

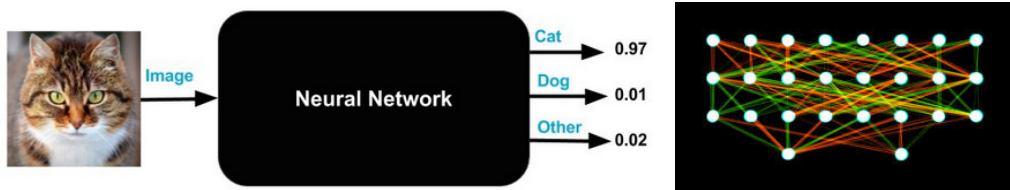
Neural Networks and Deep Learning: Deep Learning Weaknesses

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Deep Neural Networks: Weaknesses & Drawbacks

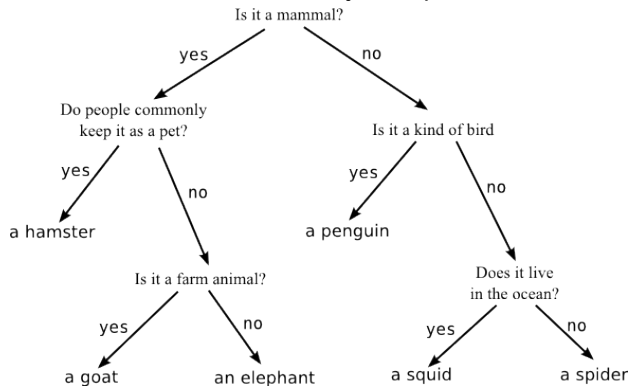
Criticisms at two main levels



1. Modeling level: Neural Networks \leftrightarrow Black Boxes
2. Training level: ad hoc, expertise, efficiency, guaranty

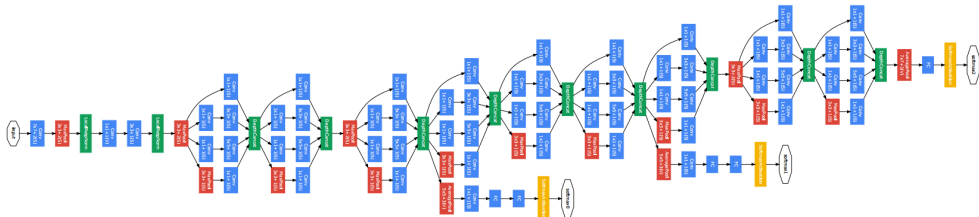
Deep Neural Networks: Black Boxes

- ▶ **Lack of explainability:** why this decision?
 - ▶ Hidden units not directly interpretable \neq others, e.g. decision trees, expert systems



⇒ Challenges: Human machine interaction, failure analysis

Deep Neural Networks: Black Boxes



- ▶ Lack of theory for architecture design
- ▶ How many layers, neurons?
- ▶ Layer type: fully connected, convolution, pooling?
- ▶ Trial/test: optimize architecture on validation set
⇒ *Ad hoc*, no theory to guide you

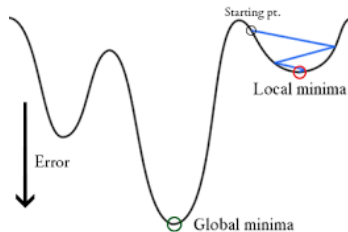
Deep Neural Networks: Training Issues

- ▶ **Optimization: non convex objective**
 - ▶ No guaranty to reach global optimum
 - ▶ Solution dependent on initialization
 - ▶ Importance of (random) initialization
⇒ training reproducibility
 - ▶ Expertise: *ad hoc* hyper-parameter tuning:
epochs, decay, etc
 - ▶ Costly Tuning

Hyperparameter
tuning



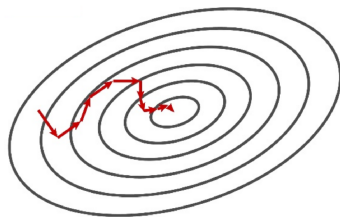
Best
hyperparameters



Deep Neural Networks: Training Issues

- **Optimization: stochastic training**

- Stochastic training for big data:
 - ⇒ gradient approximation
 - ⇒ ↑ difficulty for tuning



Hyperparameter
tuning



Best
hyperparameters

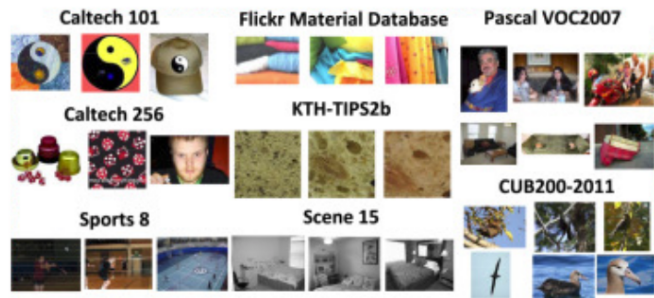
Deep Neural Networks: Training Issues

- ▶ **Big Data**
- ▶ Deep models need huge annotated datasets
 - ⇒ Huge models, huge computational demand
 - ⇒ Long be impossible to train such models with existing resources



Deep Neural Networks: Training Issues

- ▶ **Generalization:** deep models need huge annotated datasets
 - ▶ Smaller datasets: inferior predictive performances
 - ▶ Small models: not enough expressive power
 - ▶ Large models overfit
- ⇒ Performances ↓ handcrafted features



Deep Neural Network Weaknesses: Conclusion

- ▶ Deep learning Weaknesses:
 - ▶ Black box models
 - ▶ Training challenges at many levels
- ▶ Drawbacks ~~vs~~ NN strength over DL History
⇒ following!

