Machine Learning

- Successful, but requires human labor and expertise
  - Pre-process data
  - Select/ engineer features
  - Select a model family
  - Optimize hyperparameters (algorithm parameters)
  - ...
- Deep learning lets us automatically learn features
  - Automates feature engineering step, with large amount of data
  - Even more sensitive to architectures, hyperparameters, ...

Automatic Machine Learning I

- Can algorithms be trained to automatically build end-to- end machine learning systems?

Use machine learning to do better machine learning

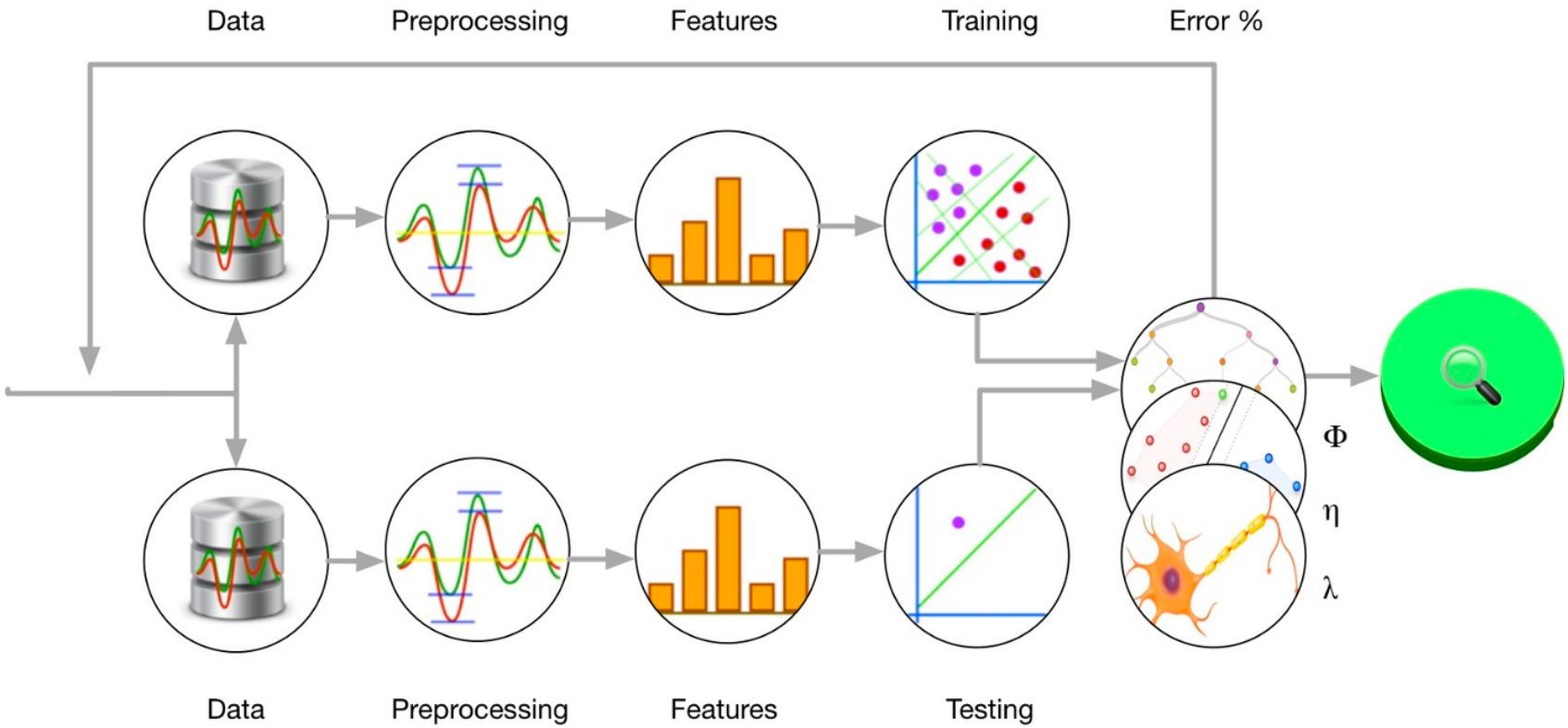
- Can we turn
  Solution = data + manual exploration + computation
- Into
  Solution = data + computation (x100)

Automatic Machine Learning II

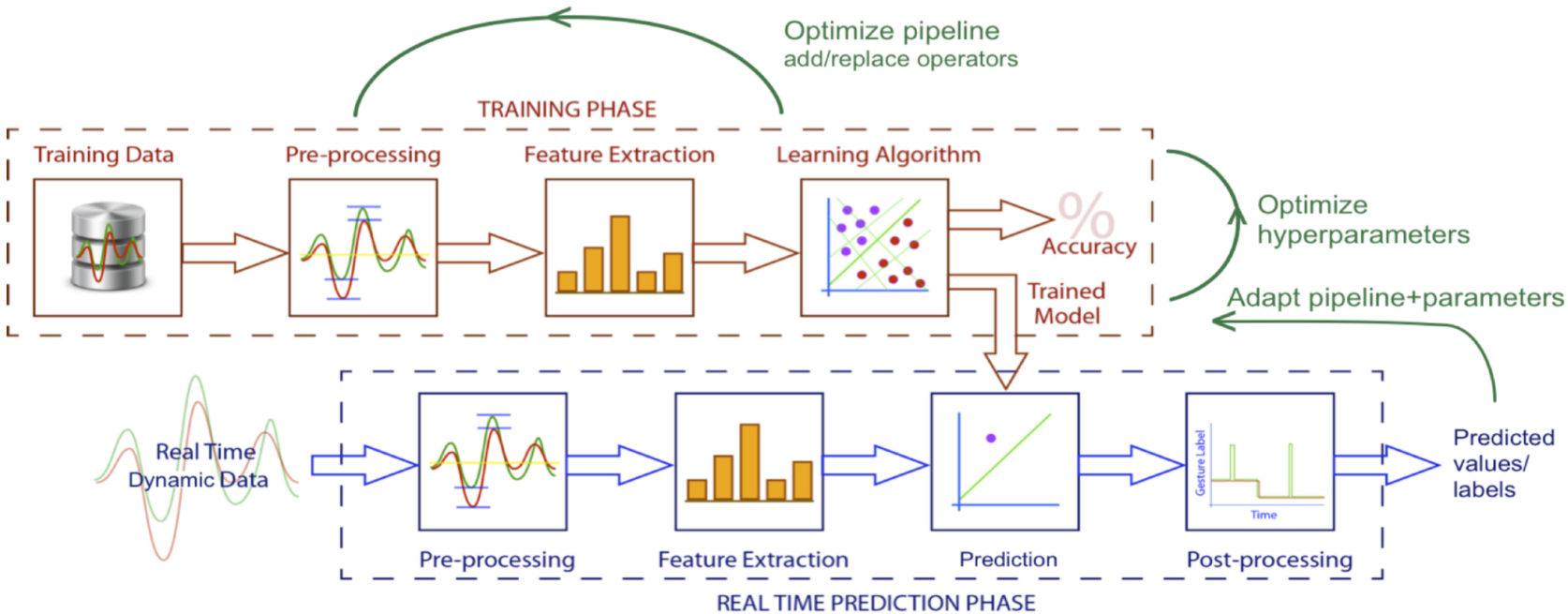
Not about automating data scientists

- Efficient exploration of techniques
  - Automate the tedious aspects (inner loop)
  - Make every data scientist a super data scientist
- Democratisation
  - Allow individuals, small companies to use machine learning effectively (at lower cost)
  - Open source tools and platforms
- Data Science
  - Better understand algorithms, develop better ones
  - Self-learning algorithms

Machine Learning Pipelines



Automating Machine Learning Pipelines



Automatic Machine Learning: Techniques

- **Bayesian Optimization:** Intelligently optimize pipelines/ architectures by iteratively choosing better ones
- **Genetic algorithms:** Evolve pipelines/architectures to work better for a given application
- **Meta-learning:** learn from previous applications to predict useful pipelines/ architectures for new problems
- **Transfer Learning:** train models on one problem, then transfer (parts) of good solutions to solve new problems.
- **Reinforcement Learning:** Train many models, use performance as "reward" for certain approaches
- **Combinations of all of these**

Black Box Optimization