Programming Basics

To specify algorithms, we must be precise. To be precise, we need a language that is more exact than English. A programming language offers this advantage. All programming languages have a basic set of features.

Recapping *Alphabetize CDs*

- *Alphabetize CDs* illustrates an intuitively understandable process not involving a computer
- The *Alphabetize CDs* program demonstrated several features of algorithms and programs …
  - The program illustrated the 5 properties of algorithms -- input and output specs, definiteness, effectiveness, finiteness
  - In order to reference the different slots, we used two "pointers" called *Alpha* and *Bet*
  - *Alpha* referenced all slots but the last, and for each slot *Alpha* referenced, *Bet* referenced each slot to its right
  - Can you "visualize" *Alphabetize CDs'* processing strategy?

Alphabetize CDs illustrates nearly all of the programming concepts to be covered in FIT100, but it did so in English

An Approach To Programming

- Though Alphabetize CDs was precise enough for a person to execute successfully, computers demand greater precision from programs
- The plan …
  - Adopt a better notation than English to express algorithms
    - General ideas are given in lecture
    - VB6 will be used in lecture and lab
  - Discuss standard ways of using a programming language
  - Practice the ideas by writing programs
  - Add a few more language features and describe their use
  - Practice with a few more programs

Variables

- In normal language, names are (usually) tightly fixed to their values --
  - "penny" means 1 cent … it doesn't change its meaning, and sometimes refer to $8.41 or a time zone or an action
- In computing names can change values
  - Example: *Alpha* and *Bet* in *Alphabetize CDs* changed
  - Names must change values in a program because programs specify a *transformation* of input into output … as the transformation proceeds the things named change values
- *variable* is the term for program names that can change value

Variables are analogous to titles in normal language since titles are expected to change values: president, mayor, James Bond

On Variable Names

- The term "variable" reminds us the value can change
- The names used for variables are arbitrary, provided:
  - Variable names must begin with a letter
  - Variable names can contain any letter, numeral or _
  - Variable names should be meaningful and accurate
    - total, averageOverClass, average_over_class but not o0OO0o, bet. Also (for now) not i, n, x, etc.
  - Most languages are *case sensitive*: a ≠ A

Convention: In all programming for FIT100, variables should start with lowercase letters so as to avoid confusion with other names in VB6 … *ignore this convention at your peril*

On Variable Values

- A variable can be thought of as a "named container"

averageOverClass

- Variables name computer memory locations, so the value of a variable is the quantity stored in its memory
- Variables can take on different *types* of values
  - Whole numbers or *integers*: **`2, -9, 1048576`**
  - Character sequences or *strings*: **`"2", "&^%$#@", " "`**
  - Floating point numbers or *doubles*: **`2.0, 3.14159, -999.99 (numbers that can have some digits after the decimal point)`**
- A variable's values have a specific type
- Variables are *declared* and their type is specified
  - **`Dim averageOverClass As Double`**

Assignment

- Computers must be told what value to assign to variables, using an *assignment statement* such as

  `averageOverClass = 21.14`

  `mayor = "Paul Schell"`

- The general form of an assignment statement is

  <variable name> <assignment symbol> <expression>

  - ❑ Languages use different assignment symbols: **`=  :=  ←`**
  - ❑ Read assignment as "is assigned", or "becomes" or "gets"
  - ❑ All three components must always be present

- Fundamental property of assignment

  The "flow" of information is always right-to-left

  - ❑ **`destination = source`**
  - ❑ **`changedVariable = value`**

Meta-brackets < > enclose language defining terms

Expressions

- Expressions are formulae made from variables and operators, e.g. calculator operations: +, -, *, /, ^

❑ **`weeks = days / 7`**	*divide value of days by 7*
❑ **`grossPay = hours * rate`**	*multiply the two values*
❑ **`area = pi * radius ^ 2`**	*π times radius squared*

- In the last example, the ^ operator has *precedence* over the * operator.
- We could also write
  - ❑ **`area = pi * (radius ^ 2)`**
- When in doubt, use extra parentheses in expressions! It's always safe.
- See the Snyder text for more about precedence, and page 77 of the VB book for a complete table of operator precedence in VB.

Mini-Exercise #1

- Suppose you have a variable that represents the total amount of a loan. What is a good name for this variable?
- Suppose the computer executes the following statements. What is the value of total at the end?

```
x = 1
total = x+3
```

- What is the value of squid after executing these statements?

```
clam = 1
squid = 4 + 2*clam
```

Mini-Exercise #1 -- Answers

- Suppose you have a variable that represents the total amount of a loan. What is a good name for this variable?

  `loanAmount or loan_amount`

- Suppose the computer executes the following statements. What is the value of total at the end?

```
     x = 1
     total = x + 3
total is 4
```

- What is the value of squid after executing these statements?

```
     clam = 1
     squid = 4 + 2*clam
squid is 6
```

Fundamental Rule of Assignment

- Fundamental rule of assignment

  The expression is evaluated before the assignment is made

  - ❑ **`score = score + 3`**
  - ❑ **`shotClock = shotClock - 1`**

Computing is NOT *algebra*: Though = is used in assignment statements, it means "becomes" whereas in algebra it means equality. So, **`score = score + 3`** is essential to computing, but meaningless in algebra

Mini-Exercise #2

- Suppose the computer executes the following statements. What is the value of total at the end?

```
total = 1
total = total + 5
```

- Harder:

```
x = 0
x = x+4
x = x*2
```

Mini-Exercise #2 -- Answers

- Suppose the computer executes the following statements. What is the value of total at the end?

```
      total = 1
      total = total + 5
total is 6
```

- Harder:

```
      x = 0
      x = x+4
      x = x*2
x is 8
```

Operators

- Most programming languages have more operators than a pocket calculator
  - ❑ Operators like **+** taking 2 operands are called *binary*: `a + b`
  - ❑ Operators like **-** taking 1 operand are called *unary*: `- a`
- A very useful operator is *concatenate*, & in VB6, which connects two strings together:
  - ❑ `plural = "dog" & "s"`
- The relational operators are:
  - ✢ a < b   less than   a > b   greater than
  - ✢ a <= b less than or equal to a >= b greater than or equal
  - ✢ a = b   equal to   a <> b not equal

Conditionals

- Programs must frequently test if some condition holds, e.g. are two CDs in alphabetical order
- Conditional statements have been invented to make tests
  - ❑ `If temp < 32 Then waterState = "frozen"`
- General form of basic conditional:

```
If <T/F expression> Then <assignment statement>
```

- The meaning is that the <*T/F expression*> is *evaluated*
  - ❑ If the outcome is true, then the assignment statement is performed
  - ❑ If the outcome is false, then the assignment statement is skipped

More Complex Conditionals

- The basic conditional is too limited, so generalize it
- General form of an If-statement

```
If <T/F expression> Then
   <statement list>
End If
```

End If ← List terminator, one word

- Example:

```
If temp >= 212 Then
   state = "gaseous"
   form = "steam"
End If
```

General Conditional Statement

- When operations must be performed for the true outcome and different operations are need for a false outcome, use the If-Then-Else statement
- General form

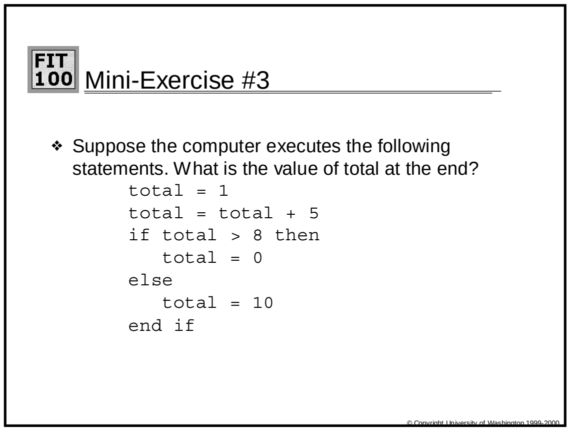
```
If <T/F expression> Then
   <statement list>
Else
   <statement list>
End If
```

```
If sideUp = sideCalled Then
   coinTossWinner = hostTeam
   firstHalfOffense = hostTeam
   secondHalfOffense = visitorTeam
Else
   coinTossWinner = visitorTeam
   firstHalfOffense = visitorTeam
   secondHalfOffene = hostTeam
End If
```

Example of If-Then-Else

- An advantage of the general conditional is that the statement lists can contain other conditionals

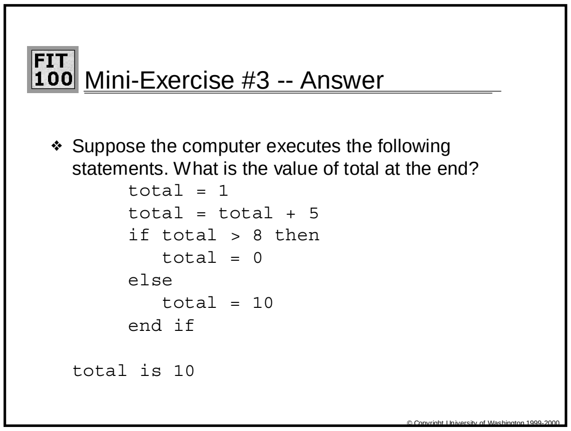
```
If flip1 = guess1 Then
   If flip2 = guess2 Then
      score = "win win"
   Else
      score = "win lose"
   End If
Else
   If flip2 = guess2 Then
      score = "lose win"
   Else
      score = "lose lose"
   End If
End If
```



Mini-Exercise #3

- Suppose the computer executes the following statements. What is the value of total at the end?

```
total = 1
total = total + 5
if total > 8 then
   total = 0
else
   total = 10
end if
```



Mini-Exercise #3 -- Answer

- Suppose the computer executes the following statements. What is the value of total at the end?

```
total = 1
total = total + 5
if total > 8 then
   total = 0
else
   total = 10
end if
```

```
total is 10
```