POSITION OFFER

COURBON Software

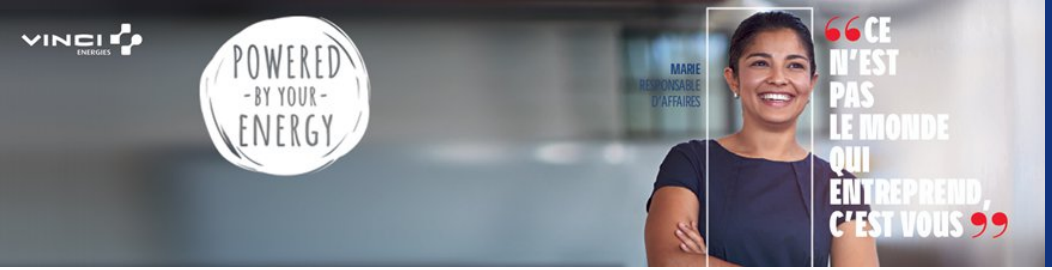
LIMOS

MINES Saint-Étienne
Une école de l'IMT

PH.D. POSITION OFFER

Title : On the contribution of domain-specific knowledge to machine learning
Research institution: Laboratoire d'informatique, de modélisation et d'optimisation des systèmes (LIMOS) – École des Mines de Saint-Etienne

Applications to send to: audrey.bruyere@vinci-energies.com



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CONTEXT

The context of the PhD topic is the “Industry of the future” (or Industry 4.0), meant to be more flexible and autonomous thanks to digital technologies and Big Data.

Courbon Software, an industrial software development company, has access to an important amount of industrial data it would like to leverage to offer new services to its customers. Such new services, including predictive maintenance (to predict machine failure and address it before it occurs) and task scheduling optimization (for instance, with respect to fluctuating prices from electricity utilities), are made possible through well-known machine learning techniques and, mostly, deep learning.

However, applying deep learning to industrial data comes with several issues, which must be addressed by computer science research. In particular, the diversity of available data sources in production (numerical, topological, temporal, structured data and others) implies a significant amount of pre-processing work that lowers the reliability of any model obtained from that data, compared to evaluations on test data. Yet, reliability is a strong requirement of any industrial system. Moreover, deep learning models are hardly interpretable, e.g. to establish legal responsibility (who, of the software developer or the company providing data, is responsible) when a severe failure occurs.

See also:

- Gusmeroli S., Dalle Carbonare D. (eds) (2020). Big Data challenges in Smart Manufacturing Industry (v. 2020). Brussels. BDVA.

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OBJECTIVE AND RESEARCH TOPICS

The approach to explore in the thesis is to integrate formal knowledge to deep learning techniques on industrial data. Formal knowledge can be represented as logical formulas, relational data or, more generally, as knowledge graphs, such as the Google Knowledge Graph or Wikidata. It allows both to integrate heterogeneous data sources into a single knowledge base and to offer an “explainability” framework for machine learning models.

Work done during the thesis will be based on recent progress in self-supervised learning methods applied on knowledge graphs, including those of Antoine Bordes (now at Facebook AI) and Pascal Hitzler. The objective of the thesis will be to specify a method to integrate generic formal knowledge to distinct machine learning tasks such as failure detection and the estimation of key performance indicators when scheduling production.

The research topics related to the thesis include (among others):

- semantic data integration (RDF, SPARQL, OWL)
- deep learning (PyTorch, TensorFlow)
- industrial data models (OPC-UA, AutomationML)

See also :

- Bordes A., Usunier N., Garcia-Duran A., Weston J., Yakhnenko O. (2013). "Translating Embeddings for Modeling Multi-relational Data," Neural Information Processing Systems (NIPS). South Lake Tahoe, United States.
- Hitzler P., Bianchi F., Ebrahimia M., Sarker M.K. (2020). "Neural-Symbolic Integration and the Semantic Web," Semantic Web, vol. 11, no. 1, pp. 3-11. IOS Press.

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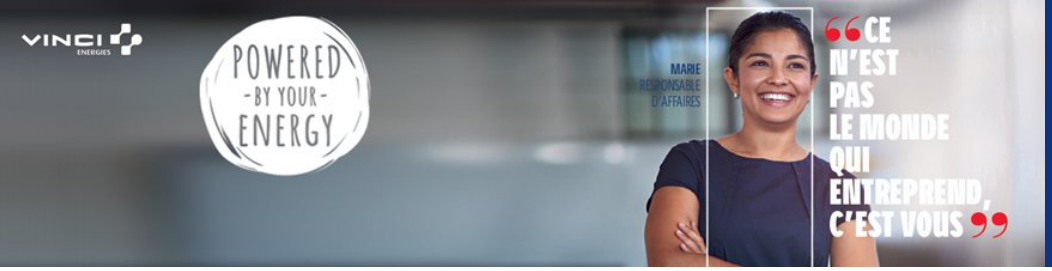

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REQUIRED SKILLS

- Master in computer science or data science
- Fluency in English (reading)
- String knowledge in database management and big data (SQL, NoSQL, Hadoop, ...)
- Strong programming knowledge in a high-level programming language (Python, Java, JavaScript, ...)

DESCRIPTION ENTREPRISE / LABORATOIRE (FR)

Rattachée au Groupe VINCI Energies, COURBON SOFTWARE est une entreprise dynamique et innovante, spécialiste de l'édition logiciel pour la transformation digitale.
COURBON SOFTWARE conçoit des logiciels innovants intégrables à tous les process de production. Nos suites logicielles sont élaborées en fonction des exigences de chaque secteur d'activité : industrie pharmaceutique, agroalimentaire, chimie des matériaux, manufacturier. COURBON SOFTWARE accompagne ainsi la transformation digitale des entreprises et participe à la croissance de leur performance industrielle. COURBON SOFTWARE se distingue par des logiciels innovants et totalement adaptables à tous les processus de fabrication.

Le Laboratoire d'Informatique, de Modélisation et d'Optimisation des Systèmes (LIMOS), qui sera le laboratoire d'accueil, est une Unité Mixte de Recherche (UMR 6158) en informatique, et plus généralement en Sciences et Technologies de l'Information et de la Communication (STIC). Le LIMOS est principalement rattaché à l'Institut des Sciences de l'Information et de leurs Interactions (INS2I) du CNRS et de façon secondaire à l'Institut des Sciences de l'Ingénierie et des Systèmes (INSIS). Il a pour tutelles académiques l'Université Clermont Auvergne et Mines Saint-Etienne (MSE). Le positionnement scientifique du LIMOS est centré autour de l'Informatique, la Modélisation et l'Optimisation des Systèmes Organisationnels et Vivants. Le poste est à pourvoir dans l'axe des systèmes d'information et de communication (SIC).

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