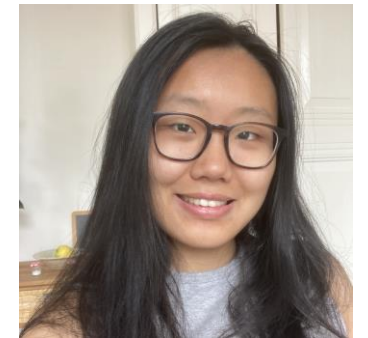


FOUND IN TRANSLATION

Building explainable model for transparent decision making & interdisciplinary communication in precision livestock farming

Presenter: **Yuuko Xue**

Centre for Quantitative Genetics and Genomics
Aarhus University, Denmark



INTRODUCTION

Decision making



TECHNICAL SCIENCES

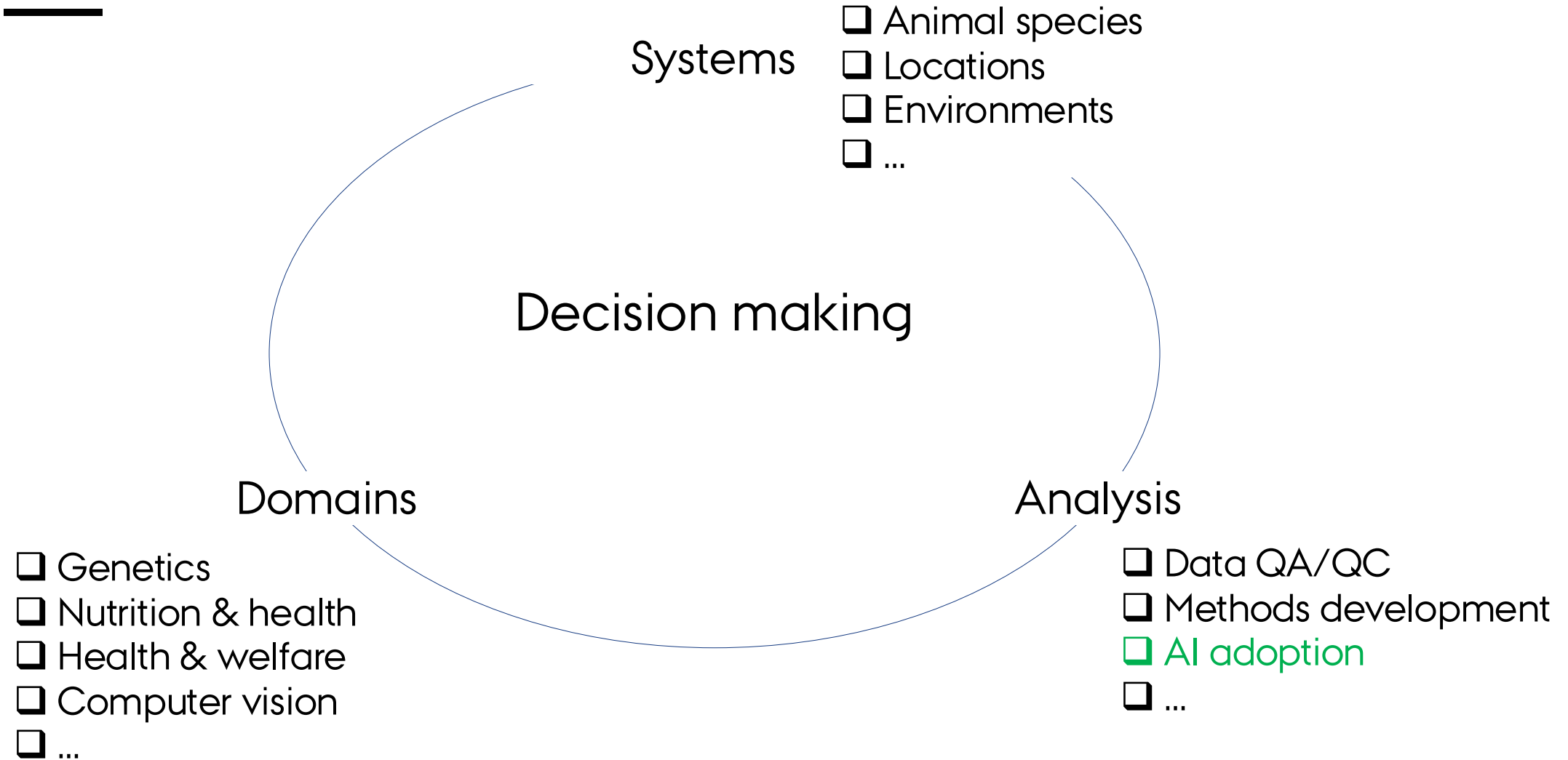
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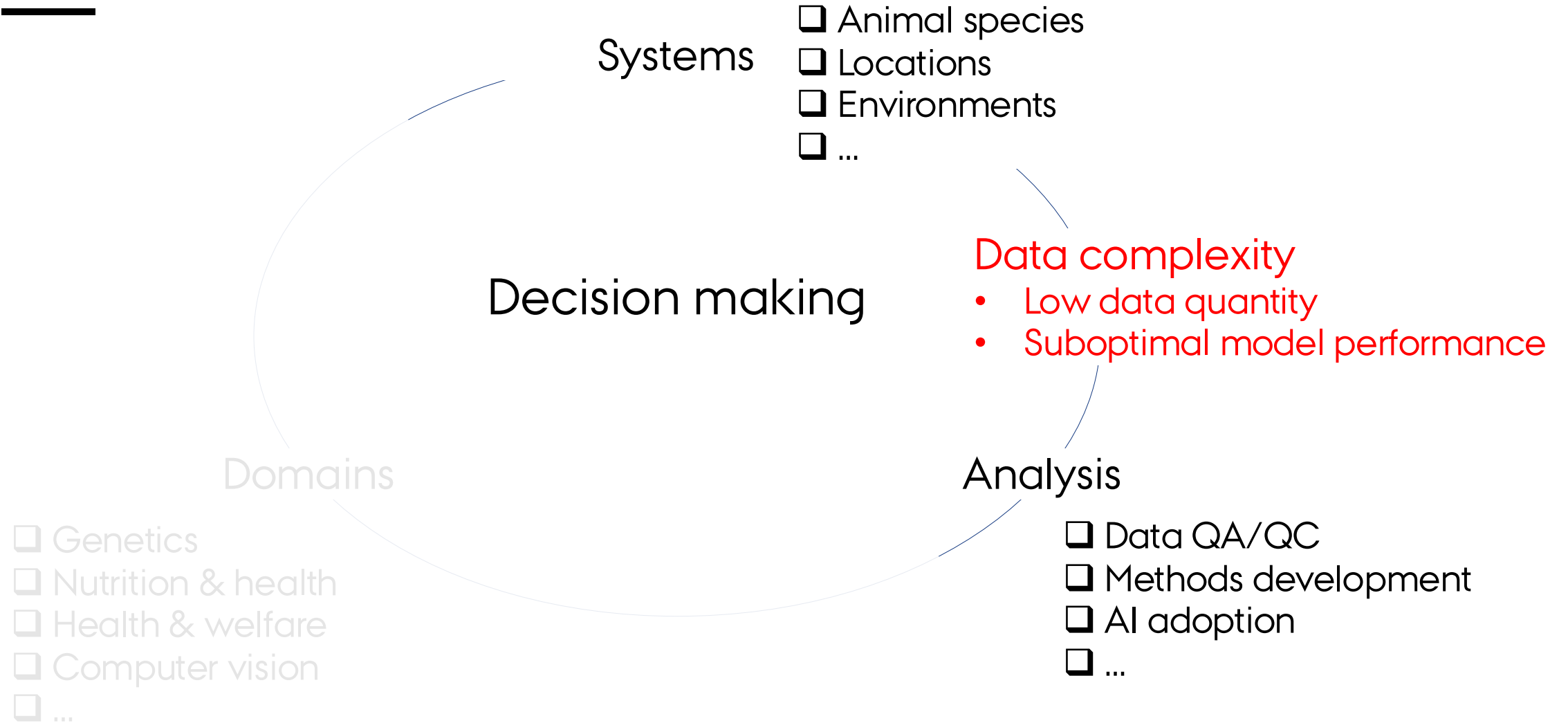
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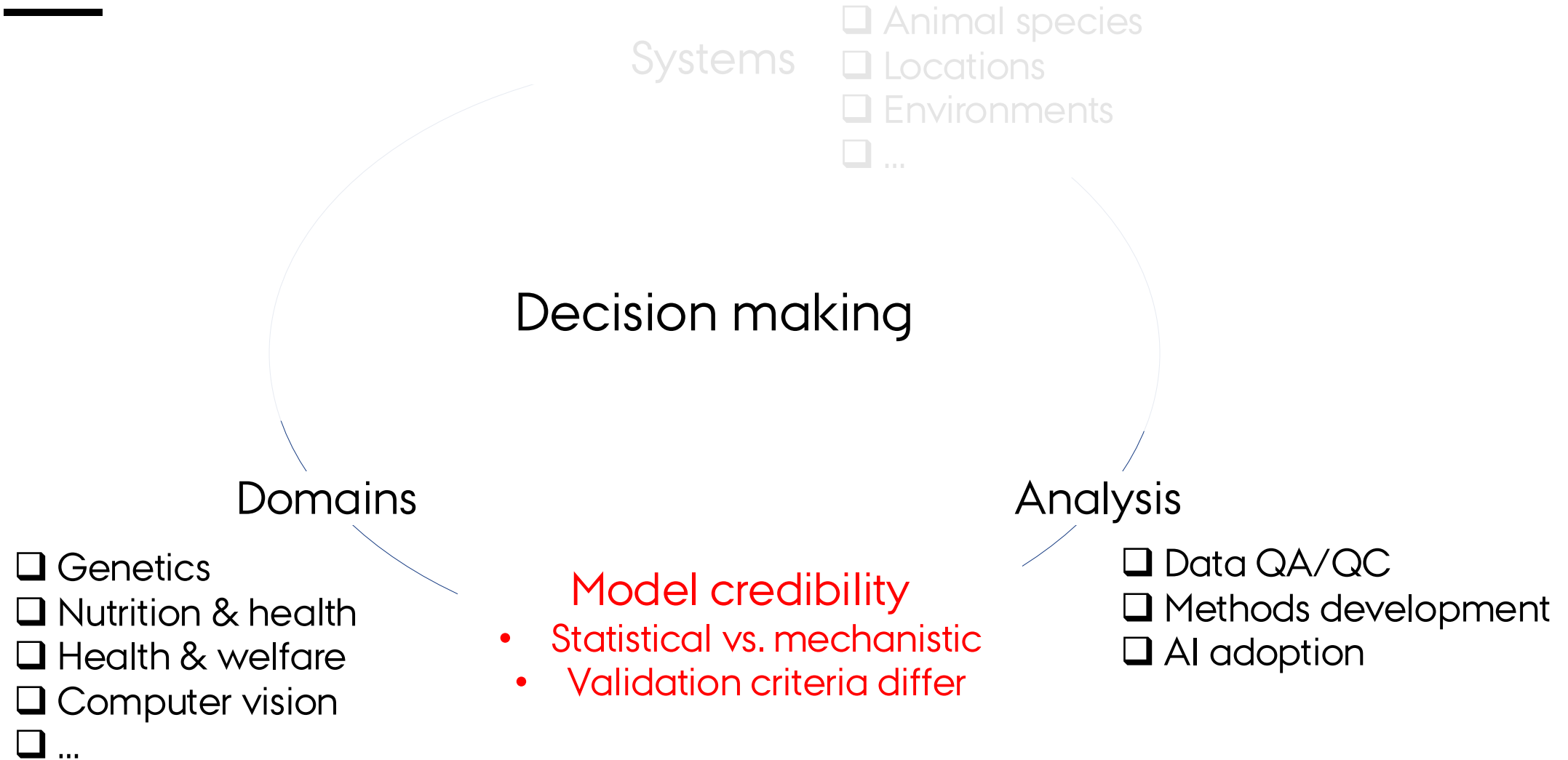
INTRODUCTION



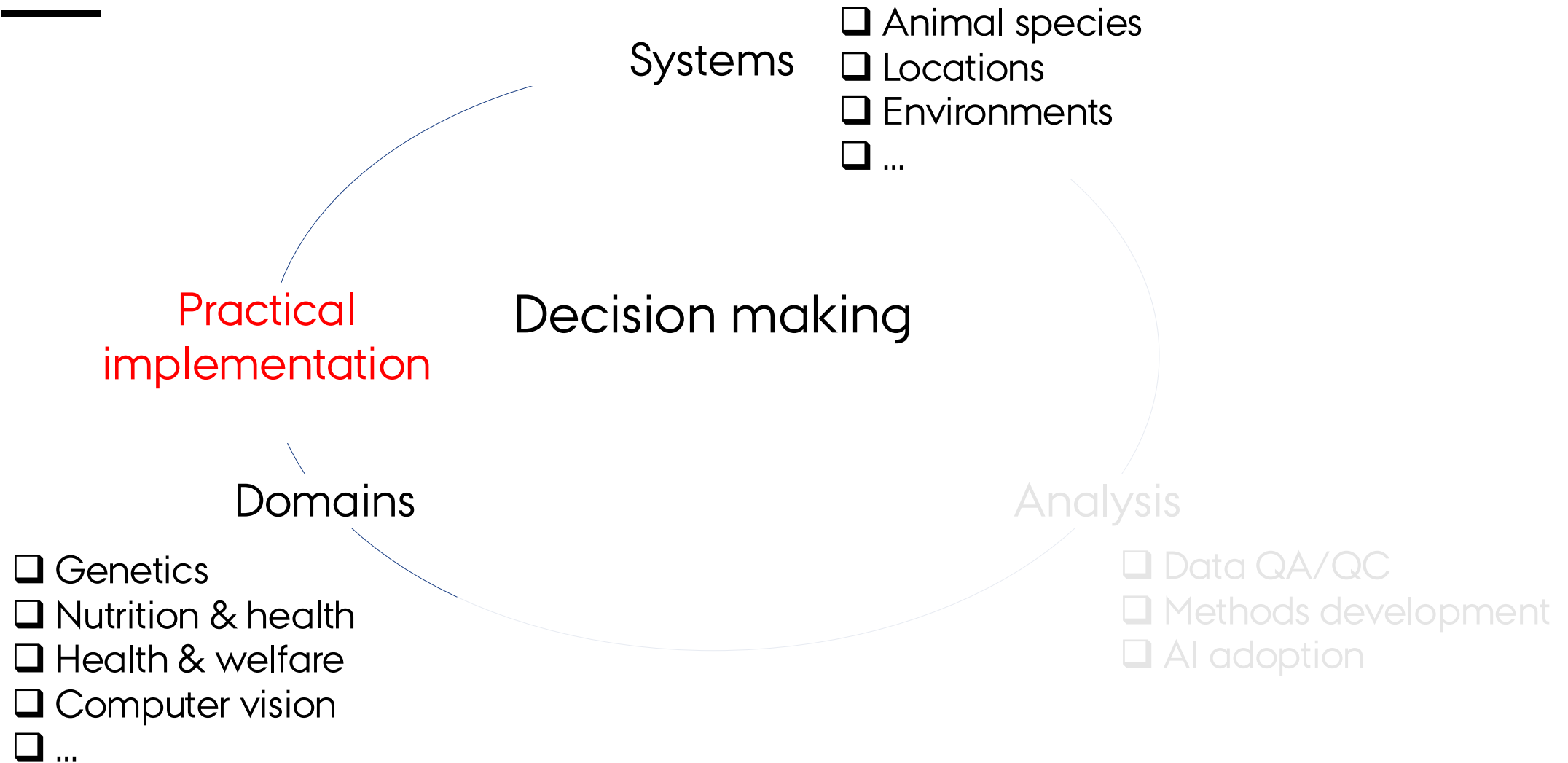
CHALLENGES



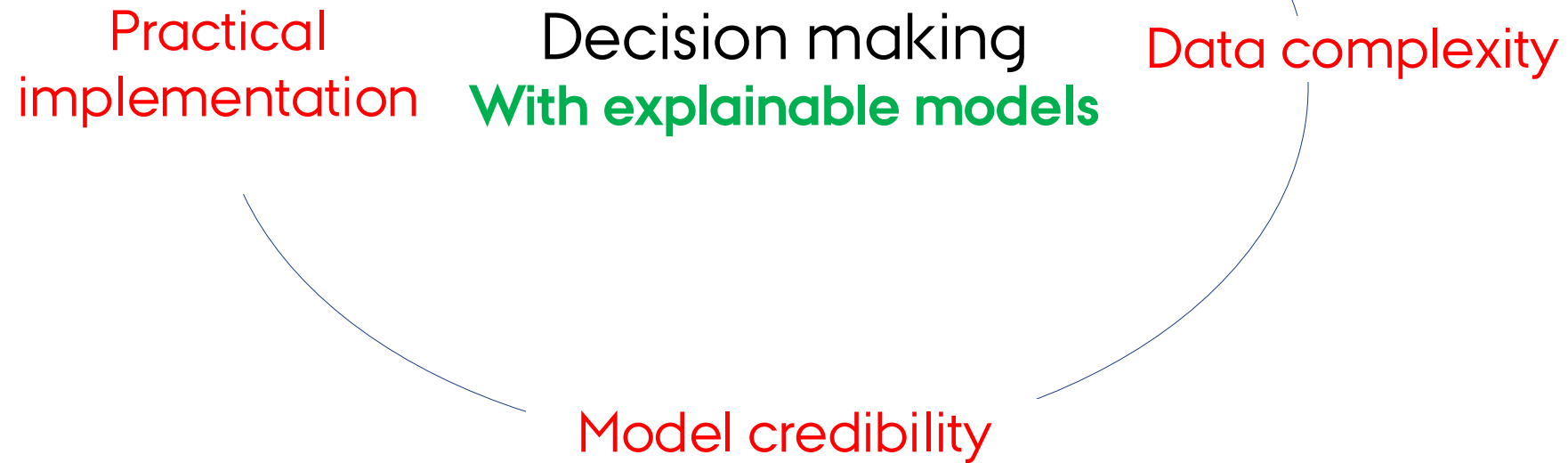
CHALLENGES



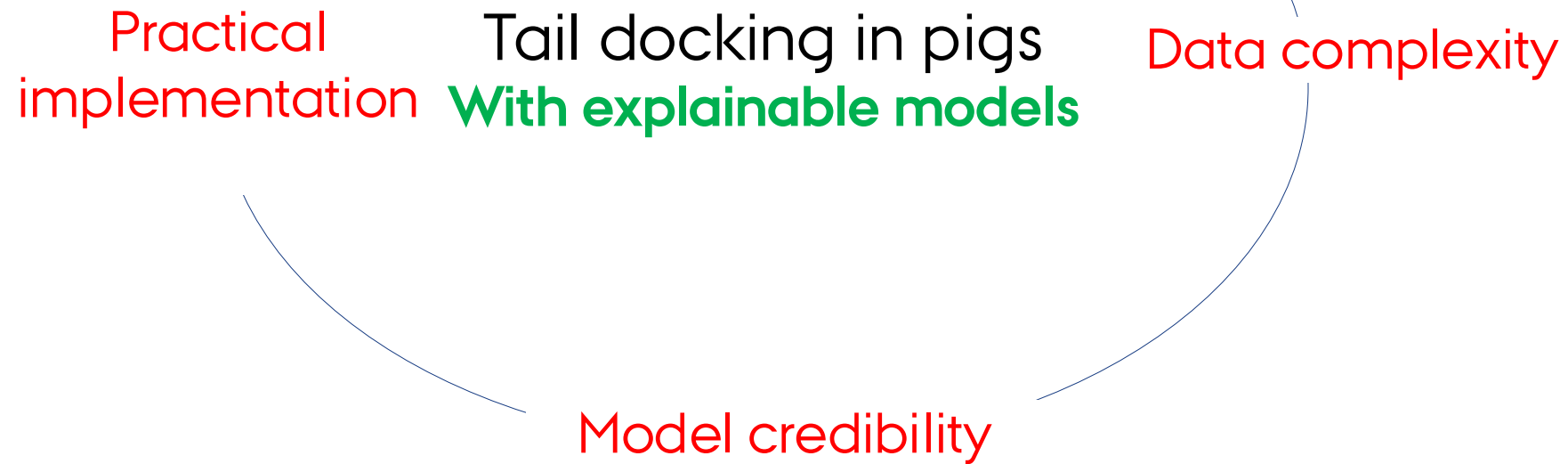
CHALLENGES



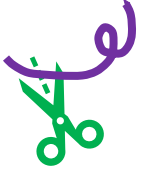
SOLUTIONS



EXAMPLE

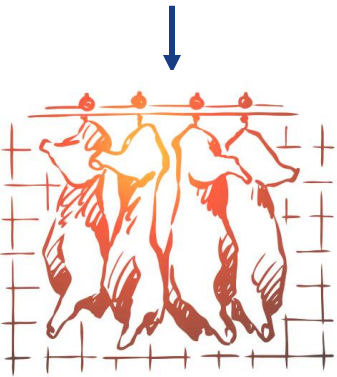
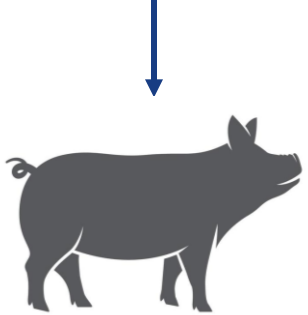


BACKGROUND



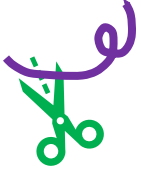
Tail docking in pigs

- Conduct when one day old



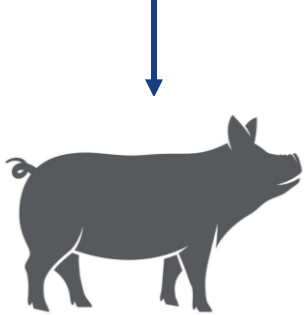
- Measure with images or video at slaughterhouse

BACKGROUND



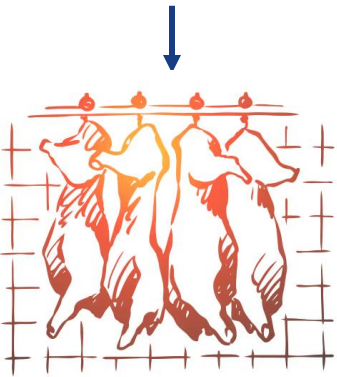
Tail docking in pigs

- Conduct when one day old



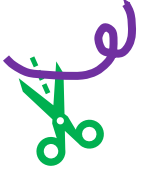
Goal -

Assess tail docking severity **on farm** with images (phone quality) of **adult pigs**



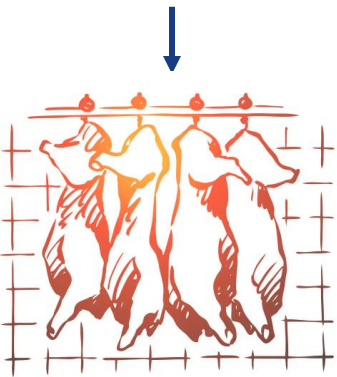
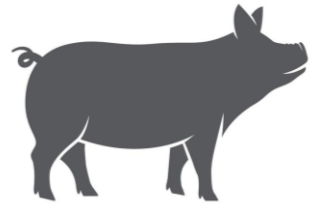
- Measure with images or video at slaughterhouse

BACKGROUND



Tail docking in pigs

- Conduct when one day old



Challenges – data quality & quantity

Full length

- 44 manual measurements
- 40 images

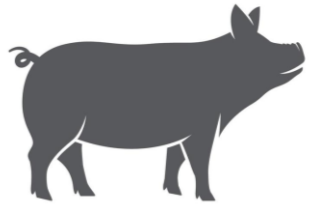


- Measure with images or video at slaughterhouse

MATERIALS

Full length

Ground truth measurement



TECHNICAL SCIENCES

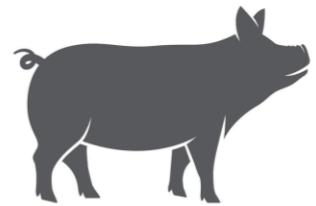
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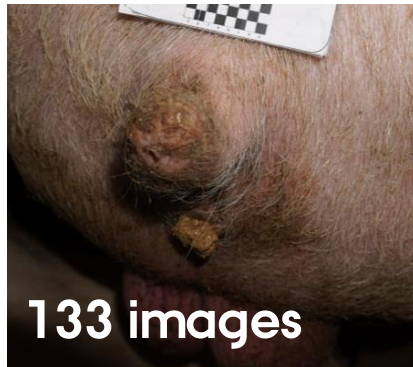
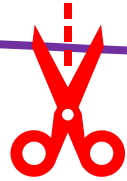
YUUKO XUE
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MATERIALS

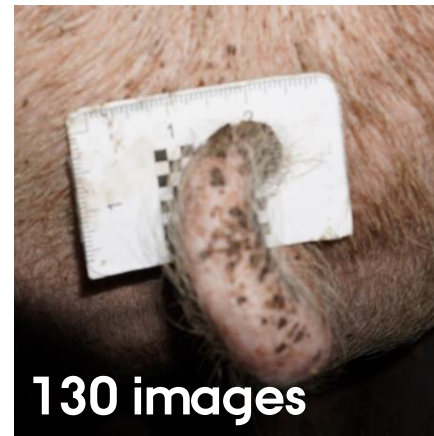


Quarter
docking



133 images

Half
docking



130 images

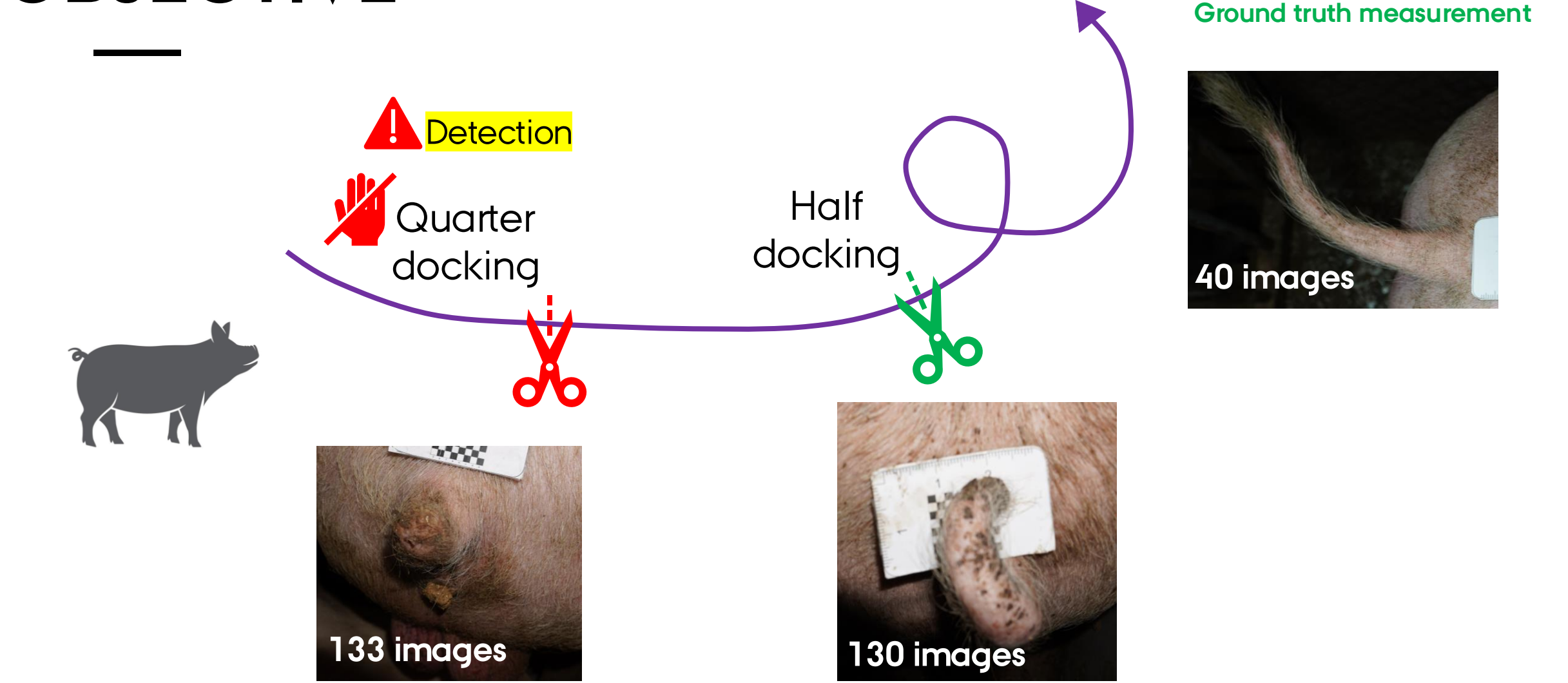
Full length

Ground truth measurement

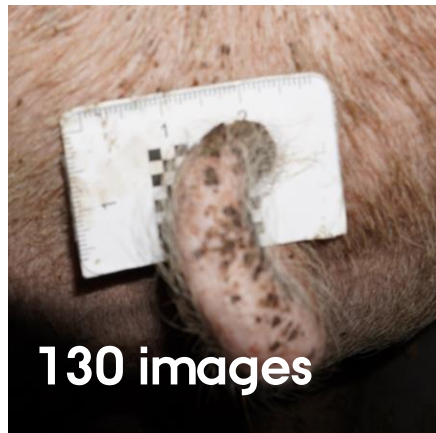
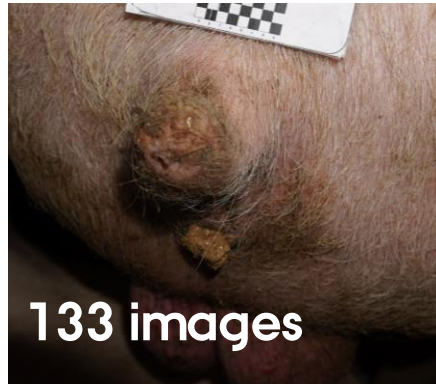


40 images

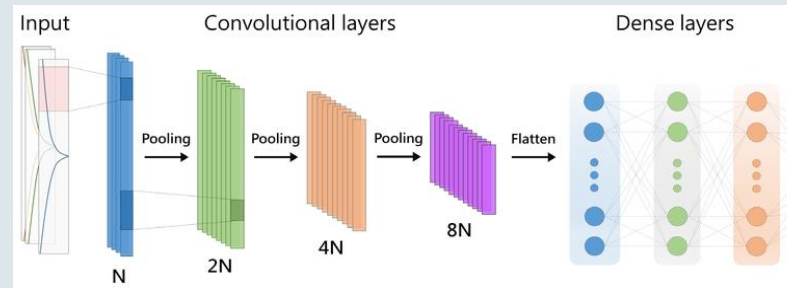
OBJECTIVE



METHODS



ResNet 18
with pre-trained weights



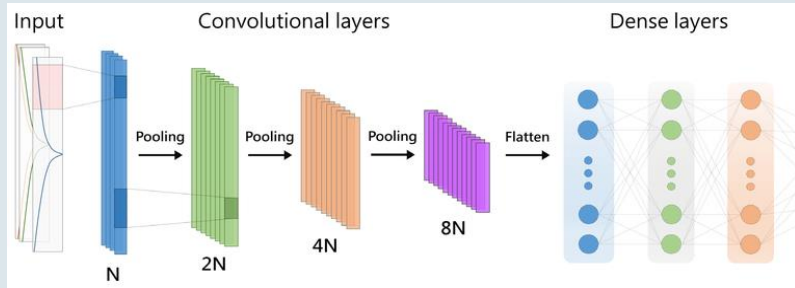
Quarter
docking

OR

Half
docking

RESULTS

ResNet 18 with pre-trained weights



Model performance

AUC = 0.95

Accuracy = 80%

Challenges –

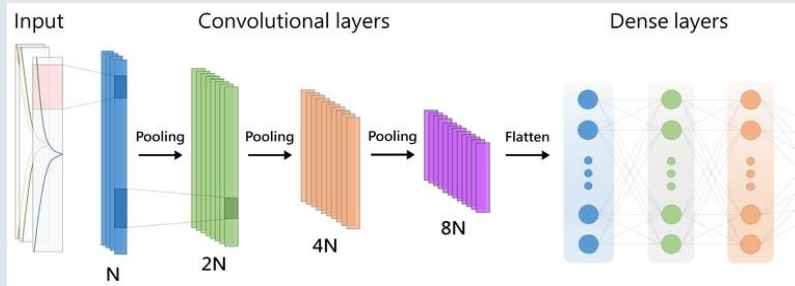
- Limited test samples
- Lack of explainability

true Half	22	1
true Quarter	8	15
	pred Half	pred Quarter

METHODS

GradCAM heat map

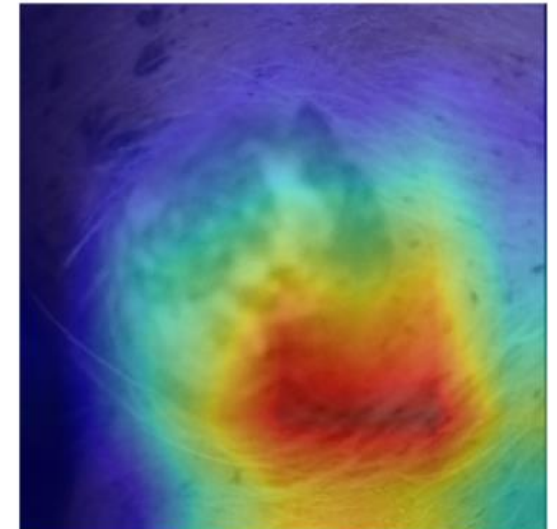
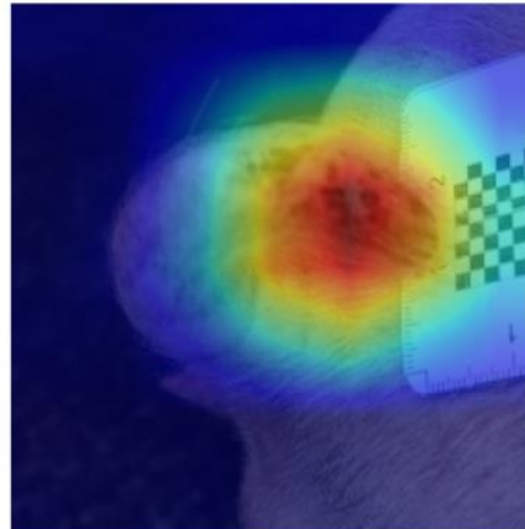
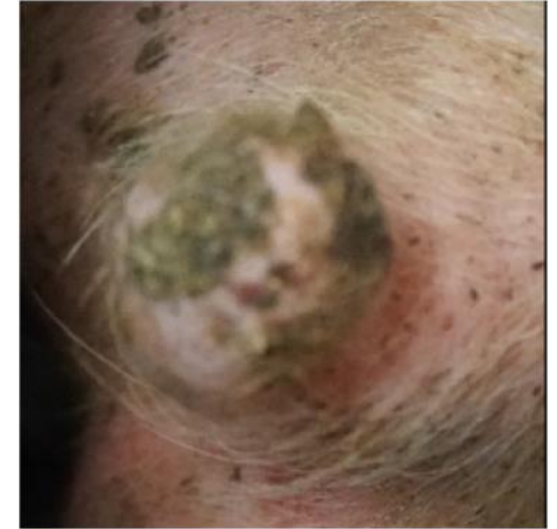
ResNet 18 with pre-trained weights



Half

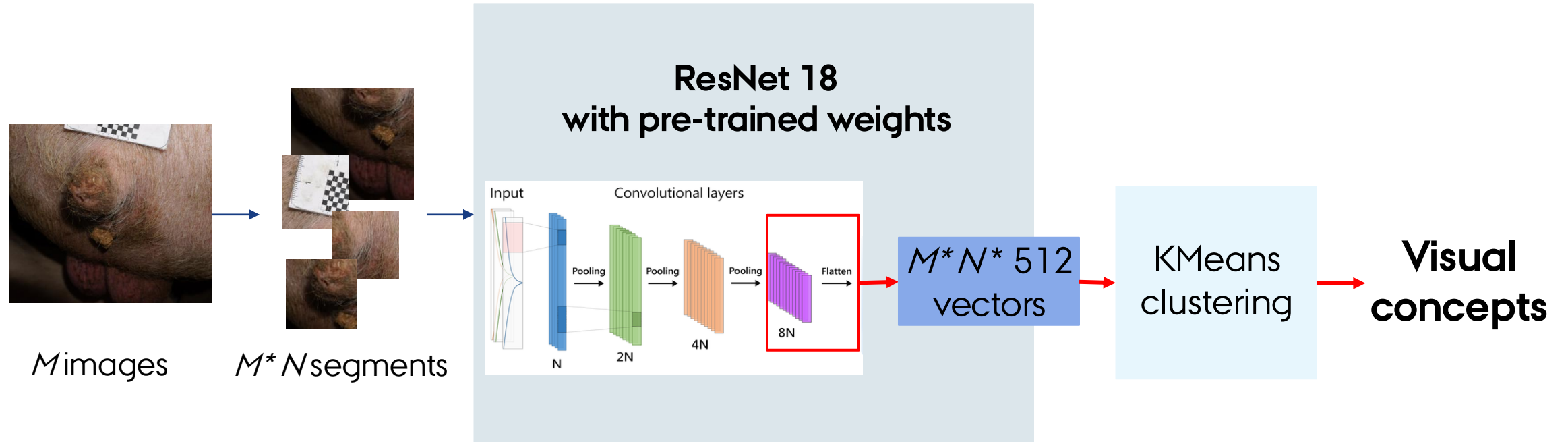


Quarter



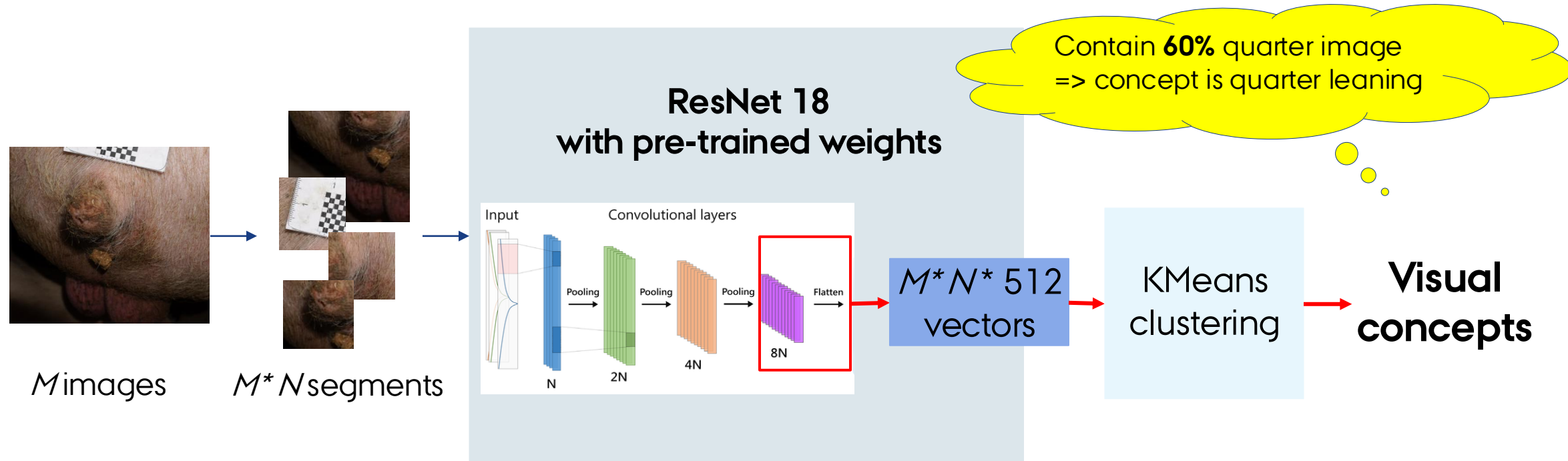
METHODS

ACE – Automated Concept-based Explanations

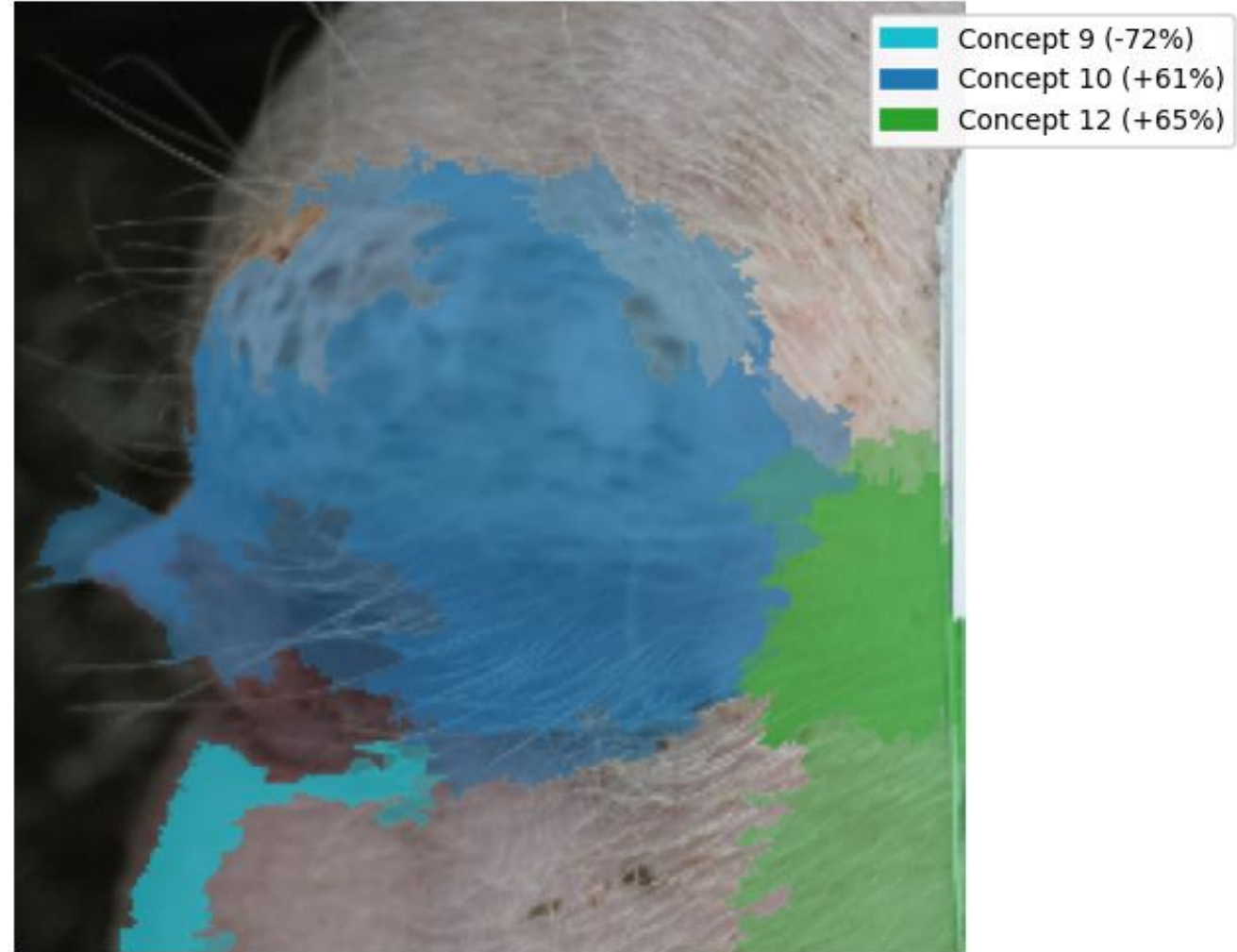
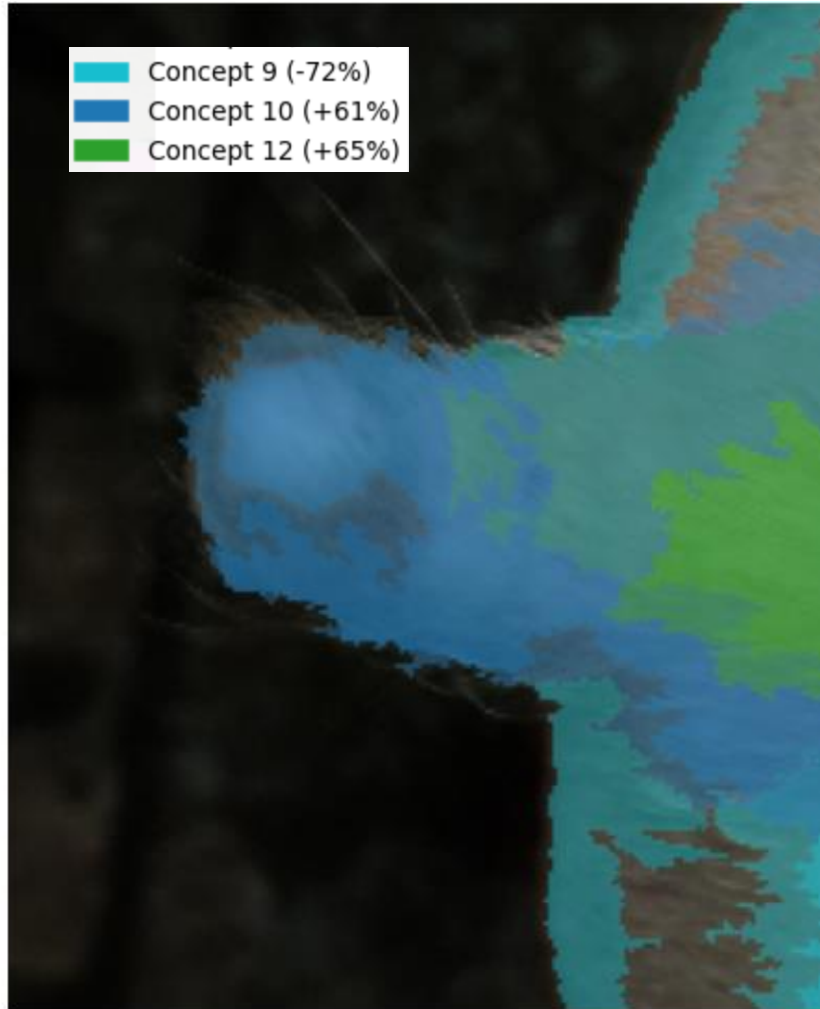


METHODS

ACE – Automated Concept-based Explanations



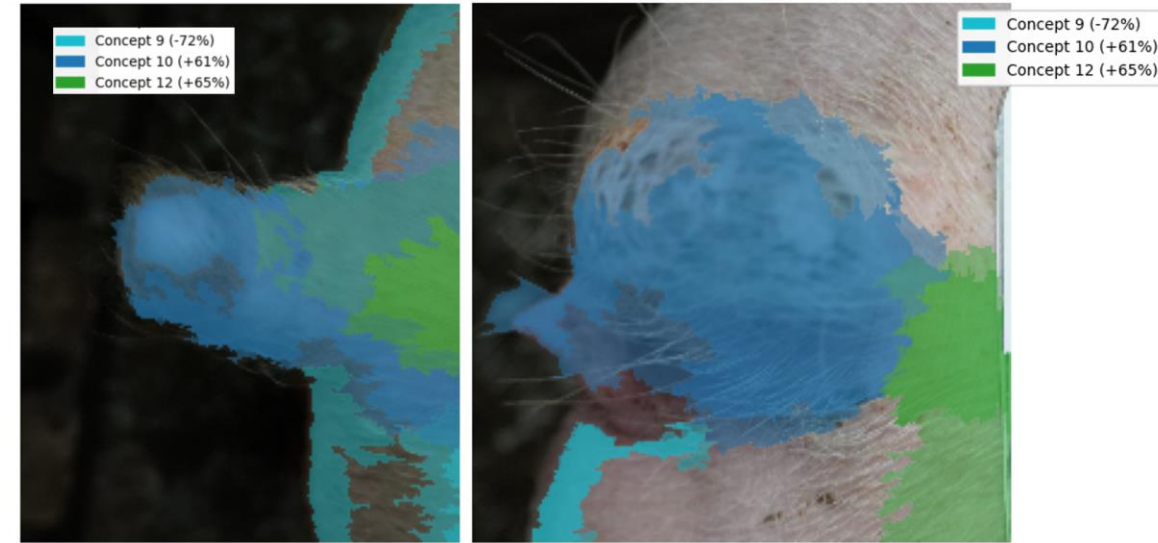
RESULTS



RESULTS

Alignment with anatomical features

- Relationship between concepts
- Locations of concepts
- Sizes of concepts



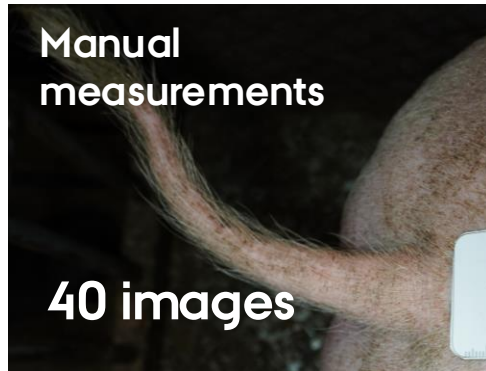
Decisive image features -

Length, thickness (top, bottom, average), compactness, circularity, volume

RESULTS

Decisive image features -

Length, thickness (top, bottom, average), compactness, circularity, volume



Expected full length model

Expected length ~ F(Decisive image features)

$$\text{Docking ratio} = 1 - \frac{\text{Image length}}{\text{Expected length}}$$

METHODS



Extract
decisive features

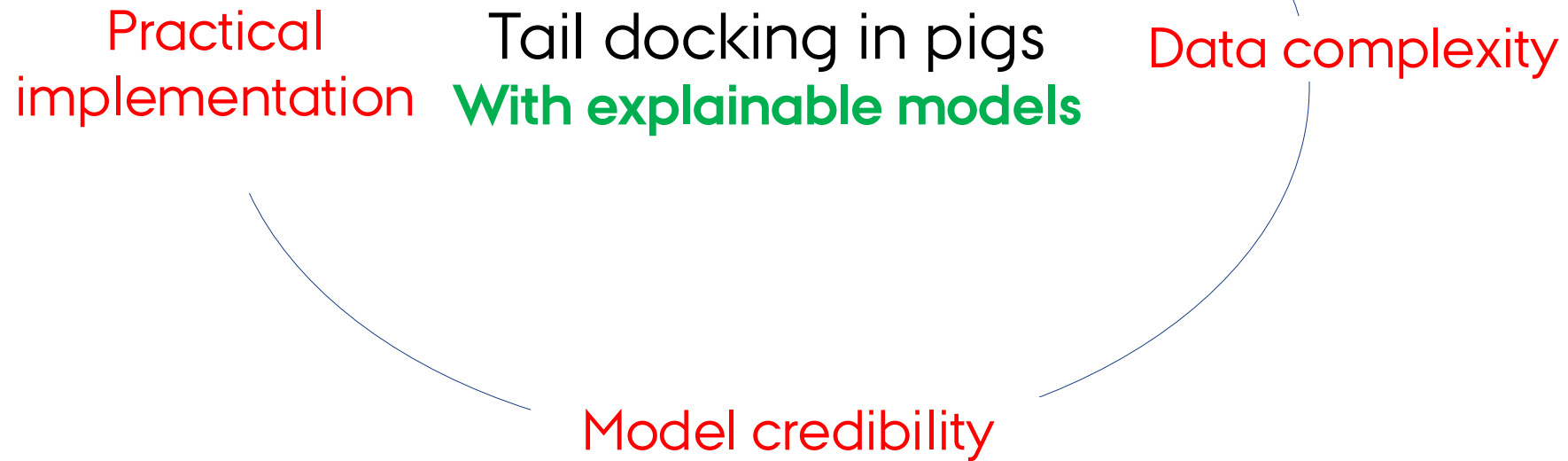
Predict
expected length

Calculate
docking ratio

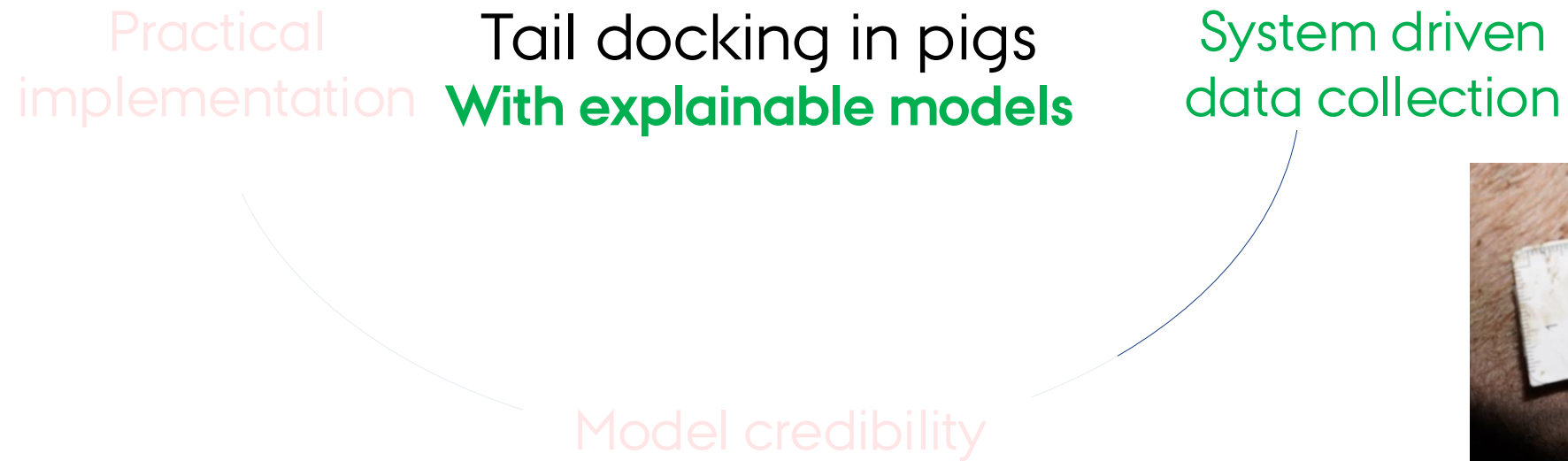
Docking ratio > 50% - Quarter

Model performance - Accuracy = 97%
Sample size ~260

DISCUSSION



DISCUSSION



DISCUSSION

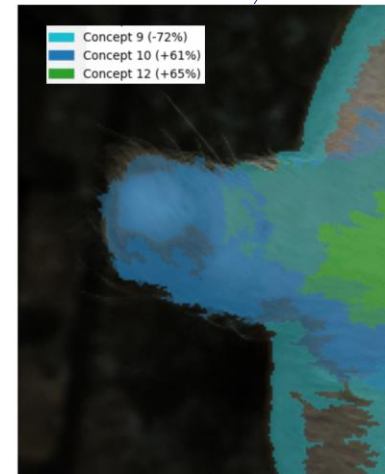
Practical
implementation

Tail docking in pigs
With explainable models

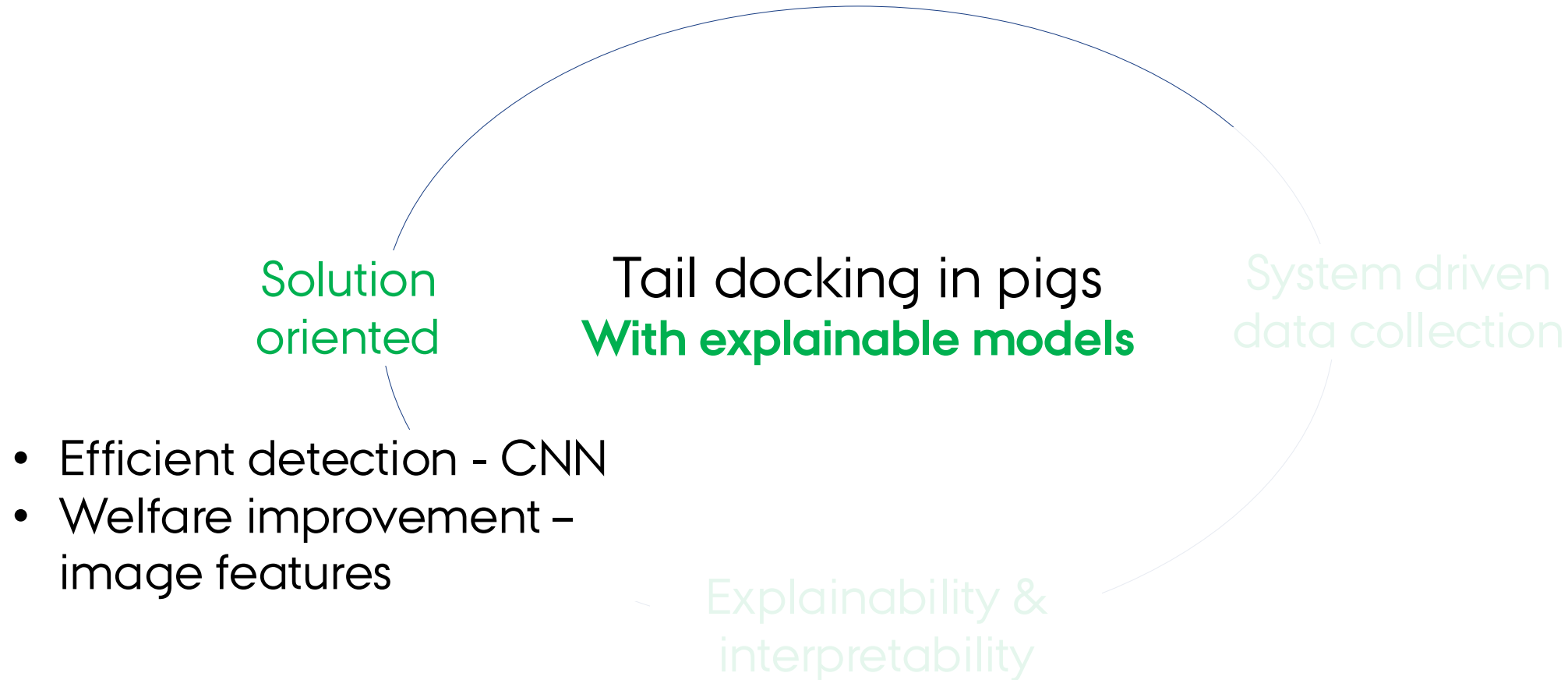
System driven
data collection

Explainability &
interpretability

- *Expected full length model*



DISCUSSION





Ministeriet for Fødevarer, Landbrug og Fiskeri

Center for Quantitative Genetics and Genomics

Grum Gebreyesus

Department of Animal and Veterinary Sciences

Leslie Foldager

Karen Thodberg



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Thank you for listening



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