In the past few years, there has been an increased interest in designing autonomous systems that are both fault-tolerant and flexible. The continual innovation of these systems makes it an exciting area for research pertaining to multiple fields. However, despite of achieving remarkable results in simulated environments, challenges remain in training artificial intelligence models and development of autonomous systems, to solve real world problems. Current solutions have still yet to tap the power of artificial intelligence. Therefore, I am eager to complete doctoral research in this area and I am certain that the interdisciplinary structure of this programme would provide a nurturing environment for this to be undertaken.\\

I have demonstrated a capacity for sustained and intense work throughout my academic career, commencing with my achievement of distinction at bachelors of engineering in electronics, at the International Institute of Information technology, Pune. I have always strived to align my research and projects, during my time in academia, to solve real world problems. My journey in the field of machine learning started with the project Forecasting Potential Health Threats, at the Intel higher education challenge on cyber-physical systems, where I proposed the use of machine learning algorithms trained over a corpus of medical data to predict health threats by analysing and identifying patterns observed in vital signs. The project secured an astounding 9th place nation wide. This soon followed by winning the prestigious Smart India Hackathon organized by the ministry of defense where I developed an open source intelligence gathering tool and was successfully deployed and is still being used to date by the Indian army. Working on concepts of natural language processing like sentiment analysis, topical modelling and social network clusterization was surely the most challenging yet exciting learning throughout my internship. These experiences of solving challenging problems under tight deadlines surely made a challenging yet an amazing start to my academic journey. I developed excellent project management and communication skills, which I know will make me a valued and enthusiastic participant in all of the CDTs activities.

Motivated by innovative solutions, I was interested in bridging the gap between machine learning and hardware systems to realize autonomous solutions to real world problems. I built an 8-legged spider with proximity sensors and visual systems, that can not only clear mazes but learns the unknown pathways using localization and mapping. The aim of the project was to build a robot that can explore undesired terrains and map hazardous environments and is able to learn the pathways, similar to clearing a maze. This bolstered various aspects of the field of robotics from mechanical design to hardware integration to computer vision systems. It also got rewarded the highest achieved mark of the cohort of 97/100.

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During my masters, I obtained a broad knowledge in various fields of robotics and autonomous systems. I a received a first-class honours overall and a distinction in the taught modules. Inspired by multi agent systems, my dissertation, was to design considerate swarms; Agents working in harmony and develop a considerate behaviour endogenously, based on conjecture profiles other agents. I completed a through literature review of Bayesian conditioning and evolutionary computational algorithms and profound insights on cooperation and coordination in multi agent systems. This was tested in an evacuation scenario with agents had to evacuate through a single door and played tournaments with each other in case of contention. They were given random strategies of iterated prisoners dilemma, that made them either cooperate or defect effect. They also had access to the history of actions taken by other agents. Interesting challenges can arise when any agent’s state is impacted by the actions of the other agents. Agents were able to develop a cooperative analogy and formed distinct queues to exit, where as traditional algorithms formed clusters in order to maximize individual reward. The project was a success and was published in the Artificial Life conference 2021.\\

Outside academia I gained practical experience as a machine learning engineer at ALGOB, working on various projects related to computer vision, natural language processing, regression analysis and anomaly detection. I gained an appreciation for system challenges faced in machine learning through my current title as robotics engineer at HALCON. Working in the research and development department, my work focuses on finding innovative solutions using artificial intelligence in the field of robotics, specifically drones. I was awarded the 2nd place in the EDGE innovation challenge in smart systems for Speed control using deep q networks, using reinforcement learning to optimize the energy consumption of brush-less DC motors, increasing the flight time of drones significantly. I am currently working on computational fluid dynamics using graph neural networks in JAX frame work. I also work on projects related to industrial automation and ASRS (automated storage and retrieval systems) with integration of AGVs(Automated Guided Vehicles). I believe my industrial experience reflects my core aspiration of research and ensures the beneficial application of increasingly powerful AI in the industry.

Adamant on conducting academic research and to continue my work in multi-agent systems, I am currently working on an ongoing research on predicting collective dynamics using dynamic attention neural inference (DANI) along with Dr.Namid Stillman at the cell and development biology lab at UCL. The aim of the research is to successfully predict trajectories of swarming agents in a simulated environment. We believe the application of this research will allow us to get a better understanding of cancer cells of malignant tumors which exhibit complex dynamic, self-organizing behaviours similar to collective decisions and patterns observed in swarming multi agent systems, this will ensure better drug development. \ref{deisboeck2009collective}

In large-scale multi-agent systems, like that of cancer cells, the large number of cells and their complex relationships of cells cause great difficulty for policy learning. However, the methods cannot be directly used in a large-scale environment due to the difficulty of transforming the complex interactions between agents into rules.( https://ojs.aaai.org/index.php/AAAI/article/view/6211) Therefore graph neural networks act as a quintessential method to model temporal interaction dynamics of cells reducing the complexity constraint and simplifying the learning process.GNN

The interactions between cells and that of agent often happen locally, which means that the behaviour of adjacent cells contribute more towards the regional cluster. Hence graph attention networks will play an essential part to understand the underlying behaviour of cancer cells.

(https://ieeexplore.ieee.org/abstract/document/9728758

Equally, the interdisciplinary approach will deepen my expertise in the variety of research avenues that show promise in enabling us to build trustworthy scalable autonomous svstems.

This diverse background means I appreciate the valuable cross fertilization of approaches that an interdisciplinary perspective brings.

Conclusion

Throughout my academic career and industrial experience maintaining a focus on the application and impact of my work kept me motivated to complete it to a high standard. I therefore believe that the CDTS holistic perspective is essential for addressing the many possible collaborations across various sciences. The cdts exciting range of taught courses, representing the breadth of the four research themes, will guide and pave a research oriented path to accommodate my multifaceted experiences. The chance to undertake two mini projects is a unique opportunity to gain practical exposure to a variety of the areas and associated experts, which will similarly give me a more integrated perspective on my main thesis. for this reason the aims cdt,aligns with both my interest and motivation for research The first years taught modules would allow me to develop an understanding of the application of autonomous systems across many domains, whilst the research projects and seminars would provide key research skills and experience. Furthermore, the center's overachieving focus on developing theoretical, practical and systems skills in autonomous systems would provide me a broad base with which to produce theoretically sound research with consideration of practical limitations. I am also particularly interested in the emphasis on transferable skills such as entrepreneurship and teaching which make this programme stand out from the doctoral programmes. In addition to developing an expertise in my field completing the Dphil with competence in these skills would effectively prepare me to pursue a research career in both academia and industry.

I am also excited by the center industrial partnerships which would provide exposure to the industrial application of autonomous systems research in addition to the opportunity to build a network with industrial leaders. This may also inform academia research in my primary field of interest solving challenges faced by real world models.

lam therefore keen to explore this field through doctoral research, as it presents a promising solution to this problem. In conclusion the field of autonomous and intelligent systems excites me greatly and I am driven to contribute to this development. I believe my academic and industrial machine learning experience has prepared me to be a successful candidate and presented promising initial areas of research. This BefEtalie would provide a strong foundation of theoretical and practical knowledge in addition to a broad base of transferable skills with which I hope to begin a rewarding career in research.

Machine learning implicitly unifies all of these areas, which the CDT recognizes by placing this theme as the central hub of the training programme.

This cognizance of the needs of end users means the CDs extensive industrial collaboration, including internship placements, are very attractive.

To ensure that autonomous systems are beneficial, this process must be bidirectional, and I am therefore excited by the Cdts outreach activities. Indeed, certified favorable outcomes must become the central rather than secondary objective in autonomous machines research, making CDT cohort base environment and inclusive inter cohort research seminars very appealing, offering an opportunity to form mutually informative research collaborations. This will build cdts own training

The AIMS CDS unified training makes it the ideal preparation for a career in research in safe autonomous systems.