

Thesis subject : Knowledge representation and reasoning for cultural heritage - PATRIMALP Materials, Pigments, Lights: the colors of Heritage

Laboratory of assignment: Laboratoire d'informatique de Grenoble/LIG-D. Ziébelin ; UMR litt&Arts-CNRS V.Adam

Context and work environment

UMR 5217, the LIG (Laboratoire d'Informatique de Grenoble) is composed by 500 members: faculty, full-time researchers, PhD students, administrative and technical staff. The LIG's mission is to contribute to the development of fundamental aspects of computer science (models, languages, methodologies, algorithms) and to meet conceptual, technological and societal challenges. The 22 research teams of LIG are organized into 5 focus areas: Software and Information Systems Engineering; Formal Methods, Models and Languages; Intelligent Systems for Linking Data, Knowledge and Humans; Interactive and Cognitive Systems; Distributed Systems, Parallel Computing and Networks. Our research group is part of the area: Intelligent systems for linking data, knowledge and human beings, and is interested in spatio-temporal information, adaptability, multimedia and knowledge representation.

UMR 5316 Litt&Arts. Director: Isabelle Cogitore. Members: 70 researchers, as many doctoral students in literature, digital humanities and performing arts, a CNRS researcher and a group of 3 digital humanities engineers (ELAN) and 4 administrative staff. The PhD student will reinforce the research carried out within the framework of the laboratory's "Nouvelles philologies" and "Transversalité des humanités numériques" axes.

Team description (N+1 and colleagues) : under the authority of Team composed of X agents (X A, X B, X C...)

Supervisors:

Pr Danielle Ziébelin (Knowledge representation) UGA / LIG

Dr Véronique Adam (Littérature et science, Transferts de savoirs) UGA/Litt&Art

Team agents :

Pr Francois Portet (Natural Language Processing)

Dr Philippe Genoud (Web of data engineering)

Dr German Vega (Software engineering)

Position's mission and main activities

Mission:

The main challenge of the Patrimalp project is the development of an integrated and interdisciplinary Heritage Science, in order to ensure cultural Heritage sustainability, promotion and dissemination in contemporary society. The ambition is to produce the forms of intelligibility of a global and moving process which starts from the collection of the raw material, its transformation into a primitive object, different lives as a material (alterations, degradations, transformations ...), and finally from its election as an object of historical and heritage value and its "promotion" into a work of art.

This research is applied to understand how colors have been perceived, conceived, used from the late 15th century to early 18th, by craftsmen, scientists, counterfeiters in a specific field (jewelry) that may be reduplicated in other fields (Smith 2010). To make this study possible, the project has started gathering a large collection of textual material made up of alchemical works and collections of natural or artificial objects collected between the late 15th and the 18th centuries curated and largely digitized in European libraries [see corpus below]. To narrow the field of research, the corpus will be focused on treaties about making false gems, with recipes of color [Canella 2006, Cherry 2001, Bycroft, 2018, Leonhard 2015]. The corpus is mainly printed but few manuscripts will also be helpful as compilation of most

practiced readings (Darduin, 1986). To better understand the choice of colors for these "wonders", to better understand the connection between separated fields of knowledge (jewelry, chemical experiences, mineralogy, medical or magic lapidary..., Halleux, 1975) we want to reconstruct the recipes for making colored material in its context of thought, whether technical or symbolic, textual or pictorial manifestations. The corpus will combine treaties used by non-artistic practitioners (scientists, craftsmen...) and practical treaties of colors dedicated to artists. To better understand the choice of colors for these "wonders", we want to reconstruct the knowledge transfer between books, authors, sciences and its disposal in recipes for making colored material in its context of thought, whether technical or symbolic. These recipes will constitute a new body of research for literary people and a new data-study case for understanding color and history of knowledge (Oltrogge 2015). This corpus indeed offers modes of verbalization, objects and representation inscribed in complex forms of writing and fiction whose modalities and frames of reference remain to be analyzed (accounts of technical, medical or physico-chemical experiments inscribed in fictional worlds or mythological, symbolic descriptions of artifacts, engravings, or materials collected in nature, mines).

Studying this corpus will enable us to formalize our knowledge of these different skills over time. This corpus will thus provide complex data on the material and symbolic origins of color ingredients, on their use, their names and their physical or symbolic perception: these data represent a challenge for computer researchers who will have to organize them for the benefit of curators, chemists or physicists, in ontologies representing the state of knowledge from the point of view of scholars through the ages. As far as objects are concerned, the data will also provide information for the history of books (overall structure of book production, relationship with the reader and printer, uses of indexing, dialogue between illustrations and texts, authorship).

The final objective is to build a knowledge graph composed by patrimonial objects, components of objects, materials, colors, know-how, reference framework, metadata. Each of the parts of the knowledge graph being able to reference a specific ontology well known of a scientific community (ontology of pigments, ontology of materials, ontology of colors...). In order to enable researchers to observe and reconstruct the trajectory of writing describing color, an analysis of symbols and literary styles will be represented, as well as the trajectory of know-how and technical and artisanal practices, and elements of the corpus relating to recipes. To modelise and implement this analysis, the thesis will propose a suitable knowledge representation language. In particular, this language will cover the constitutional and temporal relations necessary for the color modeling in the diversity set out above.

Main activities:

List here the activities in the order of importance or quota

The PHD project will focus on the segmentation, extraction and representation of recipes from the corpus in order to make them accessible to humanities researchers. This involves to

- Represent lexical semantic network: categories, relations and instructions (Cruse, 1990)(Polguère 2009)
- Characterize relations: subsumption, composition, causality, time relations (Danash 2023) (Danash 2022) (Kuipers 1984) (Rottman 2014)
- Formalize of relation ontology for recipes representation (Bittner 2004)
- Modelise these recipes as ontology pattern of instructions (http://ontologydesignpatterns.org/wiki/Main_Page)
- Extend these recipes in a formal representation of the knowledge that characterizes them and marks their datation and practices over time (Artale 2008) and track their evolution.

The results of this treatment will :

- Modelisation of recipes as an ontology design pattern
- The documentation of this corpus of texts, by inserting the extracted elements into a meta-database of the corpus documents to facilitate searches and queries.
- The ontology will be implemented in a knowledge graph integrated into a web data platform. This knowledge graph should list the pigments (with their multiple denominations), binders, supports, techniques, utensils and fields of knowledge contained in the recipe texts; the texts should be referenced using standard DublinCore metadata; the work should be described as a heritage object, and the symbols used in the alchemical recipes should be explained and referenced in the texts. If open-licensed, the resources will be published as Linked Open Data, mainly those associated with the annotated texts in the corpus.
- The knowledge graph will be open to standards: [CIDOC-CRM](#) (International Committee for Documentation - Conceptual Reference Model), [Europeana Data Model \(EDM\)](#), [DublinCore](#), [ISO21127](#), [FRBRoo](#)

Restriction or constraints related to the position

Research and work should be located in Grenoble (LIG& Litt&Arts)

Desired profile**Expected skills (priority) :**

- Master 2 in Computer science or data science
- Good mastering of knowledge representation programming (OWL; RDF, SPARQL ...).
 - good knowledge of databases
- Previous experience in Knowledge representation.
- Very good communication skills in English and good command of French.
- **Trade skills/ expertise**

Interest in literature, patrimonial science or digital humanities

- **Personal skills**

Autonomy, creativity, adaptability (working in a team)

Desired professional experience: beginner 2 to 5 years

Previous formation, diplomas:

Master 2 in Computer science

General information

Contact for the questions related to the position:

Danielle Ziebelin, Full Professor, Thesis supervisor, computer science

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Annexe diffusion PhD

Informations projet de recherche

Description du sujet	
Sujet de thèse	Knowledge representation and reasoning for cultural heritage - PATRIMALP Materials, Pigments, Lights: the colors of Heritage
Mots clés	Early modern heritage, color, ontologies, graph of data, semantic relation.
Champ scientifiques	Artificial intelligence and digital humanity Intelligence artificielle et humanité numérique/
Champs scientifiques secondaires	Patrimonial Sciences and literature Science du patrimoine, Littérature
Ecole doctorale	ED MSTII
Directeur de thèse (NOM Prénom, mail)	Ziébelin Danielle, Danielle.Ziebelin@imag.fr
Co-encadrant (NOM Prénom, mail)	Adam Véronique, veronique.adam@univ-grenoble-alpes.fr
Co-tutelle	NO
Co-financement	NO

Calendrier

Date début diffusion	As soon as possible
Date fin diffusion	Open
Date limite candidature	Open
Date pré-sélection (facultatif)	
Date début entretien	Immediately
Date résultats sélection	Immediately
Date début de contrat	As soon as possible

Dossier candidature

Documents à fournir	CV en français or in English
	Motivation Letter en français or in English
	Recommendation Letters en français or in English
	Master thesis in CS with knowledge representation skills en français or in English
	Official Master or equivalent diploma and transcripts en français or in English

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