

EDA Final Project

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1. Problem definition

What problem is your program to solve?

Programming Assignment 5-1: Two-Way F-M Circuit Partitione

Explain the problem.

作業紙上的敘述: Problem Descriptions: Given a net-list for a circuit, partition the circuit to two subcircuits A and B so that the cut-set of subcircuits A and B is

minimized under the constraint of $|\text{size}(A) - \text{size}(B)| < \frac{1}{100} * n$

基本上，這次的作業就是在實現 F-M Heuristic 的演算法，針對連線的 cells 之間，做出適當的分割。而這次作業在題目卷上，有希望有(如下)吃 net list 的 input format 敘述，並最後羅列 group 的 cell 和整體的 cutsize，以及最後仍說形式自由。

Input format:

```
NET n1 c2 c3 c4
NET n2 c3 c7
NET n3 c3 c5 c7
NET n4 c1 c3 c5 c7
NET n5 c2 c4 c8
NET n6 c4 c6
NET n7 c2 c6 c8
```

我認為給使用者輸入時，輸入 net 有哪些 cell 是可以的做法，如題目卷的例子，但我覺得單就例子而言，可知這樣無法輸入各 cell 的 size。所以我仍有列出，各 net 連結 cell 的狀況(如圖)，但我是讓使用者以輸入 cell 狀況的方式來進行，已讓這演算法算 cell-size 的方式得以實現。

```
input the Cell_number=6:
cell_size= 1
pin_number= 3
group= B
cell_pin01 connect the net= 4
cell_pin02 connect the net= 5
cell_pin03 connect the net= 6

Now, the situation is (Group in random condition):
Cell_number=1: Group=A Size=1 net: net1,net2
Cell_number=2: Group=A Size=1 net: net1,net3
Cell_number=3: Group=B Size=1 net: net1,net4
Cell_number=4: Group=B Size=1 net: net1,net5,net6
Cell_number=5: Group=A Size=1 net: net2,net3
Cell_number=6: Group=B Size=1 net: net4,net5,net6
Net_number=1: Net_connect_Cell_num:4 Connect Cell: Cell 1 Cell 2 Cell 3 Cell 4
Net_number=2: Net_connect_Cell_num:2 Connect Cell: Cell 1 Cell 5
Net_number=3: Net_connect_Cell_num:2 Connect Cell: Cell 2 Cell 5
Net_number=4: Net_connect_Cell_num:2 Connect Cell: Cell 3 Cell 6
Net_number=5: Net_connect_Cell_num:2 Connect Cell: Cell 4 Cell 6
Net_number=6: Net_connect_Cell_num:2 Connect Cell: Cell 4 Cell 6
Net1: from 2 to 2
Net2: from 2 to 0
Net3: from 2 to 0
Net4: from 0 to 2
Net5: from 0 to 2
Net6: from 0 to 2
Cell1 gain: -1
Cell2 gain: -1
Cell3 gain: -1
Cell4 gain: -2
Cell5 gain: -2
Cell6 gain: -3請按任意鍵繼續 . . .
```

其中一個給使用者自己輸入的cell資訊

羅列目前cell的資訊
和Net的資訊
(和講義的input format相同)

2. program explanation

對於資料的儲存，我是用 linking-list 並且如老師上課講義所羅列的，對於 cell 和 net，分別儲存(如下)。

```
typedef struct cell{//record Cell information
    char group;//decide cell in which group
    int cell_size;//decide the size of the cell
    int number;//record the number of the cell
    int gain;//count the gain of the cell
    int pin_number;//record the number of the cell pins
    int net_A,net_B,net_C;//record what net of the cell
    struct cell* link;//I use link-list to save data,so I need this to connect data
}Cell;
typedef struct net{//record Cell information
    int Net_number;//record the number of the net
    int Net_connect_cell_num[5];//record which cell connect net
    int Net_connect_cell_number;//record how many cells connect the net
    int Net_before_from,Net_before_to;//before swap cell,net_from record how many cell in the "from" part or "to" part
    int Net_after_from,Net_after_to;//before swap cell,net_from record how many cell in the "from" part or "to" part
    struct net* link;//I use link-list to save data,so I need this to connect data
}Net;
Cell *NewCell(void);//it can create a new data(cell) space in the memory
Net *NewNet(void);//it can create a new data(net) space in the memory
```

```
Cell *NewCell(void){    //it declare a new data(cell) space in the memory
    Cell *pt;
    pt = (Cell*)malloc(sizeof(Cell));
    if(pt==NULL){
        printf("Memory is not sufficient!!");
        exit(1);
    }
    return pt;
}

Net *NewNet(void){    //it declare a new data(cell) space in the memory
    Net *pt;
    pt = (Net*)malloc(sizeof(Net));
    if(pt==NULL){
        printf("Memory is not sufficient!!");
        exit(1);
    }
    return pt;
}
```

再來，對於 input，我打在 main function 中。

```
printf("Please input the number of the cell:");
scanf("%d",&Cell_num);
printf("Please input the number of the net:");
scanf("%d",&Net_num);
Head->number=1;
printf("Input the Cell_number=1:\n");
printf("Cell_size= ");
scanf("%d",&Head->cell_size);
printf("Group= ");
fflush(stdin);
scanf("%c",&Head->group);
printf("Pin_number= ");
scanf("%d",&Head->pin_number);
printf("Cell_pin01 connect the net= ");
scanf("%d",&Head->net_A);
if(Head->pin_number == 2){
    printf("Cell_pin02 connect the net= ");
    scanf("%d",&Head->net_B);
}

if( Head->pin_number >= 3){
    printf("Cell_pin02 connect the net= ");
    scanf("%d",&Head->net_B);
    printf("Cell_pin0 %d connect the net= ",Head->pin_number);
    scanf("%d",&Head->net_C);
}
```

可輸入 Cell 和 Net 的數量
也可輸入第一個 cell 的資訊。

(程式中的第 68 到 93 行則是可讓除了第一個 cell 之外，輸入資料)

輸入 Net 的資訊：

```
for(i=1;i<=Net_num;i++){
    temp=Head; //run the while in the for
    Net_temp->Net_number=i;
    j=1;
    k=0;
    while(temp!=NULL){
        if(temp->pin_number==1){
            if(temp->net_A==i){
                Net_temp->Net_connect_cell_num[k]=j;
                k++;
            }
        }
        else if(temp->pin_number==2){
            if(temp->net_A==i || temp->net_B==i){
                Net_temp->Net_connect_cell_num[k]=j;
                k++;
            }
        }
        else {
            if(temp->net_A==i || temp->net_B==i || temp->net_C==i){
                Net_temp->Net_connect_cell_num[k]=j;
                k++;
            }
        }
        temp=temp->link;
        j++;
    }
    Net_temp->Net_connect_cell_number=k;
    if(i==Net_num){
        Net_temp->link=NULL;
        break;
    }
    Net_temp->link=NewNet();
    Net_temp=Net_temp->link;
}
```

最後，是這三個 function 的功能

```
printf("\nNow, the situation is :\n");
printlist(Head,Net_Head);
gain_initial(Head,Net_Head);
swap(Head,Net_Head,Cell_num);
system("pause");
return 0;
```

分別是：

void printlist(Cell*,Net*); 將使用者輸入的 cell 資訊分析後，印出如作業上述的 input-format

void gain_initial(Cell*,Net*); 計算各 cell 初始的 gain 值

void swap(Cell*,Net*,int); 處理所有 cell 的交換程序，並結束在 total_gain<=0 的時候。

3. Program screenshot(程式執行結果)

註:我在測試時，使用的例子，是講義的第 25 頁。

我列出的 gain 值和講義計算上一樣，完全正確。(對於只有兩個 cell 的基本測試也有做，也是正確的) constraint 的條件判斷，如作業: $|\text{size(A)} - \text{size(B)}| < \frac{1}{100} * n$

```
C:\Users\ao695\Desktop\EDA_HW_104501019.exe
Please input the number of the cell:6
Please input the number of the net:6
Input the Cell_number=1:
Cell_size= 1
Group= A
Pin_number= 2
Cell_pin01 connect the net= 1
Cell_pin02 connect the net= 2

Input the Cell_number=2:
Cell_size= 1
Pin_number= 2
Group= A
Cell_pin01 connect the net= 1
Cell_pin02 connect the net= 3

Input the Cell_number=3:
Cell_size= 1
Pin_number= 2
Group= B
Cell_pin01 connect the net= 1
Cell_pin02 connect the net= 4

Input the Cell_number=4:
Cell_size= 1
Pin_number= 3
Group= B
Cell_pin01 connect the net= 1
Cell_pin02 connect the net= 5
Cell_pin03 connect the net= 6

Input the Cell_number=5:
Cell_size= 1
Pin_number= 2
Group= A
Cell_pin01 connect the net= 2
Cell_pin02 connect the net= 3

Input the Cell_number=6:
Cell_size= 1
Pin_number= 3
Group= B
Cell_pin01 connect the net= 4
Cell_pin02 connect the net= 5
Cell_pin03 connect the net= 6
```

使用者輸入情形

```
Cell_size= 1
Pin_number= 3
Group= B
Cell_pin01 connect the net= 4
Cell_pin02 connect the net= 5
Cell_pin03 connect the net= 6

Now, the situation is :
Cell_number=1: Group=A Size=1 net: net1,net2
Cell_number=2: Group=A Size=1 net: net1,net3
Cell_number=3: Group=B Size=1 net: net1,net4
Cell_number=4: Group=B Size=1 net: net1,net5,net6
Cell_number=5: Group=A Size=1 net: net2,net3
Cell_number=6: Group=B Size=1 net: net4,net5,net6
```

Cell的儲存資訊

```
input format(like the example in problem):
Net_number=1: Net_connect_Cell_num:4 Connect Cell: Cell 1 Cell 2 Cell 3 Cell 4
Net_number=2: Net_connect_Cell_num:2 Connect Cell: Cell 1 Cell 5
Net_number=3: Net_connect_Cell_num:2 Connect Cell: Cell 2 Cell 5
Net_number=4: Net_connect_Cell_num:2 Connect Cell: Cell 3 Cell 6
Net_number=5: Net_connect_Cell_num:2 Connect Cell: Cell 4 Cell 6
Net_number=6: Net_connect_Cell_num:2 Connect Cell: Cell 4 Cell 6
```

如講義上一樣的Input format

```
Net1: from 2 to 2
Net2: from 2 to 0
Net3: from 2 to 0
Net4: from 0 to 2
Net5: from 0 to 2
Net6: from 0 to 2
```

net的from以及to的情形

```
Cell1 gain: -1
Cell2 gain: -1
Cell3 gain: -1
Cell4 gain: -2
Cell5 gain: -2
Cell6 gain: -3
It's not necessary to change
```

Total gain<=0所以沒有交換必要

```
Output format:
Group A: cell1 cell2 cell5
Group B: cell3 cell4 cell6
Autsize=1
```

計算Gain值後，group分配的情形

請按任意鍵繼續 . . .