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Rhine-Waal University
of Applied Sciences

Operations Research Club

Rhine-Waal University of Applied Sciences

Kamp-Lintfort

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The Club

- **Our Operations Research Club was originally initiated as a students' project of Rhine-Waal University.**
- **Today, the Club consists of students, experts and professors.**
- **The club cooperates in finding suitable solutions ranging from process optimization to forecasting for business problems.**

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Operations Research

- **Operational research (OR) is a scientific approach to the solution of problems in the management of systems that enables decision makers to make better decisions.**
- **The benefits of OR can be a wide range of performance improvements including cost reduction, revenue enhancement, or process optimization.**
- **OR has been boosted thanks to thriving AI and Machine Learning.**

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Our Resources

- **We enjoy the new fresh ideas of our students thanks to our multicultural environment.**
- **We have plenty of scientific resources; labs, software, experts…**
- **Relevant study programs like Logistics, Business Administration, Computer Science, or Information Engineering.**

Opportunities for both students and companies

- **Bachelor's and master's thesis, as well as internships**
- **Interdisciplinary projects in winter semesters**
- **Implementation of fresh ideas**
- **Continuous engagement & support**
- **Follow-up larger projects**
- **Networking**
- **Optimization of the real-world processes**

Problem

- **The hospital wants to maximize the usage of operations room.**
- **It has 8 operations rooms. Each of them is available for a certain time for each day.**
- **Each department has also a daily capacity due to staff restrictions.**

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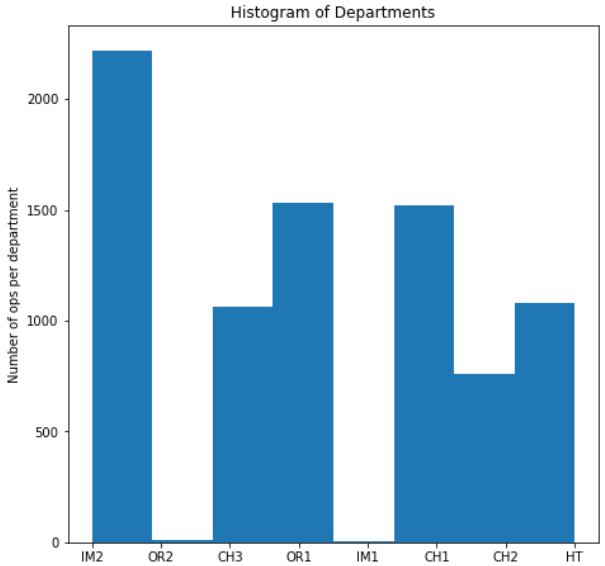
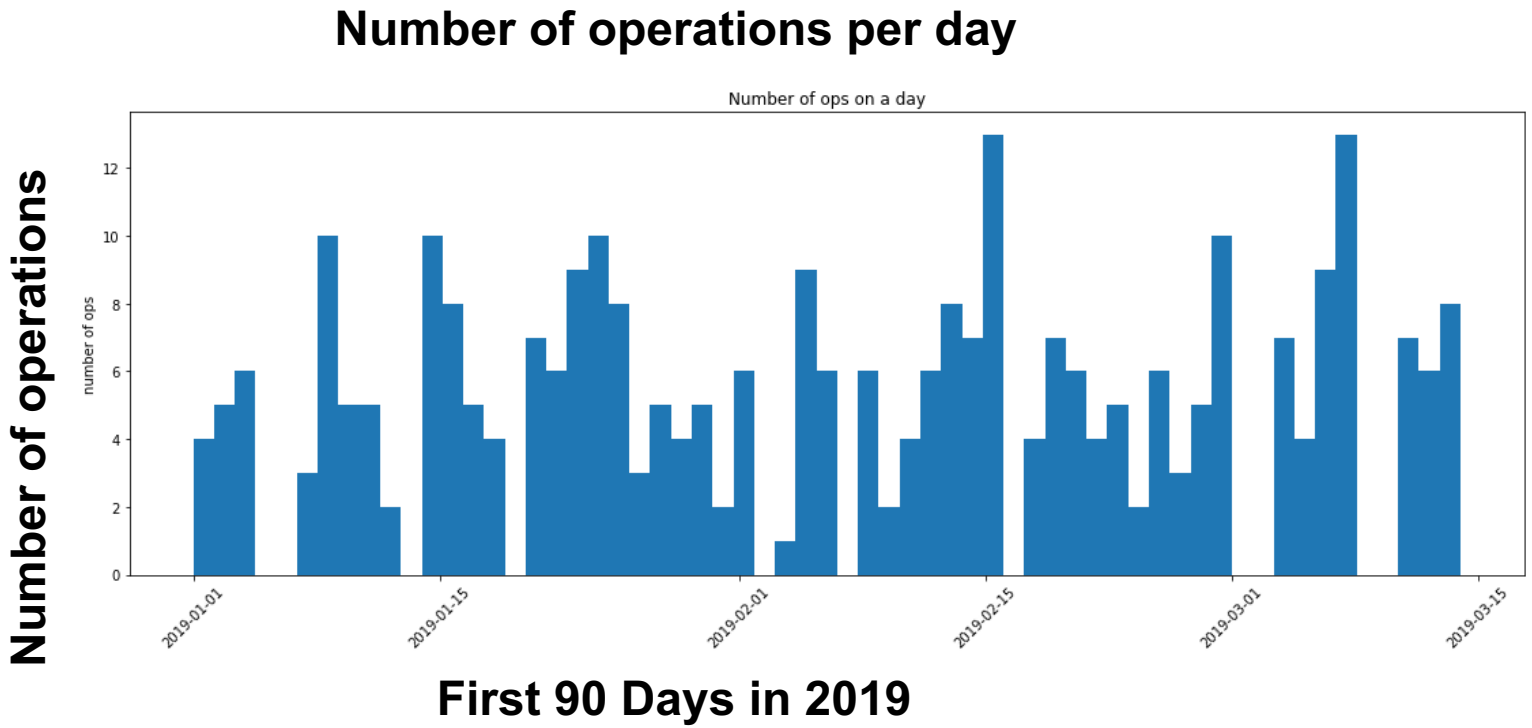
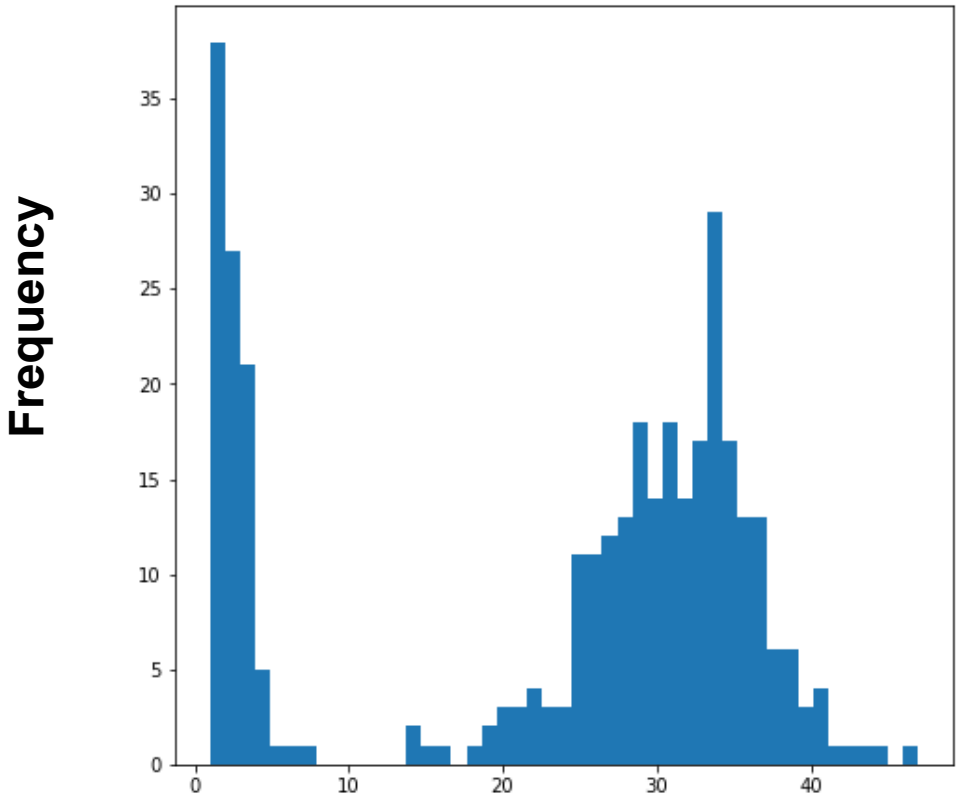
Performance in 2019



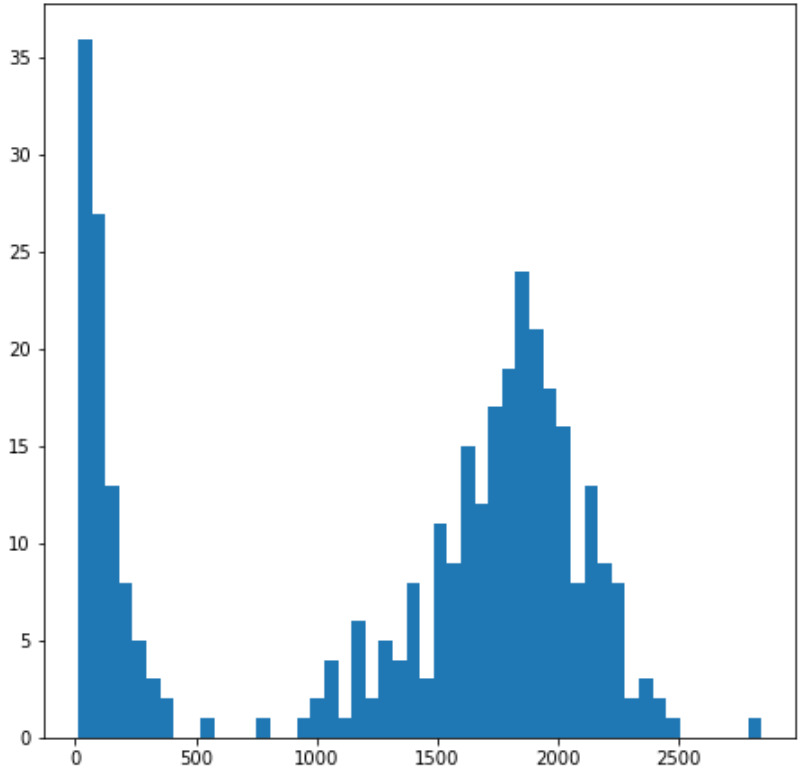


Utilization in 2019

Distribution of number of the ops per day



Distribution of total time of the ops per day



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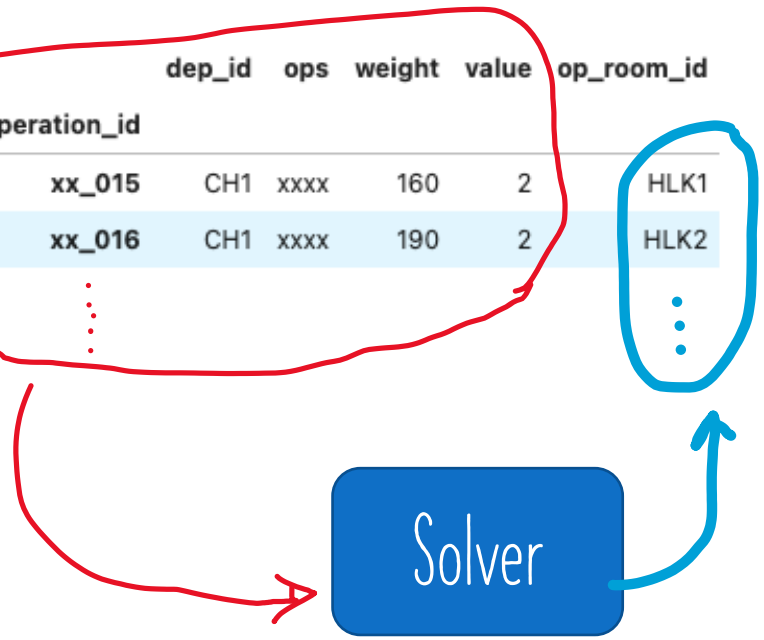
Optimization

Problem statement: The hospital wants to increase the utilization of its operations rooms.

Multiple departments are doing operations in multiple operation rooms.

dep_name	dep_cap
CH1	660
CH2	435
CH3	600
HT	260
IM1	0
IM2	825
OR1	930
OR2	0

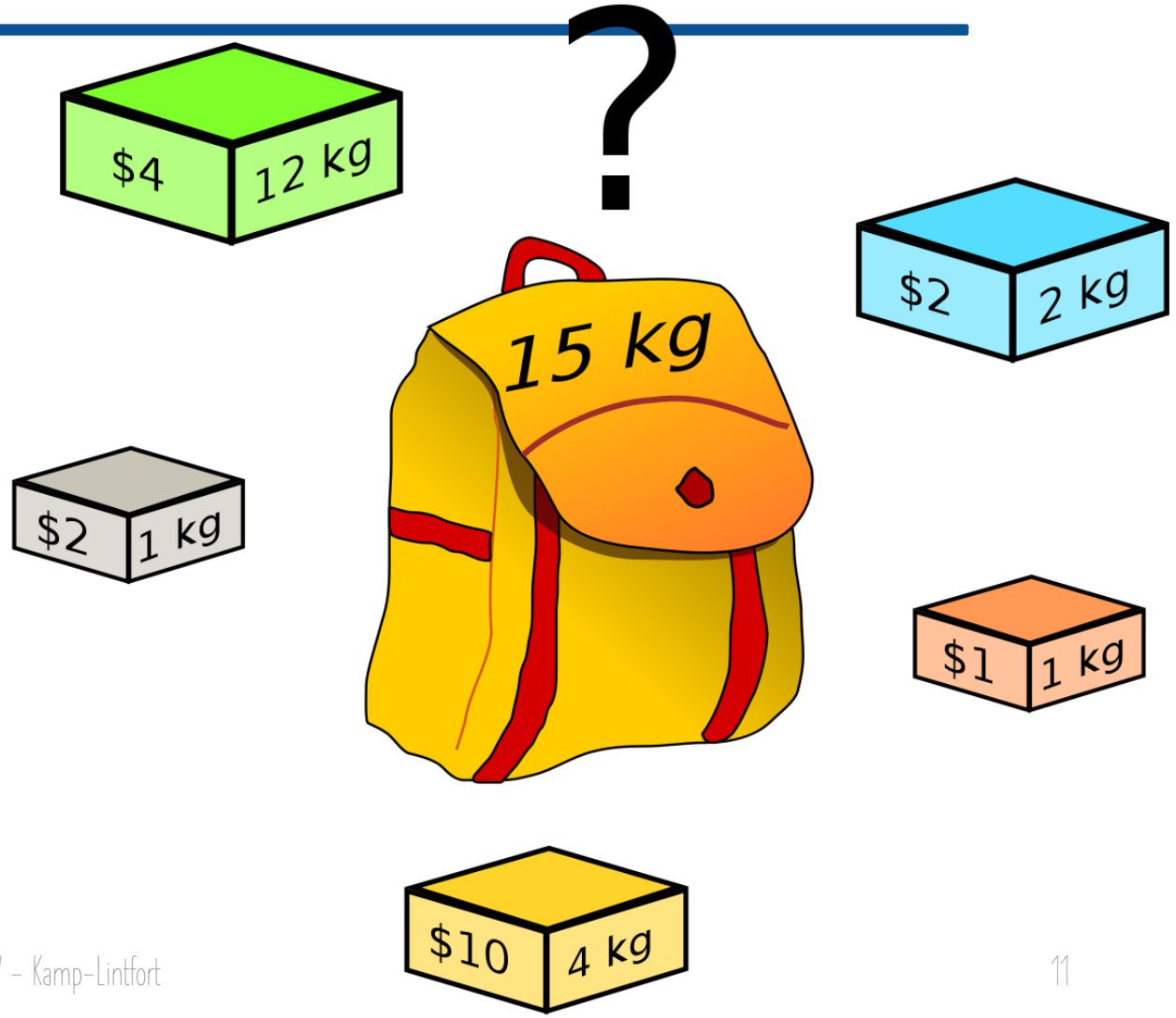
operation_id	dep_id	ops	weight	value	op_room_id
xx_015	CH1	xxxx	160	2	HLK1
xx_016	CH1	xxxx	190	2	HLK2
⋮					⋮



op_room_name	op_room_cap
HLK1	435
HLK2	390
OP1	555
OP2	555
OP3	555
OP4	435
OP5	435
OP6	320

Problem type

- Instead of a single knapsack:
- Multiple bags(op rooms),
- Multiple departments that leads a set of additional constraints



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Software implementation

- Does not contain hospital data.
- A demo to show the process.
- 3 main webpages:
  - Departments
  - Operation Rooms
  - List of operations
- Input and output data is saved into a database.

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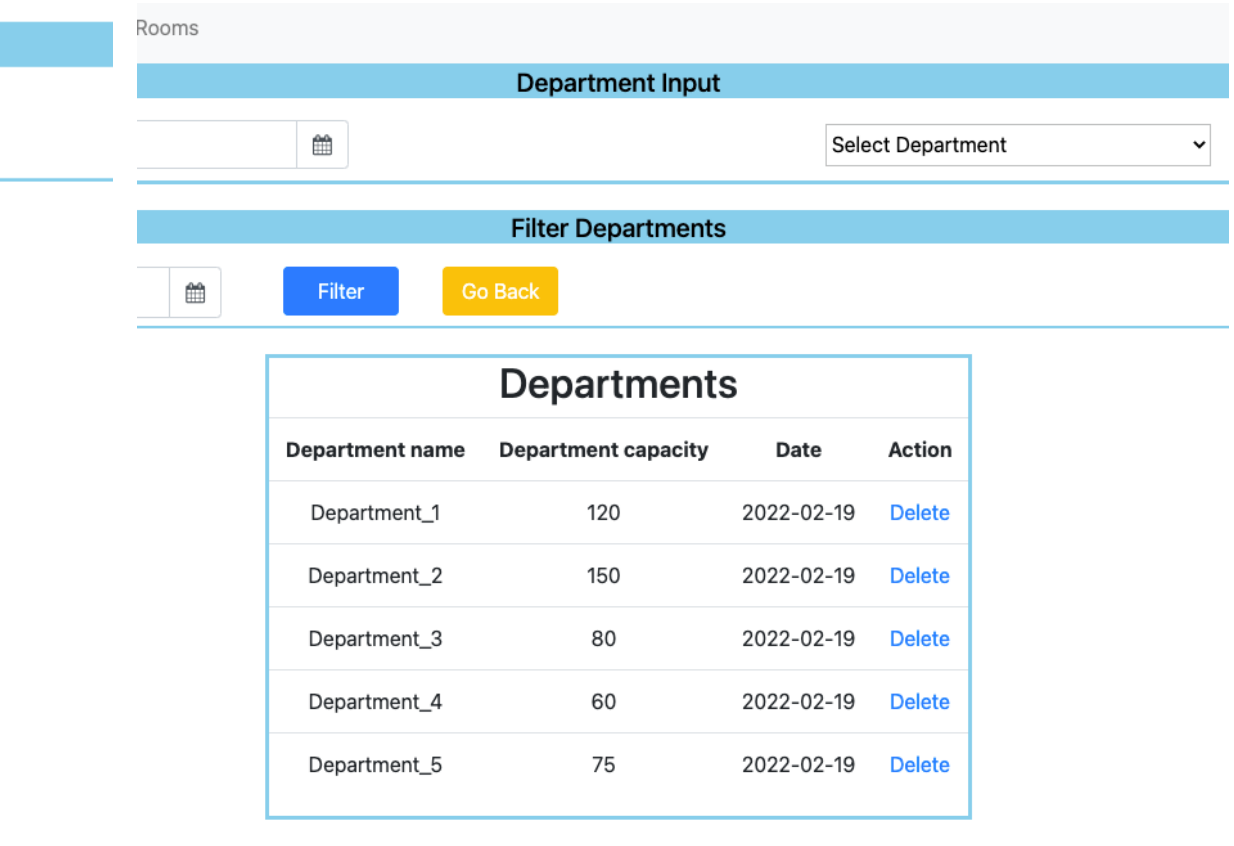
Software implementation



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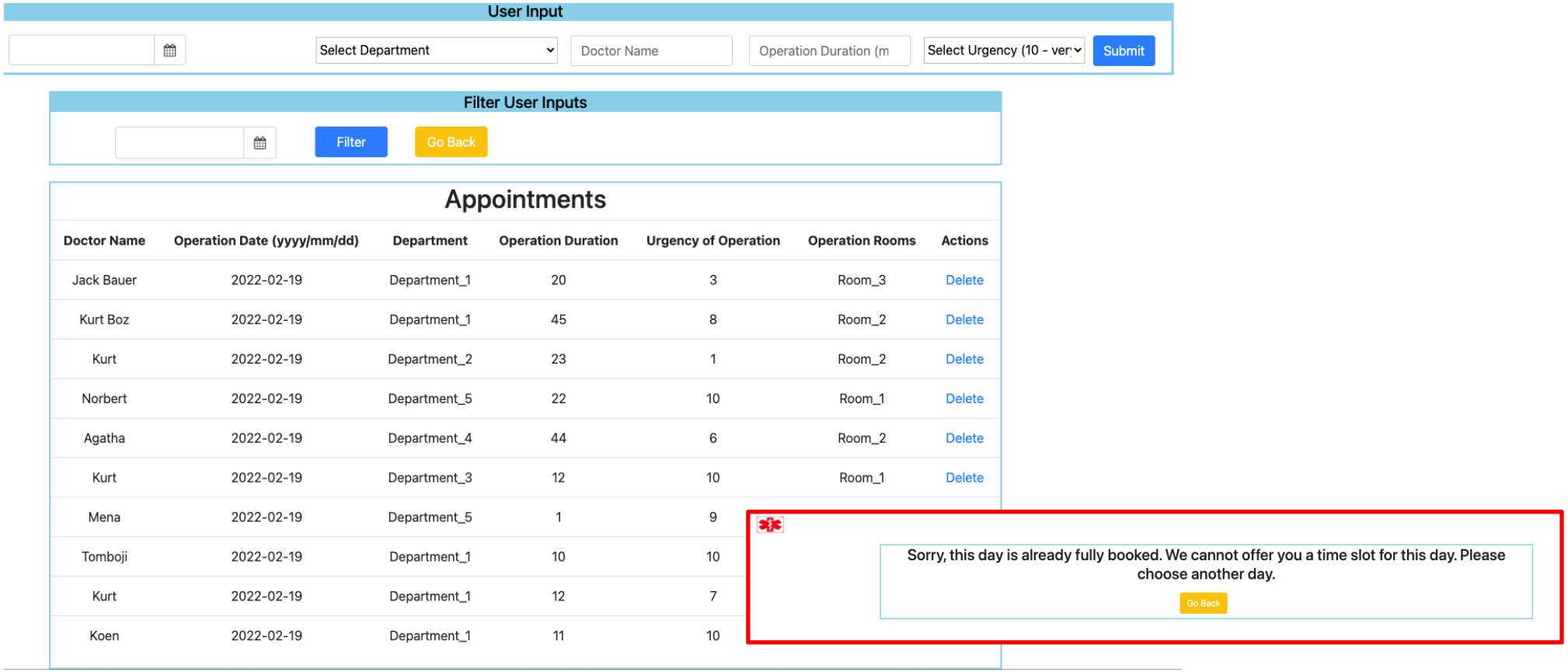
Software implementation



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Simulation

Assumptions

- **Very high demand per day, e.g. 50+ random selection from data of 2019**
- **FIFO, an existing registered op can not be excluded for the sake of better utilization.**
- **Promise a patient only the day of operation, not a specific time at the beginning**
- **No staff limitations**
- **Ignored all kind of urgent use of op-rooms**
- **No other resource limitations except op room time capacity and department time capacity**
- **As simple as a knapsack problem.**

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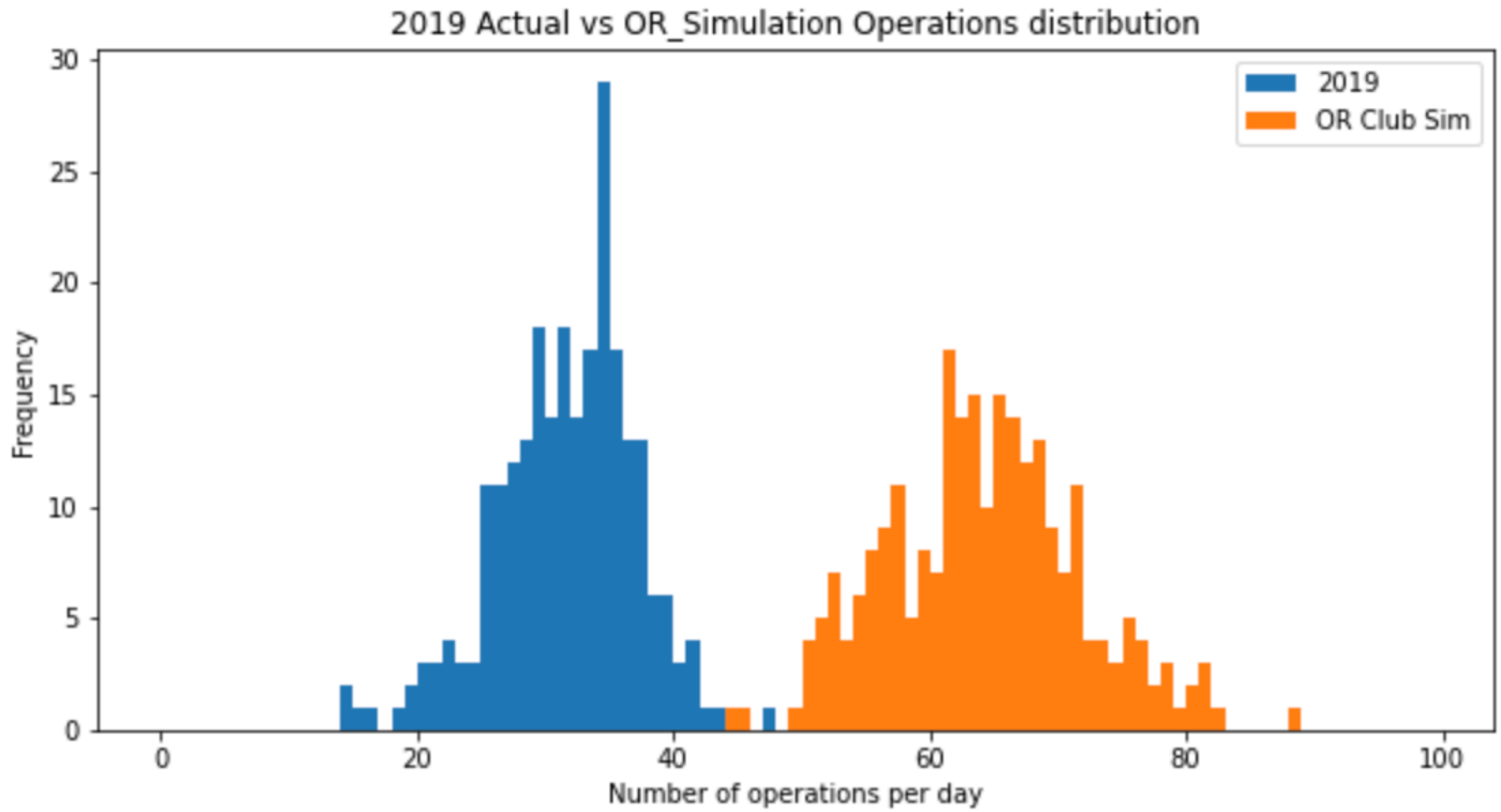
Simulation

Distribution of number of the ops per day



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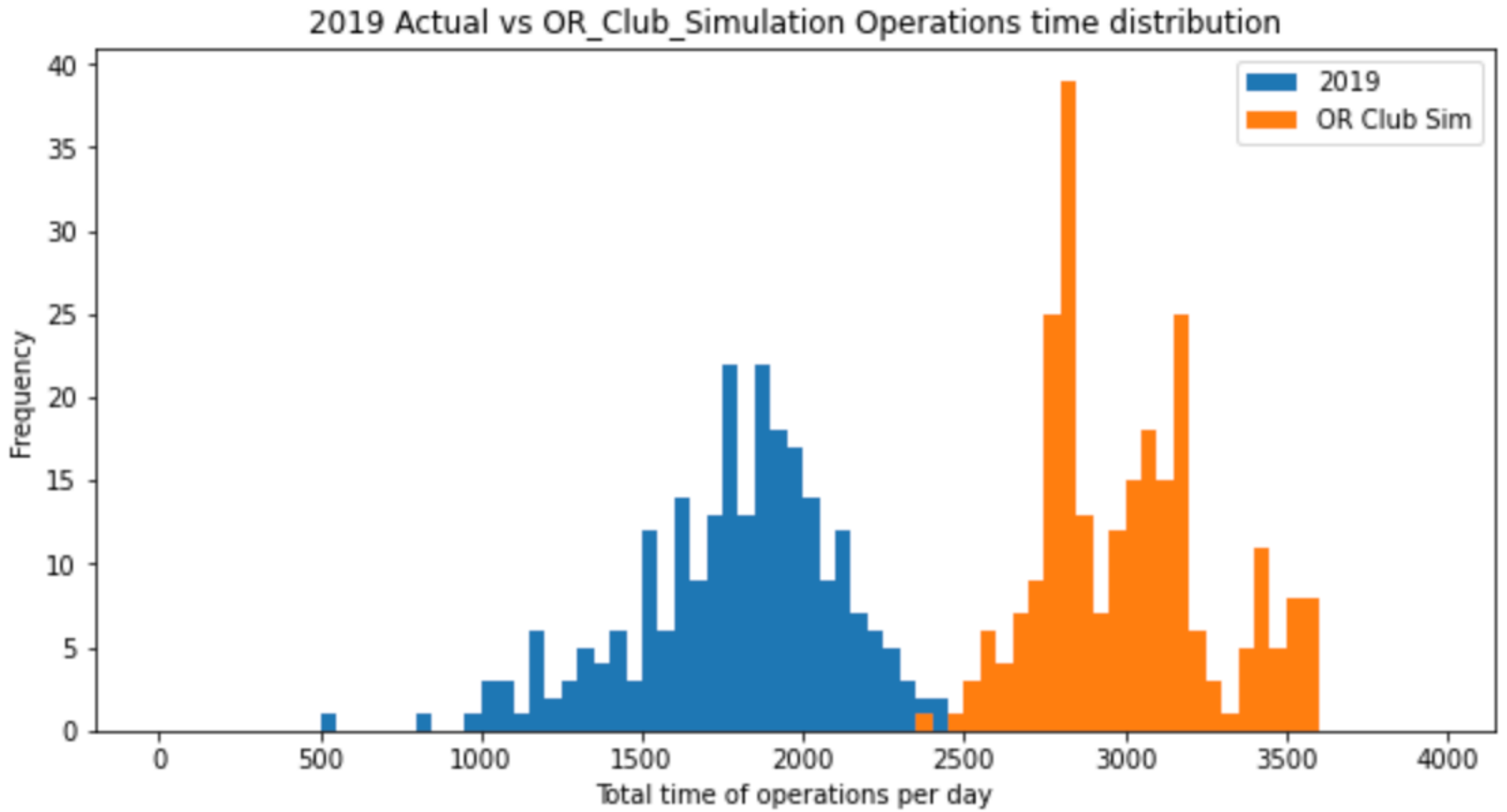
Simulation

Distribution of the total ops times per day



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Result

- **OR Club provided a solution:**
- **It almost doubles the usage of operations rooms in terms of:**
  - **duration time of operations from 1600 min/day to 3000 min/day,**
  - **number of operations from 30 to 65 per day.**
- **Open source tools, mostly python packages have been used to create the solution and the simulation.**

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Potential improvements

- An interface, website
- Connection with the database of the hospital
- Deployment on the hospital's server
- Additional sensor integration for further KPIs
- An interface for doctor comments and grading for the ops
- Forecast of the demand
- Including other complexities into the model, e.g. staff or anaesthesia
- …

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Win-Win!

- **OR Club has real-world problems to utilize its expertise!**
- **The Hospital has intelligent solutions for its problems!**