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WARWICK BUSINESS SCHOOL
THE UNIVERSITY OF WARWICK

For the Open Minded

Mathematical Programming I


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STAFF


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STAFF


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STAFF

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Agenda

- What is Mathematical Programming
- Math Programming & Operational Research
- Syllabus
- Who is teaching
- Have you reflected on how we learn?
- What is to focus on …
- What we do next
- Summary

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https://www.britannica.com/science/mathematical-programming

Article History

Mathematical programming, theoretical tool of management science and economics in which management operations are described by mathematical equations that can be manipulated for a variety of purposes. If the basic descriptions involved take the form of linear algebraic equations, the technique is described as linear programming. If more complex forms are required, the term nonlinear programming is applied. Mathematical programming is used in planning production schedules, in transportation, in military logistics, and in calculating economic growth, by inserting assumed values for the variables in the equations and solving for the unknowns. Computers are widely used in obtaining solutions.

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Management science = Operational Research

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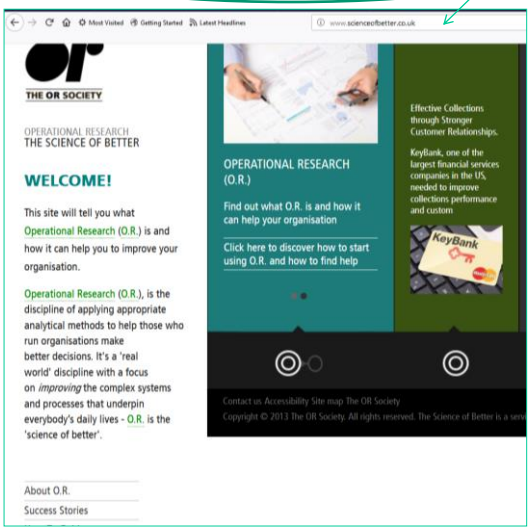
Operational Research

http://www.scienceofbetter.co.uk/



...analytical methods...

...better decisions...

...real world...

...systems and processes...

...everybody's daily lives...

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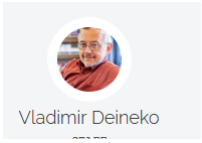
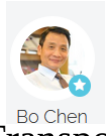
Mathematical Programming I

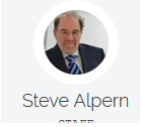


1. Formulation of Linear Programming Models (LP)
2. Solving Linear Programming Problems



3. Duality in LP
4. Algorithm for the Transportation Problem

5. Introduction to game theory



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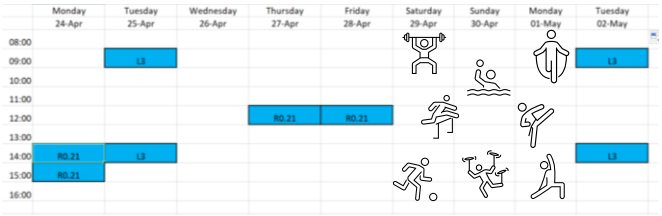

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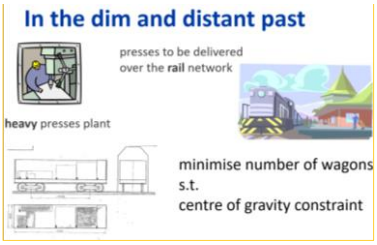

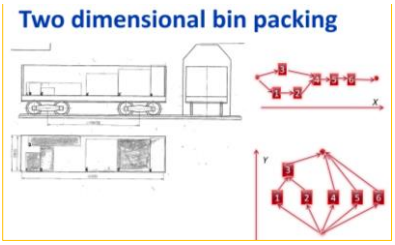

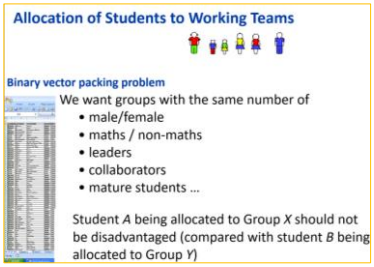

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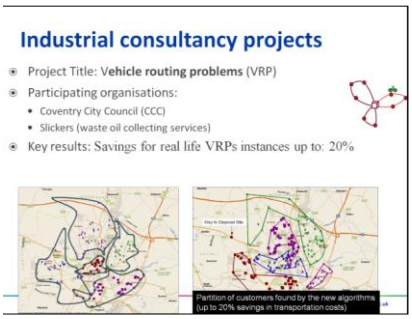
Business Analytics Consultancy Project



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Few tips

1+1+1+1 >> 10

much greater than

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Few tips

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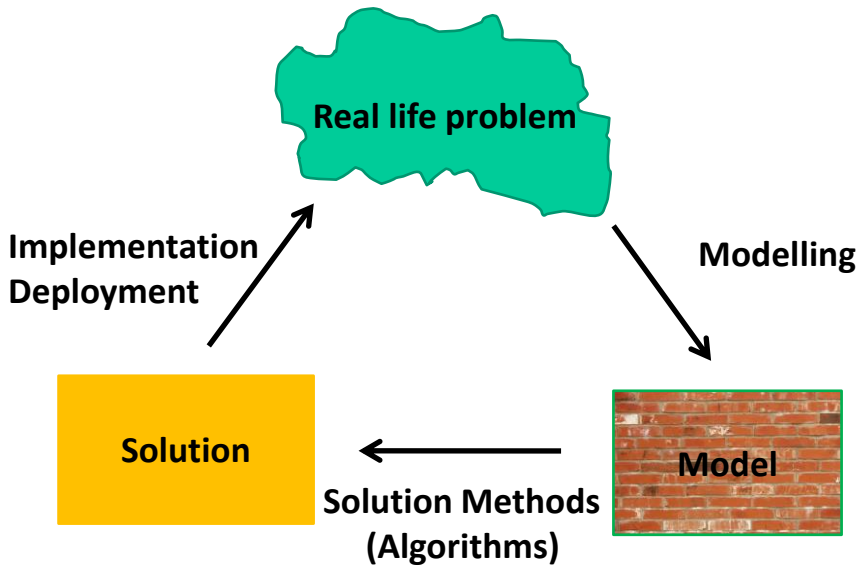

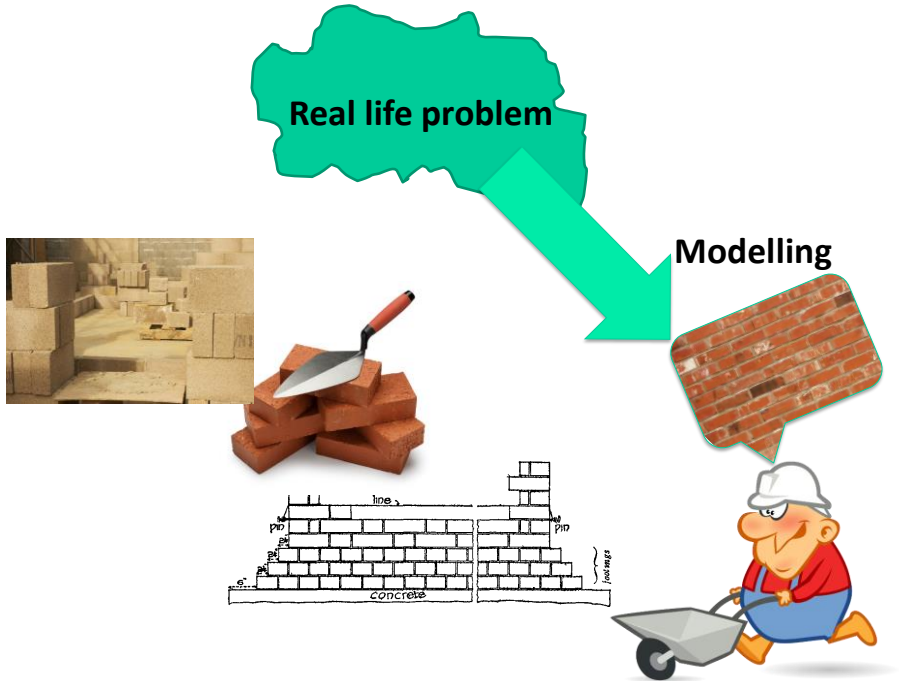
Real life problem
Modelling
line
pin
pin
concrete
footings

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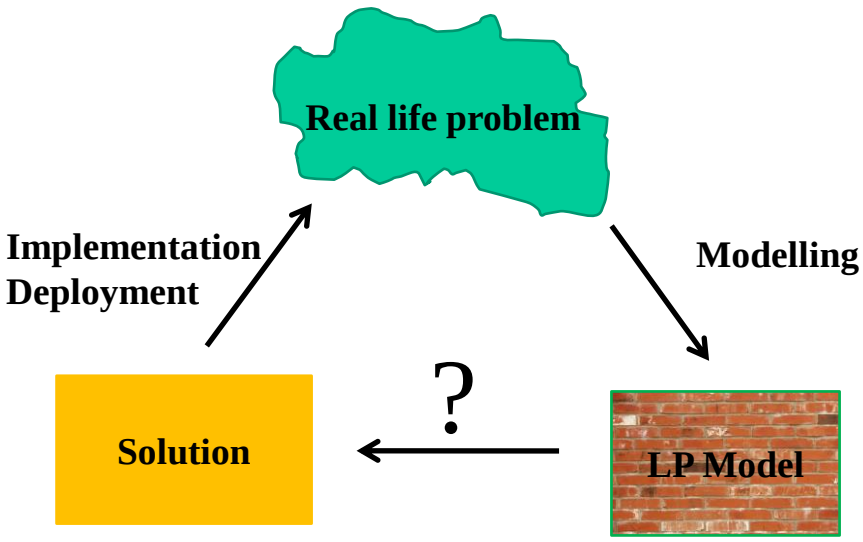
Real life problem
Implementation
Deployment
Modelling
?
Solution
LP Model

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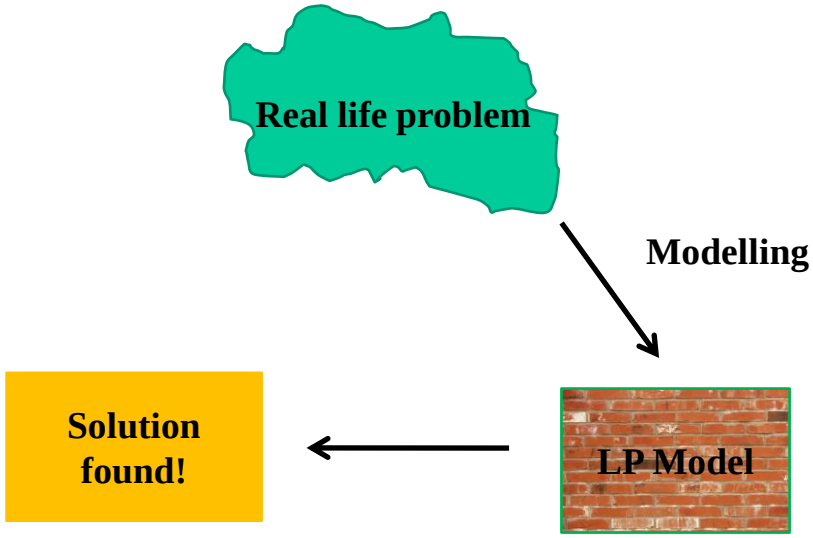

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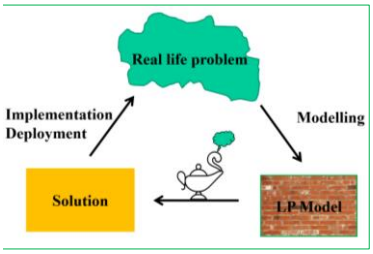

There are many LP Solvers that implement various algorithms

in libraries in R, Python,…
or as stand-alone: Cplex, Concord (commercial)

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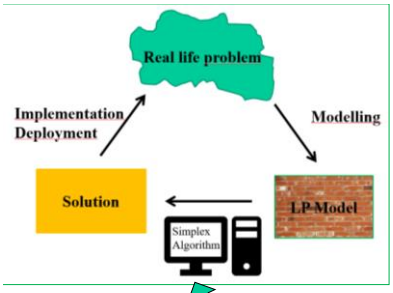

Improved versions of the very first LP algorithm – Simplex algorithm – is still in Excel Solver

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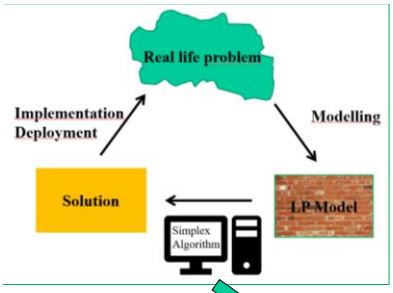
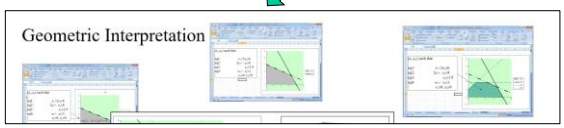
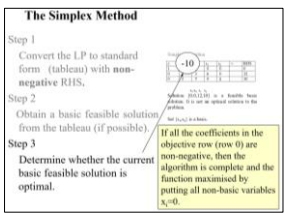


Simplex algorithm





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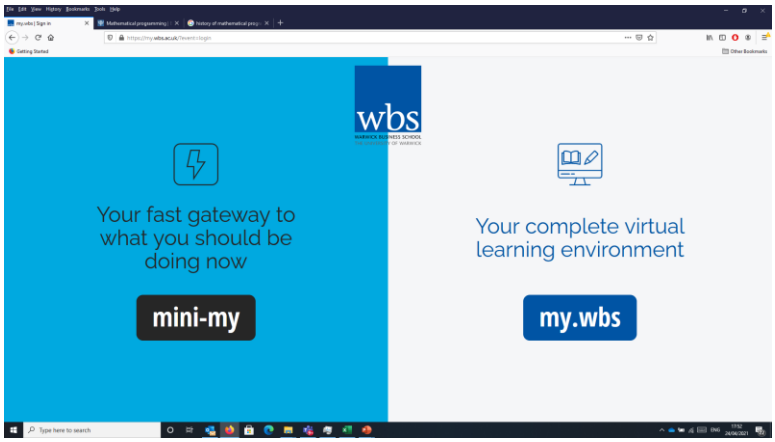
All teaching material is here



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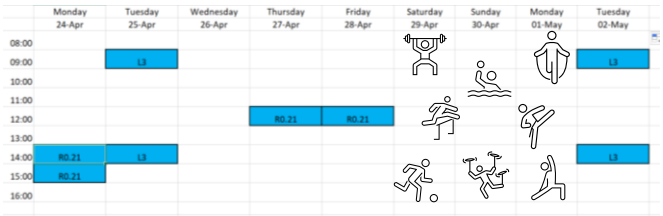
Tasks to accomplish



Introduction to LP1

Introduction to LP2

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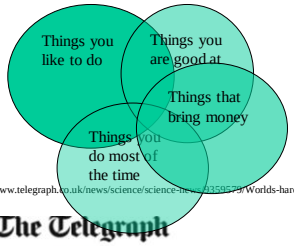

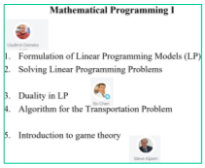

https://www.telegraph.co.uk/news/science/science-news/9359579/Worlds-hardest-sudoku-can-you-crack-it.html

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World's hardest sudoku: can you crack it?

Readers who spend hours grappling in vain with the Telegraph's daily sudoku puzzles should look away now.

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	7			9		2		
	5				7			
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		8	5				1	
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The Telegraph https://www.telegraph.co.uk/news/science/science-news/9359579/Worlds-hardest-sudoku-can-you-crack-it.html

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- **In one of the papers published in a maths journal this instance was claimed to be the most difficult to solve**

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The Telegraph https://www.telegraph.co.uk/news/science/science-news/9359579/Worlds-hardest-sudoku-can-you-crack-it.html

LP MODEL with 729 variables and 27 constraints

https://pythonhosted.org/PuLP/CaseStudies/a_sudoku_problem.html

Authors: Antony Phillips, Dr Stuart Mitchell

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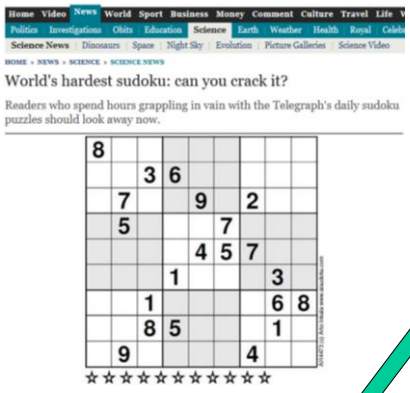


```
+-------+-------+-------+
| 8 1 2 | 7 5 3 | 6 4 9 |
| 9 4 3 | 6 8 2 | 1 7 5 |
| 6 7 5 | 4 9 1 | 2 8 3 |
+-------+-------+-------+
| 1 5 4 | 2 3 7 | 8 9 6 |
| 3 6 9 | 8 4 5 | 7 2 1 |
| 2 8 7 | 1 6 9 | 5 3 4 |
+-------+-------+-------+
| 5 2 1 | 9 7 4 | 3 6 8 |
| 4 3 8 | 5 2 6 | 9 1 7 |
| 7 9 6 | 3 1 8 | 4 5 2 |
+-------+-------+-------+
```

My Python solution

LP MODEL with 729 variables and 27 constraints

https://pythonhosted.org/PuLP/CaseStudies/a_sudoku_problem.html

Authors: Antony Phillips, Dr Stuart Mitchell

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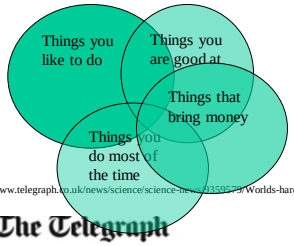

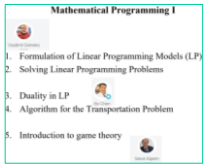

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