Conditional Statement

Program and Algorithm

- Swap two elements
- Search an element from the list
- …

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

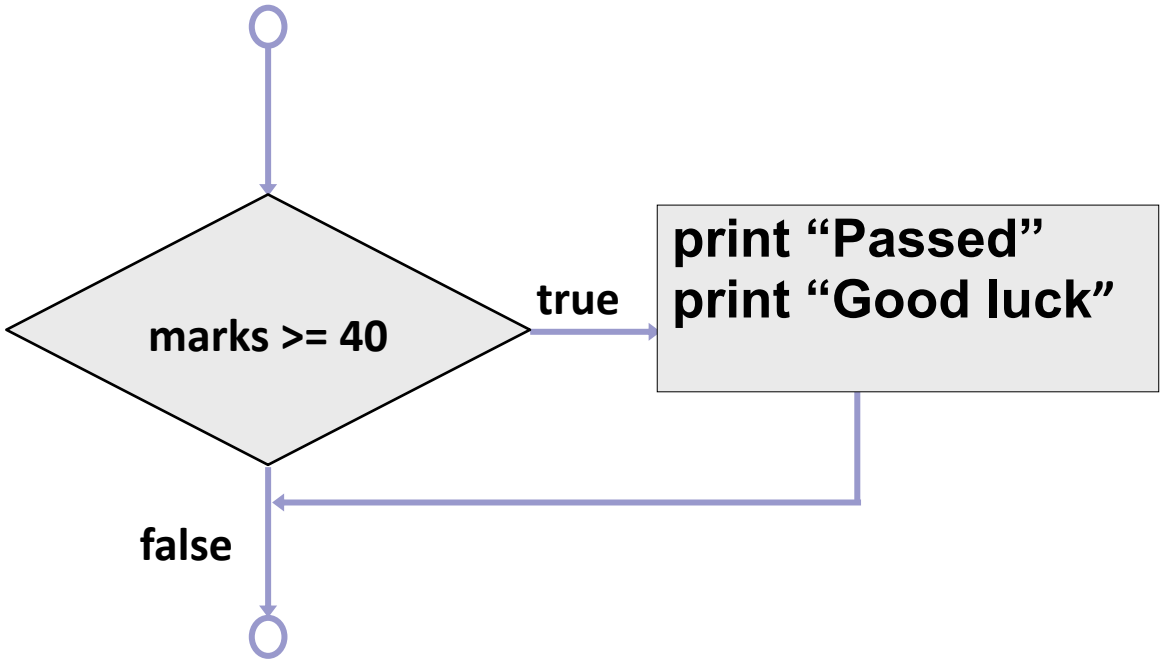
Branching: if Statement

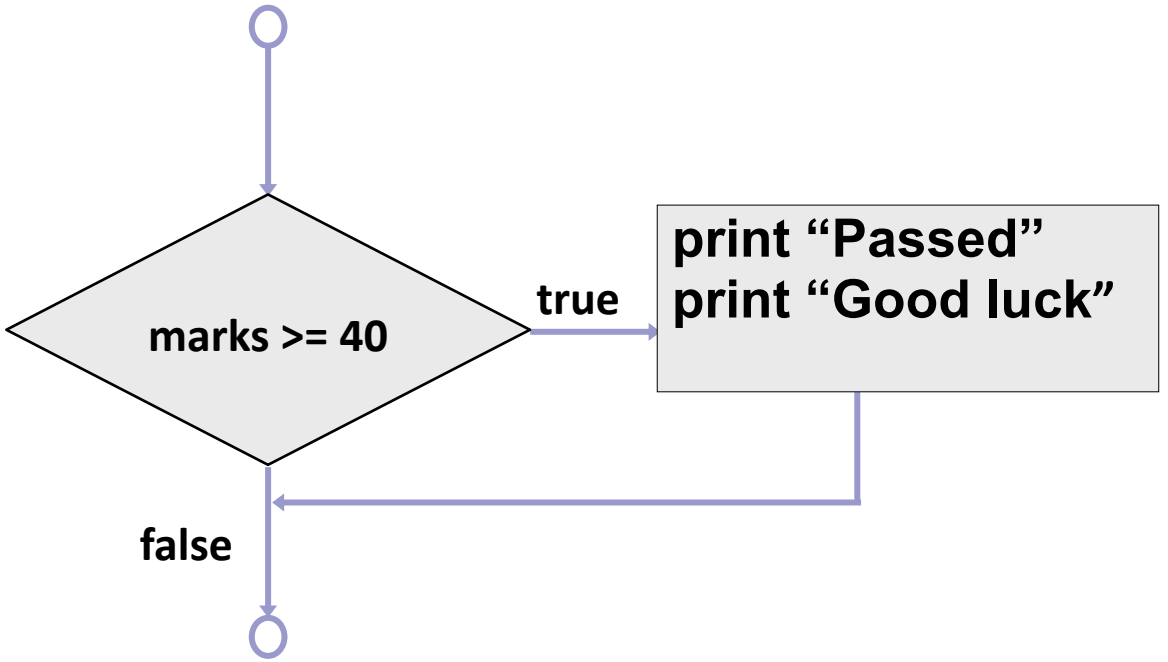
```
if (expression)
        statement;

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

Branching: if Statement

```
if (expression)
        statement;

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

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

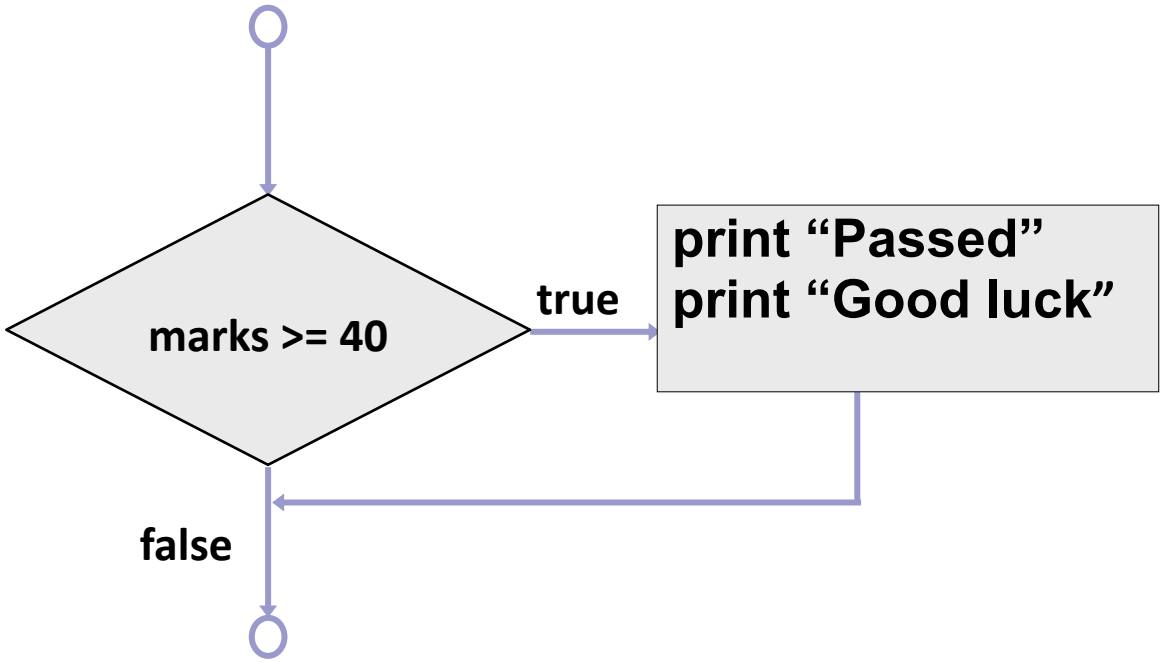

marks >= 40
true
print “Passed”
print “Good luck”
false



A decision can be made on any expression.

zero - false

nonzero - true



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”) ;
```

Branching: if-else Statement

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

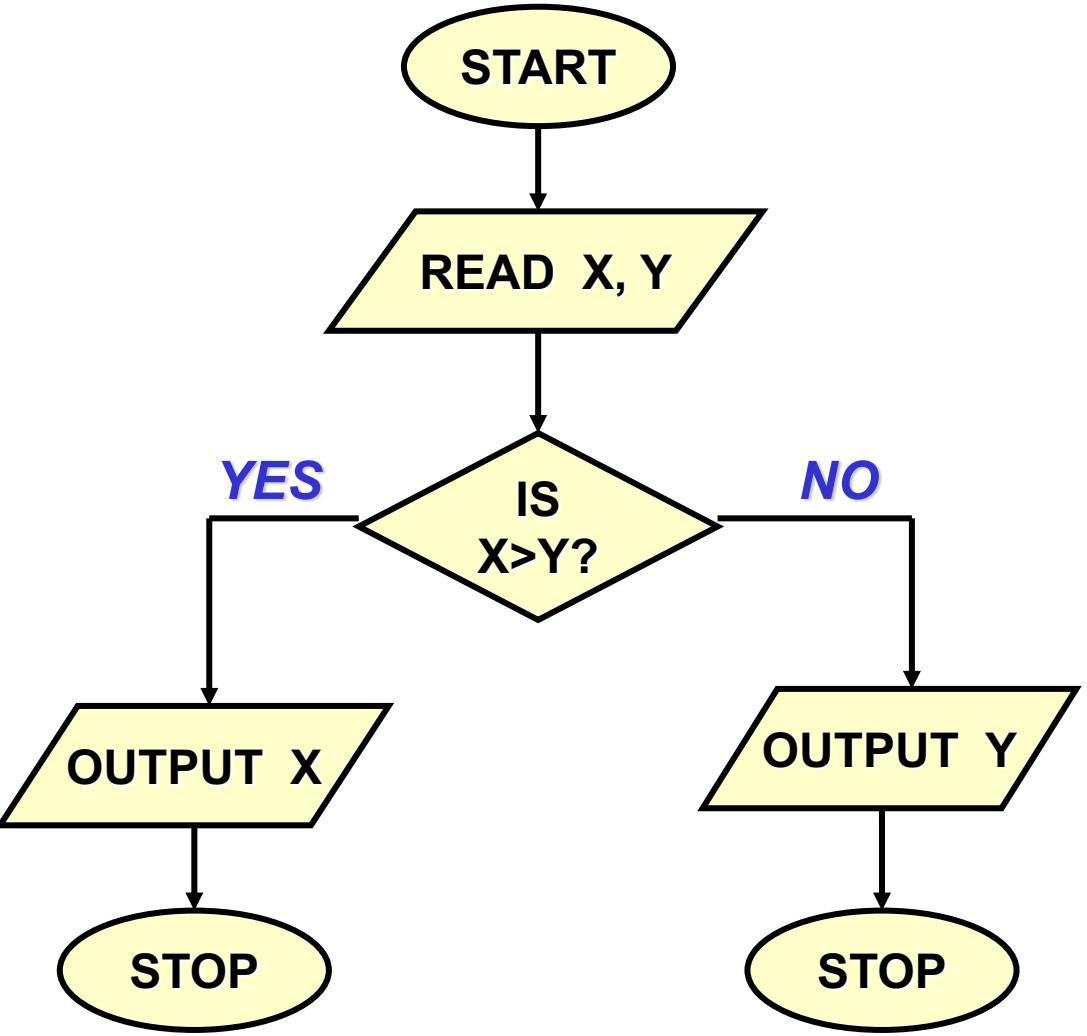
```
if (expression) {
    Block of statements;
}
else if  (expression) {
    Block of statements;
}
else {
    Block of statements;
}
```

Grade Computation

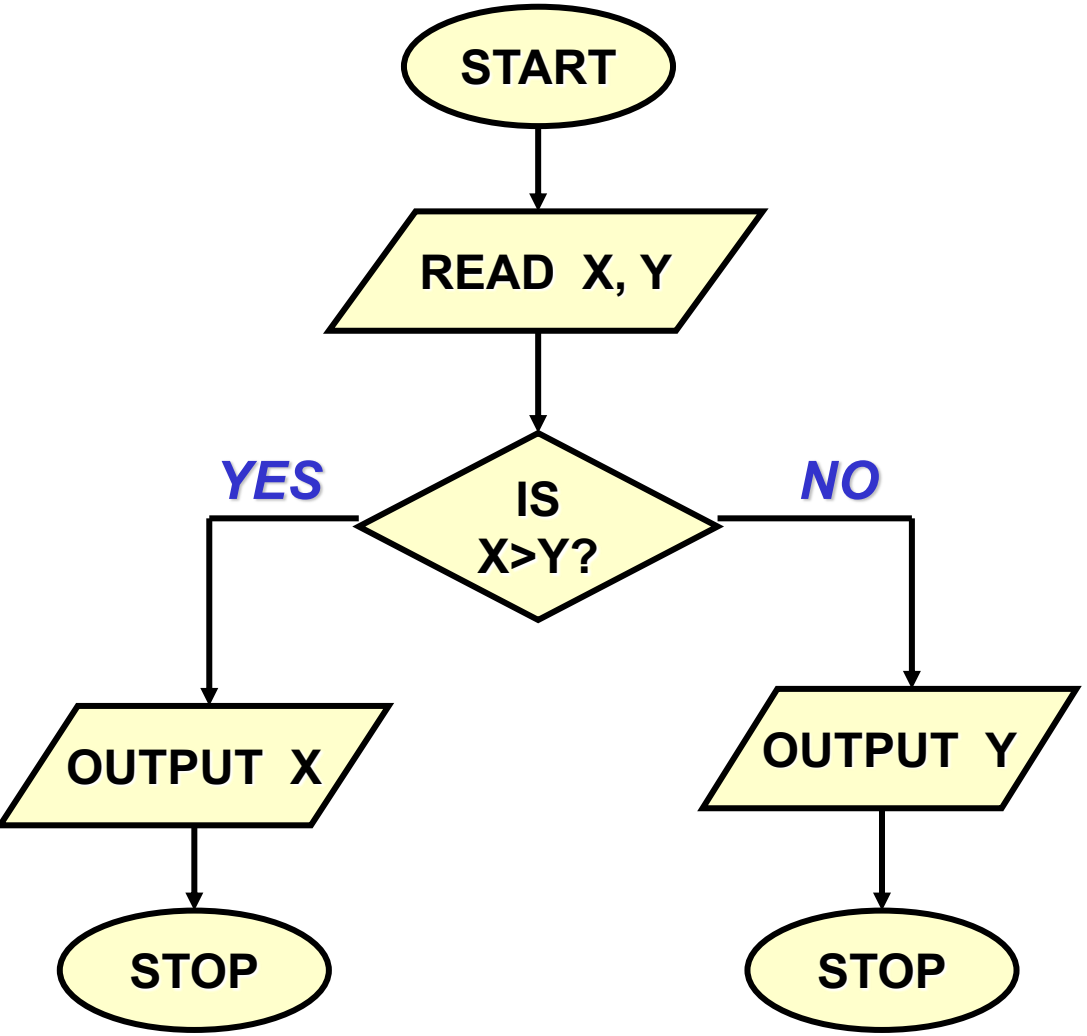
```
void main()  {
    int marks;
    scanf("%d", &marks);
    if (marks >= 80)
        printf ("A") ;
   else if (marks >= 70)
        printf ("B") ;
    else if (marks >= 60)
        printf ("C") ;
     else printf ("Failed") ;
}
```

```
void 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 for the supplementary”) ;
     }
}
```

Find the larger of two numbers

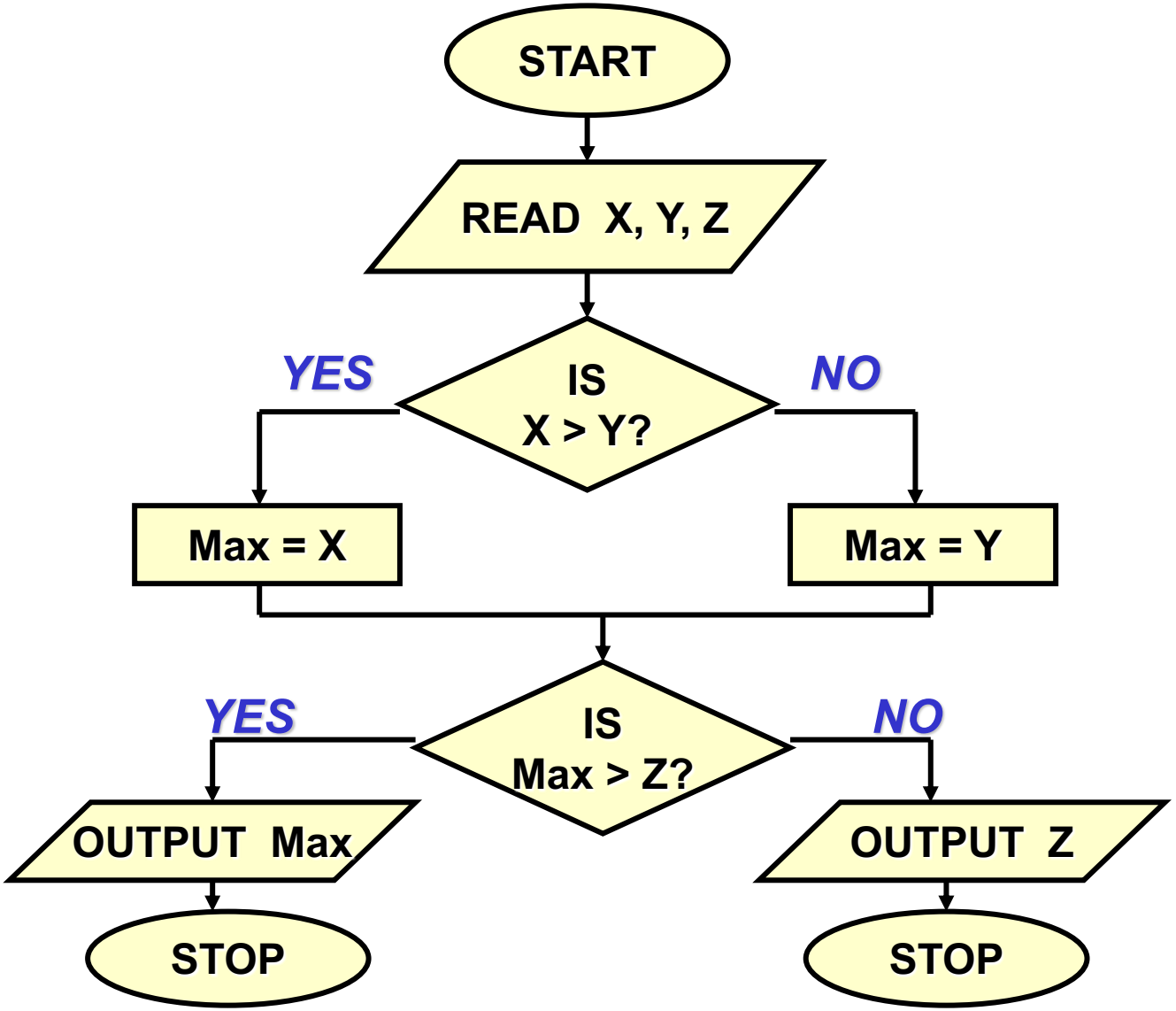


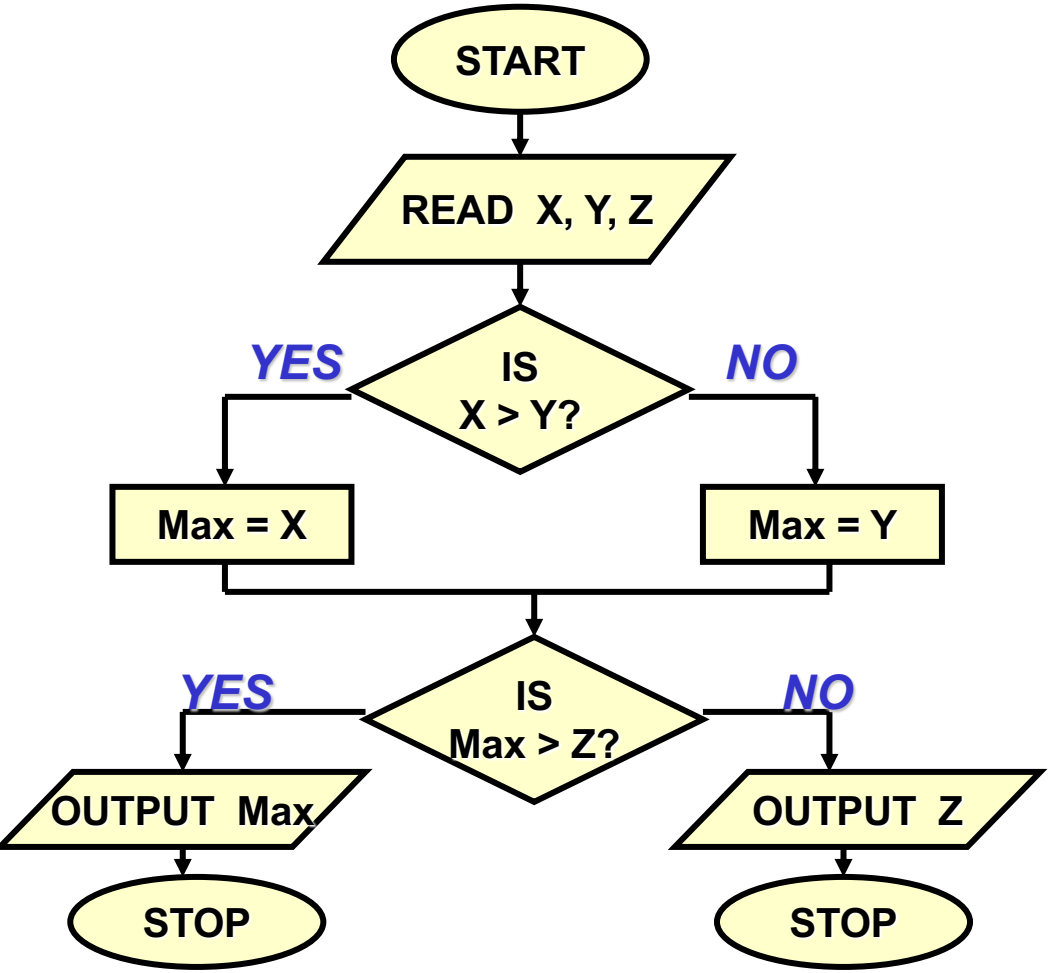
Find the larger of two numbers

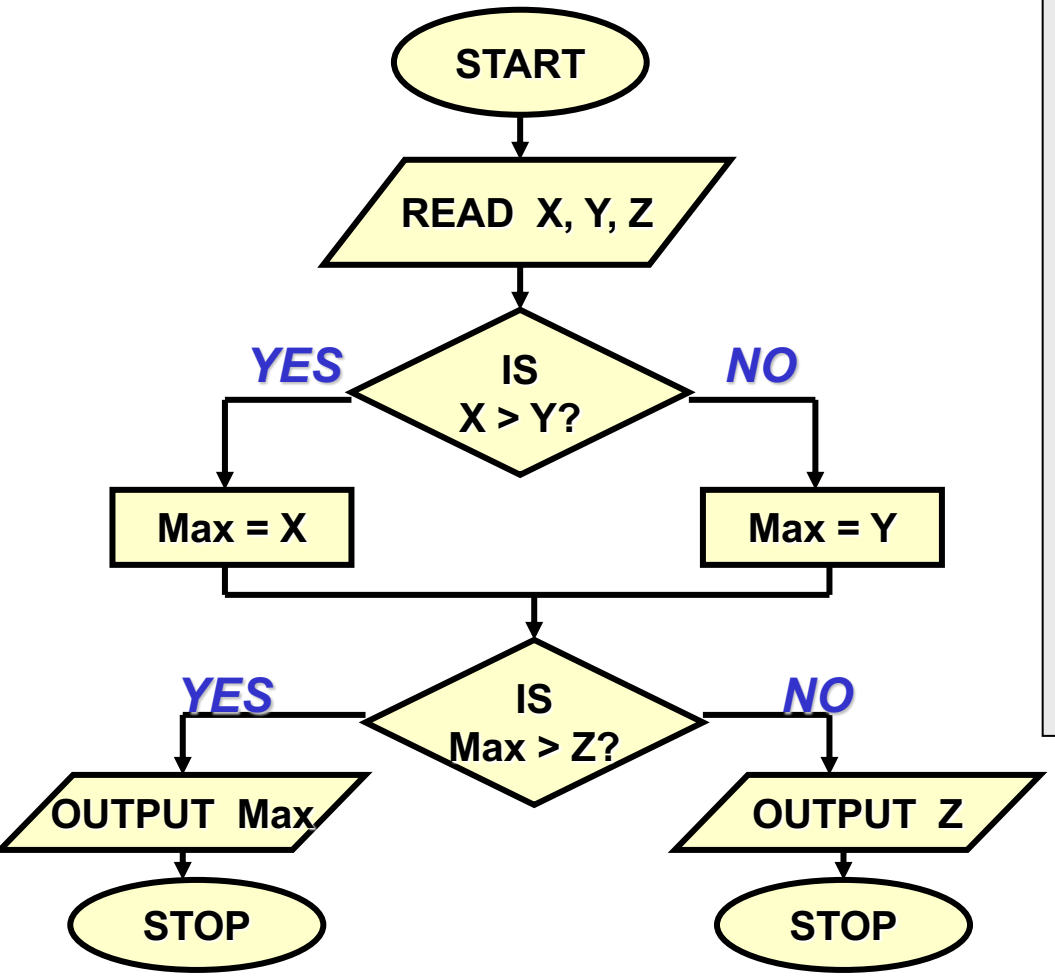



```
void main () {
    int x, y;
    scanf (“%d%d”, &x,
    &y) ;
    if (x > y)
        printf (“%d\n”, x);
    else
        printf (“%d\n”, y);
}
```

Largest of three numbers




START
READ X, Y, Z
YES
IS
X > Y?
NO
Max = X
Max = Y
YES
IS
Max > Z?
NO
OUTPUT Max
OUTPUT Z
STOP
STOP




```
void 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);
}
```

Another version

```
void 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);
}
```

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:

WRONG! Will always print the line

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

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
  - 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
```

Answers

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

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

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

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

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

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

The Conditional Operator ?:

- This makes use of an expression that is either non-0 or 0. An appropriate value is selected, depending on the value of the expression
- 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;
```

More Examples

- ```
  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");
```

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

Example

```
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

switch-1.c

Correct Program

```
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.

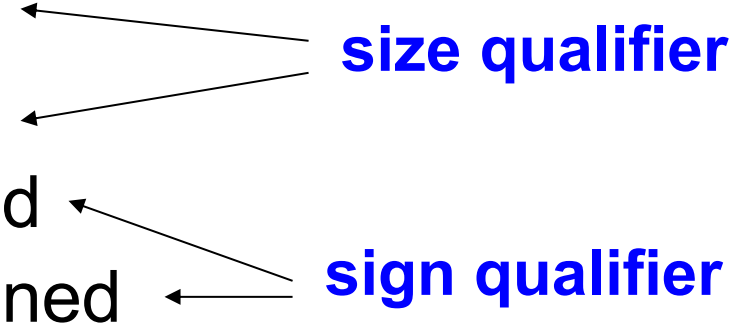
The break Statement

- 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



- Typical examples:
  - short int (usually 2 bytes)
  - long int (usually 4 bytes)
  - unsigned int (usually 4 bytes, but no way to store + or -)

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

Integer data type	Bit size	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 an integer type internally
- Each character has an integer code associated with it (ASCII code value)
- Internally, storing a character means storing its integer code
- All operators that are allowed 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 296 (97*3 + 5)

(ASCII code of ‘c’ = 97

```
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

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

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

```
void 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);
}
```

The bool type

- Used to store boolean variables, like flags to check if a condition is true or false
- Can take only two values, true and false

```
bool negative = false;
int n;
scanf(%d”, &n);
if (n < 0) negative = true;
```

- Internally, false is represented by 0, true is usually represented by 1 but can be different (print a bool variable with %d to see what you get)
- More compact storage internally