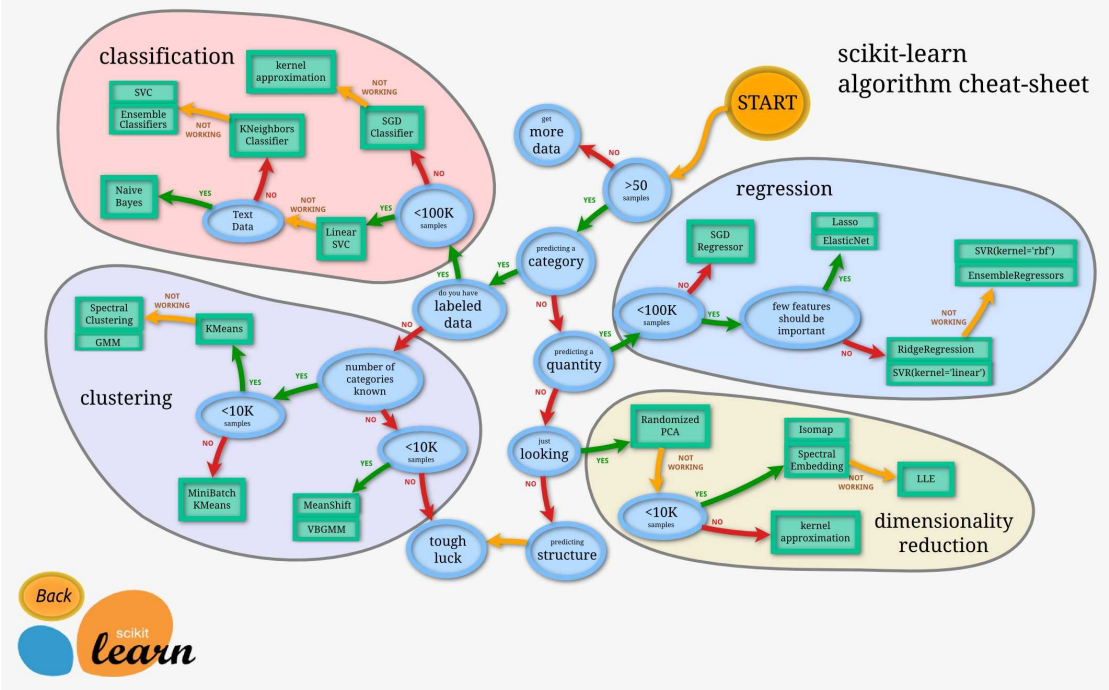
Lesson 1 Introduction

ML 定义： A computer program is said to learn from experience E with respect to some class of tasks T and performance measure P, if its performance at tasks in T, as measured by P, improves with experience E

ML 方法判断：



广义分类：

1. 监督学习/supervised learning：回归 regression 及分类 classification

   回归：定量输出，连续变量预测，例如给出一个点，求模型的预测输出

   分类：定性输出，离散变量预测，例如给出一个点，求其分类

   分类问题：二分类及多分类，函数近似问题 function approximation（离散）

   泛化能力 generalization：利用模型预测未知标签输入之输出的能力

   分类问题的概率模型：将最高概率的例子加入某一分类

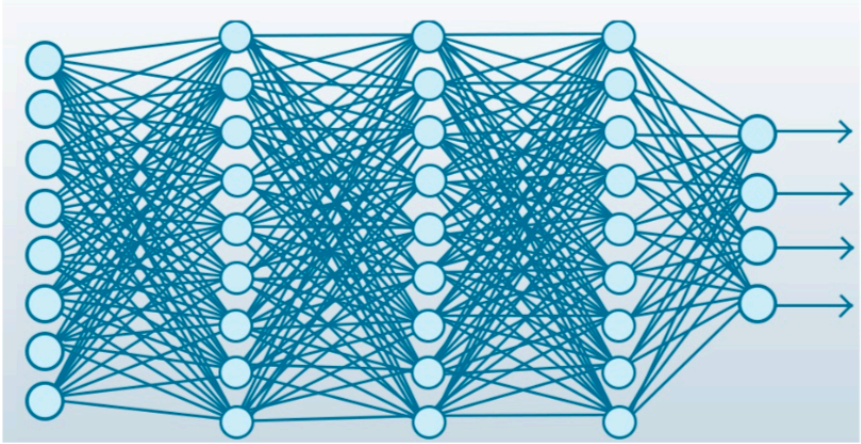
   A probabilistic formulation of classification:
   - From training data $\mathcal{D} = \{\mathbf{x}_i, y_i\}_{i=1}^{N}$, learn a conditional distribution $p(y|\mathbf{x})$.
   - Assign an instance $\mathbf{x}$ to the classification with the maximum probability:

   $$\hat{y} = \hat{f}(\mathbf{x}) = \arg\max_{c=1}^{C} p(y|\mathbf{x})$$

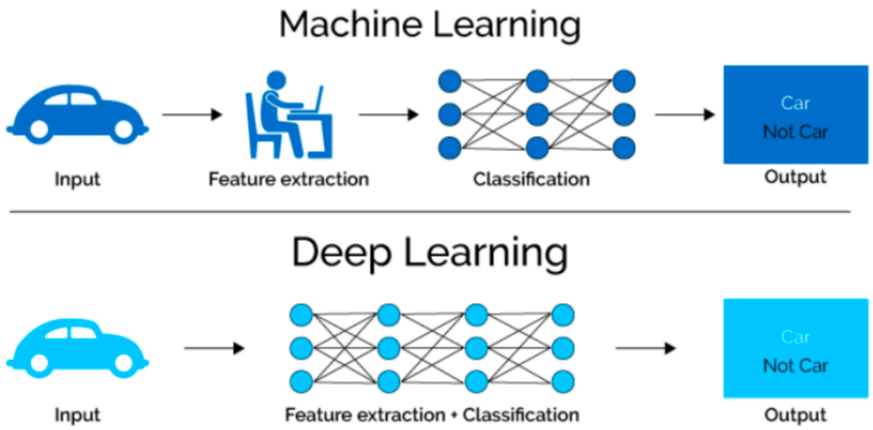
   回归问题：给定训练数据 x 以及对应的标签 y，学习 y 与 x 之间的映射 y = f(x)，其中 y 是连续的

2. 非监督学习 unsupervised: 聚类 clustering/降维 dimensionality reduction/结构发现 structure discovery...目标是为了发现有趣的 pattern
   聚类问题：类内距离最小，类间距离最大
   降维：降低数据维度，常用于数据可视化 data visualization
   结构发现：discover a graph structure about how a set of variables are related.
3. 增强学习 reinforcement learning：agent 通过偶然的奖励或者惩罚信号学习如何表现的更好；深度学习 Deep Learning：相比较机器学习不用人为生成 feature

- **Deep learning** is a class of machine learning algorithms that:
  - Use a cascade of multiple layers of nonlinear processing units for feature extraction and transformation.
  - Each successive layer uses the output from the previous layer as input.
  - Learn in supervised (e.g., classification) and/or unsupervised (e.g., pattern analysis) manners.
  - Learn multiple levels of representations that correspond to different levels of abstraction; the levels form a hierarchy of concepts.



- Deep learning has a unique advantage, i.e., **automatic feature extraction**.
- It means that this algorithm automatically grasps the relevant features required for the solution of the problem.
- It reduces the burden on the programmer to select the features explicitly.



课程规划：

1. Supervised Learning

   Linear and Polynomial Regression: Lect 03

   Logistic and Softmax Regression: Lect 04

   Generative Models for Classification: Lect 05

   Support Vector Machines: Lect 06

   Learning Theory: Lect 07

2. Deep Learning

   Deep Feedforward Networks: Lect 08

   Convolutional Neural Networks: Lect 09

   Recurrent Neural Networks: Lect 10

3. Unsupervised Learning

   Variational Autoencoders: Lect 11

   Generative Adversarial Networks: Lect 12

   Finite Mixture Models: Lect 13