



PDHonline Course L153 (5 PDH)

Geographic Information Systems (GIS) - Hardware and software in GIS

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Lecture 1 Content

□ **Geographic Information Systems (GIS)**

– Hardware and software in GIS

Following the course content description, we are going to look at basic hardware and software available in today's information technology (IT) because they contribute to the successful implementation of GIS.

** Note that this lecture series provides a brief overview of computer hardware and software so that students can have a basic understanding of how computers operate and this lecture will introduce some of the common computer terminologies. We are going to discuss them with the emphasis of being able to implement a GIS.

- Introduction**
- Understanding Computer Data**
- Computer Hardware**
 - **Central Processing Unit**
 - **Memory**
 - **Peripherals**

This is the “Introduction to GIS” series lecture 1 contents page. These are the topics which will be covered in this lecture.

❑ 1.0 Introduction

- **The environment in which a GIS operates is defined by:**

1. Hardware

- Refers to the computer machinery.
- This includes computers:
 - » Ranging from a stand-alone microcomputer to a large mainframe supporting many users; and
 - » And the devices for handling machinery input and output

2. Software

- Refers to the programs that tell the computer what to do; and
- The data the programs will use.

To be able to develop and use GIS, hardware and software is required. In the IT environment, the hardware includes the CPU, monitor, printers/plotters. The software refers to the operating systems, and application programs such as GIS programs, word processors, and other third party programs (which are also used in GIS programs). The choice of suitable hardware and software is needed in order to have an efficient GIS that is capable of running the GIS application in terms of suitable response time, adequate results, and such like.

❑ Understanding Computer Data

- **computer data is coded, manipulated and stored by use of an exclusive two-state condition**
- **in English such two-state forms of data can coded as:**
 - **1/0, yes/no, on/off, open/close, hole/nohole**
 - **And note that one of the two exclusive states always exist**

Data sets used in the computer are coded using an exclusive two-state condition. This is the simplistic understanding of how data is used. Examples of such two-state conditions are shown on the slide. The conditions shown represents where we are presently which is, using a set of 1's and 0's, to where we came from which was paper based with a set of "holes" and "no-holes" (when computer were first introduced). When comparing present day computers with early computers, one will certainly agree that there have been great improvements.

- **Computer files which contain data coded in ASCII are easily transferred and processed by different computers and programs.**
- **Such files are often called “ASCII” or “text” or “coded” files.**
- **ASCII characters are the dominant basis for communication between different systems, and communications with peripherals.**
- **Files which are not ASCII are often coded in “binary” and generally can be processed or understood only by specific programs.**

In today's IT world the Internet has certainly open up a new dimension of computing, which is (among others), the ability to perform shared computing over the Internet. To share data, a common format is sought and the basic common format is called ASCII. ASCII is a common computer file standard which is used to transfer data between computers. This is well known standard. The acronym ASCII spells out American Standard Code for Information Interchange which is a code for information exchange between computers made by different companies; a string of 7 binary digits represents each character; used in microcomputers.

❑ Computer Hardware

- Computers consist of several different hardware components:**

A. Central Processing Unit (CPU)

- the central processing unit is the essential component of a computer because it is the part that executes the programs and controls the operation of all the hardware**

Now we are going to look at some of the common hardware components of a computer. The most important is the Central Processing Unit (CPU). This is the main processing component of the computer. It is responsible for the operations of the computer with the programs and the other hardware which is connected to it. Over the past decade the progression of the CPU has been developing at a very fast rate, where presently, there are computers with multiple processing capabilities.

- **Powerful computers may have several processors handling different tasks, although there will be need to be one central processing unit controlling the flow of instructions and data through the subsidiary processors**
- **The CPUs of PCs running GIS applications are generally based on a series of processors or "chips" compliant with the x86 chip architecture originally developed by Intel® corporation with their 8086 microprocessor and subsequently adopted or emulated by companies such as AMD® and others**
- **Development in models use the 8 bit, 16 bit, 32 bit, 64 bit, and such like**
- **the Macintosh CPUs are based on a series of chips from Motorola**

Today's CPUs are multi processors and they are capable of performing multiple tasks at very high speeds. Macintosh CPUs are available however they are not supported by most of the popular GIS software vendors. Macintosh is mainly used by publishing organizations.

□ Memory:

- **The memory in a computer stores input for and output from the CPU, as well as, the instructions that are followed by the CPU**
- **The amount of memory is measured in bits, bytes, Kbytes (K, Kb, 10³ bytes), Megabytes (Mb, 10⁶ bytes) Gigabytes (Gb, 10⁹), Terabytes (Tb, 10¹²)**

Memory is critical for the running of computer programs in particular, high demanding computers that does high-end data processing. Enough memory is needed to store all of the instructions provided by the software program and in addition, the data sets which are the input into the program. All programs have a minimum specification in order for them to be executed. Today's computer memory is in its gigabytes and terabytes capability.

– There are three types of memory:

1. *Main Memory*

- also called internal or primary memory**
- it is essential for the operation of the computer, all data and instructions must be in main memory first before it can be processed by the computer**
- most costly memory**
- in the form of microchips integrated with the computer's central processor**
- fastest access - any byte can be accessed equally rapidly (random access, hence it is called RAM)**

The main memory is the memory which is referred to as RAM. Random Access Memory (RAM) provides space for your computer to read and write data accessed by the CPU. RAM is relatively, very expensive memory because it is the memory which is required to run the application programs, operating system, and the data sets for the programs.

2. *Temporary Memory*

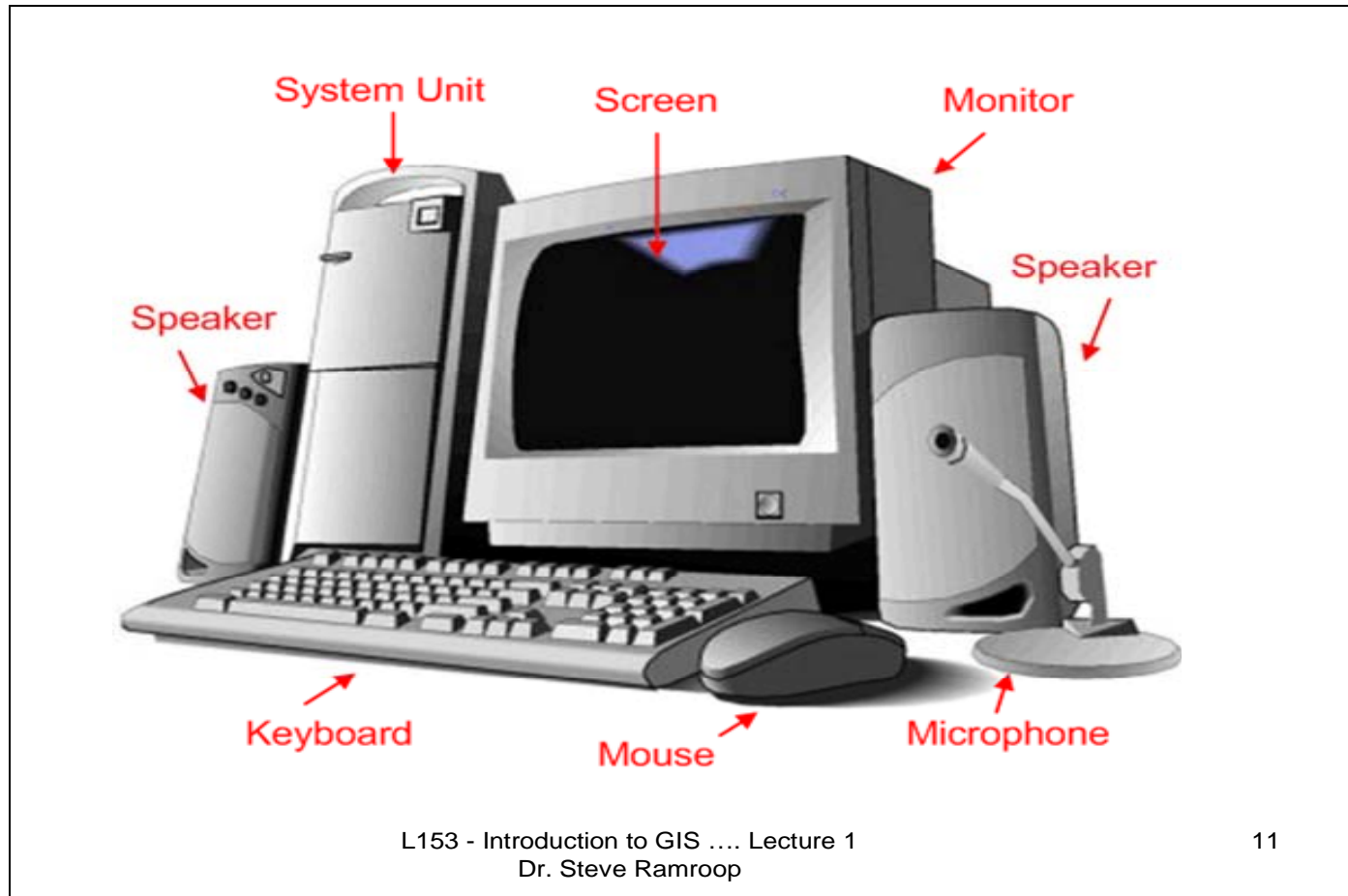
- **since data and instructions are stored in main memory as electrical voltages, power failures cause loss of all data in main memory**
- **ranges from several hundred Kbytes for a typical PC to many gigabytes for mainframes**

3. *Secondary Memory*

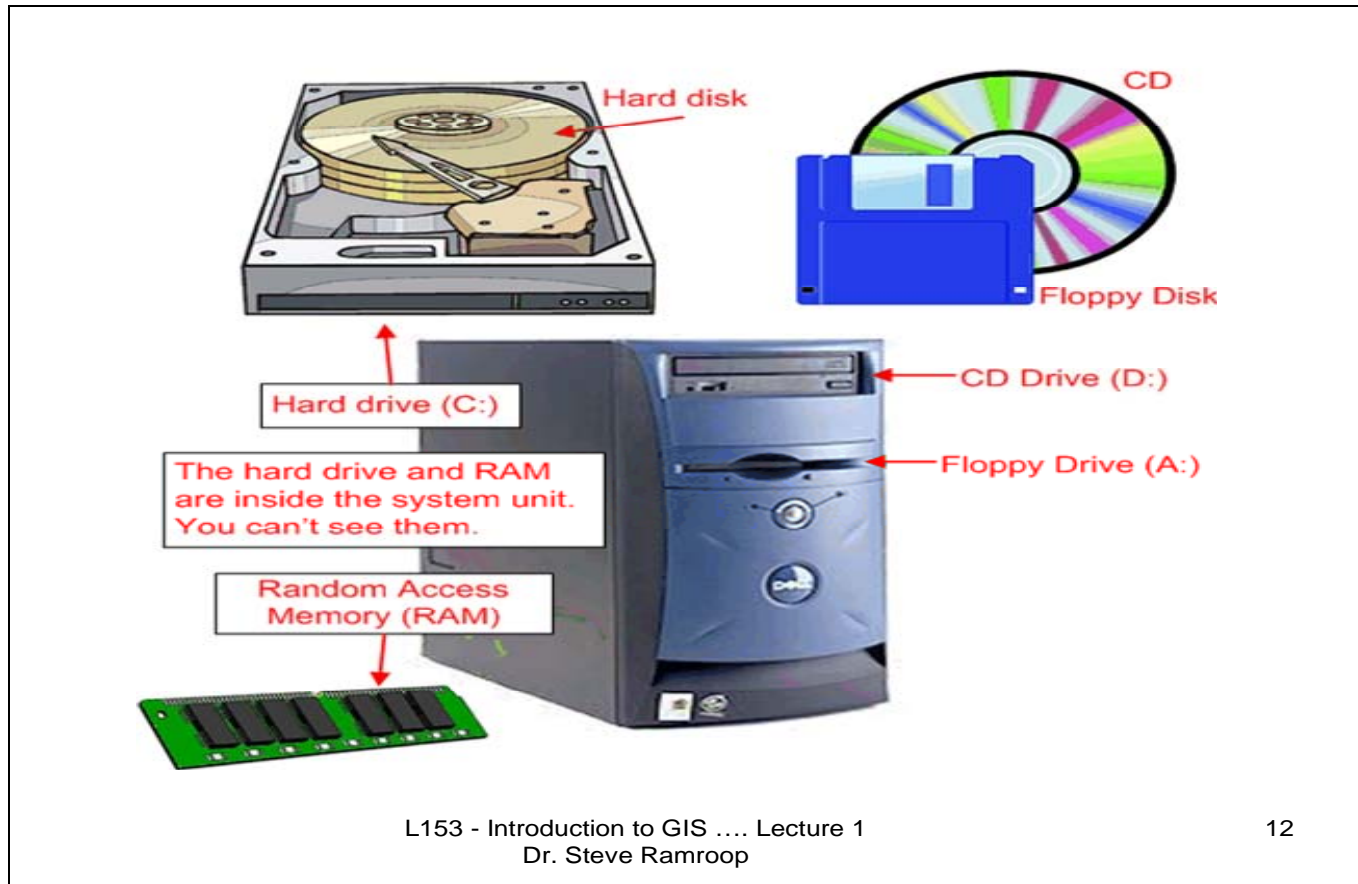
- **used for large permanent or semi-permanent files**
- **GIS programs and data generally require very large amounts of storage**

The temporary memory is the memory typically called cache which is important for the recovery of the computer, in cases when the computer hangs or there is a power failure. The CPU uses cache memory to store instructions that are repeatedly required to run programs, improving overall system speed.

The secondary memory refers to the hard drives. This is where the programs and data sets are stored permanently (until they are removed).



The slide shows some of the common components of the computer, (desk top model). In terms of GIS usage, the interaction with the computer is achieved using the keyboard, mouse and the microphone, while the results from the interaction is seen on the monitor and heard through the speaker. The system unit is the CPU as discussed in previous slides.



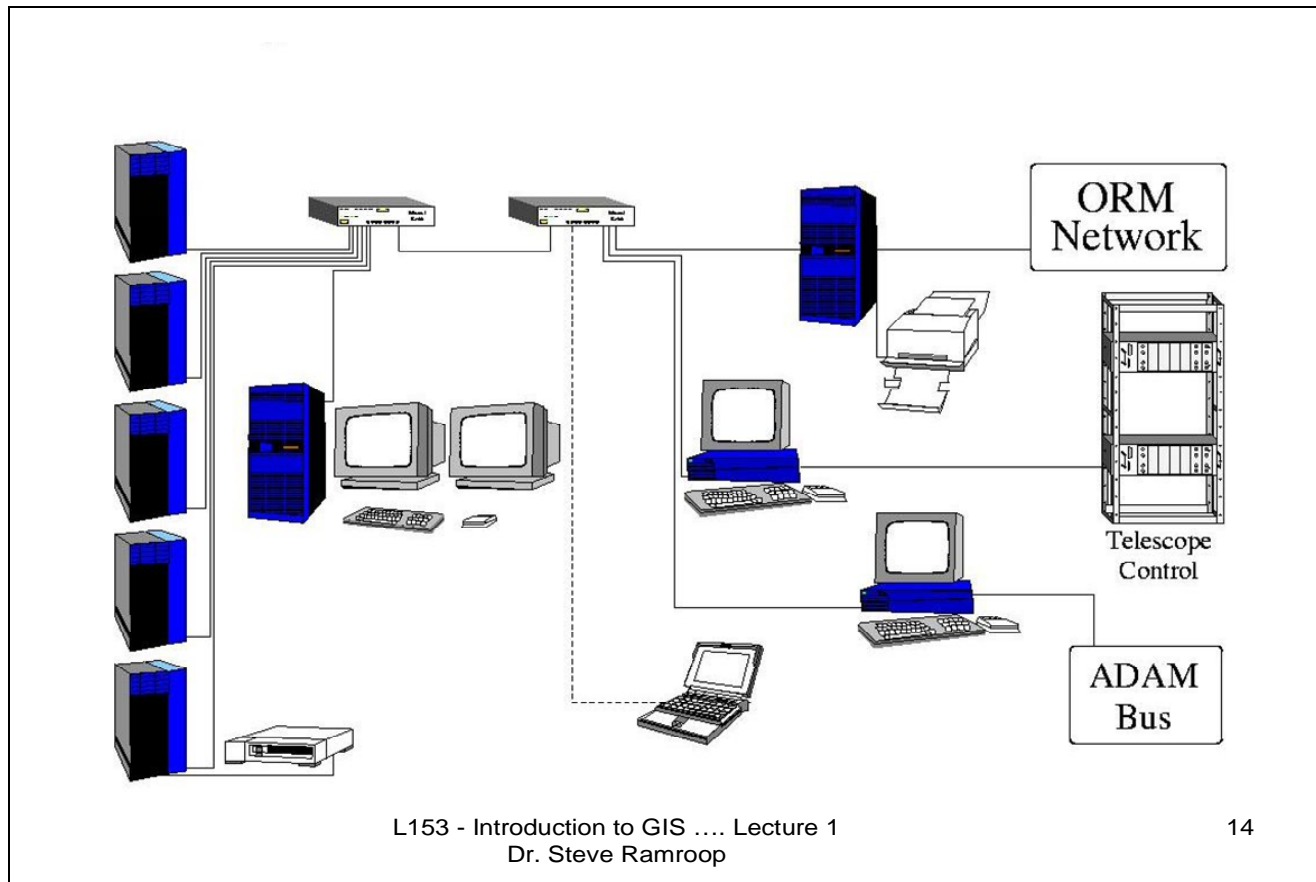
This slide shows a cross section of some of the components of the computer. The main memory is shown in the diagram as RAM. The secondary memory refers to the hard disk (also know as the hard drive). The temporary memory (called cache), is internal and is typically built into the mother board of the computer. The CDs and floppy disk (out dated) are used to extend the storage of the hard disk.

□ Peripherals:

- refer to all the other devices attached to computers that handle input and output**
- input devices include keyboards, mice, trackballs, digitizers, disk drives**
- output devices include screens, printers, plotters**

The peripherals are the other supporting hardware which is used by the CPU. Depending upon their specification of the intended GIS project, these peripherals are usually less expensive than the CPU. The peripherals are the connectable devices that interface with the CPU via hard wiring or through wireless connections.

Slide 14



This slide shows an example of a computer network that connects multiple computers together with other peripherals such as printers, hubs, and such like. This network can be extended to wide areas or within local areas. The larger the area the higher will be cost of the implementation. This represents an example of a computer network which presently many organizations have adopted. This will be discussed in more detail later on in the lectures of this series.

... The End ...