



LEVEL 4
COMPUTER SYSTEMS
Student Workbook



Modification History

Version	Revision Description
V1.0	For Release
V1.1	Assessment methodology updated

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1. Module Overview and Objectives

This unit aims to provide you with an underlying knowledge of the computer hardware components and peripherals commonly found in a business environment, different approaches to the connection and architecture of these components, and an understanding of approaches to troubleshooting these systems.

2. Learning Outcomes

Learning Outcomes; The Learner will:	Assessment Criteria; The Learner can:
1. Understand the function of computer systems	1.1 Explain the role of computer systems in different environments 1.2 Explain the hardware, software and peripheral components of a computer system 1.3 Compare different types of computer systems
2. Be able to design computer systems	2.1 Produce a system design specification to meet a client's needs 2.2 Evaluate the suitability of a system design specification
3. Be able to build and configure computer systems	3.1 Build and configure a computer system to meet a design specification 3.2 Test and document a computer system
4. Be able to undertake routine maintenance on computer systems	4.1 Perform routine maintenance tasks on a computer system 4.2 Upgrade the hardware and software on a computer system

3. Syllabus

Syllabus			
Topic No	Title	Proportion	Content
1	Introduction to Computer Systems	1/12 2 hours of lectures 3 hours of laboratory sessions	<ul style="list-style-type: none"> • Overview of the module • Types of computer <ul style="list-style-type: none"> - Personal, mini, mainframe, mobile, - Network, supercomputer, multiprocessor • History of modern computers <ul style="list-style-type: none"> - Show & tell of old and modern computer equipment - Student research on generations of computer <p>Learning Outcome: 1</p>

2	Environments, Functions of Components and Health Safety &	1/12 2 hours of lectures 3 hours of laboratory sessions	<ul style="list-style-type: none"> • Computing Environments <ul style="list-style-type: none"> - Home, business, computer gaming, networking, real-time, communication • Von Neumann architecture <ul style="list-style-type: none"> - Example processors - Fetch execute cycle • Internet research – Different types of processor. <ul style="list-style-type: none"> - RISC v CISC - Single v multi core - Multiprocessor - Distributed • Health and safety practices; mains electricity, hot components, lifting and carrying, electrostatic precautions. <p>Learning Outcome: 1</p>
3	Hardware	1/12 2 hours of lectures 3 hours of laboratory sessions	<ul style="list-style-type: none"> • Standard architecture <ul style="list-style-type: none"> - CPU, main memory (RAM, ROM), Backing storage, I/O • Current implementation of standard architecture <ul style="list-style-type: none"> - CPU, motherboard, Power supply, cooling, backing store (hard disk, optical disks), memory types, interfaces (PCI, AGP, PCI Express), NIC, graphics card, sound. • Inside a PC <ul style="list-style-type: none"> - Identify components and their functions • Identify alternative components and packaging <p>Learning Outcome: 1</p>
4	Peripherals and System Building	1/12 2 hours of lectures 3 hours of laboratory sessions	<ul style="list-style-type: none"> • Printers, & plotters, cameras & scanners; keyboard, mouse, touch screen/pad; monitors, display adapters; multimedia devices; storage media; networking; portable drives; plug and play components; performance factors • Disassemble and assemble a computer system <ul style="list-style-type: none"> - Install motherboard, processor, heat-sink and fan, memory, power supply unit - Install hard disc drive, optical drive; - Install specialised cards - Install peripheral devices <p>Learning Outcomes: 1 & 3</p>

5	Software, Installation and Configuration	1/12 2 hours of lectures 3 hours of laboratory sessions	<ul style="list-style-type: none"> • Systems software <ul style="list-style-type: none"> - Operating systems, - Utility programs - Library programs, - Translator programs • Applications software <ul style="list-style-type: none"> - Standard packages - Customised packages - Special purpose software - Bespoke software • Install key software <ul style="list-style-type: none"> - Windows Operating Systems - Office package - Free utility software - Anti-virus and security software <p>Learning Outcomes: 1 & 3</p>
6	Alternative Operating Systems	1/12 2 hours of lectures 3 hours of laboratory sessions	<ul style="list-style-type: none"> • Alternative operating systems <ul style="list-style-type: none"> ○ UNIX/Linux, OS X, Android • Linux installation <p>Learning Outcome: 1</p>
7	System Testing	1/12 2 hours of lectures 3 hours of laboratory sessions	<ul style="list-style-type: none"> • Test plan • Test documentation • Fault detection, diagnostics, troubleshooting • Technical support • Test hardware and software • Repair • Fault diagnosis exercises <p>Learning Outcome: 3</p>
8	Software Maintenance	1/12 2 hours of lectures 3 hours of laboratory sessions	<ul style="list-style-type: none"> • Software problems • Automatic updates • Upgrades • Utility software • Security software • Scheduling maintenance • Windows update exercise • Package update exercise • Driver update <p>Learning Outcome: 4</p>

9	Hardware Maintenance	1/12 2 hours of lectures 3 hours of laboratory sessions	<ul style="list-style-type: none"> • Preventative maintenance • Upgrade v replace • Hardware upgrade <ul style="list-style-type: none"> - Priorities - Internal components - Peripherals • Hardware upgrade exercises e.g. <ul style="list-style-type: none"> - Memory update - Graphics upgrade - Hard disk upgrade - Add second NIC <p>Learning Outcome: 4</p>
10	File Management	1/12 2 hours of lectures 3 hours of laboratory sessions	<ul style="list-style-type: none"> • File systems operation and organisation <ul style="list-style-type: none"> - FAT, NTFS, ext - Directories/folders - Security, sharing and access rights • Data Protection <ul style="list-style-type: none"> - Backup - File/folder organisation • Windows file management exercises <p>Learning Outcome: 4</p>
11	Needs Analysis	1/12 2 hours of lectures 3 hours of laboratory sessions	<ul style="list-style-type: none"> • Client and system requirements <ul style="list-style-type: none"> - Investigation/analytical techniques - Problems/limitations with current/new system, - Functionality, costs, timescales, resources • Case study <ul style="list-style-type: none"> - Introduction - Needs analysis exercise <p>Learning Outcome: 2</p>
12	Selection and Systems Specification	1/12 2 hours of lectures 3 hours of laboratory sessions	<ul style="list-style-type: none"> • Selection criteria • System integration • Accessibility • Alternative solutions <ul style="list-style-type: none"> - Identification, selection & justification • Matching client requirements and system requirements with system components • Systems options <ul style="list-style-type: none"> - Off the shelf, self build, customise - Alternatives • System documentation • Case study – Selection & specification <p>Learning Outcome: 2 & 3</p>

4. Related National Occupational Standards

The UK National Occupational Standards describe the skills that professionals are expected to demonstrate in their jobs in order to carry them out effectively. They are developed by employers and this information can be helpful in explaining the practical skills you have covered in this module.

Related National Occupational Standards (NOS)
Sector Subject Area: 6.1 ICT Professional Competence Related NOS: 4.1.A.1 – Contribute to IT architecture work; 4.1.A.2 – Gather, use and maintain information relating to IT architecture models; 4.8.A.1 – Prepare, under supervision, for IT/technology infrastructure design and planning activities; 4.8.A.2 – Assist with IT/technology infrastructure design and planning activities; 4.8.A.3 – Assist others with relevant information concerning IT/technology infrastructure design and planning assignments; 5.4.A.1 - Perform systems integration activities as directed; 5.4.P.2 - Perform systems integration activities.

5. Teaching and Learning

Suggested Learning Hours					
Lectures:	Tutorial:	Seminar:	Laboratory:	Private Study:	Total:
24	-	-	36	90	150

The lecturer-led time for this module is comprised of lectures and laboratory sessions (labs). The breakdown of the hours for each topic is given in the Topic Notes which follow.

5.1. Lectures

Your lecturer will be presenting the basic knowledge required for the topic during this time. He/she will use PowerPoint slides during the lecture time and you will be expected to take notes.

The lectures are designed to last for 2 hours. You will be encouraged to be active during this time and to discuss and/or practice the concepts covered.

5.2. Laboratory Sessions

These sessions allow you to practise the skills covered in this module. You will work through the material and practical tasks provided in this Student Workbook under the supervision of your lecturer.

5.3. Private Study

This Student Workbook also contains details of the Private Study exercises. You are expected to revise the content of lectures and complete these exercises to improve your understanding. This may include preparing for the next lesson or conducting research in the library or online.

Your teacher will set deadlines for the completion of exercises and go over the suggested answers with you. Some of the private study tasks require you to work in a small group so you will need to plan your time carefully and ensure that you can meet with your group members to complete the work required before the deadline.

6. Further Reading List

You will also be expected to undertake further reading to consolidate and extend your knowledge of the topics covered in this module. Your Accredited Partner Centre's library will contain a selection of useful sources of information. The list below also provides suggestions of suitable reference books you may like to use.

Dulaney, E. (2014). *Linux All-in-One for Dummies*, 5th edition. John Wiley & Sons.
ISBN-10: 1118844351
ISBN-13: 978-1118844359

Marmel, E. (2011). *PCs Simplified*. John Wiley & Sons.
ISBN-10: 0470888474
ISBN-13: 978-0470888476

Mueller, S. (2015). *Upgrading and Repairing PCs*, 22nd edition. QUE Pearson.
ISBN-10: 0789756102
ISBN-13: 978-0789756107

Rizvi, A. (2011). *Click Start to Upgrade: Upgrading Your PC*. Click Start Publishing
ISBN-10: 0956780717
ISBN-13: 978-0956780713

Shoup, K. (2011). *Laptops Simplified*. John Wiley & Sons.
ISBN-10: 0470769025
ISBN-13: 978-0470769027

Thompson, R.B. (2010). *Building the Perfect PC: The Perfect PC is the One You Build Yourself*, 3rd edition. O'Reilly Media.
ISBN-10: 9781449388249
ISBN-13: 978-1449388249

There are many websites which give technical details of computer systems and architecture, the history and development of computer systems, and operating systems information. Here are a few examples:

<http://www.tomshardware.co.uk/>
<http://www.pctechguide.com/>
<http://www.build-your-own-computer.net/>
<http://www.linux.org>

7. Assessment

This module will be assessed by means of an examination worth 50% of the total mark and an assignment worth 50% of the total mark. These assessments will be based on the assessment criteria given above and you will be expected to demonstrate that you have met the module's learning outcomes.



Topic 1: Introduction to Computer Systems

1.1 Learning Outcomes

This topic provides an overview of the module and an introduction to different types of computer system.

On completion of this topic, you will be able to:

- Outline the purpose and structure of this module;
- Identify and classify different types of computer system;
- Compare different types of computer systems;
- Outline the history and development of electronic computers.

1.2 Notes to Teachers and Students

This topic will cover the following material:

- Overview of the module – a lecture with PowerPoint slides.
- Types of computer – a lecture with PowerPoint slides.
 - Personal, mini, mainframe, mobile, network, supercomputer, multiprocessor
- History of modern computers
 - Show & tell of old and modern computer equipment – a presentation of computer equipment by the lecturer and students.
 - Student research on generations of computer – individual research by students, using the Internet and other available resources.

1.3 Timings

The approximate amount of time that you can expect to spend on each type of activity in this topic is as follows:

Lectures:	2 hour
Laboratory Sessions:	3 hours
Private Study:	7.5 hours

1.4 Lecture Notes

1.4.1 Step 1: Introductions and Module Overview

In the first part of this lecture, you will be introduced to your lecturer, who will give an outline of the module, covering how it will be taught, what assessments there are, and the resources and facilities available to help you study. You will also get an opportunity to introduce yourself to some of the other students in your class. Take this time to find out who will be studying with you. You will find that having others to discuss the work with is a great help.

1.4.2 Step 2: Types of Computer System

The second part of this lecture will introduce you to the different types of computer system that are in use today, together with a little of the history of computer systems.

In all your lectures, you should take an active part in any discussions that take place. Also, take notes as the lecture progresses, adding to the material that is on the slides. Your private study and laboratory work (see later) will also add to the basic information from the lecture. This allows you to build up a comprehensive set of course material and learn as you do so.

Most of the lecture time will involve the lecturer explaining material to you, with questions to make sure you understand and think about what is covered. You will get plenty of opportunity to do practical work and further research in the laboratory (lab) sessions and private study.

IMPORTANT NOTES

At the end of the lectures, make sure that you understand everything that was covered in this topic. When you find anything new to you, read the slides and follow up the information with study in the library and on the Internet. There is a vast amount of information available online at all levels from basic introductions to cutting edge research papers.

1.5 Laboratory Sessions

Task 1: Show and Tell

Unlike most laboratory tasks, this one will be led mainly by your lecturer. They will show the class a selection of computer hardware, outlining what it is, what it does and how old it is. Comparisons will be made if different generations of the same technology are available. For example, it is useful to see different generations of hard disk drive to compare the physical size, capacity, speed and cost.

If you have any old computer parts, then bring them along to this session and discuss them with the class.

Modern components can also be examined to compare what we can buy now with older technology.

Task 2: Accessing Computer Facilities and the Internet

This task is to ensure that you can access the computer facilities and the Internet properly. If you do not already have a username and password to use in your laboratory, talk to your lecturer. Make sure that you can log in properly and that you can access local facilities such as shared and private network storage and printing. Also make sure that you can access the Internet properly. Check that common search engines are available (e.g. www.google.com, www.yahoo.com).

If you have already used computer facilities here, this may be a very quick task. If this is the first time you have logged on here, it may take a little time to get used to how the facilities work. The next task will give you some practice using the facilities.

Task 3: History of Computing

Introduction

Man has calculated since pre-historic times and there have been mechanical calculating machines since the early abacus. Other technologies that are now commonly used in computing were originally developed for other purposes; for example, the keyboard (typewriter) and screen (television). Modern electronics dates back to the invention of the transistor and before that to valve technology. Once the key elements were in place, computer technology has developed at a phenomenal rate. All these aspects of the history of computing lead us to the current computer systems that we all use and also indicate the directions that computer technology may develop in the future. It is helpful to know where we came from and how we got here, to help us see where we are going.

Student Activity

Select a particular aspect of the history of computing and agree it with your lecturer, who will ensure that a wide range of topics are covered within the class. Possible topics include:

- Overall history
- Pre-electronics
- 1st generation - valves
- 2nd generation - transistors

- 3rd generation – integrated circuits
- 4th generation - microprocessors
- PC compatible systems
- Operating systems

Research your topic using the library, the Internet and any other resources you have available and use the information you find to produce a PowerPoint presentation outlining the topic.

Your lecturer will collect the PowerPoint presentations and make them available for everyone in the class, to help you with your studies. If time permits, some or all students may present their findings to the class.

Your lecturer will also mark your presentations and provide feedback. This will not count towards your grade but is a valuable way for you to find out whether you are working at the correct level.

IMPORTANT NOTES

1. As part of your studies, you will be expected to research further into all the material covered in the module. This is a good place to start learning how to do this.
2. You also need to develop the ability to work independently and to determine how to tackle the set tasks. Try to decide for yourself the depth and level of detail that is appropriate for the task.
3. Once you have drafted a presentation, discuss it with your friends in the class.

REFERENCING

For any material that you produce during academic study, and in particular for any work submitted for assessment, it is vital that you provide references. A reference is a note, usually at the end of the document, which ties in with a citation within the text. Together, these tell the reader where the information comes from. For example, slide 14 of this topic's PowerPoint presentation contains a citation which says "(NASA, 2006)". This tells you that the information on that slide originated from NASA and was published in 2006. If you look at the references slide at the end of the presentation, you will see the top entry ties in with this citation. NASA, (2006). "Black Hole Simulations Take Us inside the Mind of Einstein." [Available Online] <http://imagine.gsfc.nasa.gov/docs/features/news/10may06.html>. This tells the reader the name of the author (in this case the organisation, as the actual author is not given), the date of publication, the title and where it can be found. This particular example is from the web but there are appropriate styles of reference available for many different sources such as books and academic journals.

Referencing is important for three reasons:

1. It acknowledges the original source of the information, giving them credit for their work
2. It allows the reader to check the information to ensure that it is being reported correctly and is academically credible.
3. It gives the reader a starting point for further study in the subject.

If you do not reference, then you are trying to pass other people's work off as your own. This is a form of cheating called plagiarism, which is treated very seriously in academic circles.

1.6 Private Study Exercises

Exercise 1

Read through the material covered in lectures. Make sure that you understand it all. Look up anything that you are not sure of. Discuss the material with others in your class. If necessary, make a list of questions to ask your lecturer and either email them or ask in the next class.

Exercise 2

Read through the material for the next topic. Do some initial research so that when you are in class, you can follow the material and ask relevant questions.

Exercise 3

Complete the PowerPoint presentation on the History of Computing. You need to submit this to your lecturer for marking.

IMPORTANT NOTE

Remember that you should be doing 7.5 hours of private study for this topic. It is better to do this in a number of shorter periods of study, rather than trying to fit it all in during one long session.



Topic 2: Environments, Functions of Components and Health & Safety

2.1 Learning Outcomes

On completion of this topic, you will be able to:

- Explain the role of computer systems in different environments:
 - Outline the main areas of computer use;
 - Identify key features of application areas and the computer technology used in each area.
- Compare different types of computer systems:
 - Explain the basic operation of a computer;
 - Explain the key features of different types of computer system and how these features are applicable in the areas of application;
 - Outline the key features of different types of CPU.
- Build and configure a computer system to meet a design specification;
- Explain and use appropriate health and safety procedures in a computer lab.

2.2 Notes to Teachers and Students

This topic will cover the following:

- Computing Environments
 - Home computing
 - Games consoles & computer games
 - Business computing
 - Networking
 - Real time computing
 - Communications
- Functions of Components
 - Basic architecture
 - Von Neumann architecture
 - CPU
 - Example CPUs
 - Fetch execute cycle

- Health & Safety
 - For people
 - For equipment

2.3 Timings

The approximate amount of time that you can expect to spend on each type of activity in this topic is as follows:

Lectures:	2 hour
Laboratory Sessions:	3 hours
Private Study:	7.5 hours

2.4 Lecture Notes

2.4.1 Step 1: Computing Environments

In the first section of Topic 2, your lecturer will outline the main areas of the application of computing, focusing on the particular features of each environment and the effect these features have on the types of computer systems and technology used. Remember to take notes as the lecture is being given and to engage fully in any discussions that take place. Also, remember that part of the Private Study activities (see later) is to follow up on material from the lectures.

The computer games market is far too large and varied to cover in detail in this topic. You should follow up this lecture by looking into other types of computer games.

For example, online multi-user games, sometimes called Multi-User Dungeon (MUD) from early versions based on roll play games like Dungeons and Dragons. These have developed into Massively Multiplayer Online Role-Playing Games (MMORPGs), e.g. World of Warcraft. Another example is the children's game site www.clubpenguin.com. These are also related virtual worlds such as Second Life.

2.4.2 Additional Notes to Accompany the Lecture Slides

Slide 17: The Internet

Make sure you are clear on the distinction between the Internet, which is the communications infrastructure, and the World Wide Web, which is just one of many services carried by the Internet. The Internet can also carry email, streaming media and lots of other things. As an analogy, the Internet is like a road system with junctions, traffic lights etc. whereas the Web is like cars. The road system carries many cars but also carries many other vehicles, so the road network is not the same as cars.

Also note that the Internet should start with a capital "I". It is the Internet, a proper name. An internet is just a group of networks connected together. The Internet is the global system.

Slide 19: Network Technology

The following devices may be used in building a network. A brief note on each is given here. Much more detail will be covered in modules on networking. You can also look these devices up on the Internet for more information.

- Repeaters - boosting the transmission by receiving a signal and resending it
- Hubs - copying a data packet from the receiving port to all output ports and hence transmitting the information to the rest of the network
- Bridges - connecting a number of network segments. Bridges build knowledge of which side of the bridge a host is and only forward frames when necessary
- Switches - filtering arriving data packets and transmitting them to the required ports only. Switches are a merger of hub and bridge technology.
- Routers - forwarding the arriving information depending on routing information (addresses for recipients) that exists in a routing table.
- Modem – Modulator/Demodulator – translates computer (digital) signals into analogue signals that can be sent over long distances, e.g. on phone lines, ADSL.

Slide 21: Communications

Here are some more examples of computer based communications systems. Even this list is not exhaustive!

- Workflow - enabling documentation to move through an organisation in a way similar to an assembly line
- Hypertext - supporting the collaborative creation of documents
- Electronic meeting systems - facilitating online meetings, sometimes including voting tools
- Group decision support systems - providing communication tools, such as brainstorming for synchronous decision making
- Multi player games - supporting multiple users of the same application – see previous notes on games.

2.4.3 Step 2: Computer Architecture

The second section of this topic explains the central component of any computer system, the central processing unit or CPU. You will see a general model of the CPU and discuss two examples; one is the first ever microprocessor (Intel 4004) and the other is a current Intel model (i7). Once you have the basic structure, the detailed operation of a CPU whilst a program is running will be discussed in the fetch-execute cycle.

There is plenty of material available on the Internet on this subject, so make the best use of the links provided and search for more information yourself. For example, you could look into other processors in more detail. There are also a number of emulators available online that you can use to experience older types of computer system.

2.4.4 Additional Notes to Accompany the Lecture Slides

Slide 30: Parts of the CPU – Control Unit

There are two ways of building a control unit:

- Hard Wired

Each operation is performed using dedicated electronic circuits. Complex operations require complex electronics but are generally faster in execution. However, hard wired processors are much more complex to design and to change or expand.

- Micro Programmed

Each operation is split into smaller steps. Each of these small steps is done by dedicated electronics. Complex operations, such as multiplication are done by micro-programs which call on different simple operations in turn. Micro programmed processors are theoretically slower in execution although this is not noticeable in modern systems because they are so fast anyway. Micro programmed processors make it easier to design and implement new instructions by building new micro programs that run on the existing hardware.

The vast majority of modern systems are micro-programmed.

Example of Micro Programmed Steps – Adding Two Numbers:

- Connect Register 1 to "A" side of ALU

- Connect Register 7 to "B" side of ALU
- Set ALU to do addition
- Set carry input to zero
- Store result in Register 8
- Update condition codes with ALU status flags
- Negative, Zero, Overflow, Carry
- Microjump to MicroPC nnn for next microinstruction

Slide 31-32: Example Processors

There is plenty of information on the web about every processor, including these two examples.

- Intel 4004

More information from Intel's website at:

<http://www.intel.com/about/companyinfo/museum/exhibits/4004/index.htm>

Data sheet, including block diagram, available at:

http://www.intel.com/Assets/PDF/DataSheet/4004_datasheet.pdf

Schematic Diagram available at

http://www.intel.com/Assets/PDF/General/4004_schematic.pdf

Manual available at <http://www.intel.com/Assets/PDF/Manual/msc4.pdf>

- Intel i7

Data sheets from <http://download.intel.com/design/processor/datashts/324641.pdf> and

<http://download.intel.com/design/processor/datashts/324642.pdf>

IMPORTANT NOTES

The fetch-execute cycle is a fundamental concept in computing. Make sure that you understand it fully and that you have studied the material provided, followed up with further research in the library and on the Internet.

2.5 Laboratory Sessions

Task 1: Health & Safety Briefing

The laboratory session will start with a briefing on health and safety. It is important for both the safety of the people in the lab, including you, and for the equipment, that all the guidelines are followed. Although the tasks in this laboratory session are based on Internet searches, future sessions will require practical work involving equipment, such as the inside of a PC.

Task 2: Accessing Computer Facilities and the Internet

Although this was covered during Topic 1, there is another chance here to check that you have full access to the computer facilities you need at your centre. See your lecturer or arrange to see your IT Support person if you are still having any difficulties. Note: This will not be covered explicitly again; it is up to you to make sure that you do have access to facilities.

Task 3: Different Processor Architectures – Internet Research

Introduction

Although the majority of computers you use are based on a single architecture (the Intel x86 family), there are a number of variations even within this family. There are also other ways to design and build processors, some of which are significantly different from x86. For example, the Apple iPhone uses an ARM Cortex-A8 which is a 32-bit reduced instruction set computer (RISC) design. In fact, the vast majority of mobile phones use ARM RISC processors.

Student Activity

For one of the topics below, agreed with your lecturer, produce a set of notes to explain the key issues and features of the particular computer architecture under discussion. You do not have to write a formal paper on the subject, but your notes should be coherent and should stand alone as a source of introductory information on the topic. **DO NOT JUST COPY FROM WIKIPEDIA!**

The target reader is someone in your class who is not doing your topic. Your lecturer will collect in the notes from everyone in the class and make them available (electronically if possible) so that the whole class has a set of resources on these topics within processor design.

Topics:

- Reduced Instruction Set Computer (RISC) v Complex Instruction Set Computer (CISC)
- Hyperthreading
- Single v Multi core processors
- Multi-processor computers
- Distributed Computing

IMPORTANT NOTES

Remember to reference properly.

Your lecturer will review your notes and provide feedback.

The key objectives of this laboratory session are:

- To develop your research capabilities; this will allow you to keep up-to-date with a rapidly changing subject.
- To develop your ability to explain complex technical issues in writing to others; this will be required throughout your course and the rest of your life with computers.
- To broaden your horizons beyond the standard desktop PC architecture.
- To give you the opportunity to discuss the subject with others in your class and with your lecturer.

2.6 Private Study Exercises

Exercise 1: Lecture Follow Up

Follow the links on the slides and the additional notes above to get more details on the examples given.

In particular, look at online games systems as mentioned on Slide 12 and in step 1 of the lecture notes above.

Exercise 2: Computer Architecture

Complete your processor architecture notes and hand them in, electronically if possible.

Exercise 3: Old Systems Emulation

Search for, download and run emulation software for an old home computer or games console. The aim is to get some experience of early computer games like Pong and Pac Man and to see how far the games industry has progressed. There are no further links here; as a student of computing, you should be able to find these things on the Internet for yourself.

Hint: Get in a group with friends in your class and search for different emulators and games to run. You should easily be able to build up a large collection between you.

Exercise 4: Online Games

Investigate some online games and virtual worlds. There are so many that it is left up to you to find something. Be aware of acceptable use policies at your college and do not engage in any online game that is not appropriate.

IMPORTANT NOTE

Whilst you may regard Exercises 3 and 4 as the most interesting ones, it is important to complete the academic work from Exercises 1 and 2 first!

Your lecturer may ask you to briefly show something you have found in Exercise 3 or 4.



Topic 3: Hardware

3.1 Learning Outcomes

On completion of this topic, you will be able to:

- Explain the hardware, software and peripheral components of a computer system:
 - Explain the purpose and basic operation of the key components in a modern PC.
- Build and configure a computer system to meet a design specification:
 - Identify the key components in a modern PC.

3.2 Notes to Teachers and Students

This topic will cover the following:

- CPU construction, packaging and sockets
- Primary storage (RAM and ROM) technology and packaging
- Secondary storage (hard disk, optical disk and flash memory) technology, packaging and interfacing
- Input and output devices – basic concepts and interfacing
- Buses – internal, and external
- Motherboard and chip set
- Other key components – power supply, cooling, graphics card, sound, NIC, case
- Laptops
- Component identification and systems specification

3.3 Timings

The approximate amount of time that you can expect to spend on each type of activity in this topic is as follows:

Lectures:	2 hour
Laboratory Sessions:	3 hours
Private Study:	7.5 hours

3.4 Lecture Notes

3.4.1 Computer Hardware Lecture

Your lecturer will outline the key hardware components of a modern PC system. Examples will be given for each item and you should enter into discussion with the lecturer and the class about the variations that are available for each key component. This discussion will focus on the components inside the PC case and the connections to it. Peripherals (devices that connect to the PC from outside the case) will be discussed in the next topic.

There are many websites that give further information on this topic. These broadly split into:

- Manufacturers' websites – giving detailed technical information as well as marketing and support. E.g. www.intel.com and www.nvidia.com
- Retailers' websites – where you can buy computers and components. These are generally based in a particular country, so examples from the UK would be www.dabs.com and www.pcworld.co.uk. Track down suitable sites for your country to get price and availability information for the various devices discussed in the lecture.
- General information sites – these will cover anything from reviews and news to “how to...” instructions. See www.hardwarezone.com.au for an example but there are many others.

These sites will provide you with plenty of material for private study (see later).

3.4.2 Additional Notes to Accompany the Lecture Slides

Slide 18: Optical Disk

A rival technology to Blu-ray existed: HD-DVD – High Definition or High Density DVD – 15GB single and 30 GB dual layer. Developed by Toshiba and others but eventually lost the commercial battle and is no longer being developed.

Slide 20: Secondary Storage Interfaces

Other interfaces have been used for secondary storage, including:

- ST506 – has been obsolete for years – look it up if interested
- Small Computer System Interface (SCSI) - A more generic interface than IDE or SATA. SCSI is used on high end disks and systems, particularly in servers and also by Apple on early Mac systems. SCSI will interface other devices as well and was commonly used for scanners until the development of Universal Serial Bus (USB).

Slide 22: Secondary Storage – Flash

It is not advisable to use USB memory sticks as storage. They are a transport mechanism. They are very useful for moving data between (for example) your home PC and college, but are very susceptible to physical damage from impacts, leaking drinks, rain etc. in your bag.

Slide 26: Buses – Internal

Timing diagrams are used to show the operation of internal buses (amongst other things). On a timing diagram, single lines represent single signals (and form part of the control bus); double crossing lines represent parallel buses and generally refer to address and data buses.

There is an example timing diagram at:

http://www.electricalfun.com/workbenchfun/images/Multilabs_figure6.jpg

Another timing diagram example shows the most common control line, the clock, at the top, and multiplexed address/data bus AD15:0:

http://www.ece.wisc.edu/~morrow/ECE315/ARM7-PGA/aduc7026_timing/timing%20diagram%20-%20basic%20read.jpg

Note: Timing diagrams will not be examined in this module. These examples are given for your information only.

Slide 36: Power Supply (PSU)

Make sure you have enough power. Most off-the-shelf PCs have a minimum specification power supply to reduce costs. If you add extra hard drives or a much faster graphics card, you may exceed the power supply rating. This leads to instability, crashes and possible overheating. In general, a PSU should be running at about 80% of capacity.

A small PC may have a 300W-500W supply; larger systems may go to 1000W or more.

Slide 37: Cooling

The range of cooling equipment available is large. See <http://www.quietpc.com/> for examples.

It is possible to build a PC which only has passive cooling, without the use of fans. Again, see <http://www.quietpc.com/> for more information.

IMPORTANT NOTES

There is not necessarily a definitive answer to questions like “which is the best processor?” There are many choices available for each of the key components and the “best” one will depend on the requirements and application area. E.g. if you are rendering big graphics or video files, then high speed image processing is a top priority. If you want to be able to use your laptop computer on a long train journey, then long battery life is the key issue. For most users, price and reliability are more important than outright performance.

Computer technology is developing very rapidly. For example, a new, top of the range graphics card launched today will become the norm in a year’s time, will be the bottom of the range in two years and will be obsolete in three years. Unless you must have the top performance, it is advised that you look for a *price break*. This entails listing your options in price order and looking for a big jump in price; then buying just below that jump. This will give you the best performance value, i.e. the best balance between performance and cost.

Given these two important points, the key is not to know what is available today but to know how to find out what is available and how to compare and select. We will discuss this further later in the module.

3.5 Laboratory Sessions

Task 1: Old Systems Emulation – Show and Tell

This laboratory session starts with a 'show and tell' from last week's emulation search. If you have found a good emulation, show the class your favourite old system/game emulation. Try to have a range of systems on show. This may need setting up beforehand, but should not take up more than 15 minutes in the class time.

Task 2: Remember Health & Safety

During the last topic we discussed issues of health and safety in the lab. This referred to both people and equipment. Make sure that you are following the guidelines given.

- Is your work area clear and safe?
- Have you discharged and static electricity and fitted yourself with an earth strap?
- Have you switched off and unplugged the system?
- Have you left enough time for the system to cool and discharge its capacitors?

Task 3

The objective in this laboratory session is to identify the components of a PC. This doesn't just mean pointing and saying "there's the processor, there's the graphics card" etc. It means finding out exactly which components you have.

You will need a PC that you can look inside. This does not need to be a modern PC, but it is helpful if it works. You can work on the practical tasks in small groups as directed by your lecturer but you will write your report on your own.

It is not necessary for this topic to take it apart completely (that comes next topic). You do not need any of the peripherals such as keyboard for this lab session. Start by making sure you have followed Task 1 above.

Task 4

Take the lid off your PC. This may need a screwdriver; there may be thumb screws or clips. If your PC has been used for this lab session a number of times before, then all the screws may be missing. We cannot give detailed instructions here because every PC case is different. If you have difficulty getting inside, ask your lecturer for help.

Task 5

Identify the components inside your PC. Start by noting the key components in general terms, i.e. identifying where they are: the motherboard, processor, northbridge, southbridge, graphics card, hard disk, optical drive, power supply, case and anything else fitted to your PC. Either draw a diagram or, if you have a digital camera available, take photographs.

Task 6

Make a list of the components and for each one, note any identifying marks or text on it. This will be easier with some items than others. Often graphics cards will have the make and model printed on the circuit board. There may be a stuck on label (which of course may have fallen off if it is an old PC). Some items may not have anything that will identify them, or it may be under a heat sink. CPUs are often like this. Have a good look round to see how many items you can specifically identify. Use this list to label your diagram or photographs.

Task 7

Use your list to search the Internet for information about the components in your PC. You should be able to build up a detailed specification for the machine you have.

Task 8

Put your machine back together properly, ready for the next person.

Task 9

If your machine works, boot up your machine and use Windows Device Manager to find out more about the components. If the machine you looked inside does not work, you can do this task on another Windows based PC instead. The exact way to do this depends on the version of Windows you have, but in general, go to Control Panel and select Device Manager. Then expand each item to see details of what Windows thinks is installed.

Task 10

Write a document that gives the details of the components inside your PC. This would be particularly useful for future maintenance tasks like downloading updated drivers or replacing faulty components. If you cannot identify exactly the make and model for a particular component, then note this down and provide details based on your best judgement of exactly what the item is. Present your report in a professional manner and reference your sources.

IMPORTANT NOTE

It does not matter how old your PC is for this laboratory session. It will be more of a challenge to track down the details of older components, but most of the PCs in use today are not brand new, so it is good practice to be able to find this information for older items.

3.6 Private Study Exercises

Exercise 1: Lecture Follow Up

Follow up the activities identified in the lecture slides. In particular, follow the links on the slides to get more details on the examples given.

Exercise 2

Using the information gathered in the laboratory session, finish your documentation for the PC you inspected.

Exercise 3

If you have a PC at home, repeat the exercise for that machine and compare the specification with the lab PC.

Exercise 4

Using the websites identified and those of local suppliers, write a specification for the most powerful PC you can currently build, assuming that money is no object, i.e. it doesn't matter how much it costs, but it has to have the highest performance components you can find.

Exercise 5

Using the websites identified and those of local suppliers, write a specification for the cheapest PC you can currently build, i.e. it doesn't matter how powerful it is as long as it will run Windows (any version from XP onwards will do; it does not have to run the latest, most powerful version).



Topic 4: Peripherals and System Building

4.1 Learning Outcomes

On completion of this topic, you will be able to:

- Explain the hardware, software and peripheral components of a computer system:
 - Explain the purpose, basic operation and connection of peripheral devices for input, output, storage and communications.
- Build and configure a computer system to meet a design specification:
 - Dismantle and re-assemble a personal computer, including the installation and connection of the key components.

4.2 Notes to Teachers and Students

This topic will cover the following:

- The purpose, operation and connection of the following devices:
 - Printers & plotters; cameras & scanners; keyboard; mouse; touch screen/pad; monitors; display adapters; multimedia devices; storage media; networking; portable drives; plug and play components; performance factors
- Disassemble and assemble a computer system (laboratory session):
 - Install motherboard, processor, heat-sink and fan, memory, power supply unit
 - Install hard disc drive, optical drive
 - Install specialised cards
 - Install peripheral devices

4.3 Timings

The approximate amount of time that you can expect to spend on each type of activity in this topic is as follows:

Lectures:	2 hours
Laboratory Sessions:	3 hours
Private Study:	7.5 hours

4.4 Lecture Notes

In this topic there is only one section. Your lecturer will outline key peripherals, describing their function, operation and connection to the main computer system. Examples will be given for each item and you should enter into discussion with the lecturer and the class about the variations that are available for each peripheral. There are a large number of different devices available and a wide range within each device. For example, many different printers are available using a number of different technologies, but they all do the same basic job of providing hard copy of computer data. You need to think about selecting appropriate versions of peripherals for particular jobs. For example, a family will have different printer requirements from a publishing house.

As with the previous topic, there are many websites that give further information on this topic. Most of the sites from Topic 3 also cover peripherals. These broadly split into:

- Manufacturers' websites – giving detailed technical information, as well as marketing and support. For example, www.hp.com and www.canon.com.
- Retailers' websites – places where you can buy computers and components. These are generally based in a particular country, so examples from the UK would be www.dabs.com and www.pcworld.co.uk. Track down suitable sites for your country to get price and availability information for the various devices discussed in the lecture.
- General information sites – these will cover anything from reviews and news to “how to...” instructions. See www.hardwarezone.com.au for an example, but there are many others.

These sites will provide you with plenty of material for private study (see later).

IMPORTANT NOTES

As with processors, there is not necessarily a definitive answer to questions like “which is the best printer?” The application area is very important, but there is such a wide choice available that you're your final selection may be based on which device you can buy locally, or whether you already have some devices from that manufacturer. For some products, in particular printers, the cost of consumables like ink cartridges is likely to be more important than the initial purchase price.

As with the components inside the PC, you need to keep up-to-date with what is available.

4.5 Laboratory Sessions

These laboratory sessions does not have detailed step-by-step instructions like you may find in a module on spreadsheets or programming. The emphasis is on you exploring the hardware of a computer system. Each manufacturer also has their own way of putting things together, so writing a set of detailed instructions that cover every PC is not possible. The exact order that you remove components may also have to be different, depending on your PC.

Read each task through completely before you start to make sure you have all the information you need to complete it correctly.

Task 1: Remember Health & Safety

Previously, we discussed issues of health and safety in the lab. This referred to both people and equipment. Make sure that you are following the guidelines given. Is your work area clear and safe? Have you discharged and static electricity and fitted yourself with an earth strap? Have you switched off and unplugged the system? Have you left enough time for the system to cool and discharge its capacitors?

This note will appear in each laboratory session to remind you of how important it is.

Also note that older PCs can be full of dust, which you should avoid inhaling, so take care as you take the machine apart. It is NOT recommended to use a vacuum cleaner inside a PC, as they tend to generate lots of static.

Task 2

Take the lid off your PC. You probably did this in the last topic, but it is where we need to start. If there are a number of different PCs available, try to pick a different one from last time. This may need a screwdriver; there may be thumb screws or clips. If your PC has been used for this laboratory session a number of times before, then all the screws may be missing. We cannot give detailed instructions here because every PC case is different. If you have difficulty getting inside, ask your lecturer for help.

In order to help you put it all back together, it is worth laying out the components in the order that you remove them and putting any screws or clips with the correct component.

Task 3

Disconnect and remove all the cables inside the PC.

Some are just a push fit on their connectors, but others will have clips. Again, there is a lot of variation so you will have to inspect each connector to see how it comes off. You should not need a large amount of force to remove a connector, so if it seems stuck, check again for clips and check with your lecturer.

As you remove each cable, make sure you make a note of where it goes and which way it goes. Some cables or connectors are marked to show which way up they go. For example, IDE data cables (40 or 80 wire ribbon cables) generally have a red stripe down the side that connects to pin 1 of the motherboard and pin 1 of the drive. On the motherboard, pin 1 should be labelled. On the hard drive, pin 1 is nearest the power connector.

Power connectors should be removed from the device or motherboard they feed, but can be left connected to the PSU.

Task 4

If the disk cage is in the way, do task 6 first.

Remove any expansion cards. These are usually held in place by a screw or clip on the back of the PC, above the connectors on the back of the card. Some cases use individual screws for each card, others have a single clip holding all the cards in place.

Most graphics cards also have a clip on the motherboard at the opposite end from the back plate.

When handling any components, try to not touch the connectors as you will leave corrosive deposits which may cause later failure.

Note down where each card came from and the order they came out. You may find that you have to put them back in the same order as well as in the same place.

Task 5

If the disk cage is in the way, do task 6 first.

Find and remove the RAM modules. These are probably DIMMS, but may be SIMMs depending on the age of your PC. They are usually held in place by a clip at each end. Push the clips away from the module and down. This will push the module up and release it from the connector. Remember that memory is particularly sensitive to static, so handle with care.

Make sure you note which slots the modules come from. On some motherboards it matters.

Task 6

You may need to do this before task 4 or task 5 depending on your PC. If the disk cage is in the way of the memory modules, remove the disk cage first.

Remove the disk drives. Some are carried separately in a frame built in to the case. Others are mounted on a removable cage, so check carefully. If the disk cage is removable, take it out and remove the drives separately.

Task 7

Remove the power supply. This is usually held on by screws, even if the rest of the case uses clips. The common arrangement is to have four screws around the fan vent on the back of the PC, but you need to make sure you are undoing the PSU screws and not the fan screws.

We shall not be taking the PSU apart. Inside the PSU is mains voltage when the PC is in use and there are no parts inside that can be repaired without specialist knowledge or equipment.

Task 8

You should now be able to see all of the motherboard. If any pieces of case are in the way that can be removed, take them off.

Now remove the motherboard. This may be held in place by screws, clips or a mixture of both. Most clips require squeezing to release the barbs. If a screw has a washer under it, make sure you keep it to refit. If you have released all the fastenings, the motherboard should lift out easily. If it seems stuck, check again carefully for more fastenings.

Task 9

You should now have a PC in pieces on your table. Hopefully you have labelled everything as it came out. If you have a digital camera, take some photographs as a record of this lab session.

Task 10

Reassembly is the reverse of strip down:

- Fit the motherboard with all its screws and clips.
- Fit the PSU with all the screws.
- Fit the drives and/or drive cage. As with strip down, you may need to do this after the memory modules and the expansion cards, depending on your PC.
- Fit the memory modules. They should just push in to the slots, but they are keyed to make sure you fit them the correct way round. Look at the connector to see where the slots are. These line up with ridges in the connectors. As you push straight down, the clips will engage at the ends. If the module is difficult to push in, make sure you have it the right way round.
- Fit the expansion cards. The graphics card clip on the motherboard may need pushing aside to fit the card. Make sure you secure all the expansion cards. A loose card may move when the PC is on, which can cause a power surge and failure.
- Connect all the cables up. Take care to get them the correct way round and to push them fully home. As with expansion cards, a loose cable can cause failure.

Task 11

If your PC worked before you started, then plug it in and try it. Some PCs used in this lab session may not be working at all. In general, PCs do not like being taken apart, and your college will not give you brand new PCs to take apart, so it may or may not work. If it worked before you took it apart, it should work when you have put it back together.

Task 12

Write up your laboratory session, describing what you have done and illustrating it with your photographs. In particular, make notes on anything that was difficult. For example, if there was a screw that was hard to find, or a clip that you could not release easily, note it down. Link this write-up in with Topic 3 by gathering all the technical information on the PC you took apart. If it was the same machine as in the previous topic, you should already have most of the details, but there may be things that you could not identify until you had removed them from the case. If some of the components were different, then track down their details on the Internet and include them in your documentation. The combination of last topic's and this topic's report should provide a detailed set of documentation for the PC.

IMPORTANT NOTES

In general, you should not take a PC apart unless you need to for a repair or upgrade. In the case of repair or upgrade, only take out the components that need to be replaced.

If you upgrade a PC, it is worth keeping the old components if they still work. They may be useful in repairing another PC in the future. If you regularly upgrade and repair PCs, you will build up a stock of components and may even be able to build full PCs from the spare parts. These may not be the latest high performance games machines, but will still work and be suitable for less demanding jobs like email and word processing.

4.6 Private Study Exercises

Exercise 1: Lecture Follow Up

Follow up the activities identified in the lecture slides. In particular, follow the links on the slides to get more details on the examples given.

Exercise 2

Using the information gathered in the laboratory session, finish your documentation of the PC strip down and rebuild.

Exercise 3

What would you upgrade? Using the information from your laboratory sessions and documentation, identify three (3) components in the PC you worked on that you would upgrade, and suggest what you would upgrade them with.

You need to be specific, identifying exactly how you could improve the PC with upgrades, rather than replacing it with a completely new machine. You should name the new items you would fit, say where you would get them from and how much they would cost.

Put your upgrades in priority order, trying to maximise the improvement in performance that you would gain. Remember that your upgrades must fit the PC. For example, if you have an AGP graphics card slot, it is no good recommending a PCIe graphics card.

Finally, compare the cost of the upgrades with a new PC to check whether it is worth doing the upgrades.



Topic 5: Software, Installation and Configuration

5.1 Learning Outcomes

On completion of this topic, you will be able to:

- Explain the hardware, software and peripheral components of a computer system:
 - Explain the purpose of different classes of software (operating system, utility, application).
- Build and configure a computer system to meet a design specification:
 - Install a version of Microsoft Windows, an office package, a utility package (e.g. a web browser) and an anti-virus package.

5.2 Notes to Teachers and Students

This topic will cover:

- Systems software:
 - Operating systems
 - Utility programs
 - Library programs
 - Translator programs
- Applications software:
 - Standard packages
 - Customised packages
 - Special purpose software
 - Bespoke software
- Installation of key software (laboratory session):
 - Windows Operating Systems
 - Office package
 - Free utility software
 - Anti-virus security software

5.3 Timings

The approximate amount of time that you can expect to spend on each type of activity in this topic is as follows:

Lectures:	2 hours
Laboratory Sessions:	3 hours
Private Study:	7.5 hours

5.4 Lecture Notes

This topic's lecture will outline the key features of the main classifications of software (systems, utility and application). There are many possible examples in some areas, such as application software, whilst others, e.g. operating systems are completely dominated by one example (Microsoft Windows). It is important to remember that even if one system or package is dominant in the market, there are probably alternatives available that will do just as good a job, often at a fraction of the price. It is very easy to assume that there is only one way to do things and that this is the Microsoft way. As a student of computing, you must look into the alternatives and get as wide a range of experience as possible of different software.

The next topic will look at alternative operating systems, in particular Linux, in more detail. This topic focuses on Microsoft Windows based systems.

There are many websites covering Microsoft products. One of the skills you need to develop is the ability to look things up on the Internet. This is particularly important with operating systems and application packages as new versions are released regularly and you will need to be able to keep up-to-date with new versions.

One example website is:

<http://www.hardwarezone.com.au/reviews/view.php?id=2894&cid=19&pg=1>

This website has been mentioned in previous topics and covers not only hardware, but also software installation.

There are many others, including extensive documentation from Microsoft:

<http://windows.microsoft.com/en-us/windows/help/install-reinstall-uninstall>

IMPORTANT NOTES

You may not want to install different operating systems on your PC. Making major changes to the software installed can seriously affect the reliability of your system. There are alternative ways of experimenting.

If you have some old components, build a system to experiment with. This was mentioned in the last topic. If you are just using it to look at different operating systems, the performance of the system is not that important.

Most modern PCs will boot off USB, allowing you to use an external drive as a boot disk. You can then install a different operating system on the external drive and boot from that to try the new system. Just unplug the external drive to get back to your old system.

There are a number of virtual machine systems available that run under Windows or Linux and allow you to install different virtual machines with different operating systems on them. For example, VirtualBox developed by Oracle (www.virtualbox.org) and Microsoft's Virtual PC (<http://www.microsoft.com/windows/virtual-pc/default.aspx>). Virtual machines tend to be a bit slow, but you can get the feel for an operating system.

Install a dual boot system. Linux distributions come with a menu driven dual boot system that allows you to select the required operating system at boot time. This carries slightly more risk as you are changing the contents of your system's drive, but it is generally reliable.

5.5 Laboratory Sessions

This laboratory session deals with installations. In general, the installation of Microsoft Windows and most off the shelf packages is straight forward. In most cases, you just insert the software CD/DVD and the installation will start automatically. If you are installing a new operating system, or installing onto a new hard disk, you may have to boot from the installation media. You should read the information on screen and follow the instructions given.

As your system installs, make notes of what is happening and in particular of any issues you find. You will need these notes for this topic's lab report.

Task 1: Remember Health & Safety

You are not taking anything apart this time, but there are still issues to consider (in particular, the safety of your data). Before you start this laboratory session, make sure that all data from the system you are working on has been backed up. If possible, do these tasks on a system that is not used for other activities, to avoid the risk of losing data or having a system that is needed, but does not work.

See also the notes on the previous page (under 'Important Notes') on ways to experiment with operating systems safely.

Task 2: Install Windows

Detailed instructions are not given here. Part of the task is for you to find out how to install Windows by referring to the instructions that came with Windows (which are very brief) and by looking things up on the Internet. For example:

<http://windows.microsoft.com/en-us/windows/help/install-reinstall-uninstall>.

The actual installation of Windows itself is straight forward, but you may have to find device drivers either from Microsoft or from a manufacturer's website. The previous two topics gave you some experience in finding out exactly what hardware is in your PC. Most manufacturers have large support websites with downloads of drivers for their products, although you may find it difficult to get drivers if you are using old hardware and the latest version of Windows or vice versa. Your first aim is to get everything working, i.e. find suitable drivers so that all the components in your system work. Then try to ensure that you have the latest versions of all drivers for best performance. It is recommended that you get the network interface working first, as this will allow you to download all the other drivers directly to the PC. Even the graphics card can wait, as all graphics cards will work with generic drivers that come with Windows, possibly at reduced speed and resolution.

Task 3: Install Anti-Virus Software

Computer viruses are very common and as soon as you connect your PC to the Internet, you are likely to come under attack. It is important to have proper anti-virus protection on your PC as soon as possible to avoid problems later. There are many commercial packages available, plus a number of free trial systems. For example, AVG produce a free version for personal use (free.avg.com), although you have to be careful to click the correct links or you will pick up the pay-for version instead.

Task 4: Install an Office Package

Install the office package supplied by your college for this lab. This can be Microsoft Office or a different package. Again, there are open source versions available, such as Open Office (www.openoffice.org). The object of this task is to get a PC that you can do something useful with. Since most PCs are used for office applications, this is a good place to start.

Task 5: Install a Free Utility

There are many useful utilities available free on the Internet. The objective of this task is to find one and install it. It doesn't really matter what it does as long as it is useful. Games are not useful in this context! One example (which you may NOT use – find your own!) is Audacity (audacity.sourceforge.net) which is a sound recording and editing package.

Task 6

Write up a lab report describing the installation you have just done. You should focus on the issues that you found, such as the device drivers you have to download, where you got them from and any that could not be found. The resulting report should document the entire installation of Windows on this hardware.

IMPORTANT NOTE

Some of this laboratory session's time will be spent waiting for things to install. You should use this time to take notes and pictures and to start working on your report.

5.6 Private Study Exercises

Exercise 1

Search the Internet for more details on the topics covered. You should also review the content of this topic and make sure you understand the information covered.

Exercise 2

Using the notes you took in the laboratory session, write your lab report documenting the installation of Windows on this hardware.

Exercise 3

Referring to the notes in Section 5.4 above, investigate virtual machine software. The examples given are freely available, so you can try them. At this stage, just try to get the virtual machine running and if you have a spare copy of Windows (even a very old version will do), install it on the virtual machine. This is also good preparation for the next topic, which will look at other operating systems.



Topic 6: Alternative Operating Systems

6.1 Learning Outcomes

On completion of this topic, you will be able to:

- Compare different types of computer systems:
 - Compare different operating systems;
 - Explain how the selection of the operating system affects the remainder of the systems design.
- Build and configure a computer system to meet a design specification:
 - Install an operating system that is not a version of Microsoft Windows.

6.2 Notes to Teachers and Students

This topic will cover alternative operating systems:

- Unix/Linux, OS X, Android
- Linux installation

6.3 Timings

The approximate amount of time that you can expect to spend on each type of activity in this topic is as follows:

Lectures:	2 hours
Laboratory Sessions:	3 hours
Private Study:	7.5 hours

6.4 Lecture Notes

This topic covers alternatives to the Microsoft Windows family of operating systems. Although Windows has a large majority of the market (nearly 90%), there are alternatives available that offer different facilities and are appropriate for certain application areas. These include Unix and its derivatives, such as Linux and Apple's Mac OS X. It also includes the mobile computing area, where Microsoft Windows has so far failed to become dominant. In mobile computing, Apple is the key driving force with its iPhone and iPad operating system (iOS). Alternatives are also available, including Android, which is discussed here.

You should broaden your studies by looking at other operating systems. For example, other mobile systems include Symbian and Palm OS. As with previous topics, an Internet search is the place to start.

IMPORTANT NOTES

During Topic 5, we noted that we can use virtual machines to install different operating systems without risking our main operating system installation. An alternative approach is to use an **emulator**. An emulator is a software package that mimics the behaviour of another system. We looked at emulators for old games consoles in Topic 2. For example, Google have produced a software developer kit (SDK) for Android which includes an emulator to run on Windows. This is a complex system aimed at people who are writing apps for Android, but it would allow you to have a look at Android without the expense of buying an Android phone. Search for "android emulator" to find more on this.

6.5 Laboratory Sessions

Linux is an increasingly popular alternative to Windows. You can now buy PCs, and in particular Netbook computers with Linux as the default installed operating system. Having both Linux and Windows on a PC is also useful, allowing the most appropriate operating system to be used for any job.

You have already installed Windows in Topic 5. This session covers the addition of Linux to that installation to create a dual boot system.

As your system installs, make notes of what is happening and in particular of any issues you find. You will need these notes for this topic's lab report.

Task 1: Remember Health & Safety

You are not taking anything apart this time, but there are still issues to consider, in particular, the safety of your data. Before you start this lab session, make sure that all data from the system you are working on has been backed up. If possible, do this lab session on a system that is not used for other activities, to avoid the risk of losing data or having a system that is needed but does not work.

See also the notes on the previous topic on ways to experiment with operating systems safely.

Task 2: Installing Linux

Detailed instructions are not given here. Part of the task is for you to find out how to do this by referring to the instructions that came with your Linux distribution (which are very brief) and by looking things up on the Internet. The best place to look is the website for your distribution, for example: <http://www.opensuse.org/> if you are using the openSUSE distribution, or <http://fedoraproject.org/> if you are using Fedora. You do not need to use any particular distribution for this lab session. Use the one that your college provides.

The actual installation of Linux itself is straight fairly forwards but not always as easy as Windows.

Disk Partitioning

One decision you have to make when installing Linux is how to split up your disk space. Windows does allow you to do this as well, but it assumes that you will only be using Windows, so it skips over this option very quickly. Linux assumes that you will be running multiple operating systems, so it goes into much more detail. Since Linux and Windows handle disk space differently, you must divide your disk space up and allocate different partitions to each operating system. If you already have Windows installed, your Linux installation software will make the Windows partition smaller to allow space for Linux. In this lab session, it does not really matter how big you make the partitions as long as they are big enough to take the installation. For most modern Linux (and Windows) systems, this means 10GB.

Your Linux installation software will offer a recommended partitioning. Check that this will keep the Windows partition and then you can accept the defaults.

Much more information on this, ranging from beginner's guides to detailed technical discussions, can be found by searching "linux disk partitioning" online.

Installation Order and Boot Manager

Because Windows assumes it is the only operating system in use, you must install it first if you are going to use it at all. You can then install Linux. Linux will install a boot manager such as GRUB. With GRUB installed, when your computer first boots, it will present you with a menu from which you can choose the operating system you want to run. GRUB is fully configurable, allowing you to set up a number of different operating systems and set a default.

Drivers for Linux

You may have to find device drivers either from a manufacturer's website or from the Linux community online. The previous topics gave you some experience in finding out exactly what hardware is in your PC. Most manufacturers have large support websites with downloads of drivers for their products. For Linux, it is generally easier to find drivers for older devices. It can take some time for Linux drivers for new hardware to become available, as the manufacturers concentrate on the bulk market of Windows. In practice, unless you have very new hardware, you will probably find that drivers included in the distribution will work, although they may not give the best possible performance from your hardware.

Task 3

During installation, you will be asked for a `root` password. In Linux (and Unix), `root` is the systems administrator login name. This user can do absolutely anything on the system, including read all files and delete the entire system if they wish. Obviously, it is important to have a secure password on `root`. You should only use `root` to do administrator tasks that require it.

You should also set up at least one normal user for standard use of the system.

Task 4

You will also be asked about network connections. Usually the defaults will work properly, but there may be some restrictions or particular values, such as IP addresses that your college requires you to use. Check with your tutor on this.

Task 5

Most distributions come with a range of applications for common tasks, often including OpenOffice or similar. Install these applications.

Task 6

At the end of this lab session, you should have a Linux system that does the following:

1. Boots into Linux when selected from the boot menu.
2. Has a normal user and the root user setup with suitable passwords (which you must document).
3. Handles all the hardware in the PC properly.
4. Has networking setup sufficiently to talk to the Internet, i.e. Firefox must be able to reach an external website such as www.google.com.

Task 7

Using the virtual machine software that you looked at in Topic 5, or by repeating the installation lab session task above and overwriting the previous Linux version if you do not have much disk space, install a different distribution. If a number of PCs are available, you can also set up different distributions on different machines to allow side-by-side comparisons.

Try to find distributions that are significantly different from the first one you used.

Task 8

If anyone in the class has a different operating system available, arrange to demonstrate it to the class. This may include iOS on an iPhone or iPad, or an Android device. You could also try to find old MS-DOS systems or Windows versions before 95. Demonstrations can be done whilst you are waiting for Linux to actually install.

IMPORTANT NOTE

As with the previous lab session, a significant amount of time will be taken up waiting for Linux to install. Use this time to demonstrate other systems.

6.6 Private Study Exercises

Exercise 1

Follow up the lecture material, making sure that you understand it all. Search the Internet for more details on the topics covered. In particular, find out about other operating systems, both current and historical.

Exercise 2

Using the notes you took in the laboratory sessions, write your lab report documenting the installation of Linux on this hardware.

Exercise 3

Use the Internet to track down alternative distributions of Linux. Make notes on what is available and which distributions are aimed at which markets. You should identify at least three distributions other than those used in the laboratory sessions. Try to make them as different as possible.



Topic 7: System Testing

7.1 Learning Outcomes

On completion of this topic, you will be able to:

- Test and document a computer system:
 - Explain the purpose of testing and fault diagnosis;
 - Outline the key steps in fault diagnosis;
 - Produce a basic test plan.
- Diagnose and repair basic hardware faults on PCs:
 - Follow a standard series of steps to identify and repair common, simple hardware faults on PCs;
 - Document the diagnosis and repair.

7.2 Notes to Teachers and Students

This topic will cover the following:

- Test plan
- Test documentation
- Fault detection, diagnostics, troubleshooting
- Technical support
- Test hardware and software
- Repair
- Fault diagnosis exercises

7.3 Timings

The approximate amount of time that you can expect to spend on each type of activity in this topic is as follows:

Lectures:	2 hour
Laboratory Sessions:	3 hours
Private Study:	7.5 hours

7.4 Lecture Notes

This topic focuses on hardware testing and repair. Your lecturer will outline the concepts of testing and discuss a number of approaches to fault diagnosis and repair.

In discussions, it will be helpful to share examples of hardware faults, saying how they presented and what you needed to do to repair them. These can come from your own experience as well as from college.

Test plans are an important tool to ensure that all aspects of the system are working. IEEE 829 is a complex test plan scheme that covers very large projects. There is plenty of documentation on the web (search for it). You can also use it as a starting point for a simpler plan for PC fault diagnosis.

Most websites on PC hardware repair are either very general, giving the basic steps covered in the lecture, or very specific, covering particular faults with particular devices. It is worth reading some of the general sites to widen your understanding of the systematic test and diagnosis procedures. The device specific information is much more helpful when you have a particular fault to resolve.

Sites on building PCs are also helpful on testing. For example, this page discusses final checks before powering up, which would apply to a repaired systems as well as a new one:

<http://www.hardwarezone.com.au/reviews/view.php?id=2894&cid=19&pg=20>

Many fault finding guides are available from suppliers. See http://www.pennylane.co.uk/computers_pcs_faults_ipswich_suffolk.html for an example.

For information on particular faults, search the actual fault, e.g. “noisy fan on nvidia 9300” to see if it is a common problem and if there is a well known fix.

IMPORTANT NOTES

Fault finding and repair becomes easier the more you do. Experience is very valuable in this area. With experience, you will be able to diagnose many faults over the phone without even looking at the PC. Of course, you may still have to go to the PC to repair it, but at least you can take the right components.

To help build this experience, document the repairs you do. It will help you remember the common ones and may also help you solve problems that do not come up often.

Remember to ***back up the data first.***

7.5 Laboratory Sessions

Task 1

You will be supplied with PCs that are not working. The task is to identify the faults and repair them. The exact faults and how many PCs there are to repair will depend on the facilities at your college. For each system, you need to take notes as you work, so that you can write a report.

Task 2

For each faulty PC, try to power it up and make notes on what happens.

Task 3

Depending on the faults you see, go through the easy checks on this PC first:

- Are all the cables connected correctly?
- Is there any power on the PC at all (indicator lights for example)?
- Is the monitor switched on? (This is a much more common “fault” than you might think.)

Task 4

Now look at the next easiest stage:

- Swap cables with known good ones, depending on the fault.
- Try a different (known good) monitor on this PC and try a different (known good) PC on this monitor.
- If it is a network problem, are other machines still working correctly?

Task 5

Once you have checked the easy stuff, you can take the lid off and do internal checks.

Remember health and safety!

- Check for loose connectors or cables inside the PC.
- Check for loose cards (graphics, expansion, memory).
- Check that all the components are actually there – graphics cards are expensive and so is memory – they sometimes get stolen!

Task 6

Assuming the PC is still not working, or you have not found a fault yet, start substituting components, depending on the fault. You will need a supply of known good items for this.

Task 7

Once you have solved the problem, re-assemble the PC and test it. Then document your repair in detail.

7.6 Private Study Exercises

Exercise 1: Lecture Follow Up

Follow up on the activities identified in the lecture slides. In particular, follow the links on the slides to get more details on the examples given.

Exercise 2: Laboratory Session Write Up

Using the information gathered in the laboratory sessions, finish your documentation of the PC repairs.

Exercise 3: IEEE 829 Test Plan Writing

Write an IEEE 829 test plan for a newly built PC. Follow the headings given in Slide 9 and fill in all the appropriate information in each section. Then compare your plan with the example given in the Slide 10 link.

Exercise 4: IEEE 829 Test Plan Testing

Even test plans need testing!

Swap your test plan from Exercise 3 with another student's plan. You can then try their test plan and they can try yours. Get feedback on your plan and use this to improve your test plan.



Topic 8: Software Maintenance

8.1 Learning Outcomes

On completion of this topic, you will be able to:

- Perform routine maintenance tasks on a computer system:
 - Update software manually and configure automatic software updates;
 - Defragment and clean up a disk.
- Upgrade the hardware and software on a computer system:
 - Perform an upgrade on a current software package or operating system.

8.2 Notes to Teachers and Students

This topic will cover the following:

- Software problems
- Automatic updates
- Upgrades
- Utility software
- Security software
- Scheduling maintenance
- Windows update exercise
- Package update exercise
- Driver update exercise

8.3 Timings

The approximate amount of time that you can expect to spend on each type of activity in this topic is as follows:

Lectures:	2 hours
Laboratory Sessions:	3 hours
Private Study:	7.5 hours

8.4 Lecture Notes

This topic focuses on software maintenance. Your lecturer will outline the concepts of software maintenance and discuss a number of approaches to maintaining, updating and upgrading software.

In discussions, it will be helpful to share examples of software updates and upgrades that you have done, saying why you did them, how you knew they were available and discussing any issues that you had either before the update, leading you to do it, or after the update. These can come from your own experience as well as from college.

It will be particularly helpful to discuss the automatic update facilities provided in Windows and with some packages. Think about how they work, when they actually do the updates and whether you should have option of delaying or rejecting an update.

Many updates may be released to fix problems that you do not have on your particular system. Should you still install those updates?

Why is it important to install security updates, even if you have not yet had the problem to which they refer?

You should also discuss the impact of updates and upgrades on your own work, in college and outside.

IMPORTANT NOTES

Make sure you **back up data**.

Even the biggest manufacturers occasionally release faulty updates that can cause many more problems than they solve.

If your software licences are not genuine, up-to-date and fully paid for, you may find that automatic and/or manual updates fail, leaving your system inoperable.

8.5 Laboratory Sessions

This session involves updating software. Your PC should have a clean installation of Windows installed from the CD/DVD. If not, then do a clean installation first, like we did in Topic 5.

During the activities, take screen shots to record the required information and keep notes for use in your report.

Task 1

Run a Windows Update. The way to do this depends on the version of Windows you are running. In Windows Vista and 7, go to the Control Panel and select Windows Update. On Windows XP, you need to visit the Windows Update website, which you can get to by opening Control Panel, selecting Automatic Updates and clicking on the link to the Windows Updates Website.

Whichever system you are using, you will (eventually) get a list of available updates. If your original installation was done with a fairly old CD/DVD, this may be a very long list!

Select a small number of items (NOT driver updates) from the list and select install. There is no need to do the whole list for this lab task, as it could literally take all day!

Task 2

Identify any software package on your system. You probably need to be using an Open Source package for this task, so a web browser like Mozilla Firefox or Google Chrome (but not Internet Explorer) is a good example to use. Using the Help, About menu, identify the version that is running. Now via the Internet find the manufacturer's website and update the software. Check using Help, About that you have updated.

Task 3

Identify the key components in your system. The graphics card is probably the best example to use. Check using the device driver information via the Device Manager which version of the drivers is running. From the manufacturer's website, download and install the latest version of the drivers for your device. You may need to reboot after installation. Now use Device Manager again to check that you have updated drivers running.

If your machine will not boot after the driver update, use the boot options to boot with "last known good" settings, or to boot into "safe mode". If you are not familiar with these terms, search the Internet.

Task 4

Write up your lab report as usual, including the screen shots taken during the updates. Document any problems that you had, including issues finding updates, problems with the installation or any issues that the update caused later.

8.6 Private Study Exercises

Exercise 1

Follow up the material covered in the lecture. In particular, make sure that you understand how Windows Update and other automatic update systems work.

You should also search for maintenance utilities such as disk defragmentation and cleanup tools.

Exercise 2

Using the information and screen shots gathered in the laboratory sessions, complete your report.

Exercise 3

If you have computer systems at home, check that they are up-to-date with patches and updates for all the software installed.

Exercise 4

If you have a smartphone, remember that it is also a computer with an operating system and application software installed. Find out how to check and update your smartphone software.

Exercise 5

Updates apply to any computer based system. Even devices like personal video recorders (PVRs) and digital televisions have software that may need updating. Look into how this is done and check whether any other computer-based systems you own are up-to-date.

IMPORTANT NOTE

As discussed in the lecture, updating software can cause new problems, so make sure that you know what you are doing!



Topic 9: Hardware Maintenance

9.1 Learning Outcomes

On completion of this topic, you will be able to:

- Perform routine maintenance tasks on a computer system:
 - Clean a computer system.
- Upgrade the hardware and software on a computer system:
 - Perform an upgrade to the hardware of a system.

9.2 Notes to Teachers and Students

This topic will cover:

- Preventative maintenance
- Upgrade vs. replace
- Hardware upgrade
- Priorities
- Internal components
- Peripherals
- Hardware upgrade exercises – some of:
 - Memory update
 - Graphics upgrade
 - Hard disk upgrade
 - Add a second NIC

9.3 Timings

The approximate amount of time that you can expect to spend on each type of activity in this topic is as follows:

Lectures:	2 hours
Laboratory Sessions:	3 hours
Private Study:	7.5 hours

9.4 Lecture Notes

This topic focuses on hardware maintenance. Your lecturer will outline the concepts of hardware maintenance and discuss a number of approaches to maintaining and upgrading hardware.

In discussions, it will be helpful to share examples of hardware upgrades that you have done, saying why you did them and discussing any issues that you had either before the upgrade, leading you to do it, or after the upgrade. These can come from your own experience as well as from college.

It will be particularly helpful to discuss why you chose to upgrade the specific items (RAM, graphics etc.) and whether the upgrade was successful in improving the system's performance.

You should also discuss the most effective upgrades that could be done to college computer systems.

IMPORTANT NOTES

Make sure you **back up data**.

This applies just as much to hardware upgrades as it does to software. Whilst it is obvious if you are replacing a hard disk, even changing a graphics card or putting in more memory can cause problems. For example, you may disturb the power cable to the disk, leaving it loose. This could cause a power surge when the system is switched on which damages the disk and causes data loss.

If you are upgrading hard disks, be careful how you dispose of the old drives. There may be valuable or confidential data on the old disk, so use a proper security package to wipe the disk by overwriting if you plan to use the disk again. If the disk is not to be used again, have it securely destroyed, usually by physically crushing it.

9.5 Laboratory Sessions

In this session, the actual upgrade(s) you do will be largely dependant on the hardware available. The process is more important than the resulting improvement in the systems performance. In fact, the same principles and learning can actually be achieved by “downgrading”, i.e. replacing a better component with a worse one or removing some RAM. We are more concerned here with the process of removing a component and replacing it with another. You would not normally do this unless you were upgrading or repairing the machine, but the practice is a valuable aid to learning.

As usual, make notes as you do the tasks. If you have a camera available, take photos to show the stages.

Task 1: Health & Safety

We shall be taking the PC apart (again), so remember all the health & safety material covered in previous topics.

Task 2: Identification

Identify the components available for this laboratory session. In a normal upgrade, you would have to select and purchase the new components, but for this session, they are already supplied. Make sure you know which components you are to replace. Check that you have the correct version for your PC. E.g. is the graphics card AGP or PCIe? Which type of DIMM memory do you need for your motherboard? Which interface does your hard disk use?

Task 3: Drivers

Before you take anything apart, make sure that you have the correct drivers for the new hardware. This is particularly important if you are upgrading the machine you need to access the Internet. If you take it apart and install new components before you have downloaded the drivers, you may not be able to access the Internet at all to get the drivers later.

Task 4: Dismantle

Take the PC apart as much as required to do the upgrade. This will certainly mean taking the lid off the case. It may also include removing some other components. E.g. it is common to have to disconnect some cables or even remove hard disk carriers to get to the memory slots. Try to not remove anything you do not need to, as the more you disturb, the higher the chance of a fault being introduced.

Task 5: Remove the Old Component (if applicable)

If you are upgrading memory by putting in more RAM, you will have nothing to remove. However, if all the DIMM slots are full, you may be replacing some of the DIMMs with higher capacity modules. Graphics card upgrades will mean removing the old card. Hard disk upgrades may be replacing the old disk or fitting an extra one. If you are replacing a hard disk, remember to transfer the data from the old disk to the new one.

Label the old components clearly, particularly noting whether they still work or not. Then put them safely to one side.

Task 6: Installing New Components

Check the packaging and instructions to see if there are any special instructions with the new component. Then install it, following any instructions provided.

Task 7: Check the Rest of the Machine

Whilst you have the machine open, check the rest of it. Are all the cards and cables connected properly? Does it need cleaning out? Are all the cable runs tidy and clear from key components?

Task 8: Re-Assembly

Put the machine back together and secure the lid.

Task 9: Initial Testing

Power up the system and make sure it boots. You may have to install new drivers.

Task 10: Installing New Drivers

Using the drivers that came with the new device, or ones downloaded from the Internet, update the software on the PC.

Task 11: Systems Test

Test the system fully to make sure that the upgraded device is working and that the rest of the computer also functions correctly.

Task 12

Document the upgrade you have performed. This should include noting the identification information for the PC (which may be a serial number or a systems id added by your college), a note of what was removed (if anything) and what was added. This should be in detail with make, model, version, serial number and date. Also note the driver version installed.

Task 13

Write up your lab report as usual, including the photos taken during the upgrade. Document any problems that you had, including issues finding drivers, problems with the installation or any issues that the upgrade caused later.

9.6 Private Study Exercises

Exercise 1

Follow up on the material covered in the lecture. In particular, make sure that you understand when to upgrade and when to replace. You should also be clear about the benefits of different upgrades and the appropriate priorities of each.

Exercise 2

Using the information and photos gathered in the laboratory sessions, complete your report.

Exercise 3

For other PCs you use in your centre and for any you have at home, identify appropriate upgrades and note how much they will cost and what benefits they may bring. Draft a report of your findings.

Exercise 4

By looking at prices for components and full systems, work out the point at which you should replace a system, i.e. how much upgrading can you do before it becomes more cost effective to just buy a new system. This can be discussed in class.

Exercise 5

Identify different types of user within your college, based on their computing needs. From this, work out an upgrade path whereby new PCs are provided for the highest demand users and older PCs are upgraded if necessary and cascaded down to users with less demanding tasks, in PC terms.



Topic 10: File Management

10.1 Learning Outcomes

On completion of this topic, you will be able to:

- Perform routine maintenance tasks on a computer system:
 - Identify a number of common file systems;
 - Explain the different file systems used by common operating systems;
 - Manage file storage on a common operating system.

10.2 Notes to Teachers and Students

This topic will cover the following:

- File systems operation and organisation:
 - FAT, NTFS, ext
 - Directories/folders
 - Security, sharing and access rights
- Data Protection:
 - Backup
 - File/folder organisation
- Windows file management exercises

10.3 Timings

The approximate amount of time that you can expect to spend on each type of activity in this topic is as follows:

Lectures:	2 hours
Laboratory Sessions:	3 hours
Private Study:	7.5 hours

10.4 Lecture Notes

This topic covers the way that computers organise disk storage. Most modern computers have a large amount of storage space and hold many files. This requires sophisticated software (built into the operating system) to manage the space and control access to the files.

In this topic we give an overview of some of the main file systems, covering which operating systems use them and a brief guide to some of their features. This is an extremely large area and we only have time to do a brief introduction. There is a vast amount of information available on the Internet at all levels from basic user tutorials to detailed discussions on how each system works. It is up to you to follow up most of the technical issues.

IMPORTANT NOTES

It is possible to convert between file systems but the risks are high. Should there be a power cut or some other issue half way through, you may lose all the data on the disk. In general, it is better to take a copy of everything on the disk, reformat the disk to the new system and then restore the data.

Although there are packages that let operating systems read and write other file systems, in general this is less reliable than using native file systems and may lead to corruption of data. It is recommended that each operating system uses its own native file system and if you need to move data between systems, you do it either via a network share or using memory sticks formatted to FAT.

10.5 Laboratory Sessions

File handling and directory management are so fundamental to driving an operating system that you probably have significant experience already in handling Windows files and folders. Therefore, this laboratory session gives you a number of tasks to perform without saying how you should do them. If you do not know how to do these tasks, then look them up. When a new version of Windows comes out, everyone has to learn how to use the new features and you need to be confident not only with the current systems, but also in learning how to use new ones.

Throughout this session, take screen shots as you do each task so that you can write your report.

Task 1

Using Windows Explorer (the normal file handling utility), find out and make a note of the organisation of the disk space on your machine, including which disks are available and the structure of the folders on each disk. Take screen shots to support your notes. Remember that ALT/PrintScreen (i.e. hold down the ALT key and press PrintScreen) will copy the currently active window to the clipboard, from where you can paste it into Word.

Task 2

In a folder where you have write access, create a new folder. Within that folder, create new document files for use with Notepad and with one of the packages available on your system. Give all of these items sensible names that clearly say what they contain.

Task 3

Rename the folder you created and the files in that folder.

Task 4

Copy your folder to a USB memory stick or to a different folder or disk if you do not have a memory stick.

Task 5

Safely remove your memory stick from the PC.

Task 6

Delete the files from the original folder.

Task 7

Empty the Recycle Bin.

Task 8

Restore the files from your memory stick or other backup copy.

Task 9

In Windows Explorer, go to the root of the drive which holds your files and use the search facility to find your files.

Task 10

Change the Folder Options so that systems files and hidden files are visible. Now have a look at the desktop. What do you notice?

Task 11

Also within Folder Options, change the setting so that file extensions are shown.

Task 12

Change the view to show file details. Now sort the file list be in date order.

Task 13

Tidy up the system to remove all the files and folders you created in this lab session.

Task 14

Repeat the lab exercises on a Linux system and compare the two operating systems for these tasks.

Task 15

Since you have probably done all these tasks using the GUI, try repeating them all on Windows, using the Command Prompt, and on Linux, using the shell.

IMPORTANT NOTES

You may be able to complete tasks 1-13 very quickly if you are used to using Windows. In this case, spend your time exploring the file management tools in Linux and from the command line in both Windows and Linux.

10.6 Private Study Exercises

Exercise 1

Follow up the material covered in the lecture. Make sure you understand which operating systems use which file systems, and which can read and write other systems.

You should also search for more detailed information on the operation of the file systems discussed.

Exercise 2

Using the information and screen shots gathered in the laboratory sessions, complete your report on the lab activities. This should cover the disk organisation from Task 1 and provide a user guide on how to manage files and folders.

Exercise 3

Find something new about Windows. This is a challenge. Search the Internet to find out something you did not already know about driving Windows. It does not have to be related to file handling; any topic will do. In your next class, as a whole group, compile a list of things that you found out and share them, so that everyone benefits from everyone else's searches. As a bigger challenge, try to find out something that your lecturer did not know!



Topic 11: Needs Analysis

11.1 Learning Outcomes

On completion of this topic, you will be able to:

- Produce a system design specification to meet a client's needs:
 - Determine and evaluate client and systems requirements;
 - Apply appropriate systems analysis techniques to determining systems requirements;
 - Determine functional requirements of a system, taking into account timescales, costs and resources.

11.2 Notes to Teachers and Students

This topic will cover the following:

- Client and system requirements:
 - Investigation/analytical techniques
 - Problems/limitations with current/new system
 - Functionality, costs, timescales, resources
- Introduction to a case study
- Needs analysis exercise

11.3 Timings

The approximate amount of time that you can expect to spend on each type of activity in this topic is as follows:

Lectures:	2 hours
Laboratory Sessions:	3 hours
Private Study:	7.5 hours

11.4 Lecture Notes

11.4.1 Needs Analysis Lecture

This topic has one section, which is Needs Analysis. Your lecturer will outline the topic and discuss various aspects of determining the needs of a new computer system.

If you have experience of specifying new computer systems, you can contribute your examples to the class discussion.

11.4.2 Additional Notes

Some of the slides for this topic only include lists of key points, in order to keep the contents of each slide to a readable size and quantity. Below is additional information that will be covered in explaining each key point.

Slides 4-5: Systems Development Life Cycle

- **Initiation** - this stage is concerned with the development of an initial idea that attempts to solve a specific problem to a project that will lead to the development of a system.
- **System concept development** - this stage becomes more involved in the development of a feasibility study, ensuring that cost benefit analysis, risk analysis, contingency planning and strategic planning have taken place.
- **Planning** - this stage offers an opportunity for a more detailed project plan and setting the specific aims and objectives for the system development project. The main documentation that is used throughout the management of the project is prepared during this stage.
- **Requirements analysis** - this stage provides a detailed assessment of the user requirements and any needs of system stakeholders.
- **Design** - this stage provides an opportunity to create detailed system designs according to the identified requirements. The designs can then be used as blue prints for the system architects to decide how the development stage takes place.
- **Development** - this stage is based on the detailed design and ensures that the system is coded accordingly, adhering to system development principles, following good design rules.
- **Integration and testing** - this is a stage focusing on quality assurance, providing sufficient time to test different components, deal with installation issues and check whether sub-systems communicate according to plan.
- **Implementation** - this stage deals with coding and production activities.
- **Maintenance (operational stage)** - this stage is entered once the system is implemented and installed and deals with troubleshooting, incremental development of additional functionality and perhaps alignment to changing user requirements.
- **Termination** - this stage is only entered when the system becomes obsolete and phasing out is required, usually involving hand over activities and perhaps the identification of alternative solutions.

Slides 6-7: Project Management Phases

- **Planning** - ensuring customer needs are identified and setting the scene for the project aims and objectives.
- **Implementation** - producing the required artefacts of services that will form the operational element of the project and ensure the customer needs are met.
- **Delivery** - delivering the project output that may be in the form of an interim prototype, a final product or a continuously evolving service.
- **Support** - offering continuous support to customers, ensuring the project remains viable and it is possible to expand in the future to a family of products or services.
- **Monitoring** - observing how the deliverables survive the operational stage and making sure after care is adequate.

Slide 9: Requirements Elicitation

- **Unclear mission** - when the system objectives have not been identified properly or remain unclear. The aim of the project is not specific enough, and therefore the design and specification attempts are not properly set out.
- **Misalignment of understanding and different agendas** - it is quite often the case for the requirements seeker to be on a different page from those who hold the information necessary to identify the requirements. It is important to share a common understanding and goals when collecting the requirements for the computer system that is to be designed.
- **Changing requirements** - with the continuous developments in technology and latest advances of information systems and the computer industry, it is expected that larger and longer projects fail to meet the user requirements as these may change during the project.
- **Understanding (or otherwise) of technology** – different stakeholders will have different levels of understanding about what technology is available and what it will do. This can lead to unrealistic expectations of the new system if people think that technology can solve all their business problems. It can also lead to a limited view of potential if a technology exists that can help, but stakeholders do not know or understand its capabilities.

IMPORTANT NOTES

Establishing the needs of a system is a complex topic and entire modules can be devoted to it. This topic only provides an overview and gives you a starting point to help you determine the systems requirements in the context of computer technology.

Further information may of course be found online and there may be other modules on systems analysis within your course. Check with your tutor.

11.5 Laboratory Sessions

This laboratory session is somewhat different from previous topics. Rather than having hands on practical work with PCs, you have a case study to undertake, covering both this topic and the next one.

The case study will be introduced to you by your lecturer, who will discuss the scenario and will act as the customer for the remainder of the case study exercise. You are required to produce a report that satisfies the task given.

Please note that the hotel used in this case study is fictional. The rest of the information in the case study is factually correct, but the hotel, as described in the scenario, does not exist.

11.5.1 Case Study

Scenario

The Muckle Flugga Hotel is a country house hotel on the remote island of Unst, one of the Shetland Isles off the north east coast of Scotland. (More information on the Shetland Isle can be found online, e.g. the tourist board site www.visitshetland.com and their location can be seen on Google Maps maps.google.com by entering "Shetland Isles, United Kingdom" in the search box). The hotel justifiably claims to be the most northerly hotel in the British Isles. It has 30 rooms and its client base is a mixture of holiday makers (mainly walkers and wildlife enthusiasts coming to see the vast sea bird colonies – guided by hotel staff) and business people working at the nearby Saxa Vord oil terminal.

The Shetland Isles has recently upgraded its Internet facilities by connecting in to the main fibre optic feed which connects Iceland and the Faroe Islands to the UK. An Internet search should enable you to get more background information on the nature of this upgrade, but one possible article you may wish to read is the following from 20 April 2011:

<http://www.shetnews.co.uk/component/content/article/36-latest-new/327-superfast-broadband-will-change-isles-fate.html>.

The hotel wishes to take advantage of the new high speed (20Mbps) connection, but to do so they need to upgrade their facilities. They want to host their own website which will provide both a standard hotel website with tourist information for public access, and extra facilities on an intranet for the hotel staff and customers. The hotel has come to an arrangement with a major mobile phone company to host a mast on top of their building, which will provide 3G coverage across much of the island of Unst. (The details of the mobile phone mast are outside the scope of this case study.)

Task

The hotel has asked you to specify the hardware and software that they should purchase to satisfy the following criteria:

- a. A server capable of both hosting their public website and intranet, as well as being used within the hotel for file and printer sharing.
- b. A number of identical desktop systems to be used by hotel staff for standard office applications and the reception desk.
- c. A number of identical mobile phone systems for use by hotel staff when out on the island away from the hotel.

- d. Since the hotel is in a remote area where there are not entertainment facilities nearby, the hotel hosts entertainment events for the local people, such as wildlife talks and a weekly cinema showing. Therefore, they need a system that can be used for presentations and DVD screenings.
- e. The hotel has many clients who are keen photographers and so they would like to provide suitable facilities for these customers to process, store and print their photographs, either in the evening or on days when the weather is unsuitable for outdoor activity.

For each of these requirements, you should identify the specifications needed for both hardware (system and peripherals) and software in detail. In Topic 12, you will need to identify specific products that match the specification you have given and include where on the Internet they may be bought (there are no large shops in Shetland that could supply this type of equipment, so online suppliers should be used), and the price. You should give at least two purchase options for each system, with an evaluation of each choice related to the hotel's requirements. The hotel is in the UK, so prices and suppliers should be UK based. This task should be written as a formal report and addressed to the hotel manager, who has been using PCs and the Internet for a number of years. You do not need to explain standard terms, but you do need to justify the specific equipment you suggest.

For this topic, you are required to identify the needs of the hotel in terms of computer systems functionality. Remember that this is what they need the systems to do, not which systems to buy (that comes in the next topic). You should use the requirements documentation template discussed in the lecture and available at:

www.stanford.edu/dept/its/projects/PMO/files/linked_files/templates/requirements_document.doc

11.6 Private Study Exercises

Exercise 1: Lecture Follow Up

Follow up on the material covered in the lecture. In particular, look up different systems development life cycle (SDLC) methodologies and determine which may be appropriate to determining the computer systems requirements for the case study.

Exercise 2: Case Study Follow Up

Look up further information about the Shetland Isles on the Internet. In order to understand the case study and properly specify systems to meet the hotel's requirements, you will need to appreciate the location and environment in which the hotel is situated. For example, the nearest large city is Aberdeen (in Scotland) or Bergen (in Norway), both of which are a 12-hour ferry crossings away. Do some background reading to support your understanding of the case study scenario.

Exercise 3: Case Study Report (Part 1)

Complete this topic's part of the case study by documenting the requirements of the hotel in a suitable format. This will form part of your final report to the hotel, to be completed in the next topic.



Topic 12: Systems Specification and Selection

12.1 Learning Outcomes

On completion of this topic, you will be able to:

- Produce a system design specification to meet a client's needs:
 - Determine and evaluate client and systems requirements;
 - Determine appropriate systems specifications based on client requirements;
 - Select appropriate hardware and software to meet systems specifications.
- Evaluate the suitability of a system design specification:
 - Match hardware and software specifications to user requirements;
 - Offer alternative systems solutions, select appropriately from these alternatives and justify the selection.
- Build and configure a computer system to meet a design specification:
 - Provide instructions on how to assemble a system.

12.2 Notes to Teachers and Students

This topic will cover the following:

- Selection criteria
- System integration
- Accessibility
- Alternative solutions
- Identification, selection & justification
- Matching client requirements and system requirements with system components
- Systems options
- Off the shelf, self build, customise
- Alternatives
- System documentation
- Case study – selection & specification

12.3 Timings

The approximate amount of time that you can expect to spend on each type of activity in this topic is as follows:

Lectures: 2 hours

Laboratory Sessions: 3 hours

Private Study: 7.5 hours

12.4 Lecture Notes

This final topic discusses the selection and specification of computer systems to meet the requirements determined in the previous topic. Your lecturer will outline issues relating to the selection of computer systems to meet the various needs that have been determined using the techniques discussed in the previous topic.

As usual, you should share your own experiences relating to systems selection.

Note that when selecting a computer system to meet a particular set of requirements, there is usually more than one valid answer. There will be many systems that will meet the needs and there may be a significant number that satisfy all the requirements to the same degree. Often, final choice of system is based on less technical issues such as delivery time, proximity of a suitable dealer or shop, reputation or personal experience of the manufacturer or product. There is no single “right” answer but there may be many valid solutions.

It is important to document your decisions. In particular you need to be able to explain why you have selected particular products. This justification should be based on meeting the requirements.

IMPORTANT NOTES

You will need to do considerable research on the Internet to find out what computer systems and software are currently available in your area. Some suppliers operate internationally (such as Dell, www.dell.com) but there are also local suppliers that only operate in one country, or even in one town. Whilst you may get a lower initial price from a large supplier, there are advantages in being able to talk to the person who built the system face-to-face.

12.5 Laboratory Sessions

This laboratory session is a continuation of the case study started during the previous topic. By now you should have determined the requirements of the hotel and completed the documentation on this. Your lecturer should have checked your requirements before you start this topic's tasks.

These tasks relate to the case study that was detailed in the previous topic. Please refer to Topic 11 for details of the case study.

Task 1

Based on the requirements you have already determined, produce systems specifications for the hotel's needs. Remember that at this stage, these are still generic specifications and should not identify particular products. That is the next step.

Task 2

Having identified the system specifications, identify two different products for each area that meet these specifications. You should try to offer alternatives that are significantly different if possible. For example, a desktop PC could be an Intel/Windows or an Apple Mac system. You need to provide exact product details, including suppliers, costs, exact configuration and options to be included. There needs to be enough detail to actually order the systems specified. The systems should be available in your location, either from a shop or by mail or Internet ordering and delivery. Information, such as costs and taxes should be in your local currency and terms.

Task 3

From the options you have offered in Task 2, select one solution for each area and justify that selection.

Task 4

Having taken delivery of the equipment you specified, the hotel has commissioned you to install the new facilities. Outline the procedures that you would undertake, from delivery of the boxes to the hotel to being ready to show the manager how to use the system. Be sure to cover not only the unpacking and setting up of the system, but also testing and health and safety considerations. To keep the case study manageable, you should only discuss the presentation/cinema system. This task should be presented as a step-by-step guide, supported by appropriate diagrams, photographs and screen shots showing the hardware, operating system and application software installation, configuration and testing.

Task 5

For this system, produce a user guide that will enable hotel staff to use this system to show a commercially produced DVD film. This guide should cover everything from switching on the equipment, through loading the DVD and running the film to shutting down at the end of the show. This should be in the format of a single sheet user guide for the use of hotel staff, who have some experience using a PC, but not with playing DVDs or using a projector.

12.6 Private Study Exercises

Exercise 1: Lecture Follow Up

Follow up on the material covered in the lecture. Look up alternative systems solutions, different from the normal Intel/Windows solutions, and research local and international suppliers for computer systems to see what is available to customers in your area.

Exercise 2: Case Study Report (Part 2)

Complete this topic's part of the case study by documenting the systems specifications and the particular products you are suggesting, recommending and justifying.

The final report should contain a complete set of documentation from the determination of requirements to the details required to order the equipment, as well as instructions on setting up the DVD system and using it.