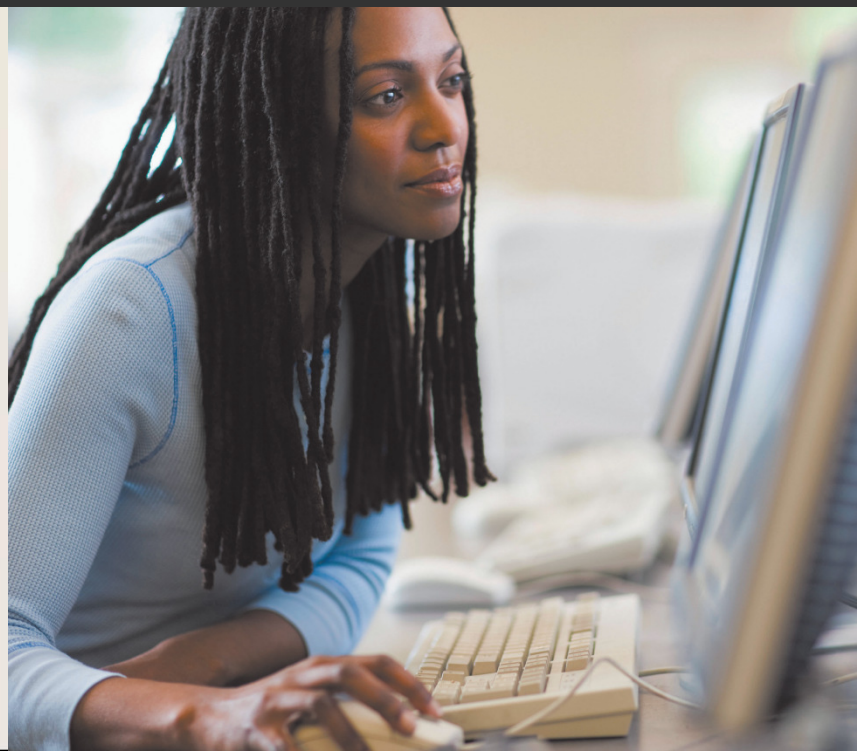
Chapter Thirteen

Programming Languages and Program Development

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

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**

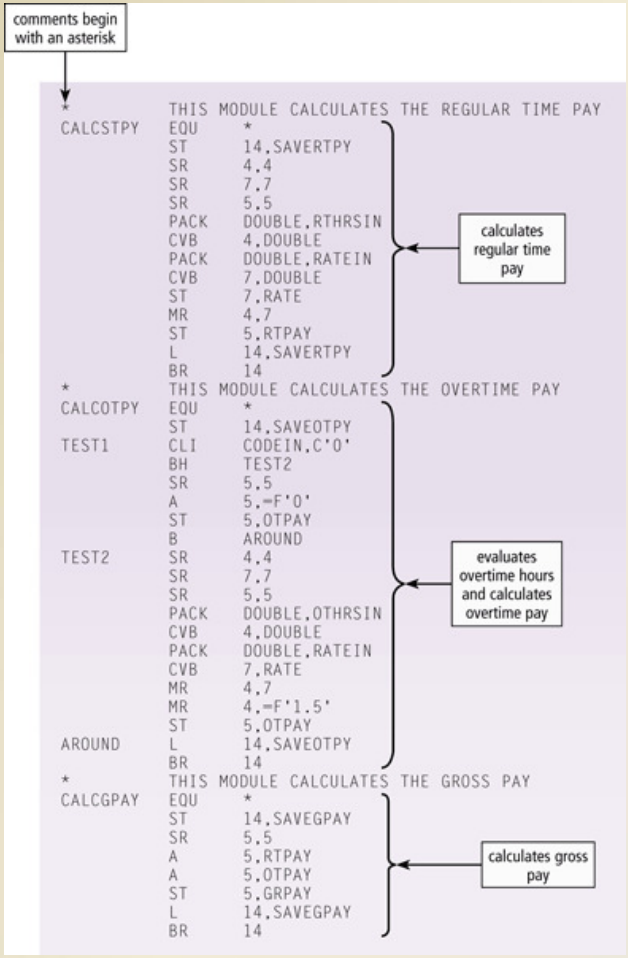
Pages 664 – 665
Figure 13-1

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
                                          00122
000122   50E0   30BA                      010BC
000126   1B55
000128   5A50   304E                      01050
00012C   5B50   3052                      01054
000130   5050   305A                      0105C
000134   58E0   30BA                      010BC
000138   07FE
```

Low-Level Languages

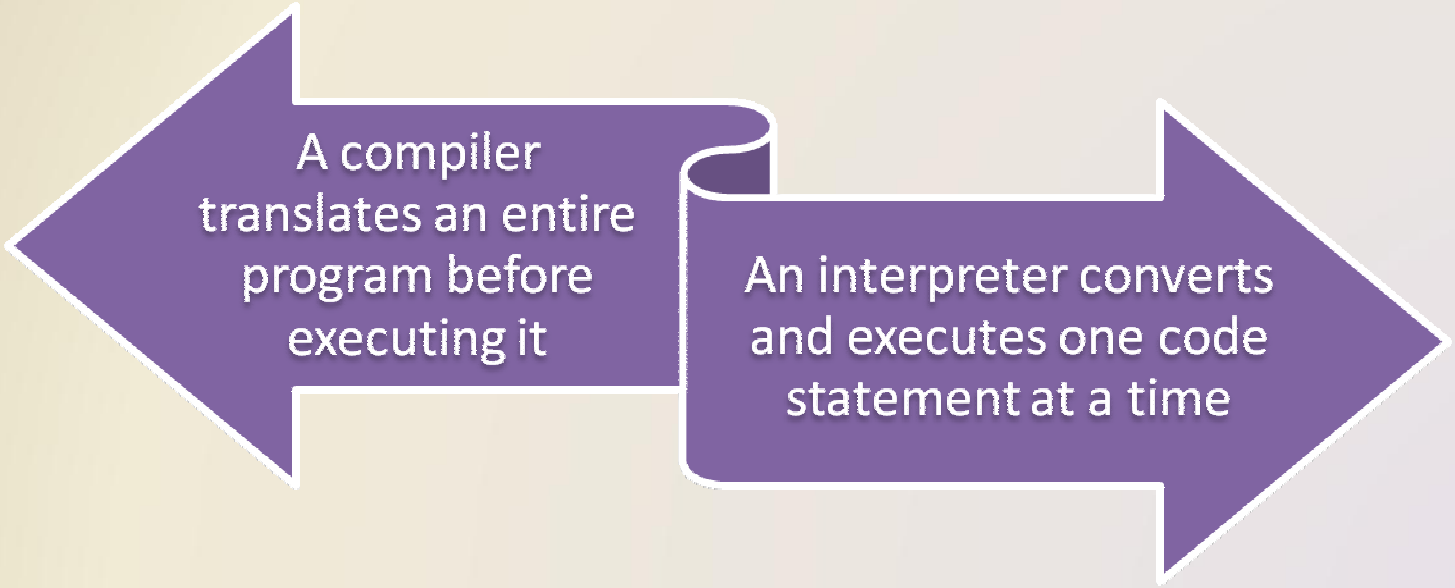


- **Assembly language** is the second generation of programming languages
- Programmer writes instructions using symbolic instruction codes
- A **source program** contains the code to be converted to machine language

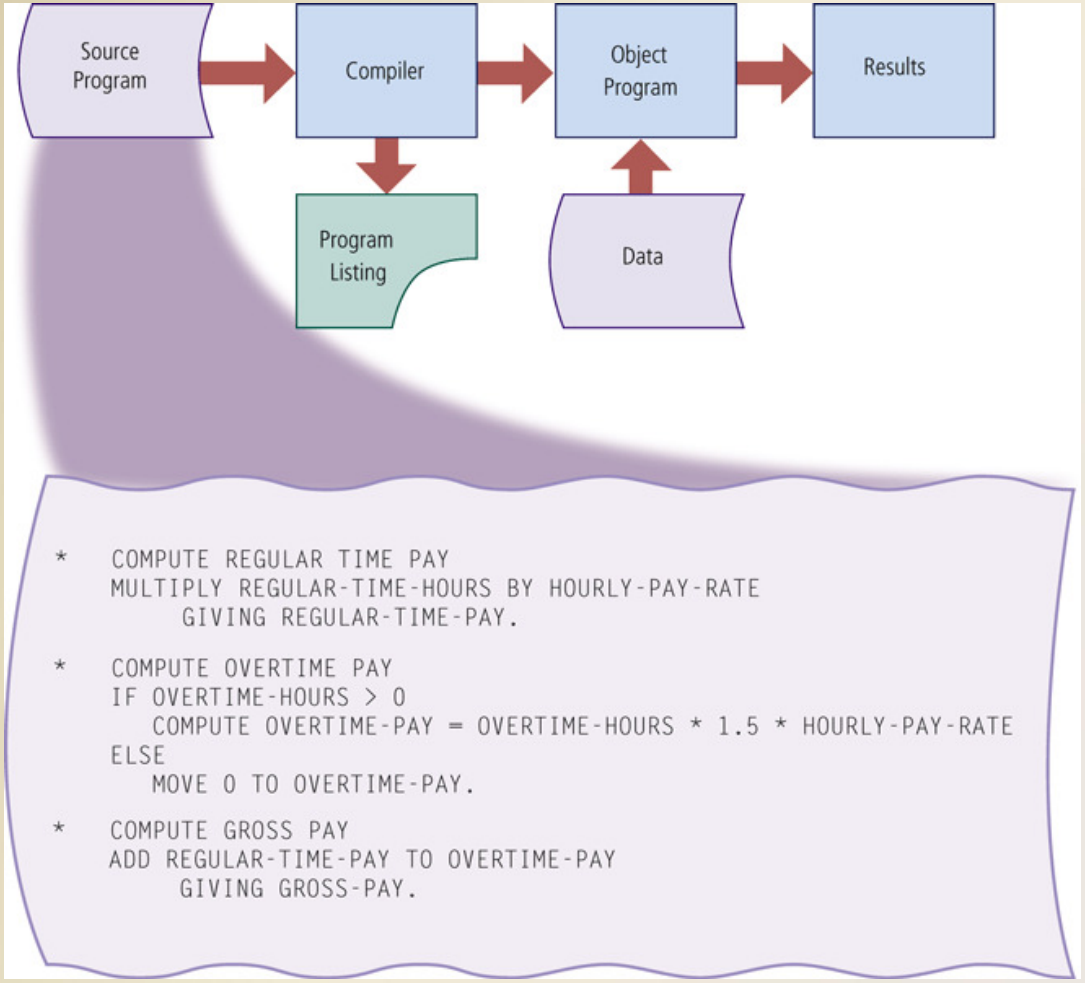
Pages 665 – 666
Figure 13-3

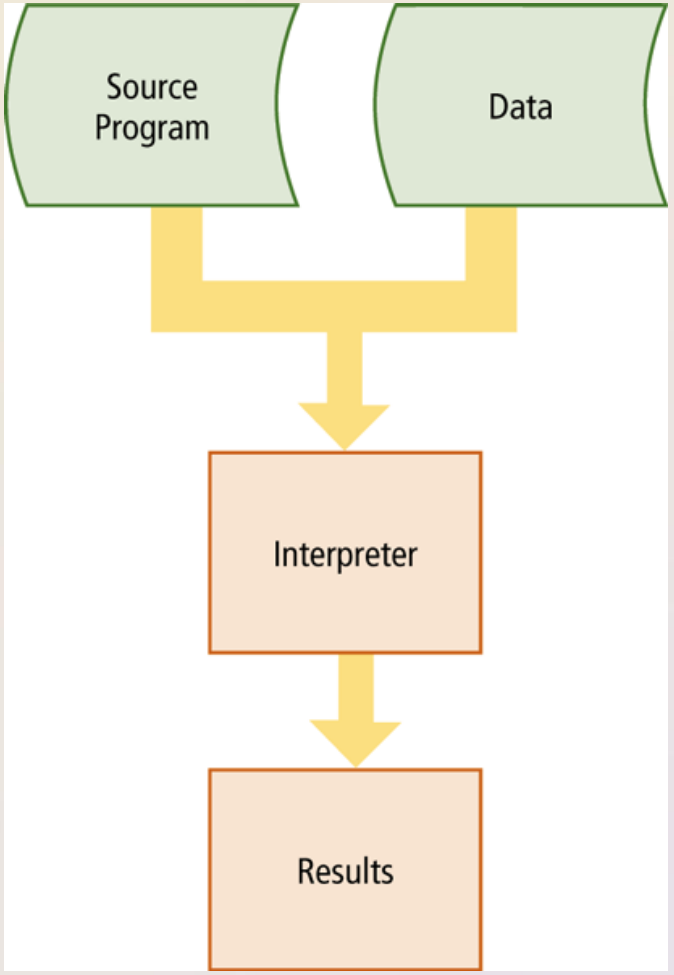
Procedural Languages

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



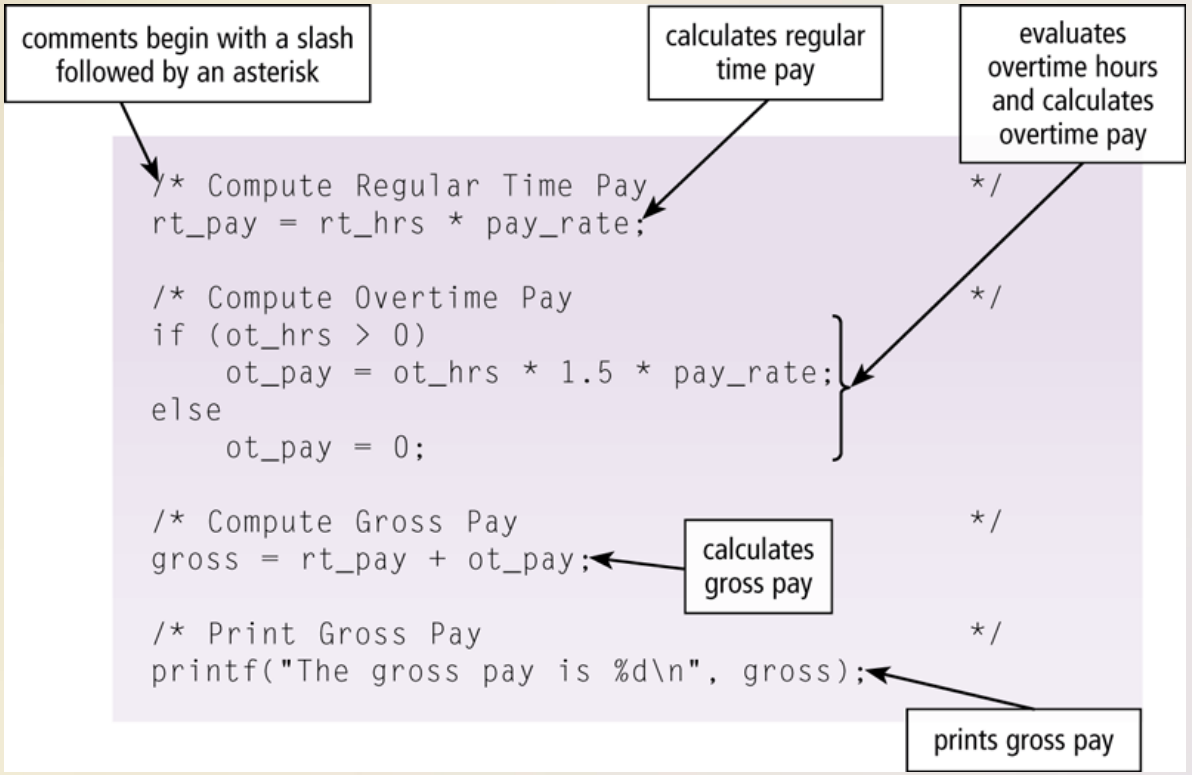
Procedural Languages





Procedural Languages

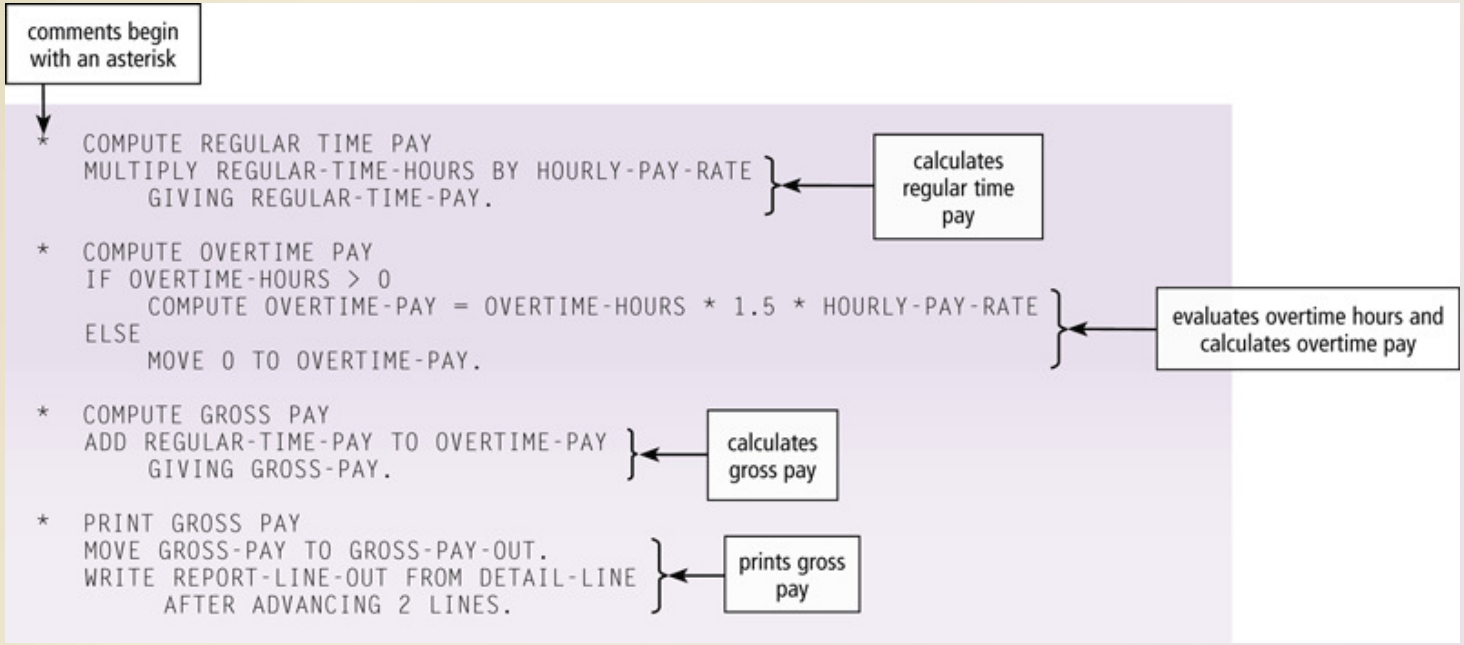
- The C programming language is used to write many of today's programs



Page 668
Figure 13-6

Procedural Languages

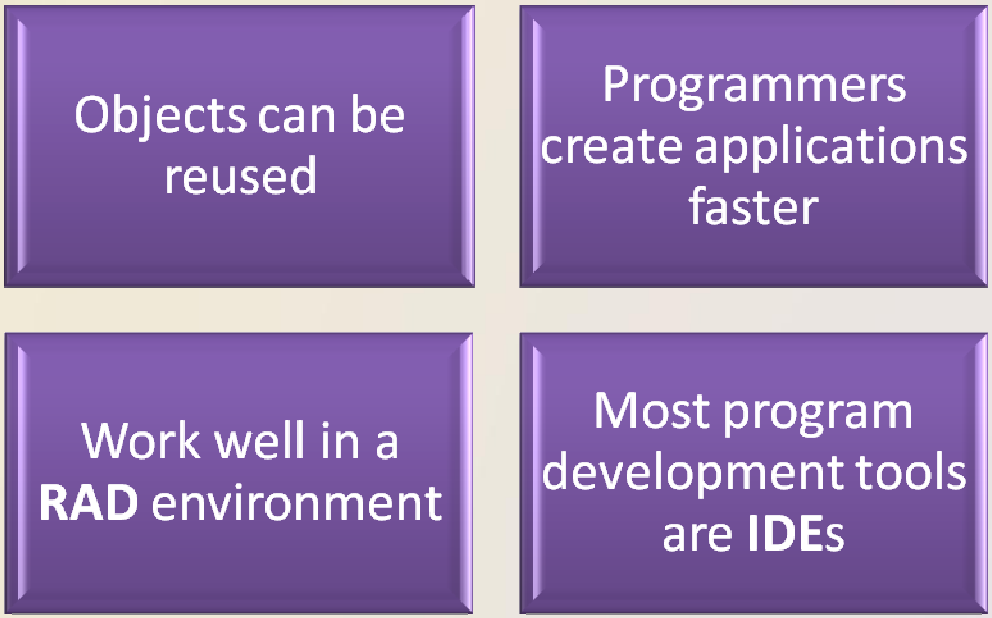
- **COBOL** (COmmon Business-Oriented Language) is designed for business applications, but easy to read because of the English-like statements



Pages 668 – 669
Figure 13-7

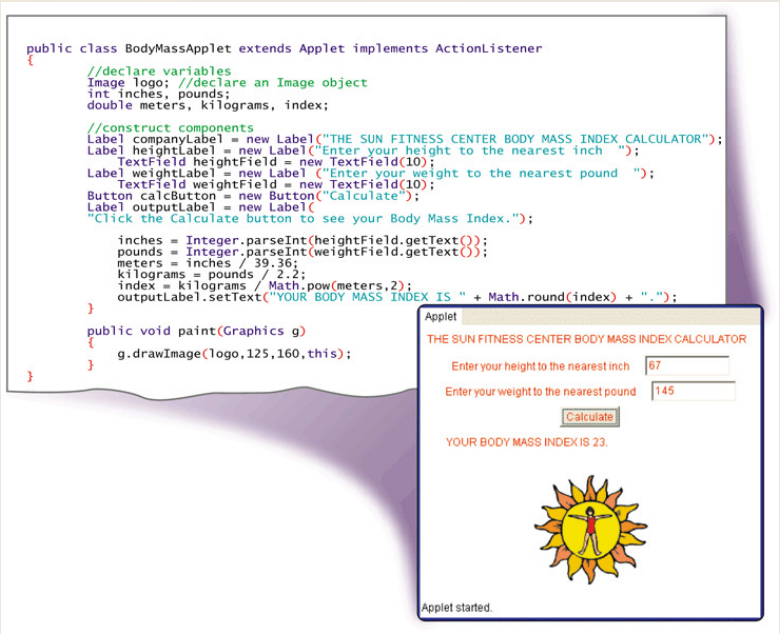
Object-Oriented Programming Languages and Program Development Tools

- An **object-oriented programming** (**OOP**) **language** allows programmers the ability to reuse and modify existing objects
- Other advantages include:



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



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

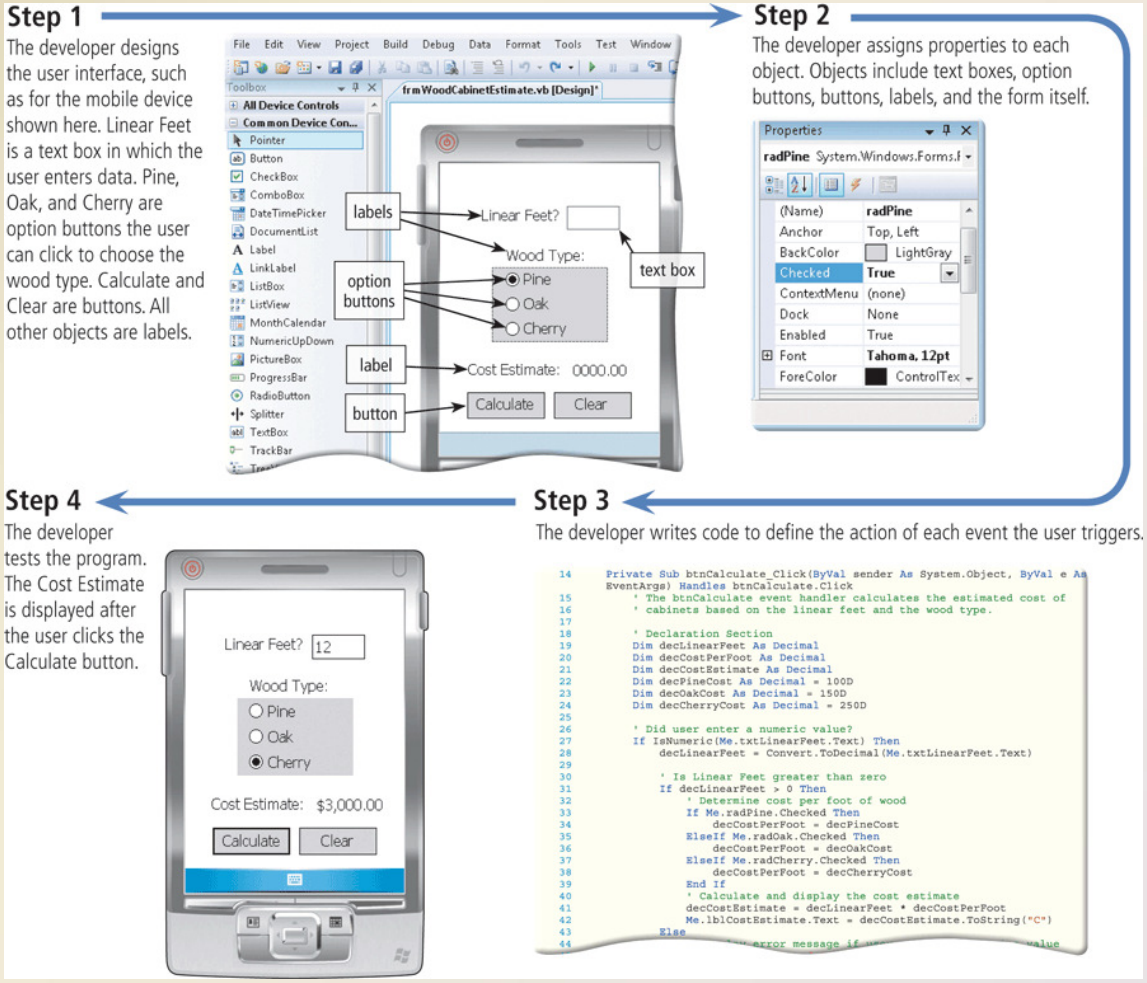
```
// portion of a C++ program that allows users to create
// a new zip code from a string or a number and expand
// zip codes, as appropriate, to a 10-digit number

ZipC::ZipC( const unsigned long zipnum )
{
  ostringstream strInt;
  strInt << zipnum;
  code = strInt.str();
}

const string ZipC::getCode()
{
  return code;
}

void ZipC::setCode(const string newCode)
{
  code = newCode;
}

void ZipC::expand( const string suffix )
{

  if(code.length() == 5 &&       // small size?
     suffix.length() == 4)       // length ok?
  {
     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

Object-Oriented Programming Languages and Program Development Tools

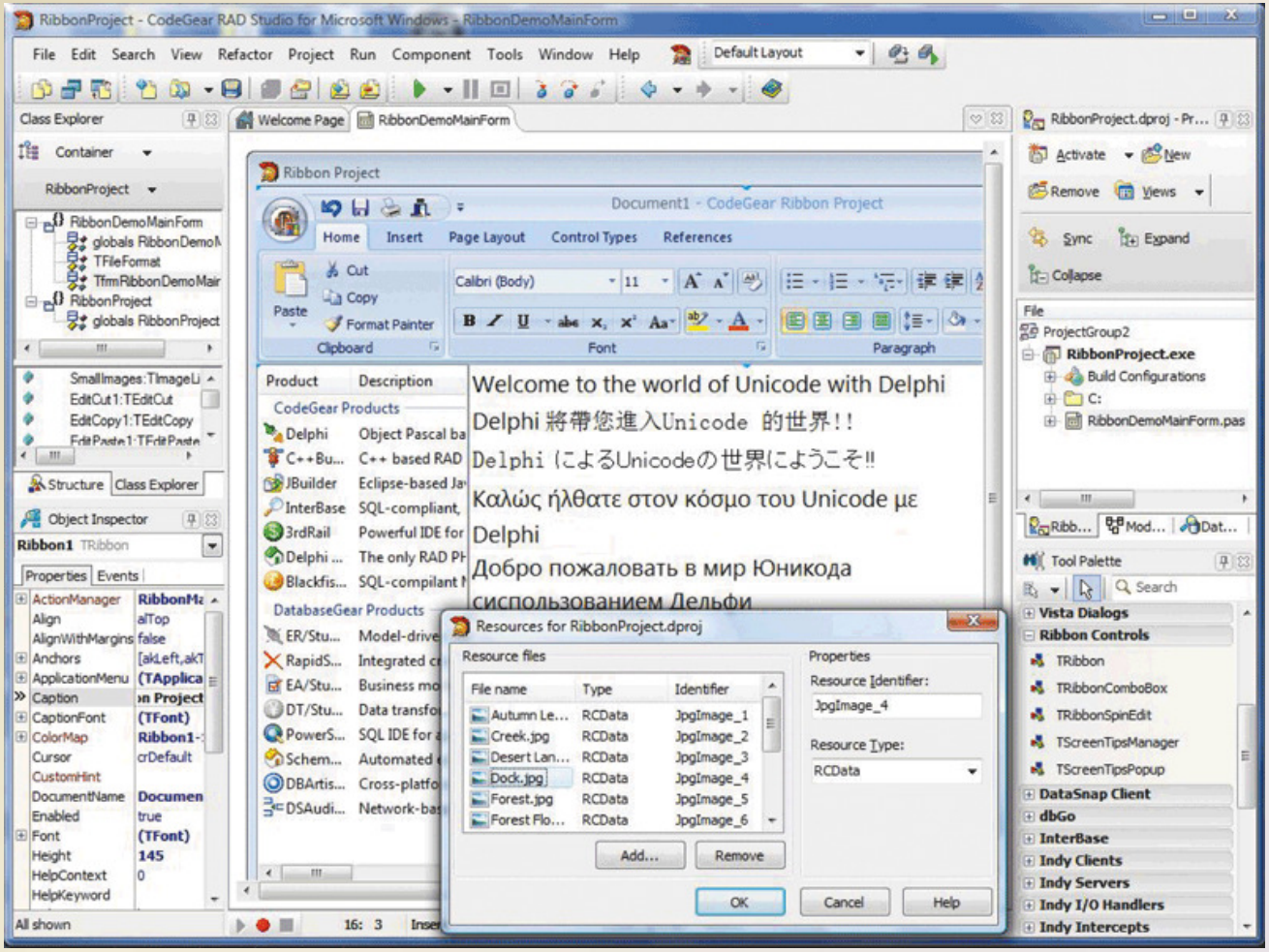


Object-Oriented Programming Languages and Program Development Tools

A **visual programming language** is a language that uses a visual or graphical interface for creating all source code

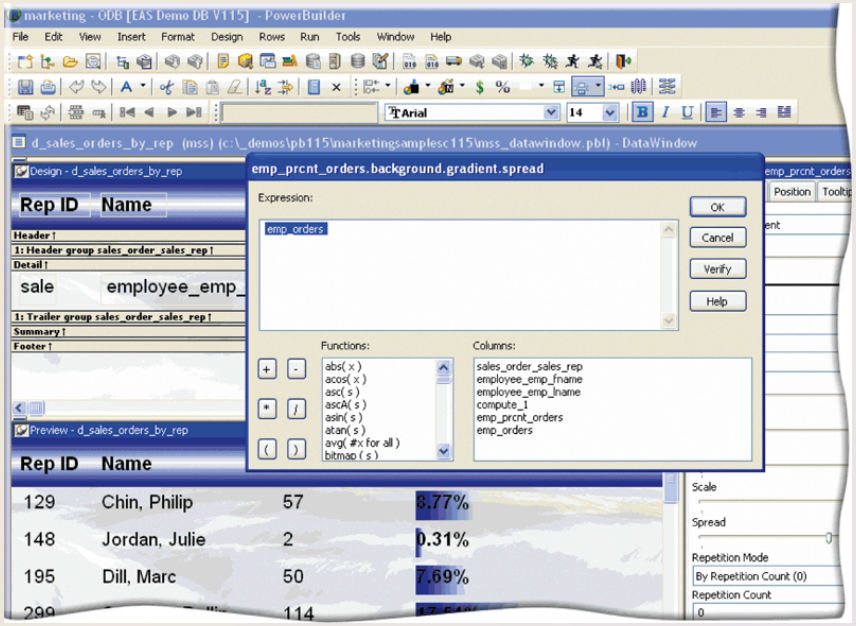
Borland's **Delphi** is a powerful program development tool that is ideal for building large-scale enterprise and Web applications in a RAD environment

Object-Oriented Programming Languages and Program Development Tools



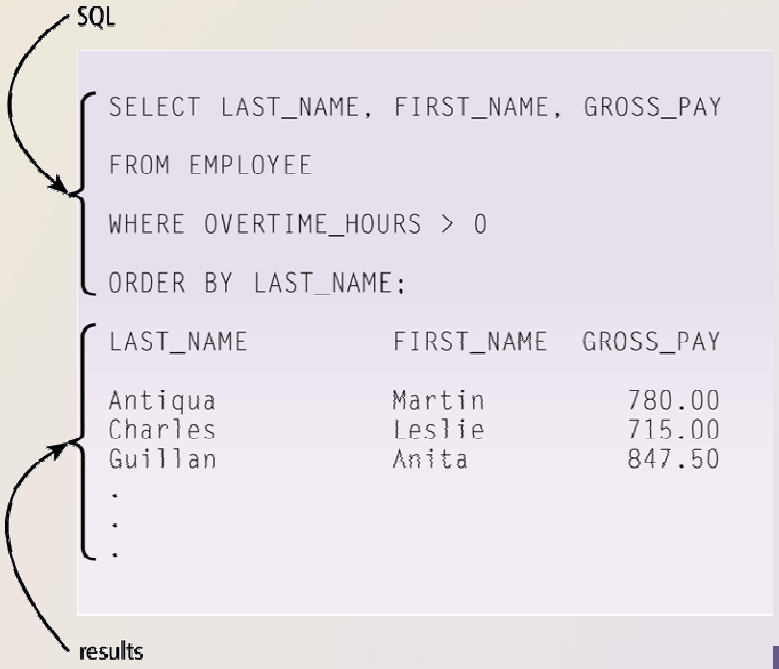
Object-Oriented Programming Languages and Program Development Tools

- **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**



Other Programming Languages and Development Tools

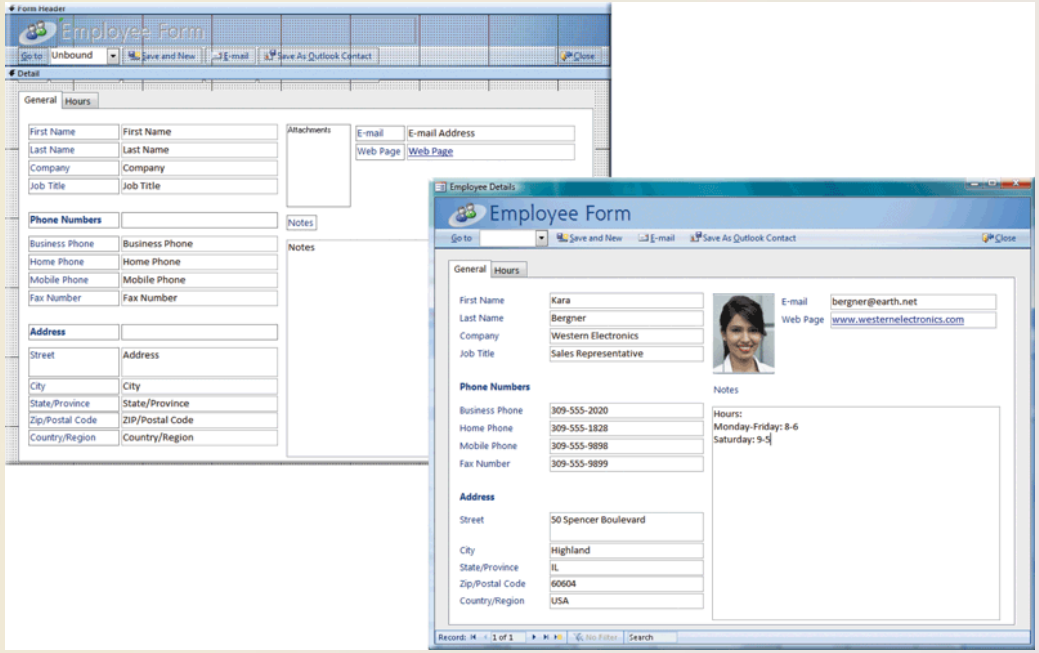
- Classic programming languages include:

Ada	ALGOL	APL	BASIC
Forth	FORTRAN	HyperTalk	LISP
Logo	Modula-2	Pascal	PILOT
PL/1	Prolog	RPG	Smalltalk

Page 675
Figure 13-14

Other Programming Languages and Development Tools

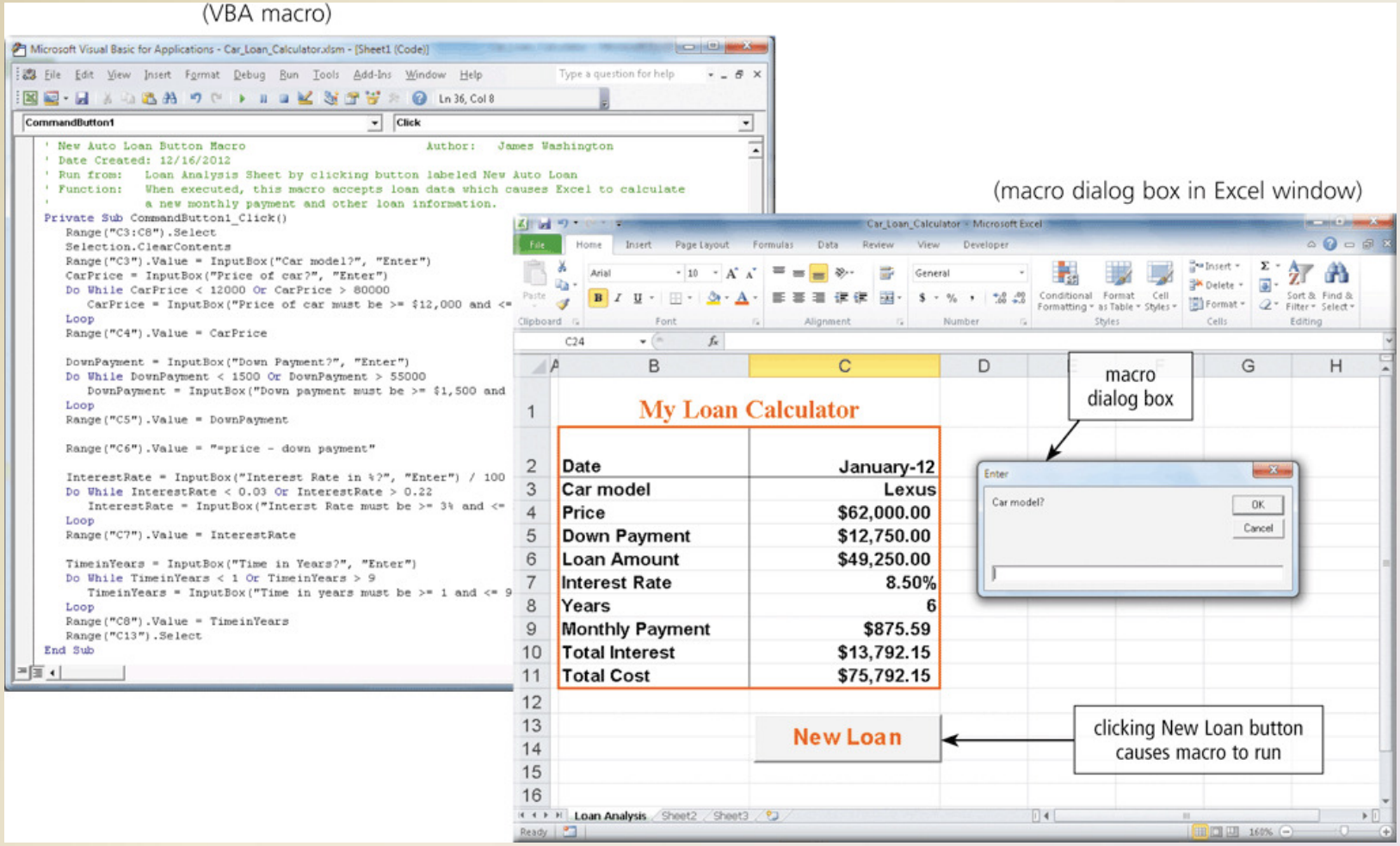
- An **application generator** is a program that creates source code or machine code from a specification of the required functionality
  - Often bundled as part of a DBMS



Other Programming Languages and Development Tools

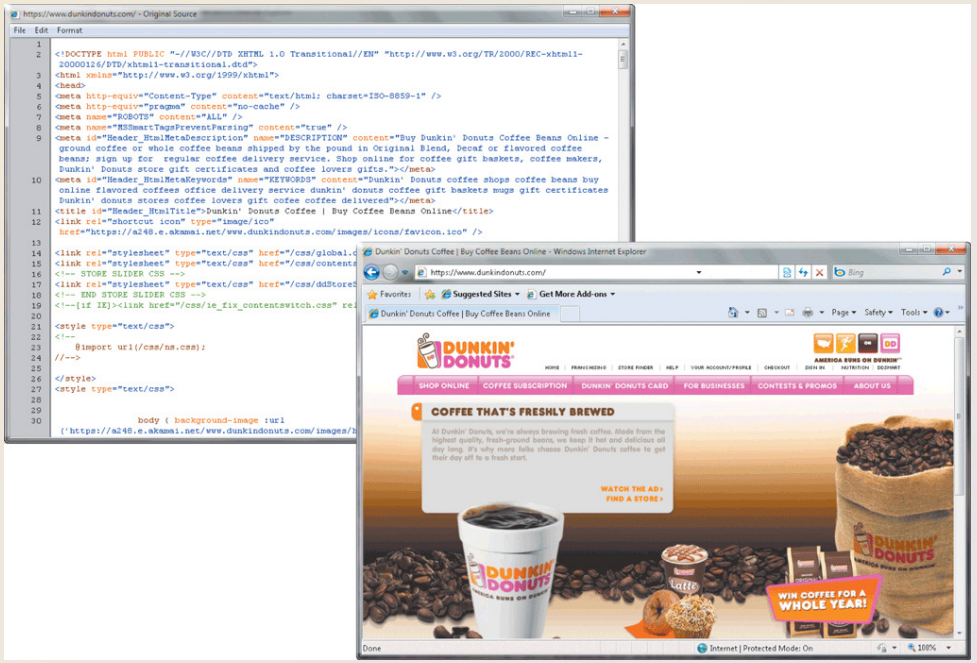
- A **macro** is a series of statements that instructs an application how to complete a task
- You usually create the macro in one of two ways:
  - Record the macro with a macro recorder
  - Write the macro

Other Programming Languages and Development Tools



Web Page Development

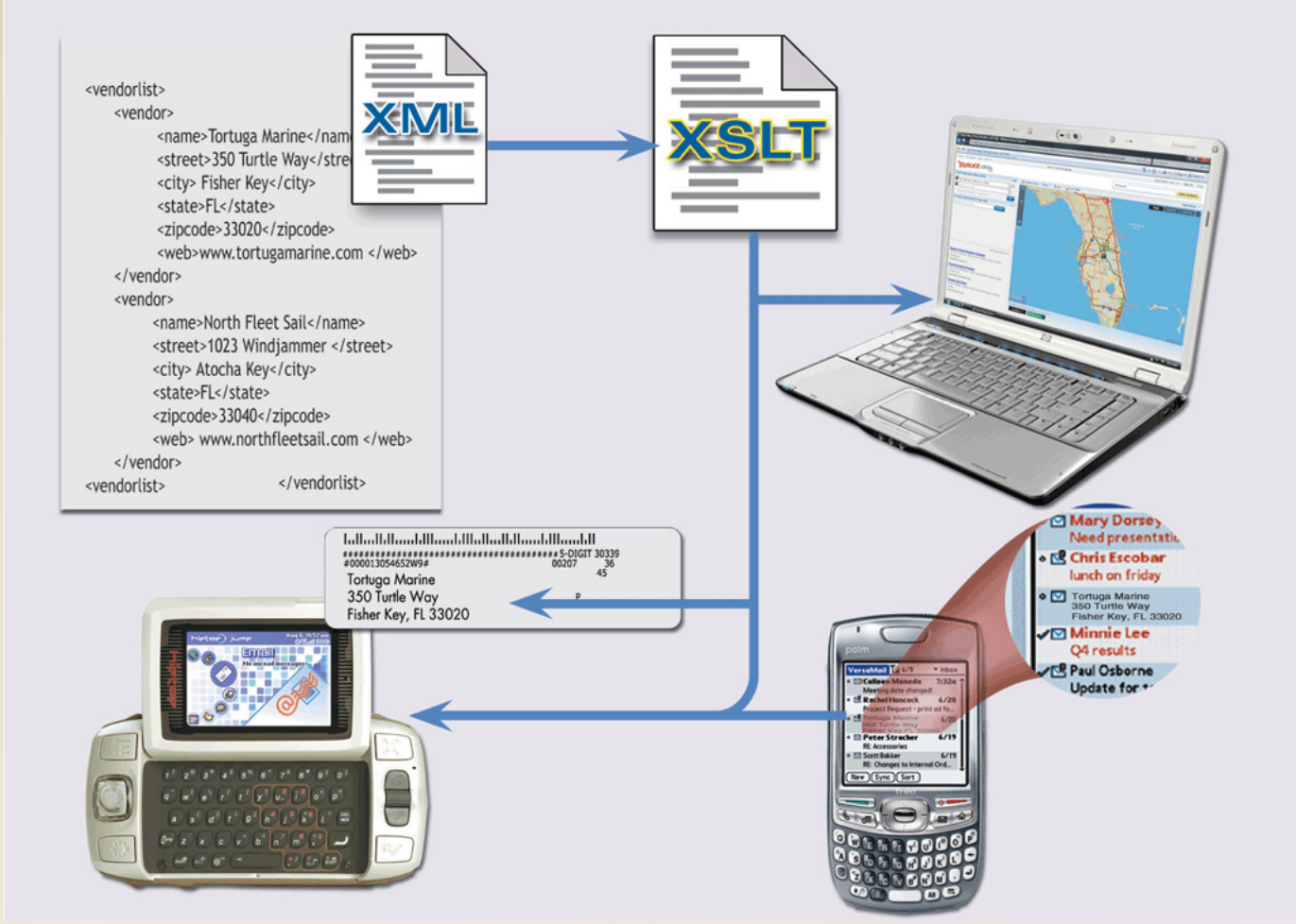
- **HTML** is a special formatting language that programmers use to format documents for display on the Web
- **XHTML** is a markup language that allows Web sites to be displayed more easily on mobile devices



Web Page Development

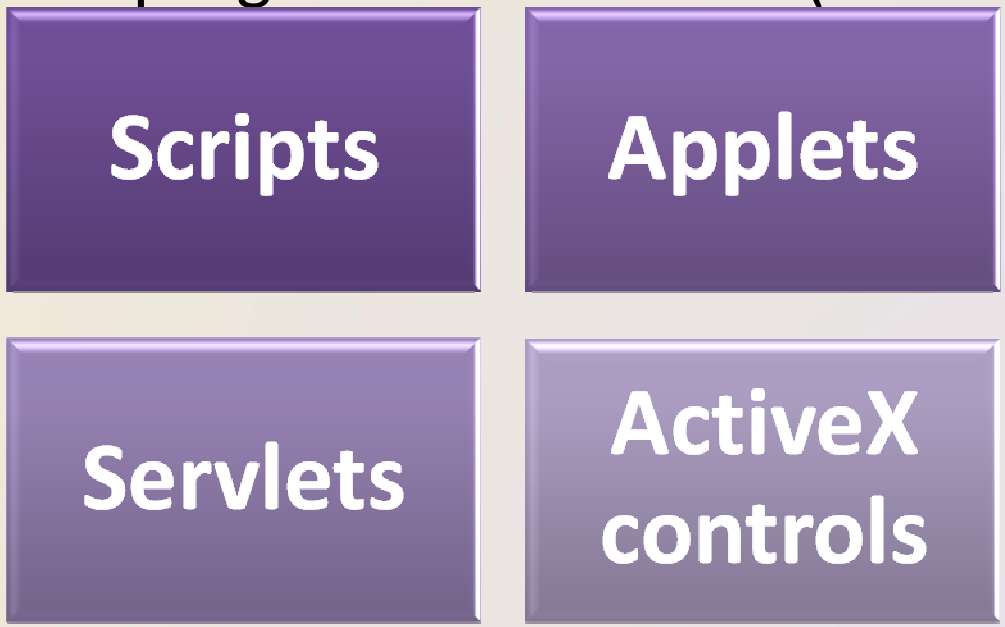
- **XML** allows Web developers to create customized tags and use predefined tags to display content appropriately on various devices
  - **WML** is a subset of XML and is used to design pages for microbrowsers
- Two applications of XML are **RSS 2.0** and **ATOM**

Web Page Development

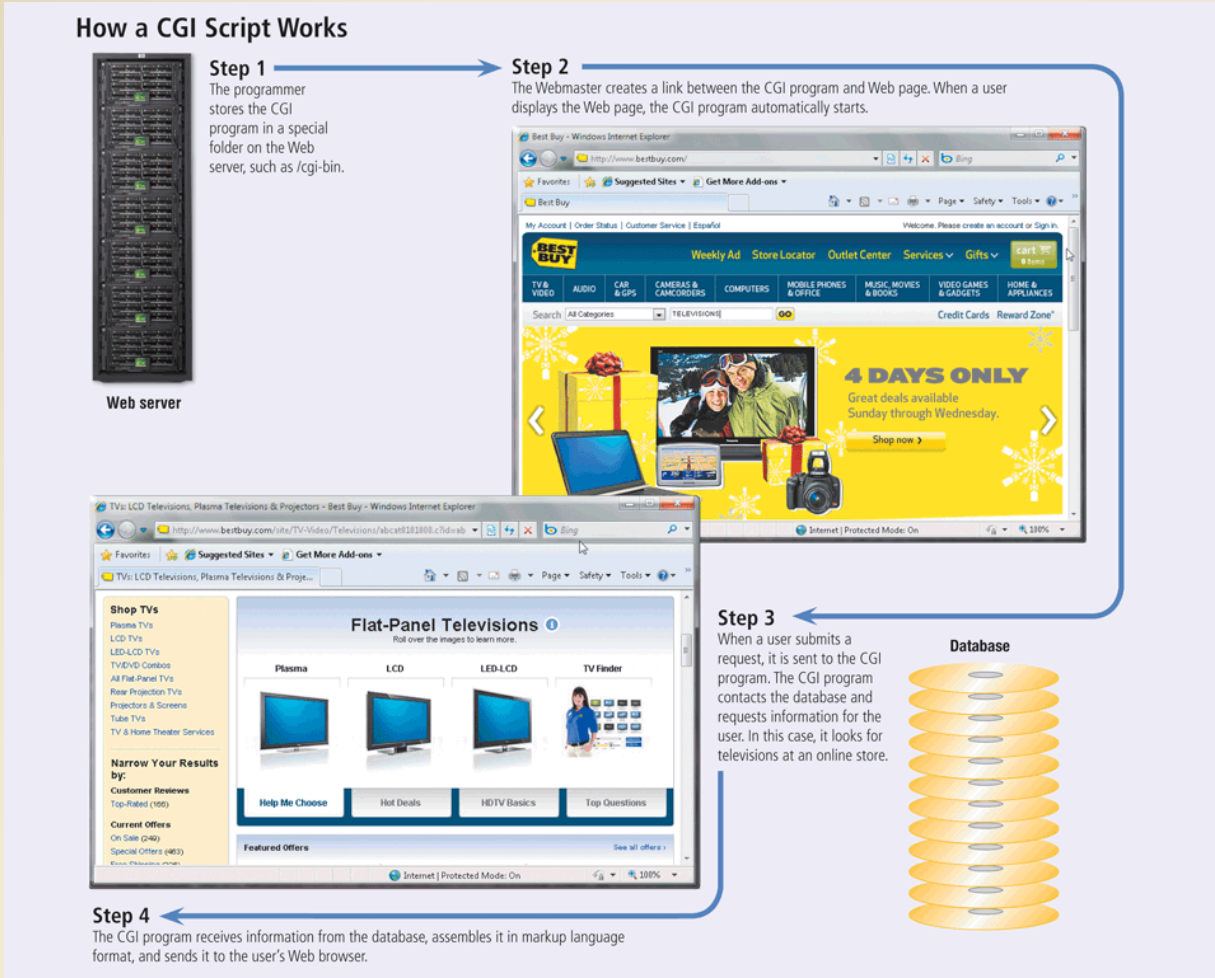


Web Page Development

- 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)

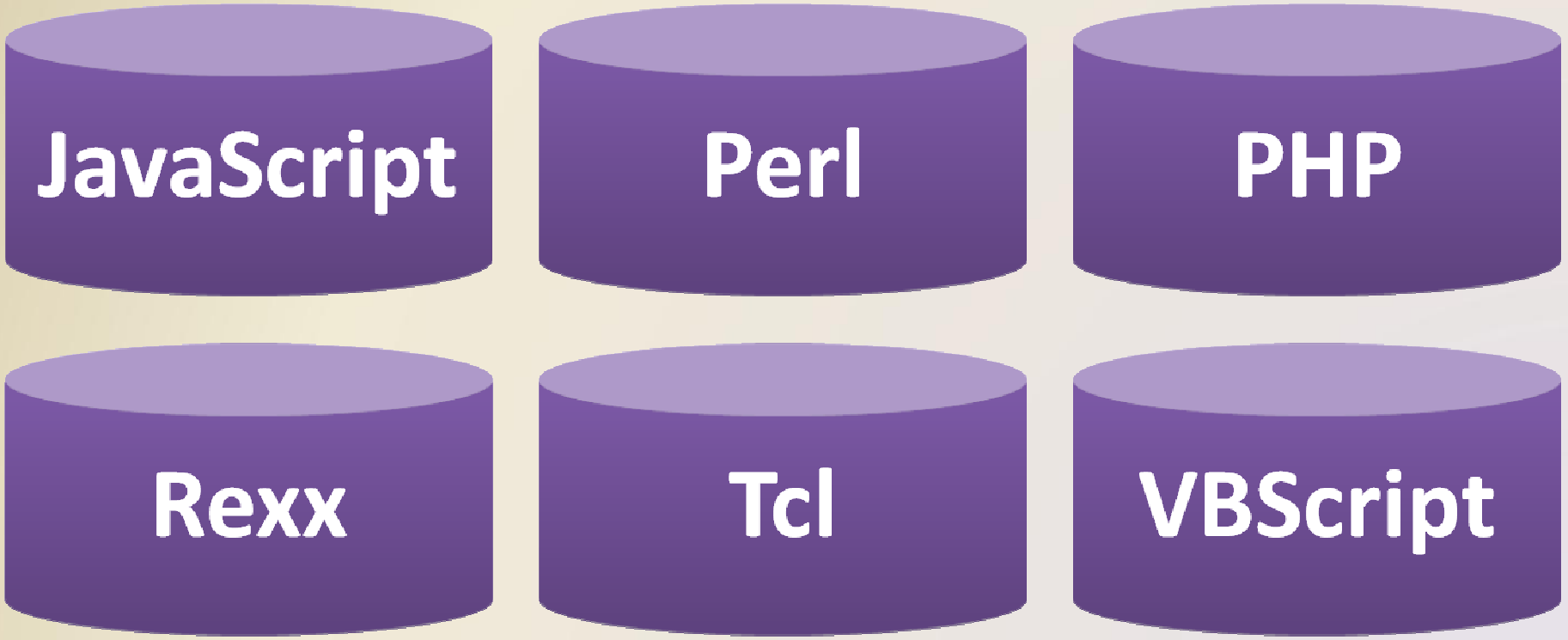


Web Page Development

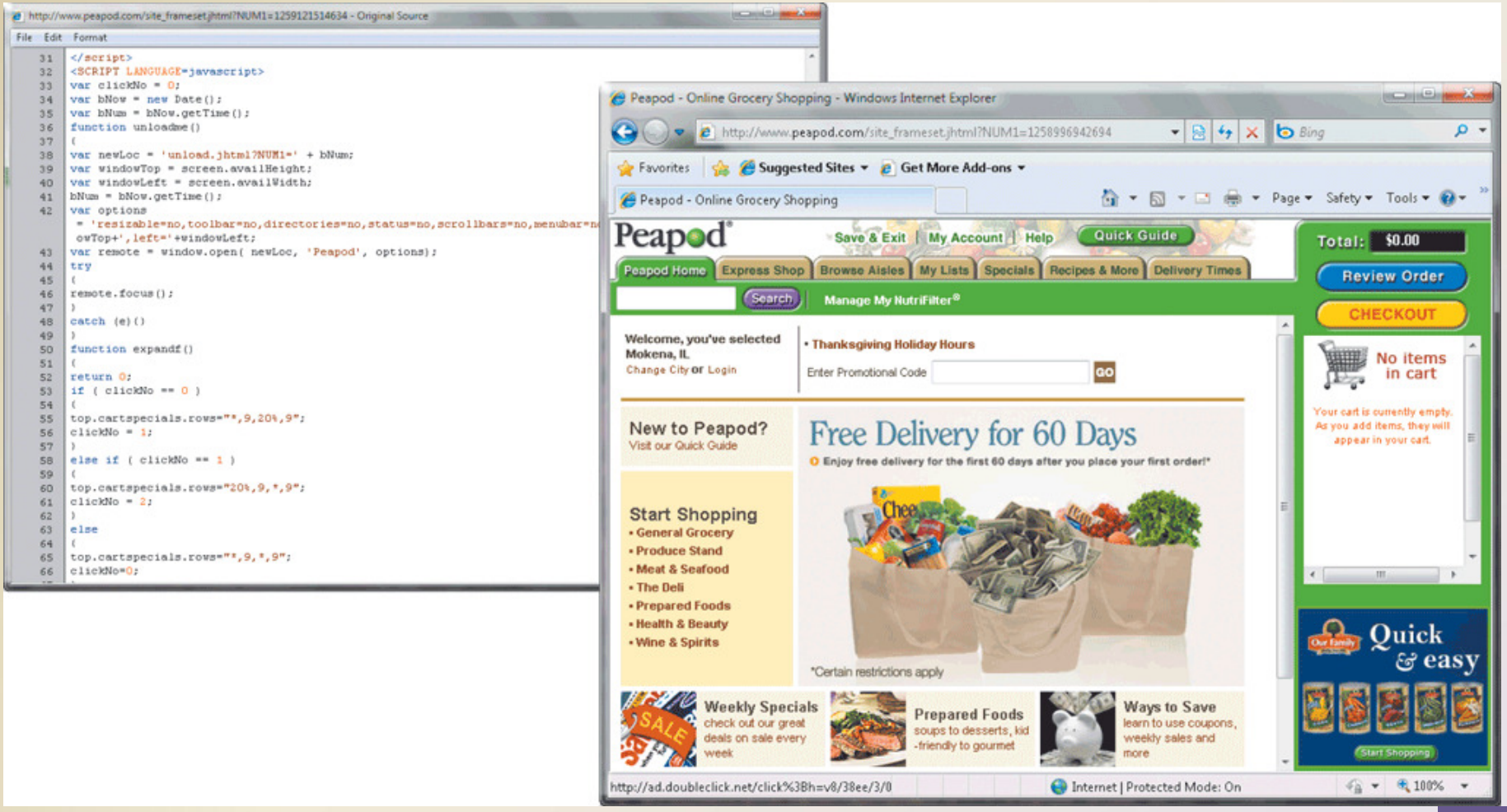


Web Page Development

- Programmers write scripts, applets, servlets, or ActiveX controls using a variety of languages



Web Page Development



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:

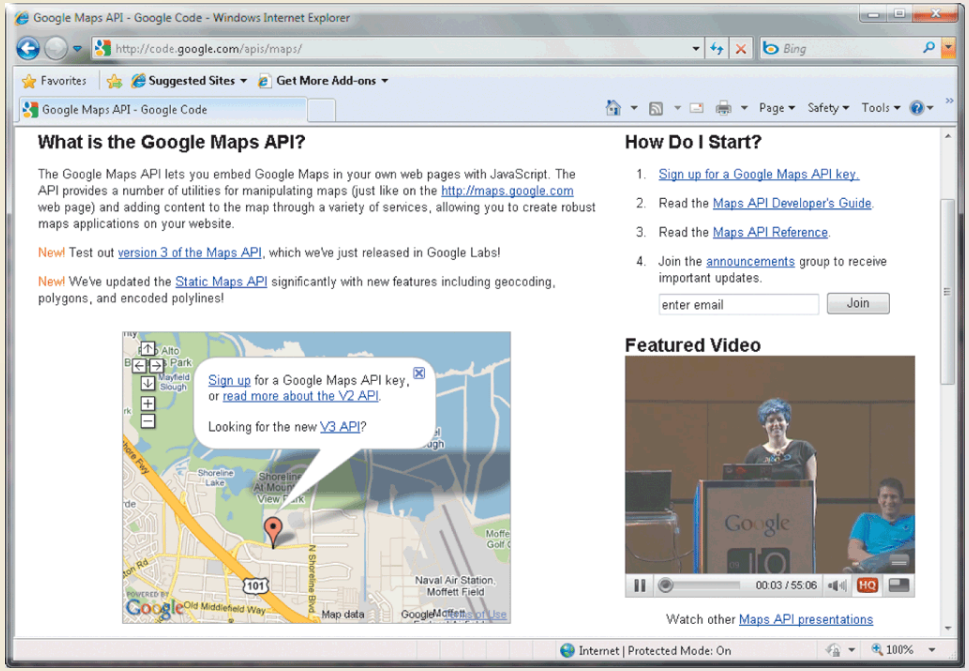
Share personal information

Allow users to modify Web site content

Have application software built into the site

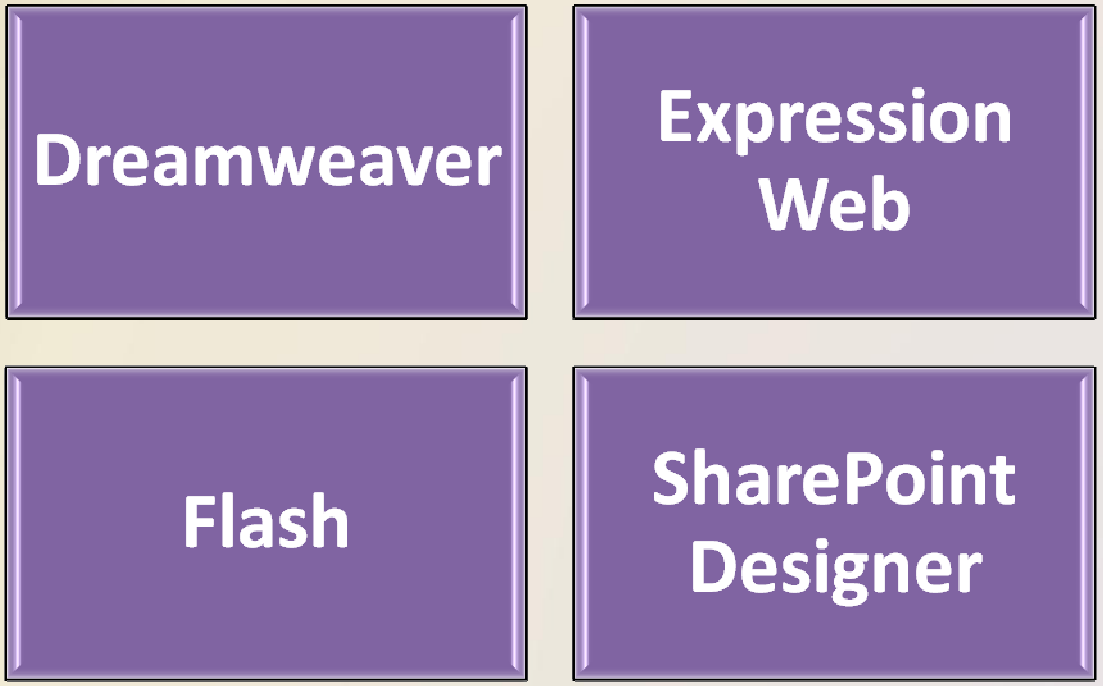
Web Page Development

- 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

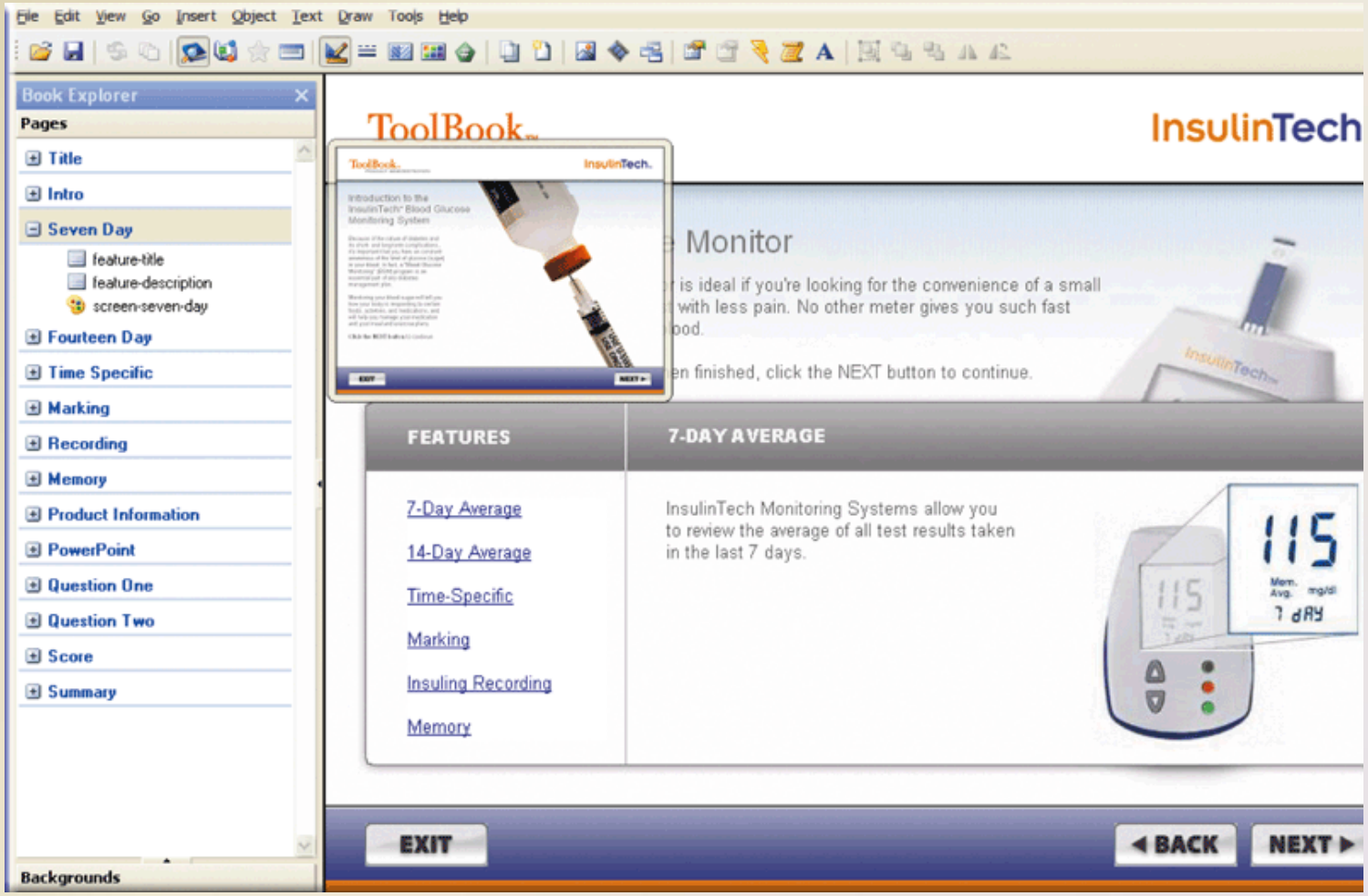
- **Web page authoring software** can create sophisticated Web pages that include images, video, audio, animation, and other effects



Multimedia Program Development

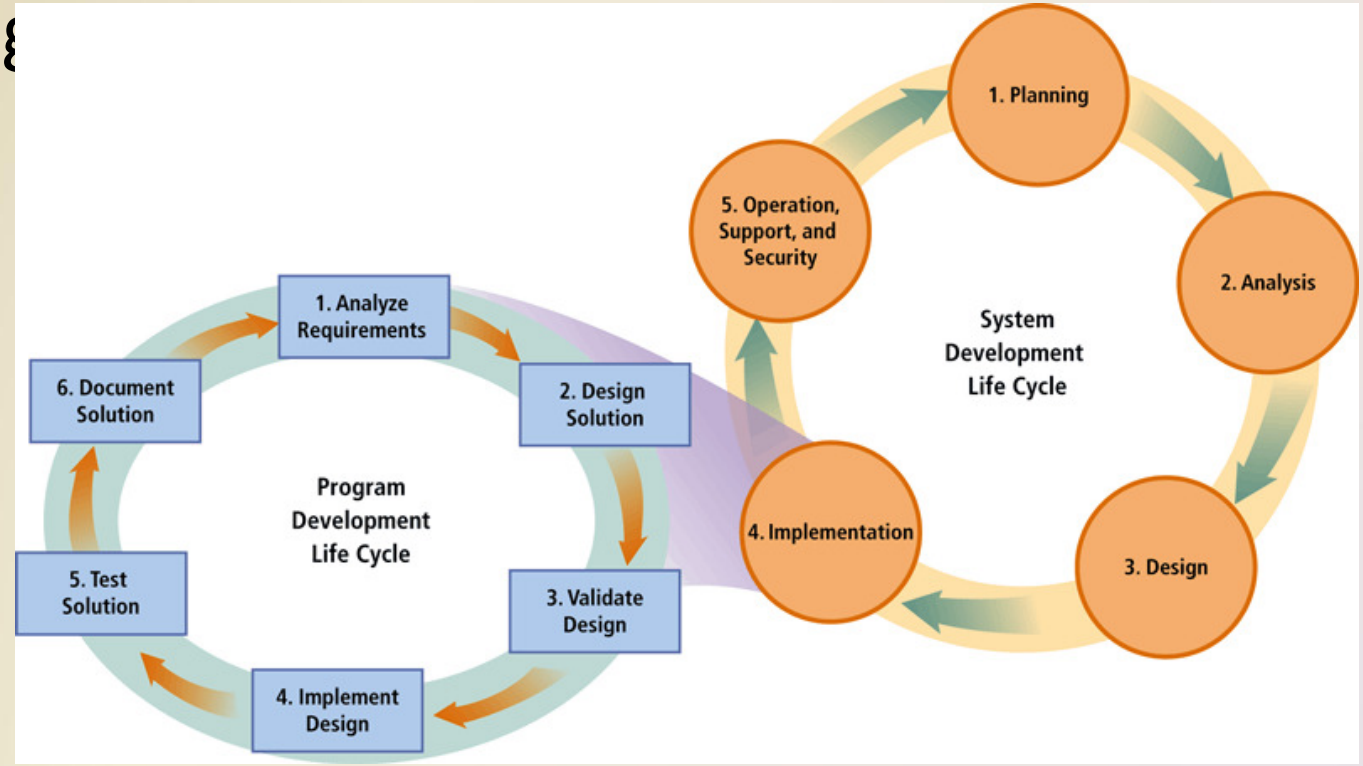
- **Multimedia authoring software** allows programmers to combine text, graphics, animation, audio, and video in an interactive presentation

Multimedia Program Development



Program Development

- **Program development** consists of a series of steps programmers use to build computer prog



Page 686
Figure 13-23

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

IPO Chart

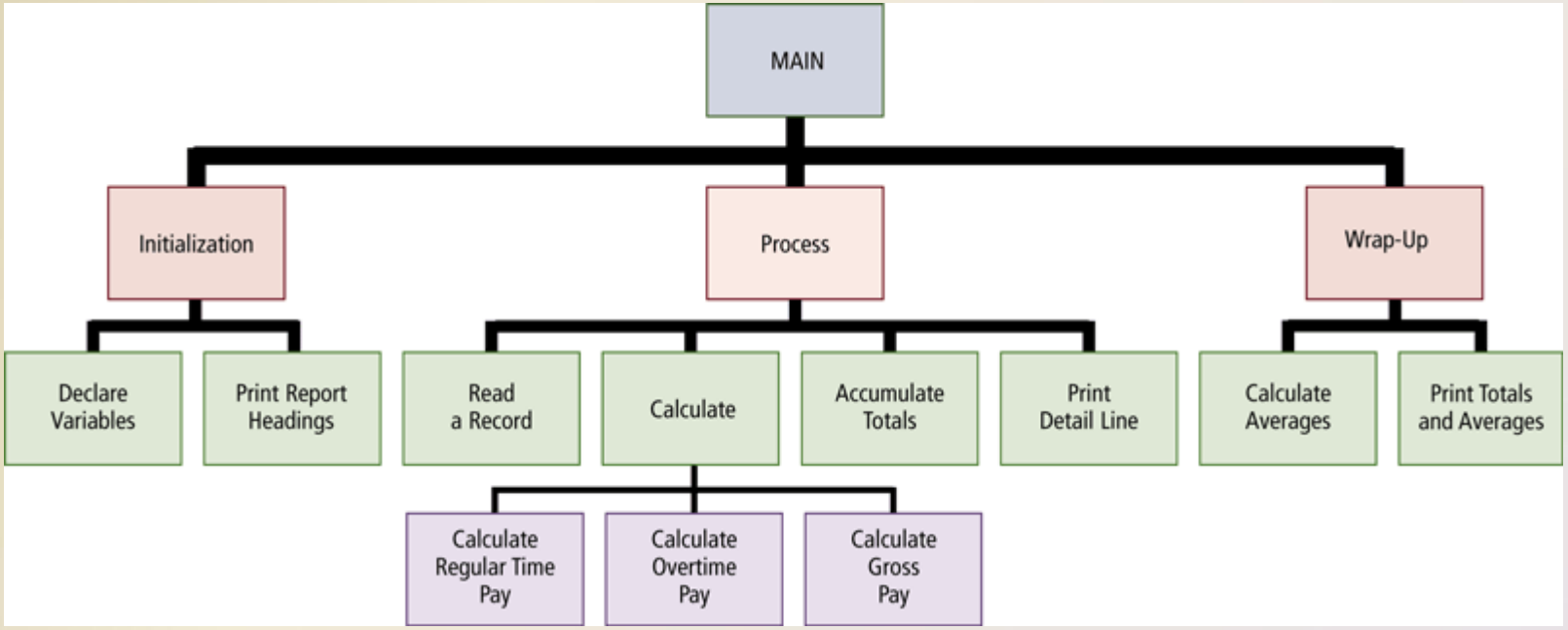
Input	Processing	Output
Regular Time Hours Worked Overtime Hours Worked Hourly Pay Rate	Read regular time hours worked, overtime hours worked, hourly pay rate. Calculate regular time pay. If employee worked overtime, calculate overtime pay. Calculate gross pay. Print gross pay.	Gross Pay

Page 687
Figure 13-24

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

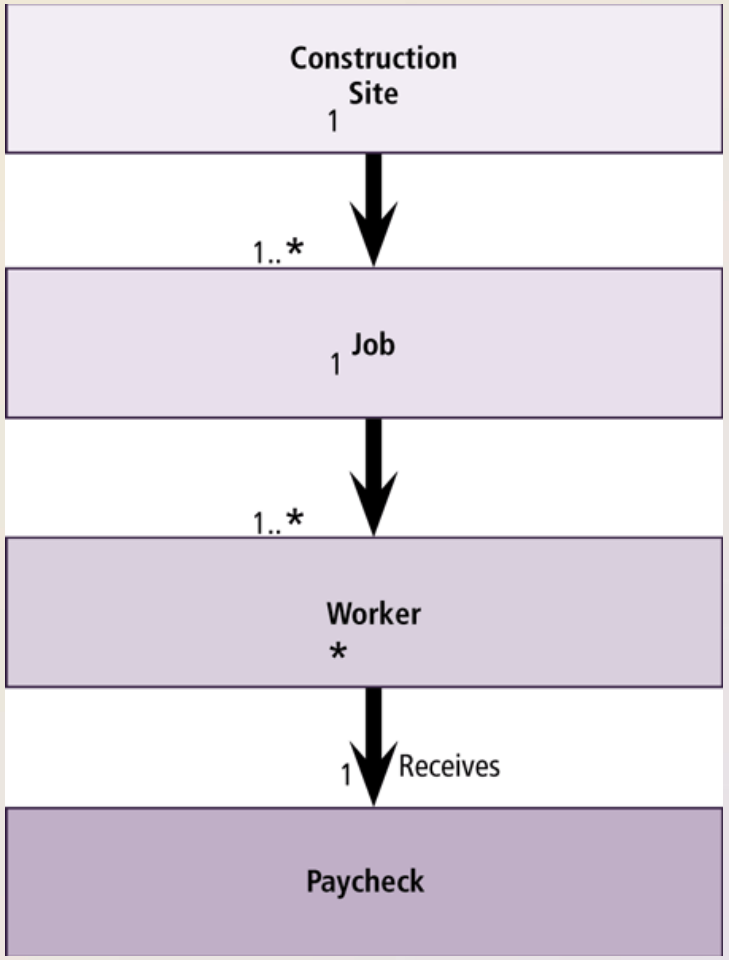
Step 2 – Design Solution



Page 688
Figure 13-25

Step 2 – Design Solution

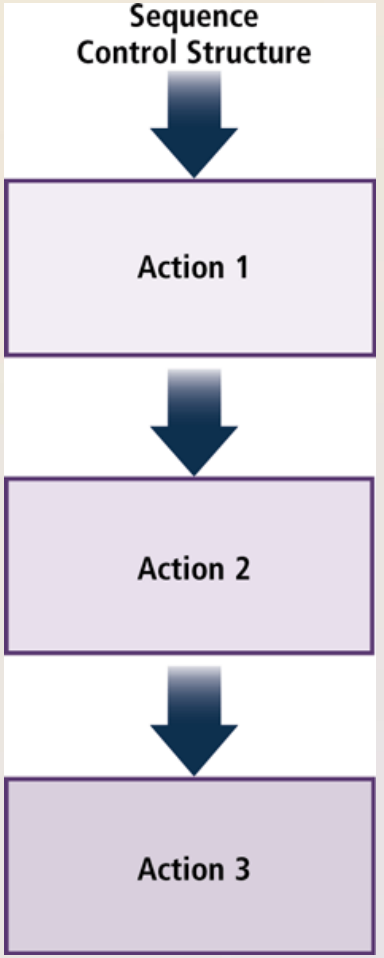
- With **object-oriented** (**OO**) design, the programmer packages the data and the program into a single object
  - Encapsulation



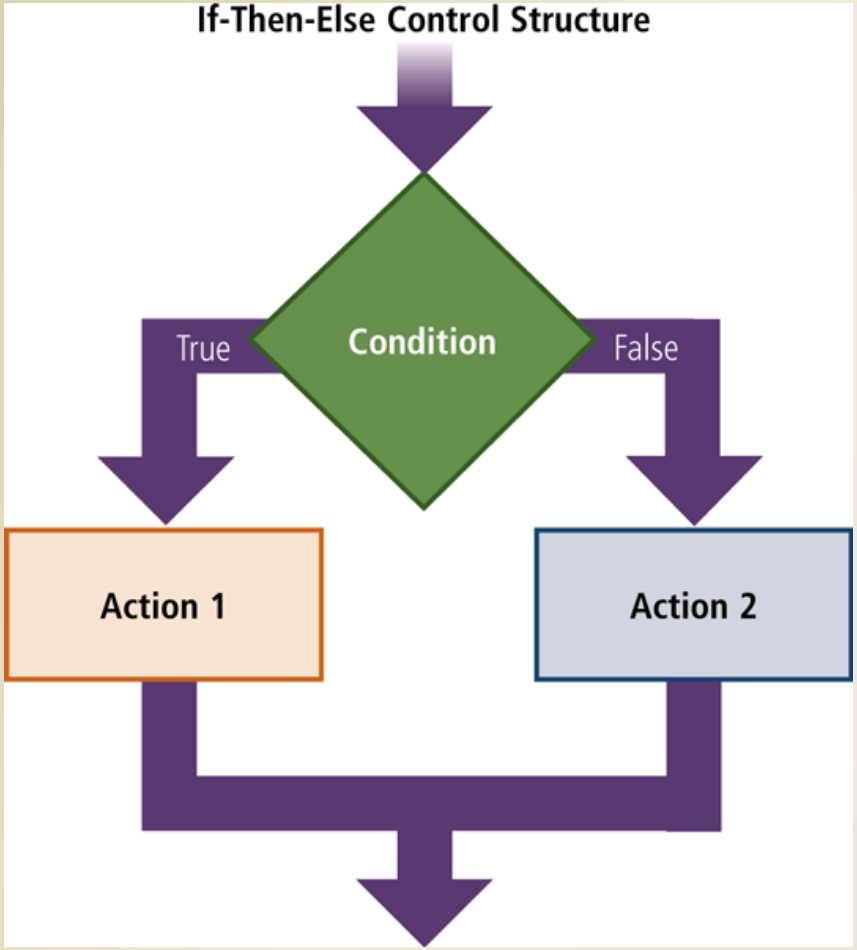
Page 689
Figure 13-26

Step 2 – Design Solution

- The sequence control structure shows one or more actions following each other in order



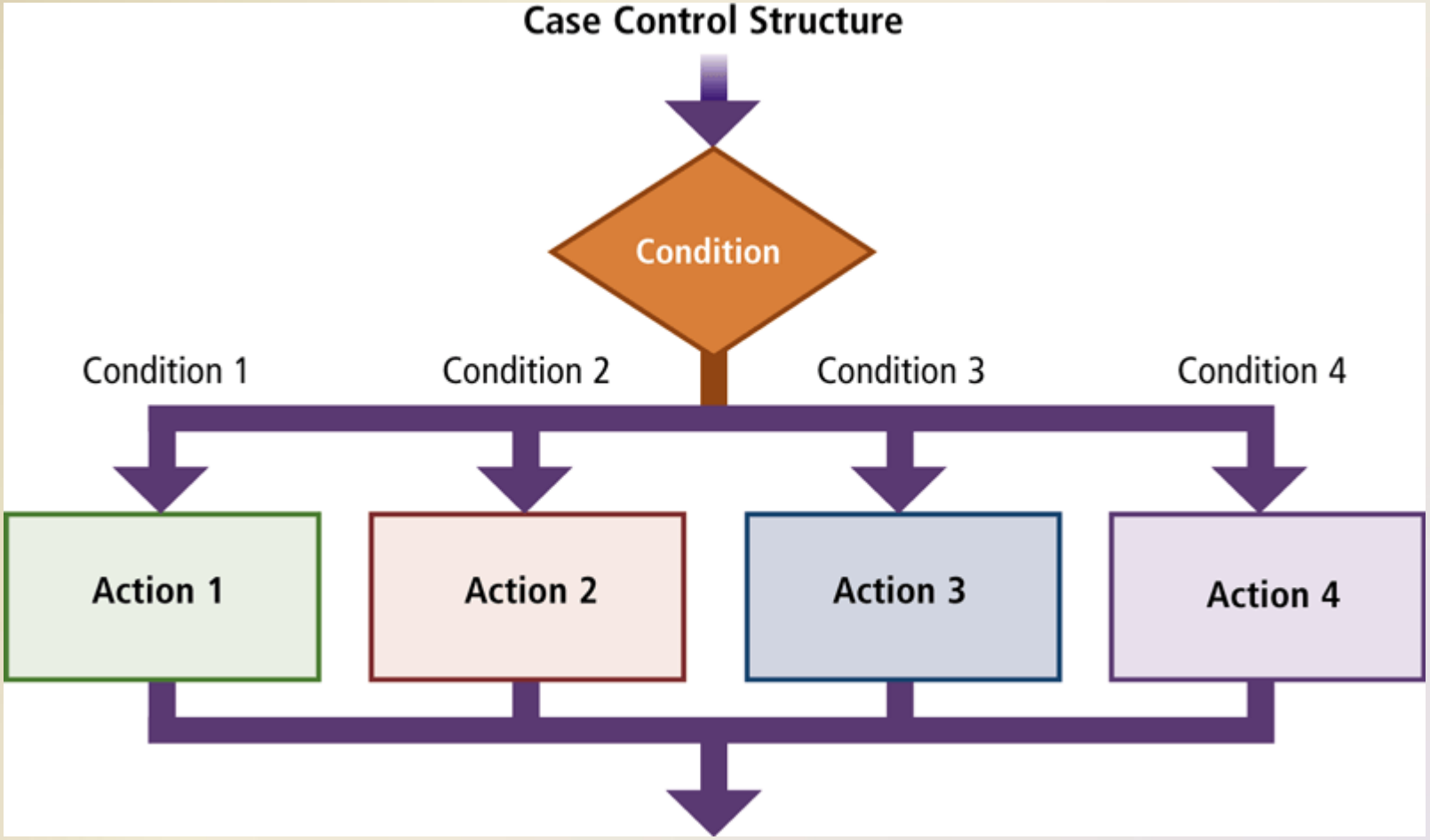
Step 2 – Design Solution



- The selection control structure tells the program which action to take, based on a certain condition
  - If-then-else
  - Case

Page 689
Figure 13-28

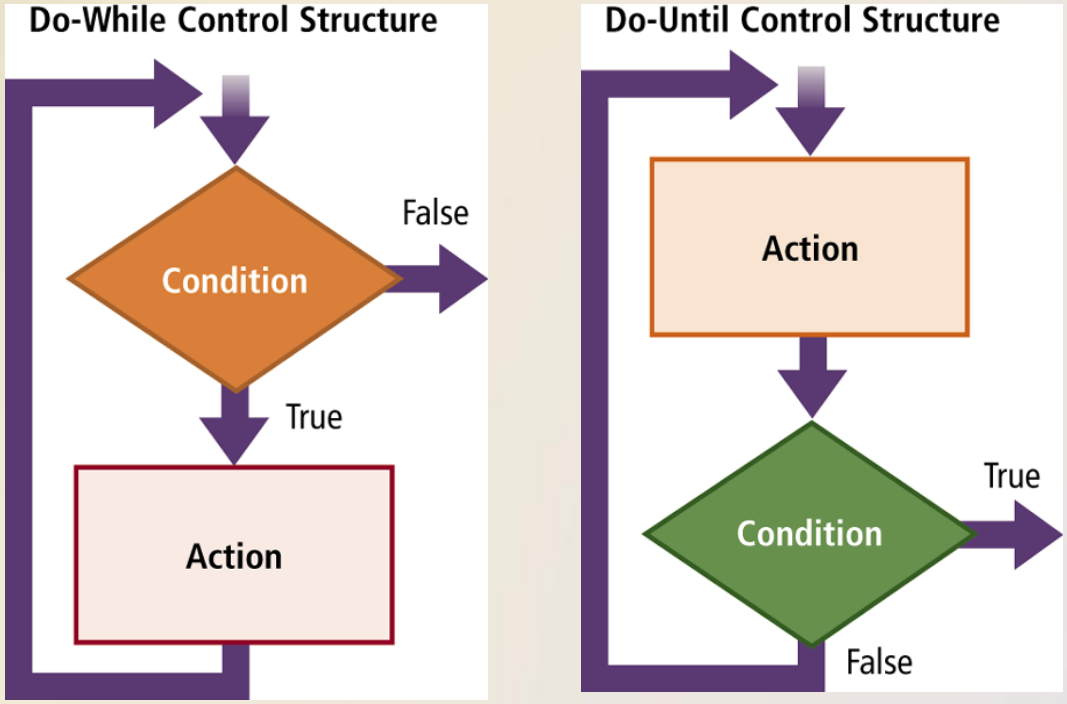
Step 2 – Design Solution



Page 690
Figure 13-29

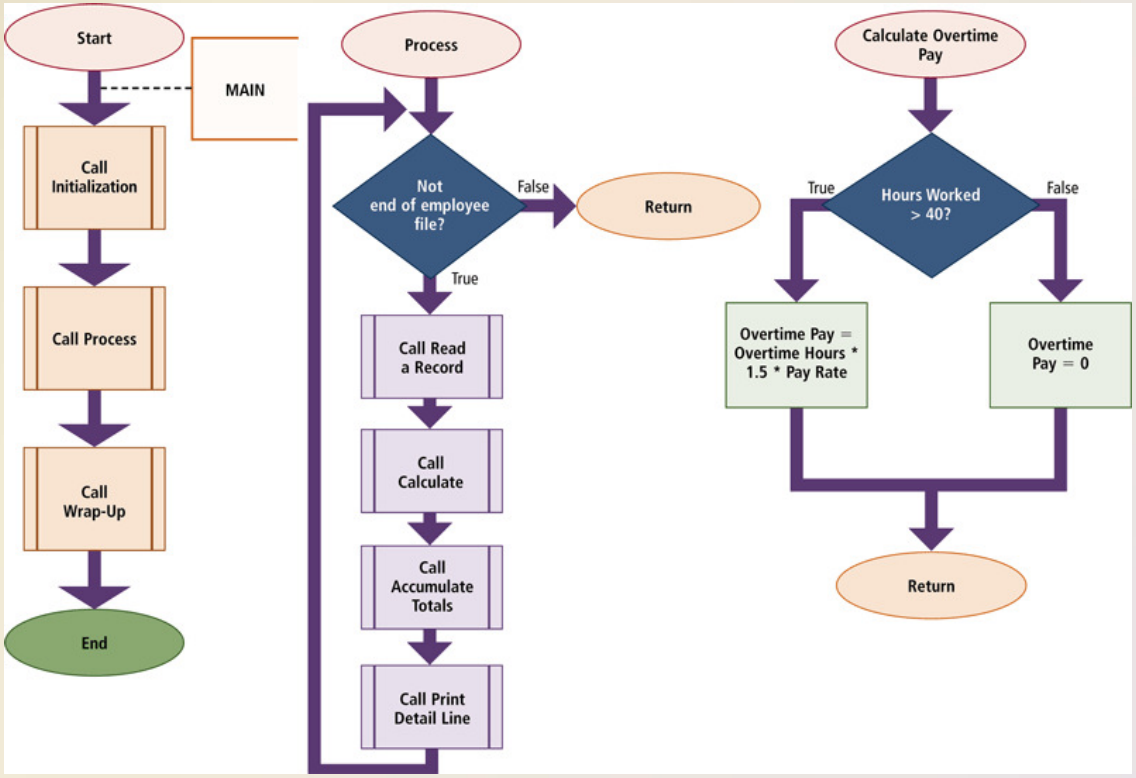
Step 2 – Design Solution

- 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

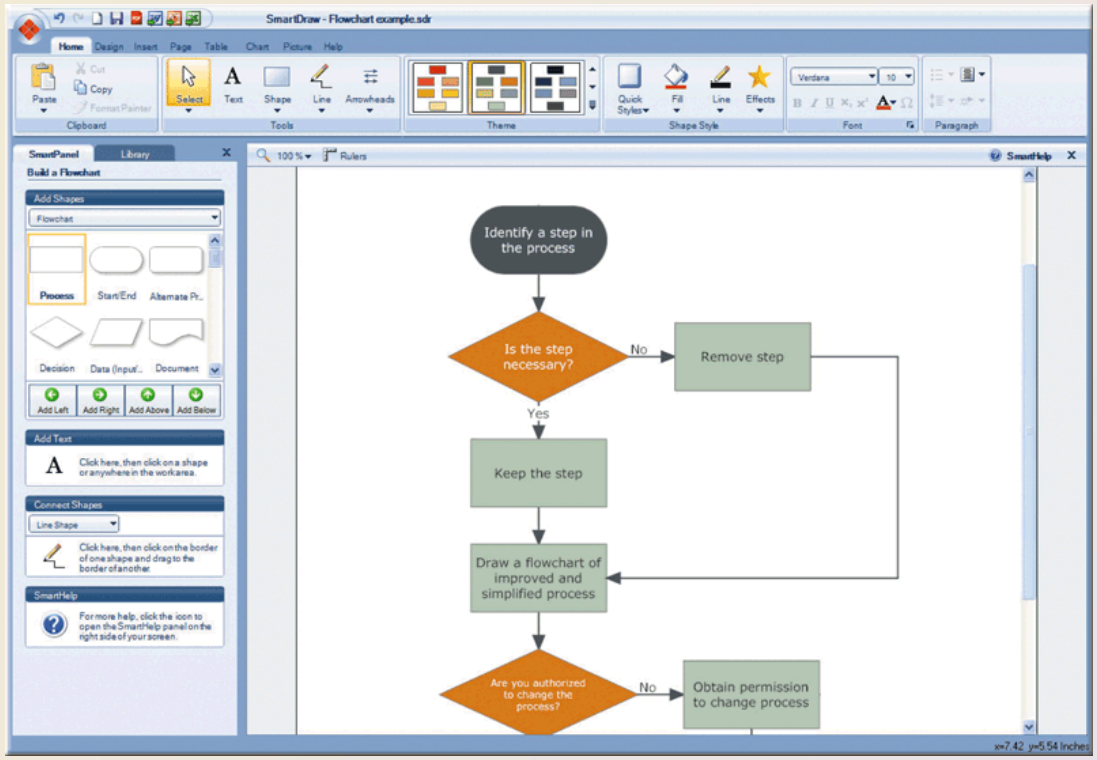
- A program **flowchart** graphically shows the logic in a solution algorithm



Page 691
Figure 13-33

Step 2 – Design Solution

- **Flowcharting software** makes it easy to modify and update flowcharts
  - SmartDraw
  - Visio



Page 692
Figure 13-34

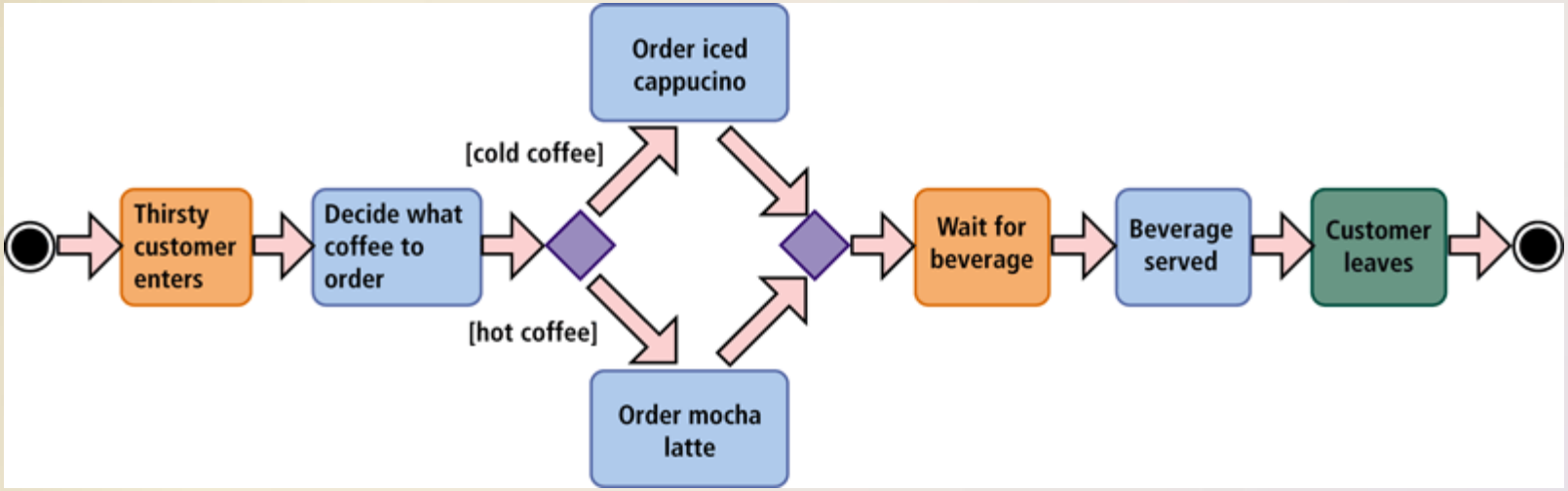
Step 2 – Design Solution

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

```
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
```

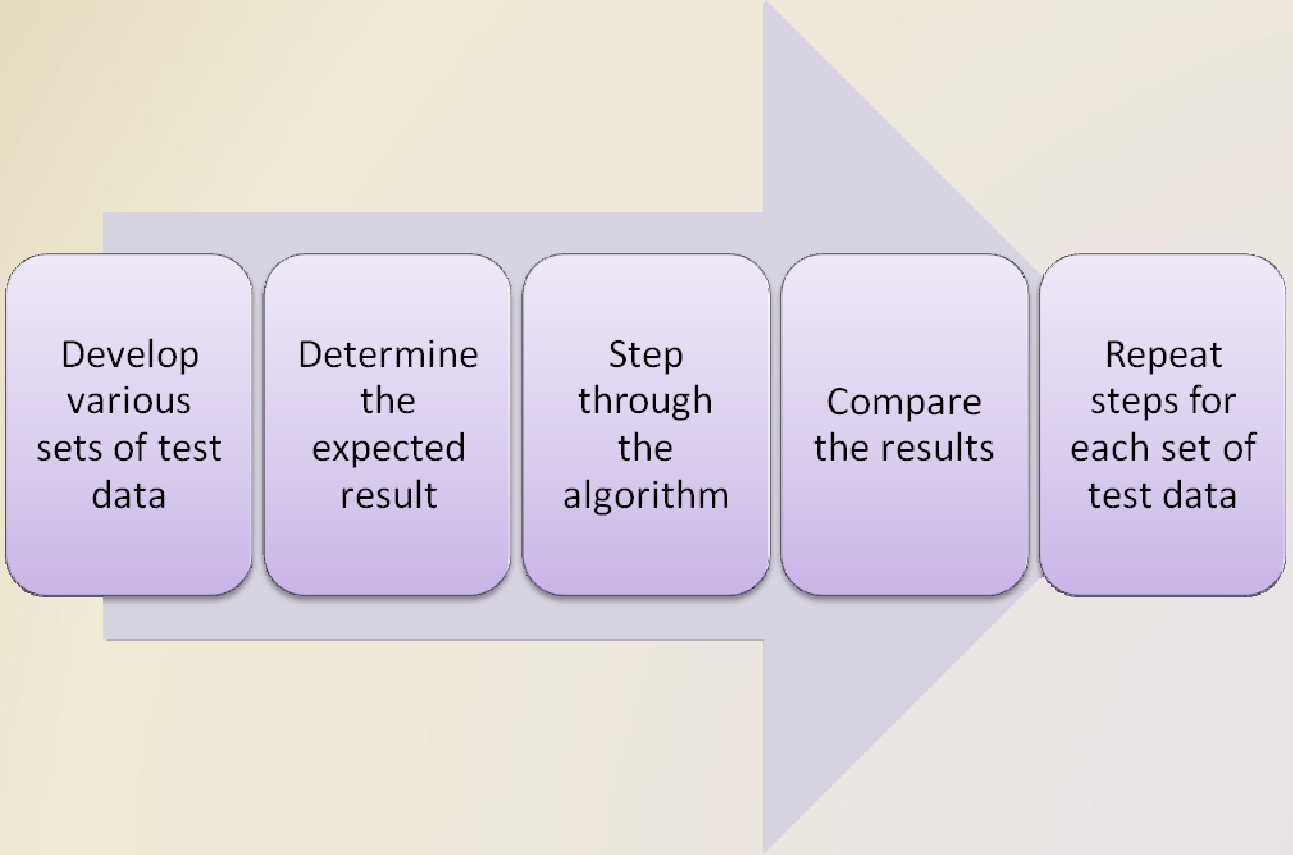
Step 2 – Design Solution

- 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**



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

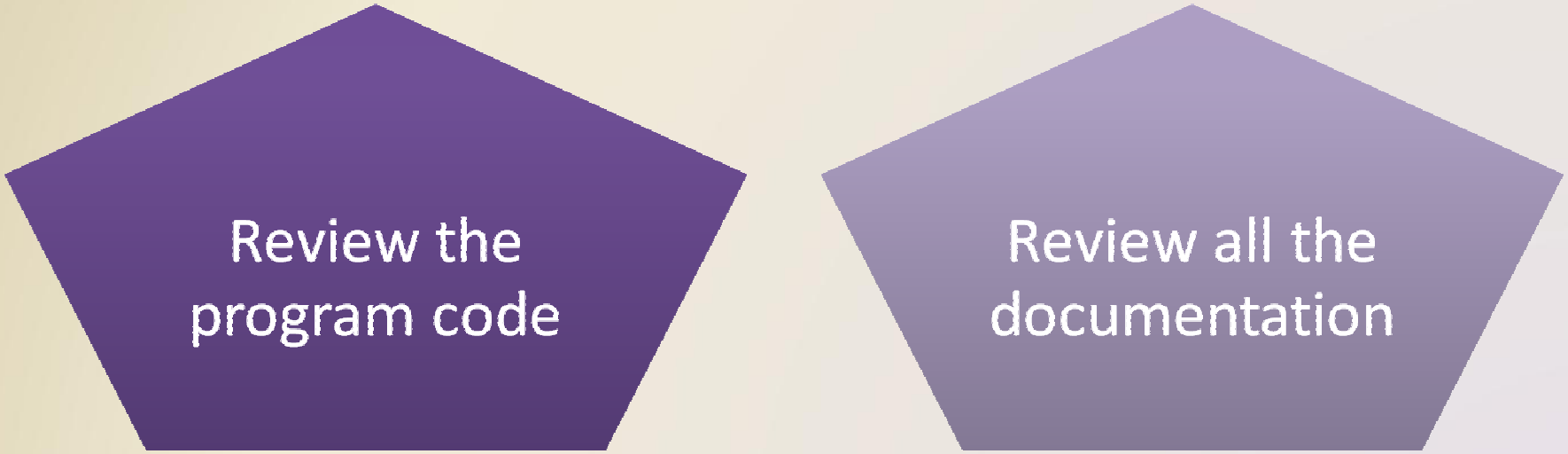
Step 5 – Test Solution

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:



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 Thirteen

Programming Languages and Program Development

Discovering Computers 2012

Your Interactive Guide to the Digital World

Chapter 13 Complete