Instructor Notes:

Instructor Notes:

Lesson Objectives

- To understand the following concepts
  - Good programming practices
    - Readable(Naming Conventions , Comments, Guidelines for writing good code)
    - Maintainable (Remove Hardcoded constants)
  - Modular programming
  - Coupling and Cohesion
  - Robust program
  - Composite Datatype
  - Review

Instructor Notes:

1.1.1 Readable

Naming Conventions

- Use Meaningful names
  - Use Verb-noun format (be specific):
  - Avoid generic names
- Good variable names ensures readability.
- Use naming conventions to distinguish Scope of data.
- Use capitalized names for distinguishing constants among other variables.
- Names should be readable, memorable and appropriate
- A good name tends to express the "what" than the "how"

Naming Conventions

- Meaningful Names:
  - The name fully and accurately describes what the variable represents
  - The name should refer to the real-world problem rather than to the programming-language solution
  - Use Verb-noun format (be specific):

    For example: Read-Employee-Record, Calculate-Deductions, Print-Pay-slip
  - Avoid generic names:

    For example: Process-inputs, Handle-calculations
- Good variable names are a key element of program readability.
- Use naming conventions to distinguish Scope of data like local/global.

  For an Example, MAX_USERS_G variable scope is global
- Use capitalized names for distinguishing among type names, named constants, enumerated types, and variables.

Instructor Notes:

1.1.1 Readable

Naming Conventions (Cont….)

- Example of Poor Variable Names:

```
X       =  X – XX;
marypoppins = (superman + starship) / god ;
X       = X + Interest( X1, X );
```

- Example of Good Variable Names:

```
Balance  = Balance – LastPayment;
Balance  = Balance + Interest ( CustomerID,Balance);
```

Instructor Notes:

1.1.1 Readable

Naming Conventions (Cont....)

Variable Type	Strategy	Variable Name	Example
Temporary Variable	Bad	Temp	Temp = sqrt(b^2 – 4 *a*c);
	Good	Discriminant	Discriminant== sqrt(b^2 – 4 *a*c);

Boolean Variable	Bad	NotFound, NotSuccess	If (Found)
			PRINT "ELEMENT IS PRESENT"
			Else

	Good	Found, Success	PRINT "ELEMENT IS NOT PRESENT"
Status Variable	Bad	StatusFlag = 0x80. DataReady=r	
	Good	CharacterType = CONTROL_CHARACTER DataReady = TRUE;	

Naming Status Variable: Think of a better name than "flag" for status variables.

```
if ( DataReady ) ….
 if ( CharacterType & PRINTABLE_CHAR) …
 if ( ReportType == AnnualRpt ) …
 DataReady   = TRUE;
 CharacterType = CONTROL_CHARACTER ;
 ReportType   = AnnualRpt;
 RecalcNeeded = FALSE;
```

CharacterType = CONTROL_CHARACTER is more meaningful than StatusFlag = 0x80.

Naming Temporary Variable: Use meaningful, descriptive names for Temporary variables. Don't use Temp, x or some other vague name.

Bad Temporary variable Name

```
Temp  = sqrt( b^2 – 4 *a*c );
```

A Better approach is

```
Discriminant  = sqrt( b^2 – 4 *a*c );
```

Never use a numeric suffix to differentiate variables

Instructor Notes:

1.1.1 Readable

Optimum Name Length

- The name is long enough that you don't have to puzzle it out.

Too Long	NumberOfPeopleOnTheUSOlympicTeam, NumberOfSeatInTheSaddleDome
Too Short	N, NP, NTM, M, MP, Max, Points
Just Right	NumTeamMembers, TeamMbrCount, MaxTeamPoints, RecordPoints, cPoints

Naming Boolean Variables: Use names that imply true or false like done, error, found, success as Boolean variables

Avoid using negative names like NotFound, NotDone and NotSuccessful

"If not notFound" is difficult to read

Better way is to use "if found" instead

Give meaningful names for Loop index.

```
i = 0
ACCEPT Emp, Basic
G = B * 1.8 + 1700
PF = 0.12*B
T = ((G*12 - 150000)*0.3 + 19000)/12
N = G - PF - T – 200
PRINT Emp, B, G, PF, T, N
i=i +1
IF i==10  THEN Stop
Continue
```

In this example variable 'i' is used to count how many pay slips have been generated.

'Rec_Count' can be used instead of 'i'

Instructor Notes:

1.1.1 Readable

Kinds of Comments

- Repeat of the code
- Explanation of the code
- Marker in the code /** @@to do */
- Summary of the code
- Description of the code's intent

Kinds of comments

- Repeat of the code:

A repetitious comment restates what the code does in different words. It merely gives the reader of the code more to read without providing additional information

- Explanatory Comments:

Explanatory comments are typically used to explain complicated, tricky or sensitive pieces of code. If the code is so complicated that it needs to be explained, its nearly always better to improve the code than it is to add comments. Make the code itself cleared and then use summary comments

- Marker in the code /** @@todo*/ :

todo is a form of comment used to convey that the code is yet to be completed by replacing todo comment with the functionality logic. For an example, /**@@todo*/

- Summary of the code : Use comment to provide description of the program like header block comment. For an example,

//Program Description:

- Description of the code's intent : Use this comment, to describe the layout used

Instructor Notes:

1.1.1Readable

Commenting Techniques

- Endline comments:
  - Avoid Endline comments on single lines or multiple lines.
  - Use Endline comments to annotate data declarations and to mark ends of blocks.
- Paragraph comments:
  - Focus paragraph comments on the why rather than the how.
  - Use comments to prepare the reader for what is to follow.
  - Avoid abbreviations, comments should be unambiguous.

Commenting Techniques

Commenting is amenable to several different techniques depending on the level to which the comments apply : program, file, routine, paragraph, or individual line

- Endline Comments
  - Endline comments are comments that appear at the ends of lines of code
  - Use endline comments to annotate data declarations like

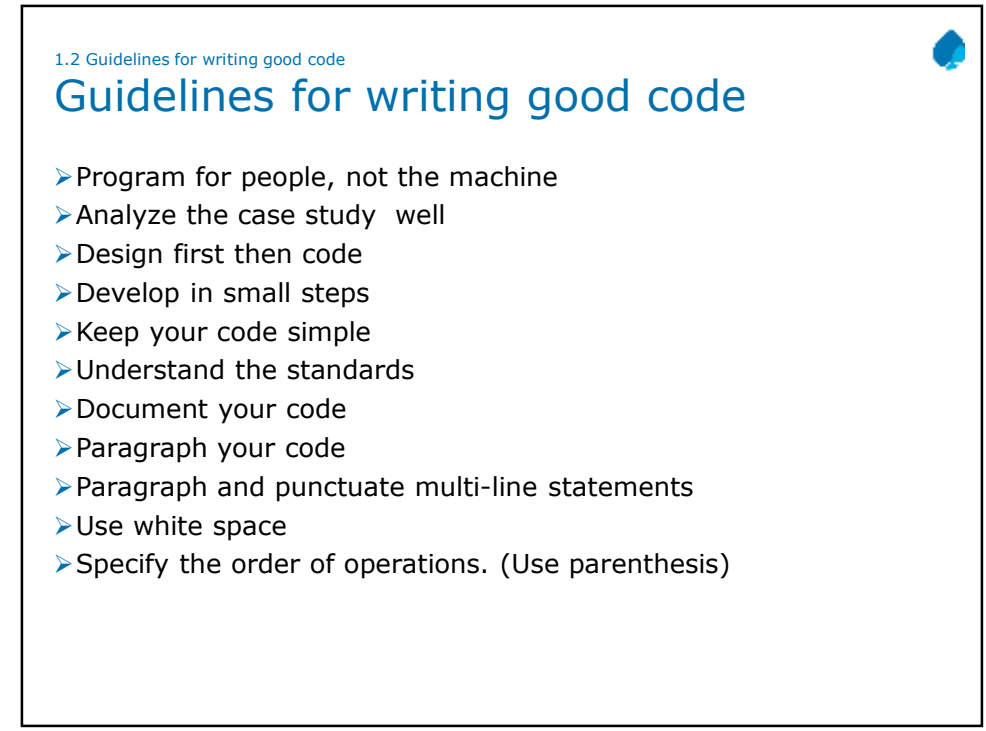
    Declare index as integer and store 0. //upper index of an array

  - Use endline comments to mark ends of blocks

- Paragraph Comments
  - Most comments in a well documented program are one sentence or two sentence comments that describe paragraphs of code
  - Use to describe the purpose of the block of code
  - For an example,

```
/*******************************
*          Search for an employee
* *******************************/
```

Instructor Notes:



Guidelines for writing good code

- While writing program, keep in your mind that program will be used by people, so make program to be user friendly.
- Before starts with development , analyze the case study well to incorporate all the requirements.
- Do the high level (like database design) and low level designing(pseudocode) of an application before working in coding phase.
- Create program in an incremental approach, so that after implementation of each logic it can be easily tested for finding defects.(As finding defects in earlier stage, decreases cost and save development time).
- Make your code to more simple by avoiding the usage of complex data structure/constructs
- Understand the standards:
    - All the coding standards as well as processed should be understandable and apply the same in your code.
    - Believe in them
    - Make them part of your quality assurance process
    - Adopt the standards that make the most sense for you
- Document your code using comments for making it to be more readable
- Paragraph your code by applying modularity to make code reusable.
- Use whitespace as a layout technique to make code more readable
- Specify the order of operations using parenthesis for prioritizing

Instructor Notes:

Additional notes for instructor

1.1.2 Maintainable

Maintainable

- If the program is easy to understand and if it is easy to modify then the program is called as maintainable.
- Selection of proper data management technique helps to make code more simpler and maintainable.
- Achieve maintainability by eliminating hard coded constants from the code

If the program is easy to understand and if it is easy to modify then the program is called as maintainable. Selection of proper data management technique helps to make code more simpler and maintainable. Achieve maintainability by eliminating hard coded constants from the code.

Instructor Notes:

Additional notes for instructor

1.1.2 Maintainable

Maintainable - Example

- Program to find the circumference of a circle.

```
BEGIN
        ACCEPT radius
        circumference = 2 * 3.14159 * radius
        PRINT "Circumference of a circle : ", circumference
END
```

- Better Version

```
BEGIN
        DECLARE CONSTANT PI AS INTEGER AND STORE
3.14159
        ACCEPT radius
        circumference = 2 * PI* radius
        PRINT "Circumference of a circle : ", circumference
END
```

Example:

The given program is used to find the circumference of a circle based on radius. In the given code, hardcoded constant exists which is eliminated by using hard coded constant.

Instructor Notes:

- Show this code to participants and give them time to find issues in the code
- Subsequently, explain the issues given in the notes pages

1.1.2 Maintainable

Program for Printing Pay-slip – Example 2

➢ What does the following Program (example) do?

Version 1

```
BEGIN
ACCEPT ecode, ename, B
G = B * 0.8 + 1700
PF = 0.12*B
T = ((G*12 - 150000)*0.3 + 19000)/12
N = G - PF - T – 200
PRINT ecode, ename, B, G, PF, T, N
END
```

What are problems in the code above:

Variable names are not meaningful. Understanding meaning of variables G, B, T, N etc. is difficult. Hence the code is not easily understandable
We don't understand what the given code is doing?

Instructor Notes:

- Show this code to participants and give them time to find improvements in the code
- Explain improvements
  - Given in the notes pages

1.1.2 Maintainable

Program for Printing Pay-slip - Example 2 (Cont....)

- Is Version 2 better than version 1 – why?

Version 2

```
BEGIN
ACCEPT ecode, ename, Basic
Gross = Basic * 0.8 + 1700
PF = 0.12 * Basic
Tax = ((Gross * 12 - 150000) *0.3 + 19000)/12
Net = Gross - PF - Tax – 200
PRINT ecode, ename Basic, Gross, PF, Tax, Net
END
```

- **What the code is doing is understandable**
- **The variable names given are meaningful than given in previous example.**

See the above example what it is doing?
It reads employee code, employee name and basic salary from keyboard.
Calculates Gross pay, Provident Fund (PF), Tax and Net pay.
Prints the pay slip

It is understandable because the variable names given are meaningful than given in previous example.
It shows that if you give meaningful variable names then it helps you to understand program better.

Instructor Notes:

None

1.1.2 Maintainable

Program for Printing Pay-slip - Issues

- What are the issues in understanding the program calculating the gross pay?
  - Poor readability
    - Comments are not added in the code
    - Poor variable names
  - Maintainability
    - Hard-coded constants
    - The program is not modular

Programming standards that are to be followed are given below:

- Use meaningful variable names. It helps to easily understand the program. Avoid using hard-coded constants in the program. Instead, declare them as constants at the beginning of the program, and use these constant names through the program. If value of constant changes later, the value can be modified for the declared constant at one place. The effect will be visible everywhere this constant name is used.

  For example: tax rate

- Include comments at the header and module level
- Don't use literal values in the program instead create constant variable to store fixed literal value for making program to be more maintainable.
- Ensure that you have created more modular program.

Instructor Notes:

None

1.1.2 Maintainable

Program for Printing Pay-slip - Solution

- What solutions do you recommend for these issues?
  - Use Header block for comments.
  - Use meaningful variable names.
  - Eliminate hard coded constants from the code.
  - Avoid use of obscure code

For an example:

```
HRA = 0.5 * Basic  /*** avoid obscure code G = B * 0.8 +1700 ***/
OPA = 0.3 * Basic      /*** Offshore project allowance ***/
Conveyance = 1700
```

- Use comments to describe program flow or complex sections of code.

If we use above solution to update the code then the code will become more readable, maintainable.

By reading the code, G = B * 0.8 + 1700, we do not understand what is meant by 1700, nor what is meant by 1.8 in the gross calculation.

However, the given code explains that Conveyance is 1700. HRA is 50% of Basic. Offshore Project allowance is 30% of Basic. So do not try to club these equations. Otherwise, maintenance of the code will be difficult, and understandability of code will reduce, as well.

Hence avoid such obscure code. Keep it simplified.

Instructor Notes:

Explain the what can be added the header block

1.1.2 Maintainable

Program for Printing Pay-slip - Solution

- Header Block

```
/************************************************
*  File                    : Example.txt
 * Author Name             : Capgemini
 * Description        : Program to Print Pay Slips for all employees
 * Version                 : 3.0
 * Last Modified Date      : 21-Feb-2015
 * Change Description      : Added meaningful variable names, made use of blank lines
************************************************/
```

See the given header block of comments
It includes:

- File : Give the name of the file.
- Author name : Provide the author name who involved in the development of program
- Description : Detailed description of the program
- Version : Version of the program
- Last modified date : Date on which the program is last modified
- Change Description: History of changes happened in the program

Instructor Notes:

- Show this code to participants and give them time to find changes in the code
- Explain what other improvements are required

Given in the notes pages and on the next slide

1.1.2 Maintainable

Program for Printing Pay-slip - Example

➢ Is Version 3 better than version 1 and 2– why?"

Obscure code is removed

```
BEGIN
        ACCEPT ecode, ename, Basic
        HRA = 0.5 * Basic   /*** avoid obscure code G = B * 0.8 + 1700 ***/
        OPA = 0.3 * Basic   /*** Offshore project allowance ***/
        Conveyance = 1700
        Gross = Basic + HRA + OPA + Conveyance
        Income_Tax = ((Gross * 12 - 150000) * 0.3 + 19000)/12
        Provident_Fund = 0.12 * Basic
        Prof_Tax = 200
        Net = Gross – Provident_Fund - Tax – Prof_Tax
        PRINT ecode, ename, Basic, HRA, OPA, Conveyance, Gross
        PRINT Provident_Fund, Income_Tax, Prof_Tax, Net
END
```

Why version 3 is better than version 1 and 2
1. Hard coded constants are given proper names. E.g. – HRA, OPA, Conveyance.
2. The given code is easy to maintain because if conveyance amount , percentage for HRA or OPA changes then we can easily understand where to make the change in the code, which was difficult in version 1 and 2
3. Code is readable as naming conventions are followed and layout is applied

Following improvements are required in the code:
a) If your code includes any complicated calculations It is necessary to document it in the code. In the above example the calculation of income tax includes many operations. What is meaning of it need to be documented in the code.

Steps involved in income tax calculations
1. Calculate annual salary : Gross * 12
2. Calculate taxable amount: 1,50,000 will be subtracted from annual salary
3. Calculate annual tax: Annual Tax = 30% of taxable amount + 19000
4. Calculate monthly tax Monthly tax = Annual tax/12

b) The given code is not modular. It doesn't have any modular structure.
If the code is huge. It is performing various functions then it is better to create separate module for each function which increases reusability of the program.
If any of these modules can be reused in some other application Programmer's efforts and time will be saved.
A good example is login module. Almost every application requires login screen which authenticate users. Such modules can be written once and used in multiple applications.

Instructor Notes:

Additional notes for instructor

1.2 Modular Programming

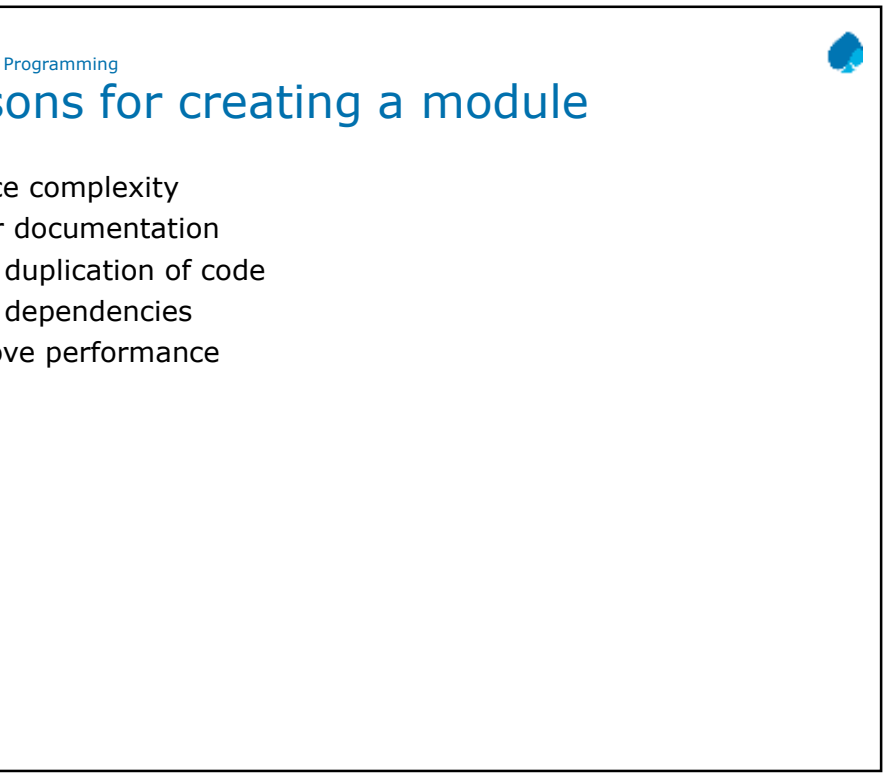
Modular Programming

- A small unit of code for a single purpose
- Intended to operate in a larger program unit
- Can be a function, a method, a procedure or a sub-program or a component
- Is a self contained piece of code, but cannot be independent by itself

Modular : A small unit of code for a single purpose intended to operate in a larger program unit . It can be a function, a method, a procedure or a sub-program or a component. Module is a self contained piece of code , but cannot be independent by itself

Instructor Notes:

Additional notes for instructor



Reasons for creating a module

- Reduce complexity : By using the abstracting power of modules, complex code can be made to appear simpler and easy to understand
- Better documentation : By putting a set code into a well defined module, makes the code self –explanatory
- Avoid duplication of code
- Avoid dependencies : Sections of code that depend on each other makes changes difficult to incorporate
- Improve performance : Easy to test and debug units of code, than a long one

Instructor Notes:

Additional notes for instructor

1.2 Modular Programming

Advantages of Modularity

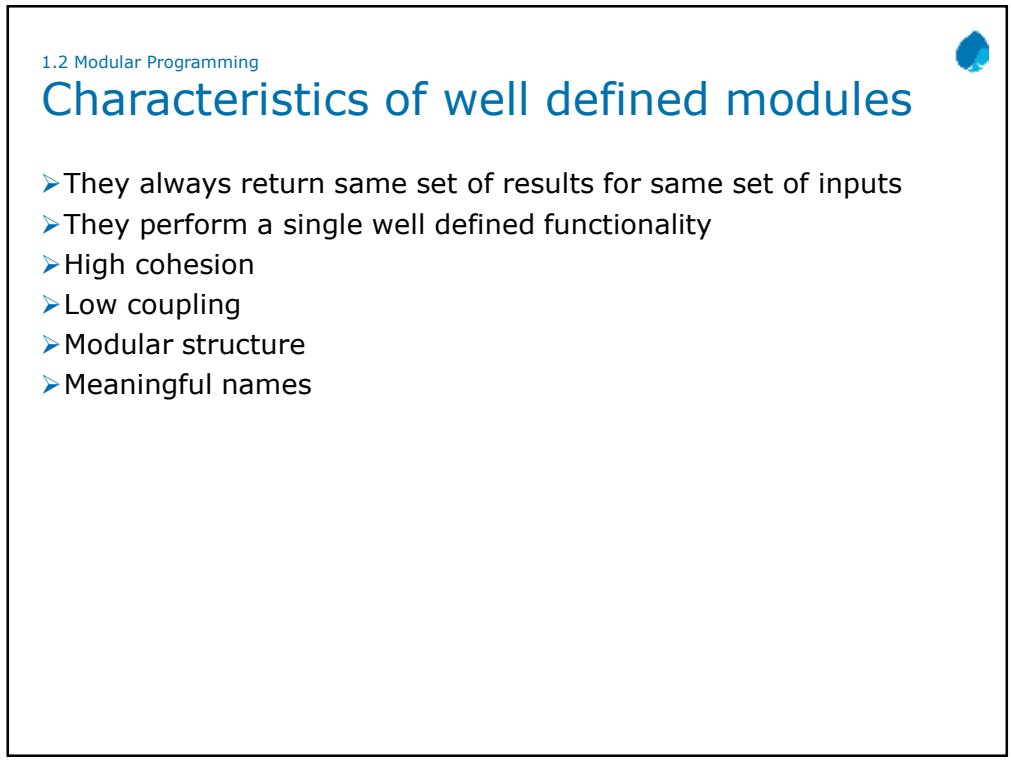
- Easy to test and debug each unit independently
- Divide work among multiple developers
- Reuse code
- Easy to incorporate changes, as required
- Easy to understand
- Cleaner Code

Advantages of Modularity

- Easy to test and debug each unit independently so that defects will be identified at the earlier stage.
- Divide work among multiple developers so that application development time will be reduced.
- Reuse code: Once a module is written, the same module can be reused in another application.
- Easy to incorporate changes, as required so that the code will be more maintainable.
- Easy to understand as the code is written in a single unit called module.
- Cleaner Code

Instructor Notes:

Additional notes for instructor



Characteristics of well defined modules

- They always return same set of results for same set of inputs
- They perform a single well defined functionality
- **High Cohesion** – do one thing, and do it well
- **Low Coupling** – reduce dependencies between modules

Ideally when there is "high cohesion" and "low coupling", one can change the implementation of a routine without impacting the call interface.

For example: A sort routine can change its algorithm from "Bubble" to "Quick sort" – without causing the calling code to break.

- **Meaningful names**

Use Verb-noun format (be specific):

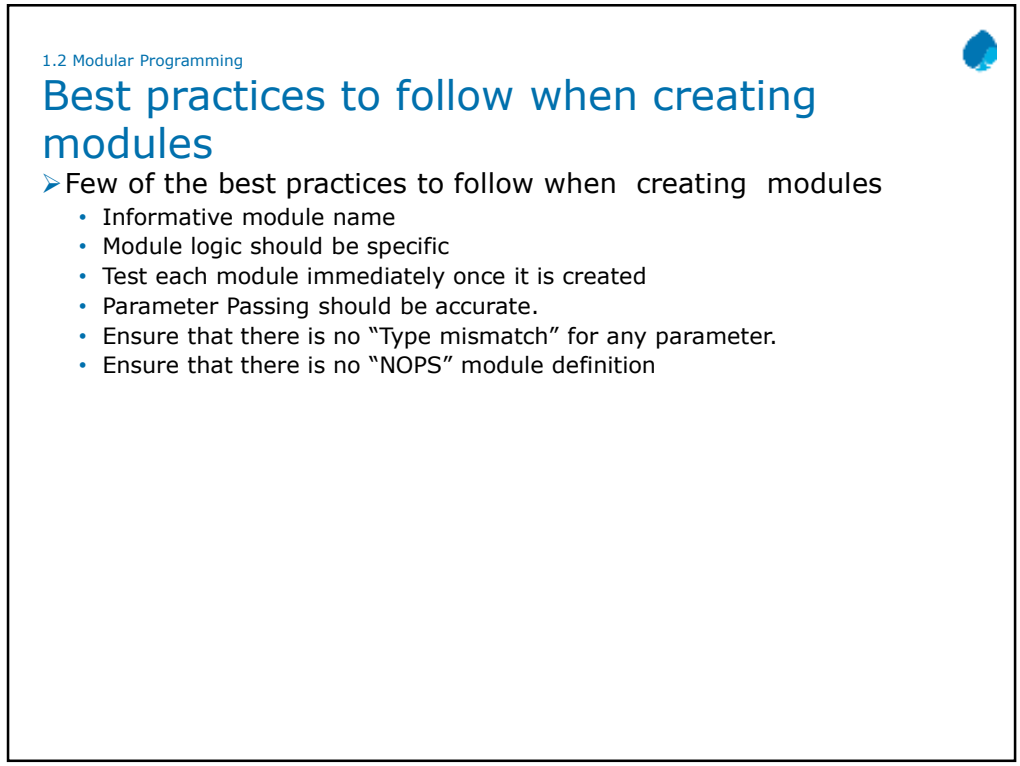
For example: Read-Employee-Record, Calculate-Deductions, Print-Pay-slip

Avoid generic names:

For example: Process-inputs, Handle-calculations

Instructor Notes:

Additional notes for instructor



Best Practices to follow when creating modules

- **Informative Module Name:** Give the module an informative name like getProductPrice, calculateSalary, printDetails.
- **Module logic should be specific: I**dentify a clear purpose for the module before you start writing
- Test each module as it is created by performing unit testing
- Parameter passing should be accurate: Ensure that the number of parameters, and the sequence is correct for the module call.
- Ensure that there is no "Type mismatch" for any parameter.
- Ensure that there is no "NOPS"(No Operation) Module definition. i.e. Empty module definition shouldn't be there.

calculateTotal(Integer price, Integer quantity)

Refer the valid and invalid statements to invoke a module

- **calculateTotal(3,5); //Valid**
- **calculateTotal(4,3,4); //Invalid**
- **calculateTotal('Test',3); //Invalid**

Instructor Notes:

Additional notes for instructor

Example - 1

- Pseudocode to calculate the net billing amount to be paid by the customer. The discount is calculated on Purchase amount as given below
  - 30 % above 5000
  - 20 % for 3001 – 5000
  - 10 % for 1001 – 3000

Instructor Notes:

Additional notes for instructor

Solution - 1

- Pseudocode for calculating bill amount. (Not Modularized)

```
BEGIN
        DECLARE PurchaseAmount, DiscountAmount, BillAmount  AS INTEGER
        DECLARE TaxPerc  AS REAL AND STORE .15
        PROMPT "Enter Purchase amount" AND STORE IN PurchaseAmount
        IF PurchaseAmount < 0 THEN
                DISPLAY "Invalid Amount"
        ELSE IF PurchaseAmount > 5000 THEN
                DiscountAmount  = .30  *  PurchaseAmount
        ELSE IF PurchaseAmount > 3000 THEN
                DiscountAmount  = .20 * PurchaseAmount
        ELSE IF PurchaseAmount > 1000 THEN
                DiscountAmount  = .10 * PurchaseAmount
        END IF
        CALCULATE BillAmount = (PurchaseAmount - DiscountAmount) +
                                TaxPerc * (PurchaseAmount-DiscountAmount)
        DISPLAY BillAmount
END
```

The above pseudocode for calculating bill amount is not modularized

Instructor Notes:

Additional notes for instructor

Solution - 2

- Modularized Pseudocode for calculating bill amount.(Contd..)

```
SUB  CalculateDiscount(PurchaseAmount)
        DECLARE DiscountAmt AS INTEGER AND STORE 0
        IF PurchaseAmount > 5000 THEN
                DiscountAmt = .30 * PurchaseAmount
        ELSE IF PurchaseAmount > 3000 THEN
                DiscountAmount = .20 * PurchaseAmount
        ELSE IF PurchaseAmount > 1000 THEN
                DiscountAmt = .10 * PurchaseAmount
        END IF
        RETURN DiscountAmt
END SUB
```

The above pseudocode for calculating bill amount is modularized

Instructor Notes:

Additional notes for instructor

Code Considerations During Modularization

- During modularization of the code we need to decide:
  - Input Parameters:
    - For each lower level routine, what input parameters should be passed?
  - Output Parameters:
    - Should the output be in the form of a "parameter" or a "return value"?

Instructor Notes:

Discuss about the input and output parameters in the given module.

1.2 Modular Programming

Code Considerations

- Analyze parameters and return values for Accept_Employee_Details, Compute_Deductions, Compute_Gross_Pay

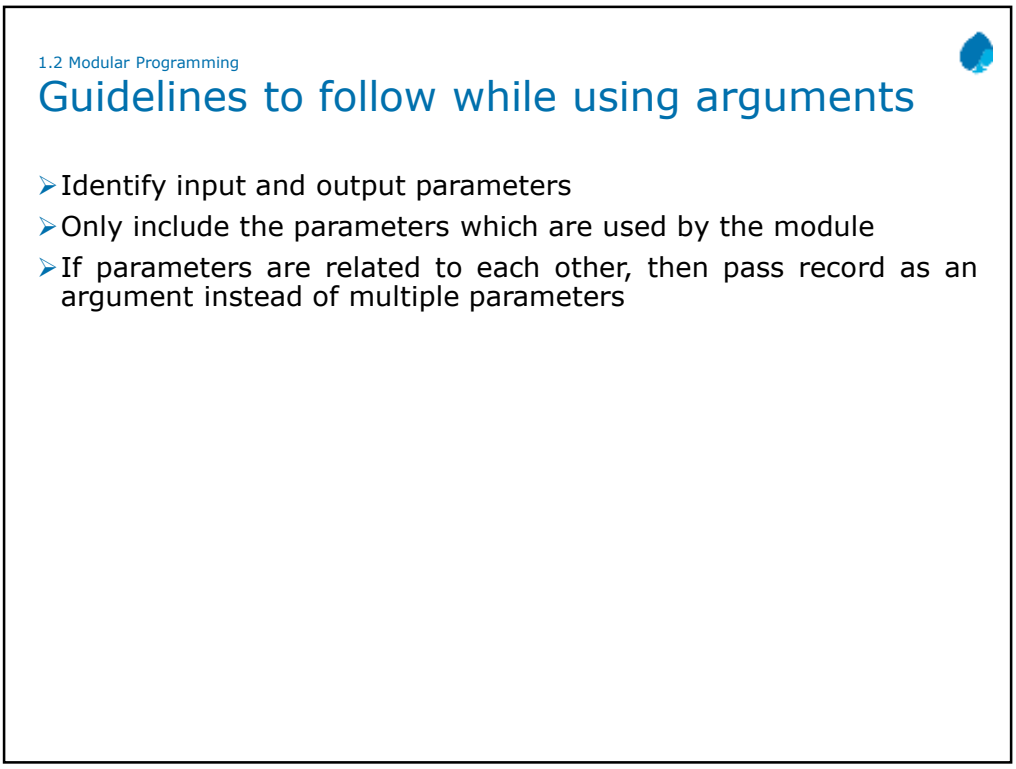
```
SUB Accept_Employee_Details()
      ACCEPT emp_code, Basic
END SUB
```

```
SUB Compute_Deductions(Basic)
  Provident_Fund = 0.12 * Basic
  Prof_Tax = 200
  Compute_Income_Tax (Basic)
END SUB
```

```
SUB Compute_Gross_Pay(Basic)
  HRA = 0.5 * Basic       /*** House Rent Allowance ***/
  OPA = 0.3 * Basic       /*** Offshore project allowance ***/
  Conveyance = 1700
  Gross = Basic + HRA + OPA + Conveyance
END SUB
```

Instructor Notes:

Additional notes for instructor



Guidelines to follow while using arguments

- Identify input and output parameters: After analyzing the requirement, identify input and output parameters before writing module code. For an Example, if you want to create a module for implementing a logic related to retrieving product details based on product id, then input parameter is productid and output parameter is variable of type record which contains product details.
- Only include the parameters which are used by the module, never pass unused parameters.
- If parameters are related to each other, then pass record as an argument instead of multiple parameters which strive for high cohesion and low coupling. For an example, refer the below module code snippet to add an employee details

  SUB addEmployee(empId, name, salary)

  END SUB

Instead use the below module signature

SUB addEmployee(Employee emp) //Consider Employee is a record

END SUB

Instructor Notes:

Additional notes for instructor

1.2 Modular Programming

Best practice to follow for return values

- Have a single exit point from each module
- Return null values instead of zero length arrays
- Use well defined exceptions and error codes
- Based on the number of values to be returned, use specific return type like array or records.
- Consider the side effects of return values while integrating all the modules together.

Best Practice to follow for return values

- Use only one return statement in each module as shown below:

```
SUB checkDigit(number)
        DELCARE result AS BOOLEAN
        IF(num>0) THEN
                result=true
        ELSE
                result=false
        END IF
        RETURN result
END SUB
```

- Return null values instead of zero length arrays.
- Return exceptions/error code if an invalid input is accepted.

```
SUB getProductPrice(productId)
                DECLARE errorcode AS INTEGER AND STORE 0
                IF(elementfound(productId)) THEN
                    RETURN productPrice
                ELSE
                                errorcode = -1
                                RETURN errorcode;
                END IF
END SUB
```

- Use array as return type if more than one value has to be returned of same type or use record if more than one value has to be returned of different type.

Instructor Notes:

Explain the meaning of coupling with examples

1.3 Coupling and cohesion

Coupling

- Coupling or Dependency is the degree to which each program module relies on each other.
- Tightly coupled systems disadvantages:
  - A change in one module forces a ripple-effect of changes in other modules.
  - Assembly of modules might require more effort and/or time due to the increased inter-module dependency.
  - A particular module might be harder to reuse and/or test because dependent modules must be included

Example for Coupling:

Make Tea in Pot (min)
Pour Boiling Water in Pot
Add Tea powder in Pot
Wait min Minutes

Well Coupled - all parameters are needed

If a module does only one thing, we need to pass less parameters.
If a module does too many things, we need to pass more parameters.
Passing more parameters means high coupling.

We should strive for low coupling.

Make Tea in Pot (min, temp)
Pour Boiling Water in Pot
Add Tea powder in Pot
Wait min Minutes

Not Well Coupled - temp variable is not used

Instructor Notes:

Additional notes for instructor

1.3 Coupling and cohesion

Coupling

- Loosely coupled systems advantages :
  - A change in one module usually does not force a ripple-effect of changes in other modules.
  - Assembly of modules might require less effort and/or time due to the decreased inter-module dependency.
  - A particular module might be easier to reuse and/or test because dependent modules do not need to be included

Low Coupling – reduce dependencies between modules

- Note that changes in one routine should not normally impact other routines, as long as the interface is the same.
- Remember that, in case too many things are done in one routine, a lot of data needs to be shared. This increases the dependencies, and also the chances of defects
- Consider "Smaller interface" (low coupling) versus "long list of parameters" (high)
- Consider data sharing through "parameters" (low) versus "global data" or "global files" (high)
- Note that passing "flags" that control the processing implies High coupling.

Instructor Notes:

Additional notes for instructor

1.3 Coupling and Cohesion

Cohesion

- A cohesion is a measure of how the activities within a single module are related to one another.
- Principle of Cohesion:
  - A module should do one thing and do it well
- If a module follows the given principle, then it is high cohesion.

Writing function with high cohesion is always good practice.
Ideally, we should strive for **High Cohesion** and **Low Coupling**.

For example:
1. Sin (x); Cos (x); Tan (x); (High Cohesion, Low Coupling)

Note:
A good program requires high cohesion and low coupling.

2.Trig (Type, x)
where type is Sin, Cos, or Tan; (Less Cohesion, High Coupling)

Note:
Since in function trig we are trying to add all three functions together, we require to pass one extra parameter i.e. Type. This parameter indicates whether to calculate Sin, Cos, or Tan.

a. More number of parameters are required to pass, so it is High Coupling.
b. b. The function is not performing just a single task, so it is Low Cohesion.

Instructor Notes:

Additional notes for instructor

1.3 Coupling and Cohesion

Example

- Example 2: Now, consider the following piece of code as an example
- Review the code for any issues (Coupling, cohesion)

```
SUB ReadCust (filename, custrec)
      custfile=Fopen (filename)
      Fread (custrec, custfile);
END SUB

SUB writeCust (custrec)
      Rewind (custfile);
      Fwrite (custrec, custfile);
      Fclose (custfile);
END SUB

SUB UpdateCust (filename, newbalance)
      ReadCust (filename, custrec);
      Custrec.Balance = newbalance;
      WriteCust (custrec);
END SUB
```

Consider Fopen, Fwrite, Rewind, Fclose are predefined functions.

Fopen : To open a file
Fwrite : To write data to a file
Fclose : To close the opened file
Rewind :Moving cursor back to the first position of a file.

Instructor Notes:

Explain why the program will crash because of change request.
It is discussed on further slides.

Change Request - Example

- Suppose there is a Change Request to code in the above example:
  - Do not update balance, in case the new balance is less than 0. How will you implement this change?
  - Are any problems created due to the change?

Instructor Notes:

Additional notes for instructor

Change Request - Example

- Sometimes the change is made as follows

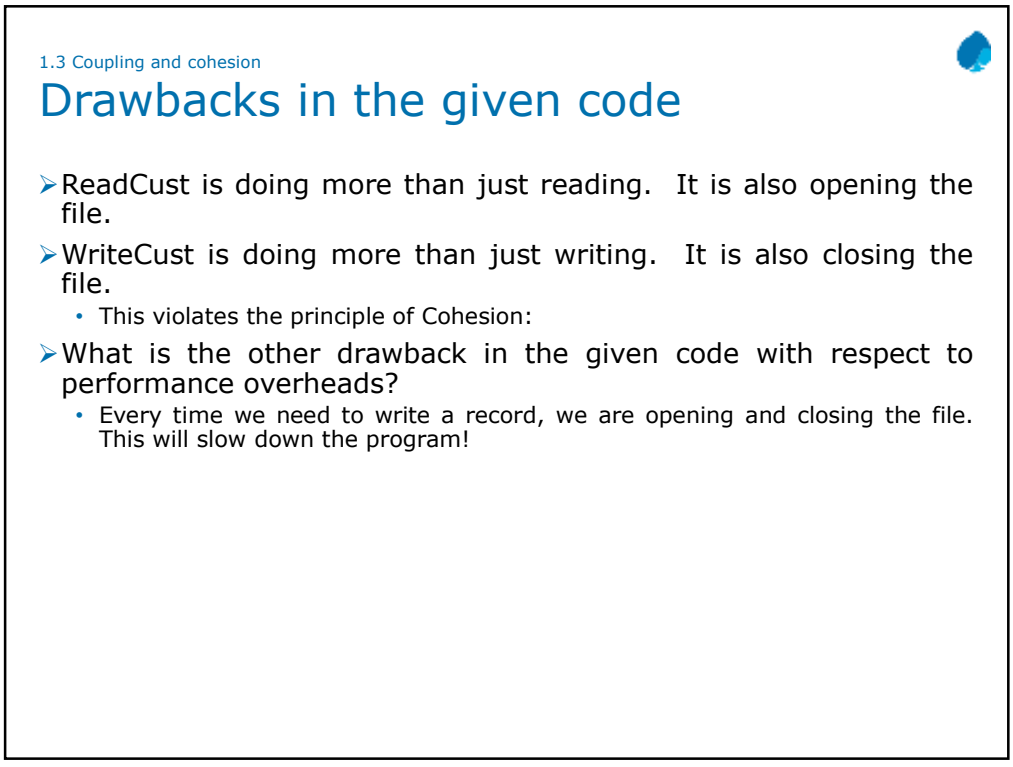
```
SUB UpdateCust (filename, newbalance)
    ReadCust (filename, custrec);
    IF(newbalance >= 0) THEN
        Custrec.Balance = newbalance;
        WriteCust (custrec);
    END IF
END SUB
```

- This means file will not be closed whenever "newbalance < 0". This is because file gets closed in writecust, and writecust will not be called.
- After a few hours the program will crash saying "too many open files".

Instructor Notes:

Once participants found the issues explain the problems in the code because of not following principle of coupling and cohesion.

Cohesion principle:



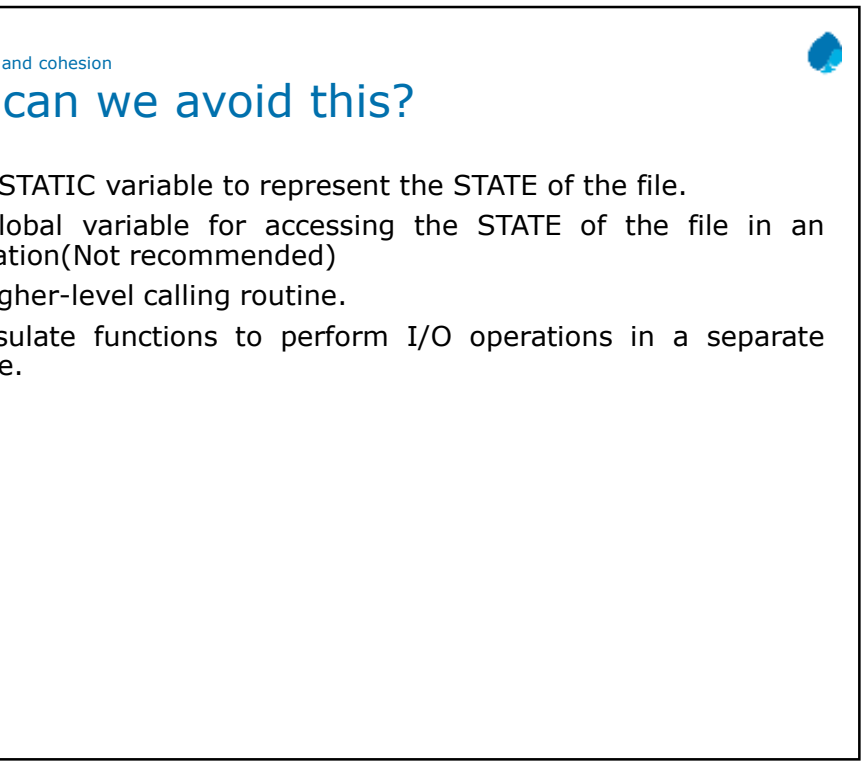
Cohesion:

- It means, the function should do one thing only, and the code should not be mixed up.
- As a result, the code becomes more readable and more maintainable.

Instructor Notes:

Once participants found the issues explain the problems in the code because of not following principle of coupling and cohesion.

Cohesion principle:



Steps to be taken care for avoiding drawbacks on the implementation of cohesion and coupling:

- Use a STATIC variable(cust-file-already-open) to represent the STATE of the file as OPEN or not
- We cannot access the STATIC variable cust-file-already-open outside this routine
- We will be able to access it outside the routine if we declare it as GLOBAL. However, that is not a good practice.
- It is better to open and close the cust-file in the higher-level calling routine. The routine should call UpdateCust only to write the record.
- The calls to fread / fwrite / fopen / fclose are encapsulated or wrapped in the modules ReadCust / WriteCust / OpenCust / CloseCust respectively.

Instructor Notes:

Once participants found the issues explain the problems in the code because of not following principle of coupling and cohesion.

Cohesion principle:

Revised Code

```
SUB ReadCust (filename, custrec)
      Fread (custrec, sizeof (custrec), 1, custfile);
END SUB

SUB WriteCust (custrec)
      Fwrite (custrec, sizeof (custrec), 1, custfile);
END SUB

SUB OpenCust (filename, mode, Cfile)
      Cfile = Fopen (filename, mode);
END SUB

SUB CloseCust (Cfile)
      Fclose (Cfile);
END SUB
```

The calls to fread / fwrite / fopen / fclose are encapsulated or wrapped in the modules ReadCust / WriteCust / OpenCust / CloseCust respectively.

Instructor Notes:

Explain why the program will crash because of change request.
It is discussed on further slides.

Revised Code (Contd..)

```
SUB UpdateCust (filename, newbalance)
      STATIC BOOLEAN cust-file-already-open = FALSE;
      IF (newbalance < 0) THEN
            {return;}
      ELSE IF (NOT cust-file-already-open) THEN
            OpenCust (filename, "r+", Cfile);
      END IF
      ReadCust (Cfile, custrec);
      Custrec.Balance = newbalance;
      WriteCust (custrec);
      CloseCust (Cfile);
END SUB
/****
Now we need to close the file only once at the end ***/
```

Used STATIC variable(cust-file-already-open) to represent the STATE of the file as OPEN or not

Instructor Notes:

Additional notes for instructor

1.3 Coupling and Cohesion

Advantages

- Wrapper modules help isolate system specific code in one place rather than all over the application.
  - They are easier to change during migration to different versions of Compiler or OS.
  - They are extremely useful when porting code:
    - To different platforms, or
    - To different database management systems
  - For example: In the code given in Example 2, "Read_cust" is acting as "wrapper module". It is hiding the details about how to read the file.

Instructor Notes:

None

1.4 Robust Program

What is Robust program ?

- Robust program anticipates common and uncommon problems
- To ensure software is well defended, one should write robust program
- Robust program ensures that software handles invalid inputs reasonably preventing abnormal termination
- The program should terminate gracefully and provide appropriate debugging information for the programmer

Robust program ensures that software handles invalid inputs reasonably preventing abnormal termination. Robust program anticipates common and uncommon problems. To ensure software is well defended, one should write robust program. The program should terminate gracefully and provide appropriate debugging information for the programmer

Instructor Notes:

1.4 Robust Program

Example

- Read the following code for compute_Income_Tax()
- Are there any errors in Compute_Income_Tax module?

```
SUB Compute_Income_Tax(Gross)
      Annual_gross = Gross * 12
      Annual_Tax = 0
/****
"for gross between 50 to 60K, tax is 10% of gross over 50K, max 1000"
"for gross between 60 to 150K, tax is 20% of gross over 60K, max 18000"
"for gross exceeding 150K, tax is 30% of gross over 150K" ******/
      IF (Annual_gross > 50000 and < 60000) THEN
            Annual_Tax = (Annual_gross – 50000) * 0.1
      ELSE IF (Gross > 60000 and < 150000) THEN
             Annual_Tax = 1000 + (Annual_gross – 60000) * 0.2
      ELSE
               Annual_Tax = 1000 + 18000 + (Annual_gross – 150000) * 0.3
      END IF
      Income_Tax  = Annual_Tax / 12
END SUB
```

In the above program we are not considering a case where annual_gross is less than 40000. As a result, in case the statements at the bottom of the program are executed, we will get wrong result.
Note: When we use a nested IF, be careful while writing the last ELSE. This is because, the program will be executed for all unhandled conditions, as well.

The above program has one more mistake. We have used Gross instead of Annual_Gross. This error will not be detected by the compiler because we are using Gross as a variable form during calculation of monthly gross. This will result in wrong output.

Instructor Notes:

1.4 Robust Program

Defects Introduced in the Program

- Do you see any new defects introduced in the program?
  - What tax will be calculated in the Compute_Income_Tax module for an income of 40000?
  - Nested IF-THEN-ELSE should take care of all possible conditions. Is the nested clause doing so?
  - Be careful about the last ELSE – it may end up doing more than it should
  - Program has mistakes in variable name references:

  Example: Gross instead of Annual_Gross

For resolving all the defects mentioned in the slide, rework on the code.

Instructor Notes:

1.4 Robust Program

Example

- Is the defects resolved in the below given revised code?

```
SUB Compute_Income_Tax(Gross)
      Annual_gross = Gross * 12
      Annual_Tax = 0
      IF(Annual_gross<=0) THEN
                PRINT "Gross salary cannot be negative"
      IF (Annual_gross >0 and Annual_gross <50000) THEN
            Annual_Tax = (Annual_gross – 49000) * 0.05
      ELSE IF (Annual_gross > =50000 and Annual_gross < 60000) THEN
            Annual_Tax = (Annual_gross – 50000) * 0.1
      ELSE IF (Annual_gross >= 60000 and Annual_gross<= 150000) THEN
             Annual_Tax = 1000 + (Annual_gross – 60000) * 0.2
      ELSE
              Annual_Tax = 1000 + 18000 + (Annual_gross – 150000) * 0.3
      END IF
      Income_Tax  = Annual_Tax / 12
END
```

In the above program we have considered a case where annual_gross is less than 40000. We have renamed, Gross as Annual_Gross. The statements in ELSE block will be executed only if Annual_Gross value is greater than 150000.

Annual Gross salary is calculation is taken care based on the below data

/****

"for gross less than 50K, tax is 5% of gross over 49K"

"for gross between 50 to 60K, tax is 10% of gross over 50K, max 1000"

"for gross between 60 to 150K, tax is 20% of gross over 60K, max 18000"

"for gross exceeding 150K, tax is 30% of gross over 150K" ******/

Instructor Notes:

None

1.4 Robust Program

Make a Program Robust

- Will the program work (or fail gracefully) with unexpected input?
  - Check if it can display error message as "Input cannot be negative " .
- Do not assume everything will be alright.
- Check for unexpected inputs or conditions.
- Remember GIGO – Garbage In, Garbage Out.
- Provide meaningful error messages

Is the program robust?

- We test the program with different expected values, and it works fine as per our expectation.
- However, what if somebody provides an unexpected input?
  - will the program give proper error message and stop gracefully, or
  - will the program fail and give some garbage output
- Hence to make the program robust, add appropriate messages to handle unexpected input as mentioned in the slide.
- How can we make the program robust?

  Check if it can display error message as "Input cannot be negative"

  Check if it can accept extreme values for inputs.

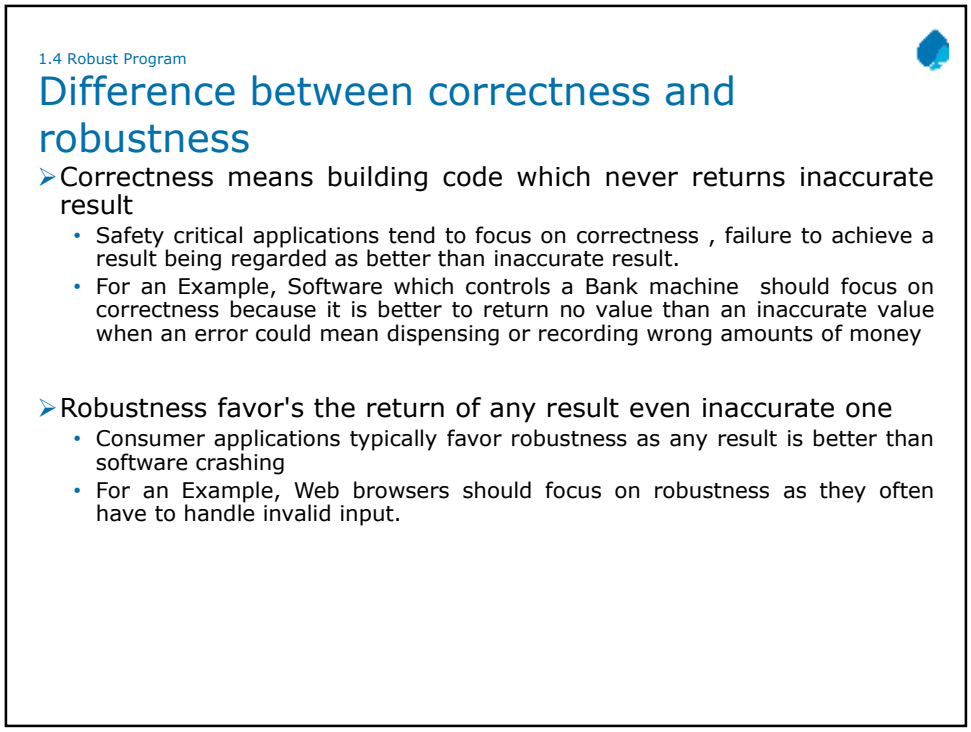
  For example: Basic = 1 crore

  Check if it can handle Output / Printer related problems.
- Check whether:

  "Can the Tax calculated be negative?" or

  "Can the Net Pay calculated be negative?"

Instructor Notes:



First determine whether you want the program to primarily offer robustness or correctness

- Examples of Robustness
    - Consumer applications typically favor robustness as any result is better than software crashing
    - You may want a word processing program to sometimes display unwanted characters rather than to shut down when it detects them
    - Web browsers should focus on robustness as they often have to handle invalid input.
- Examples of Correctness
    - Safety critical applications tend to focus on correctness , failure to achieve a result being regarded as better than inaccurate result.
    - E,g software which controls radiation equipment for patients is best shut down if it receives bad input for a radiation dosage.
    - Software which controls a Bank machine should focus on correctness because it is better to return no value than an inaccurate value when an error could mean dispensing or recording wrong amounts of money

Instructor Notes:

1.5 Composite Datatype

What is a record?

- Record is one of the composite data type, consisting of two or more values or variables stored in consecutive memory positions of different data types.
- Use them to simplify operations on blocks of data
- Use them to simplify module parameter lists

  Example:
  - Call Hardway (Name, Address, Phone, SSN, Sex, Salary)
  - Call Easyway (EmployeeRec)
- Use them to reduce maintenance of related data as changes to a record is easier to implement.
- Used to create user defined data types

Record: Record is one of the composite data type, consisting of two or more values or variables stored in consecutive memory positions .

Example for record:

```
RECORD Employee
        DECLARE ecode AS INTEGER
        DECLARE ename AS STRING
        DECLARE esal AS INTEGER
        DECLARE edept AS STRING
END RECORD
```

The above record is used to hold details about an employee such as employee code, employee name, employee salary and department in which employee is working.

Instructor Notes:

1.5 Composite Datatype

User Defined Data Type - Example

```
RECORD Student
        DECLARE RollNo AS INTEGER
        DECLARE Sname AS STRING
        DECLARE Course AS STRING
END RECORD

//Pseudo Code to read Student data and print it

BEGIN
  ACCEPT Id, Name, Crs

  Student.RollNo=Id
  Student.Sname=Name
  Student.Course=Crs

  PRINT "Student INFO:"
  PRINT "Student Roll Number      : " , Student.RollNo
  PRINT "Student Name             : " , Student.Sname
  PRINT "Student Course           : " , Student.Course
END
```

The code given in slide is used to maintain information about a student like rollno, sname and course details.

- Functionalities implemented in the above code are
    - Accepting student details like id, name and course
    - Printing the same.

Instructor Notes:

Explain how to review the code/document using checklist

1.6: Review

Code Review

- Static Testing Methods
  - Self Review
    - Done by the author himself with the aid of tools like checklists, review guidelines, rules, etc
  - Code Inspection
    - It is a more systematic and rigorous type of peer review.
    - Code inspection is a set of procedures and error detection techniques for group code reading.
    - Involves reading or visual inspection of a program by a team of people , hence it is a group activity
  - Walk Through
    - Like code inspection it is also an group activity.
    - In Walkthrough meeting, three to five people are involved. Out of the three, one is moderator, the second one is Secretary who is responsible for recording all the errors and the third person plays a role of Test Engineer.

Review Process

Input : Work Product , Specifications, Checklists, Guidelines, Historical Data

Process

- Prepare for Review
- Conduct Reviews
- Analyze Deviations
- Correct Defects

Output : Review Form, reviewed work product

Instructor Notes:

Explain how to review the code/document using checklist

1.6: Review

Pseudocode Review Checklist

- Pseudocode Review Checklist

Review Process

Input : Work Product , Specifications, Checklists, Guidelines, Historical Data

Process

- Prepare for Review
- Conduct Reviews
- Analyze Deviations
- Correct Defects

Output : Review Form, reviewed work product

Instructor Notes:

Demo

- Modular Programming Demo
  - In this demo observe the Naming convention, Layout and comment style followed with modular programming approach.

Instructor Notes:

Case Study

- Rima is working in State Electricity Board Project. She got the following requirement. The following information has to be accepted from the user to calculate the net electricity bill amount.
  - User ID
  - User Name
  - Last month meter reading
  - Current month meter reading

Unit consumed = (Last month meter reading) – (Current month meter reading)

Net Amount = Unit consumed * 1.15 +Fixed Charge

[Assume Fixed Charge is always Rs.100.]

Instructor Notes:

Case Study

- Write pseudo code to print the electricity bill. The bill should be in the following format
  - User ID:
  - User Name:
  - Unit Consumed:
  - Net amount:

Take care of good programming practices, modular programming approach and robustness.

Instructor Notes:

Summary

- In this lesson, you have learnt about:
  - Good programming practices.
    - Readable(Naming Conventions , Comments, Guidelines for writing good code)
    - Maintainable (Remove Hardcoded constants)
  - Modular programming
  - Coupling and Cohesion
  - Composite Datatype
  - Robust program
  - Review

Instructor Notes:

Question 1: A,B,C
Question 2: B

Review Questions

- Question 1: Why should you make code self documenting?
  - A. To help the review process
  - B. To improve the quality of the code
  - C. To make it easier to debug
  - D. To meet international standards

- Question 2: How can you minimize hard coding?
  - A. By changing named constants in several places in your code
  - B. By using enumerated types instead of named constants
  - C. By using named constants to replace Booleans when you require more answers than true or false

Instructor Notes:

Question 3: A,C,D
Question 4: A,B,C

Review Questions

- Question 3: What are the objectives of good layout?
  - A. An accurate logical structure
  - B. To improve compatibility with compiler
  - C. To improve readability
  - D. To withstand modifications

- Question 4 : What are the guidelines for good layout?
  - A. Use braces as boundaries to demarcate block of code
  - B. Use indentation to show logical structure of code
  - C. Use line breaks for statements over 80 characters
  - D. Use white space sparingly

Instructor Notes:

Question 5 : A,C
Question 6: C,D

Review Questions

- Question 5 : You are writing a module to update the visitor counter on a web page ,what steps can you take to make this module as strong as possible?
  - A. Call the module pageCountUpdate()
  - B. Call the module webPage6()
  - C. Test the module as soon as it is complete
  - D. Wait until all modules have been added to the program before testing it
- Question 6 : Which of these applications should be robust?
  - A. Bank machine software
  - B. Radiation machine software
  - C. Web browser software
  - D. Word processing software