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Trustworthy AI – Practical Collaborative Engineering

Results of industry consultation
TAIBOM: a foundation for trustable AI

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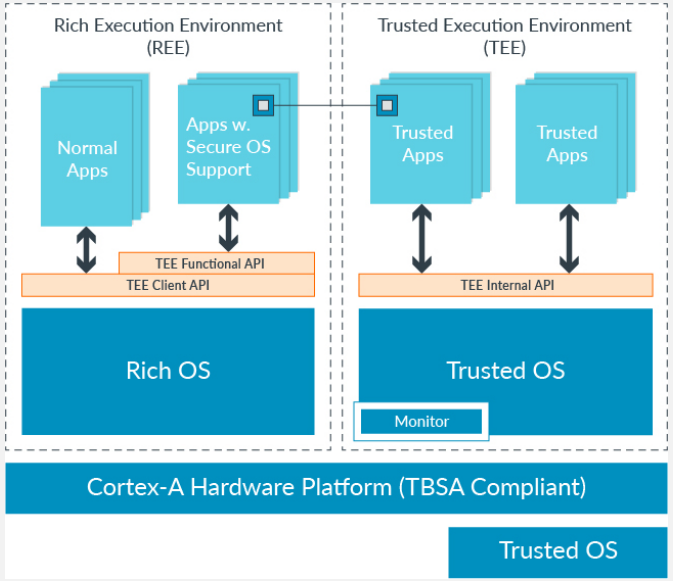
Trust



Hardware trust foundation for modern computing

AI

Connectionism and Symbolism in Symbiosis

Known unknowns

What is: Trustworthy AI?

How to build Trustworthy AI?

Practical Collaborative Engineering

Consultation

TechWorks AESIN IoT Security Foundation TechNES

Your invitation to the Engineering Trustworthy AI Workshop

Caledonian Club
London

REGISTER HERE:
TECHWORKS.ORG.UK/EVENT/ENGINEERING-TRUSTWORTHY-AI-WORKSHOP

ON TUESDAY, 18TH JULY 2023 **12:00 - 16:30 BST**

Questions descoped

- What is AI?
- Can the outputs of an AI system be explained? Is there transparency in the decision process?
- How do we ensure fairness and prevent bias?
- Does UK industry have access to necessary capabilities (skills etc)?
- Does the UK have the infrastructure to train large AI models?
- Compared to traditional/contemporary systems, how complex are AI systems?

https://www.techworks.org.uk/wp-content/uploads/2024/01/Engineering-Trustworthy-AI.pdf

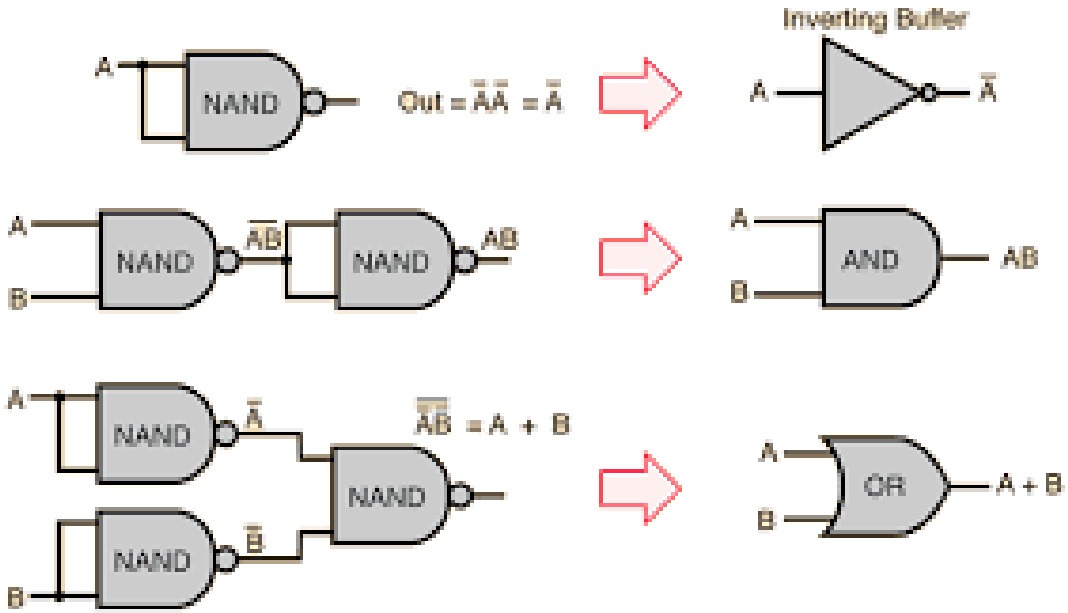
Questions in scope

- How do you know if an AI system's behaviour will be fundamentally changed?
- How can we encourage best practice amongst AI system developers and AI users?
- How do we confidently test an AI system?
- Who is liable if/when damage is done by an AI system?
- Is there a notion of consent to train?
- Where did your AI system come from?
- Trustworthiness is dependent on the hardware we train and run the AI systems on
- Trustworthiness is dependent on the software we train and run the AI systems on
- What is the system being used for?
- Are assertions of trustworthiness inherently subjective?
- How do we ensure supply of good quality and requisite quantity of data for the UK industry?
- How can we ensure our AI system fails in a controlled/defined manner?

Framing the Problem

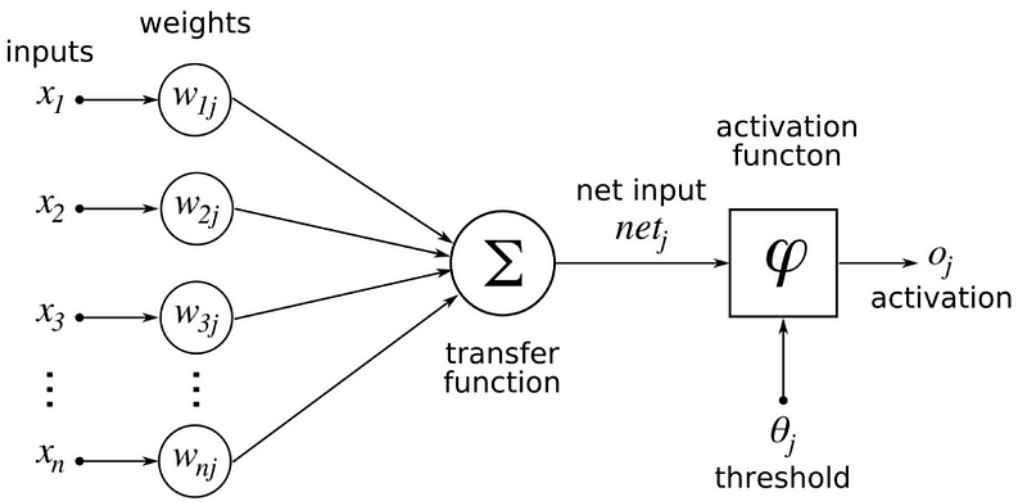
Logical foundation

Most modern computing



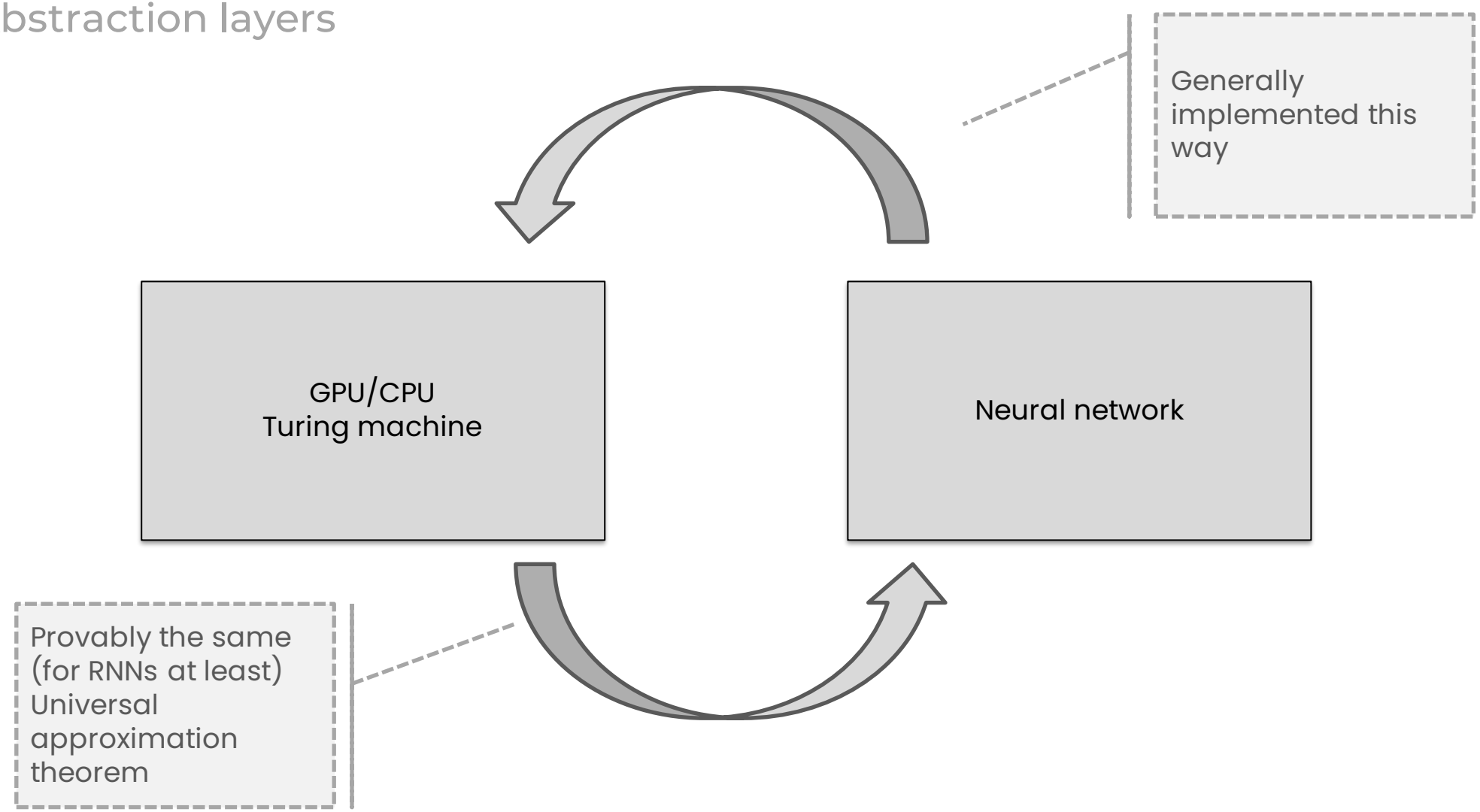
Neural foundation

Most modern AI



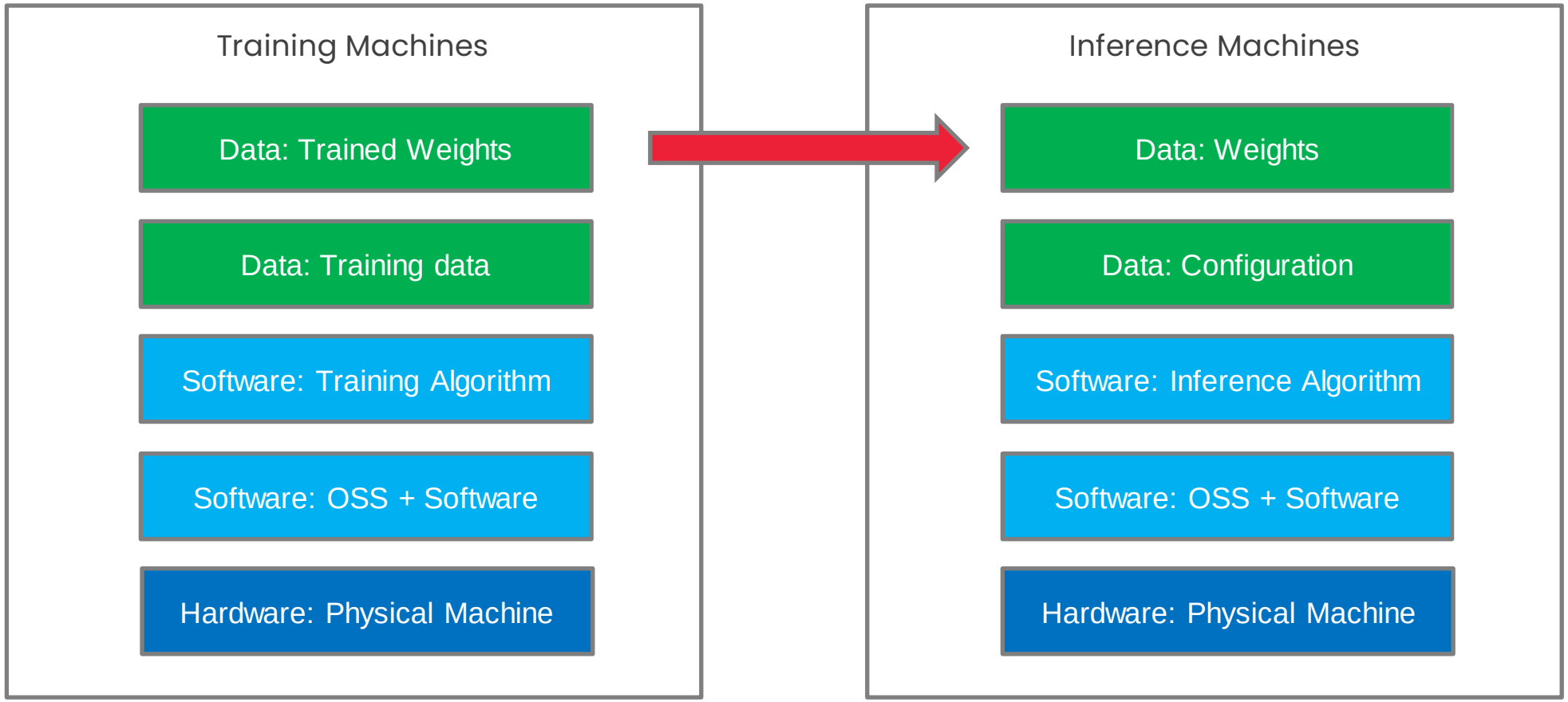
Emulation – Substitution

Abstraction layers



Simplified NN lifecycle

Most modern computing



Dimensionality

Which bits do we need to trust

Training data: 13 Trillion Tokens

OS (Linux kernel) 27 million lines of code

Training weights: 1.76 Trillion Parameters

GPH hardware (Nvidia H100): 80 Billion transistors

- All of it!!!
- Emergent/complex behaviours.
- Across the lifecycle (training v inference)
- And dynamic
- A single bit/weight can change behaviour.

Trust

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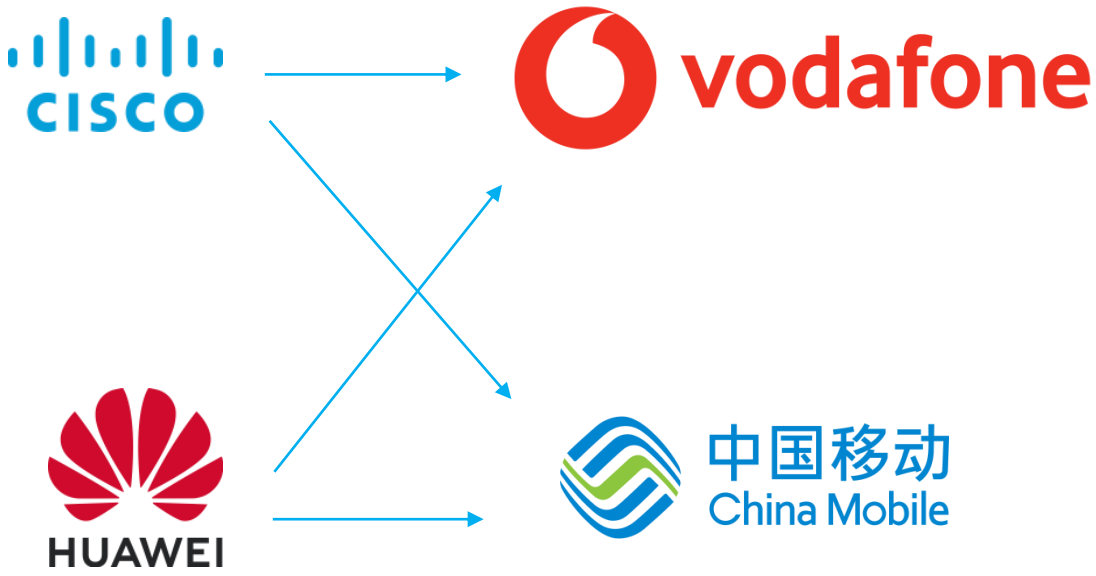
Trust

Is Subjective

Not linguistically intransitive

Trust (A)
Trust (A,B)
Trust (A,B,t)
Trust (A,B,t,X)



The Government has asked Vodafone and other mobile operators to remove Huawei kit from our 5G networks by 2027, and to stop buying any new Huawei 5G kit from the end of this year. So what does this mean for customers?

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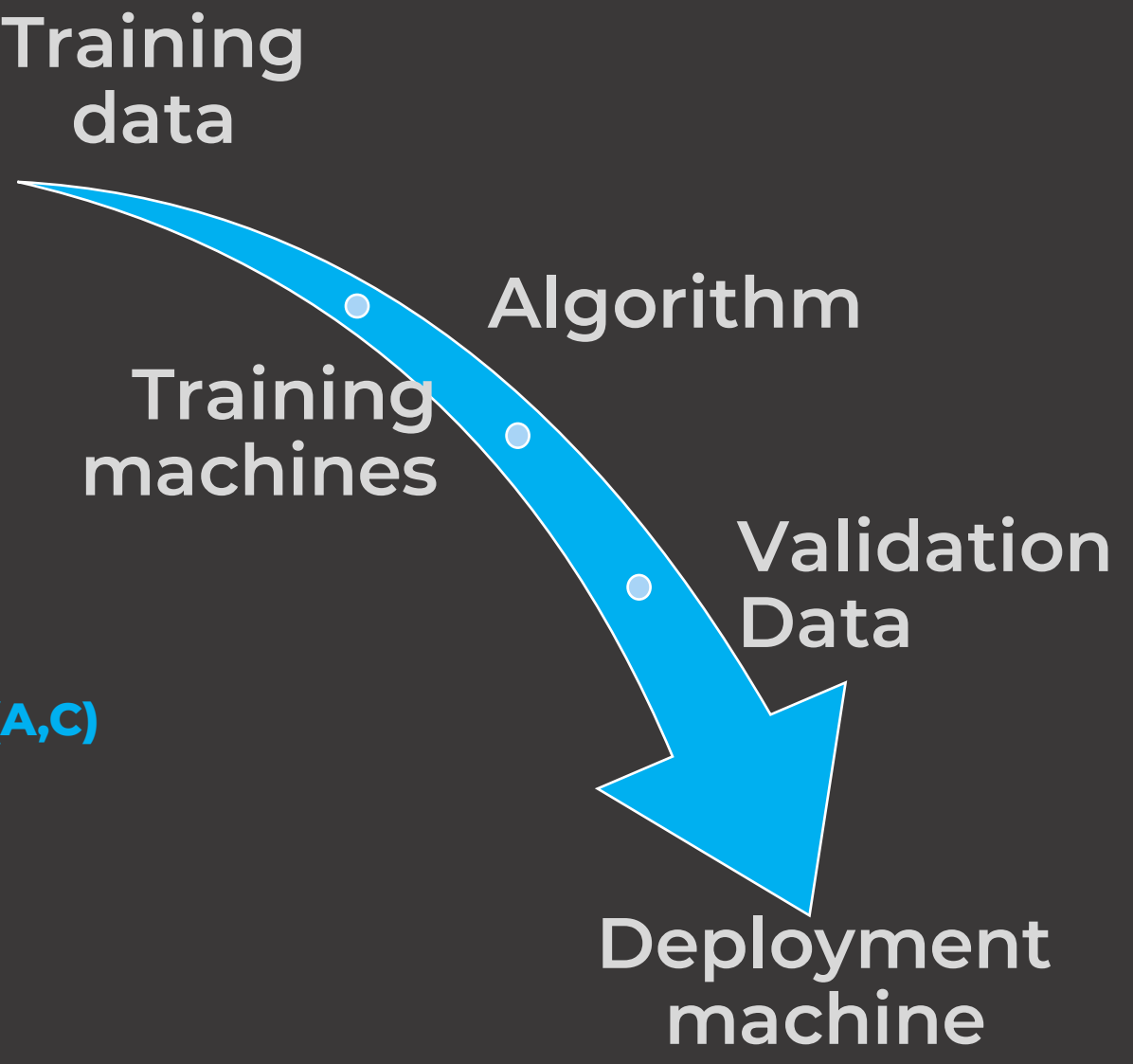
Trust

Is Transitive
(mathematically)

Trust(A,B), Trust (B,C) -> Trust(A,C)



TAIBOM
Trusted AI Bill of Materials

Scope

Addressing the Challenge

- How do we delineate the AI system we are measuring?
- How do we define and ideally measure trustworthiness?

Scope

Addressing the Challenge

TAIBOM (Trusted AI Bill of Materials) directly addresses this challenge by providing

- A method of defining the immutable properties of a complete but complex AI system; defining a stable AI system
- A method of making and evaluating both objective and subjective claims about the trustworthy attributes of a stable AI system and its continent parts.

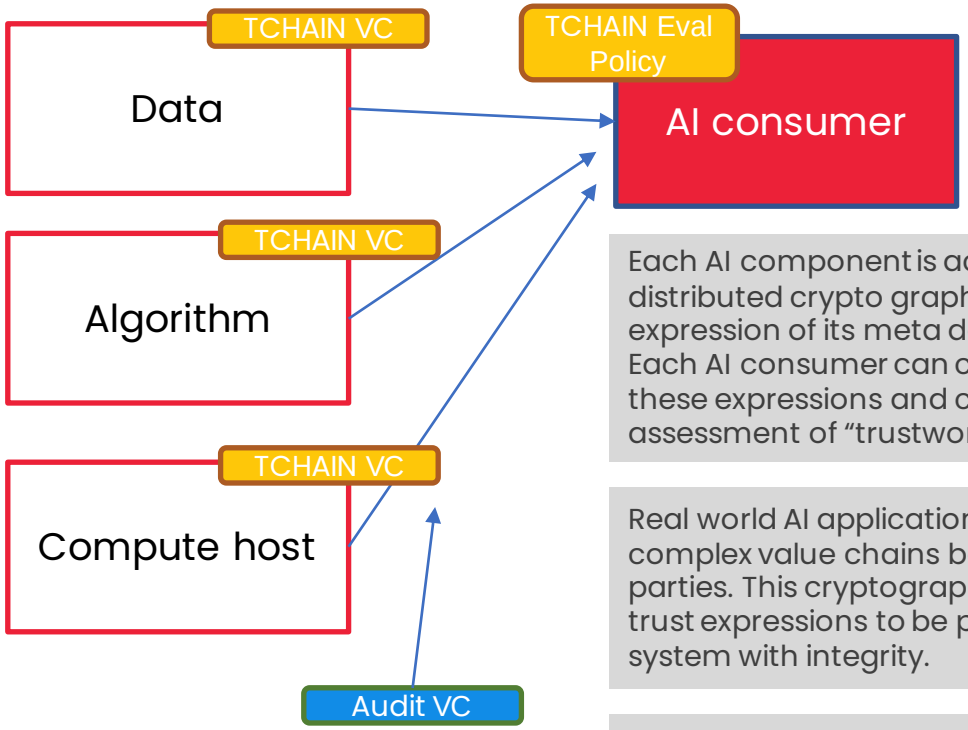
TAIBOM will produce two essential deliveries

- TAIBOM standard: a formal industry standard for making trustworthy assertions over AI building blocks and complete, stable AI systems. (collaborative)
- TAIBOM software suite: a suite of commercial tools for making and publishing compliant AI building blocks on a fully distributed basis (proprietary)

These will enable the AI ecosystem to buy and sell with confidence, and provide a potential route for building trustworthy AI marketplaces.

TAIBOM

Trustworthiness evaluation polices are subjective. An algorithm suitable for one application is not for another. A validation data set might be representative for one application – not for another. E.g. (real world example) genomic model trained on US health records, exhibits major anomalies (bias) when applied to Taiwanese data. The system works is trustworthy in US, not Taiwan

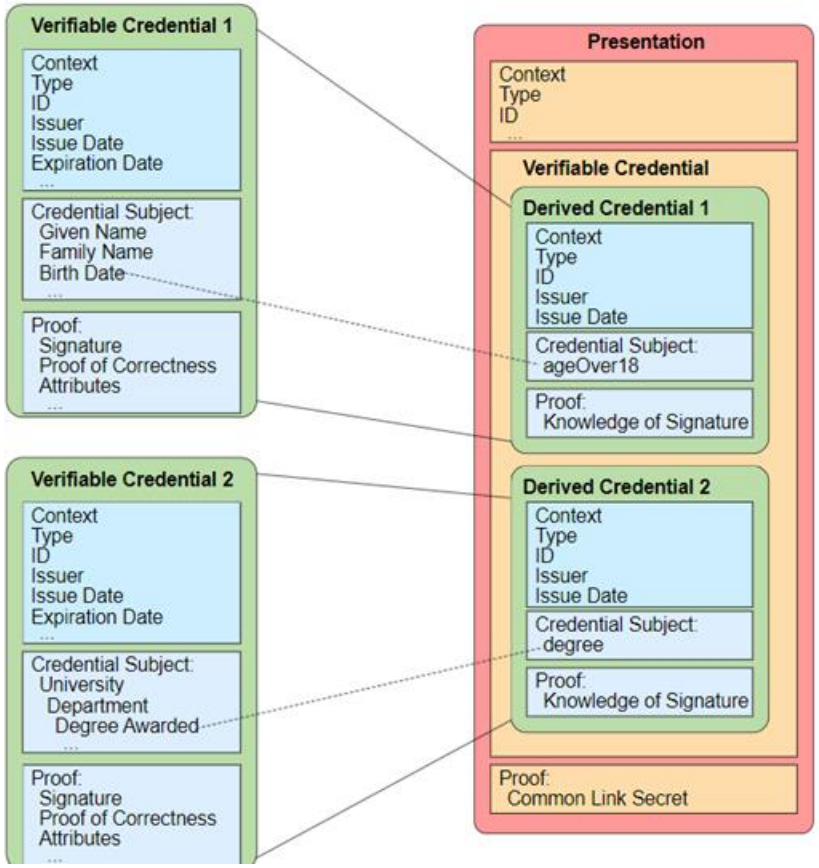


Each AI component is accompanied with a distributed crypto graphically secure expression of its meta data and provenance. Each AI consumer can confidently consume these expressions and come up with its assessment of "trustworthiness"

Real world AI applications, are embodied in complex value chains between multiple parties. This cryptographic method allows the trust expressions to be passed across the system with integrity.

The trustworthiness of individuals element can be audited by third parties. People or AI systems. These auditors may comment on "fairness", "security", "bias" (etc) Any other quality on which trust assessments are made

W3C VCs allows limited disclosure. Parties can exchange "trusted assurances" without over disclosure.



Verifiable Credentials Data Model v1.1
https://www.w3.org/TR/vc-data-model/

Similar work from CISA

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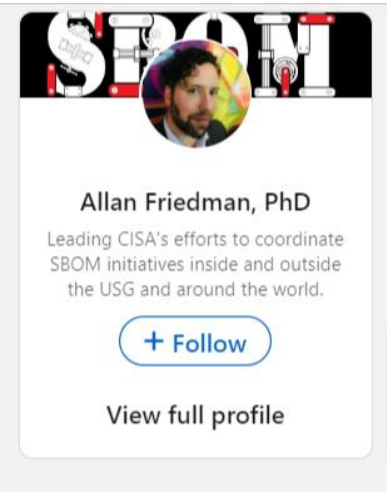
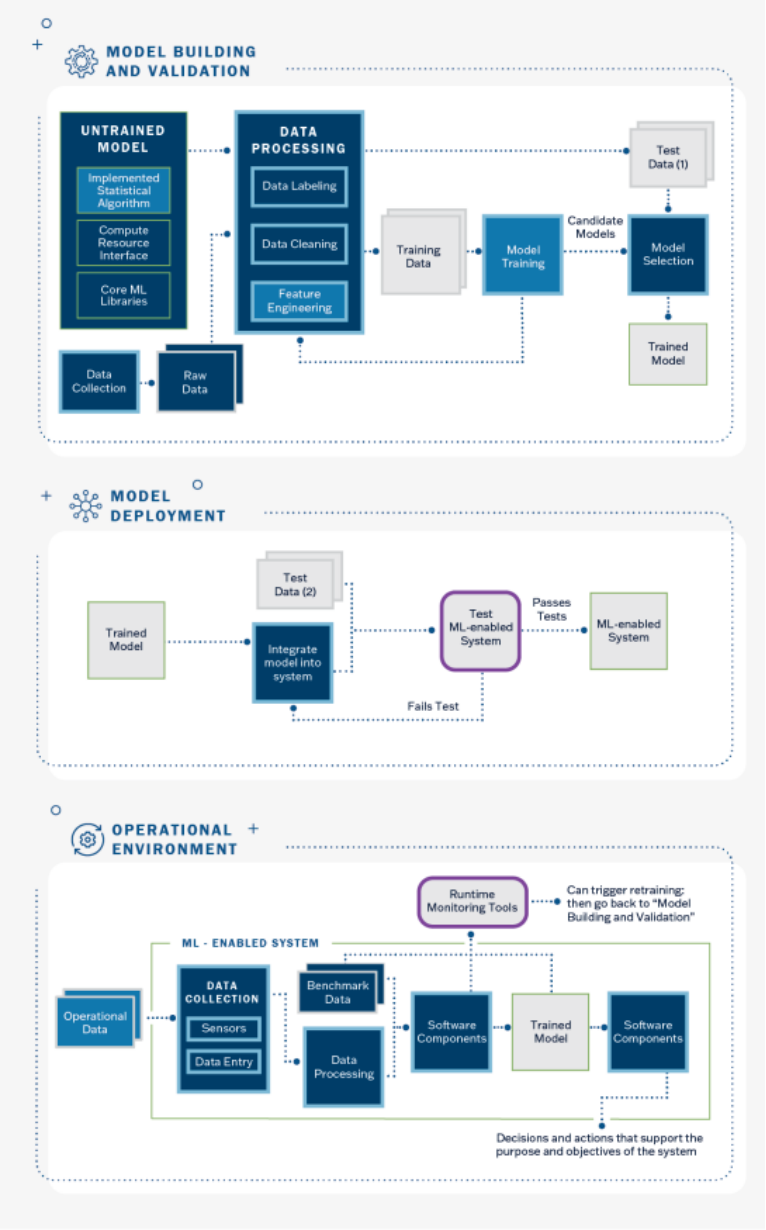
Software Must Be Secure by Design, and Artificial Intelligence Is No Exception

Released: August 18, 2023

By Christine Lai, AI Security Lead and Dr. Jonathan Spring, Senior Technical Advisor





https://www.cisa.gov/news-events/news/software-must-be-secure-design-and-artificial-intelligence-no-exception

Features

TAIBOM – Basic capabilities

Labelling/Versioning

Every aspect of a complex AI system needs labelling and versioning. (data, code and physical systems). Ideally there should be a method of attesting to the version. There can be various trust models to implement this

Dependencies

A complex AI system has dependencies that need describing to fully understand provenance. TAIBOM will provide an interoperable method of describing these dependencies

Attestation

Any actor (author or third party) can provide descriptors for each component of the system as a whole. (e.g. a training content review, as SBOM validation, a system integrity check, a fairness assessment).

TAIBOM provides both a mechanism of making these attestations, but also a framework for the dynamic and subjective evaluation, of combinations of these attestations.

TAIBOM Use Cases

TAIBOM – How used

AI Store / Distribution

Distribution of systems (paid or internally managed) needs workflow and compliance. If this is distributed, you need a sophisticated signing mechanism. The deep provenance TAIBOM provides enhances this considerably. It also underpin security evaluation and revocation

WAC experience informs this.

TAIBOM – How used

AI system inventory

Any actor using an ensemble of AI systems will benefit from automated process that can create dynamic inventory of working systems. If this system can determine provenance, dependencies and third party attestations, then this process is more effective. There are many use cases for this

- license validation
- security assessment
- data flow validation etc.

TAIBOM – How used

Operational chaining

The result of any real-time AI system will produce a result. This result can be annotated with meta data describing the full provenance, dependencies author and third party attestations relating to the production of this result.

This is useful for real-time analysis and monitoring and essential for complex AI systems of many parts

https://contentcredentials.org/ addresses similar issues for a very narror use case and scope

Community building

TAIBOM - Trusted AI Bill of Materials

Register interest: https://www.techworks.org.uk/ai

Questions: nick@nqminds.com

Press Release: