Machine Learning I: Supervised Methods

B. Keith Jenkins

Announcements

- Project Reports and code are due Friday 4/26
  - See piazza for late submission policy
- Final exam is Wed., May 1
  - 4:30 - 6:30 PM
  - SAL 101 (on-campus exam)
  - Ground rules same as midterm exam except 2 formula sheets allowed (1 new + 1 old).
- Sample exam problems
  - Will be posted soon (2 sets)
  - More in Discussion 15 this Friday
- HW solutions will be posted
- Course (learning experience) evaluation
  - Please fill out at your convenience
  - Email from USC learning experience evaluation: c-evals@usc.edu

Today's lecture

- Summary of supervised ML
  - Key elements and paradigm
  - Design cycle and processing streams
  - Overall view of course topics
- Review of material for final exam

Key Elements of Machine Learning Systems - Summary

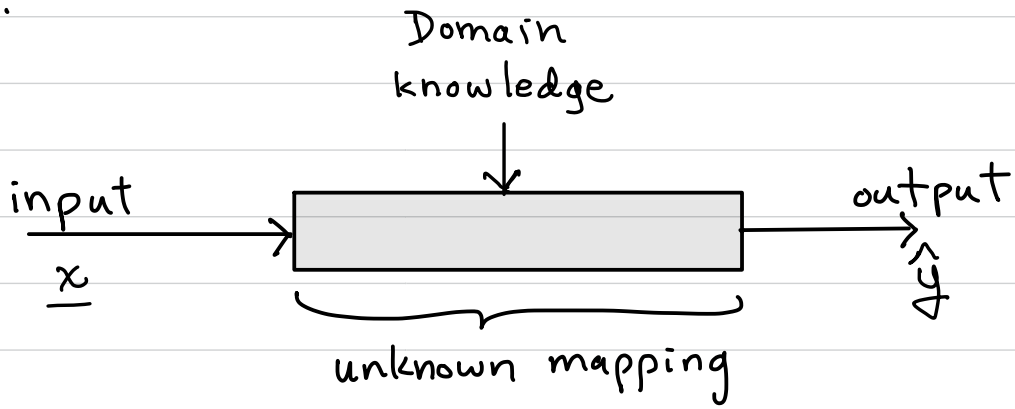
- Data
- Features
- Models
- Learning
- Prediction
- Post-processing

Included in these elements are

- Optimization
- Criterion functions and loss functions
- Performance measures and estimates

Supervised ML Paradigm

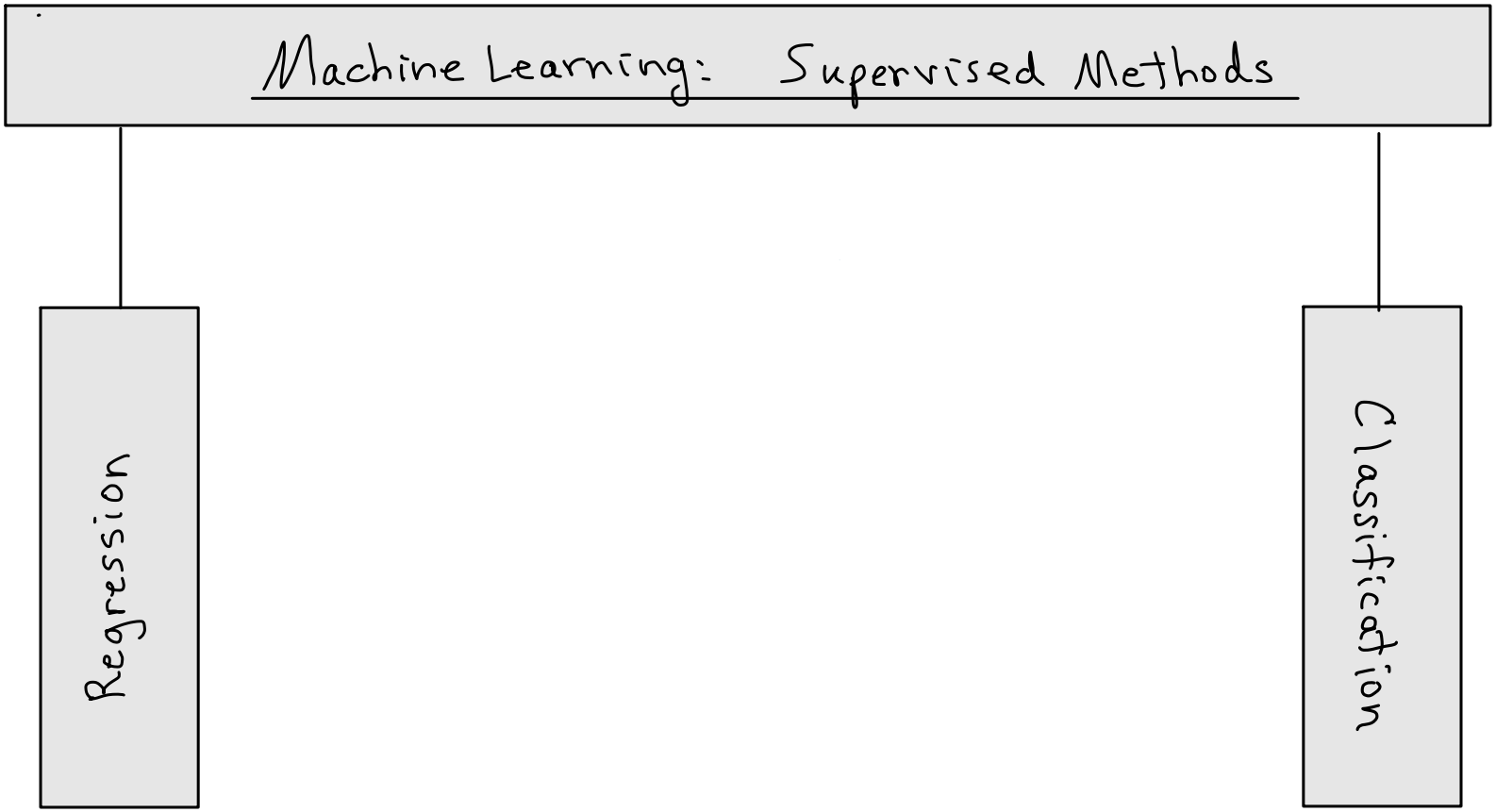
Typical problem:

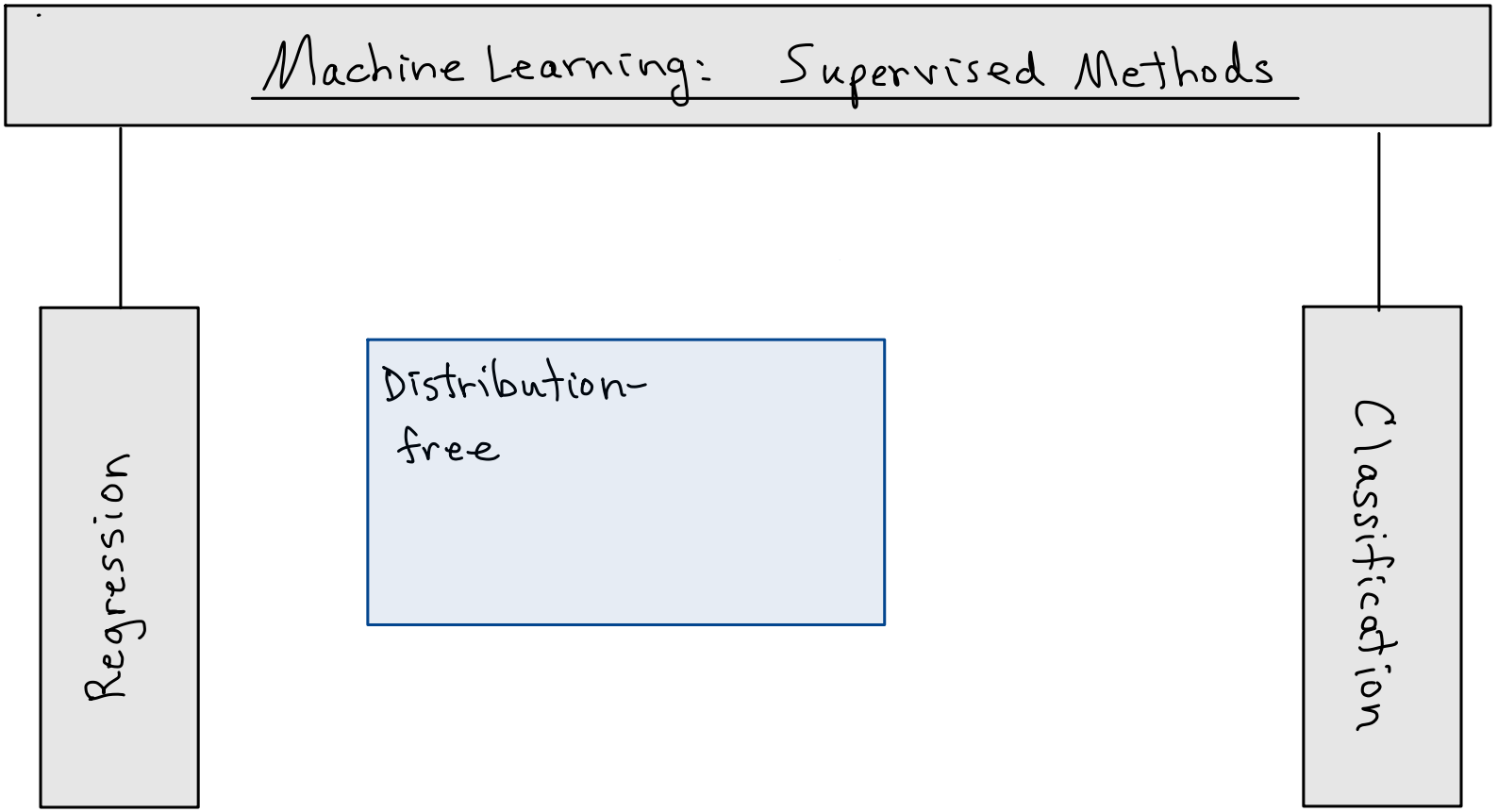


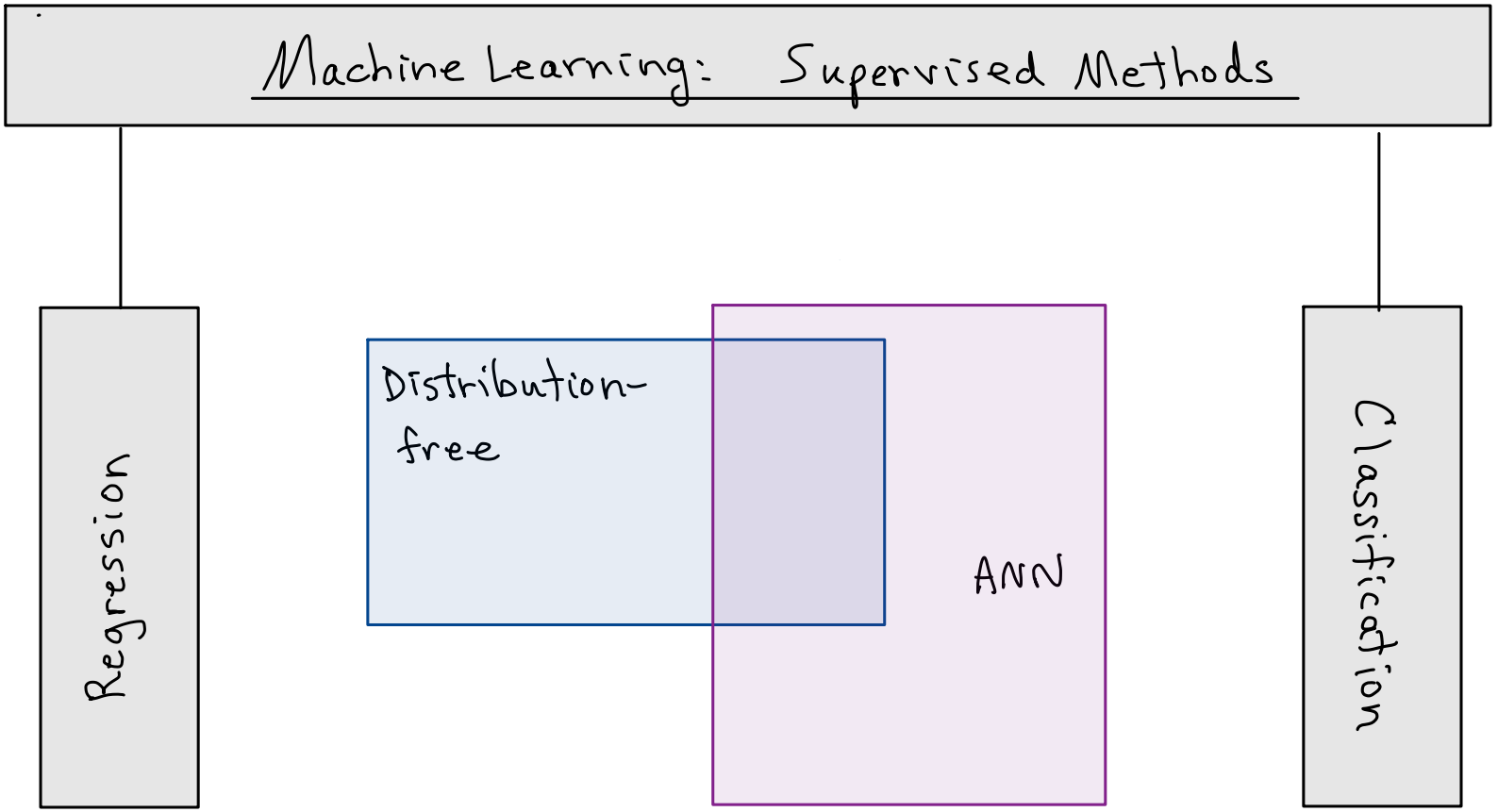
Use data – examples of (input, output) pairs – to estimate or model the unknown mapping, so that the system can generalize, that is, can estimate or predict outputs corresponding to previously unseen inputs.

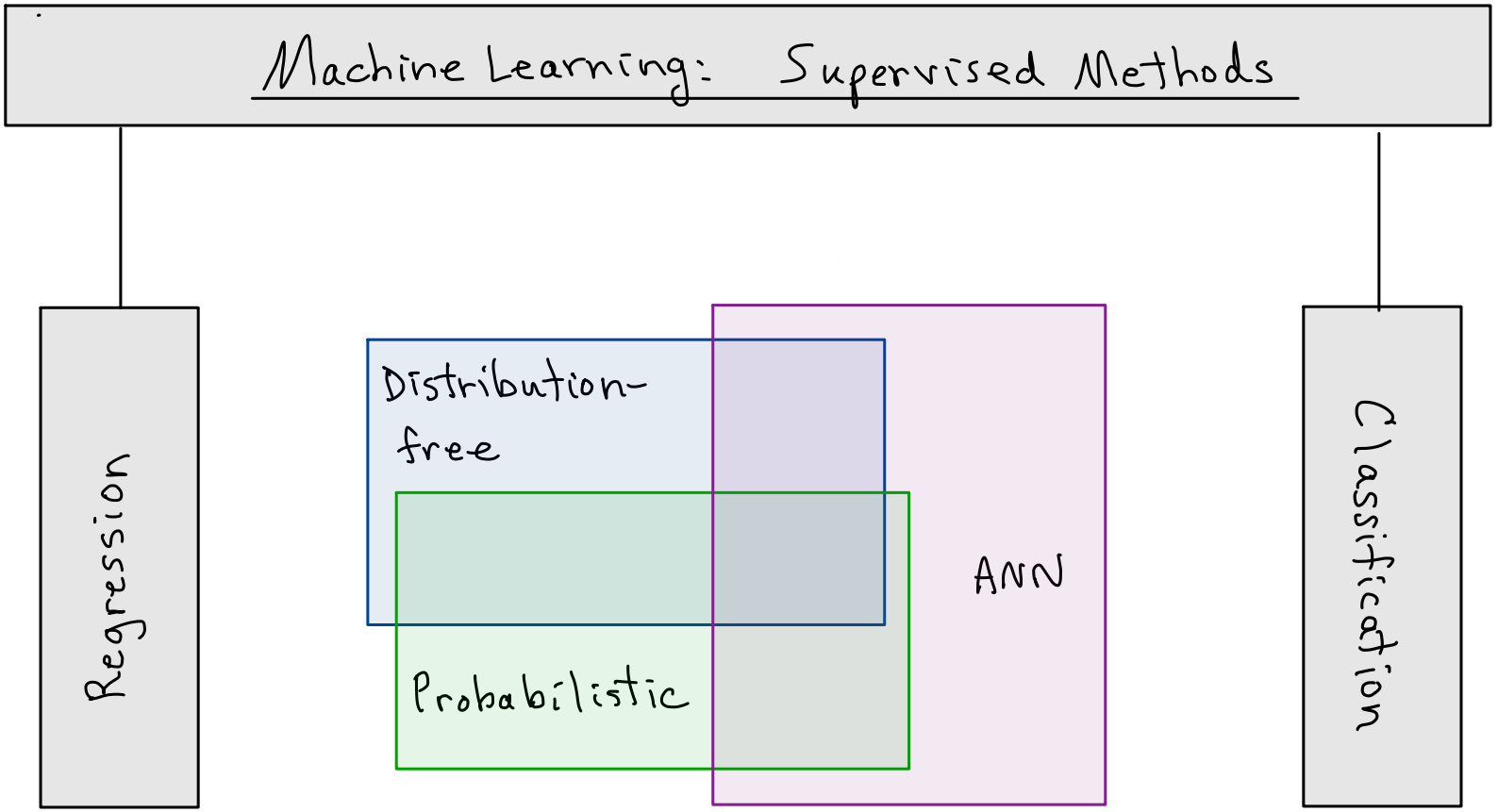
Elements	Design cycle (person)	Processing stream (learning / design phase) (automated)	Processing stream (prediction from unknowns) (automated)
Data	- Data gathering	⇒	- Sensing / acquisition
	- Data engineering	⇔ - Preprocessing - Optimization	⇒ - Preprocessing
	- Data management	⇒ - Dataset splits and usage	
	⇓	⇕	⇓
Features	- Feature engineering - or design of feature learning method	⇔ - Feature reduction / expansion ⇔ - Feature learning	⇒ - Feature extraction
	⇕	⇕	
Models	- Choice of models ("hypothesis set")	⇒ - Model selection (optimization)	⇓

Learning	- Choice of • loss function • criterion fcn. • optimization method	⇔ - Learning algorithm (optimization)	⇓ (Optional fine tuning based on new data)
Prediction (from estimate of unknown mapping)	- Choice of final system	⇒ - Final system	⇒ - Calculation of prediction
Post processing	- Performance evaluation/ assessment	- Calculate performance measures	- Optional confidence measure - Optional action - Optional check by people; revisit or tweak design or learning


Machine Learning: Supervised Methods
Regression
Classification


Machine Learning: Supervised Methods
Regression
Distribution-free
Classification


Machine Learning: Supervised Methods
Regression
Distribution-free
ANN
Classification


Machine Learning: Supervised Methods
Regression
Distribution-free
Probabilistic
ANN
Classification

Review of Lectures 12-25