Data Science

Ensembles Continued

Review Last Time

- What is an ensemble?
- Bootstrap
- Bagging
- Random Forest

Today

- Boosting
- Stacked Generalization

Boosting

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  - What are weak and strong learners?

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  - Q: What are we doing when we try bagging?
  - A: Trying to average out variance. Reduce variance
  - Q: What do you think we're doing with boosting?
  - A: We're combing weak learners, high bias, into a strong learner. Reduce bias

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- Loop:
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  - Increase weights of misclassified examples
- Combine models by a weighted average

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  - Unlike bagging we can overfit by adding more learners
  - However, generally we can achieve good results

Boosting

- What you should know:
  - Combines weak learners, those performing just better than random (50%)
  - Results in a strong learner. Can achieve zero training error
  - Can overfit by adding more iterations but are very powerful in general
  - Many different algorithms: AdaBoost, Gradient Boosting, LogitBoost, etc…
  - Most popular AdaBoost, historically, and Gradient Boosting

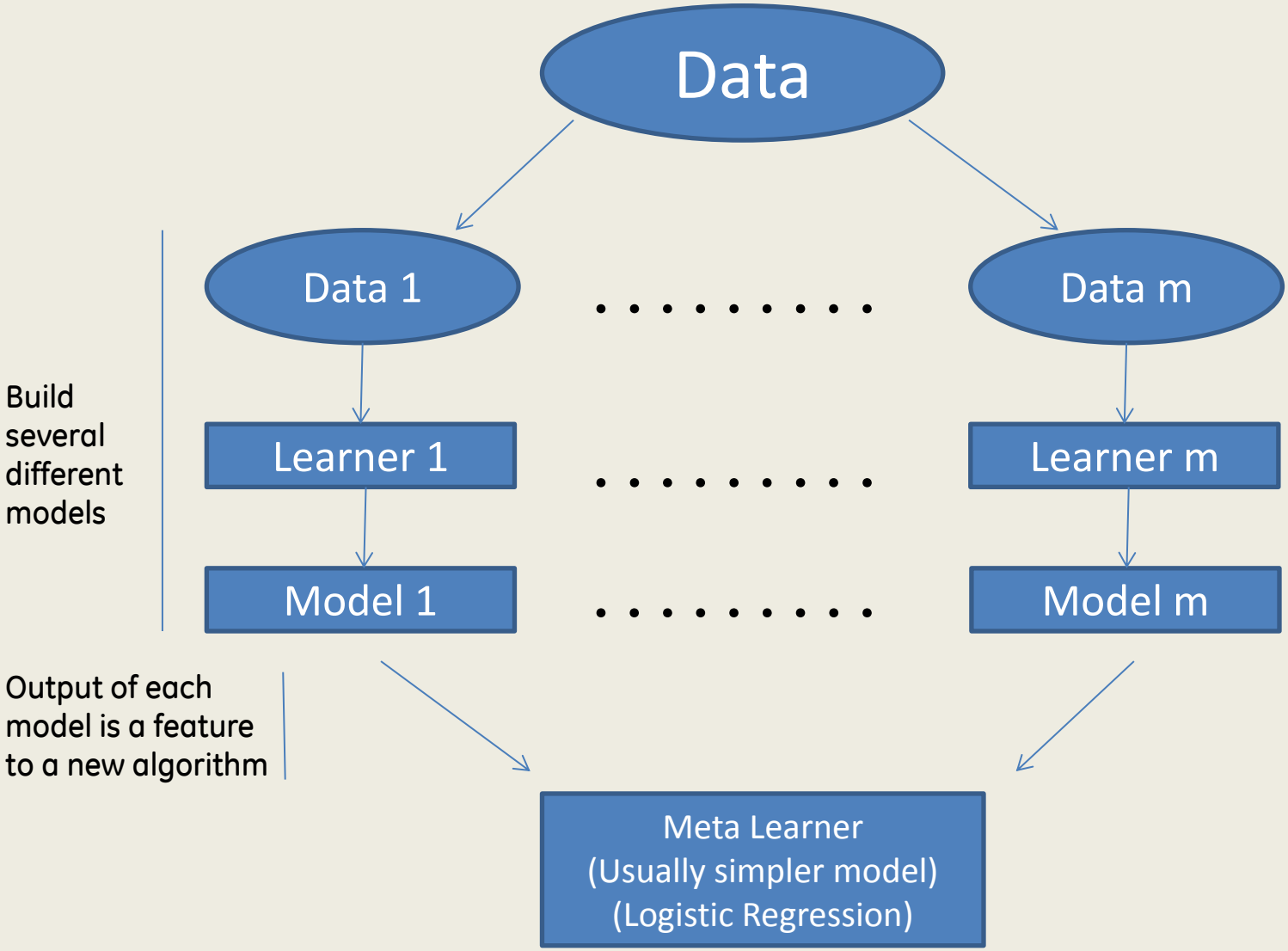
AdaBoost

- Input: Training set (S), learning algorithm, # rounds
- Initialize weights uniformly: w1(i) = 1/m
- Loop for number of rounds r:
  - Renormalize the weight
  - Train learner on weighted dataset
  - Measure the error rate, er, of the classifier on weighted S
  - If error > ½:
    - Exclude current learner and exit return all previous learners
  - Calculate learner performance
  - Reweight examples
- Return a weighted average

AdaBoost

- Input: Training set (S), learning algorithm, # rounds
- Initialize weights uniformly: w1(i) = 1/m
- Loop for number of rounds r:
  - Renormalize the weight: pr(i) = wr(i)/sum(wr(i))
  - Train learner on weighted dataset, hr
  - Measure the error rate, er, of the classifier on weighted S
    - er = sum(pr*I[hr(i) <> yi]
  - If error > ½:
    - Exclude current learner and exit return all previous learners, r-1
  - Calculate learner performance: br = er/(1-er)
  - Reweight examples: w(r+1)(i) = wr(i)b_r^(1-I[hr(xi)<> yi])
- Return a weighted average: sum(log(1/b_r)*hr(x))

Stacked Generalization



- Questions?