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| **Summary** |  |
| **Partner name** | Luci.AI Inc. |
| **Project location** | Canada, Toronto, Ontario |
| **Contact details** | Jinhui Jiao, jinhui@luci.ai |
| **# positions**  | Maximum 6 students in total, including 2-4 masters and 1-3 PhD/Post-Docs |
| **Project desired start & end dates** | ASAP, Spetember 2019 – September 2021 (2-year duration) |
| **Preferred Academic institution(s)**  | Any, preferrably in the GTA area so that the student will be available to work onsite during work days |
| **Discipline(s)** | Computer Science, Computer Engineering, Machine Learning, Artificial Intelligence, Software Engineering, Software Development, Operational Research, Data Science, Statistics, Information Engineering, Applied Mathematics, Applied Computing, Computational Mathematics, Informatics, Systems Engineering, Advanced Computing |
| **Preferred language**  | English |

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| **Research project** |  |
| **Project title** | LuciX: AI-Optimization SaaS for Logistics Planning (with sub-projects) |
| About the company max 200 words | Luci.AI is a Toronto-based AI technology start-up. The company pursues for optimization excellence in logistics planning through proprietary research and development in machine learning, deep learning, optimization, data science, and the most advanced computation technologies (including quantum).We start by building up an AI Scheduling SaaS Platform, LuciX. It empowers large and small businesses whose employees are on the go and who envy for market expansion and revenue growth. Our efforts are well recognized by our industry clients, leading incubators, universities and research institutes.At Luci.AI, we revolve around our core vision and values as we grow. Things and people are connected, and that ignites unlimited possibilities and dreams in the coming AI era. We are passionate about this vision by bringing forward lean and efficient AI solutions and products to that end.Located in Toronto, Canada, Luci.ai is born with an open, inclusive and diverse internal community. We are a team of people with strong ambition and initiative. Now, our team welcomes the best and most dedicated professionals from various backgrounds who share the same passion and common goal. |
| Describe the project max 300 words | *Project in General:*LuciX is an AI-Optimization brain for dynamic scheduling, dispatching and routing in logistics planning industry. It is a typical combinatorial optimization problem: A set of drivers has to serve for a number of requests with specific location and time. This classic NP-hard mathematic challenge requires efficient and state-of-the-art data-driven AI and optimization methodologies or algorithms. On the engineering side, it adopts Software as a Service platform structure. The system should also stay robust and support stochastic decision catering for crisis and dynamic demands. The project can be further divided into four sub-projects, following respective research and development focuses.Subproject 1: Implement Reinforcement Learning for Logistic Planning ProblemsMachine learning, including Reinforcement Learning, is an effective fix to the dispatching and scheduling complex. LuciX sets to rescue our clients from the operating chaos and accommodates for all the randomness and uncertainties with prompt actionable plans. Dispatching, scheduling, and routing are computationally difficult problems for which many exact and heuristic algorithms have been proposed, but providing fast and reliable solutions is still a challenging task. Our previous research has found that neural networks and reinforcement learning is a compelling choice with a high potential toward solving the problems. The project goal is to research, design, and develop a model or algorithm that supports adaptive optimization to solve real-world problems with sparse data and allow for further improvements and extensions that incorporate other realistic constraints.Subproject 2: Adaptive Optimization for On-Demand Logistics Planning Automatic optimization and execution capabilities extend the logistic planning system accordingly. Classic optimization frameworks support precise and logical decisions a larger scale, but industry also calls for parallel processing to cater optimization demands of high frequency. For example, food delivery, an important application scenario for LuciX, requires prompt response serving for thousands of requests per minute. We are on the process to develop a proprietary multi-objective constraint optimization model or algorithm, which achieves fully automated route optimization with the state-of-the-art performance and speed. The adaptive optimization framework supports efficient customization with high scalability and enables LuciX as a general dispatching and scheduling platform, which rescues our clients from growing pains when they expand to new market and customers.Subproject 3: Data-Driven Software as a Service (SaaS) Platform DevelopmentLuciX benefits from the unprecedented computational power from cutting-edge cloud computing, GPUs, CPUs, and quantum computing. For the engineering design and development, it currently adopts a serverless architecture that supports data-driven demands and parallel processing. Our current architecture enables one-click cloud deployment, and minimal maintaining and labor cost. It further adopts a dual system responding to peak hour demands and integrates dynamic problem decomposition with distributed computing. As a third-party cross-dataset platform, it will further provide predictive analytics and prediction services for both reactive and proactive operational needs. As a result, the system will adaptively adjust computing resources of all types as our clients’ business expands, which supports a powerful and lean SaaS for large and small businesses in the industry. Subproject 4: Cross-Dataset Learning for Motion Detection and PredictionLuciX is a data-driven platform. We maximize data utilization at various matrices to get the most valuable, efficient and flexible results. We generate patterns from unstructured data from multiple sources, including weather and traffic, graph-based live data, and Point-of-Interests to achieve industry-wide optimization. The project goal is to recognize object motions with an effective action classifier across different datasets. It will adopt both real-time analytics and machine learning to explores the spatial and temporal coherence of motions of different objects. Studies shows that adaptive action detection approaches can reduce training label requirements, thus to increase the efficiency of machine learning and optimization. By making good use of prior industry datasets from various resources, semi-supervised or unsupervised learning should become highly applicable. As a result, that will contribute to our proprietary logistics planning machine learning and optimization methodologies. |
| Required expertise/ skillsmax 200 words | Subproject 1: Implement Reinforcement Learning for Logistic Planning ProblemsThe project expects 1-2 PhD or Post-Doc level students through the Mitacs program. Qualified master-level students are also encouraged to apply. The candidate will focus on the research and development of optimization and machine learning algorithms toward implementation, testing, deployment and evaluation. You are expected to have extensive knowledge of machine learning algorithms and to be able to effectively deliver them to various application levels with other members of our team. - Research experience in Machine Learning, Computer Science, or a related quantitative discipline.- Grounding in machine learning theory and recent advances, e.g., deep learning, reinforcement learning, etc.- Experience with machine learning frameworks – PyTorch, Keras, Scikit, SparkMLib.- Deep understanding of statistics, e.g., hypothesis testing.- Experience with big data processing, e.g., Spark.- Expertise in Python. Java, or Scala is a plus.- Understanding of software engineering practices for the full software development life cycle.Subproject 2: Adaptive Optimization for On-Demand Logistics PlanningThe project expects 1-2 PhD or Post-Doc level students through the Mitacs program. Qualified master-level students are also encouraged to apply. The candidate will focus on the research and development of optimization and machine learning algorithms toward implementation, testing, deployment and evaluation. You are expected to have extensive knowledge of optimization algorithms and to be able to effectively deliver them to various application levels with other members of our team. - Experience with data science, artificial intelligence, applied statistics, integer/linear/dynamic programming, mathematical optimization, stochastic systems.- Experience with semantic systems.- Solid Python/R/MATLAB programming skills.- Understanding of software engineering practices for the full software development life cycle.Subproject 3: Data-Driven Software as a Service (SaaS) Platform DevelopmentThe project expects 1-2 master-level students through the Mitacs program. The candidate will focus on the development, testing, and deployment of our AI Scheduling SaaS platform. You are expected to have solid knowledge of backend software development and be able to effectively deliver it to various application levels. - Research experience in computer science or a related field.- Programming experience with Python including knowledge of various Python frameworks like Django or Flask.- Experience with Object Oriented analysis and design principles.- Experience with Git and Bitbucket.- AWS experience is highly describable.- Experience with Pandas and Numpy is a plus.- Knowledge of software engineering practices for the full software development life cycle, including coding standards, code reviews, source control management, process building, and testing.Subproject 4: Cross-Dataset Learning for Motion Detection and PredictionThe project expects 1-2 master-level students through the Mitacs program. The candidate will work closely with our team, provide analytical and strategic support, and assist in machine learning algorithm implementation, testing, deployment and evaluation. You are expected to demonstrate high proficiency in data processing, analysis and interpretation, and to support a wide array of strategic analyses and initiatives for other members of our team.- Research experience in mathematics, statistics or other related quantitative fields.- Programming experience with Python including knowledge of various Python frameworks like Django or Flask.- Deep understanding of statistics, e.g., hypothesis testing.- Experience with machine learning model development and working with cross-datasets- Proficient in building statistical and algorithmic models, including but not limited to: supervised statistical learning, clustering, experimental design (A/B testing), data visualization and deep learning.- Experience working with a range of Databases/Distributed data stores such as SQL, Hadoop, Spark.- Understanding of software engineering practices for the full software development life cycle. |

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