CSE 105 – Structure Programming

Topic:

- if, if-else statement,
- Arithmetic Operation

The `if` Selection Statement

- Selection structure:
  - Used to choose among alternative courses of action
  - Pseudocode:

```
If your grade is greater than or equal to 60
    Print "Passed"
```

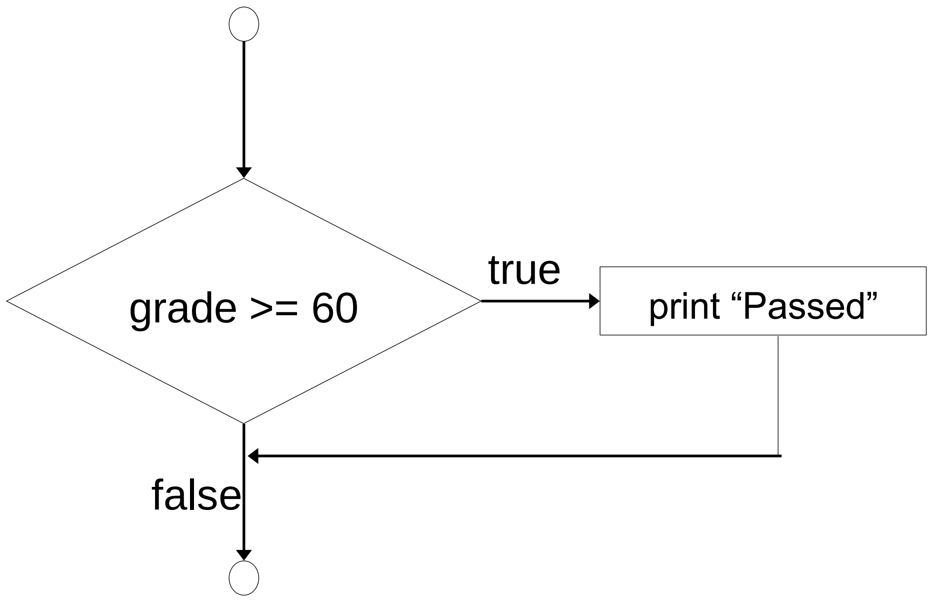
- Pseudocode statement in C:

```c
if ( grade >= 60 )
   printf( "Passed\n" );
```

  - C code corresponds closely to the Pseudocode/Flowchart

The `if` Selection Flowchart

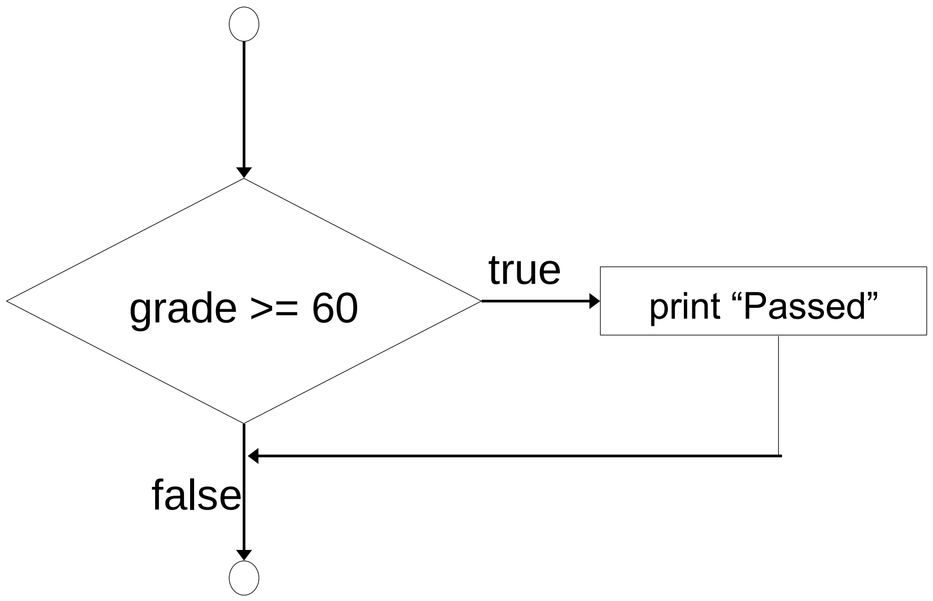
- `if` statement is a single-entry/single-exit structure



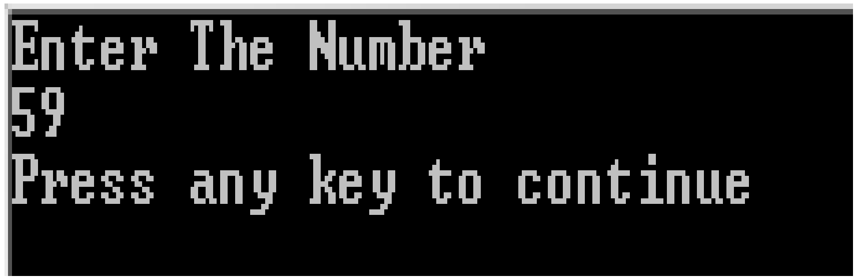
A decision can be made on any expression.
zero - `false`
nonzero - `true`
Example:
`3 - 4` is `true`

The `if` Selection Flowchart

- `if` statement is a single-entry/single-exit structure



```c
#include<stdio.h>
#include<math.h>

int main()
{
int grade_number;
printf("Enter The Number\n");

scanf("%d",&grade_number);

if(grade_number>=60)
printf("\nPassed\n");

return 0;
}
```



```
Enter The Number
59
Press any key to continue
```

The `if…else` Selection Statement

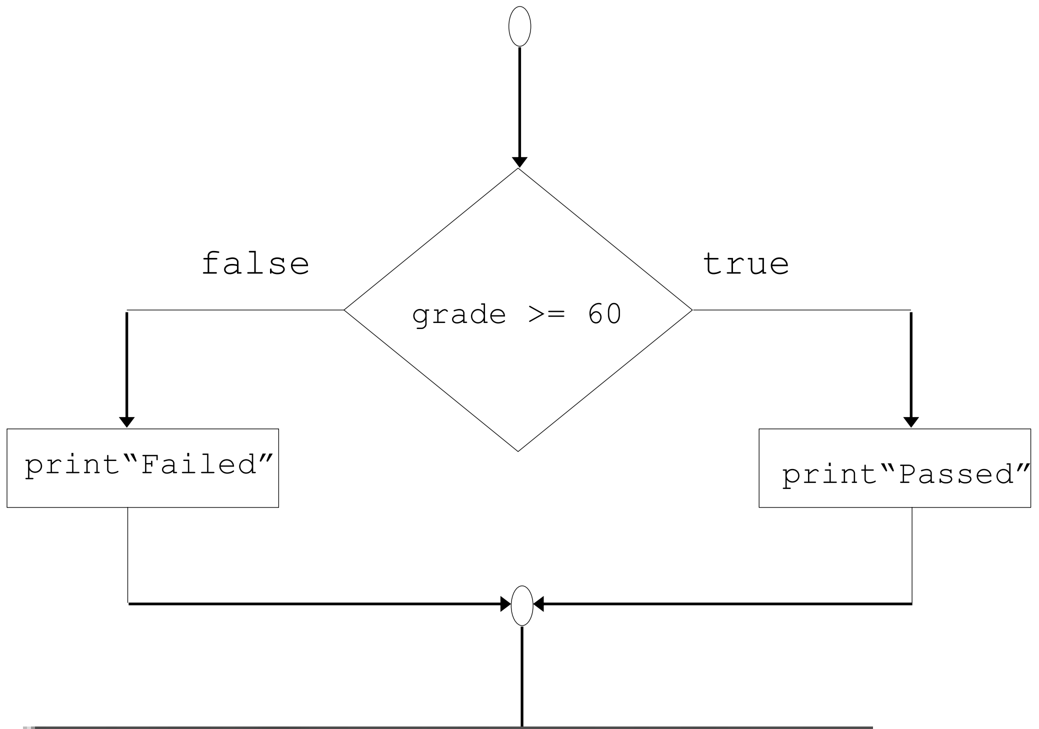
- `if`
  - Only performs an action if the condition is `true`
- `if…else`
  - Specifies an action to be performed both when the condition is `true` and when it is `false`
- Psuedocode:

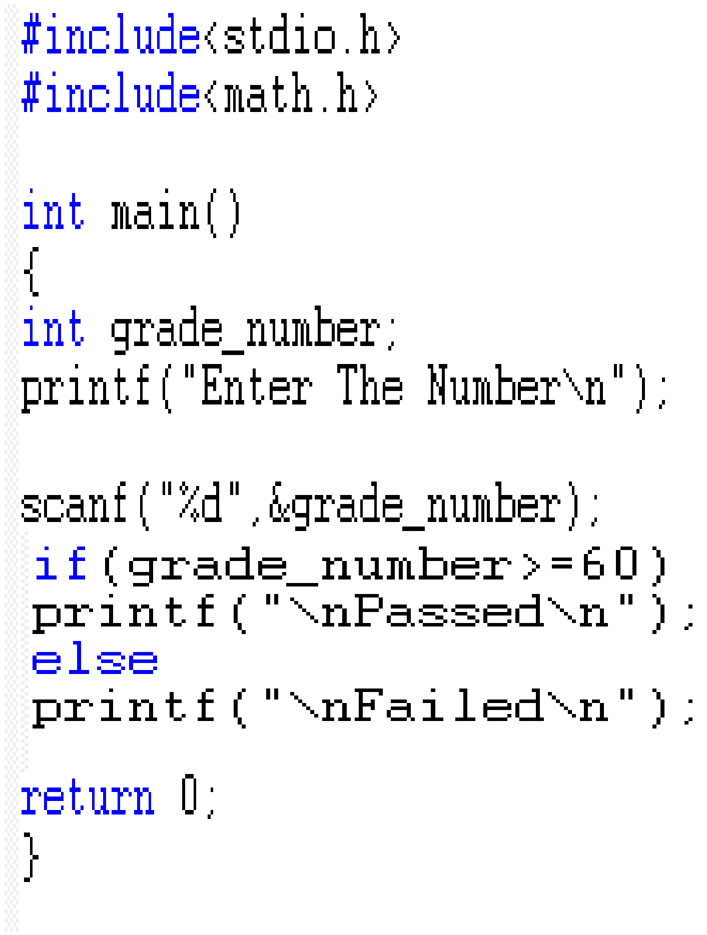
```
If student's grade is greater than or equal to 60
   Print "Passed"
else
   Print "Failed"
```

  - Note spacing/indentation conventions

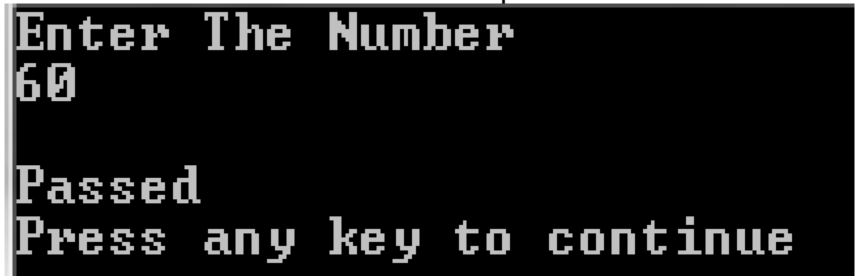
The if…else Selection Statement

- Flowchart of the if…else selection statement





```
#include<stdio.h>
#include<math.h>

int main()
{
int grade_number;
printf("Enter The Number\n");

scanf("%d",&grade_number);
 if(grade_number>=60)
 printf("\nPassed\n");
 else
 printf("\nFailed\n");

return 0;
}
```



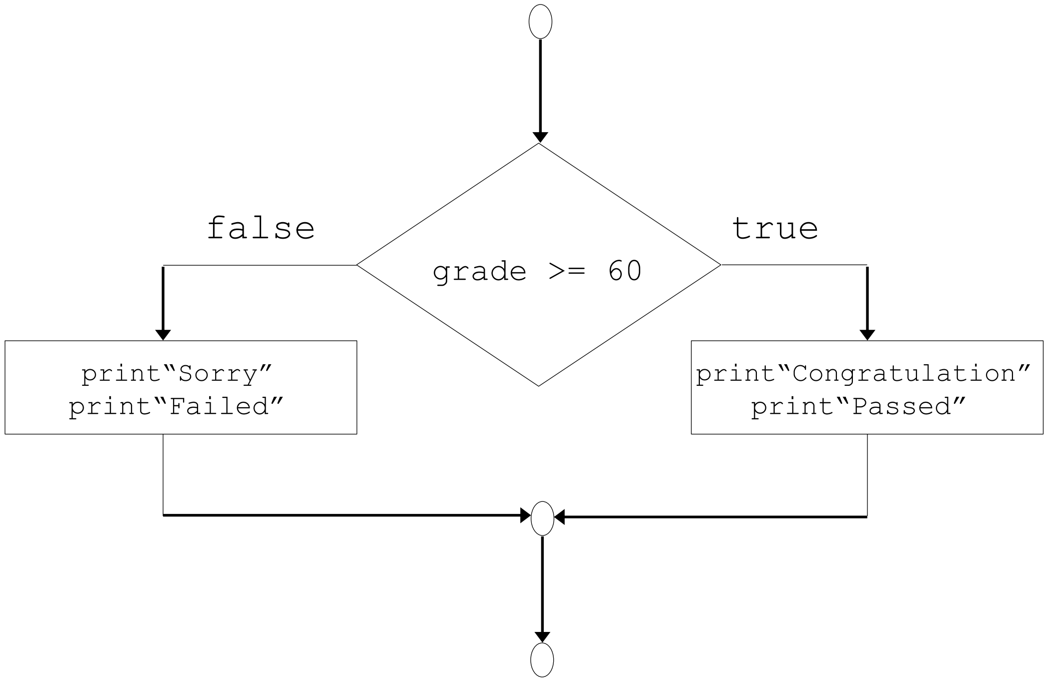
```
Enter The Number
60

Passed
Press any key to continue
```

Compound Statements

- In the `if` statement template, notice that *statement* is singular, not plural:

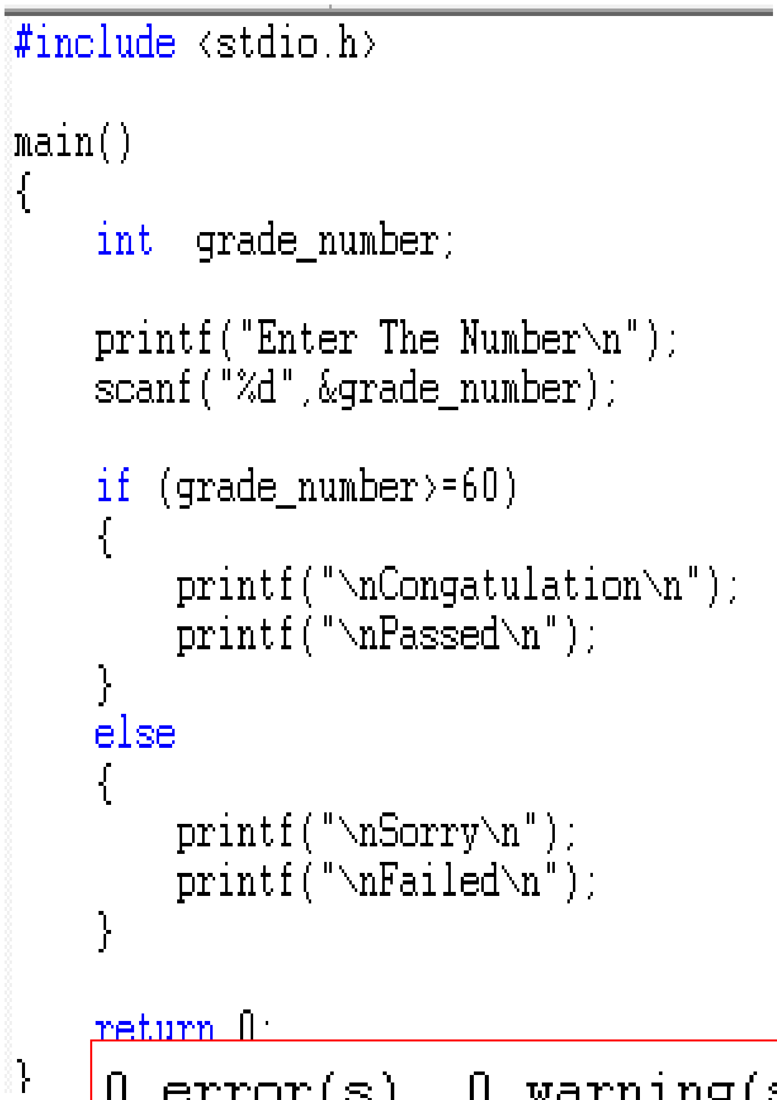
  `if (` *expression* `)`
  statement

- To make an `if` statement control two or more statements, use a ***compound statement***.

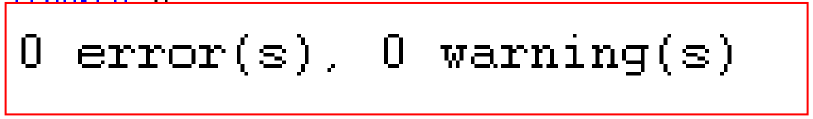


A compound statement has the form
{
Statement 1;
Statement 2;
Statement 3;
}
Putting braces around a group of statements forces the compiler to treat it as a single statement.

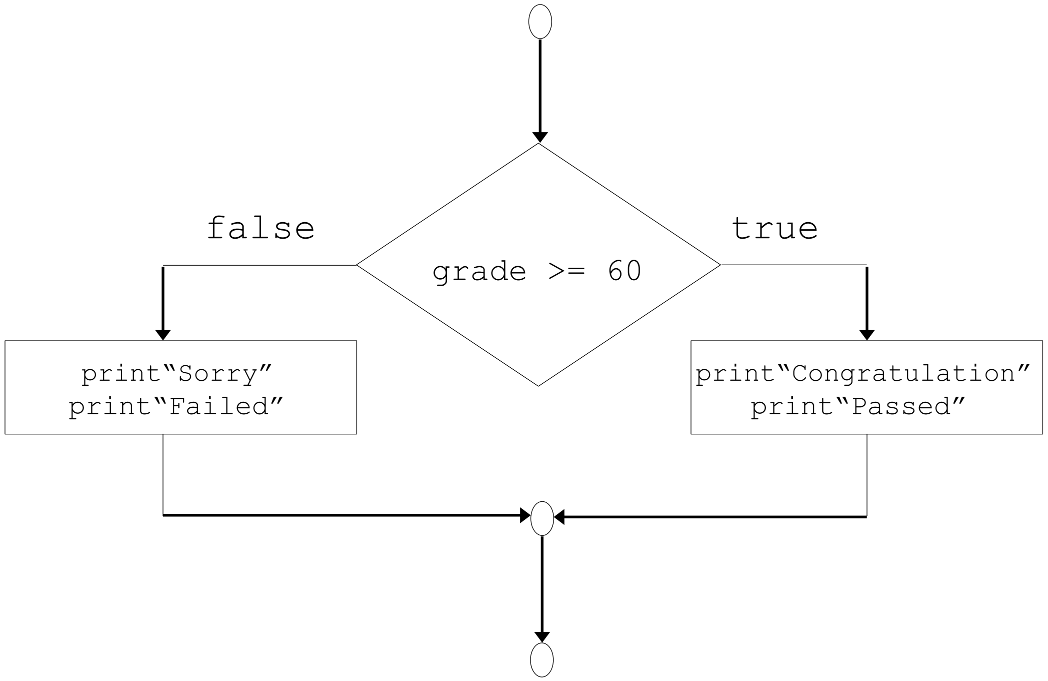
Compound Statements

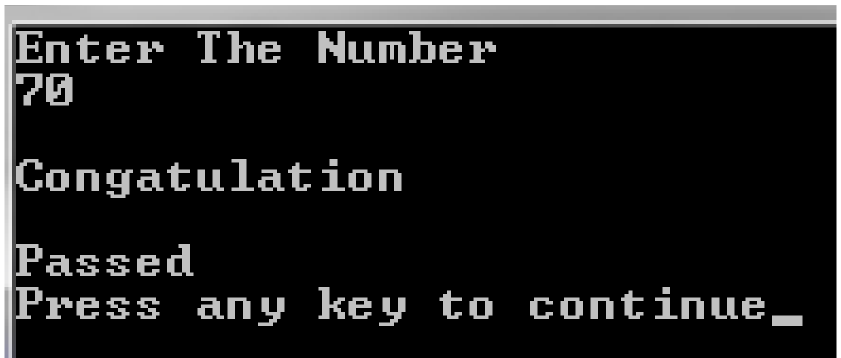


```
#include <stdio.h>

main()
{
    int  grade_number;

    printf("Enter The Number\n");
    scanf("%d",&grade_number);

    if (grade_number>=60)
    {
        printf("\nCongatulation\n");
        printf("\nPassed\n");
    }
    else
    {
        printf("\nSorry\n");
        printf("\nFailed\n");
    }

    return 0;
}
```



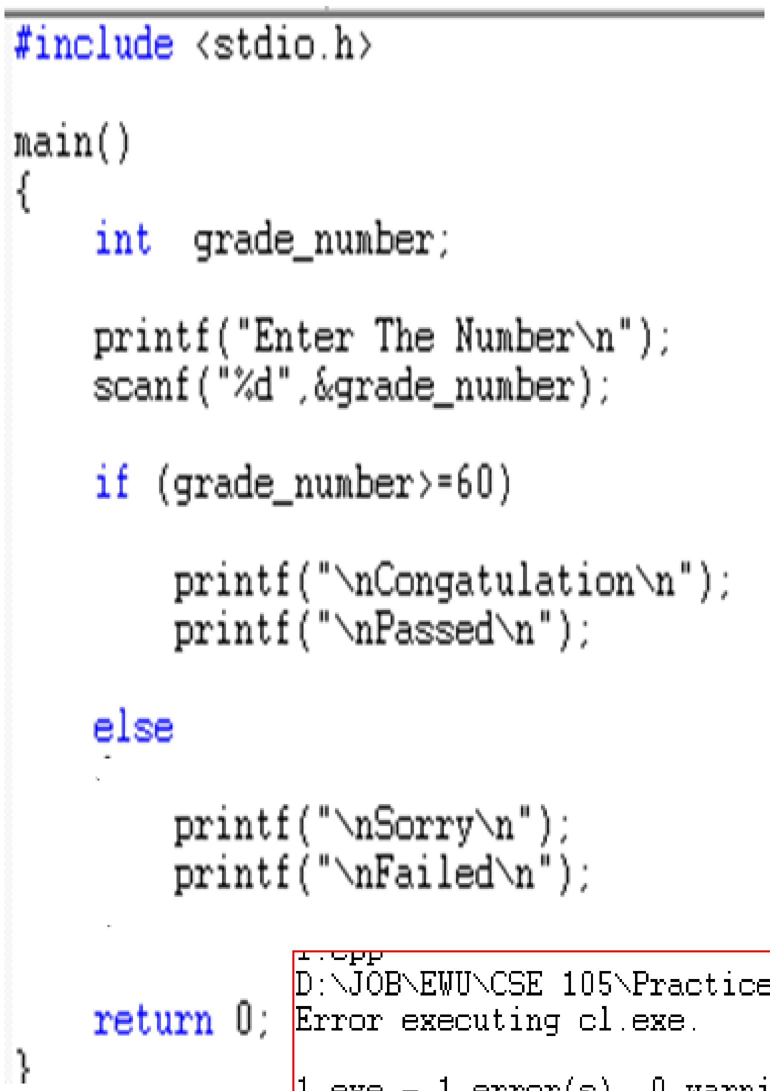
```
0 error(s), 0 warning(s)
```



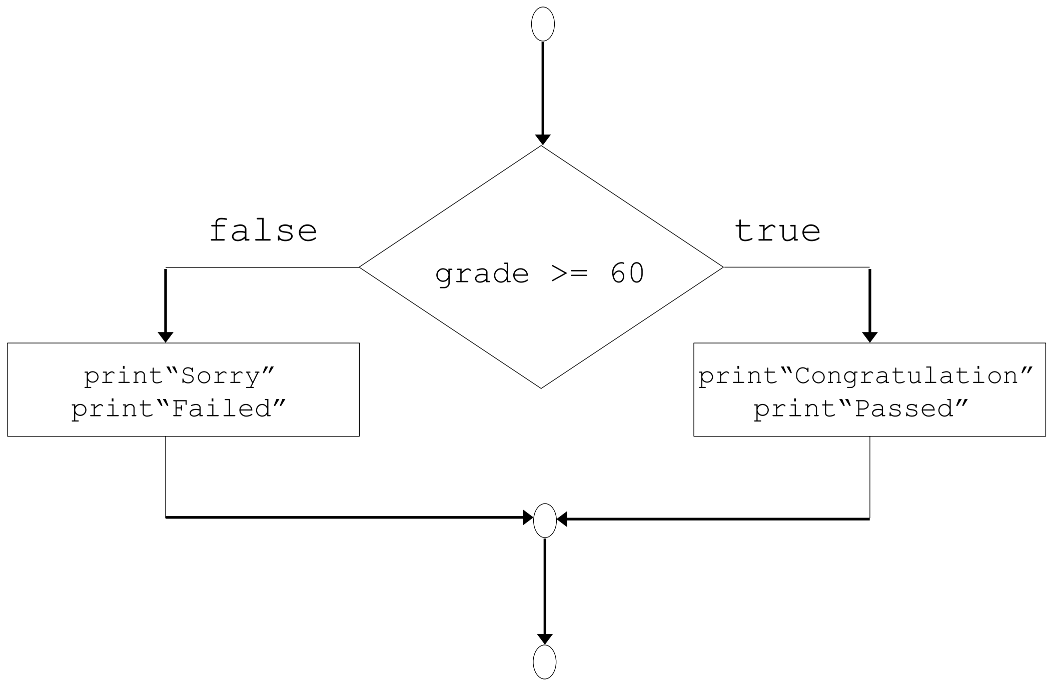


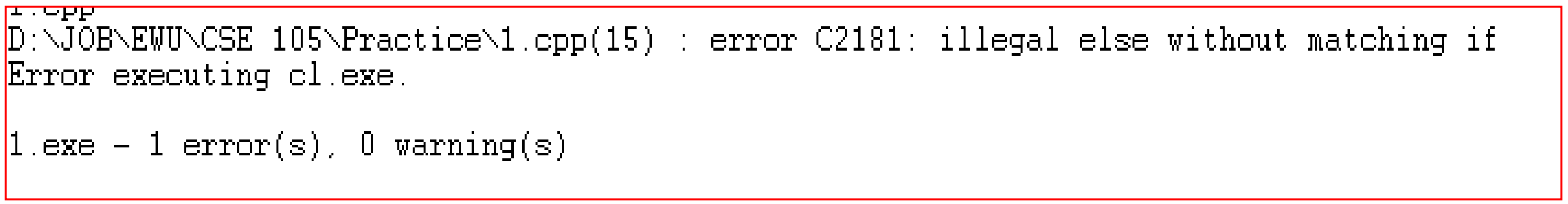
```
Enter The Number
70

Congatulation

Passed
Press any key to continue_
```

Compound Statements



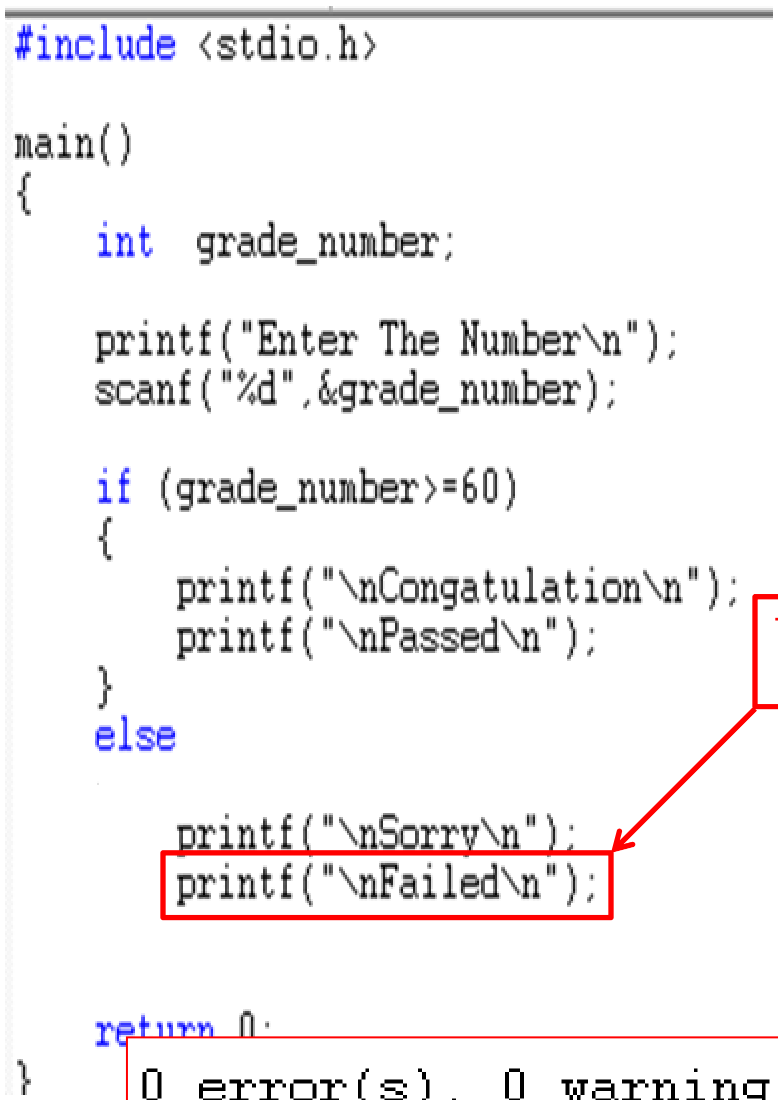
```c
#include <stdio.h>

main()
{
    int  grade_number;

    printf("Enter The Number\n");
    scanf("%d",&grade_number);

    if (grade_number>=60)

        printf("\nCongatulation\n");
        printf("\nPassed\n");

    else

        printf("\nSorry\n");
        printf("\nFailed\n");


    return 0;
}
```



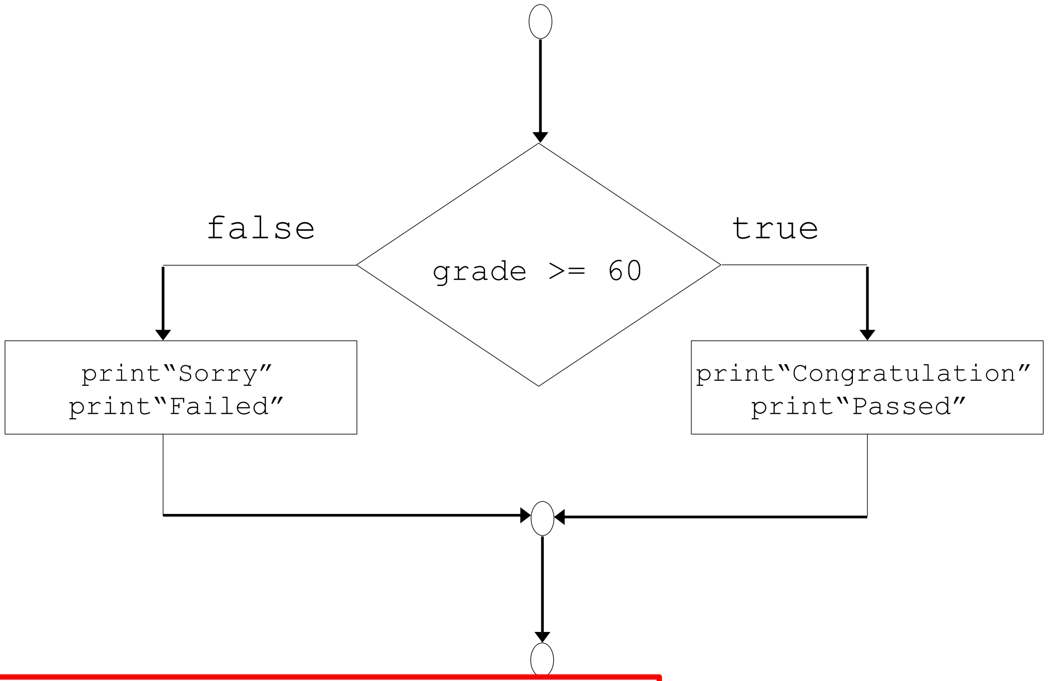


```
1.cpp
D:\JOB\EWU\CSE 105\Practice\1.cpp(15) : error C2181: illegal else without matching if
Error executing cl.exe.

1.exe - 1 error(s), 0 warning(s)
```

Compound Statements

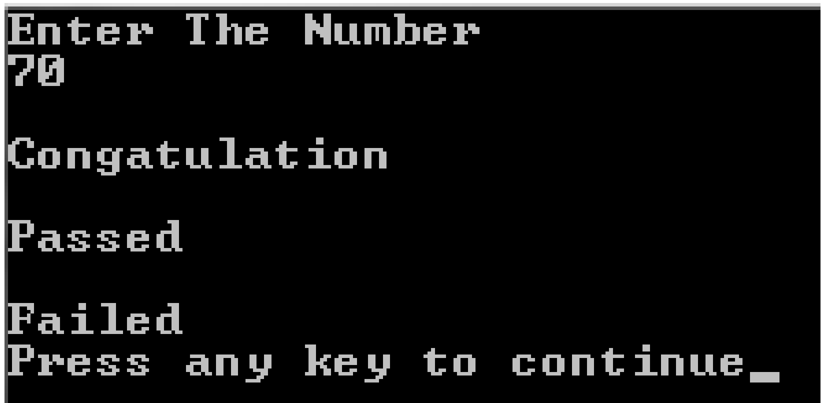


```
#include <stdio.h>

main()
{
    int  grade_number;

    printf("Enter The Number\n");
    scanf("%d",&grade_number);

    if (grade_number>=60)
    {
        printf("\nCongatulation\n");
        printf("\nPassed\n");
    }
    else

        printf("\nSorry\n");
        printf("\nFailed\n");


    return 0;
}
```



That is Whatever the Value of GRADE
It Always Execute the Failed Statements

```
0 error(s), 0 warning(s)
```



```
Enter The Number
70

Congatulation

Passed

Failed
Press any key to continue_
```

Compound Statements

- Example:

```
{ line_num = 0; page_num++; }
```

- A compound statement is usually put on multiple lines, with one statement per line:

```
{
  line_num = 0;
  page_num++;
}
```

- Each inner statement still ends with a semicolon, but the compound statement itself does not.

Compound Statements

- Example of a compound statement used inside an `if` statement:

```
if (line_num == 15) {
  line_num = 0;
  page_num++;
}
```

- Compound statements are also common in loops and other places where the syntax of C requires a single statement.

Relational Operators

- C's ***relational operators:***

<	less than
>	greater than
<=	less than or equal to
>=	greater than or equal to

- These operators produce 0 (false) or 1 (true) when used in expressions.
- The relational operators can be used to compare integers and floating-point numbers, with operands of mixed types allowed.

Equality Operators

- C provides two ***equality operators:***

==	equal to
!=	not equal to

- The equality operators produce either 0 (false) or 1 (true) as their result.

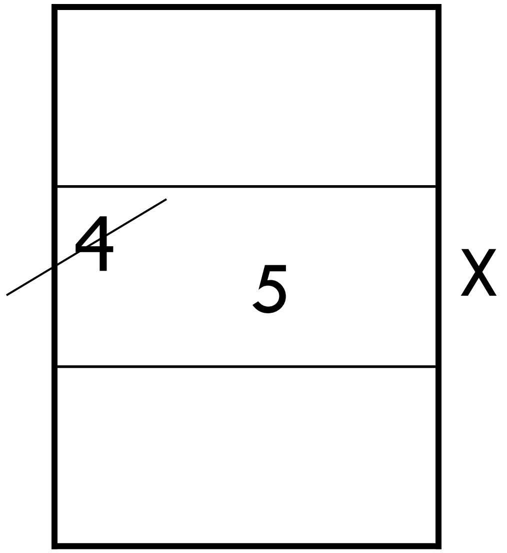
Arithmetic Operators

Addition	+	sum = num1 + num2;
Subtraction	-	age = 2007 – my_birth_year;
Multiplication	*	area = side1 * side2;
Division	/	avg = total / number;
Modulus	%	lastdigit = num % 10;

  - Modulus returns remainder of division between two *integers*
  - Example 5%2 returns a value of 1
- Binary vs. Unary operators
  - All the above operators are binary (why)
  - - is an unary operator, e.g., a = -3 * -4

Arithmetic Operators (cont'd)

- Note that 'id = exp' means assign the result of exp to id, so
- X=X+1 means
  - first perform X+1 and
  - Assign the result to X
- Suppose X is 4, and
- We execute X=X+1



Integer division vs Real division

- Division between two integers results in an integer.
- The result is truncated, not rounded
- Example:

  int A=5/3; → A will have the value of 1

  int B=3/6; → B will have the value of 0
- To have floating point values:

  double A=5.0/3;   → A will have the value of 1.666

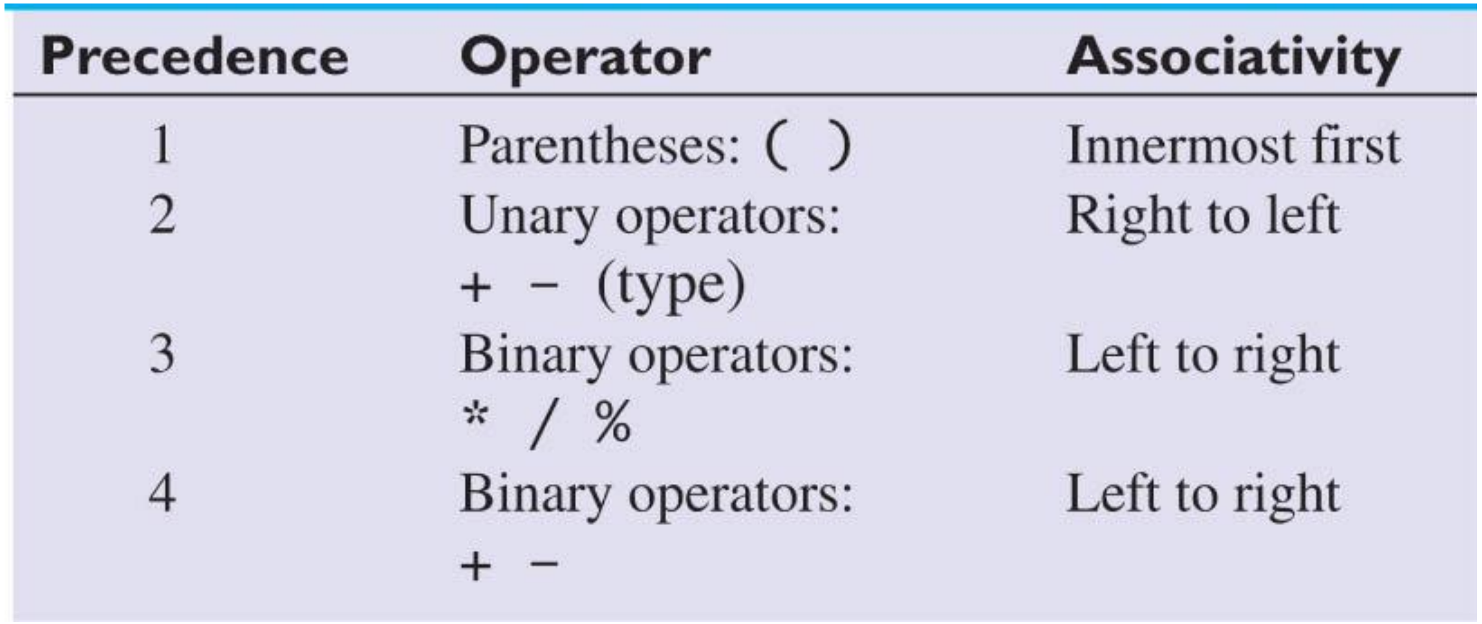
  double B=3.0/6.0; → B will have the value of 0.5

Precedence of Arithmetic Operators

Mixed operations:

int a=4+6/3*2; → a=?　　　a= 4+2*2 = 4+4 = 8

int b=(4+6)/3*2; → b=?　　　b= 10/3*2 = 3*2= 6



Precedence	Operator	Associativity
1	Parentheses: ( )	Innermost first
2	Unary operators: + − (type)	Right to left
3	Binary operators: * / %	Left to right
4	Binary operators: + −	Left to right
5	assign =	Right to left

Exercise

- Compute the following
  - 2*(3+2)
  - 2*3+2
  - 6-3*2

Exercise

- Write a C statement to compute the following

$$f = \frac{x^3 - 2x^2 + x - 6.3}{x^2 + 0.05x + 3.14}$$

```
f = (x*x*x-2*x*x+x-6.3)/(x*x+0.05*x+3.14);
```

- Write a C statement to compute the following

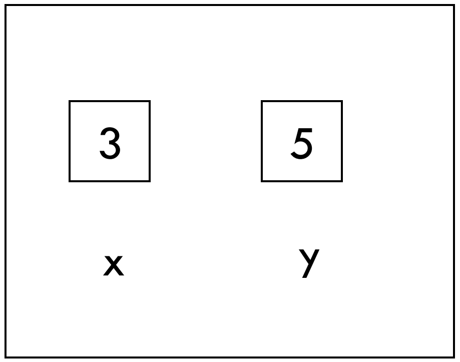
$$Tension = \frac{2m_1m_2}{m_1 + m_2} \times g$$

```
Tension = 2*m1*m2 / m1 + m2 * g;
```
wrong

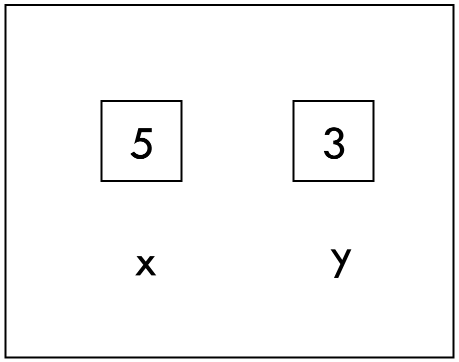
```
Tension = 2*m1*m2 / (m1 + m2) * g
```

Exercise: swap

- Write a set of statements that swaps the contents of variables x and y



Before

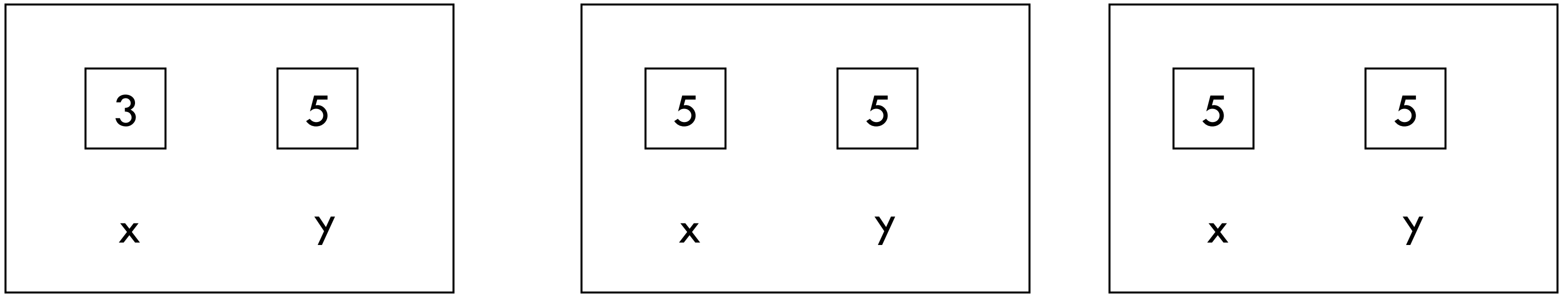


After

Exercise: swap

First Attempt

```
x=y;
y=x;
```



Before

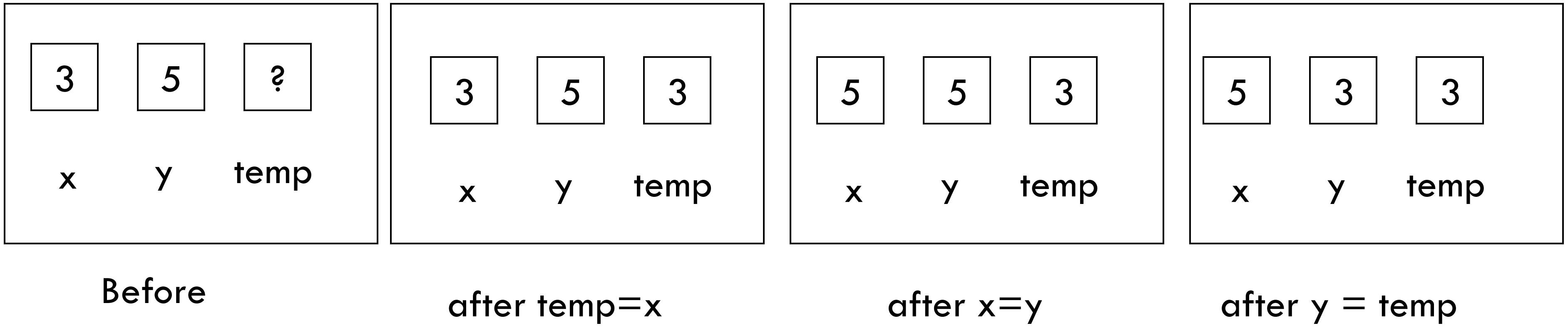
After x=y

After y=x

Exercise: swap

Solution

```
temp= x;
x=y;
y=temp;
```



Can you do it without using temp?
i.e., without using any extra variable ?

Exercise: reverse a number

- Suppose you are given a number in the range [100 to 999]
- Write a program to reverse it
- For example,

  num is 258

  reverse is 852

We Can do it using % operators, try 5 mins.

Ans the Q

1. What is the result of **num/10** and **num %10**?
2. How many digits ?
3. What will be the next steps ?

Exercise: Arithmetic operations

- Show the memory snapshot after the following operations by hand

```
int a, b, c=7;
double x, y;
a = c * 2.5;
b = a % c * 2 - 1;
x = (5 + c) * 2.5;
y = x - (-3 * a) / 2;
```

Write a C program and print out the values of a, b, c, x, y and compare them with the ones that you determined by hand.

?	a
?	b
5	c
?	x
?	y

Fill the table, try 5 mins.

a = 17 b = 5 c= 5 x = 30.0000 y = 55.0000

Exercise: Arithmetic operations

- Show how C will perform the following statements and what will be the final output?

```
int a =  6, b = -3, c =  2;
c = a - b * (a + c * 2) + a / 2 * b;
printf("Value of c = %d \n", c);
```

c = 6 - -3 * (6 + **2 * 2**) + 6 / 2 * -3;

c = 6 - -3 * (6 + 4) + 3 * -3

c = 6 - -3 *10 + -9

c = 6 - -30 + -9

c = 36 + -9

c = 27

Math Functions

`#include <math.h>`

`fabs(x)`	Absolute value of `x`.
`sqrt(x)`	Square root of `x`, where `x`>=0.
`pow(x,y)`	Exponentiation, x^y. Errors occur if `x`=0 and `y`<=0, or if `x`<0 and `y` is not an integer.
`ceil(x)`	Rounds `x` to the nearest integer toward ∞ (infinity). Example, `ceil(2.01)` is equal to 3.
`floor(x)`	Rounds `x` to the nearest integer toward -∞ (negative infinity). Example, `floor(2.01)` is equal to 2.
`exp(x)`	Computes the value of e^x.
`log(x)`	Returns ln x, the natural logarithm of `x` to the base *e*. Errors occur if `x`<=0.
`log10(x)`	Returns log10x, logarithm of x to the base 10. Errors occur if `x`<=0.

Trigonometric Functions

sin(x)	Computes the sine of x, where x is in radians.
cos(x)	Computes the cosine of x, where x is in radians
tan(x)	Computes the tangent of x, where x is in radians.
asin(x)	Computes the arcsine or inverse sine of x, where x must be in the range [-1, 1]. Returns an angle in radians in the range [-π/2,π/2].
acos(x)	Computes the arccosine or inverse cosine of x, where x must be in the range [-1, 1]. Returns an angle in radians in the range [0, π].
atan(x)	Computes the arctangent or inverse tangent of x. The Returns an angle in radians in the range [-π/2,π/2].
atan2(y,x)	Computes the arctangent or inverse tangent of the value y/x. Returns an angle in radians in the range [-π, π].

Exercise

- Write an expression to compute velocity using the following equation
- Assume that the variables are declared

$$velocity = \sqrt{vo^2 + 2a(x - xo)}$$

```
velocity = sqrt(vo*vo+2*a*(x-xo));
```

Exercise

- Write an expression to compute velocity using the following equation
- Assume that the variables are declared

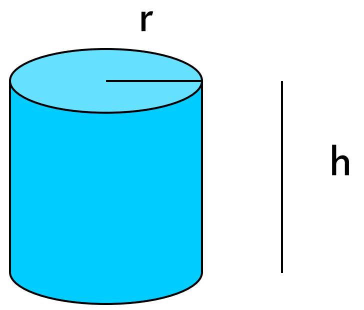
$$center = \frac{38.19(r^3 - s^3)\sin a}{(r^2 - s^2)a}$$

```
center = (38.19*(pow(r,3)-pow(s,3))*sin(a))/
                        ((pow(r,2)-pow(s,2))*a);
```

Exercise: Compute Volume

- Write a program to compute the **volume** of a cylinder of radius r and height h

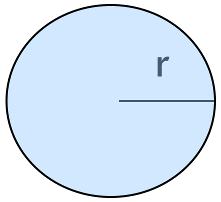
$$V = \pi r^2 h$$



Exercise

- Write a program to find the **radius** of a circle given its area. Read area from user. Compute radius and display it.

$$A = \pi r^2$$



Questions or Suggestions

THANK YOU!

Inquiry
dishacse@yahoo.com