

# 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

## 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

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## 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

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## 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
000114	4F50	30D6		01054
000118	5050	3052		01054
00011C	58E0	30B6		01088
000120	07FE			
000122	50E0	30BA		01222
000126	1B55			010BC
000128	5A50	304E		01050
00012C	5B50	3052		01054
000130	5050	305A		0105C
000134	58E0	30BA		0108C
000138	07FE			

## Low-Level Languages

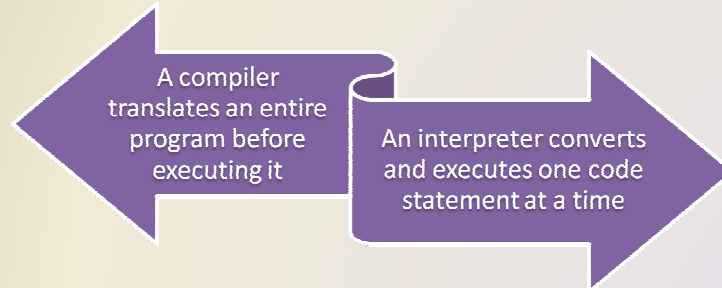
```

comments begin
with an asterisk
THIS MODULE CALCULATES THE REGULAR TIME PAY
CALCSTPY EQU 14,SAVERTPY
ST 14,SAVERTPY
SR 4,4
SR 7,7
SR 5,5
PACK 4,DOUBLE,RTHRIN
CXB 4,DOUBLE,DOUBLE,RATEIN
CXB 7,DOUBLE,7,RATE
MR ST 4,7
SR 5,RTPAY
ST 14,SAVERTPY
L 14
BR THIS MODULE CALCULATES THE OVERTIME PAY
* CALCOTPY EQU 14,SAVEDTPY
TEST1 CLI CODEIN,C'0'
BH TEST2
SR 5,5
A 5,-*10*
ST 5,OTPAY
B AROUND
SR 7,7
SR 5,5
PACK 4,DOUBLE,OTHRIN
CXB 4,DOUBLE,DOUBLE,RATEIN
CXB 7,RATE
MR ST 4,7
A 4,-*1,5*
ST 5,OTPAY
L 14,SAVEDTPY
BR THIS MODULE CALCULATES THE GROSS PAY
* CALCGPAY EQU 14,SAVEGPAY
SR 5,5
A 5,RTPAY
A 5,OTPAY
ST 14,SAVEGPAY
L 14
BR
    
```

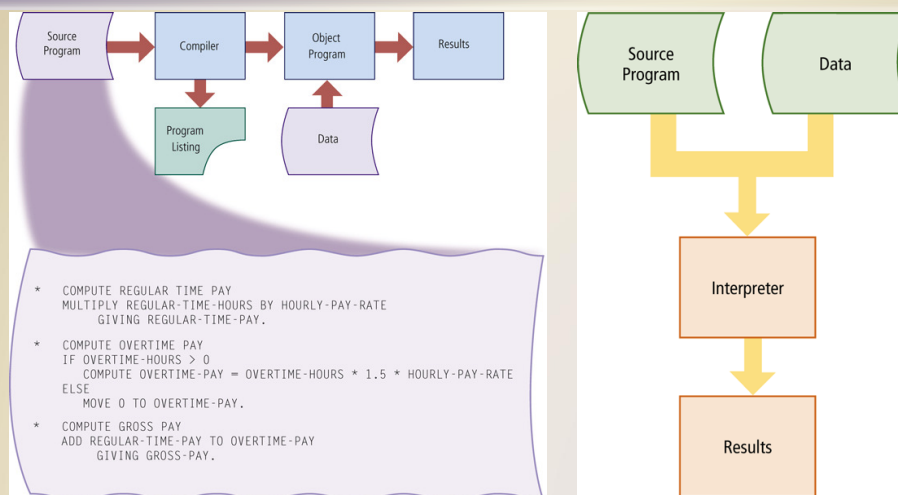
- **Assembly language** is the second generation of programming languages
- Programmer writes instructions using symbolic instruction codes
- A **source program** contains the code to be converted to machine language

## 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)**



## Procedural Languages



## Procedural Languages

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

```
/* Compute Regular Time Pay */
rt_pay = rt_hrs * pay_rate;

/* Compute Overtime Pay
if (ot_hrs > 0)
    ot_pay = ot_hrs * 1.5 * pay_rate;
else
    ot_pay = 0;

/* Compute Gross Pay
gross = rt_pay + ot_pay;

/* Print Gross Pay
printf("The gross pay is %d\n", gross);
```

Annotations:

- comments begin with a slash followed by an asterisk
- calculates regular time pay
- evaluates overtime hours and calculates overtime pay
- calculates gross pay
- prints gross pay

## Procedural Languages

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

```
* 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.
```

Annotations:

- comments begin with an asterisk
- calculates regular time pay
- evaluates overtime hours and calculates overtime pay
- calculates gross pay
- prints 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

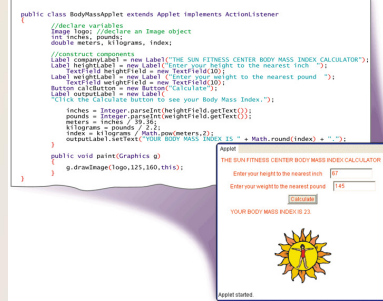
Programmers create applications faster

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



## 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

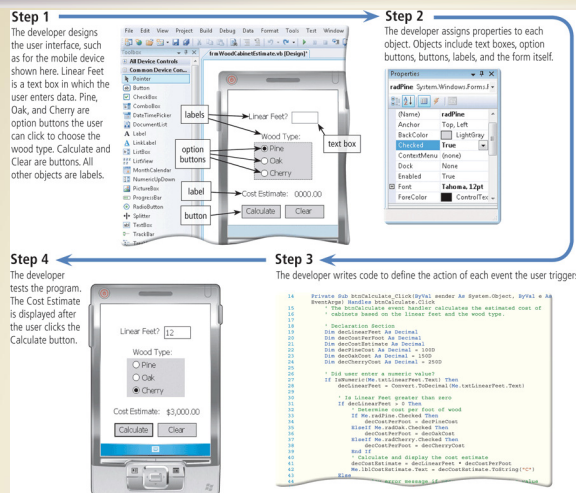
## Visual Studio is Microsoft's suite of program development tools

**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



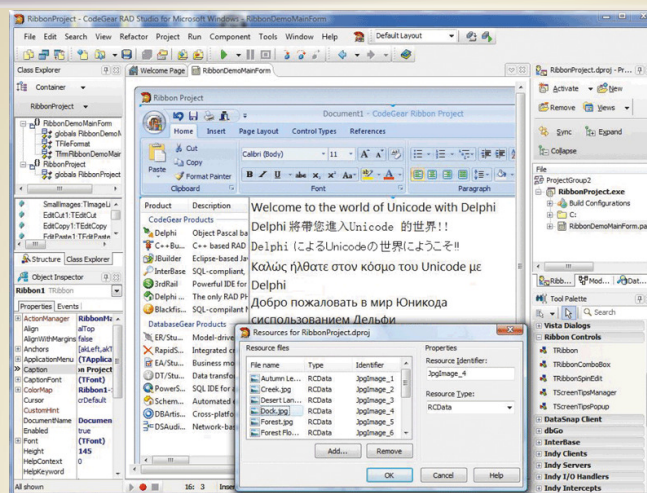


## Object-Oriented Programming Languages and Program Development Tools

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

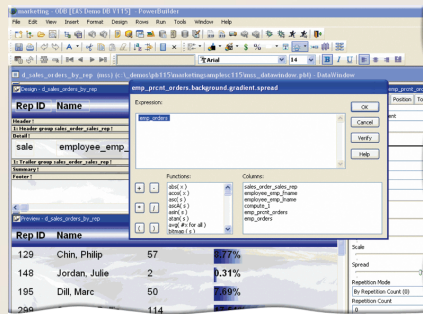
Borland's **Delphi** is a powerful program development tool that is ideal for building large-scale enterprise and Web applications in a RAD environment

## Object-Oriented Programming Languages and Program Development Tools



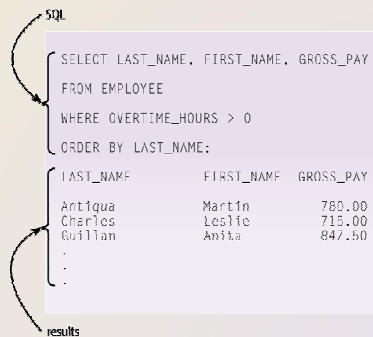
## Object-Oriented Programming Languages and Program Development Tools

- **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

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Figure 13-14

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## 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

The image displays two screenshots of a software application form. The left screenshot shows the form's structure with various input fields categorized under 'Personal Information', 'Phone Numbers', and 'Address'. The right screenshot shows the form populated with data for an employee named 'Kang, Angela', including a profile picture, contact details, and address information.

Page 676  
Figure 13-15

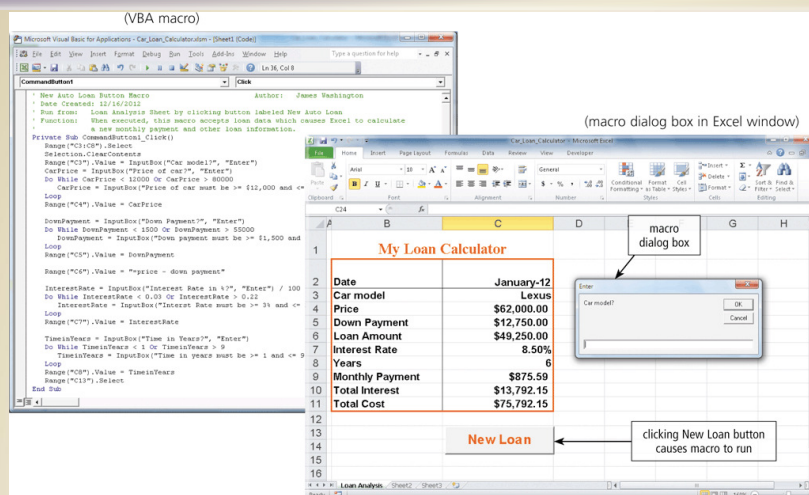
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## Other Programming Languages and Development Tools

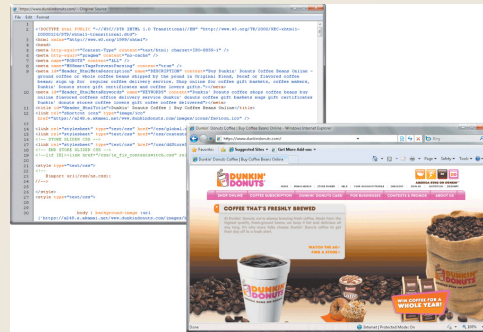
- A **macro** is a series of statements that instructs an application how to complete a task
- You usually create the macro in one of two ways:
  - Record the macro with a macro recorder
  - Write the macro

## Other Programming Languages and Development Tools



## Web Page Development

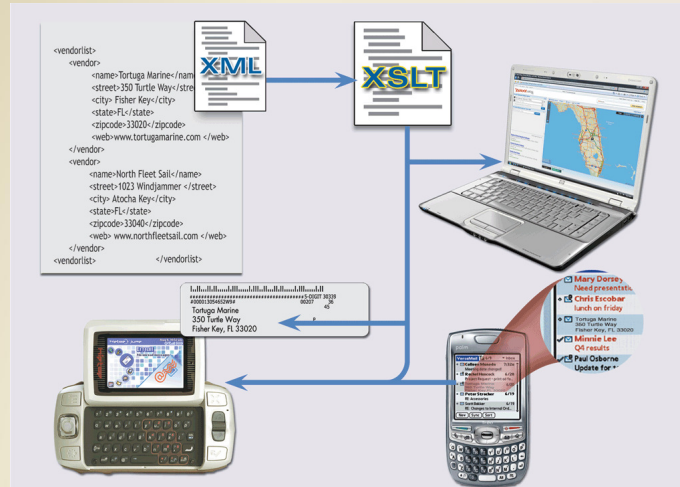
- **HTML** is a special formatting language that programmers use to format documents for display on the Web
- **XHTML** is a markup language that allows Web sites to be displayed more easily on mobile devices



## 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



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Figure 13-18

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## 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)

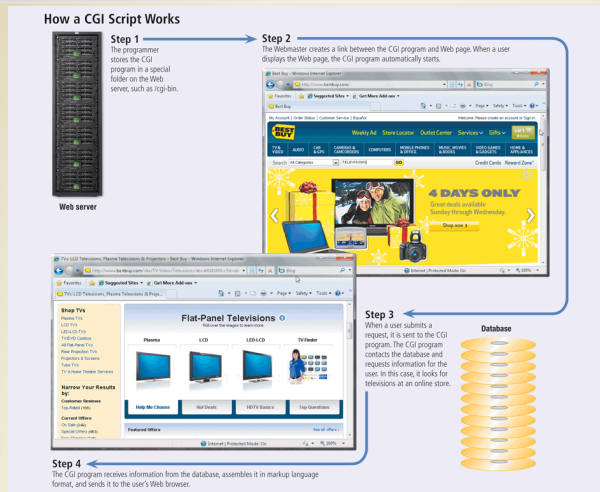


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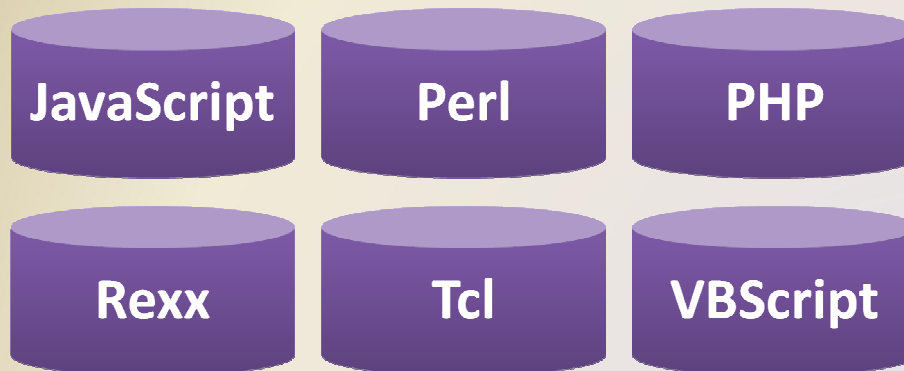
# Web Page Development



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Figure 13-19

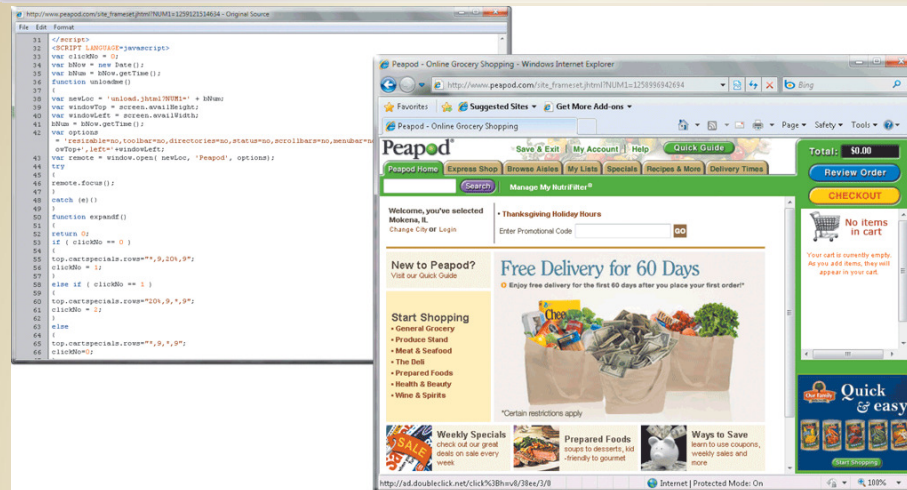
# Web Page Development

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





# Web Page Development



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Figure 13-20

# 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:

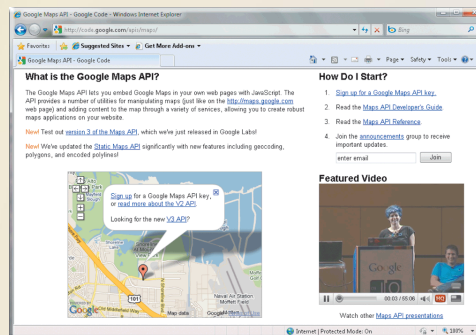
Share personal  
information

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

Dreamweaver

Expression  
Web

Flash

SharePoint  
Designer

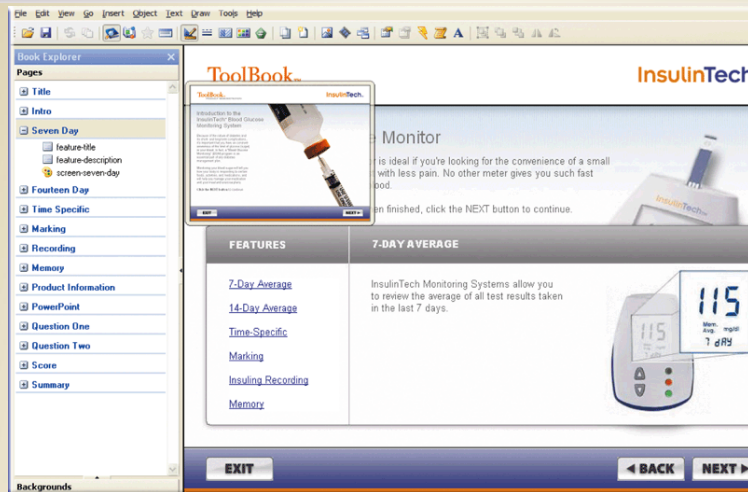
## Multimedia Program Development

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

ToolBook

Director

# Multimedia Program Development



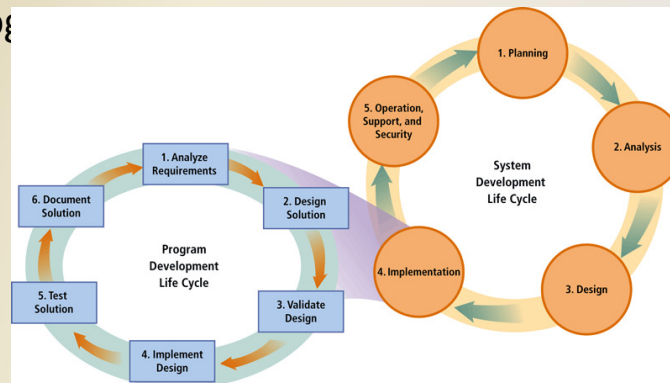
Page 685  
Figure 13-22

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# Program Development

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



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Figure 13-23

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## Step 1 – Analyze Requirements

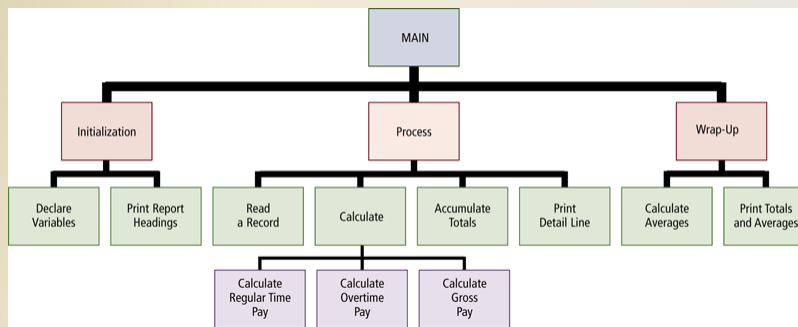
- To initiate program development, programmer:
  - Reviews the requirements
  - Meets with the systems analyst and users
  - Identifies input, processing, and output
    - IPO chart

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

## Step 2 – Design Solution

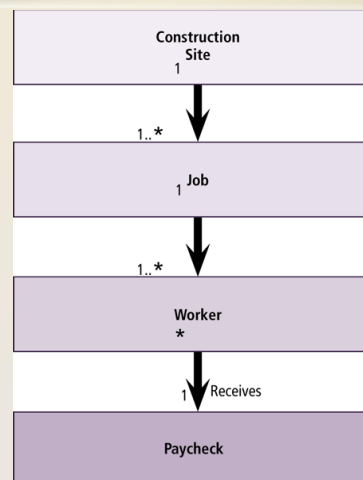
- Design a solution algorithm
- In **structured design**, the programmer typically begins with a general design and moves toward a more detailed design
- Programmers use a **hierarchy chart** to show program modules graphically

## Step 2 – Design Solution



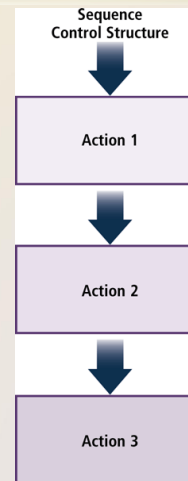
## Step 2 – Design Solution

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



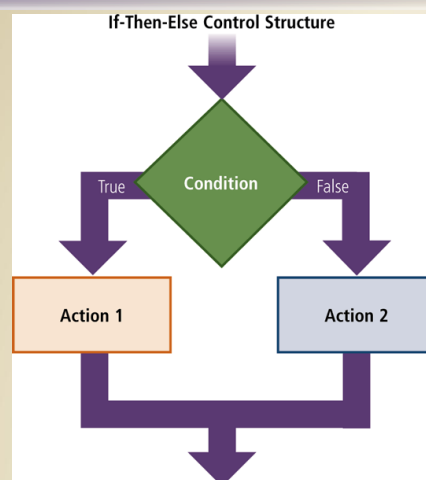
## Step 2 – Design Solution

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

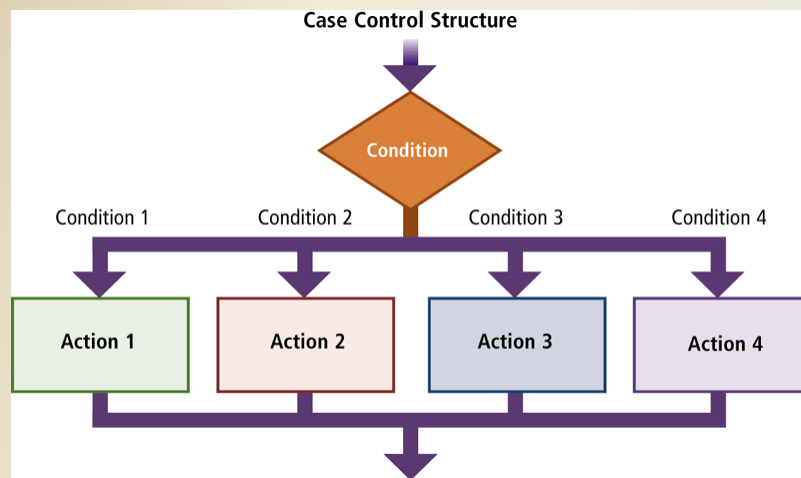


## Step 2 – Design Solution

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

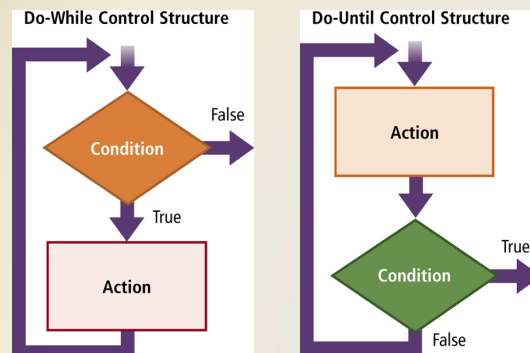


## Step 2 – Design Solution



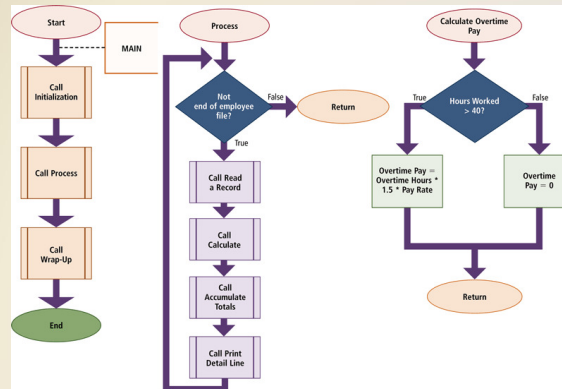
## Step 2 – Design Solution

- 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

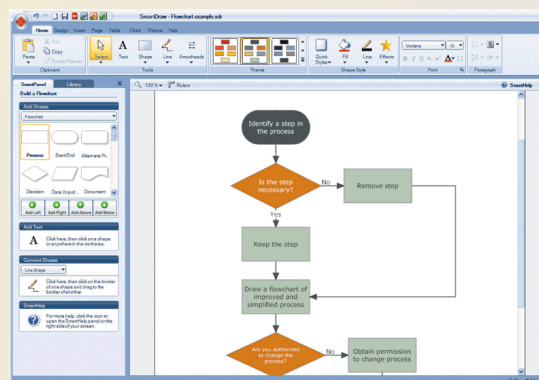
- A program **flowchart** graphically shows the logic in a solution algorithm



## Step 2 – Design Solution

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

- SmartDraw
- Visio





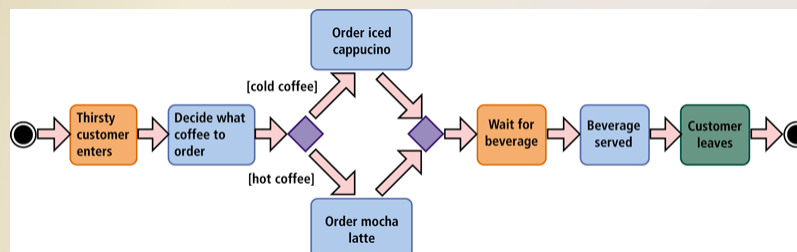
## Step 2 – Design Solution

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

```
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
```

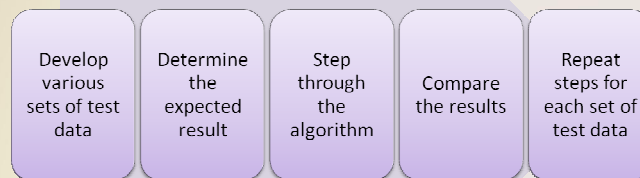
## Step 2 – Design Solution

- 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

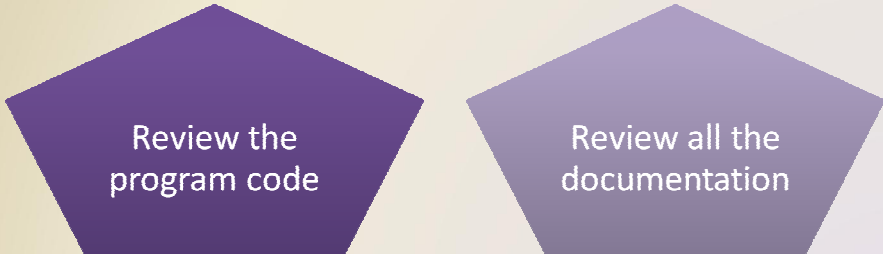
## Step 5 – Test Solution

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:



Review the  
program code

Review all the  
documentation

## 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

