Chapter4

Flowchart and Decision Making in C Language

Faculty of Engineering

King Mongkut's Institute of Technology Ladkrabang

Objective

- Introduction to Flow charts
- How to write a program using Flow chart information.
- To write Flowchart and program that have a condition.

Reference..www.ce.kmitl.ac.th King Mongkut's Institute of Technology Ladkrabang

How to develop program

- Before Developing a program

  - Understand the problem

  - Find a appropriate method to solve the problem

- Developing Period

  - Consider the structures and commands of the used language.

  - Follow the process of good developing program.

Reference..www.ce.kmitl.ac.th King Mongkut's Institute of Technology Ladkrabang

Attributes of good programming

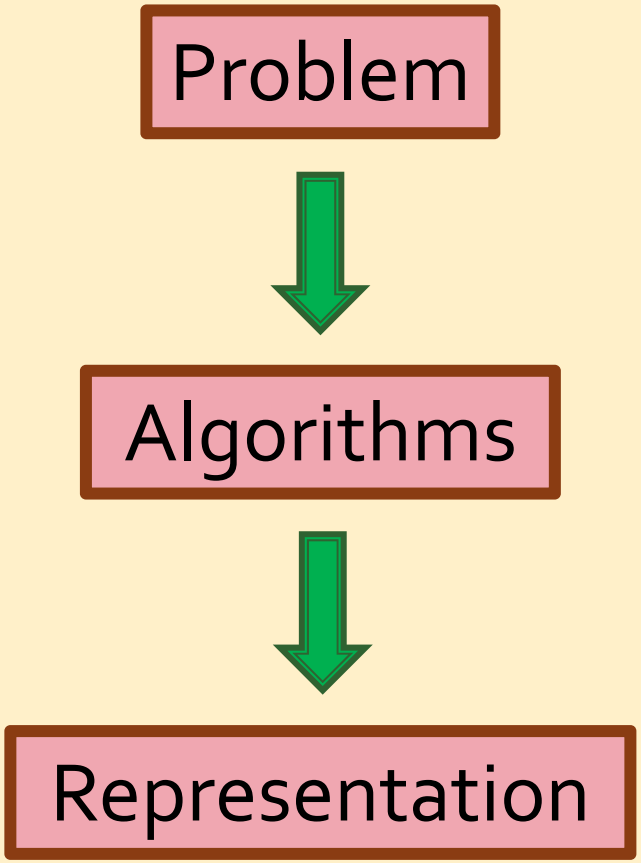
- Meet the requirements
- Accuracy
- Readability
- Maintainability
- User friendly
- Systematic design

Reference..www.ce.kmitl.ac.th King Mongkut's Institute of Technology Ladkrabang

Algorithms

- Problem
  - Can solve the problem by using sequentially command.
- Algorithm
  - A Sequence that define the method which solve the problem
- Representation
  - To convert the designed algorithm to the programming language

Algorithms

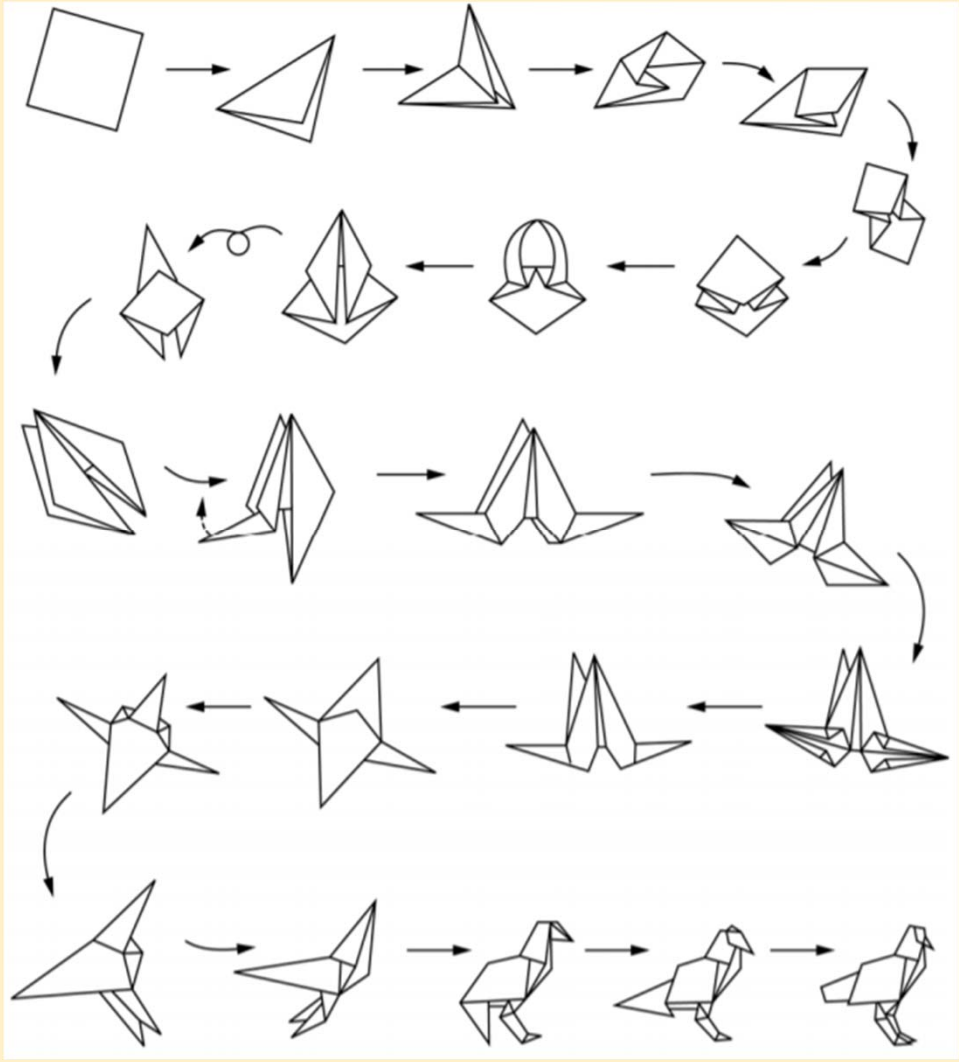


Problem: How to use computer

- Turn on computer
- Key Password
- Open program
- Type your job
- Save
- Shutdown Computer

- Turn on computer
- Key Password
- Type your job
- Open program
- Save
- Shutdown Computer

Origami



Flowchart

- Flowchart is a diagrammatic representation of an algorithm. also Flowcharts are very helpful in writing programs and explaining programs to others.
- Different symbols are used for different states in flowchart and their order is connected by arrows.
- Each symbol represents a piece of the code written in the program.

Benefit of Flowchart

- Simply clarifying progresses. Offers an easy, visual method to help designer instantly understand, what they should do step by step.
- The flowchart lists each necessary steps to perform a process and helps a designer remove unnecessary steps in a process, as well as catch the errors.
- In conclusion with the help of flowchart, problem can be analyzed in more effective way and help the others instantly understand what they should do next.

Type of Flowchart

- System Flowcharts

  - System Flowchart is the flowchart that shows the scope and sequence of any systems. Moreover, it also show the type of input and output that enter or display on the system. Since system flowchart is a diagram that shows overview of the system. Thus a process or a program may show only a part of the process in the system flowchart.

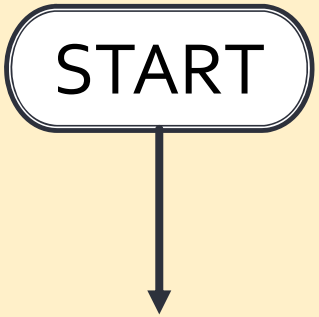
- Program Flowcharts

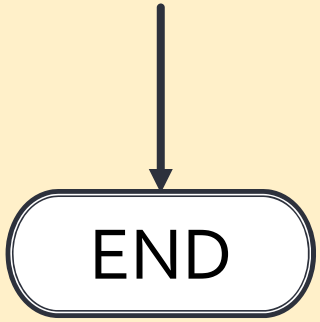
  - Program Flowchart is the flowchart that shows a sequential task of any program.

Symbol of Flowchart

Terminal(Stop/Start)

Used to represent start and end of flowchart.



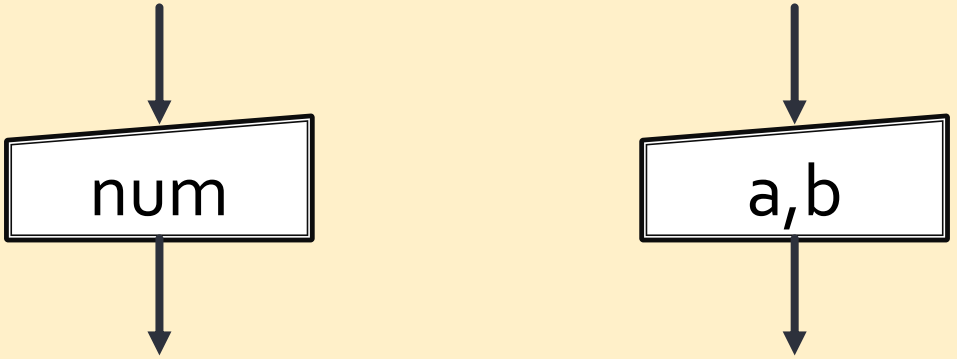


https://www.smartdraw.com/flowchart/flowchart-symbols.htm

Symbol of Flowchart

Manual Input Symbol

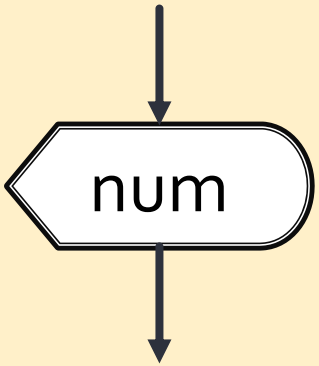
Represents a step where a user is prompted to enter information manually.

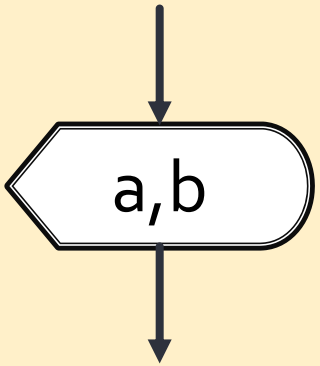


Symbol of Flowchart

Display Symbol

Indicates a step that displays information.

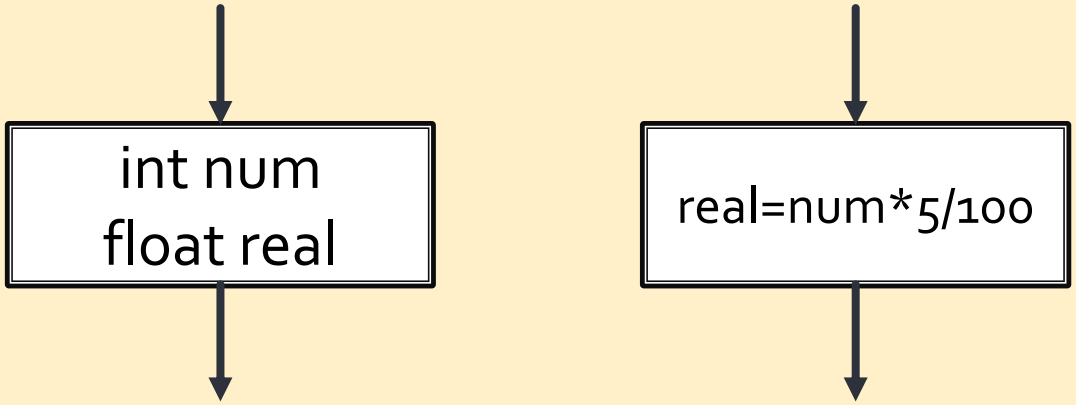




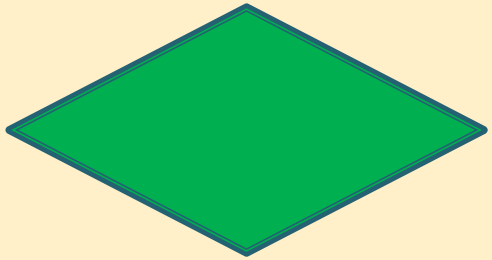
Symbol of Flowchart

Action or Process Symbol

Used for arithmetic operations and data-manipulations.

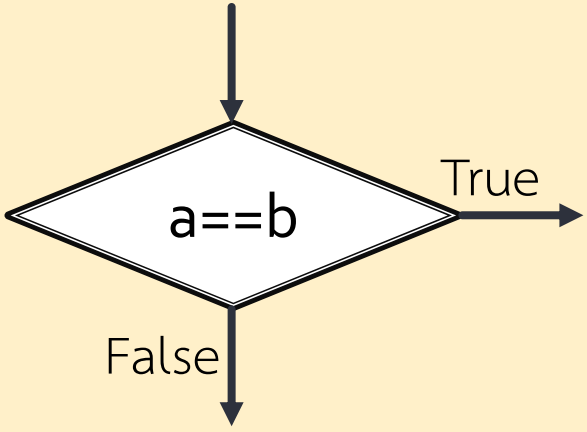


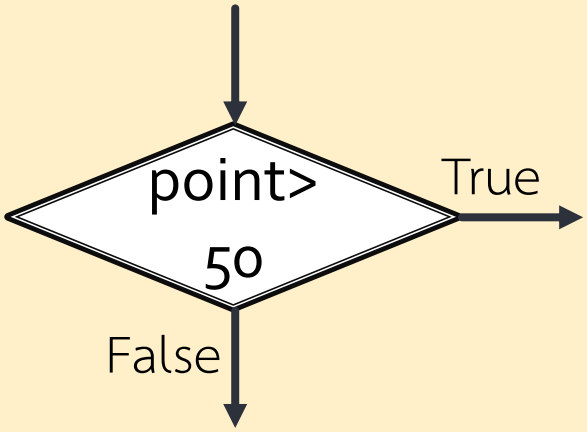
Symbol of Flowchart



Decision Symbol

Used to represent the operation in which there are two alternatives, true and false.

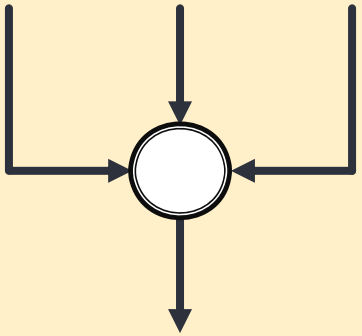




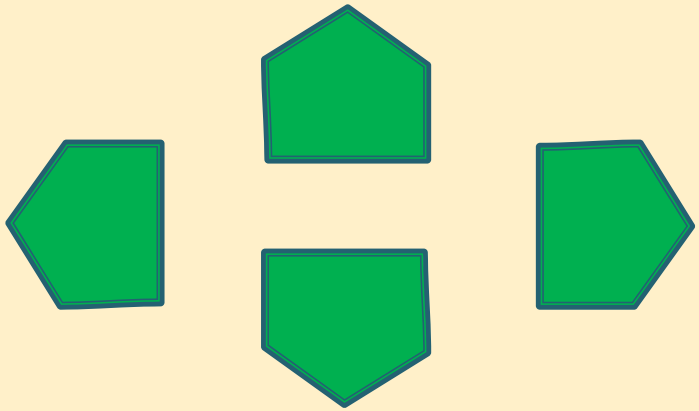
Symbol of Flowchart

Connector Symbol

Used to join different flowline

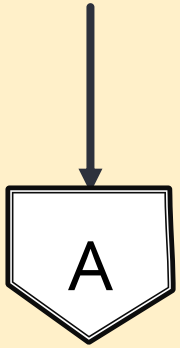


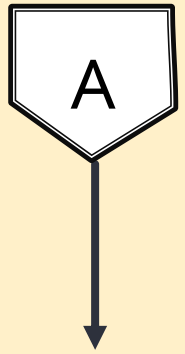
Symbol of Flowchart



Off Page

Used to connect flowchart portion on different page.

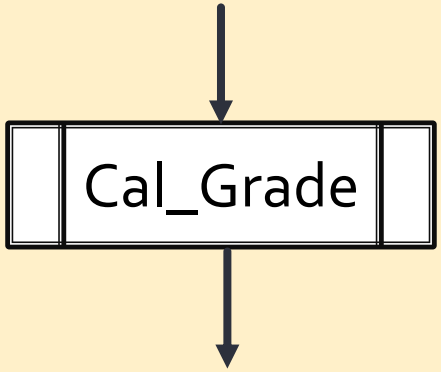




Symbol of Flowchart

Predefined Process/Function

Indicates a sequence of actions that perform a specific task embedded within a larger process. This sequence of actions could be described in more detail on a separate flowchart.



Rule of Flowchart

- Size of symbol can be different but ratio have to match with the standard.
- The direction of arrow in Flowchart should be up to down or left to right.
- Flowchart should neat and clean. Should avoid cross over arrow because it difficult to understand.
- If necessary to write text, should use short text or write command inside the symbol.

Example of Flowchart

How to create Flowchart

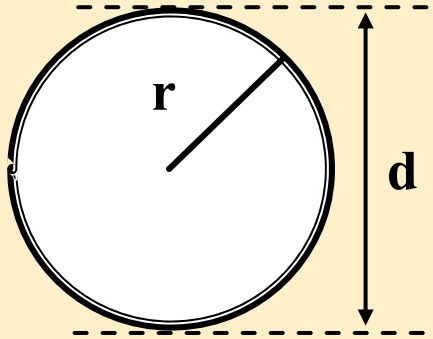
- **Output Analysis** Analyze the requirement of user or result of the problem. (identify the method to solve the problem)
- **Input Analysis** Analyze the Input data from user or problem.(Check what causes the problem (input))
- **Process Analysis** Analyze the process determine the final results.
- **Variable Definition** Identify the variables use to write the program.

Create a program to calculate circle area

- **Program 1** Write the Flowchart and Program to calculate circle area.

Output Analysis

The result is the Area of the given Circle



Input Analysis

You must know the range of the Radius(Dimension)in order to calculate the area of the given Circle

Create a program to calculate circle area

Process Analysis

1. Obtain the radius value(or dimension) from user
2. Calculate circle area from formula

$$A = \pi r^2$$

3. Show the results on the screen.

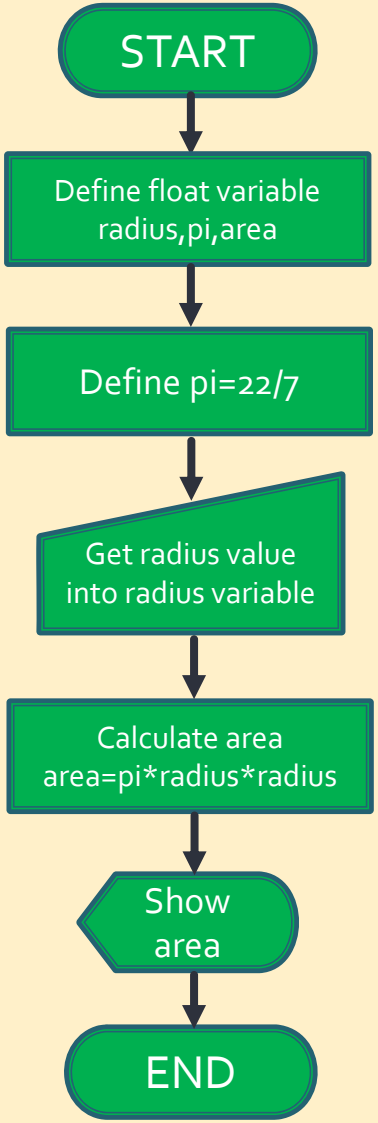
Variable Definition

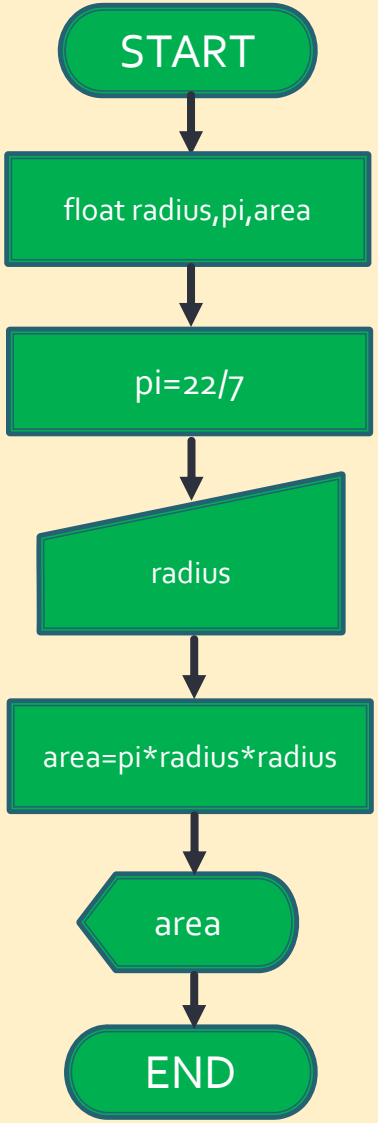
radius : float variable to get radius

pi : float variable to keep the value

area : float variable to keep the area

Create the program to calculate the Area of a Circle





Create the program to calculate the Area of a Circle

```
#include<stdio.h>
int main()
{
    float radius, pi, area;
    pi = 22.0/7; // pi = 3.14;
    printf (“Enter Radius of Circular : ”);
    scanf (“%f”, &radius);
    area = pi*radius*radius;
    printf (“Area of Circular : %f”, area);
    return 0;
}
```

Example: Program to display the summary students exam Score

Write Flowchart and Program to get Name, Surname, ID and Score then show summary of Scores

Example Results of the program

```
Enter your Name Surname : Engineer KMITL
Enter your Student ID : 51000000
Enter your Score
        Laboratory (15%) = 15
        Midterm (35%)    = 30
        Final (50%)      = 42
Total (100%)             = 87
```

Conditions in C programming

- In programming, **decision making** is used to specify the order of the statements to be executed. Most popular commands for decision making are **if** and **if...else** statements. These Commands consider the process of True or False.
- Decision making commands usually use in a program along with Relational Operators and Logical Operators.

Relational Operators

Operator	Comparison	Example
==	Equal to	5==3 return 0
>	Greater than	5 > 3 returns 1
<	Less than	5 < 3 returns 0
!=	Not equal to	5 != 3 returns 1
>=	Greater than or equal to	5 >= 3 returns 1
<=	Less than or equal to	5 <= 3 returns 0

Reference.. https://www.programiz.com/c-programming/c-operators

Relational Operators

Comparison	Result
7 == 9	False
7 != 9	True
8 > 8	False
8 >= 8	True
(10+9) < 7	False
4 <= 3	False

Comparison	Result
22 == 22	True
(3+5) != 8	False
9 > 7	True
7 >= 9	False
7 < (10+9)	True
3 <= 4	True

Logical Operators

Operator	Comparison	Example
&&	Logical AND. True only if all operands are true	x && y
||	Logical OR. True only if either one operand is true	x || y
!	Logical NOT. True only if the operand is 0	!x

Reference.. https://www.programiz.com/c-programming/c-operators

Logical Operators

Example	Result
T && T	T
T && F	F
F && T	F
F && F	F

Example	Result
T || T	T
T || F	T
F || T	T
F || F	F

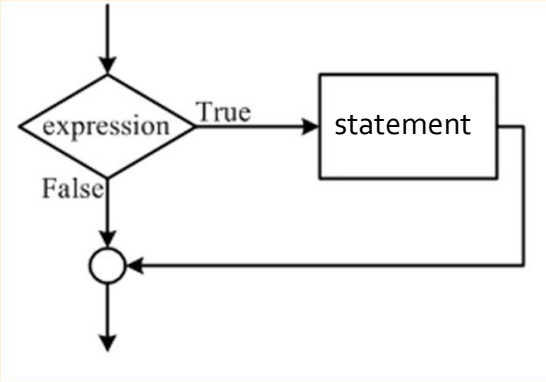
Example	Result
!T	F
!F	T

Example of Logical Operators

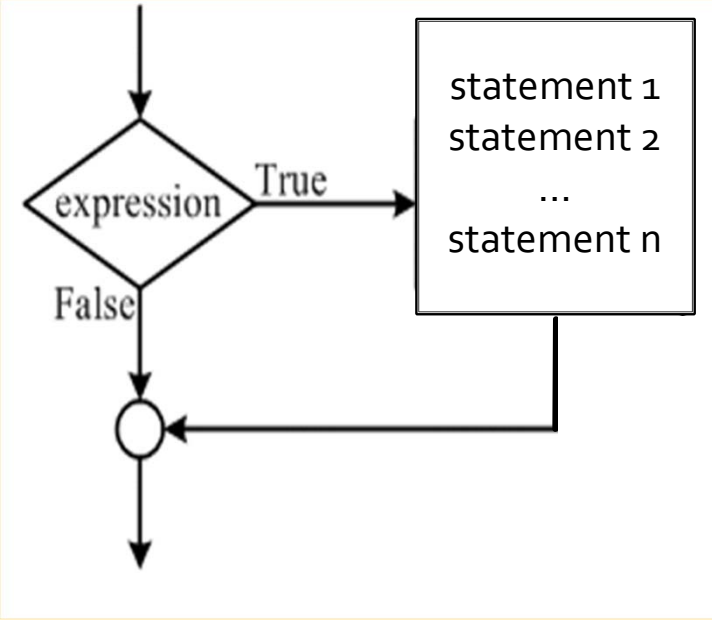
```
int num1 = 10, num2 = 20, num3 = 30;
num1 == num2
num1 > num2
(num1 < num2) && (num2 < num3)
(num1 > num2) || (num1 > num3)
(num1 > num2) || (num2 < num3)
```

if

```
if (expression)
    statement;
```

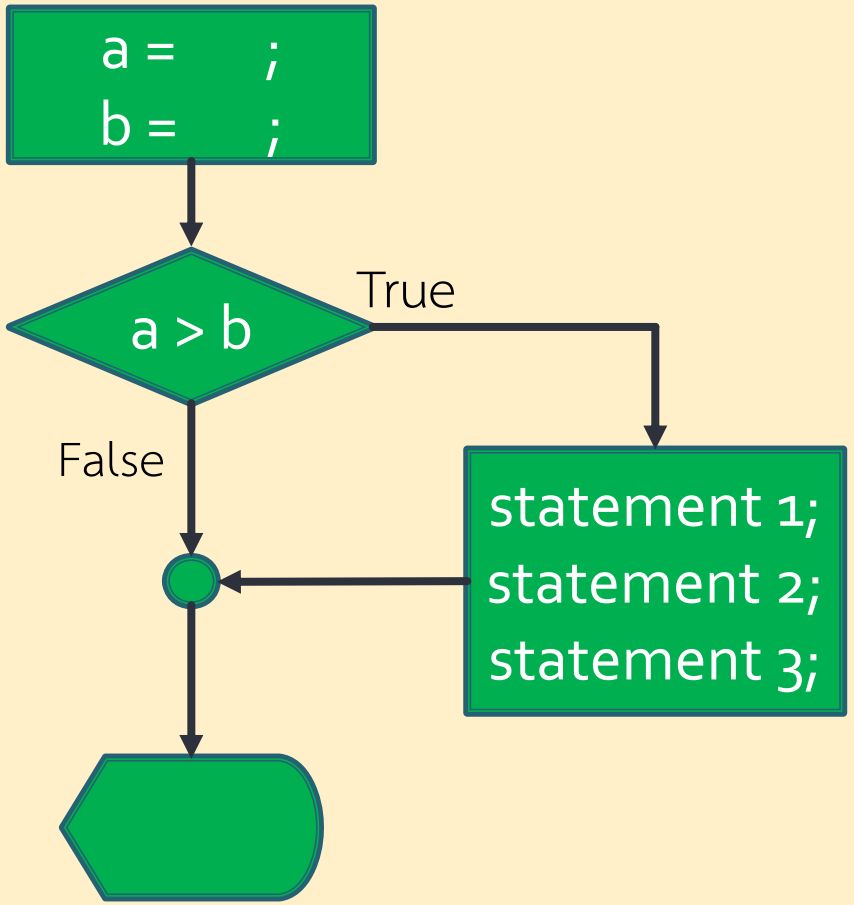



```
if (expression)
{
    statement 1;
    statement 2;
    ...
    statement n;
}
```



if

```
int a =        ;
Int b =        ;
If (a>b)
{
        statement 1;
        statement 2;
        statement 3;
}
printf ();
```



Example of if condition

- Write the Flowchart and Program to get Name, Surname, ID, Total test score and Full score. If student get score more than 60% should show Name, Surname, ID, Score and Pass result.

Output Analysis

Show Name, Surname, ID, Score and Result.

Example of if

Input Analysis

Name/Surname/ID/Total test Score/Full Score

Process Analysis

Program get Name/Surname/ID/Total test Score/Full Score

Compare score, is it more than 60% or not. If True should show Name, Surname, ID, Score and Pass result.

Example of if

Variable Definition

first : char variable for get Name 20 char

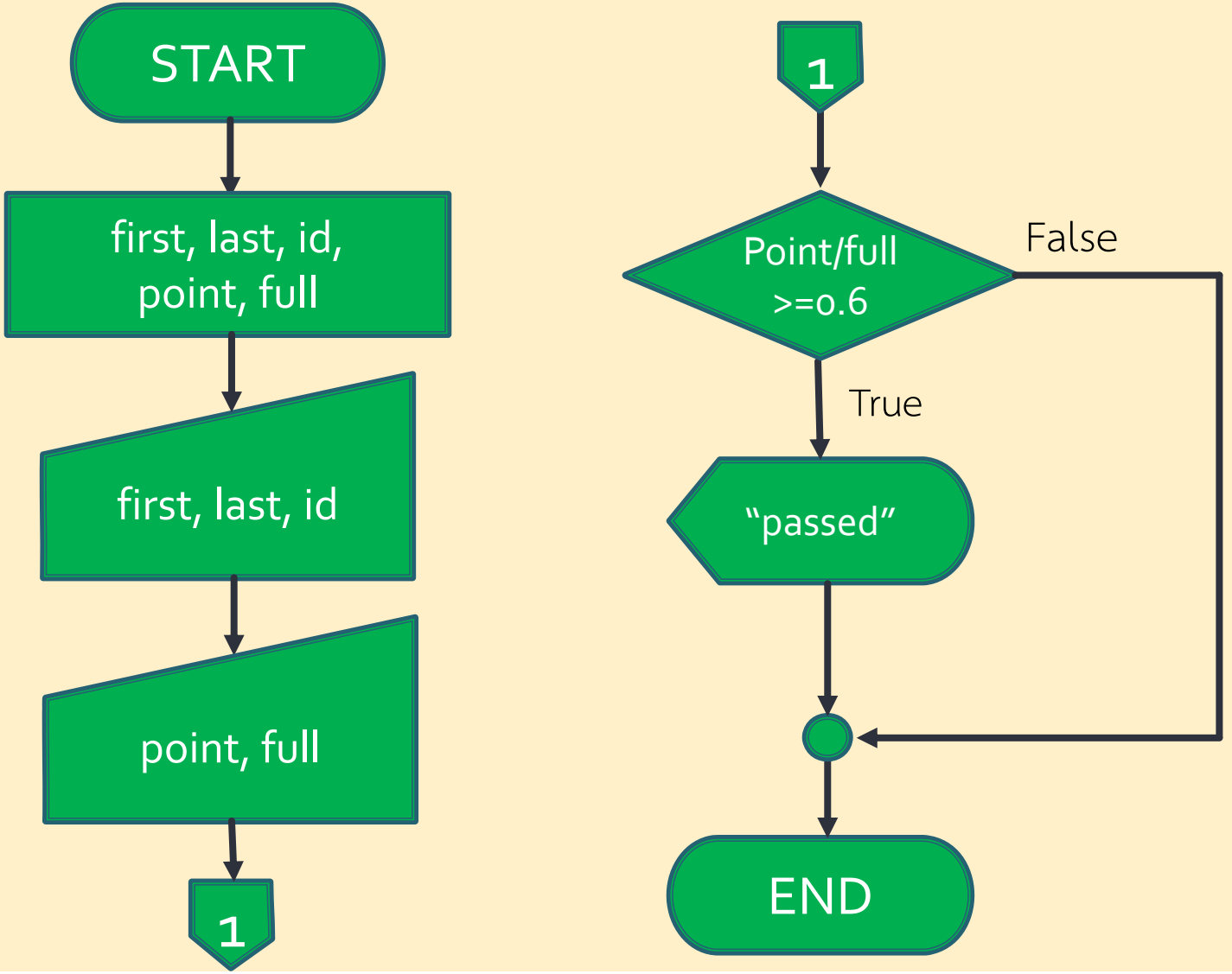
Last : char variable for get Surname 20 char

id : char variable for get ID 9 char

point : float variable for get Total Test Score

full : float variable for get Full Score

Example of if



Create a program to calculate the Area of a Circle

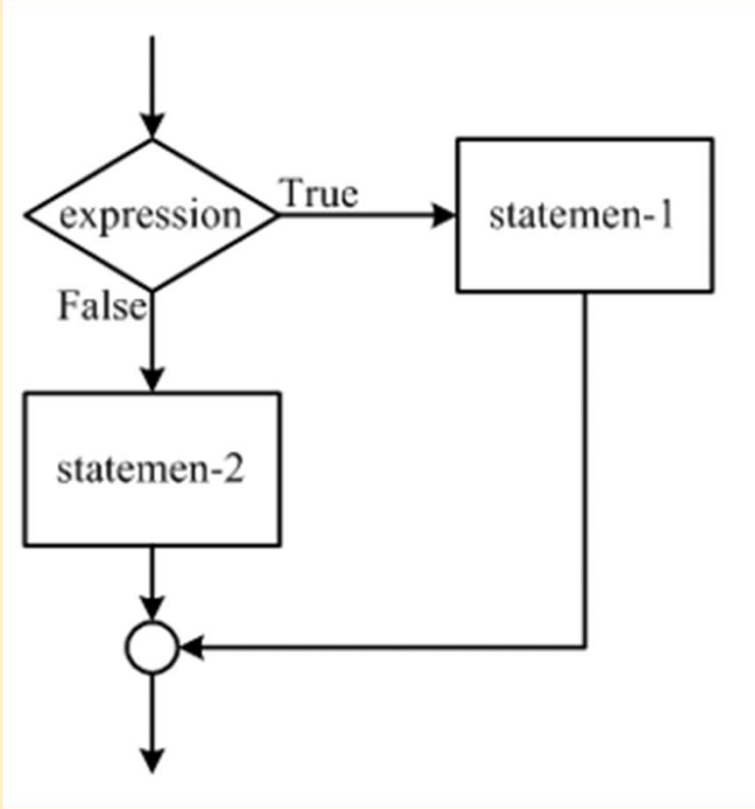
```
#include<stdio.h>
int main()
{
    char   first[20], last[20], id[9];
    float   point, full;
    printf (“Enter your Name : ”);
    scanf (“%s”, first);
    printf (“Enter your Surname : ”);
    scanf (“%s”, last);
    printf (“Enter your ID : ”);
    scanf (“%s”, id);
```

Create the program to calculate the Area of a Circle

```
    printf (“Enter your examination points : ”);
    scanf (“%f”, &point);
    printf (“Enter your total point : ”);
    scanf (“%f”, &full);
    if ((point/full) >= 0.6)
    {
        printf (“Name : %s %s\n”, first, last);
        printf (“ID : %s\n”,id);
        printf (“Examination points : %f / %f\n”, point, full);
        printf (“You passed, Congratulation\n”);
    }
    return 0;
}
```

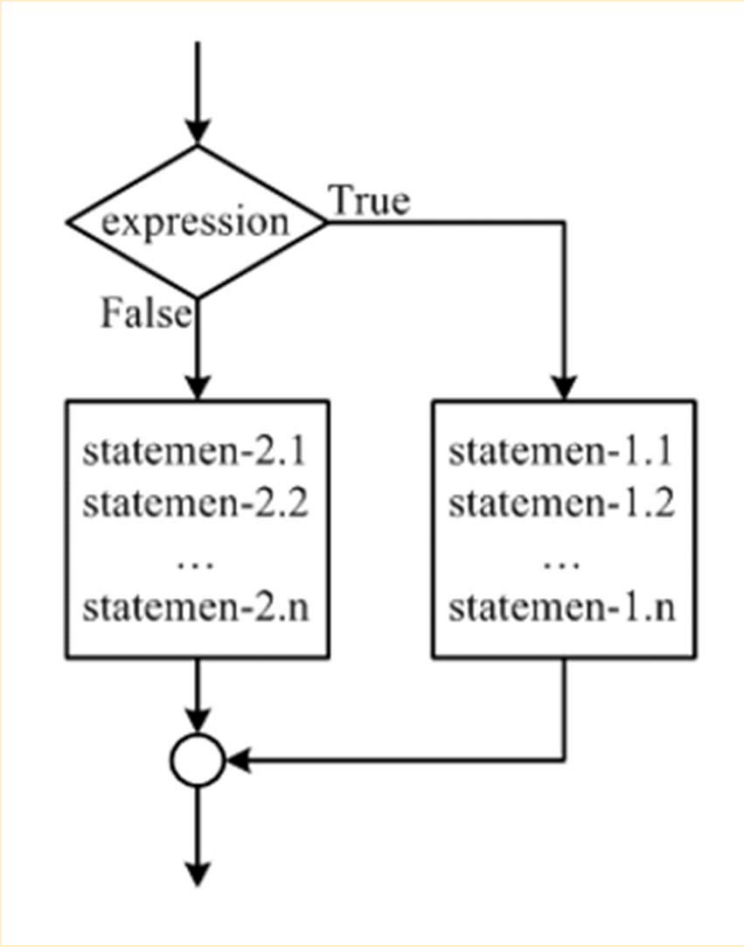
If-else

```
if (expression)
    statement-1;
else
    statement-2;
```



If-else

```
if (expression)
{
    statement-1.1;
    statement-1.2;
    ...
    statement-1.n;
}
else
{
    statement-1.1;
    statement-1.2;
    ...
    statement-1.n;
}
```



Example of if-else Condition

- Write a Flowchart and write a Program to divide 2 numbers with a condition of the program has to detect divider must not be “0”

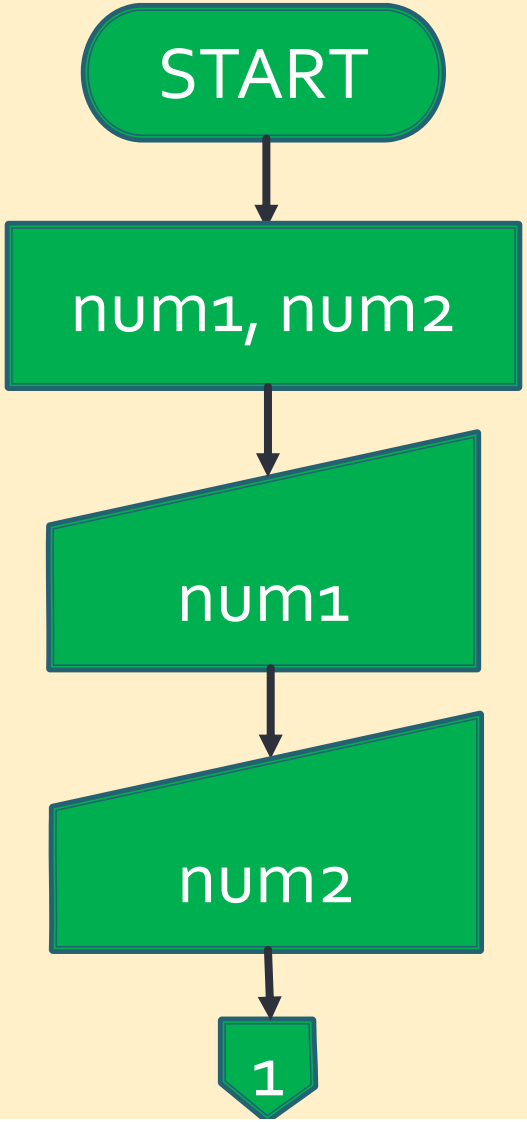
Output Analysis

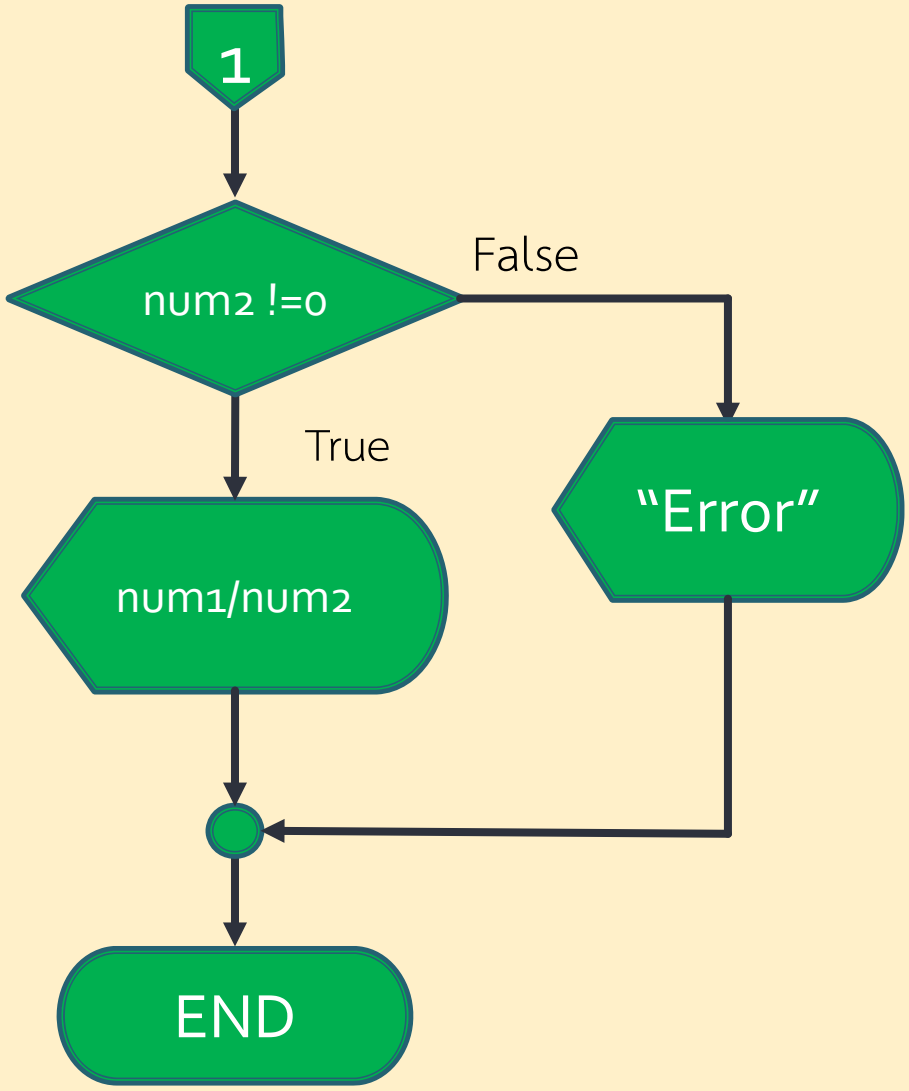
- Show quotient result of 2 numbers.
- Show the result can not divide because divider not equal 0

Input Analysis

- Dividend and Divider

Example of if-else Condition





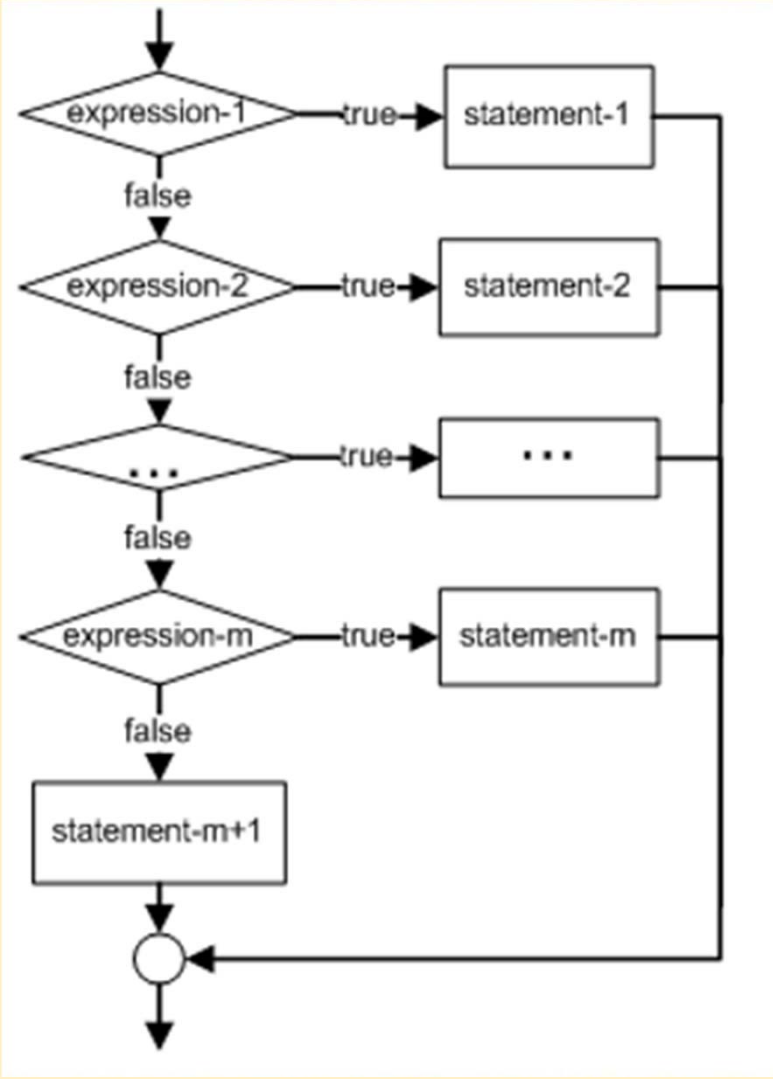
Example of if-else Condition

```
#include<stdio.h>
int main()
{
    float    num1, num2;
    printf (“Enter number1 : ”);
    scanf (“%f”, &num1);
    printf (“Enter number2 : ”);
    scanf (“%f”, &num2);
    if (num2 != 0)
        printf (“%.2f / %.2f = %.2f”, num1, num2, num1/num2);
    else
    printf (“Error divided by zero\n”);
    return 0;
}
```

Reference..www.ce.kmitl.ac.th King Mongkut’s Institute of Technology Ladkrabang

if-else-if (One condition)

```
if (expression-1)
    statement-1;
else if (expression-2)
    statement-2;
    ...
    ...
else if (expression-m)
statement-m;
else
    statement-m+1;
```



if-else-if (One condition)

```
if (expression-1)
{
    statement-1.1;
    ...
    statement-1.n;
}
else if (expression-2)
    statement-2.1;
    ...
    statement-2.n;
}
...
```

```
...
else if (expression-m)
{
    statement-m.1;
    ...
    statement-m.n;
}
else
    statement-m+1.1;
    ...
    statement-m+1.n;
}
```

Example of if-else-if

- Write a Flowchart and Program to get Name, Surname, ID and Programming score then calculate grade by this criteria and show the result Name, Surname, ID, Score and Grade.

Points 90-100	Grade A	Points 80-89.99	Grade B
Points 70-79.99	Grade C	Points 60-69.99	Grade D
Points 0-59.99	Grade F		

Example of if-else-if

Output Analysis

Show Name, Surname, ID, Score and Grade.

Input Analysis

Name / Surname / ID / Score

Process Analysis

- Program get Name, Surname, ID, Score and Grade.
- Show Name, Surname, ID and Score

Example of if-else-if

Process Analysis (continued)

- Calculate the score
  - If more than or equal 90, show Grade A
  - If more than or equal 80, show Grade B
  - If more than or equal 70, show Grade C
  - If more than or equal 60, show Grade D
  - If the score is not same as all condition, show Grade F

Example of if-else-if

Variable Definition

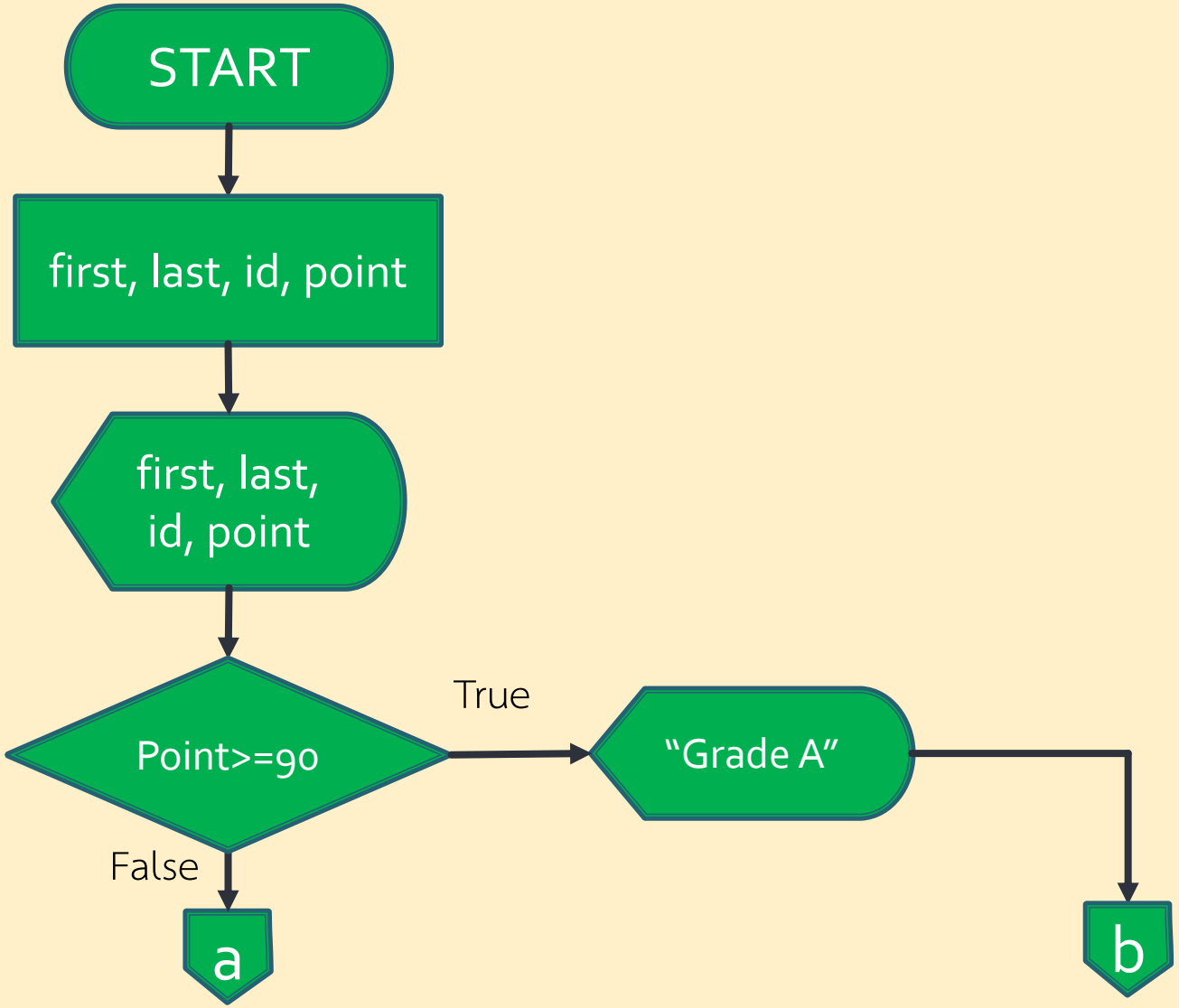
first : char variable for get Name 20 char

last : char variable for get Surname 20 char

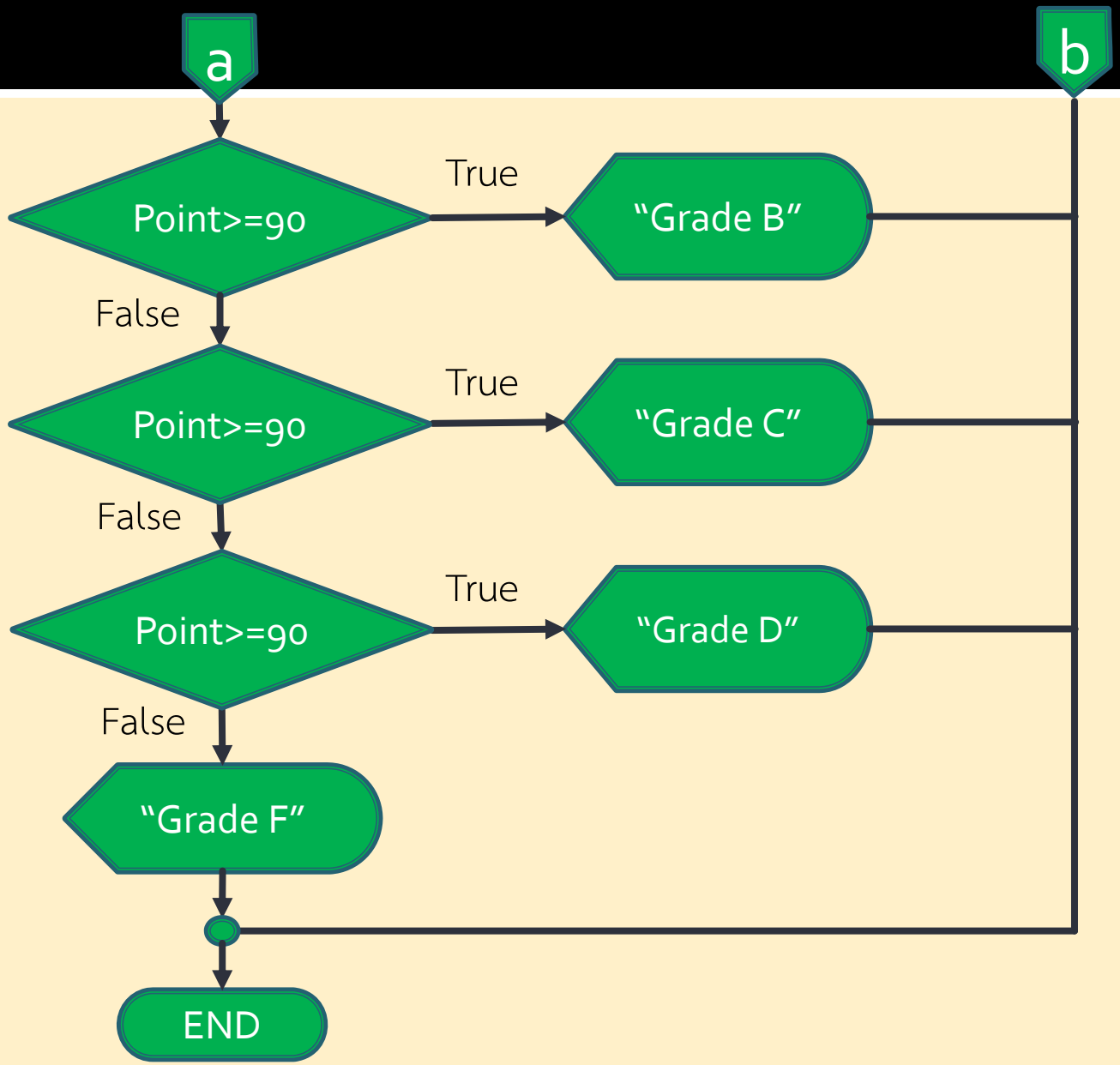
id : char variable for get ID 9 char

point : float variable for get Total Test Score

Example of if-else-if



Example of if-else-if

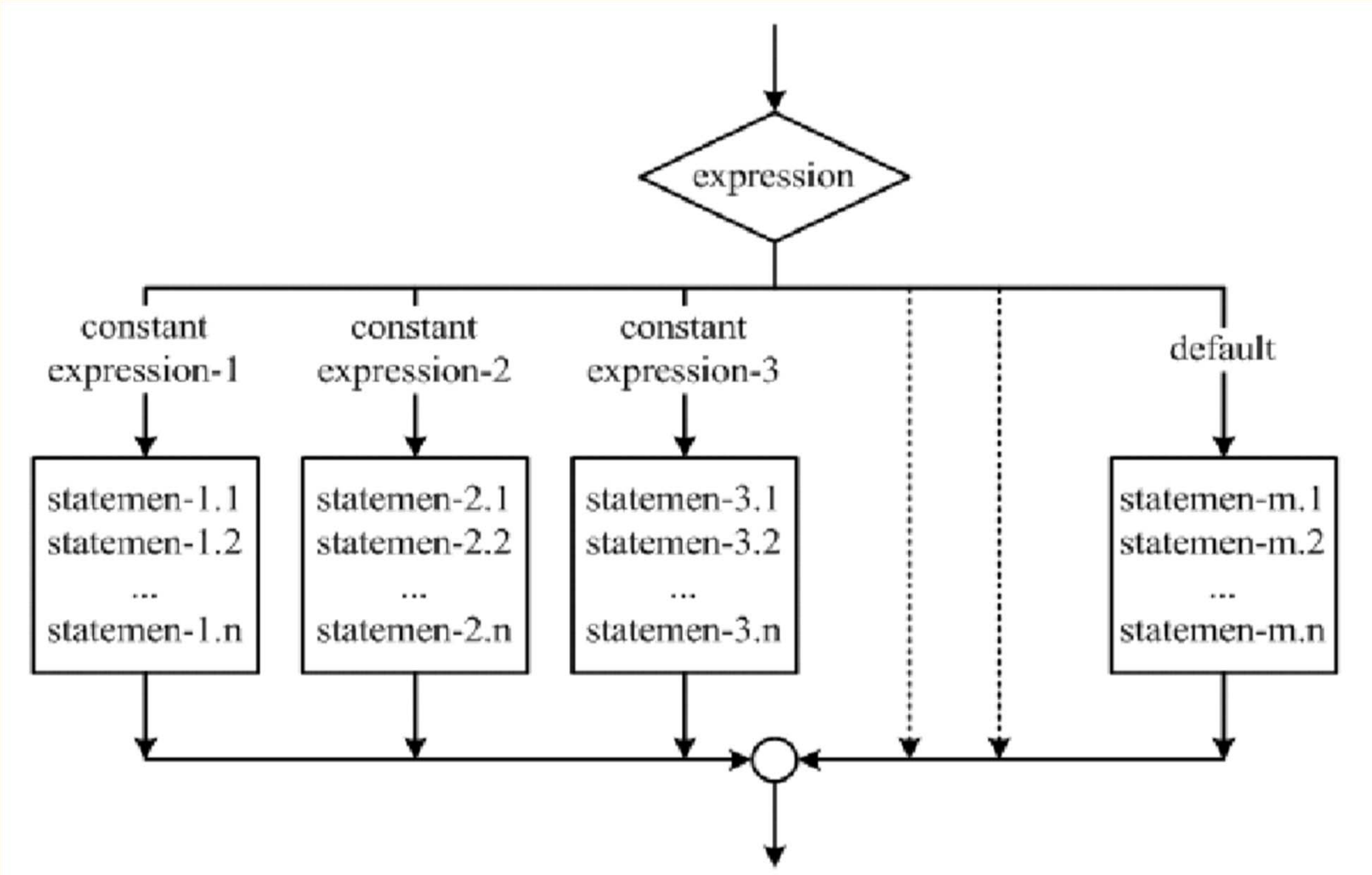


switch

```
switch (expression-1)
{
case constant-expr-1:
    statement-1.1;
    ...
    statement-1.n;
    break;
case constant-expr-2:
    statement-2.1;
    ...
    statement-2.n;
    break;
...
```

```
...
case constant-expr-m:
    statement-m.1;
    ...
    statement-m.n;
    break;
default:
    statement-d.1;
    ...
    statement-d.n;
}
```

switch Flowchart



Example of switch statement

```
#include<stdio.h>
int main()
{
    int   d;
    printf (“Enter a number from 1 to 9: ”);
    scanf (“%d”, &d);
    switch (d)
    {
        case 1: puts (“A stitch in time saves nine. “);
                break;
        case 2:
        case 6:
        case 9: puts (“Handsome is as handsome does.”);
                break;
        default: puts (“Very clever. Try again.”);
    }
    return 0;
}
```

Example of switch statement

```
#include<stdio.h>
int main()
{
    int   d;
    printf (“Enter a number from 1 to 9: ”);
    scanf (“%d”, &d);
    switch (d)
    {
        case 1:   puts (“A stitch in time saves nine. “);
                  break;
        case 2:   break;
        case 6:   break;
        case 9:   puts (“Handsome is as handsome does.”);
                  break;
        default:  puts (“Very clever. Try again.”);
    }
    return 0;
}
```

Example of switch statement

- Write a Flowchart and Program to get GPA of the last semester then show student status by using the below criteria.
    - $GPA_{(old)} < 1.00$ show status Retired end program
    - $GPA_{(old)} < 2.00$ show status Probation
    - $GPA_{(old)} < 1.00$ show status Normal

After show status then get GPS and GPA of current semester and show status.

Example of switch statement

- Use this criteria
  - $GPA_{(new)} < 1.00$ show status Retired
  - $GPA_{(new)} >= 2.00$ show status Normal
  - $GPA_{(old)} < 2.00$
    - $GPS_{(New)} >= 2.00$ show status Probation
    - $GPS_{(New)} < 2.00$ show status Retired

switch

```
Enter GPA (past) : 0.74
 Your Status : Retired
Sorry, Try again.
```

```
Enter GPA (past) : 1.50
   Your Status : Probation
Enter GPS (present) : 3.00
Enter GPA (present) : 2.25
   Your Status : Normal
```

```
Enter GPA (past) : 2.50
   Your Status : Normal
Enter GPS (present) : 1.00
Enter GPA (present) : 1.75
   Your Status : Probation
```

```
Enter GPA (past) : 1.50
   Your Status : Probation
Enter GPS (present) : 2.00
Enter GPA (present) : 1.75
   Your Status : Probation
```

```
Enter GPA (past) : 1.50
   Your Status : Probation
Enter GPS (present) : 1.00
Enter GPA (present) : 1.25
   Your Status : Retired
Sorry, Try again.
```

Exercise

1. Write a Flowchart and a Program calculator that display results as below.

```
Enter Num1 : 3
Enter Num1 : 6
Calculator Menu :
  1. +
  2. –
  3. *
  4. /
  5. %
Choose menu : 1
Ans : Num1 + Num2 = 9
```

Exercise

2. Write a Program to separate compounds which have qualification as below

Type 1 consist of Carbon, 5 atoms, gas

Type 2 consist of Carbon, 6 atoms, liquid

Type 3 consist of Nitrogen, 6 atoms, gas

Type 4 consist of Nitrogen, 4 atoms, solid

Type 5 is compound type 1 and consist of Hydrogen.

Exercise

3. Write a Program by using switch command to calculate x, y and z. Define x=1,y=0 and z=0

```
switch (x%2)
{
        case 0 : x=2; y=3;
        case 1 : x=4; break;
        default : y=3; x=z;
}
```