STANDARDISING AND AUDITING AI

Challenges, current state, and UMU’s contribution

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UMEÅ UNIVERSITY
OUTLINE

Our (lack of) Theory of Mind for AI
The need for Governance (and what it is)
Ethical Guidelines
Standards, guest starring IEEE P7001
Why Contribute to Standards
Auditing Systems
Accountability and Transparency
Conclusions
Lunch
OUR (LACK OF) THEORY OF MIND FOR AI
1.1. Opaque machines

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“Trying to create a 3D map of the area? At one stage I thought it might be going to throw something into the bucket once it had mapped out but couldn't quite tell if it had anything to throw.”

“aiming for the black spot in the picture.”

• “Is it trying to identify where the abstract picture is and how to show the complete picture?”

“is circling the room, gathering information about it with a sensor. It moves the sensor every so often in different parts of the room, so I think it is trying to gather spacial information about the room “

THEORY OF MIND FOR AGENTS

• We understand each other thanks to **similarity**.

• Even if we are all **black boxes**, we can match our actuators, our goals, and our beliefs to generate models for each other.

• We can extend that to other biological intelligent agents; animals.

THEORY OF MIND FOR AI

• Humans are not equipped by genetic or cultural evolution to deal with machine agency.

• Even the same looking machines could be programmed in different ways.

• We make our own narratives based on our own beliefs.

• We make things up!

SLAM THE BREAKS


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EXPERIMENTAL SETUP

- 3x1 study using the “Godspeed Questionnaire”:

<table>
<thead>
<tr>
<th>Condition</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Opaque AV</td>
<td>Participants told that they will be driven in an AV; no post-crash explanation.</td>
</tr>
<tr>
<td>Transparent AV</td>
<td>Participants told that they will be driven in an AV; post-crash explanation: “The self-driving car made the decision on the basis that...”.</td>
</tr>
<tr>
<td>“Human” Driver</td>
<td>Participants told that they will be driven in a human-controlled car.</td>
</tr>
</tbody>
</table>

- 10x repetitions
- Small twist: there is no “real human” driver.
KEY FINDINGS

• Least blame towards the ‘human’ driver (rated least machinelike), medium blame to the opaque AV (rated “medium” machinelike), but most blame to the transparent AV (rated most machinelike).

• Literature also suggests that utilitarian action is also be more permissible —if not expected— when taken by a robot than human (Malle et al., 2015).

• We believe that the increased attribution of moral responsibility is due to realisation that the action was determined based on social values.
WHAT IS AI?
DEPENDING WHO YOU ASK
AI IS...

• A (computational) technology that is able to infer patterns and possibly draw conclusions from data (currently AI technologies are often based on machine learning and/or neural networking based paradigms)

• A field of scientific research (this is the original reference and still predominant in academia); the field of AI includes the study of theories and methods for adaptability, interaction and autonomy of machines (virtual or embedded)

• An (autonomous) entity (e.g. when one refers to ‘an’ AI); this is the most usual reference in media and science fiction, but is however the most incorrect one. Brings with it the (dystopic) view of magic powers and a desire to conquer the world.

This lack of agreement leads to...

- **Increases public’s misconceptions:** “true AI”, “superintelligence.”
  - AI is not a magic abstraction.
  - Computation is a physical process; it requires *energy, space, and time*.
  - We are *moral agents* not the machines.

<table>
<thead>
<tr>
<th>Common carbon footprint benchmarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>in lbs of CO₂ equivalent</td>
</tr>
<tr>
<td>Roundtrip flight b/w NY and SF (1 passenger)</td>
</tr>
<tr>
<td>Human life (avg. 1 year)</td>
</tr>
<tr>
<td>American life (avg. 1 year)</td>
</tr>
<tr>
<td>US car including fuel (avg. 1 lifetime)</td>
</tr>
<tr>
<td>Transformer (213M parameters) w/ neural architecture search</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 3: Estimated cost of training a model in terms of CO₂ emissions (lbs) and cloud compute cost (USD). Power and carbon footprint are omitted for TPUs due to lack of public information on power draw for this hardware.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
</tr>
<tr>
<td>Transformer</td>
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<tr>
<td>Transformer</td>
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<tr>
<td>ELMo</td>
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<tr>
<td>BERT_base</td>
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<td>BERT_base</td>
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<tr>
<td>NAS</td>
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<tr>
<td>NAS</td>
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<tr>
<td>GPT-2</td>
</tr>
</tbody>
</table>

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A constant re-writing of similar high-level policy statements.

Creates loopholes to be exploited.

“AS SOON AS IT WORKS, NO ONE CALLS IT AI ANY MORE.”

John McCarthy
IS A THERMOSTAT AN INTELLIGENT SYSTEM?

McCarthy J. (1979). *Ascribing mental qualities to machines*. In: Philosophical perspectives in artificial intelligence

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“AI IS WHATEVER HASN'T BEEN DONE YET.”

Douglas Hofstadter, *Gödel, Escher, Bach: An Eternal Golden Braid*
IN SHORT

• We **do not** always understand a system’s **actions/behaviours**.

• We **do not** always understand **that we are interacting** with an intelligent system.

• We **do not** understand a system’s **limitations**.

• We **do not** even agree on what actually is AI.
THE NEED FOR GOVERNANCE

(and what it is)
2017 EUROBAROMETER

- 61% of respondents have a **positive view** of robots
- 84% of respondents agree that **robots can do jobs** that are too **hard/dangerous** for people
- 68% agree that robots are a **good thing for society** because they help people
- 88% of respondents consider robotics a technology that **requires careful management**
- 72% of respondents think robots **steal people's jobs**
LIKE THE ELEVATORS
WE NEED TO BUILD PUBLIC’S TRUST TO OUR SYSTEMS

• Perform as we expect them to.

• Demonstrate how we take into consideration
  o Ethical
  o Legal
  o Social
  o Economic
  o Cultural
  (ESLEC) specifications and values we want to protect.

• Governance can help.
AI GOVERNANCE

Soft Governance
- Roboethics Roadmap (2006)
- EPSRC Principles (2010)
- EU’s HLEG Ethical Guidelines (2019)

Standards
- ISO 13482
- BSI 8611
- ISO JTC/42
- IEEE P7000

Ethics

Emerging legislation:
- Drones?
- AVs?
- Robots?

Hard Governance:
- Legislation

Winfield & Jirotka (2018)
• **Soft governance** is any *not legally enforceable* policy or initiative.

  o **Ethical guidelines** define what actions are morally right or wrong. May provide *codes of conduct* or *design/usage suggestions*.

  o **Standards** are formalised specifications or methodological guidelines collectively agreed by a group of experts.
    ▪ Specifications for compatibility purposes, e.g. IEEE 802.11 (WiFi), or safety specifications, e.g. ISO 13482 for robots.
    ▪ Definition; e.g. ISO 8373:201 for robots
    ▪ Process standards; e.g. ISO 9000 family for quality management.
    ▪ **Ethical standards for formalising ethical guidelines**, e.g. IEEE P70xx series.
• **Certification** is a procedure by which a neutral third party gives written assurance that a product/service adheres to certain standards.

• **Hard governance** is any *legally enforceable* policy, i.e. legislation.

• Standards are *sometimes* enforced by legislation.
ETHICAL GUIDELINES
1. **Robots are multi-use tools.** Robots should not be designed solely or primarily to kill or harm humans, except in the interests of national security.

2. **Humans, not robots, are responsible agents.** Robots should be designed; operated as far as is practicable to comply with existing laws & fundamental rights & freedoms, including privacy.

3. **Robots are products.** They should be designed using processes which assure their safety and security.

4. **Robots are manufactured artefacts.** They should not be designed in a deceptive way to exploit vulnerable users; instead their machine nature should be transparent.

5. **The person with legal responsibility for a robot should be attributed.**
<table>
<thead>
<tr>
<th><strong>EU HLEG</strong></th>
<th><strong>OECD</strong></th>
<th><strong>IEEE EAD</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Human agency and oversight</td>
<td>• benefit people and the planet</td>
<td>• How can we ensure that A/IS do not infringe human rights?</td>
</tr>
<tr>
<td>• <strong>Technical robustness and safety</strong></td>
<td>• respects the rule of law, human rights, democratic values and diversity, include appropriate safeguards (e.g. human intervention) to ensure a fair and just society.</td>
<td></td>
</tr>
<tr>
<td>• Privacy and data governance</td>
<td>• robust, secure and safe</td>
<td>• Traditional metrics of prosperity do not take into account the full effect of A/IS technologies on human well-being.</td>
</tr>
<tr>
<td>• <strong>Transparency</strong></td>
<td>• Hold organisations and individuals accountable for proper functioning of AI</td>
<td>• How can we assure that designers, manufacturers, owners and operators of A/IS are responsible and accountable?</td>
</tr>
<tr>
<td>• <strong>Diversity</strong>, non-discrimination and fairness</td>
<td>• transparency and responsible disclosure</td>
<td>• How can we ensure that A/IS are transparent?</td>
</tr>
<tr>
<td>• <strong>Societal and environmental well-being</strong></td>
<td>• robust, secure and safe</td>
<td>• How can we extend the benefits and minimize the risks of AI/AS technology being misused?</td>
</tr>
<tr>
<td>• <strong>Accountability</strong></td>
<td>• Hold organisations and individuals accountable for proper functioning of AI</td>
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HOW DO YOU INTERPRET THEM?

• There is no universal morality!

• Values have **different interpretations** in different contexts and cultures.

AND IT LOOKS LIKE... YES! WOW! THE UTILITARIANS ARE EMERGING, BATHED IN THE BLOOD OF THE VIRTUE ETHICISTS AND THE DEONTOLOGISTS!

Two weeks after locking all moral philosophers in a steel cage with no food, we were finally able to decide who is correct.
How can we make international *standards* if we can’t agree on anything or even understand what we are standarise?
SHOULD WE GIVE UP?
Even if we can’t agree what each value means...

...it should be made explicit and transparent.

Only then we can assign requirements to check if the interpretation complies with social norm and law.

STANDARDS

Guest staring the IEEE P7001: Transparency of Autonomous Systems
DEFINING TRANSPARENCY

- **Transparency**: “The transfer of information from an autonomous system or its designers to a stakeholder, which is honest, contains information relevant to the causes of some action, decision or behaviour and is presented at a level of abstraction and in a form meaningful to the stakeholder.”

- We make it clear that this is the definition *within the scope of this standard*. 

DEFINING TRANSPARENCY

• “To consider an autonomous system transparent to inspection, the stakeholder should have the ability to request meaningful explanations of the system’s status either at a specific moment or over a specific period or of the general principles by which decisions are made (as appropriate to the stakeholder) (Theodorou et. al., 2017)”

• We make it clear, in the standard, that we don’t ‘support’ often linked –if not complimentary– properties, e.g. *explainability*.

DEFINING TRANSPARENCY

- Other P70xx standards may have their own definitions of transparency.

- It does not have to be a ‘perfect’ definition. Rather, it needs to be:
  - Abstract enough to accommodate a variety of requirements, fitting to multiple levels.
  - Concrete enough that requirements could be extracted and validated.
DIFFERENT STAKEHOLDERS

• Not an one-size-fits-all approach.

• We identified multiple stakeholders that may need “transparency in ‘their’ systems.” E.g.:
  o Users
  o General public/bystanders
  o Validation and certification agencies and auditors
  o Incident investigators
  o Lawyers & Expert Witnesses

• We define each stakeholder and added requirements specific to that stakeholder.
DIFFERENT MATURITY LEVELS

• **5 different non-addictive levels** of compliance for each stakeholder.

  • Lower levels:
    o *passive* (e.g. documentation);
    o *easy-to-implement* (e.g. LED lights on a robot).

  • Higher levels:
    o *interactive* (e.g. user can query for more information);
    o *proactive* (e.g. agent alerts user)
DIFFERENT MATURITY LEVELS

Low level (1)

The user shall be provided with accessible* documentation that provides as a minimum the following information:

1. example scenarios with the expected and anticipated system behavior including degraded modes of operation;
2. general principles of its operation, i.e. if there is a learning component and what data it uses.

*accessible means: in a format which is appropriate to the audio, visual or cognitive capabilities of the system’s intended users.

…

High level (5)

The user shall be provided with a continuous explanation of behavior, which adapts the content and presentation of the explanation based on the user’s information needs and context.

This may include access to log files and training data as long as they do not contain sensitive information such as personal data.

…
IN SHORT

• We didn’t fix the problem of definitions.

• We worked *around the problem*.

• We provided definitions – and most importantly concrete requirements – for each stakeholder.

• Allowing different maturity levels, opens flexibility for different domains and AI approaches.
THIS IS NOT THE ONLY IEEE STANDARD
IEEE P7000 Working Groups

IEEE P7000™ - Model Process for Addressing Ethical Concerns During System Design
IEEE P7001™ - Transparency of Autonomous Systems
IEEE P7002™ - Data Privacy Process
IEEE P7003™ - Algorithmic Bias Considerations
IEEE P7004™ - Standard on Child and Student Data Governance
IEEE P7005™ - Standard on Employer Data Governance
IEEE P7006™ - Standard on Personal Data AI Agent Working Group
IEEE P7007™ - Ontological Standard for Ethically driven Robotics and Automation Systems
IEEE P7008™ - Standard for Ethically Driven Nudging for Robotic, Intelligent and Autonomous Systems
IEEE P7009™ - Standard for Fail-Safe Design of Autonomous and Semi-Autonomous Systems
IEEE P7010™ - Wellbeing Metrics Standard for Ethical Artificial Intelligence and Autonomous Systems
IEEE P7011™ - Standard for the Process of Identifying and Rating the Trustworthiness of News Sources
IEEE P7012™ - Standard for Machine Readable Personal Privacy Terms
IEEE P7013™ - Inclusion and Application Standards for Automated Facial Analysis Technology
IEEE P7000 Working Groups

IEEE P7000™ - Model Process for Addressing Ethical Concerns During System Design
IEEE P7001™ - Transparency of Autonomous Systems
IEEE P7002™ - Data Privacy Process
IEEE P7003™ - Algorithmic Bias Considerations
IEEE P7004™ - Standard on Child and Student Data Governance
IEEE P7005™ - Standard on Employer Data Governance
IEEE P7006™ - Standard on Personal Data AI Agent Working Group
IEEE P7007™ - Ontological Standard for Ethically driven Robotics and Automation Systems
IEEE P7008™ - Standard for Ethically Driven Nudging for Robotic, Intelligent and Autonomous Systems
IEEE P7009™ - Standard for Fail-Safe Design of Autonomous and Semi-Autonomous Systems
IEEE P7010™ - Wellbeing Metrics Standard for Ethical Artificial Intelligence and Autonomous Systems
IEEE P7011™ - Standard for the Process of Identifying and Rating the Trustworthiness of News Sources
IEEE P7012™ - Standard for Machine Readable Personal Privacy Terms
IEEE P7013™ - Inclusion and Application Standards for Automated Facial Analysis Technology
The Ethically Aligned Design (EAD) led to the creation of the P70xx series of standards.

Instead of technical specifications around the development of AI, IEEE SA is concerned with the impact of the technology.

Ad-hoc work begun in late 2015 and public launch in 2016. Contributions from over 250 experts.
CONTRIBUTING TO IEEE SA 1-0-1

• Anyone can join, at a personal or institutional capacity, any WG. Simple process:
  1. Find a standard within your research interests.
  2. Email the person.
  3. ...
  4. Profit work in the standard!

• Once submitted for formal valuation (balloting), any IEEE SA members can vote and add comments.
ISO/IEC JTC1/SC 42

Since 2017:

- **6** Published Standards
- **21** Under Development Standards
- **31** Participating Members
- **16** Observing Members

[Map of Participating Members]
ISO/IEC JTC1/SC 42

WG1
Foundational standards

WG2
(Big) Data

WG3
Trustworthiness

WG4
Use cases and applications

WG5
Computational approaches and computational characteristics of AI system

AG2
AI Systems Engineering

JWG1:
Governance implications of AI
• Acknowledges that we can’t – and probably won’t – agree on what AI is.

• Tries to provide a workable definition.

• Discusses the main approaches:
  o Symbolic AI – referred to as Classical AI
  o Machine Learning
  and other relevant keywords Computational Intelligence and Cognitive Computing.
• Transferred to SC 42.
• Focuses on the handling and using ‘big’ data; e.g. on gathering, filtering, storing, etc.
• Has already developed 5 standards!

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO/IEC 20546:2019</td>
<td>Big data Overview and vocabulary</td>
</tr>
<tr>
<td>ISO/IEC TR 20547-2:2018</td>
<td>Big data reference architecture — Part 2: Use cases and derived requirements</td>
</tr>
</tbody>
</table>
• Investigates threats and risk associated with AI systems.

• Looks into mitigation of such risks through concepts such as robustness, resiliency, reliability, accuracy, and safety.

• Investigates key issues such as transparency, verifiability, controllability, explainability, and privacy.

• Most likely, it is the WG with a scope closest to the IEEE P70xx series.
WG4
USE CASES AND APPLICATIONS

- Classifies different AI application domains and the different context of their use case.

- Identifies related to the use cases.

- Applies the terminology produced by WG1 in the use case – and extends it, when needed.
WG5 COMPUTATIONAL APPROACHES AND COMPUTATIONAL CHARACTERISTICS OF AI SYSTEMS

• Identifies the state of the art in AI by looking into:
  o the main computational characteristics of AI system; and
  o main approaches used.

• Does its task by using WG4’s use cases.

• Wins the award for the longest title with the most tech jargon in a row.
CONTRIBUTING TO ISO 1-0-1

• You don’t join ISO directly!

1. You join a national standardisation institute, e.g. BSI, and be part of its own committee for a specific topic, e.g. BSI’s ART/1 National Committee for AI.

2. The national-level institute joins an ISO Standardisation Committee (SC), e.g. JTC1/ SC41.

3. Your national body may propose you for joining a Working Group (WG) setup by the SC.

4. Once inside a WG, you may work towards a standard!
CONTRIBUTING TO ISO 1-0-1

• All standards are subject to voting by its members.

• In fact, throughout the development, each proposal/ amendment is subject to discussion by all member countries.

• You vote alongside with the rest of your national committee as one. This –and how exactly you interact with ISO– is different country-by-country.

• Once a standard is published by ISO, your national committee may republish it.
  o E.g. BSI EN 9001 is a republish of ISO 9001
A SHORT COMPARISON

ISO/IEC JTC1/SC42

• (Mostly a) Bottom-up approach: Focus on standards to tackle technical challenges to avoid ethical social issues.

• Slightly complicated to get started.

• Significant more jargon (and emails).

IEEE SA P7xx

• Top-down approach: Focus on standards to tackle specific ethical social issues by coming up with technical solutions.

• Straight forward and open to all to contribute.
WHY CONTRIBUTE TO STANDARDS?
(for our PhD students)
4 SELFISH REASONS TO WORK IN STANDARDS

• Impact / contributing to society.

• Networking.

• Good way to promote your work.

• Not too bad for your CV.
HOW DO I START?

• Talk to your supervision; they may know someone already in an ISO committee or an IEEE WG.

• Contact an IEEE WG Chair.

• Get on Twitter and link with the right people to be the ‘first’ to learn when work on a standard is announced.

• Contact me!
HOW DO WE CERTIFY STANDARDS?
Responsible AI = ethical + legal + robust + verifiable AI

Trustworthy AI (HLEG)

Trust, but Verify
For effective governance, we need to be able to audit our systems to:

- find out what went wrong and why;
- debug our systems;
- check compliance of a system adheres to our values.

EXAMPLE ASSESSMENT
HLEG’S ALTAI

• Did you build in mechanisms for notice and control over personal data depending on the use case (such as valid consent and possibility to revoke, when applicable)?

• Did you assess what level and definition of accuracy would be required in the context of the AI system and use case?
  o Did you assess how accuracy is measured and assured?
  o Did you put in place measures to ensure that the data used is comprehensive and up to date?
  o Did you put in place measures in place to assess whether there is a need for additional data, for example to improve accuracy or to eliminate bias?

• Did you assess:
  o to what extent the decisions and hence the outcome made by the AI system can be understood?
  o to what degree the system’s decision influences the organisation’s decision-making processes?
  o why this particular system was deployed in this specific area?
  o what the system’s business model is (for example, how does it create value for the organisation)?

• In case the AI system interacts directly with humans:
  o Did you assess whether the AI system encourages humans to develop attachment and empathy towards the system?
  o Did you ensure that the AI system clearly signals that its social interaction is simulated and that it
WE NEED TO DO BETTER

KEEPING THE BLACK BOX

• Sometimes black boxes are inevitable.

• Some of the best performing methods for pattern recognition, e.g. deep learning, are black boxes right now.

• Yet, we still need to audit our systems.

• Traceability of all decisions is necessary; that starts with your policy and goes to usage.
GOVERNANCE BY GLASS BOX

- Checks whether a system adheres to ESLEC values.

TRANSPARENCY THROUGH INFORMATION-SEEKING DIALOGUES

- Our ‘investigator’ asks the ‘suspect’ system under audit a series of queries.
- We use argumentation semantics to check consistency in the queries.

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IT IS NOT *JUST*
AUDITING THE
INTELLIGENT SYSTEM

These are socio-technical systems
RESPONSIBLE ARTIFICIAL INTELLIGENCE (RAIN)
THE END GOAL SHOULD BE RESPONSIBILITY AND ACCOUNTABILITY

ACCOUNTABILITY & RESPONSIBILITY
WE STILL NEED TO GUARANTEE CONTESTABILITY

• General provisions for transparency are not sufficient to guarantee the right of contest.

• Explanation and transparency methodologies inside the system do not necessarily reveal whether relevant rules and regulations have been adhered to or violated and why.

• We need to focus not only on a specific decision, but also on the socio-legal context in which it was taken.

Responsibility refers to the role of people themselves.

There is a “chain of responsibility”.

We are moral agents, never the machines.
ACCOUNTABILITY

• When things go wrong, we may held individuals accountable.

• Accountability is not just about “punishing”, it is also about addressing issues (sometimes readdressing).

• The “threat” of legal liability motivates organisations (and individuals) to demonstrate their *due diligence*.

• *Your policy, your decisions, and your system form your due diligence.*
WE NEED

• Ethics in Design: Development is influenced by ESLEC issues.

• Ethics by Design: Integration of ethical abilities as part of the behaviour of artificial intelligent systems.

• Ethics for Design: Codes of conduct, standards, and certification processes that ensure the integrity of developers and users.

WE NEED

• Ethics in Design: Development is influenced by ESLEC issues.

• Ethics by Design: Integration of ethical abilities as part of the behaviour of artificial intelligent systems.

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WE FOCUSED ON THE TECH PART AND FORGOT ABOUT THE SOCIO PART
OPEN ISSUES

• There is a need for *formal training and education* of basic ethical governance to all AI developer (Theodorou & Dignum, 2020).

• There are **no recognisable standard nor any certifications** for *AI developers*.

• There are **no recognisable standard nor any certifications** for “*AI Ethicists*.”

OPEN ISSUES

• We are working on helping Nordic companies:
  o develop concrete policies;
  o assess compliance to ethical guidelines;
  o map existing standards & AI-specific standards to AI policies.

• Funded by the Knut & Alice Wallenberg Foundation.

• We are open for collaborations!
We invite submissions that address any of the following aspects:

- mathematical, logical, computational, philosophical and pragmatic issues related to COINE;
- modelling, animation and simulation techniques for open MAS;
- tools, prototypes and working systems;
- experimental investigation of the effectiveness of COINE technologies;
- challenging or innovative ideas relevant to the field;
- methodologies for the development of trustworthy AI; and
- trustworthy AI education within the scope of MAS.

• **Deadline 26th February**

http://coin-workshop.github.io/

UMEÅ UNIVERSITY

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Q & A

Read our group’s research:

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🐦 @ResponsibleAIU1

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