

# Visual Basic for Applications Programming

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Week 1



# Outline

- 1 Visual Basic for Applications Programming Language
- 2 Programming
- 3 Data and Data Structure
  - Data
  - Data Structure
- 4 Programming Language
  - Expression
  - Assignment

# Visual Basic for Applications

Goal

## GOAL: LEARNING EXCEL PROGRAMMING

- ① **Basics of Programming:** Basics about the programming language namely  
**Visual Basic for Applications (VBA) language**
- ② **Excel Object Model:** The objects that the language handles  
i.e. *Workbooks, Worksheets, Rows, Columns, Ranges, Cells, etc.*
- ③ **Visual Basic Editor:** The environment in which Excel programming is done namely  
**Visual Basic Integrated Development Environment (IDE)**

# Programming Language 1

## Programming Language

- *Visual Basic for Application* programming language is a formal language used to describe and control the behaviour of our personal computer
- *Visual Basic for Application* is defined by its **syntax** and **semantics**
  - The **syntax** is a formal language which defines its correct expressions
  - The **semantics** defines the meaning of the language elements, expressions, and programs
- *Visual Basic for Application* is an **interpreted language**: code is immediately executed. The interpreter usually performs a syntactic and a semantic analysis

# Programming Language 2

## Programming Language

- *Visual Basic for Application* is an **IMPERATIVE** programming language. Imperative programming with subroutines is often called procedural programming
- Imperative languages describe “How” the computation of the solution for a certain problem takes place

# Programming Language 3

```
Function proportion( (1) ByVal k As Integer, ByVal n As Integer)
As Double
    (2) Dim p As Double
    (3) p = k / n
    (4) proportion = p
End Function
```

This imperative VBA program describes the computation as ...

- 1** Read the values  $k$  (i.e. number of observations in a given category) and  $n$  (i.e. total number of observations in all categories)
- 2** Create a variable able to store a real number (i.e. proportion of observations in a given category)
- 3** Compute the proportion  $k/n$  and assign it to the variable
- 4** Finally return the result ...

# Algorithm and Data Structure

**Algorithms** + **Data Structures** = **Programs** (Niklaus Wirth)

## Algorithm:

Sequence of statements that given information (**data**) as input determine the solution of the problem.

An algorithm is: *non ambiguous, executable, finite*

## Data Structure:

Named storage location that can contain data

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### Literal

A literal is a value that is expressed as itself, hence a literal value is any part of a statement or expression that is to be used exactly as it is

### Example

- "Today is Wednesday"
- 1000000
- 23.15
- #06/10/2011#
- True

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# Data Structure

## Variable

### Variable

- A Variable is a named storage location that can contain data that *can be modified during program execution*
- Each variable has a **name** that uniquely identifies it and a data **type**
- Data type is a characteristic of a variable that determines what kind of data it can hold
- Variable names must begin with an alphabetic character, can not be longer than 255 characters

# Data Structure

## Variable

### Variable Declaration

```
Dim varname As type
```

This statement declares ... create a storage location, identified by the name **varname**, that can contain data of type **type** ...

# Variable

## Data Type

### Data Type Summary

Data Type	Description
BOOLEAN	Boolean can only be True or False
INTEGER	Integer are numbers ranging in value from $-32768$ to $32767$
LONG	Long (long integer) are numbers ranging in value from $-2147483648$ to $2147483647$
SINGLE	floating-point numbers ranging in value from $-3.402823\text{E}(38)$ to $-1.401298\text{E}(-45)$ for negative values and from $1.401298\text{E}(-45)$ to $3.402823\text{E}(38)$ for positive values
DOUBLE	floating-point numbers ranging in value from $-1.79769313486231\text{E}(308)$ to $-4.94065645841247\text{E}(-324)$ for negative values and from $4.94065645841247\text{E}(-324)$ to $1.79769313486232\text{E}(308)$ for positive values
DATE	floating-point numbers that represent dates ranging from 1 January 100 to 31 December 9999 and times from 0:00:00 to 23:59:59
STRING	string containing up to approximately 2 billion characters, the codes for String characters range from 0 – 255

# Data Structure

## Variable

### Examples

- Dim *word* As **String**
- Dim *sentence* As **String**
- Dim *n* As **Integer**
- Dim *total* As **Long**
- Dim *i* As **Single**
- Dim *p* As **Double**
- Dim *today* As **Date**
- Dim *check* As **Boolean**

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# Programming Language

## Expression

### Expression

An expression is a combination of

- **Keywords** (i.e. mathematical functions Round, Sqr, Log, ...)
- **Operators** (+, \*, &, Like, And ...)
- **Variables** (n, word, today, ...)
- **Literal** values (23, "Sunday", #31/12/2011# ...)

that yields strings, numbers, logical values, ...

An expression is typically used to perform a calculation or characters manipulation

# Programming Language

## Expression

### Examples

- `"Today is " & #05/10/2011#`
- `3 * (5.15 + Sqr(12.10))`
- `Round(Sqr(2)) + 1`
- `"Total = " & sum & " Euro"`
- `name Like "D*"`
- `(sum >= 1000) And (sum <= 5000)`

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# Programming Language

## Assignment

### Assignment

Assignment statements assign a

- **Literal** value (23, "Monday", #05/11/2011#, ...)
- **Expression**

to a variable

### Assignment Declaration

**varname = expression** (or literal)

The statement declares ... the variable **varname** receives the value's expression (or the literal value) ... hence the value's expression (or the literal value) is stored in the variable **varname** ...

# Programming Language

## Assignment

### Examples

- `word = "Free University of Bozen"`
- `n = 10245`
- `r = 34.65`
- `today = #25/12/2011#`
- `message = "Today is " & #25/12/2011#`
- `result = 3 * (5.15 + Sqr(12.10))`
- `i = 21/100`
- `total = "Total = " & n*(1 + i) & " Euro"`
- `check = ((k / n) >= 0.5)`

# Programming Language

## Assignment

### Issues

- `word = 12345`
- `n = "Free University of Bozen"` (**Type Mismatch**)
- `p = 434`
- `n = 3.14` (**Round**)
- `today = 12345`
- `p = #25/12/2011#`
- `word = True`

# Operators

Some operators and relations

## Operators

Type	Name	Symbol
Arithmetic Operators	Addition	+
	Subtraction	-
	Multiplication	*
	Division	/
	Exponentiation	^
String Operator	Concatenation	&
Comparison relations	Comparison	Like
	Equal	=
	Less than	<
	Greater than	>
	Less than or equal to greater than or equal to	<= >=
	Not equal to	<>

# Mathematical Functions

Some useful mathematical functions

## Mathematical Functions

Function	Description	Syntax
<b>Sqr</b>	Returns the square root of a number	$SQR(number)$
<b>Log</b>	Returns the natural logarithm of a number ( $e$ is approximately 2.718282)	$LOG(number)$
<b>Exp</b>	Returns $e$ (the base of natural logarithms) raised to a power	$EXP(number)$
<b>Fix</b>	Returns the integer portion of a number	$Fix(number)$
<b>Abs</b>	Returns the absolute value of a number	$ABS(number)$

# Expression and Assignment

## Exercise

The goal of this exercise is to familiarize yourself with expressions, hence for each question write an expression that yields a suitable answer. Further assign the expression to a variable (declare explicitly the variable)

- 1 The net value of the price  $p$  discounted by 25% ( $p$  holds the price)
- 2 The function  $f$  in  $x: f(x) \rightarrow x^2 + 4x + 2$  ( $x$  holds an integer)
- 3 The distance between two points in the plane ( $P_1(x, y)$  and  $P_2(x, y)$ ;  $x_1, y_1, x_2, y_2$  holds the corresponding coordinates)
- 4 A sentence reporting whether *name* contains at least two "s" (i.e. Weierstrass) (*name* holds the last name)
- 5 The circumference of a circle having radius  $r$ , the value should have three decimal places ( $r$  hold a real number)
- 6 A sentence reporting the date of the next lecture

# Expression and Assignment

## Solution

- 1 `Dim nv As Double`  
`nv = p * (1 - 0.5)`
- 2 `Dim f As Long`  
`f = x ^ 2 + 4 * x + 2`
- 3 `Dim d As Double`  
`d = sqr((x1 - x2) ^ 2 + (y1 - y2) ^ 2)`
- 4 `Dim s As String`  
`s = "The name " & name & " has at least two s = " _`  
`& (name Like "*s*s*")`
- 5 `Dim c As Double`  
`c = Round((2 * r * 3.14), 3)`
- 6 `Dim s As String`  
`s = "Next Lecture: " & #12/10/2011#`