



# Next Release Problem

Exhauro Project

# Problem Definition

Given:

- A set of requirements  $R = \{r_1, r_2, \dots, r_n\} \dots$
- ... each one with a cost  $c_j$  and value  $w_j$
- A set of functional interaction among requirements
  - **Implication** ( $r_i$  before  $r_j$ ):  $r_i \Rightarrow r_j$
  - **Combination** ( $r_i$  at the same time as  $r_j$ ):  $r_i \odot r_j$
  - **Exclusion** (not both):  $r_i \oplus r_j$

Find a subset of requirements  $X \subseteq R$  fulfilling the interactions and minimizing **cost** and maximizing **value**

$$\min \quad \text{coste}(\hat{R}) = \sum_{j, r_j \in \hat{R}}^n c_j,$$

$$\max \quad \text{valor}(\hat{R}) = \sum_{i=1}^m w_i \prod_{j, r_j \in \hat{R}} v_{ij}$$

Xuan et al.

$$\text{valor}(\hat{R}) = \sum_{j, r_j \in \hat{R}}^n s_j,$$

Del Sagrado et al.

$$\sum_{i=1}^m w_i * v_{ij}$$

# State of The Art in NRP

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**An Integer Linear Programming approach to the single and bi-objective Next Release Problem**

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**ABSTRACT**

*Context:* The Next Release Problem involves determining the set of requirements to implement in the next release of a software project. When the problem was first formulated in 2001, Integer Linear Programming, an exact method, was found to be impractical because of large execution times. Since then, the problem has mainly been addressed by employing metaheuristic techniques.

*Objective:* In this paper, we investigate if the single-objective and bi-objective Next Release Problem can be solved exactly and how to better approximate the results when exact resolution is costly.

*Methods:* We revisit Integer Linear Programming for the single-objective version of the problem. In addition, we integrate it within the Epsilon-constraint method to address the bi-objective problem. We also investigate how the Pareto front of the bi-objective problem can be approximated through an anytime deterministic Integer Linear Programming-based algorithm when results are required within strict runtime constraints. Comparisons are carried out against NSGA-II. Experiments are performed on a combination of synthetic and real-world datasets.

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## Dos estrategias de búsqueda anytime basadas en programación lineal entera para resolver el problema de selección de requisitos

### Resumen:

El problema de selección de requisitos (o Next Release Problem, NRP) consiste en seleccionar el subconjunto de requisitos que se va a desarrollar en la siguiente versión de una aplicación software. Esta selección se debe hacer de tal forma que maximice la satisfacción de las partes interesadas a la vez que se minimiza el esfuerzo empleado en el desarrollo y se cumplen un conjunto de restricciones. Trabajos recientes han abordado la formulación bi-objetivo de este problema usando técnicas exactas basadas en resolutores SAT y resolutores de programación lineal entera. Ambos se enfrentan a dificultades cuando las instancias tienen un gran tamaño, sin embargo la programación lineal entera (LP) parece ser más efectiva que los resolutores SAT. En la práctica, no es necesario calcular todas las

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## Lingbo Li work

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