

CS1010E Programming Methodology

Semester 1 2016/2017

Week of 29 August – 2 September 2016

Tutorial 2 Suggested Answers

Control Structures – Selection

1. The following program fragment determines the maximum of three possibly duplicating integers.

```
if ((a >= b) && (a >= c)) {
    max = a;
}
if ((b >= a) && (b >= c)) {
    max = b;
}
if ((c >= a) && (c >= b)) {
    max = c;
}
```

For each of the following code fragments below, fill in the missing parts .. so that it can be used in place of the selection constructs in the above program to effectively output the maximum of three input values.

- (a)

```
if ((a >= b) && (a >= c)) /* or simply ((a > b) && (a > c)) */
    max = a;
else
    if ((b >= a) && (b >= c)) /* or simply (b > c) */
        max = b;
    else
        max = c;
```
- (b)

```
max = a;
if (b > max)
    max = b;
if (c > max)
    max = c;
```
- (c)

```
if (a > b)
    if (a > c)
        max = a;
    else
        max = c;
else
    if (b > c)
        max = b;
    else
        max = c;
```

2. Study the following program fragment.

```
if (a > 0)
    if (a >= 1000)
        a = 0;
    else
        if (a < 500)
            a = a * 2;
        else
            a = a * 10;
else
    a = a + 3;
```

Deduce the functionality of the program fragment and re-compose the nested `if..else` statements into a form that is easier to understand.

Careful trace of all possible paths of the nested if..else statements gives the following:

- *a is set to 0 if $a \geq 1000$;*
- *a is multiplied by 10 if $500 \leq a < 1000$;*
- *a is multiplied by 2 if $0 < a < 500$;*
- *a is incremented by 3 if $a \leq 0$;*

Re-composing the nested if..else statements in order of largest to smallest possible values of a into the following form which is easier to read and understand:

```
if (a >= 1000)
    a = 0;
else
    if (a >= 500)
        a = a * 10;
    else
        if (a > 0)
            a = a * 2;
        else
            a = a + 3;
```

3. The following rules describe a way to determine if a year is a leap year or otherwise.

- 2000, 2004, 2008, ... are leap years; however
- 2100, 2200, 2300, 2500, 2600, 2700, ... are not; but
- 2000, 2400, 2800, ... are.
- All other years are not.

Write a program that accepts a year and determines whether it is a leap year or otherwise. Assume that the year spans from 1 to 9999. The following are several sample runs of the program. User input is underlined.

- Enter year: 2000
Year 2000 is a leap year.
- Enter year: 1900
Year 1900 is not a leap year.
- Enter year: 2012
Year 2012 is a leap year.
- Enter year: 2015
Year 2015 is not a leap year.

Implement your program in the following ways.

- (a) Using nested `if..else` with conditions involving arithmetic and relational operators. You may also use a boolean variable if you wish.

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

int main(void) {
    int year;
    bool leap = false;

    printf("Enter year: ");
    scanf("%d", &year);

    if (year%400 == 0) {
        leap = true;
    } else {
        if (year%4 == 0) {
            if (year%100 != 0) {
                leap = true;
            }
        }
    }
}
```

```

    if (leap) {
        printf("Year %d is a leap year.\n", year);
    } else {
        printf("Year %d is not a leap year.\n", year);
    }

    return 0;
}

```

(b) Using one condition comprising of arithmetic, relational and logical operators.

```

#include <stdio.h>

int main(void) {
    int year;

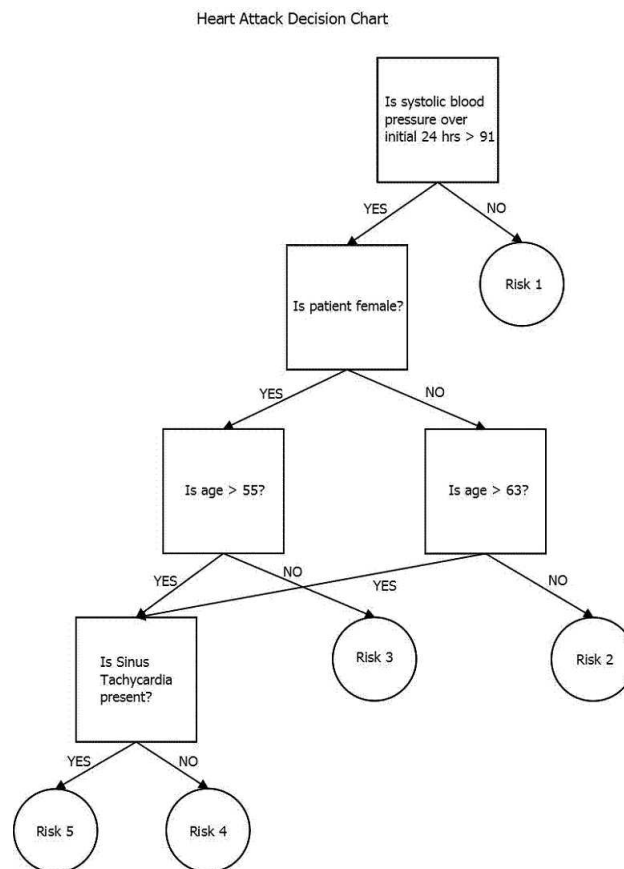
    printf("Enter year: ");
    scanf("%d", &year);

    if ((year%400 == 0) || (year%4 == 0 && year%100 != 0)) {
        printf("Year %d is a leap year.\n", year);
    } else {
        printf("Year %d is not a leap year.\n", year);
    }

    return 0;
}

```

4. The following decision chart allows doctors to decide whether a patient is at a low or high risk of having a heart attack. Note that this is a mere simplification of the actual chart.



Write a program to simulate the decision chart by first reading in four user input values representing the Systolic blood pressure, gender, age and presence of Sinus Tachycardia.

- Systolic BP: an integer value ≥ 0 ;
- Gender: 0 for male, 1 for female
- Age: integer value ≥ 0
- Presence of Sinus Tachycardia: 0 for absent, 1 for present

The program then outputs whether the patient's risk level (ranging from 1 to 5). The following is a sample run of the program. User input is underlined.

Systolic blood pressure: 135
Gender: 1
Age: 64
Presence of Sinus Tachycardia: 1
Risk level: 5

```

#include <stdio.h>

int main(void) {
    int bp, gender, age, sinus, risk;

    printf("Systolic blood pressure: ");
    scanf("%d", &bp);
    printf("Gender: ");
    scanf("%d", &gender);
    printf("Age: ");
    scanf("%d", &age);
    printf("Presence of Sinus Tachycardia: ");
    scanf("%d", &sinus);

    if (bp > 91) {
        if (gender == 1) { /* if (female) */
            if (age > 55) {
                if (sinus == 1) {
                    risk = 5;
                } else {
                    risk = 4;
                }
            } else {
                risk = 3;
            }
        } else {
            if (age > 63) {
                if (sinus == 1) {
                    risk = 5;
                } else {
                    risk = 4;
                }
            } else {
                risk = 2;
            }
        }
    } else {
        risk = 1;
    }

    printf("Risk level: %d\n", risk);

    return 0;
}

```