

# Kshitij Goyal

Researcher in Machine Learning and Artificial Intelligence

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## Experience

**KU Leuven**  
Sep 2018 - Present

### PhD in Machine Learning and Artificial Intelligence

**Thesis:** Verifying Learning Artificial Intelligence Systems.

- Primary focus on learning machine learning models with domain based constraints.
- Submitted a paper which presents a way to learn parametric models that satisfy domain constraints.
- Currently working on an optimal decision tree implementation using SMT solvers which can be used to learn noise robust decision trees.

#### Other Projects:

##### 1. Feature Interactions in XGBoost.

- Learned interactions between features using mutual information on the data.
- Used the learned interaction with XGBoost to enforce interaction constraints.

##### 2. ITOS: Improving Decision Trees using Optimal Subtrees.

- Utilised optimal subtrees of depth 2 to improve a binary greedy decision tree in a bottom up approach.
- Proposed approach led to an average improvement of more than 10% in the performance of the tree.

##### 3. Industry Collaboration: Tunify (A music streaming service for commercial clients)

- Tunify product is based around the concept of musical environments.
- Designed a novel algorithm that combines unsupervised clustering with decision tree learning to identify musical environments automatically.

##### 4. CeGL: Counter-Example Guided Learning

- A counter example guided approach to learn models that satisfy domain constraints in neural networks.
- The proposed approach significantly outperformed the regularization based baselines in terms of performance.

#### Student Thesis Projects:

1. Machine learning in Shapley Space: Demonstrated that clustering in the Shapley space leads to better quality clusters.
2. Personalised Search with Deep Learning: Used VAE and LDA as encodings to learn personalised search models that outperform the baselines.

**Zynga Games**  
May 2017 - August  
2017

#### Data Analyst

- Worked as a data analyst for multiple mobile games.
- Analysed key performance metrics to provide insights on the business strategies.

**Accenture Services  
Pvt. Limited**  
May 2014 - March 2017

### **Business Analyst**

Worked on a number of projects:

- Inventory optimisation for European Telecom Company.
- Reliability Analysis for an automotive manufacturer.
- Social media analytics in demand planning.

**Media iQ Digital**  
May 2013 - July 2013

### **Business Intern**

- Developed an algorithm using simple heuristics to forecast maximum number of impressions won.
- Analysed twitter stream data in python to obtain the sentiments of people for a carrier airline

## **Education**

**KU Leuven**  
Sep 2017 - August 2018

### **Master of Engineering in Computer Science (Artificial Intelligence)**

Graduated Magna Cum Laude.

**Thesis:** Personalised Search with Deep Learning.

**Indian Institute of  
Technology, Kanpur**  
June 2009 - May 2014

### **Integrated Masters in Mathematics and Scientific Computing**

**Thesis:** Analysis of Middle Censored data to estimate the lifetime distribution function.

## **Technical skills**

### **Data Science**

Machine Learning, Constraints in Machine Learning, Satisfiability (SAT), Satisfiability Modulo Theories (SMT), Tree Ensembles, Optimal Decision Trees, Natural Language Processing, Music Streaming Analysis, Neural Networks, Game Theory in Machine Learning.

### **Software Development**

Expert Python Programmer. Proficient with libraries such as Scikit-learn, Pandas, Numpy and Matplotlib, tools such as Jupiter Notebooks. Moderate experience with Java, R, SQL, z3 etc.

## **Publications**

### **Peer reviewed conference publications**

SaDe: Learning Models that Provably Satisfy Domain Constraints  
**K. Goyal**, S. Dumancic, H. Blockeel.  
ECML 2022  
(Under Review)

### **Peer reviewed workshop publications**

Feature Interactions in XGBoost  
**K. Goyal**, S. Dumancic, H. Blockeel.  
AIMLAI-XKDD Workshop @ECML 2019