Tutorial 3- Solution

Objectives: To practice with
- Relational and logical operators
- if…else and switch selection statements

1. Suppose integer variables `x=3, y=0, z=-4`, what is the value of each of the following expressions `true` or `false`?

`a. x >= 0 && y <= 0`	Answer:	**true**
`b. x != y || x != z`	Answer:	**true**
`c. ++x > 3 && y++ == 0`	Answer:	**true**
`d. !(x != y)`	Answer:	***false***
`e. x > 0 && 'B' < 'A'`	Answer:	***false***

Further clarification:
Using the C language operators' precedence and associativity, the above expressions are evaluated as follows

```
a. x >= 0 && y <= b  as  (x >= 0) && (y <= b)
b. x != y || x != z  as  (x != y) || (x != z)
c. ++x > 3 && y++ ==0   as (++x > 3) && (y++ ==0), the old current value
   of y is used first in the expression before being incremented at the
   end
d. !(x != y)
e. x > 0 && 'B' <'A'     as (x > 0) && ('B' <'A')
```

Operators Precedence
function calls, (…), postfix ++, --
! + - & (unary operator)
* / %
+ -
< <= >= >
== !=
&&
||
=

2. What is Short-Circuit Evaluation? Evaluate the following expressions and variables?

```
bool flag;
int   x, y;
```

```
a. x=y=10;
   flag = x>0 || y++;

b. x=y=10;
   flag = x<0 && --y;

c. x=y=10;
   if( x==10 && ++y>10 )
     flag = true;
   else flag= false;
```

flag = true	**y = 10**
flag = false	**y = 10**
flag = true	**y = 11**

Answer:
Please refer to the precedence operators table above, or check the most complete one in Lecture 1, slide 46 or condstat_supp , slide 7

Short-Circuit Evaluation: C stops further evaluation of an expression when the result becomes obvious.

- x=y=10 is equivalent to x=(y=10), associativity of '=' is from right to left, which leads x=10;
  The expression `x>0 || y++; is grouped as (x>0) || (y++);`

in the *flag* statement, x>0 is true and given the || operator, the right side of the expression won't be evaluated as the while expression is true regardless. Therefore, y is not updated.

- In this case, the expression `x<0 && --y; is grouped as (x<0) && (--y);`
  Given the value of x, (x<0) is false, therefore the whole expression is false and --y" is not executed.
- The expression x==10 && ++y>10 corresponds to (x==10) && ((++yy)>10)
  As X==10 is true , the (++yy>10) will be evaluated to calculate the Boolean value of the whole and expression. Given the precedence of the operator, y gets incremented first before being compared to 10. This sets the whole expression to True.

3. Suppose an integer `number = 5` What is the output:

a.

```
if(number < 3)
     printf("1\n");
else if(number == 5)
     printf("2\n");
else
     printf("3\n");
```

Answer: **2**

```
b. if(number < 3)
       if(number == 5)
           printf("1\n");
       else
          printf("2\n");
   else
           printf("3\n");
```

Answer: **3**

```
. if(number < 3)
       if(number == 5)
           printf("1\n");
       else
          printf("2\n");
        else
           printf("3\n");
```

would give the same output. The compiler going through the lines of the program as per their order, pairs "else" with the first free preceding "if"

4. Suppose integers x=0, y=0, z=1. What are the values of x, y and z after executing the code:

```
switch ( x )
{
   case 0:  y=2;
            z=3;
   case 1:  y=4;
            break;
   default: z=0;
}
```

Answer: **x = 0 y = 4 z = 3**

Case 0 statements are executed, since we did not add a "break; statement", the following statements in the switch case will get executed unless a" break; statement" is encountered; it is the break; statement which takes the code out of the switch block

5. Write an expression to test for each of the following relationships.

a. Age is from 18 to 21 inclusive.
b. water is less than 1.5 and also greater than 0.1.
c. year is divisible by 4. (*Hint:* Use %.)
d. speed is not greater than 55.
e. y is greater than x and less than z.
f. w is either equal to 6 or not greater than 3.

```
a. age >= 18 && age <= 21
   The expression 18<=age<=21 would be equivalent to (18<=age)<=21;
   its resulting value is therefore always true as 18<= age can be
   either 0 or 1 which is always <=21
```

```
b. water < 1.5 && water > 0.1
c. year % 4 == 0
d. speed <= 55
e. y > x && y < z
f. w == 6 || w <= 3
```

6. Write assignment statements for the following:

a. Assign a value of 0 to `between` if `n` is less than −`k` or greater than +`k`; otherwise, assign 1.
b. Assign a value of 1 to `divisor` if `digit` is a divisor of `num`; otherwise, assign a value of 0, including the case `digit` = 0.
c. Assign a value of 1 to `lowercase` if `ch` is a lowercase letter; otherwise, a value of 0.

```
a. if (n < -k || n > k)
        between = 0;
   else
      between = 1;
```

The value of between is hence the opposite of the if condition, we can thus write: `between = !(n < -k || n > k);`

```
b. if (digit == 0)            /* check for divide by 0 before attempting division */
           divisor = 0;
  else if (num % digit == 0)
           divisor = 1;
  else
           divisor = 0;
```

another elegant answer:

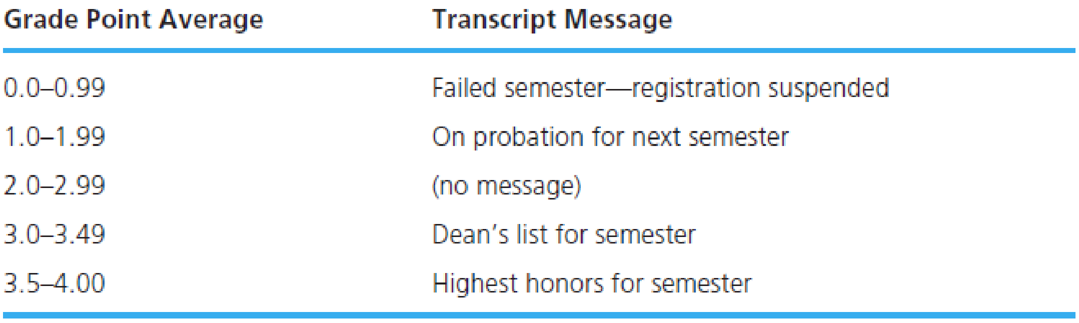
```
  switch(digit){
  case 0: divisor =0; break;
  default: if (num % digit == 0)
           divisor = 1;
            else
           divisor = 0;
}
```

```
c. if (ch >= 'a' && ch <= 'z')
           lowercase = 1;
  else
           lowercase = 0;
```

7. Write an `if` statement that displays an acceptance message for an astronaut candidate if the person's weight is between the values of `opt_min` and `opt_max` inclusive, the person's age is between `age_min` and `age_max` inclusive, and the person is a nonsmoker (`smoker` is false).

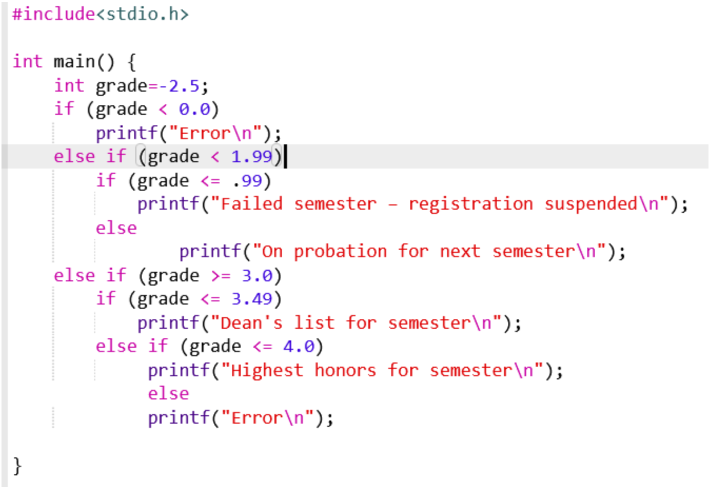
```
if (weight >= opt_min  &&  weight <= opt_max  && age >= age_min  &&
    age <= age_max  && !smoker)

      printf("Acceptable astronaut candidate.\n");
```

8. **Implement the following decision table using a nested if statement. Assume that the grade point average is within the range 0.0 through 4.0.**



Grade Point Average	Transcript Message
0.0–0.99	Failed semester—registration suspended
1.0–1.99	On probation for next semester
2.0–2.99	(no message)
3.0–3.49	Dean’s list for semester
3.5–4.00	Highest honors for semester

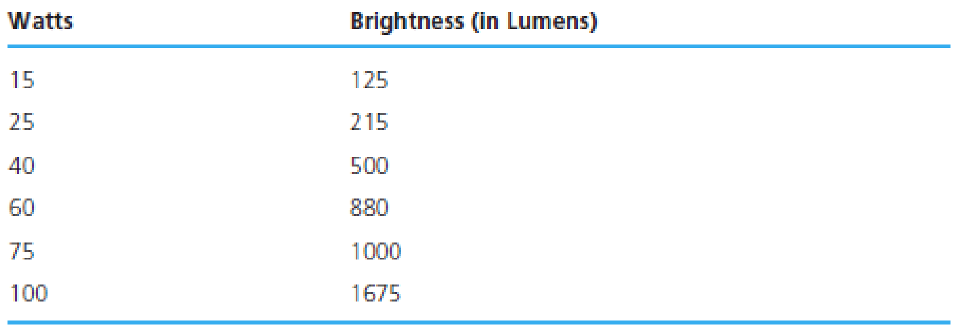
Answer:



```
#include<stdio.h>

int main() {
    int grade=-2.5;
    if (grade < 0.0)
        printf("Error\n");
    else if (grade < 1.99)
        if (grade <= .99)
            printf("Failed semester – registration suspended\n");
        else
                printf("On probation for next semester\n");
    else if (grade >= 3.0)
        if (grade <= 3.49)
            printf("Dean's list for semester\n");
        else if (grade <= 4.0)
             printf("Highest honors for semester\n");
             else
             printf("Error\n");

}
```

Good indentation helps a lot to understand the correct “else” – “if” pairing

9. **Write a switch statement that assigns to the variable `lumens` the expected brightness of a standard light bulb whose wattage has been stored in `watts`. Use this table:**

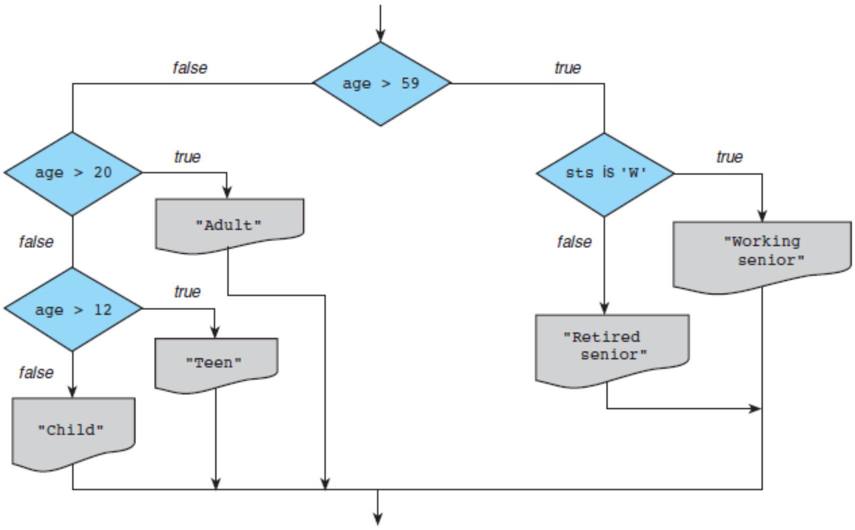


Watts	Brightness (in Lumens)
15	125
25	215
40	500
60	880
75	1000
100	1675

Assign −1 to lumens if the value of watts is not in the table.

```
switch (watts) {
case 15:
   lumens = 125;
   break;

case 25:
   lumens = 215;
   break;

case 40:
   lumens = 500;
   break;

case 60:
   lumens = 880;
   break;

case 75:
   lumens = 1000;
   break;

case 100:
   lumens = 1675;
   break;

default:
   printf("\nError: Unknown lumens.");
   lumens = -1;}
```

10. Implement the flow diagram in below Fig. using a nested if structure.



```
if (age > 59)
    if ( sts == 'W')
       printf("Working senior\n");
    else
       printf("Retired senior\n");
else if (age > 20)
    printf("Adult\n");
else if (age > 12)
    printf("Teen\n");
else
    printf("Child\n");
```

11. Write an interactive program that contains an if statement that may be used to compute the area of a square (area = *side*^{2}) or a circle (area = π × *radius*^{2}) after prompting the user to type the first character of the figure name (S or C).

```
#include <stdio.h>

/* Different type shapes to compute area for. */
#define SELECT_CIRCLE 'C'      /* Type Circle */
#define SELECT_SQUARE 'S'     /* Type Square */
#define PI 3.14159265

int main(void)
{
      char type;     /* Type of shape. */
      double  area, side_base, radius;

     /* Display menu and get the type of shape to compute the
        area. */
      printf("Enter a:\n");
      printf("   %c -- To compute the area of a circle.\n",
             SELECT_CIRCLE);
      printf("   %c -- To compute the area of a square.\n",
             SELECT_SQUARE);
      printf("Select> ");
      scanf("%c", &type);

      /* Compute the area of different shapes. */
      if (type == SELECT_CIRCLE) {
      /* Get information for CIRCLE radius needed to
      compute the area. */
            printf("Enter radius> ");
            scanf("%lf", &radius);
            area = PI * radius * radius;
            printf("The area of the circle is %.4f\n", area);
      } else {
       /* Get information for SQUARE edge needed to
       compute the area. */
            if (type == SELECT_SQUARE) {
               printf("Enter side> ");
               scanf("%d", &side_base);
               area = side_base * side_base;
               printf("The area of the square is %d\n", area);
            } else {
               printf("ERROR: Invalid selection.\n");
            }
      }

      return (0);
}
```

See attached tut3_ex11 for another solution to this question.