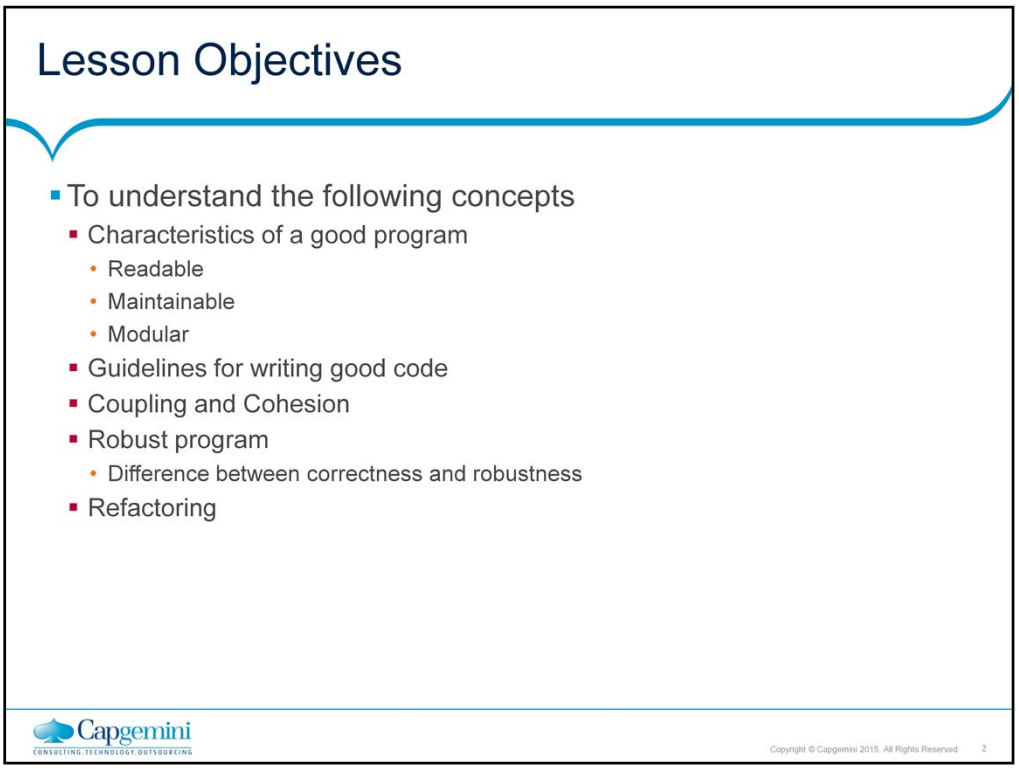
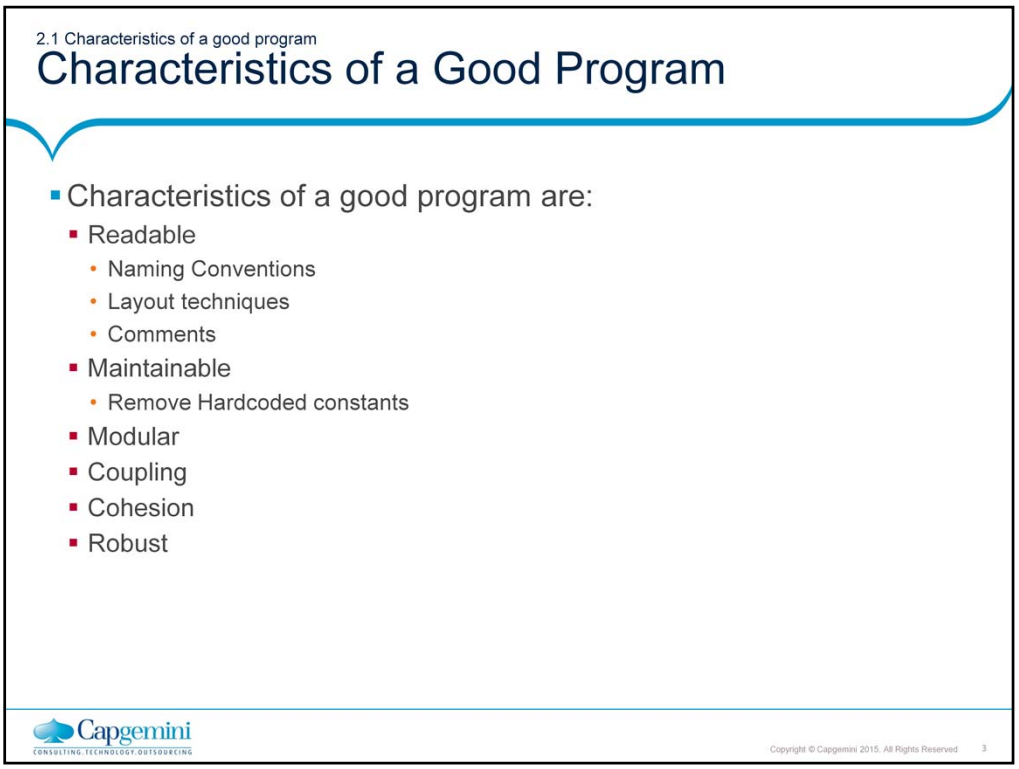
Programming Foundation With Pseudocode

Lesson 2: Good Programming Practices


Lesson Objectives
To understand the following concepts
Characteristics of a good program
Readable
Maintainable
Modular
Guidelines for writing good code
Coupling and Cohesion
Robust program
Difference between correctness and robustness
Refactoring
Capgemini
CONSULTING.TECHNOLOGY.OUTSOURCING
Copyright © Capgemini 2015. All Rights Reserved
2



If any program has following features then it is called as good program
1. Readable
   If the names of variables are meaningful and the code is easy to understand

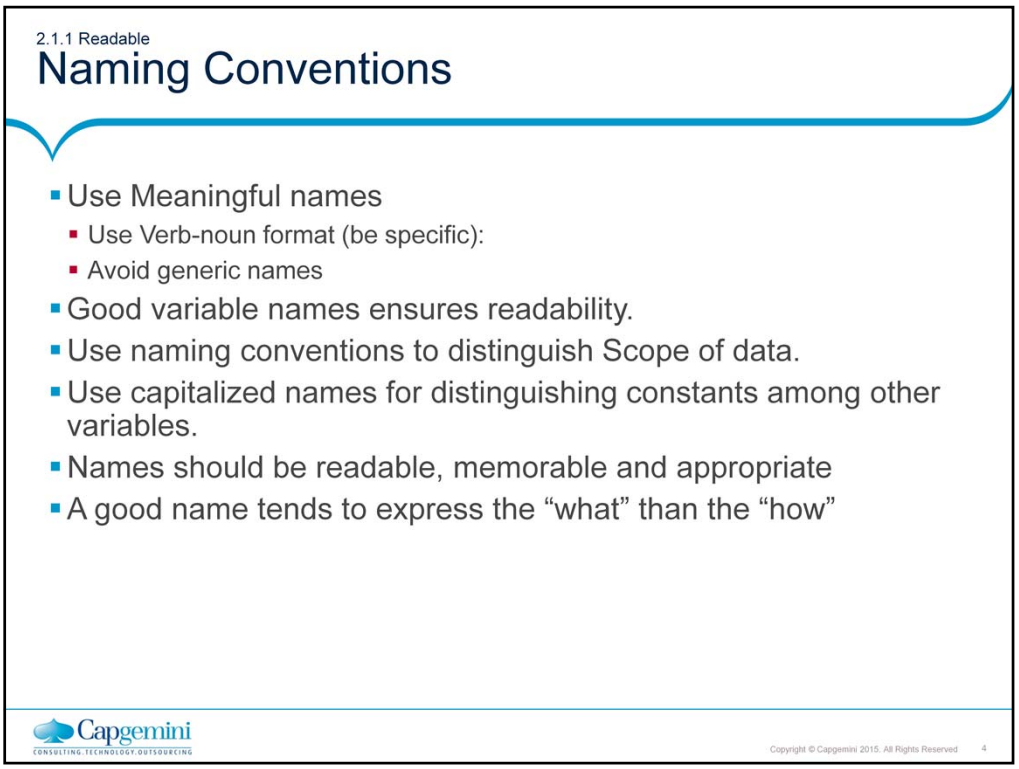
2. Maintainable
   If the program is easy to understand and If it is easy to modify then the program is called as maintainable

3. Modular
   A small unit of code for a single purpose

4. Coupling
   Coupling or Dependency is the degree to which each program module relies on each other.

5. Cohesion
   A cohesion is a measure of how the activities within a single module are related to one another.

6. Robustness
A program is said to be robust when it is fault tolerant. You should test your program extensively with positive and negative test conditions to prove its robustness



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.

2.1.1 Readable

Naming Conventions (Contd…)

- 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);
```

Capgemini
CONSULTING.TECHNOLOGY.OUTSOURCING

 5

2.1.1 Readable

Naming Conventions (Contd…)

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

Capgemini CONSULTING.TECHNOLOGY.OUTSOURCING

 6

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

2.1.1 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

Capgemini
CONSULTING.TECHNOLOGY.OUTSOURCING

 7

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

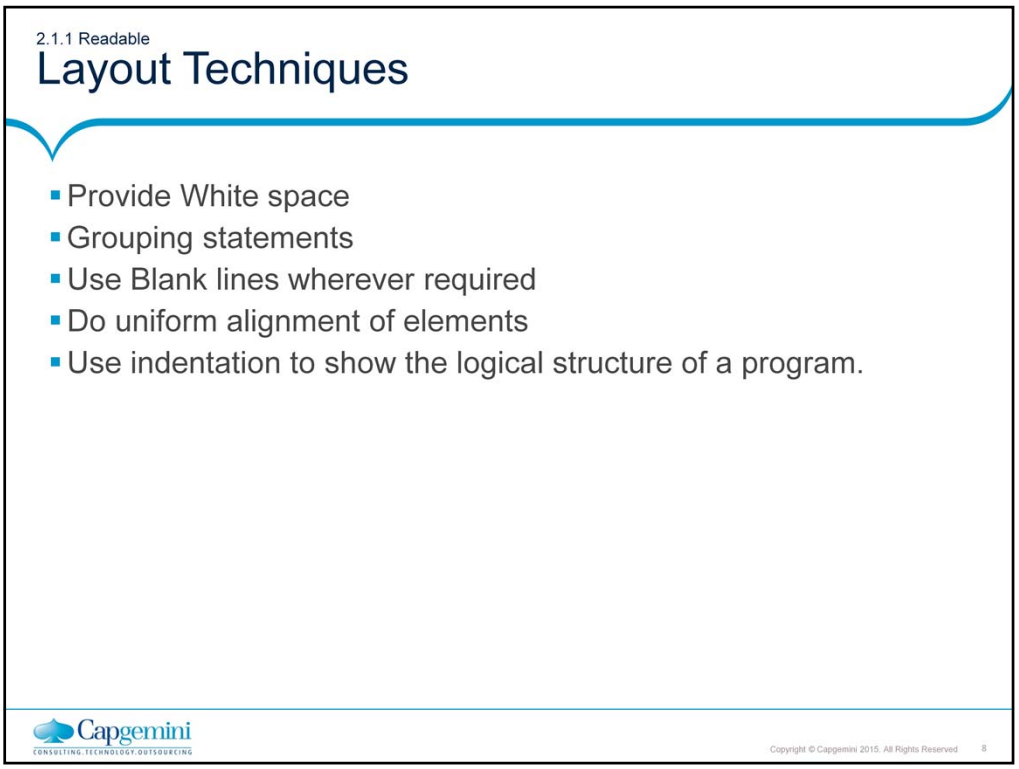
Better way is to use "if found" instead

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
```

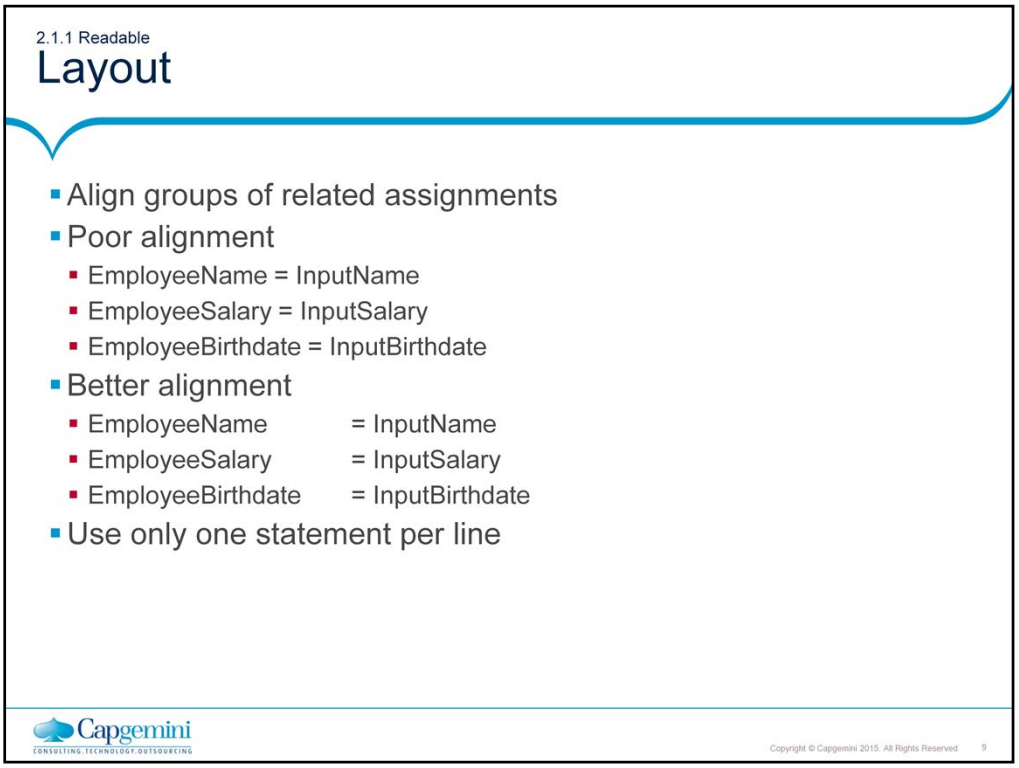
In this example variable 'i' is used to count how many pay slips have been generated.

'*Rec_Count*' can be used instead of 'i'



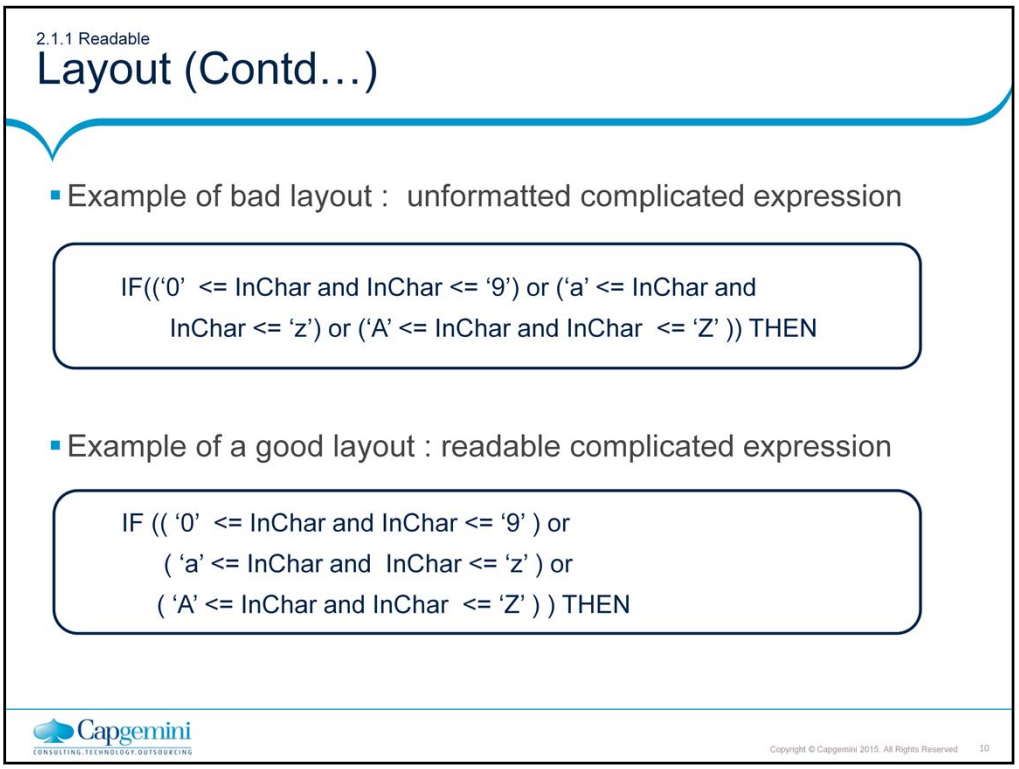
Layout Techniques :

- Use white space to enhance readability.
    - Use vertical and horizontal whitespace generously.
    - Indentation and spacing should reflect the block structure of the code.
    - A long string of conditional operators should be split onto separate lines
- Grouping: ensure related statements are grouped together.
- Blank lines: separate unrelated statements from each other. Use blank lines to divide groups of related statements into paragraphs, to separate routines from one another, and to highlight comments.
- Alignment: align elements that belong together.
- Indentation: use indentation to show the logical structure of a program



Layout :

- Use “=“ in a uniform positions in a group of statements.
- Use only one statement per line
- Within a block, Provide tabspace to start with a statement.



Layout Techniques:

- Statement belongs to if/loop should be started after a tab space
- A long string of conditional operators should be split onto separate lines. For example the below if statement

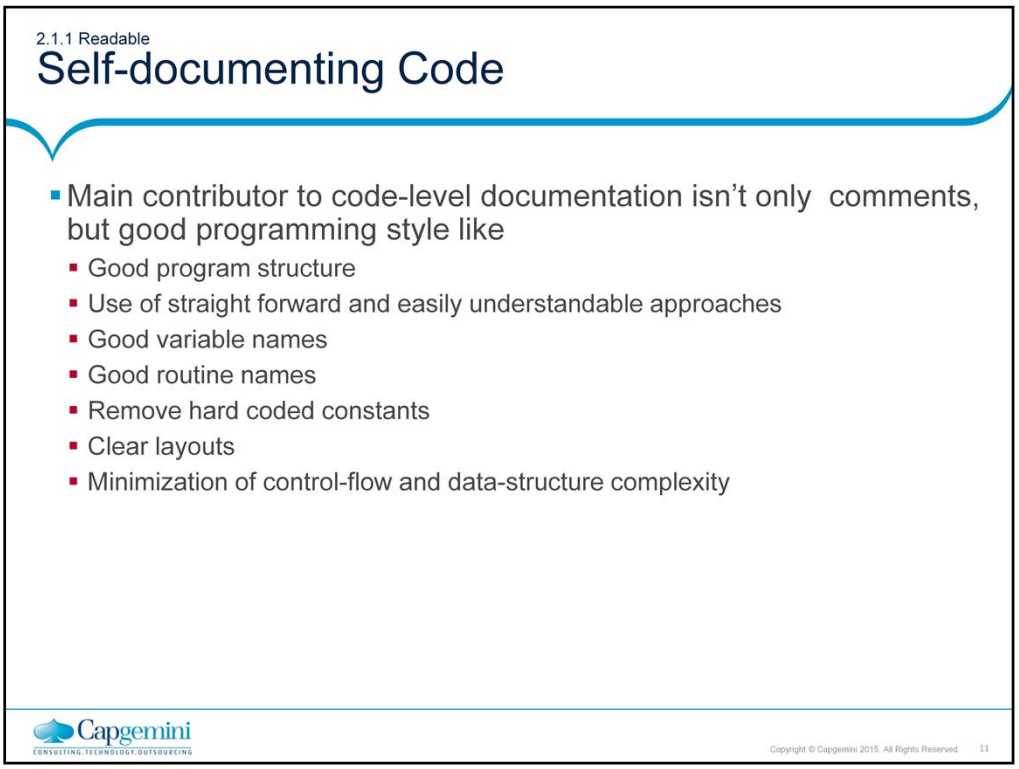
```
if (foo->next==NULL && number < limit && limit
        <=SIZE    && node_active(this_input)) {...
```

might be written better as:

```
if (foo->next == NULL
    && number < limit && limit <= SIZE
   && node_active(this_input))       {        ...
```

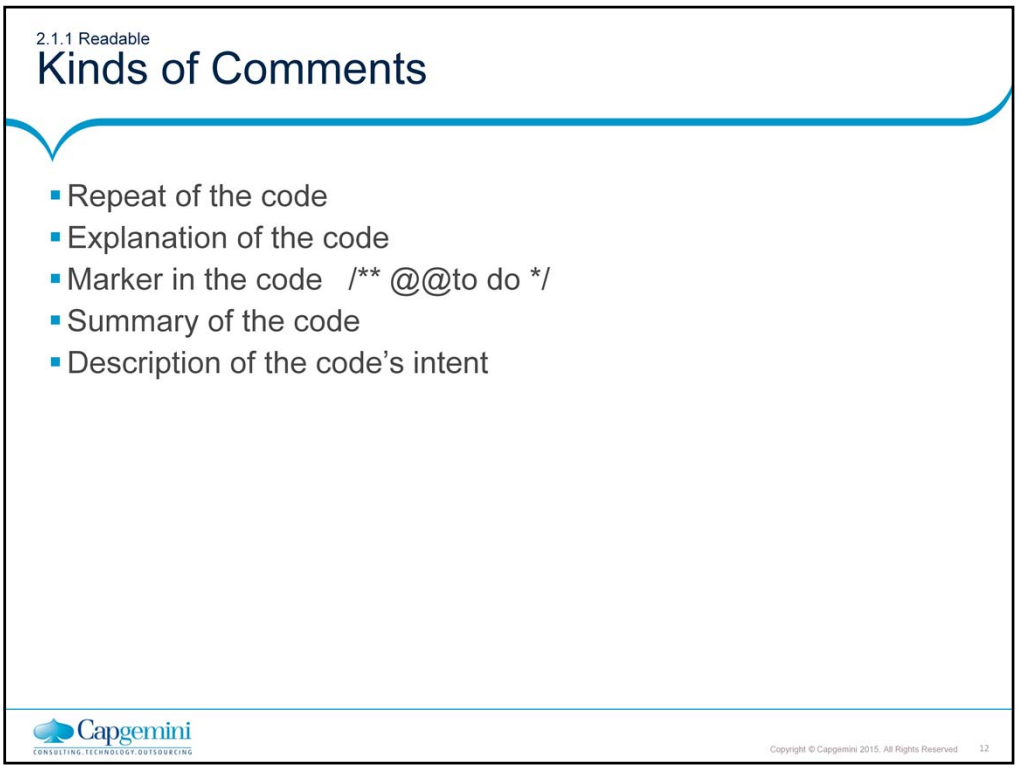
Better version of using For LOOP: Consider for loop have 3 sections

```
FOR (curr = *varp, trail = varp;
     curr != NULL;
     trail = &(curr->next), curr = curr->next )
{
```



Self documenting code:

- Good Program Structure: Follow program structure like modularity
- Use of straight forward and easily understandable approaches.
- Good variable names : Meaningful variable names
- Good routine names : Meaningful routine names
- Remove hard coded constants: Use of named constants instead of literals
- Clear Layout : Follow all the layout techniques



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

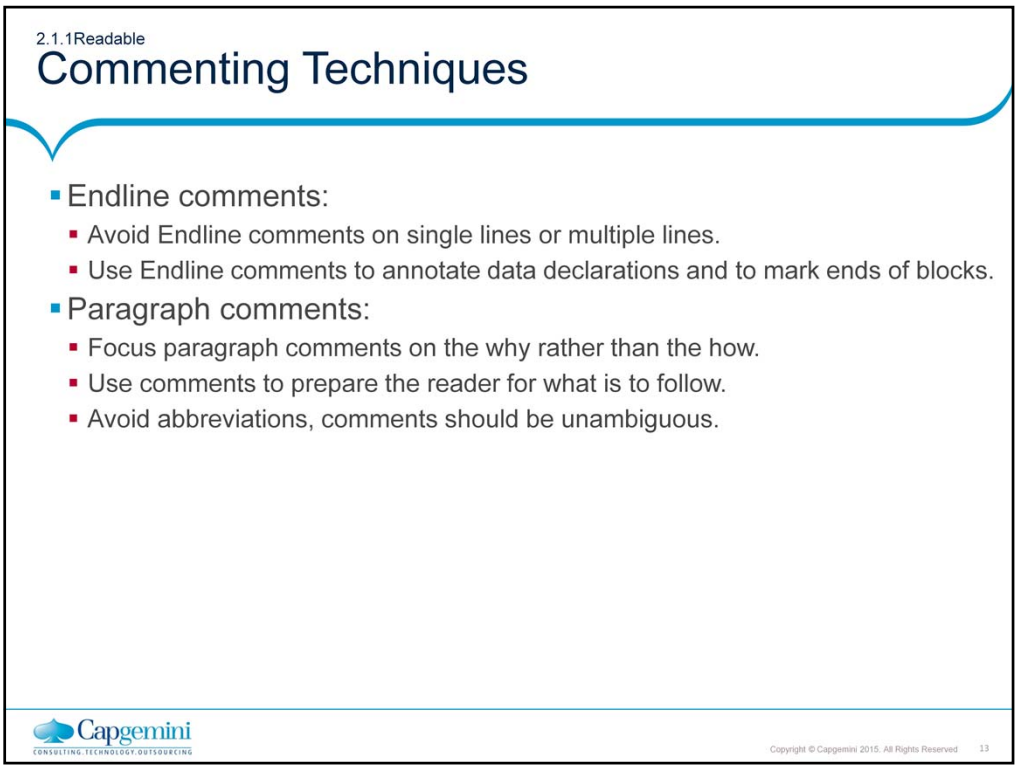
- Marker in the code /** @@todo*/ :

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



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

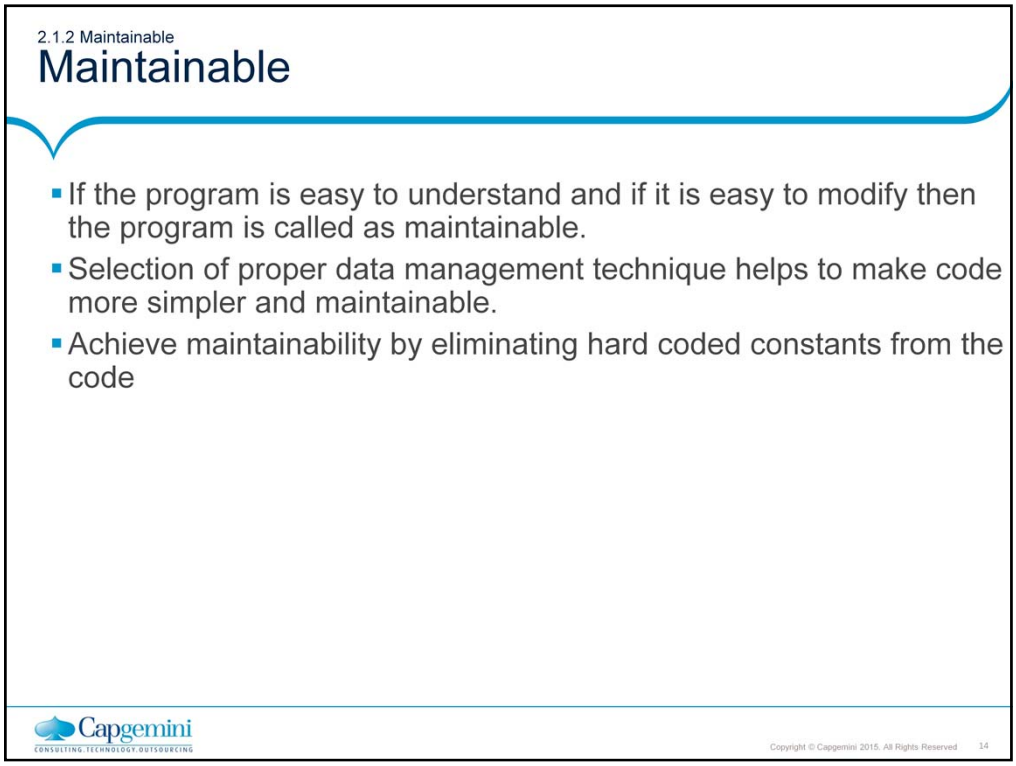
- Endline Comments
  - Endline comments are comments that appear at the ends of lines of code
  - Use endline comments to annotate data declarations like

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

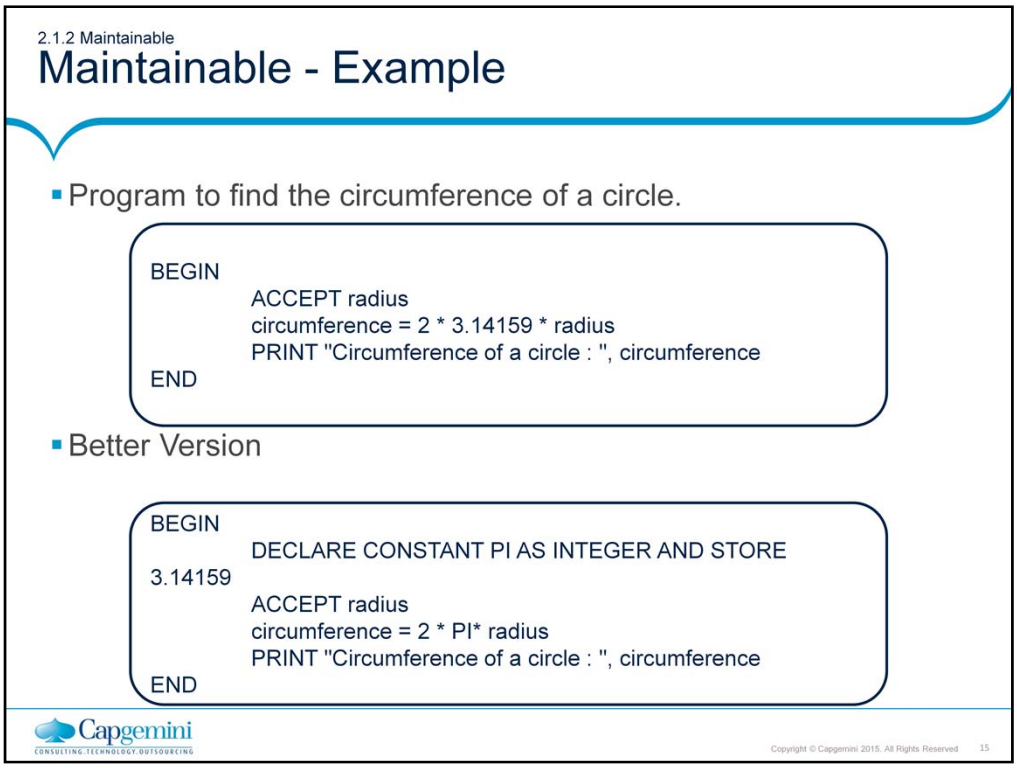
  - Use endline comments to mark ends of blocks

- 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
* *******************************/
```

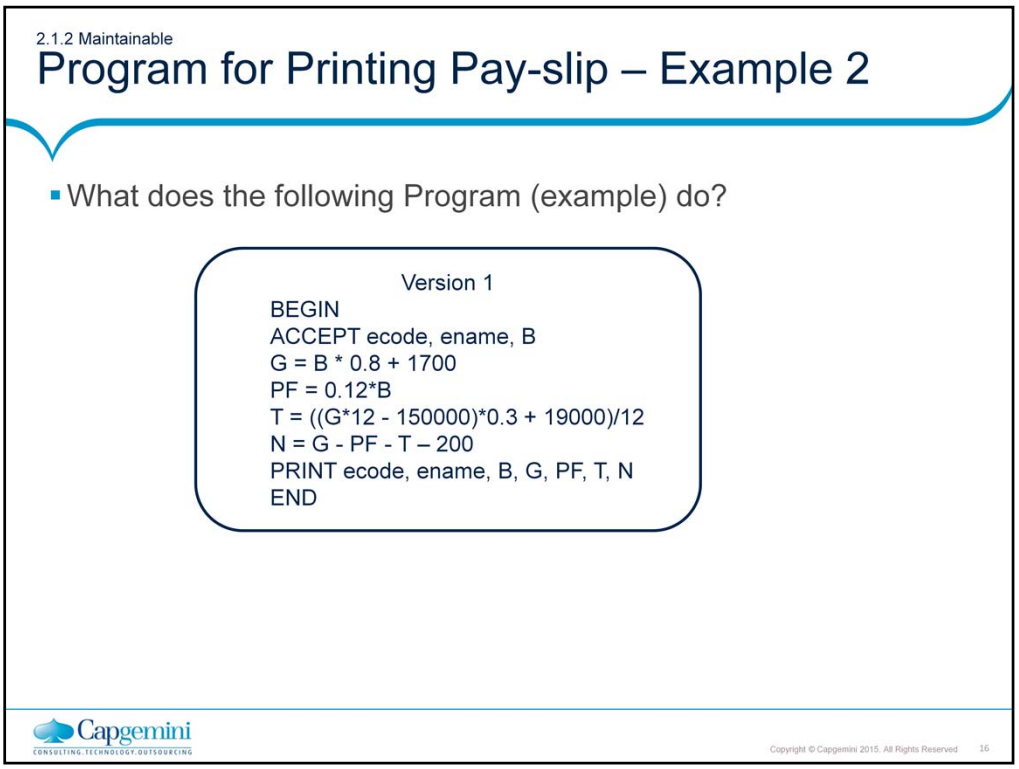


If the program is easy to understand and if it is easy to modify then the program is called as maintainable. Selection of proper data management technique helps to make code more simpler and maintainable. Achieve maintainability by eliminating hard coded constants from the code.



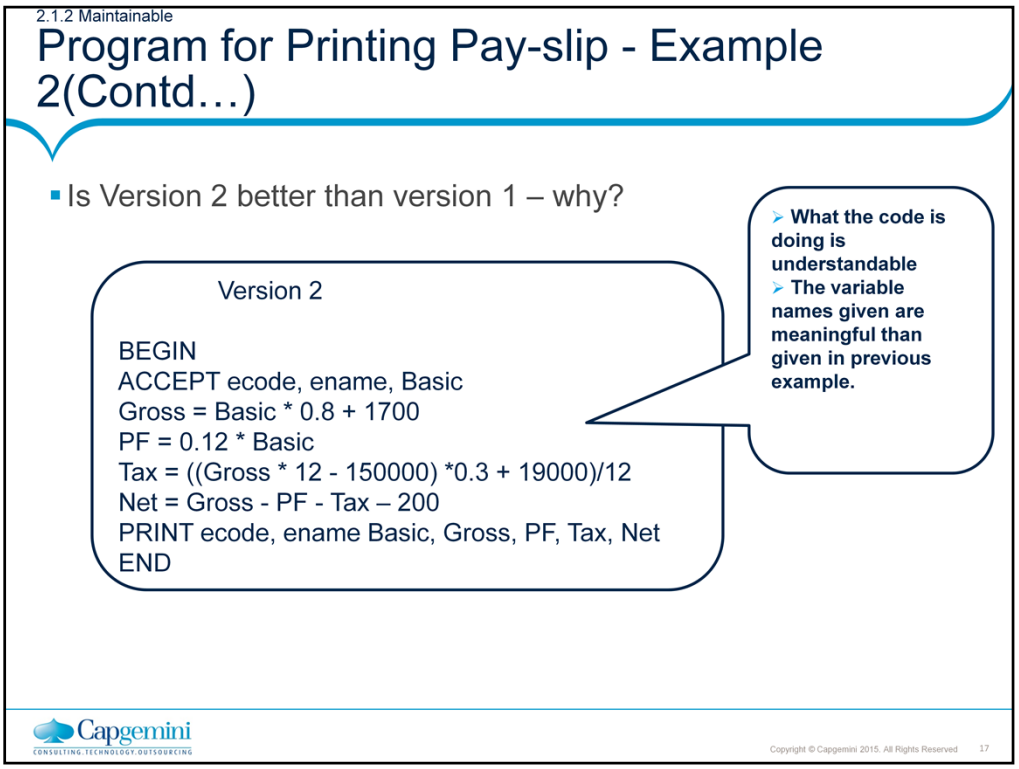
Example:

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.



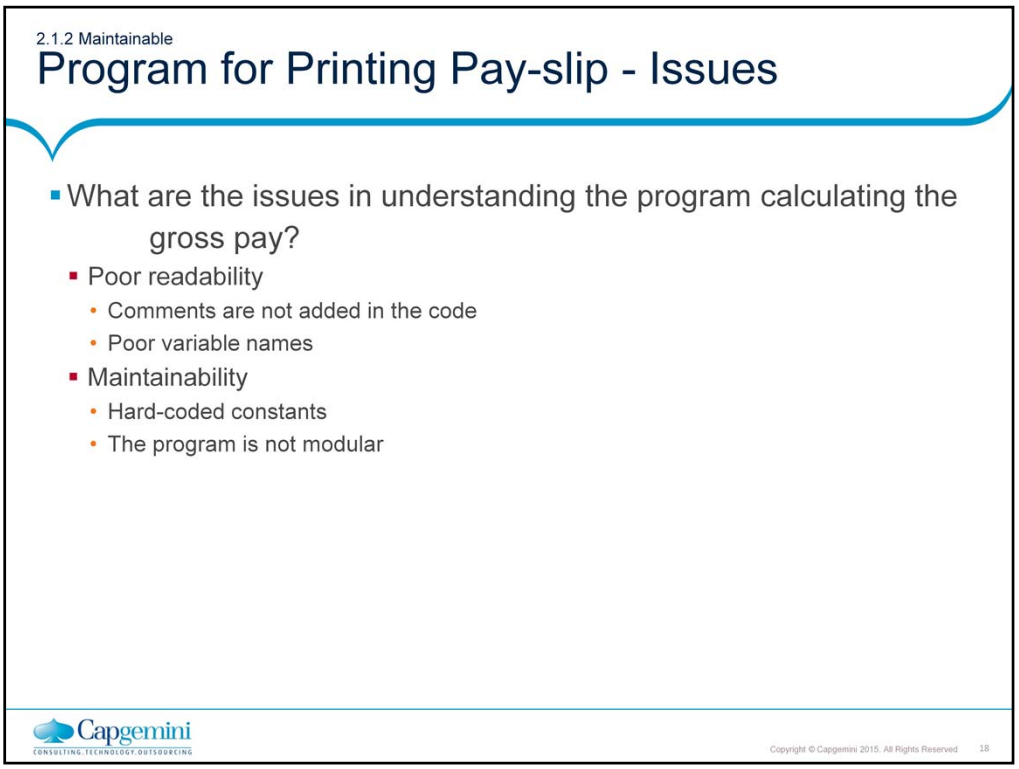
What are problems in the code above:

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?



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

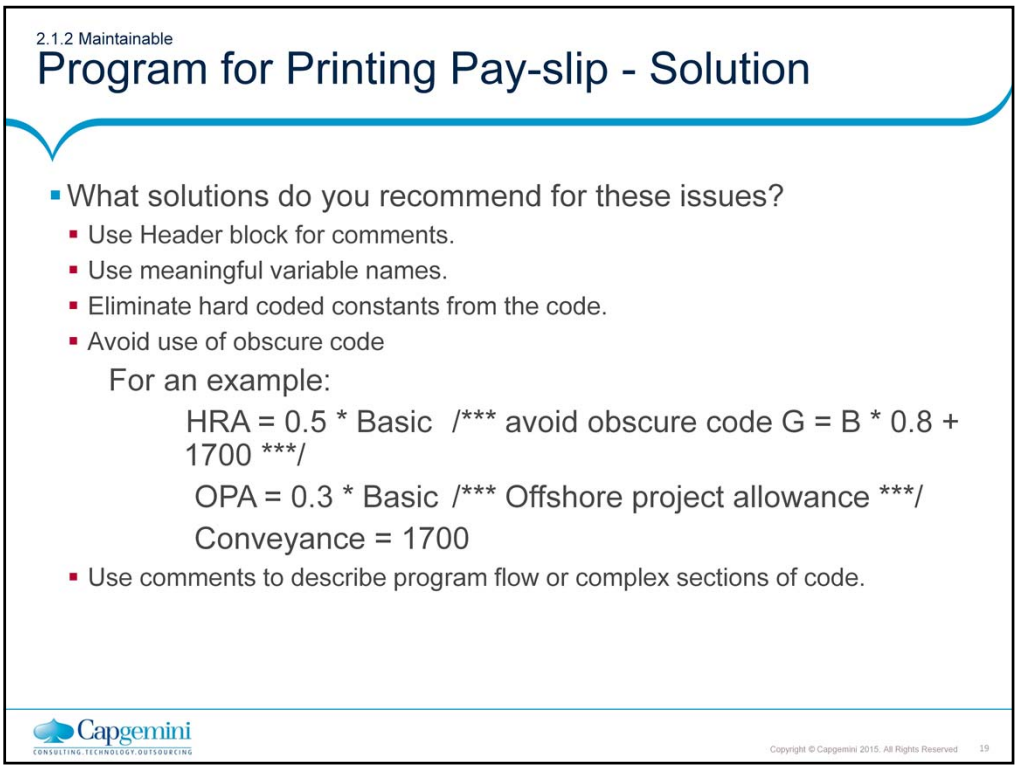
It is understandable because the variable names given are meaningful than given in previous example.
It shows that if you give meaningful variable names then it helps you to understand program better.



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.

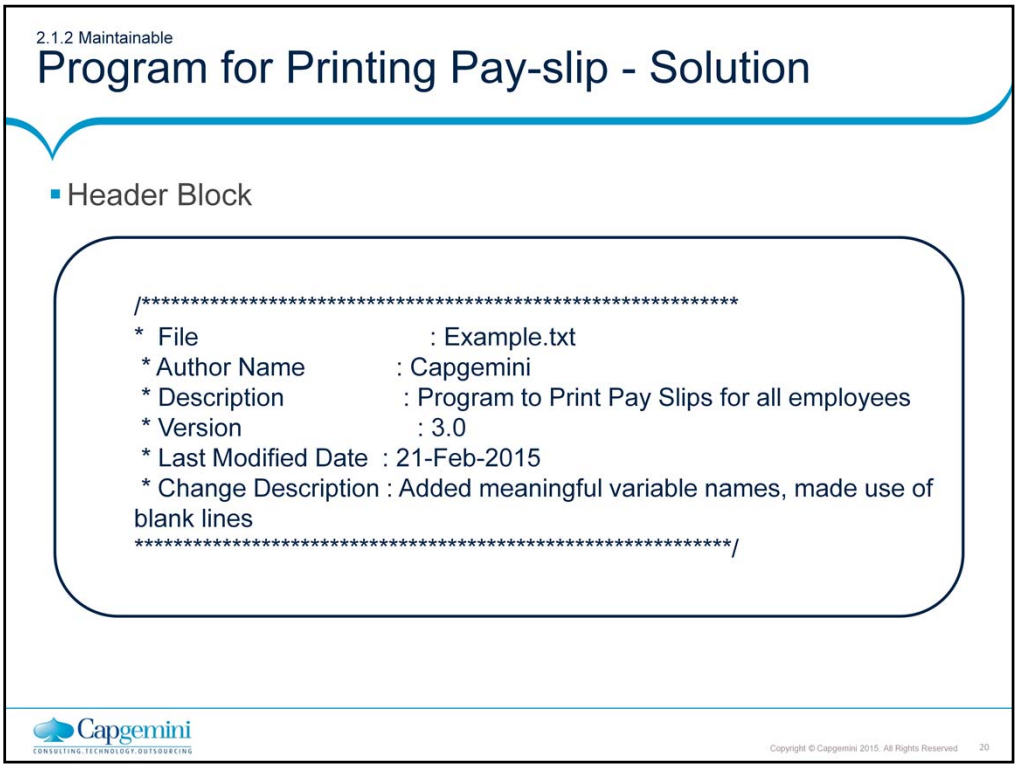


If we use above solution to update the code then the code will become more readable, maintainable.

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.

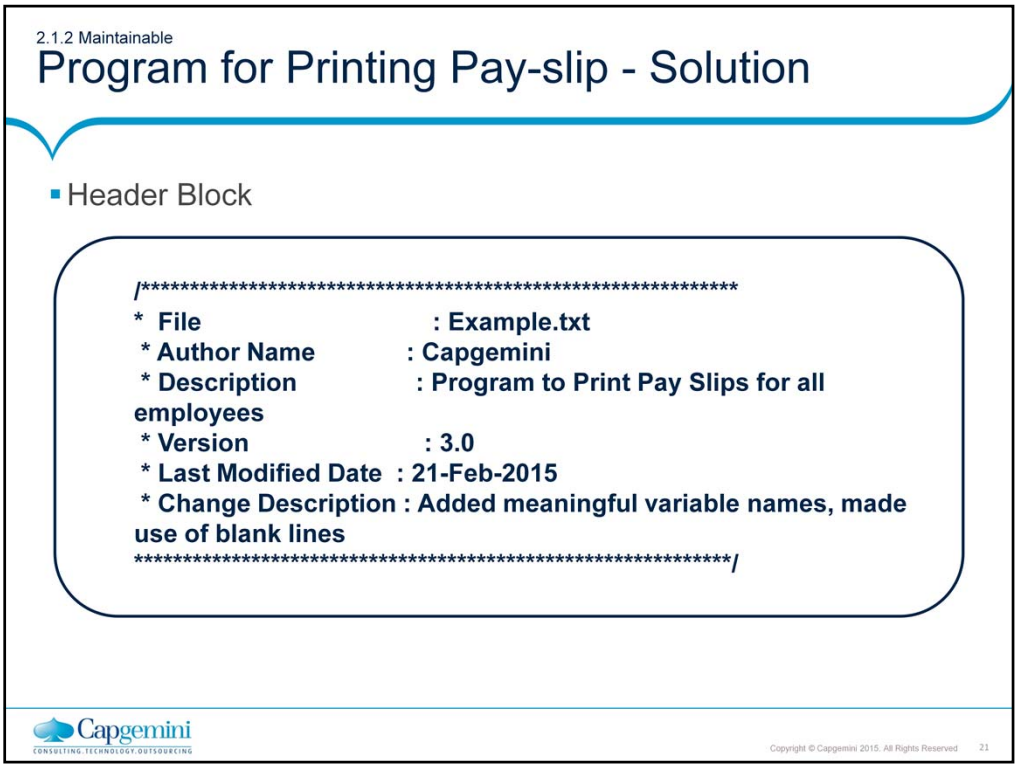
However, the given code explains that Conveyance is 1700. HRA is 50% of Basic. Offshore Project allowance is 30% of Basic. So do not try to club these equations. Otherwise, maintenance of the code will be difficult, and understandability of code will reduce, as well.

Hence avoid such obscure code. Keep it simplified.



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



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

2.1.2 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
```

Capgemini CONSULTING.TECHNOLOGY.OUTSOURCING

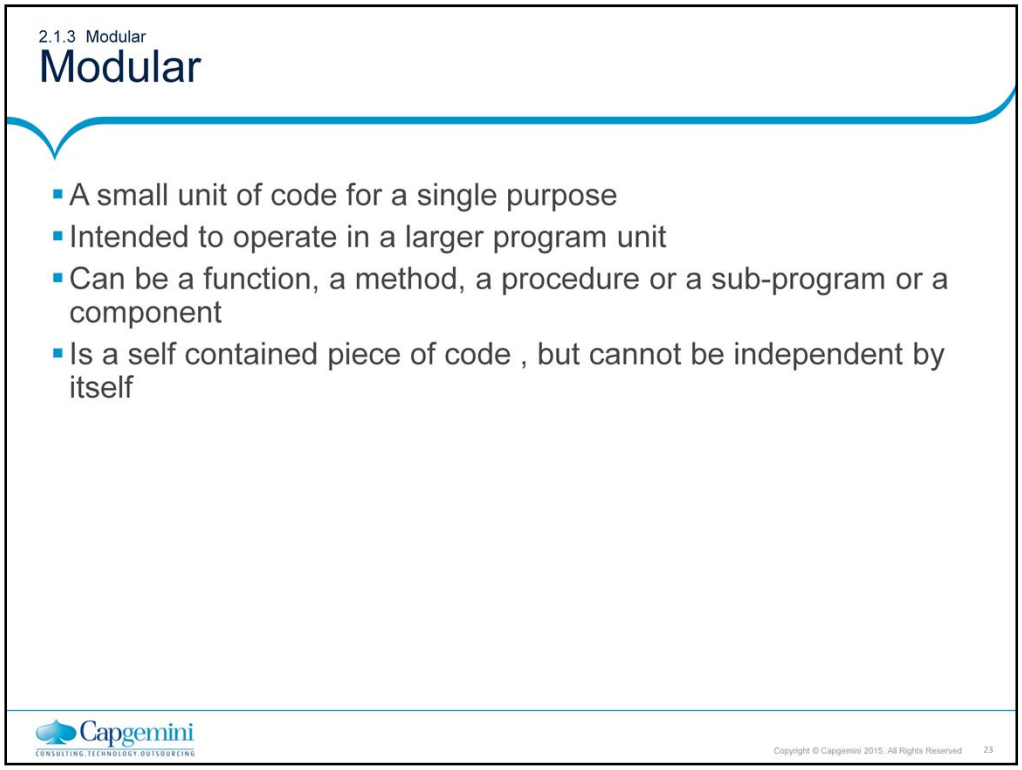
 22

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

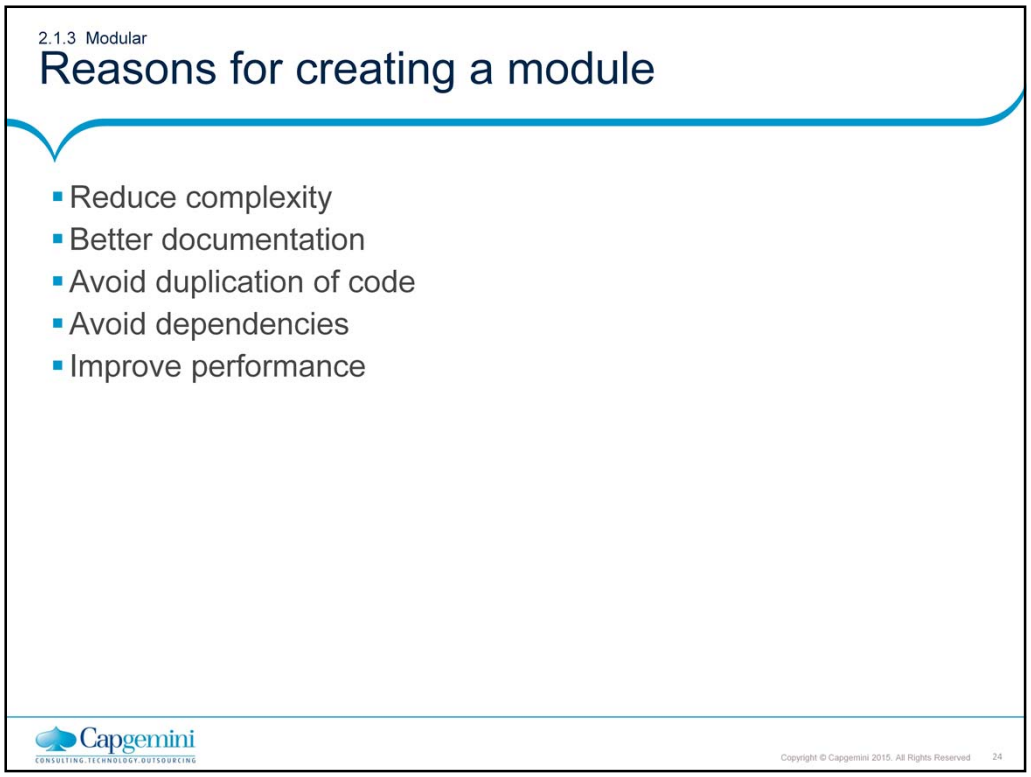
Following improvements are required in the code:
a) If your code includes any complicated calculations It is necessary to document it in the code. In the above example the calculation of income tax includes many operations. What is meaning of it need to be documented in the code.

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.

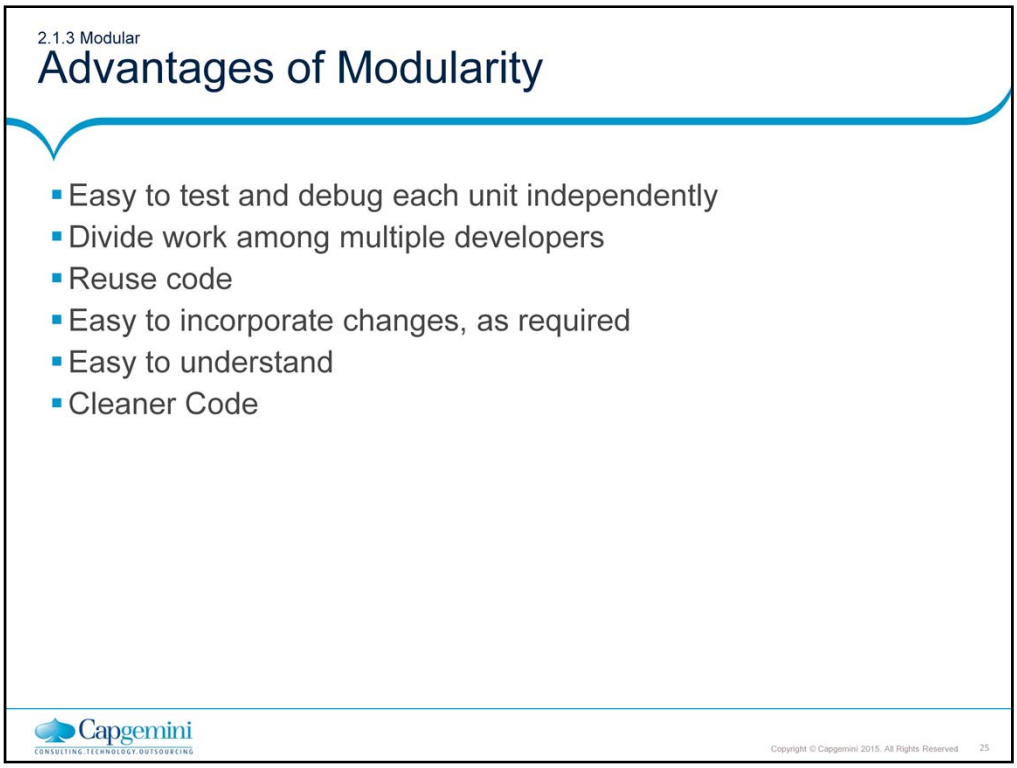


Modular : A small unit of code for a single purpose intended to operate in a larger program unit . It can be a function, a method, a procedure or a sub-program or a component. Module is a self contained piece of code , but cannot be independent by itself



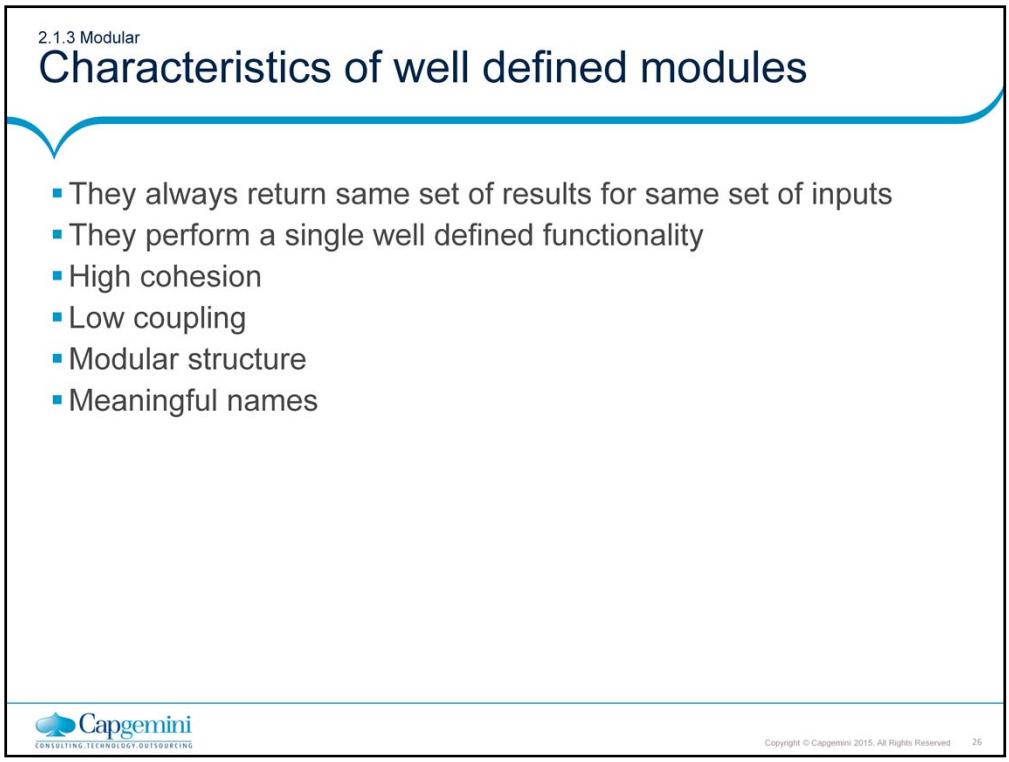
Reasons for creating a module

- 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



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



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.

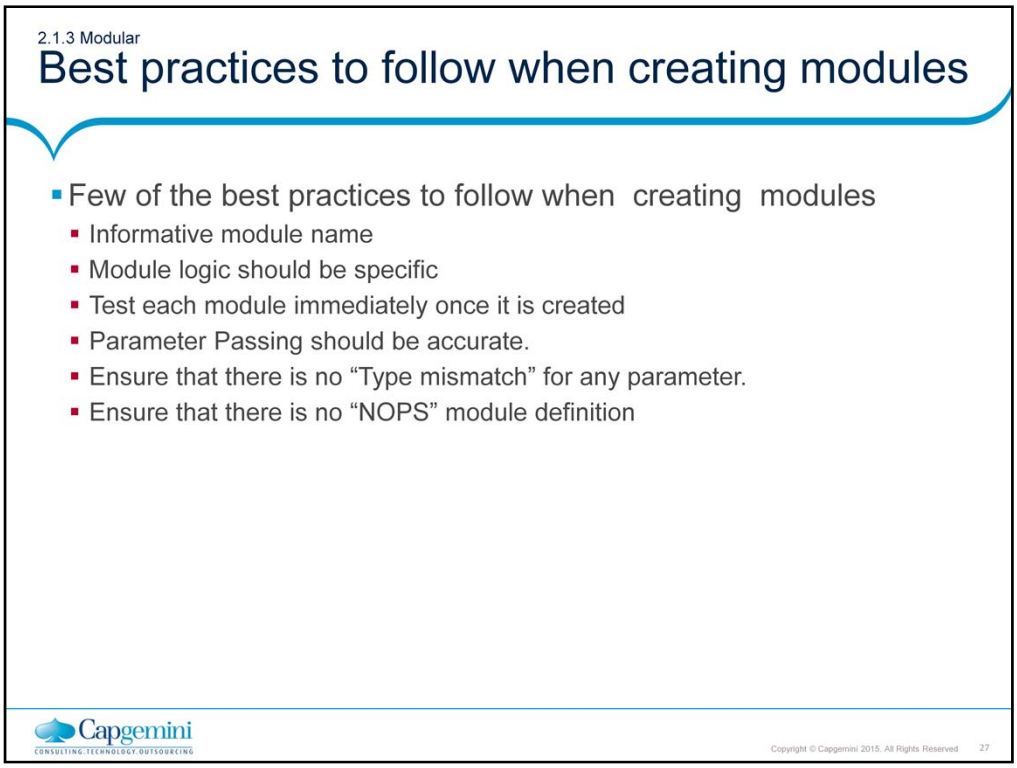
- **Meaningful names**

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



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**

2.1.3 Modular

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

Capgemini
CONSULTING.TECHNOLOGY.OUTSOURCING

 28

2.1.3 Modular

Solution - 1

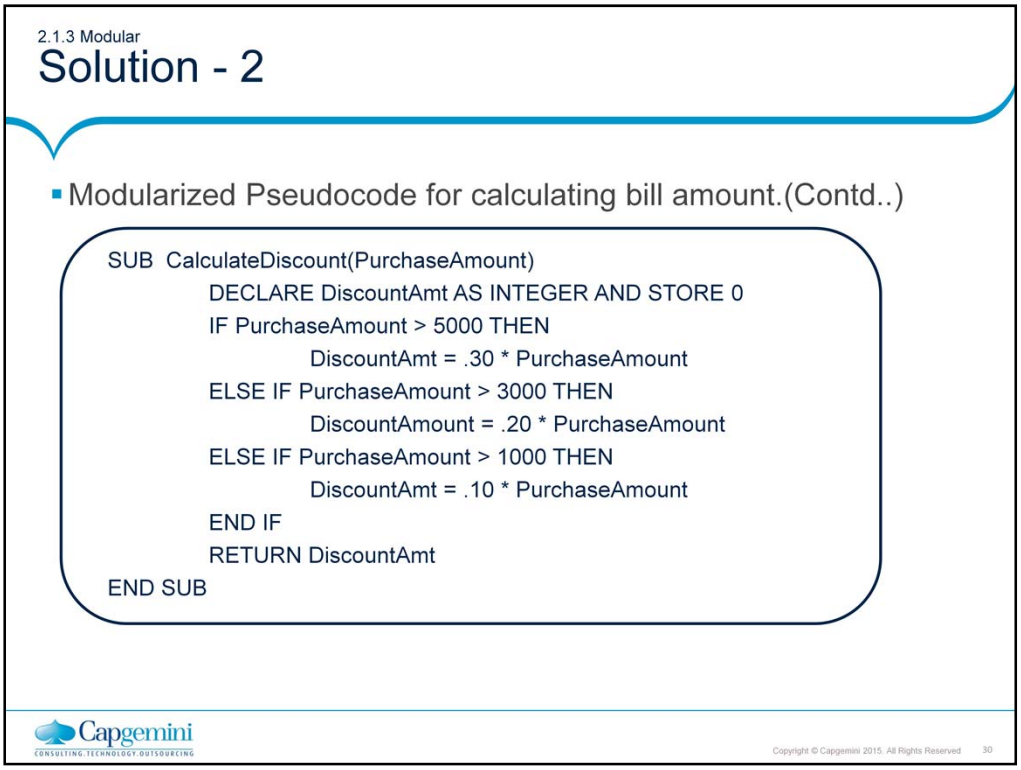
- Pseudocode for calculating bill amount. (Not Modularized)

```
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
```

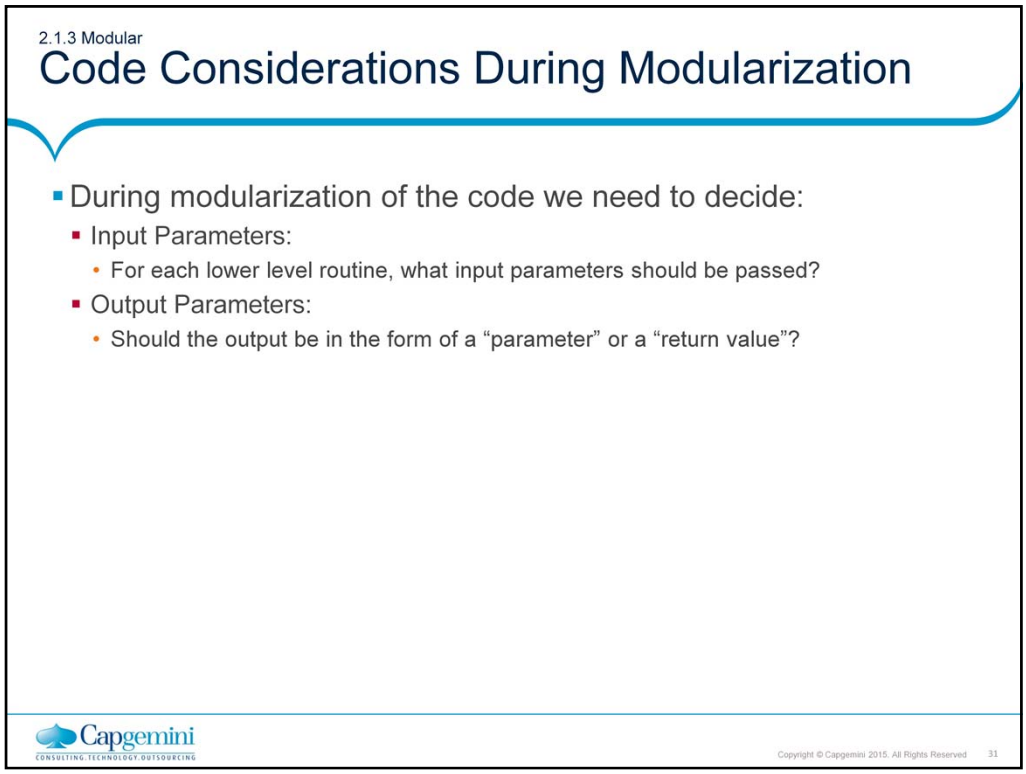
Capgemini
CONSULTING.TECHNOLOGY.OUTSOURCING

 29

The above pseudocode for calculating bill amount is not modularized



The above pseudocode for calculating bill amount is modularized


2.1.3 Modular
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”?
Capgemini
CONSULTING.TECHNOLOGY.OUTSOURCING
Copyright © Capgemini 2015. All Rights Reserved
31

2.1.3 Modular

Code Considerations

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

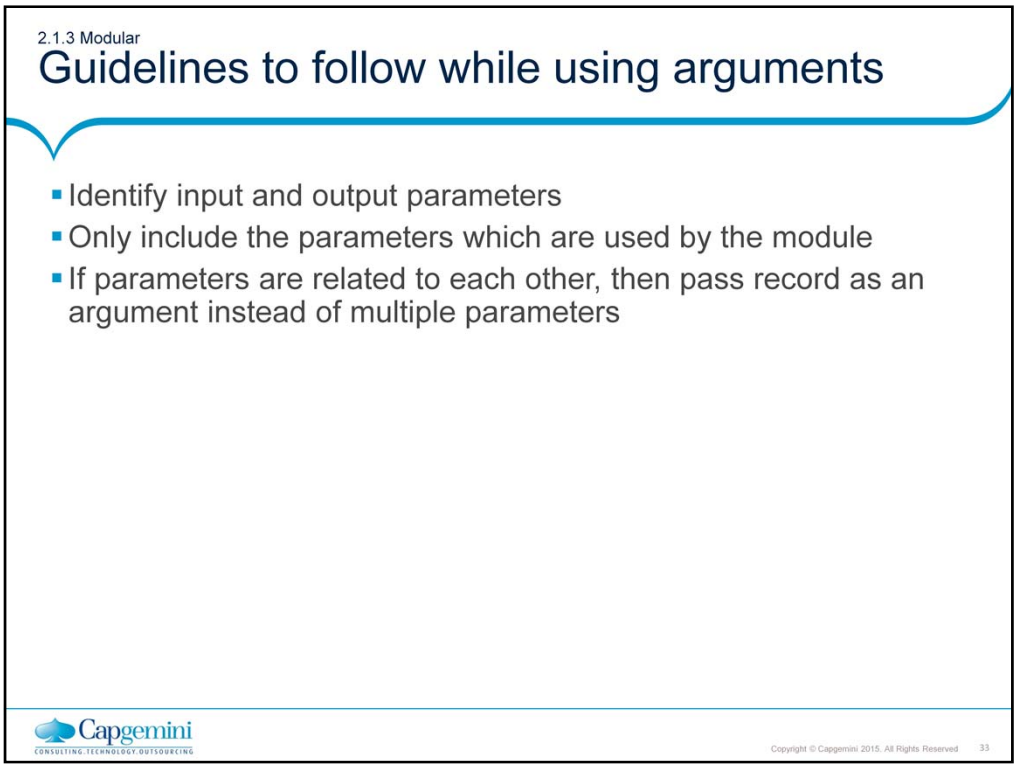
```
SUB Accept_Employee_Details()
      ACCEPT emp_code, Basic
END SUB
```

```
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
```

Capgemini
CONSULTING.TECHNOLOGY.OUTSOURCING

 32



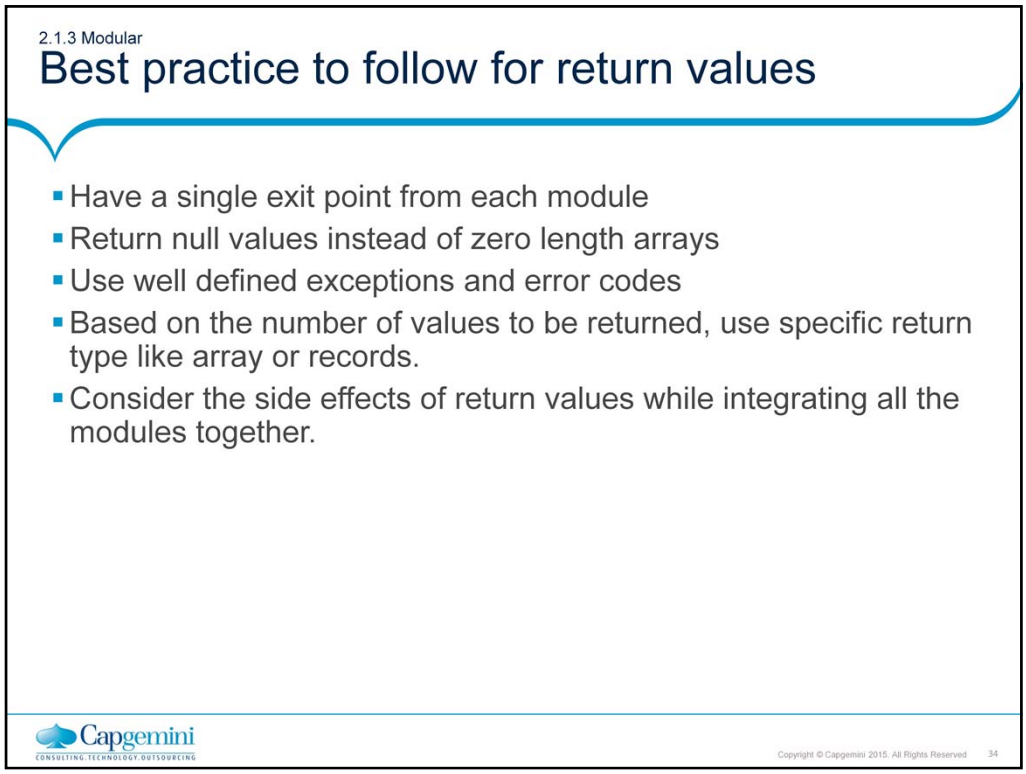
Guidelines to follow while using arguments

- 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
```



Best Practice to follow for return values

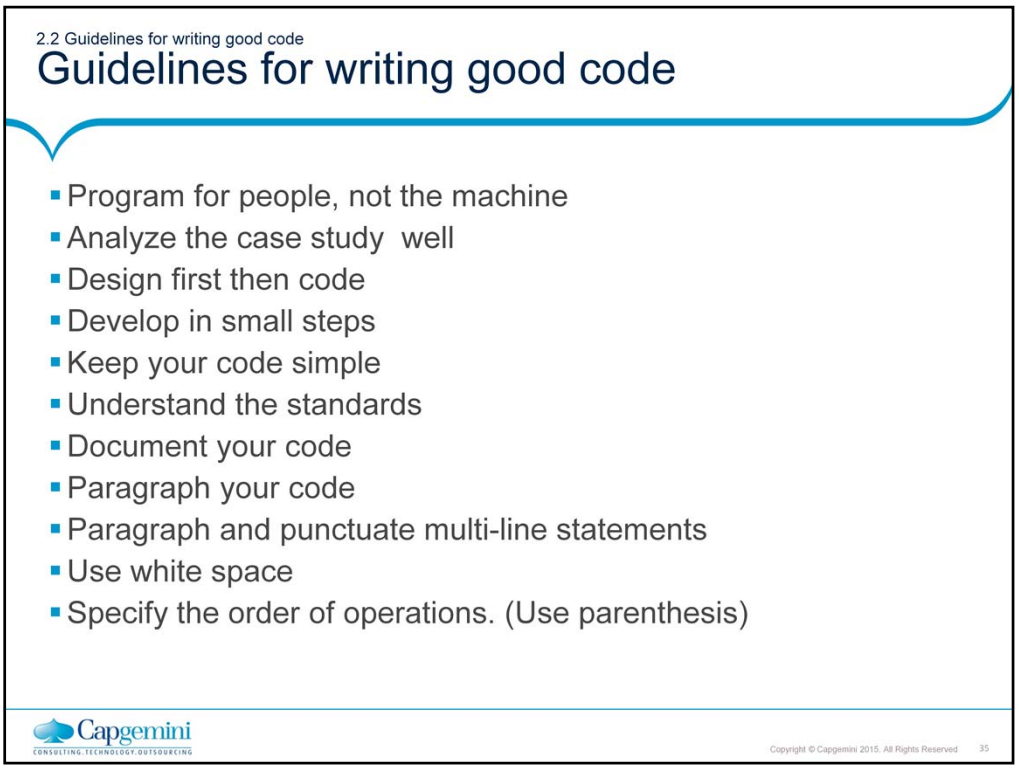
- Use only one return statement in each module as shown below:

```
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.

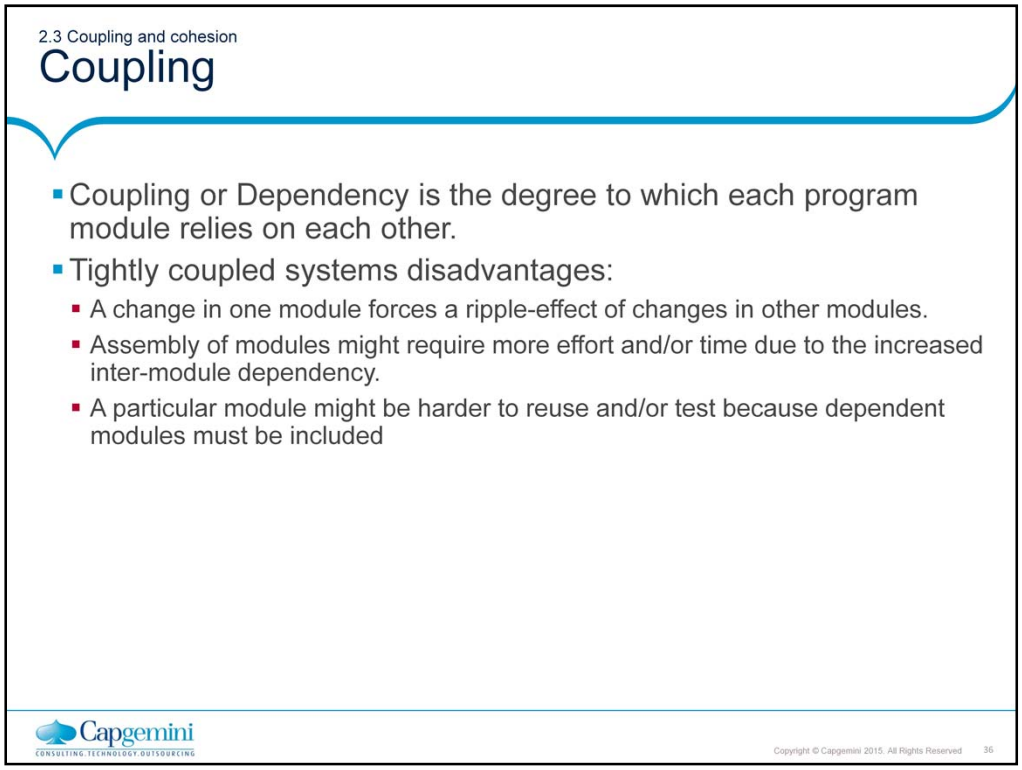
```
SUB getProductPrice(productId)
                DECLARE errorcode AS INTEGER AND STORE 0
                IF(elementfound(productId)) THEN
                      RETURN productPrice
                ELSE
                                errorcode = -1
                                RETURN errorcode;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



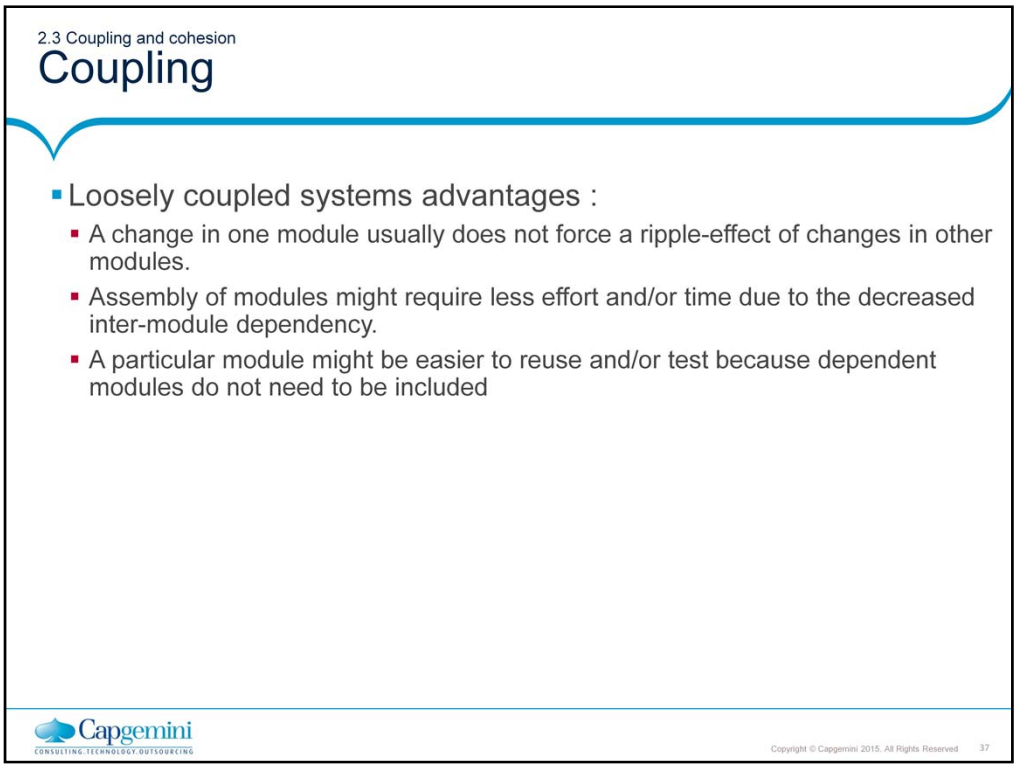
Guidelines for writing good code

- 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



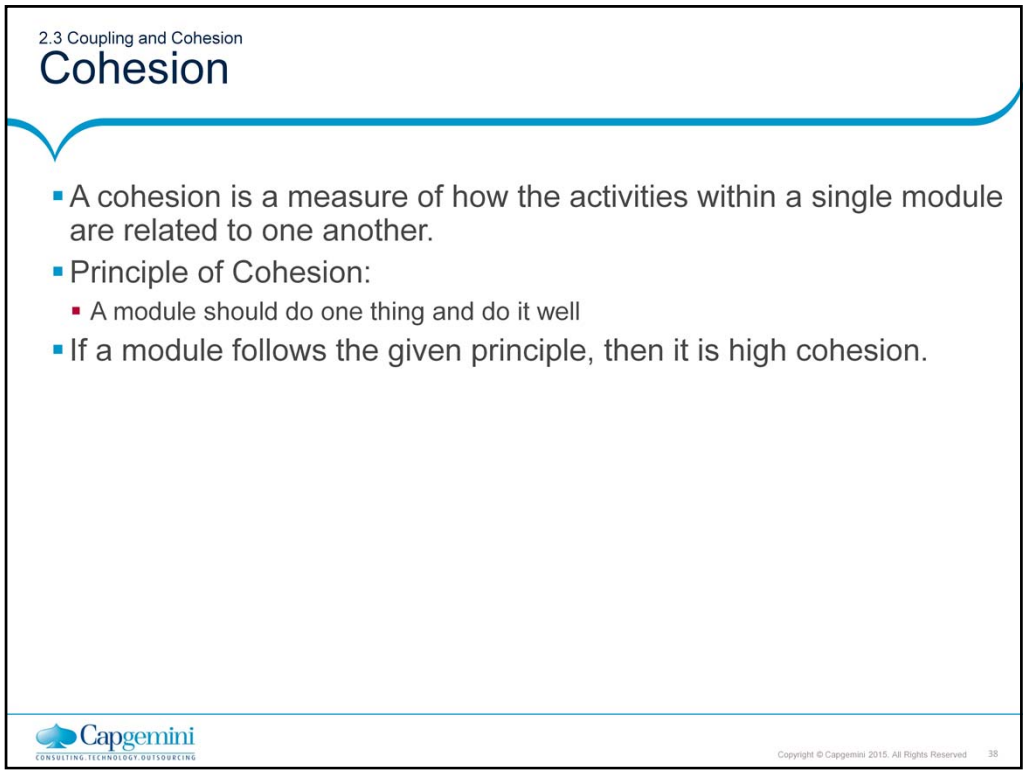
If a module does only one thing, we need to pass less parameters.
If a module does too many things, we need to pass more parameters.
Passing more parameters means high coupling.

We should strive for low coupling.



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.



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

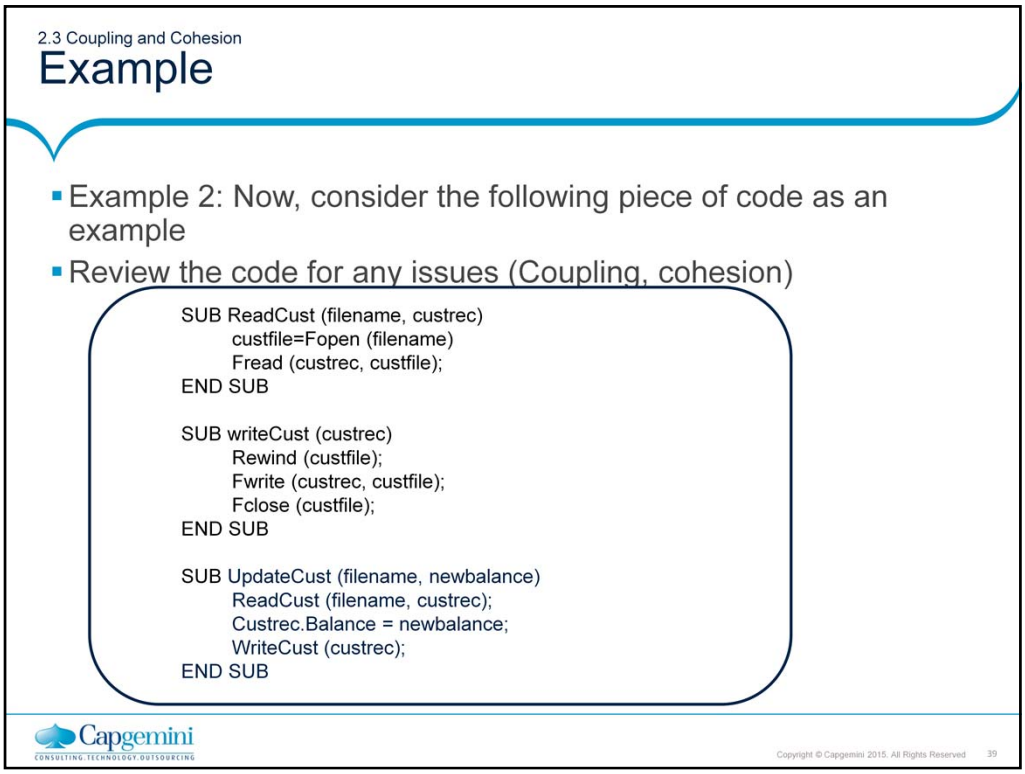
For example:
1. Sin (x); Cos (x); Tan (x); (High Cohesion, Low Coupling)

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)

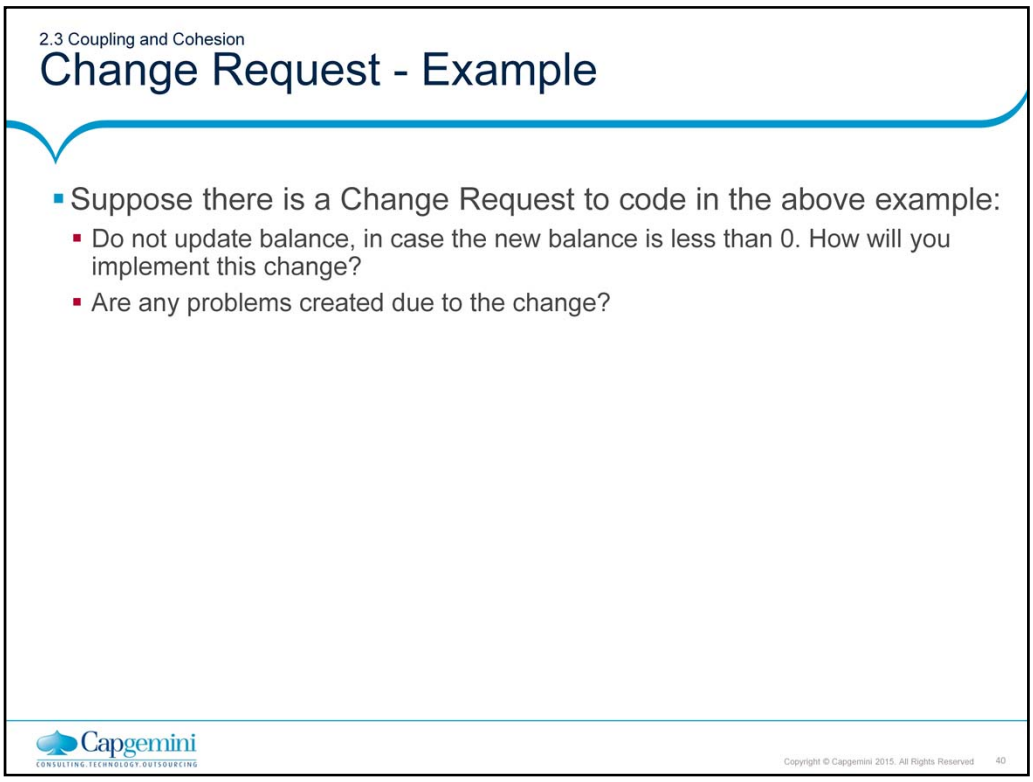
Note:
Since in function trig we are trying to add all three functions together, we require to pass one extra parameter i.e. Type. This parameter indicates whether to calculate Sin, Cos, or Tan.

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.



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.


2.3 Coupling and Cohesion
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?
Capgemini
CONSULTING.TECHNOLOGY.OUTSOURCING
Copyright © Capgemini 2015. All Rights Reserved
40

2.3 Coupling and Cohesion

Change Request - Example

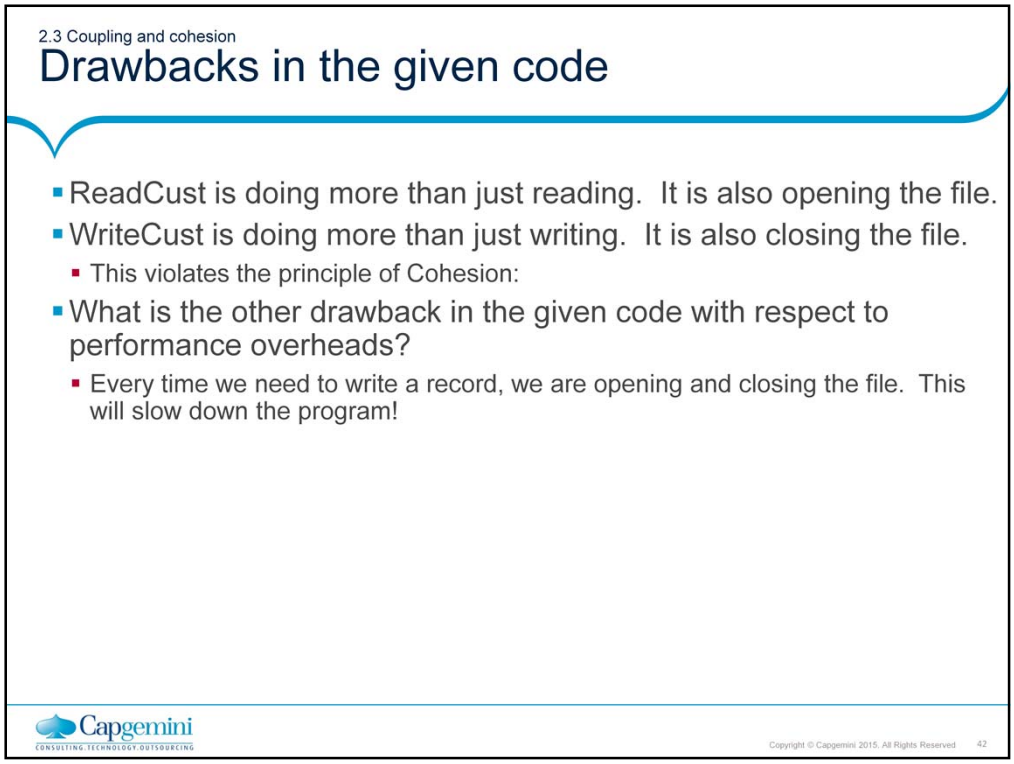
- Sometimes the change is made as follows

```
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”.

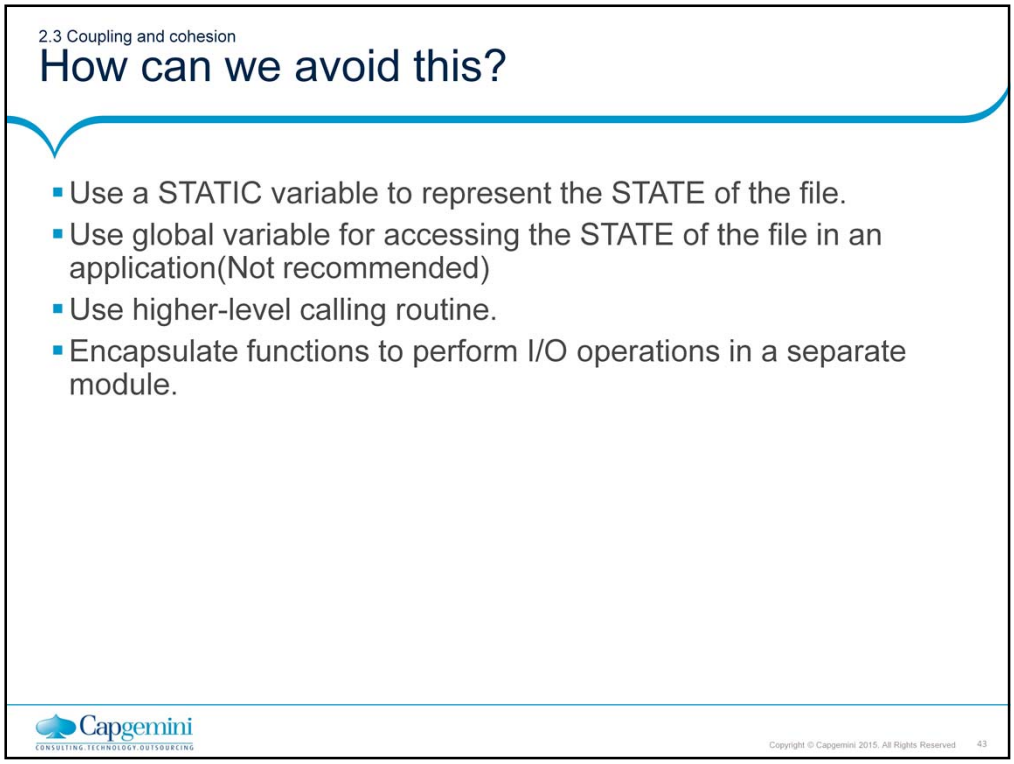
Capgemini
CONSULTING.TECHNOLOGY.OUTSOURCING

 41



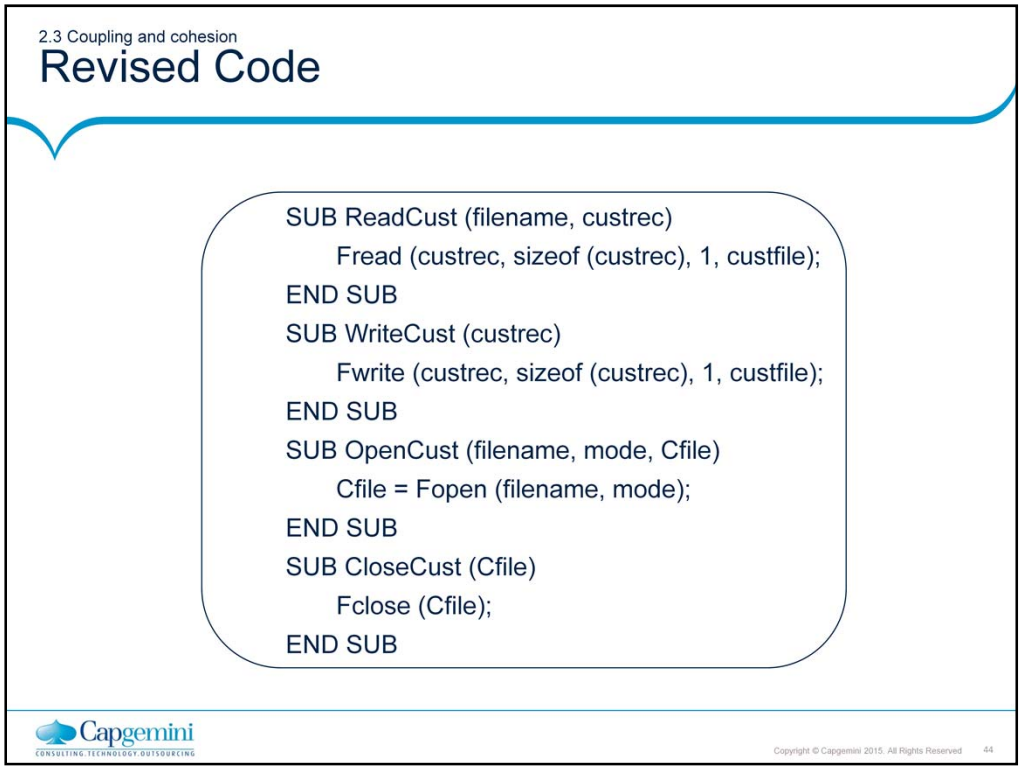
Cohesion:

- 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.

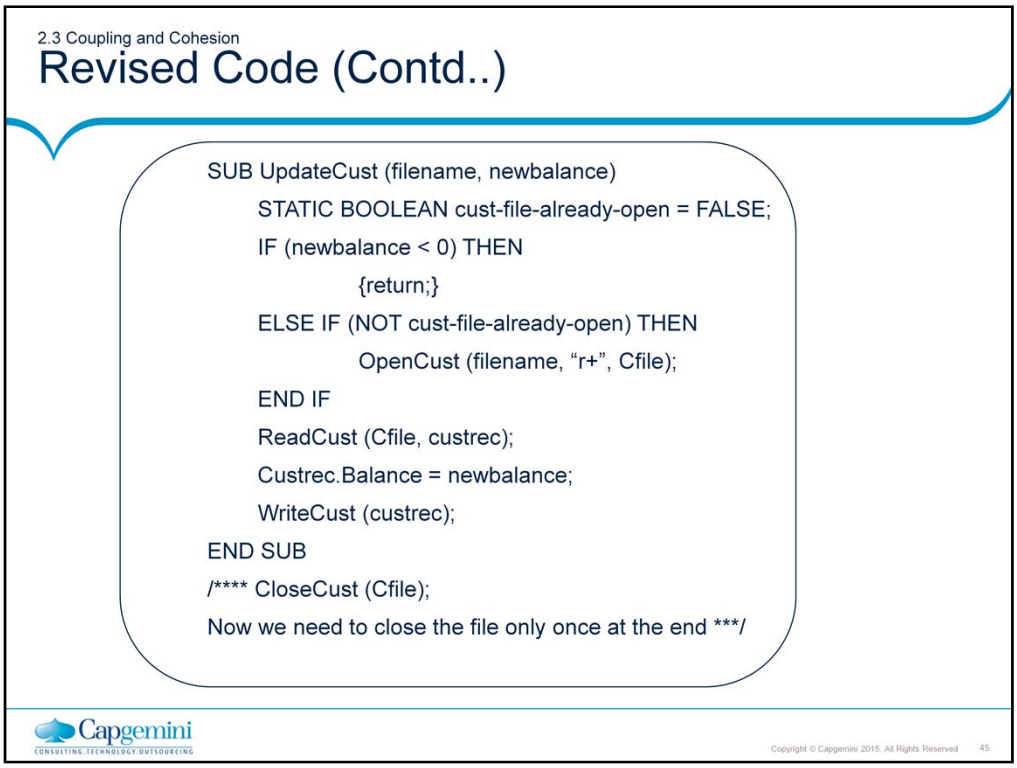


Steps to be taken care for avoiding drawbacks on the implementation of cohesion and coupling:

- 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.



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



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

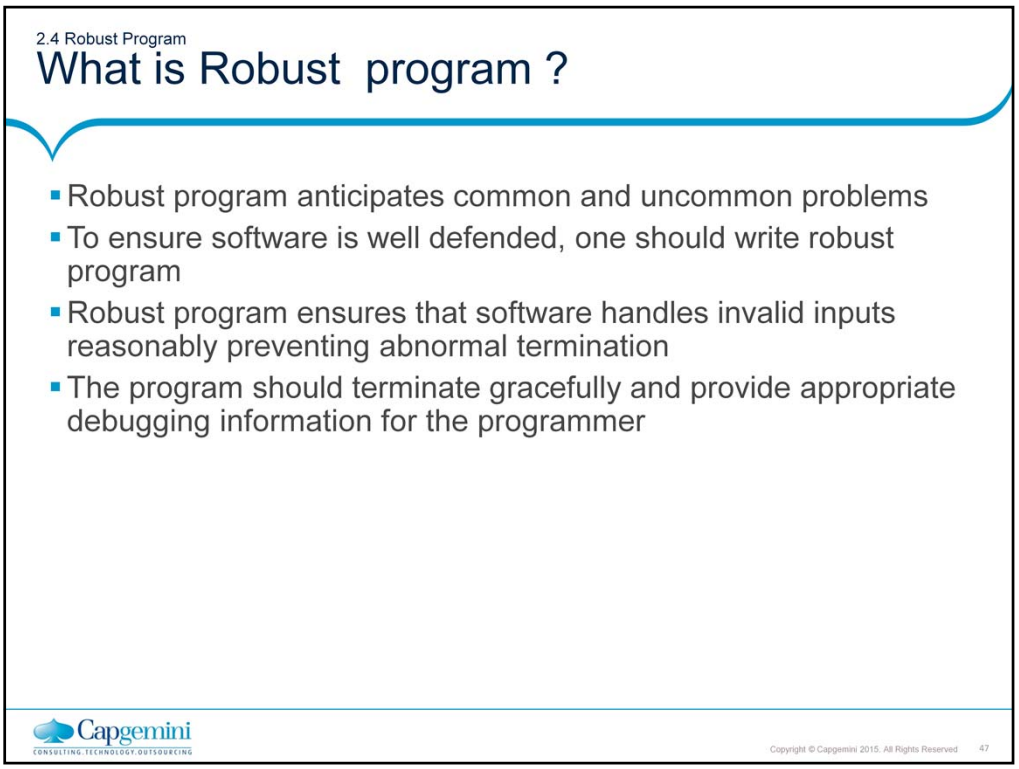
2.3 Coupling and Cohesion

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.

Capgemini
CONSULTING.TECHNOLOGY.OUTSOURCING

 46



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

2.4 Robust Program

Example

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

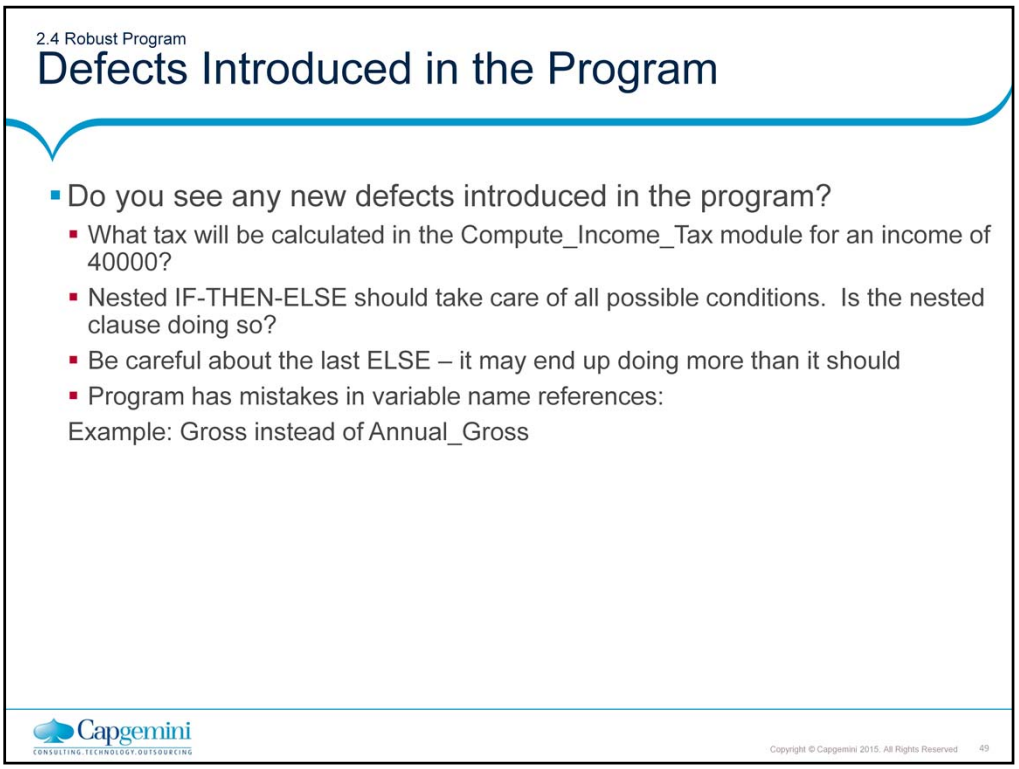
```
SUB Compute_Income_Tax(Gross)
        Annual_gross = Gross * 12
        Annual_Tax = 0
/****
"for gross between 50 to 60K, tax is 10% of gross over 50K, max 1000"
"for gross between 60 to 150K, tax is 20% of gross over 60K, max 18000"
"for gross exceeding 150K, tax is 30% of gross over 150K" ******/
        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
```

Capgemini
CONSULTING.TECHNOLOGY.OUTSOURCING

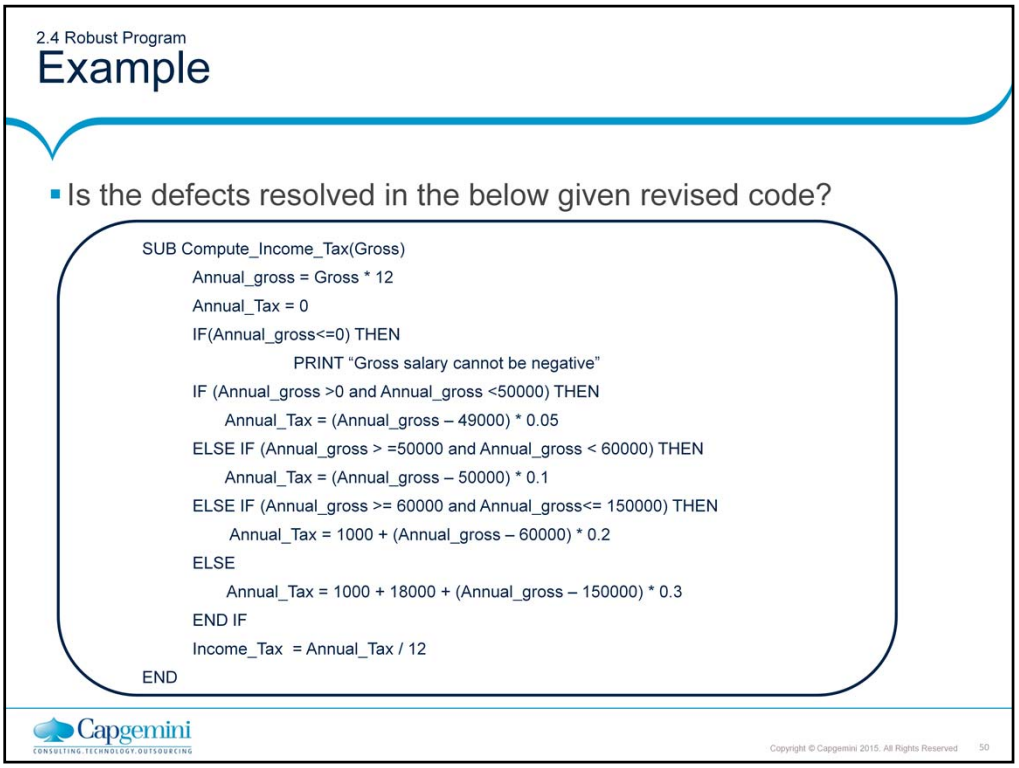
 48

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.



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



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

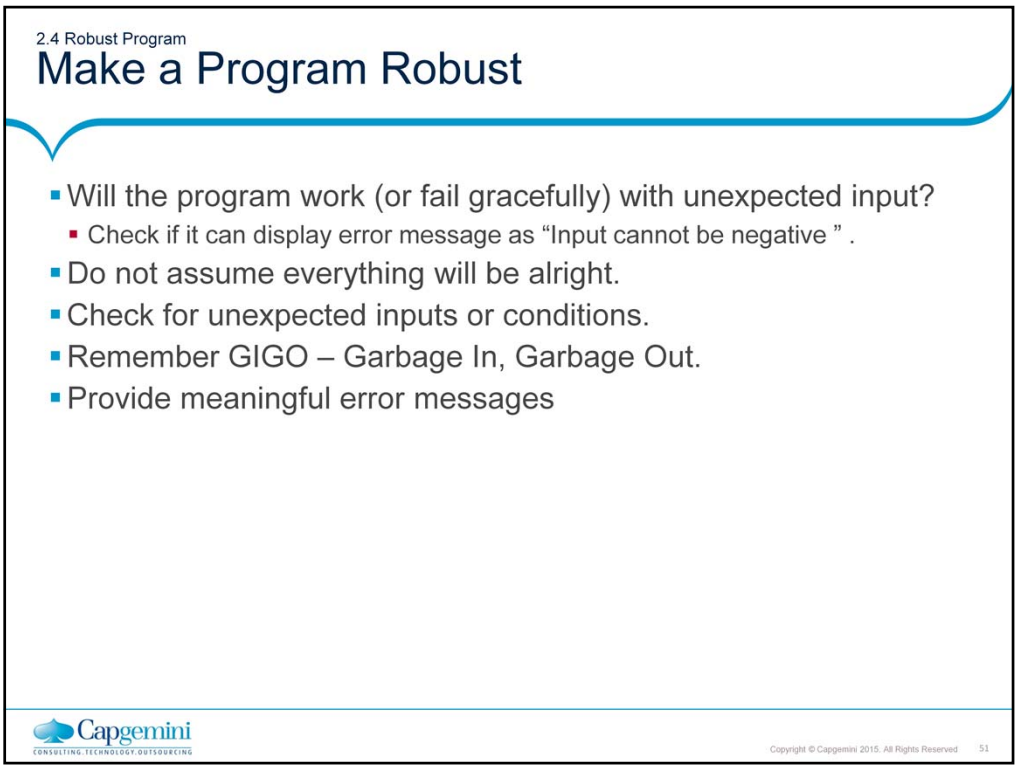
/****

"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" ******/



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”

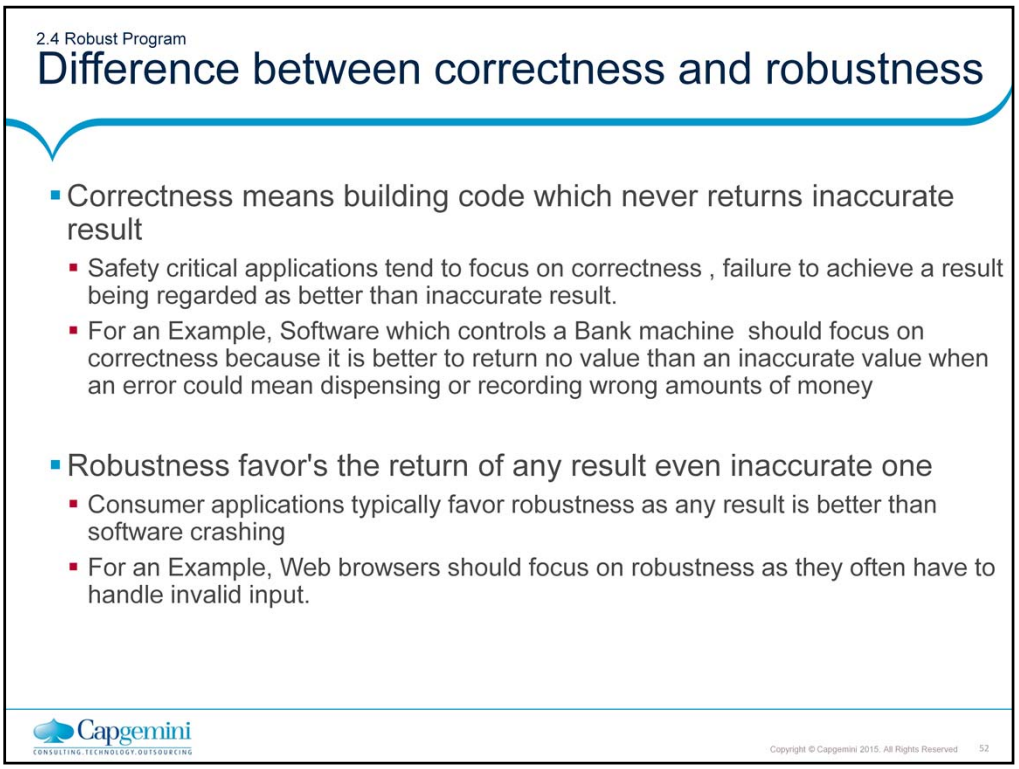
  Check if it can accept extreme values for inputs.

  For example: Basic = 1 crore

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

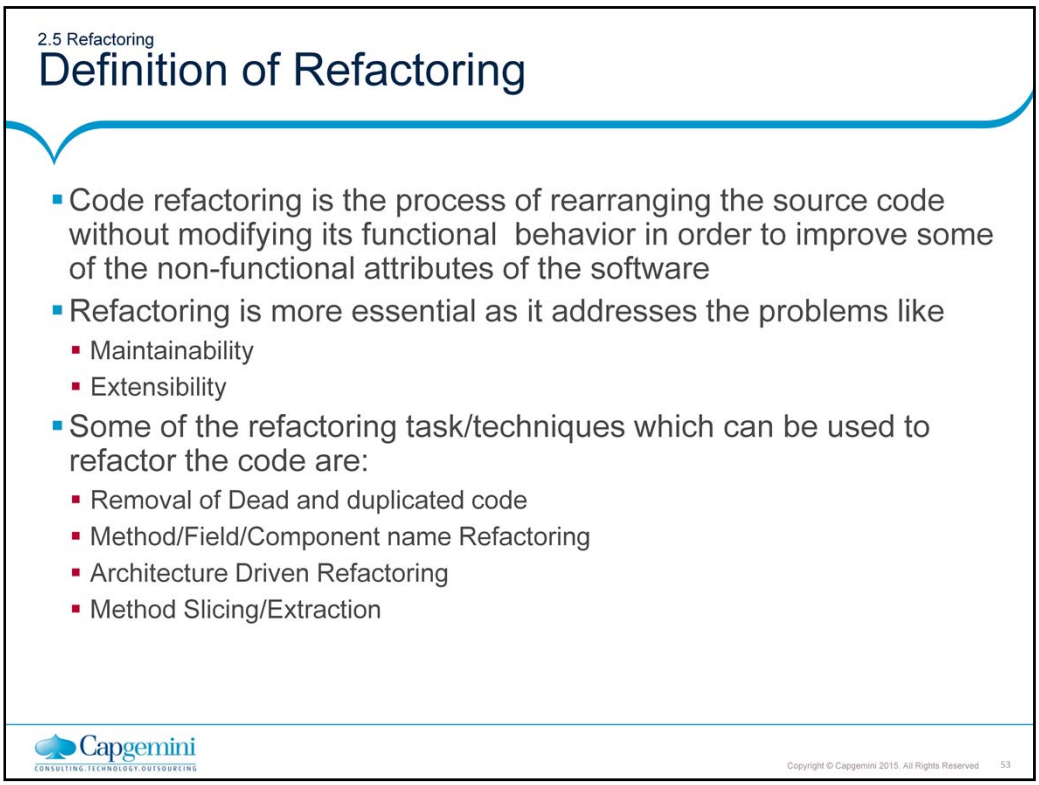
  “Can the Tax calculated be negative?” or

  “Can the Net Pay calculated be negative?”



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



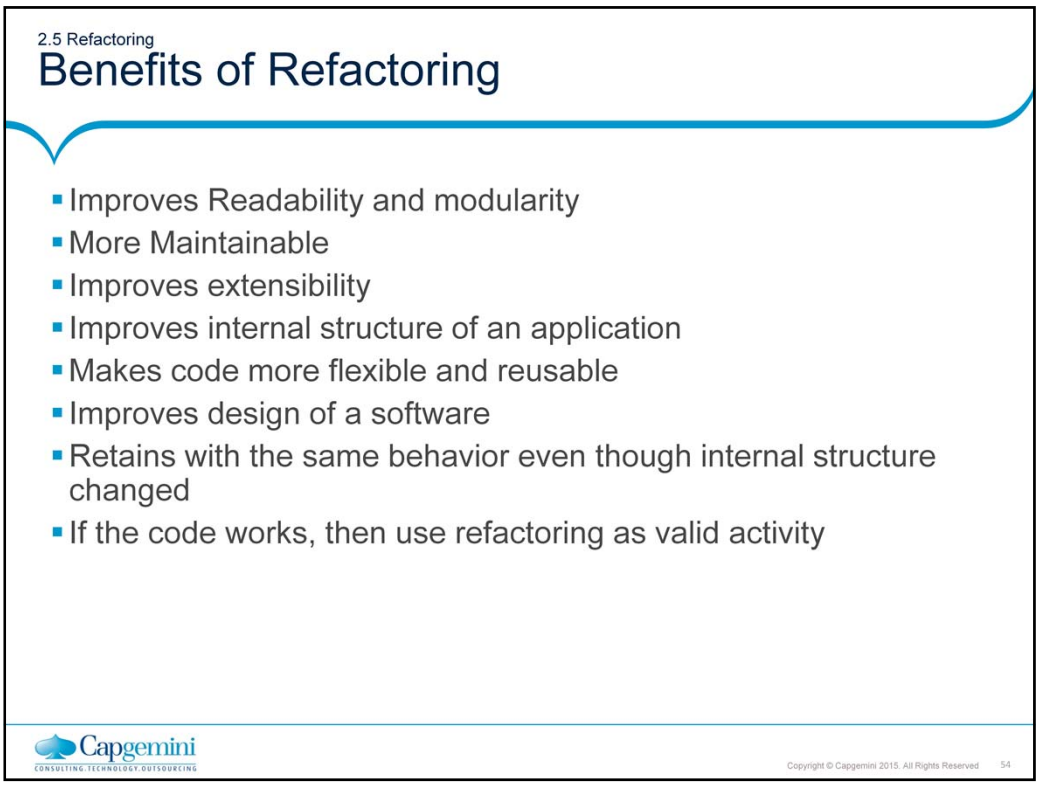
Refactoring is the process of clarifying and simplifying the design of existing code, without changing its behavior. Refactoring requires care because it can introduce bugs to the code

Refactoring is more essential as it addresses the problems like

- Maintainability – Code is not maintainable
- Extensibility – Very difficult to add new feature or upgrade an existing feature

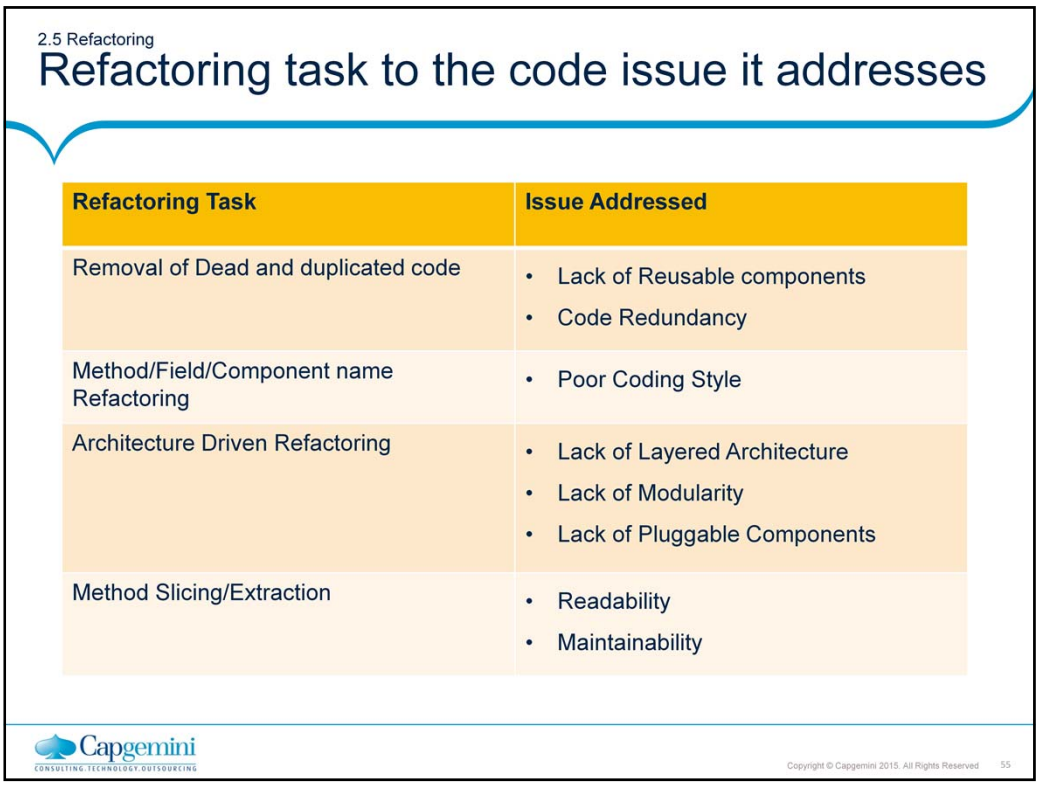
Refactoring task/techniques are:

- Removal of Dead and duplicated code - Remove the unused variables/code, unreachable statements and duplicated code.
- Method/Field/Component name Refactoring – Name of a method/field/component might be confusing, provide a meaningful name for the same and ensure the changes are reflected in other references wherever the variable/field/component is used.
- Architecture Driven Refactoring - Few functionalities in an application can be potentially reused in other applications. In order to reuse such a functionality, separate the code in a separate component by adhering to the architecture design.
- Method Slicing/Extraction - Longer method needs to be broken up into smaller ones to enhance readability and maintainability. Also need to achieve cohesion by implementing only one logic in a method with more suitable name.

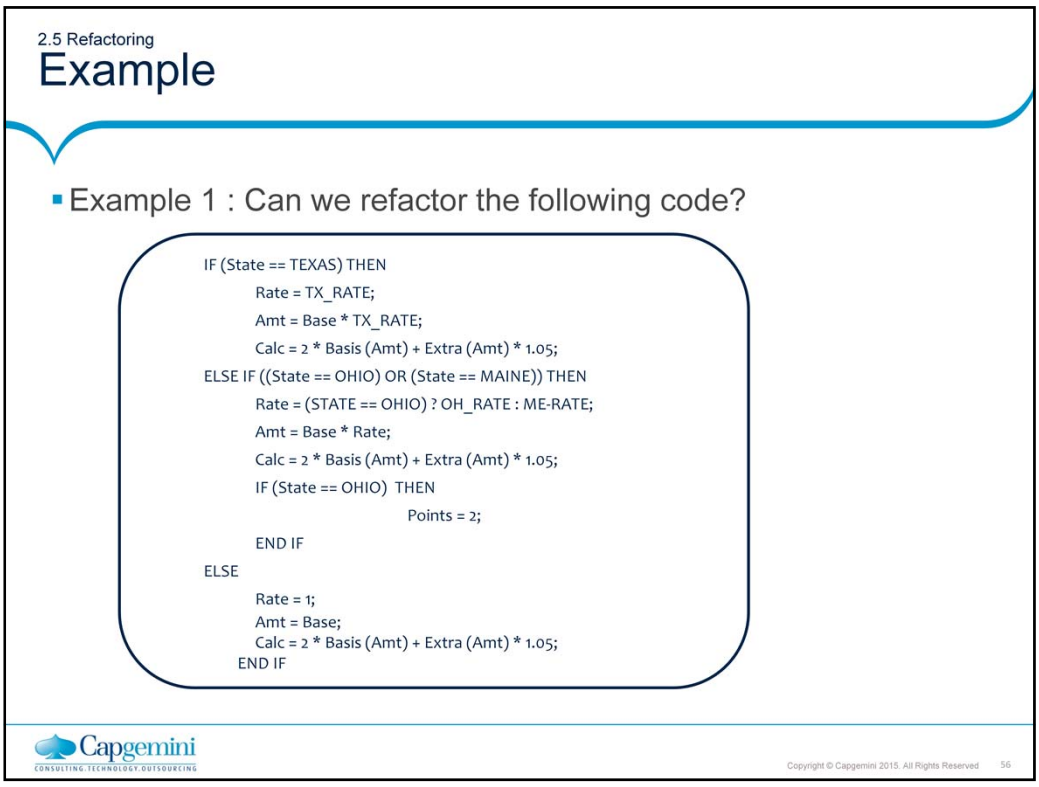


Benefits of Refactoring:

- Improves code readability and modularity by improving code structure and design
- Reduced complexity to improve the maintainability of the source code
- Improves extensibility: Easier to add new features
- Refactoring involves improving internal structure of a software without altering its external behavior
- Goal of refactoring is to make the software more flexible and reusable
- It involves changing the design of the software after it has been coded to improve the design of a software. Refactoring is mainly used to improve badly designed software.
- Ensure software's external behavior remains the same after refactoring
- Refactoring is a valid activity only when the code is already in working state



Each refactoring task is addressed to the code issue it addresses.

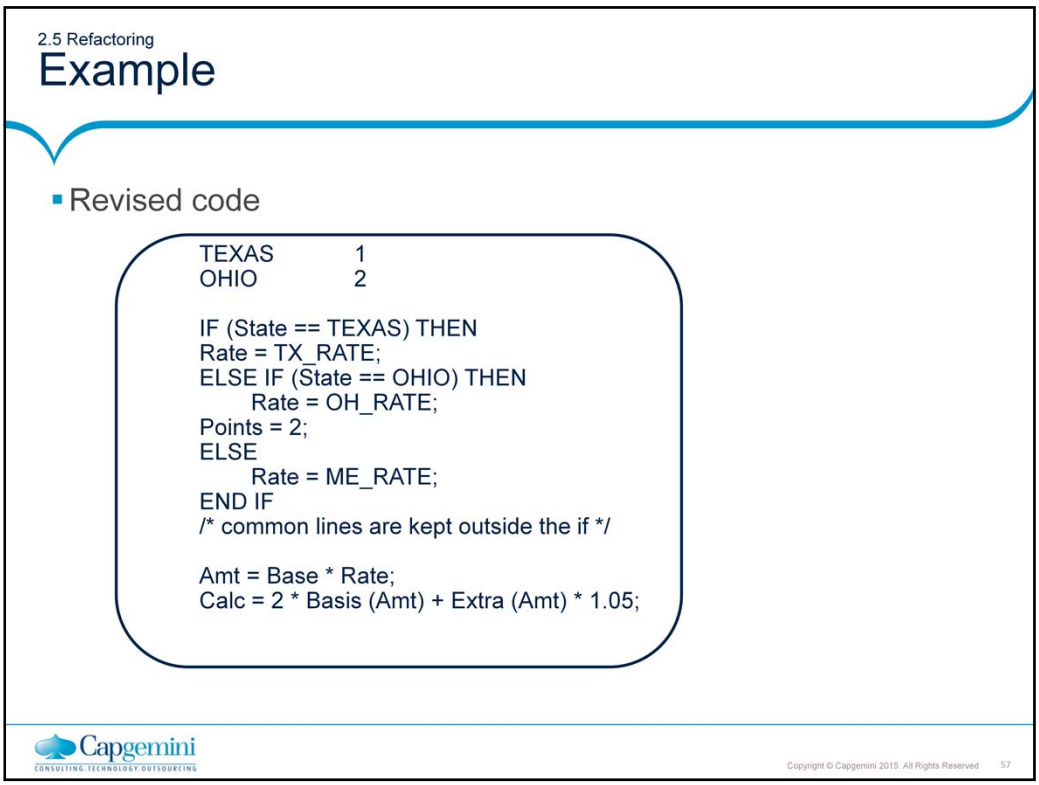


The above code is used to calculate tax based on the state. Tax rate varies for each state but similarity exists in the tax calculation.

Rate, Amt and Calc variables are assigned values in each if-else condition.

Use Refactoring for performing the below task:

- Avoid Duplicate code in each if else condition
- Common code should be kept outside if condition



Note: The code is more efficient and readable as compared to the previous code.

Are any further improvements possible?
If the program is used for three states, it is likely to be used for other states, as well, in the future.
Instead of using a nested IF ELSE statement, using a table or an array for tax rates of all states will make it easy to add more states later on.

Lab

- Implementation of good programming practices

Capgemini
CONSULTING.TECHNOLOGY.OUTSOURCING

 58

Write pseudocode for all assignments in lab 2 to apply the characteristics of good programming practices like modularity approach.

Summary

- In this lesson, you have learnt about:
  - Characteristics of a good program
    - Readable
    - Maintainable
    - Modular
  - Guidelines for writing good code
  - Coupling and Cohesion
  - Robust program
    - Difference between correctness and robustness

Capgemini
CONSULTING.TECHNOLOGY.OUTSOURCING

 59

Review Question

- 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

Capgemini
CONSULTING.TECHNOLOGY.OUTSOURCING

 60

Review Question

- 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

Capgemini
CONSULTING.TECHNOLOGY.OUTSOURCING

 61

Review Question

- 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

Capgemini
CONSULTING.TECHNOLOGY.OUTSOURCING

 62