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AI RESEARCH @ EDINBURGH NAPIER UNIVERSITY

Presented to the 2021 SICSA-AI All Hands meeting held virtually on 17th June 2021

OVERVIEW

- No Easy way to approach this
- AI research mainly split across two large research groups
 - Data Group
 - Nature Inspired Group
- But also within all other research groups in the school (and probably outside the school - I didn't survey other schools)
 - **LESSON:** Aspects of AI are currently embedded within and across many (most) socio-technical research activities
 - Partly because we're hot (again [for now])
 - Partly because AI is characterised in many ways
 - Isn't necessarily about building "a machine that thinks like a person" (strong AI)
 - Can also be about solving specific & isolated problems. Often characterised as those that are "simple for humans and difficult for machines" (weak AI)
 - Successful AI + time = software engineering (of the future)
 - **THEREFORE:** Rest of this slide deck focusses on surveying the breadth of activity in the SoC@ENU (not specific people, projects, or grants)
 - If you want further information about specific activities then get in touch s.wells@napier.ac.uk and I'll try to connect you to the right people.

AREAS OF AI

- AI for cyber security; Security and privacy of AI
- Meta-heuristic optimization
- Natural Language Generation
- Natural Language Processing
- Natural Language Understanding
- Evolutionary Robotics
- Institutions and multi-agent systems.
- Machine-learning
- Reinforcement Learning
- Cognitively inspired AI,
- AI+healthcare
- Computer Vision
- Vision and Language;

- situated interaction and Human Robot Interaction (HRI)
- Evolutionary Computation
- Classification
- Multi-agent systems;
- Trust in intelligent systems;
- Agent-based modelling
- Argumentation Theory
- Defeasible, Non-Monotonic, Automated Reasoning
- Dialogue Systems
- Explainable AI,
- Topic Modelling
- Deep learning
- Knowledge-based systems & Knowledge engineering

DOMAINS

- Security
- Privacy
- Mental & Physical health & healthcare
- Labour-market intelligence
- Travel, transport, logistics
- Domestic tasks
- Combinatorial problems such as packing, scheduling and routing
- Linguistics
- Sustainability & Environment
- Behaviour Change
- Law/legal Reasoning
- Policy setting

PROBLEMS

- The problems for policy-approximation reinforcement learning.
- Adversarial machine learning for Anomaly/Malware detection
- Virtualisation security based on non-parametric behaviour modelling
- Knowledge transfer (Transfer Machine Learning) in cyber-security problems
- IoT Security with focuses on Cloud and Edge computing security issues
- Divulging the Secrets of Artificial Intelligence
- GDPR compliant Machine Learning
- Adversary-resilient Collaborative Machine Learning
- Plant image analysis/plant phenotyping
- Task-oriented dialogue, e.g. cooking scenario where an agent provides instructions to a human
- Developing NLG/Dialogue systems for low-resource settings when not enough data is available
- Evaluation aspects of NLG/dialogue systems
- Common-sense-enhanced NLG
- Fact Checking
- Cooperation between autonomous self-interested agents

- Multi-agent systems for smart energy and community energy systems
- Fair and decentralised resource allocation algorithms that put humans in the loop, e.g. agents running on smart meters to negotiate schedules for when different households should use their high-powered appliances
- Using cognitive science and agent-based modelling to understand how cooperation is/can be maintained in large-scale human societies
- Using evolutionary game theory and behavioural experiments to predict the effects of possible interventions on how trustworthy users perceive an autonomous system to be.
- Present complicated ML techniques such as topic modelling, in a way that non-expert users can understand
- Improved search – by using large queries (such as a whole document) to more accurately find semantically similar documents in a large dataset
- Develop novel methods for machine learning and knowledge engineering to build emerging smart systems, including IoT-based systems, cyber physical systems and cloud/edge-based systems.
- Web/Data Search - easily finding the right information in a timely manner
- Sensemaking - humans working with machines in complex knowledge domains to solve wicked problems
- Next generation conversational AI (open domain, goal oriented, heterogeneous, mixed initiative)

COLLABORATION

- Cybersecurity
- Networking
- Medical/e-health practitioners
- Biomedical department
- Physics
- Veterinary science
- Psychology
- Plant biologists
- Arts, creative, & cultural industries & institutions
- Software Engineering
- Linguists

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- News Organisations
- Economics
- Anthropology
- Evolutionary biology
- Social psychology
- Mathematicians
- UI/UX specialists
- Computer graphics,
- Computer vision,
- Visualization
- Creative Digital Entertainment Industry

TOWARDS...

- Securing smart IoT, including digital healthcare services, creative industry
- Mobile endpoint security using AI
- Securing social networks
- Applications of AI to unprocessed radio frequency data for new modality of imaging
- Transfer learning/domain adaptation
- Algorithm Selection & Generation (for Combinatorial Problems)
- Using behavioural experiments to measure perceived fairness of algorithms
- Intelligence-driven smart systems and intelligence-driven software engineering
- Extracting knowledge from data/text (primarily Argumentative structure & content)
- Intelligent, goal-directed, human-machine dialogue

A VIBRANT & RICH RANGE OF AI-RELATED RESEARCH ACTIVITIES

RUNS THE GAMUT OF OLD & NEW, SYMBOLIC & CONNECTIONIST APPROACHES

NOT A SINGLE, FOCUSSED RESEARCH GROUP, BUT A VARIED COHORT WITH A VARIETY OF SKILLS