Overview

Gurobi OptiMods

Simple APIs for common optimization tasks

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GUROBI OPTIMIZATION

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Agenda

OptiMods

Why, how, and what

Example: Optimal Portfolios

Optimal asset allocation made easy

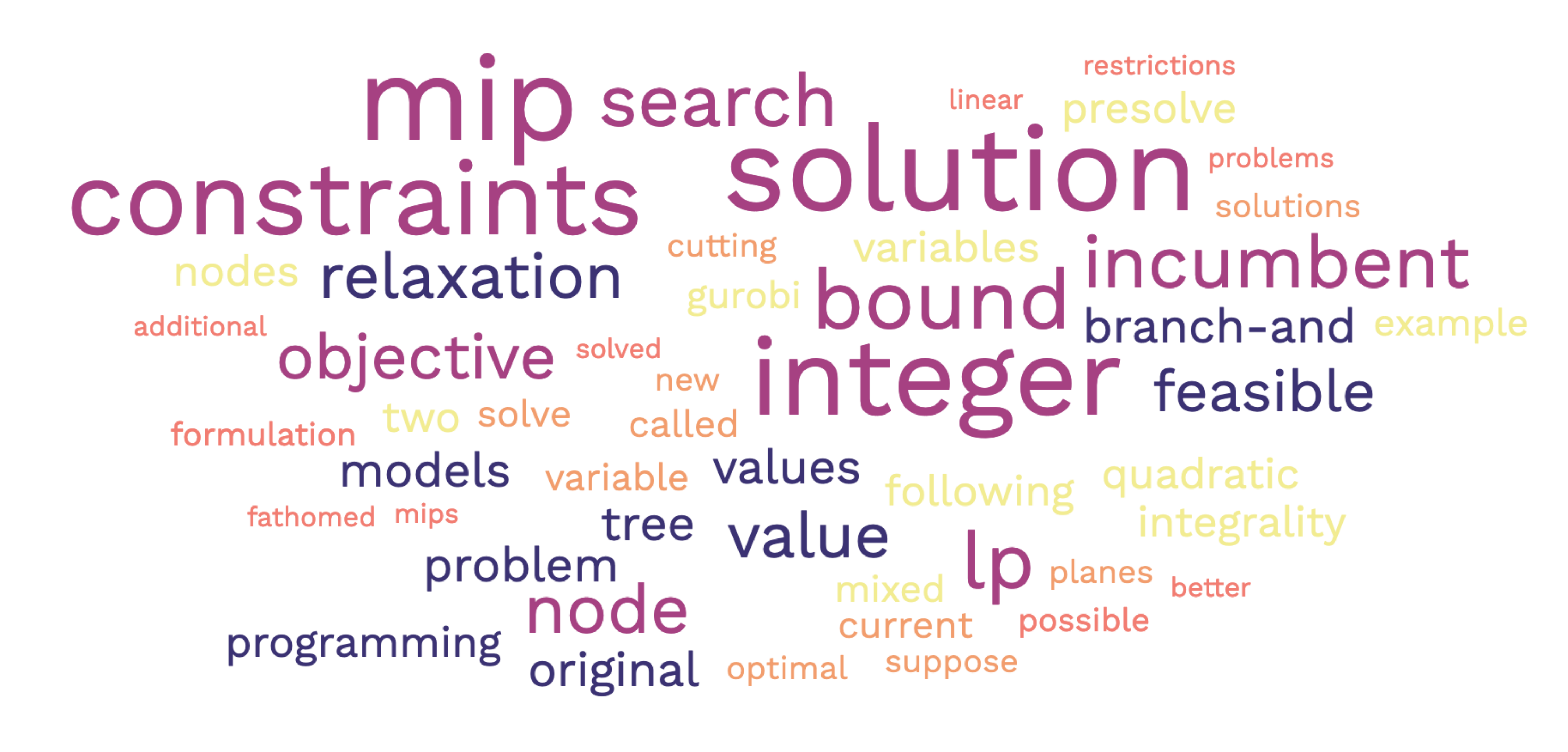
Example: Workforce scheduling

Easy staff scheduling to meet requirements

What’s next

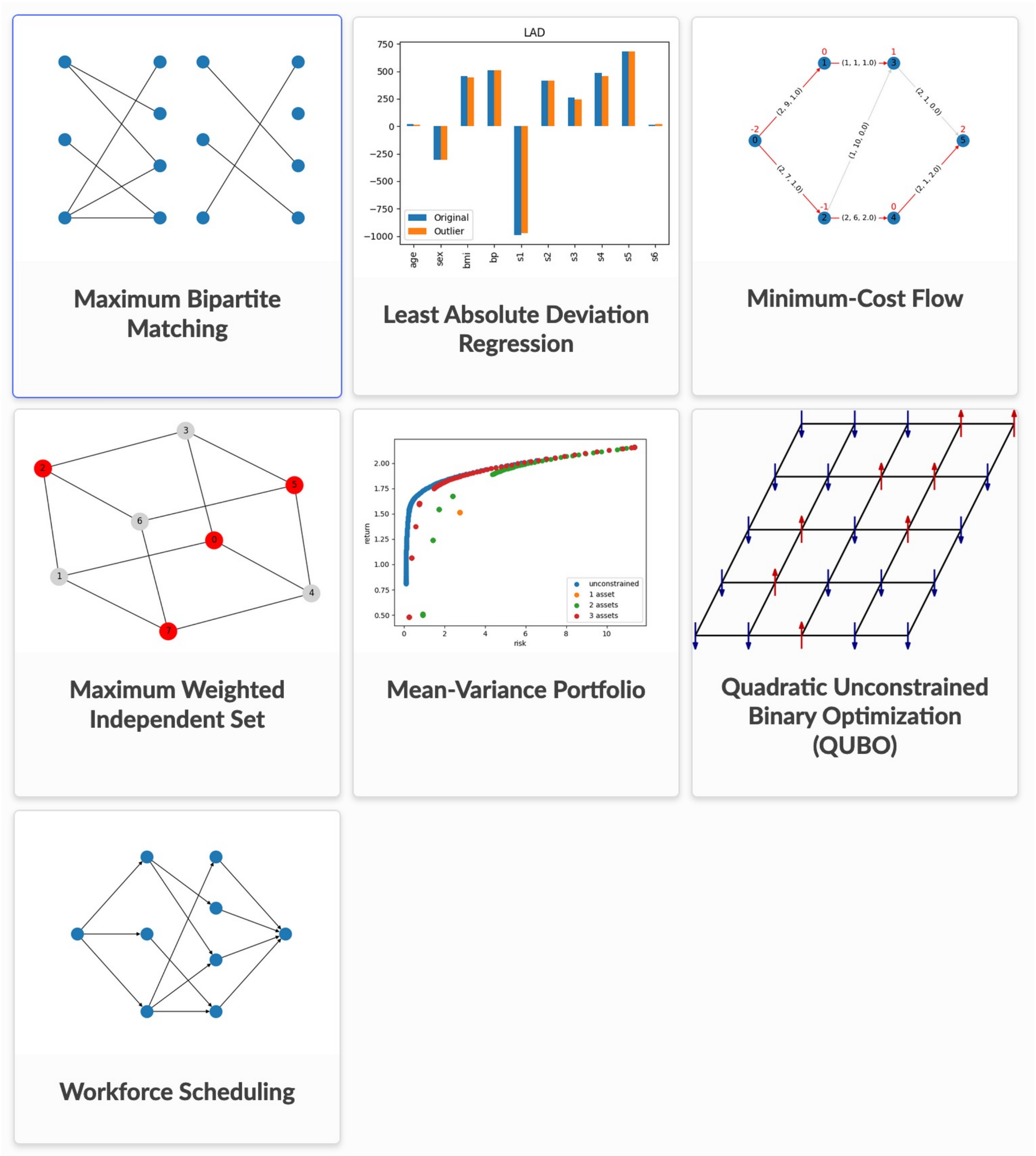
Extending Mods, proposing and implementing new Mods

If you dive into mathematical optimization…



An OptiMod...

- Is a tool to solve a specific, practical problem
- Has a data-driven API and integrates with the greater Python ecosystem
- Takes data in “natural form”, returns a solution in “natural form”
- Solves a mathematical optimization problem using Gurobi’s MIP technology without the need to dive into mathematical modeling



Maximum Bipartite Matching

Least Absolute Deviation Regression

Minimum-Cost Flow

Maximum Weighted Independent Set

Mean-Variance Portfolio

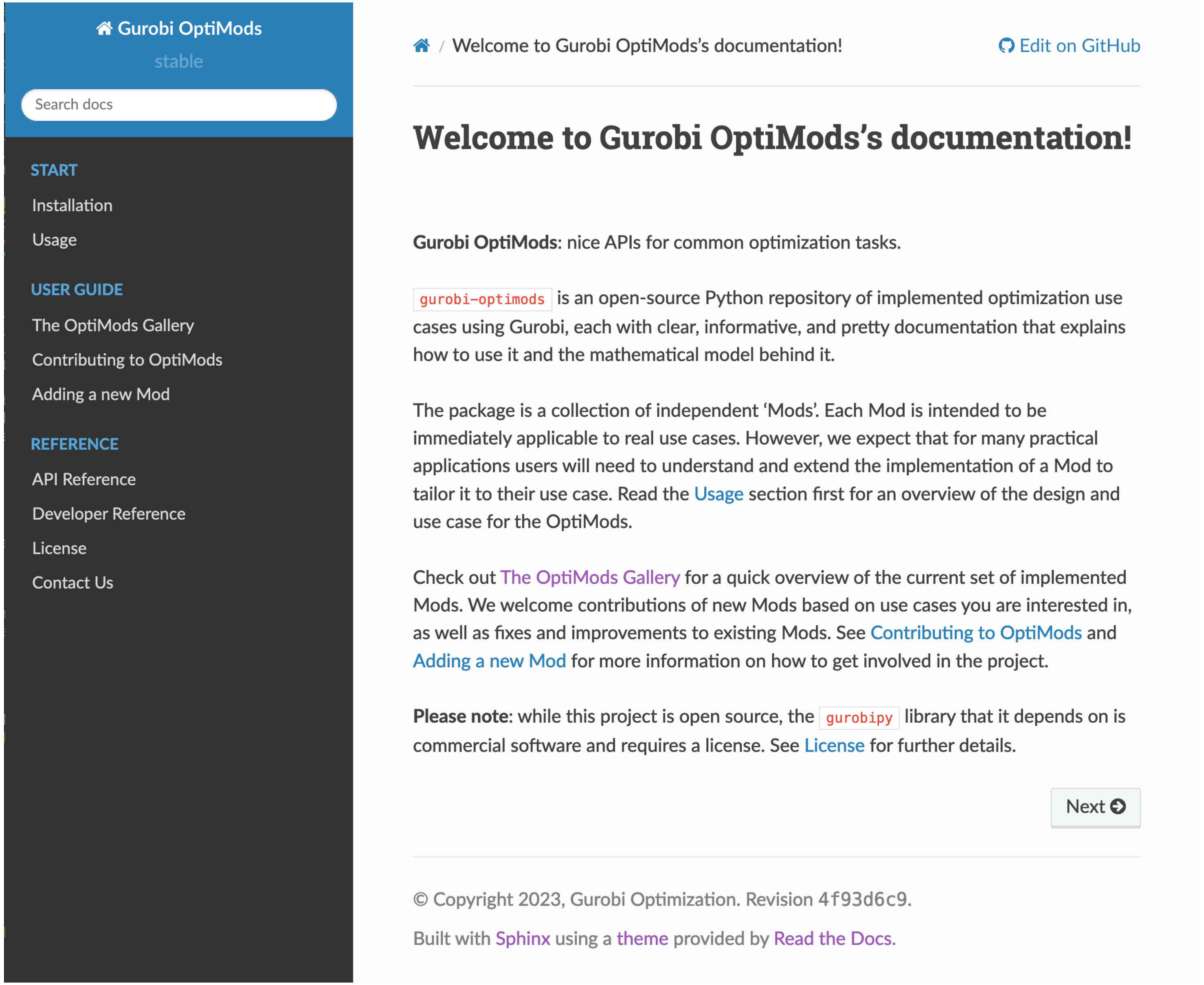
Quadratic Unconstrained Binary Optimization (QUBO)

Workforce Scheduling

First seed of Mods

Where to get it

- pip install gurobi-optimods
- Documentation on Read the Docs



Welcome to Gurobi OptiMods's documentation!

Gurobi OptiMods: nice APIs for common optimization tasks.

`gurobi-optimods` is an open-source Python repository of implemented optimization use cases using Gurobi, each with clear, informative, and pretty documentation that explains how to use it and the mathematical model behind it.

The package is a collection of independent 'Mods'. Each Mod is intended to be immediately applicable to real use cases. However, we expect that for many practical applications users will need to understand and extend the implementation of a Mod to tailor it to their use case. Read the Usage section first for an overview of the design and use case for the OptiMods.

Check out The OptiMods Gallery for a quick overview of the current set of implemented Mods. We welcome contributions of new Mods based on use cases you are interested in, as well as fixes and improvements to existing Mods. See Contributing to OptiMods and Adding a new Mod for more information on how to get involved in the project.

Please note: while this project is open source, the `gurobipy` library that it depends on is commercial software and requires a license. See License for further details.

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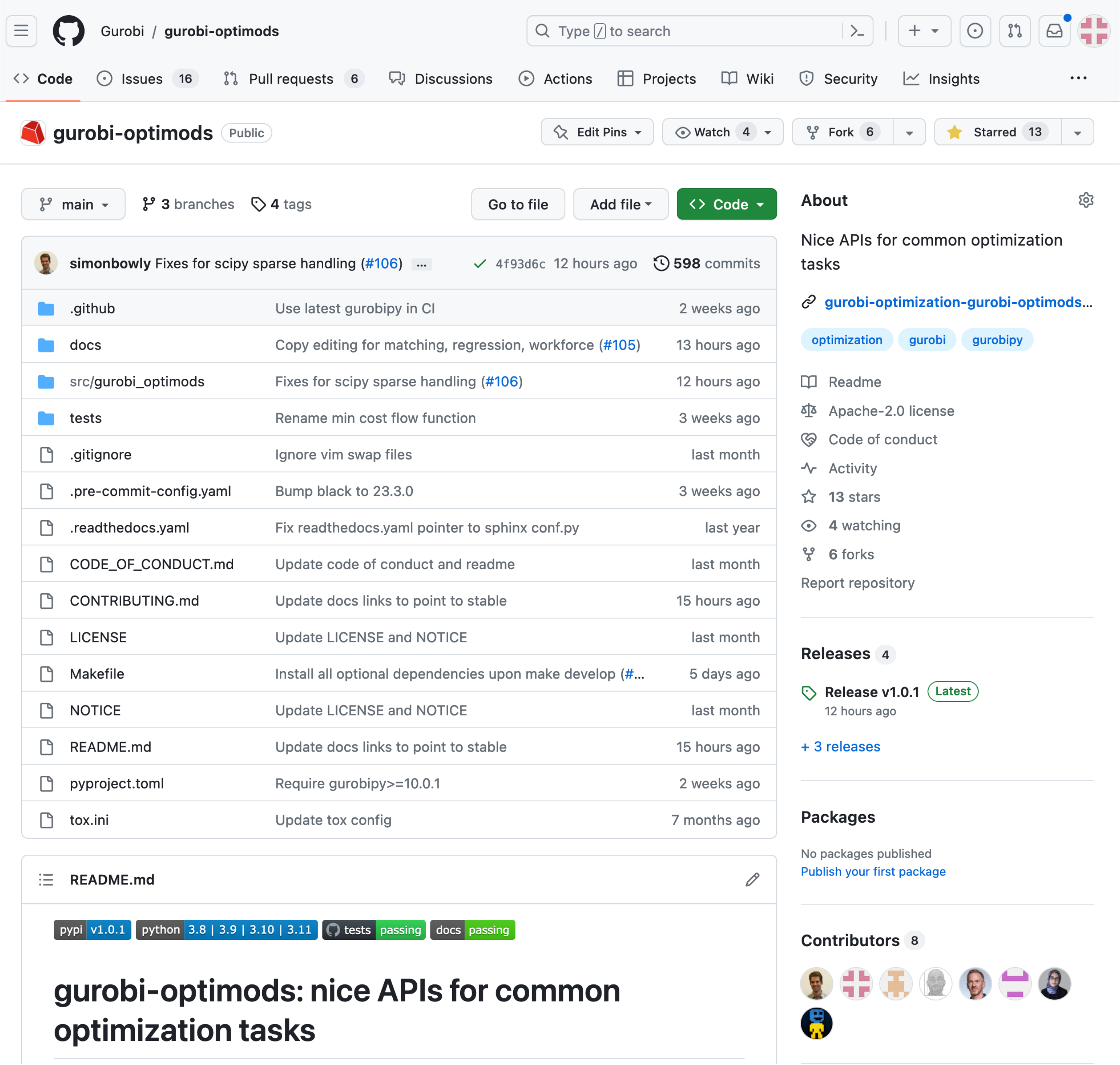
Built with Sphinx using a theme provided by Read the Docs.

Example: Optimal mean-variance portfolios

Example: Staff scheduling



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gurobi-optimods Public

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main | 3 branches | 4 tags | Go to file | Add file | Code

simonbowly Fixes for scipy sparse handling (#106) … ✓ 4f93d6c 12 hours ago | 598 commits

.github	Use latest gurobipy in CI	2 weeks ago
docs	Copy editing for matching, regression, workforce (#105)	13 hours ago
src/gurobi_optimods	Fixes for scipy sparse handling (#106)	12 hours ago
tests	Rename min cost flow function	3 weeks ago
.gitignore	Ignore vim swap files	last month
.pre-commit-config.yaml	Bump black to 23.3.0	3 weeks ago
.readthedocs.yaml	Fix readthedocs.yaml pointer to sphinx conf.py	last year
CODE_OF_CONDUCT.md	Update code of conduct and readme	last month
CONTRIBUTING.md	Update docs links to point to stable	15 hours ago
LICENSE	Update LICENSE and NOTICE	last month
Makefile	Install all optional dependencies upon make develop (#…	5 days ago
NOTICE	Update LICENSE and NOTICE	last month
README.md	Update docs links to point to stable	15 hours ago
pyproject.toml	Require gurobipy>=10.0.1	2 weeks ago
tox.ini	Update tox config	7 months ago

README.md

pypi v1.0.1 | python 3.8 | 3.9 | 3.10 | 3.11 | tests passing | docs passing

gurobi-optimods: nice APIs for common optimization tasks

About

Nice APIs for common optimization tasks

gurobi-optimization-gurobi-optimods...

optimization | gurobi | gurobipy

Readme
Apache-2.0 license
Code of conduct
Activity
13 stars
4 watching
6 forks
Report repository

Releases 4

Release v1.0.1 Latest
12 hours ago

+ 3 releases

Packages

No packages published
Publish your first package

Contributors 8

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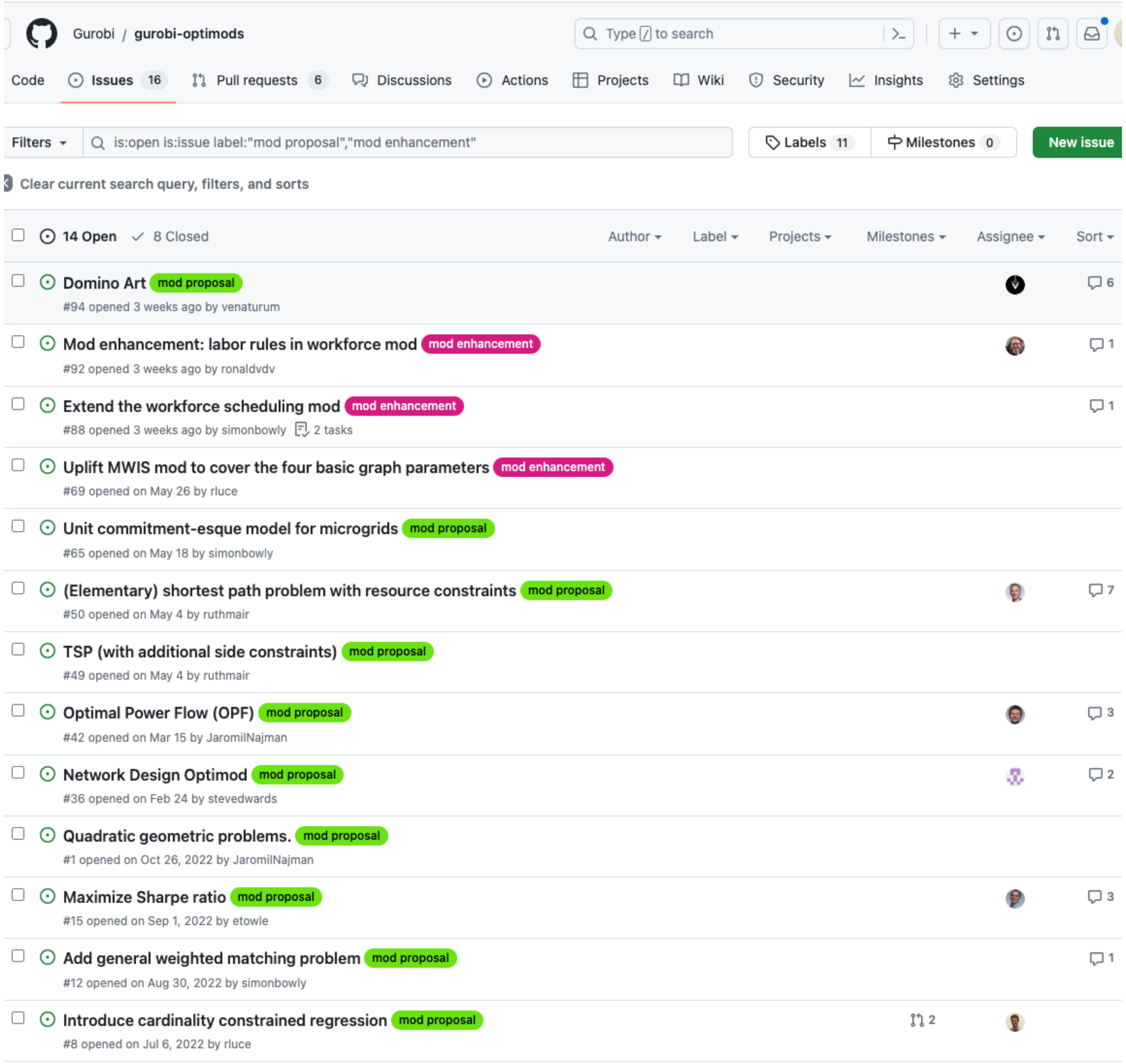
Gurobi/gurobi-optimods

- Apache 2.0 licensed
- Detailed contribution guideline
- Easy to get started
- Use issues, PRs as usual



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Filters ▾ is:open is:issue label:"mod proposal","mod enhancement"

Labels 11 · Milestones 0 · New issue

Clear current search query, filters, and sorts

□ 14 Open ✓ 8 Closed — Author ▾ Label ▾ Projects ▾ Milestones ▾ Assignee ▾ Sort ▾

□ Domino Art mod proposal — 6
#94 opened 3 weeks ago by venaturum

□ Mod enhancement: labor rules in workforce mod mod enhancement — 1
#92 opened 3 weeks ago by ronaldvdv

□ Extend the workforce scheduling mod mod enhancement — 1
#88 opened 3 weeks ago by simonbowly 2 tasks

□ Uplift MWIS mod to cover the four basic graph parameters mod enhancement
#69 opened on May 26 by rluce

□ Unit commitment-esque model for microgrids mod proposal
#65 opened on May 18 by simonbowly

□ (Elementary) shortest path problem with resource constraints mod proposal — 7
#50 opened on May 4 by ruthmair

□ TSP (with additional side constraints) mod proposal
#49 opened on May 4 by ruthmair

□ Optimal Power Flow (OPF) mod proposal — 3
#42 opened on Mar 15 by JaromilNajman

□ Network Design Optimod mod proposal — 2
#36 opened on Feb 24 by stevedwards

□ Quadratic geometric problems. mod proposal
#1 opened on Oct 26, 2022 by JaromilNajman

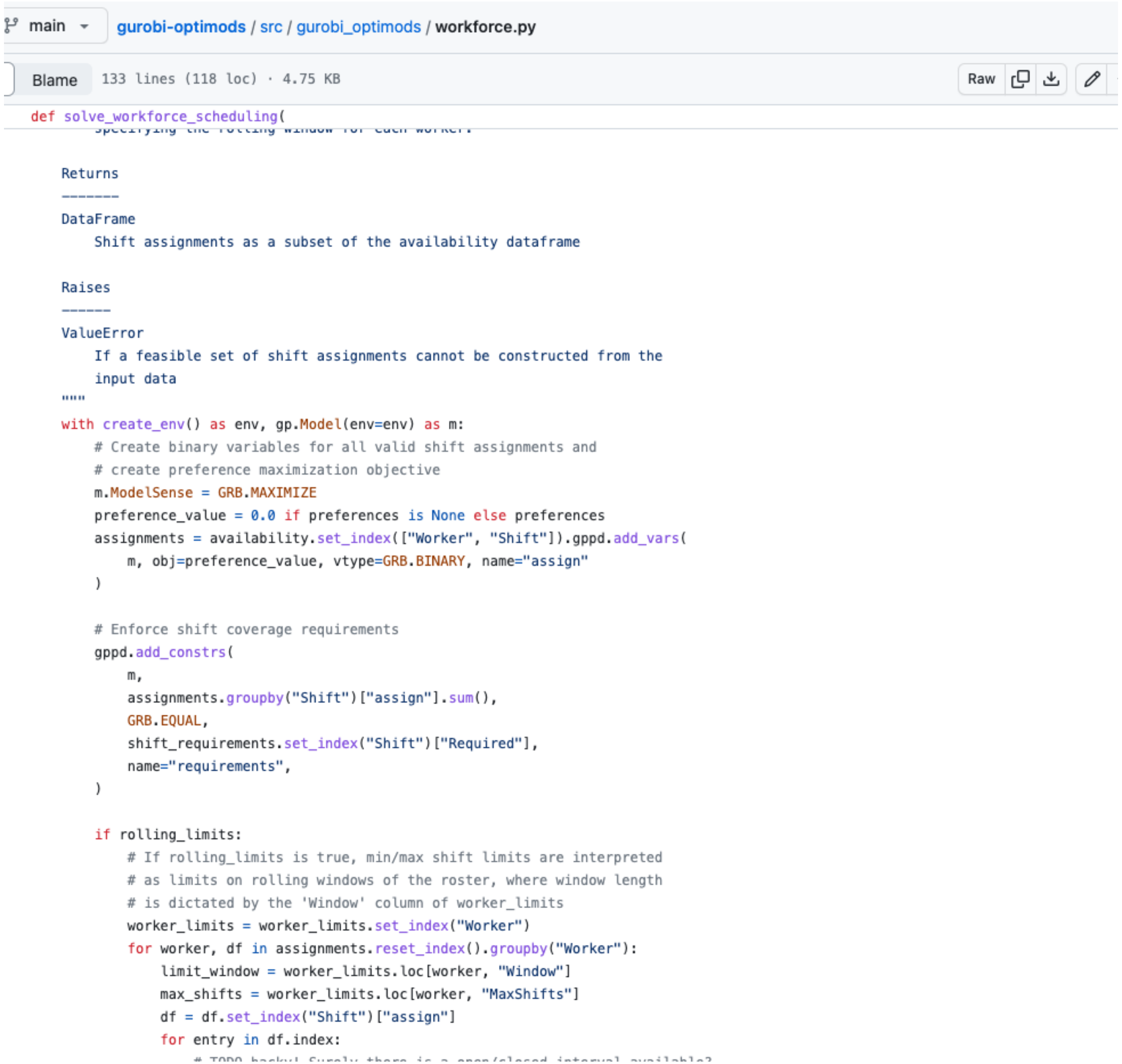
□ Maximize Sharpe ratio mod proposal — 3
#15 opened on Sep 1, 2022 by etowle

□ Add general weighted matching problem mod proposal — 1
#12 opened on Aug 30, 2022 by simonbowly

□ Introduce cardinality constrained regression mod proposal — 2
#8 opened on Jul 6, 2022 by rluce

Join the project

- Open an issue to propose a new Mod
- Comment to register interest
- Pull requests welcome!


main
gurobi-optimods / src / gurobi_optimods / workforce.py
Blame
133 lines (118 loc) · 4.75 KB
Raw

```
def solve_workforce_scheduling(
        specifying the rolling window for each worker.

    Returns
    -------
    DataFrame
        Shift assignments as a subset of the availability dataframe

    Raises
    ------
    ValueError
        If a feasible set of shift assignments cannot be constructed from the
        input data
    """
    with create_env() as env, gp.Model(env=env) as m:
        # Create binary variables for all valid shift assignments and
        # create preference maximization objective
        m.ModelSense = GRB.MAXIMIZE
        preference_value = 0.0 if preferences is None else preferences
        assignments = availability.set_index(["Worker", "Shift"]).gppd.add_vars(
            m, obj=preference_value, vtype=GRB.BINARY, name="assign"
        )

        # Enforce shift coverage requirements
        gppd.add_constrs(
            m,
            assignments.groupby("Shift")["assign"].sum(),
            GRB.EQUAL,
            shift_requirements.set_index("Shift")["Required"],
            name="requirements",
        )

        if rolling_limits:
            # If rolling_limits is true, min/max shift limits are interpreted
            # as limits on rolling windows of the roster, where window length
            # is dictated by the 'Window' column of worker_limits
            worker_limits = worker_limits.set_index("Worker")
            for worker, df in assignments.reset_index().groupby("Worker"):
                limit_window = worker_limits.loc[worker, "Window"]
                max_shifts = worker_limits.loc[worker, "MaxShifts"]
                df = df.set_index("Shift")["assign"]
                for entry in df.index:
                    # TODO hacky! Surely there is a open/closed interval available?
```

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Need more functionality?

- Mods don’t cover every use case
- Fork the code, hack in new features
- Contribute back if useful in general
- Use OptiMod code as a starting point for other projects

Thank You

https://github.com/Gurobi/gurobi-OptiMods

https://gurobi-optimization-gurobi-optimods.readthedocs-hosted.com/en/stable/index.html