1 Software

1.1 Types of software and interrupts

(1) *Describe the difference between system software and application software and provide examples of each.*

System software provides the services that a computer requires, which includes the operating system and utility software. Application software provides services required by the user, such as word processing, emails etc.

(2) *Describe the roles and basic functions of an operating system.*

This includes managing user files; handling interrupts; providing interface; managing peripherals and drivers; managing memory; managing multitasking; providing applications a platform; providing system security and managing user accounts.

(3) *Understand how hardware, firmware and an operating system are required to run application software.*

Applications are run on the operating system, which is run on the firmware (bootloader), which is run on the firmware. The firmware runs on the hardware.

(4) *Understand the role and operation of interrupts.*

An interrupt is a signal sent to the computers processor to signal that something requires its attention. It is generated when something has gone wrong, and can originate from software or hardware. Software interrupts include events such as division by zero and hardware interrupts may be generated when two simultaneous inputs are registered, from two separate peripherals.

1.2 Types of programming language, translators and integrated development environments (IDEs)

1 *Understand what is meant by a high level and low level language, understanding the advantages and disadvantages of each*

High level languages uses words from human language. Keywords in such a language include `if`, `while`, etc.

Such a program is easier for humans to understand, read, write and amend. It is hence easier for humans to debug the code. The code itself is portable and machine independent. A single high level statement can represent multiple low level statemnts.

However, it is slower to work with in the sense that it must be converted to a low level language before the code can be run. High level languages cannot usually directly manipulate hardware.

Low level languages are of two types, machine code and assembly language. A computer executes machine code consisting of 0s and 1s. This kind of code is non portable, the machine code that runs on one machine may not run on another. Example of such code would be `01001011`.

Assembly language is an in between stage, that uses mnemonics to represent code. For example `STO` can be used to store some memory at some address. All high level languages are translated to assembly before being converted to machine code.

Low level languages need not be converted through multiple stages, machine code can be executed directly and assembly can be translated directly to machine code with no in between stages, making it a faster process. Such languages can directly manipulate hardware, by writing to specific memory locations, making the program more efficient in terms of speed and memory usage.

Such a language is harder to read, write and amend, and hence harder to debug. Code written in this language tends to be machine dependent. Several instructions are required per high level statement.

2 *Understand that assembly language is a form of low-level language that uses mnemonics, and that an assembler is needed to translate an assembly language program into machine code.*

Statements in assembly look like:

```
LDD count
ADD 1
STO count
```

which use shortened words, mnemonics, to represent statements.

Assemblers are translator software which translate or convert assembly statements into machine code that can then be executed by the computer.

3 *Describe the operation of a compiler and an interpreter, including how high-level language is translated by each and how errors are reported.*

High level languages are translated to machine code by means of translation software called compilers and interpreters.

A compiler translates the whole code at once, producing an executable file, if there are no errors in the code. If there are errors, all the errors in the file are reported together by the compiler.

An interpreter translates and executes the code line by line, and stops execution if a line with an error is encountered.

4 *Explain the advantages and disadvantages of a compiler and an interpreter.*

An interpreter is used during the development of a program. This allows users to see when an error is encountered, amend it and continue running the program from the same point.

Once the program has been developed, a compiler will be used, as this will produce a machine independent executable file. The executable file can then be distributed, safely given that the code is undecipherable from the binary of an executable file. An interpreter, in this situation would not be appropriate as the source code and the interpreter software would both have to be distributed, meaning users can also have access to the source code, being able to change it as they like.

5 *Explain the role of an IDE in writing program code and the common functions IDEs provide*

IDEs provide code editors, a run time environment, translators, error diagnostics, auto completion, auto correction and pretty print.

2 The internet and its uses

2.1 The internet and the world wide web

1 *Understand the difference between the internet and the world wide web.*

The internet is an infrastructure, it is a wide area network. The world wide web is the collective term for all the websites and webpages available to access through the internet.

2 *Understand what is meant by a uniform resource locator (URL).*

A URL is a text based address for a webpage, it controls the protocol, domain name and webpage/webfile name. A URL has the following format:

```
protocol://www.domain-name/webpage-name
```

3 *Describe the purpose and operation of hypertext transfer protocol (HTTP) and hypertext transfer protocol secure (HTTPS).*

Webpages are written using the hypertext markup language (HTML), cascading style sheets (CSS) and JavaScript. The hypertext transfer protocol, HTTP, is used for the transfer of these webpages across the internet. HTTPS stands for hyptertext transfer protocol secure and adds a layer of encryption and hence security to these transfers of webpages.

4 *Explain the purpose and functions of a web browser.*

The main purpose of a web browser is to render the HTML of webpages and hence display them. They have several additional functions.

Modern web browsers allows users to bookmark certain webpages. The user's history is stored by most web browsers and multiple tabs are provided allowing for simultaneous browsing. Navigation tools amonsgst and through webpages, and an address bar is provided to the user, so that they can enter the URL of the website they desire.

i

3 Automated and emerging technologies

3.1 Automated systems

1 *Describe how sensors, microprocessors and actuators can be used in collaboration to create automated systems.*

An automated system consists of sensors, which measure the environment, a microprocessor, which processes data from the sensors and determine if an action needs to be taken and actuators to create a movement depending on the inputs gathered.

Inputs gathered by the sensors are analogue, and must be converted to digital to be processed by a microprocessor. This conversion is done by a digital to analogue converter or DAC. In the microprocessor, recieved values are compared against stored values, and depending on the range of the values read by the sensor, signals are sent to actuators. The actuators perform analogue actions, but recieve digital signals, which must be converted to analogue, which is done by means of a digital to analogue converter or DAC. This process of taking readings through sensors, passing it through the microprocessor and performing a corresponding actions repeats until the system is switched off.

2 *Describe the advantages and disadvantages of an automated system used for a given scenario.*

In almost all situations, initial costs for automated systems are high as development of the technology and price of the technology itself is all quite expensive. The running costs of the system is high as the system requires maintenance, but as fewer people need be employed, long term costs will be lower. Absence of humans, and their distractions will mean its all very safe, as robots will make less mistakes. These systems will replace human jobs, but jobs will be created in maintenance of the system. These robots will work all day every day, with no complaints, increasin efficiency, and since robots make no mistakes, no errors will result.

3.2 Robotics

1 *Understand what is meant by robotics.*

Robotics is a branch of computer science that incorporates the design, construction and operation of robots. Factory equipment, domestic robots and drones are examples.

2 *Describe the characteristics of a robot.*

A robot consists of a mechanical structure or framework; electrical components such as sensors, microprocessors and actuators with functions the same as automated systems; and are programmable.

3 *Understand the roles that robots can perform and describe the advantages and disadvantages of their use*

Identical to Section 6.1.2.

3.3 Artificial intelligence

1 *Understand what is meant by artificial intelligence (AI).*

AI is a branch of computer science dealing with the simulation of intelligent behaviours of by computers.

2 *Describe the main characteristics of AI as the collection of data and the rules for using that data, the ability to reason, and can include the ability to learn and adapt.*

As given.

3 *Explain the basic operation and components of AI systems to simulate intelligent behaviour.*

An expert system is a special type of system that attempts to emulate the expertise of a human. It takes questions from a user and determines solutions or answers.

It consists of a knowledge base, a rule base, an inference engine and an user interface. The knowledge base is a list of facts, the rule base links the facts. The inference engine is the part of the program that decides what questions to ask next and what answers to give. The user interface is that through which the user inputs questions and the program outputs questions and/or solutions.

Machine learning is when a program has the ability to automatically adapt its processes and/or data. It can be supervised or unsupervised. Supervised machine learning consists of a user tellin what data being fed to it means. Unsupervised learning is when data is fed to the machine and the machine learns from it.