CENG 5270 Tutorial 5: **Homework 1**

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Problem

- Area minimization using MILP
- Given a set of n blocks, $\{w_i \times h_i \mid i = 1 \ldots n\}$, a fixed width W and a time limit t, minimize the height of the final packing of all the n blocks within the time limit t. Write a C++ program to solve this problem using solver Gurobi.

Input format

chipWidth: <chipWidth>

numBlocks: <numBlocks>

0 : <width0> <height0>

1 : <width1> <height1>

…

chipWidth: 100

numBlocks: 5

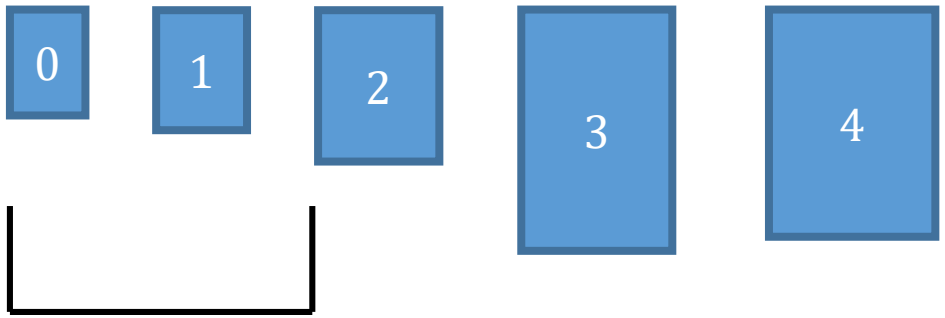
0 : 25 35

1 : 30 40

2 : 40 50

3 : 50 80

4 : 55 75



Output format

0 : <x0> <x0> <rotate0>

1 : <y1> <y1> <rotate1>

…

0 means no rotation

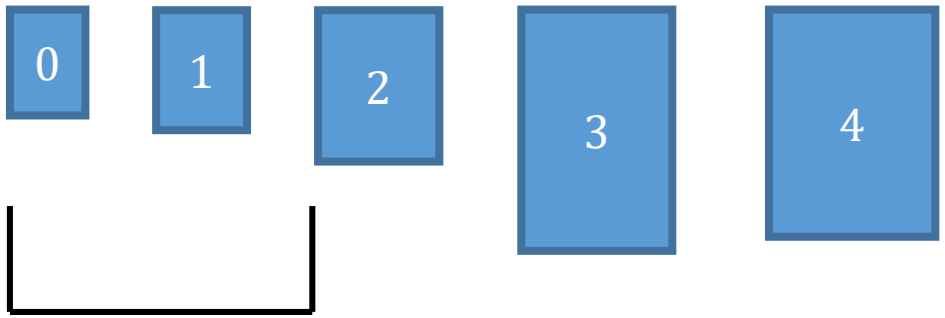
0 : 75 0 0

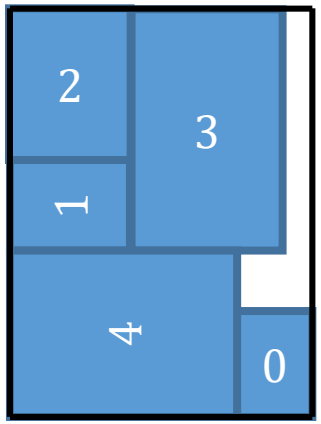
1 : 0 55 1

2 : 0 85 0

3 : 40 55 0

4 : 0 0 1





Binary interface

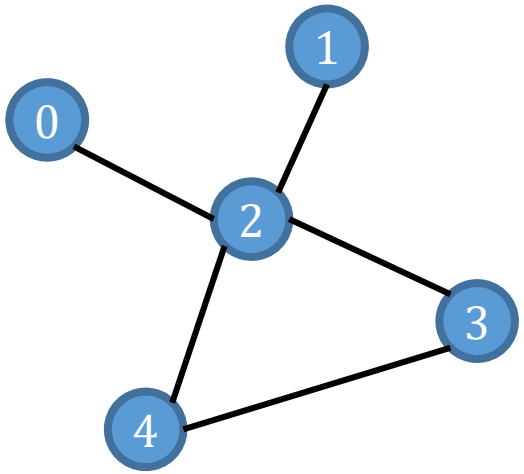
- Name the binary as “floorplan”
- Can be ran by “./floorplan <sampleName>.txt <timeLimit>”
- Output the results to “<sampleName>_solution.txt”

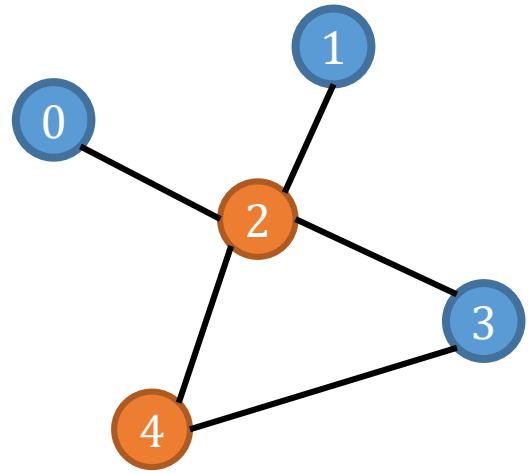
Gurobi

- A commercial ILP solver
- Has free academic license
  - Install license: http://www.gurobi.com/documentation/7.5/quickstart_linux/index.html
  - Blocked by CSE firewall (cannot work around by proxy), except linux10
- Get started
  - http://www.gurobi.com/documentation/7.5/quickstart_linux/cpp_interface.html
  - http://www.gurobi.com/documentation/7.5/refman/cpp_api_overview.html
  - http://www.gurobi.com/documentation/7.5/refman/cpp_api_details.html

Gurobi: a vertex cover example

- A vertex cover of a graph is a set of vertices such that each edge of the graph is incident to at least one vertex of the set.
- A NP-hard problem: minimum vertex cover





Gurobi: a vertex cover example

- Steps
  - Init Gurobi env & model
  - Add variables
  - Add constraints
  - Solve & retrieve solutions
- Debug methods
  - Start from a toy case
  - Write formulation “xxx.lp” file before solving
  - Write solution “xxx.sol” file after solving
  - Compute Irreducible Inconsistent Subsystem (IIS): http://www.gurobi.com/documentation/7.5/refman/py_model_computeiis.html

Gurobi: hint for floorplan

- The following may ease your life
  - GRBModel::addGenConstrXxx(), e.g.
    - GRBModel::addGenConstrOr
    - GRBModel::addGenConstrIndicator
  - GRBLinExpr
- A version without rotation first?

Misc

- Have been posted:
  - These slides
  - Sample codes (and debug files) for vertex cover
  - First two toy samples for floorplan
- To be posted soon:
  - Three more samples
  - An evaluator
- Please submit your binary and source codes to Blackboard
- For a total time limit of 1 second, it is better to set a smaller solver time limit (e.g., 0.8 second):
  - model.set(GRB_DoubleParam_TimeLimit, 0.8)
  - Or to be accurate, you can record the time used before solving