. **Mutual exclusion**

b. **Progress**

c. **Bounded waiting**

c) **RAID 0**

Each strip is a number of contiguous sectors

High data-rate

Large requests can be dealt with in parallel

Can also handle simultaneous requests

No redundancy or robustness to disk failure

So not really a true RAID design

Poor response for many small sector requests

RAID 1

Duplicate all the disks in the RAID 0 design

If a drive crashes, can simply replace and copy the backup

Read performance can be twice as good

Main disadvantage is the number of disks needed

RAID 2

Each byte split into two 4-bit segments then add 3 error correction bits to each

Synchronise the arm and rotational position of the 7 drives

Fast, as can read/write 1/2 byte each cycle

Robust, as error-correction allows any drive to fail

With 32 drives and 6 parity drives, overhead is 19%

Disadvantage: hard to synchronise drives

RAID 3

Simpler version of RAID 2

Still requires drive synchronisation

Parity drive provides robustness

Know which drive went wrong, so we can correct any single error

Both RAID 2 and 3 have a high data rate

But cannot handle parallel IO

Single parity bit is calculated for each data word and written to parity drive

Might seem that we can only detect errors and not correct

If a drive crashes we know the position of the bad bit, controller zeros all bits and if the word has a parity error then we know the value of the bad bit must be 1

Raid 2 & 3 have very high data rates the number of I/O requests per second is no better than a single drive.

RAID 4

Like RAID 0, but with strip parity kept on a separate drive

Does not require drive synchronisation

Poor performance for small updates

All drives must be ready to re-compute parity

Heavy load on parity drive may become a bottle-neck

RAID 5

Like RAID 4, but distribute parity blocks over all drives

Can be difficult to reconstruct the contents of a drive if one fails though

d)

Physical Layer

The drive itself

File System Layer (Partition Information)

Data Layer (Where data is stored)

Blocks and clusters

Metadata Layer

Structure information (EXT2/3, FAT, NTFS)

File Name layer

Name of the file