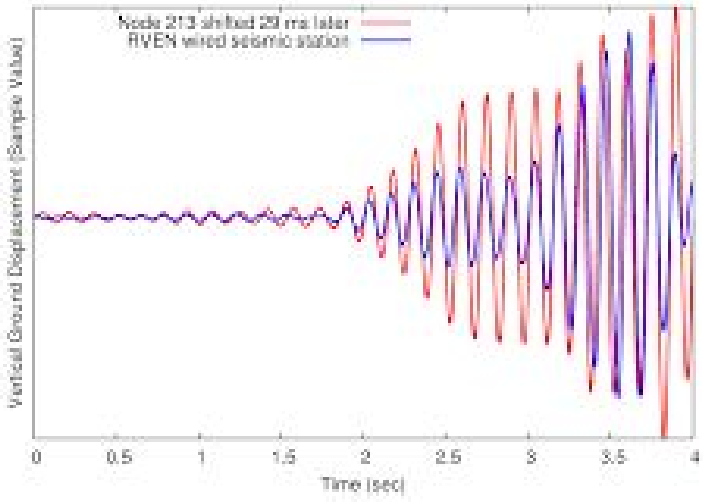
Machine Learning Predicts Laboratory Earthquakes

Sydney Ng

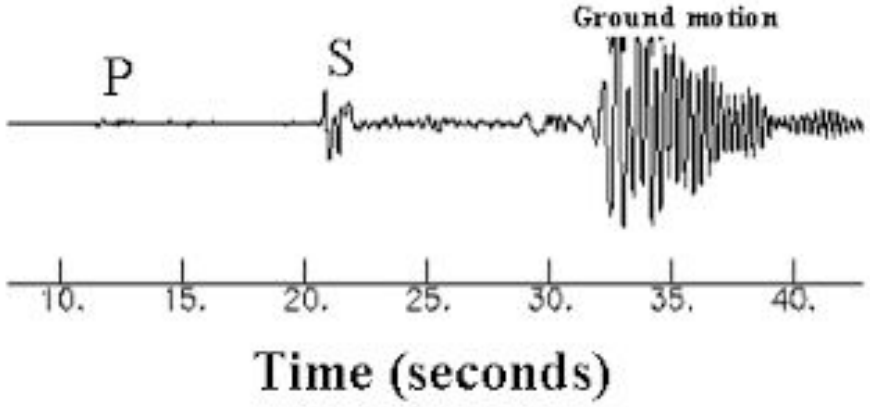
Current Methods

- Measure frequency of earthquakes
- Ineffective
  - Earth is Dynamic
- Cascadia
  - Around 29 years
  - Happened 1966, 2004



Background

- Acoustic & Seismic Precursors
- Minute so Ignored
- ML Algorithm identify these patterns

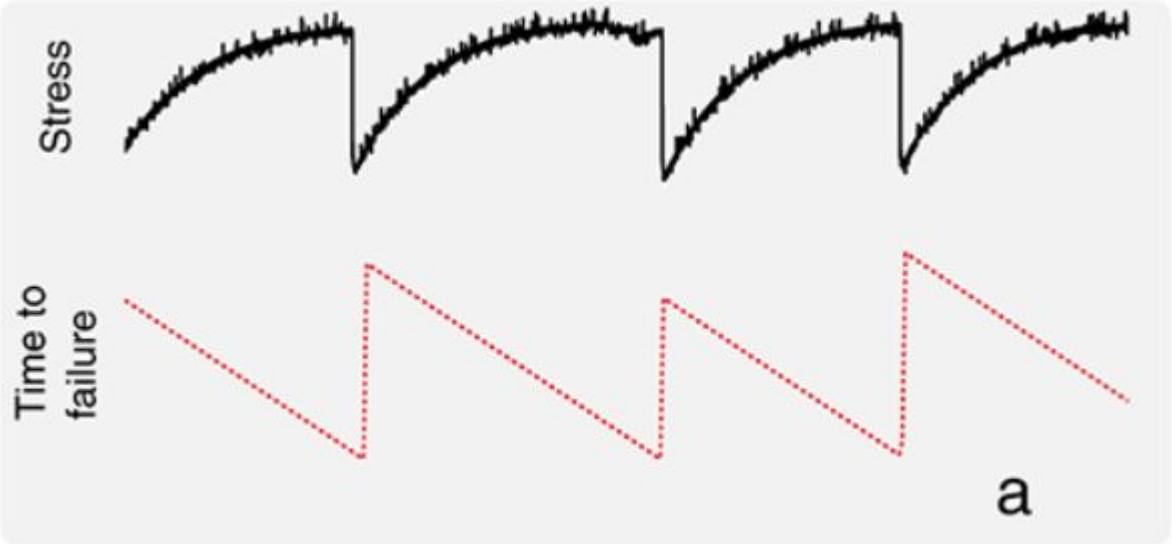


Experiment

- Patterns
  - Stress on the Fault
  - Energy in the Fault
  - Time Before Earthquake
- Laboratory
  - Steel Blocks of 160 GPa calibur
  - Driving Piston for force

What are they Measuring?

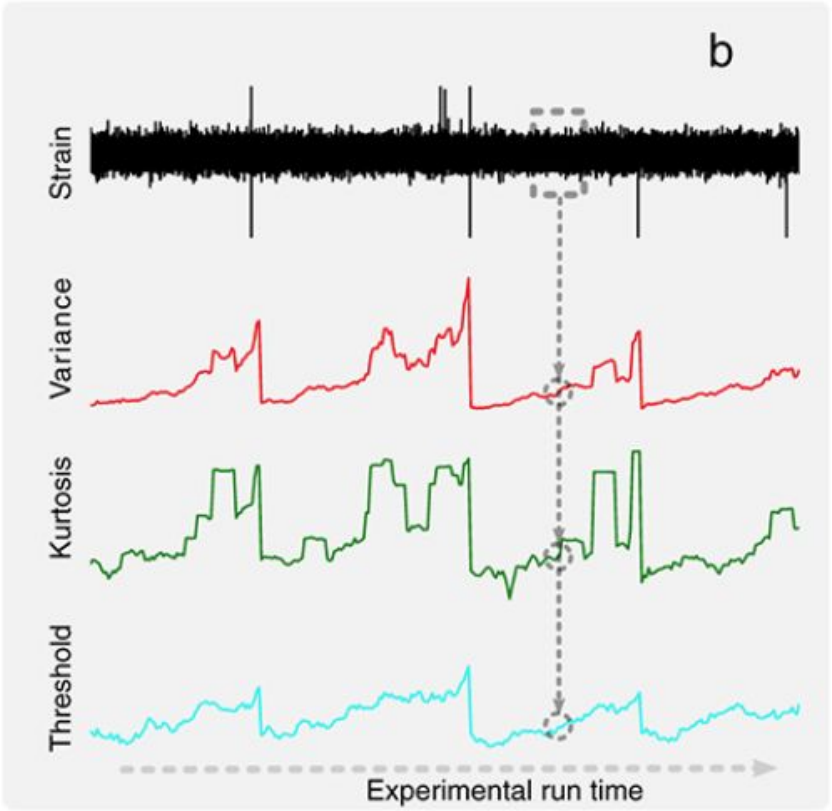
- Actual Results
- Can ML reproduce?



ML Data

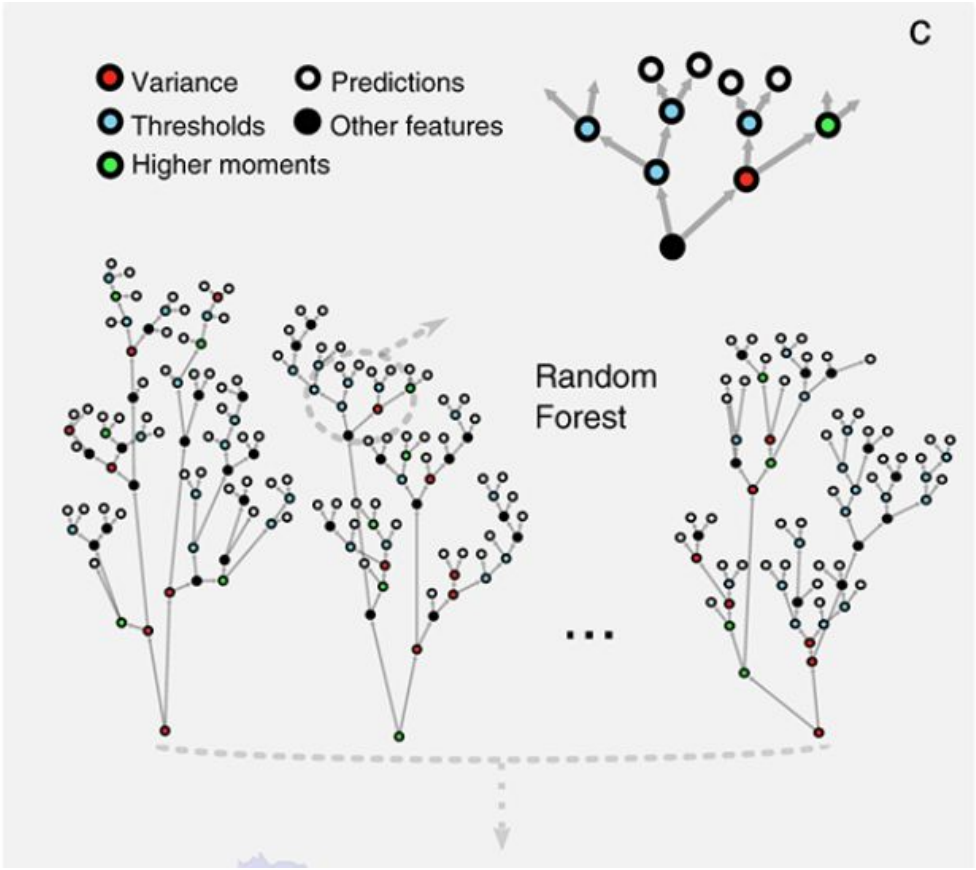
- Strain = force

- Only Acoustic Data
  - Variance
  - Kurtosis
    - (sharpness of curve)
  - Threshold

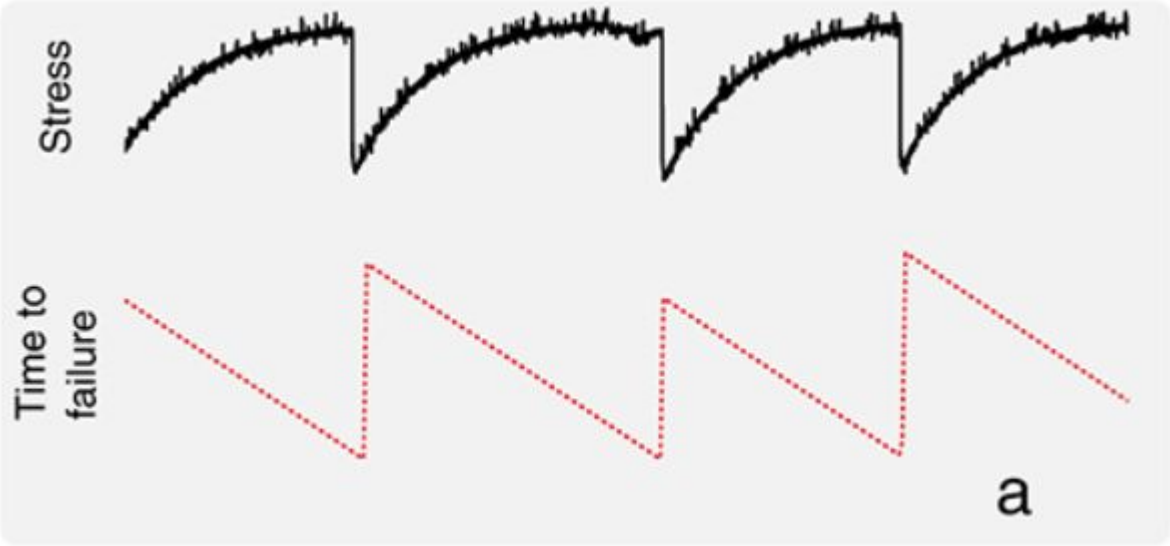


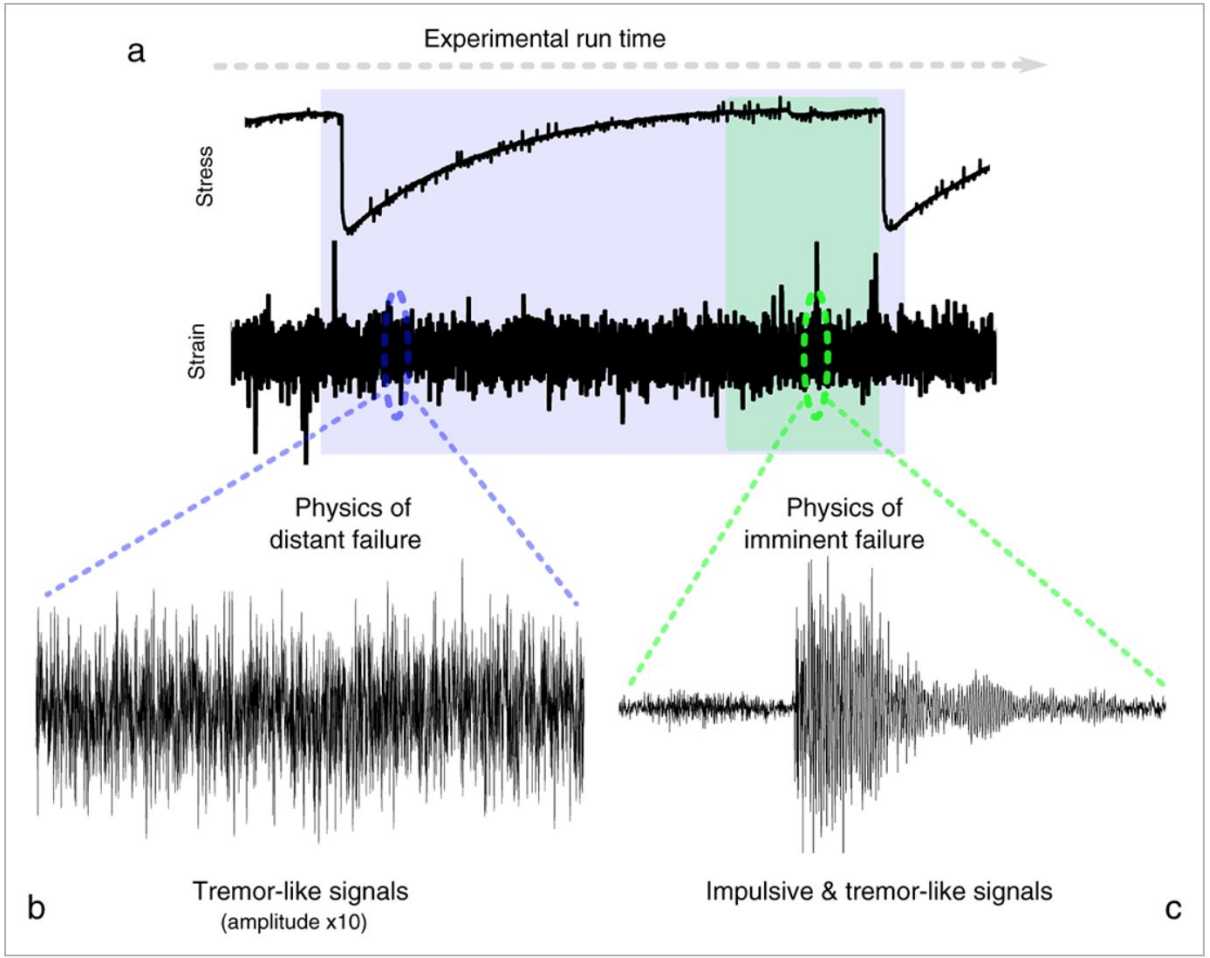
Decision Tree

- Track possibilities Of Earthquake
- Likelihood



Does it line up with the original?




a
Experimental run time
Stress
Strain
Physics of
distant failure
Physics of
imminent failure
b
Tremor-like signals
(amplitude x10)
Impulsive & tremor-like signals
c

What are they Measuring?

- Actual Results
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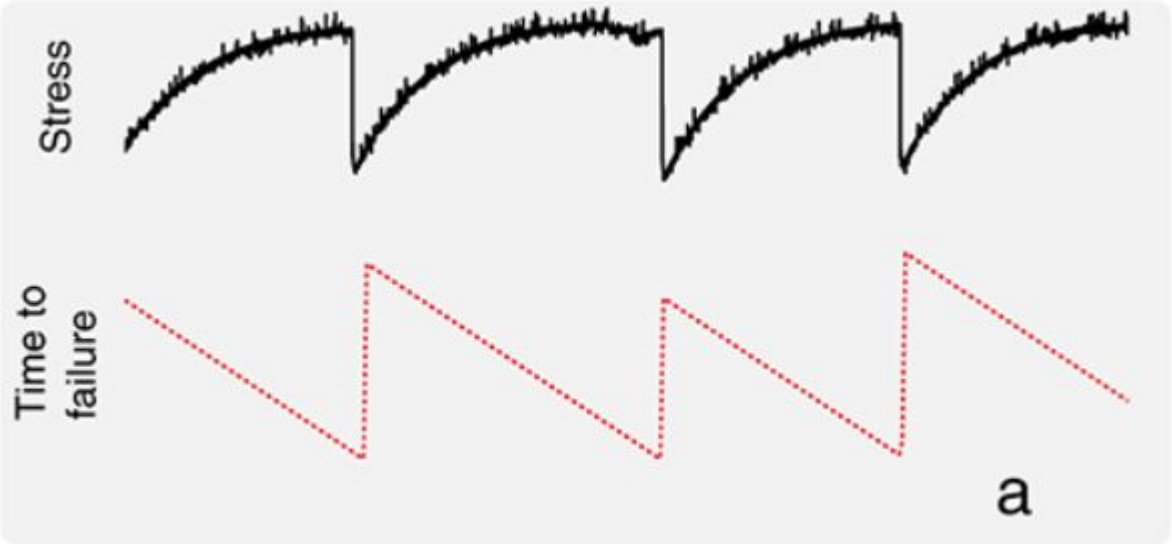
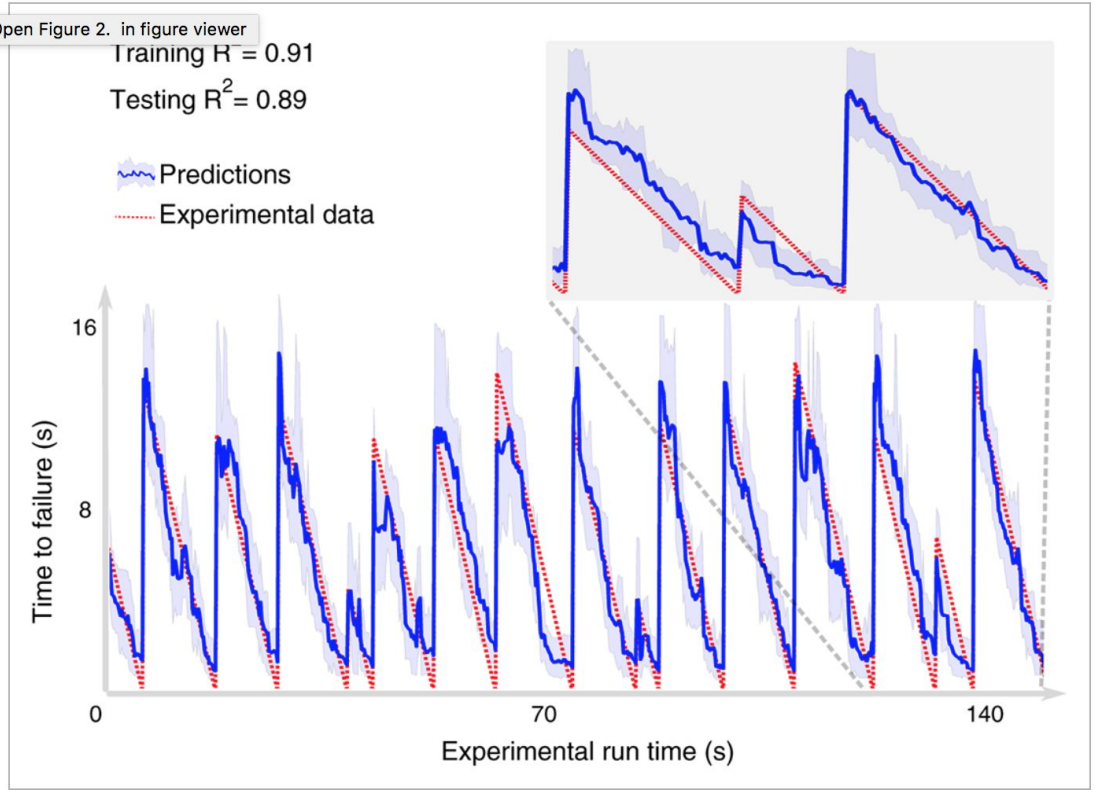


Results

- Red = actual
- Blue = ML



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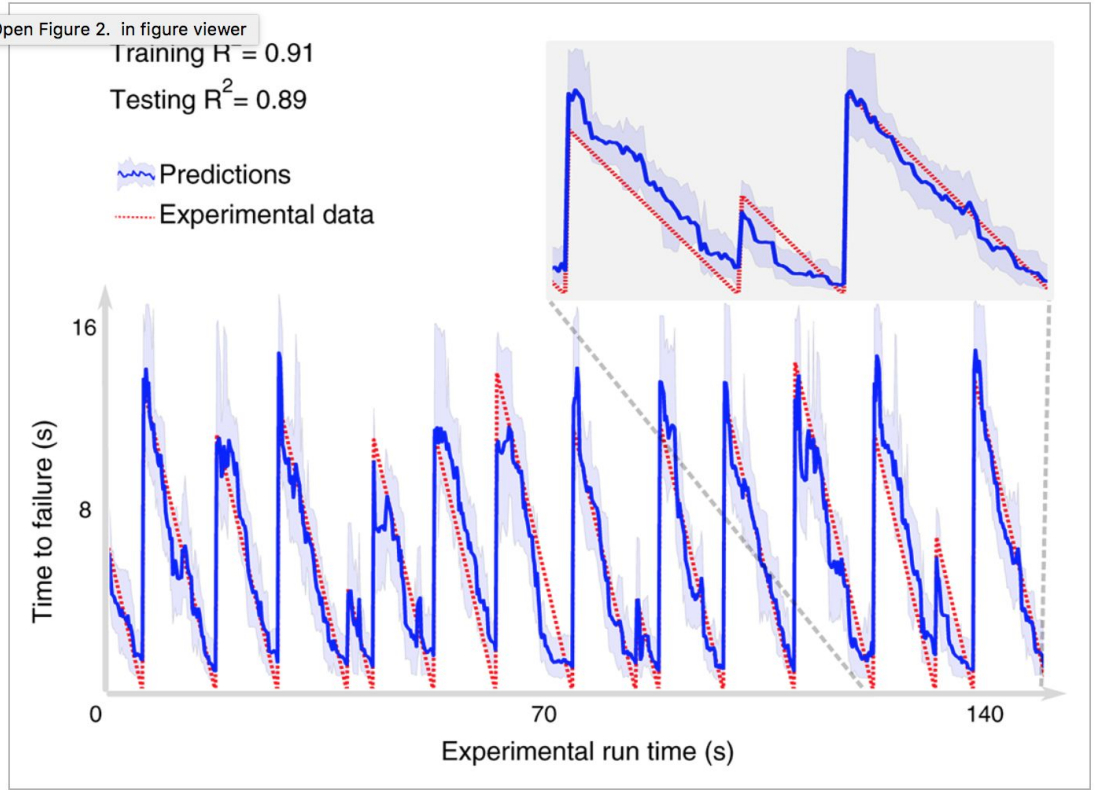


Future Applications

- Currently only in Laboratory
- San Andreas Fault
- Real World Applications

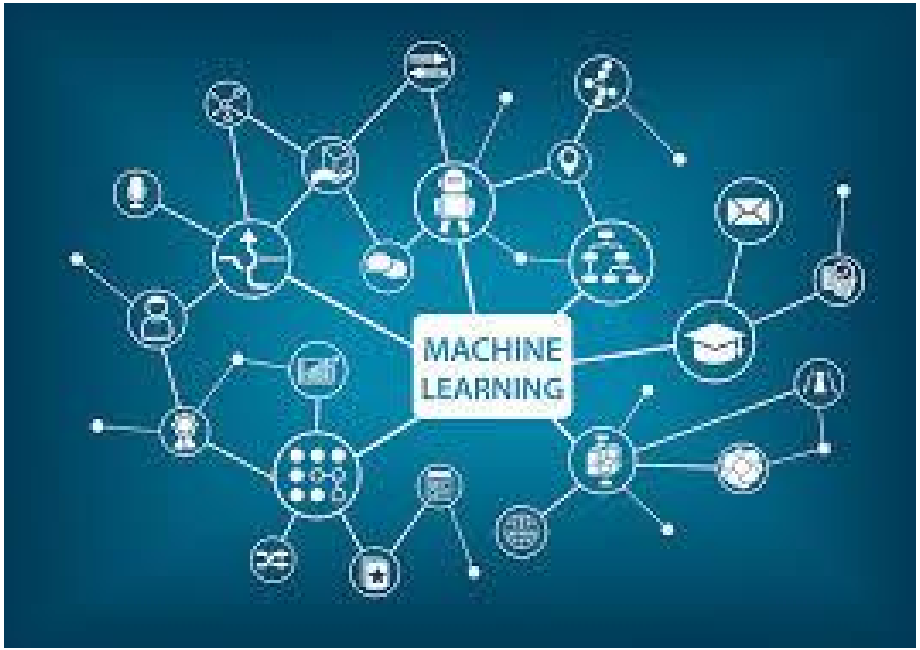
Future Applications

- High death Toll
  - 2015:
    9,624 deaths

- People
  - Get to Safety/
    Shelter

Personal Response

- Avant-Garde
  - First ML to process continuous data
  - No human bias/ external variables
  - Minutia



Bibliography

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Thank you!

Questions?