Chapter 13
Computer Programs and Programming Languages

Discovering Computers 2012
Your Interactive Guide to the Digital World
Objectives Overview

Differentiate between machine and assembly languages

Identify and discuss the purpose of procedural programming languages, and describe the features of C and COBOL

Identify and discuss the characteristics of these object-oriented programming languages and program development tools

Identify the uses of other programming languages and program development tools

Describe various ways to develop Web pages

See Page 663 for Detailed Objectives

Discovering Computers 2012: Chapter 13
Objectives Overview

- Identify the uses of popular multimedia authoring programs
- List the six steps in the program development life cycle
- Differentiate between structured design and object-oriented design
- Explain the basic control structures and design tools used in designing solutions to programming problems

See Page 663 for Detailed Objectives
Computer Programs and Programming Languages

- A **computer program** is a series of instructions that directs a computer to perform tasks
  - Created by a **programmer** using a **programming language**
Low-Level Languages

- **Machine language** is the first generation of programming languages.
- Only language the computer directly recognizes.

```
0000DE 5A50 35AA 015AC
0000E2 47F0 2100 00102
000102 1B77
000104 5870 304E 01050
000108 1C47
00010A 4E50 30D6 010D8
00010E F075 30D6 003E 010D8 0003E
000114 4F50 30D6 010D8
000118 5050 3052 01054
00011C 58E0 30B6 010B8
000120 07FE
000122 50E0 30BA 00122
000126 1B55
000128 5A50 304E 01050
00012C 5B50 3052 01054
000130 5050 305A 0105C
000134 58E0 30BA 010BC
000138 07FE
```
**Low-Level Languages**

- **Assembly language** is the second generation of programming languages.
- Programmer writes instructions using symbolic instruction codes.
- A *source program* contains the code to be converted to machine language.
Procedural Languages

- In a **procedural language**, the programmer writes instructions that tell the computer what to accomplish and how to do it
  - Third-generation language (3GL)

A compiler translates an entire program before executing it

An interpreter converts and executes one code statement at a time
* COMPUTE REGULAR TIME PAY
  MULTIPLY REGULAR-TIME-HOURS BY HOURLY-PAY-RATE
  GIVING REGULAR-TIME-PAY.

* COMPUTE OVERTIME PAY
  IF OVERTIME-HOURS > 0
    COMPUTE OVERTIME-PAY = OVERTIME-HOURS * 1.5 * HOURLY-PAY-RATE
  ELSE
    MOVE 0 TO OVERTIME-PAY.

* COMPUTE GROSS PAY
  ADD REGULAR-TIME-PAY TO OVERTIME-PAY
  GIVING GROSS-PAY.
Procedural Languages
The C programming language is used to write many of today’s programs.
Procedural Languages

- **COBOL** (CCommon Business-Oriented Language) is designed for business applications, but easy to read because of the English-like statements.

```plaintext
* comments begin with an asterisk

* COMPUTE REGULAR TIME PAY
  MULTIPLY REGULAR-TIME-HOURS BY HOURLY-PAY-RATE
  GIVING REGULAR-TIME-PAY.

* COMPUTE OVERTIME PAY
  IF OVERTIME-HOURS > 0
    COMPUTE OVERTIME-PAY = OVERTIME-HOURS * 1.5 * HOURLY-PAY-RATE
  ELSE
    MOVE 0 TO OVERTIME-PAY.

* COMPUTE GROSS PAY
  ADD REGULAR-TIME-PAY TO OVERTIME-PAY
  GIVING GROSS-PAY.

* PRINT GROSS PAY
  MOVE GROSS-PAY TO GROSS-PAY-OUT.
  WRITE REPORT-LINE-OUT FROM DETAIL-LINE
  AFTER ADVANCING 2 LINES.
```

The diagram illustrates the flow of the COBOL program, highlighting the calculation of regular and overtime pay, as well as the final gross pay.
Object-Oriented Programming Languages and Program Development Tools

• An object-oriented programming (OOP) language allows programmers the ability to reuse and modify existing objects

• Other advantages include:
  - Objects can be reused
  - Programmers create applications faster
  - Work well in a RAD environment
  - Most program development tools are IDEs
Object-Oriented Programming Languages and Program Development Tools

- **Java** is an object-oriented programming language developed by Sun Microsystems.
- The Just-in-time (JIT) compiler converts the bytecode into machine-dependent code.

```java
public class BodyMassApplet extends Applet implements ActionListener {
    //declare variables
    Image logo; //Declare an Image object
    int inches, pounds;
    double meters, kilograms, index;

    //construct components
    Label companyLabel = new Label("THE SUN FITNESS CENTER BODY MASS INDEX CALCULATOR");
    Label heightLabel = new Label("Enter your height to the nearest inch ");
    TextField heightField = new TextField(10);
    Label weightLabel = new Label("Enter your weight to the nearest pound ");
    TextField weightField = new TextField(10);
    Button calcButton = new Button("Calculate");
    Label outputLabel = new Label("Click the Calculate button to see your Body Mass Index.");
    inches = Integer.parseInt(heightField.getText());
    pounds = Integer.parseInt(weightField.getText());
    meters = inches / 39.36;
    kilograms = pounds / 2.2;
    index = kilograms / Math.pow(meters, 2);
    outputLabel.setText("YOUR BODY MASS INDEX IS " + Math.round(index) + ".");
}
```

![Applet interface](image-url)
Object-Oriented Programming Languages and Program Development Tools

- The Microsoft .NET Framework allows almost any type of program to run on the Internet or an internal business network, as well as computers and mobile devices.

- Features include:
  - CLR (Common Language Runtime)
  - Classes
Object-Oriented Programming Languages and Program Development Tools

- **C++** is an extension of the C programming language.
- **C#** is based on C++ and was developed by Microsoft.
- **F#** combines the benefits of an object-oriented language with those of a functional language.

```cpp
// portion of a C++ program that allows users to create
// a new zip code from a string or a number and expand
// zip codes, as appropriate, to a 10-digit number

class ZipC:
    def __init__(self, const unsigned long zipnum):
        ostringstream strInt;
        strInt << zipnum;
        code = strInt.str();

    def getCode(self):
        return code;

    def setCode(self, const string newCode):
        code = newCode;

    def expand(self, const string suffix):
        if code.length() == 5 && suffix.length() == 4:
            code += "-";
            code.append(suffix);
```
## Object-Oriented Programming Languages and Program Development Tools

Visual Studio is Microsoft’s suite of program development tools

| **Visual Basic** is based on the BASIC programming language | **Visual C++** is based on C++ | **Visual C#** combines the programming elements of C++ with an easier, rapid-development environment |

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**Discovering Computers 2012: Chapter 13**
Step 1
The developer designs the user interface, such as for the mobile device shown here. Linear Feet is a text box in which the user enters data. Pine, Oak, and Cherry are option buttons the user can click to choose the wood type. Calculate and Clear are buttons. All other objects are labels.

Step 2
The developer assigns properties to each object. Objects include text boxes, option buttons, buttons, labels, and the form itself.

Step 3
The developer writes code to define the action of each event the user triggers.

Step 4
The developer tests the program. The Cost Estimate is displayed after the user clicks the Calculate button.
A **visual programming language** is a language that uses a visual or graphical interface for creating all source code.

Borland’s **Delphi** is a powerful program development tool that is ideal for building large-scale enterprise and Web applications in a RAD environment.
Figure 13-11

Welcome to the world of Unicode with Delphi

Delphi 將帶您進入Unicode 的世界!!

Delphi によるUnicodeの世界によこうこそ!!

Kalώς ἡλθατε στον κόσμο του Unicode με Delphi

Добро пожаловать в мир Юникода

использованием Дельфи
Object-Oriented Programming Languages and Program Development Tools

- **PowerBuilder** is a powerful program development RAD tool.
- Best suited for Web-based, .NET, and large-scale enterprise object-oriented applications.
Other Programming Languages and Development Tools

- A **4GL** (fourth-generation language) is a nonprocedural language that enables users and programmers to access data in a database.
- One popular 4GL is **SQL**

```
SELECT LAST_NAME, FIRST_NAME, GROSS_PAY
FROM EMPLOYEE
WHERE OVERTIME HOURS > 0;
ORDER BY LAST_NAME;
```

<table>
<thead>
<tr>
<th>LAST_NAME</th>
<th>FIRST_NAME</th>
<th>GROSS_PAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antiqua</td>
<td>Martin</td>
<td>780.00</td>
</tr>
<tr>
<td>Charles</td>
<td>Leslie</td>
<td>715.00</td>
</tr>
<tr>
<td>Guillan</td>
<td>Anita</td>
<td>847.50</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>
Other Programming Languages and Development Tools

- Classic programming languages include:

  - Ada
  - ALGOL
  - APL
  - BASIC
  - Forth
  - FORTRAN
  - HyperTalk
  - LISP
  - Logo
  - Modula-2
  - Pascal
  - PILOT
  - PL/1
  - Prolog
  - RPG
  - Smalltalk
Other Programming Languages and Development Tools

- An **application generator** is a program that creates source code or machine code from a specification of the required functionality
  - Often bundled as part of a DBMS
Other Programming Languages and Development Tools

• A macro is a series of statements that instructs an application how to complete a task
• You usually create the macro in one of two ways:
  – Record the macro with a macro recorder
  – Write the macro
(VBA macro)

Private Sub CommandButton1_Click()
    Range("C3:C9").Select
    Selection.ClearContents
    Range("C3").Value = InputBox("Car model?", "Enter")
    CarPrice = InputBox("Price of car?", "Enter")
    Do While CarPrice < 12000 Or CarPrice > 80000
        CarPrice = InputBox("Price of car must be $12,000 and <=
    Loop

    Range("C4").Value = CarPrice
    DownPayment = InputBox("Down Payment?", "Enter")
    Do While DownPayment < 1500 Or DownPayment > 55000
        DownPayment = InputBox("Down payment must be $1,500 and <=
    Loop

    Range("C5").Value = DownPayment
    Rate = InputBox("Interest Rate?", "Enter")
    Do While Rate < 0.03 Or Rate > 0.22
        Rate = InputBox("Interest Rate must be >= 3% and <=
    Loop

    Range("C6").Value = "Price - down payment"
    InterestRate = InputBox("Interest Rate in %?", "Enter") / 100
    Do While InterestRate < 0.03 Or InterestRate > 0.22
        InterestRate = InputBox("Interest Rate must be >= 3 and <=
    Loop

    Range("C7").Value = InterestRate
    TimeInYears = InputBox("Time in Years?", "Enter")
    Do While TimeInYears < 1 Or TimeInYears > 9
        TimeInYears = InputBox("Time in years must be >= 1 and <= 9"
    Loop

    Range("C8").Value = TimeInYears
    Range("C13").Select
End Sub

My Loan Calculator

<table>
<thead>
<tr>
<th>Date</th>
<th>January-12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Car model</td>
<td>Lexus</td>
</tr>
<tr>
<td>Price</td>
<td>$62,000.00</td>
</tr>
<tr>
<td>Down Payment</td>
<td>$12,750.00</td>
</tr>
<tr>
<td>Loan Amount</td>
<td>$49,250.00</td>
</tr>
<tr>
<td>Interest Rate</td>
<td>8.50%</td>
</tr>
<tr>
<td>Years</td>
<td>6</td>
</tr>
<tr>
<td>Monthly Payment</td>
<td>$875.59</td>
</tr>
<tr>
<td>Total Interest</td>
<td>$13,792.15</td>
</tr>
<tr>
<td>Total Cost</td>
<td>$75,792.15</td>
</tr>
</tbody>
</table>

New Loan

Clicking New Loan button causes macro to run

(macro dialog box in Excel window)

macro dialog box
Web Page Development

- **HTML** is a special formatting language that programmers use to format documents for display on the Web.
- **XHTML** is a markup language that allows Web sites to be displayed more easily on mobile devices.
Web Page Development

• **XML** allows Web developers to create customized tags and use predefined tags to display content appropriately on various devices
  – **WML** is a subset of XML and is used to design pages for microbrowsers

• Two applications of XML are **RSS 2.0** and **ATOM**
Figure 13-18
Web Page Development

- Web browsers can execute short programs to add interactive elements to Web pages.
- To send and receive information between your computer and a Web server, these programs use the CGI (common gateway interface).
How a CGI Script Works

**Step 1**
The programmer stores the CGI program in a special folder on the Web server, such as /cgi-bin.

**Step 2**
The Webmaster creates a link between the CGI program and Web page. When a user displays the Web page, the CGI program automatically starts.

**Step 3**
When a user submits a request, it is sent to the CGI program. The CGI program contacts the database and requests information for the user. In this case, it looks for televisions at an online store.

**Step 4**
The CGI program receives information from the database, assembles it in markup language format, and sends it to the user's Web browser.
Web Page Development

- Programmers write scripts, applets, servlets, or ActiveX controls using a variety of languages:
  - JavaScript
  - Perl
  - PHP
  - Rexx
  - Tcl
  - VBScript
Web Page Development

Dynamic HTML (DHTML) allows Web developers to include more graphical interest and interactivity.

- Cascading style sheets (CSS) contain the formats for how a particular object should be displayed.

Ruby on Rails (RoR) provides technologies for developing object-oriented, database-driven Web sites.
Web Page Development

- Web 2.0 allows Web sites to provide a means for users to:
  - Share personal information
  - Allow users to modify Web site content
  - Have application software built into the site
Web Page Development

• Most Web 2.0 sites use APIs
  – An API enables programmers to interact with an environment such as a Web site or operating system
Web Page Development

- **Web page authoring software** can create sophisticated Web pages that include images, video, audio, animation, and other effects.

![Diagram showing Dreamweaver, Expression Web, Flash, SharePoint Designer]
Multimedia Program Development

- **Multimedia authoring software** allows programmers to combine text, graphics, animation, audio, and video in an interactive presentation.

![ToolBook](image1.png) ![Director](image2.png)
Figure 13-22

InsulinTech Monitor

This is ideal if you're looking for the convenience of a small device with less pain. No other meter gives you such fast results.

When finished, click the NEXT button to continue.

Features

- 7-Day Average
- 14-Day Average
- Time-Specific
- Marking
- Insuling Recording
- Memory

7-Day Average

InsulinTech Monitoring Systems allow you to review the average of all test results taken in the last 7 days.
Program Development

- Program development consists of a series of steps programmers use to build computer programs.
Step 1 – Analyze Requirements

• To initiate program development, programmer:
  – Reviews the requirements
  – Meets with the systems analyst and users
  – Identifies input, processing, and output

• IPO chart

<table>
<thead>
<tr>
<th><strong>Input</strong></th>
<th><strong>Processing</strong></th>
<th><strong>Output</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular Time Hours Worked</td>
<td>Read regular time hours worked, overtime hours worked, hourly pay rate.</td>
<td>Gross Pay</td>
</tr>
<tr>
<td>Overtime Hours Worked</td>
<td>Calculate regular time pay.</td>
<td></td>
</tr>
<tr>
<td>Hourly Pay Rate</td>
<td>If employee worked overtime, calculate overtime pay.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Calculate gross pay.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Print gross pay.</td>
<td></td>
</tr>
</tbody>
</table>
Step 2 – Design Solution

• Design a solution algorithm
• In **structured design**, the programmer typically begins with a general design and moves toward a more detailed design
• Programmers use a **hierarchy chart** to show program modules graphically
Step 2 – Design Solution

Figure 13-25
Step 2 – Design Solution

- With **object-oriented (OO)** design, the programmer packages the data and the program into a single object
  - Encapsulation
Step 2 – Design Solution

- The sequence control structure shows one or more actions following each other in order.
Step 2 – Design Solution

The selection control structure tells the program which action to take, based on a certain condition:
- If-then-else
- Case
Step 2 – Design Solution

![Case Control Structure Diagram](image)

- **Condition**
  - Condition 1
  - Condition 2
  - Condition 3
  - Condition 4

- **Actions**
  - Action 1
  - Action 2
  - Action 3
  - Action 4
Step 2 – Design Solution

• The repetition control structure enables a program to perform one or more actions repeatedly as long as a certain condition is met.
Step 2 – Design Solution

- A program **flowchart** graphically shows the logic in a solution algorithm.
Step 2 – Design Solution

- **Flowcharting software** makes it easy to modify and update flowcharts
  - SmartDraw
  - Visio
Step 2 – Design Solution

- Pseudocode uses a condensed form of English to convey program logic.

```plaintext
MAIN MODULE:
CALL Initialization
CALL Process
CALL Wrap-Up
END

PROCESS MODULE:
DO WHILE Not EOF
  CALL Read a Record
  CALL Calculate
  CALL Accumulate Totals
  CALL Print Detail Line
ENDDO
RETURN

CALCULATE OVERTIME PAY MODULE:
IF Hours Worked > 40 THEN
  Overtime Pay = Overtime Hours * 1.5 * Pay Rate
ELSE
  Overtime Pay = 0
ENDIF
RETURN
```
Step 2 – Design Solution

- UML (Unified Modeling Language) has been adopted as a standard notation for object modeling and development.
Step 3 – Validate Design

• Check for **logic errors using test data**

- Develop various sets of test data
- Determine the expected result
- Step through the algorithm
- Compare the results
- Repeat steps for each set of test data
Step 4 – Implement Design

- **Implementation** of the design includes using a program development tool that assists the programmer by:
  - Generating or providing some or all code
  - Writing the code that translates the design into a computer program
  - Creating the user interface

- Extreme programming is a strategy where programmers immediately begin coding and testing solutions as soon as requirements are defined.
The goal of program testing is to ensure the program runs correctly and is error free.

- Errors include syntax errors and logic errors.
- **Debugging** the program involves removing the bugs.
- A **beta** is a program that has most or all of its features and functionality implemented.
Step 6 – Document Solution

- In documenting the solution, the programmer performs two activities:
  - Review the program code
  - Review all the documentation
Video: Electronic Arts Going Mobile

CLICK TO START

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Summary

Various programming languages used to create computer programs

A variety of Web development and multimedia development tools

Steps in the program development life cycle and tools used to make this process efficient
Chapter 13
Computer Programs and Programming Languages

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Chapter 13 Complete