Requirements

Operating System

Ubuntu
Windows

Compiler

CMake

Programming Language

C++

Development Tool

Visual Studio code
Eclipse

Remote Access

Mobexterm (ssh)

Run Instructions

Step 1

```
ssh -Y sadhikari@garfield.cs.mun.ca
sadhikari@garfield.cs.mun.ca's password:
```

Step 2

```
sadhikari@garfield ~ $ cd WBTree/
sadhikari@garfield WBTree $ ls
'Answer th question.docx'                apte.constraint   fplan.cc   sa.o
'Difference between B star and CB.png'   apte.design       fplan.h
wbtree
'Last update.png'                        apte.info         fplan.o
wbtree.cc
 Result_myside                           apte.res          makefile
wbtree.h
 WBTree.pro                              cbtree.cc         output.m
wbtree.o
 WBTree.pro.user                         cbtree.h          sa.cc
```

```
wbtree_main.cc
 apte                                    cbtree.o          sa.h
wbtree_main.o
```

Step 3

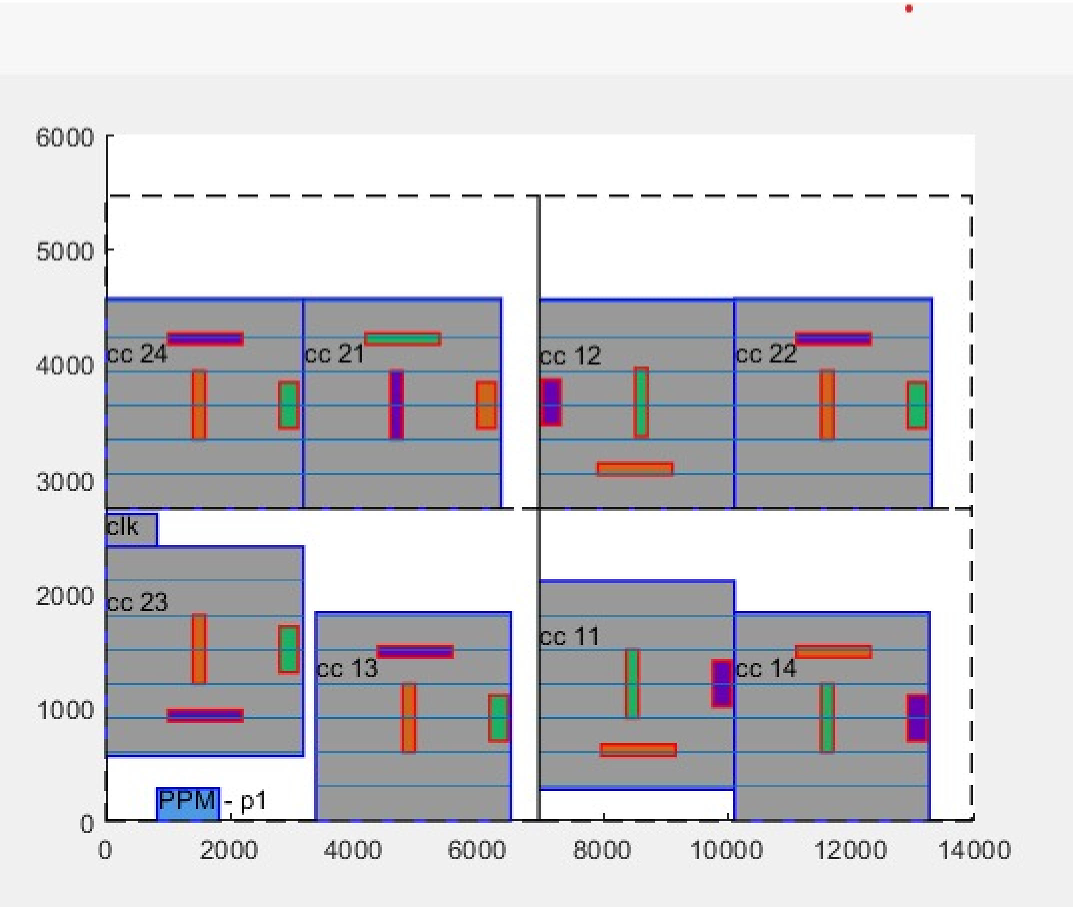
```
sadhikari@garfield WBTree $ make all
```

Step 4

```
sadhikari@garfield WBTree $ ./wbtree apte
normalize area=120117709, wire=1097347
Estimate Average Delta Cost = 0.000533333
Iteration 1, T= 1.00
135
   ==>  Cost= 7238.665712, Area= 111.222160, Wire= 1178.141
   ==>  Cost= 4547.929402, Area= 136.470200, Wire= 1190.651
   ==>  Cost= 3788.945124, Area= 88.391296, Wire= 958.125
   ==>  Cost= 3181.045805, Area= 57.074160, Wire= 837.443
   ==>  Cost= 2876.308064, Area= 64.284928, Wire= 843.613
   ==>  Cost= 104.062880, Area= 64.284928, Wire= 838.877
   ==>  Cost= 104.062101, Area= 64.284928, Wire= 835.761
   ==>  Cost= 104.061556, Area= 64.284928, Wire= 833.584
   ==>  Cost= 104.061377, Area= 64.284928, Wire= 832.868
   ==>  Cost= 104.053893, Area= 64.284928, Wire= 802.931
   ==>  Cost= 104.053593, Area= 64.284928, Wire= 801.729
81.5261
  T= 1.00, r= 1.00, reject= 0.90

Iteration 2, T= 1.00
135
78.0495
  T= 1.00, r= 1.00, reject= 0.91

Iteration 3, T= 1.00
135
84.068
  T= 1.00, r= 1.00, reject= 0.95

Iteration 4, T= 1.00
135
85.0882
  T= 1.00, r= 1.00, reject= 0.93

Iteration 5, T= 1.00
135
   ==>  Cost= 104.031030, Area= 60.719456, Wire= 788.052
   ==>  Cost= 104.030729, Area= 60.719456, Wire= 786.850
86.4177
```

```
  T= 1.00, r= 1.00, reject= 0.93

Iteration 6, T= 1.00
135
79.9629
  T= 1.00, r= 1.00, reject= 0.95

Iteration 7, T= 1.00
135
   ==>  Cost= 0.527934, Area= 60.719456, Wire= 807.670
95.6839
  T= 0.80, r= 1.00, reject= 0.93

Iteration 8, T= 0.80
135
99.7802
  T= 0.80, r= 1.00, reject= 0.93


  Convergent!

 good = 17, bad=3

recover last :
row:0, col:0
root : 6
6: 2 -1 8
2: -1 6 -1
8: -1 6 -1
row:0, col:1
root : 0
0: 3 -1 -1
3: -1 0 -1
row:1, col:0
root : 7
7: 4 -1 -1
4: -1 7 -1
row:1, col:1
root : 1
1: 5 -1 -1
5: -1 1 -1
Num of Module      = 10
Wire Length        = 807.67
Height             = 4.564
Width              = 13.304
Area               = 60.7195
Out of bound Area  = 0
Total Area         = 46.5616
Total cost         = 0.527934
MDD         = 0
     ----  0.12
Dead Space     = 22.16
CPU time       = 690.58
Last CPU time  = 521.47
```

Final Output



Input Files

apte.constraint

```
PROXIMITY                   // Start of the Proximity constraint.
    cc_21 cc_24;            // module1_name module2_name.
END_PROXIMITY               // End of the Proximity constraint.

// Explaination : cc_21 and cc_24 must be placed neighbour.

BOUNDARY                    // Start of the Boundary constraint.
    cc_14;                  // module_name.
END_BOUNDARY                // End of the Proximity constraint.

// Explaination : cc_14 must be placed in the boundary of the window.

MINIMUM_SEPERATION          // Start of the Minimum_Separation.
    cc_13 200;              // module_name minimum_separation_distance.
END_MINIMUM_SEPERATION      // End of the Minimum_Separation.

// Explaination : cc_13 must be placed distanced as 300 from other modules.
```

```
FIXED_BOUNDARY          // Start of the Fixed_Boundary
    cc_23 1 1;          // module_name rotate_flag(1:rotate,  0: not)
flip_flag(1:flip, 0:not).
END_FIXED_BOUNDARY      // End of the Fixed_boundary.

// Explaination : cc_23 must be placed on the boundary of the window with
fixed rotation and flip.

SYMMETRY                            // Start of the Symmetry.
    [cc_11,cc_12] HORIZONTAL 2416;  // [mod1,mod2] means sequence_pair.
                                    // HORIZONTAL/VERTICAL Axis.
    clk VERTICAL 413;               // mod means self symmetry. mod1 mod2
mod3.
                                    // VERTICAL/HORIZONTAL Axis.
END_SYMMETRY                        // end of the Symmetry

// Explaination : symmetry pair, cc_11 and cc_12 must be placed
//                symmetrically based on the horizontal axis 2416.
//                Self_symmetry module, clk must be placed on the center of
the vertical axis 413

PREPLACED               // start of the Preplaced constraint.
    p1 826 0 1826 286;  // module_name left bottom right top.
END_PREPLACED           // end of the Preplaced constraint
```

apte.design

```
LAYOUT;                     // Means start of the Layout patterns
information.
    MODULE cc_11;           // MODULE module_name.
        PATTERNS;           // Means the patterns information of the
MODULE["cc_11"].
            P_0 1000 1430 2200 1530;    // Pattern_name left bottom right
top.
            P_1 1400 600 1600 1200;     // Pattern_name left bottom right
top.
            P_2 2800 700 3100 1100;     // Pattern_name left bottom right
top.
        END_PATTERNS;       // End of the patterns information of the
MODULE["cc_11"].
        FIN 300 300;        // FIN Dfin Dbot;
                            // Dfin: distance between the fin lines,
                            // Dbot: distance between the bottom of the
module and the last fin line.
    END_MODULE;             // End of the MODULE["cc_11"].
    MODULE cc_12;           // MODULE module_name.
        PATTERNS;           // Means the patterns information of the
MODULE["cc_12"].
            P_0 1000 1430 2200 1530;    // Pattern_name left bottom right
top.
```

```
            P_1 1400 600 1600 1200;     // Pattern_name left bottom right
top.
            P_2 2800 700 3100 1100;     // Pattern_name left bottom right
top.
        END_PATTERNS;       // End of the patterns information of the
MODULE["cc_12"].
        FIN 300 300;        // FIN Dfin Dbot;
                            // Dfin: distance between the fin lines,
                            // Dbot: distance between the bottom of the
module and the last fin line.
    END_MODULE;             // End of the MODULE["cc_12"].
    MODULE cc_13;           // MODULE module_name.
        PATTERNS;           // Means the patterns information of the
MODULE["cc_13"].
            P_0 1000 1430 2200 1530;    // Pattern_name left bottom right
top.
            P_1 1400 600 1600 1200;     // Pattern_name left bottom right
top.
            P_2 2800 700 3100 1100;     // Pattern_name left bottom right
top.
        END_PATTERNS;       // End of the patterns information of the
MODULE["cc_13"]
        FIN 300 300;        // FIN Dfin Dbot;
                            // Dfin: distance between the fin lines.
                            // Dbot: distance between the bottom of the
module and the last fin line.
    END_MODULE;             // End of the MODULE["cc_13"].
    MODULE cc_14;           // MODULE module_name.
        PATTERNS;           // Means the patterns information of the
MODULE["cc_14"].
            P_0 1000 1430 2200 1530;    // Pattern_name left bottom right
top.
            P_1 1400 600 1600 1200;     // Pattern_name left bottom right
top.
            P_2 2800 700 3100 1100;     // Pattern_name left bottom right
top.
        END_PATTERNS;       // End of the patterns information of the
MODULE["cc_14"].
        FIN 300 300;        // FIN Dfin Dbot.
                            // Dfin: distance between the fin lines.
                            // Dbot: distance between the bottom of the
module and the last fin line.
    END_MODULE;             // End of the MODULE["cc_14"].
    MODULE cc_21;           // MODULE module_name.
        PATTERNS;           // Means the patterns information of the
MODULE["cc_21"].
            P_0 1000 1430 2200 1530;    // Pattern_name left bottom right
top.
            P_1 1400 600 1600 1200;     // Pattern_name left bottom right
top.
            P_2 2800 700 3100 1100;     // Pattern_name left bottom right
top.
        END_PATTERNS;       // End of the patterns information of the
MODULE["cc_21"].
```

```
        FIN 300 300;        // FIN Dfin Dbot;
                            // Dfin: distance between the fin lines.
                            // Dbot: distance between the bottom of the
module and the last fin line.
    END_MODULE;             // End of the MODULE["cc_21"].
    MODULE cc_22;           // MODULE module_name.
        PATTERNS;           // Means the patterns information of the
MODULE["cc_22"].
            P_0 1000 1430 2200 1530;    // Pattern_name left bottom right
top.
            P_1 1400 600 1600 1200;     // Pattern_name left bottom right
top.
            P_2 2800 700 3100 1100;     // Pattern_name left bottom right
top.
        END_PATTERNS;       // End of the patterns information of the
MODULE["cc_22"].
        FIN 300 300;        // FIN Dfin Dbot.
                            // Dfin: distance between the fin lines.
                            // Dbot: distance between the bottom of the
module and the last fin line.
    END_MODULE;             // End of the MODULE["cc_22"].
    MODULE cc_23;           // MODULE module_name.
        PATTERNS;           // Means the patterns information of the
MODULE["cc_23"].
            P_0 1000 1430 2200 1530;    // Pattern_name left bottom right
top.
            P_1 1400 600 1600 1200;     // Pattern_name left bottom right
top.
            P_2 2800 700 3100 1100;     // Pattern_name left bottom right
top.
        END_PATTERNS;       // End of the patterns information of the
MODULE["cc_23"].
        FIN 300 300         // FIN Dfin Dbot.
                            // Dfin: distance between the fin lines.
                            // Dbot: distance between the bottom of the
module and the last fin line.
    END_MODULE;             // End of the MODULE["cc_23"].
    MODULE cc_24;           // MODULE module_name;
        PATTERNS;           // Means the patterns information of the
MODULE["cc_24"].
            P_0 1000 1430 2200 1530;    // Pattern_name left bottom right
top.
            P_1 1400 600 1600 1200;     // Pattern_name left bottom right
top.
            P_2 2800 700 3100 1100;     // Pattern_name left bottom right
top.
        END_PATTERNS;       // End of the patterns information of the
MODULE["cc_24"].
        FIN 300 300;        // FIN Dfin Dbot.
                            // Dfin: distance between the fin lines.
                            // Dbot: distance between the bottom of the
module and the last fin line.
    END_MODULE;             // End of the MODULE["cc_24"].
END_LAYOUT;                 // End of the Layout Patterns.
```

```
    DESIGN_RULES;           // Start of the Design Rules.
    MINIMUM_DISTANCE 300;   // MINMUM_DISTANCE value;
                            // Explaination : all same mask patterns should
be placed
                            // distanced at least 300 or more.
                            // value: minimum distance that occurs mask
conflict constraints
    MASK_NUM 3;             // MASK_NUM value.
                            // value: MASK numbers.
                            // Explaination : there will be 3 different
masks.
    WINDOW_SIZE 6972 2732;  // WINDOW_SIZE width height;  size of the
window
                            // Explaination : Each window size will be 6972
x 2732.

    BIN_SIZE 3500 1500;     // BIN_SIZE width height;   size of the bin
                            // Explaination : Each bin size will be 3500 x
1500.

    MAXIMUM_DENSITY_DIFFERENCE 0.5; // MAXIMUM_DENSITY_DIFFERENCE value.
                                    // value: maximum density difference
values that
                                    // satisfies the density balance
constraint
                                    // Explaination : In
look_ahead_density_checking,
                                    // each wbnode(window node) has mask
density value,
                                    // the maximum difference between them
must be
                                    // same or smaller than 0.5.
                                    // In Global_mask_density_checking, we
calculate the mask density
                                    // in every window. And the maximum
difference between them must
                                    // be same or smaller than 0.5.
                                    // In Local_mask_density_checking, we
find the dense patterns,
                                    // and create the Bin based on those
patterns’ center point,
                                    // calculate the mask density.
                                    // And the maximum difference between
those bins must
                                    // be same or smaller than 0.5
ENDDESIGNRULES;             // End of the design rules
```