



UNIVERSITI
TEKNOLOGI
MALAYSIA
www.utm.my

Week 5

Arithmetic Expressions



UNIVERSITI
TEKNOLOGI
MALAYSIA
www.utm.my

3.1

The **scanf**

The `scanf`

- `scanf`, requires `stdio.h` file
- Used to read input from keyboard
- The `scanf` has two arguments
- The first argument, the format control string, indicates the type of data that should be input by the user.
- The second argument begins with an ampersand (&)—called the address operator in C—followed by the variable name.



```
1  /* Fig. 2.5: fig02_05.c
2     Addition program */
3  #include <stdio.h>
4
5  /* function main begins program execution */
6  int main( void )
7  {
8     int integer1; /* first number to be input by user */
9     int integer2; /* second number to be input by user */
10    int sum; /* variable in which sum will be stored */
11
12    printf( "Enter first integer\n" ); /* prompt */
13    scanf( "%d", &integer1 ); /* read an integer */
14
15    printf( "Enter second integer\n" ); /* prompt */
16    scanf( "%d", &integer2 ); /* read an integer */
17
18    sum = integer1 + integer2; /* assign total to sum */
19
20    printf( "Sum is %d\n", sum ); /* print sum */
21
22    return 0; /* indicate that program ended successfully */
23 } /* end function main */
```

Fig. 2.5 | Addition program. (Part I of 2.)



The scanf

- This `scanf` has two arguments, `"%d"` and `&integer1`.
- The `%d` conversion specifier indicates that the data should be an integer (the letter `d` stands for “decimal integer”).
- The ampersand, when combined with the variable name, tells `scanf` the location (or address) in memory at which the variable `integer1` is stored



Displaying a Prompt

- A prompt is a message that instructs the user to enter data.
- You should always use printf to display a prompt before each scanf statement.

```
printf( "Enter first integer\n" ); /* prompt */  
scanf( "%d", &integer1 ); /* read an integer */
```



The scanf

- Can be used to input more than one value:

```
scanf ("%d %d", &integer1, &integer2);
```

- Order is important: first value entered goes to first variable, etc.



Example

```
#include "stdio.h"
```

```
int main()
```

```
{
```

```
    int minx, x, y, z;
```

```
    printf("Enter four ints: ");
```

```
    scanf( "%d %d %d %d", &minx, &x, &y, &z);
```

```
    printf("You wrote: %d %d %d %d", minx, x, y, z);
```

```
    return 0;
```

```
}
```



Format specifiers

- **%c** for single characters

- `scanf ("%c", &some_character);`

always put a space between " and % when reading characters

- **%d** for integers

- `scanf ("%d", &some_integer);`

- **%f** for float

- `scanf ("%f", &some_float);`

- **%lf** for double

- `scanf ("%lf", &some_double);`



Reading Strings with `scanf`

- Can be used to read in a string
- Must first declare an array to hold characters in string:

```
char str[50];
```

- `str` is name of array, 50 is the number of characters that can be stored (the size of the array), including the NULL character at the end
- Can be used with `scanf` to assign a value:

```
scanf("%s", str);
```



Example

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

```
#include <conio.h>
```

```
int main(){
```

```
    // static declaration
```

```
    char str[50] = {0};
```

```
    // shorthand way to initialize all elements to 0
```

```
    int n;
```

```
    printf("Enter your First name and Age: ");
```

```
    scanf("%s%d", str, &n); //
```

```
    printf("Your name is %s and you are %d old\n", str, n);
```

```
    getch();
```

```
    return 0;
```

```
}
```



Exercise Week5_1

- Write a C program that asks the user to enter an integer, a floating point number, and a character, and write the results back out. All output must be in the format shown in the sample output.

Sample input:

Enter a single character : R

Enter an array of characters: Hello

Enter an integer: 7

Enter a decimal number : 2.25

Sample output:

You entered r

You entered Hello

You entered 7

You entered 2.25





UNIVERSITI
TEKNOLOGI
MALAYSIA
www.utm.my

3.2

Mathematical Expressions

Primary expression

a

Identifier

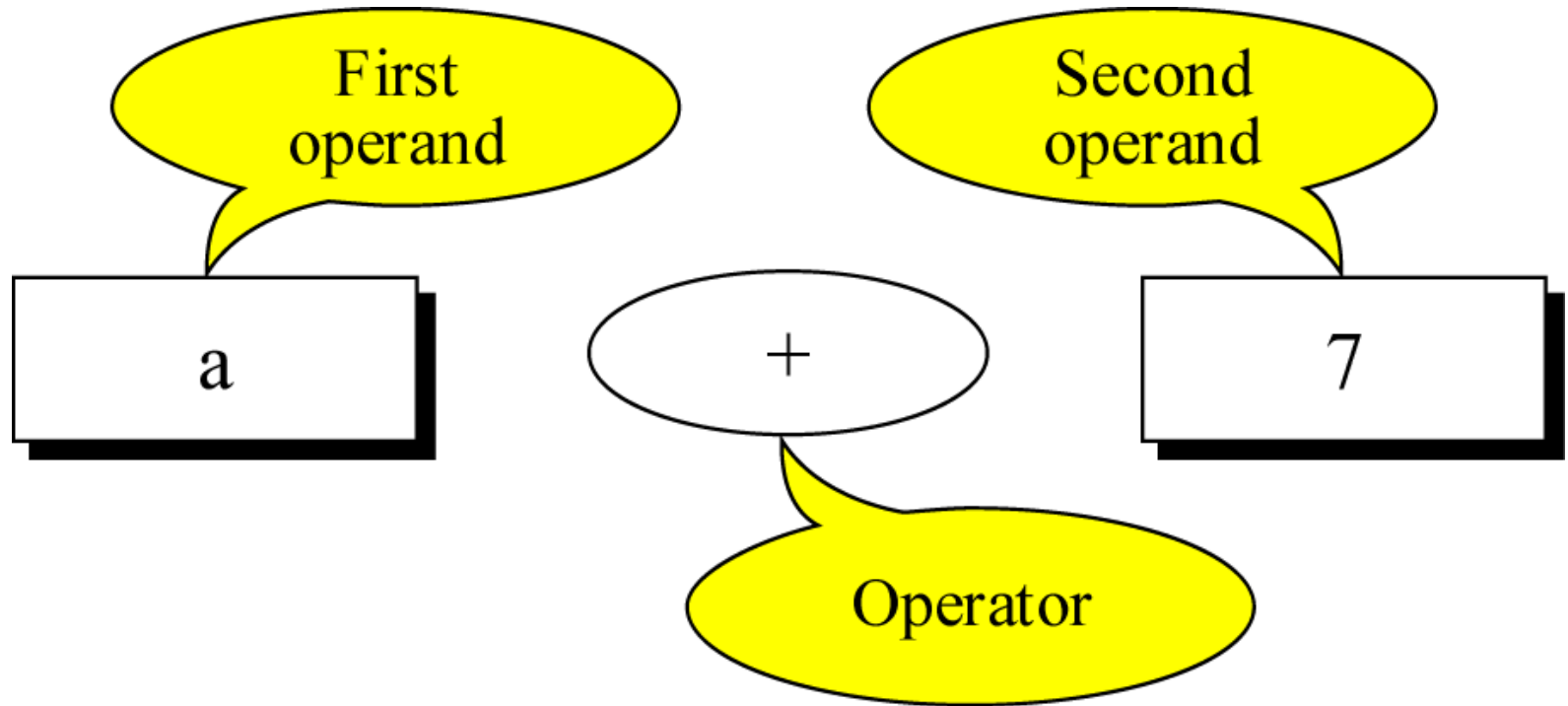
7

Constant

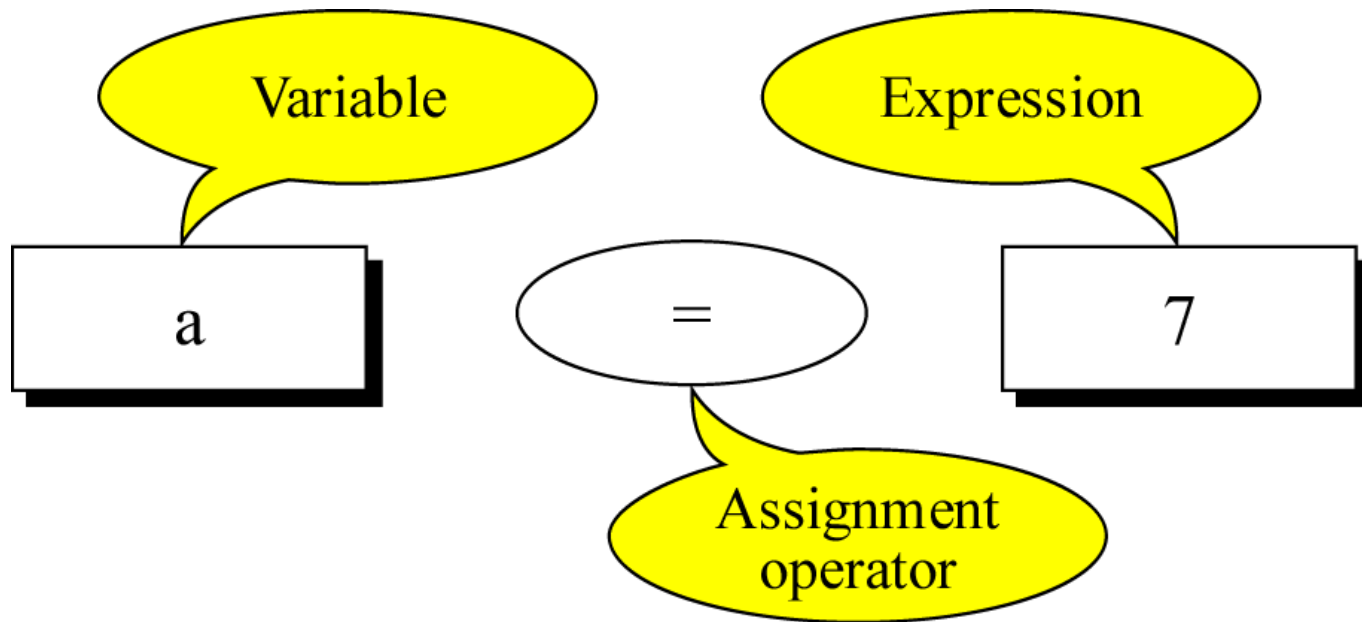
$(2 + a - 3)$

Expression

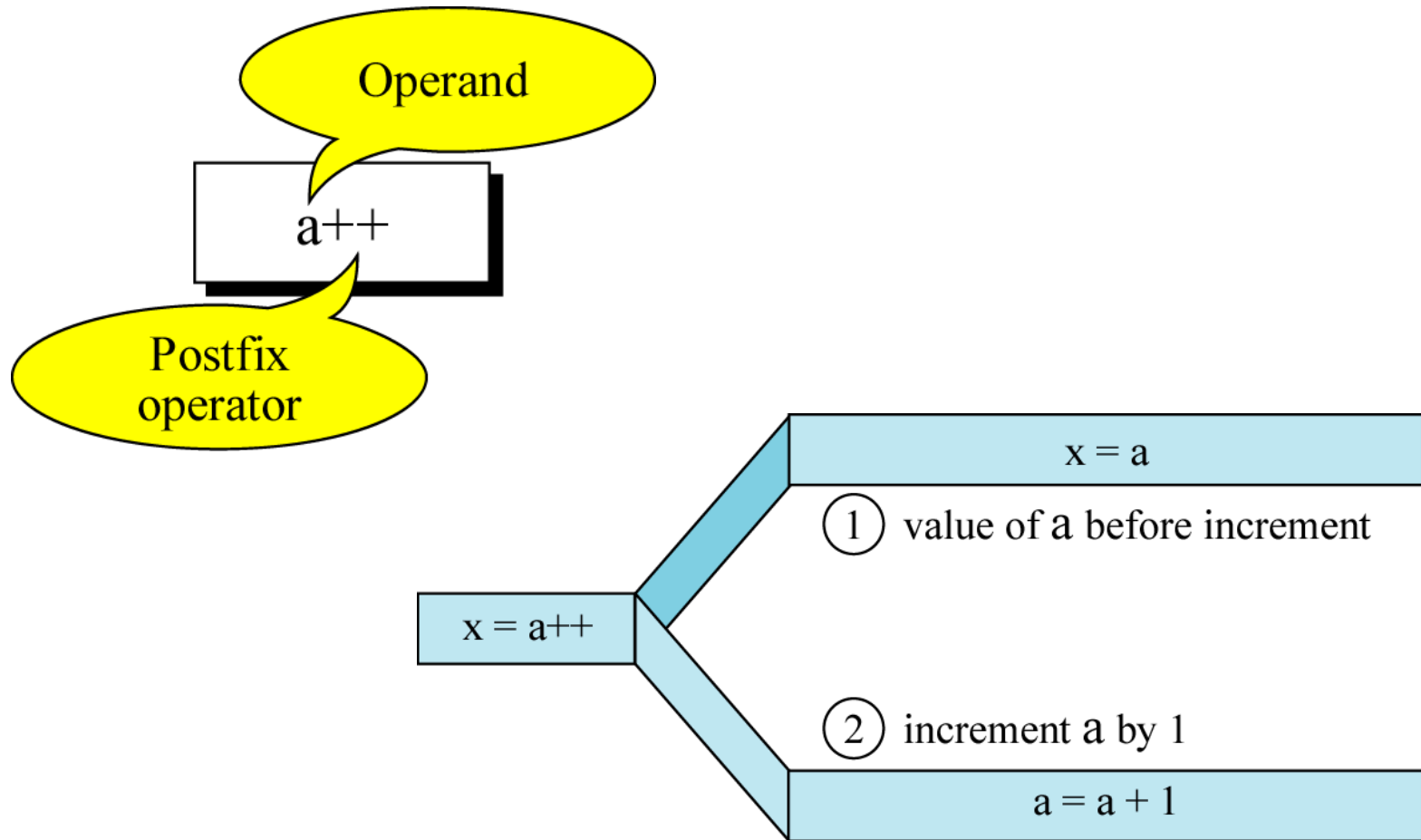
Binary expression



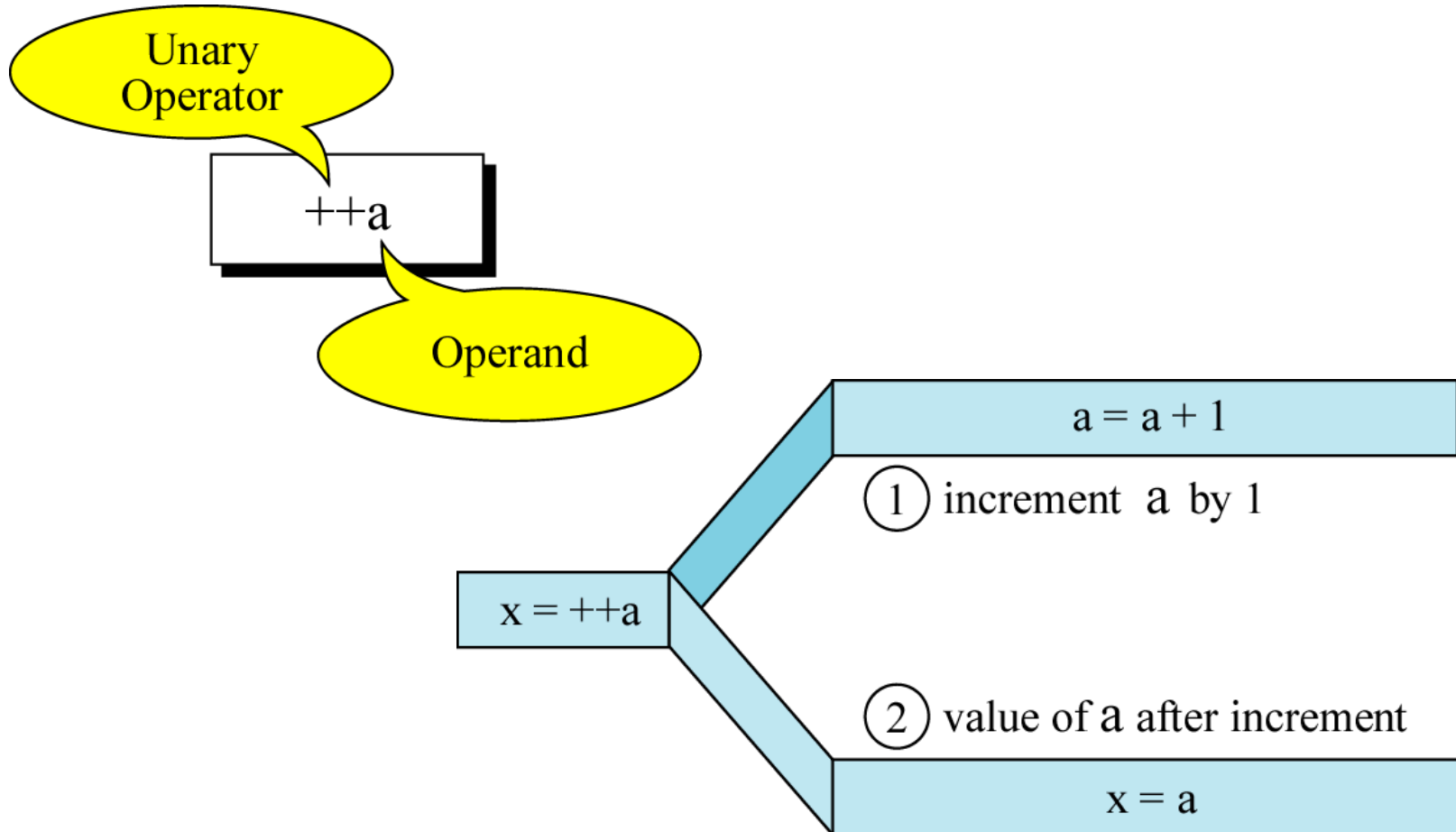
Assignment expression



Postfix expression



Prefix expression



Mathematical Expressions

- Can create complex expressions using multiple mathematical operators
- An expression can be a literal, a variable, or a mathematical combination of constants and variables
- Can be used in assignment, `printf`, other statements:

```
area = 2 * PI * radius;
```

```
printf ("border is: %d", 2*(1+w));
```



Assignment operator =

- Binary operator used to assign a value to a variable.
- Its left operand is the destination variable
- Its right operand is an expression.

```
int var;  
var = 10;
```



Order of Operations

In an expression with more than one operator, evaluate in this order:

()

– (unary negation), in order, left to right

* / %, in order, left to right

+ –, in order, left to right

In the expression $2 + 2 * 2 - 2$

evaluate
second

evaluate
first

evaluate
third

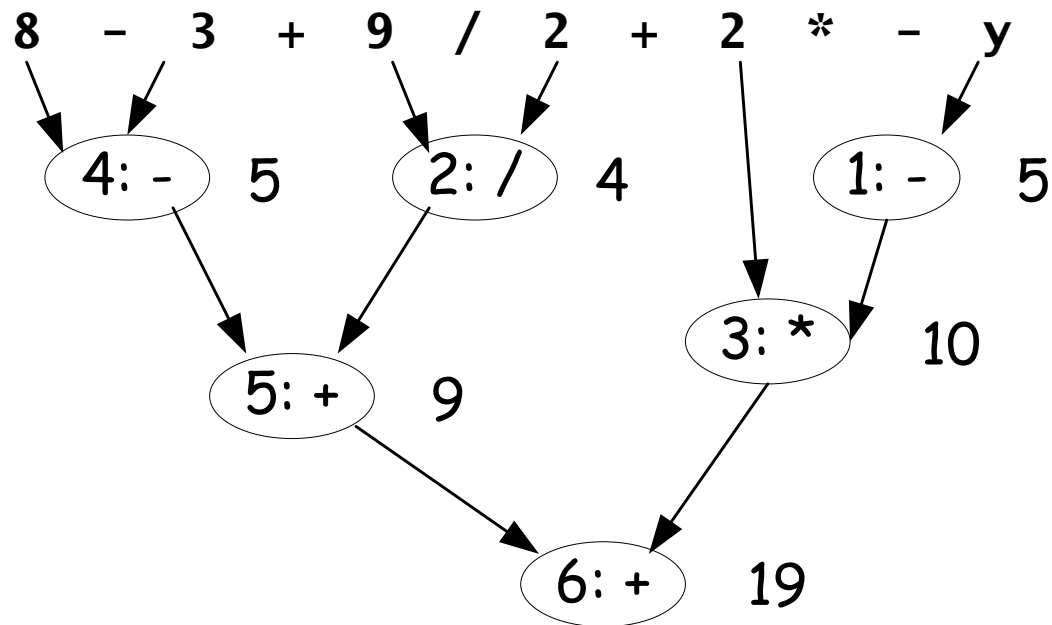


Example

```
int z, y=-5;
```

```
z= 8 - 3 + 9 / 2 + 2 * - y;
```

```
z= 8 - (3 + 9 / 2) + 2 * - y; // try this
```



Order of Operations

Show prove for the following expression

Table 3-2 Some Expressions

Expression	Value
$5 + 2 * 4$	13
$10 / 2 - 3$	2
$8 + 12 * 2 - 4$	28
$4 + 17 \% 2 - 1$	4
$6 - 3 * 2 + 7 - 1$	6

Associativity of Operators

- $-$ (unary negation) associates right to left
- $*$, $/$, $\%$, $+$, $-$ associate left to right
- parentheses $()$ can be used to override the order of operations:

$$2 + 2 * 2 - 2 = 4$$

$$(2 + 2) * 2 - 2 = 6$$

$$2 + 2 * (2 - 2) = 2$$

$$(2 + 2) * (2 - 2) = 0$$



Grouping with Parentheses

Table 3-4 More Expressions

Expression	Value
$(5 + 2) * 4$	28
$10 / (5 - 3)$	5
$8 + 12 * (6 - 2)$	56
$(4 + 17) \% 2 - 1$	0
$(6 - 3) * (2 + 7) / 3$	9

Algebraic Expressions

- Multiplication requires an operator:

$Area = lw$ is written as `Area = l * w;`

- There is no exponentiation operator:

$Area = s^2$ is written as `Area = pow(s, 2);`

- Parentheses may be needed to maintain order of operations:

$m = \frac{y_2 - y_1}{x_2 - x_1}$ is written as
`m = (y2 - y1) / (x2 - x1);`



Algebraic and C Multiplication Expressions

Algebraic Expression	Operation	C Equivalent
$6B$	6 times B	$6 * B$
$(3)(12)$	3 times 12	$3 * 12$
$4xy$	4 times x times y	$4 * x * y$



Exercise Week5_2

- Write the formula in C statement.

$$b^2 - 4ac$$

$$\frac{a + b}{c + d}$$

$$\frac{1}{1 + x^2}$$





UNIVERSITI
TEKNOLOGI
MALAYSIA
www.utm.my

3.3

When You Mix Apples and
Oranges: *Type Conversion*

When You Mix Apples and Oranges: *Type Conversion*

- Operations are performed between operands of the same type.
- If not of the same type, C will convert one to be the type of the other
- The type of the result depends on the types of the operands.
- If the types of the operands differ (e.g. an integer added to a floating point number), one is "promoted" to other.
 - The "smaller" type is promoted to the "larger" one.
char → int → float → double
- This can impact the results of calculations.



int and double

If all operands are integer, the output will be integer, otherwise, the output will be double



Example

```
main()
{
    int i1=3, i2=2, output1, output2;
    double d=2.0, output3, output4;

    output1 = i1/i2; /* 3/2 */
    output2 = i1/d; /* 3/2.0 */
    output3 = i1/i2; /* 3/2 */
    output4 = i1/d; /* 3/2.0 */
}
```

output1	output ²	output3	output4
1	1	1.0	1.5





UNIVERSITI
TEKNOLOGI
MALAYSIA
www.utm.my

3.4

Type Casting

Type Casting

- Used for manual data type conversion
- Useful for floating point division using int
- Format

`(data type)variable`



Example 1

```
double a=3.0, b=2.0, output;  
output = a % b; /*syntax error!!!*/
```

Solution:

```
output = (int)a % (int)b; /*free from error!*/
```



Example 2

```
main()
{
    int total_marks = 456, num_studs = 5;
    double ave_marks1, ave_marks2;

    ave_marks1 = total_marks/num_studs; ave_marks2 =
    (double) total_marks / num_studs;
}
```

ave_marks1	ave_marks2
91.0	91.2





UNIVERSITI
TEKNOLOGI
MALAYSIA
www.utm.my

3.6

Named Constants

Named Constants

- Named constant (constant variable): variable whose content cannot be changed during program execution
- Used for representing constant values with descriptive names:

```
const double TAX_RATE = 0.0675;
```

```
const int NUM_STATES = 50;
```

- Often named in uppercase letters



Named Constants - example

What will be the output?

```
void main()
{
    const int a=5;
    a++;

    printf("%d", a);
}
```



const vs. #define

- #define

```
#define NUM_STATES 50
```

- Note no ; at end

- Interpreted by pre-processor rather than compiler
- Does not occupy memory location like const



Exercise Week5_3

- Write a program that will convert Malaysian Ringgit (RM) amounts to Japanese Yen and to Euros. The conversion factors to use are:
$$1 \text{ RM} = 0.21734 \text{ Euros}$$
$$1 \text{ RM} = 36.0665 \text{ Yen}$$
- Solve the problems using constant values.





UNIVERSITI
TEKNOLOGI
MALAYSIA
www.utm.my

3.7

Multiple Assignment and Combined Assignment

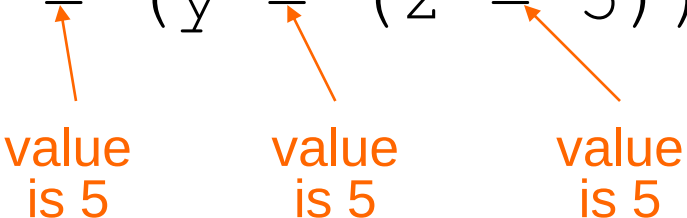
Multiple Assignment and Combined Assignment

- The = can be used to assign a value to multiple variables:

`x = y = z = 5;`

- Value of = is the value that is assigned
- Associates right to left:

`x = (y = (z = 5)) ;`



value is 5 value is 5 value is 5

Combined Assignment

- Look at the following statement:

```
sum = sum + 1;
```

This adds 1 to the variable **sum**.



Other Similar Statements

Table 3-8 (Assume $x = 6$)

Statement	What It Does	Value of x After the Statement
$x = x + 4;$	Adds 4 to x	10
$x = x - 3;$	Subtracts 3 from x	3
$x = x * 10;$	Multiplies x by 10	60
$x = x / 2;$	Divides x by 2	3
$x = x \% 4$	Makes x the remainder of $x / 4$	2

Combined Assignment

- The combined assignment operators provide a shorthand for these types of statements.
- The statement

`sum = sum + 1;`

is equivalent to

`sum += 1;`



Combined Assignment Operators

Table 3-9

Operator	Example Usage	Equivalent to
<code>+=</code>	<code>x += 5;</code>	<code>x = x + 5;</code>
<code>-=</code>	<code>y -= 2;</code>	<code>y = y - 2;</code>
<code>*=</code>	<code>z *= 10;</code>	<code>z = z * 10;</code>
<code>/=</code>	<code>a /= b;</code>	<code>a = a / b;</code>
<code>%=</code>	<code>c %= 3;</code>	<code>c = c % 3;</code>

Increment, decrement operators: ++, --

- Increment, decrement operators: ++, --
 - Instead of `a = a + 1` you can write `a++` or `++a`
 - Instead of `a = a - 1` you can write `a--` or `--a`
- What is the difference?

post-increment

```
num = 10;  
ans = num++;
```

First assign num to ans,
then increment num.

In the end,

num is 11

ans is 10

pre-increment

```
num = 10;  
ans = ++num;
```

First increment num,
then assign num to ans.

In the end,

num is 11

ans is 11



Mathematic Library Functions

- Available in C
- Can be called upon during pre-processing
#include
#include <math.h>
#include <stdlib.h>



Some functions from Maths Library

Function	Library Func.	Purpose and example	Argument	Output
abs(x)	stdlib.h	x abs(-5) output 5	int	int
exp (x)	math.h	e^x exp(1.0) output 2.71828	double	double
log(x)	math.h	$\log_e(x)$ log((2.71828)) output 1.0	double	double
pow(x, y)	math.h	X^y pow(0.16, 0.5) output 0.4	double, double	double
sqrt(x)	math.h	$\sqrt{x}$ and $x \geq 0.0$ sqrt(2.25) output 1.5	double	double





**UNIVERSITI
TEKNOLOGI
MALAYSIA**
www.utm.my

Thank You

Q & A

