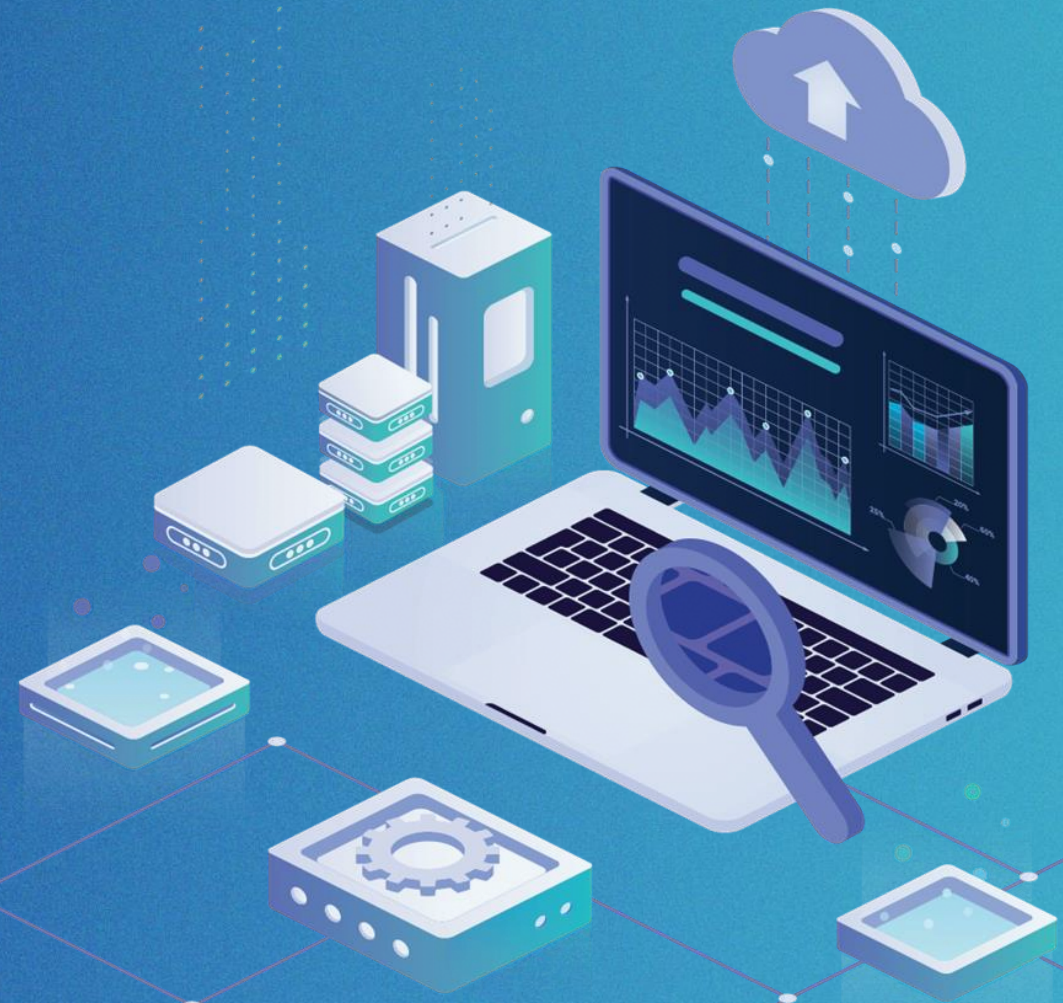




# Lessons in Successful Delivery from a Large-scale Workforce Scheduling Project

Gurobi Connect – Atlanta

April 2024



# Meet your speaker



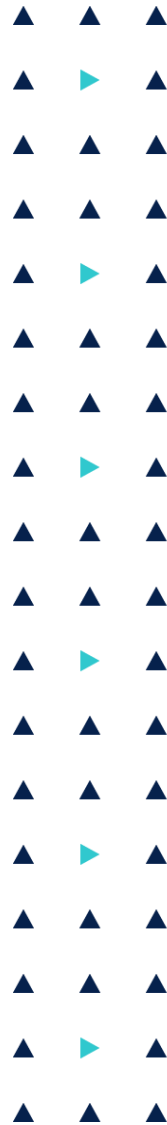
## Yash Puranik

Principal Data Scientist  
Boston, MA

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- PhD in Chemical Engineering
- Optimization theory, algorithms and commercial solver development
- Optimization projects across multiple industries

# Sections



01  
Aimpoint Digital



02  
Large-scale Workforce Scheduling



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Lessons & Discussion

# Aimpoint Digital

Aimpoint Digital is a market-leading analytics, data engineering, operations research, and Artificial Intelligence advisory and solution engineering firm

We exist to support organizations of all sizes – from Fortune 100 companies to seed-funded start-ups – to deliver business value through data

We partner with innovative companies across various industries, helping them craft effective strategies for monetizing their data assets, modernizing their data infrastructure, and developing impactful applications of GenAI.

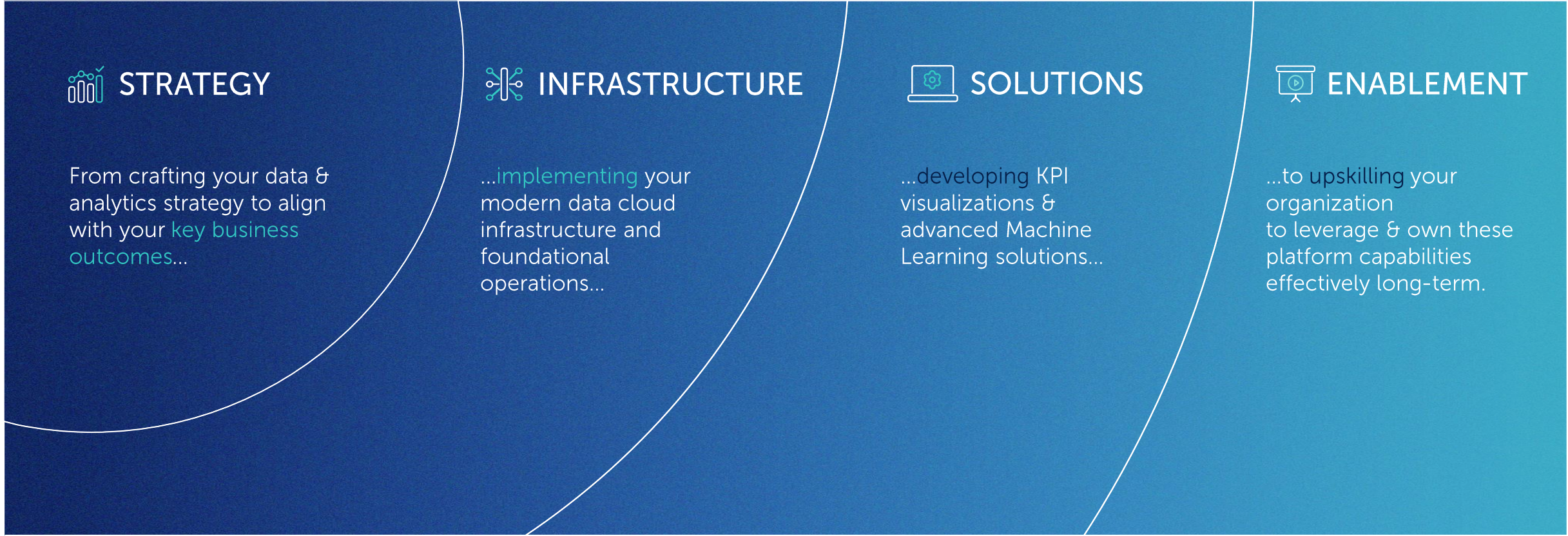


## Recognition

-  Ranked #295 out of 5,000 organizations in growth
-  Ranked #26 best small workplaces in US (Fortune)
-  Ranked #37 fastest-growing company in Southeast US
-  2023 Best Workplaces

# Our Services Span the full Data & Analytics Lifecycle

We start with your key business outcomes & drive value in all phases, from ideation through implementation & enablement.



Our Partners

alteryx aws databricks dataiku dbt Fivetran GUROBI OPTIMIZATION snowflake + a b l e a u

# What we offer

Our four key services and adjacent offerings support organizations across diverse industries and maturity levels.

## Our services

01

Data & Analytics Consulting

Analytics Strategy

Data Engineering & Infrastructure

Analytics

Decision Science

02

Solutions & Custom Product Development

APD Products & Solutions

Custom Product Development

03

Analytics-As-A-Service

Center of Excellence

Managed Services

04

Aimpoint Labs

AI Research

GenAI Software

# Our experience

We have deep & diverse experience working with clients to transform data challenges into market advantages across a variety of industries & functions.

## Industries we serve:



*And more, including Sports & Gaming, Hospitality & Restaurants*

## Business Functions we support:

- Supply Chain & Operations
- Revenue Management
- Research, Development, Product
- FP&A
- Sales and Marketing
- Customer Experience



From Large, Global Enterprises

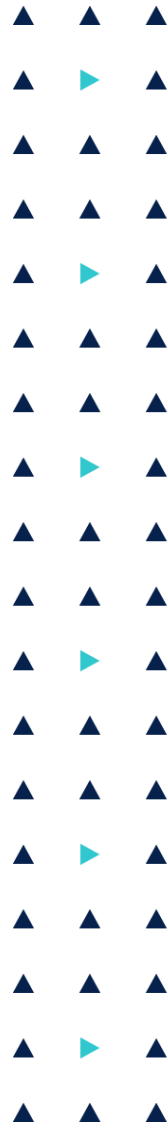


Serving over 100 clients



To Start-Ups & Emerging Companies

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# Client: Workforce management provider

Client's product is used by large corporations to plan schedules for support agents

## Large-scale

Used to plan schedules for thousands of agents that may be spread across many locations

## Multiple channels

Changing channels of support as increasing requests come through email, chat and text over voice

## Uncertainty in requests

The number of requests across channels is uncertain

## Fairness

Weekend shifts, overtime and worker preferences must be accounted for fairly

## Support local regulations

Workers are spread across geographies: schedules must follow local laws

## Limited capacity

Seating capacity in certain offices might be limited

## Cloud architecture

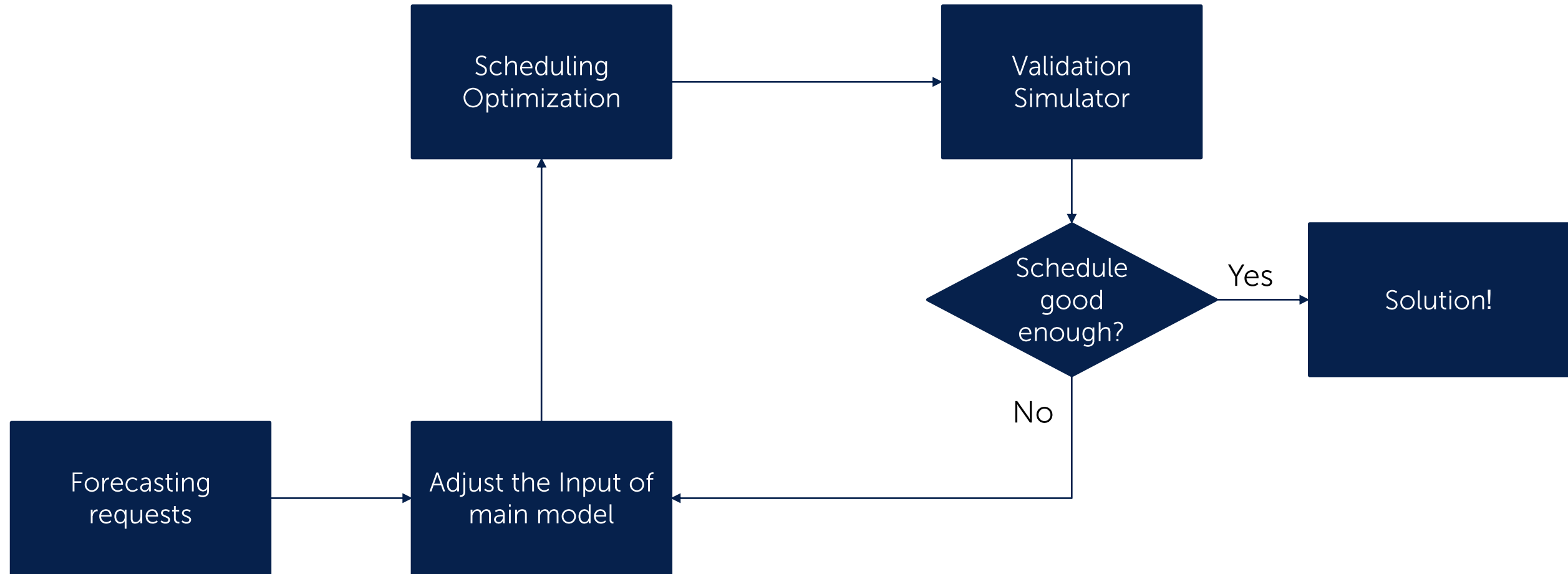
Switching architectures to a cloud-based microservices architecture

## Speed

Desire to obtain schedules for up to two weeks in the future efficiently and support scenario analysis

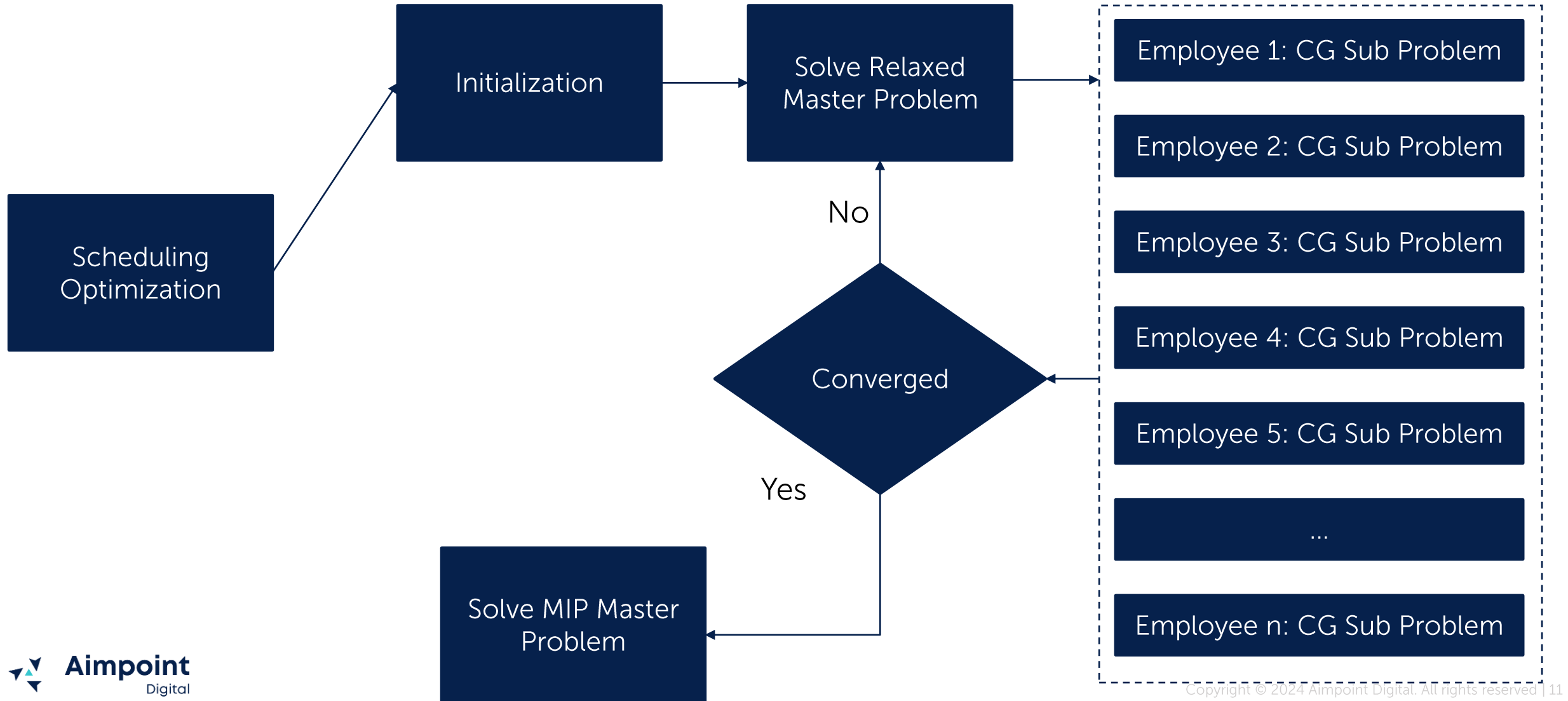
# High-level workflow

The full solution involves many elements including simulation and forecasting



# Column generation-based solution approach

Column generation provides a scalable way to solve the large-scale problems



# Relying on versatility of MIP models

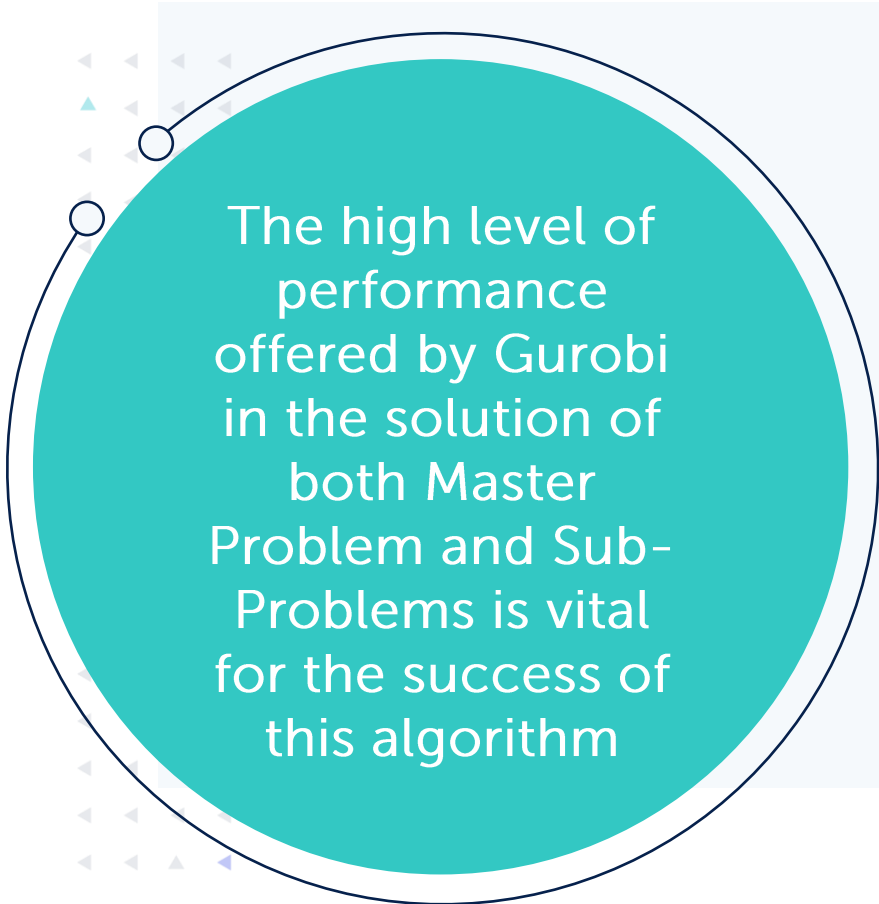
Use of MIP models for solving both master and column generation sub problems

## Master Problem Considerations

- Choosing between schedule candidates for each employee
- Minimizing overage and underages in staffing needs
- Enforcing fairness between employees in choices of schedules

## Column Generation Sub-Problem Considerations

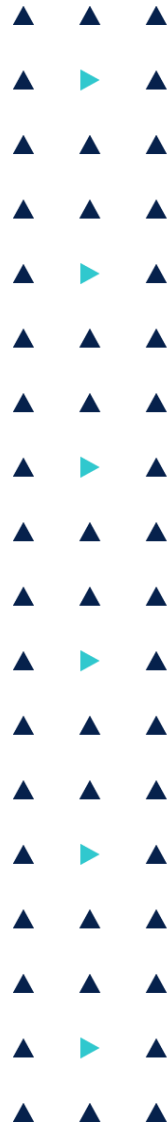
- Satisfaction of local laws and regulations
- Specification of minimum and maximum working hours (days)
- Specification on choices of days off
- Specification on minimum and maximum consecutive (non) working days
- Specification on start times and break times



The high level of performance offered by Gurobi in the solution of both Master Problem and Sub-Problems is vital for the success of this algorithm

Using MIP models for sub-problems was vital for **speed of development, extensibility and maintenance**

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# Managing expectations around computational time and optimality is vital

## Challenges



- IT/Business teams request SLAs on computational times
- The desire for “global optimality” sometimes outweighs practicality

## Solution



- Having a baseline to compare speed and quality of solutions
- Emphasizing the flexibility of MIP solutions
- Having heuristics and fallbacks in case fast solutions are critical

Remain hyper focused on **communicating business value** over considerations of speed and/or global optimality

Response Number	Percentage
4	11.32%
8	22.64%
29	84.48%

### Business Value

- 30%** Increase in employee satisfaction
- +10%** CSAT improvement

# Extensive computational testing is a must



Computational Infrastructure

Generating a test set and setting up computational infrastructure is important prior to solutioning



Options + Smart Defaults

It is useful to retain options to choose between different solution mechanisms implemented while setting smart defaults



Gurobi support for option tuning

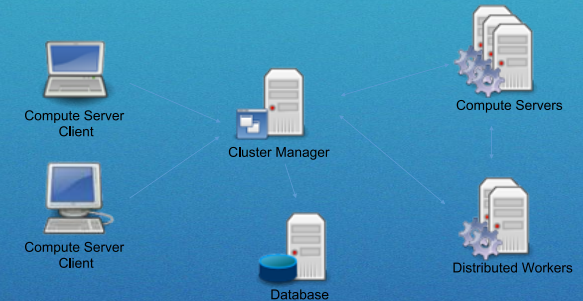
Gurobi comes with a parameter tuning tool. Gurobi expert team is also available to help



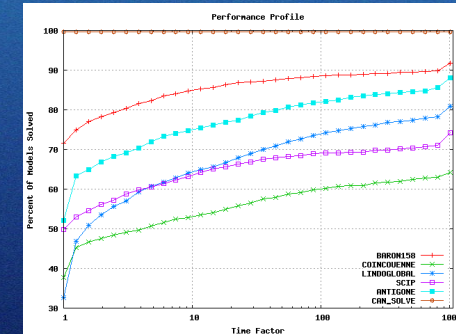
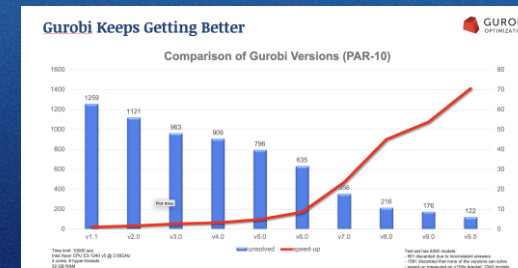
Periodic monitoring and retuning

Optimal parameter choices can change over time as data or solver libraries change. Periodically retuning options is useful

Test infrastructure to mimic deployment



Tooling to measure, analyze and visualize computational results



# Agile for optimization has challenges and benefits

## Challenges

Scope & business requirements vary through the project, especially as more data and requirements become available

Timelines can be very hard to estimate for optimization/data science work due to the inherent research nature of the work involved

Deliverables can be hard to define when working with engineering teams with specific expectations and practices around them

There can be a communication barrier between IT & OR Teams

## Adaptations

Doing extensive requirements gathering before starting a project and documenting the project plan helps align all stakeholders to the innovation mindset

Breaking down the project into multiple phases such as feasibility assessment, PoC, MVP and production phases with clearly defined objectives

Encouraging an innovation mindset where sharing learnings or even null results constitute a valid deliverable

Both teams can learn from each other for the overall success of the project

Choosing pragmatism over dogmatism can benefit both IT and DS/OR teams





**Aimpoint**  
Digital