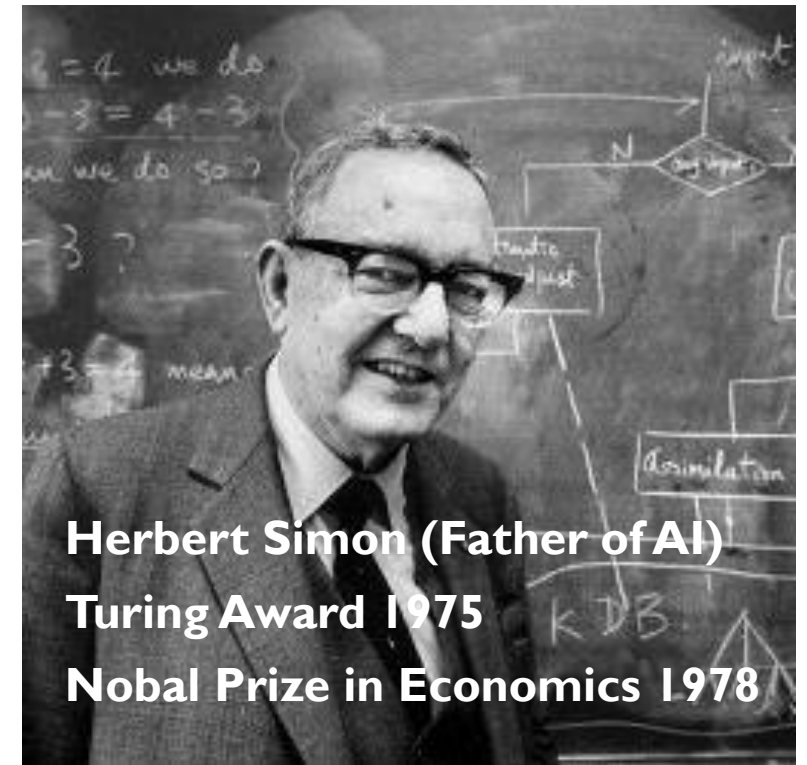


MACHINE LEARNING



MACHINE LEARNING

- “here are problems to which we simply don’t know the answer yet, but there are some things we can take actions on now, which we should take actions on now.”
- “Learning is any process by which a system improves performance from experience”
- “machine learning is concerned with computer programs that automatically improve their performance through experience”



Herbert Simon (Father of AI)
Turing Award 1975
Nobel Prize in Economics 1978

QUOTES ON MACHINE LEARNING



- “... What we want is a machine that can learn from experience.”

Alan Turing 1947

- “A breakthrough in Machine Learning would be worth 10 Microsoft.”

Bill Gates

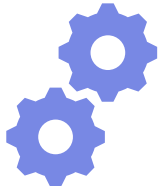
- “With artificial Intelligence we are summoning the demon.”

Elon Musk

- “Machine learning is the next Internet”

Tony Tether, Director, DARPA

SO WHAT IS MACHINE LEARNING?



Automating
automation



Getting computers to
program themselves

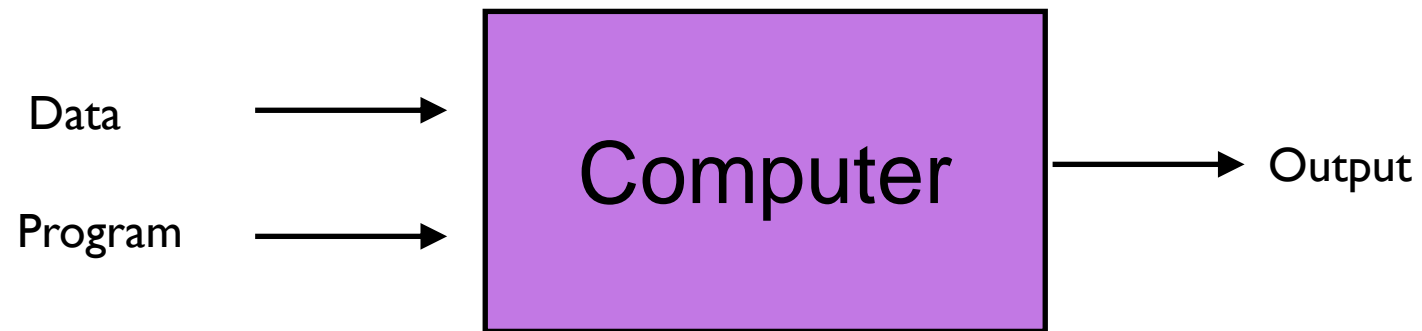


Writing software is
the bottleneck

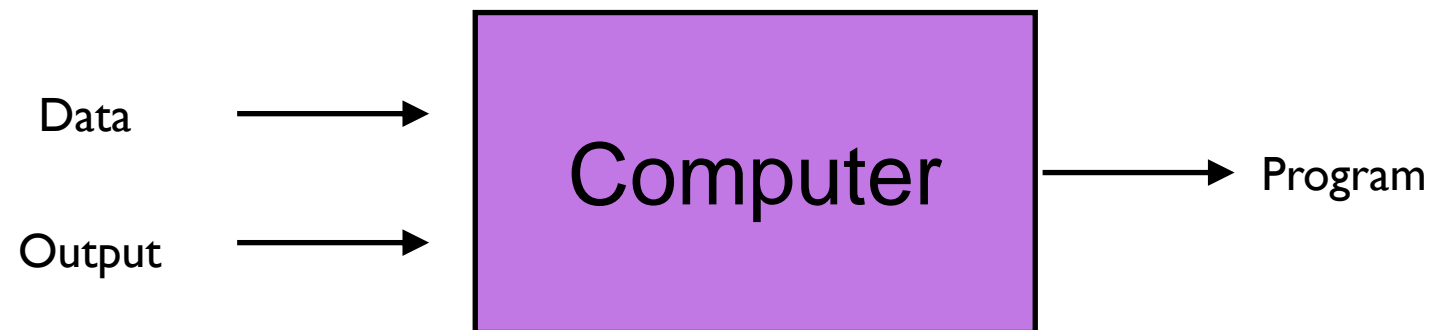


Let the data do the
work instead!

■ Traditional Programming



■ Machine Learning



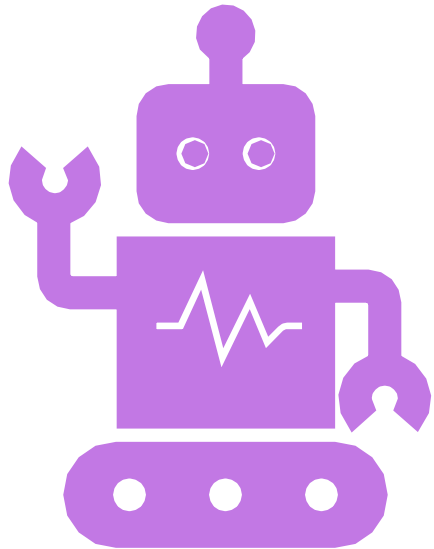
MAGIC?

No, more like gardening

- **Seeds** = Algorithms
- **Nutrients** = Data
- **Gardener** = You
- **Plants** = Programs



SAMPLE APPLICATIONS



Web search

Computational biology

Object Detection

Finance

E-commerce

Space exploration

Robotics

Information extraction

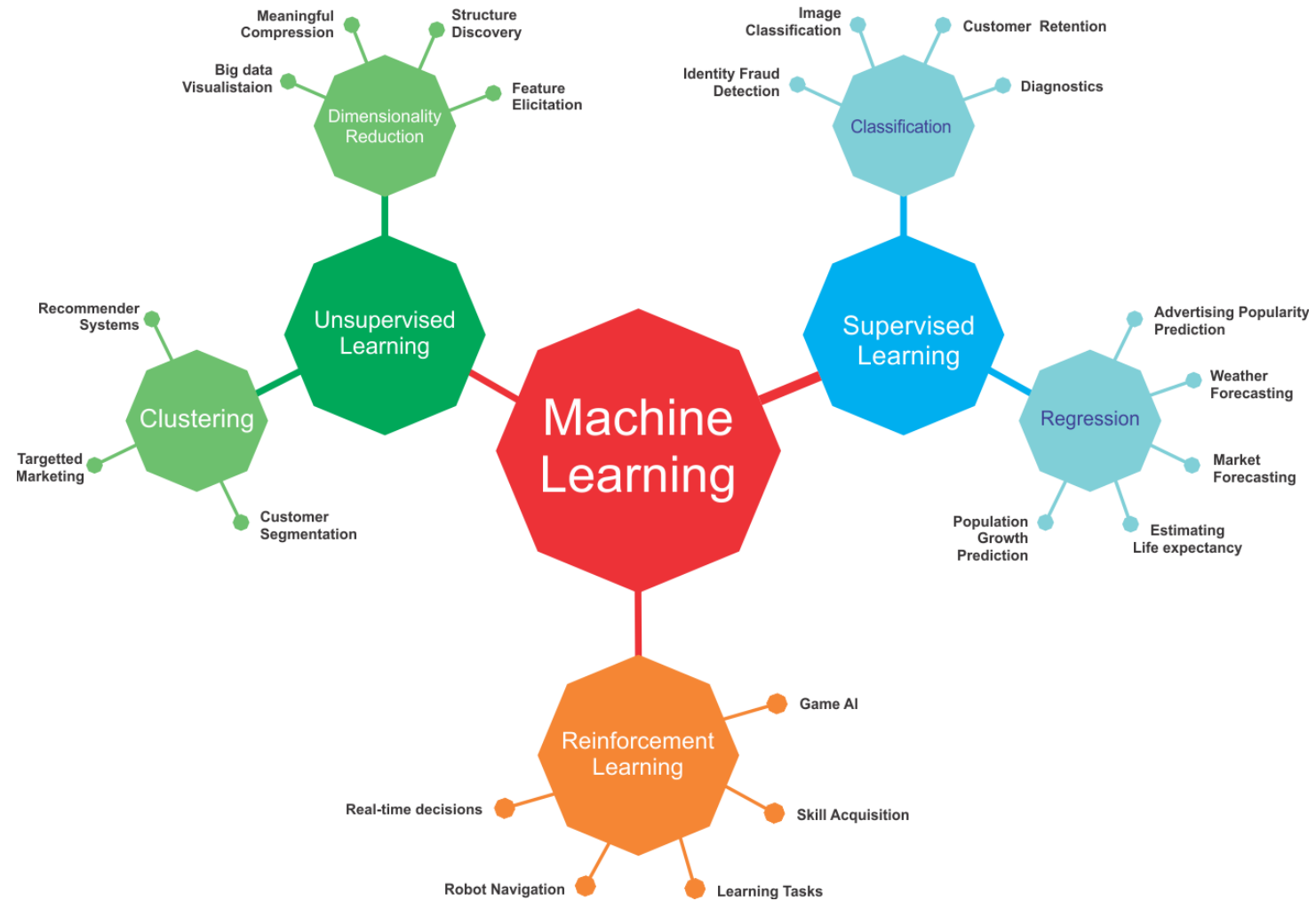
Social networks

Debugging

[Your favorite area]

REAL WORLD APPLICATIONS OF MACHINE LEARNING





ML IN A NUTSHELL



Tens of thousands of machine learning algorithms



Hundreds new every year



Every machine learning algorithm has three components:

Representation
Evaluation
Optimization

REPRESENTATION



Decision trees



Sets of rules / Logic programs



Instances



Graphical models (Bayes/Markov nets)



Neural networks



Support vector machines



Model ensembles



Etc.

EVALUATION

Accuracy

Precision and recall

Squared error

Likelihood

Posterior probability

Cost / Utility

Margin

Entropy

K-L divergence

Etc.

OPTIMIZATION

Combinatorial optimization

- E.g.: Greedy search

Convex optimization

- E.g.: Gradient descent

Constrained optimization

- E.g.: Linear programming



Supervised (inductive) learning

Training data includes desired outputs



Unsupervised learning

Training data does not include desired outputs



Semi-supervised learning

Training data includes a few desired outputs

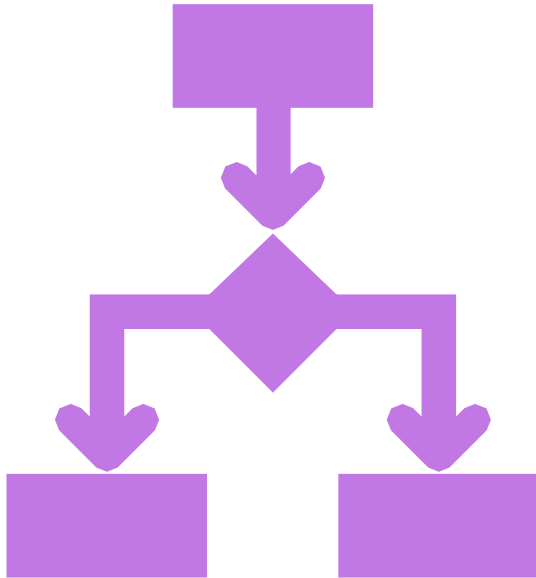


Reinforcement learning

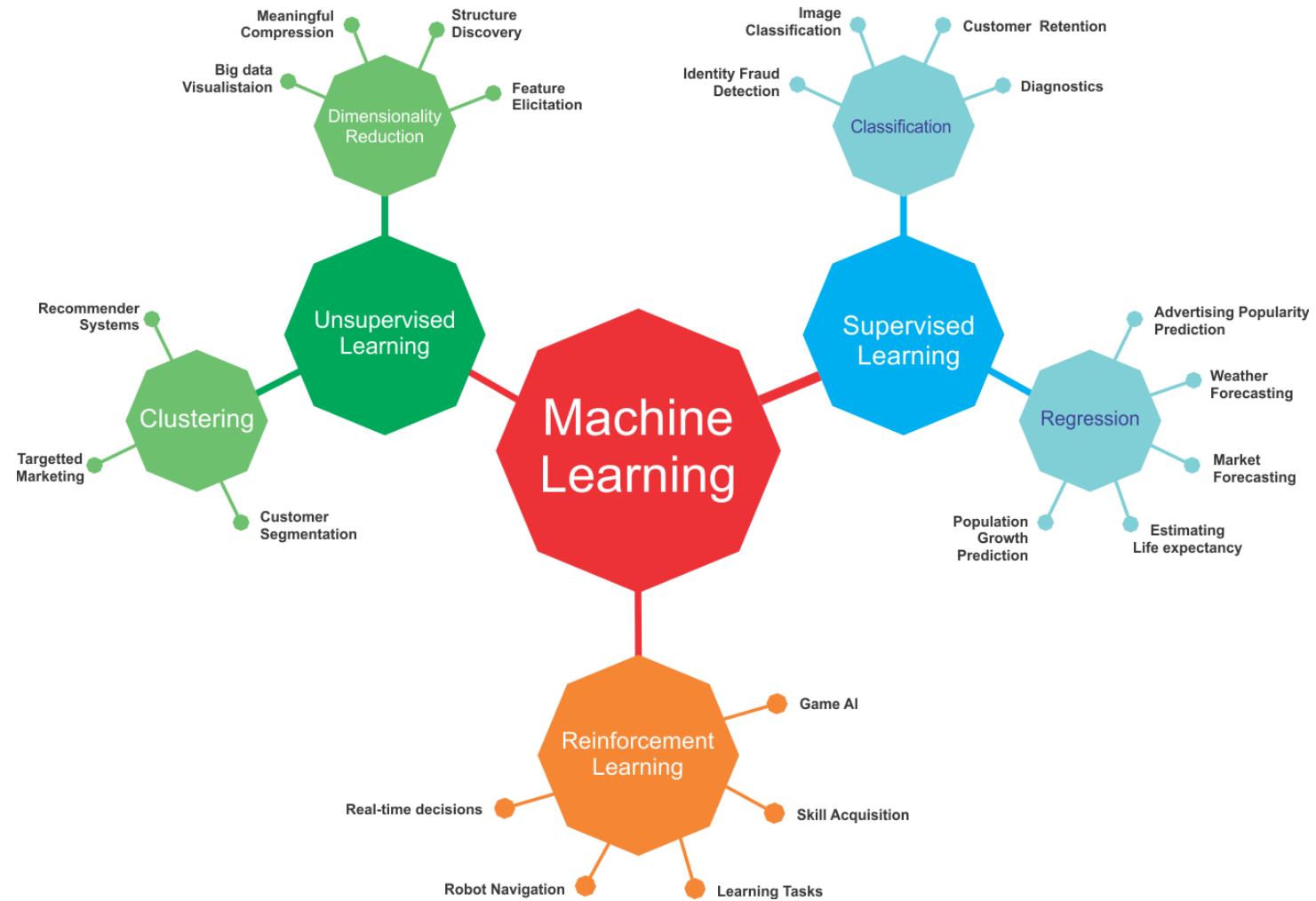
Rewards from sequence of actions

TYPES OF LEARNING

INDUCTIVE LEARNING



- **Given** examples of a function $(X, F(X))$
- **Predict** function $F(X)$ for new examples X
 - Discrete $F(X)$: Classification
 - Continuous $F(X)$: Regression
 - $F(X) = \text{Probability}(X)$: Probability estimation





WHAT WE'LL COVER

- **Supervised learning**
 - Decision tree induction
 - Rule induction
 - Instance-based learning
 - Bayesian learning
 - Neural networks
 - Support vector machines
 - Model ensembles
 - Learning theory
- **Unsupervised learning**
 - Clustering
 - Dimensionality reduction



ML IN PRACTICE

Understanding domain, prior knowledge, and goals

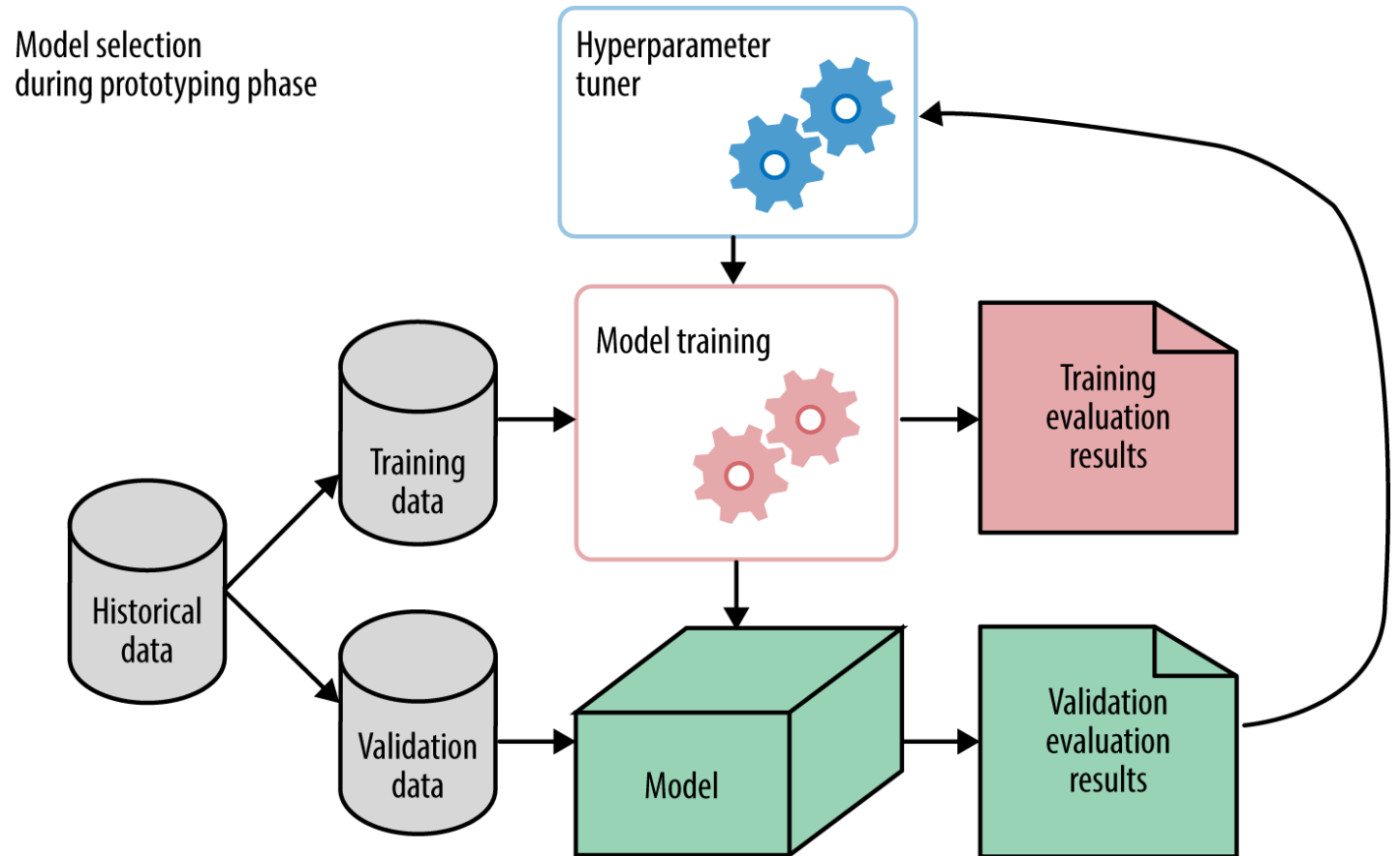
Data integration, selection, cleaning,
pre-processing, etc.

Learning models

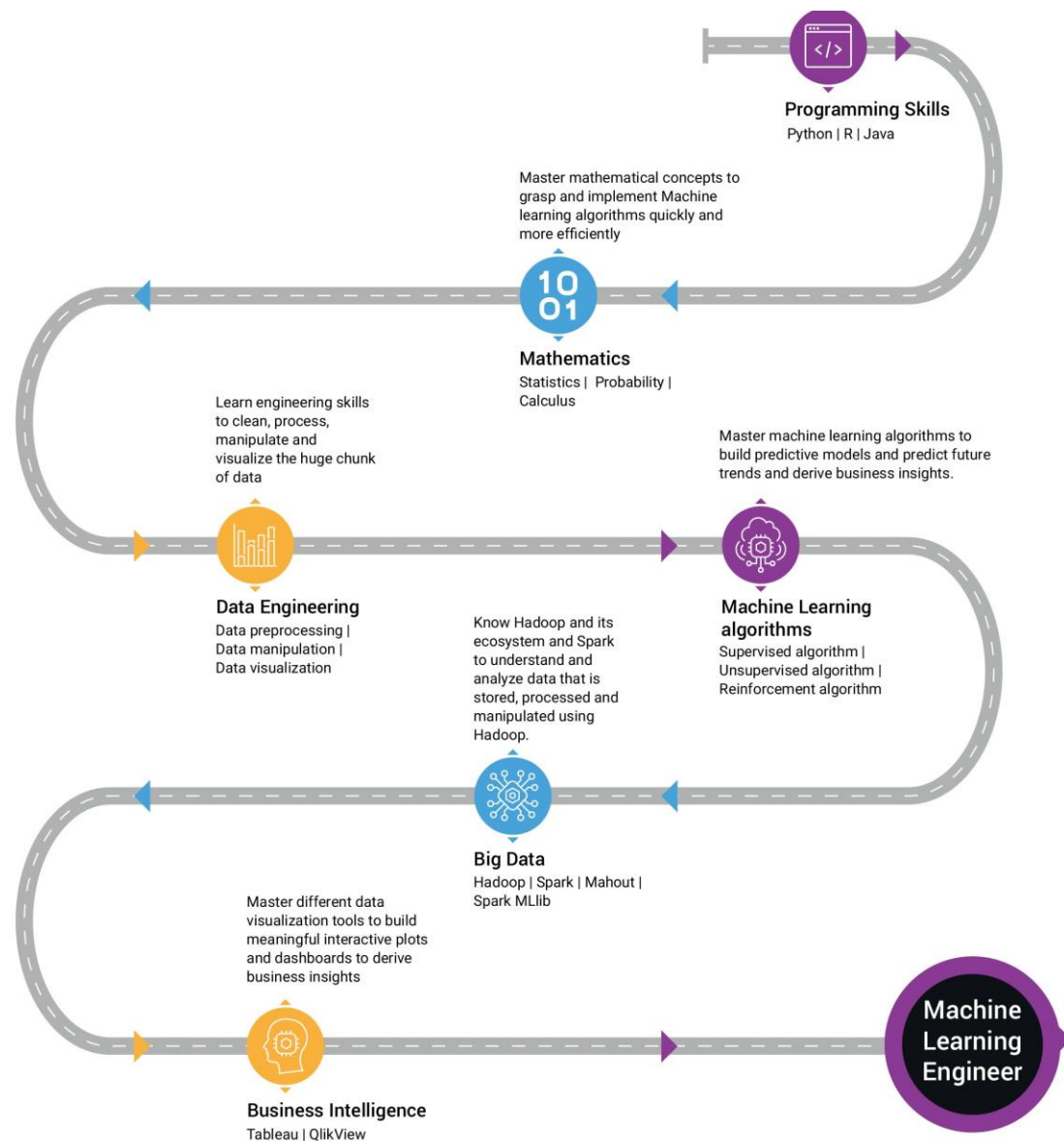
Interpreting results

Deploying Models in Real

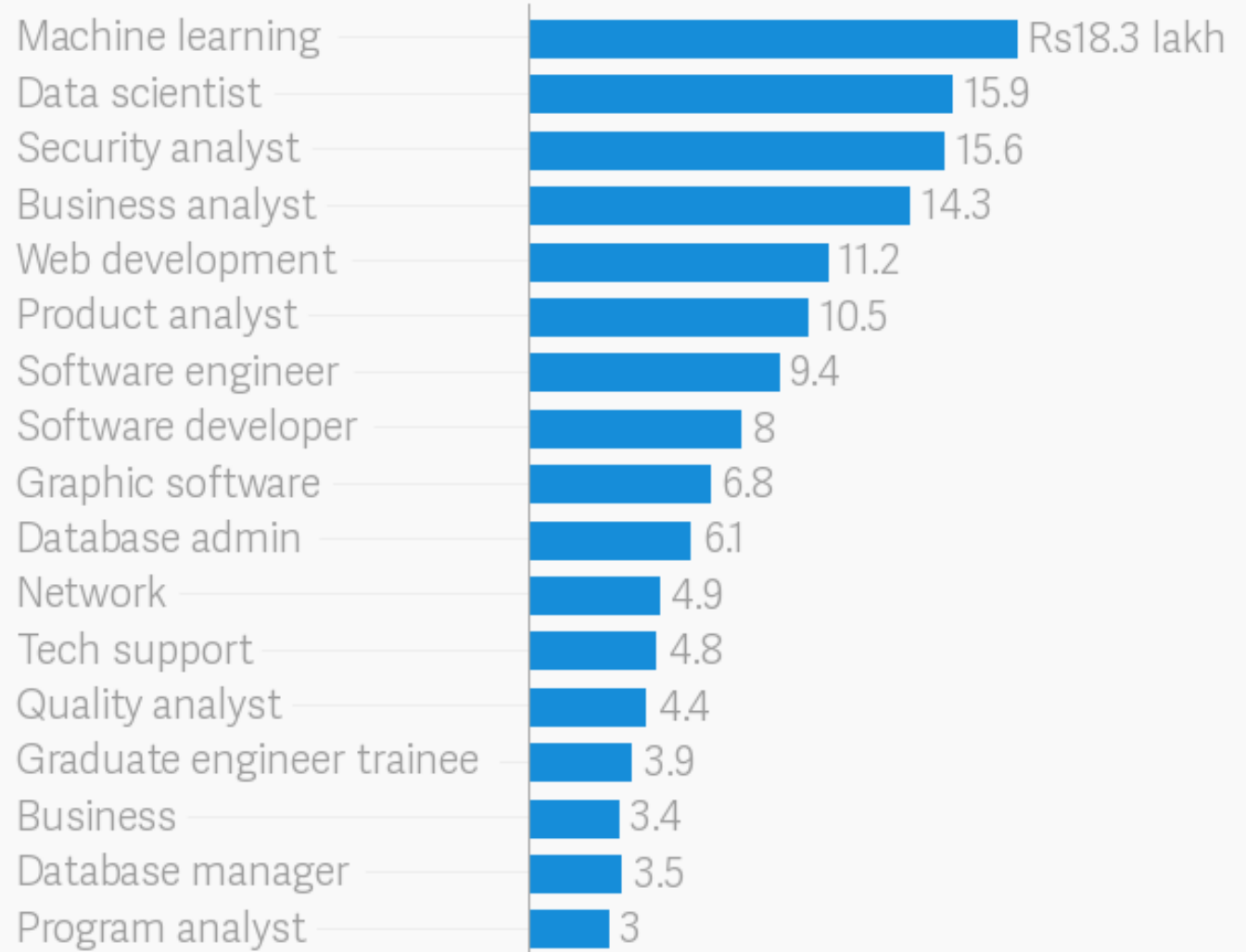
STEPS TO BUILD A MACHINE LEARNING MODEL



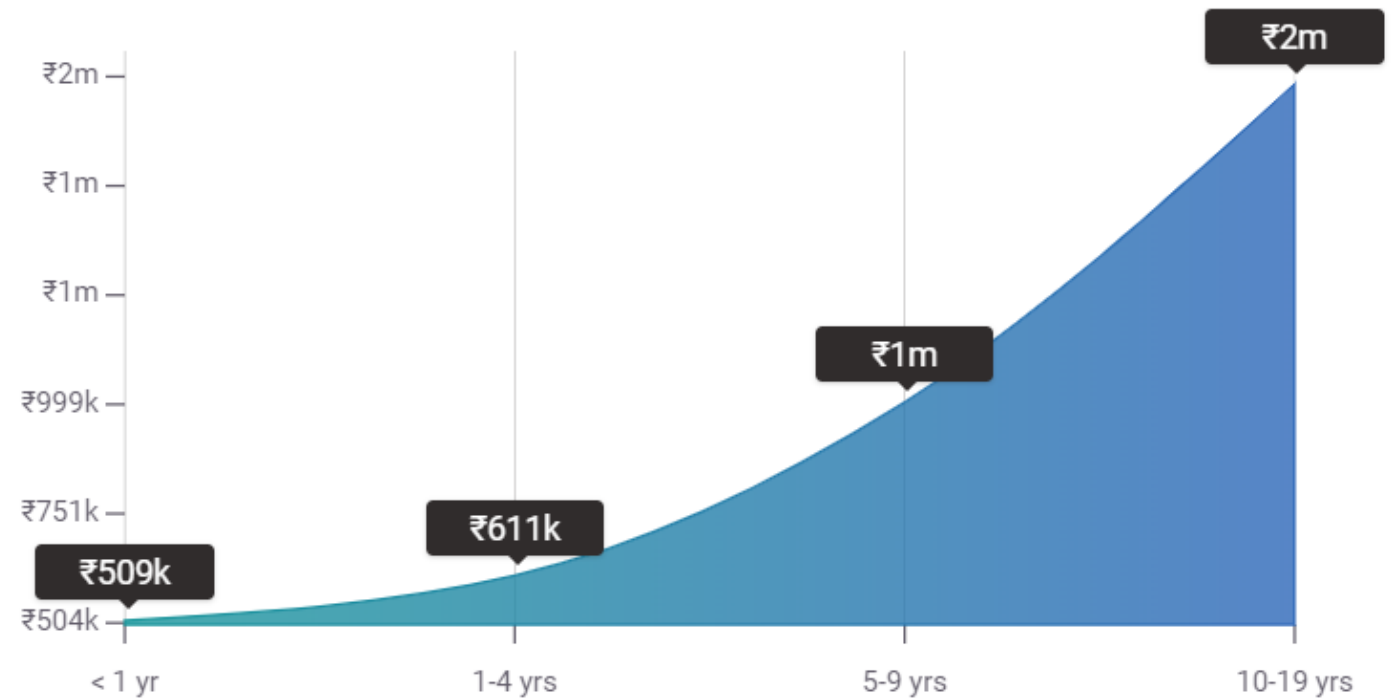
SKILLS REQUIRED



MACHINE LEARNING JOB SCOPE & SALARY TRENDS



INCREMENT WRT EXPERIENCE





QUERIES PLEASE ?



THANKS