Machine learning

ETCS 402

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Write in chat box number you feel right now

1

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Class rules

- **Mic off**
- **Videos on**
- **Respect yourself and others**
- **Raise your hand to speak**
- **Keep notebook and pen near**
- **Be punctual**
- **Keep your thinking caps on**

UNIT-I

Introduction:

Basic concepts: Definition of learning systems, Goals and applications of machine learning. Aspects of developing a learning system: training data, concept representation, function approximation.

Types of Learning: Supervised learning and unsupervised learning. Overview of classification: setup, training, test, validation dataset, over fitting.

Classification Families: linear discriminative, non-linear discriminative, decision trees, probabilistic (conditional and generative), nearest neighbor.

[T1, T2][No. of Hrs: 12]

Learning problem. What?

learning = improve with experience at some task

- T task is improved
- P with respect to performance measure
- E experience

E.g., learn to identify monkey in photo

- T: Identify monkey photo
- P: percentage of times identified correctly
- E: identify on its own

learning to identify monkey in photo

- T: Identify monkey photo
- P: percentage of times identified correctly
- What experience?
- What exactly should be learned?
- How shall it be represented?
- What specific algorithm to learn it?

Type of training experience

- Direct or indirect?
- Teacher or not?
- A problem: is a training experience representative of performance goal?

Choose the target function

- `ChoosePhoto: Photo->mark ??`
- `V: Photo -> R ??`
- `….`
-

Possible definition for target function V

- If p is a final photo state that is correctly identified, then V(p) =100
- If p is a final photo state that if not correctly identified, then V(p) =-100
- If p is a final photo state is identified, then V(p) =0
- If p is not final photo, then V(p)=V(p’), where p’ is the best final photo state that can be achieved starting from p and identifying optimally until the end of the photos to identify.
- This gives a correct values, but is not operational

Checkers game

T: ?

P: ?

E: ?

For the checkers game

T: play checkers

P: percentage of games won in tournament

E: opportunity to play against itself

Choose representation for target function

- Collection of rules?
- Neural network?
- Polynomial function of board features?
- ...

A representation for learned function

W0+w1.bp(b)+w2.rp(b)+w3.bk(b)+w4.rk(b)+w5.bt(b)+w6.rt(b)

- bp(b): number of black pieces on board b
- rp(b): number of red pieces on b
- bk(b): number of black kings on b
- rk(b): number of red kings on b
- bt(b): number of red pieces threatened by black
- rt(b): number of black pieces threatened by red
- W0 to w6: numerical coefficient / weights

Obtaining training examples

- $V(b)$: the true target function
- $\hat{V}(b)$: the learned function
- $V_{train}(b)$: the training value

One rule for estimating training values:

- $V_{train}(b) \leftarrow \hat{V}(Successor(b))$

Choose weight tuning rule

LMS Weight update rule:

Do repeatedly:

- Select a training example b at random
  1. Compute $error(b)$:

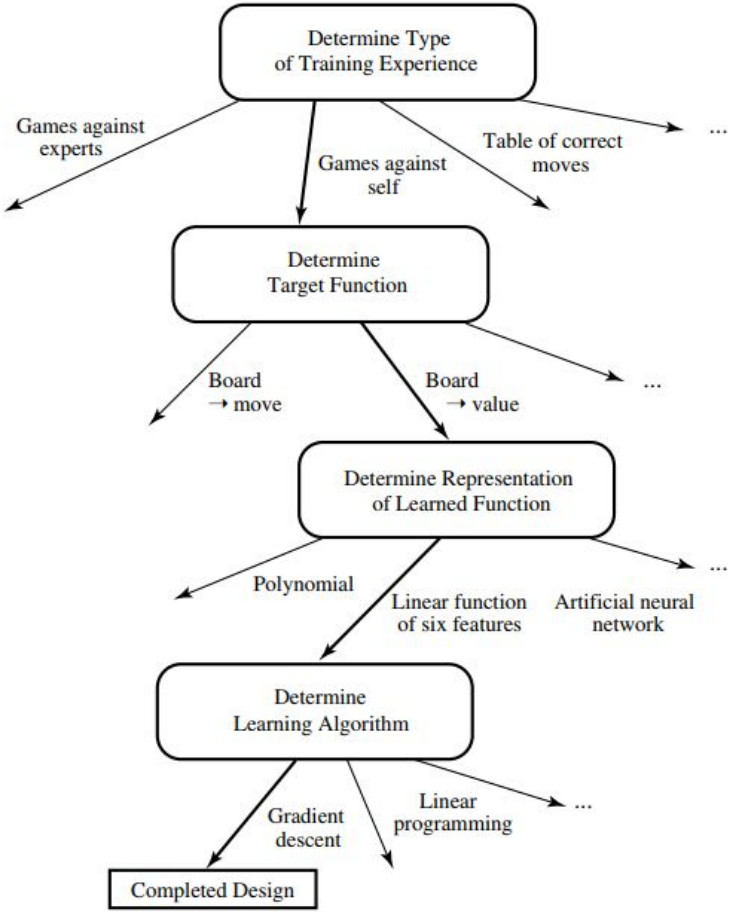
$$error(b) = V_{train}(b) - \hat{V}(b)$$

  2. For each board feature f_i, update weight w_i:

$$w_i \leftarrow w_i + c \cdot f_i \cdot error(b)$$

c is some small constant, say 0.1, to moderate the rate of learning

Design choices



Some issues in ML

- What algorithms can approximate functions well (and when)?
- How does number of training examples influence accuracy?
- How does complexity of hypothesis representation impact it?
- How does noisy data influence accuracy?
- What are the theoretical limits of learnability?
- How can prior knowledge of learner help?
- What clues can we get from biological learning systems?
- How can systems alter their own representations?

Do on your own

Pick some learning task not mentioned in the class. Describe its informally in a paragraph in english. Now describe it by stating as precisely as possible the task, performance measure, and training experience. Finally, propose a target function to be learned and a target representation. Discuss the main trade offs you considered formulating this learning