C++ How to Program - An Objects-Natural Approach 11th edition Deitel Solutions Manual

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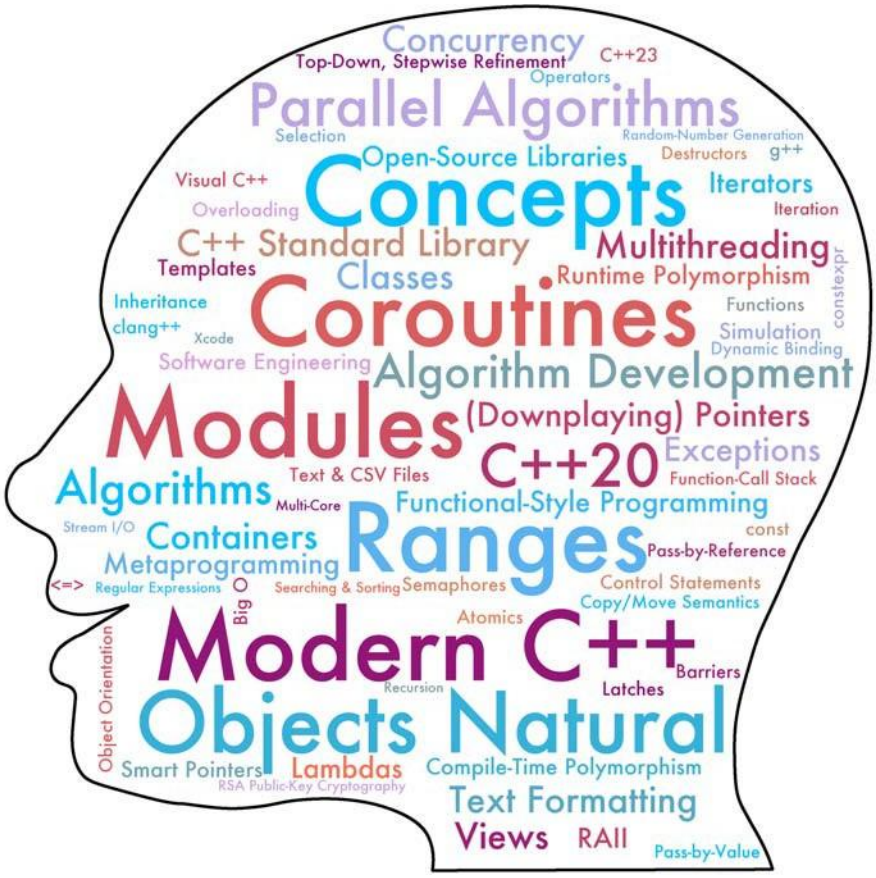
Intro to Computers and C++



Objectives

In this chapter, you'll:

- Learn computer hardware, software and Internet basics.
- Understand a data hierarchy from bits to databases.
- Understand the types of programming languages.
- Understand the strengths of C++ and other languages.
- Be introduced to the C++ standard library of reusable components.
- Compile and run a C++ application using our three preferred compilers and Docker containers.
- Be introduced to object-technology concepts used in the objects-natural case studies (Chapters 2–9) and discussed in detail in the object-oriented programming Chapters 9–11.
- Understand how concurrent programming helps maximize performance on multi-core processors.
- Be introduced to big data and data science.
- Learn about exciting recent developments in computing, including the Metaverse, artificial intelligence and related technologies.

Exercises

1.1 Categorize each of the following items as either hardware or software:

a) CPU.
Answer: Hardware.
b) C++ compiler.
Answer: Software.
c) ALU.
Answer: Hardware.
d) C++ preprocessor.
Answer: Software.
e) input unit.
Answer: Hardware.
f) an editor program.
Answer: Software.

1.2 ***(Computer Organization)*** Fill in the blanks in each of the following statements:

a) The logical unit that receives information from outside the computer for use by the computer is the _____.
Answer: input unit.
b) _____ is the logical unit that sends information the computer has already processed to various devices for use outside the computer.
Answer: output unit.
c) _____ and _____ are the computer's logical units that retain information.
Answer: memory unit, secondary storage unit.
d) _____ is the computer's logical unit for performing calculations.
Answer: ALU.
e) _____ is the computer's logical unit for making logical decisions.
Answer: ALU.
f) _____ is the computer's logical unit for coordinating the other logical units' activities.
Answer: CPU.

1.3 Discuss the purpose of each of the following:

a) `cin`
Answer: `cin` (the standard input stream), which is normally the keyboard, but `cin` can be connected to another stream.
b) `cout`
Answer: Data is often output to `cout` (the standard output stream), which is normally the computer screen, but `cout` can be connected to another stream.
c) `cerr`
Answer: The standard error stream is referred to as `cerr`. The `cerr` stream (normally connected to the screen) is used for displaying error messages. It's common to route regular output data, i.e., `cout`, to a device other than the screen while keeping `cerr` assigned to the screen so that the user can be immediately informed of errors.

1.4 Fill in the blanks in each of the following statements:

a) Information in the computer's memory unit is _____—it's typically lost when the computer's power is turned off.

Answer: volatile.

b) As a measure of computer memory size, TB stands for _____—which is 1024 gigabytes.

Answer: terabyte.

c) Most computers today have _____ processors that economically implement multiple processors on a single integrated circuit chip.

Answer: multi-core.

d) _____ enable concurrent programming with a simple sequential like coding style.

Answer: Coroutines.

e) The most popular database model is the _____ database in which data is stored in simple tables of rows and columns.

Answer: relational.

f) _____ is the process of searching through extensive collections of data to find valuable insights.

Answer: Data mining.

g) With _____ software individuals contribute to developing, maintaining and evolving the software. Anyone can then use that software for their own purposes—normally at no charge, but subject to various (typically generous) licensing requirements.

Answer: open-source.

h) Today, most of the code for general-purpose operating systems is written in _____.

Answer: C or C++.

i) The C++ programming models are _____, _____, _____, _____, _____.

Answer: procedural programming, object-oriented programming, functional-style programming, generic programming and template metaprogramming.

j) Existing older C++ code using older coding idioms is called _____ code.

Answer: legacy.

k) When writing new software avoid _____. Instead use existing pieces from code libraries.

Answer: "reinventing the wheel."

l) Microsoft's primary language for the Metaverse is _____.

Answer: C#.

m) The _____ that objects come from are essentially reusable software components.

Answer: classes.

n) The protocol for communicating over the ARPANET became known as the _____.

Answer: Transmission Control Protocol (TCP).

o) TCP ensured that messages, consisting of sequentially number pieces called _____ were properly delivered from sender to receiver, arrived intact and were reassembled in the correct order.
Answer: packets.
p) In the Internet of Things (IoT) a "thing" is any device with a(n) _____ and the ability to send, and in some cases receive, data automatically over the Internet.
Answer: IP address.
q) The applications-development methodology of _____ enables you to rapidly develop powerful software applications by combining (often free) complementary web services and various forms of information feeds.
Answer: mashups.
r) _____ typically refers to simulated, 3D environments that you interact with.
Answer: Virtual reality (VR).
s) _____ is a software-based ledger distributed over nodes on the Internet.
Answer: Blockchain.
t) A _____ is a digital or virtual currency secured by cryptography.
Answer: cryptocurrency.
u) _____ are blockchain-based "cryptographically unique tokens linked to digital or physical content, providing proof of ownership."
Answer: Non-fungible tokens.
v) _____ is by far the most widely used version control system.
Answer: GitHub.
w) The "four Vs of big data are _____, _____, _____, and _____.
Answer: Volume, Velocity, Variety and Veracity.
x) Some people feel that the ultimate problem to be solved in AI is _____.
Answer: artificial general intelligence.
y) ChatGPT is a shining example of the field of _____.
Answer: generative AI.

1.5 State which of the following are true and which are false. If false, explain why.
a) Computing costs are dropping rapidly due to impressive developments in hardware, software and Internet technologies.
Answer: True.
b) For decades, computer power approximately doubled inexpensively every year. This remarkable trend is called Moore's law.
Answer: False. It doubled approximately every two years.
c) Taking full advantage of multi-core architecture requires writing multithreaded applications.
Answer: True.
d) Any computer can directly understand only its own assembly language.
Answer: False. Actually, any computer can directly understand only is own machine language.
e) The software that contains the core operating-system components is called the kernel.
Answer: True.

f) iOS is the most widely used mobile-phone operating system.
Answer: False. It's Android.
g) C++ is the premiere language for building high-performance business-critical and mission-critical operating systems.
Answer: True.
h) The programming language most closely associated with the expression "write once, run anywhere" is Java.
Answer: True.
i) Swift is widely used to add programmability to web pages, such as animations and user interactivity.
Answer: False. Actually, it's JavaScript.
j) As the ARPANET evolved, to enable the huge variety of networking hardware and software to intercommunicate, ARPA developed the Internet Protocol (IP), which created a true "network of networks."
Answer: True.
k) Cloud computing allows you to increase or decrease computing resources to meet your needs at any given time.
Answer: True.
l) IoT is an example of edge computing.
Answer: True.
m) Augmented reality (AR) projects real-time computer-generated content onto what you see in the real world.
Answer: True.
n) Ethereum is a programmable platform that enables you to "build and deploy decentralized applications (dApps) on its network that use the blockchain to store data or control what your app can do."
Answer: True.
o) Forbes defines Web3 as "the centralized Internet__ built on distributed technologies like blockchain ... rather than on servers owned by individuals or corporations."
Answer: False. Actually, it's the "decentralized Internet."
p) By some estimates, processing just one Bitcoin transaction uses approximately the same amount of energy as powering the average American home for one month.
Answer: False. Actually, it's one week.
q) AI is often called a field with solutions but no problems.
Answer: False. Actually it's often called a field with problems and no solutions.
r) In machine learning, computers are explicitly programmed with human expertise to solve a particular problem.
Answer: False. Actually with machine learning, computers are programmed to learn from data.
s) OpenAI's Dall-E 2 can generate original images from text descriptions.
Answer: True.

1.6 ***(Clock as an Object)*** Clocks are among the world's most common objects. Discuss how each of the following terms and concepts applies to the notion of a clock: class, object,

instantiation, data member, reuse, member function, inheritance (consider, for example, an alarm clock), base class and derived class.

Answer: The entire watch is an object that is composed of many other objects (such as the moving parts, the band, the face, etc.) Watch attributes are time, color, band, style (digital or analog), etc. The behaviors of the watch include setting the time and getting the time. A watch can be considered a specific type of clock (as can an alarm clock). With that in mind, it is possible that a class called `Clock` could exist from which other classes such as watch and alarm clock could inherit the basic features in the clock. The watch is an abstraction of the mechanics needed to keep track of the time. The user of the watch does not need to know the mechanics of the watch in order to use it; the user only needs to know that the watch keeps the proper time. In this sense, the mechanics of the watch are encapsulated (hidden) inside the watch. The interface to the watch (its face and controls for setting the time) allows the user to set and get the time. The user is not allowed to directly touch the internal mechanics of the watch. All interaction with the internal mechanics is controlled by the interface to the watch. The data members stored in the watch are hidden inside the watch and the member functions (looking at the face to get the time and setting the time) provide the interface to the data.

INSTRUCTOR NOTE: The remaining exercises in this chapter are research and thought exercises for which we do not provide answers.

1.7 ***(Self-Driving Cars)*** Just a few years ago, the notion of driverless vehicles on our streets would have seemed impossible. Many of the technologies you'll read about in this book are making self-driving cars possible. Today, they're already common in some areas.

a) If you hailed a taxi and a driverless taxi stopped for you, would you get into the back seat? Would you feel comfortable telling it where you want to go and trusting it would get you there? What safety measures would you want in place?
b) What if two self-driving cars approached a one-lane bridge from opposite directions? What protocol should they go through to determine which car should proceed?
c) What if you're behind a car stopped at a red light, the light turns green, and the car doesn't move? You honk, and nothing happens. You get out of your car and notice that there's no driver. What would you do?
d) If a police officer pulls over a speeding self-driving car in which you're the only passenger, who—or what entity—should pay the ticket?
e) One especially serious concern with self-driving vehicles is that they might be hacked. What if the hacker sets the speed high (or low), which could be dangerous. What if the hacker locked all the doors then set the vehicle to drive off in the wrong direction?

1.8 ***(Research: Artificial General Intelligence)*** One of the most ambitious goals in the field of AI is to achieve artificial general intelligence—the point at which machine intelligence would equal human intelligence. Research this intriguing topic. When is this forecast to happen? What are some ethical issues this raises? Human intelligence seems to be stable over long periods. Powerful computers with artificial general intelligence could con-

ceivably (and quickly) evolve intelligence far beyond that of humans. Research and discuss the issues this raises.

1.9 ***(Research: Intelligent Assistants)*** Many companies now offer computerized intelligent assistants, such as Amazon Alexa, Apple Siri, Google Assistant and Microsoft Cortana. Research these and others, and list uses that can improve people's lives. Research privacy and ethics issues for intelligent assistants. Research intelligent-assistant anecdotes. Would you do what an intelligent assistant told you to?

1.10 ***(Research: AI in Health Care)*** Research the rapidly growing field of AI big-data applications in health care. For example, suppose a diagnostic medical application had access to every x-ray that's ever been taken and the associated diagnoses—that's surely big data. "Deep Learning" computer-vision applications could work with this "labeled" data to learn to diagnose medical problems. Research deep learning in diagnostic medicine and list some of its most significant accomplishments. What are some ethical issues of having machines instead of human doctors performing medical diagnoses? Would you trust a machine-generated diagnosis? Would you seek a second opinion from another diagnostic machine? Would you insist on a second opinion from a human doctor?

1.11 ***(Research: Privacy and Data Integrity Legislation)*** Some key privacy laws are HIPAA (the Health Insurance Portability and Accountability Act) and the California Consumer Privacy Act (CCPA)—both in the United States, and GDPR (the General Data Protection Regulation) in the European Union. Laws like these are becoming more common and stricter. Investigate these laws and the major protections they provide for your privacy.

1.12 ***(Research: Personally Identifiable Information)*** Protecting users' personally identifiable information (PII) is an important aspect of privacy. Research and comment on this issue.

1.13 ***(Research: Big Data, AI and the Cloud—How Companies Use These Technologies)*** For a major organization of your choice, research how they might be using each of the following technologies: AI, big data, the cloud, mobile, natural-language processing, speech recognition, speech synthesis, database, machine learning, deep learning, reinforcement learning, Internet of Things (IoT) and web services.

1.14 ***(Research: Raspberry Pi and the Internet of Things)*** It's now possible to have a computer at the heart of just about any device and to connect those devices to the Internet. This has led to the Internet of Things (IoT), which is already connecting billions of devices. The Raspberry Pi is an economical computer often at the heart of IoT devices, and it can be programmed in C++. Research the Raspberry Pi and some of the many IoT applications in which it's used.

1.15 ***(Research: The Ethics of Deep Fakes)*** Artificial intelligence deep-learning technologies make it possible to create deep fakes—realistic fake videos of people that capture their appearance, voice, body motions and facial expressions. You can have them say and do whatever you specify. Research the ethics of deep fakes. What would happen if you turned on your TV and saw a deep-fake video of a prominent government official or newscaster reporting that an attack was about to happen? A famous low-tech version of this was Orson Welles's "War of the Worlds" radio broadcast of 1938, in which he created a mass panic by announcing that Martians were attacking New Jersey.

1.16 ***(Research: Blockchain—A World of Opportunity)*** Cryptocurrencies like Bitcoin and Ethereum are based on blockchain technology that has seen explosive growth over the last few years. Research blockchain's origin, applications and how it came to be used as the basis for cryptocurrencies. Research other major applications of blockchain. It is expected that blockchain technology will be crucial to implementing the Metaverse. Over the next many years, there will be extraordinary opportunities for software developers who thoroughly understand blockchain application development.

1.17 ***(Public-Key Cryptography)*** Cryptography is a crucial technology for privacy and security. In this book, you'll have the opportunity to study both secret-key and public-key cryptography. Research how public-key cryptography is used to implement the Bitcoin cryptocurrency.

1.18 ***(Programmer Responsibility and Liability)*** As a programmer working in the health-care industry, suppose a software bug in one of your programs caused a cancer patient to receive an excessive dose of radiation therapy resulting in severe injury or death. Discuss the issues.

1.19 ***(2010 "Flash Crash")*** An example of the consequences of our dependency on computers was the so-called "flash crash," which occurred on May 6, 2010, when the U.S. stock market fell precipitously in a matter of minutes, wiping out trillions of dollars of investments—then recovered within minutes. Use the Internet to investigate the causes of this crash and discuss the issues it raises.