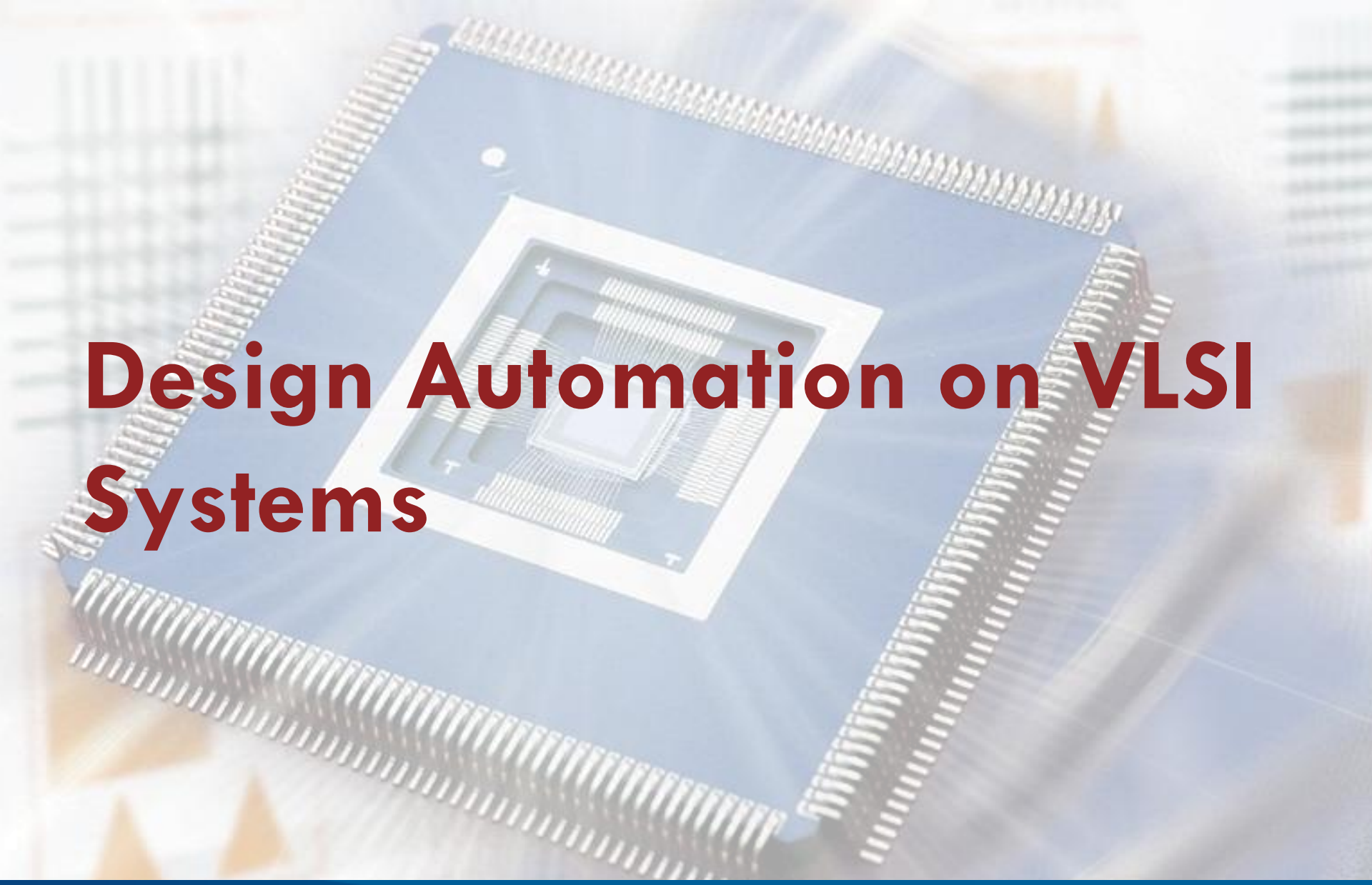


Design Automation on VLSI Systems

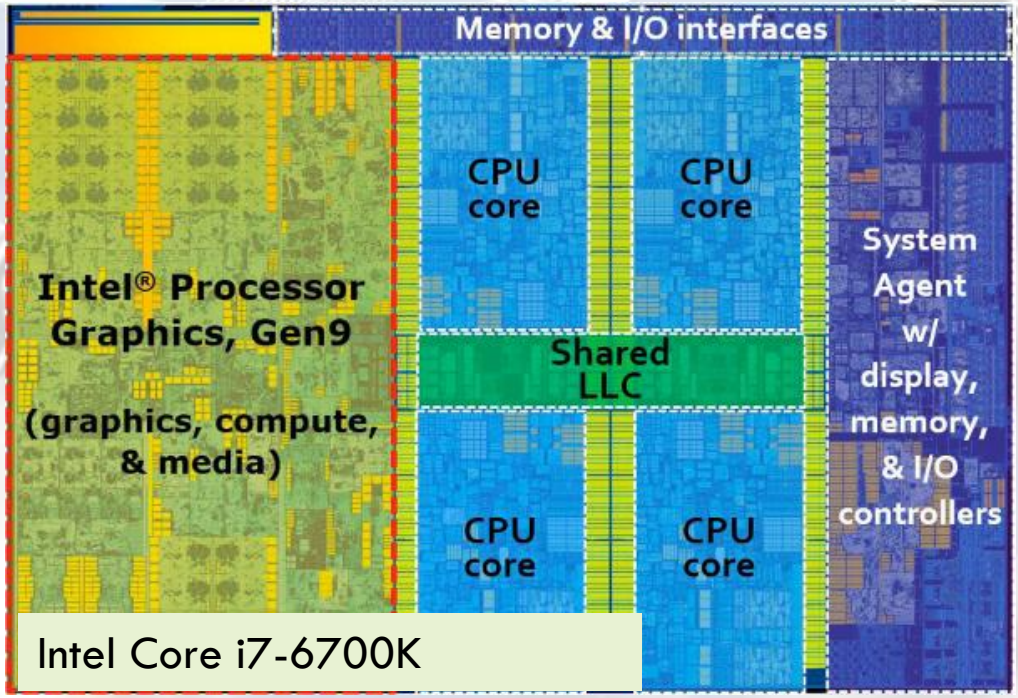
Dr. Bruce, Chiu-Wing Sham

Overview

- What is VLSI systems?
- What is design automation?

VLSI Systems

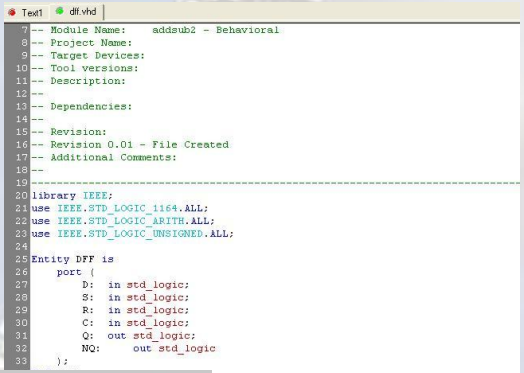
- Processors
- GPU
- Hardware Accelerators

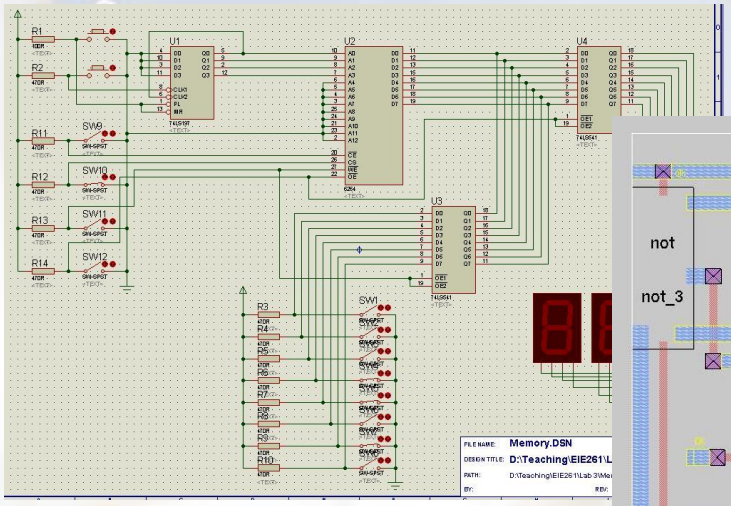


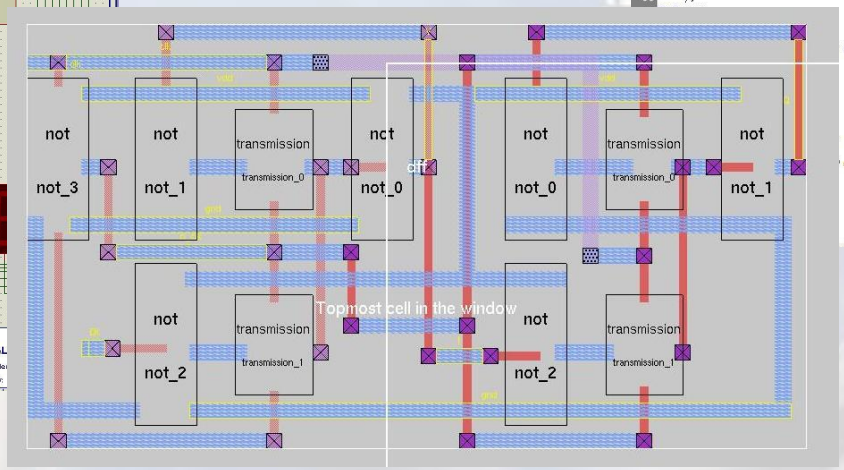
Intel Core i7-6700K

VLSI Systems

- Design procedure:
  - HDL (hardware descriptive language) design
  - Circuit diagram
  - Layout design

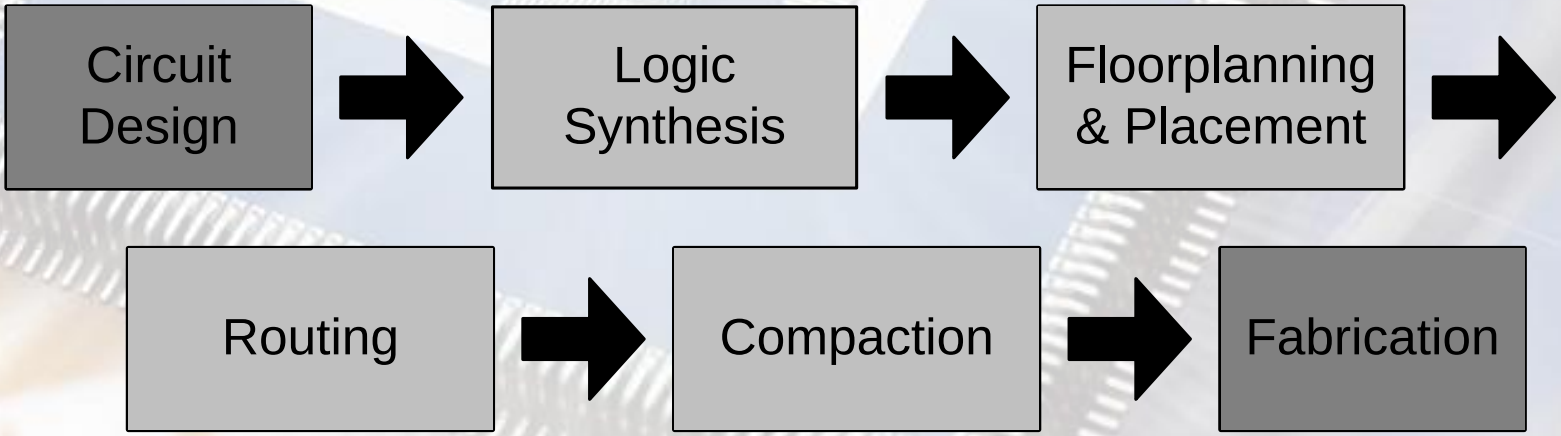






Design Automation

- By using algorithms and heuristics, the layout can be automatically generated from the HDL



Design Automation

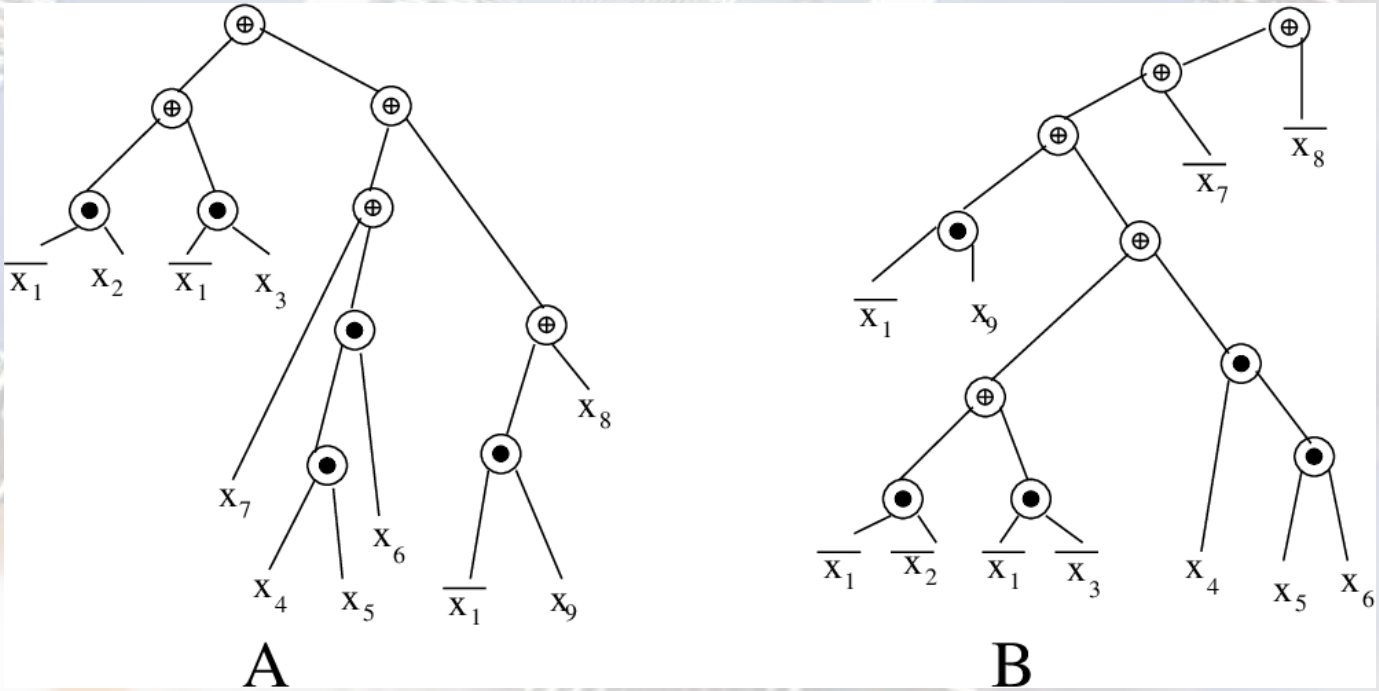
- Research Problems:
  - Logic Synthesis
  - Floorplanning and Placement
  - Routing

Logic Synthesis

- Goal:
  - Create a logic gate network which performs a given set of functions
    - Input are the Boolean formulas
    - Outputs are the logic circuits
  - Logic synthesis:
    - Maps onto available gates or IP cores
    - Restructures for the optimization of delay, area, testability, power, etc

Logic Synthesis

- Example:

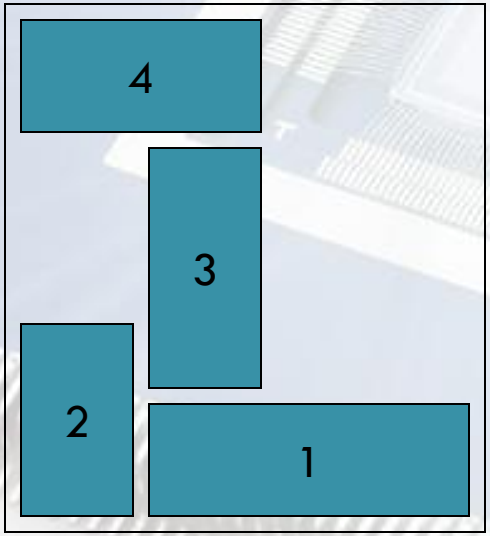


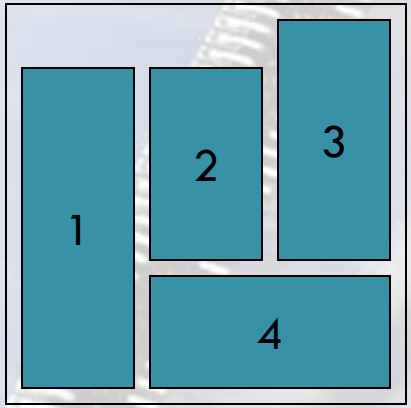
Floorplanning

- The floorplanning problem is to plan the positions and shapes of the blocks at the beginning of the design cycle to optimize circuit performance:
  - Chip area
  - Total wire length
  - Delay of critical path
  - Routability
  - Others, e.g., noise, heat dissipation, power consumption, etc

Floorplanning

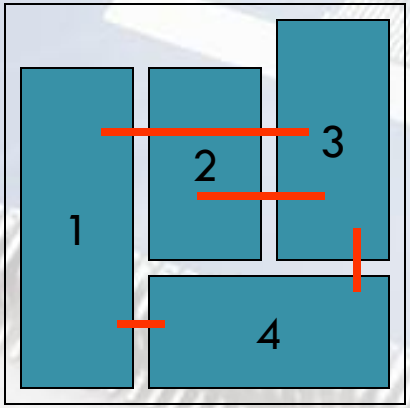
- Example: (area)

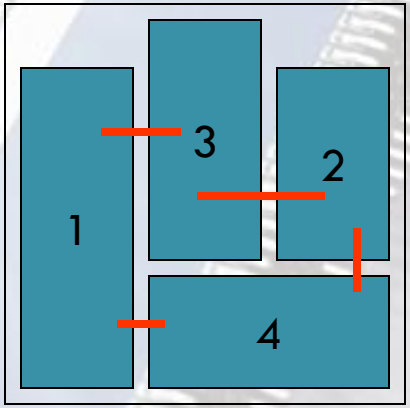




Floorplanning

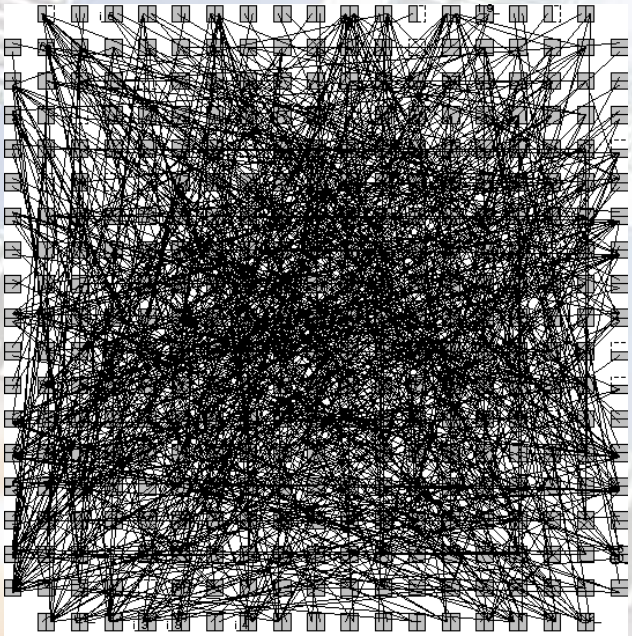
- Example: (wire length)



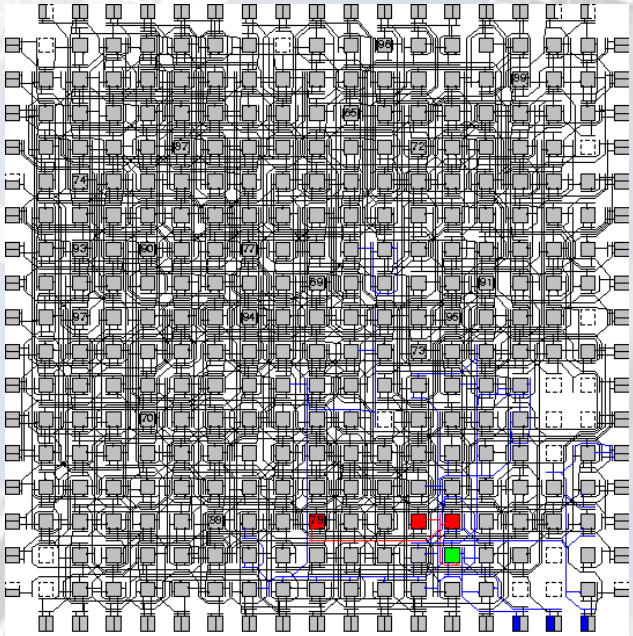


Floorplanning

- Example: (routability)



Initial Placement. Cost: 74.5562. Channel Factor: 100



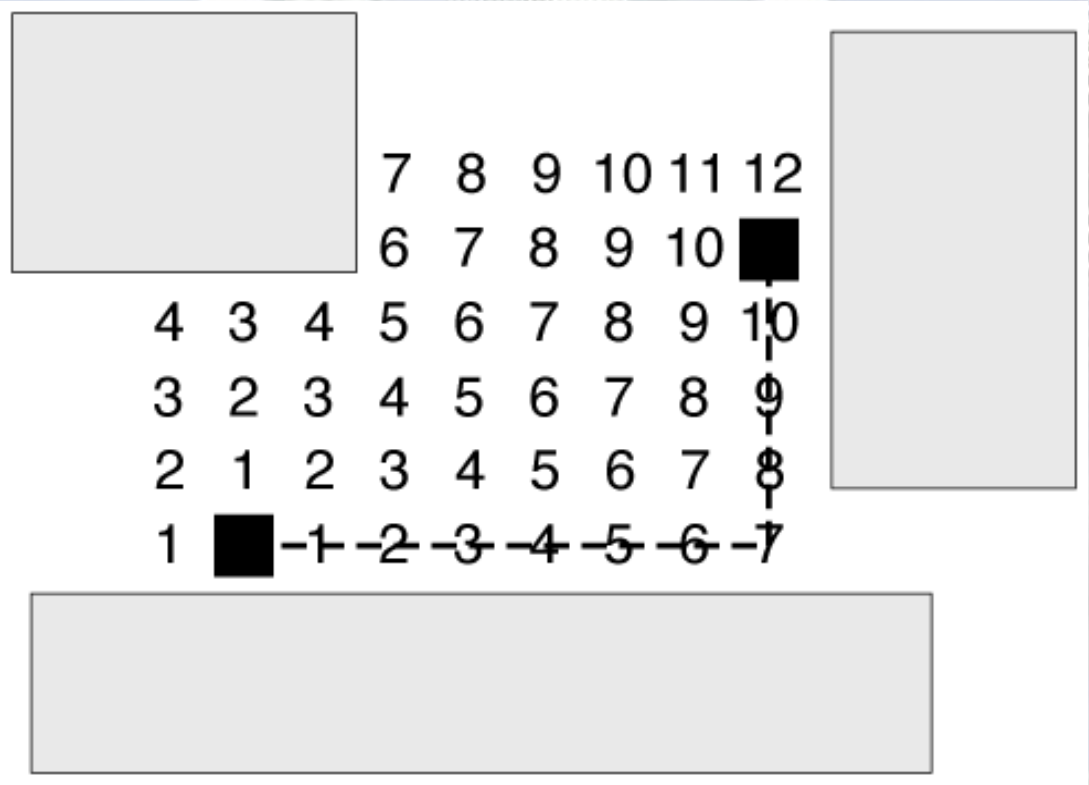
Routing succeeded with a channel width factor of 7.

Routing

- Objective
  - 100% connectivity of a system
  - Minimize area
  - Minimize wirelength
- Constraints
  - Number of routing layers
  - Design rules
  - Timing (delay)
  - Crosstalk
  - Process variations

Routing

- Example: (maze routing)



Design Automation

- Industry Leaders in the world:
  - Cadence Design Systems
    - http://www.cadence.com/
  - Synopsys
    - http://www.synopsys.com/

Design Automation

- Research Progress:
  - ISPD contest
    - http://ispd.cc/?page=contests
  - ICCAD contest
    - http://iccad-contest.org/2020/history.html