UNIVERSIDAD NACIONAL DE COLOMBIA
SEDE BOGOTÁ

FACULTAD DE INGENIERÍA
Vicedecanatura Académica
POSGRADOS

PROPOSAL SUBMISSION

DOCTORAL THESIS:	[x]	MASTER THESIS:	[ ]
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1. **BIDDER:** Robinson Andrés Jaque Pirabán **ID:** 80190790
2. **PROGRAM:** Phylosophy Doctoral in Computer Science and Systems Engineering
3. **ADVISOR:** Fabio Augusto González Osorio
   DEPARTMENT: Computer Science and Industrial Engineering
4. **TITLE: Kernel Tensor Factorization**
5. **AREA:** Computer Science
6. **LINE OF RESEARCH:** Machine Learning
7. COMMENTARY WITH ADVISOR APROVAL

8. BIDDER SIGNATURE

9. SIGNATURE OF ADVISOR

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1 Introduction

Tensors are multidimensional arraies. i.e. An N-way or N-order tensor is an element of tensor product of N vector spaces, each of which has its own coordinate system. A first order tensor is a vector, a second order tensor is a matrix, tensors of higher order are called high-order tensors.

Third-order tensor

1.1 Basics of the tensor decomposition

1.1.1 Formulation for tensor completion

Following Ji Lu et. al notation

low rank matrix completion

$$\begin{aligned} &\min_{X} \operatorname{rank}(X) \\ &\text{s.t. } X_\Omega = M_\Omega \end{aligned} \tag{1}$$

where Ω is an index set, then X_Ω is coping entries of X in the indexes Ω and missed entries $\hat{\Omega}$ would be 0

The missing entries in X are determined in order to minimize the matrix X rank. i.e. a non convex optimization problem since rank is nonconvex.

Frequently, trace norm (or nuclear norm) $||\cdot||_*$ is used to approximate the rank of matrices. Trace norm is the tighest convex envelop for the matrices rank.

$$\begin{aligned} &\min_{X} ||X||_* \\ &\text{s.t. } X_\Omega = M_\Omega \end{aligned} \tag{2}$$

Since tensor is a generalization of the matrix concept, we generalize the optimization problem as

$$\begin{aligned} &\min_{\mathcal{X}} ||\mathcal{X}||_* \\ &\text{s.t. } \mathcal{X}_\Omega = \mathcal{T}_\Omega \end{aligned} \tag{3}$$

Where $\mathcal{X}$ and $\mathcal{T}$ are n-order tensors with identical size.

1.2 Tensor probability

Given a sample set

1.3 Kernel matrix

achievement of the project activities, including successful completion of the tasks and timely production of deliverables. resource accounting. It will also be in charge of managing the relations with collaborating institutions and administrative bodies within. stage before delivery hand over to ensure compliance and coherence. Also, it will follow up project progress anticipating corrective actions and assessing risk mitigation actions.