Maximum time off, minimum leave

Solving the holiday equation with Python and math

PyBerlin - February 2026

Sander Van Aken

Operations research? Mathematical optimization?

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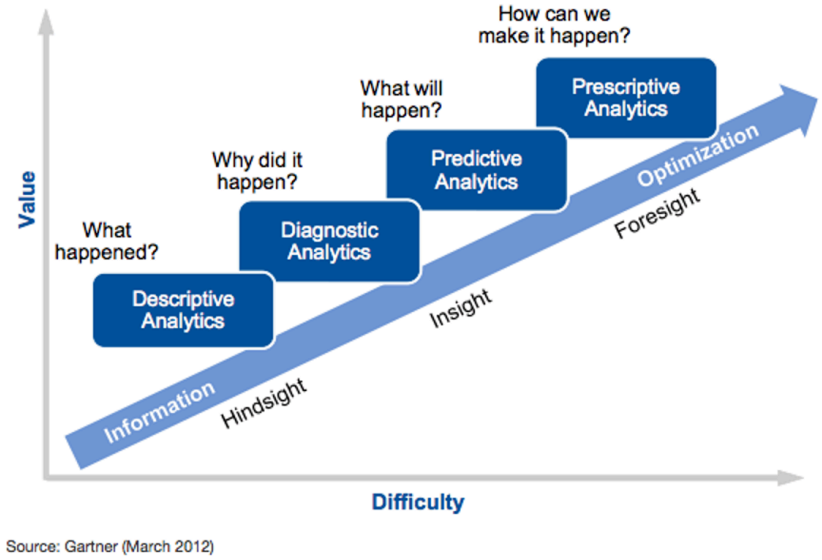
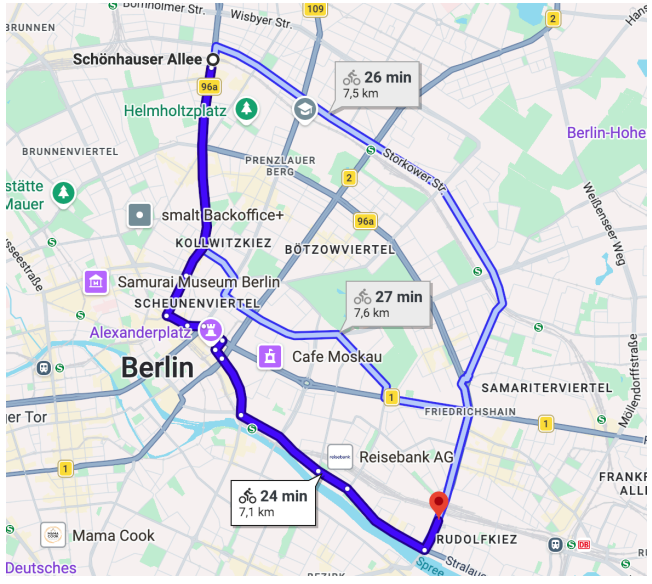


Source: Gartner's Analytics Ascendancy Modelcomputd.nl

> *"Operations research arrives at optimal or near-optimal solutions to decision-making problems"* (Wikipedia)

Optimization is Everywhere in Everyday Life ...

What is the route from home to work with the least traffic lights?



How to assign riders to orders at minimal cost while ensuring timely delivery?

... and Useful for many more Purposes

Solving Sudokus

8								
		3	6					
	7			9		2		
	5				7			
				4	5	7		
			1				3	
		1					6	8
		8	5				1	
	9					4		

AI14473 (c) Arto Inkala www.aisudoku.com

What is the fastest way to visit all FlixTrain stations based on the timetable?

Tube Challenge

Article Talk

From Wikipedia, the free encyclopedia

The **Tube Challenge** is the competition for the fastest time to travel to all London Underground stations, tracked as a Guinness World Record since 1960. The goal is to visit all the stations on the system, not necessarily all the lines; participants may connect between stations on foot, or by using other forms of scheduled public transport.

"The Holy Grail of Optimization - making optimization available to non-OR experts"

— R. Bixby, co-founder of CPLEX and Gurobi

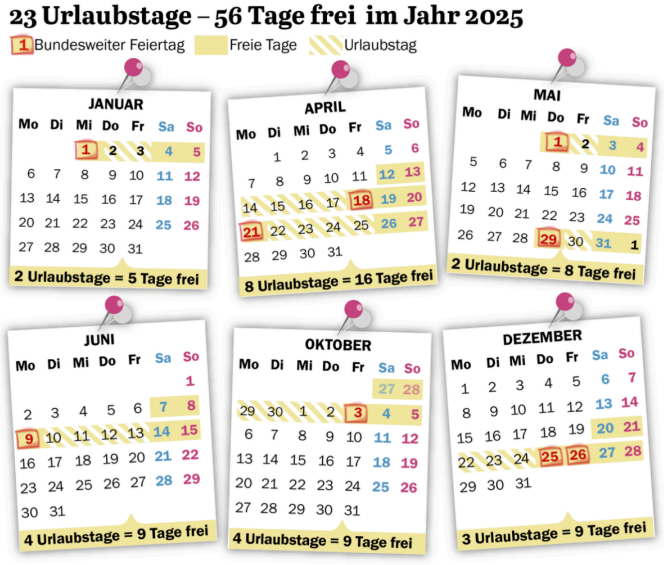
How to Become Better at Planning Your Holidays?

Manager Nov 14, 2025 at 14:23

Sander, I checked the number of remaining holidays for all team members. I wanted to point out you have 15 days left.

Sander 14:25

I know, how many can I take to next year?



23 Urlaubstage – 56 Tage frei im Jahr 2025.

Source: Tagesspiegel

Problem = Goal + Possible Decisions + Constraints + Data

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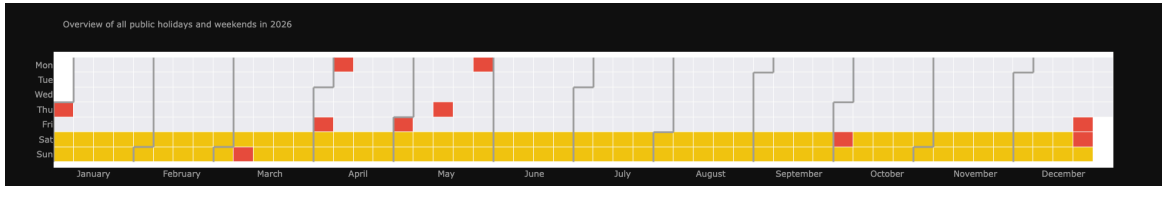
- **Goal**: maximize the utility we get from being off
- **Decisions**: on which days to schedule your day off
- **Constraints**: holiday budget; specific days we need to take off
- **Data**: German public holidays; how much value days-off bring you



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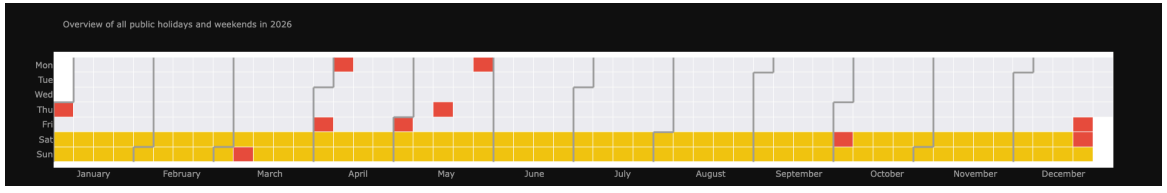

Requirements

- Need to have at least 1 period of 14 days or more
- Budget of 30 days

Preferences

- The longer the period, the higher the value
- Preferably off on September 1st, 2026

Problem = Goal + Possible Decisions + Constraints + Data

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- **Possible decisions**: on which days to schedule your day off
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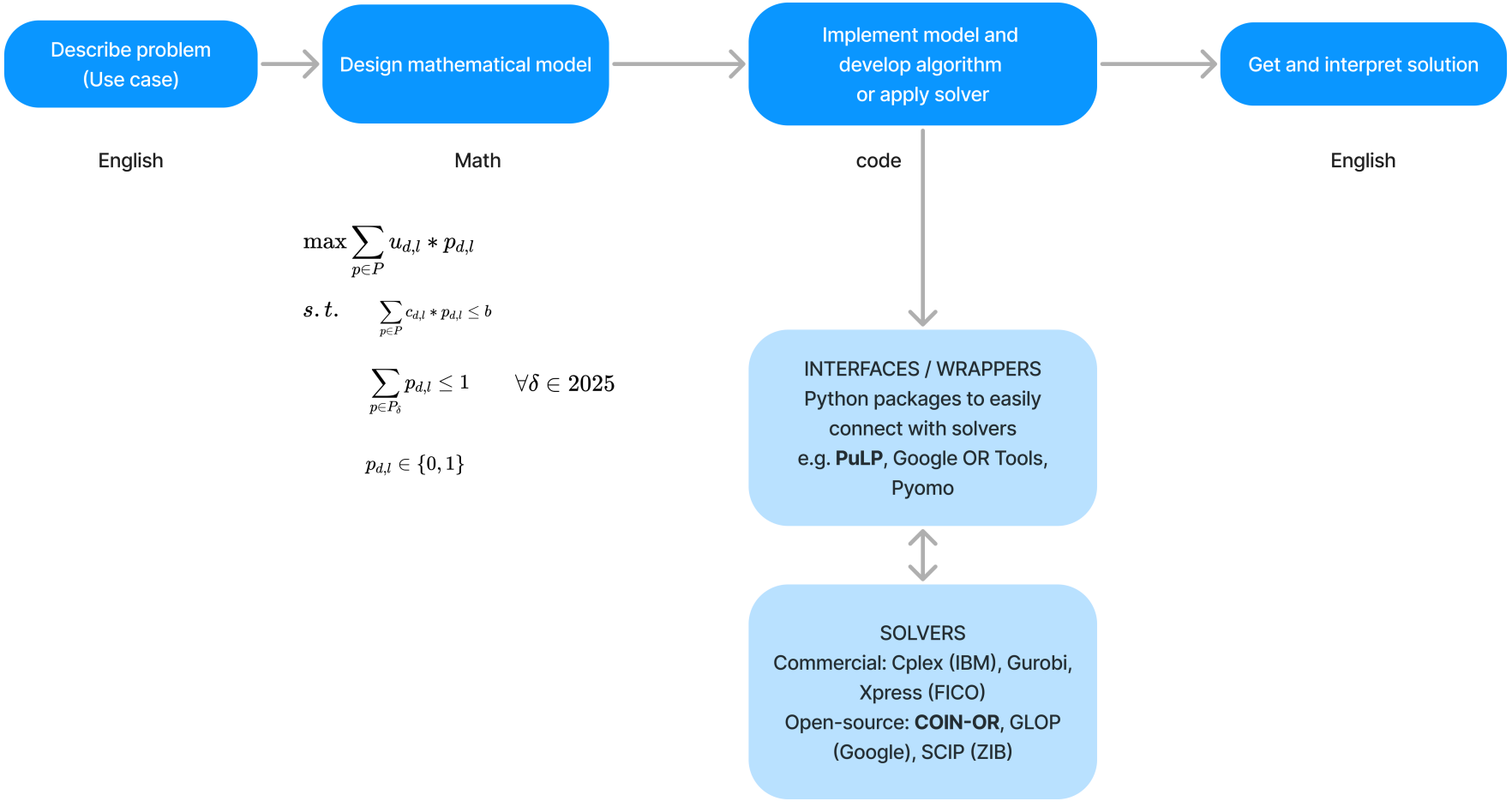
23 Urlaubstage – 56 Tage frei im Jahr 2025.

Different ways to solve:

- **Exact models** (LP, MIP, MILP, …) passed to solvers
- **Heuristics** (greedy, local search, gradient descent …)
- **Meta-heuristics** (genetic algorithms, adaptive large neighbourhood search …)
- **Dynamic programming, constraint programming…**

General Concept of Solving Problems using Exact LP, MILP and Other Models



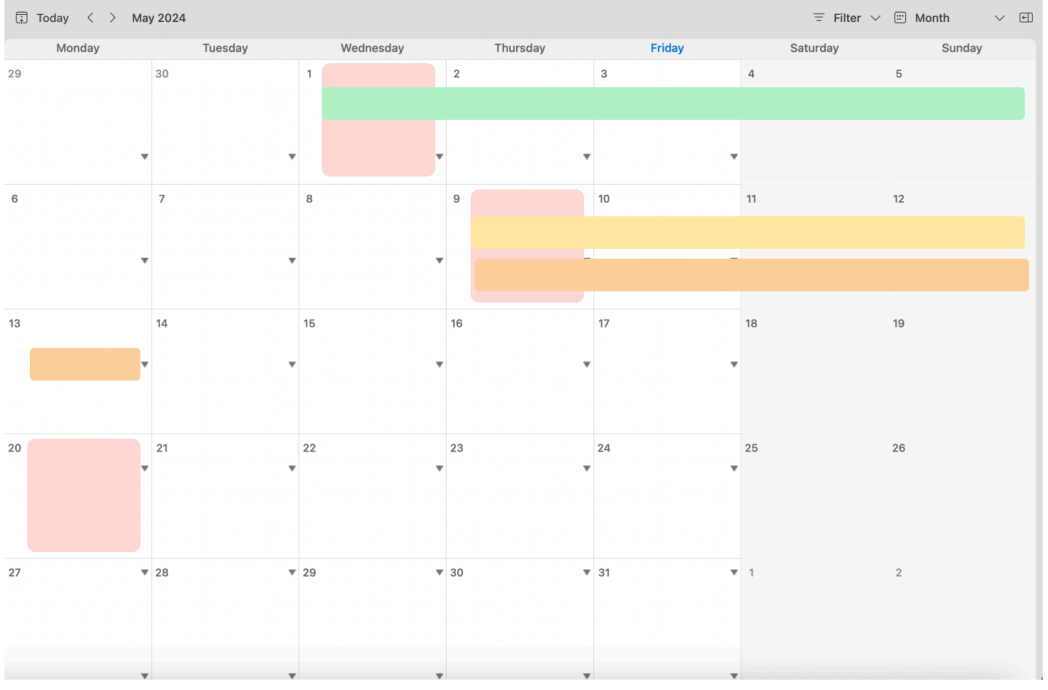
Example: Modelling Optimal Holiday Planning

Modelling our Problem as Deciding when to Start a Period of a Number of Days

Decisions: take a period with duration `l` calendar days off, starting at a particular date `d`

Examples:

- Green → (May 1, 2024; 5 days)
- Yellow → (May 9, 2024; 4 days)
- Orange → (May 9, 2024; 5 days)



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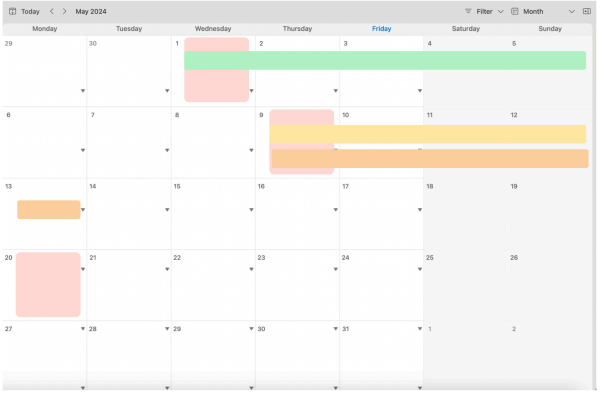
Variables:

- $x_{d,l} \in \{0, 1\}$: 1 if we take period starting at date d with length l

Parameters:

- $u_{d,l}$: value of period (d, l)
- $c_{d,l}$: cost (holidays) of period (d, l)
- b : holiday budget



$$\max \sum_{p \in P} u_{d,l} * p_{d,l}$$

$$s.t. \quad \sum_{p \in P} c_{d,l} * p_{d,l} \leq b$$

$$\sum_{p \in P_\delta} p_{d,l} \leq 1 \qquad \forall \delta \in 2025$$

$$p_{d,l} \in \{0, 1\}$$

Ready to Implement and Solve ...

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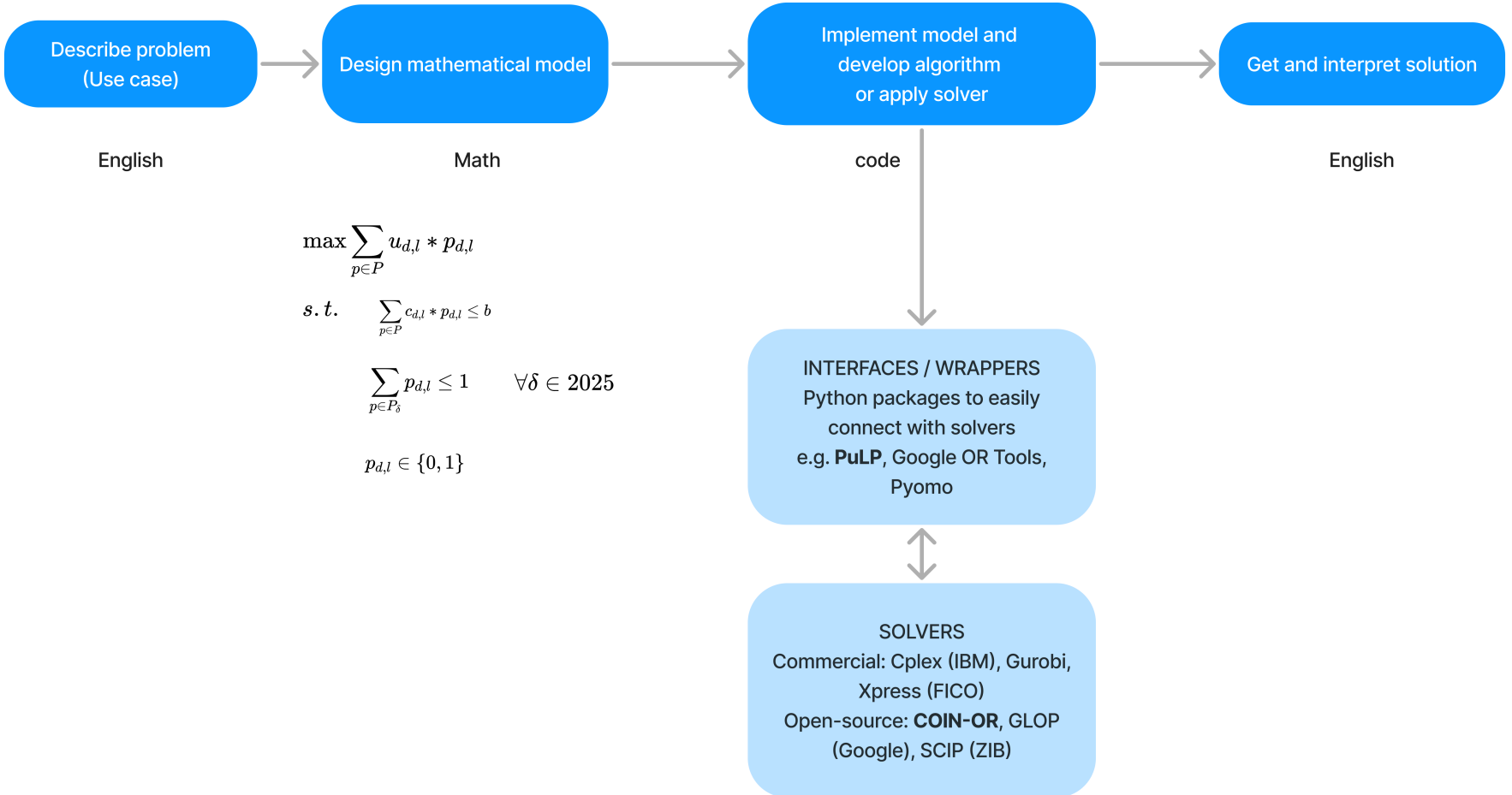
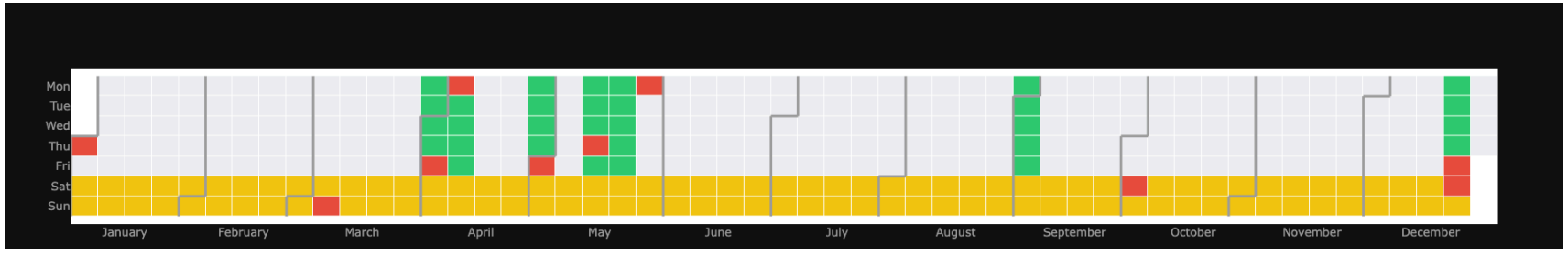


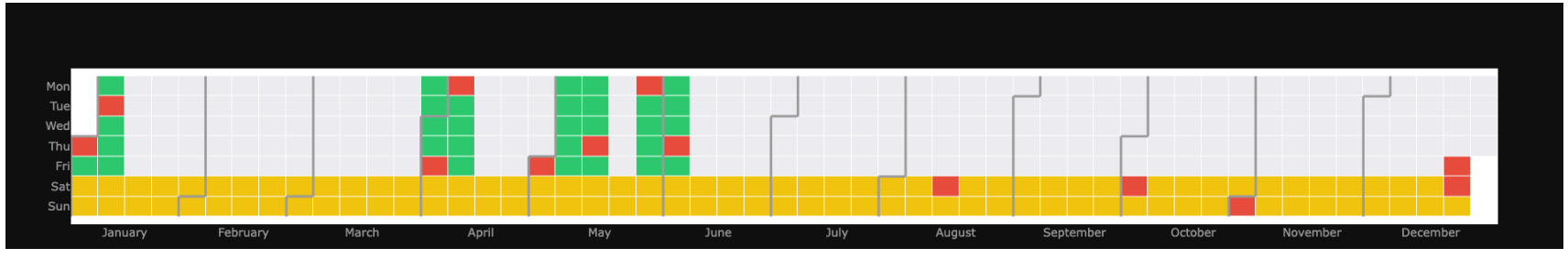
Interpreting the result

Interpreting the result

Berlin

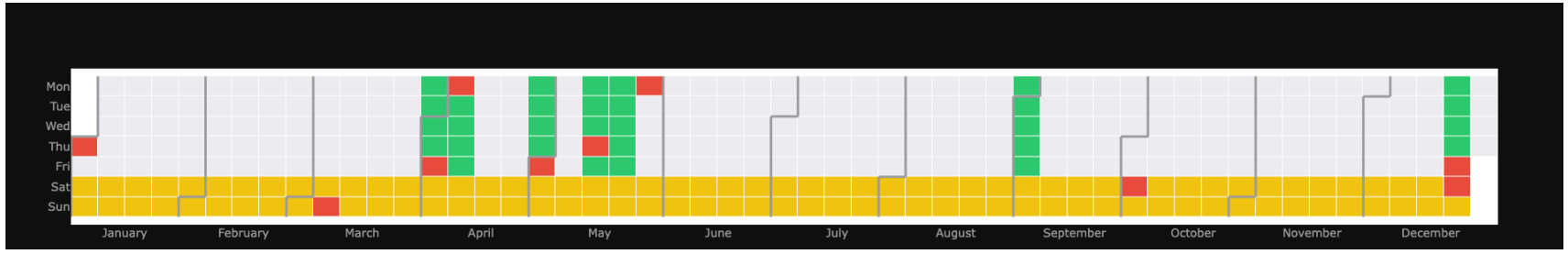


Munich

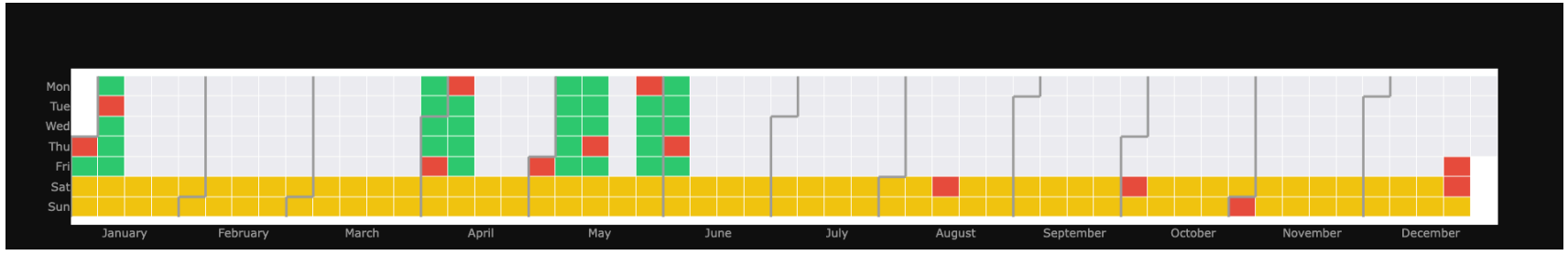


Interpreting the result

Berlin



Munich



Key takeaways

- Berlin is disadvantaged compared to Munich
- Making the result practicable requires iteration and detailing
- Mathematical optimization is as much an art as a science, but foremost fun!

Resources

Happy to connect 👋

- Sander Van Aken
- SanderVA92 - bit.ly/pyberlin-mathopt

EURO Practitioners' Forum: conferences, webinars and newsletter 💡

- Webinar March 6: "Trust but verify - testing optimization models"
- Eventbrite: EURO Practitioners' Forum
- EURO Practitioners' Forum

Python Libraries 💻

- PuLP Documentation
- Google OR-Tools
- Pyomo

Thank you for your attention!

Slideshow created using remark