Define **programming** of and describe the six steps of programming.

Discuss design tools including **top-down design**, **pseudocode**, **flowcharts**, and **logic structures**.

Describe program testing and the tools for finding and removing errors.
Competencies (Page 2 of 2)

- Describe **CASE tools** and **object-oriented software development**.
- Explain the five **generations of programming languages**.
In this chapter, you focus on Phase 4, Systems Development, of the systems life cycle and learn about the programming process and some of the programming languages that are available.

Competent end users need to understand the relationship between systems development and programming.
Programming Languages

Programs and Programming

- What is a program?
- A problem-solving procedure
  - A list of instructions
    - Prewritten
    - Custom-written
    - Application software
    - System software
What is Programming?

- A list of instructions for the computer to follow to process data
- Software development
- Six step procedure
  1. Program specification
  2. Program design
  3. Program code
  4. Program test
  5. Program documentation
  6. Program maintenance
Step 1: Program Specification

- Also called program definition or program analysis
- Five steps to complete in the process
Program Objectives in Step 1

- Objectives are the problems that you are trying to solve
- Programming requires a clear statement of the problem that you are looking to address
Desired output
Needed input data
Required processing
Documentation of program specifications

End user’s sketch of desired output

Example of input data
Plan a solution using structured programming techniques
- Top-down design
- Pseudocode
- Flowcharts
- Logic structures
Top-Down Program Design

- Identify the program modules required

Diagram:
- Time-and-billing process
  - Obtain input
    - Obtain daily logs
    - Compute time on client A jobs
  - Produce output
    - Compute hours for billing
    - Compute time on client Z jobs
    - Print client bills
    - Print time-and-billing report
    - Client A bills
    - Client Z bills
Pseudocode

- Provide an outline of the logic and summarize the program you will write

Compute time for Client A

Set total regular hours and total overtime hours to zero.
Get time in and time out for a job.
If worked past 1700 hours, then compute overtime hours.
Compute regular hours.
Add regular hours to total regular hours.
Add overtime hours to total overtime hours.
If there are more jobs for that client, go back and compute for that job as well.
Flowcharts

- Graphically depict the sequence of steps required to solve a programming problem

**Flowchart Symbols**

- **Process**
- **Input/output**
- **Decision**
- **Connector**
- **Terminal**

**Start**

1. Initialize total regular hours and total overtime hours to be zero.

2. Read in information about when the job was started and completed.

3. Check to see if there was any overtime on the job.

4. Compute overtime hours

5. If there was overtime, compute how much.

6. Compute the number of regular hours.

7. Work past 1700?

- **Yes**
- **No**

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Logic Structures

- Concatenation structure
- Selection structure
- Repetition structure

Concatenation

Selection

Return
Step 3: Program Code

- Writing the program or coding
- Characteristics of a good program
  - Works reliably
  - Produces the correct output
  - Catches common input errors
  - Code is well-documented and understandable
  - Uses an appropriate computer language
Coding in Step 3

- Content-markup languages
- Programming languages

<table>
<thead>
<tr>
<th>Language</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>HTML</td>
<td>Stands for HyperText Markup Language; used to create Web pages</td>
</tr>
<tr>
<td>XML</td>
<td>Stands for eXtensible Markup Language; assists sharing of data across networks and different systems</td>
</tr>
<tr>
<td>XHTML</td>
<td>Stands for eXtended HTML; combines HTML and XML to add structure and flexibility to HTML</td>
</tr>
<tr>
<td>SVG</td>
<td>Stands for Scalable Vector Graphics; provides a standard for describing two-dimensional graphics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Language</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>Widely used programming language, often associated with the UNIX operating system</td>
</tr>
<tr>
<td>C++</td>
<td>Extends C to use objects or program modules that can be reused and interchanged between programs</td>
</tr>
<tr>
<td>C#</td>
<td>Extends C++ to include XML functionality and support for a new Microsoft initiative called .NET</td>
</tr>
<tr>
<td>Java</td>
<td>Primarily used for Internet applications; similar to C++; runs with a variety of operating systems</td>
</tr>
<tr>
<td>JavaScript</td>
<td>Embedded into Web pages to provide dynamic and interactive content</td>
</tr>
<tr>
<td>Visual Basic</td>
<td>Uses a very graphical interface, making it easy to learn and to rapidly develop Windows and other applications</td>
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</table>
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<meta http-equiv="Content-Type" content="text/html; charset=windows-1252">
<meta http-equiv="Content-Language" content="en-us">
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<meta name="ProgId" content="FrontPage.Editor.Document">
</head>
<body>
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<tr><td>
<p></p>
<p><img border="0" src="/images/logo_newsletter.jpg" width="271" height="188" align="left"></p>
<p>&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&n
```
Step 4: Program Test

- **Debugging** to test code and eliminate errors
  - Syntax errors
  - Logic errors
  - Testing process

Diagram:

1. Translate
2. Sample data
3. Manual test
4. Desk check
5. Step 4 Program test
6. Beta test
7. Document
Step 5: Program Documentation

- Written descriptions about a program
- Important for people who will use and/or support the program
  - Users
  - Operators
  - Programmers
Step 6: Program Maintenance

- 75% of total lifetime cost
- Ensures program is
  - Error-free
  - Effective
  - Efficient
- Two activity categories
  - Operations
  - Changing needs
Case Tools

- Computer-aided software engineering (CASE)
  - Automates portions of the development process
    - Program design
    - Coding
    - Testing
Object-oriented programming (OOP)

Focuses less on procedures, more on relationships between objects

Objects contain both the data and the processing operations needed to perform a task
Generations of Programming Languages
(Page 1 of 2)

- Occurring in “generations” or “levels”
  - Coding from machine languages to human or natural languages

- There are five distinct generations
  - Lower level is closer to machine language
  - Higher level is closer to human-like language
Generations of Programming Languages  
(Page 2 of 2)

- 1st Gen: Machine languages
- 2nd Gen: Assembly languages
- 3rd Gen: High level procedural languages (3GLs)
- 4th Gen: Task-oriented languages (4GLs)
- 5th Gen: Problem and Constraint languages (5GL)

<table>
<thead>
<tr>
<th>Generation</th>
<th>Sample Statement</th>
</tr>
</thead>
<tbody>
<tr>
<td>First: Machine</td>
<td>1111001001110011101001000010000111000000101011</td>
</tr>
<tr>
<td>Second: Assembly</td>
<td>ADD 210(8,13),02B(4,7)</td>
</tr>
<tr>
<td>Third: Procedural</td>
<td>if (score &gt;= 90) grade = ‘A’;</td>
</tr>
<tr>
<td>Fourth: Task</td>
<td>SELECT client FROM dailyLog WHERE serviceEnd &gt; 17</td>
</tr>
<tr>
<td>Fifth: Problems and</td>
<td>Get patientDiagnosis from patientSymptoms “sneezing”, “coughing”, “aching”</td>
</tr>
<tr>
<td>Constraints</td>
<td></td>
</tr>
</tbody>
</table>


- Computer programmers create, test, troubleshoot, update and repair programs
- Employers seek individuals with
  - Degree in Computer Science or Information Systems
  - Desired traits include patience, logical thinking, and attention to detail
- Computer Programmers can expect to earn $51,500 to $88,000 annually
A Look to the Future

Using a Wish List to Create a Program

- Synapse Solutions has created a system called MI-tech that understands word order and meaning in English.
- Computer translates "wish list" into machine language.
Open-Ended Questions (Page 1 of 2)

- Identify and discuss each of the six steps of programming.

- Describe CASE tools and OOP. How does CASE assist programmers?

- What is meant by “generation” in reference to programming languages? What is the difference between low-level and high-level languages?
What is the difference between a compiler and an interpreter?

What are logic structures? Describe the differences between the three logic types.