CSE 105 – Structure Programming

Topic:

- Reading Input
- identifier,
- if statement,
- Arithmetic Operation

Reading Input

- `scanf` is the C library’s counterpart to `printf`.
- `scanf` requires a ***format string*** to specify the appearance of the input data.
- Example of using `scanf` to read an `int` value:

  ```
  scanf("%d", &i);
  /* reads an integer; stores into i */
  ```
- The `&` symbol is usually (but not always) required when using `scanf`.

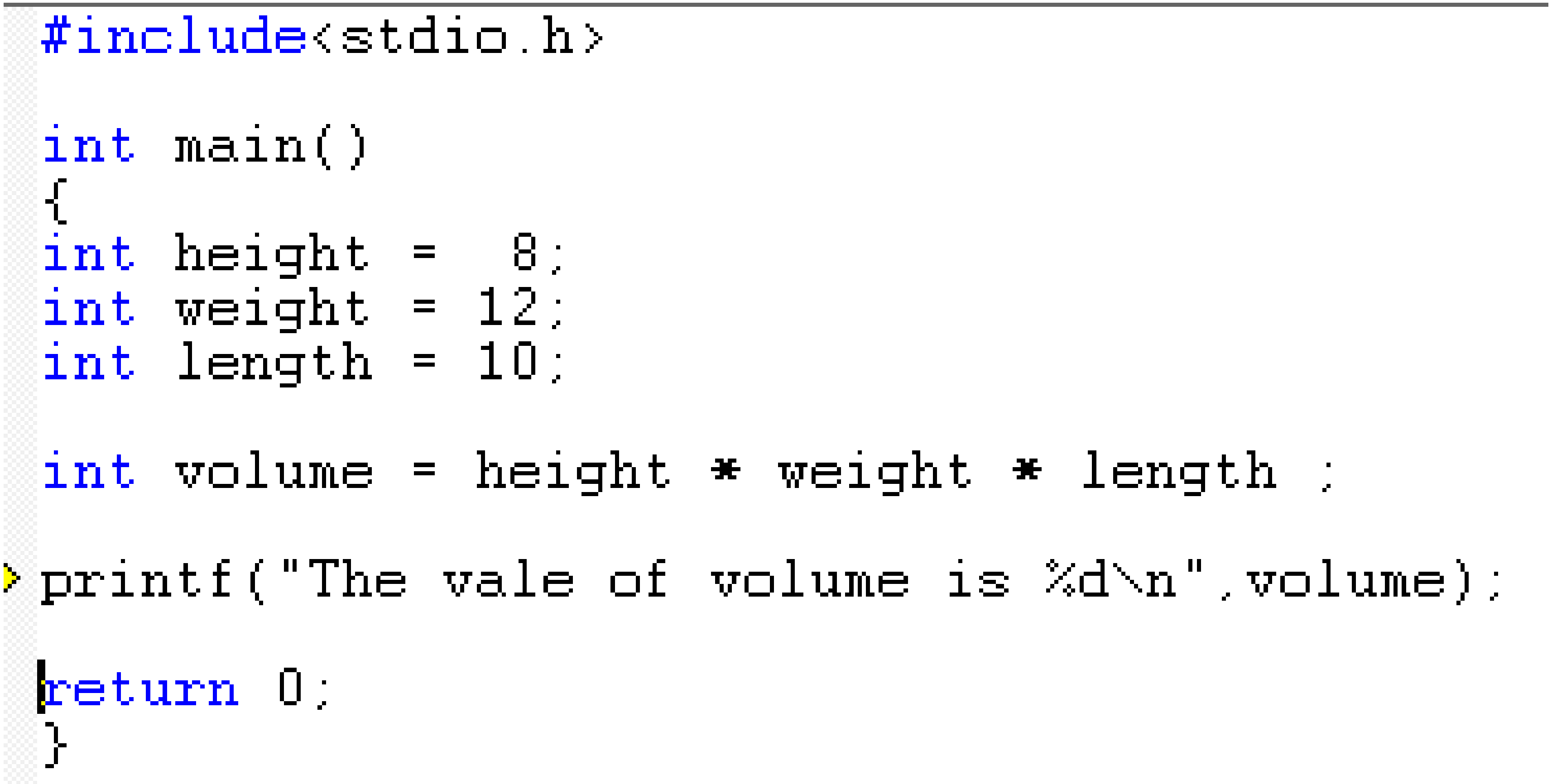
Reading Input

- □ Reading a `float` value requires a slightly different call of `scanf`:

  ```
  scanf("%f", &x);
  ```

- □ `"%f"` tells `scanf` to look for an input value in `float` format (the number may contain a decimal point, but doesn’t have to).

Computing volume of a Box



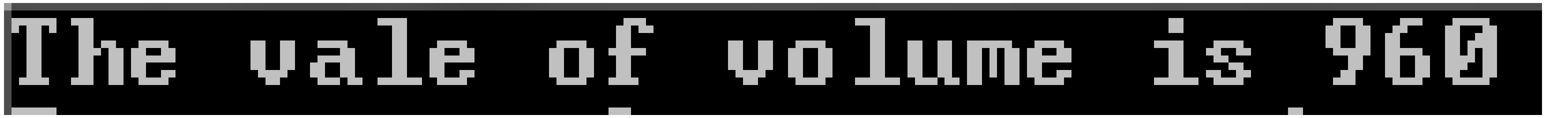
```
#include<stdio.h>

int main()
{
int height =  8;
int weight = 12;
int length = 10;

int volume = height * weight * length ;

printf("The vale of volume is %d\n",volume);

return 0;
}
```



```
The vale of volume is 960
```

Computing volume of a Box

```
/* Computes the dimensional weight of a box from input provided by the user */

#include <stdio.h>

int main()
{
  int height, length, width, volume;

  printf("Enter height of box: ");
  scanf("%d", &height);
  printf("Enter length of box: ");
  scanf("%d", &length);
  printf("Enter width of box: ");
  scanf("%d", &width);
  volume = height * length * width;

  printf("Volume (cubic inches): %d\n“,
  volume);

  return 0;
}
```

Computing volume of a Box

- Sample output of program:

```
Enter height of box: 8
Enter length of box: 12
Enter width of box: 10
Volume (cubic inches): 960
```

- Note that a prompt shouldn’t end with a new-line character.

Return value of **scanf** function:

```
int a, b, c;
printf(“Enter 2 Numbers:”);
c=scanf(“%d %d”,&a, &b);
printf(“returned value of scanf = %d\n”,c);
```

- Sample Input:
- Enter 2 Numbers: 10 20 Output: ??
- Enter 2 Numbers: 20 A Output: ??
- Enter 2 Numbers: A 20 Output: ??
- Enter 2 Numbers: A B Output: ??

Identifiers

- Names for variables, functions, macros, and other entities are called ***identifiers.***
- An identifier may contain
  - letters,
  - digits, and
  - underscores,
  - **but must begin with a letter or underscore:**

  `times10   get_next_char   _done`

  It's usually best to avoid identifiers that begin with an underscore.
- Examples of illegal identifiers:

  `10times   get-next-char`

Identifiers

- C is ***case-sensitive:*** it distinguishes between upper-case and lower-case letters in identifiers.
- For example, the following identifiers are all different:

```
job   joB   jOb   jOB   Job   JoB   JOb   JOB
```

Identifiers

- Many programmers use only lower-case letters in identifiers (other than macros), with underscores inserted for legibility:

```
symbol_table  current_page  name_and_address
```

- Other programmers use an upper-case letter to begin each word within an identifier:

```
symbolTable  currentPage  nameAndAddress
```

- C places no limit on the maximum length of an identifier.

Keywords

Keywords			
auto	double	int	struct
break	else	long	switch
case	enum	register	typedef
char	extern	return	union
const	float	short	unsigned
continue	for	signed	void
default	goto	sizeof	volatile
do	if	static	while

Fig. 2.15 C’s reserved keywords.

Conditional Statement

- If
- If-else
- If-else-if
- Switch

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:

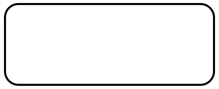
```
if ( grade >= 60 )
   printf( "Passed\n" );
```

  - C code corresponds closely to the Pseudocode/Flowchart

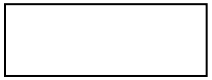
Flowcharts

- Flowcharts is a graph used to depict or show a step by step solution using **symbols** which represent a task.
- The symbols used consist of geometrical shapes that are connected by **flow lines.**
- It is an alternative to pseudocoding; whereas a pseudocode description is verbal, a flowchart is graphical in nature.

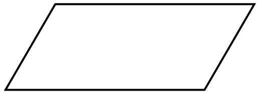
Flowchart Symbols



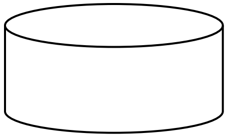
Terminal symbol - indicates the beginning and end points of an algorithm.



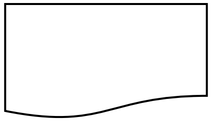
Process symbol - shows an instruction other than input, output or selection.



Input-output symbol - shows an input or an output operation.

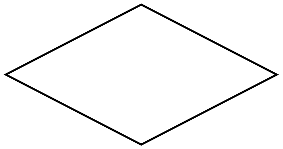


Disk storage I/O symbol - indicates input from or output to disk storage.

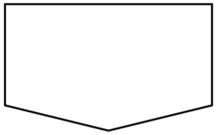


Printer output symbol - shows hardcopy printer output.

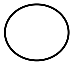
Flowchart Symbols cont…



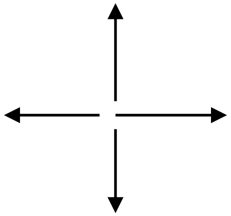
Selection symbol - shows a selection process for two-way selection.



Off-page connector - provides continuation of a logical path on another page.



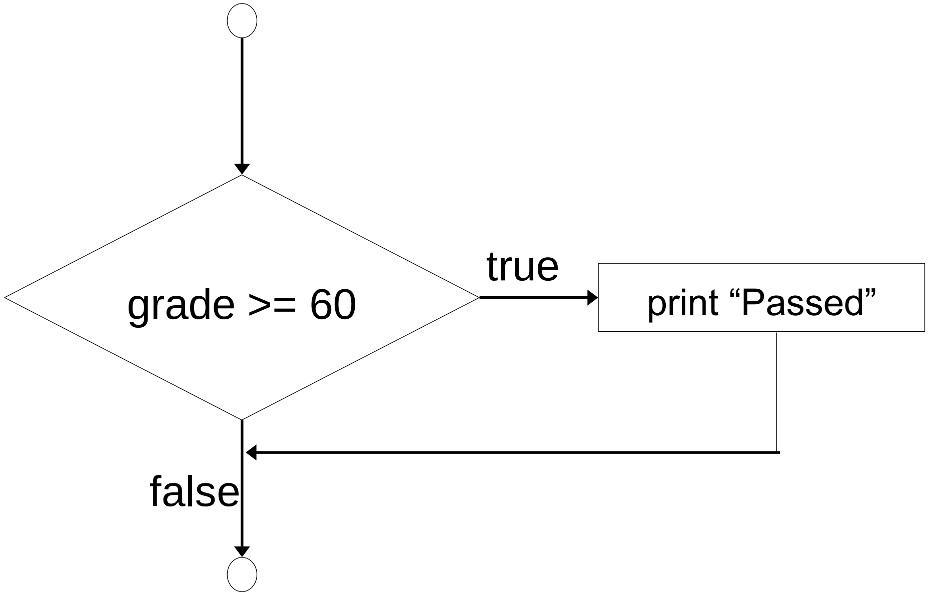
On-page connector - provides continuation of logical path at another point in the same page.



Flow lines - indicate the logical sequence of execution steps in the algorithm.

The `if` Selection Flowchart

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



A decision can be made on any expression.

zero - `false`

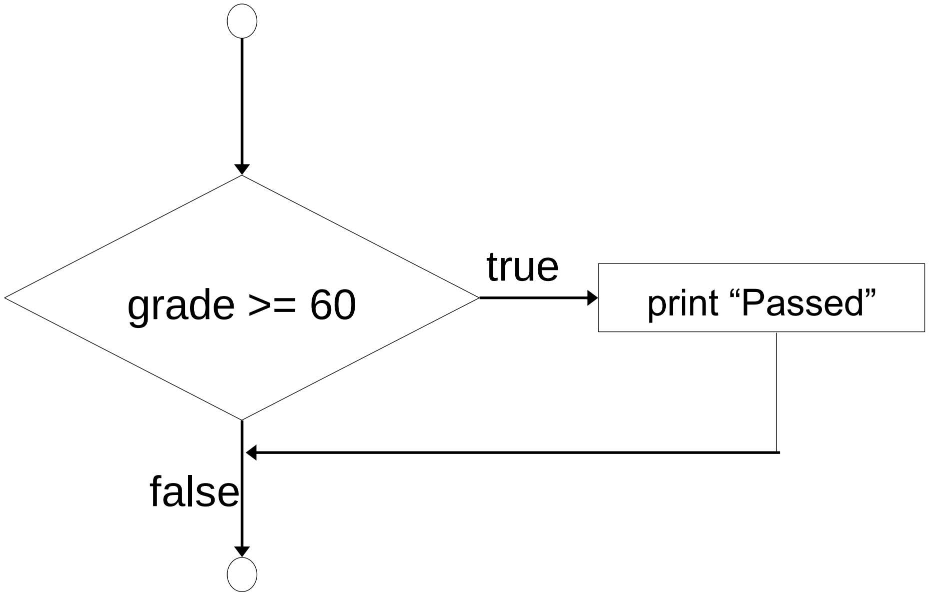
nonzero - `true`

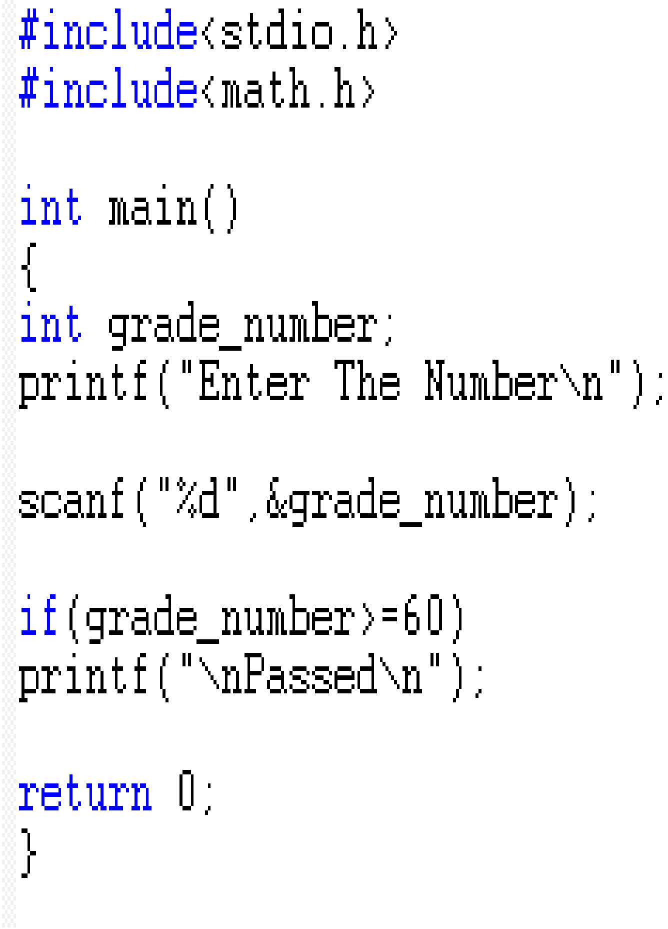
Example:

`3 - 4` is `true`

The `if` Selection Flowchart

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





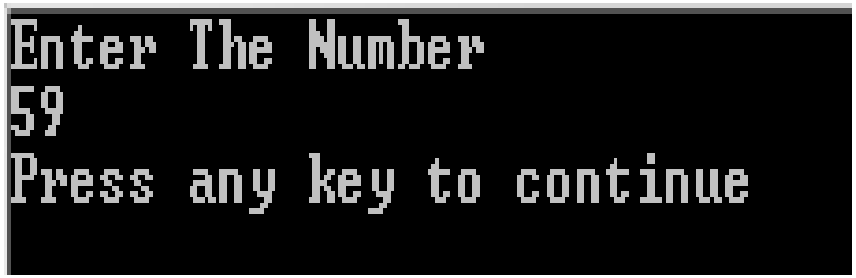
```
#include<stdio.h>
#include<math.h>

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

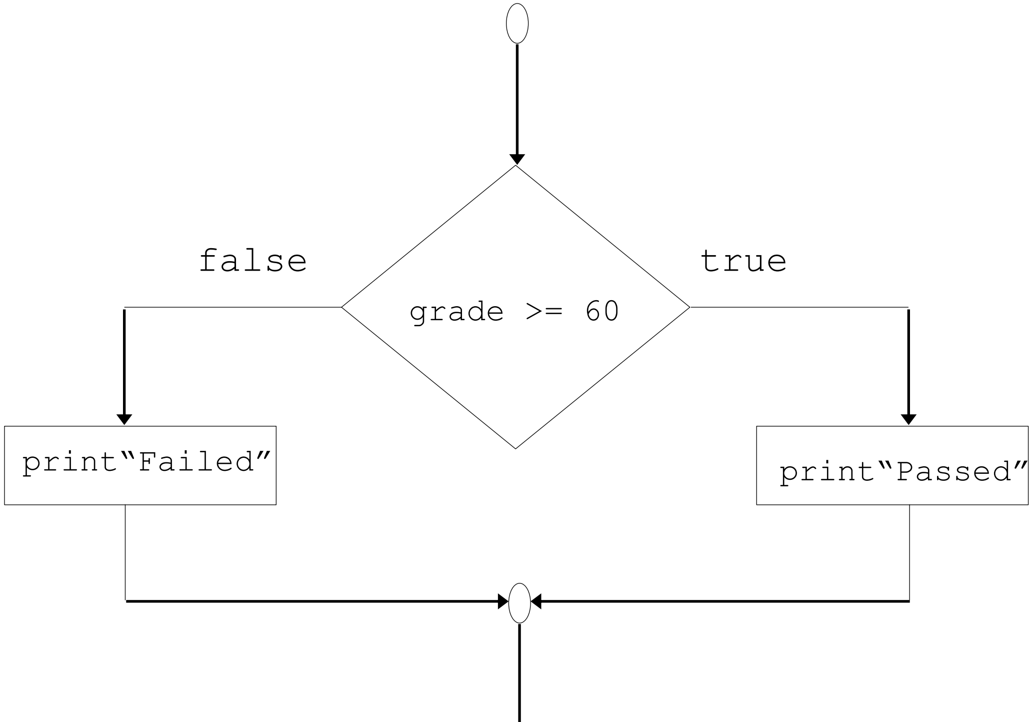
- `if`
  - Only performs an action if the condition is `true`
- `if…else`
  - Specifies an action to be performed both when the condition is `true` and when it is `false`
- Psuedocode:

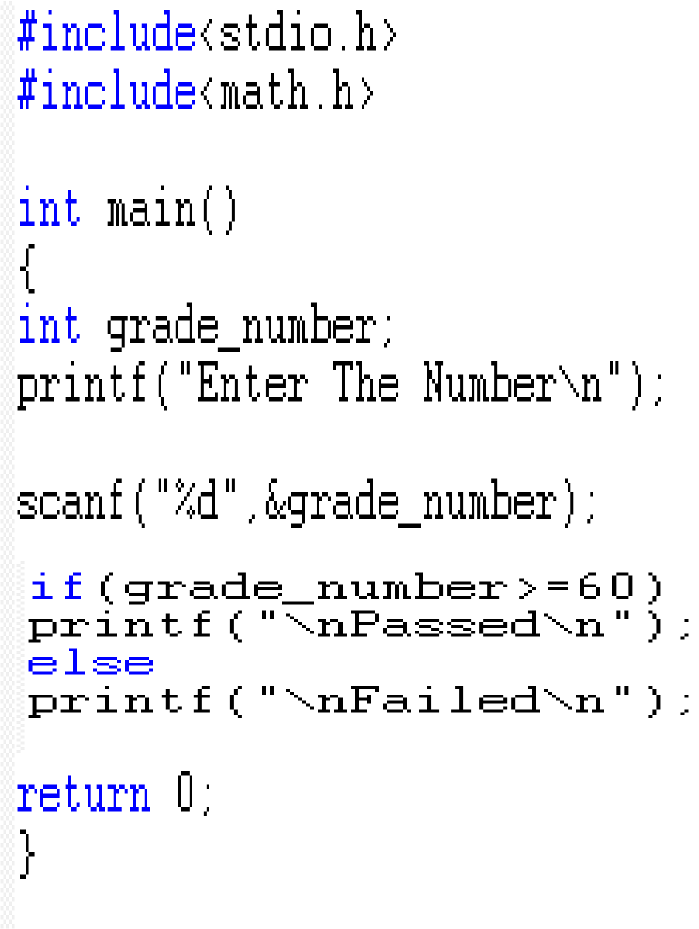
```
If student’s grade is greater than or equal to 60
   Print “Passed”
else
   Print “Failed”
```

  - Note spacing/indentation conventions

The if…else Selection Statement

- Flowchart of the if…else selection statement





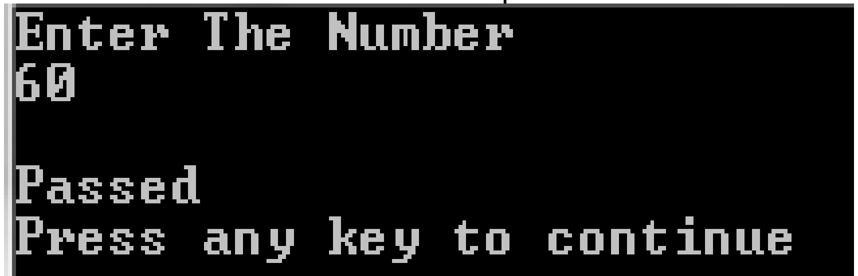
```
#include<stdio.h>
#include<math.h>

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

  `{` *statements* `}`

- Putting braces around a group of statements forces the compiler to treat it as a single statement.

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;

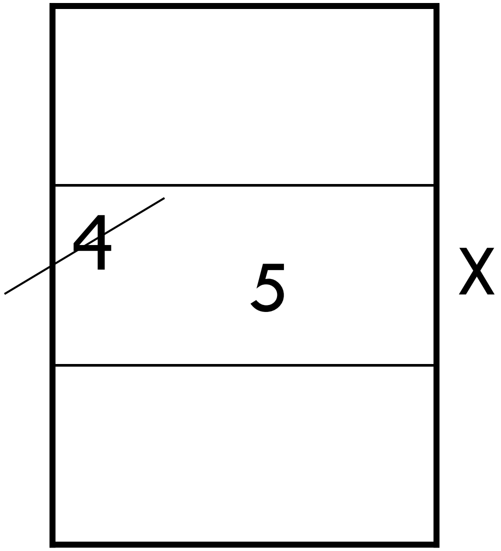
- Modulus returns remainder of division between two *integers*
- Example 5%2 returns a value of 1

□ 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

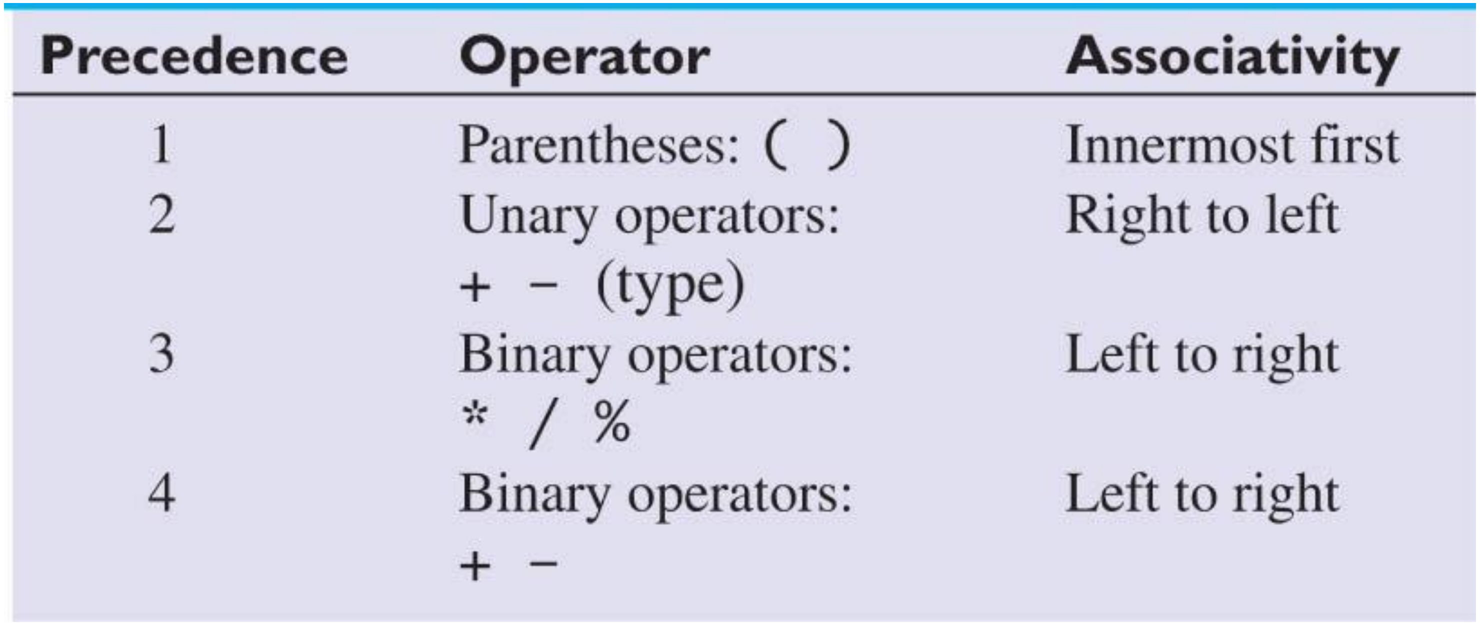
Mixed operations:

int a=4+6/3*2; → a=?

int b=(4+6)/3*2; → b=?

a= 4+2*2 = 4+4 = 8

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

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

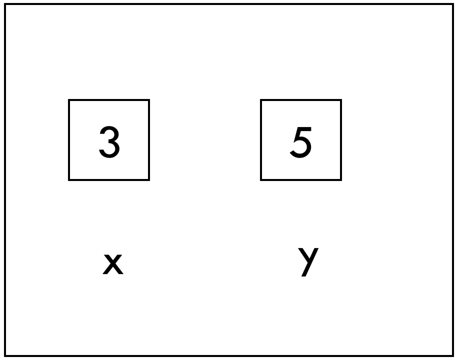
```
Tension = 2*m1*m2 / m1 + m2 * g;
```

wrong

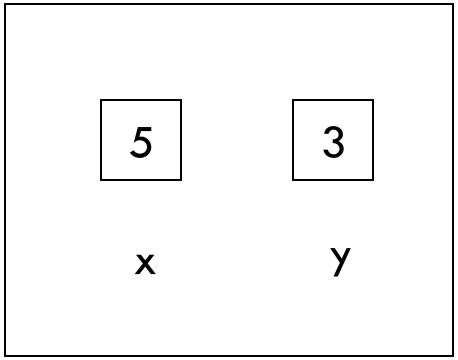
```
Tension = 2*m1*m2 / (m1 + m2) * g
```

Exercise: swap

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



Before

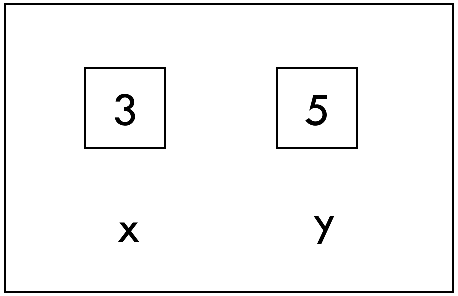


After

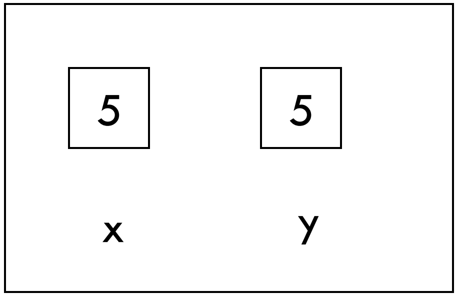
Exercise: swap

First Attempt

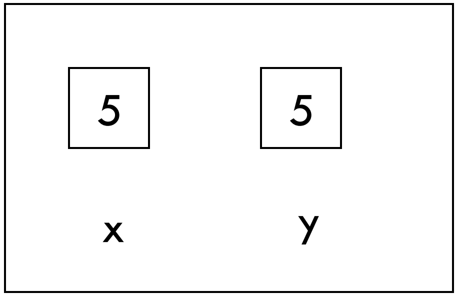
```
x=y;
y=x;
```



Before



After x=y

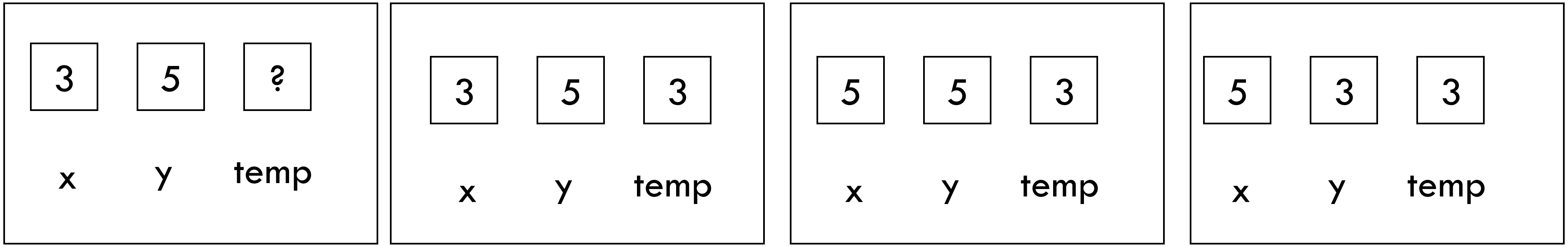


After y=x

Exercise: swap

Solution

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



3 5 ?

x y temp

3 5 3

x y temp

5 5 3

x y temp

5 3 3

x y temp

Before

after temp=x

after x=y

after y = temp

Exercise: reverse a number

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

  num is 258

  reverse is 852

Exercise: Arithmetic operations

- Show the memory snapshot after the following operations by hand

```
int a, b, c=5;
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

a = 12 b = 3 c= 5   x = 25.0000 y = 43.0000

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);
```

Step-by-step show how C will perform the operations

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

□ output:

Value of 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

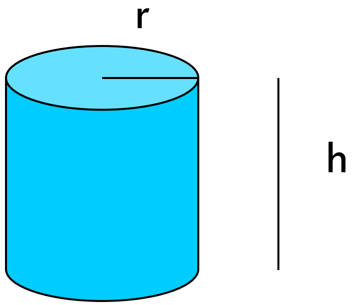
$$center = \frac{38.19(r^3 - s^3)\sin a}{(r^2 - s^2)a}$$

```
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

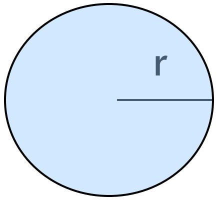
$$V = \pi r^2 h$$



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!

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