

Algorithms in Genome Research  
Winter 2023/2024

Exercises

Number 1, Discussion: 2023-November-10

- Remember physical mapping by clone-probe hybridization.
  - What are the main assumptions when the problem is modeled as the consecutive ones problem? Will it be problematic if the assumptions are not met?
  - Discuss experimental reasons why the assumptions may not hold in practice.
  - How severe are these limitations?
- Solve the consecutive-ones problem for the following clone-probe hybridization matrix  $M$  (if possible).

$$M = \begin{pmatrix} 0 & 1 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 1 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 1 & 1 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 1 & 1 & 0 \\ 1 & 0 & 0 & 1 & 0 & 0 & 0 & 1 \\ 0 & 1 & 1 & 0 & 1 & 1 & 1 & 0 \\ 0 & 1 & 0 & 0 & 1 & 1 & 1 & 0 \\ 1 & 0 & 0 & 1 & 1 & 0 & 0 & 1 \\ 0 & 1 & 1 & 0 & 0 & 0 & 1 & 0 \\ 1 & 0 & 0 & 1 & 1 & 1 & 1 & 0 \end{pmatrix}$$

- Is it possible to transform the following matrix  $M$  by column re-ordering into a matrix  $M'$  that satisfies the Consecutive Ones Property?

$$M = \begin{pmatrix} 1 & 0 & 0 & 1 & 1 \\ 1 & 0 & 1 & 1 & 0 \\ 1 & 0 & 0 & 1 & 1 \\ 1 & 1 & 1 & 0 & 0 \\ 1 & 0 & 1 & 1 & 0 \\ 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 1 & 0 & 1 \end{pmatrix}$$

If not, can you identify a property that is satisfied instead?

- Use the matrix  $M$  from the previous exercise and perform the following steps, in order to find a layout with the minimum number of runs of consecutive ones:
  - Create the graph  $G(M)$  and solve the Traveling Salesman Problem.
  - What is the length of the shortest tour?
  - What is the probe order that this tour corresponds to?
  - What is the overall number of blocks of consecutive ones in this order?