Week 3: Types of Learning

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Learning with Different Output Space

1. Binary Classification (true/false)
2. Multiclass Classification
    - y = {1,2,...,K}
    - Binary classification can be thought as a special type of multiclass classification, where K=2
3. Regression: Features mapped to a continuous range of output values, bounded or unbounded
4. Structured Learning
    - Multiclass classification problem where the number of possible combination of classes (structures) can be too huge to be explicitly defined
        - $structure \equiv hyperclass$

Learning with Different Data Label

1. Supervised Learning: All training input labeled with ground truth
2. Unsupervised Learning: Training input not labeled
3. Semi-supervised Learning: Some training input labeled with ground truth
4. Reinforcement Learning: No ground truth available, but able to tell if a predicted outcome is desired/correct or not

Learning with Different Learning Protocol

1. Batching Learning: Train the model by supplying all input at once
2. Online Learning: Start with a base model. Iteratively rebuild and improve the model as it makes prediction for sequential user inputs, and learns from mistakes.
3. Active Learning: Have the model query for the value of y_n for *strategically chosen* x_n, such that the model improves faster and requires fewer labeled training input.
    - Useful when acquiring labeled training input is costly.

Learning with Different Input Space

1. Concrete Features
    - Each dimension of $\chi \subseteq \mathbb{R}^d$ represents *sophisticated physical meaning*

    - Meaning of feature might be related to that of target
    - Human domain knowledge is involved to help understand and make sense of the inputs
2. Raw Features
    - Input dimension only has simple meaning, e.g. pixel density in an image
    - Requires feature engineering to extract/convert raw feature into more concrete ones (involving context of the learning problem)
3. Abstract Features
    - Input has no physical meaning, e.g. obfuscated customer id, item id
    - Feature engineering required
    - Algorithm needs to infer meaning of/relationship between input values and target