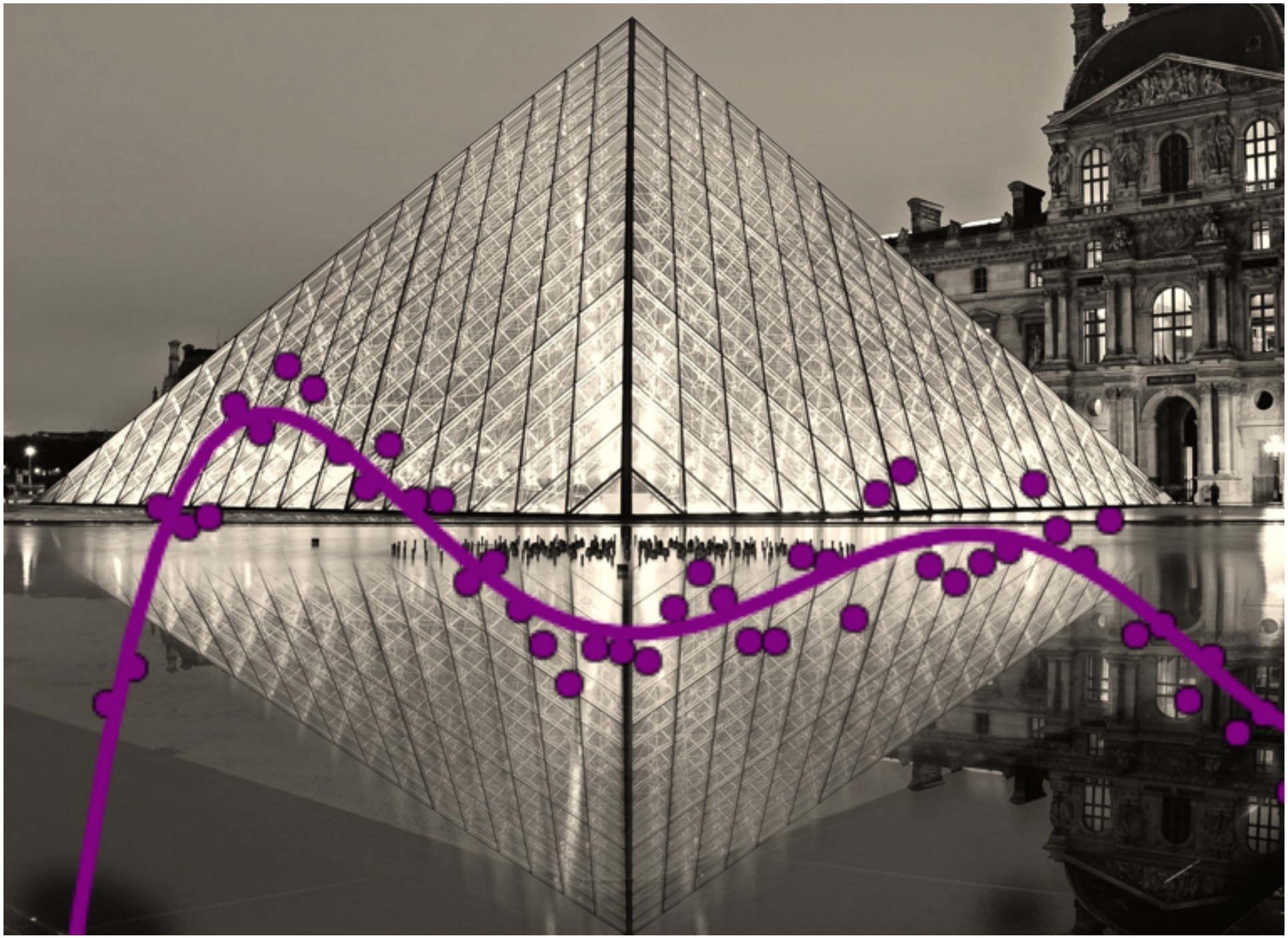
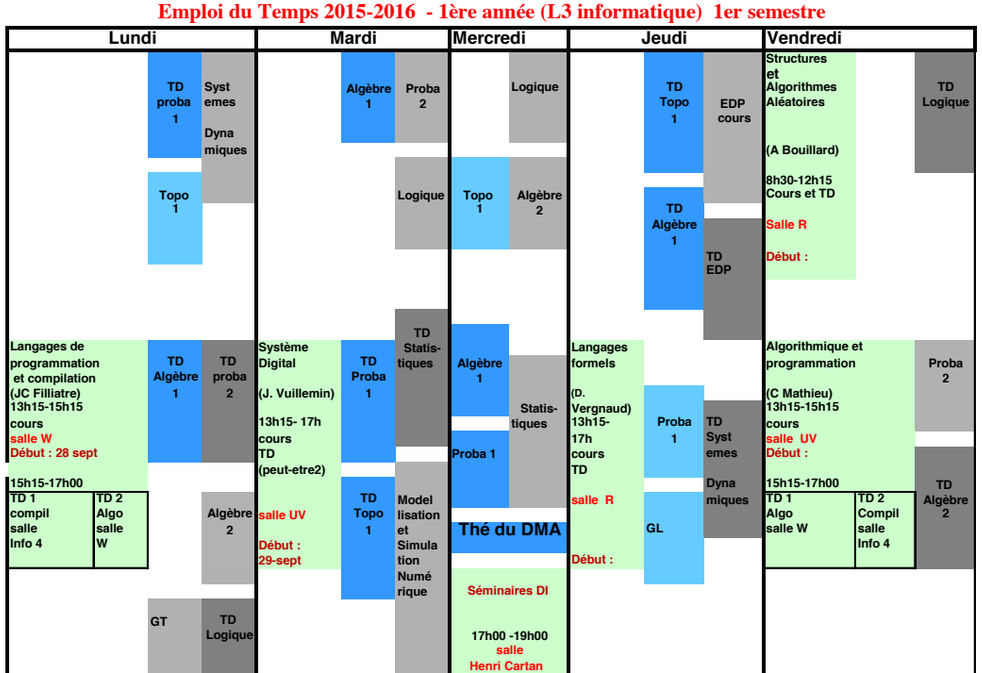
Approximation Algorithms



Combinatorial optimization:

- Scheduling classes
- Planning delivery routes for trucks
- …

Most are NP-hard



What's that?

Dealing with NP-hard problems

- Give up?
- Roll up our sleeves?
- Try something, hoping for luck?
- Do a rough but good enough job

In polynomial time, we find a solution whose value is provably within a "small" factor of the optimal solution

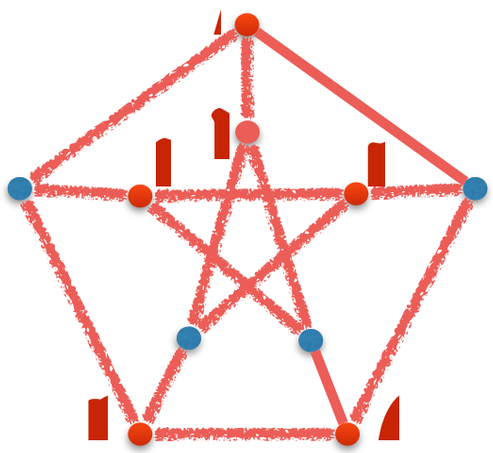
Designing approximation algorithms

- Real-life problems are too complex
- Study idealized problems
- Theorems: new algorithmic and structural insights

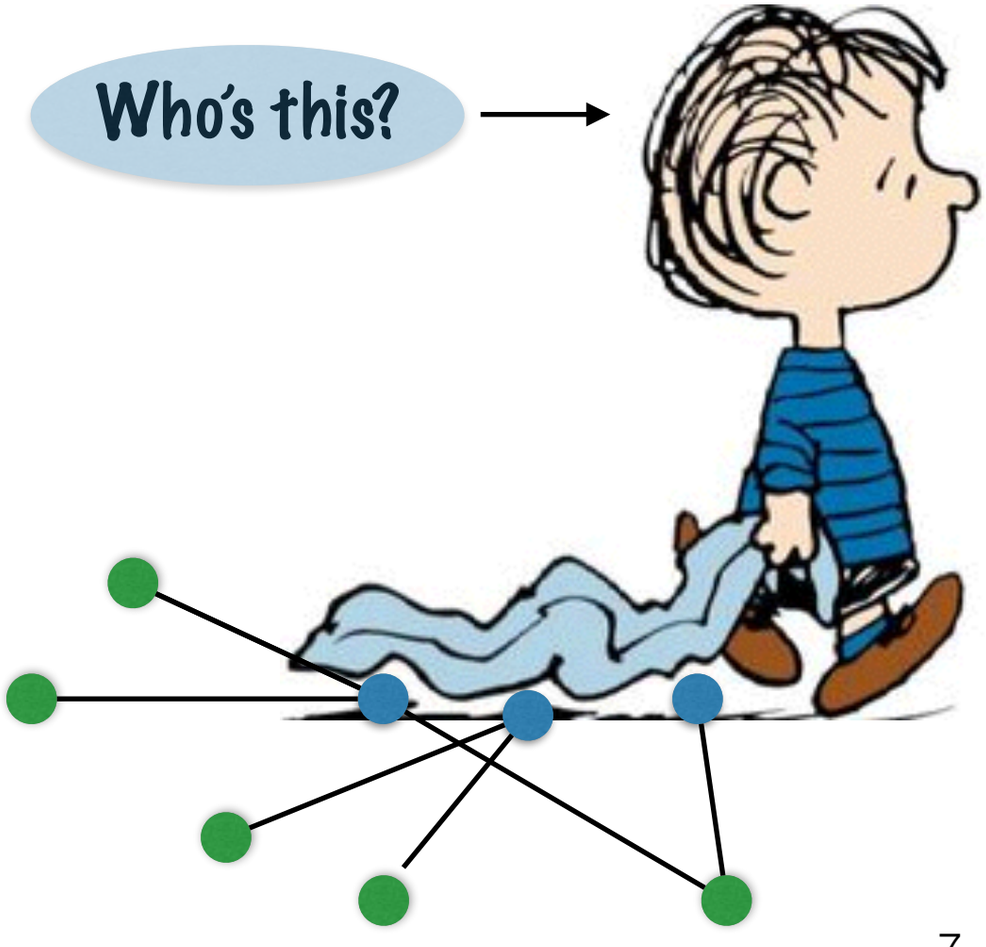
The interface with real life

A course with two parts
Approximation algorithms, Part I

- Vertex cover
- Knapsack
- Bin packing
- Set cover
- Multiway cut



Approximation algorithms, vertex cover, and linear programming

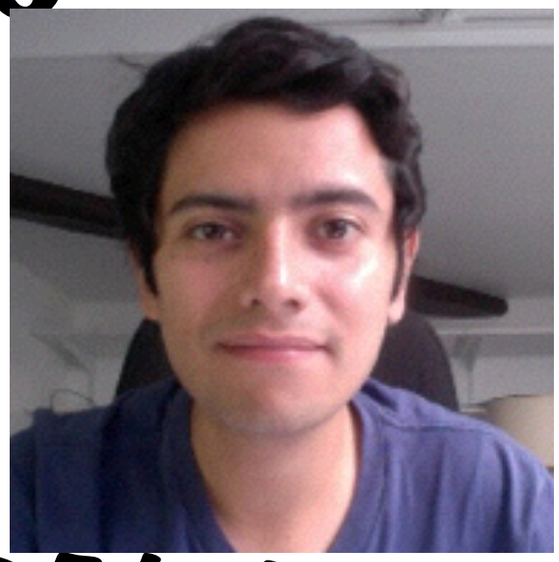


What's that?

$$\min c_1x_1 + c_2x_2 + \cdots + c_nx_n$$
such that
$$\begin{cases} a_{11}x_1 + a_{12}x_2 + \cdots + a_{1n}x_n & \geq b_1 \\ a_{21}x_1 + a_{22}x_2 + \cdots + a_{2n}x_n & \geq b_2 \\ \cdots & \\ a_{m1}x_1 + a_{m2}x_2 + \cdots + a_{mn}x_n & \geq b_m \\ \forall i: \quad 0 \leq x_i \leq 1 & \\ \forall i: \quad x_i \text{ real number} & \end{cases}$$

Teaching staff behind the scenes

- Vincent Cohen-Addad
- Frederik Mallmann-Trenn
- Victor Verdugo



Film director: Nordine Méziane

Cameraman: Jovanny Parvedy