

Studying Permutation-based Combinatorial Optimization Problems and Proposing Efficient Estimation of Distribution Algorithms

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Personal Information

Josu Ceberio

- ▶ Computer Science, University of the Basque Country (UPV/EHU).
- ▶ Master in Computational Engineering and Intelligent Systems, University of the Basque Country (UPV/EHU).
- ▶ PhD Student at the Intelligent Systems Group (ISG), University of the Basque Country (UPV/EHU)
- ▶ Supervised by Alexander Mendiburu and Jose A. Lozano.
- ▶ Predoctoral grant of the Basque Government. 3rd year.

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- ▶ Predoctoral grant of the Basque Government. 3rd year.
- ▶ ISG research interests: Bioinformatics, High Performance Computing, Machine Learning and **Optimization**.

Thesis Proposal

"Propose state-of-the-art solutions to permutation problems by means of estimation of distribution algorithms"

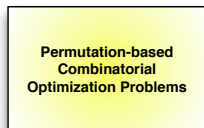
Thesis Proposal

The foundations

**Permutation-based
Combinatorial
Optimization Problems**

Thesis Proposal

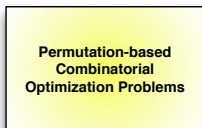
The foundations



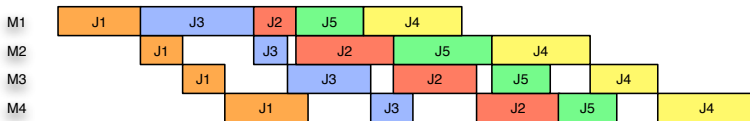
- Problems whose solutions are naturally **codified as permutations**.

Thesis Proposal

The foundations



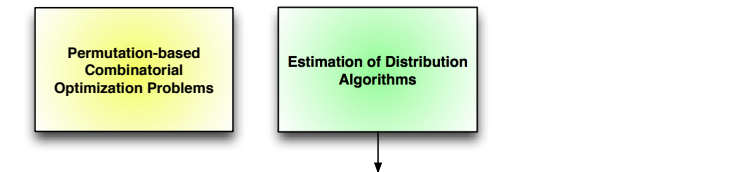
- Problems whose solutions are naturally **codified as permutations**.



Permutation Flowshop Scheduling Problem

Thesis Proposal

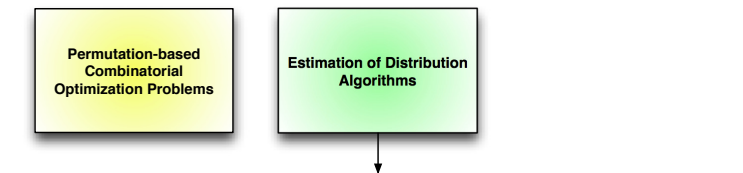
The foundations



- Existing EDAs-based approaches do not propose efficient solutions.

Thesis Proposal

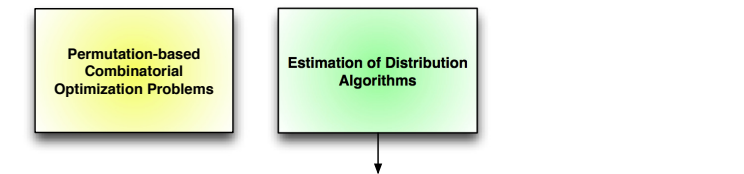
The foundations



- ▶ Existing EDAs-based approaches do not propose efficient solutions.
- ▶ Designed for integer or real encoding problems.

Thesis Proposal

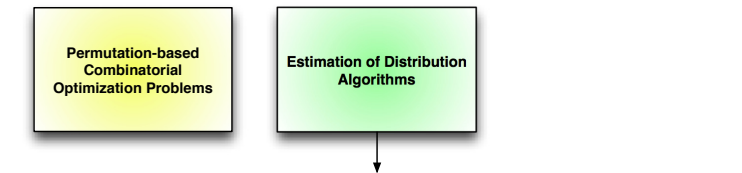
The foundations



- ▶ Existing EDAs-based approaches do not propose efficient solutions.
 - ▶ Designed for **integer** or real encoding problems.
-
- ▶ $\Omega = \Omega_1 \times \Omega_2 \times \dots \times \Omega_n$ where $\Omega_i = \{1, \dots, r_i\}$ and $r_i \in \mathbb{N}, i = 1, \dots, n$.

Thesis Proposal

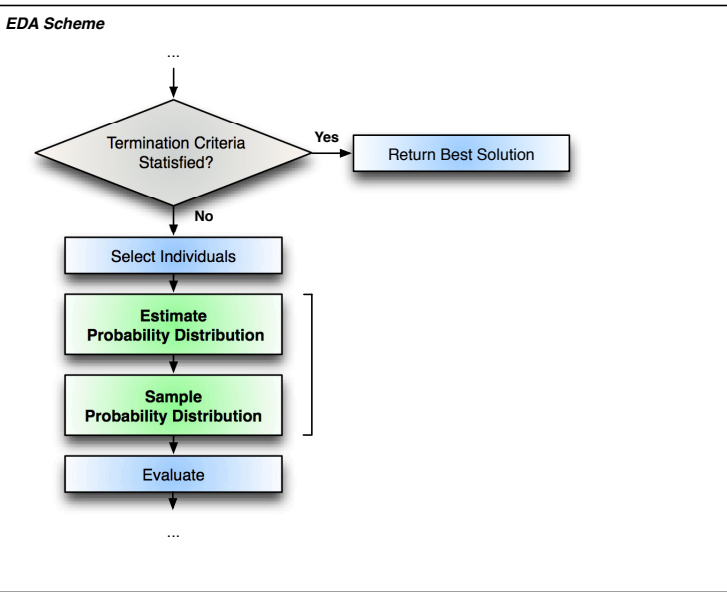
The foundations



- ▶ Existing EDAs-based approaches do not propose efficient solutions.
- ▶ Designed for integer or **real** encoding problems.
- ▶ An infinite non-numerable subset of \mathbb{R}^n .

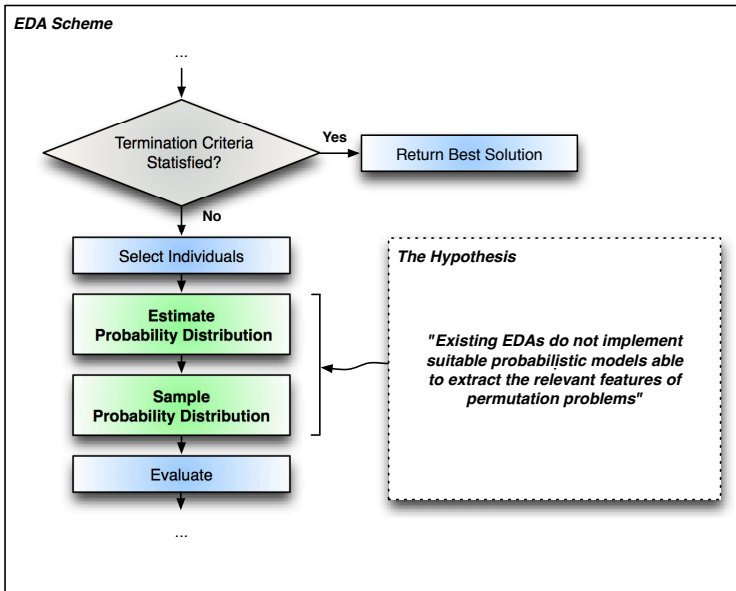
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The Hypothesis



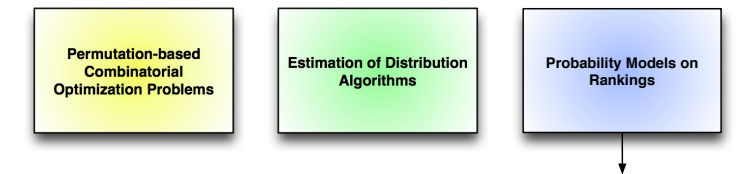
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The Hypothesis



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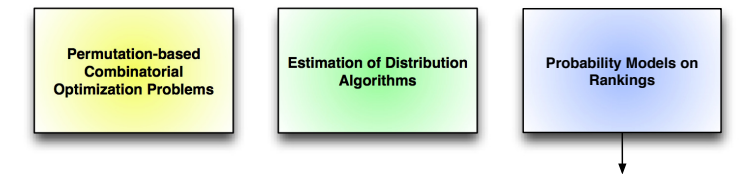
The contribution



- Estimate an **explicit** probability distribution on \mathbb{S}_n .

Thesis Proposal

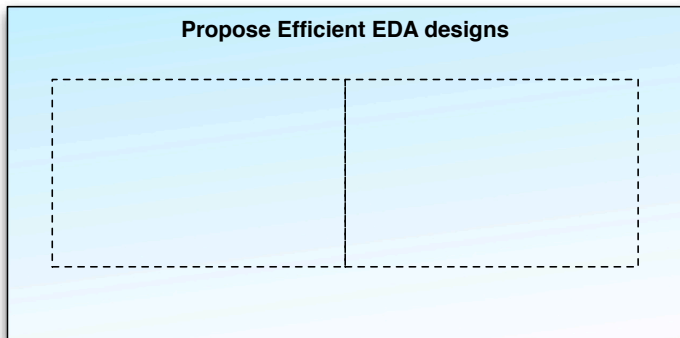
The contribution



- ▶ Estimate an **explicit** probability distribution on \mathcal{S}_n .
- ▶ Thurstone order statistics → **Plackett-Luce**
- ▶ Induced by paired comparisons → **Bradley-Terry**
- ▶ Distance-based ranking models. → **Mallows**
- ▶ Multistage ranking models. → **Generalized Mallows**

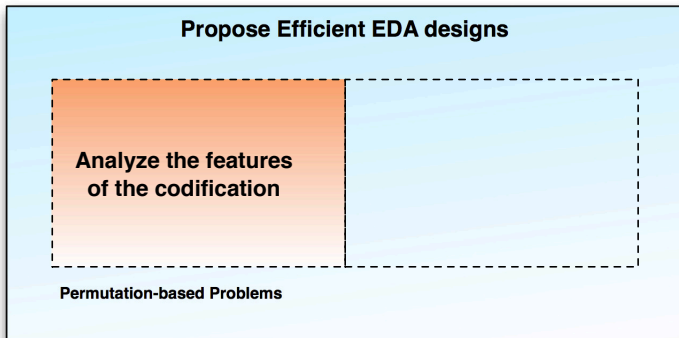
Thesis Proposal

The Challenge



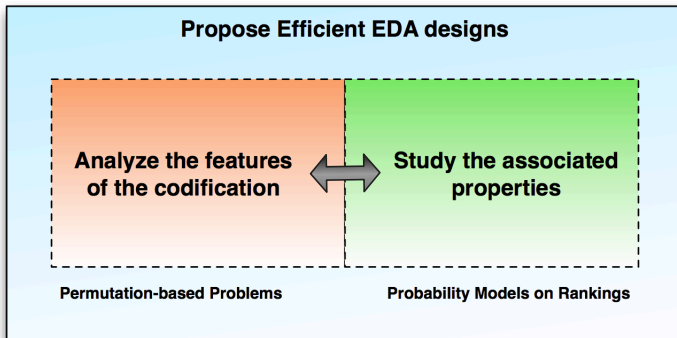
Thesis Proposal

The Challenge



Thesis Proposal

The Challenge



Aims & Objectives

1. Review existing EDAs for
Permutation-based Problems

Publications:

- ▶ J. Ceberio, E. Irurozki, A. Mendiburu, J.A. Lozano. **A Review on Estimation of Distribution Algorithms in Permutation-based Combinatorial Optimization Problems.** *Progress in Artificial Intelligence*. April 2012, Volume 1, Issue 1, pp 103-117. **Cited by 10 papers.**

Aims & Objectives

1. Review existing EDAs for
Permutation-based Problems

2. Study probability models on
rankings and introduce a model in
EDAs

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- ▶ J. Ceberio, A. Mendiburu, J.A. Lozano.
**Introducing The Mallows Model on
Estimation of Distribution Algorithms.**
*In Proceedings of 2011 International
Conference on Neural Information Processing
(ICONIP-2011)*, Shanghai, China, November
2011.

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3. Propose an EDA based approach
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art results of a problem

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- ▶ J. Ceberio, E. Irurozki, A. Mendiburu, J.A. Lozano. **A Distance-based Ranking Model Estimation of Distribution Algorithm for the Flowshop Scheduling Problem.** *IEEE Transactions on Evolutionary Computation*. 2013. *In Press*.

Aims & Objectives

1. Review existing EDAs for Permutation-based Problems

2. Study probability models on rankings and introduce a model in EDAs

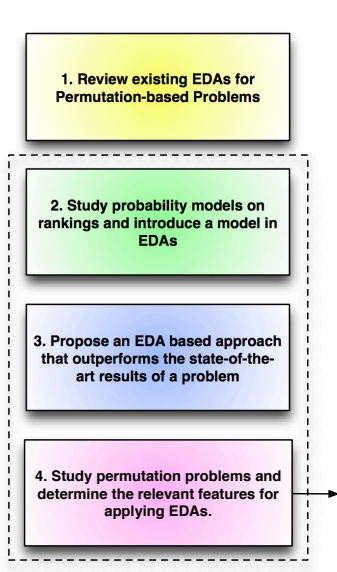
3. Propose an EDA based approach that outperforms the state-of-the-art results of a problem

4. Study permutation problems and determine the relevant features for applying EDAs.

Publications:

- ▶ J. Ceberio, A. Mendiburu, J.A. Lozano. **The Plackett-Luce Ranking Model on Permutation-based Optimization Problems.** *2013 IEEE Congress on Evolutionary Computation (CEC-2013)*, Cancun, Mexico, June 2013.
- ▶ J. Ceberio, A. Mendiburu, J.A. Lozano. **Understanding Instance Complexity in the Linear Ordering Problem.** *The International Conference on Intelligent Data Engineering and Automated Learning (IDEAL-2013)*, Hefei, China, October 2013.

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Ongoing Work:

- ▶ Structural analysis of the Linear Ordering Problem.
- ▶ Incorporate information about the problem in the search process.

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