953103 Programming Logic Thinking

Concept of Sequential Programming

Flowchart and Pseudo-Code

Agenda

- Solution Breakdown
- Sequential Programming
- Flowchart
- Pseudo-code

Application

- A computer software designed to help the user to perform specific tasks.

- A task is defined as a problem or a sub-problem.

- To solve the problem
  - The solution must be designed

Solution Design Pattern : IPO Pattern

- The most fundamental design pattern
- Separate a program into 3 parts
- Each program consists of
  - Input
  - Process
  - Output

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Input

- Provide the input information
- Can be
  - Set from the program
  - Received from the user
  - Retrieved from storage
- Use for preparing a set of data for processing

Process

- A solution part
- Get the input to calculate the result
- Other variables may be introduced for solution
- Programming structure
  - Sequential programming
  - Selection programming
  - Iterative programming
- Design document is required for ease the programming.

Output

- Receive the result from the process.
- The output may be one output or more.
- It needs to be formatted for readability.

Why IPO ?

- Concern separation
- Focus only on the part which it responds
- Make code easier to understand

How to Program?

- Break the problem into pieces
  - One piece for one operation
  - Smallest operation
  - Simple
  - Atomic

- Each pieces will have to be synchronized to solve the problem.

How small is a operation?

- You should be able to write the purpose of the operation in one sentence without using any conjunction.

- For example :

  - Calculate the total price and calculate the number of hour

  - Calculate the number of hour
  - Calculate the total price

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How to Program?

- If you work as a part-time employee in each day with the different begin time, and end time. and the wage can be varied. How much money will you get?
- The program must be able to be used with all possible input.
- If you work from 6 am - 2 pm and the wage is 10 Baht per hour.
- If you work from 2 am - 3 am and the wage is 20 Baht per hour.

What are the tasks you have to do

- 1. Get the input
  - Starting time and Finishing time
  - Wage
- 2. Calculate total hours worked
- 3. Calculate the payment amount
- 4. Display the result

Can the order of the operations be in other ways???

The Design Document

- Searching for the solution
- Write the solution for others to be able to understand
  - Use to validate your solution
    - By other person
- Technique
  - Natural language
  - Formatted description
  - Diagram

Natural Language

- Simple text explanation
- Free hand writing
- Describe as what authors want
- Programmers required skills to transform description to a program

Formatted Text

- Templates for document are prepared
  - Blank to be filled
  - Conventional writing
  - Formal language
    - Mathematic expression
- Easier for programmers to understand
  - The text should be in the proper format
- The flow of the program could not be seen clearly
- Example
  - Pseudo code

Diagram

- One picture is equal to thousands word
- Use the picture for explain the program
- Easy to see the whole system
- Example
  - UML diagram
  - Flow chart

What we focus ?

- Pseudo code
  - The formatted text used to explain a program.
  - It implements structured concept.
  - Some complex algorithms can be explained by pseudo code.

- Flow chart
  - Visualize the concept
  - Easy to understand (in the complex system)
  - The fundamental knowledge for UML diagram

Hint

- Try to find the small solution
  - 1 Step at a time
  - Do not solve the whole problem in 1 step
  - IPO structure

- Which lead to another/bigger solution

Separate Part to be changed

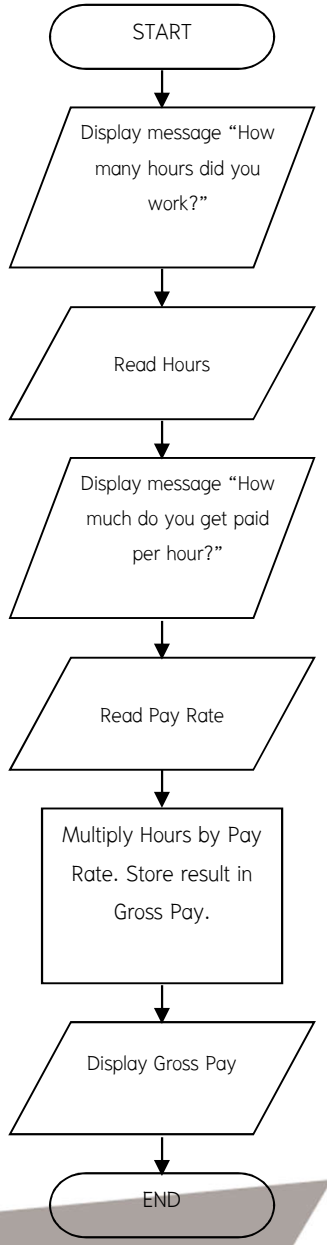
- In most of applications
  - Same calculation methods
  - Different inputs
    - Will return different results

- What should we do
  - Try to separate the input
  - Receive all the inputs at the beginning
    - If possible

FLOWCHART

What is a Flowchart?

- A flowchart is a diagram that depicts the "flow" of a program.



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The Flowchart

- (Dictionary) A schematic representation of a sequence of operations, as in a manufacturing process or computer program.

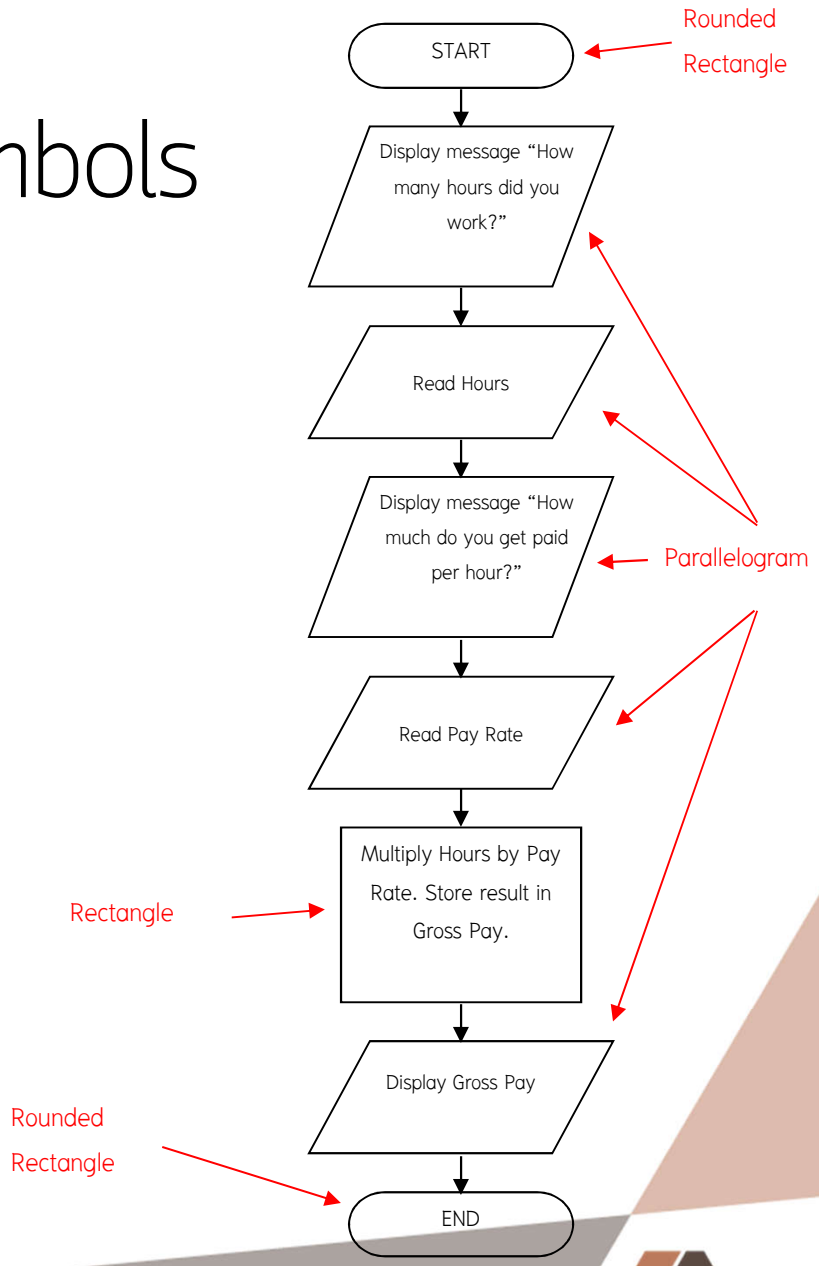
- (Technical) A graphical representation of the sequence of operations in an information system or program
  - Information system-type flowcharts show how data flows from source documents through the computer to final distribution to users
  - Program-type flowcharts show the sequence of instructions in a single program or subroutine
  - Different symbols are used to draw different components of flowchart.

Flowchart

- Show logic of an algorithm
- Emphasize individual steps and their interconnections
- e.g. control flow from one action to the next one

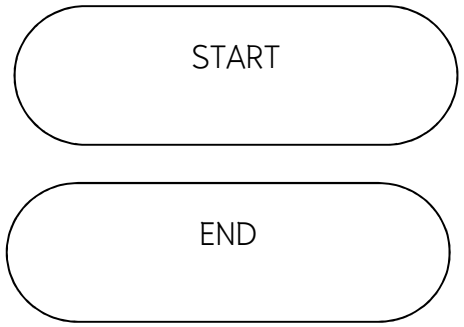
Basic Flowchart Symbols

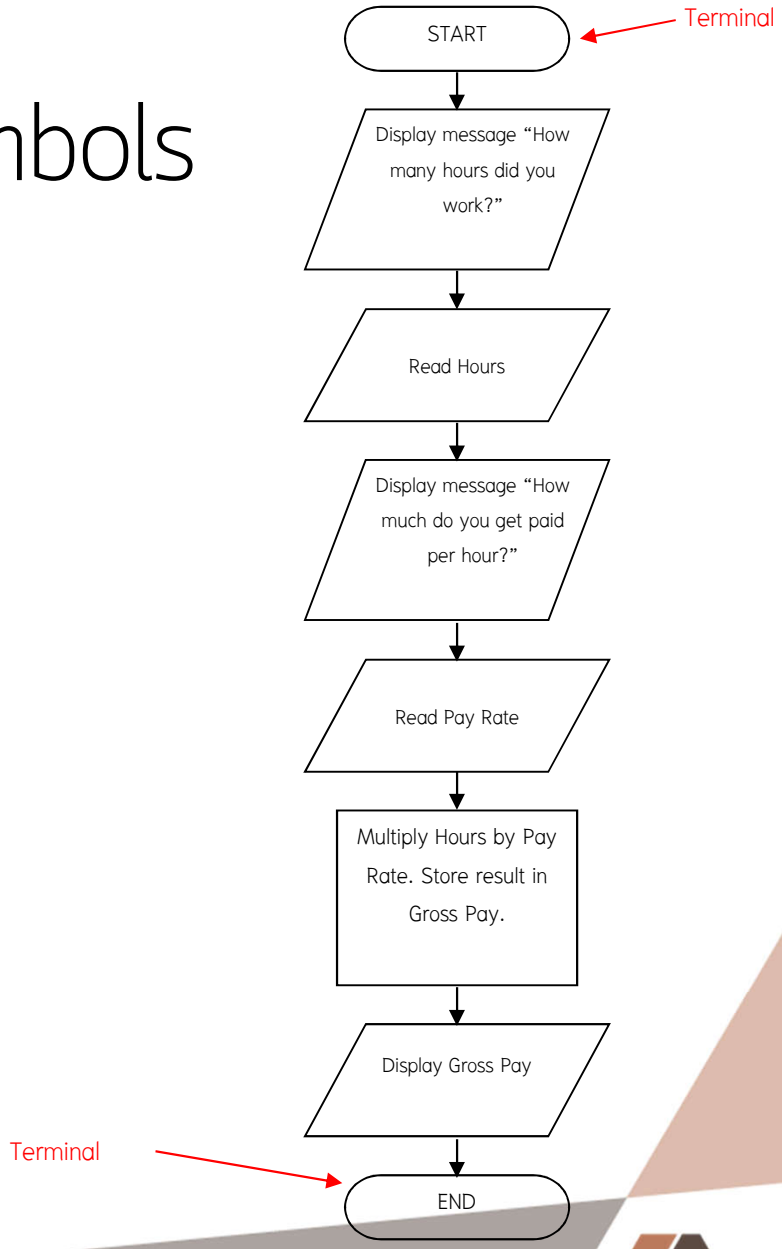
- Notice that there are three types of symbols in this flowchart:
  - rounded rectangles
  - parallelograms
  - a rectangle
- Each symbol represents a different type of operation.



Basic Flowchart Symbols

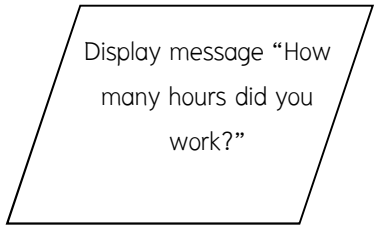
- Terminals
  - represented by rounded rectangles
  - indicate starting or ending point

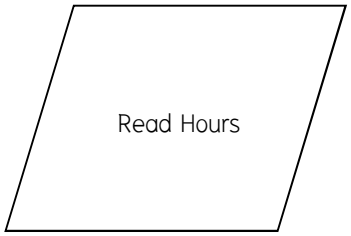


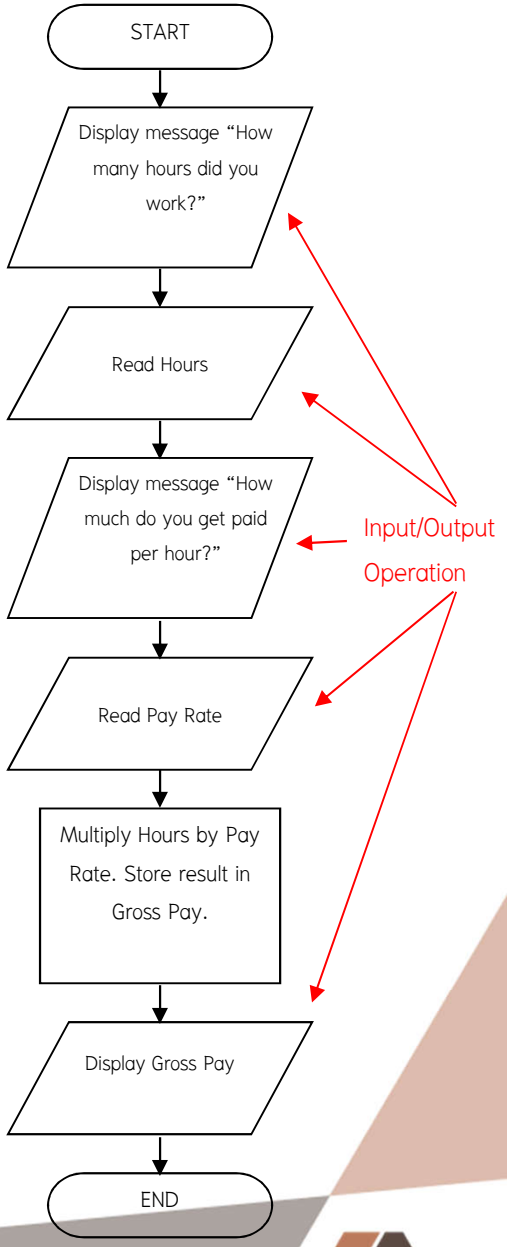


Basic Flowchart Symbols

- Input/Output Operations
  - represented by parallelograms
  - indicate an input or output operation



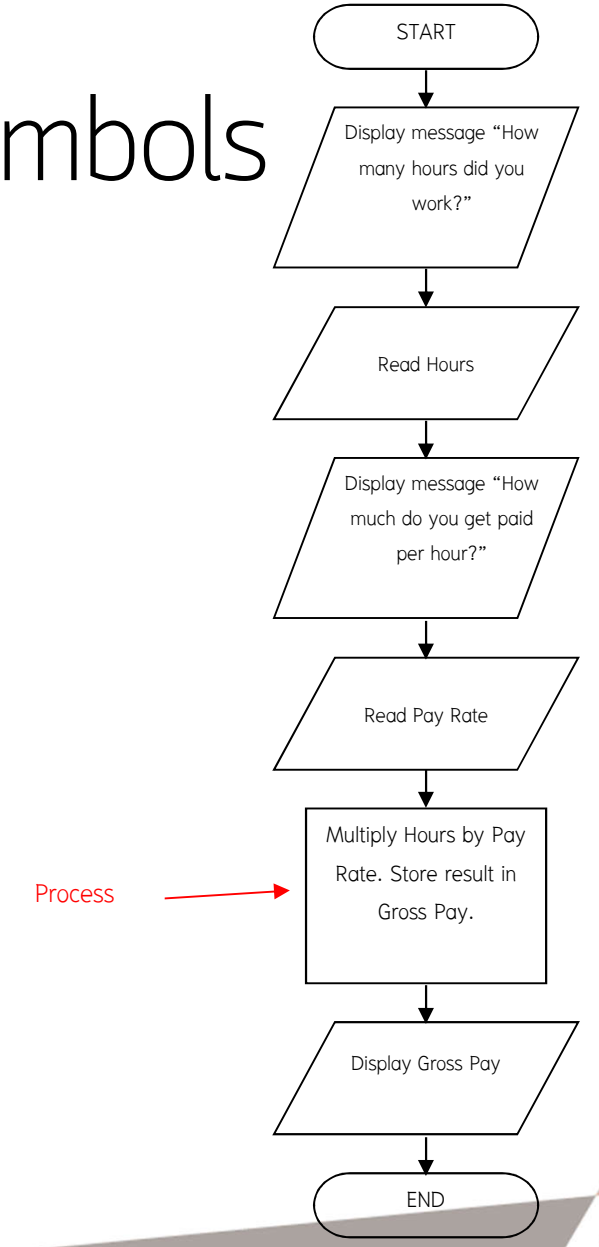




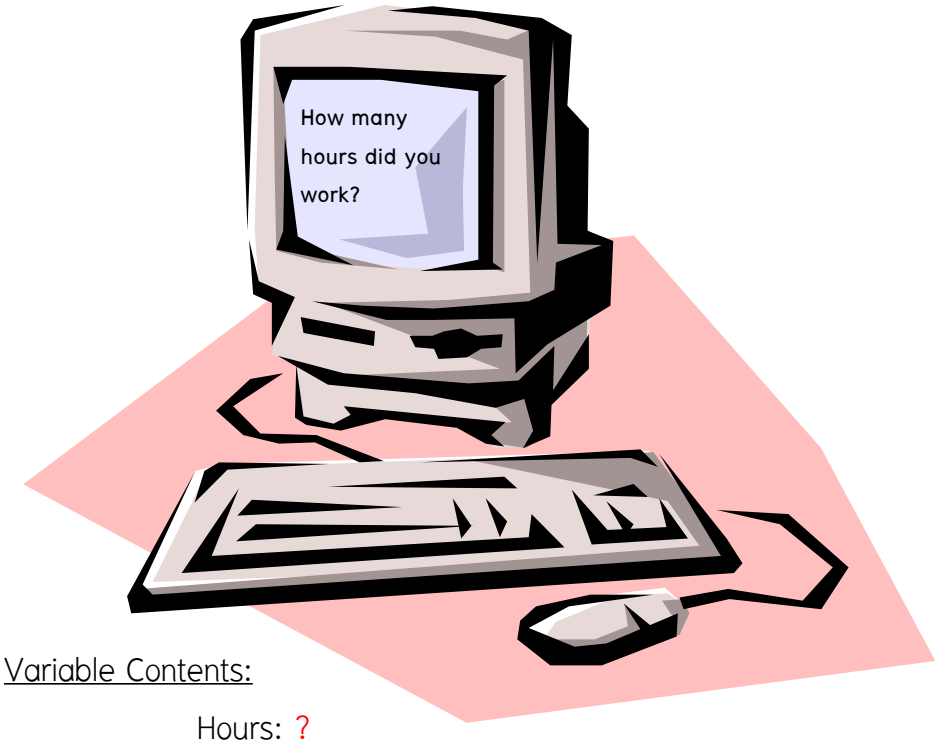
Basic Flowchart Symbols

- Processes
  - represented by rectangles
  - indicates a process such as a mathematical computation or variable assignment

Multiply Hours by Pay Rate. Store result in Gross Pay.



Stepping Through the Flowchart

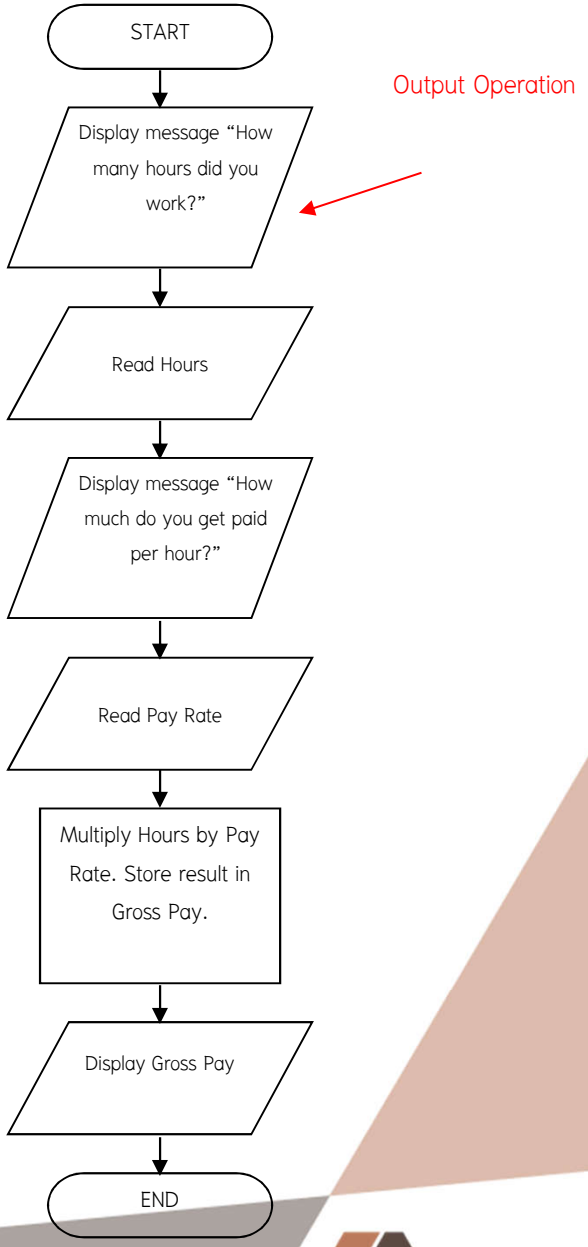


Variable Contents:

Hours: ?

Pay Rate: ?

Gross Pay: ?



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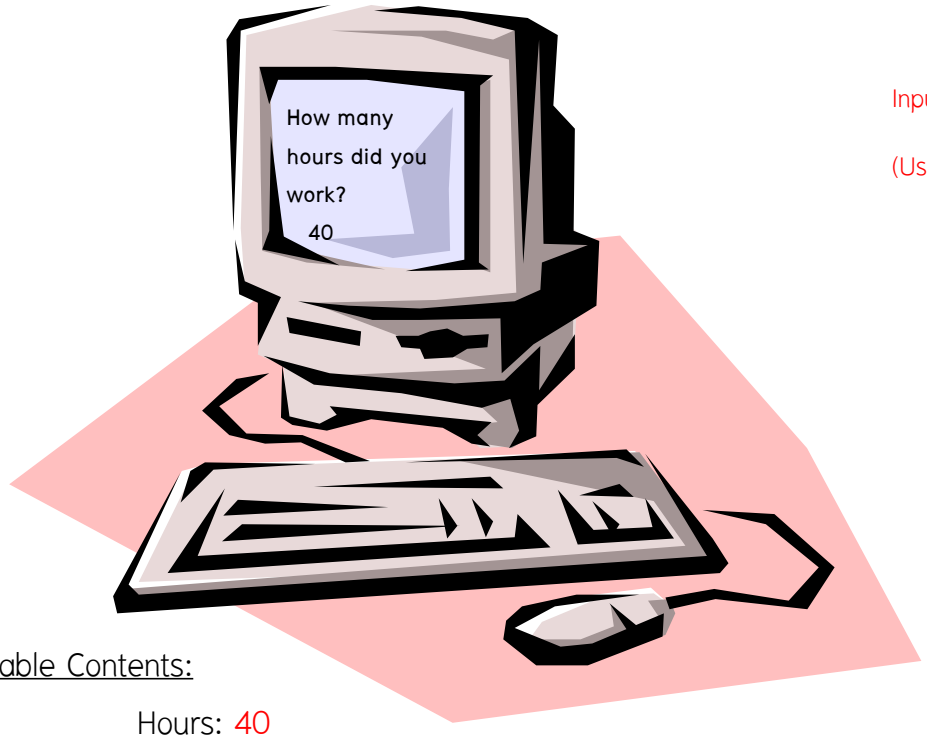
Stepping Through the Flowchart

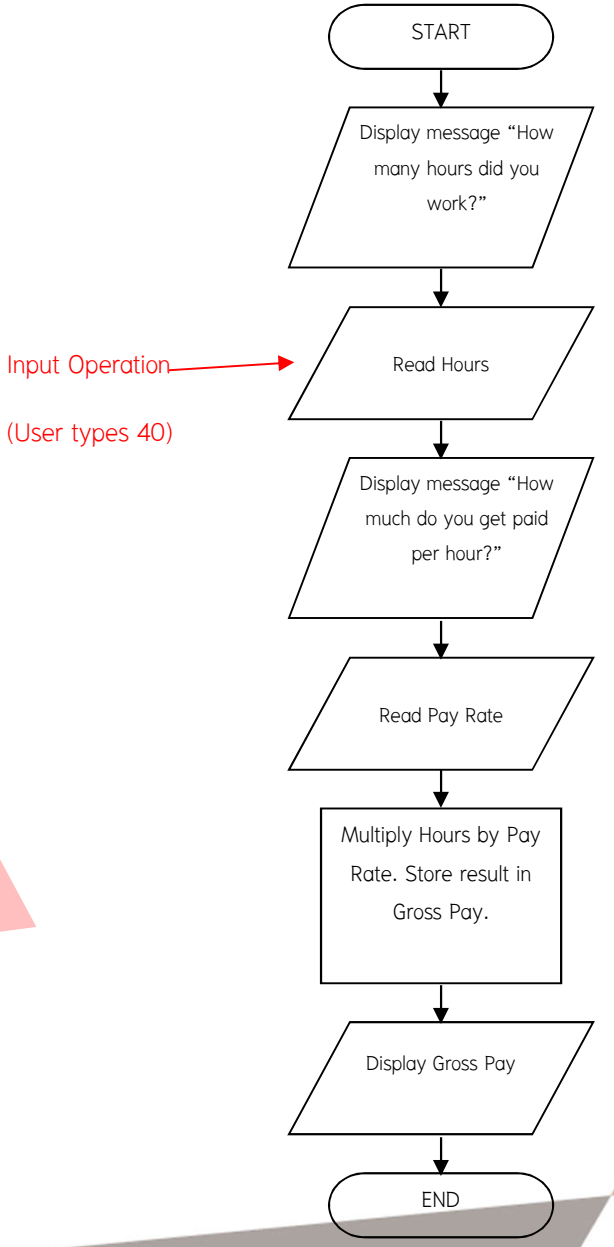


Variable Contents:

Hours: 40

Pay Rate: ?

Gross Pay: ?



Input Operation

(User types 40)

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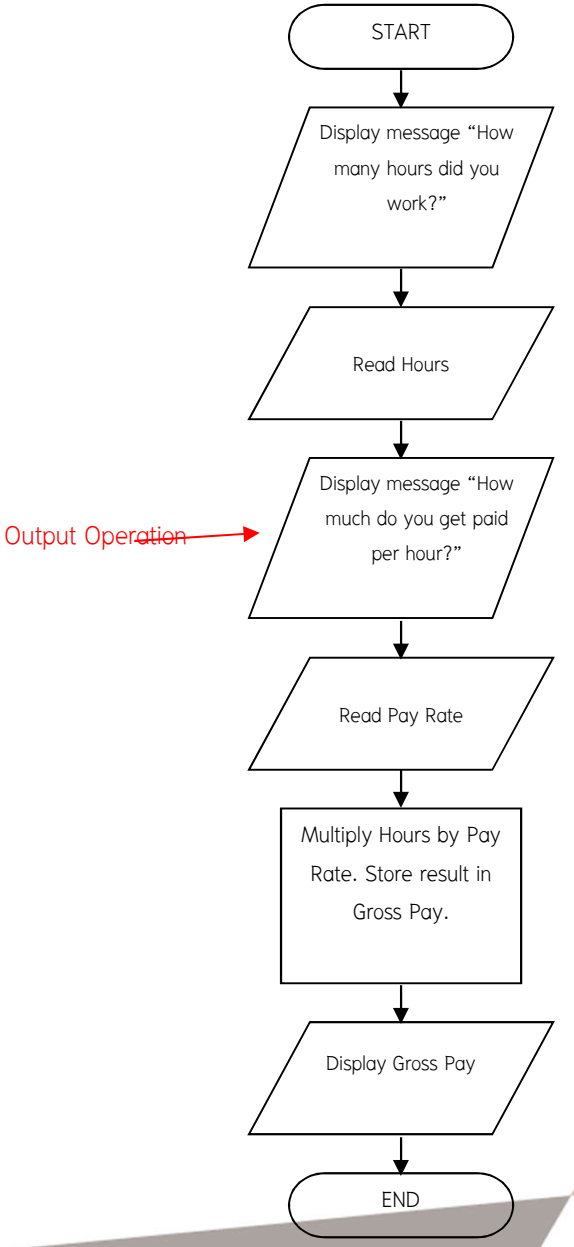
Stepping Through the Flowchart

Variable Contents:

Hours: 40

Pay Rate: ?

Gross Pay: ?



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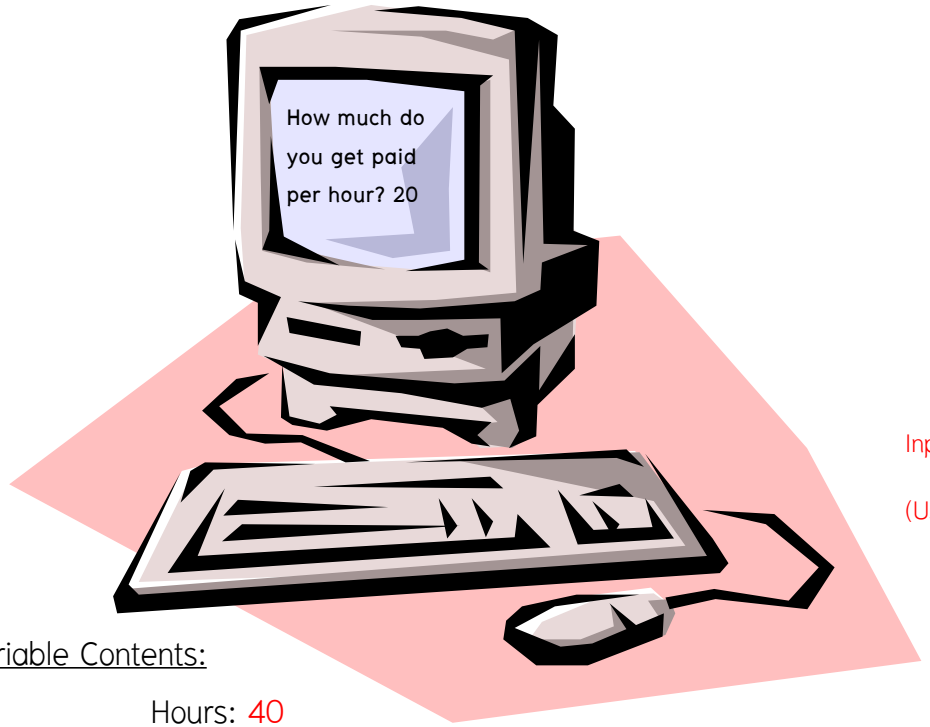
Stepping Through the Flowchart

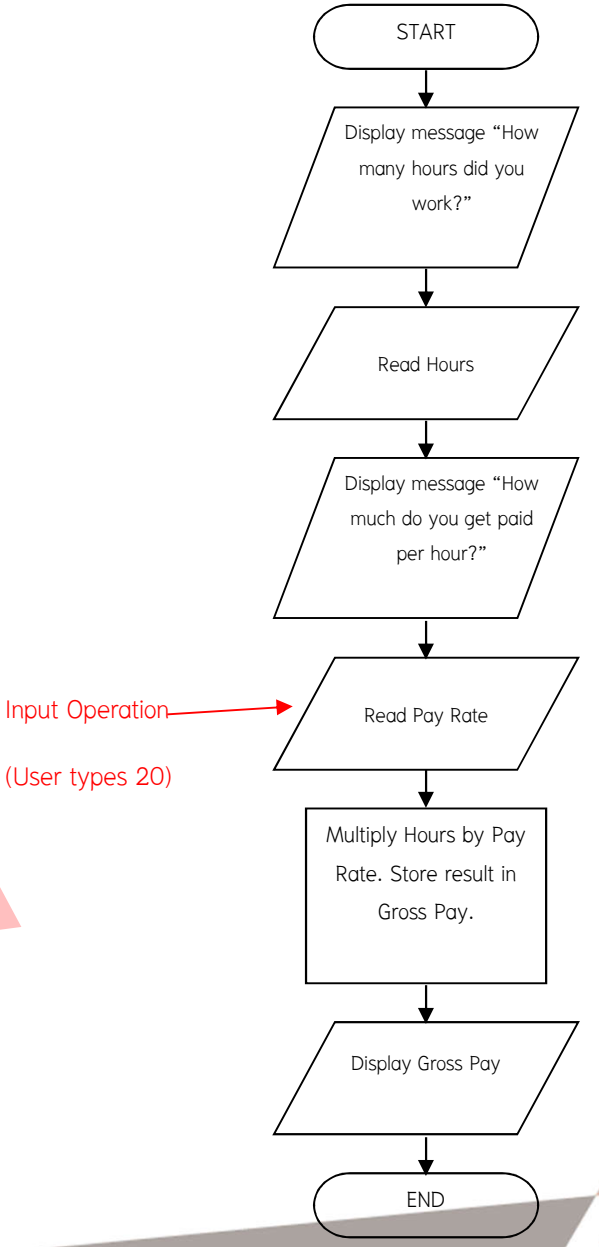


Variable Contents:

Hours: 40

Pay Rate: 20

Gross Pay: ?



Input Operation

(User types 20)

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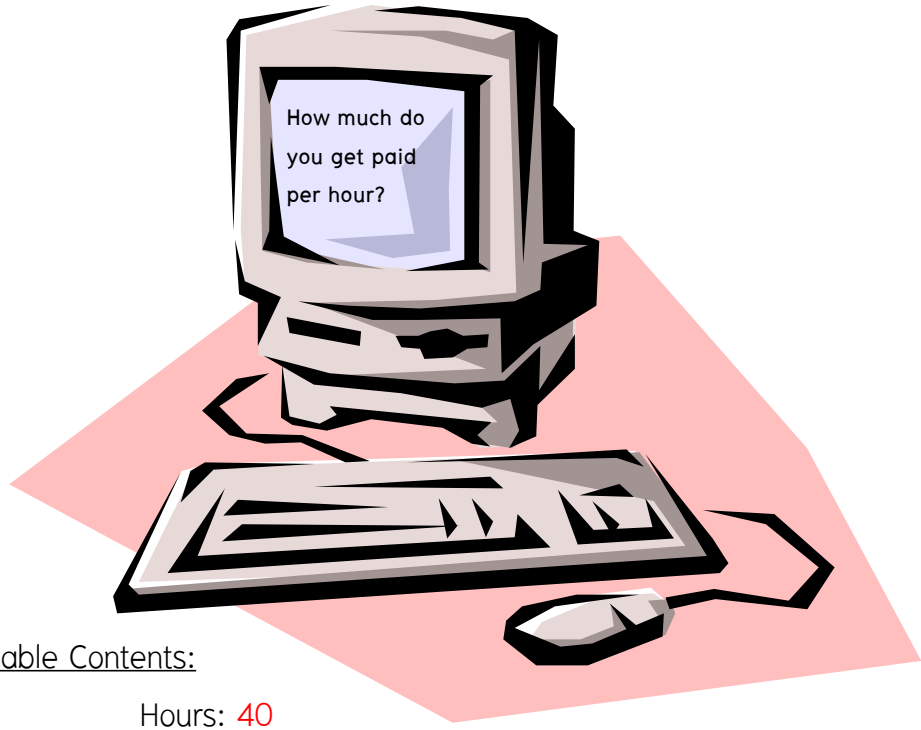
Stepping Through the Flowchart



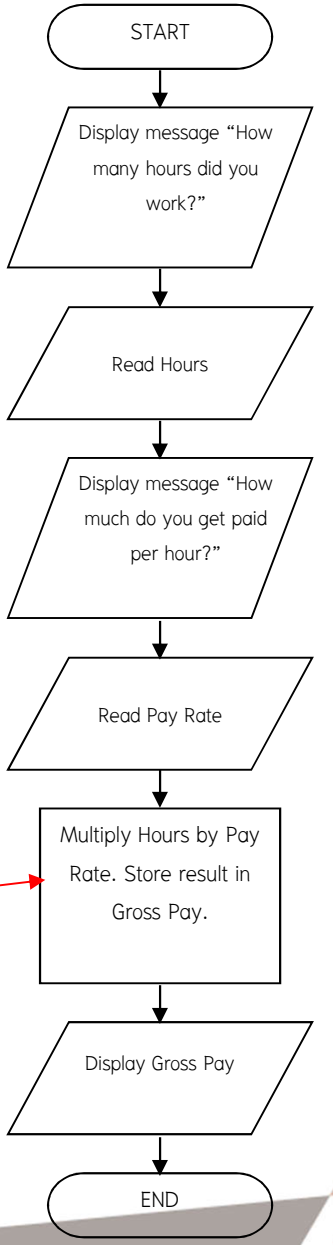
<u>Variable Contents:</u>

Hours: 40

Pay Rate: 20

Gross Pay: 800

Process: The product of 40 times 20 is stored in Gross Pay



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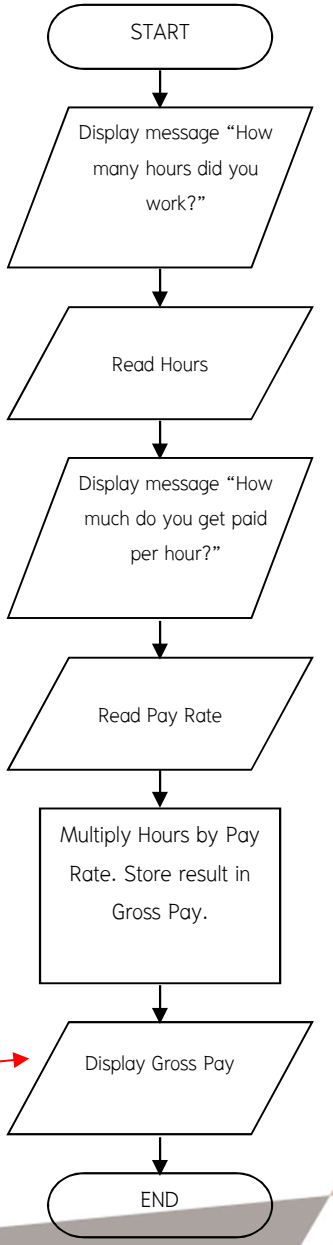
Stepping Through the Flowchart

Variable Contents:

Hours: 40

Pay Rate: 20

Gross Pay: 800



Output Operation

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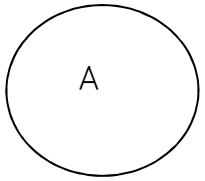
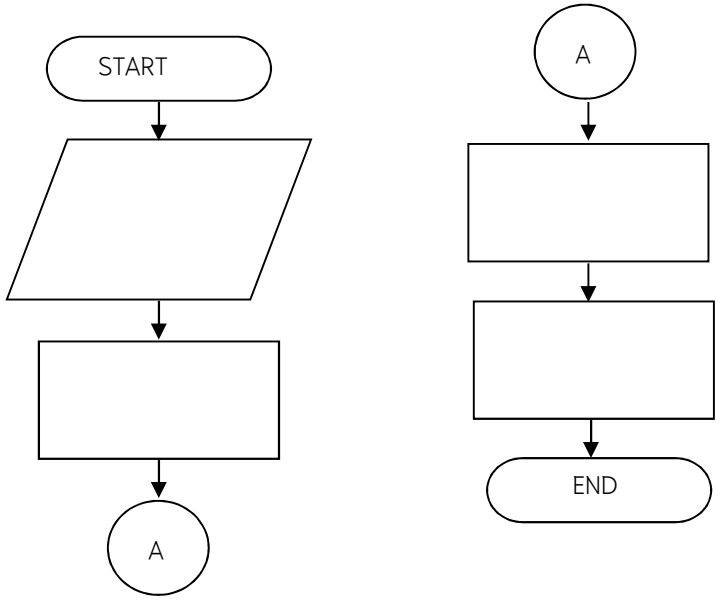
Connectors

- Sometimes a flowchart will not fit on one page.
- A connector (represented by a small circle) allows you to connect two flowchart segments.



Connectors

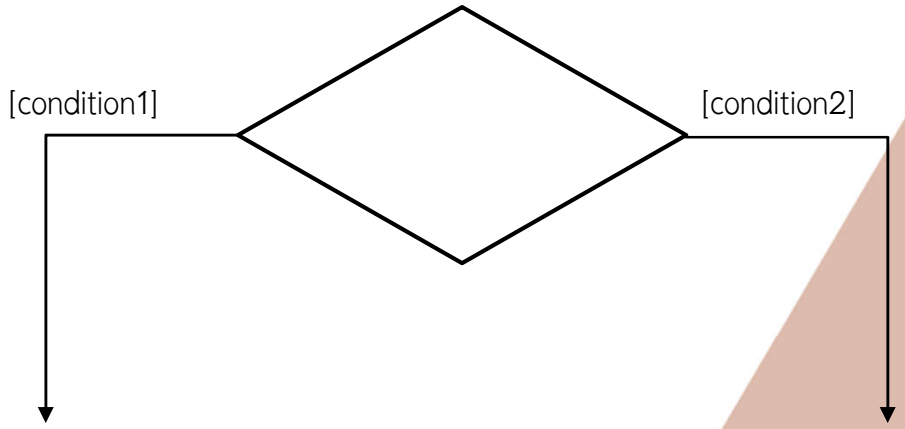
- The "A" connector indicates that the second flowchart segment begins where the first segment ends.



Condition

- Sometimes, the program is not a straight line from the beginning to the end.

- There are more than one path.

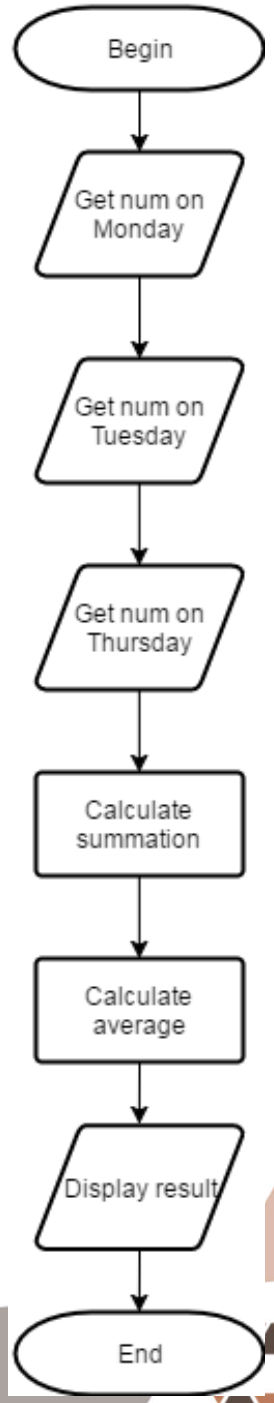


Another Try

- Last week, there are cheer activities on Monday, Tuesday, and Thursday. Staffs record an amount of students who come to the activities in each day.

- Write a program to record an amount of students and calculate the amount of student

- 1. Get the number of student on Monday
- 2. Get the number of student on Tuesday
- 3. Get the number of student on Thursday
- 4. Calculate the summation
- 5. Calculate the average
- 6. Display the result.



The proper output

- Output should be understandable
- User can read and understand
- -Rewrite your output?

Pseudocode

- A mixture of English and formatting to make the step in an algorithm
- A way of expressing algorithms that uses a mixture of *English phrases* and *indention* to make the steps in the solution explicit
- No grammar rules in pseudocode
- Not case sensitive

Rules for Pseudocode

- Write only one statement per line
- Capitalize initial keyword
- Indent to show hierarchy
- End multiline structures
- Keep statements language independent

One statement Per Line

- Each statement expresses one action for computer
- Each task will correspond to one line of pseudo code

Task List

Read name, hours worked, rate of pay

Perform calculations

gross = hours worked * rate of pay

Write name, hours worked, gross

Pseudocode

```
READ name, hoursWorked, payRate

gross = hoursWorked * payRate


WRITE name, hoursWorked, gross
```

Capitalize Initial Keyword

- Keyword such as
  - READ, WRITE (I/O process)
  - IF, ELSE, ENDIF (Selection process)
  - WHILE, ENDWHILE (Repetition process)

Pseudocode

```
READ name, hoursWorked, payRate
gross = hoursWorked * payRate
WRITE name, hoursWorked, gross
```

Indent to show Hierarchy

- Each design structure uses a particular indentation pattern
- Sequence:
  - Keep statements in sequence all starting in the same column
- Selection:
  - Indent statements that fall inside selection structure, but not the keywords that form the selection

```
READ name, grossPay, taxes
IF taxes > 0
      net = grossPay - taxes
ELSE
      net = grossPay
ENDIF
WRITE name, net
```

- Loop:
  - Indent statements that fall inside the loop but not keywords that form the loop

End Multiline Structures

```
READ name, grossPay, taxes
IF taxes > 0
     net = grossPay - taxes
ELSE
     net = grossPay
ENDIF
WRITE name, net
```

- `ENDIF` used for end multiline of `IF`
- The same applies for `WHILE/ENDWHILE`

Language Independence

- Describe a logic plan to develop a program
- Not programming
- The grammar rules for programing are not applied

Rules for Variable Names

- Begin with lowercase letter
- Contain no spaces
- Unique names within code
- Consistent use of names

Working with Fields

Calculations

+	add
–	subtract
*	multiply
/	divide
** or ^	exponentiation
( )	grouping

Selection

>	greater than
<	less than
=	equal to
>=	greater than or equal to
<=	less than or equal to
<>	not equal to

Pseudo code Trick

- Separate the part of pseudo code as input (READ), process (the statements), and output(WRITE)
- No variable declaration required
  - Leave it for the programmer to select the proper type
  - Can be defined if you required the specific data type
- The decoration of output
  - Programmers have to decorate the output themselves
  - Do anything to make the output meaningful to the users

Computer Basic Operations

- Receive information
  - PROMPT instruction
    - For waiting for user input
  - GET instruction to read input from user to the variable
  - READ instruction to read input from user to the variable

Example pseudocode

```
PROMPT FOR studentMark
GET studentMark
```

Computer Basic Operations

- Put out the information
  - PRINT
    - Send output to printer
  - WRITE
    - Send output to file
  - PUT, OUTPUT, DISPLAY
    - Send to screen

Example pseudocode

```
PRINT 'Program Completed'
WRITE customer record TO master file
OUTPUT total tax
DISPLAY 'End of data'
```

Computer Basic Operations

- Perform arithmetic
  - To be consistent with high-level programming language

    \+ for Add - for Subtract

    * for Multiply / for Divide( ) for Parentheses
  - The order of operations are the same as in normal programming language

Computer Basic Operations

- Assign a value to a variable or memory location
  - Initialization
    - Use INITIALIZE or SET
  - Assign a value
    - Use '=' or '←'
  - To keep a variable for later use
    - Use SAVE or STORE

Example pseudocode

```
INITIALIZE total_price TO zero
SET student_count TO zero
Total_price = cost_price + sales_tax
STORE customer_num IN last_customer_num
```

Example pseudocode

```
INITIALIZE total_price TO zero
SET student_count TO zero
Total_price ← cost_price + sales_tax
STORE customer_num IN last_customer_num
```