d-learn.ir/orpy

دوره آموزشی بهینه سازی پایتون

مدرس
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INSTRUCTOR

NEWSLETTER

Optimization in open-source

Business Intelligence using optimal decision making tools

By **Alireza Soroudi**
Lead Data Scientist @ bluecrux || SMIEEE || Optimiz...

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TITLE

Decision m
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Power Sys
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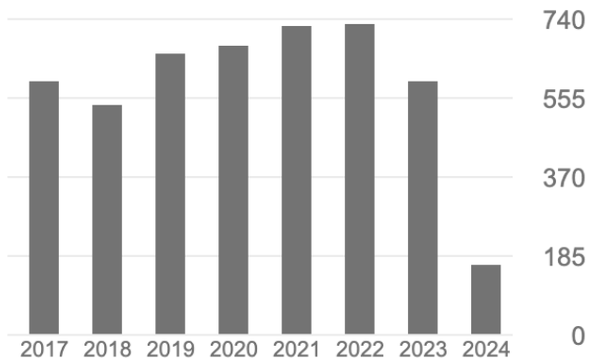

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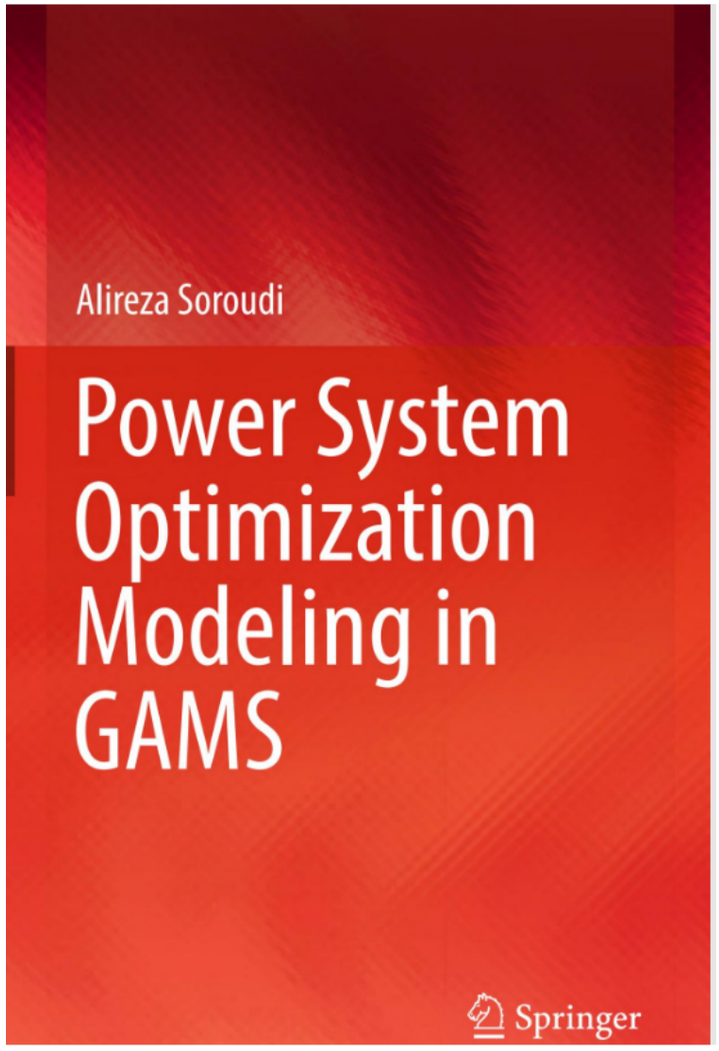
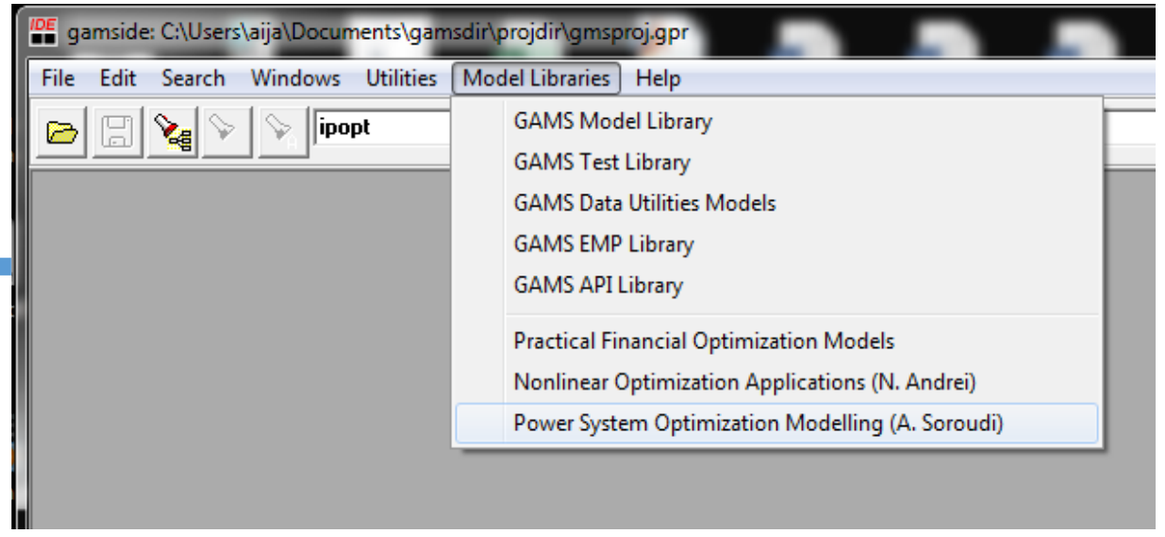
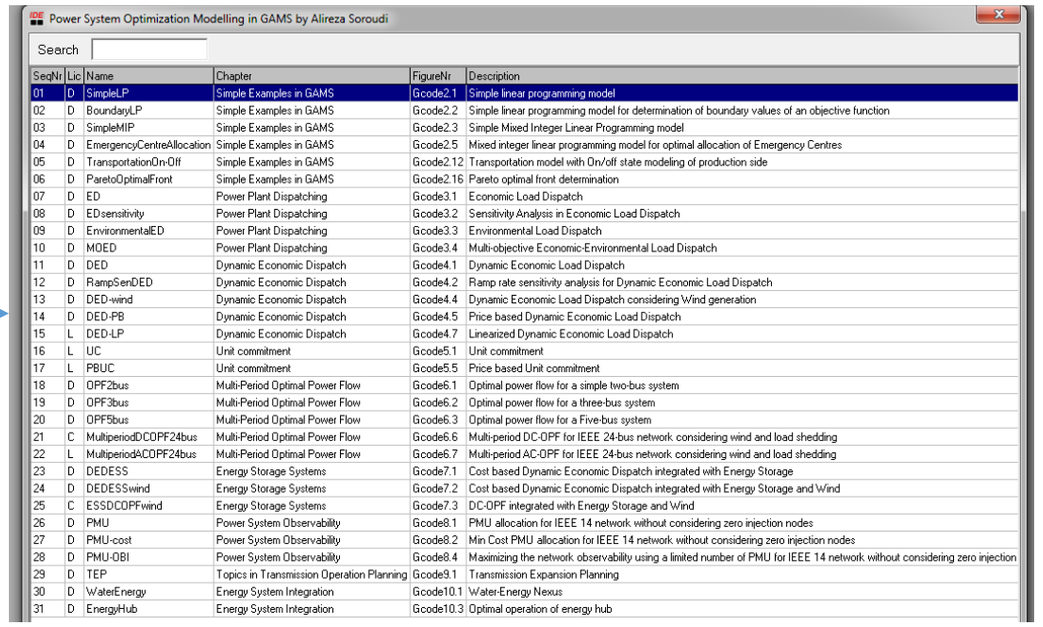






SeqNr	Lic	Name	Chapter	FigureNr	Description
01	D	SimpleLP	Simple Examples in GAMS	Gcode2.1	Simple linear programming model
02	D	BoundaryLP	Simple Examples in GAMS	Gcode2.2	Simple linear programming model for determination of boundary values of an objective function
03	D	SimpleMIP	Simple Examples in GAMS	Gcode2.3	Simple Mixed Integer Linear Programming model
04	D	EmergencyCentreAllocation	Simple Examples in GAMS	Gcode2.5	Mixed integer linear programming model for optimal allocation of Emergency Centres
05	D	TransportationOn-Off	Simple Examples in GAMS	Gcode2.12	Transportation model with On/off state modeling of production side
06	D	ParetoOptimalFront	Simple Examples in GAMS	Gcode2.16	Pareto optimal front determination
07	D	ED	Power Plant Dispatching	Gcode3.1	Economic Load Dispatch
08	D	EDsensitivity	Power Plant Dispatching	Gcode3.2	Sensitivity Analysis in Economic Load Dispatch
09	D	EnvironmentalED	Power Plant Dispatching	Gcode3.3	Environmental Load Dispatch
10	D	MOED	Power Plant Dispatching	Gcode3.4	Multi-objective Economic-Environmental Load Dispatch
11	D	DED	Dynamic Economic Dispatch	Gcode4.1	Dynamic Economic Load Dispatch
12	D	RampSenDED	Dynamic Economic Dispatch	Gcode4.2	Ramp rate sensitivity analysis for Dynamic Economic Load Dispatch
13	D	DED-wind	Dynamic Economic Dispatch	Gcode4.4	Dynamic Economic Load Dispatch considering Wind generation
14	D	DED-PB	Dynamic Economic Dispatch	Gcode4.5	Price based Dynamic Economic Load Dispatch
15	L	DED-LP	Dynamic Economic Dispatch	Gcode4.7	Linearized Dynamic Economic Load Dispatch
16	L	UC	Unit commitment	Gcode5.1	Unit commitment
17	L	PBUC	Unit commitment	Gcode5.5	Price based Unit commitment
18	D	OPF2bus	Multi-Period Optimal Power Flow	Gcode6.1	Optimal power flow for a simple two-bus system
19	D	OPF3bus	Multi-Period Optimal Power Flow	Gcode6.2	Optimal power flow for a three-bus system
20	D	OPF5bus	Multi-Period Optimal Power Flow	Gcode6.3	Optimal power flow for a Five-bus system
21	C	MultiperiodDCOPF24bus	Multi-Period Optimal Power Flow	Gcode6.6	Multi-period DC-OPF for IEEE 24-bus network considering wind and load shedding
22	L	MultiperiodACOPF24bus	Multi-Period Optimal Power Flow	Gcode6.7	Multi-period AC-OPF for IEEE 24-bus network considering wind and load shedding
23	D	DEDESS	Energy Storage Systems	Gcode7.1	Cost based Dynamic Economic Dispatch integrated with Energy Storage
24	D	DEDESSwind	Energy Storage Systems	Gcode7.2	Cost based Dynamic Economic Dispatch integrated with Energy Storage and Wind
25	C	ESSDCOPFwind	Energy Storage Systems	Gcode7.3	DC-OPF integrated with Energy Storage and Wind
26	D	PMU	Power System Observability	Gcode8.1	PMU allocation for IEEE 14 network without considering zero injection nodes
27	D	PMU-cost	Power System Observability	Gcode8.2	Min Cost PMU allocation for IEEE 14 network without considering zero injection nodes
28	D	PMU-OBI	Power System Observability	Gcode8.4	Maximizing the network observability using a limited number of PMU for IEEE 14 network without considering zero injection
29	D	TEP	Topics in Transmission Operation Planning	Gcode9.1	Transmission Expansion Planning
30	D	WaterEnergy	Energy System Integration	Gcode10.1	Water-Energy Nexus
31	D	EnergyHub	Energy System Integration	Gcode10.3	Optimal operation of energy hub

SESSION ONE

Introduction

WHY PYTHON?

Vast library

Open Source

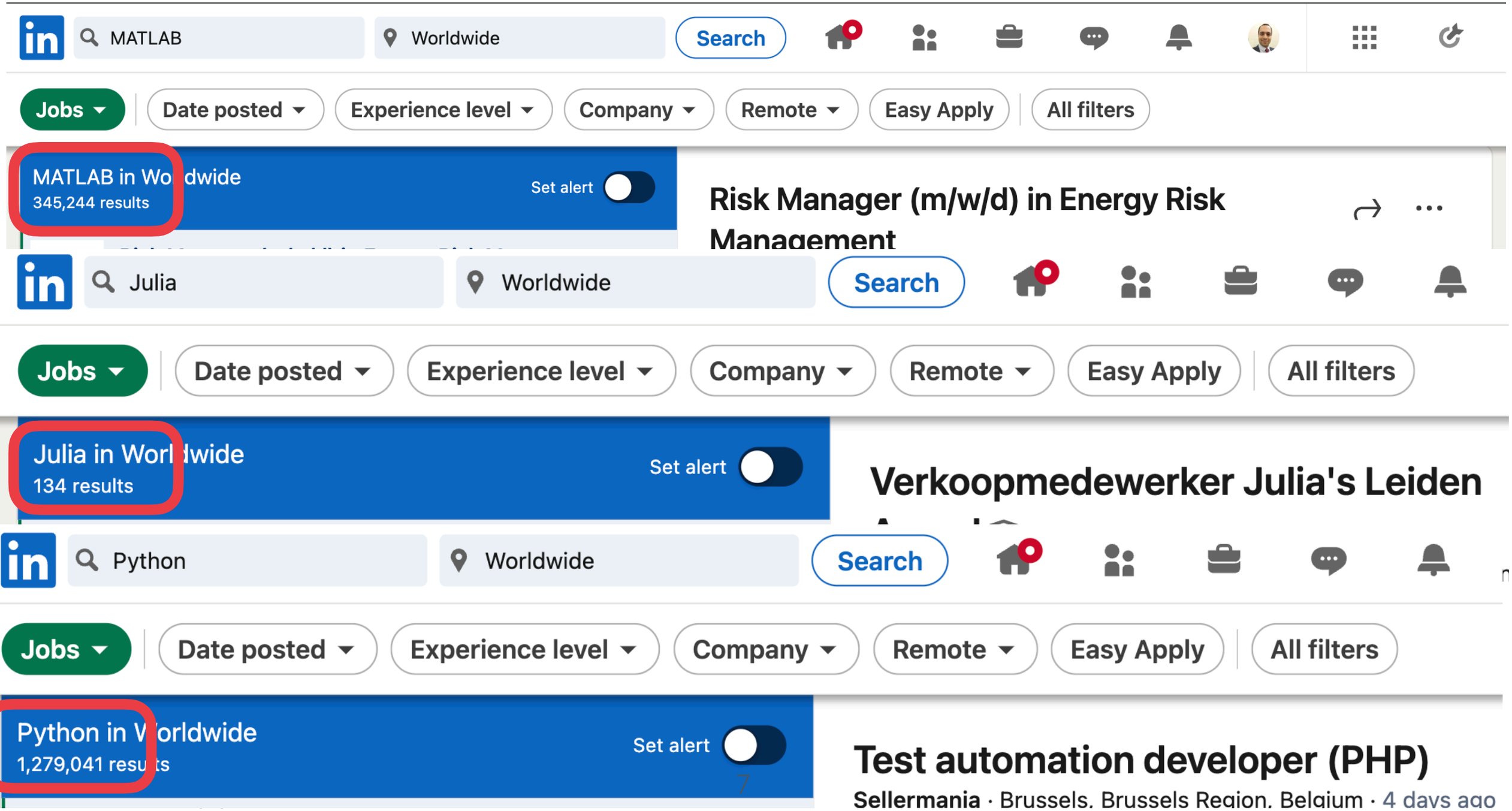
Enterprise level

Easy to learn

OOP

WHY PYTHON?

WHY PYTHON?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Python in W orldwide
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Set alert
Test automation developer (PHP)
Sellermania · Brussels, Brussels Region, Belgium · 4 days ago

Open Source or Commercial ?

	Open Source	Commercial
Positive	• Free • Capable of using both open-source and commercial solvers • Great Visualisation • Capable of linking to different databases • Using other Python Packages	• Stable • Good Support
Negative	• You need to wait for Stack-overflow	• Expensive • No Visualisation • Limited databases to communicate with

CODING PLATFORM

PyCharm

Visual Studio Code

Sublime Text

Vim

GNU Emacs

Spyder

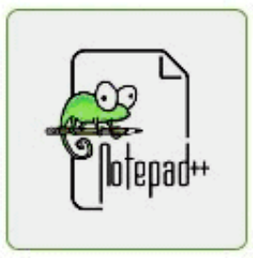
Atom

Jupyter

Eclipse

IntelliJ IDEA

Notepad++



DIFFERENT OPTIMISATION MODELS

Linear

Non Linear

LP

MIP

QCP

NLP

MIQCP

MINLP

DIFFERENT OPTIMISATION MODELS

LP

$$OF = x_1 + x_2$$
$$2x_1 + x_2 \leq 1$$
$$x_i \in R^+$$

NLP

$$OF = x_1 + x_2$$
$$2x_1^2 + x_2^2 + x^3 \leq 5$$
$$x_i \in R^+$$

MIP

$$OF = x_1 + x_2$$
$$2x_1 + x_2 \leq 1$$
$$x_1 \in R^+, x_2 \in B$$

MIQCP

$$OF = x_1 + x_2$$
$$2x_1^2 + x_2^2 \leq 5$$
$$x_1 \in R^+, x_2 \in B$$

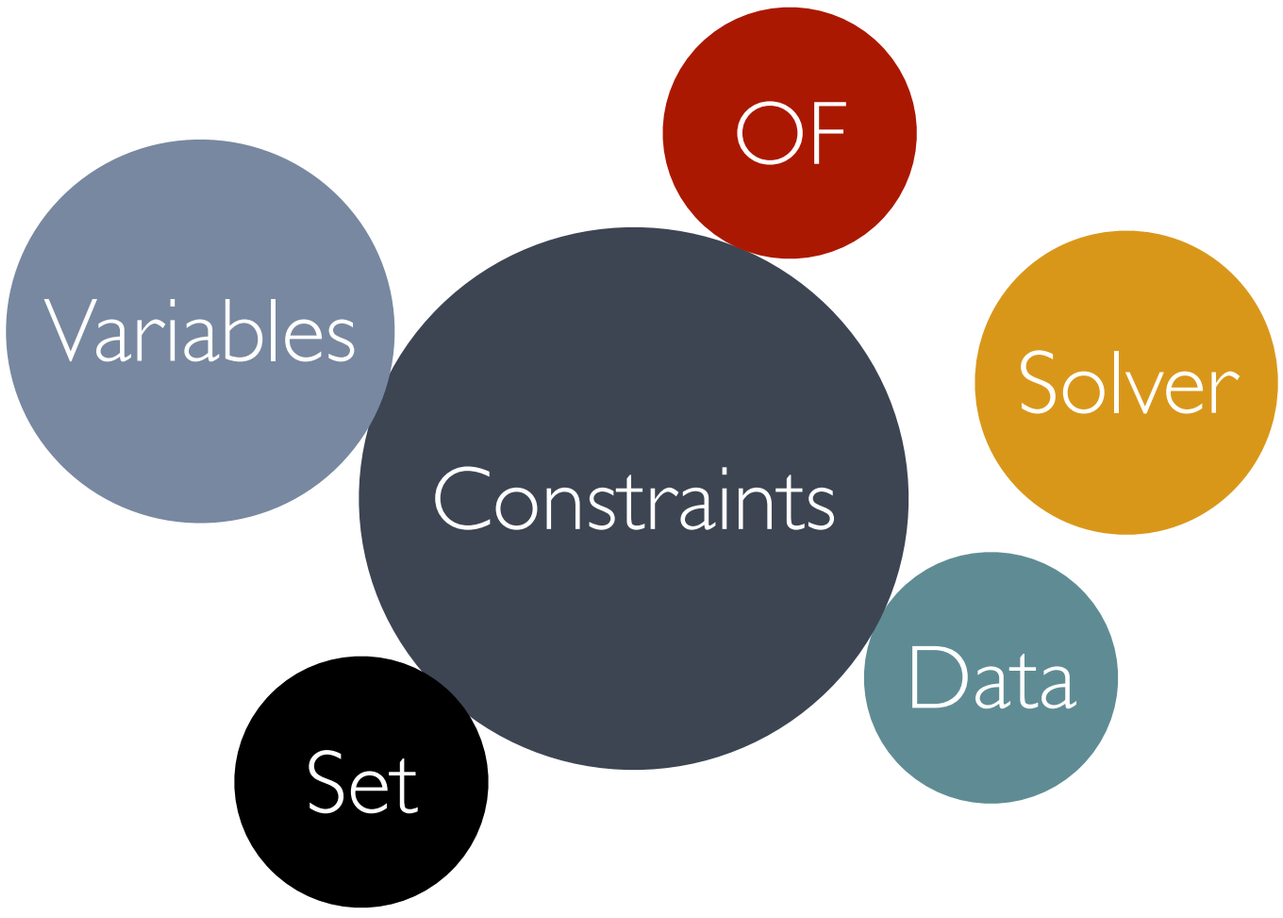
QCP

$$OF = x_1 + x_2$$
$$2x_1^2 + x_2^2 \leq 5$$
$$x_i \in R^+$$

MINLP

$$OF = x_1 + x_2$$
$$2x_1^2 + x_2^2 + x_1^3 \leq 5$$
$$x_1 \in R^+, x_2 \in B$$

STRUCTURE OF MODEL?



STRUCTURE OF MODEL?

OF

Total costs

Total income

Emission weight

Risk of failure

Probability of happening

Time of arrival

STRUCTURE OF MODEL?

Variables

Investment decisions

Vehicle to pick

Sequence of nodes

Asset Location

STRUCTURE OF MODEL?

Cost of each item Vehicle's capacity

Data

Job duration

Required sequence

STRUCTURE OF MODEL?

Index for referring an item

Set

Generator i

Passenger j

Car n

STRUCTURE OF MODEL?

Constraints

Cost of all items $\leq$ Budget

$\forall_i$ arrival time of i $\leq T_i^{max}$

$$\forall_i \quad P_i^{min} \leq P_i \leq P_i^{max}$$

$$\forall_i \quad P_i^{min} \times U_i \leq P_i \leq P_i^{max} \times U_i$$

STRUCTURE OF MODEL?

Solver

The table below lists the LP solvers available in OR-Tools and indicates which of the three families of algorithms is implemented in each solver.

Solver	Simplex	Barrier	First order
Clp	X	X	
CPLEX[L]	X	X	
Glop[G]	X		
GLPK	X	X	
Gurobi[L]	X	X	
PDLP[G]			X
Xpress[L]	X	X	

G indicates the solver is developed by Google. **L** indicates that the solver requires a license issued by the respective third-party developer.

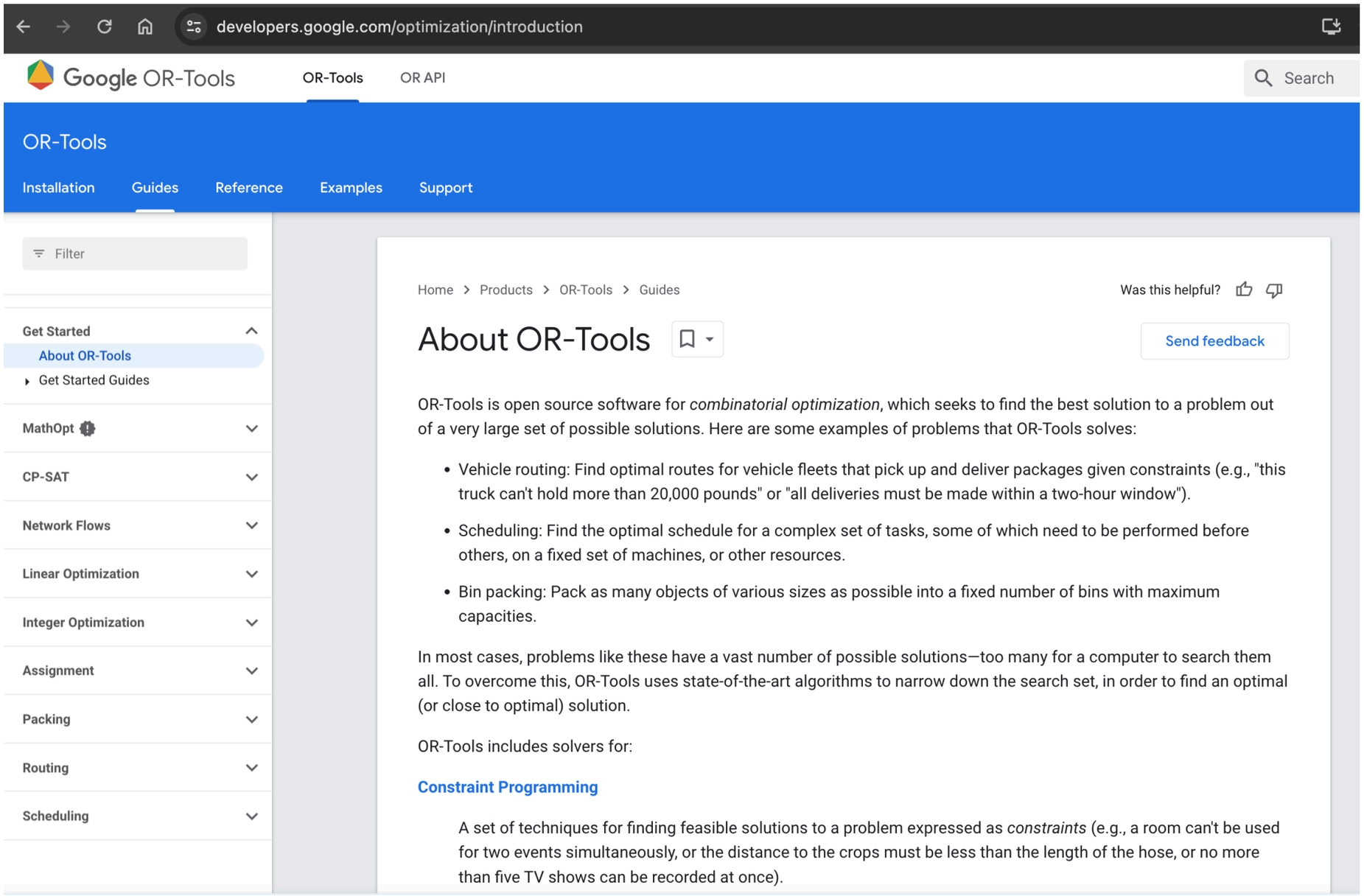
CP-SAT SOLVER

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

RESOURCES

ORTOOLS

https://developers.google.com/optimization



ORTOOLS

https://developers.google.com/optimization/reference/python/sat/python/cp_model

Google OR-Tools | OR-Tools | OR API | Search | English

OR-Tools

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- OR-Tools Reference
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    - Algorithms
    - CP-SAT
    - Network Flow and Graph
    - Linear Solver
    - Routing
    - Domain Module

Home > Products > OR-Tools > Reference

Was this helpful?

Python Reference: CP-SAT

Send feedback

Module `cp_model`

Methods for building and solving CP-SAT models.

The following two sections describe the main methods for building and solving CP-SAT models.

- `CpModel`: Methods for creating models, including variables and constraints.
- `CPSolver`: Methods for solving a model and evaluating solutions.

The following methods implement callbacks that the solver calls each time it finds a new solution.

- `CpSolverSolutionCallback`: A general method for implementing callbacks.
- `ObjectiveSolutionPrinter`: Print objective values and elapsed time for intermediate solutions.
- `VarArraySolutionPrinter`: Print intermediate solutions (variable values, time).
- [`VarArrayAndObjectiveSolutionPrinter`] (#cp_model.VarArrayAndObjectiveSolutionPrinter): Print both intermediate solutions and objective values.

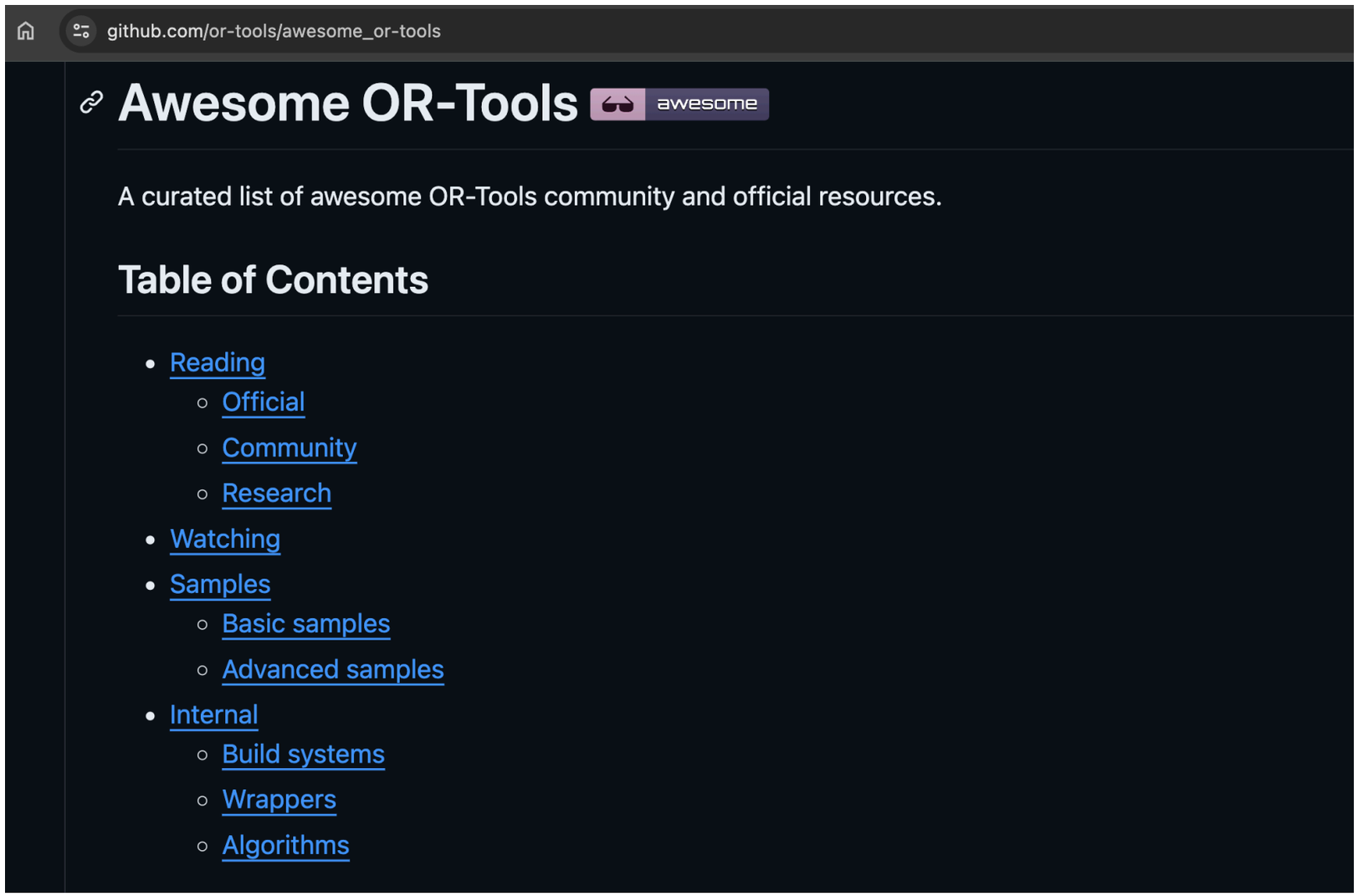
Additional methods for solving CP-SAT models:

On this page

- BoundedLinearExpression
  - Bounds
  - Expression
- Constraint
  - Index
  - OnlyEnforceIf
  - Proto
- CpModel
  - Add
  - AddAbsEquality
  - AddAllDifferent
  - AddAllowedAssignments
  - AddAutomaton
  - AddBoolAnd
  - AddBoolOr
  - AddBoolXOr
  - AddCircuit
  - AddCumulative
  - AddDecisionStrategy
  - AddDivisionEquality
  - AddElement
  - AddForbiddenAssignments
  - AddHint
  - AddImplication
  - AddInverse

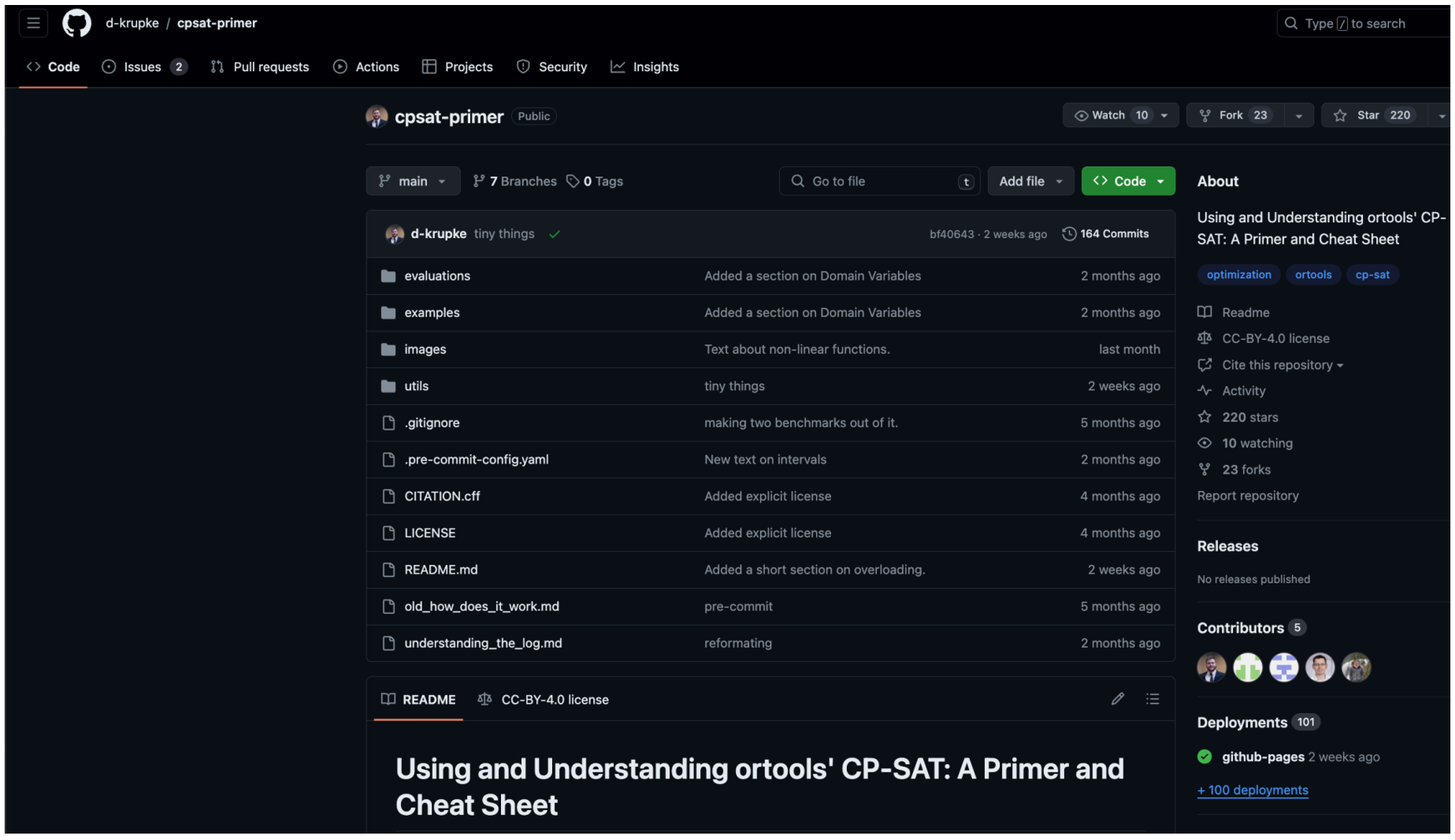
GITHUB

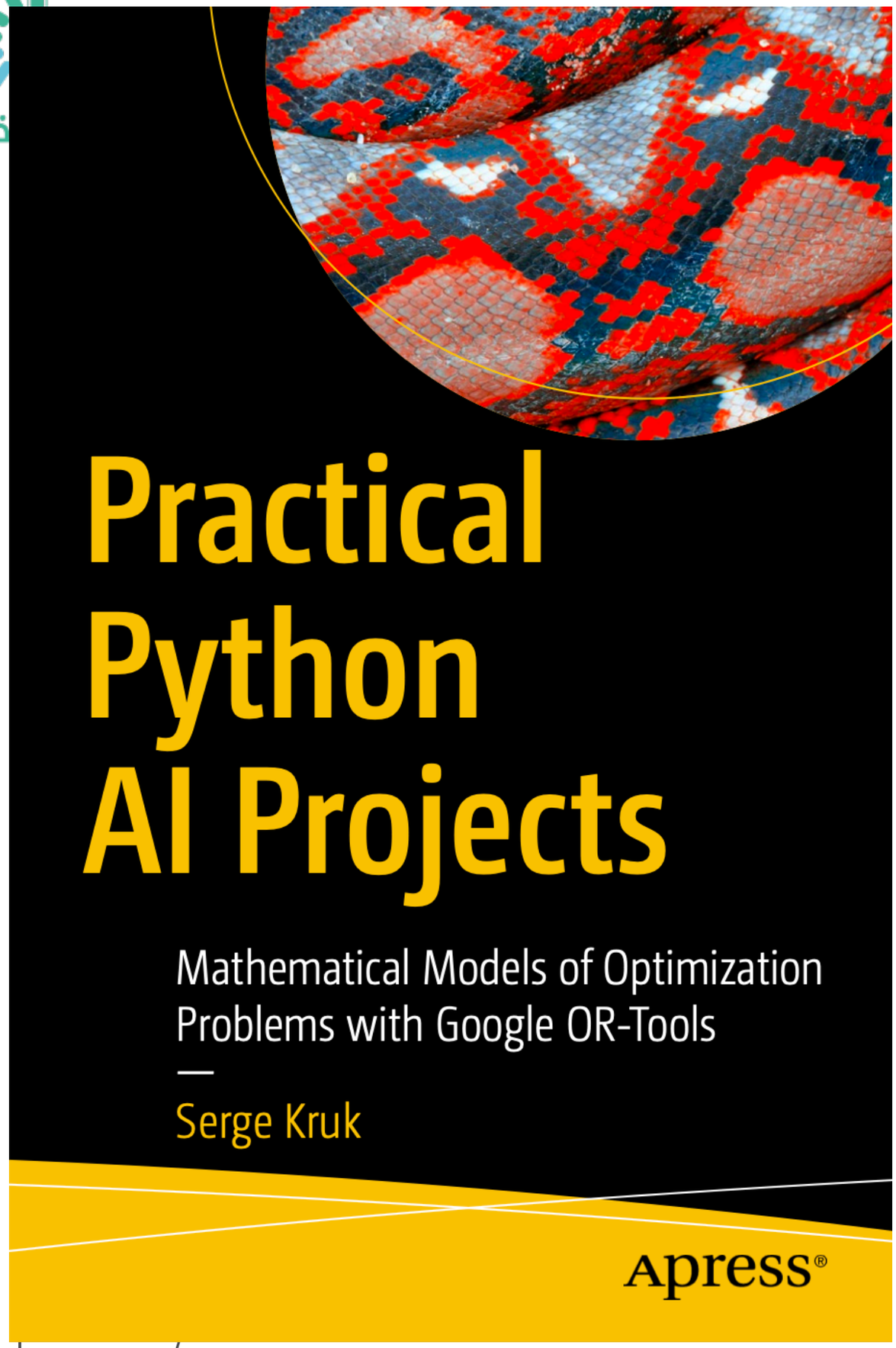
https://github.com/or-tools/awesome_or-tools



GITHUB

https://github.com/d-krupke/cpsat-primer

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