Cinema Seating

Computing Potatoes

Safia Aarouss
Lalitha Boddapati
Yasmin van Dijk
Georgiana Juglan
Rebecca Ruiter

Contents

Problem Statement

- 1,5 meter distance between groups
- Groups can not be split up

Goal

- Maximize number of visitors under the given constraints

Offline / Exact Algorithms

First fit
- Small groups first
- Big groups first

Best Fit
- Small groups first
- Big groups first

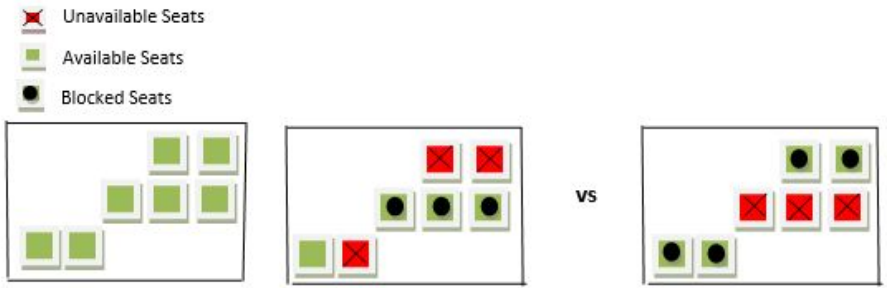
Branch and bound

Offline First Fit

- Finds seats for groups one by one
- 2 versions:
  - Smallest groups first
  - Biggest groups first
- Places groups from top to bottom row, left to right
- First found seating given the constraints

Offline First Fit

➔ Seating larger groups first does not mean maximising the total number of people



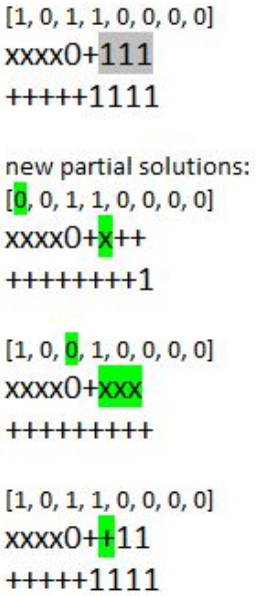
➔ But neither does seating smaller groups first

Offline Best Fit

- Finds seats for groups one by one
- 2 versions:
  - Smallest groups first
  - Biggest groups first
- Minimize amount of new blocked seats

Offline Branch and Bound

- Priority queue with partial solutions
  - First partial solution: the empty cinema
  - Ordered on number of visitors placed
- Branch:
  - Find first adjacent group of available seats
  - Place groups of different sizes left-most
  - Mark one seat as unavailable



Offline Branch and Bound

- Priority queue with partial solutions
  - First partial solution: the empty cinema
  - Ordered on number of visitors placed
- Branch:
  - Find first adjacent group of available seats
  - Place groups of different sizes left-most
  - Mark one seat as unavailable
- Bound:
  - Nr. of visitors placed + nr. of available seats < nr. of visitors placed in best solution
- Stop:
  - Queue is empty
  - Time-out
  - Return best found solution

Online Algorithms

- First Fit
- Best Fit
- Order of groups is fixed

Time Complexity

D = Dictionary, G = Groups

First Fit:

➔ O(n+DG)

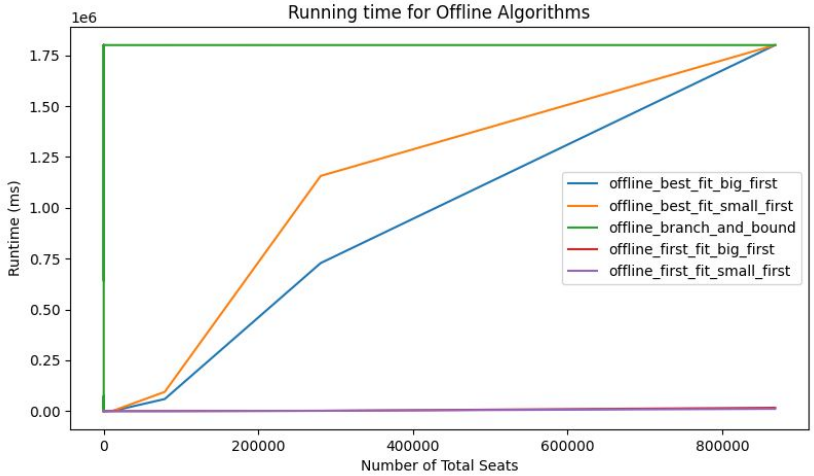
Best Fit:

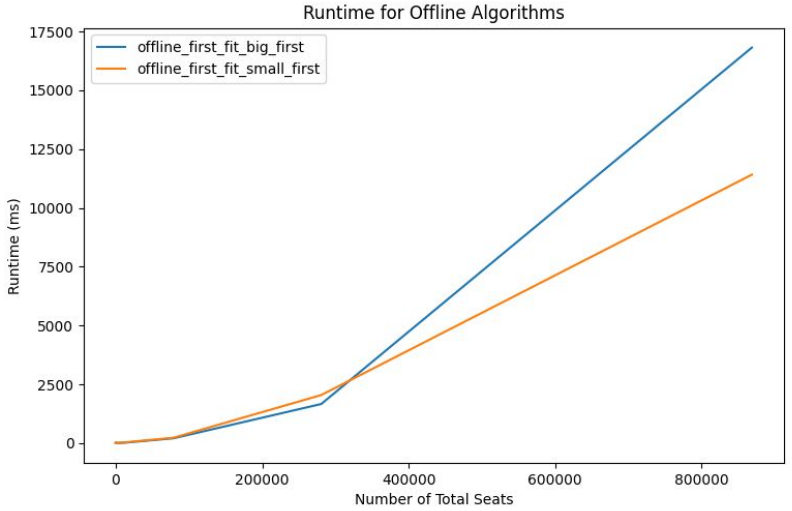
➔ Θ(n+DG)

Branch and bound:

➔ Likely O(n!)

➔ Bound

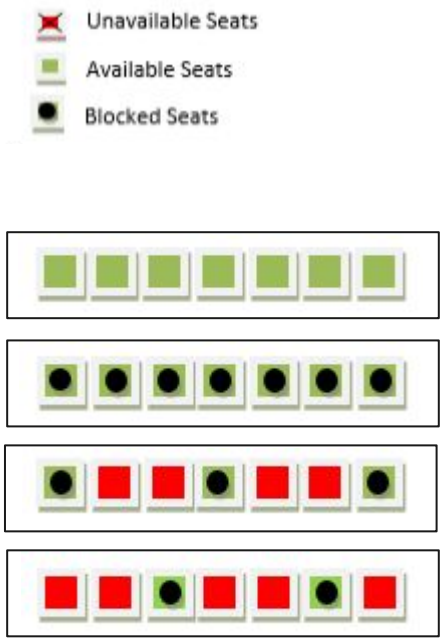




Competitive Ratio

- Simple cases: row of 8
- Larger cinemas: 3 x 8 rows and beyond

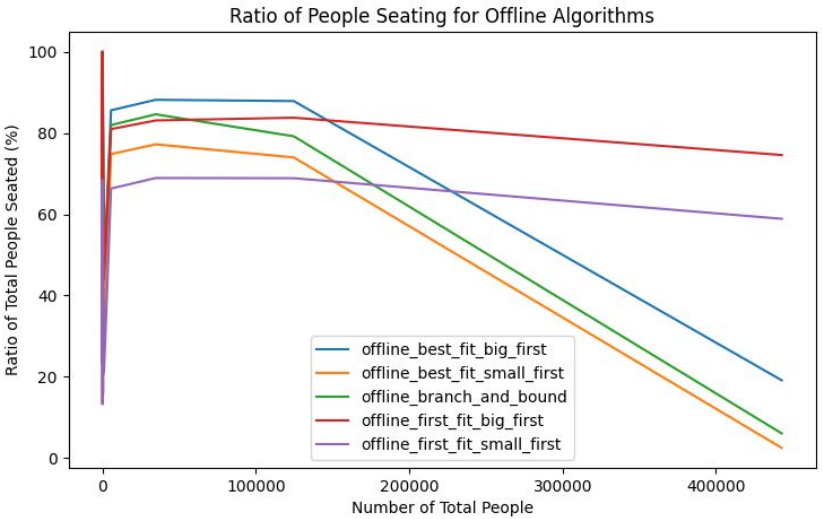
- Online behavior first-fit irrelevant in all-seats cinema
- Worst-Case vs. Average-Case

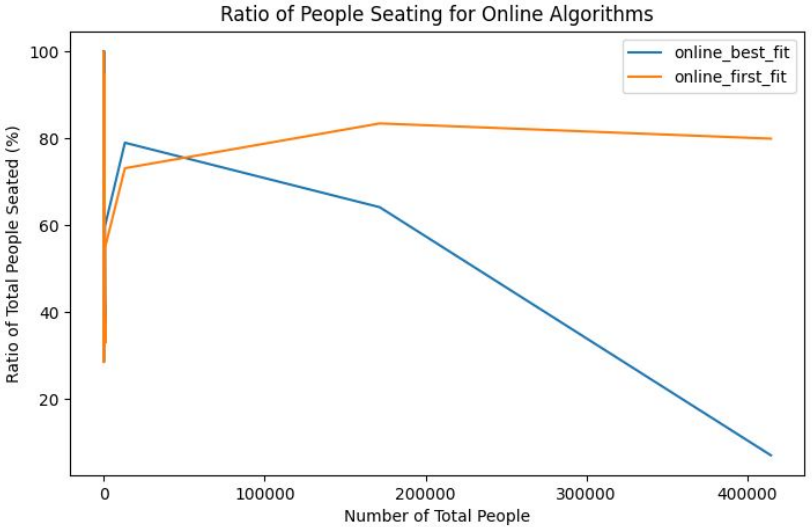


Experiments

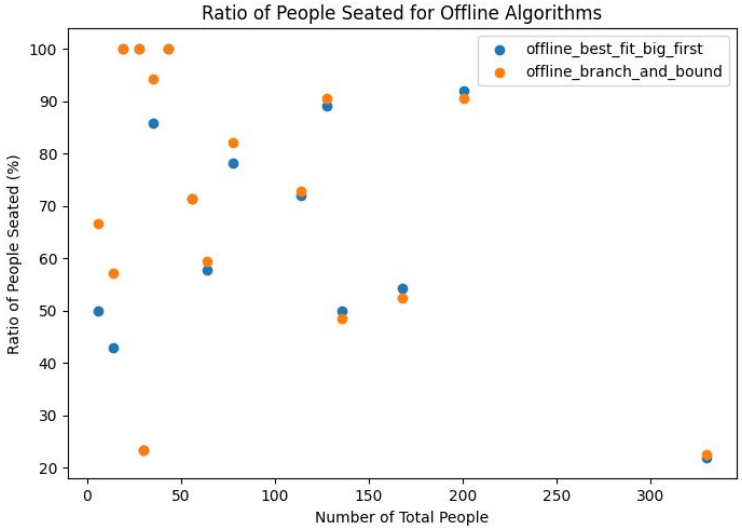
- C#
- Time-limit: 30 minutes
- PC specifications:
    - OS: Windows 10
    - CPU: Intel Core i5-7400 3.00 GHz
    - RAM: 8 GB

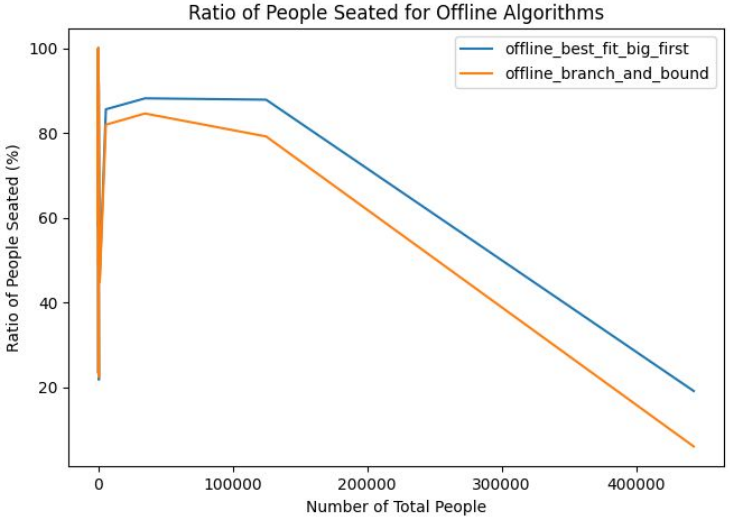
Experiments



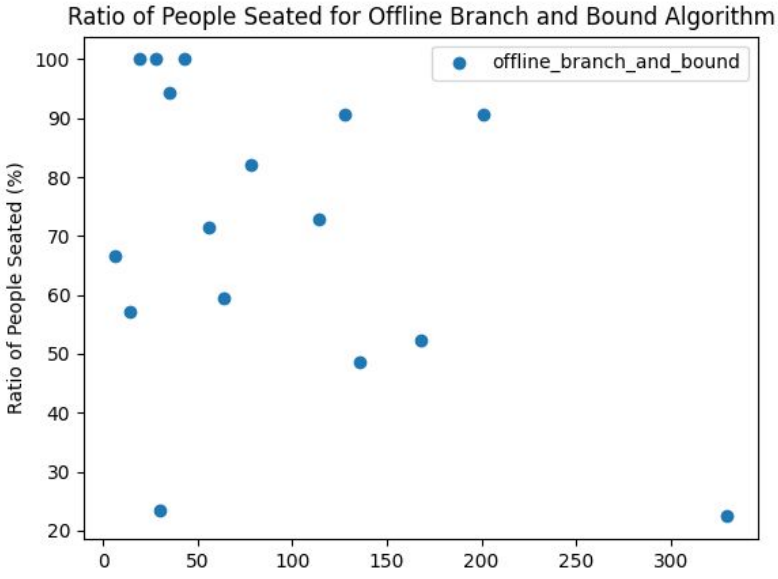


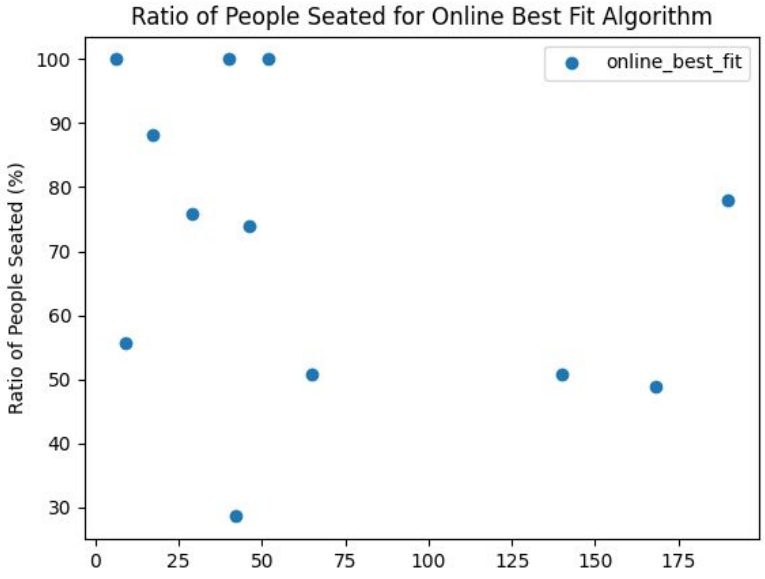
Experiments





Experiments





Conclusion

Offline / Exact algorithms:

- Smaller cinemas: branch-and-bound
- Bigger cinemas: best-fit or first- fit

Online algorithms:

- Smaller cinemas: best-fit
- Bigger cinemas: first-fit