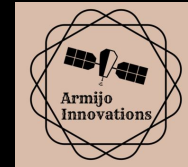


# Practical ML Tutorial: Part I

—  
George Williams



# Tutorial Collaborators



Trevor Peyton  
Machine Learning Researcher  
UT Chattanooga



James L Carpenter (Jake)  
Graduate Research Assistant  
UT Chattanooga

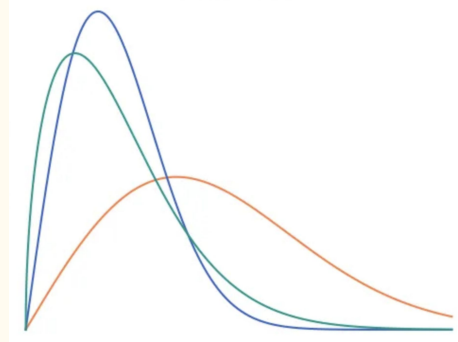


Stephen Lawrence  
Graduate Research Assistant  
UT Chattanooga

# Agenda

## Part I

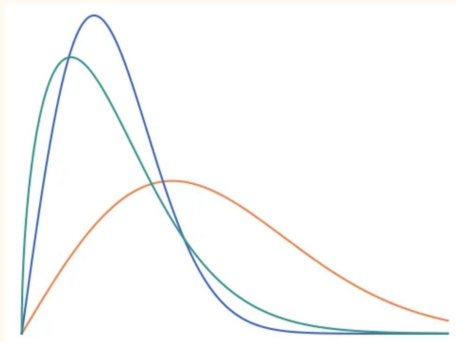
- AI Trends
- ML Basics
- Survival Analysis
- *Hands-On Programming*



# 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:

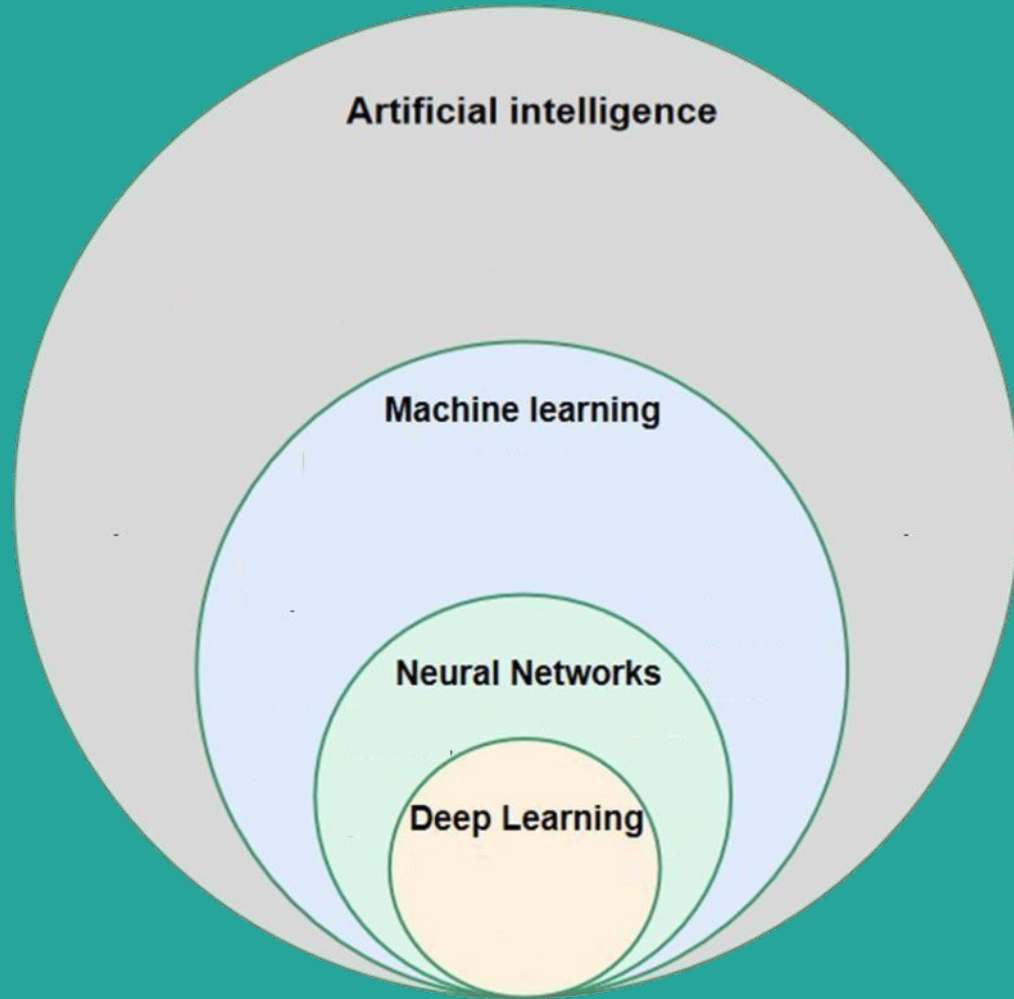
“There once was an electronic device,  
That emitted radiation quite precise,  
Its waves were quite strong,  
And could last all day long,  
But shielding it was always advised!”

nature

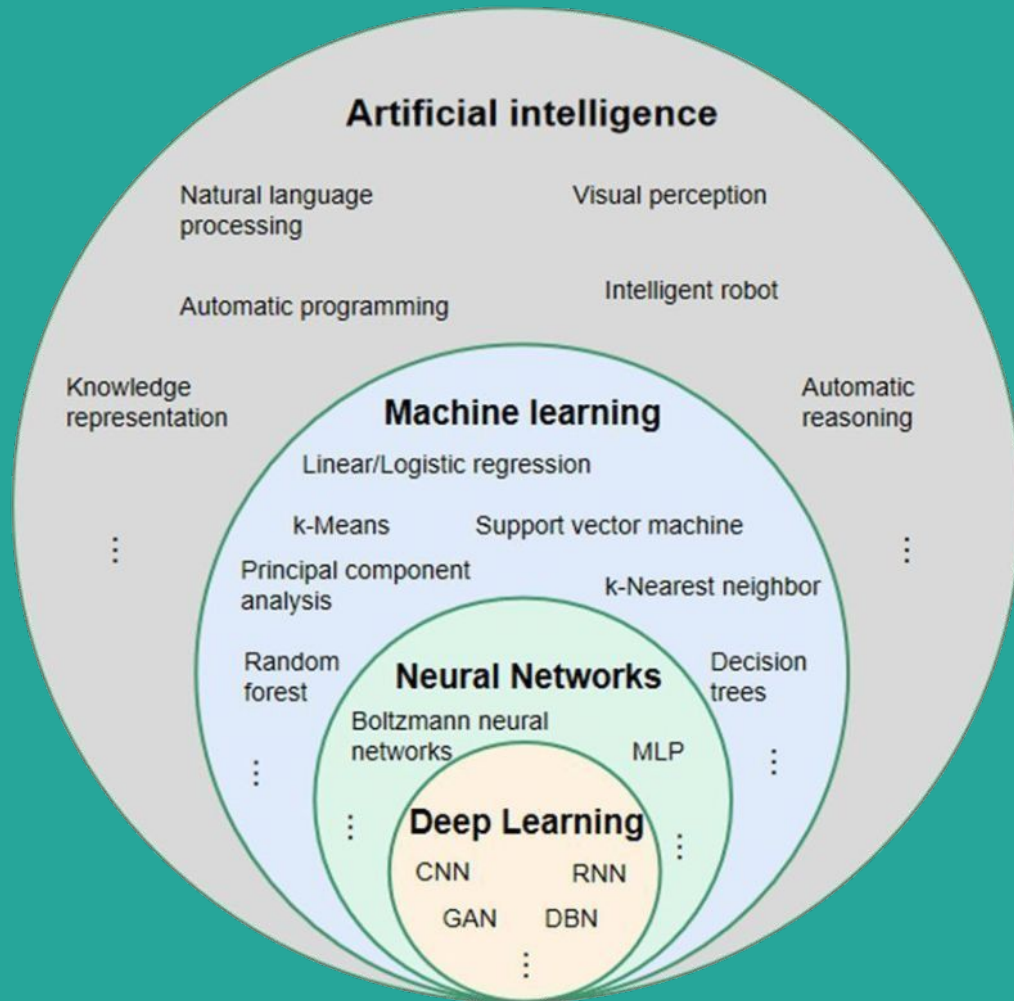


DeepMind

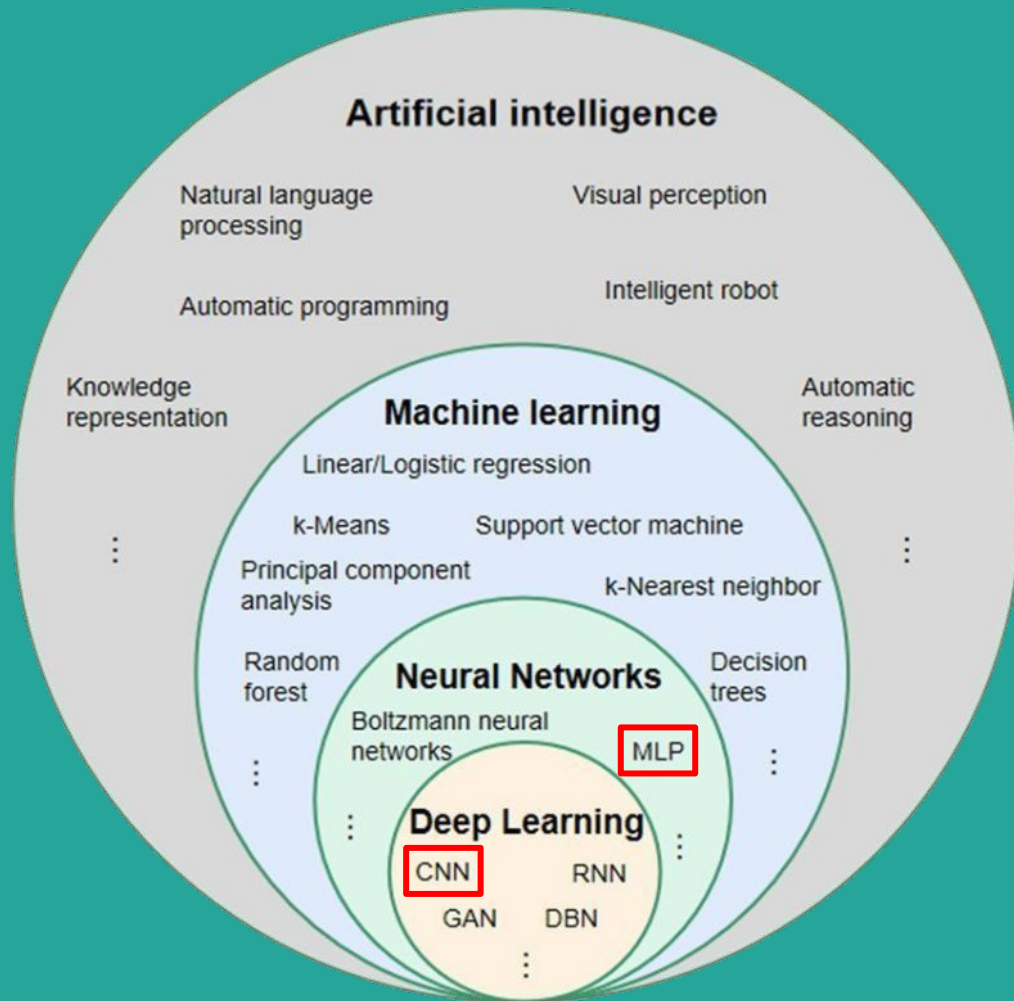
# ML



# ML

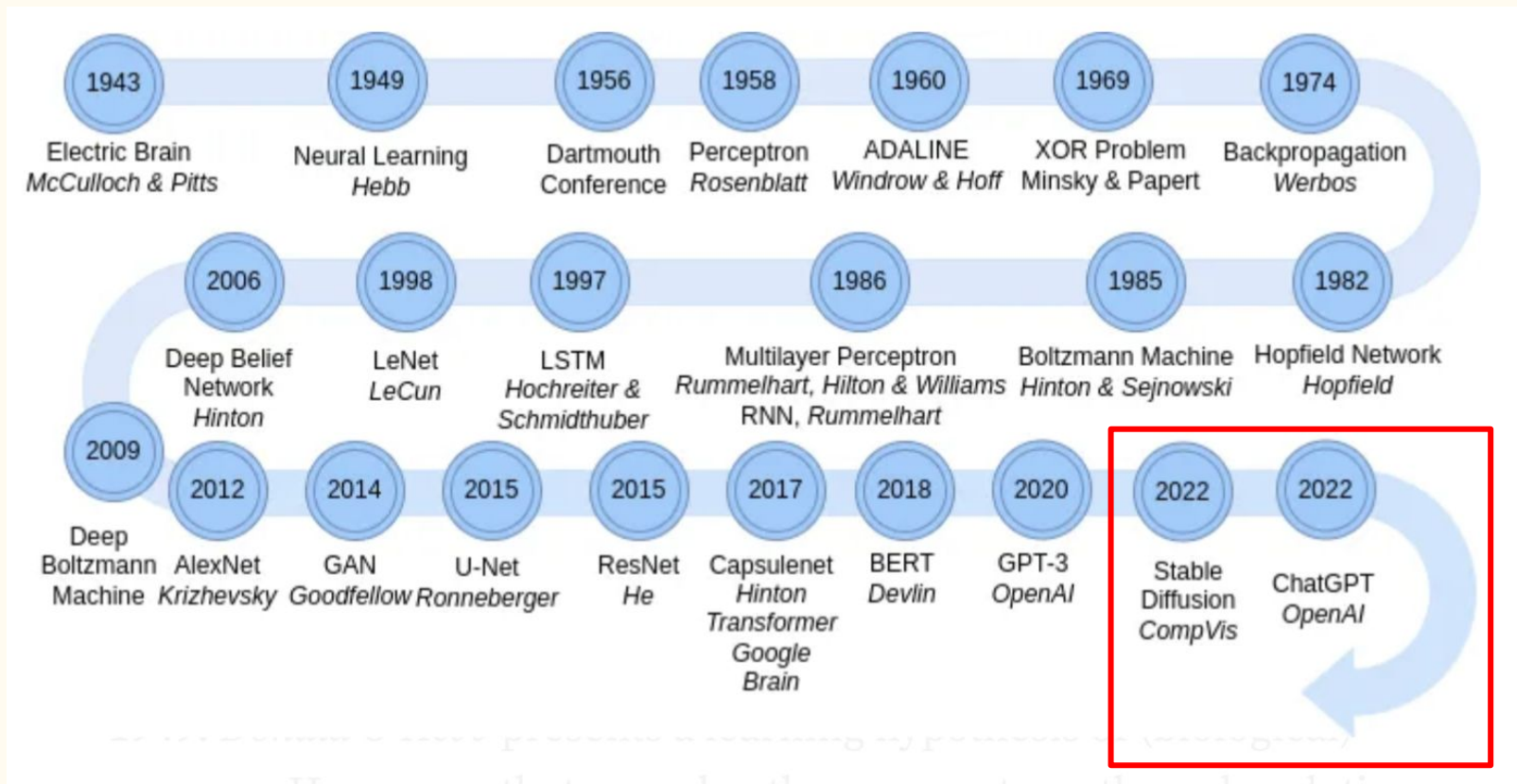


# ML

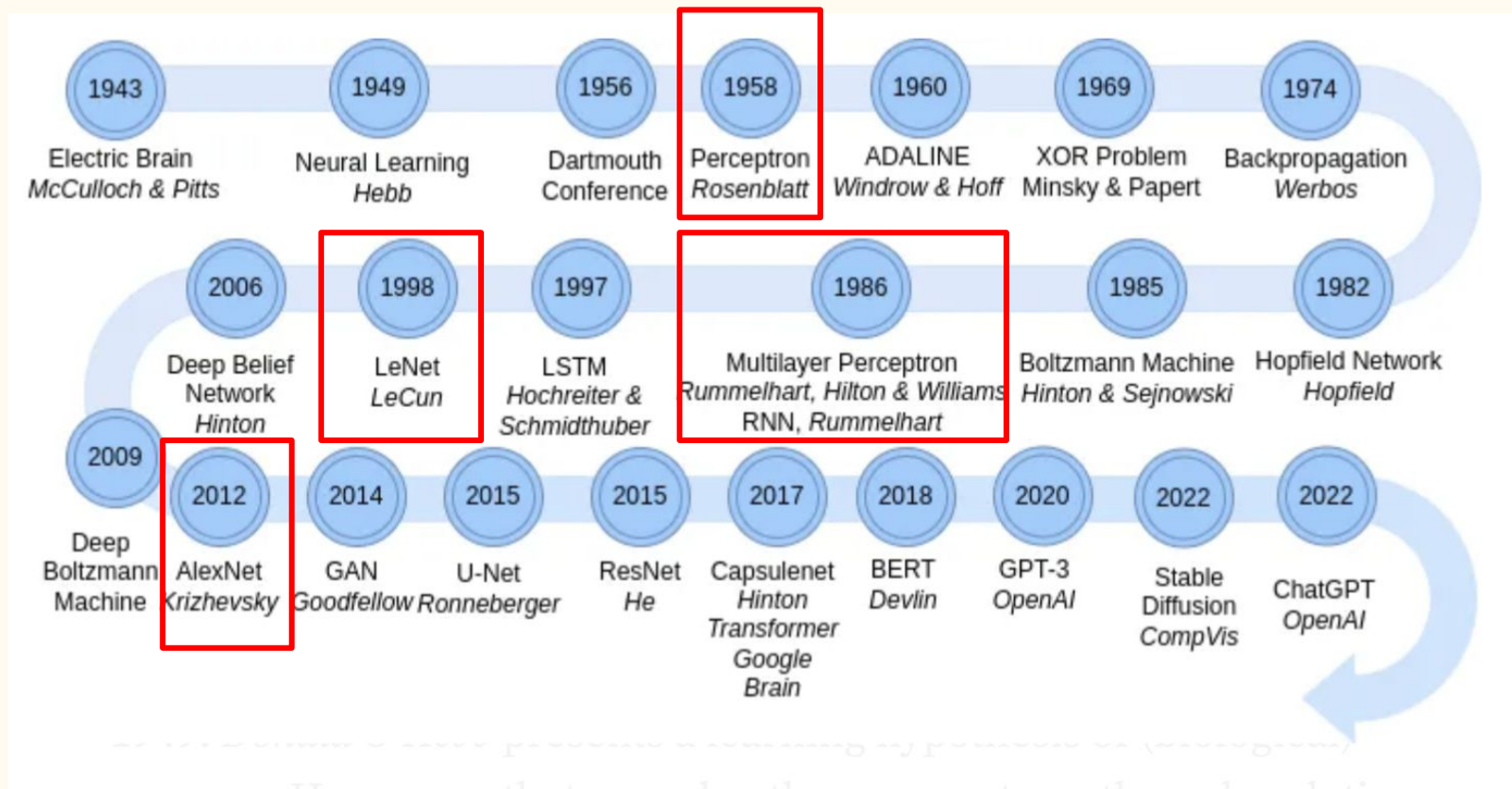




# Neural Networks



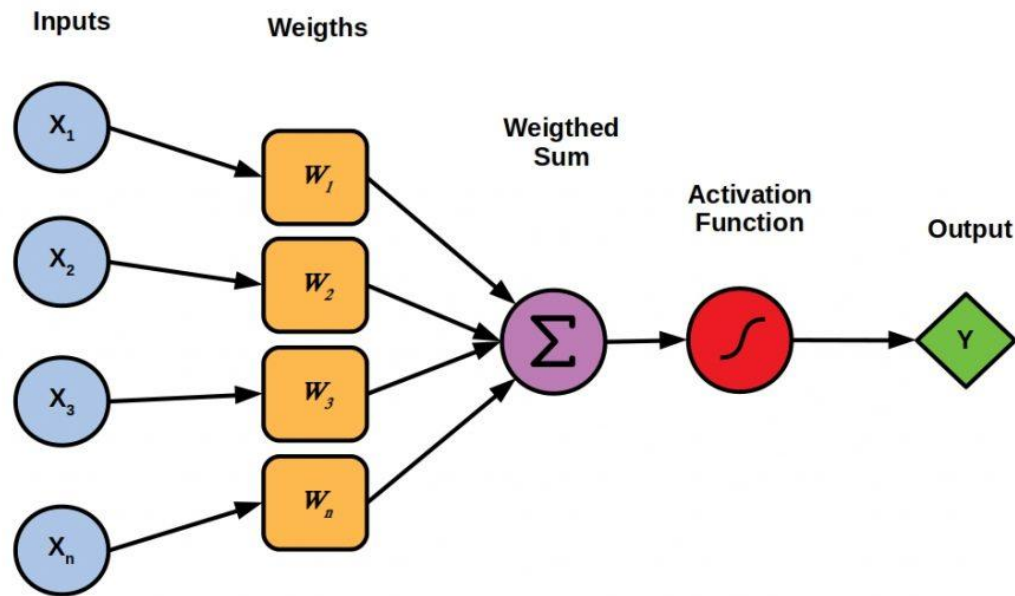
# Neural Networks



# Neural Network Basics



# Neural Networks Basic Unit



# A mostly complete chart of Neural Networks

©2019 Fjodor van Veen & Stefan Leijnen asimovinstitute.org

Perceptron (P)



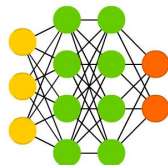
Feed Forward (FF)



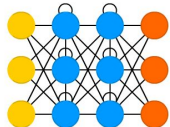
Radial Basis Network (RBF)



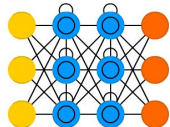
Deep Feed Forward (DFF)



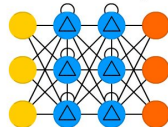
Recurrent Neural Network (RNN)



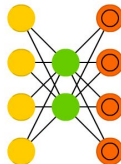
Long / Short Term Memory (LSTM)



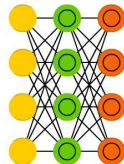
Gated Recurrent Unit (GRU)



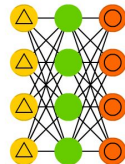
Auto Encoder (AE)



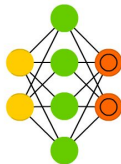
Variational AE (VAE)



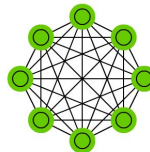
Denoising AE (DAE)



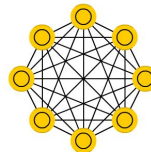
Sparse AE (SAE)



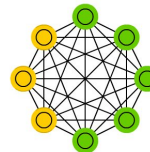
Markov Chain (MC)



Hopfield Network (HN)



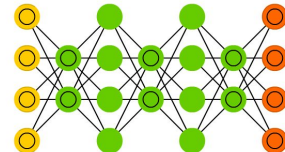
Boltzmann Machine (BM)



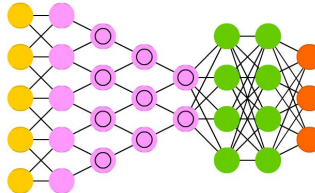
Restricted BM (RBM)



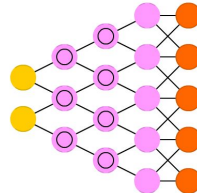
Deep Belief Network (DBN)



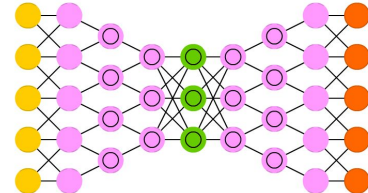
Deep Convolutional Network (DCN)



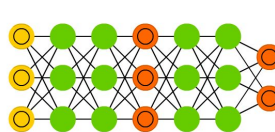
Deconvolutional Network (DN)



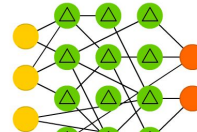
Deep Convolutional Inverse Graphics Network (DCIGN)



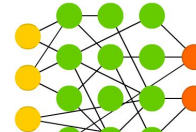
Generative Adversarial Network (GAN)



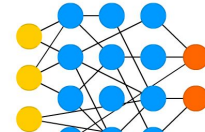
Liquid State Machine (LSM)



Extreme Learning Machine (ELM)

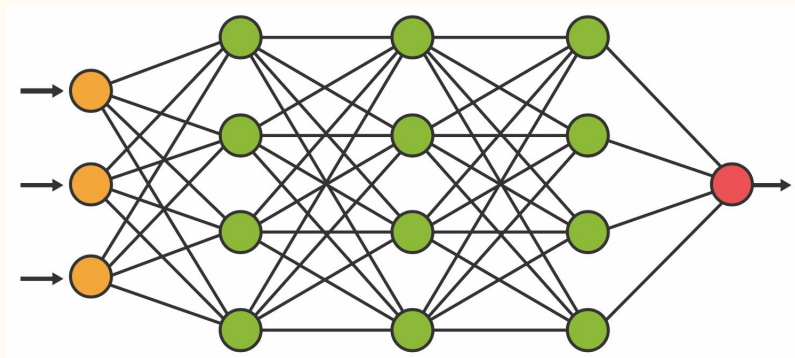


Echo State Network (ESN)



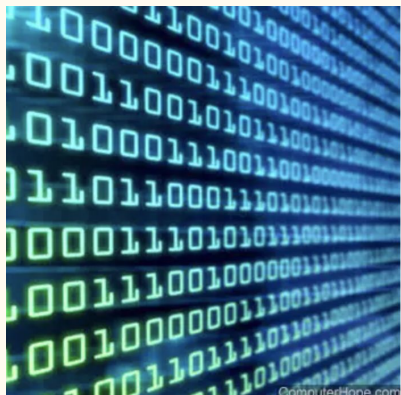
Just Google “Neural Network Zoo”...

# Neural Networks “In Practice”

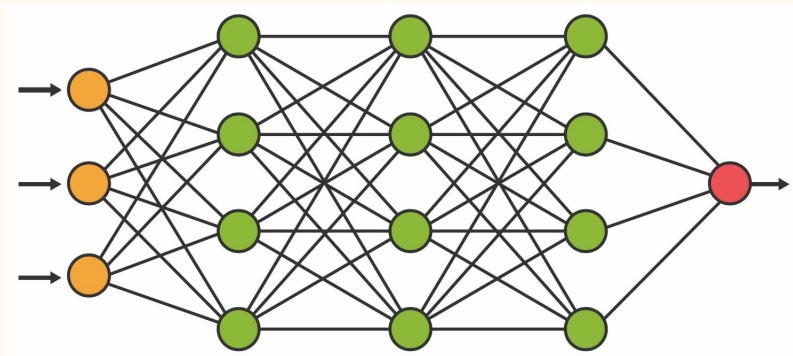


Model

# Neural Networks “In Practice”



Data



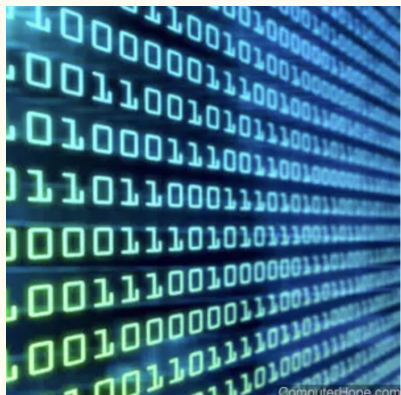
Model



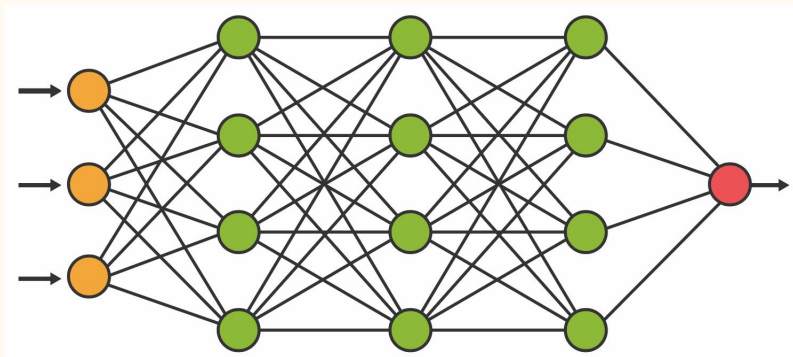
Eval



# Neural Networks “In Practice”



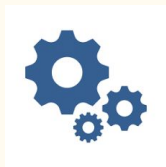
Data



Model



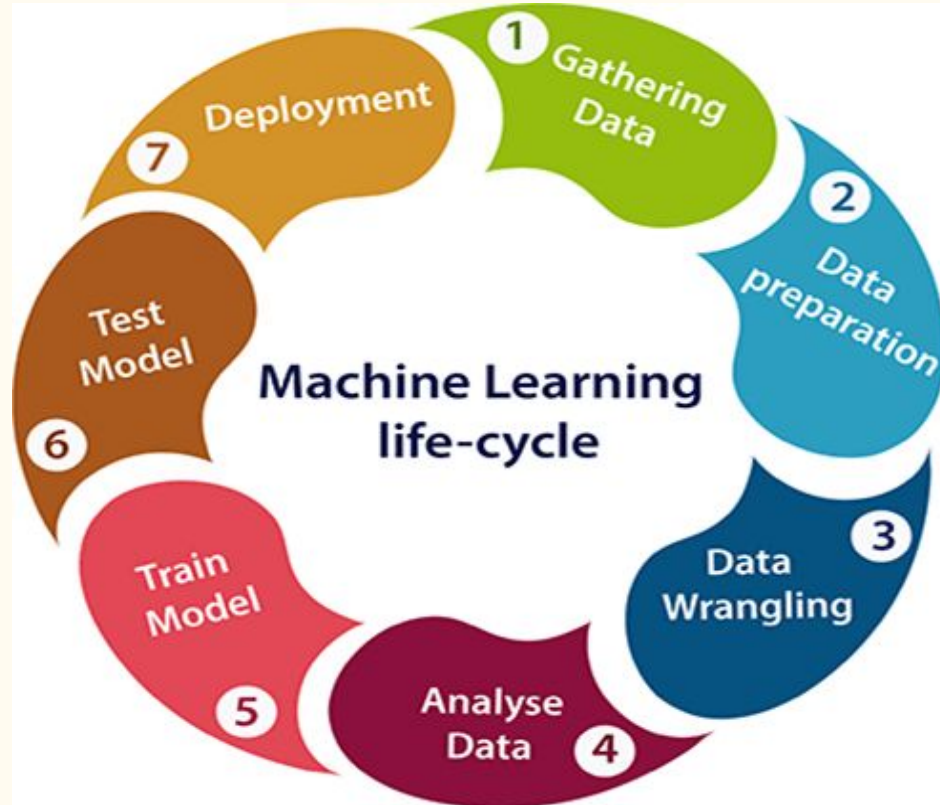
Eval



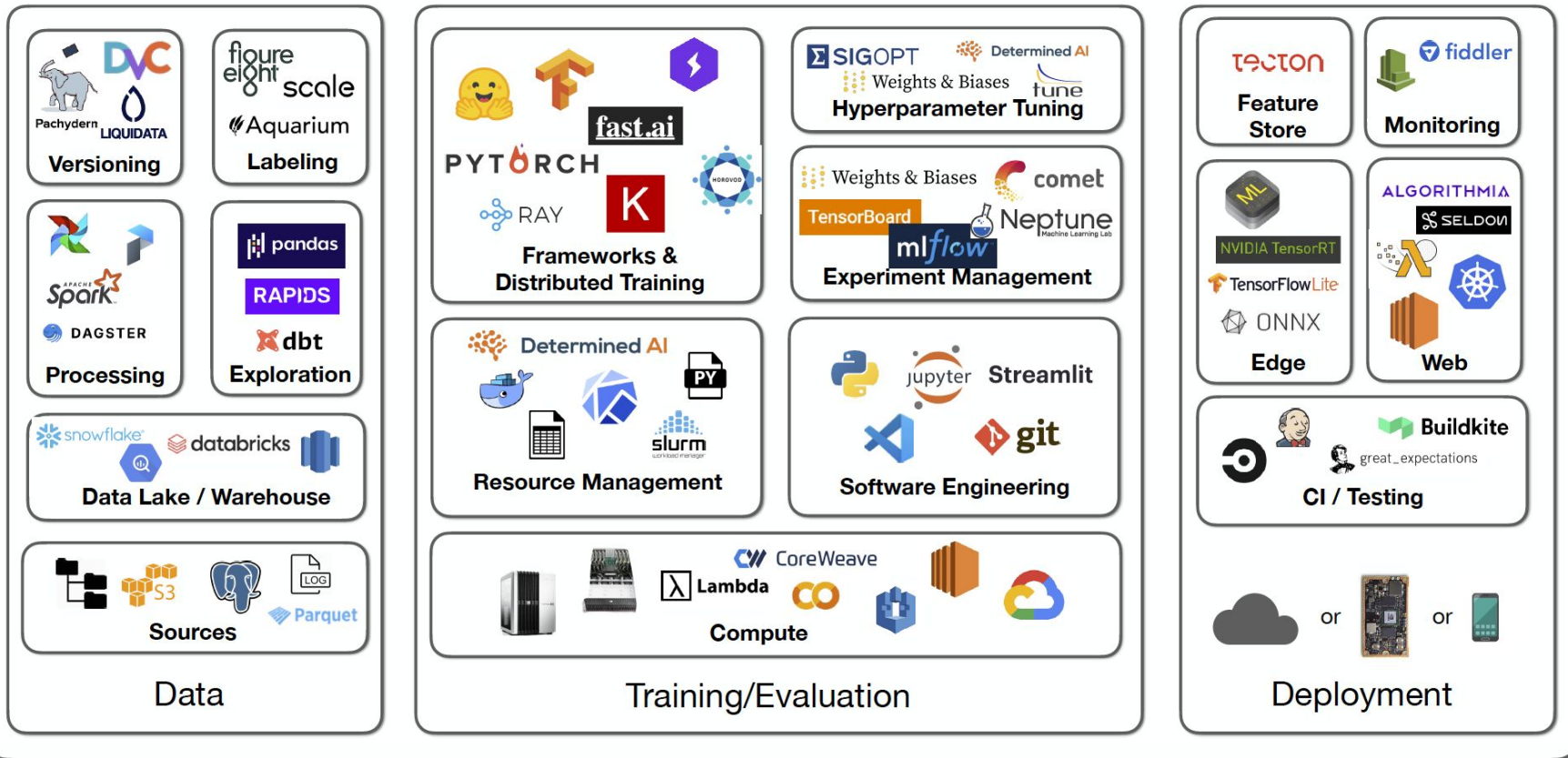
Learning Algorithm

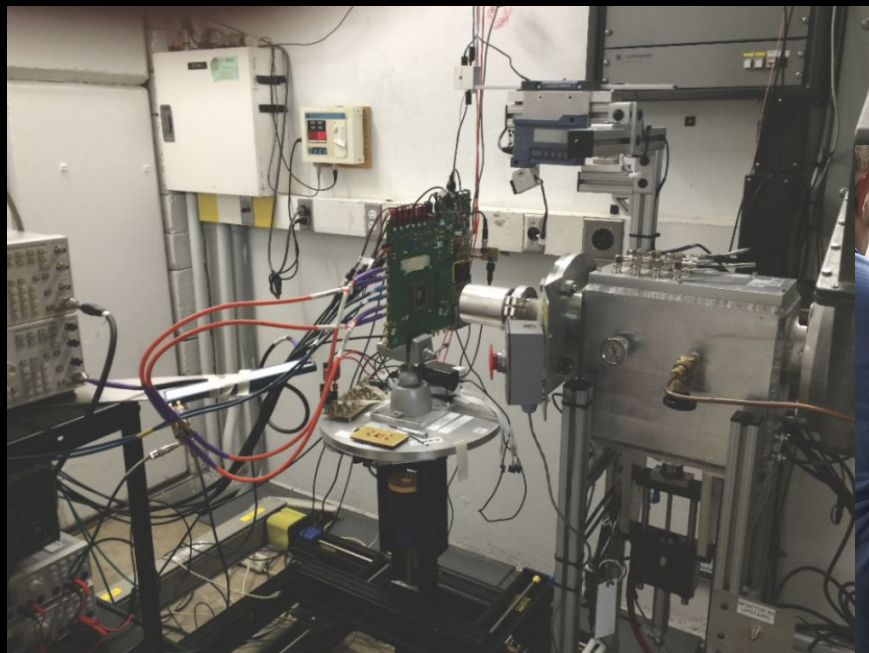


# Neural Networks “In Practice”



# Industry ML “Ecosystem”





# Survival Analysis

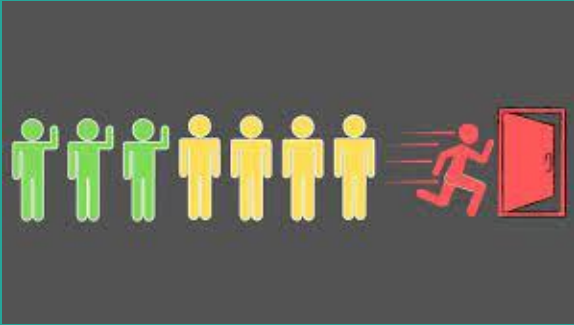
—

Tries To Answer The  
Question:

*When Will It End?*

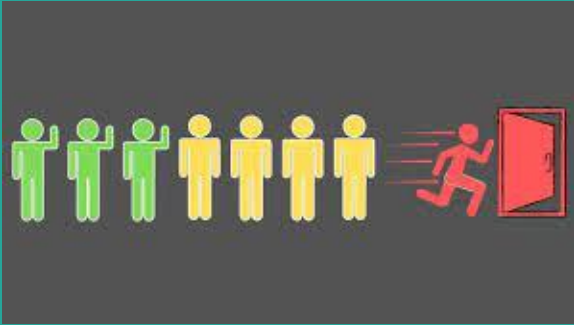
*When Will **It** End?*

# *When Will It End?*

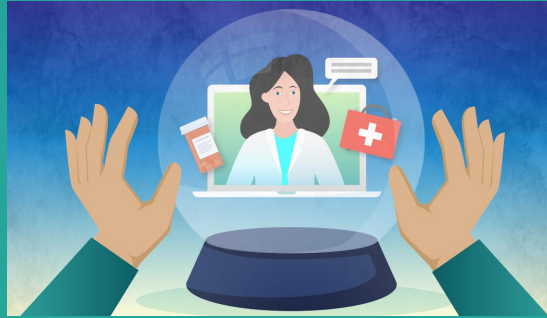


Customer Churn

# When Will *It* End?



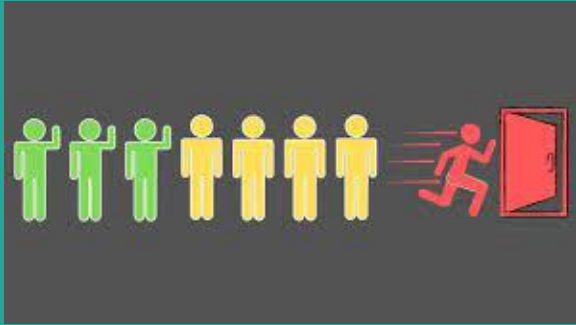
Customer Churn



Health Outcomes



# When Will *It* End?



Customer Churn

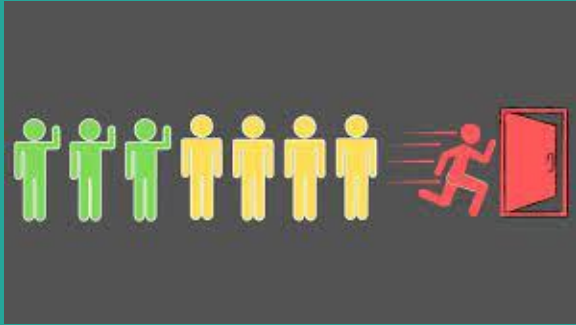


Health Outcomes



Machine Failure

# When Will *It* End?



Customer Churn



Health Outcomes



Machine Failure

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

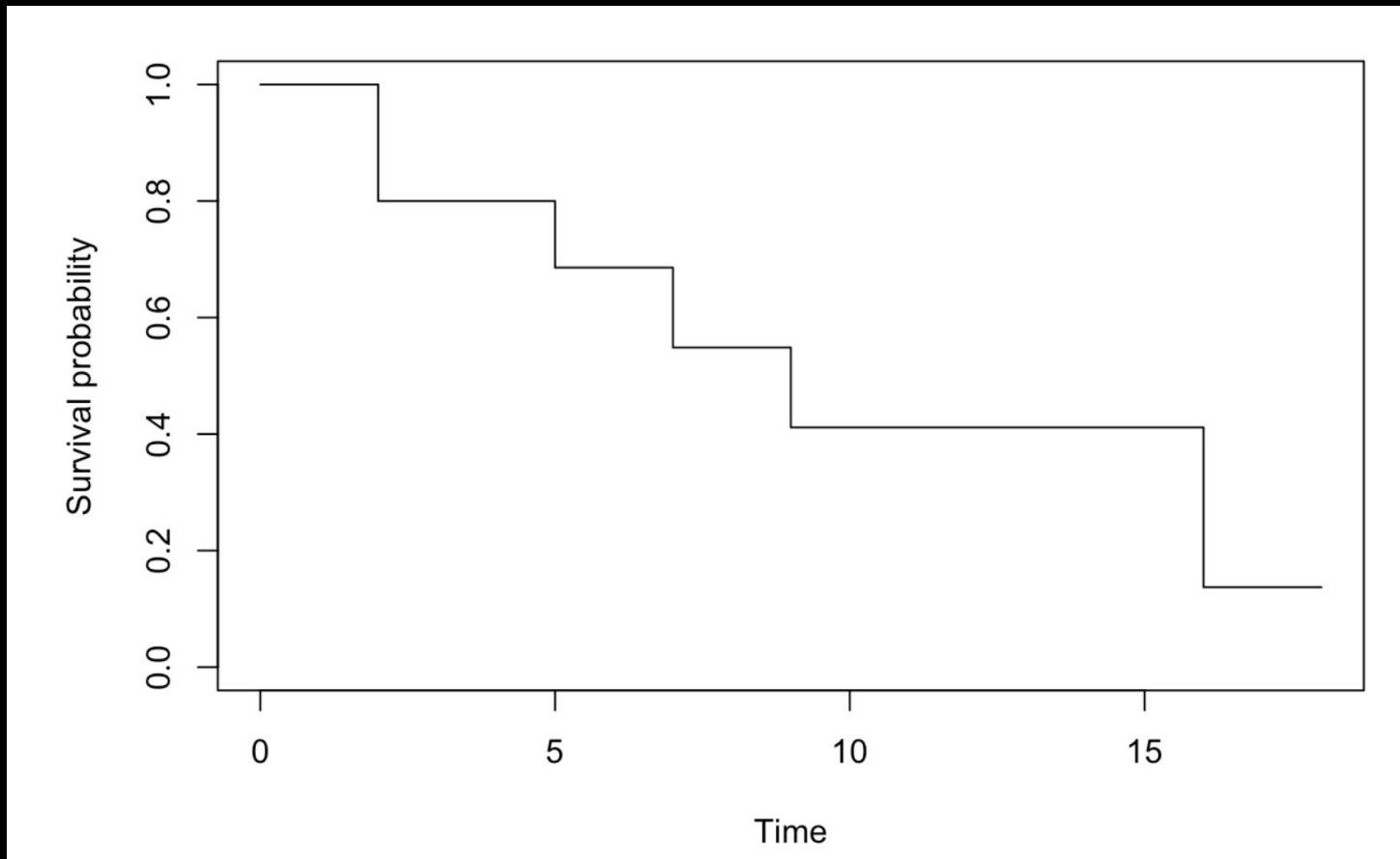
Censoring  
period<sup>free</sup>  
time  
event

Survival<sup>drops</sup>  
follow-up  
observed  
follow  
probability<sup>interest</sup>  
loss<sup>right</sup>  
censoring  
observation

A word cloud featuring various terms related to survival analysis. The words are arranged in a non-uniform, overlapping manner. The word 'probability' is highlighted with a red rectangular border. The words are in different colors (dark red, grey) and sizes, indicating their relative frequency or importance in the context.

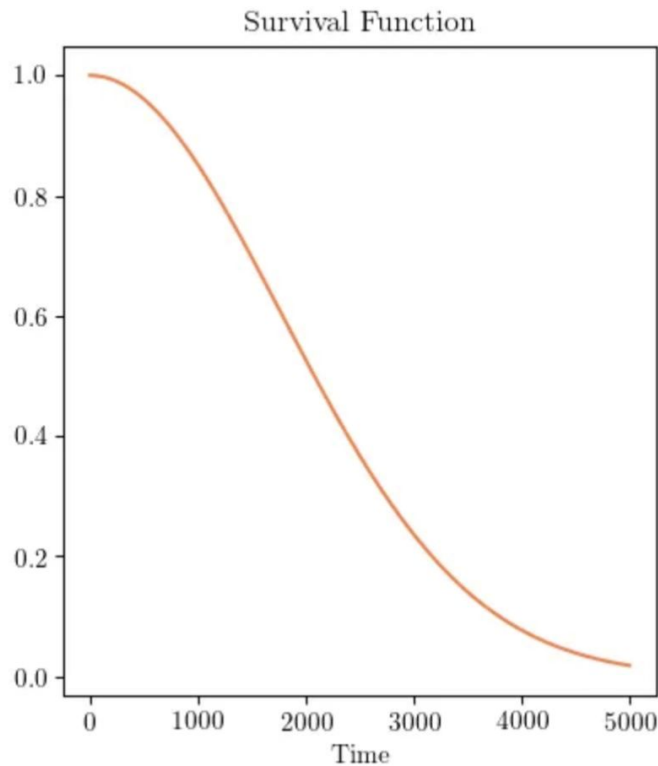
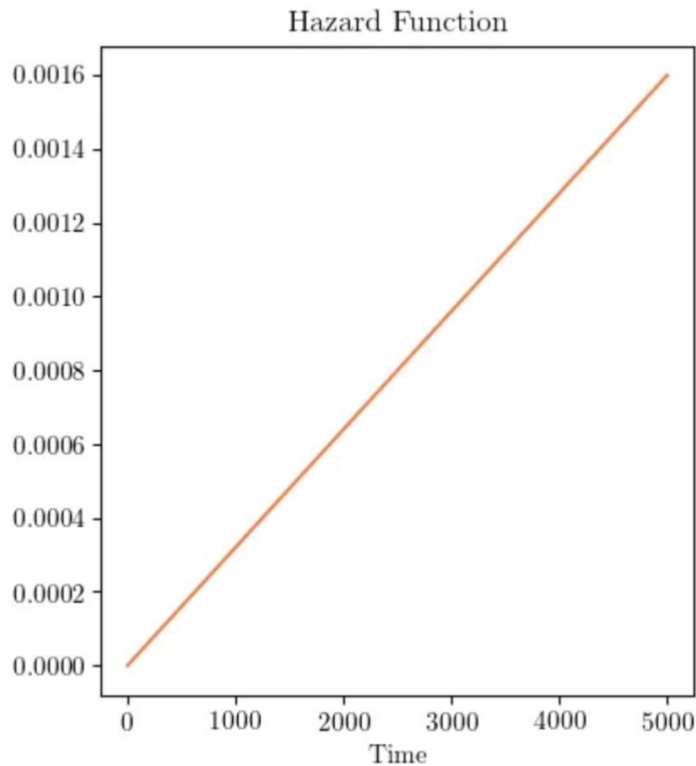
Survival  
follow-up  
period  
time  
event  
censoring  
observed  
drops  
free  
interest  
loss  
right  
censoring  
observation  
probability

# Failure/Survival Prediction Is Probabilistic...



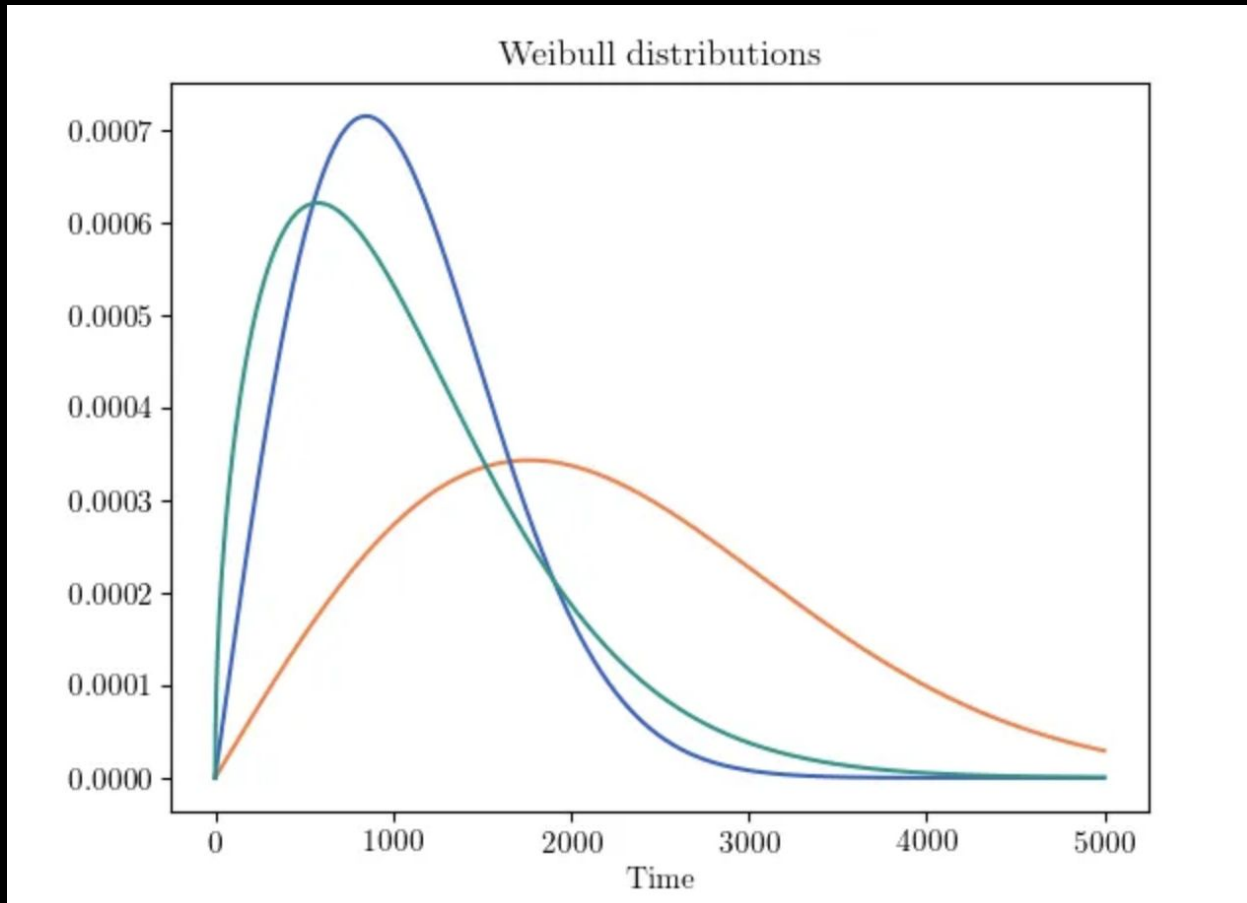
# Survival Prediction Is Probabilistic...

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

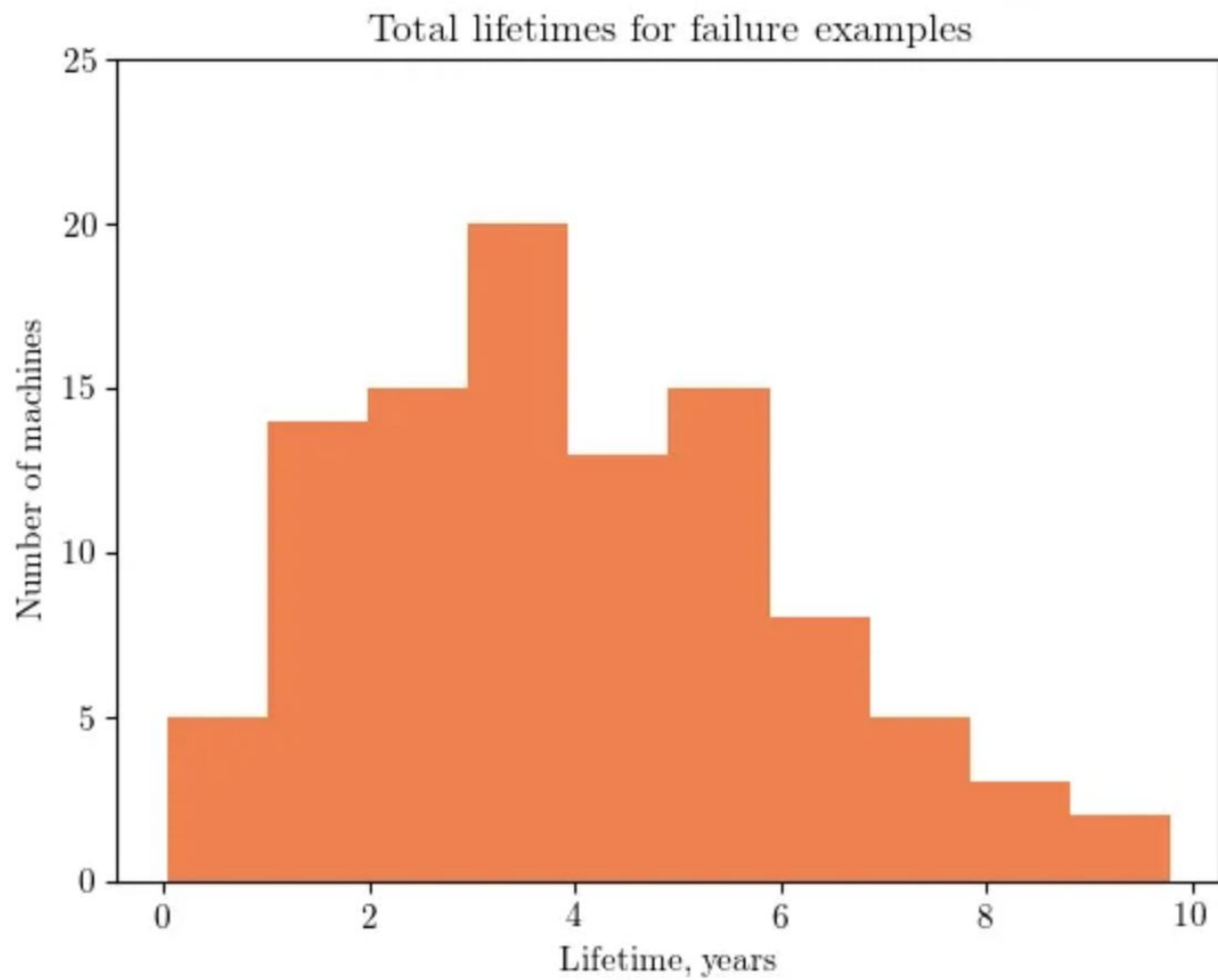


...and we can use the data we have to predict the remaining life of each of a group of machines. To understand how this can be done, it's easiest

# Survival Prediction Is Probabilistic...

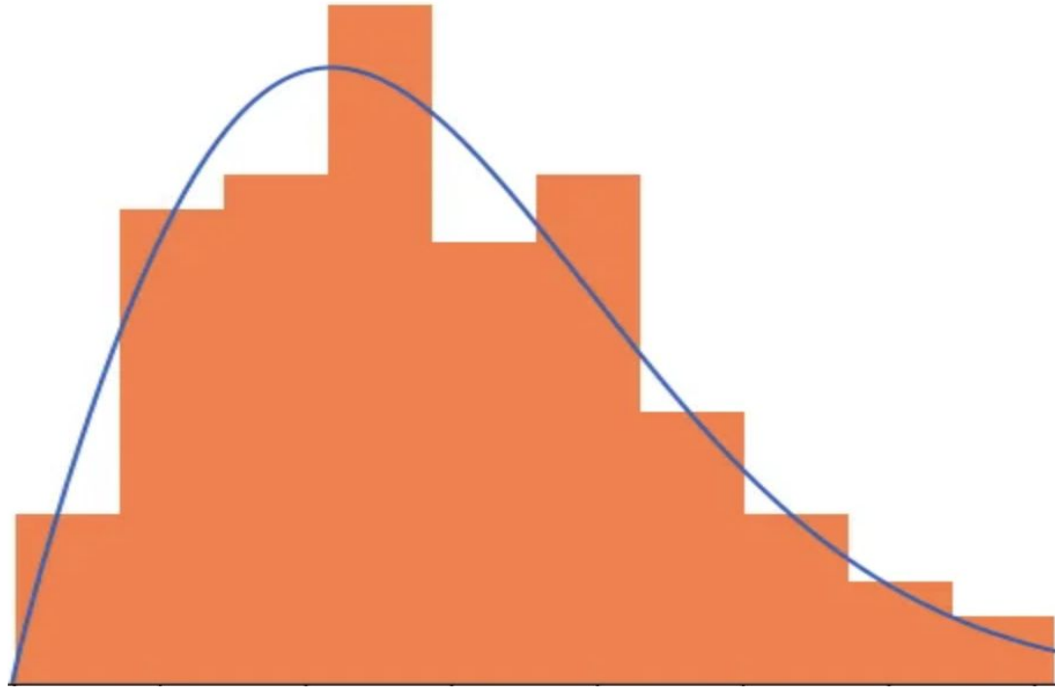


Shape  
Scale





# 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:** [ see note ]

**URL:** [ see note ]

**LOGIN:** [ see note ]

**PW:** [ I will provide ]



- 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
-