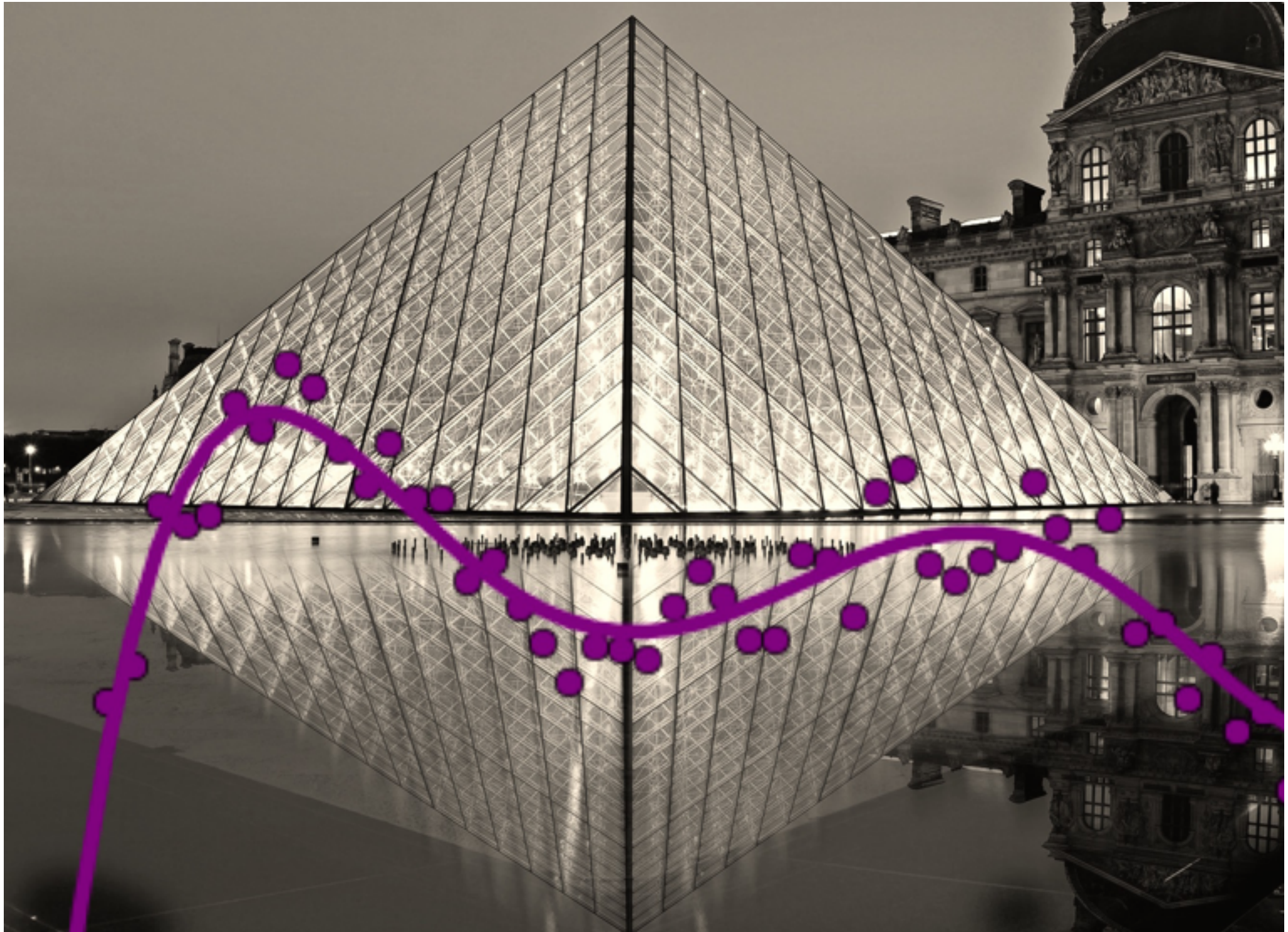


Approximation Algorithms



Combinatorial optimization:

Scheduling classes

Planning delivery routes for trucks

...

Most are NP-hard

What's that?



Le Diplôme de l'ENS - Spécialité Informatique
Emploi du Temps 2015-2016 - 1ère année (L3 informatique) 1er semestre

Lundi	Mardi	Mercredi	Jeudi	Vendredi
<div>TD proba 1</div> <div>Syst emes</div> <div>Dyna miques</div> <div>Topo 1</div>	<div>Algèbre 1</div> <div>Proba 2</div> <div>Logique</div> <div>Logique</div>	<div>Logique</div> <div>Topo 1</div> <div>Algèbre 2</div> <div>Algèbre 1</div> <div>Statistiques</div> <div>Proba 1</div> <div>Thé du DMA</div> <div>Séminaires DI</div> <div>17h00 -19h00</div> <div>salle Henri Cartan</div>	<div>TD Topo 1</div> <div>EDP cours</div> <div>TD Algèbre 1</div> <div>TD EDP</div> <div>Langages formels</div> <div>(D. Vergnaud)</div> <div>13h15-17h</div> <div>cours</div> <div>TD</div> <div>salle R</div> <div>Début :</div> <div>GL</div>	<div>Structures et Algorithmes Aléatoires</div> <div>(A Bouillard)</div> <div>8h30-12h15</div> <div>Cours et TD</div> <div>Salle R</div> <div>Début :</div> <div>Algorithmique et programmation</div> <div>(C Mathieu)</div> <div>13h15-15h15</div> <div>cours</div> <div>salle UV</div> <div>Début :</div> <div>15h15-17h00</div> <div>TD 1</div> <div>Algo</div> <div>salle W</div> <div>TD 2</div> <div>Compil</div> <div>salle Info 4</div> <div>TD Algèbre 2</div>
<div>Langages de programmation et compilation (JC Filliatre)</div> <div>13h15-15h15</div> <div>cours</div> <div>salle W</div> <div>Début : 28 sept</div> <div>15h15-17h00</div> <div>TD 1</div> <div>compil</div> <div>salle Info 4</div> <div>TD 2</div> <div>Algo</div> <div>salle W</div> <div>GT</div> <div>TD Logique</div>	<div>Système Digital</div> <div>(J. Vuillemin)</div> <div>13h15- 17h</div> <div>cours</div> <div>TD</div> <div>(peut-etre2)</div> <div>salle UV</div> <div>Début : 29-sept</div> <div>TD Topo 1</div> <div>Model isation et Simula tion Numé rique</div>	<div>TD Statistiques</div> <div>TD Proba 1</div> <div>Algèbre 1</div> <div>Statistiques</div> <div>Proba 1</div> <div>Thé du DMA</div> <div>Séminaires DI</div> <div>17h00 -19h00</div> <div>salle Henri Cartan</div>	<div>TD Topo 1</div> <div>EDP cours</div> <div>TD Algèbre 1</div> <div>TD EDP</div> <div>Langages formels</div> <div>(D. Vergnaud)</div> <div>13h15-17h</div> <div>cours</div> <div>TD</div> <div>salle R</div> <div>Début :</div> <div>GL</div>	<div>Structures et Algorithmes Aléatoires</div> <div>(A Bouillard)</div> <div>8h30-12h15</div> <div>Cours et TD</div> <div>Salle R</div> <div>Début :</div> <div>Algorithmique et programmation</div> <div>(C Mathieu)</div> <div>13h15-15h15</div> <div>cours</div> <div>salle UV</div> <div>Début :</div> <div>15h15-17h00</div> <div>TD 1</div> <div>Algo</div> <div>salle W</div> <div>TD 2</div> <div>Compil</div> <div>salle Info 4</div> <div>TD Algèbre 2</div>

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**



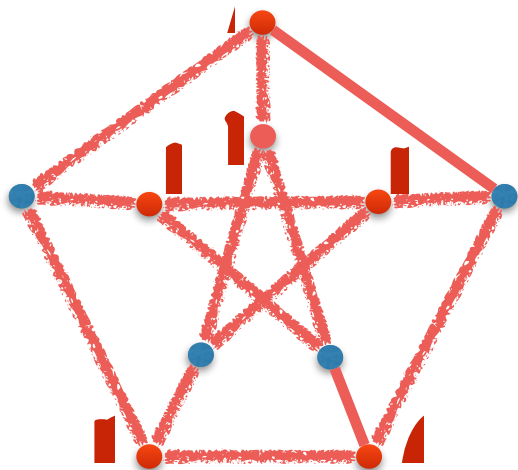
The interface with real life



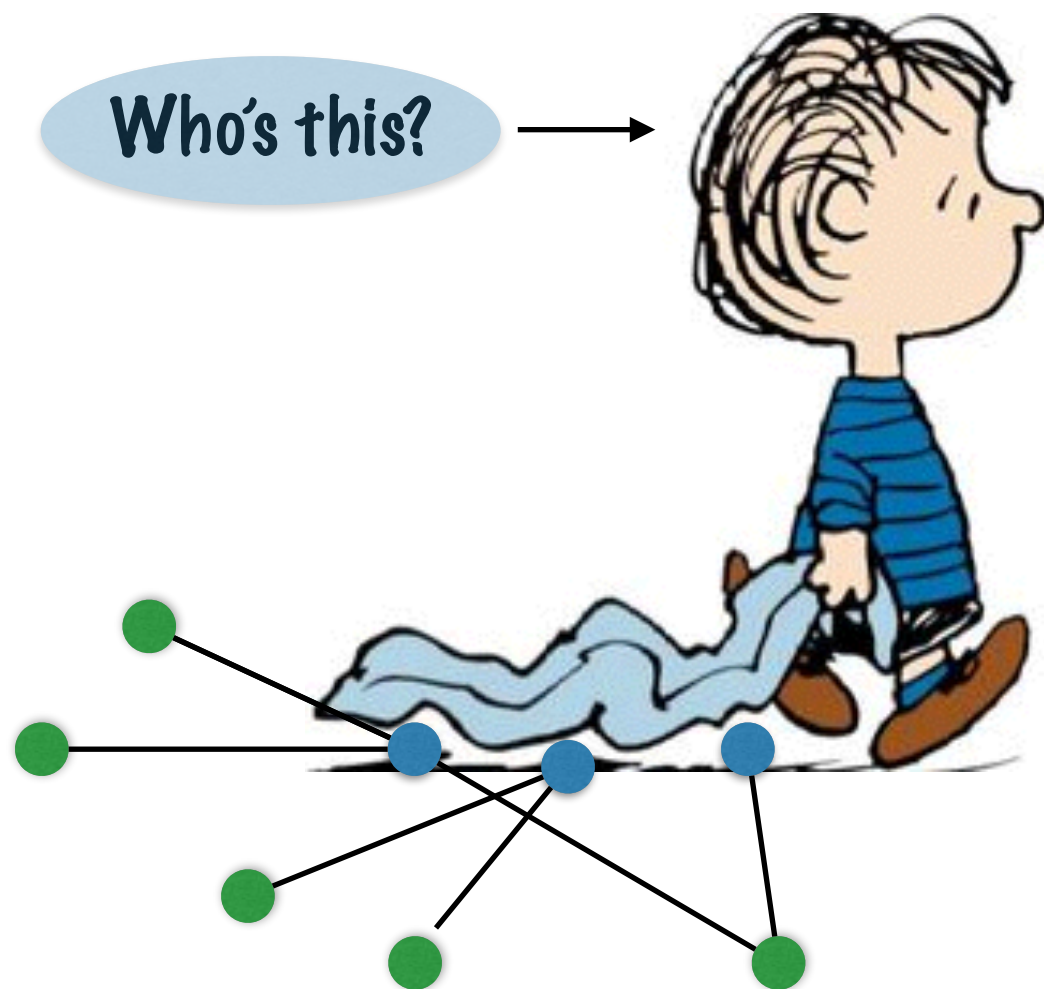
A course with two parts

Approximation algorithms, Part I

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



Approximation algorithms, vertex cover, and linear programming

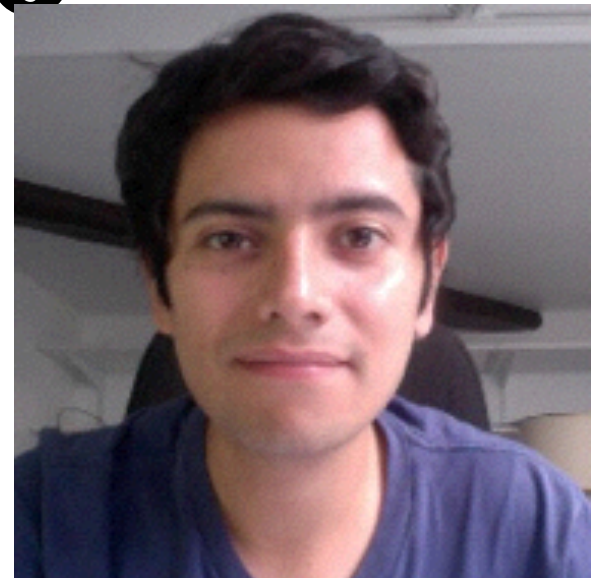


What's that?

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

Teaching staff behind the scenes

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



Film director: Nordine Méziane
Cameraman: Jovanny Parvedy