Solutions
Computing Intermediate Matsec Exam September 2013

A1

a. A bus is an electronic path to allow data or addresses or messages to be transmitted from one place to another.

b. The data bus, the address bus and the control bus.

c.

  i.   Data bus since data can be transmitted from the CPU to main memory and vice versa.

  ii. Control bus and address bus since messages (control) and addresses are sent only by the CPU to main memory.

  iii. The address bus because if the address bus has a width of n lines, then the number of memory addresses it can represent is 2^n.

  iv. The data bus because the wider it is the more data can be transmitted and processed in one clock cycle.

A2

a. $(A.B.C)' = A' + B' + C'$

b.

A	B	C	(ABC)	(ABC)'	A'	B '	C'	A'+B'+C'
0	0	0	0	1	1	1	1	1
0	0	1	0	1	1	1	0	1
0	1	0	0	1	1	0	1	1
0	1	1	0	1	1	0	0	1
1	0	0	0	1	0	1	1	1
1	0	1	0	1	0	1	0	1
1	1	0	0	1	0	0	1	1
1	1	1	1	0	0	0	0	0

A3

a. (1) Reduced data redundancy, (2) elimination of data inconsistency.

b.

  i.   DDL i.e. Data Definition Language.

  ii. Query language e.g. SQL

  iii. Data dictionary

A4

    a. The RAM holds the programs being currently executed by the CPU including the operating system.

    b.

        i. DRAM is cheaper than SRAM. DRAM requires refreshing hundreds or thousands of times per second.

        ii. SRAM is faster.

        iii. A fast memory can return a value (or, inversely, write a value in it) in less time.

        iv. DRAM can be used as RAM while SRAM can be used as cache.

A5

    a. The primary key is unique while a secondary key is not.

    b. This is called a foreign key and it is used to create a relationship between tables.

    c. A compound (composite) key is used when no attribute (field) is unique and when it is necessary to have a primary key.

    d. A record in databases is also called a tuple.

A6

    a. A router is a device that forwards data packets along networks. Routers use headers and forwarding tables to determine the best path for forwarding the packets. Very little filtering of data is done through routers.

    b. A hub simply serves as a connection point to pass packets from one network segment to another. A router reads the destination address of a packet and sends the packet through the shortest and less trafficked route.

    c. Coaxial cable.

    d. Parity checking refers to the use of parity bits to check that data has been transmitted accurately. A parity bit is added to every data unit (typically seven or eight bits) to make the number of ones even or odd. If odd parity is used the receiving device adds the number of ones and assumes the data is correct if the number of ones is odd. If it is not then this would show an error of transmission. The data will be resent.

A7

    a. Suppose that A and B are transmitting to each other. In circuit switching a path from A to B is found and this is reserved for the duration of the

communication. This technique is used for ordinary telephone calls. Message Switching is used when, for example, A sends a message to B through the points C and D. The message goes to C first and waits there. Then it goes to D and waits there too. Finally it is sent from D to B. E-mails can be sent in this way. In packet switching, messages are broken down into smaller units, known as packets, for transmission; the packets, each with an associated header, are then transmitted individually through the network.

b. One reason is that if a packet is corrupted only that packet is resent and not the whole file. Another reason is that packet switching allows sharing of a communication line (multiplexing) while circuit switching dedicates communication lines to single communications and at the same time these lines are closed for other transmissions.

c. Advantages (1) Full-duplex allows messages to be sent and received simultaneously while in half-duplex messages go in one direction at a time. For this reason full-duplex is faster than half-duplex; (2) applications like telephoning can be implemented in full-duplex but not in half-duplex.

A8

a. System software helps the computer itself to run.

b. Advantages (1) solid-state access is faster so booting will be faster; (2) solid-state drives are more durable in case of an accident where the drive is shaken or falls on the ground.

c.
   i.   word processor
   ii. desktop publisher
   iii. browser

A9

a. In object-oriented programming, polymorphism refers to a programming language's ability to process objects differently depending on their data type or class. For example, given a base class shape, polymorphism enables the programmer to define different area methods for any number of derived classes, such as circles, rectangles and triangles.

b. By means of encapsulation a programmer can 'hide' variables and methods so that they cannot be accessed by anyone else.

c. It increases productivity because new classes can be derived from superclasses saving time in creating them individually. Also it adds to good organisation in programming which in turn increases productivity.

d.

```
abstract class Shape
{
}

public class Square extends Shape
{
    double side;
}
```

A10

a. In the bubble sort adjacent elements are compared and swapped if necessary. A number of passes is performed until the elements are sorted. Insertion sort works differently. Each element is placed in a sorted subset until all elements are placed in this subset.

b.

Assume the elements are stored in an array A.

```
begin
   N = 10
   do
       swapped = false
       for i=0 to N-2 do
             begin
                   if A[i] > A[i+1]
                        then
                             begin
                                   swap( A[i], A[i+1] )
                                   swapped := true
                             end
             end
       N = N - 1
   while swapped
end
```

B1

a.
   i.   An interrupt handler is a program associated with an interrupt. Each interrupt has its own interrupt handler. When the operating system gives attention to an interrupt the state of the current program is copied in RAM and the interrupt handler is executed.

   ii.   The two possibilities are (1) the interrupt is called i.e. the interrupt is indicated in the interrupt vector, (2) the interrupt is chosen by the

operating systems (there can be more than one interrupt that is seeking the attention of the operating system).

  iii. Polling (1) in a network where the server checks whether there are calls from the PCs connected to it, (2) in a situation where a computer checks the values of sensors connected to it. Interrupts (1) in a PC where the interrupts from the devices is not so frequent, (2) in the implementation of software interrupts.

b.

  i. (1) Folder (directory), (2) hidden.

  ii. These are the rights that a particular user has on particular files. Rights on files can be different for different users.

  iii. Read a file, execute a file and modify a file.

c.

  i. Process control is the management of processes (programs) being executed.

  ii. For example the dispatcher in an operating system monitors processes and decides when to switch execution from one process to another.

d.

  i. (1) Maximum throughput, (2) avoid starvation.

  ii. It is designed especially for time-sharing systems. A small unit of time, called timeslice or quantum, is defined. All runnable processes are kept in a circular queue. The CPU scheduler goes around this queue, allocating the CPU to each process for a time interval of one quantum. New processes are added to the tail of the queue.

B2

a. The waterfall system life cycle is made up of the following steps:

  1. Identification of the problem: a problem or problems are identified and their solution thought to be found in information technology.

  2. Feasibility study: a study is made that looks into a number of possibilities of how the problems could be solved. The study looks at financial factors, schedule factors and social and legal issues amongst others.

  3. System Analysis: this is the stage that comes immediately after the decision to build the chosen information system. The system to be computerised or improved is thoroughly studied by means of interviews etc. before work can be done on the design of the new system.

  4. System Design: in this stage the new system is planned in all the details i.e. hardware, software (off-the-shelf or bespoke), programming language to be used, test plans etc.

5. Programming and testing: the new code is written and tested.

6. Implementation: the system is put together i.e. hardware purchased or built, software installed and the change-over method (direct, parallel, phased or pilot) starts. At the start of this stage the users are taught how to use the new system.

7. Maintenance: from time to time the system would need some fine tuning.

b. Black box testing is a kind of testing where inputs are given to programs and outputs are compared with known results. White box testing looks at the whole code and gives tests such that each line of code is executed at least once.

c. Top down approach is when the program is looked at as a whole and then it is divided into modules. Each module can in turn be divided into smaller modules etc. In bottom-up design small procedures are grouped into modules and these modules are then grouped into bigger modules until finally large modules are grouped together to form the whole program.

d. (1) Technical documentation: i.e. documentation of code, algorithms, ER diagrams, etc. (2) user documentation e.g. manuals (for the end-user, system administrators and support staff), tutorials etc. (3) tests performed.

e. Advantage: the new system is checked with the old system and the users work with the confidence that if an error is performed by them or by the system the data will still be stored on the old system. Disadvantage: slows down work rhythm.

f. A phased transition will be advisable where the information system is very large (and therefore will take a long time to build) and when the system can be divided into a number of subsystems.

g. (1) Corrective maintenance i.e. correcting newly discovered errors, (2) adaptive maintenance i.e. making changes due to new circumstances e.g. change programs to suit new laws, and (3) perfective maintenance i.e. making efficiency improvements e.g. add more storage or replacing slower storage devices.