Problem B: 3D Placement with D2D Vertical Connections

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Q&A

Q1. I have some questions about Problem B and need your help to check it.

Since we need to use the third party library, which provides the form of dynamic library, could the final uploaded package only be a static binary executable file?

Could we use the form of dynamic library compilation link, and provide library and binary finally?

Thank you.

A1. Yes. That is fine. You can provide multiple files in the same directory and make the dynamic link to the file(s) in the same directory for your executable binary. As long as we can successfully run the binary with all the files you provided in the same directory, that is good.

Q2. Could you please help to check the following questions? Thank you very much.

1). Can lib cells have a horizontal size less than the size of the row?

2). If I understand correctly the only connections out of the dies are the terminals on top layers, right?

3). Can pins of lib cells have multiple shapes?

    for example:

    LibCell MC1 5 15 1

    Pin P1 2 11

    Pin P1 15 20

  4). Need your help to advise if the test cases will be released.

A2. Here are the answers for these questions.

1) Yes. That is possible.

2) Yes.

3) No. To simplify this problem, each pin of lib cells will have one and only one shape.

4) will release the 1st test case at round M/Apr.

Q3. I got a question about Problem B:

Will all of the Instances be named after C1, C2, Cn, and the same questions to the libcellname, netname and pinname, will they follow the naming rule: MC1/MC2, ... and P1/P2/... ?

I am wondering whether I can use the number after the character for the index of that object.

However, if the Instance got two naming rules ex: C1 C2 CC1 CC2, there may exist duplicate problems for using the number after the character for the index for that object.

A3. Yes. You can do this assumption.

Q4. Are there any pads/fixed objects/obstacles?

A4. No. will not have fixed objects nor obstacles.

Q5. For utilization -- how is the open space to be distributed across the die? Does it need to be relatively uniform? If so, what's the "window size"?

A5. We just check the die-level utilization. No window concept.

i.e. util% = (total cell area) / (die size)

Q6. How large of designs can we expect?

A6. Please expect any value in the range of INT32

Q7. For the indexing of cells and nets -- could this be done starting with zero (rather than 1)? It would make using arrays to hold the data much simpler, esp.

if we can count on things being named C0, C1, C2, ...

A7. No. We will indexing the cells and nets from 1. You can do whatever the mapping you want inside your program.

Q8. I have a question for ICCAD2022 problem B.

For input File, whether we can trans it to LEF/DEF format ? or you are not using LEF/DEF for the sake of simplification, so we focus on the algorithm? Thank you!

For exmple,

NumNets 6

Net N1 2

Pin C1/P1

Pin C2/P2

...

trans to

DEF,

NETS 6 ;

- net1

(C1 P1) (C2 P2)

...

A8. No. We don't use LEF/DEF for the input file in this contest. We want to make the input file format as simple as possible. So, contestants will not spend much time on file parsing and can focus on the algorithm problem.

Q9. Can we find an open source dataset in this format or use open source tools for conversion, or is this a new format you proposed? Thank you.

A9. It is the new format we just proposed for this contest.

Q10. We have a question about problem B.

This problem requires outputting the center coordinates of bounding terminals, and the center coordinates are used to calculate hpwl. But we see that the width and height of the bonding terminals in case 1 are not even. Does the answer need to output coordinates with decimals?

In this way, the result of hpwl will also have decimals.

A10. We want to keep this contest problem with integer scope. Thus, we will update the values of terminal width and height in the testcases to make sure the terminal sizes are always with even numbers. Thanks for pointing this out and please check the new version of case1 on the website.

Q11. As for the cad contest, I would like to know if there is any constraint to use the open-source codes since currently more and more open-source eda programs are available on GitHub.

A11. It is fine to use open-source code.

Q12. 1. In the input file, what is the meaningfor **<repeatCount>** in **TopDieRows** and **BottomDieRows**?

A12. <repeatCount> means the number of rows that would be created from the <startY> location with the step of <rowHeight> by repeating <repeatCount> times.

Q13. Does **<rowHeight>** times **<repeatCount>** always equal to the **<upperRightY>** of **DieSize**?

A13. No. <rowHeight> times <repeatCount> would always be less than or equal to the <upperRightY> of DieSize.

Q14. Will there be more than two technologies? And also for each Die, can we choose different technologies to use? (Take Problem_B_case1 for example, **<rowHeight>** of **TopDieRows** is 10, and **<rowHeight>** of **BottomDieRows** is 15. Does this means that I can use both Tech TA (<libCellSizeY> 10) and TB (<libCellSizeY> 15) for the bottom die but just TA (<libCellSizeY> 10) for the top die?)

A14. There would be at most 2 technologies.

No. You can only use the specified technology in TopDieTech and BottomDieTech from the input file for top die and bottom die respectively.

Q15. For Problem B, can I use Python scripts, say, pybind11 environment with dynamic libraries.

A15. Please try your program on the testing machine provided by this contest. As long as your program can be run successfully on the testing machine, that is good.

Q16. We have a question about problem B. Would it be a situation that one pin connects to multiple nets? Thank you.

  For example

  Net N1 2

  Pin C1/P1   //same pin

  Pin C2/P1

  Net N2 2

  Pin C1/P1   //same pin

  Pin C3/P4

A16. It would NOT happen.

Q17. We are unsure if we understand it right for problem B, could you help checking the following questions?

1) The terminals and the cells are placed in different layers, so the overlapping of a terminal and a cell on x or y coordinate is allowed, right?

e.g. the size of terminal T1 is 20*20, the size of cell C1 is 10*10, and we place T1 at (10, 10), C1 at (5, 5), is this legal (suppose not violating other constraints)?

2) Under the spacing constraint, the only cost for placing a terminal is that it would be included in calculating the HPWL of the belonging net for both dies, right?

A17. Here are the answers for these questions.

1) Yes. The example is a legal case.

2) Yes.

Q18. Could you please help to advise if we could assume the bottom-left point of the die area is (0,0) in all cases? Thank you.

A18. Yes. You can make this assumption.

Q19. We have a question for problem B, please help us.

From the previous Q&A13, it is mentioned that <rowHeight>*<repeatCount> may be less than <upperRightY>. But in the problem description file, the bottom-left point of the die would be (0, 0), and the given placement rows would start from (0, 0) and "cover the entire die".

Wouldn't it cause conflict (if <rowHeight>*<repeatCount> is less than <upperRightY>, then there exists some space of the die not covered by placement rows)? Or is there something we misunderstood? Thank you very much!

A19. <rowHeight> times <repeatCount> would always be less than or equal to the <upperRightY> of DieSize. The height of the "uncovered portion" would be less than <rowHeight>.

That means if the row can be created completed inside DieSize, the row will be existed. Indeed, there might be a small portion at the top edge of the die which does not have placement row. But, the height of that region must be less than <rowHeight>.

Q20. I have some questions for ICCAD 2022 Problem B:

1) Will it be guaranteed that if there exists a standard cell library in TA, then there must exist a standard cell library in TB if there exist two techs?

2) Will it be ensured that there exists at least one solution for case4 to partition the instances into two dies with valid max utilities that satisfy the MAX_UTILITY constraints?

3) If there exists an Instance called C5, can I assume that there must exist C1 C2 C3 C4 in the netlist? Same as the naming rule for pinName, and netName, will they follow this rule?

Thanks for your reply!

A20. Here are the answers for these questions.

1) Yes. That is guaranteed.

2) Yes. The valid solutions do exist for all cases. You can use the released evaluator binary to check your result.

3) Not quite sure your question. But we can guarantee followings.

　　If numInstances x , then the instances are named as C1 ~ Cx.

　　If netNum y, then the nets are named as asN1 ~ Ny.

　　For a LibCell　pinCount = z, then the pins are named as P1~Pz.

Q21. I have some questions regarding problem B.

1) A19 in the Q&A states that "The height of the 'uncovered portion' would be less than <rowHeight>." However, both dies in case 4 seem to violate the statement. Can you look into it?

2) Can we make the assumption that each cell will connect to at least one net, and each net will connect to at least two different cells?

Thank you!

A21. Here are the answers for these questions.

1) Thanks for pointing this out. Please check the updated version of the case4 on the website.

2) Yes. You can make that assumption

Q22. I'm wondering if the top layer is all for bonding terminals so that I won't need to preserve any routing resource.

For example: for case2, we can have 50x40=2000 terminals at most, these terminals are all available. Thank you.

A22. Yes, you are right. Case2 can have 50x40=2000 terminals at most. All these terminals are available.

Q23. I have a problem about the evaluator in problem B.

According to description of problemB description:

Evaluation score = HPWL of top die + HPWL of bottom die

We found that the Evaluation score is really different with our calculation.

*We use a simple case (only 2 cell place in same layer and cell type are same),

when hpwl is a line ex: (5,5) (10,5), the evaluation score is not 5 .

We also try to find the calculating rule of the Evaluator, but it's very hard to speculate.

Could you please help to give us some suggestions?

A23. We found that indeed a bug in our evaluator. We have updated the evaluator. Please download the new version of the evaluator from CAD Contest Web site.

Q24. I want to ask about how the evaluator computes HPWL.

Since that we've summed up each rectangle's half parameter but got different answers with the evaluator.

Here is a brief test about it：

We copy-pasted every property in **case1.txt,** but only left InstanceC1,C2 and Net1.

NumInstances 2

Inst C1 MC1

Inst C2 MC3

NumNets 1

Net N1 2

Pin C1/P1

Pin C2/P2

Our output is as below：

TopDiePlacement 0

BottomDiePlacement 2

Inst C1 0 15

Inst C2 7 15

NumTerminals 0

In this case, HPWL

Pin C1/P1 is at (2,26) , Pin C2/P2 is at (10,18)

HPWL should be 8+8 =**16**

But the evaluator said it's **34.**

Could you please help us figure out the problem? Thanks a lot!

A24. We found that indeed a bug in our evaluator. We have updated the evaluator. Please download the new version of the evaluator from CAD Contest Web site.