IntroToComputersAndPython

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#

Introduction to Computers and Python

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University of Wyoming COSC 1010

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Adapted from: *Intro to Python* by Paul Deitel and Harvery Deitel

0.1 ## Introduction

- Python is one of the world's most popular languages
- Computers can perform any powerful tasks
- In this course you'll learn how to make computers do some of those tasks
- Python instructs computers on how to perform tasks
- Software (the python instructions or *code*) controls hardware (the computer)

0.2 ## Introduction

- Previously computer applications ran on "standalone" computers
- Now applications can communicate among all of the world's computers
- This is done through the internet

0.3 ## Hardware and Software

- Computers can perform calculations far more quickly than a human can
- they can also make logical decisions far faster
- Many *super computers* can perform billions of calculations in a second
- Computers process data under the control of sequences of instructions or *programs*
- Programs guide the computer through an ordered set of actions

0.4 ## Hardware and Software

- Programs that guide a computer on what to are written by programmers
- A computer consists of various physical devices referred to as hardware
- Hardware can include:
  - CPUs
  - RAMs
  - SSDs

  - Keyboards
  - Mice
- Computer costs drop due to rapid developments in hardware and software technologies

0.5 ## Hardware and Software

- Previously computers filled a whole room
- Now, chips can be smaller than a finger nail and cost negligible amounts
- Silicon is one of the most abundant materials on earth
- Silicon is an ingredient in common sand!
- Silicon-chip technology has made computing so economical that

0.6 ## Moore's Law

- Named for Gordon Moore, co-founder fo Intel
- Typically you expect to pay a little more for products and services
- Computers have typically been the opposite, especially in relation to hardware supporting computing technologies
- For several decades hardware costs fell rapidly
- About every year or two the capacities of computers has approximately doubled
  - This trend is called **Moore's Law**

0.7 ## Moore's Law

- Moore's Law relates primarily to
  - The amount of memory computers have for programs
  - The amount of secondary storage
  - The processor speeds, the speed at which programs can be executed
- Similar growth has occurred in the communications field

0.8 ## Computer Organization

- Regardless of appearance computers can be broken up into a set of logical units
  - Input Unit
  - Output Unit
  - Memory unit
  - Arithmetic Unit (ALU)
  - Central Processing Unit (CPU)
  - Secondary Storage Unit

0.9 ## Input Unit

- The "receiving" section
- Obtains information (data and programs) from input devices
- Typically user input is entered through mice, keyboards, or touchscreens
- Input can also include:
  - Voice commands
  - Scanning images and barcodes
  - reading from secondary storage (hard drives, Blu-ray discs, flash drives)

  - Receiving video from a webcam
  - Receiving information from the internet

0.10 ## Input Unit

- New forms of input include:
  - Positional data from GPS
  - motion and orientation from accelerometer
  - Game controllers

0.11 ## Output Unit

- The "shipping" section
- takes information the computer has processed and places it on an output device
- Typically the output is to a screen
- The output can also be:
  - Printed on paper
  - Played as audio or video
  - Transmitted over the internet
  - Used to control other devices, like self driving cars, robots, or "smart" devices

0.12 ## Output Unit

- Information is also often output to secondary storage like:
  - SSDs
  - Hard drives
  - DVD drives
  - Flash drives
- More recently output has also included things like vibration sent to a phone or controller

0.13 ## Memory Unit

- Rapid access, comparatively low-capacity "warehouse" section
- retains information that has been entered trough the input unit
- It makes that information immediately available for processing when needed
- Usually it retains processed information until it can be placed on output devices by the output unit
- Information in the memory unit is volatile
  - Meaning if power is lost so is the information
- The memory unit is either called memory, primary memory, or RAM

0.14 ## Arithmetic and Logic Unit (ALU)

- The "manufacturing" section performs calculations, like:
  - Addition
  - Subtraction
  - Multiplication
  - Division
- It also allows the computer to compare if items in memory are equal

- In today's systems the ALU is part of the CPU

0.15 ## Central Processing Unit

- The "administrative" section
- Coordinates and supervises the operation of other sections
- In charge of telling the input unit when information should be read into the memory unit
- Tells the ALU when information from the memory unit should be used in calculations
- Tells the output unit where to send information

0.16 ## Central Processing Unit

- Most computers have multicore processors
  - these implement the multiple processors ona single integrated-circuit chips
  - Such processors can perform many operations simultaneously
  - A dual-core processor has two CPUs, a quad-core has four
  - Desktop CPUs can execute billions of instructions per second

0.17 ## Secondary Storage Unit

- Long-term, high compactly storage
- Programs or data not actively being used by other units normally are placed on secondary storage
  - e.g. a hard drive
- The data is held until it is needed again
- information on secondary storage is persistent, meaning it is not lost when power is lost
- Secondary storage takes much longer to access than information stored in memory

0.18 ## Secondary Storage Unit

- Secondary storage devices can include:
  - Solid-state-drives
  - Hard drives
  - Blu-ray/DVD
  - Flash drives
- Many hard dives can hold terabytes of data
  - A terabyte is 1000 gigabytes
  - A gigabyte is about one billion bytes (1,000,000,000)
  - A byte is eight bits
  - A bit is either 0 or 1

0.19 ## Data Hierarchy

Data items processed by computers from a data hierarchy

This becomes larger and more complex in structure as data moves from bits, to more complex types

Bits are the simplest form of data

0.20 ## Bits

- Short for *binary digit*
- A digit that can assume one of two values (1,0)
- the smallest data item ina computer
- It can have the value 0 or 1
- All the functions performed by a computer involve only the simplest manipulations of 1 and 0
  - Examining a bits value
  - Setting a value
  - Reversing a value
- Bits are the basis for the binary number system

0.21 ## Characters

- Working *only* with bits would be tedious at best
- People usually prefer to work with decimal digits (0-9)
- As well as letters (a-z) (A-Z)
- Or, special symbols `$ @ % & * ( ) - + " : ; , ? /`
- Digits, letters, and special symbols are known as characters

0.22 ## Characters

- The computer's character set contains the characters used to write programs and represent data items
- Computers process only 1s and 0s
- So, a computer's character set represents every character as a pattern of 1s and 0s
- Python uses unicode characters are comprised of:
  - One byte (8 bits)
  - Two bytes (16 bits)
  - Three bytes (24 bits)
  - Four bytes (32 bits)
- This is known as UTF-8 encoding

0.23 ## Characters

- Unicode contains characters for many of the world's languages
  - The ASCII (American Standard Code for Information Interchange) character set is a subset of Unicode
- The ascii subset can be found at http://unicode.org/charts/PDF/U0000.pdf
- The unicode charts for all languages, symbols, emoji, are viewable at http://www.unicode.org/charts/

0.24 ## Fields

- Characters are composed of bits
- Fields are composed of characters, or bytes
- A field is a group of characters or bytes that conveys a meaning
- A field consisting of uppercase and lowercase letters can be used to represent a name

- A field consisting of decimal digits could represent a person's age

0.25 ## Records

- Several related fields can be sued to compose a record
- In a payroll system a record for an employee might contain:
  - Employee ID number
  - Name
  - Address
  - pay
  - Year-to-date earnings
  - Takes withheld
- All these fields would be for an individual employee, making a record

0.26 ## Files

- A file is a group of related records
- A file contains arbitrary data in arbitrary formats
- In some OSes a file is simply a sequence of bytes
- Any organization of the bytes in a file, such as into records, is a view created by a programmer
- Organizations (and individuals) often have many files

0.27 ## Databases

- A database is a collection of data
- Organized for easy access and manipulation
- The most popular variant is a a *relational database*
  - In which data is stored in simple tables
  - A table includes records and fields

0.28 ## Databases

- A table of students might include:
  - First name and last name
  - Major
  - Year
  - Student ID
  - GPA
- The data for each student is a record, composed of fields
- The data can be searched through, sorted, or otherwise manipulated

0.29 ## Big Data

The amount of data produced globally is enormous

The growth is accelerating

#

Python

0.30 ## Python

- An object-oriented scripting language first released in 1991
- developed by Guido van Rossum of the National Research Institute for Mathematics and Computer Science in Amsterdam
- Has rapidly become one of the worlds most popular languages
  - Especially popular for educational and scientific computing
  - As well as data science