Data Science Methods for Clean Energy Research

Week 10 L2: This Is the End
March 8, 2017

UNIVERSITY of WASHINGTON

Outline

- Quick review from last time
- A brief note on the support vector machine
- Comparison of supervised vs. unsupervised learning
- Principal components analysis (PCA)
- Clustering
- Wrap up

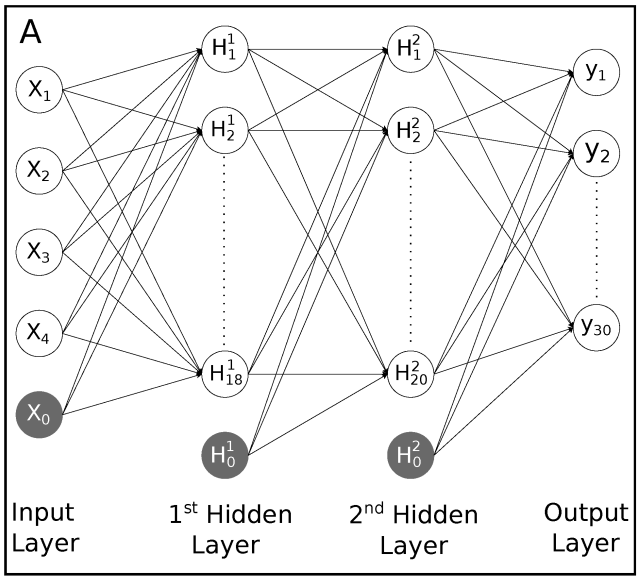
Topics last time

> ***In which I made your hearts race with a dazzling tale of unsupervised learning and intrigue***

Big picture concepts:

- *The brains of DIRECT cohort 1 are fully cooked and ready to come out the oven*

What is a neural network?



- Hidden layer neural networks are a supervised machine learning method
- Make predictions of one (or more) responses (Y) given a set of features (X)
- Inference about the relationships is essentially impossible, but predictive accuracy can be quite good
- Require large training and validation sets. Training cost can be high!
- Huge amount of tutorials, free information, literature, etc available online to learn more
- See, in particular, Elements of Statistical Learnin' CH11

Neural networks in python

- **Sklearn neural net:** no GPU implementation and not viewed as ready for “large scale applications”. Probably a great learning/teaching tool!
- **Keras:** libraries built for Python, large user base and seen to be faster and well supported. Uses the TensorFlow library (a graph system for your ML data)
- **Lasagna (nolearn):** libraries built for Python, large user base and well supported. Uses Theano (a different graph system for your ML data)

Where to learn more about time-series machine learning (when you are ready)

- **Basic concepts in ML for time series data:**
  - **You can apply a correction for either** drift **or** periodic seasonality **in your data**
    - **This solves the problem of analyzing means and variances of your data**
    - **This DOES NOT solve the problem that your data can be oversampled (e.g., sampling too much during correlated periods!)**
- **Decent sets of notes online:**
  - **https://www.analyticsvidhya.com/blog/2015/12/complete-tutorial-time-series-modeling**
  - **https://www.analyticsvidhya.com/blog/2016/02/time-series-forecasting-codes-python/**

Time series ML in python

- **I couldn't find an obvious, well-supported, "TIME SERIES FOR MACHINE LEARNING" Python package**
- **Seems like it is more of a niche area**
- **There are many examples online, and people often write their own code to condition the data** (as in last slide) **and then use established ML methods**
- **Take care!**

Capstone project process

- You have just the list and title of the projects
- Each project has a 1-2 page description (you saw the template for this already)
- Today: feedback from you on how the projects should be selected
- Friday (hopefully): release ”project book” to you
- Monday: share feedback w/DIRECT faculty and feedback from faculty
- Monday: give you instructions for project selection

How should I assign you to projects?

- **More specifically: how would you deal with the situation of over-subscribed projects?**
- **Can we come up with a list of priorities?**
  - **E.g.: "Every EE gets their 1st choice" , then "Everybody from PNNL wearing a blue shirt gets to work with a chemist"** ← those are not good rules tho
- **Any other comments / suggestions ?**

How I would start a project: If I were a DIRECT trainee

- Meet with my team asap
- Meeting 1 topics
  - Agree on timetable and work effort
    - Agree on a minimum # of hours working together / week and set a schedule
    - Agree on what you will do if people don't show up and are not contributing
    - Discuss that if people don't show up it is not because they care but because they are busy and might not be as good as time management as you are
    - Distribute this "charter" or "contract" via email and everyone reply-all that they agree

How I would start a project

- Meeting 1 topics
  - Determine what you know and “don’t know” about the project based on the description
  - Make a preliminary plan for how you will complete the project using your DIRECT class projects as an example
  - Plan your first meeting with your project sponsor
    - Rank order the things you need to know in terms of how essential they are to starting the project – you might run out of time!

How I would mentor a project: If I were a DIRECT sponsor

- Assume the following
  - A high level of independence
  - Teams will ask me if they need help
  - Someone will tell me what to do unless it is more than a regular meeting and high-level supervision of progress
  - Students will tell me if the project is interfering with their other obligations
- Aspire to the following
  - Projects will lead to a successful deliverable including software and/or publication
  - Students will reinforce existing skills/tools and get something important for their resume/jobs