113 計算機組織 Homework 2_1

● Due date: 2024/10/21

1. 須符合測資。

2. MIPS code 和 C Code 結構相同:

(1) C Code 有 Loop，MIPS 須使用 jump/loop;

(2) C Code 有 Array，MIPS 須使用相對記憶體存取

(3) C Code 有 function，MIPS 須設計 function 並用 jal 呼叫

(4) function 參數變數,須使用 a 暫存器、一般區域變數,
須使用 s 暫存器、回傳資料變數須使用 v 暫存器、迴圈
索引暫時變數與儲存暫時運算結果使用 t 暫存器。

(5) 若為 caller function，**使用 v, a, t 暫存器前須先將暫存器
值存到 sp 要求的記憶體，之後要 restore。**

(6) 若為 callee function，**使用 s 暫存器前須將暫存器值存
到 sp 要求的記憶體,之後要 restore。**

請將每一題分別寫在一個 .asm 檔，EX: q1.asm
將 4 個檔案壓縮成一個檔案，上傳到 I 學園

一、BMI Calculator (35%)
```c
#include <stdlib.h>
#include <stdio.h>
int calculateBMI(int height, int weight) {
    int bmi = (weight * 10000) / (height * height);
    return bmi;
}
void printResult (int bmi) {
    if (bmi <= 17)
        printf("%s", "underweight\n");
    else if (bmi >= 25)
        printf("%s", "overweight\n");
    else
        printf("%d\n", bmi);
}
int main() {
    int height, weight,  bmi;
    while (1) {
        scanf("%d", &height);
        if (height == -1)
            break;
        scanf("%d", &weight);
        bmi = calculateBMI(height, weight);
        printResult(bmi);
    }
    return 0;
}
```

Input	Output
170	18
53	underweight
180	overweight
45	
130	
70	
-1	
165	24
66	underweight
173	21
44	
168	
60	
-1	
152	overweight
69	24
199	underweight

98	
175	
40	
-1	

二、Recursion (35%)
```c
#include <stdio.h>
void print(int size, int *x) {
    for (int i=0; i<size; i++) {
        printf("%d,",x[i]);
    }
}
int fact (int n, int *x) {
    int t=0;
    if (n < 2) {
        x[n] = t = 1;
        return t;
    }
    else {
        x[n] = t = fact(n - 1, x) + fact(n - 2, x);
        return t;
    }
}

int main() {
    int x[100];
    int n;
    x[0]=1;
    for (int i=1; i<100; i++)
        x[i]=0;
    scanf("%d", &n);
    fact(n, x);
    print(n, x);
    return 0;
}
```

Input	Output
3	1,1,2,
5	1,1,2,3,5,
8	1,1,2,3,5,8,13,21,

三、Selection sort (30%)
```c
#include <stdlib.h>
#include <stdio.h>
void selectionSort(int array[], int n) {
    for (int i=0; i<n-1; i++) {
        int min_idx = i;
        for (int j=i+1; j<n; j++) {
            if (array[j] < array[min_idx]) {
                min_idx = j;
            }
        }
        int temp = array[min_idx];
        array[min_idx] = array[i];
        array[i] = temp;
    }
}
int main() {
    int array[5];
    for (int i = 0; i < 5; i++) {
        scanf("%d", &array[i]);
    }
    selectionSort(array, 5);
    for (int i = 0; i < 5; i++)    {
        printf("%d\n", array[i]);
    }
```

```
    return 0;
}
```

Input	Output
6	2
10	4
8	6
2	8
4	10
55	11
44	22
33	33
22	44
11	55
2	1
3	2
4	3
1	4
5	5

四、Transpose of a Matrix (35%)

```c
#include <stdlib.h>
#include <stdio.h>
void inputMatrix(int A[3][3]) {
    for (int i = 0; i < 3; i++)   {
        for (int j = 0; j < 3; j++) {
            scanf("%d", &A[i][j]);
        }
    }
}
void transposeMatrixA1(int A[3][3], int T[3][3], int size) {
    for (int i = 0; i < size; i++) {
        for (int j = 0; j < size; j++)  {
            T[j][i] = A[i][j];
        }
    }
}
void transposeMatrixA2(int *B, int *T, int size) {
    int *ptrB, *ptrT, i;
    for (ptrB=B, ptrT=T, i = 1; ptrB<(B + (size*size)); ptrB++) {
        *ptrT = *ptrB;
        if (i < size)   {
            ptrT += size;
            i++;
        }
        else      {
            ptrT -= (size * (size - 1) - 1);
            i = 1;
        }
    }
}
void outputMatrix(int A[3][3]) {
    for (int i = 0; i < 3; i++)  {
        for (int j = 0; j < 3; j++)  {
            printf("%d ", A[i][j]);
        }
        printf("\n");
    }
}
int main() {
    int A[3][3];
    int transposeOfA1[3][3];
    int transposeOfA2[3][3];
    int *ptrA = &A[0][0];
    int *ptrTA2 = &transposeOfA2[0][0];
    inputMatrix(A);
    transposeMatrixA1(A, transposeOfA1, 3);
    transposeMatrixA2(ptrA, ptrTA2, 3);
    outputMatrix(transposeOfA1);
```

```
    outputMatrix(transposeOfA2);
    return 0;
}
```

input	Output
1	1 4 7
2	2 5 8
3	3 6 9
4	1 4 7
5	2 5 8
6	3 6 9
7	
8	
9	
11	11 22 33
44	44 55 66
77	77 88 99
22	11 22 33
55	44 55 66
88	77 88 99
33	
66	
99	
63	63 43 79
72	72 88 51
58	58 56 12
43	63 43 79
88	72 88 51
56	58 56 12
79	
51	
12	