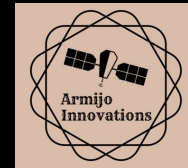


Practical ML Tutorial: Part I

—
George Williams



Tutorial Collaborators



Trevor Peyton
Machine Learning Researcher
UT Chattanooga



James L Carpenter (Jake)
Graduate Research Assistant
UT Chattanooga

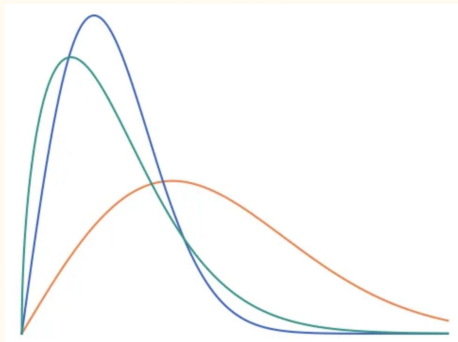


Stephen Lawrence
Graduate Research Assistant
UT Chattanooga

Agenda

Part I

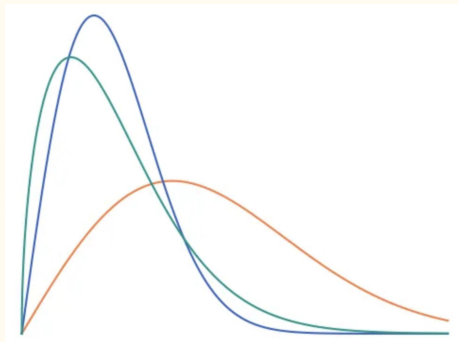
- AI Trends
- ML Basics
- Survival Analysis
- *Hands-On Programming*



Agenda

Part I

- AI Trends
- ML Basics
- Survival Analysis
- *Hands-On Programming*



Part II

- AI Hardware
- FastAI and Pytorch Basics
- Computer Vision
- *Hands-On Programming*

Hands-On

- Use contemporary software tools
- Web-based
- Tactile learning
- With Caveats...



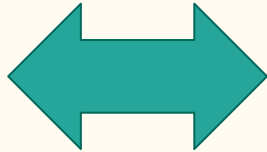
Hands-On

- Feel free to watch...
- Cheating is encouraged
- Is this science?
- Programming exp
- Small data/Small models



Connection information coming soon...

Workshop Hardware



Is it space worthy? :)

Workshop Software



AI Trends

- Deep Fakes
 - Generative AI
 - Alpha Fold
 - Stable Diffusion
 - ChatGPT
 - Foundation Models
-



LIVE ChatGPT creator faces questions
in US Congress

**Universal Music Group calls AI music a 'fraud,'
wants it banned from streaming platforms.**

MBW



**The Hollywood Writers' Strike
May Actually Be Aiding AI's
Takeover**

Hey ChatGPT, write a limerick for audience of radiation electronics experts.

Hey ChatGPT, write a limerick for audience of radiation electronics experts.

ChatGPT Says:

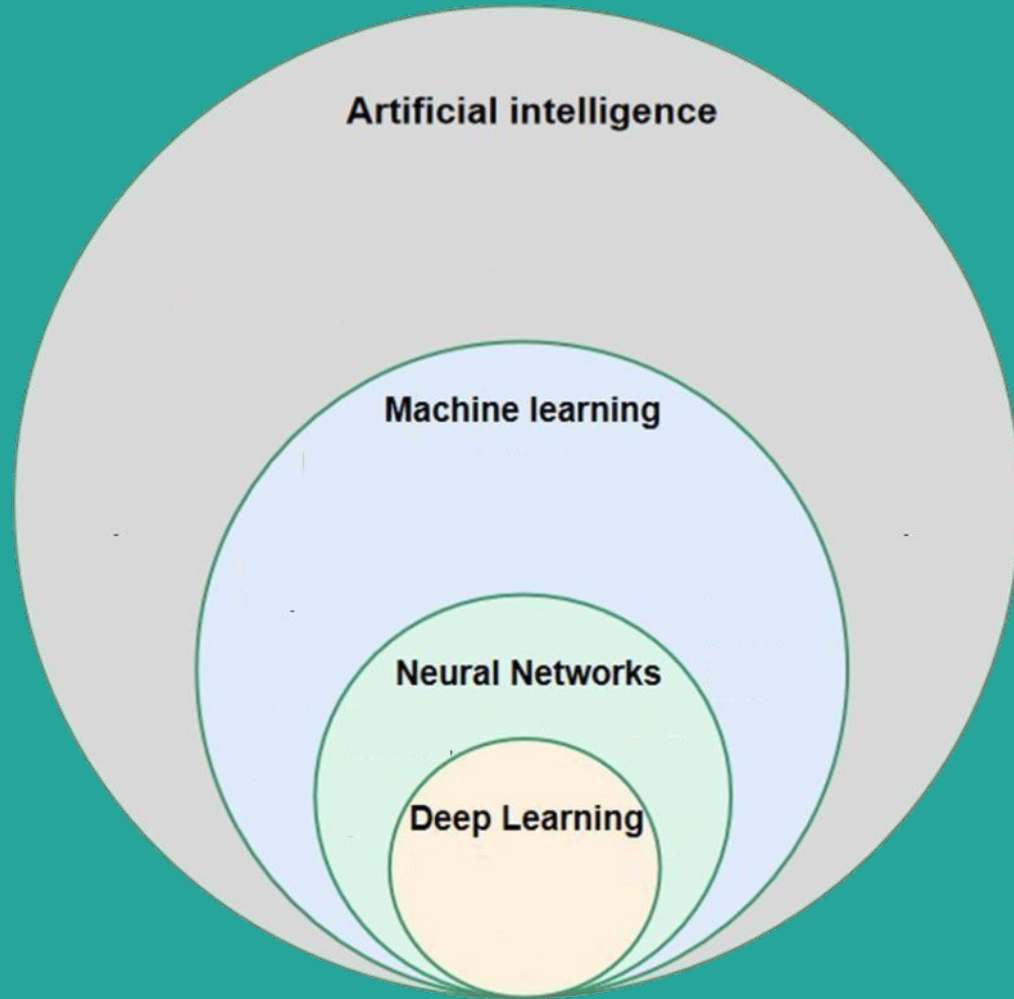
“There once was an electronic device,
That emitted radiation quite precise,
Its waves were quite strong,
And could last all day long,
But shielding it was always advised!”

nature

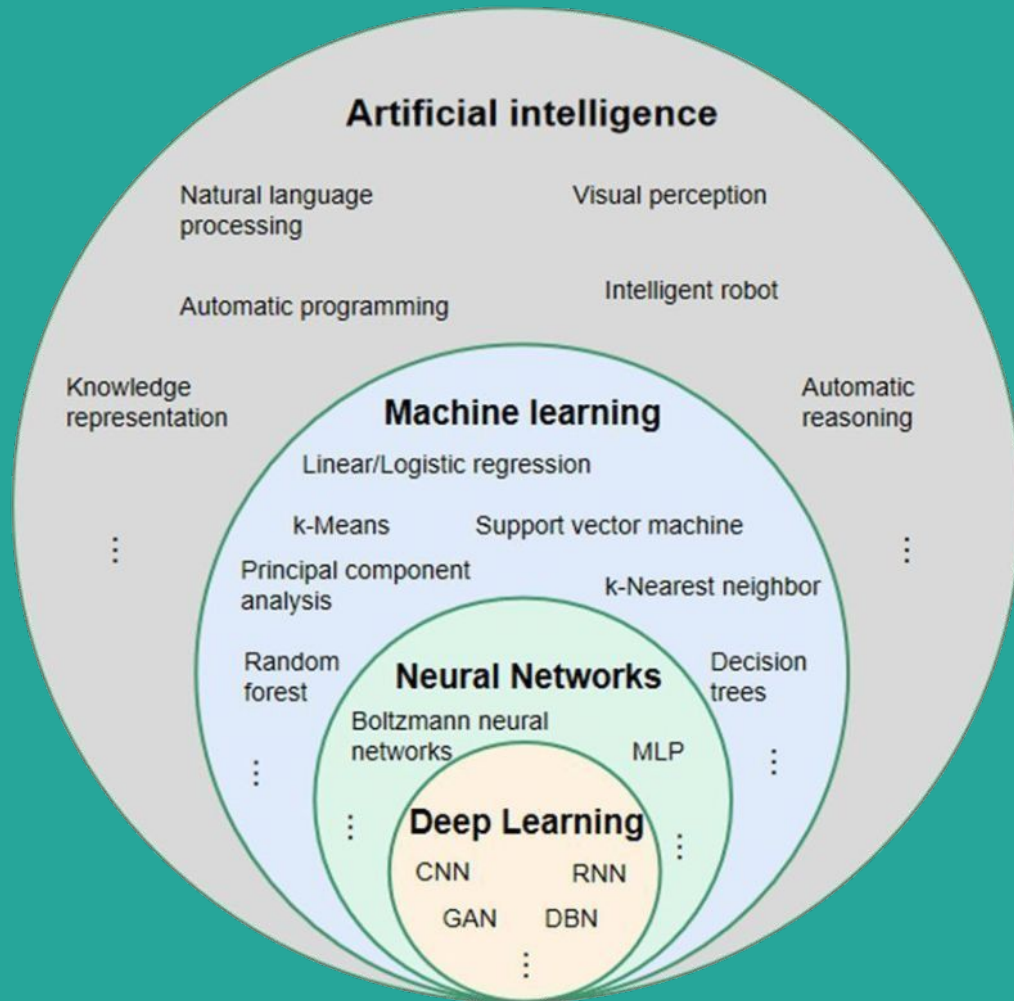


DeepMind

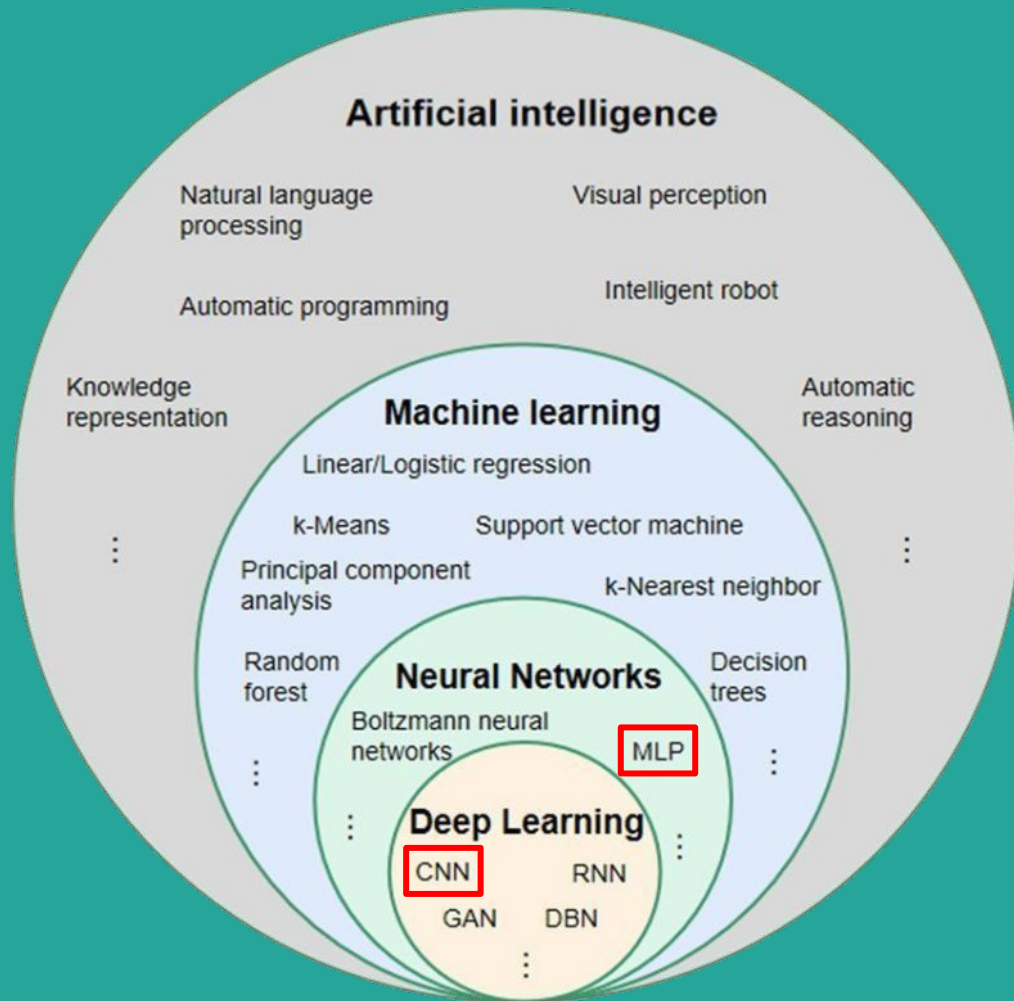
ML



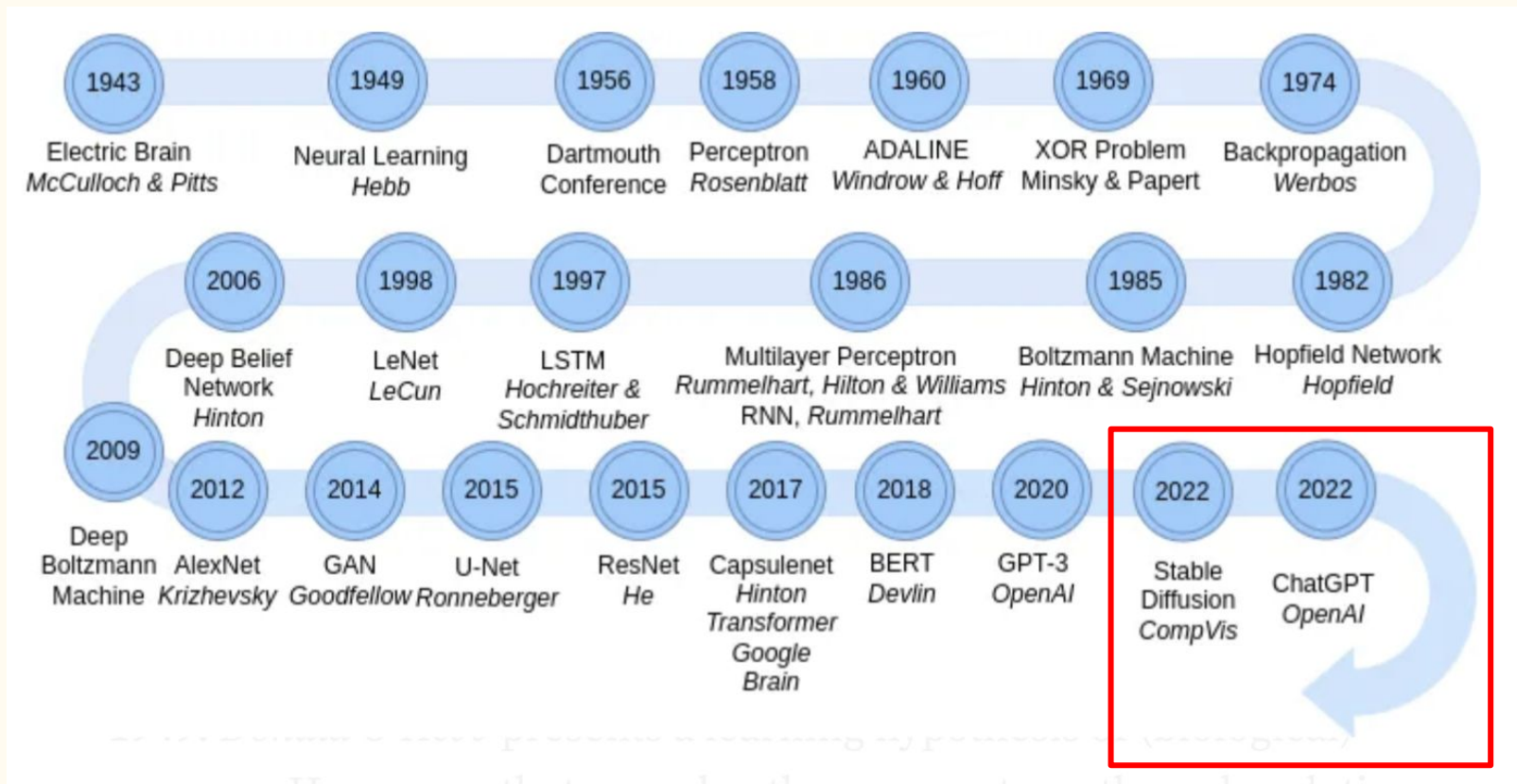
ML



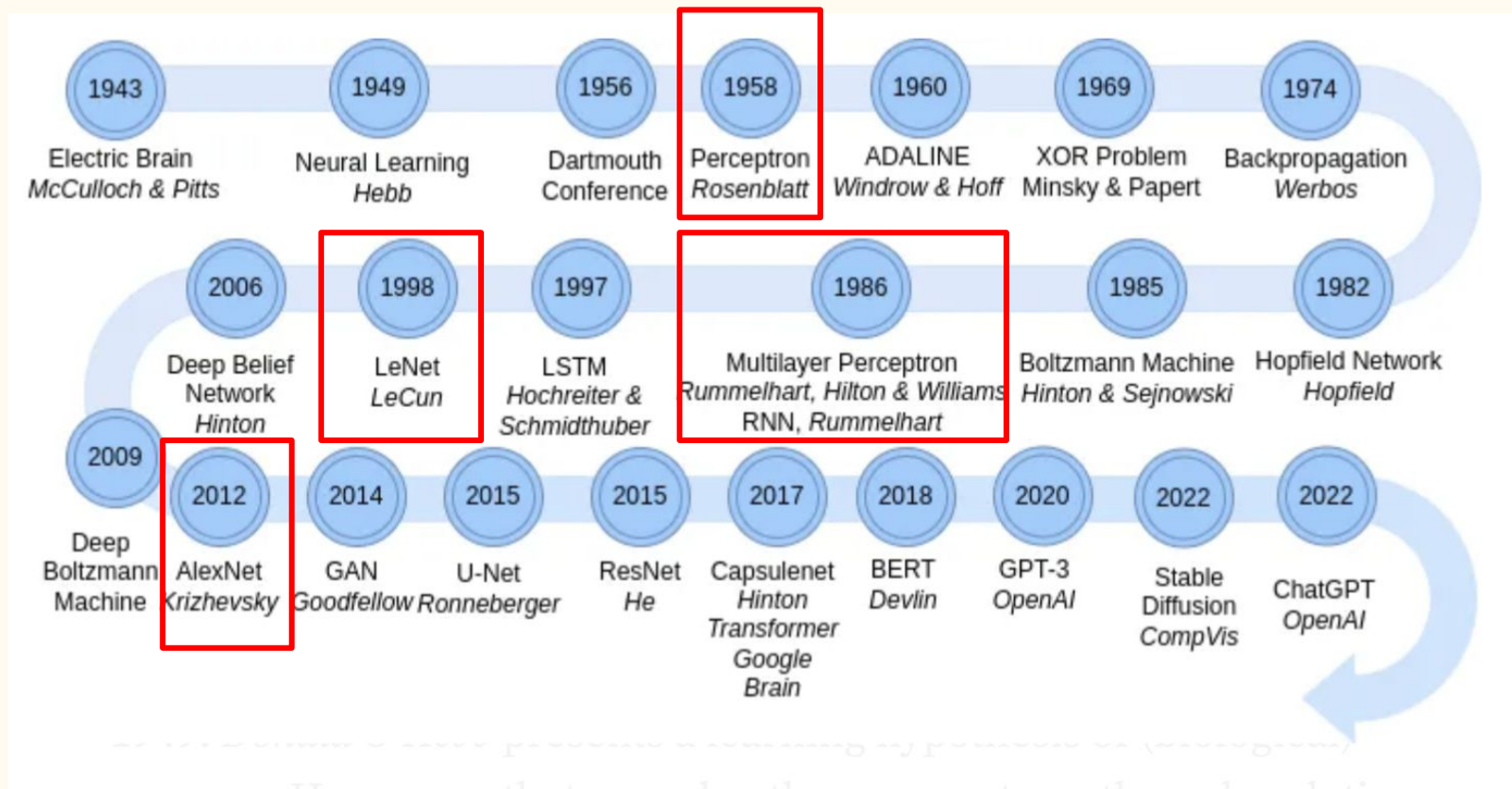
ML



Neural Networks



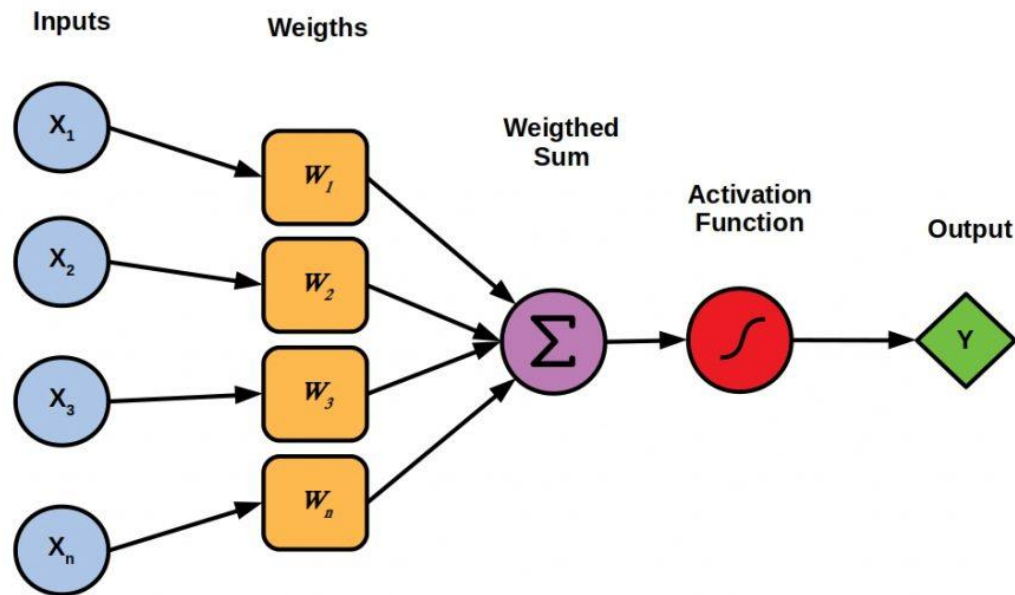
Neural Networks



Neural Network Basics



Neural Networks Basic Unit



A mostly complete chart of Neural Networks

©2019 Fjodor van Veen & Stefan Leijnen asimovinstitute.org

Perceptron (P)



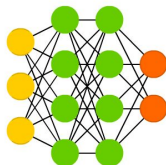
Feed Forward (FF)



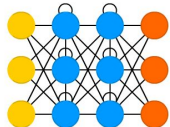
Radial Basis Network (RBF)



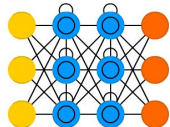
Deep Feed Forward (DFF)



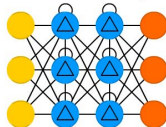
Recurrent Neural Network (RNN)



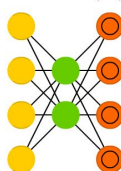
Long / Short Term Memory (LSTM)



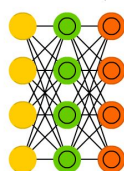
Gated Recurrent Unit (GRU)



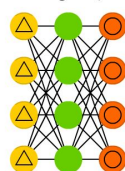
Auto Encoder (AE)



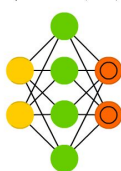
Variational AE (VAE)



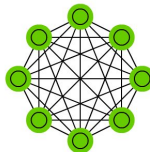
Denoising AE (DAE)



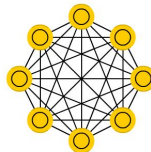
Sparse AE (SAE)



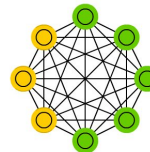
Markov Chain (MC)



Hopfield Network (HN)



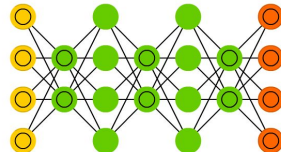
Boltzmann Machine (BM)



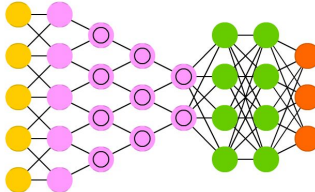
Restricted BM (RBM)



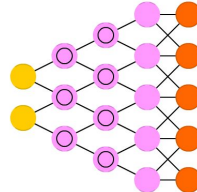
Deep Belief Network (DBN)



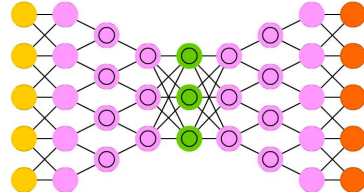
Deep Convolutional Network (DCN)



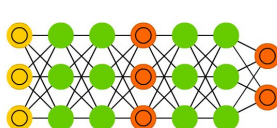
Deconvolutional Network (DN)



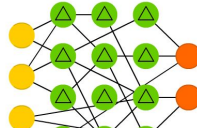
Deep Convolutional Inverse Graphics Network (DCIGN)



Generative Adversarial Network (GAN)



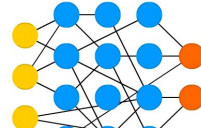
Liquid State Machine (LSM)



Extreme Learning Machine (ELM)

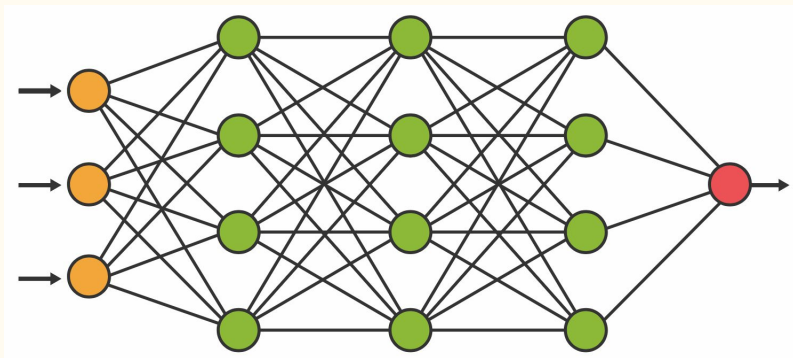


Echo State Network (ESN)



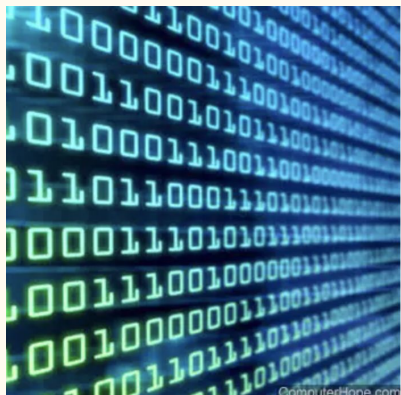
Just Google “Neural Network Zoo”...

Neural Networks “In Practice”

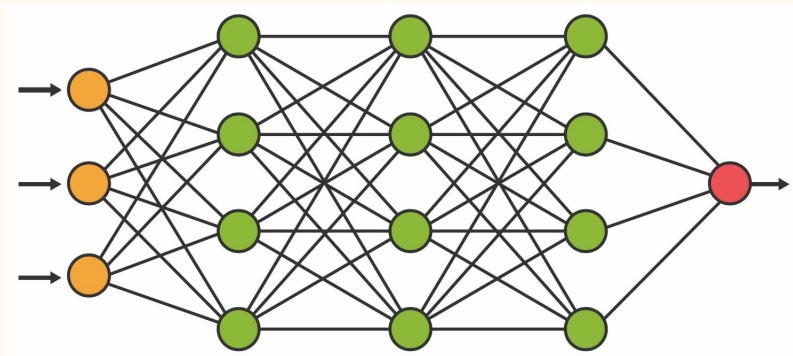


Model

Neural Networks “In Practice”



Data

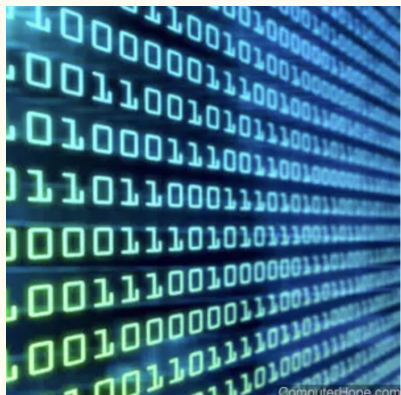


Model

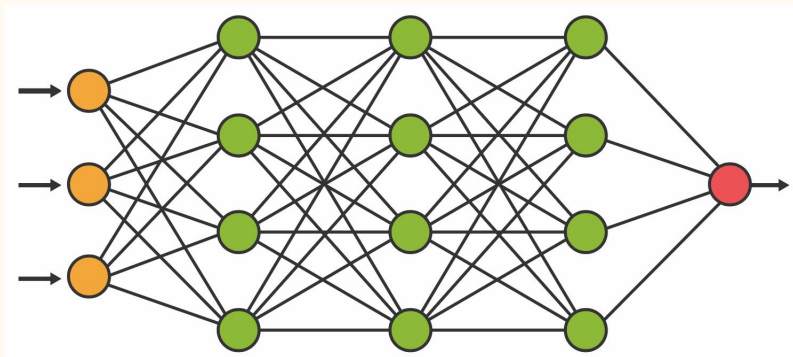


Eval

Neural Networks “In Practice”



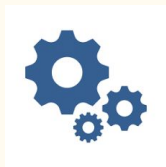
Data



Model

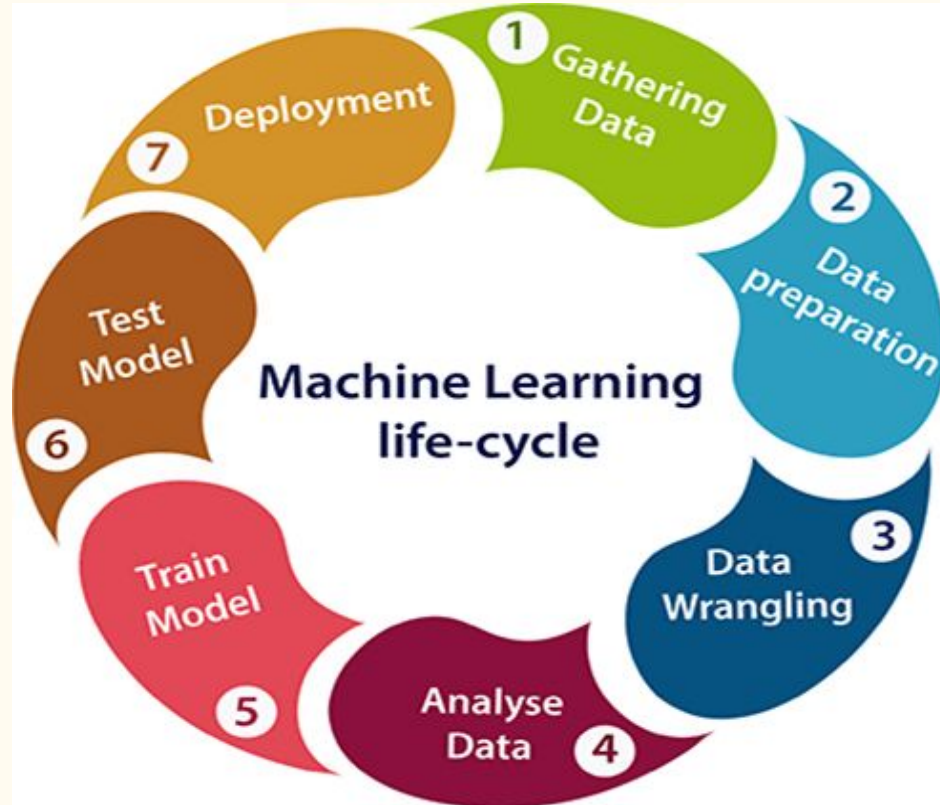


Eval

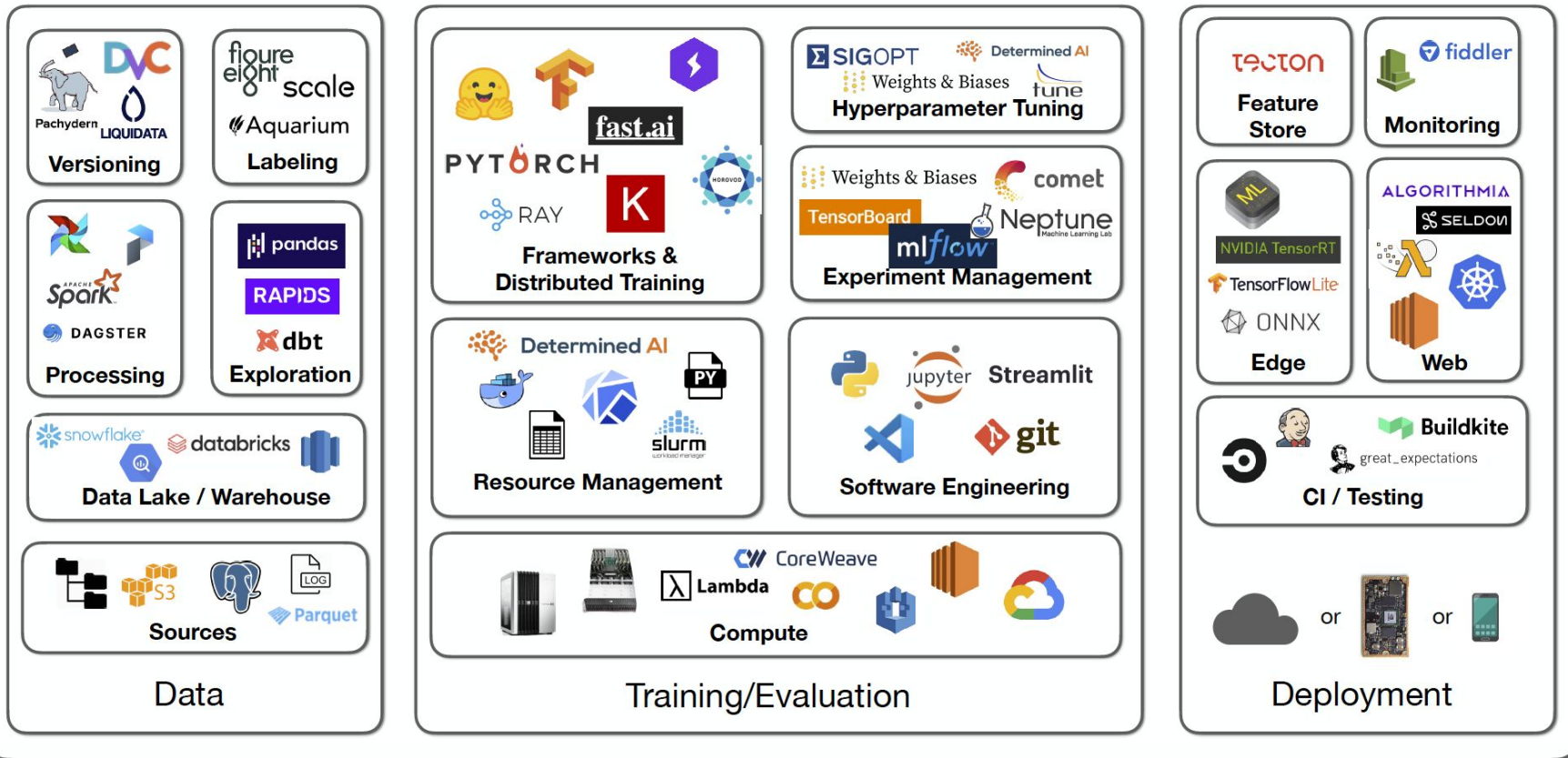


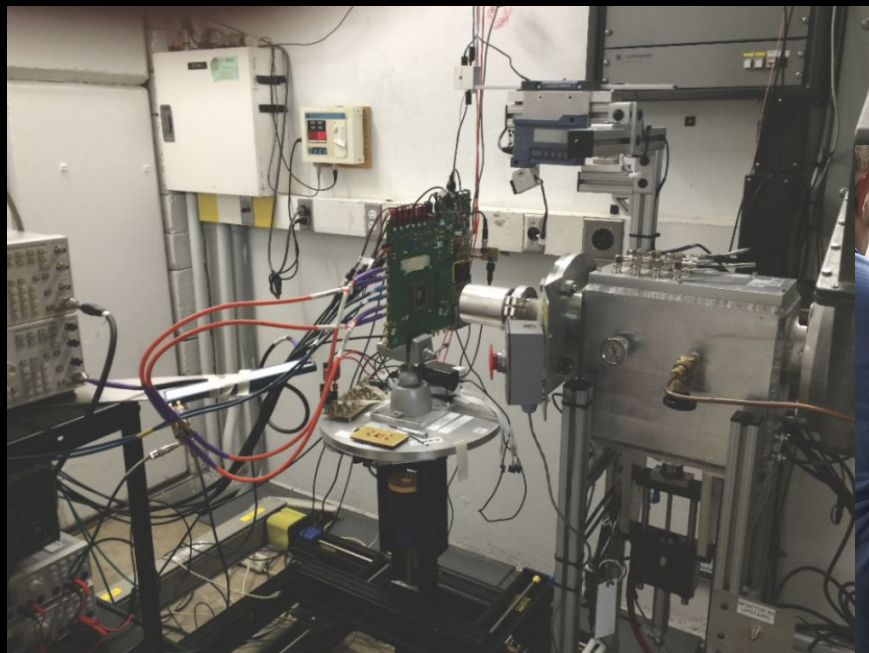
Learning Algorithm

Neural Networks “In Practice”



Industry ML “Ecosystem”





Survival Analysis

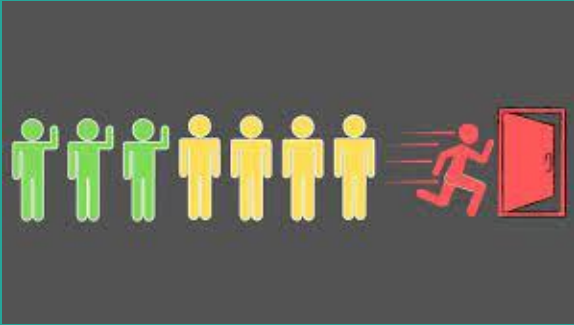
—

Tries To Answer The
Question:

When Will It End?

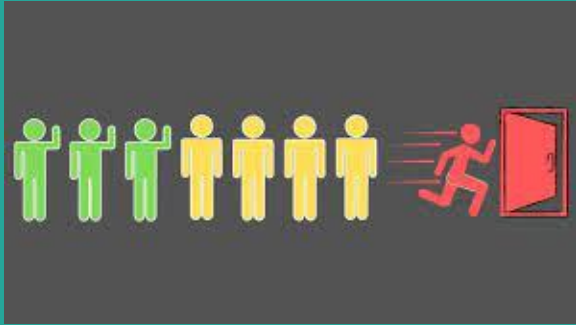
*When Will **It** End?*

When Will *It* End?

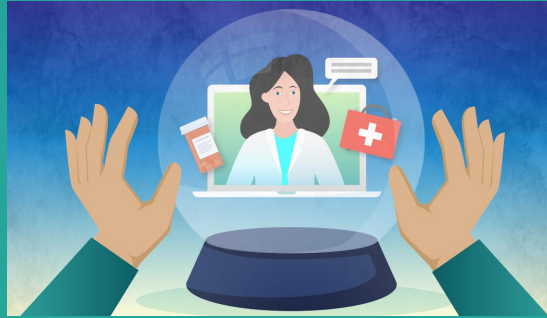


Customer Churn

When Will *It* End?

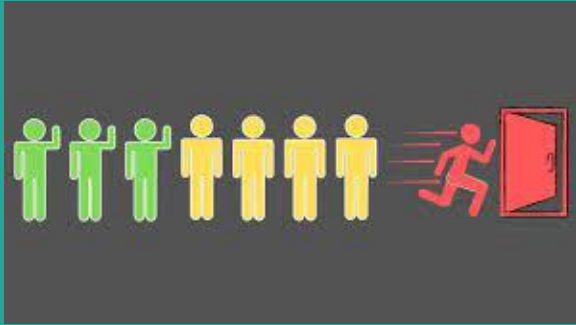


Customer Churn



Health Outcomes

When Will *It* End?



Customer Churn

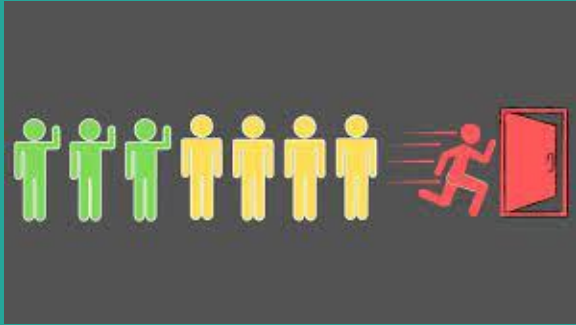


Health Outcomes



Machine Failure

When Will *It* End?



Customer Churn



Health Outcomes



Machine Failure

“Mission Critical” Predictions In Multi-Billion Dollar Industries!

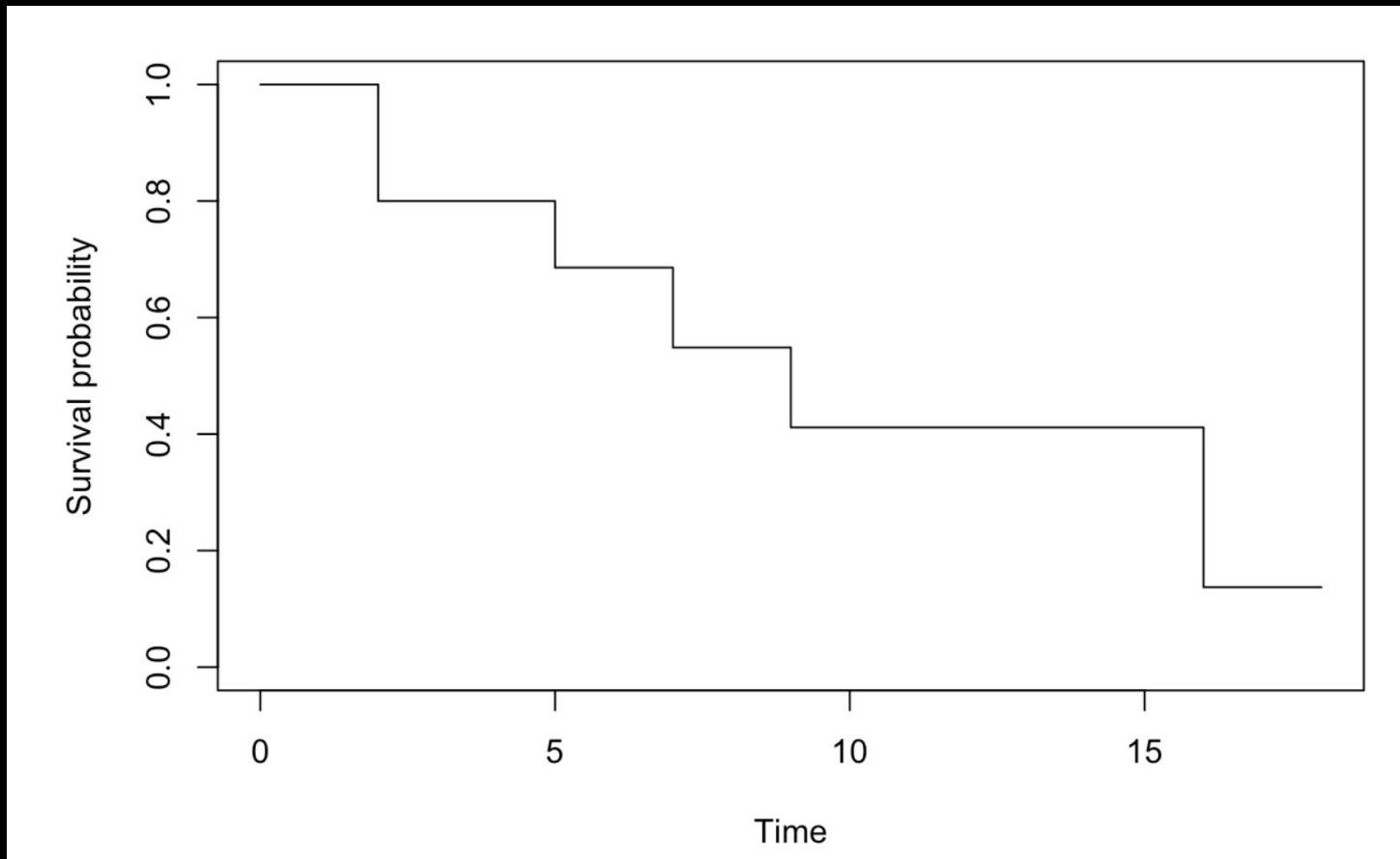
censoring
period^{free}
time
event

Survival^{drops}
follow-up
observed
follow
probability^{interest}
loss^{right}
censoring
observation

A word cloud featuring various terms related to survival analysis. The words are arranged in a non-uniform, overlapping manner. The word 'event' is the largest and most prominent, oriented vertically. Other large words include 'Survival', 'follow-up', 'censoring', 'period', 'time', and 'probability'. The word 'probability' is highlighted with a red rectangular border. Smaller words include 'drops', 'free', 'observed', 'loss', 'right', 'interest', and 'observation'. The colors of the words range from dark red to light gray.

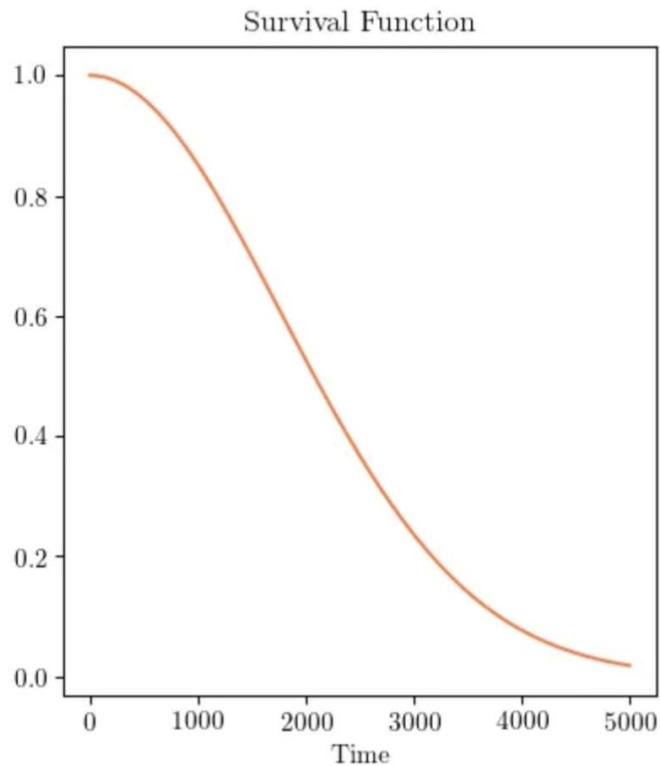
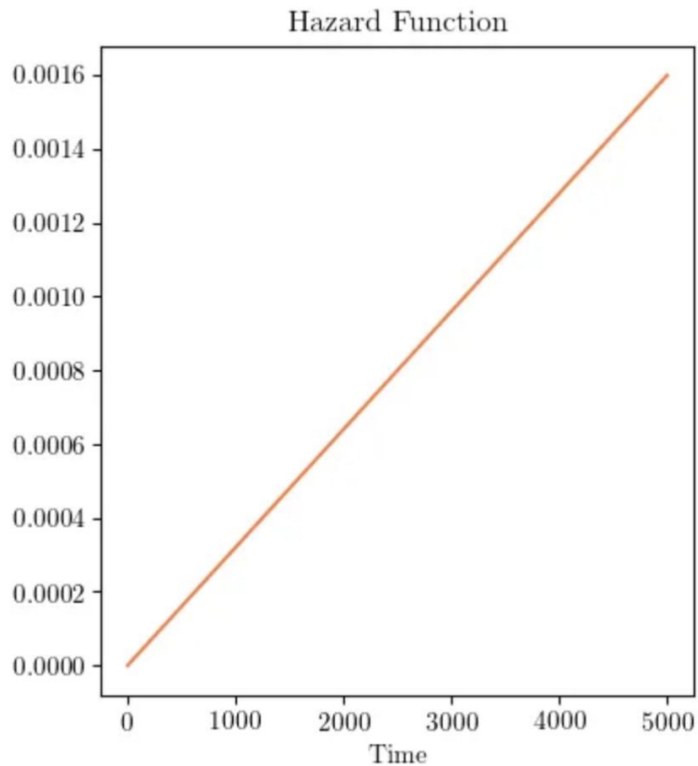
Survival^{drops}
follow-up
event
period^{free}
time
Censoring
probability
observed
loss right
censoring
interest
observation

Failure/Survival Prediction Is Probabilistic...



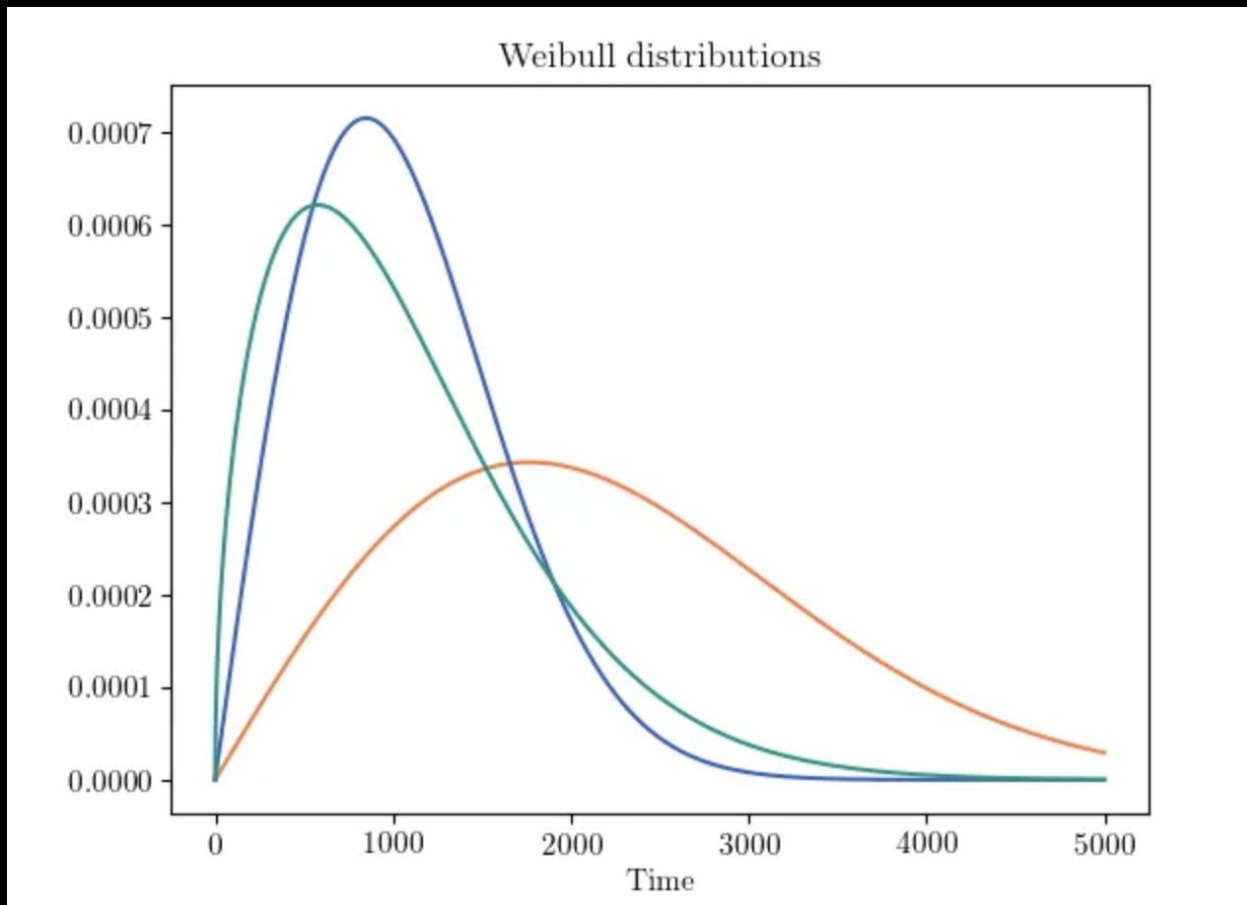
Survival Prediction Is Probabilistic...

$$S(t) = \Pr(T > t)$$

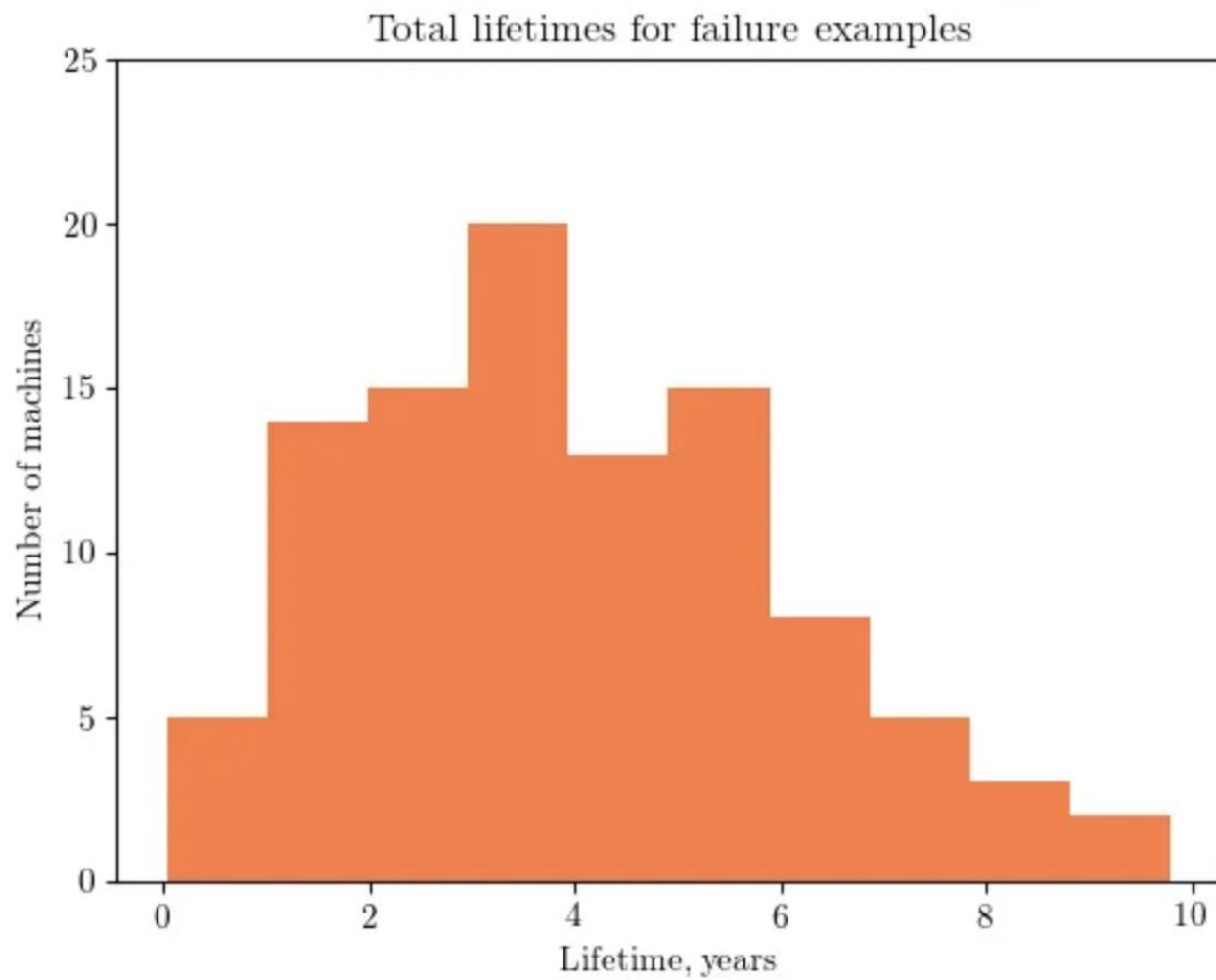


...and that is not enough. We need to predict the remaining life of each of a group of machines. To understand how this can be done, it's easiest

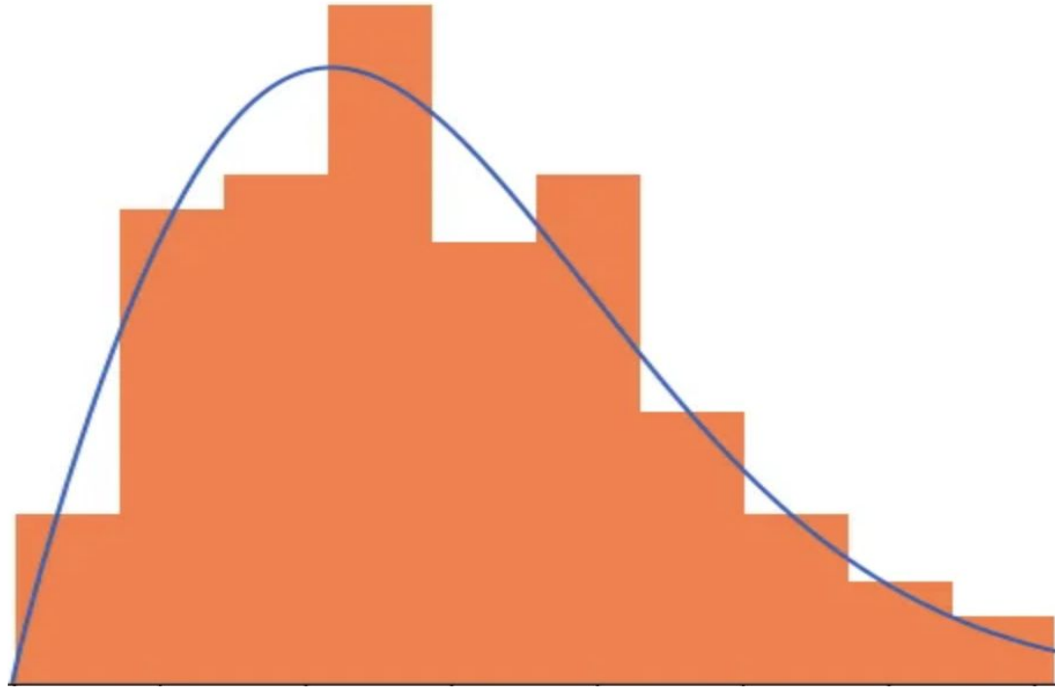
Survival Prediction Is Probabilistic...



Shape
Scale



Easy “Fit” Right?



Machine Learning Approach

Beyond Curve-Fitting

- Learning from data
 - Multiple underlying distributions
 - Best of both worlds: distribution-driven + learning-driven
-

Let's Start Coding!

—

Connect

WIFI:

SEEMAPLD_WORKSHOP

PW: TBD

URL: TBD

LOGIN/PW: TBD



- Your own Python interpreter runs on a mac-mini (“kernel”)
 - Follow me and wait to “experiment”
 - Expected technical issues:
 - check WIFI
 - open new tab and re-login
 - new profile and login
 - slow parts
-