

**Universitat  
de Lleida**

# **Is Deep Learning useful for decision making in pig production?**

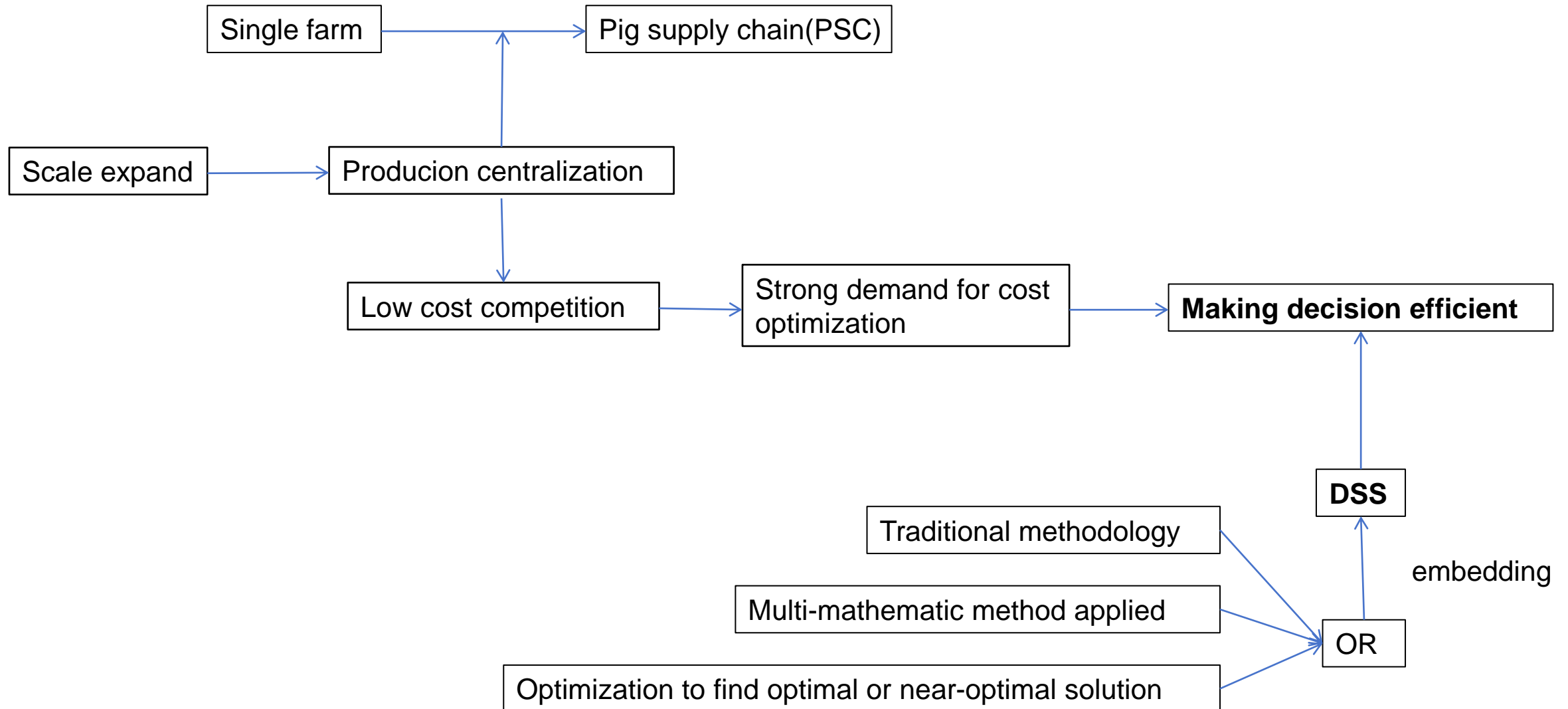
**Yun Bao**

**Universitat de Lleida**

**27.Otc 2023**

- 1. Current situation: Pig sector and DSS (Decision support system)**
- 2. Technological progress: DL (Deep learning) and OR (Operation research)**
- 3. Benefits and Challenges: Embedding DL into existing DSS**

# Current situation: Pig sector and DSS



# Pig decision problems solved by OR



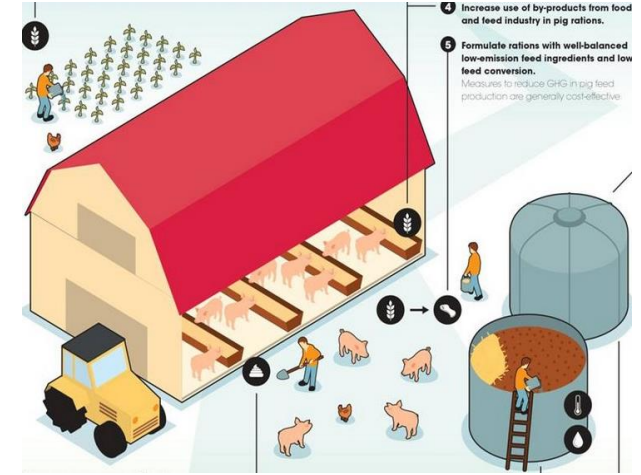
**Feed optimization**



**Goal of farrowings**



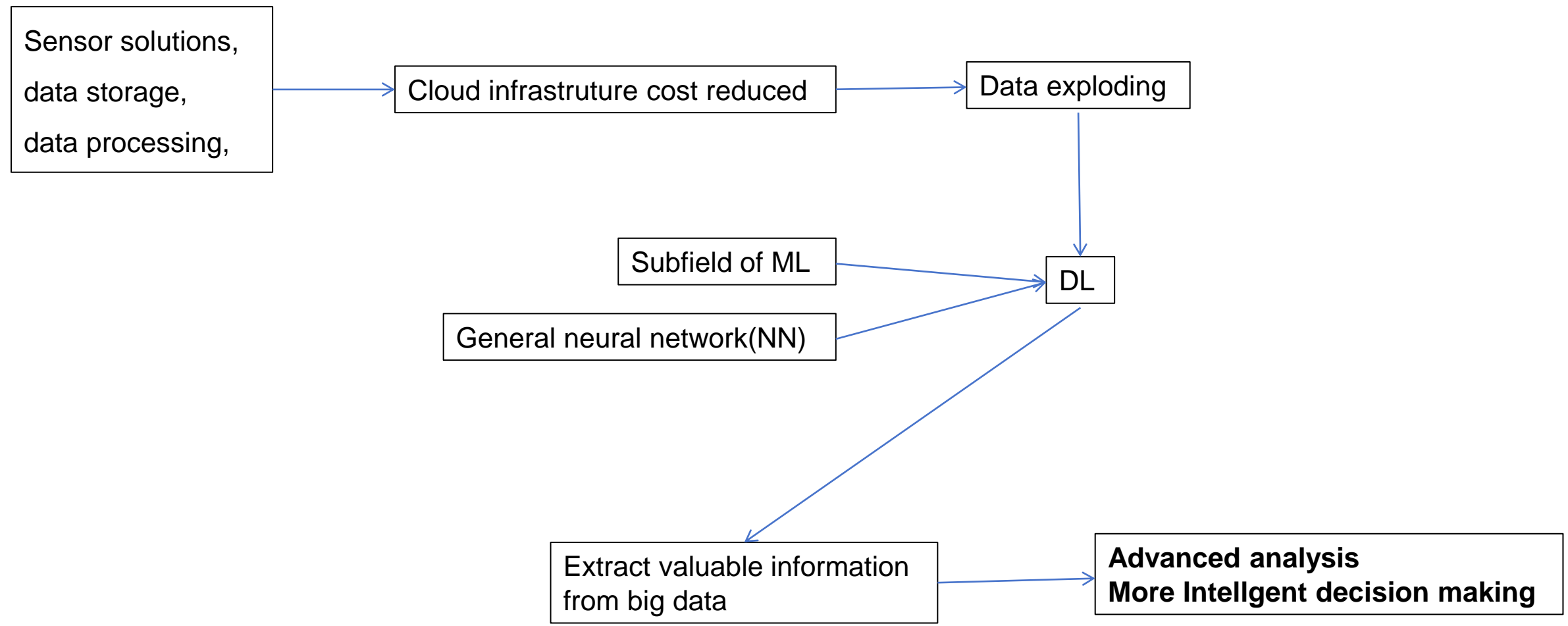
**Delivery Logistics Plan**



**GHG emissions**

**Almost all benefit-oriented : Maximize profit or Minimize costs**

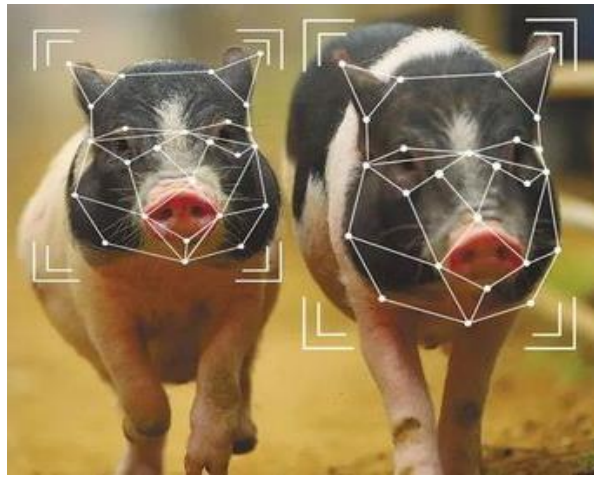
# New technology: Data exploding and AI



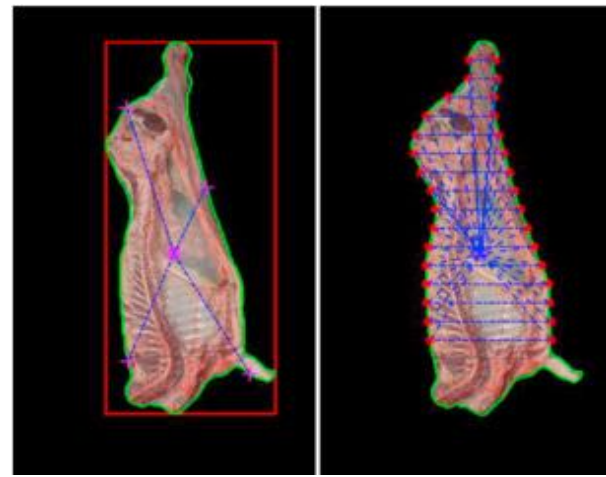
# Pig decision problems solved by DL



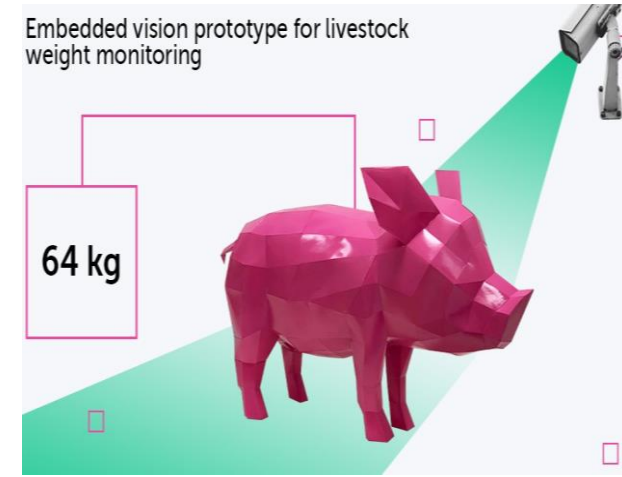
**Behaviour:**  
Fighting, eating,  
drinking, playing etc



**Individual  
identification**



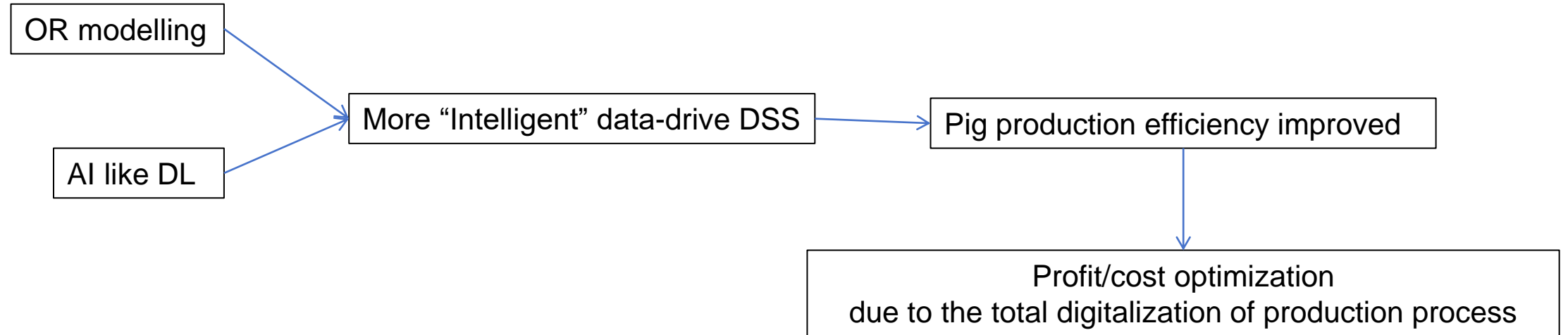
**Carcass analysis**



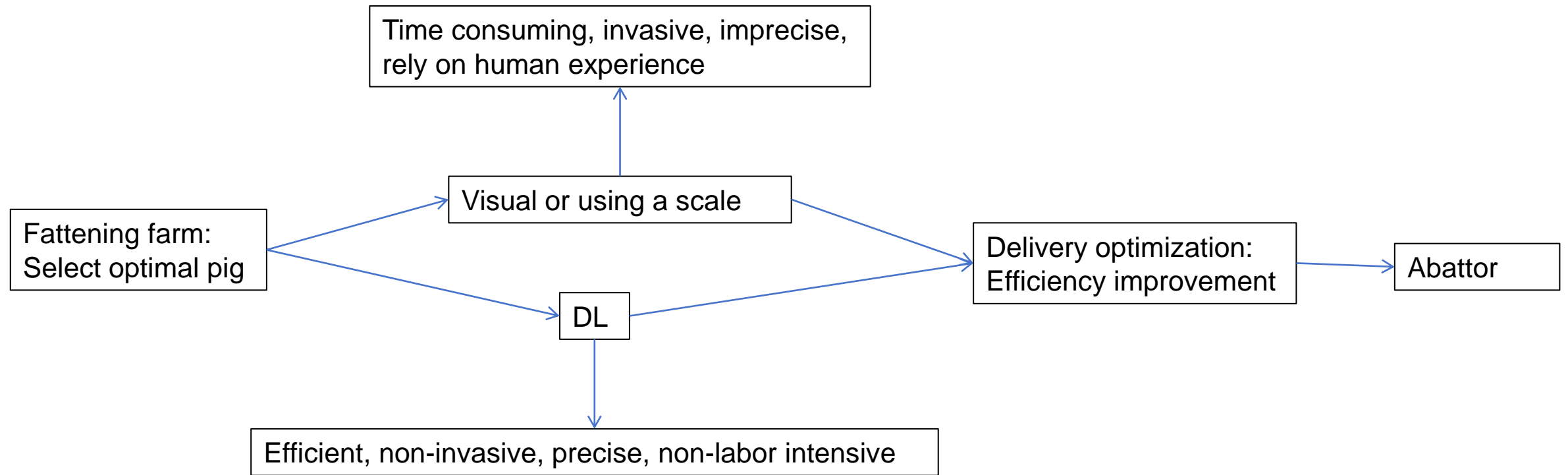
**Weight monitoring**

**Non-invasive, Completed some tasks that were difficult to complete before**

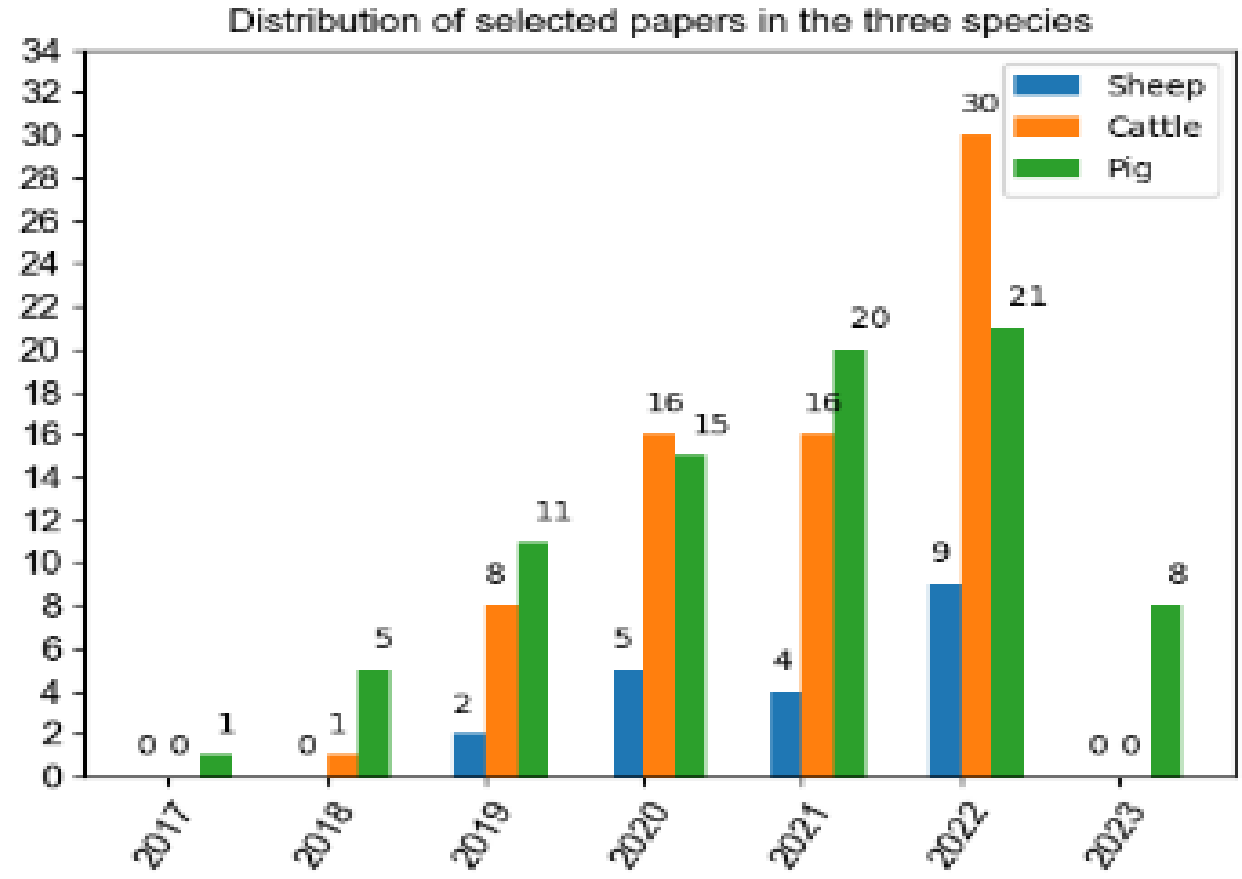
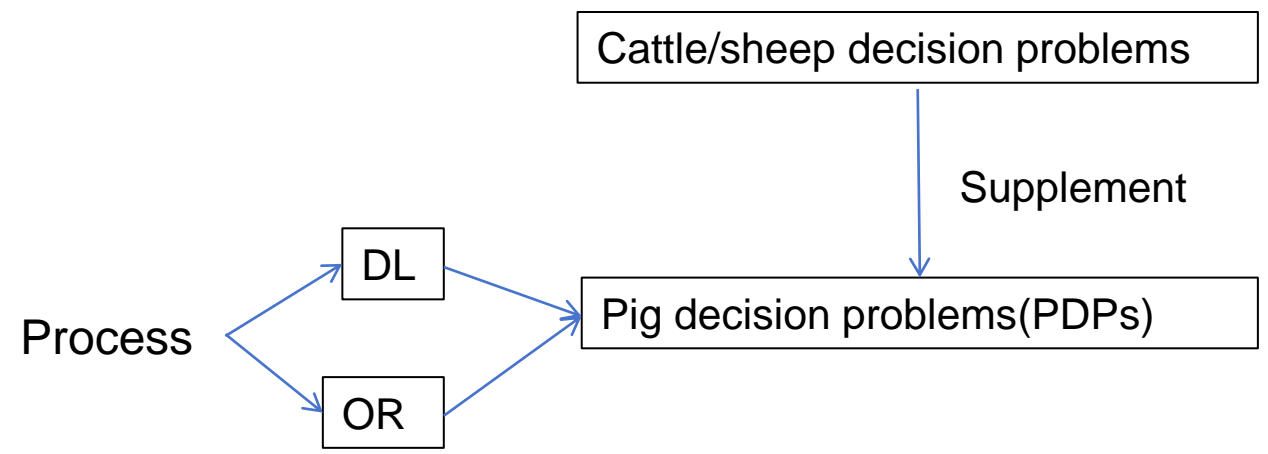
# Objective



# Example: Select optimal pig deliver to abattior



# Research structure overview



Pig: 81

Cattle: 71

Sheep: 20

## Data Type:

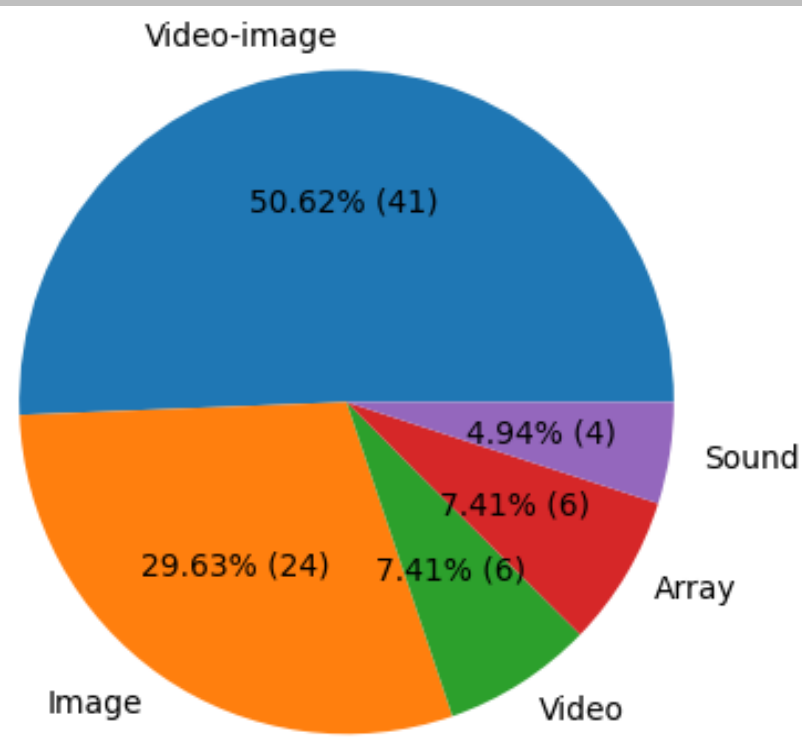
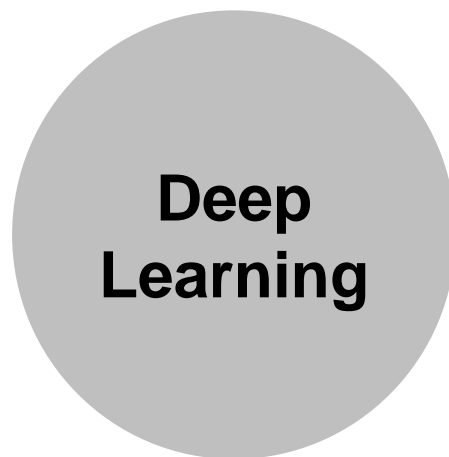


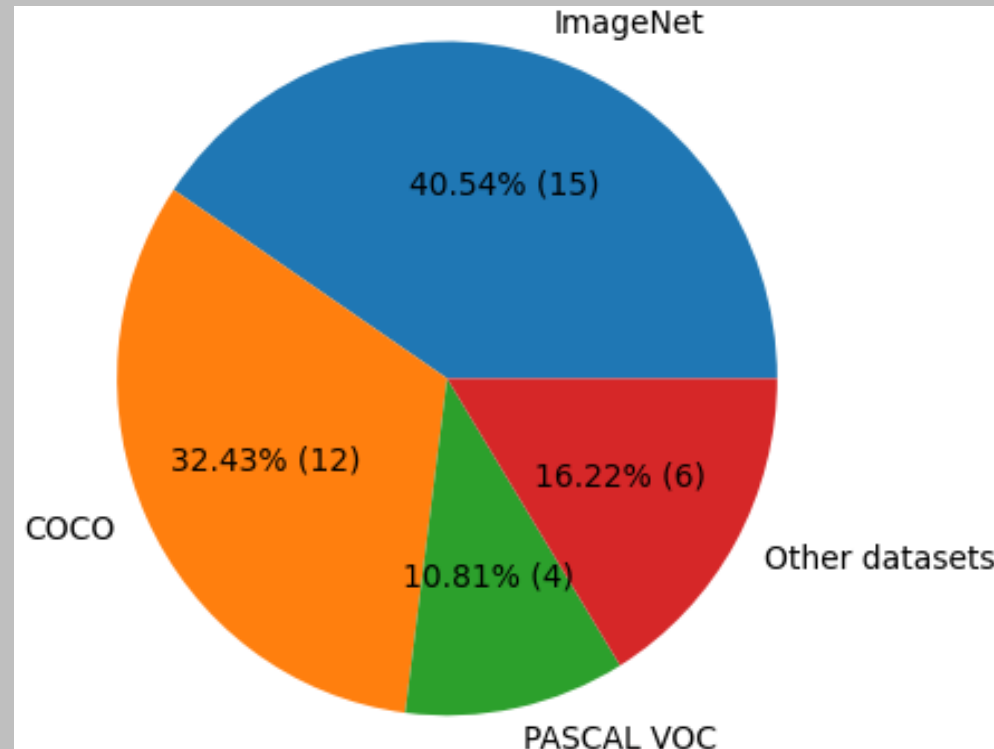
Image: 71/81      87.7%

Array: 6/81      7.4%

Sound: 4/81      4.9%



## Public datasets:



Pre-trained backbone network,

Lack of data sets

specific to pigs or animals research,

## Data collector:

## D: Depth

RGBD: Intel (BSV) 38.7%    Microsoft (TOF) 29% ;

RGB: Hikvision( affordable < 40 €) 32.3%

**Technical routes (BSV and TOF) are different,**

**TOF:** Measures pulse distance by actively emitting light pulse signals

*Prevent interference from natural light:*

Such as unseen natural light, various lighting conditions, overexposure, etc.

*Lack of RGB image feature point matching:*

pig obscured, overlapped etc.

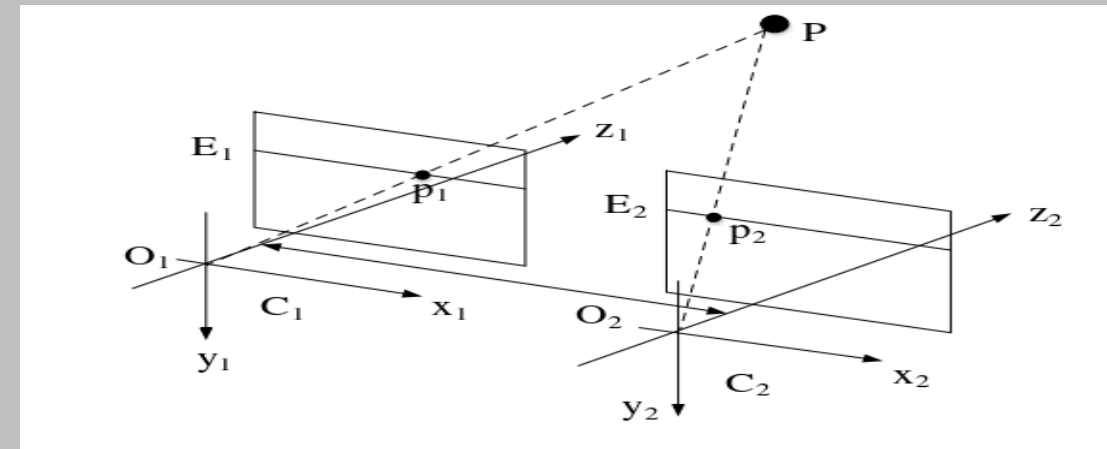
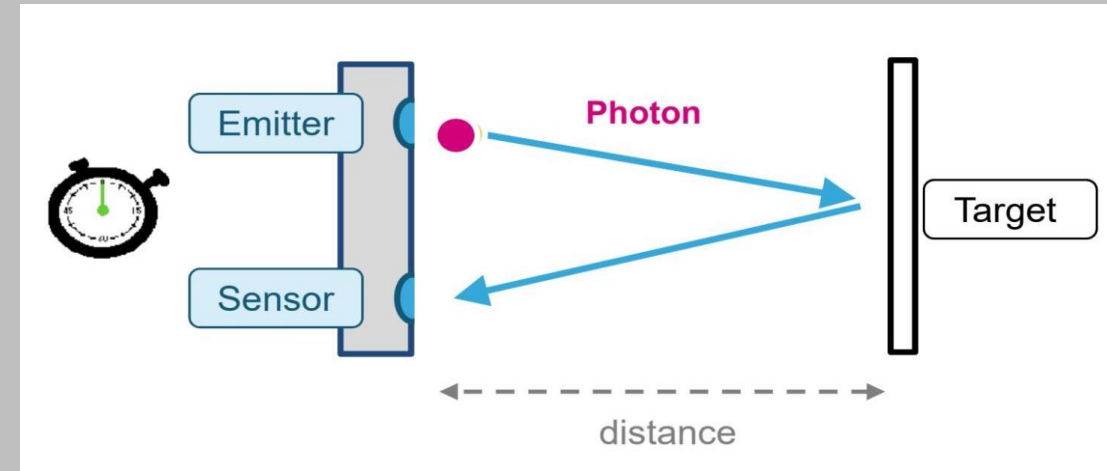
**BSV:** Calculate image deviation (Resource intensive)

*High intensity outdoor light conditions:*

TOF has some limitations that quickly saturate the light pulse receiver.

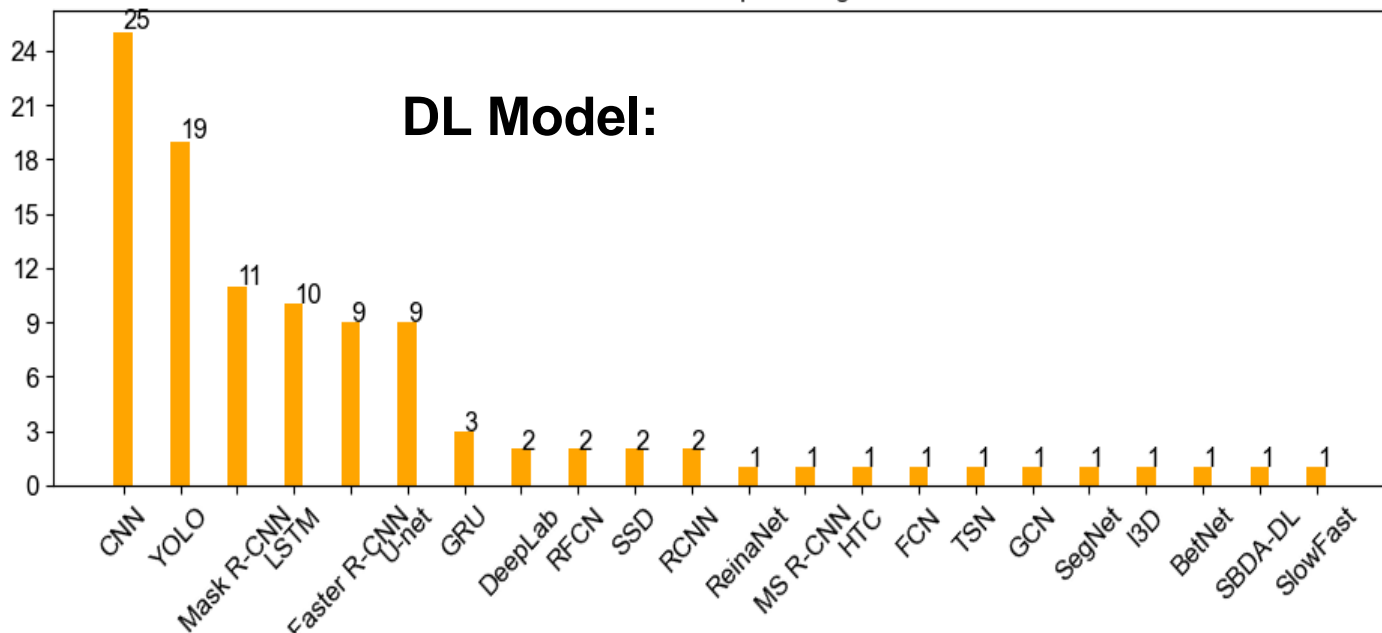
Invalid, BSV performs better.

Affordable than TOF (transport special pulse transmitters and receivers)



**Should be selected according to actual production conditions.**

Distribution of different deep learning models used



Most popular: RESNET series

Skip-connected architecture, where gradients would be more resistant to network degradation.

CNN: Most likely due to its long history of development

and simplicity of interpretation and implementation

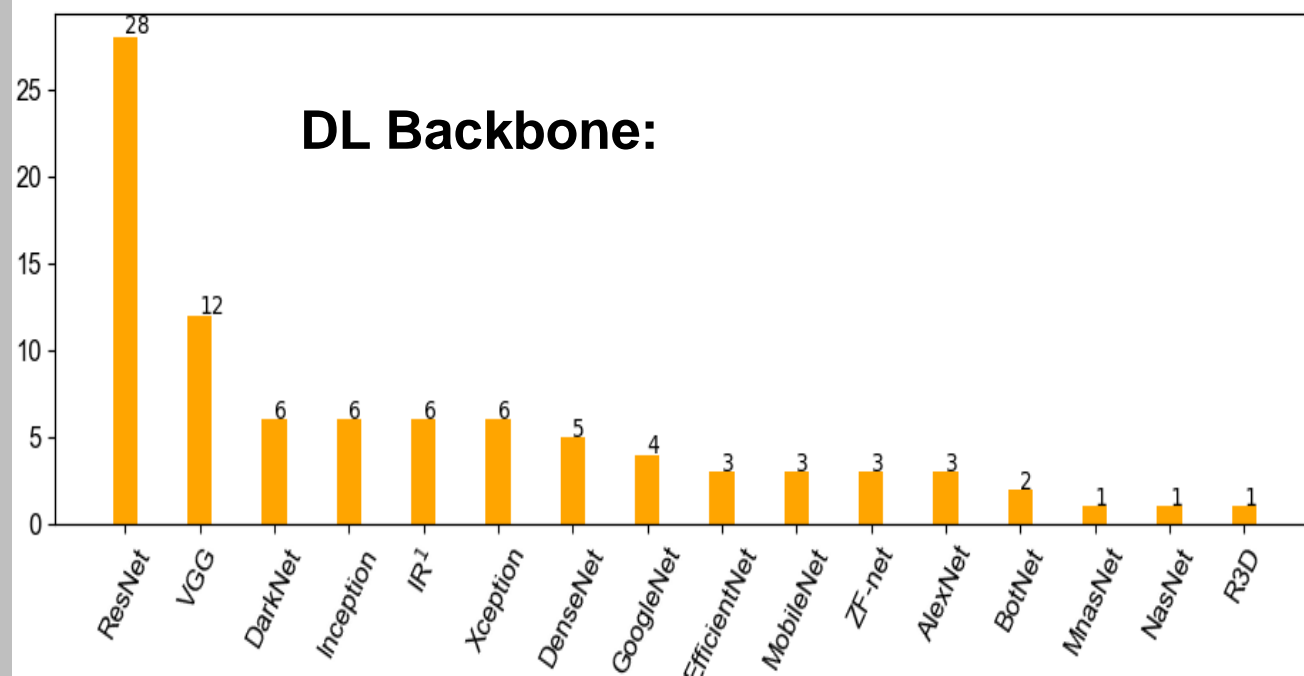
**Disadvantages:** such as vanishing gradients, fitting

problems, and low accuracy

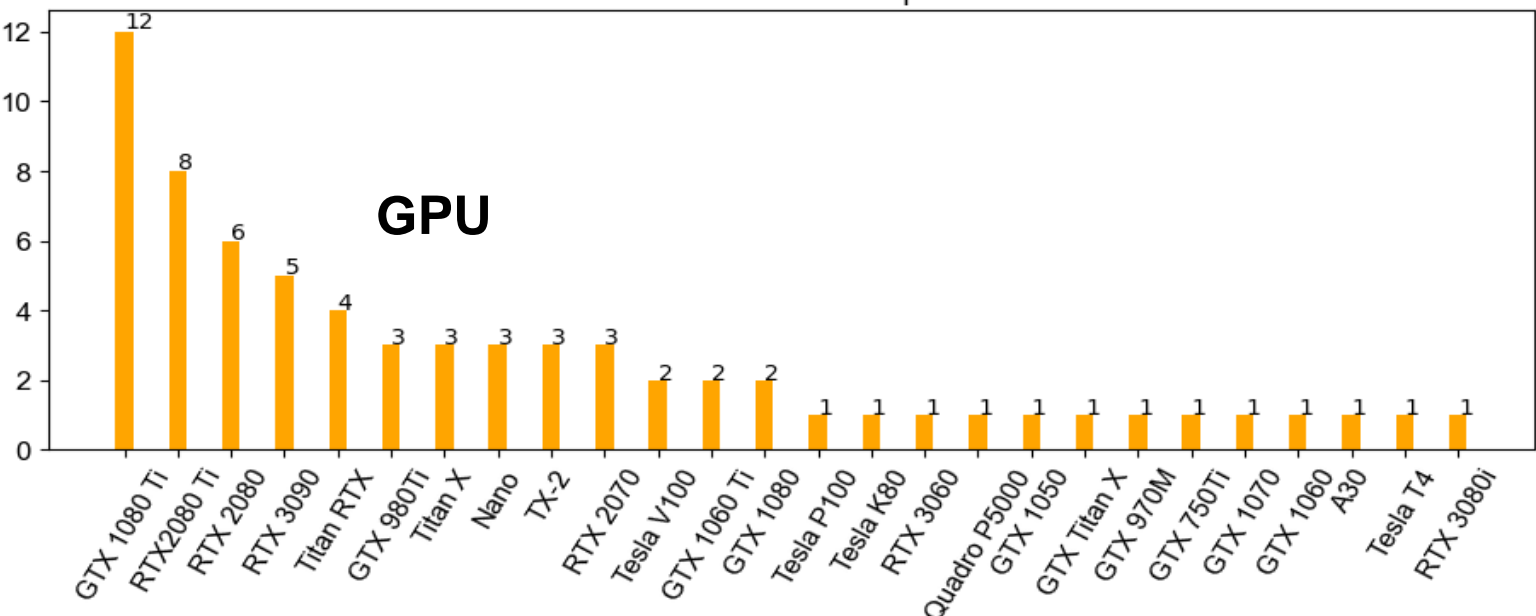
YOLO: incredibly fast speed

Segmentation tasks: Mask/Faster rcnn, U-net etc. has recently gained significant traction

Distribution of different Backbone used



Distribution of different GPU product used



## Indicator

Precision, Accuracy, Recall : Most frequently used

MOTA (7) and MOTP (2) : Tracking task

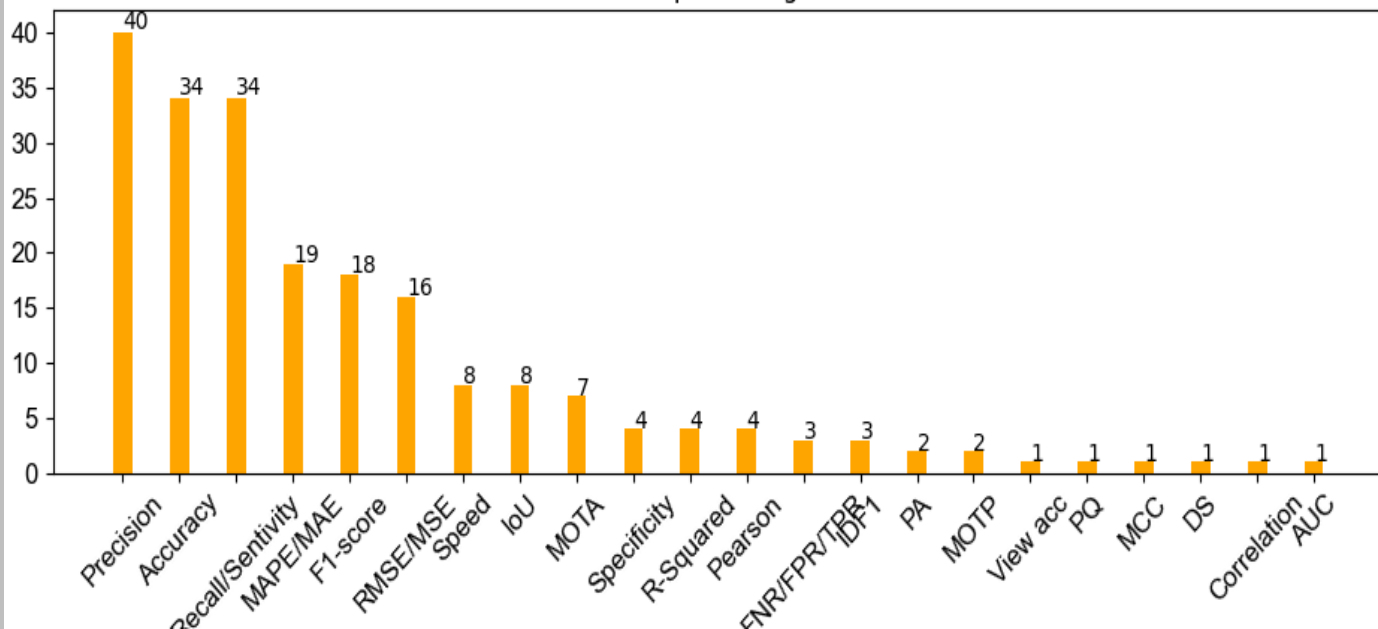
Higher the of CUDA cores number, Better the performance get;

## Key: Cost performance

High-performance GPUs have not been widely used.  
(GeForce RTX 40 series, Hopper GPU architecture etc.)

In actual commercial pig production,  
striking a balance between reasonable cost and suitable  
performance is essential

Distribution of Deep learning indicators used

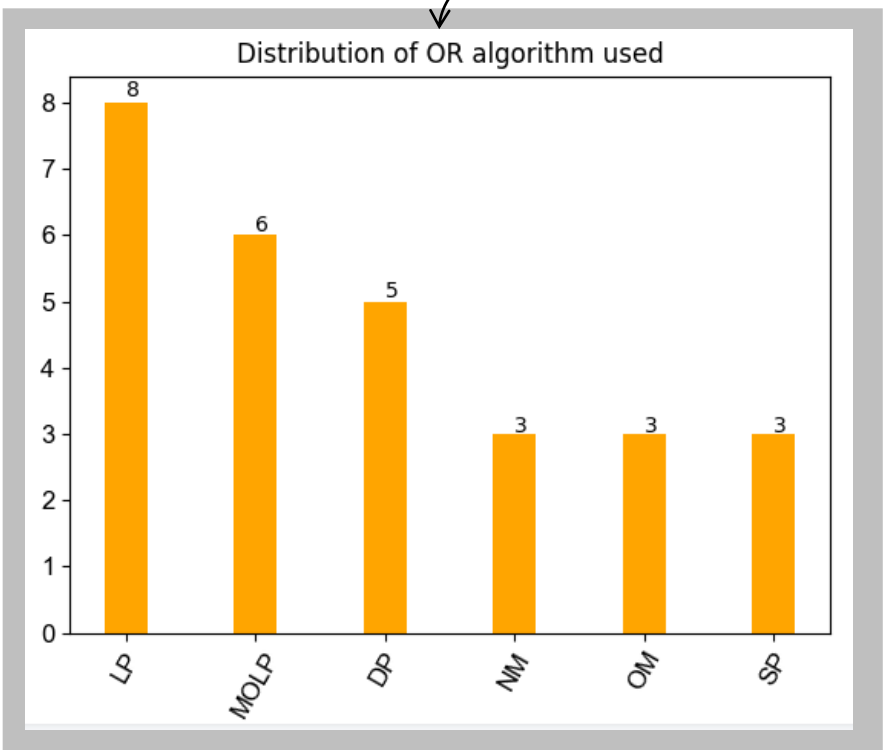


Agent	Frequency
All farm agents (NO PSC)	7
All farm agents (PSC)	4
Abattoir	4
Marketing	3
Fattening farms	3
Sow farms	1
Packers	1



**Tools(Language or Solver):**

OPL+Cplex(5),  
 Matlab(2),  
 Excel(1),  
 APML,  
 Gurobi,  
 SCIP,  
 Lingo,



# Benefits of integrating OR and DL

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- √ DL (Non-invasive) provide more information value, **expand the scope** of pig production research
- √ OR concept **contributes to the theory of DL**,  
DL breaks through many of the **bottlenecks encountered** of OR,  
(ex: DL Potential to solve: **Storage and computing efficiency** issues caused by large-scale parameters)
- √ **Transformation** of DL and OR problems  
(PJ: Converting the mathematical programming problem into an image representation(ling,2021),(Anderson2022). etc)
- etc.

- √ Data collection and annotation can be **time-consuming and costly**(data availability and quality)
- √ Standard data sets: **data compatibility and integration** (management information systems, sensors, and cloud platforms)
- √ DL **Interpretability and transparency**: hinder trust and acceptance of DL
- √ **Cost** of DL solutions

**Although there are still some challenges, integrating DL into existing DSS will effectively improve pig production performance.**

**Thanks !**