CSE 1530

Introduction to Computer Use II: Programming

Winter 2005 (Section M)

Topic B: Variables, Data Types and Expressions

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Overview (1):

- **Before We Begin**
  - Some administrative details
  - Some questions to consider
- **Data: Variables and Constants**
  - Data types & Visual Basic (cont. from last lecture)
  - Declaring variables and constants
  - Variable scope
- **Data Types**
  - Working with data types

Overview (2):

- **Arithmetic Operators**
  - Allowable arithmetic operators

Before We Begin

Administrative Details (1):

- **Lab Exercise 3-3**
  - You should be working on Exercise 3-3 this week!
  - I will drop by the Glade lab Friday after the lecture for at about 30 minutes

Some Questions to Consider (1):

- What is a variable ?
- What is a constant ?
- Why do we need variables ?
- What is a variable's type ?
- What is a variable declaration?

Data: Variables and Constants (cont. from last lecture)

Data Types and Visual Basic (5):

- **Visual Basic Variable Data Types (cont.)**
  - Most common type of variables and constants (at least in this course)
    - String, Integer, Boolean, Double
  - Of course, it is up to you as a programmer to determine the variable type but some common guidelines are as follows
    - If data is used in a calculation → numeric type
    - If not used in a calculation → String
    - Scientific calculations → Single or Double

Data Types and Visual Basic (6):

- **Visual Basic Variable Data Types (cont.)**
  - Consider the following examples

CONTENTS	DATA TYPE	REASON
Social security	String	Not used in calculation
Pay rate	Currency	Used in calculation – represents money
Hours worked	Single	Used in calculations and may contain decimal
Phone number	String	Not used in calculations
Quantity	Integer	Used in calculations but generally whole number

Data Types and Visual Basic (7):

- **Naming Conventions and Rules**
  - Its up to you as a programmer to provide the names for the variables and constants you declare
  - VB requirements
    - 1-255 characters long
    - Letters, digits and underscore characters only → no spaces or periods
    - May not be reserved words!
  - Aside from VB requirements, the main thing is to be consistent!

Data Types and Visual Basic (8):

- **Naming Conventions and Rules (cont.)**
  - Provided you follow the VB rules, you are free to choose any name you want → still have some general conventions we try to follow so that we can separate good names from bad names
    - Choose meaningful & descriptive names → a name should indicate the variables purpose
    - Precede each identifier with a lower case prefix
    - Capitalize each word of the name following the prefix → always use mixed case, never all upper case (e.g., myIntegerValue)

Data Types and Visual Basic (9):

- **Naming Conventions and Rules (cont.)**
  - Some "good" (descriptive) variable name examples

FIELD OF DATA	POSSIBLE IDENTIFIER (NAME)
Social security number	socialSecurityNumber
Pay rate	payRate
Hours worked	hoursWorked
Phone number	phoneNumber
Quantity	quantity
Tax rate	taxRate

Data Types and Visual Basic (10):

- **Naming Conventions and Rules (cont.)**
  - Some "BAD" (descriptive) variable name examples

FIELD OF DATA	POSSIBLE IDENTIFIER (NAME)
Social security number	ssn
Pay rate	a
Hours worked	w
Phone number	num
Quantity	q
Tax rate	r

Declaring Variables & Constants (1):

- **Declaring Constants**

  Const Identifier [As Datatype] =Value

  - Const → reserved word indicating a constant variable
  - Identifier → user-defined name of the variable
  - As Datatype → indicates the data type and if not included (it is optional) then data type is of type variant
  - Value → the assigned value (should be of compatible type!) and must be provided!

Declaring Variables & Constants (2):

- **Declaring Constants (cont.)**
  - Example constant declarations
    - Const courseName As String ="CSE 1530"
    - Const companyAddress ="101 – Main Street"
    - Const salesTaxRate As Single = 0.8
  - Are the following valid ? How can we test this ?
    - Const myName As String
    - Const todaysDate As Date

Declaring Variables & Constants (3):

- **Declaring Variables**

  Dim Identifier [As Datatype]

  - Dim → Dimension (size)
  - Identifier → user-defined name of the variable
  - As Datatype → indicates the data type and if not included (it is optional) data type is of type variant

Declaring Variables & Constants (4):

- **Declaring Variables**
  - Example variable declarations
    - Dim customerName As String
    - Dim totalSold As Integer
    - Dim temperature As Single
    - Dim productPrice As Currency
    - Dim changing
  - What is the type of the variable "changing" ?
    - Is this declaration valid ?

Variable Scope (1):

- **The "Visibility" of a Variable**
  - Scope of a variable describes the "visibility" of a variable you declare
    - Visibility → Where the variable exists, can be seen and is accessible to you
    - Can be for the entire project, for only one form or for only one procedure
    - Scope is said to be global, module level or local

Variable Scope (2):

- **The "Visibility" of a Variable (cont.)**
  - Global variable
    - May be used in all procedures of a project
  - Module level variable
    - Accessible from all procedures of a form
  - Local variable
    - Can be used only within the procedure in which it is declared

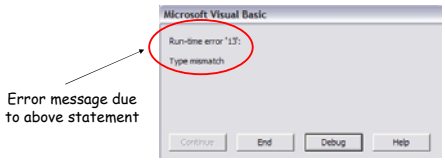
Data Types

Working With Data Types (1):

- **In General**
  - Dangerous to assign a value (data) of one type to an object property or property that should contain data of another type
    - Will typically result in an error → at times, you may not even be aware of the error (may not necessarily result in a run time error but rather, the result computed may be incorrect)
    - Visual Basic will attempt to convert to the proper data type when incorrect data types are assigned but it may not always be converted correctly!

Working With Data Types (2):

- **In General (cont.)**
  - Visual Basic will convert conversions between data types whenever it can in a sensible manner
    - Text1.Top = "Visual Basic" → will result in an error



    - Text1.Top is an Integer and "Visual Basic" is a non-alpha-numeric String

Working With Data Types (3):

- **In General (cont.)**
  - Text1.Top = "335.67" → no error! Why ?
    - Text1.Top is still an Integer of course however, the String "335.67" is a string that contains only alpha-numeric characters → Visual basic can then convert this string (automatically) to an Integer value
    - But 335.67 is not an integer ??? → Visual Basic will convert the value to an Integer by eliminating (dropping) the decimal portion
    - The String "1,001" will also be converted to 1001

Working With Data Types (4):

- **In General (cont.)**
  - Not only Strings will be converted → Visual Basic will attempt to convert any "mis-matched" data type when it can in a sensible manner!
  - In fact, typically any other data type can be converted to a String without ambiguity
  - Examples that will be converted to a String
    - Text1.Text = 232
    - Text2.Text = True
    - Text3.Text = 26.00211

Working With Data Types (5):

- **"Take-Home Message"**
  - It is dangerous to rely on visual Basic to convert between data types
    - It may often succeed but there are many times it will not!
    - You should always be aware of the data types you are using and ensure that values have the appropriate types
    - But there are times where we need to convert data from one type to another → User input is typically of type String and must be converted to some value (Integer etc.)

Working With Data Types (6):

- **Built in VB Conversion Functions**
  - Visual Basic functions to convert between data types
  - As an aside → what is a function ?
    - A convenient way to encapsulate some computation that can then be used many times over without worrying about its implementation
    - Allows us to ignore *how* a job is done
    - All we need to know is *what* is done (outcome)
    - Imagine having to compute some computation many times → you can replicate the code many times or you can write the code once within a function and simply call the function

Working With Data Types (7):

- **Built in VB Conversion Functions (cont.)**
  - In general these conversion functions take one or more arguments and produce a single result (called the function return type)
    - Argument → when you call and use the function, you may have to supply it zero or more values – these values are known as arguments
    - Function return type → the value returned by the function - the value can be used by the caller of the function where appropriate
  - More details regarding functions later on in the course

Arithmetic Operators

Arithmetic Operators (1):

- **Allowable Arithmetic Operators**
  - Addition, subtraction, multiplication, division and exponentiation

OPERATOR	OPERATION
+	Addition
-	Subtraction
*	Multiplication
/	Floating Point Division
\	Integer Division
^	Exponentiation
Mod	Modulus

Arithmetic Operators (2):

- **Usage of Arithmetic Operators**
  - Addition → result = expr1 + expr2
  - Subtraction → result = expr1 - expr2
  - Multiplication → result = expr1 * expr2
  - Division → result = expr1 / expr2 (decimal result)
    → result = expr1 \ expr2 (integer result)
  - Exponentiation → result = expr1^exponent
  - Modulus → result = expr1 Mod expr2 (remainder of after the division operation where expr1 and expr2 are both integers)

Arithmetic Operators (3):

- **Usage of Arithmetic Operators**
  - Command1.Top / 2
    - Divide the Top property of the Command 1 object in two → keep in mind that the actual value of the Top property of the Command1 object does not change – we are not assigning the result of this arithmetic operation back to the Top property
  - Command2.Top = Command1.Top / 2
    - Divide the Top property of the Command 2 object is assigned the value of the Top property of the Command1 object divided by two (e.g., if Command1.Top is 100, then Command2.Top is 50)

Arithmetic Operators (4):

- **Order of Operations**
  - The order in which arithmetic operations are performed will affect the final result
    - 3 + 4 * 2 → if addition is performed first then result is 14 but it multiplication is performed first then result is 11
  - Order of precedence in VB arithmetic operations
    1. Exponentiation
    2. Multiplication and division (in order from left to right)
    3. Addition and subtraction (in order from left to right)