More Operators: Increment (++) and Decrement (--)

- Both of these are unary operators; they operate on a single operand
- The increment operator causes its operand to be increased by 1
  - Example: **a++, ++count**
- The decrement operator causes its operand to be decreased by 1.
  - Example: **i--, --distance**

Pre-increment versus post-increment

- Operator written before the operand (++i, --i))
  - Called pre-increment operator (also sometimes called prefix ++ and prefix --)
  - Operand will be altered in value before it is utilized in the statement
- Operator written after the operand (i++, i--)
  - Called post-increment operator (also sometimes called postfix ++ and postfix --)
  - Operand will be altered in value after it is utilized in the statement

Examples

<u>Initial values :: a = 10; b = 20;</u>

x = 50 + ++a;	a = 11, x = 61
x = 50 + a++;	x = 60, a = 11
x = a++ + --b;	b = 19, x = 29, a = 11
x = a++ – ++a;	??

Called side effects (while calculating some values, something else gets changed)

Precedence among different operators (there are many other operators in C, some of which we will see later)

Operator Class	Operators	Associativity
Unary	postfix++, --	Left to Right
Unary	prefix ++, -- — ! &	Right to Left
Binary	* / %	Left to Right
Binary	+ —	Left to Right
Binary	< <= > >=	Left to Right
Binary	== !=	Left to Right
Binary	&&	Left to Right
Binary	||	Left to Right
Assignment	= += — = *= /= %=	Right to Left

Doing More Complex Mathematical Operations

- C provides some mathematical functions to use
  - perform common mathematical calculations
  - Must include a special header file

    ```
    #include <math.h>
    ```
- Example
  - `printf ("%f", sqrt(900.0));`
    - Calls function sqrt, which returns the square root of its argument
- Return values of math functions are of type double
- Arguments may be constants, variables, or expressions
- Similar to functions you have seen in school maths

Math Library Functions

double acos(double x) – Compute arc cosine of x.

double asin(double x) – Compute arc sine of x.

double atan(double x) – Compute arc tangent of x.

double atan2(double y, double x) – Compute arc tangent of y/x.

double cos(double x) – Compute cosine of angle in radians.

double cosh(double x) – Compute the hyperbolic cosine of x.

double sin(double x) – Compute sine of angle in radians.

double sinh(double x) – Compute the hyperbolic sine of x.

double tan(double x) – Compute tangent of angle in radians.

double tanh(double x) – Compute the hyperbolic tangent of x.

Math Library Functions

double ceil(double x) – Get smallest integral value that exceeds x.

double floor(double x) – Get largest integral value less than x.

double exp(double x) – Compute exponential of x.

double fabs (double x) – Compute absolute value of x.

double log(double x) – Compute log to the base e of x.

double log10 (double x) – Compute log to the base 10 of x.

double pow (double x, double y) – Compute x raised to the power y.

double sqrt(double x) – Compute the square root of x.

Computing distance between two points

```
#include <stdio.h>
#include <math.h>
int main()
{
        int x1, y1, x2, y2;
        double dist;
        printf(“Enter coordinates of first point: “);
        scanf(“%d%d”, &x1, &y1);
        printf(“Enter coordinates of second point: “);
        scanf(“%d%d”, &x2, &y2);
        dist = sqrt(pow(x1 – x2, 2) + pow(y1 – y2, 2));
        printf(“Distance = %lf\n”, dist);
        return 0;
}
```

```
Enter coordinates of first point: 3  4
Enter coordinates of second point: 2  7
Distance = 3.162278
```

Output

Practice Problems

1. Read in three integers and print their average
2. Read in four integers a, b, c, d. Compute and print the value of the expression

   a+b/c/d*10*5-b+20*d/c

   - □ Explain to yourself the value printed based on precedence of operators taught
   - □ Repeat by putting parenthesis around different parts (you choose) and first do by hand what should be printed, and then run the program to verify if you got it right
   - □ Repeat similar thing for the expression a&&b||c&&d>a||c<=b
3. Read in the coordinates (real numbers) of three points in 2-d plane, and print the area of the triangle formed by them
4. Read in the principal amount P, interest rate I, and number of years N, and print the compound interest (compounded annually) earned by P after N years

Conditional Statements

Why Are Conditional Statements Required?

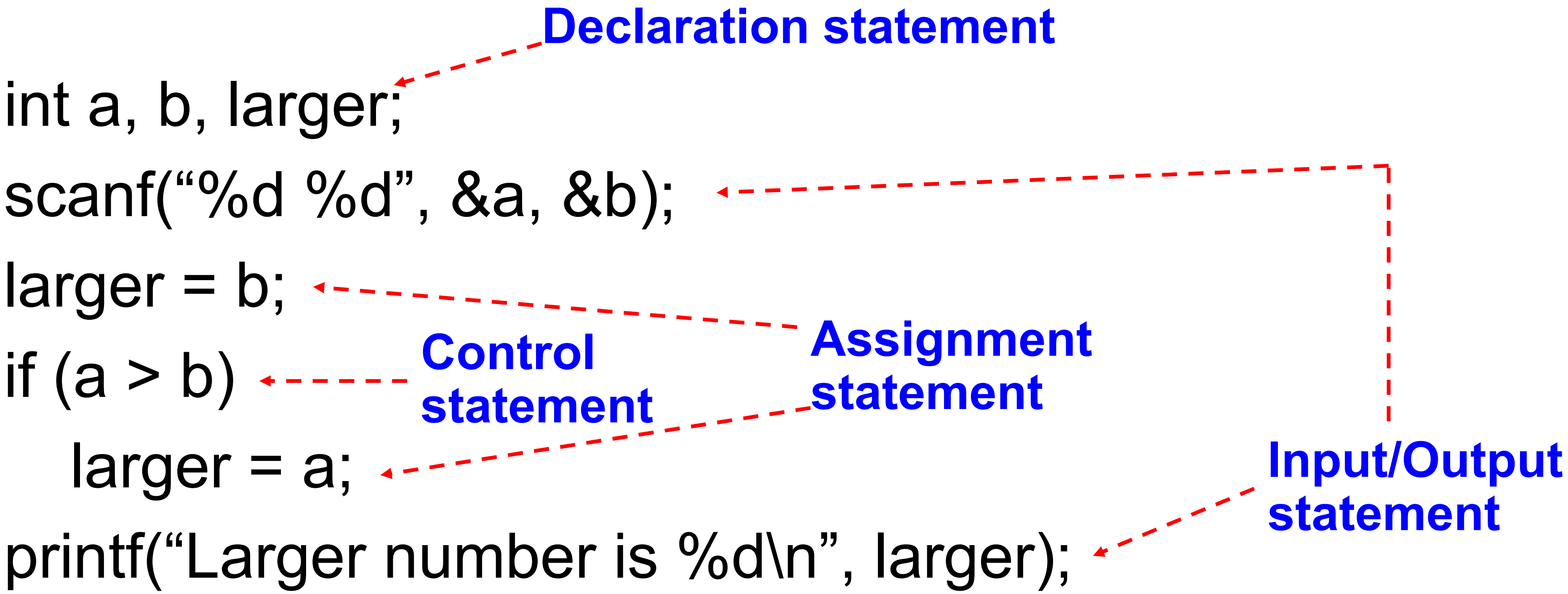
1. Sometimes execution of an instruction depends on the outcome of testing a condition.
   - Whether Outcome TRUE or FALSE.
   - **Example: divide a by b, if b is non-zero.**
   - This is also called branching.
2. Sometimes a set of instructions need to be executed repeatedly:
   - This is called looping
   - Involves branching.
   - Example**: For each student compute grade**

Statements in a C program

- Parts of C program that tell the computer what to do
- Different types
  - □ **Declaration statements**
    - Declares variables etc.
  - □ **Assignment statement**
    - Assignment expression, followed by a ;
  - □ **Control statements**
    - For branching and looping, like if-else, for, while, do-while (to be seen later)
  - □ **Input/Output**
    - Read/print, like printf/scanf

```
int a, b, larger;
scanf(“%d %d”, &a, &b);
larger = b;
if (a > b){
    larger = a;}
printf(“Larger number is %d\n”, larger);
```

Example



```
int a, b, larger;
scanf(“%d %d”, &a, &b);
larger = b;
if (a > b)
    larger = a;
printf(“Larger number is %d\n”, larger);
```

Declaration statement

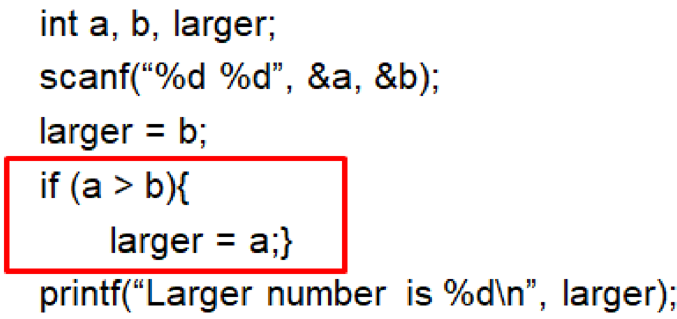
Input/Output statement

Assignment statement

Control statement

Compound Statements

- A sequence of statements enclosed within { and }
- Also called a **block of statements**
- Each statement in a block can be an assignment statement, control statement, input/output statement, or another compound statement
- There may be only one statement inside a block also



```
int a, b, larger;
scanf("%d %d", &a, &b);
larger = b;
if (a > b){
      larger = a;}
printf("Larger number  is %d\n", larger);
```

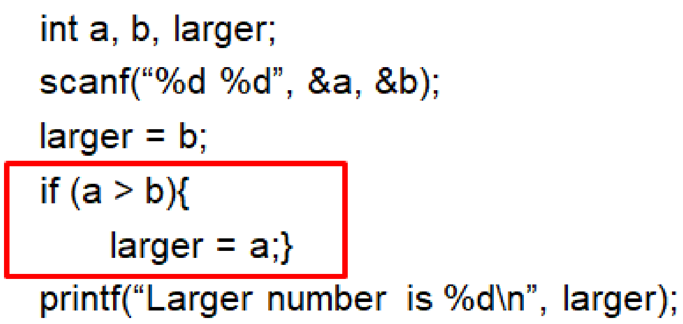
Example

```
int n;
scanf(“%d”, &n);
while(1) {
    if (n > 0) break;
    scanf(“%d”, &n);
}
```

Compound statement

Conditional Statements

- Allow different sets of instructions to be executed depending on truth or falsity of a logical condition
- Also called Branching
- How do we specify conditions?
  - □ Using expressions
    - non-zero value means condition is true
    - value 0 means condition is false
  - □ Usually logical expressions, but can be any expression
    - The value of the expression will be used
- Example: if(mark>=80) grade=‘A’



```
int a, b, larger;
scanf(“%d %d”, &a, &b);
larger = b;
if (a > b){
      larger = a;}
printf(“Larger number  is %d\n”, larger);
```

Branching: if Statement

```
if (expression)
        statement;

if (expression) {
        Block of statements;
}
```

Branching: if Statement

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

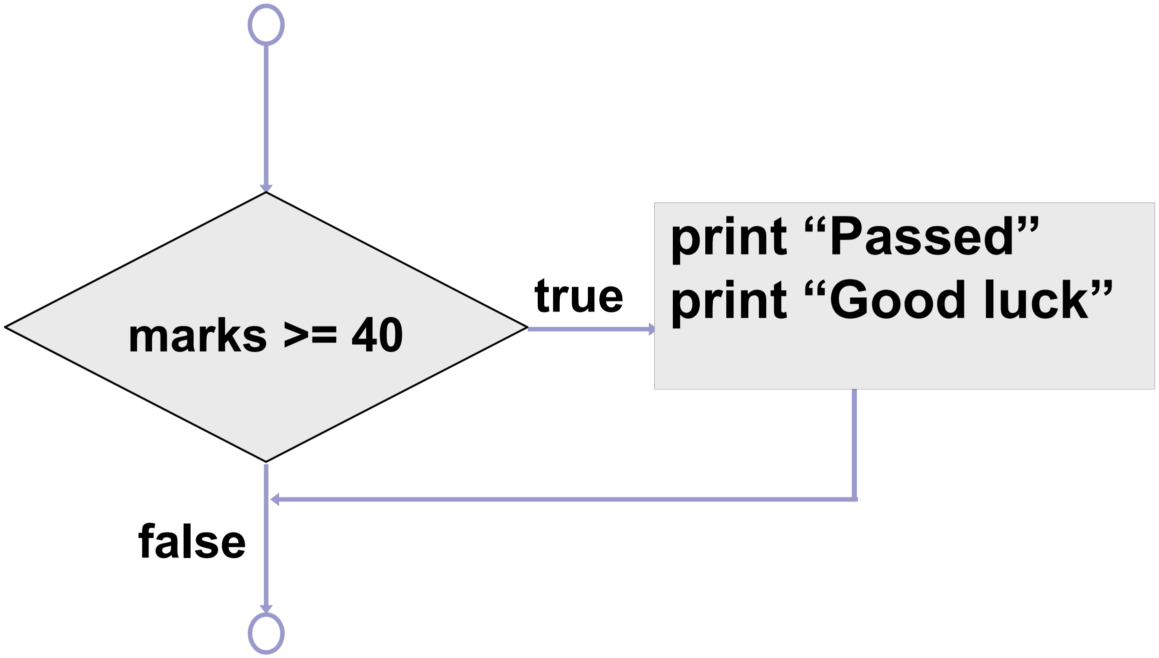
```
if(temp>100)
      emergency=ON;
```

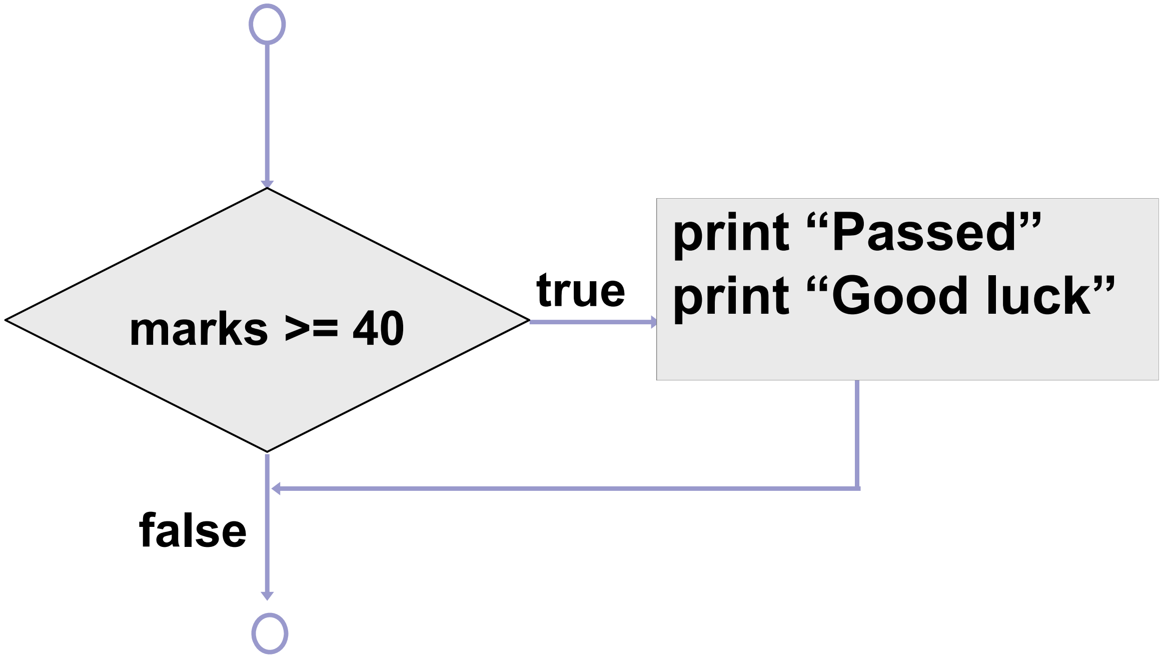
```
if (expression) {
        Block of statements;
}
```

```
If(temp>100){
      printf("Emergency\n");
      emergency=ON;
}
```

The condition to be tested is any expression enclosed in parentheses. The expression is evaluated, and if its value is non-zero, the statement/block of statements is executed.

Flow Chart Representation: if Statement

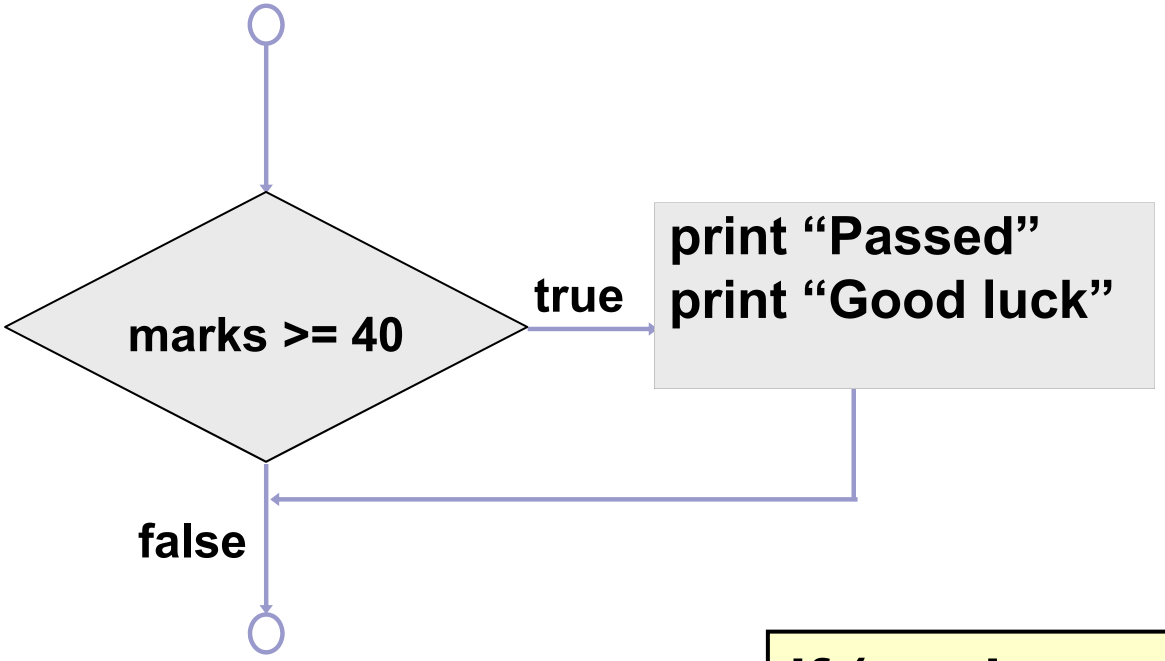




A decision can be made on any expression.

zero - false

nonzero - true



marks >= 40

true

print “Passed”
print “Good luck”

false

A decision can be made on any expression.

zero - false

nonzero - true

```
if (marks >= 40)  {
   printf(“Passed \n”);
   printf(“Good luck\n”);
}
printf (“End\n”) ;
```

Simple "if" statement

```
if (aNumber != 1000)
       countA++;
```

“if” with a block of statements

```
if (aValue <= 10)
   {
      printf("Answer is %8.2f\n", aValue);
      countB++;
   } // End if
```

Branching: if-else Statement

```
if (expression) {
    Block of statements;
}
else {
    Block of statements;
}
```

```
if (expression) {
   Block of statements;
}
else if  (expression) {
   Block of statements;
}
else {
   Block of statements;
}
```

Quiz

```
If(cgpa>=0 && cgpa<=10)
              validGrade++;
else printf(“Error\n”);
```

- Write code for the following:
  - □ If CGPA within 0 and 10, increment validGrade, else display error message
  - □ Variables: int cgpa, validGrade;

Grade Computation

```
int main()  {
    int marks;
    scanf(“%d”, &marks);
    if (marks >= 80)
         printf (”Grade= A”) ;
    else if (marks >= 70)
         printf (” Grade= B”) ;
    else if (marks >= 60)
         printf (” Grade= C”) ;
    else printf (”Failed”);
    return 0;
}
```

```
int main () {
      int marks;
     scanf (“%d”, &marks) ;
      if (marks>= 80) {
          printf (“A: ”) ;
          printf (“Good Job!”) ;
      }
      else if (marks >= 70)  printf (“B ”) ;
      else if (marks >= 60)  printf (“C ”) ;
      else {
          printf (“Failed: ”) ;
          printf (“Study hard!”) ;
     }
     return 0;
}
```

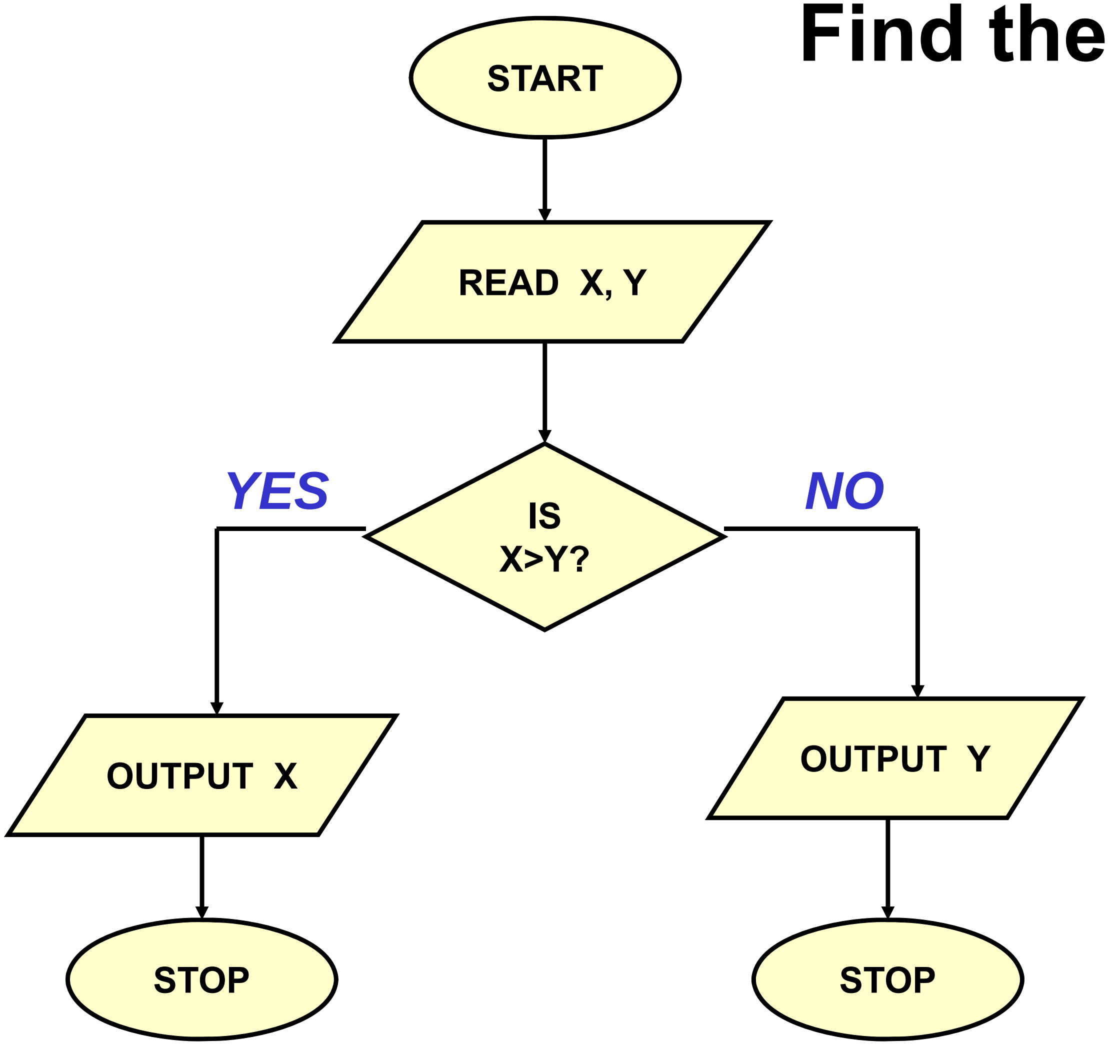
Outputs for different inputs

```
90
A: Good Job!
```

```
65
C
```

```
50
Failed: Study hard!
```

Find the larger of two numbers


START

READ X, Y

IS X>Y?

YES

NO

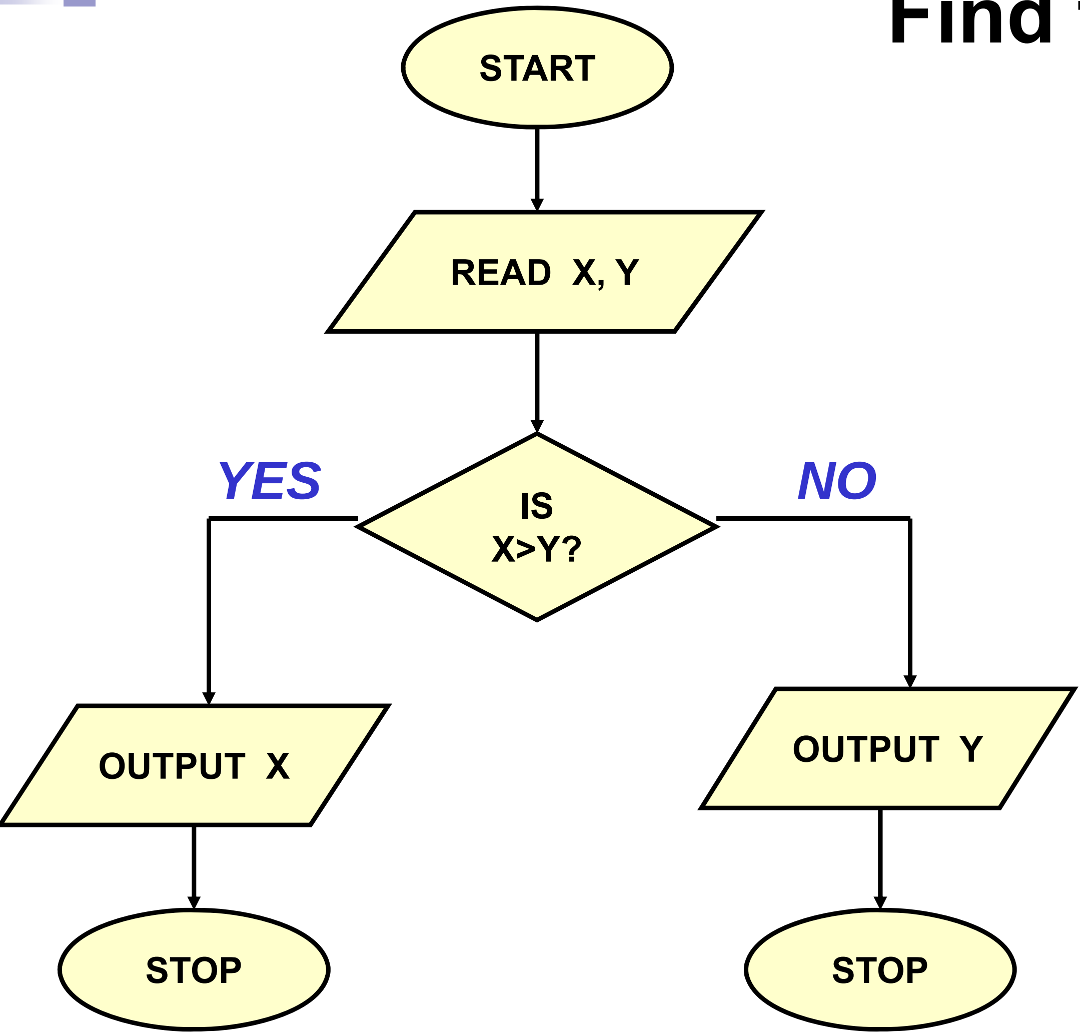
OUTPUT X

OUTPUT Y

STOP

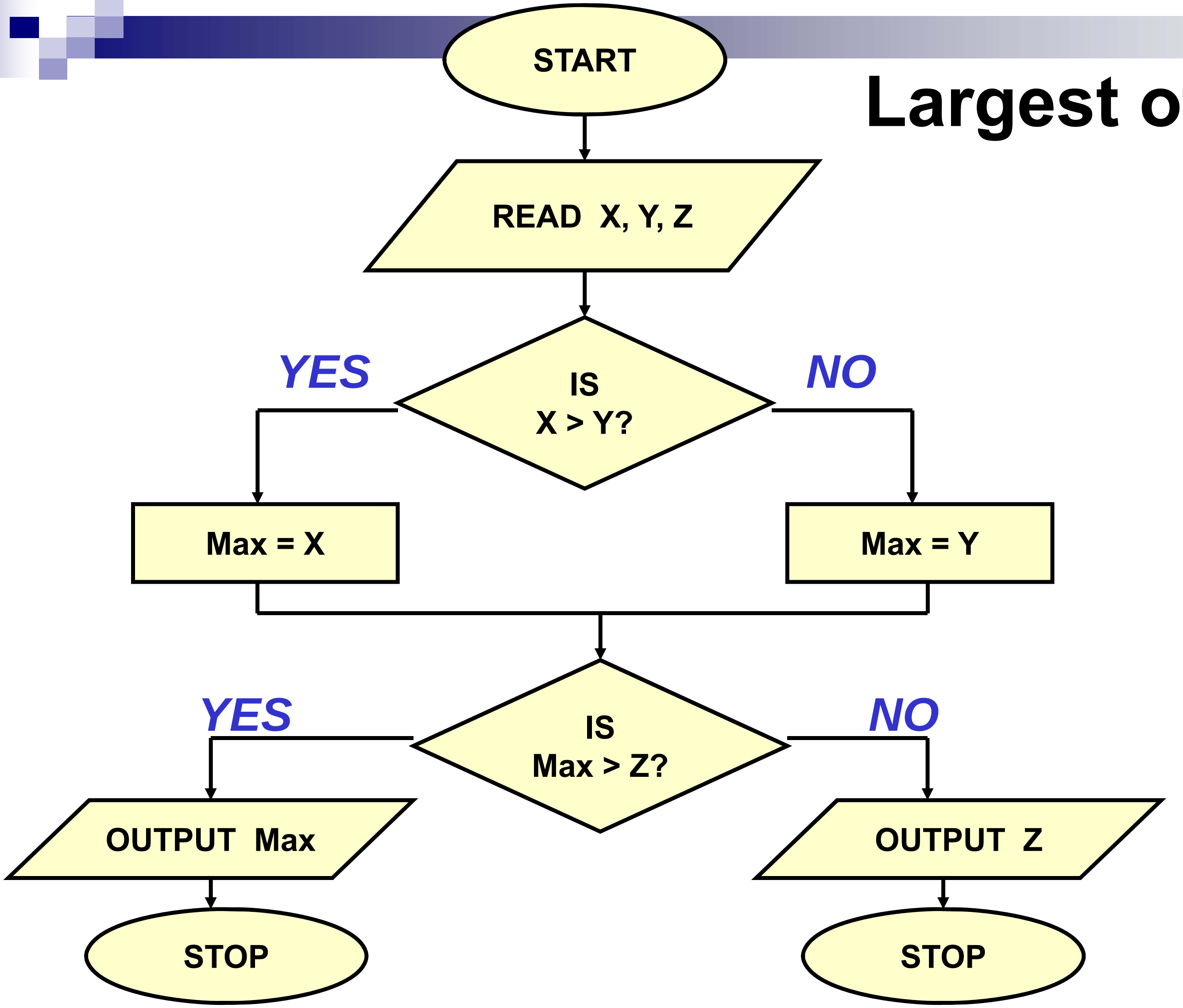
STOP

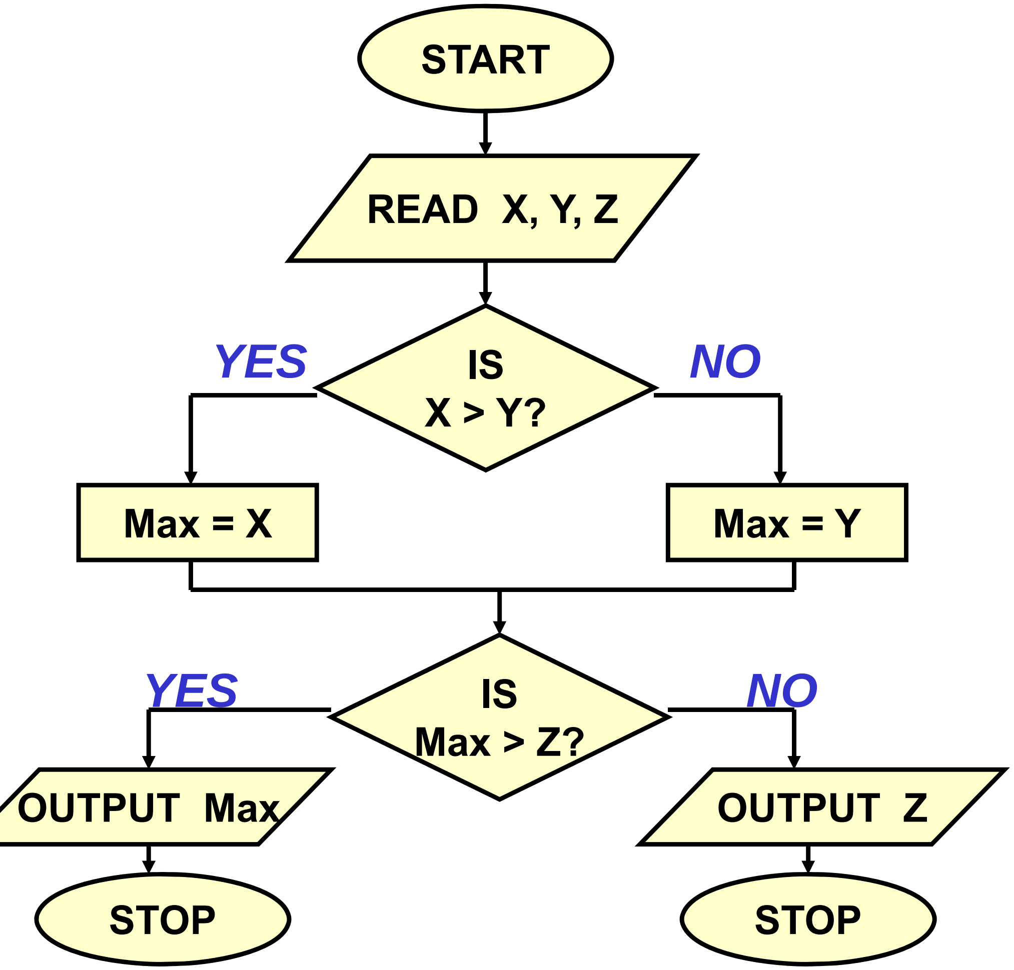
Find the larger of two numbers



```
int main () {
   int x, y;
   scanf (“%d%d”, &x, &y);
   if (x > y)
        printf (“%d\n”, x);
   else
        printf (“%d\n”, y);
   return 0;
}
```

Largest of three numbers





```
int main () {
        int x, y, z, max;
        scanf (“%d%d%d”,&x,&y,&z);
        if (x > y)
                max = x;
        else max = y;
        if (max > z)
                printf (“%d”, max) ;
        else printf (“%d”,z);
        return 0;
}
```

Another version

```
int main()  {
    int  a,b,c;
    scanf (“%d%d%d”, &a, &b, &c);
    if ((a >= b) && (a >= c))
        printf (“\n The largest number is: %d”, a);
    if ((b >= a) && (b >= c))
        printf (“\n The largest number is: %d”, b);
   if ((c >= a) && (c >= b))
        printf (“\n The largest number is: %d”, c);
   return 0;
}
```

Exercise

- Read three integers and display the integer that is neither the largest nor the smallest.

Solution

```
int main() {

    int i,j,k;

    scanf(“%d %d %d”, &i,&j,&k);

     if((i<j && i>k)|| (i>j && i<k))  printf(“Median=%d\n”, i);

     if((j<i && j>k)|| (j>i && j<k))  printf(“Median=%d\n”, j);

    if((k<j && k>i)|| (k>j && k<i))  printf(“Median=%d\n”, k);

return 0;

}
```

Assignment

- Read principal and number of months of deposit
  - Compute interest,
  - less than 1 month 4%,
  - Less than 1 year but more than a month 7%
  - Less than 2 years but more than 1 year 8%
  - Less than 5 years but more than 2 year 9%
  - More than 5 years 8%

Confusing Equality (==) and Assignment (=) Operators

- **Dangerous error!**
  - Does not ordinarily cause syntax errors
  - Any expression that produces a value can be used in control structures
  - Nonzero values are true, zero values are false
- Example:

```
if ( payCode = 4 )
        printf( "You get a bonus!\n" );
```

WRONG! Will always print the line

Nesting of if-else Structures

- It is possible to nest if-else statements, one within another

- All "if" statements may not be having the "else" part

if (exp1) if (exp2) stmta else stmtb

  - □ Confusion??

- Rule to be remembered:

  - □ **An "else" clause is associated with the closest preceding unmatched "if"**

Dangling else problem

if (exp1) if (exp2) stmta else stmtb

```
if (exp1) {
    if (exp2)
        stmta
    else
        stmtb
}
```

OR

```
if (exp1) {
    if (exp2)
        stmta
}
else
    stmtb
```

?

Which one is the correct interpretation?

Give braces explicitly in your programs to match the else with the correct if to remove any ambiguity

More Examples

```
if e1 s1
else if e2 s2
```

```
if e1 s1
else if e2 s2
else s3
```

?

```
if e1 if e2 s1
else s2
else s3
```

Lecture 5

Dangling else problem

if (exp1) if (exp2) stmta else stmtb

```
if (exp1) {
    if (exp2)
        stmta
    else
        stmtb
}
```

OR

```
if (exp1) {
    if (exp2)
        stmta
}
else
    stmtb
```

?

Which one is the correct interpretation?

Give braces explicitly in your programs to match the else with the correct if to remove any ambiguity

Answers

```
if e1 s1                       if  e1  s1
else if e2 s2        →         else  { if  e2  s2 }
```

```
if e1 s1                       if  e1  s1
else if e2 s2        →         else  { if  e2  s2
else s3                                  else s3 }
```

```
if e1 if e2 s1                 if  e1  { if  e2  s1
else s2              →                   else  s2 }
else s3                        else  s3
```

While programming, it is always good to explicitly give the { and } to avoid any mistakes

Example

```
int main()
{
    int x;
    scanf(“%d”, &x);
    if (x >= 0)
        if (x <= 100)
          printf(“ABC\n”);
    else
        printf(“XYZ\n”);
    return 0;
}
```

Print “ABC” if a number is between 0 and 100, or “XYZ” if it is –ve. Do not print anything in other cases.

Example

```
int main()
{
        int x;
        scanf(“%d”, &x);
        if (x >= 0)
                if (x <= 100)
                    printf(“ABC\n”);
        else
                printf(“XYZ\n”);
        return 0;
}
```

Print “ABC” if a number is between 0 and 100, or “XYZ” if it is –ve. Do not print anything in other cases.

Outputs for different inputs

```
150
XYZ
```

Not what we want, should not have printed anything

```
-20
```

Not what we want, should have printed XYZ

Correct Program

```
int main()
{
      int x;
      scanf(“%d”, &x);
      if (x >= 0)
      {
              if (x <= 100)
                 printf(“ABC\n”);
      }
      else
              printf(“XYZ\n”);
      return 0;
}
```

Outputs for different inputs

```
150
```

```
-20
XYZ
```

The Conditional Operator ?:

- Cryptic if-then-else, but sometimes elegant
- Example: instead of writing

```
if (balance > 5000)
      interest = balance * 0.2;
 else interest = balance * 0.1;
```

We can just write

```
interest = (balance > 5000) ? balance * 0.2 : balance * 0.1;
```

Ternary conditional operator (?:)

- Takes three arguments (condition, value if true, value if false)
  - □ Returns the evaluated value.

```
(marks >= 60) ? printf( “Passed\n”) : printf( “Failed\n” );
```

(condition)? (action 1): (action 2);

Example:

```
interest = (balance>5000) ? balance*0.2 : balance*0.1;
```

Returns a value

Express Using Ternary Operator

-
  ```
  if (((a >10) && (b < 5))
        x = a + b;
    else x = 0;
  ```

  ```
    x = ((a > 10) && (b < 5)) ? a + b : 0
  ```

-
  ```
  if (marks >= 60)
       printf("Passed \n");
   else printf("Failed \n");
  ```

```
(marks >= 60) ? printf("Passed\n") : printf("Failed\n");
```

Exercise

- Write a ternary conditional expression to express the following:
  - □ **If class attendance is 100% add 5 to the marks else add 3 to marks.**
  - □ **Assume following variable declaration:**
    - **int marks;**
    - **int percent_attendance;**

The switch Statement

- An alternative to writing lots of if-else in some special cases
- This causes a particular group of statements to be chosen from several available groups based on equality tests only
- Uses switch statement and case labels

- **Syntax**

```
switch (expression)  {
   case const-expr-1: S-1
   case const-expr-2: S-2
       :
   case const-expr-m: S-m
   default: S
}
```

- expression is any integer-valued expression
- const-expr-1, const-expr-2,…are any constant integer-valued expressions
  - □ Values must be distinct
- S-1, S-2, …,S-m, S are statements/compound statements
- Default is optional, and can come anywhere (not necessarily at the end as shown)

Behavior of switch

- expression is first evaluated
- It is then compared with const-expr-1, const-expr-2,…for equality in order
- If it matches any one, all statements from that point till the end of the switch are executed (including statements for default, if present)
  - □ Use break statements if you do not want this (see example)
- Statements corresponding to default, if present, are executed if no other expression matches

```
switch (expression) {
   case const-expr-1: S-1
   case const-expr-2: S-2
        :
   case const-expr-m: S-m
   default: S
}
```

Example

```
int main()
{
     int x;
     scanf(“%d”, &x);
     switch (x) {
             case 1: printf(“One\n”);
             case 2: printf(“Two\n”);
      default: printf(“Not one or two\n”);
     };
}
```

If x = 1 is entered, this will print

One
Two
Not one or two

Not what we want

Correct Program

```
int main()
{
     int x;
     scanf(“%d”, &x);
     switch (x) {
              case 1: printf(“One\n”);
                              break;
              case 2: printf(“Two\n”);
                             break;
              default: printf(“Not one or two\n”);
     };
}
```

If x = 1 is entered, this will print:

One

Rounding a Digit

```
switch (digit)   {
          case 0:
          case 1:
          case 2:
          case 3:
          case 4: result = 0; printf (“Round down\n”); break;
          case 5:
          case 6:
          case 7:
          case 8:
          case 9: result = 10; printf(“Round up\n”); break;
}
```

Since there isn’t a break statement here, the control passes to the next statement without checking the next condition.

It will come here if digit is any of 0 to 4. Round to 0, then break as done.

The break Statement

- Used to exit from a switch or terminate from a loop
- With respect to “switch”, the “break” statement causes a transfer of control out of the entire “switch” statement, to the first statement following the “switch” statement
- Can be used with other statements also …(will discuss later)

Switch Statement: Exercise

- Read a number between 0 and 6 and display the corresponding day of the week: Sunday, Monday, …   , Saturday.

```
switch ( day){
            case 0:  printf (“Sunday\n”) ;
                         break ;
            case 1:  printf (“Monday\n”) ;
                        break ;
            case 2:  printf (“Tuesday\n”) ;
                        break ;
            case 3:  printf (“Wednesday\n”) ;
                        break ;
            case 4:  printf (“Thursday\n”) ;
                        break ;
            case 5:  printf (“Friday\n”) ;
                        break ;
            case 6:  printf (“Saturday\n”) ;
                        break ;
            default:  printf (“Error -- invalid day.\n”) ;
                        break ;
}
```

Equivalent If-else code

```
if (day == 0 ) {
    printf (“Sunday”) ;
} else if (day == 1 ) {
    printf (“Monday”) ;
} else if (day == 2) {
    printf (“Tuesday”) ;
} else if (day == 3) {
    printf (“Wednesday”) ;
} else if (day == 4) {
    printf (“Thursday”) ;
} else if (day == 5) {
    printf (“Friday”) ;
} else if (day == 6) {
    printf (“Saturday”) ;
} else {
    printf (“Error - invalid day.\n”) ;
}
```

Is the if-else structure more elegant than the corresponding switch statement? Why?

Homework 1

- Write a program that prompts the user to input the boiling point in degree Celsius.
- The program should output the substance corresponding to the boiling point listed in the table.
- The program should output the message “substance unknown” when it does not match any substance.

Substance	Boiling point
Water	100°C
Mercury	357°C
Copper	1187°C
Silver	2193°C
Gold	2660°C

- Read student mark out of 100.
- Print grade to be awarded as per the rule shown.

Mark	Grade
0 to 35	F
35 to 50	P
50 to 60	D
60 to 70	C
70 to 80	B
80 to 90	A
90 to 100	EX

Why Use a switch Statement?

- A nested if-else structure is just as efficient as a switch statement.
  - A switch statement is easier to read.
  - Also, it is easier to add new cases to a switch statement than to a nested if-else structure.

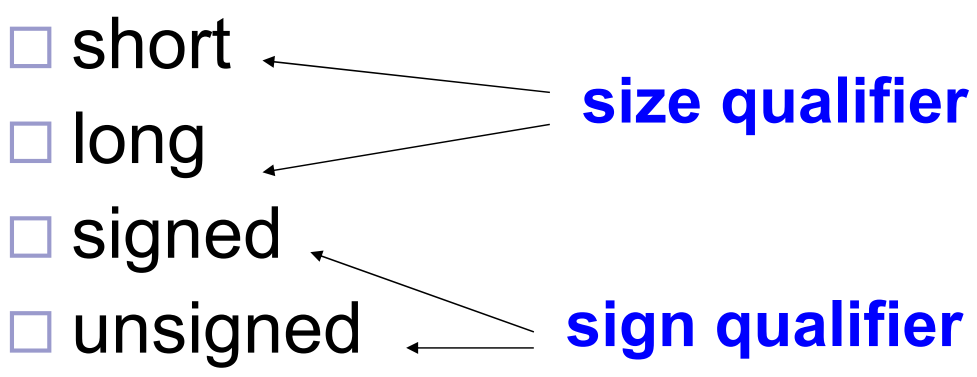
The break Statement

- Used to exit from a switch or terminate from a loop
- With respect to “switch”, the “break” statement causes a transfer of control out of the entire “switch” statement, to the first statement following the “switch” statement
- Can be used with other statements also …(will show later)

More on Data Types

More Data Types in C

- Some of the basic data types can be augmented by using certain data type qualifiers:



- □ short
- □ long
- □ signed
- □ unsigned

size qualifier

sign qualifier

- Typical examples:
  - □ short int (usually 2 bytes)
  - □ long int (usually 4 bytes)
  - □ unsigned int (usually 4 bytes, but cannot store + or -)

Some typical sizes (some of these can vary depending on type of machine)

Integer data type	#Bits	Minimum value	Maximum value
char	8	$-2^{7} = -128$	$2^{7}-1 = 127$
short int	16	$-2^{15} = -32768$	$2^{15}-1 = 32767$
int	32	$-2^{31} = -2147483648$	$2^{31}-1 = 2147483647$
long int	32	$-2^{31} = -2147483648$	$2^{31}-1 = 2147483647$
long long int	64	$-2^{63}= -9223372036854775808$	$2^{63}-1 = 9223372036854775807$
unsigned char	8	0	$2^{8}-1 = 255$
unsigned short int	16	0	$2^{16}-1 = 65535$
unsigned int	32	0	$2^{32}-1 = 4294967295$
unsigned long int	32	0	$2^{32}-1 = 4294967295$
unsigned long long int	64	0	$2^{64}-1 = 18446744073709551615$

More on the char type

- Is actually stored as an integer internally
- Each character has an integer code associated with it (ASCII code value)
- Internally, storing a character means storing its integer code
- All operators on int are allowed on char
  - □ 32 + ‘a’ will evaluate to 32 + 97 (the integer ascii code of the character ‘a’) = 129
  - □ Same for other operators
- Can switch on chars constants in switch, as they are integer constants

Another example

```
int a;
a = ‘c’ * 3 + 5;
printf(“%d”, a);
```

Will print 302 (99*3 + 5)

(ASCII code of ‘c’ = 99)

```
char c = ‘A’;
printf(“%c = %d”, c, c);
```

Will print A = 65

(ASCII code of ‘A’ = 65)

Assigning char to int is fine. But other way round is dangerous, as size of int is larger

ASCII Code

- Each character is assigned a unique integer value (code) between 32 and 127
- The code of a character is represented by an 8-bit unit.
  - □ Since an 8-bit unit can hold a total of 2^8=256 values and the computer character set is much smaller than that, some values of this 8-bit unit do not correspond to visible characters
- But not a good idea to remember exact ASCII codes while programming. Use the facts that
  - □ C stores characters as integers
  - □ Ascii codes of some important characters are contiguous (digits, lowercase alphabets, uppercase alphabets)

Decimal	Hex	Binary	Character	Decimal	Hex	Binary	Character
32	20	00100000	SPACE	80	50	01010000	P
33	21	00100001	!	81	51	01010001	Q
34	22	00100010	"	82	52	01010010	R
35	23	00100011	#	83	53	01010011	S
36	24	00100100	$	84	54	01010100	T
37	25	00100101	%	85	55	01010101	U
38	26	00100110	&	86	56	01010110	V
39	27	00100111	'	87	57	01010111	W
40	28	00101000	(	88	58	01011000	X
41	29	00101001	)	89	59	01011001	Y
42	2a	00101010	*	90	5a	01011010	Z
43	2b	00101011	+	91	5b	01011011	[
44	2c	00101100	,	92	5c	01011100	\
45	2d	00101101	-	93	5d	01011101	]
46	2e	00101110	.	94	5e	01011110	^
47	2f	00101111	/	95	5f	01011111	_
48	30	00110000	0	96	60	01100000	`
49	31	00110001	1	97	61	01100001	a
50	32	00110010	2	98	62	01100010	b

51	33	00110011	3	99	63	01100011	c
52	34	00110100	4	100	64	01100100	d
53	35	00110101	5	101	65	01100101	e
54	36	00110110	6	102	66	01100110	f
55	37	00110111	7	103	67	01100111	g
56	38	00111000	8	104	68	01101000	h
57	39	00111001	9	105	69	01101001	i
58	3a	00111010	:	106	6a	01101010	j
59	3b	00111011	;	107	6b	01101011	k
60	3c	00111100	<	108	6c	01101100	l
61	3d	00111101	=	109	6d	01101101	m
62	3e	00111110	>	110	6e	01101110	n
63	3f	00111111	?	111	6f	01101111	o
64	40	01000000	@	112	70	01110000	p
65	41	01000001	A	113	71	01110001	q
66	42	01000010	B	114	72	01110010	r
67	43	01000011	C	115	73	01110011	s
68	44	01000100	D	116	74	01110100	t
69	45	01000101	E	117	75	01110101	u
70	46	01000110	F	118	76	01110110	v

71	47	01000111	G		119	77	01110111	w
72	48	01001000	H		120	78	01111000	x
73	49	01001001	I		121	79	01111001	y
74	4a	01001010	J		122	7a	01111010	z
75	4b	01001011	K		123	7b	01111011	{
76	4c	01001100	L		124	7c	01111100	|
77	4d	01001101	M		125	7d	01111101	}
78	4e	01001110	N		126	7e	01111110	~
79	4f	01001111	O		127	7f	01111111	DELETE

Quiz…

Expression	Value?
‘9’ >= ‘0’	1 (true)
‘a’ < ‘e’	1 (true)
‘Z’ == ‘z’	0 (false)
‘a’ <= ‘A’	0 (false)

Example: checking if a character is a lowercase alphabet

```
int main()
{   /* Read a character and display whether it is lower case or upper case */
          char c1;
          scanf(“%c”, &c1);
        /* the ascii code of c1 must lie between the
           ascii codes of ‘a’ and ‘z’ */
          if (c1 >= ‘a’ && c1<= ‘z’)
              printf(“%c is a lowercase alphabet\n”, c1);
          else printf(“%c is not a lowercase alphabet\n”, c1);
          return 0;
}
```

Example: converting a character from lowercase to uppercase

```
int main()
{
        char c1;
        scanf(“%c”, &c1);
        /* convert to uppercase if lowercase, else leave as it is */
        if (c1 >= ‘a’ && c1<= ‘z’)
        /* since ascii codes of uppercase letters are contiguous, the
           uppercase version of c1 will be as far away from the ascii code
           of ‘A’ as it is from the ascii code of ‘a’ */
        c1 = ‘A’ + (c1 – ‘a’);
        printf((“The letter is %c\n”, c1);
        return 0;
}
```

Exercise

- Write a program that:
  - When the user enters a or A, displays “First letter”
  - When the user enters z or Z, displays “last letter”.
  - For any other letter entered by the user it displays “middle letter”.

Switching with char type

```
char letter;
scanf(“%c”, &letter);
switch ( letter ) {
    case 'A':
            printf ("First letter \n");
            break;
    case 'Z':
            printf ("Last letter \n");
            break;
    default :
            printf ("Middle letter \n");
}
```

Switching with char type

```
char letter;
scanf(“%c”, &letter);
switch ( letter ) {
    case 'A':
            printf ("First letter \n");
            break;
    case 'Z':
            printf ("Last letter \n");
            break;
    default :
            printf ("Middle letter \n");
}
```

Will print this statement for all letters other than A or Z

Another Example

```
switch (choice = getchar()) {
    case ‘r’ :
    case ‘R’: printf(“Red”);
              break;
    case ‘b’ :
    case ‘B’ : printf(“Blue”);
             break;
    case ‘g’ :
    case ‘G’: printf(“Green”);
             break;
    default: printf(“Black”);
}
```

Another Example

```
switch (choice = getchar()) {
    case ‘r’ :
    case ‘R’: printf(“Red”);
                break;
    case ‘b’ :
    case ‘B’ : printf(“Blue”);
               break;
    case ‘g’ :
    case ‘G’: printf(“Green”);
               break;
    default: printf(“Black”);
}
```

Since there isn’t a break statement here, the control passes to the next statement (printf) without checking the next condition.

Evaluating expressions

```
int main () {
      int operand1, operand2;
      int result = 0;
      char operation ;
      /* Get the input values */
      printf (“Enter operand1 :”);
      scanf(“%d”,&operand1) ;
      printf (“Enter operation :”);
      scanf (“\n%c”,&operation);
      printf (“Enter operand 2 :”);
      scanf (“%d”, &operand2);
      switch (operation)    {
      case ‘+’ :
            result=operand1+operand2;
           break;
```

```
     case ‘-’ :
                 result=operand1-operand2;
                 break;
     case ‘*’ :
                 result=operand1*operand2;
                 break;
     case ‘/’ :
                 if (operand2 !=0)
                    result=operand1/operand2;
                 else
                    printf(“Divide by 0 error”);
                 break;
     default:
                 printf(“Invalid operation\n”);
           return;
     }
     printf (“The answer is %d\n”,result);
     return 0;
}
```

Practice Problems

1. Read in 3 integers and print a message if any one of them is equal to the sum of the other two.
2. Read in the coordinates of two points and print the equation of the line joining them in y = mx +c form.
3. Read in the coordinates of 3 points in 2-d plane and check if they are collinear. Print a suitable message.
4. Read in the coordinates of a point, and the center and radius of a circle. Check and print if the point is inside or outside the circle.
5. Read in the coefficients a, b, c of the quadratic equation $ax^2 + bx + c = 0$, and print its roots nicely (for imaginary roots, print in x + iy form)
6. Suppose the digits 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 are mapped to the lowercase letters a, b, c, d, e, f, g, h, i, j respectively. Read in a single digit integer as a character (using %c in scanf) and print its corresponding lowercase letter. Do this both using switch and without using switch (two programs). Do not use any ascii code value directly.
7. Suppose that you have to print the grades of a student, with >= 90 marks getting EX, 80-89 getting A, 70-79 getting B, 60-69 getting C, 50-59 getting D, 35-49 getting P and <30 getting F. Read in the marks of a student and print his/her grade.