Algorithm Audit

10 examples of (non) AI-systems

To be or not to be an AI system

Learn more about practical implementation of the AI Act

Example 1: computing the average of a population is *not* an AI system

Is computing the average age of a group an AI system?
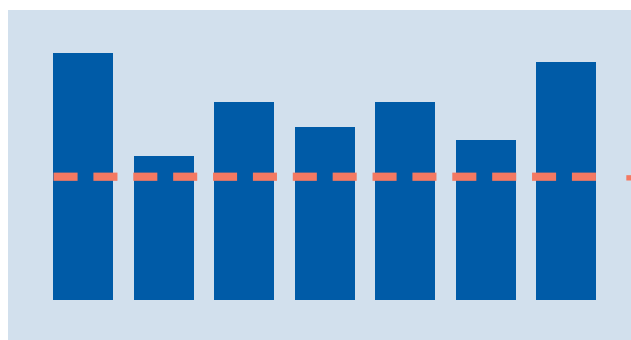
$$\text{Average} = \frac{1}{n}\,(x_1 + \cdots + x_n)$$

X

Not an AI system, because:

Recital 12

It is not
"transcending basic data processing by enabling learning, reasoning or modelling"

Example 2: a dashboard displaying descriptive statistics is *not* an AI system

Whether dashboards are an AI system depend on computations involved

$$\text{Average} = \frac{1}{n} (x_1 + \cdots + x_n)$$

and other descriptive statistics, such as frequencies, minimum and maximum values, standard deviation etc.

X

Not an AI system, because:

Recital 12

It is not
"transcending basic data processing by enabling learning, reasoning or modelling"

Example 3: a rule-based algorithm with a threshold specified by a natural person, based on data analysis, is *not* an AI system

It depends on the type of data analysis conducted whether rules are defined solely by natural persons

$$\text{Average} = \frac{1}{n} \left(x_1 + \cdots + x_n \right)$$

≤20y

Average age = 20

>20y
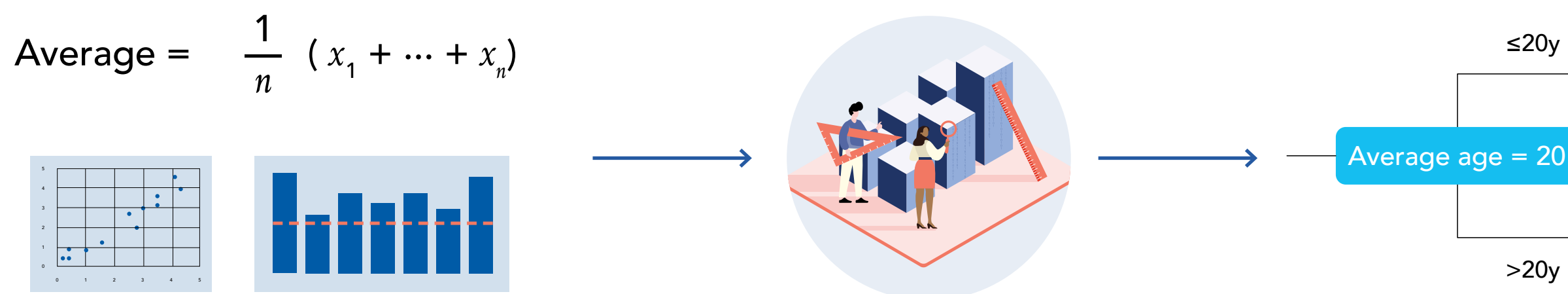
Not an AI system, because:

Recital 12

"rules defined solely by natural persons to automatically execute operations"

And there is no *"capability of AI systems capacity to derive models or algorithms"*

Loophole in AI Act!
Data analyses can be used to find very complex patterns but as long a humans construct the model, this would not be AI following recital 12

Example 4: using an automatically computed decision rule, without human interference, *is* an AI system

Decision rules are automatically derived from data, for instance, by decision tree learning

Decision tree learning, where decision rules and thresholds are automatically selected (e.g. with CART, gini or entropy)
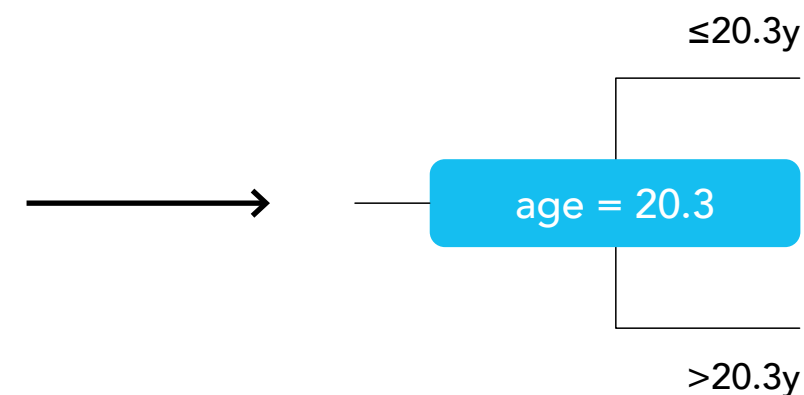
≤20.3y

age = 20.3

>20.3y

✅ **AI system, because:**

Article 3

Recital 12

This system meets the inference requirement:

Inference refers to *"capability of AI systems to derive models or algorithms, or both, from inputs or data"*

Therefore it *"transcends basic data processing by enabling learning or modelling";*

Example 5: by extension, any automated variable selection algorithm used to make predictions *are* AI systems

Algorithms inferred by statistical methods, using among others optimization (Gini, entropy etc.), regularization (L1, lasso etc.) and tree ensembles (bagging, boosting etc.)

✅ **AI system, because:**

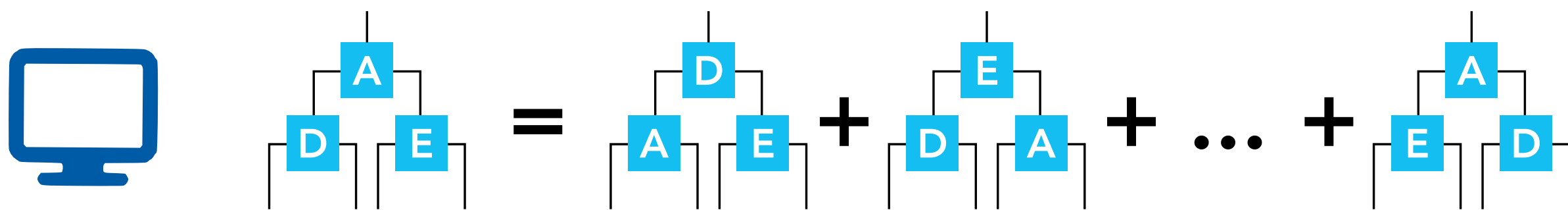| Article 3 |
| :---: |

Recital 12

This system meets the inference requirement:

Inference refers to *"capability of AI systems to derive models or algorithms, or both, from inputs or data"*

Therefore it *"transcends basic data processing by enabling learning or modelling"*;

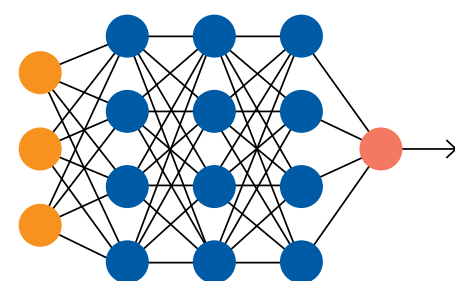# Example 6: computer vision systems *are* AI systems

Computer vision systems such as the systems used to <u>recognize containers in Amsterdam</u> are AI systems

Training data

.fit()

.predict()

Output is a prediction:

Photo contains a container with 94% certainty

✅ **AI system, because:**

Article 3

Recital 12

'prediction' is a broad term which is not understood by everybody in the same way. In object recognition the output is usually an estimate if and where an object is visible in an image. These are also predictions.
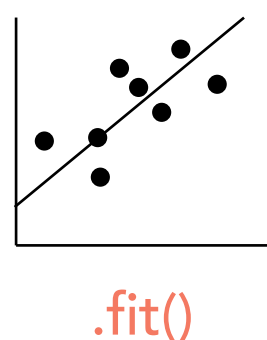
Therefore, this system meets the inference requirement:
Inference refers to *"the process of obtaining output, such as predictions ..."*

Example 7: Not all statistical modelling *is* an AI system

When modelling a treatment effect, such as medicine intake, policy intervention in social sciences etc., no predictions are made

Tumor shrinkage
= $a + b *$ Age
+ $c *$ Medicine

.fit()

The model is then used to compare, for example:

> the effect of the medicine vs a placebo; or
> the effect of different dosages

X

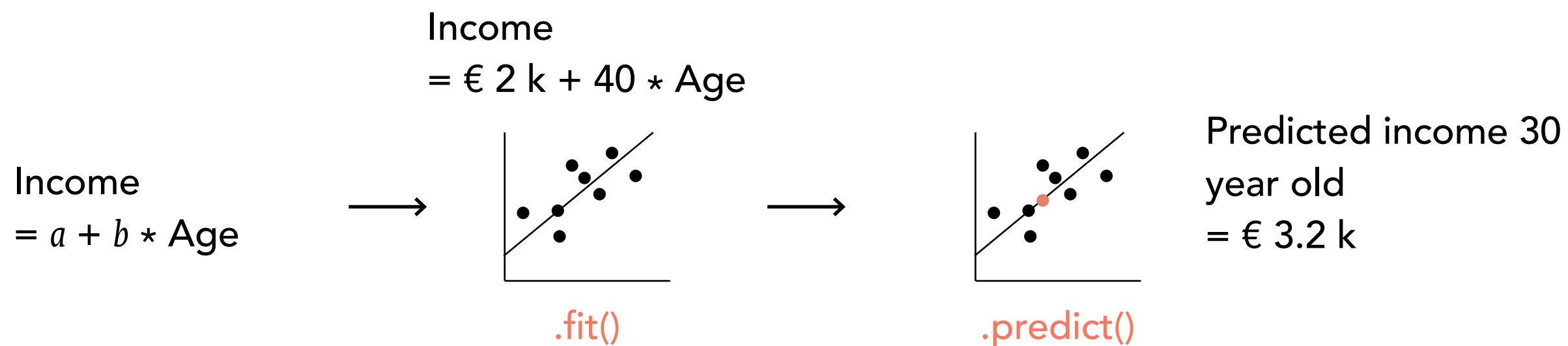**Not an AI system, because:**

| Article 3 |

| Recital 12 |

There is a *"model or algorithm derived"*

but no output generated *"such as predictions, content, recommendations, or decisions"*

Example 8: using a statistical model to make predictions *is* an AI system

Learnt linear regression model is an AI system when it's used to make predictions

Income
= € 2 k + 40 ∗ Age

Income
= $a + b$ ∗ Age

$\longrightarrow$

Predicted income 30 year old
= € 3.2 k

.fit()

.predict()

AI system, because:

This system meets the inference requirement:

Inference refers to *"capability of AI systems to derive models or algorithms, or both, from inputs or data"*

Therefore it *"transcends basic data processing by enabling learning or modelling"*;

Example 9: Weighted averages – and more advanced forms of data processing* – *could be* AI systems

Predicting university admission score based on weighted average – example loosely based on real examples such as <u>UK's A-level algorithm</u>

Math: 7.5
History: 6.5
Economics: 8
English: 6

Not AI:
Weighted average with manually chosen fixed weights:
Score = (Math * 1.5 + English * 1.2 + Econ * 0.8 + History * 0.5)/4

AI:
Weighted average with weights derived from historic data:
Score = (Math * a + English * b + Econ * c + History * d)/4

✓ **AI system, when:**

Article 3

When weights are learned from data, then this system meets the inference requirement:

Recital 12

Inference refers to *"capability of AI systems to derive models or algorithms, or both, from inputs or data"*

Therefore it *"transcends basic data processing by enabling learning or modelling"*;

* Example generalises to more advanced models, such as FIR/IIR filters, Kalman filters and hidden Markov models, if model parameters are estimated from data and it's used to produce outputs, "such as, prediction, recommendations, content and decisions"

Example 10: following this logic, is a traditional feedback-based control system an AI system?

Feedback-based control systems such as <u>proportional–integral–derivative</u> systems are widely used in cruise control, temperature control and other control systems
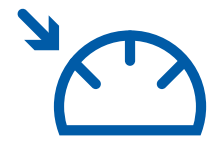
Cruise control

Air conditioning and heating

AI System?

Recital 12

In these systems the optimal control parameters are often derived by estimating them automatically from data.
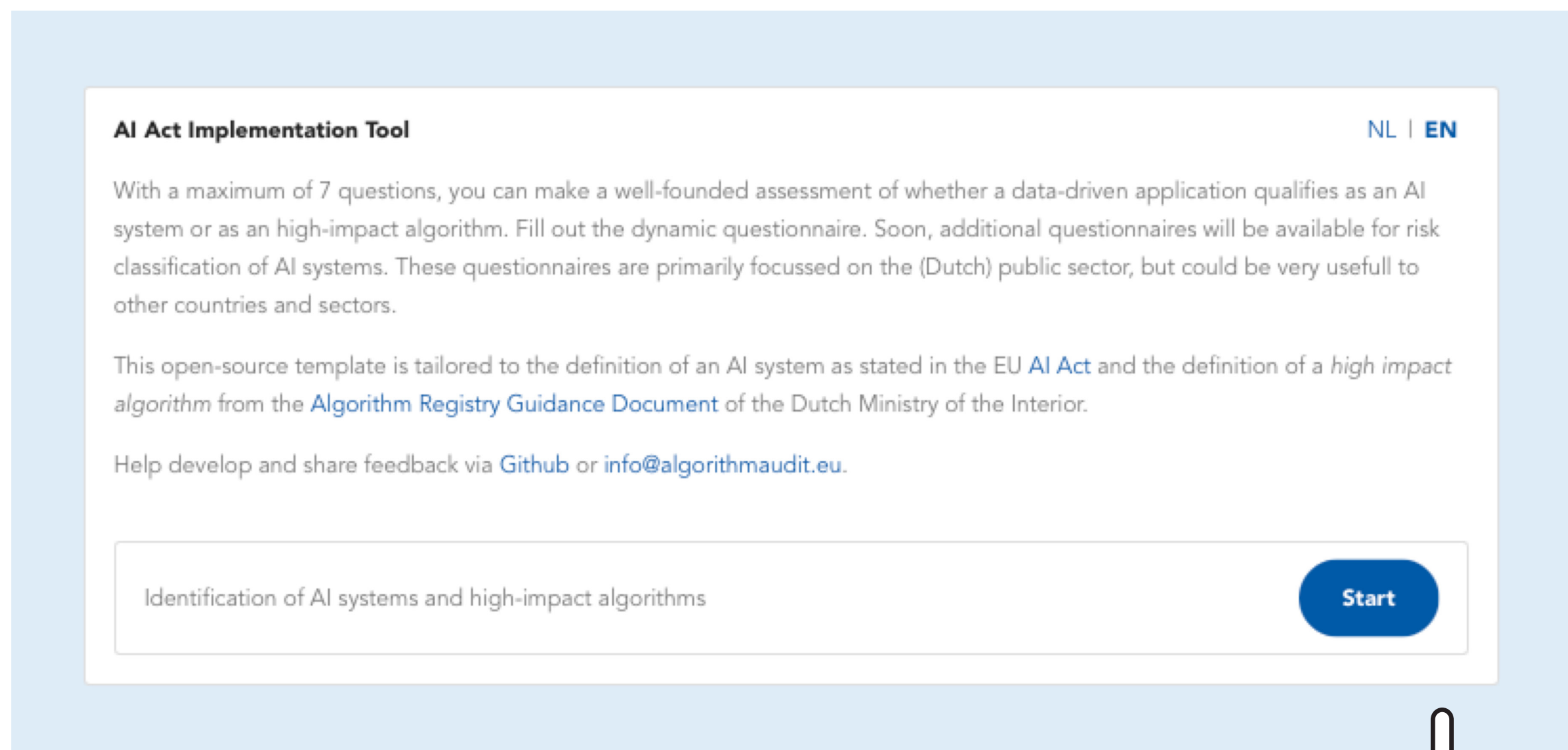
Following the logic of the earlier slides this system meets the inference requirement.

The logical conclusion from our analysis is that also these systems are AI systems under the AI Act. This broadens the scope of AI systems even beyond our own expectations.

What do you think? Do you agree that this conclusion logically follows from article 3(1) and recital 12?

Use our open-source AI Act Implementation Tool to classify AI systems and identify other edge cases

AI Act Implementation Tool   NL | **EN**

With a maximum of 7 questions, you can make a well-founded assessment of whether a data-driven application qualifies as an AI system or as an high-impact algorithm. Fill out the dynamic questionnaire. Soon, additional questionnaires will be available for risk classification of AI systems. These questionnaires are primarily focussed on the (Dutch) public sector, but could be very usefull to other countries and sectors.

This open-source template is tailored to the definition of an AI system as stated in the EU AI Act and the definition of a *high impact algorithm* from the Algorithm Registry Guidance Document of the Dutch Ministry of the Interior.

Help develop and share feedback via Github or info@algorithmaudit.eu.

Identification of AI systems and high-impact algorithms   **Start**

> Discover in three questions if your application is an AI system under the AI Act

> Open-source developed under EUPL-1.2 license

Developed and tested in collaboration with:

❌ **Gemeente**
❌ **Amsterdam**
❌

Building *public knowledge*

for *ethical algorithms*

Join the discussion!

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