Summary of Smart Augmentation

Learning an Optimal Data Augmentation Strategy

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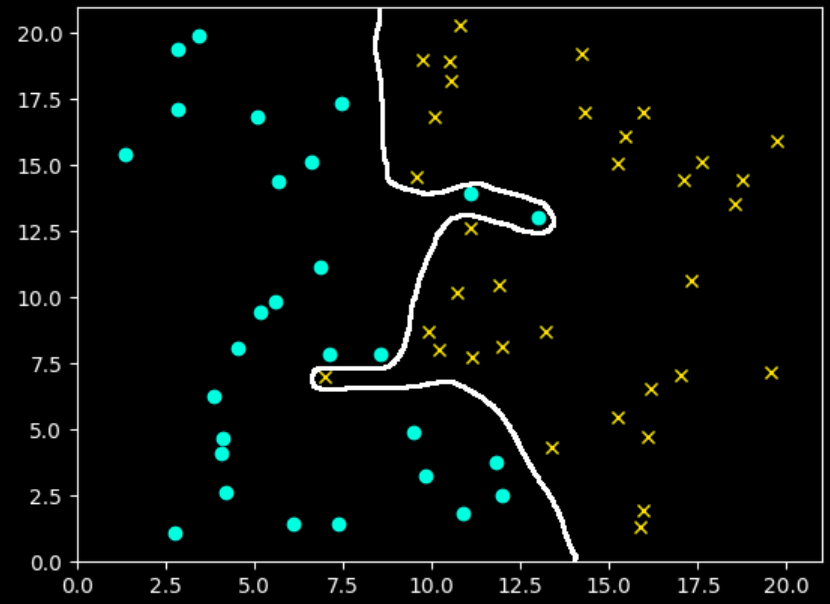
Motivation

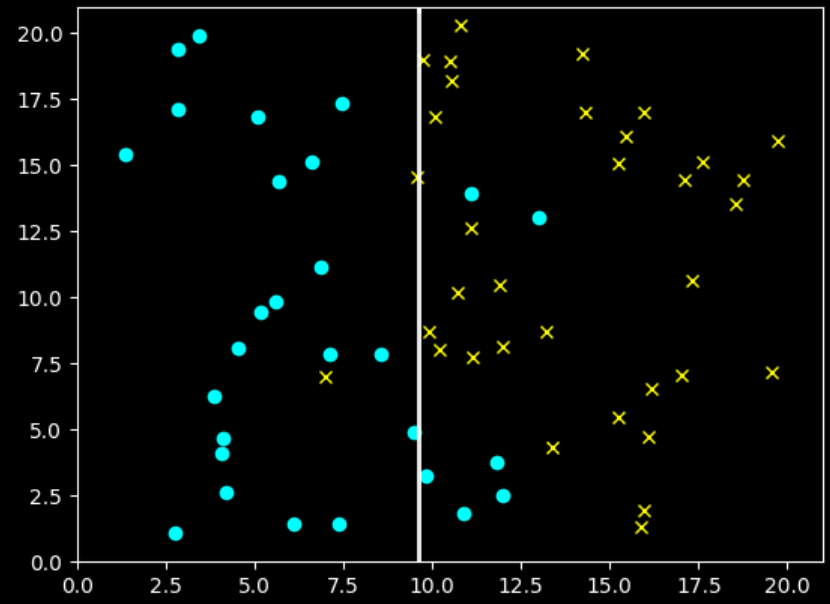
Our Problem

- Common problem by training a network:
  - You have not enough data available to maximize the generalization capacity of the network

Overfitting



Underfitting



Approach: Data Augmentation

- Problem:

  We need more data for the training step!

- Idea:

  Produce more data by augmentation
  - Can be done unsupervised or supervised

Unsupervised vs. Supervised

- Unsupervised:
  - Data driven augmentation
  - Done without feedback about the performance
- Supervised:
  - Any kind of controlled augmentation through a teacher

Augmentation Strategies

What We Want

- Supervised augmentation method
- Adjust its augmentation strategy to the current problem
- Does not worsen the trained network

→ **Smart Augmentation**

Smart Augmentation

What is Smart Augmentation?

- Gets: **dataset** and **feedback** from the network
- Finds the best augmentation strategy for classification problems
- **Reduces overfitting**
- **Increases the accuracy of the network**

How Does It Work?

- **Two networks *AN* and *DNN***

- Augmentation Network *AN*:
  - Gets samples from the dataset
  - Generates new samples for *DNN*
  - Learns the best augmentation strategy

How Does It Work?

- **Two networks *AN* and *DNN***

- Deep Neural Network *DNN*:
  - Will be trained with the sample from *AN*
  - Solves the actual claimed task
  - The loss is the feedback for *AN*

What is Smart Augmentation?

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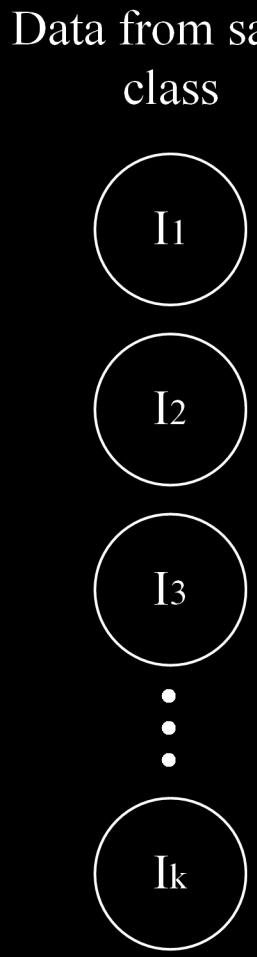

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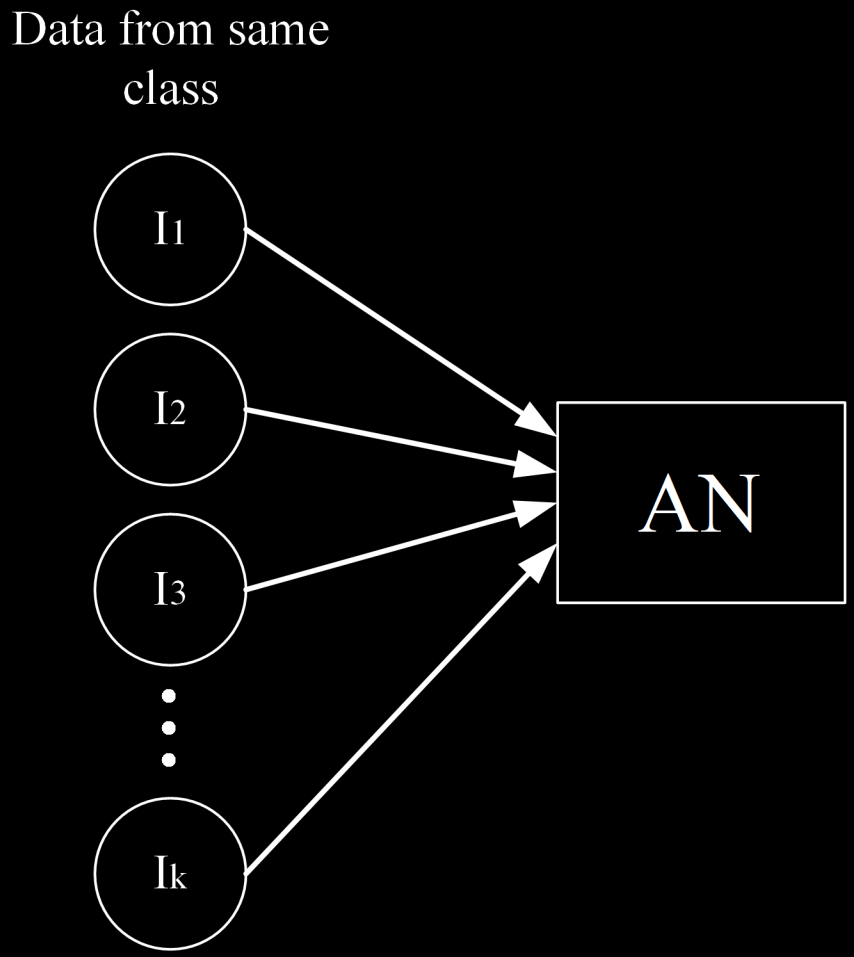
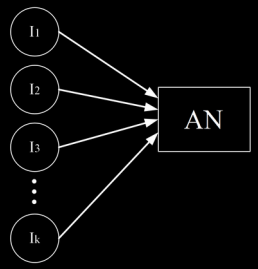
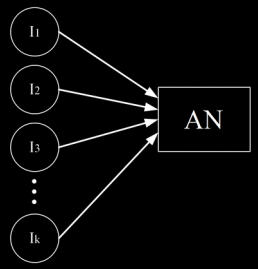


Augmentation Network



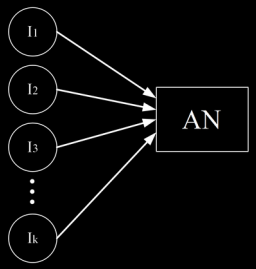
- Gets two or more samples from the same class
- Creates a new sample by intelligent blending
  - Approximates data from that class
    - → Contains features from that class

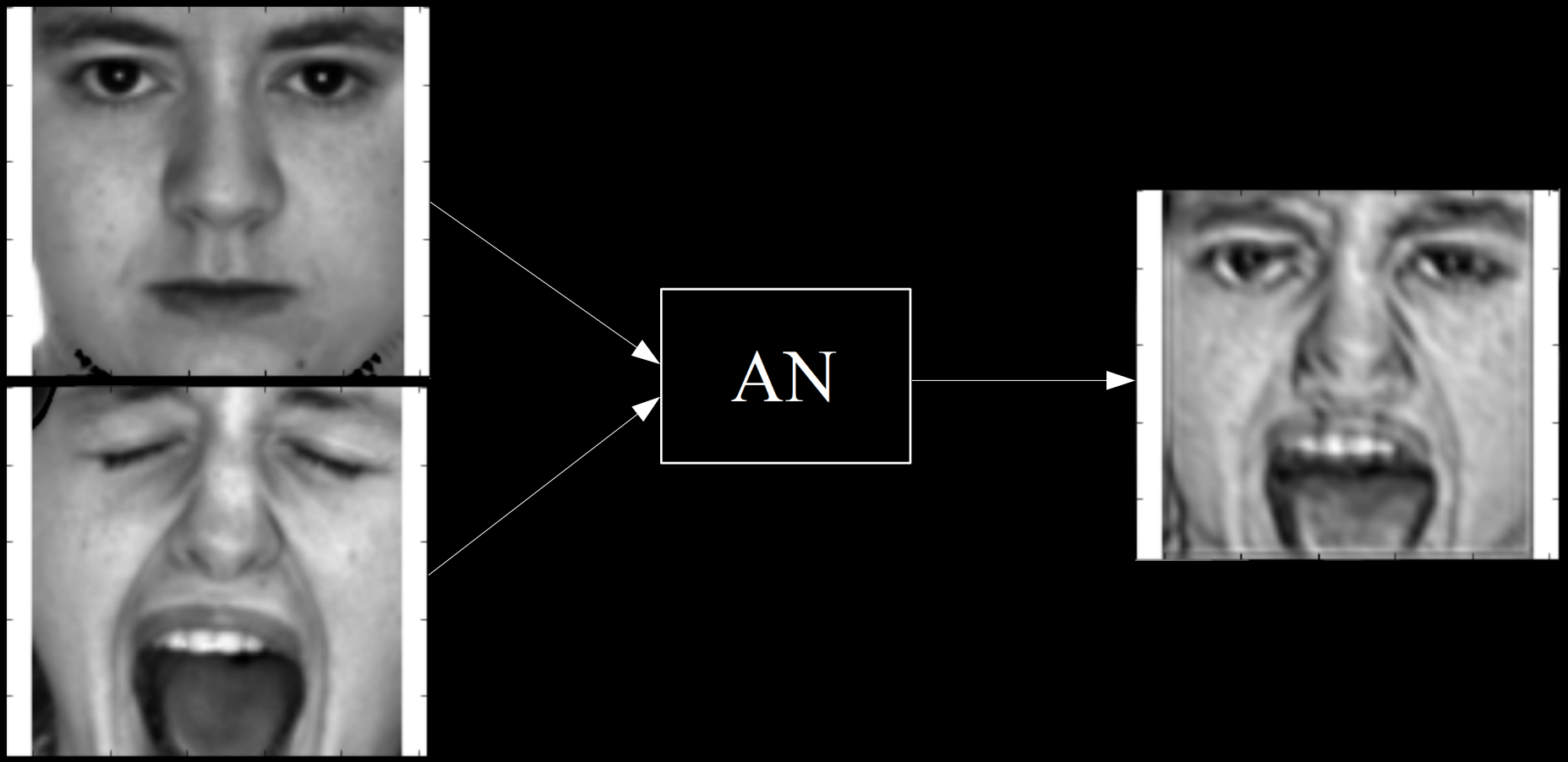
Augmentation Network



- Not important:
  - Quality of generated sample
- Important:
  - Generated sample contains features from the class of the input samples
  - Generated sample is not exactly one of its samples

Augmentation Network





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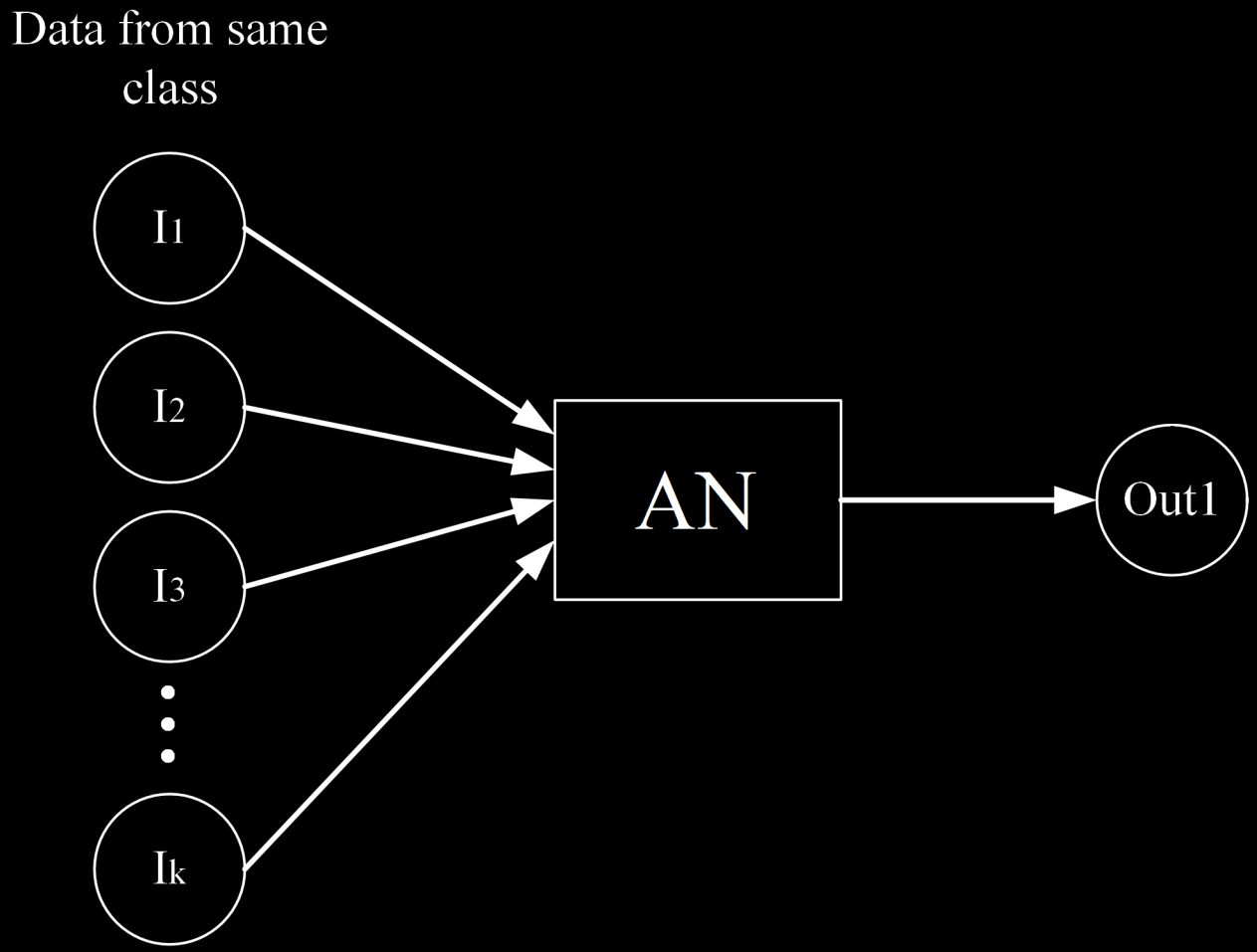

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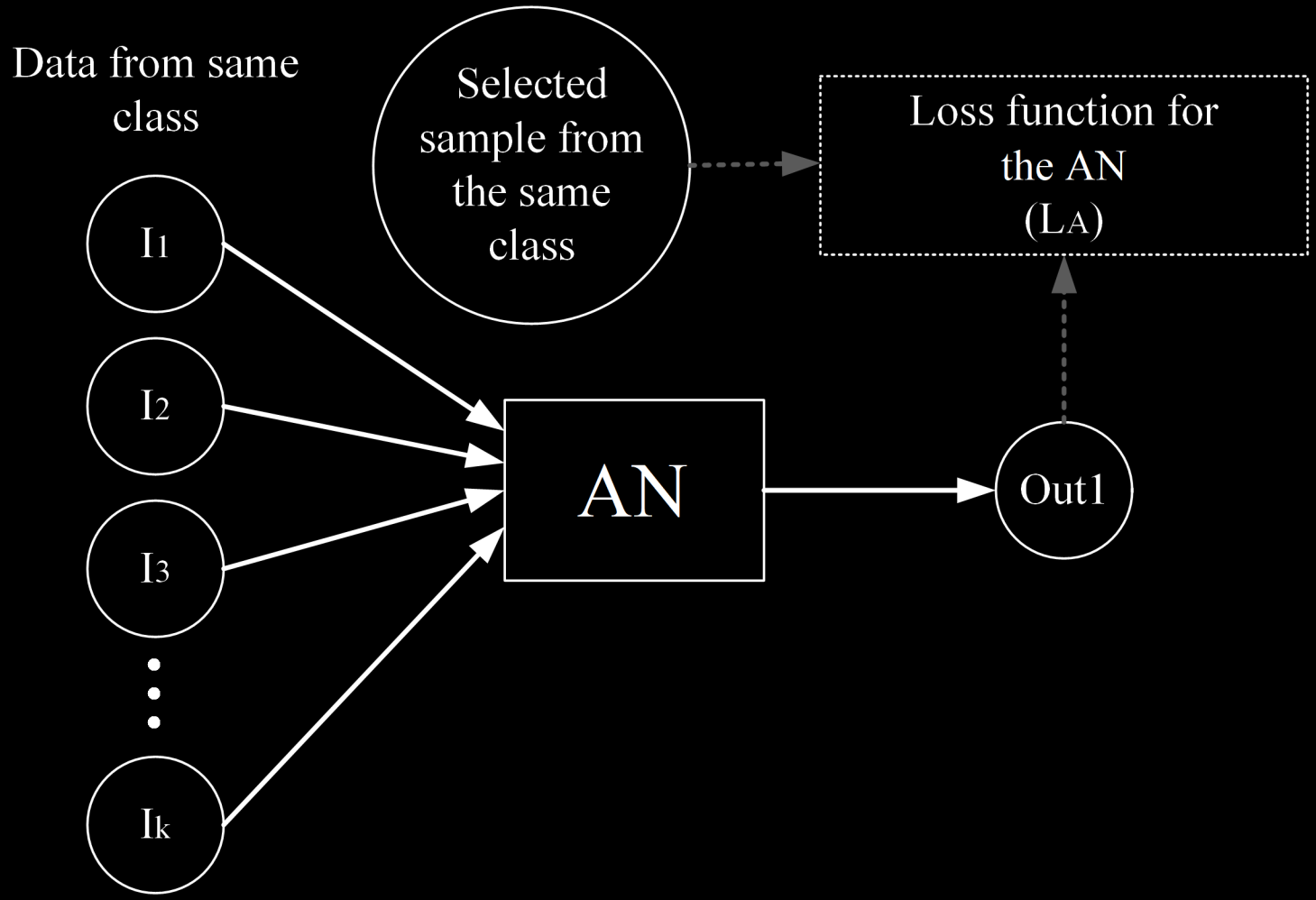

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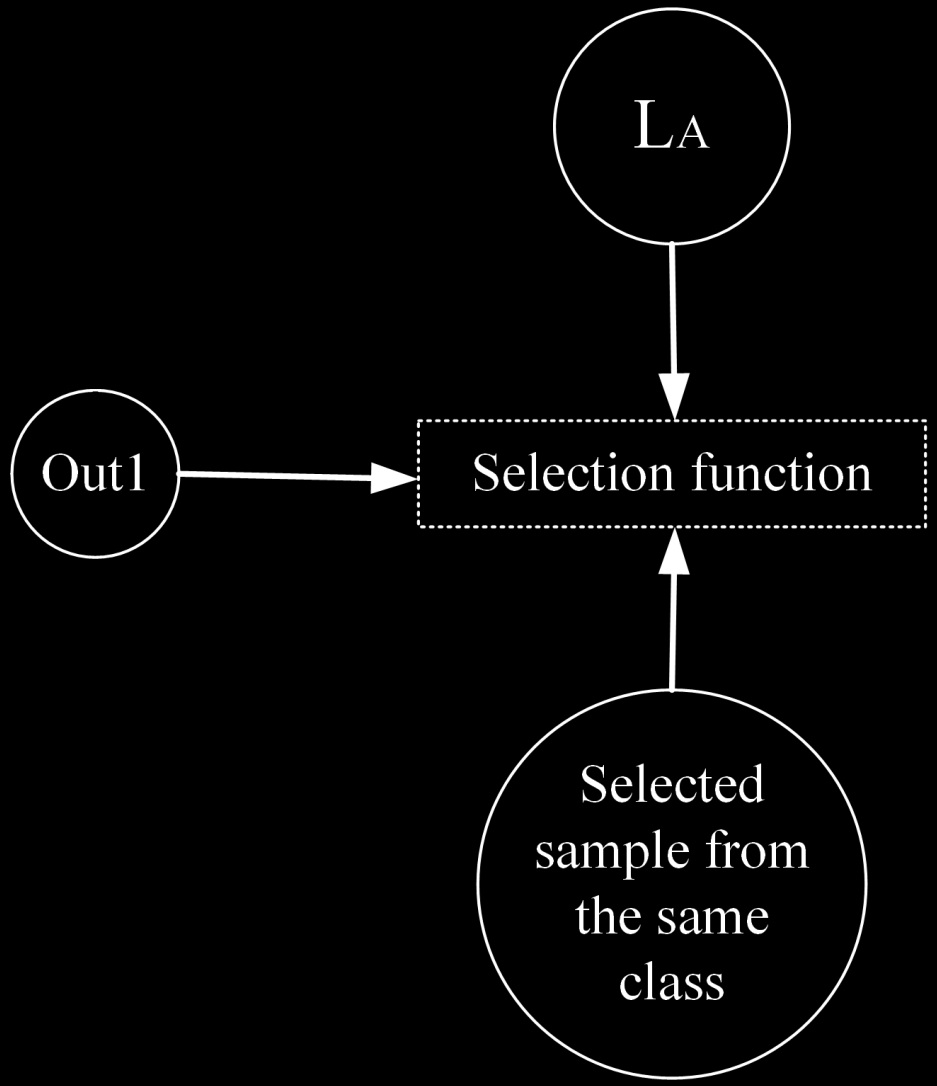

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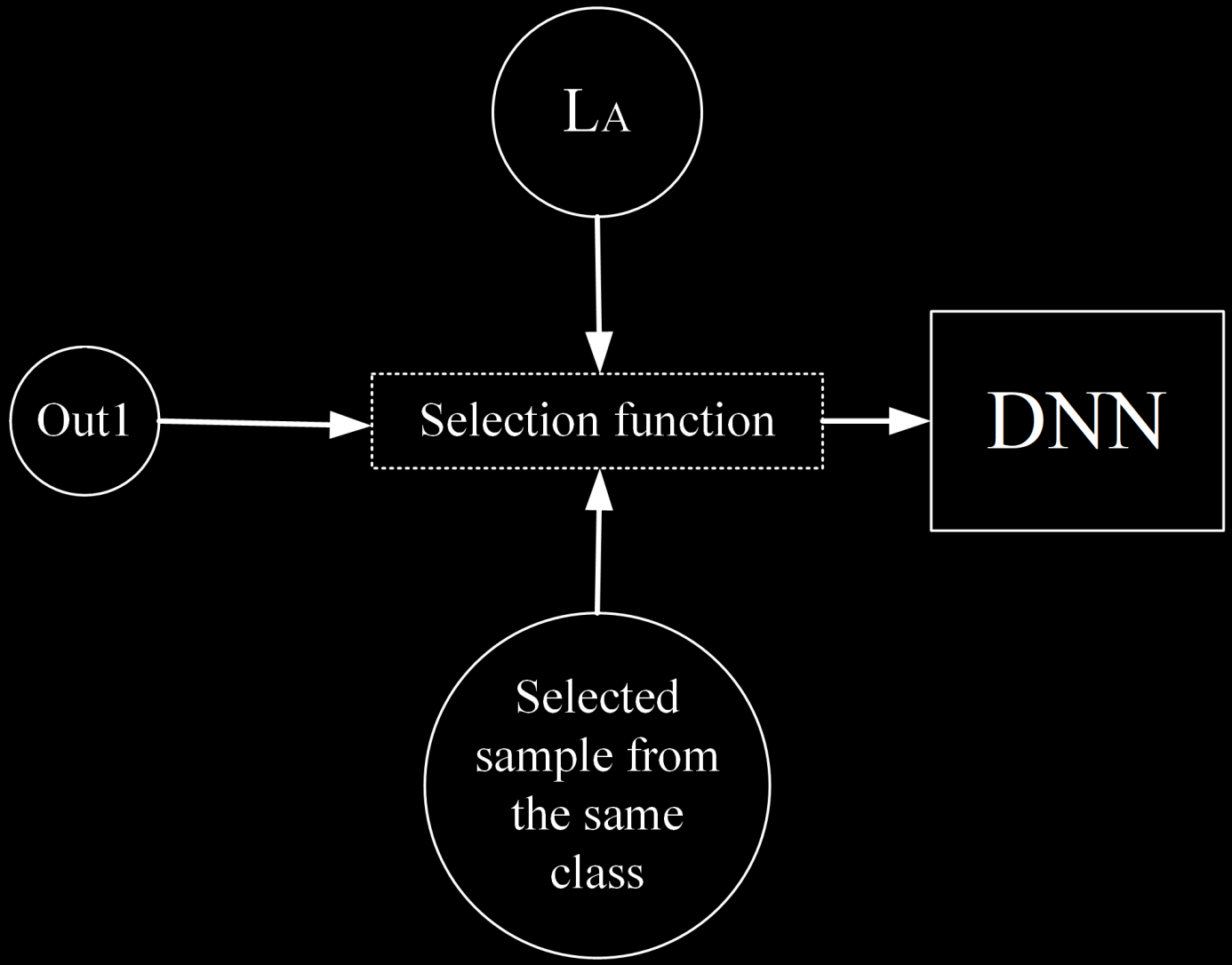

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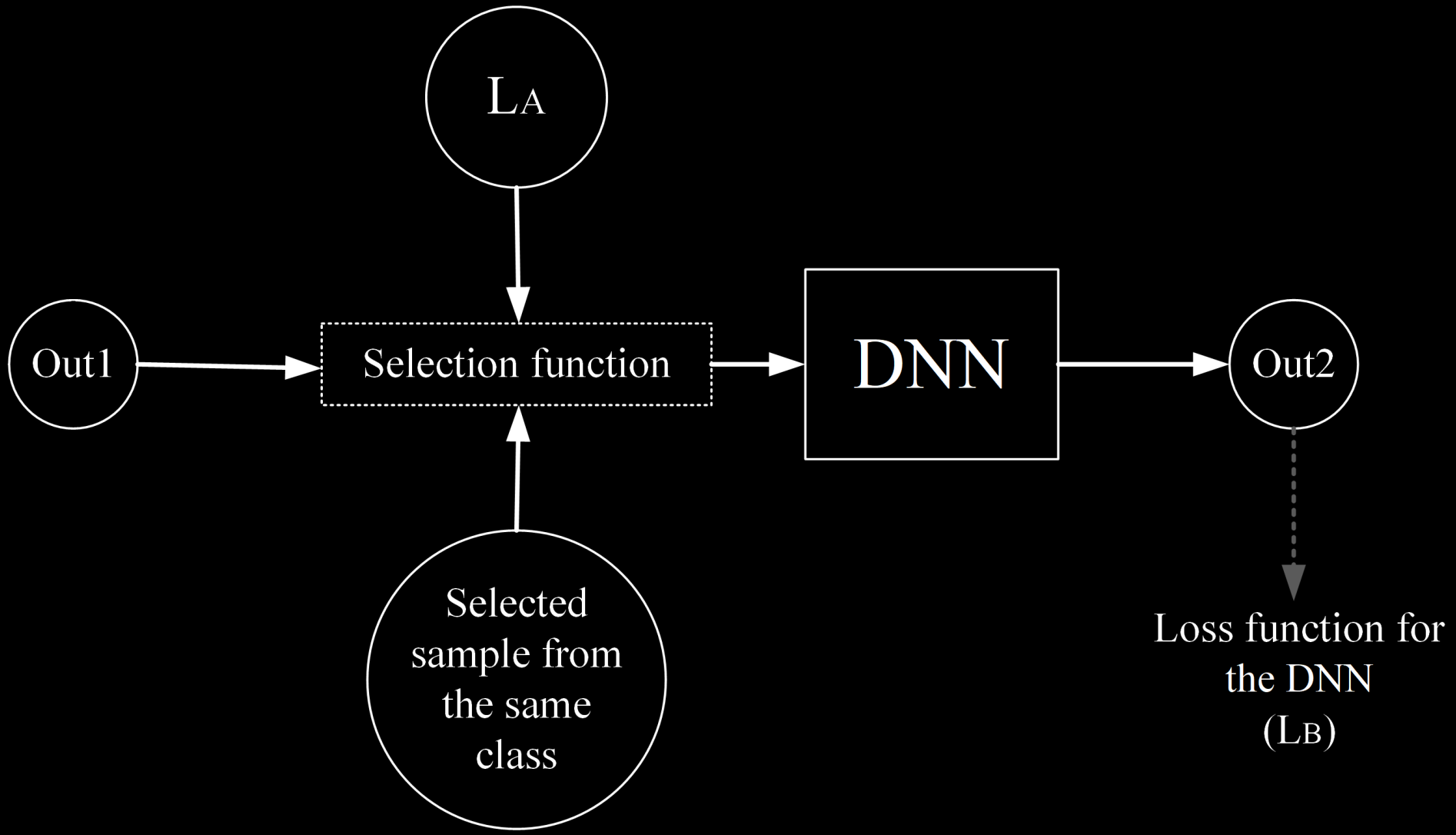

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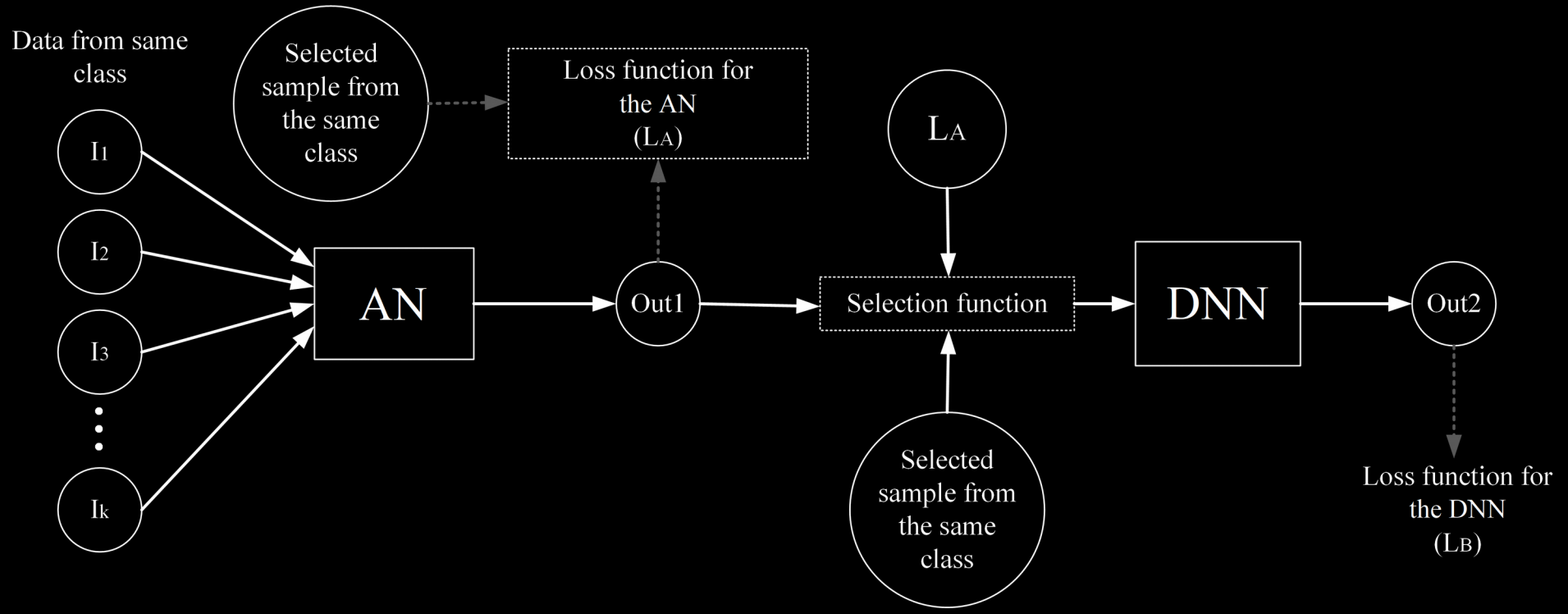
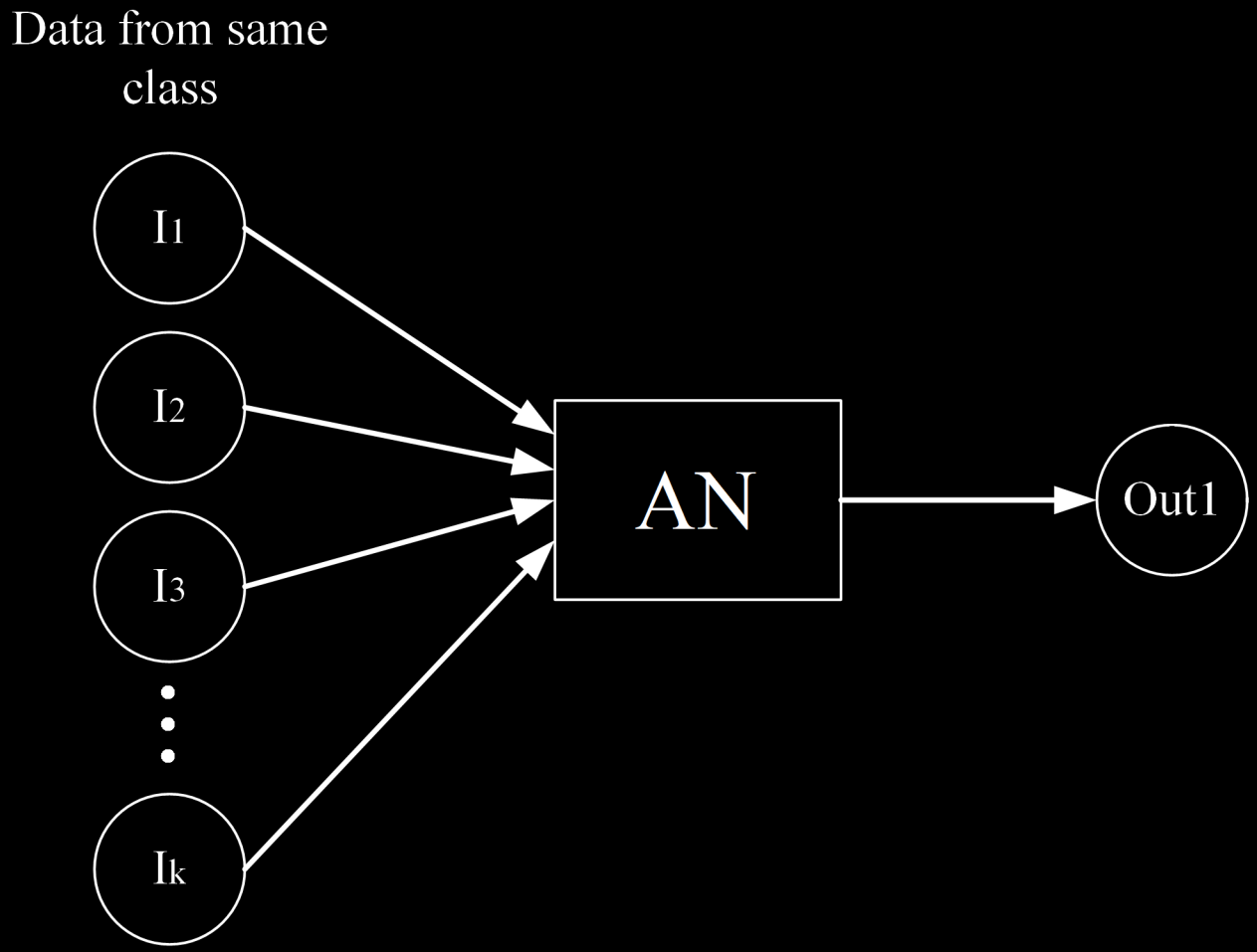


Several Augmentation Networks



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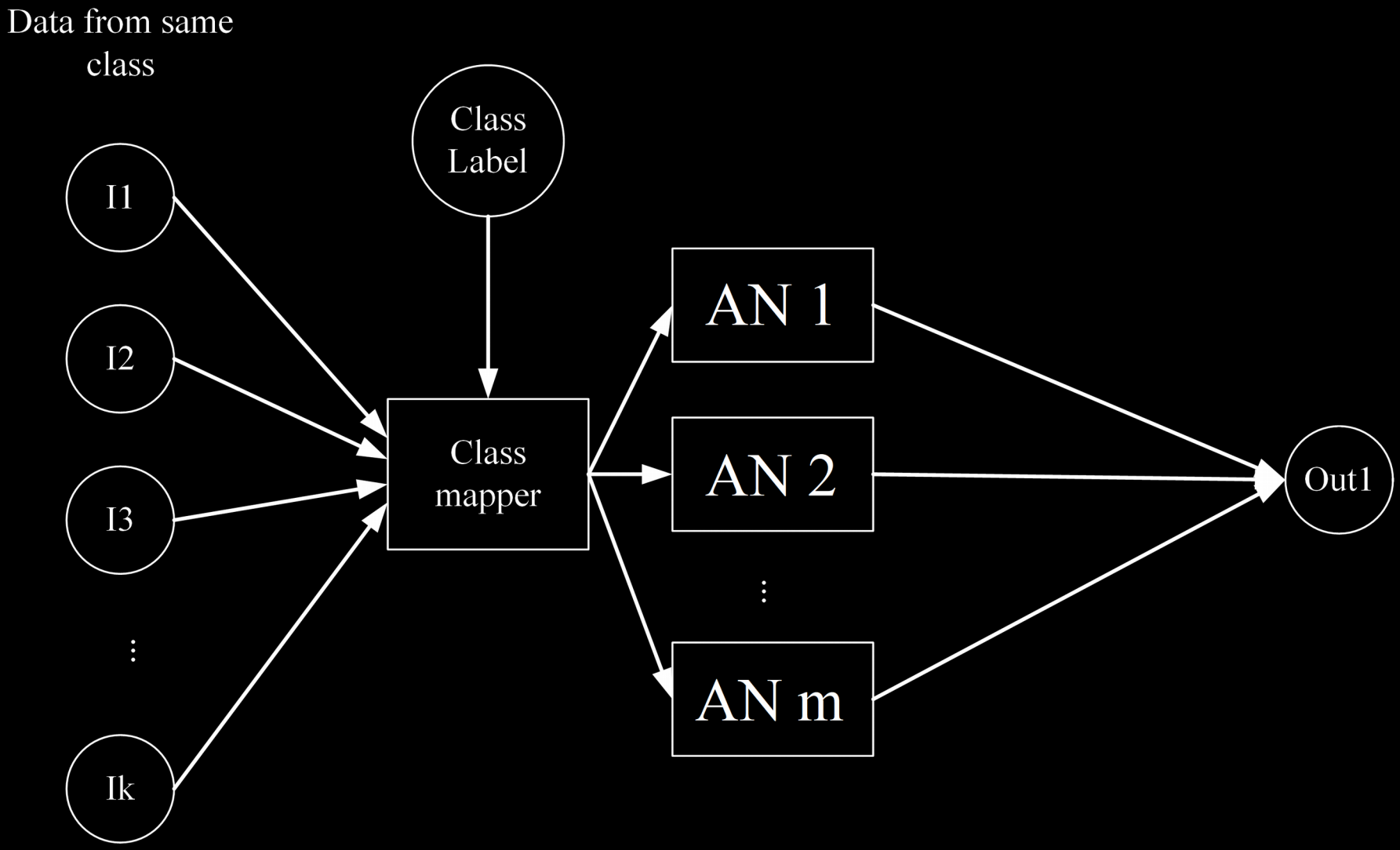

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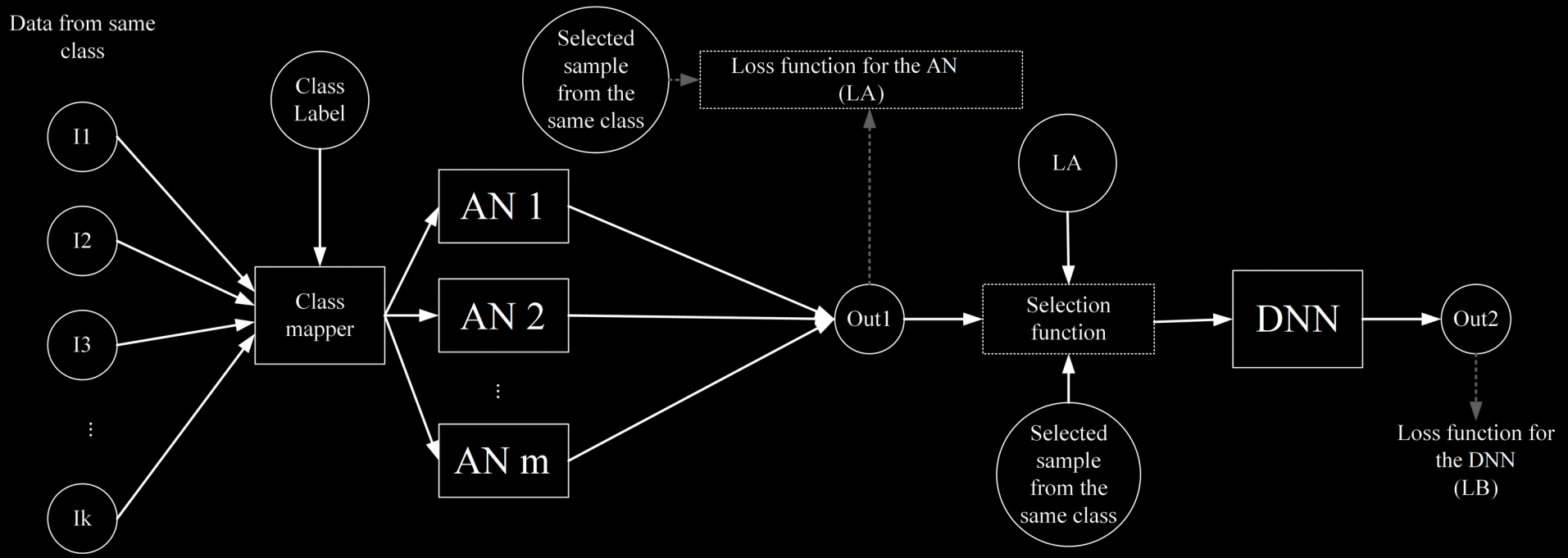


Which One is Better?

- One network for AN:
  - Only two networks have to be managed (AN and DNN)
- Several networks for AN:
  - Every network can learn its own class-specific augmentation strategies

Experimental Results

- They have only measured the impact of their method

- They have not compared their method with other methods

Experimental Results

- One network for AN:
  - Reduces overfitting and increases the accuracy significantly

	FERET dataset	Audience dataset
Without Smart Augmentation	83.52%	70.02%
With Smart Augmentation	88.46%	76.06%

Experimental Results

- Traditional augmentation and Smart Augmentation:
  - Traditional augmentation have improved the accuracy a little bit from 88.15% to 89.08%
  - Adding Smart Augmentation has improved the accuracy further to 95.66%

Experimental Results

- Two networks for the Augmentation Network (AN):
  - Average increase from 92.49% to 93.35%
  - Predominantly better than using just one network for AN

Advantages of Smart Augmentation

- Trains a workable network out of not enough samples
- Increases the accuracy of a neural network
- Reduces its overfitting
- It does not worsen the resulting network

→ **It can be used *“blindly”* on classification problems**

Discussion

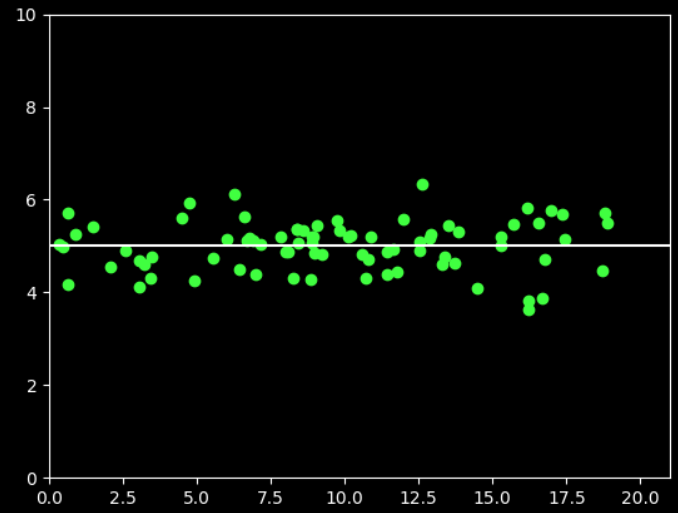
Discussion: Potential Improvements

- Concentrated on classification problems
- **NOT TESTED**: Non-classification problems
- Not possible to come to a final assessment

→ **Should just be used *"blindly"* if the problem is a classification problem**

Discussion: Regression Problems

- Try to predict a value for an input based on previous information
- Estimate a function that maps input to output
- Estimate an actual value
- Examples:
  - Payments → Credit Scores
  - Grades → Landing a Job



Discussion: Relevance for the Community

- Works really well on classification problems
- Is only tested on classification problems

→ Is not a sensational breakthrough

→ But still an important one for training neural networks for classification problems

Summary

- Useful method to improve the training step of neural networks
- Uses a second network that creates samples
- Learns the best augmentation strategy
- Only evaluated on classification problems
- Effect on non-classification problems is unknown

Thank you for your attention!

Questions?

Resources

- Joseph Lemley, Shabab Bazrafkan, and Peter Corcoran. Smart augmentation learning an optimal data augmentation strategy. IEEE Access, 5:5858–5869, 2017. Modified images used on slides 13 - 26
- Mark Hoffmann & Fabian Kahl. Lab Humanoid Robots: Toy Detection, 2018. Image used on slide 6
- https://campus.datacamp.com/courses/introduction-to-machine-learning-with-r/chapter-1-what-is-machine-learning?ex=6 Viewed: 2018-01-13