(1) Your name and student ID

111062652 吳仲晏

(2) How to compile and execute your C/C++ program and give an execution example.

--How to compile

In this directory, enter the following command:

$ make

It will generate the executable file "hw5" in "../bin/".

If you want to remove it, please enter the following command:

$ make clean

--How to Run

In this directory, enter the following command:

Usage: ../bin/[exe] [k value]

e.g.

$ ../bin/hw5 4 ../output/CS_4.def

$ ../bin/hw5 16 ../output/CS_16.def

$ ../bin/hw5 36 ../output/CS_36.def

$ ../bin/hw5 64 ../output/CS_64.def

$ ../bin/hw5 100 ../output/CS_100.def

--How to verify

In "HW5_grading/verifier/", enter "./verify [k value] [def file]"

e.g.

./verify 4 ../output/CS_4.def

./verify 16 ../output/CS_16.def

./verify 36 ../output/CS_36.def

./verify 64 ../output/CS_64.def

./verify 100 ../output/CS_100.def

(3) The details of your C/C++ program. How do you generalize the original C/C++ program to handle 16 or more current sources? You have to describe what you do step by step in detail.

使用 vector 取代 python 中的 list。

使用 class 取代原先 Component、SpecialNet……

一列 cell 的個數為 sqrt(k*4)

# of metal 3 = sqrt(k)

# of metal4 = sqrt(k)/2

Step1: create die boundary

X 軸邊界為 CS 個數*寬度 + M3_spacing*一列幾個 M3 spacing+M3 寬度 *#ofM3 in row.

Y 軸同理//上列寬度->高度、M3 改成 M4….

Step2 create CS array

因為 M4 數量隨 k 值改變，所以 off_y = (M4_spacing + M4_width)*#ofM4

Dy = CS 高度 + M4 造成的 spacing + M4 寬度

Dx = CS 寬度 + M3 造成的 spacing + M3 寬度。

使用雙迴圈依序計算出全部的 CS 座標

Step 3: create vertical ME3

這邊 Dx = CS_width + M3_spacing

使用雙迴圈計算出全部 M3

Step 4: create ME4 drain

X 取右下區塊

Y 取左上區塊

Step 5: create ME4 port

```
//inst_name, layer 命名、放入 vector 這邊沒寫
for (int i = 0; i < n; i++) {
    int x1 = 0;//貼齊 y 軸
    int x2 = die_x2;//貼齊右邊界
    int y1 = i * Dy;//Dy = CS 高度 + M4 造成的 spacing + M4 造成高度
    for (int j = 0; j < NumOfM4; j++) {
        if (j == 0) y1 = y1;//i*Dy 的高度
        else y1 = y1 + (M4_SPACING + M4_WIDTH);//只多加 M4_spacing, M4 width
        int y2 = y1 + M4_WIDTH;//往上加寬度
    }
}
```

Step 6: create Via34 from ME4 drain

造著上述範例，x 同右下區塊取法、y 同左上區塊取法。

Step 7: create Via34 to ME4 port

由外而內、由下而上，for 迴圈只走左半邊(n/2)，

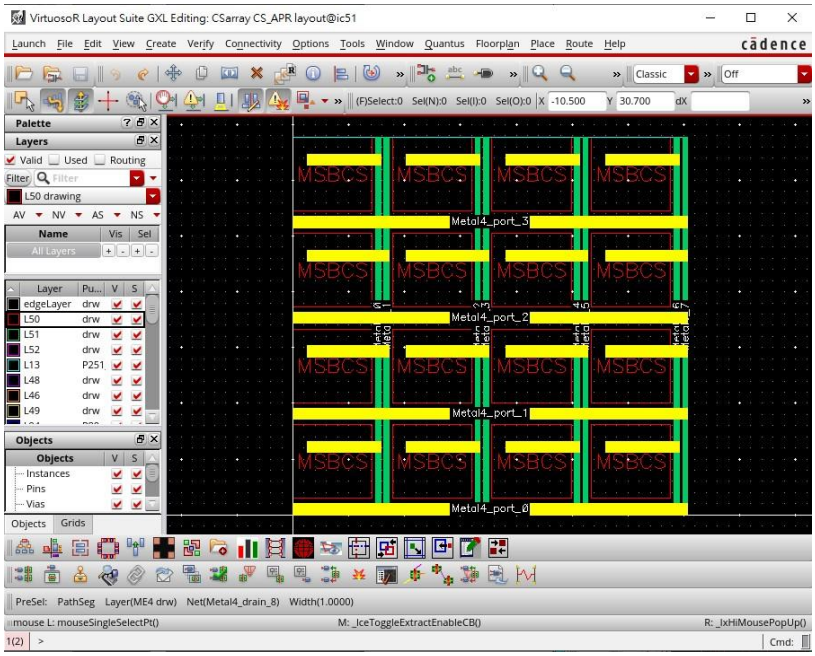
```
for (int i = 0; i < n / 2; i++) {
  for (int j = 0; j < n / 2; j++) {
    string lib_name = VIA34_LIB_NAME;
    // left units
    string inst_name = "Via34_port2ME3_" + to_string(i * (int(n / 2)) + j);
    int x = ME3_specialnet[i][j].get_x1();
    int y = ME4_specialnet_port[i * NumOfM3 + j].get_y1();
```

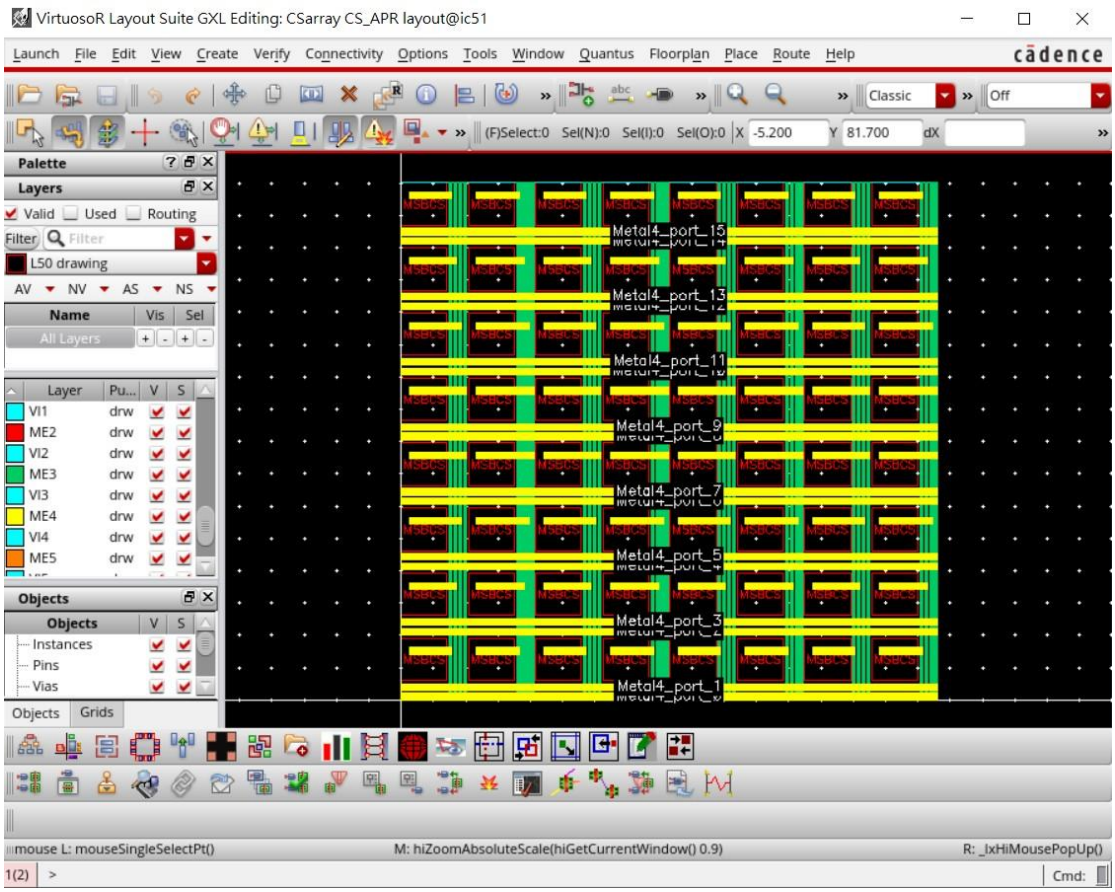
```
        Via34_port2ME3[i][j] = Component(lib_name, inst_name, x, y);
        // right units//右半邊用對稱複製的方式打上 via。
        inst_name = "Via34_port2ME3_" + to_string(i * (int(n / 2)) + j + k);
        x = ME3_specialnet[n - 1 - i][j].get_x1();
        y = y;
        Via34_port2ME3[n - 1 - i][j] = Component(lib_name, inst_name, x, y);
    }
}
```

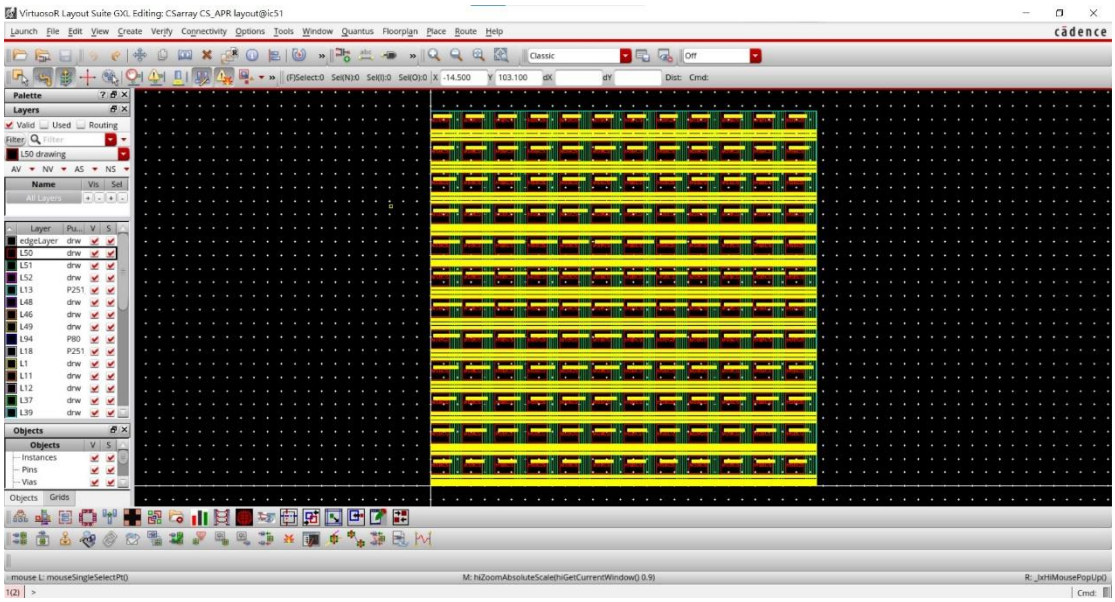
```
[g111062652@ic51 ~/HW5_grading]$ bash HW5_grading.sh
|-------------------------------------------------|
|                                                 |
|    This script is used for PDA HW5 grading.     |
|                                                 |
|-------------------------------------------------|
grading on 111062652:
  testcase |     result | status
    python |       pass | success
         4 |       pass | success
        16 |       pass | success
        36 |       pass | success
        64 |       pass | success
       100 |       pass | success
|-------------------------------------------------------|
|                                                       |
|    Successfully generate grades to HW5_grade.csv      |
|                                                       |
|-------------------------------------------------------|
```

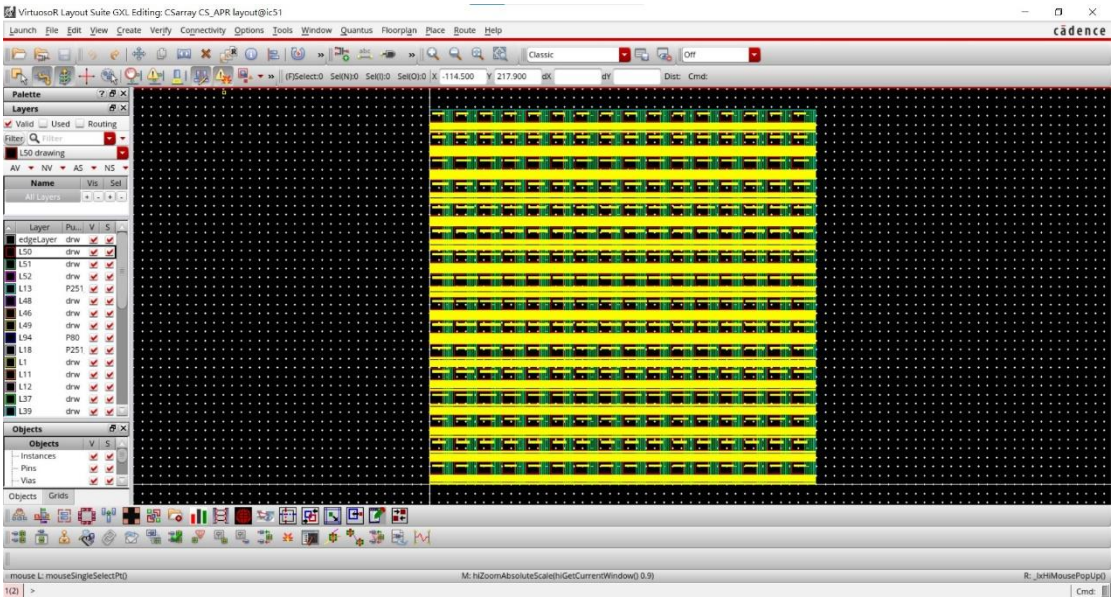
(4) The screenshots of your placement and routing results for the circuit produced by your Python program for the case of 4 current sources as well as by your C/C++ program for the cases of 4, 16, 36, 64, and 100 current sources.

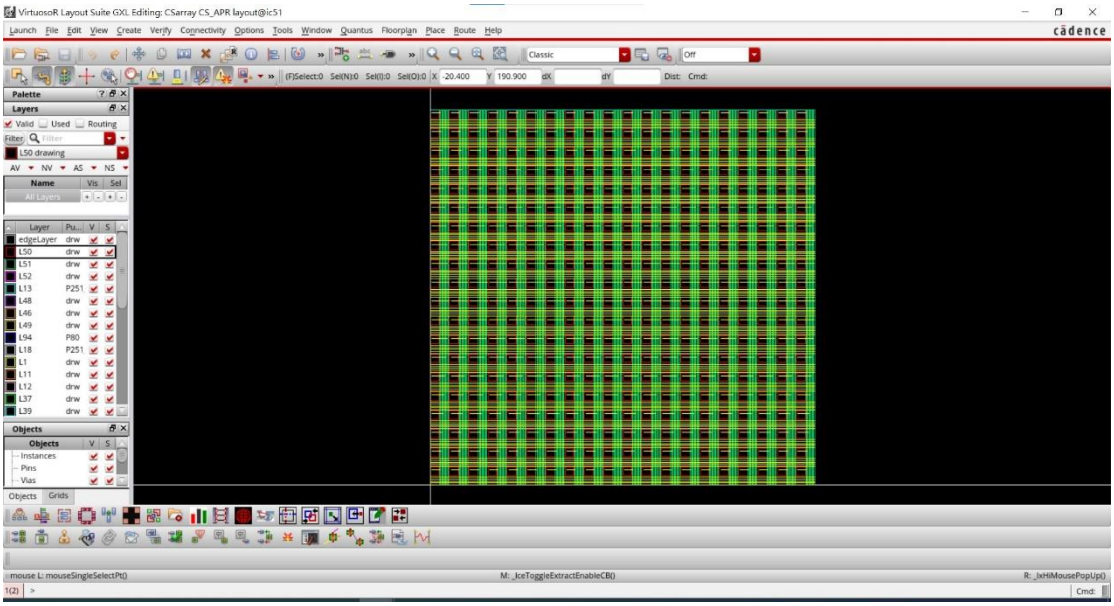
Python:




VirtuosoR Layout Suite GXL Editing: CSarray CS_APR layout@ic51
Launch File Edit View Create Verify Connectivity Options Tools Window Quantus Floorplan Place Route Help
cadence
Palette
Layers
Valid Used Routing
L50 drawing
Name Vis Sel
All Layers
Layer Pu... V S
VI1 drw
ME2 drw
VI2 drw
ME3 drw
VI3 drw
ME4 drw
VI4 drw
ME5 drw
Objects
Instances
Pins
Vias
Objects Grids
Metal4_port_15
Metal4_port_13
Metal4_port_11
Metal4_port_9
Metal4_port_7
Metal4_port_5
Metal4_port_3
Metal4_port_1
mouse L: mouseSingleSelectPt()
M: hiZoomAbsoluteScale(hiGetCurrentWindow() 0.9)
R: _lxHiMousePopUp()
Cmd:

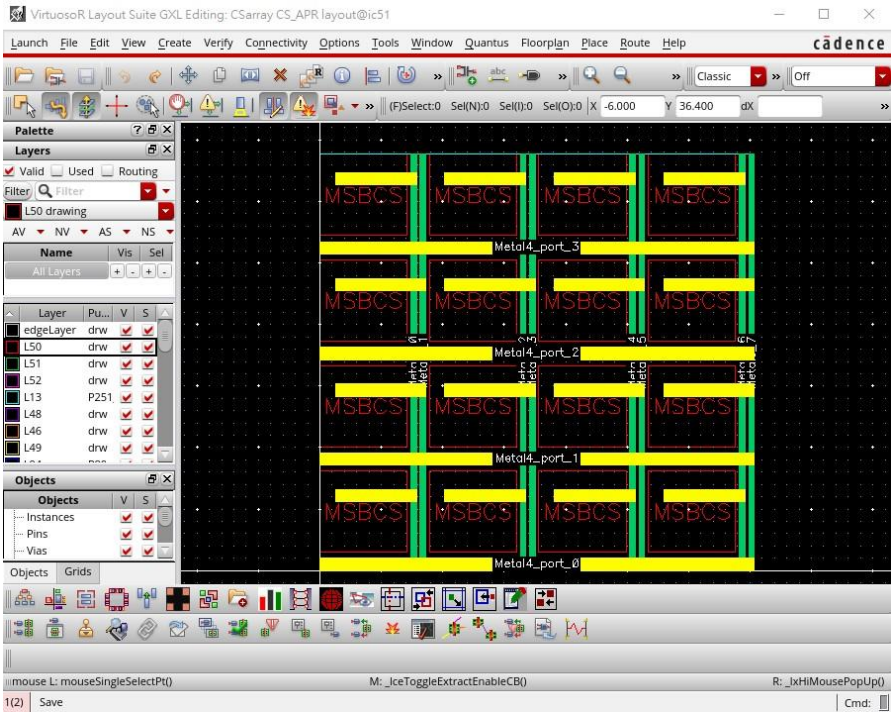



VirtuosoR Layout Suite GXL Editing: CSarray CS_APR layout@ic51
cadence

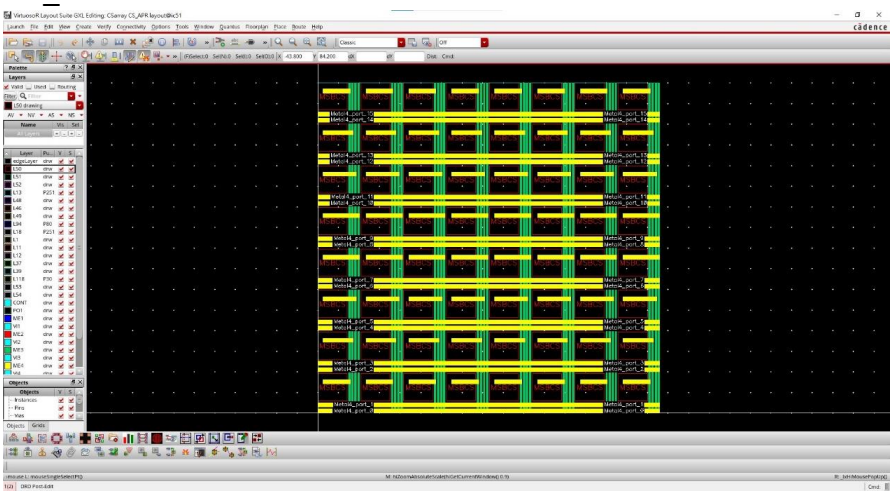

VirtuosoR Layout Suite GXL Editing: CSarray CS_APR layout@ic51
cadence

C++:

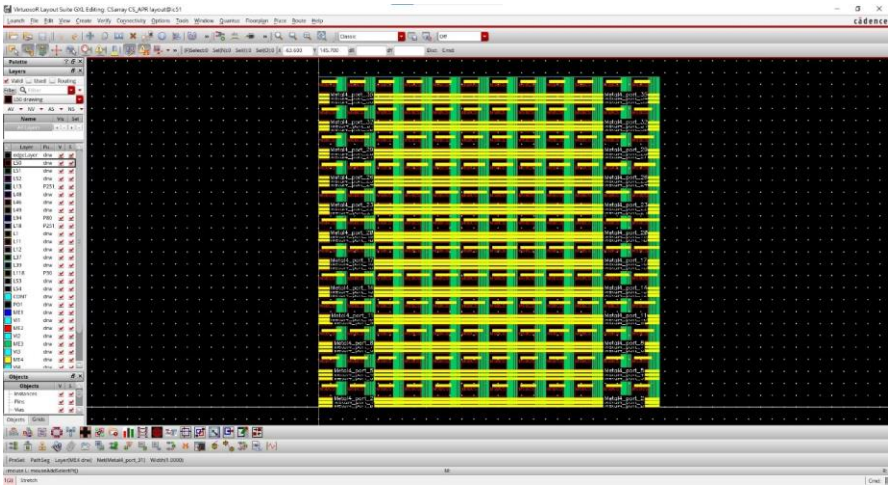
CS_4.def



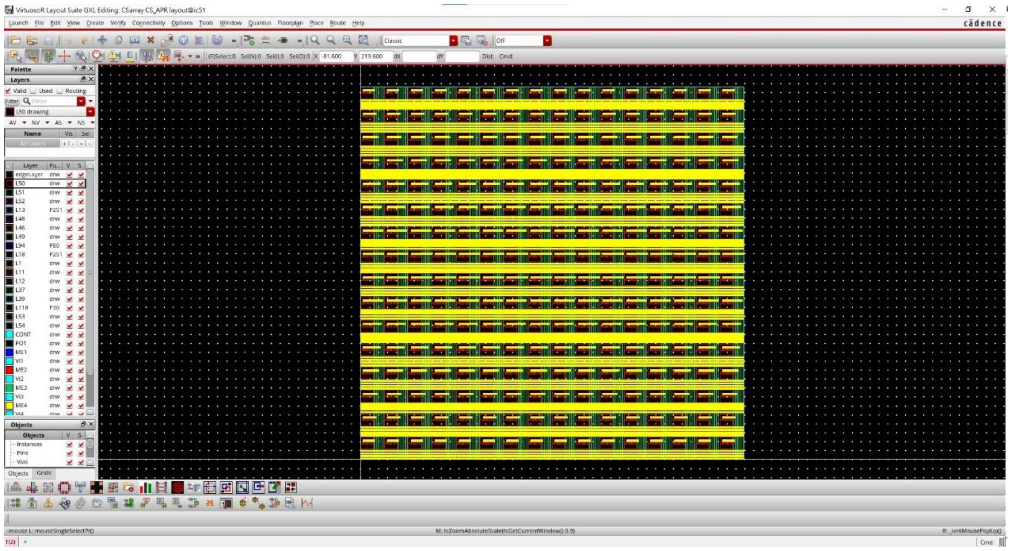
CS_16.def



CS_36.def



CS_64.def



CS_100.def