

# Supervised Machine Learning & the Automated-ML platform MILO (Machine Intelligence Learning Optimizer)

**Hooman H. Rashidi, MD, MS**

Professor & Vice Chair of GME

Vice Chair of Informatics &

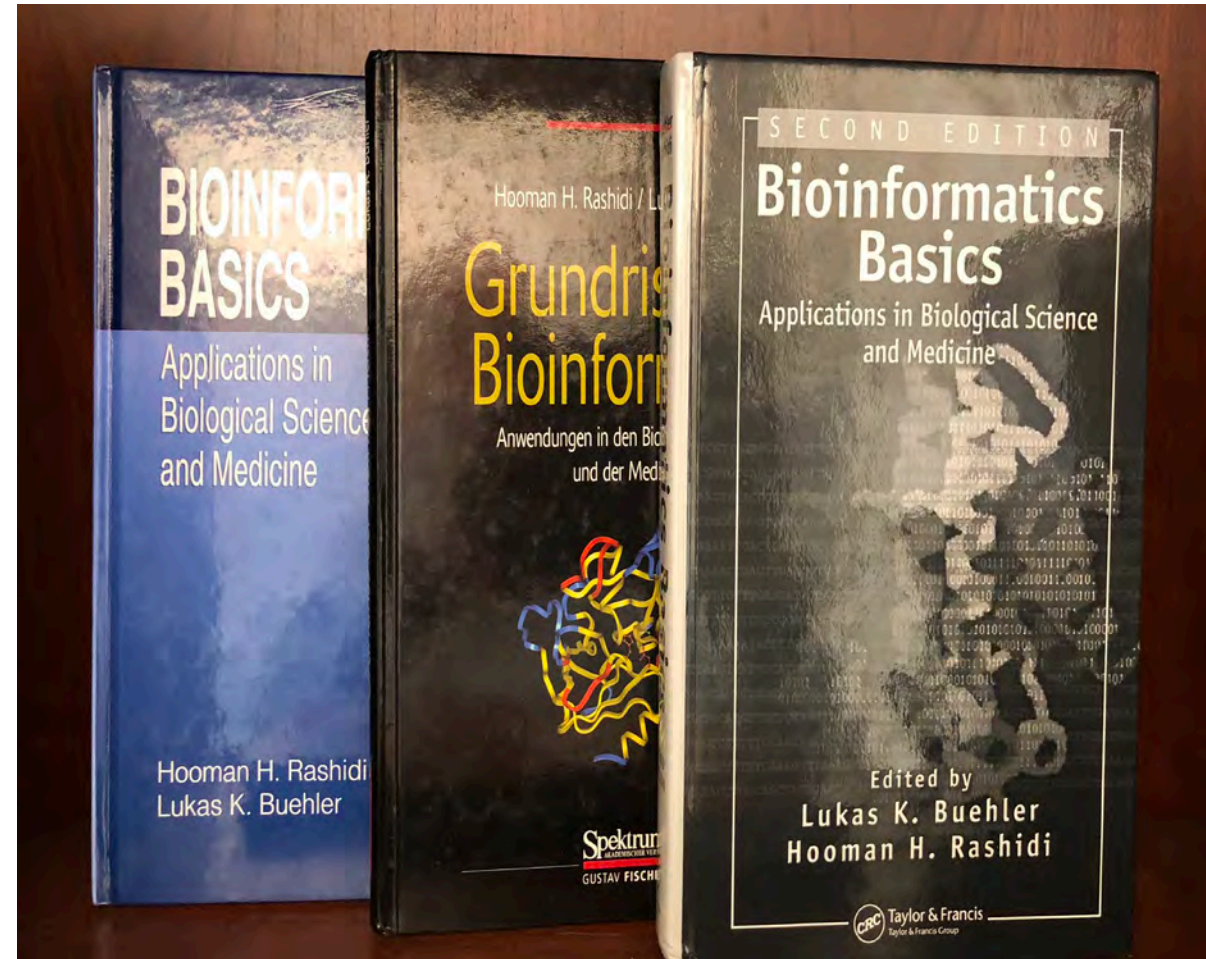
Computational Pathology

University of California, Davis  
School of Medicine



# My background

- Practicing Physician
  - Clinical Hematopathologist
- My graduate studies (UCSD) was in Bioinformatics (Masters Degree)
  - Extensive background in Bioinformatics
  - Hence the strong interest in Artificial Intelligence (AI) and Machine Learning (ML)
- PI of multiple ML research studies
  - 30+ members within the research group



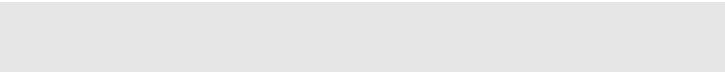
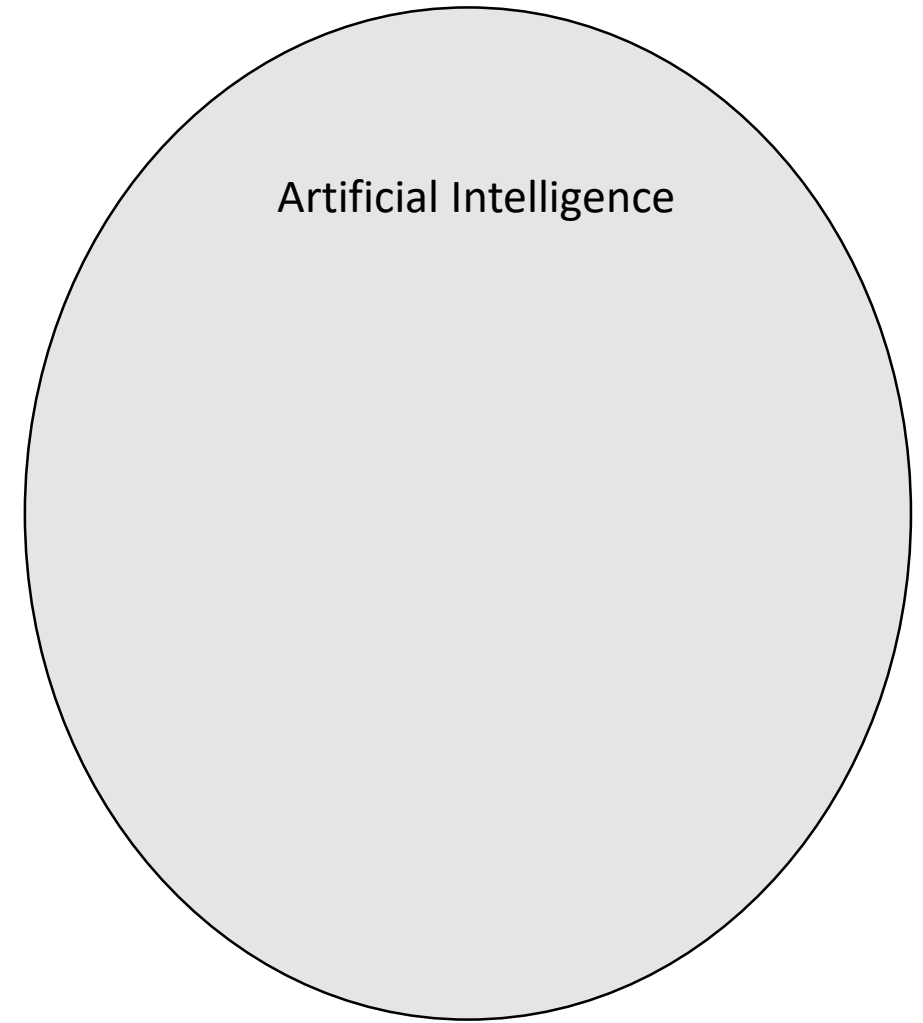
# Disclosures

- Systems And Methods For Machine Learning-based Identification Of **Acute Kidney Injury** In Trauma Surgery And Burned Patients (Early Prediction Of Aki With Machine Learning): Co-inventors (Hooman H. Rashidi MD MS & Nam Tran PhD)
  - **University Of California Intellectual Property**
- Systems And Methods For Machine Learning-based Identification Of **Sepsis** (Early Prediction Of Sepsis With Machine Learning): Co-inventors (Hooman H. Rashidi MD MS & Nam Tran PhD)
  - **University Of California Intellectual Property**
- Systems And Methods For Automated Machine Learning (**MILO**: Machine Intelligence Learning Optimizer)
  - **University Of California Intellectual Property (Patent Pending)**
    - **Co-inventors Of MILO**
    - **Hooman H. Rashidi MD MS**
    - **Samer Albahra MD**
    - **Nam Tran PhD**

# Talk Outline

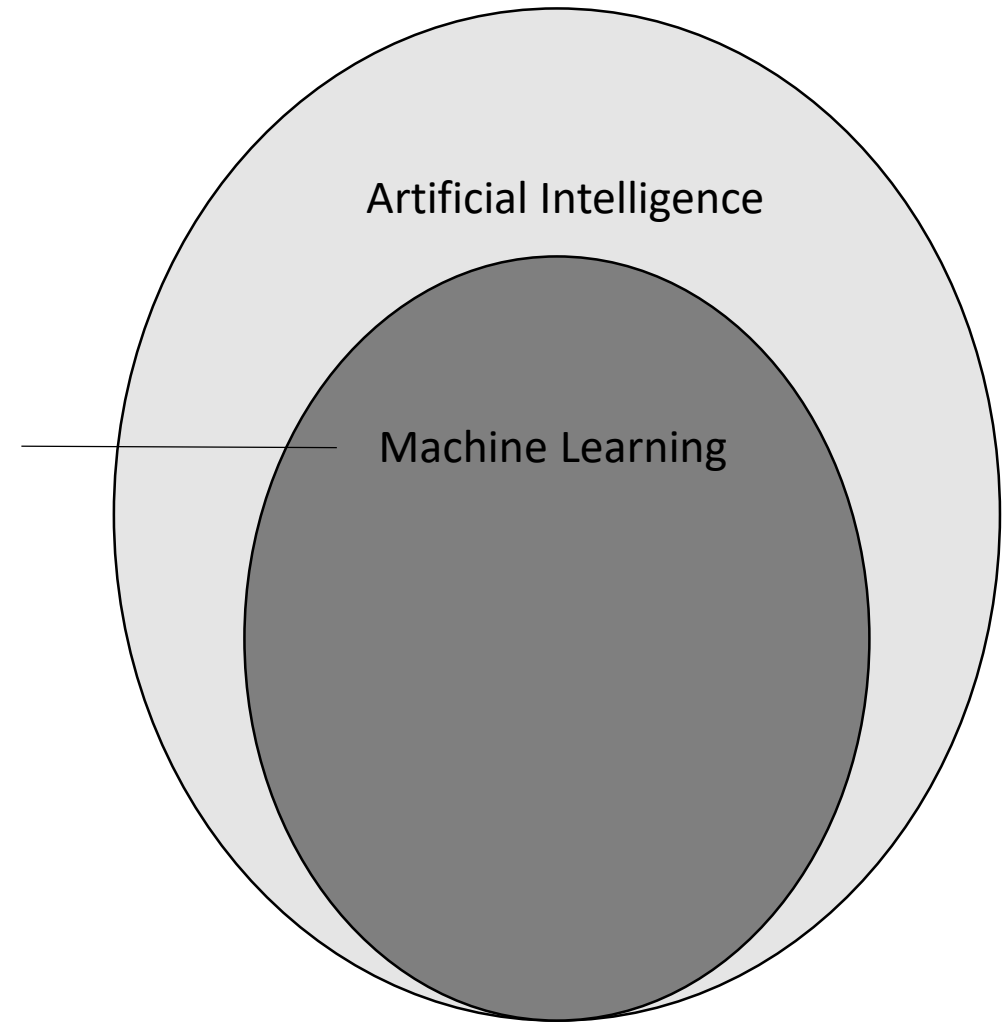
- Machine Learning (ML) overview
  - ML classification
- Supervised Machine Learning (ML)
- Non-Image ML models:
  - Our AKI ML studies
- Automated Machine Learning
  - MILO: Machine Intelligence Learning Optimizer

# What is Artificial Intelligence / Machine Learning?



# What is Artificial Intelligence / Machine Learning?

“AI is the capability for machines to imitate intelligent human behavior, while ML is an application of AI that allows computer systems to automatically learn from experience **without explicit programming**. Paraphrasing Arthur Samuel and others, ML models are constructed by a set of data points and trained through mathematical and statistical approaches that ultimately enable prediction of new previously unseen data without being explicitly programmed to do so”

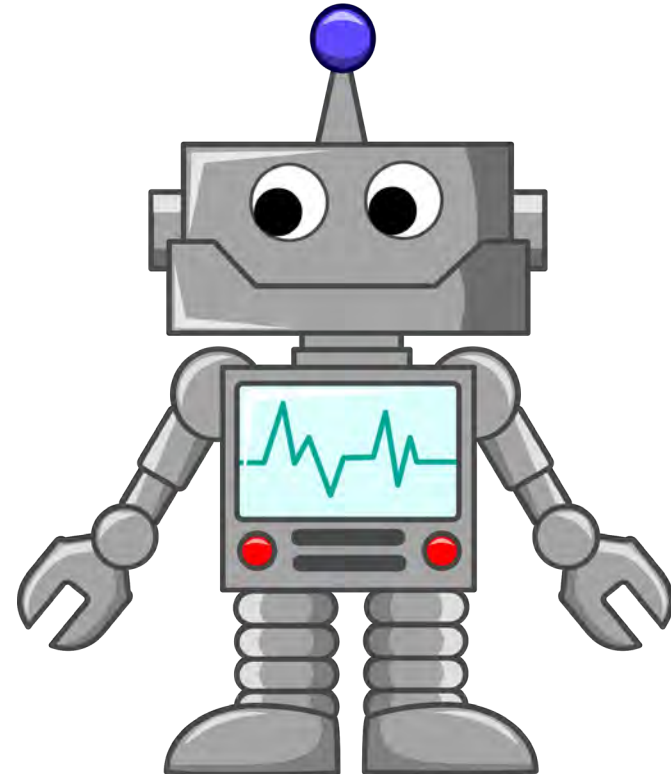


# Human Learning versus Machine Learning

**Human learns through “experiences” and forms neuronal connections to help recall**

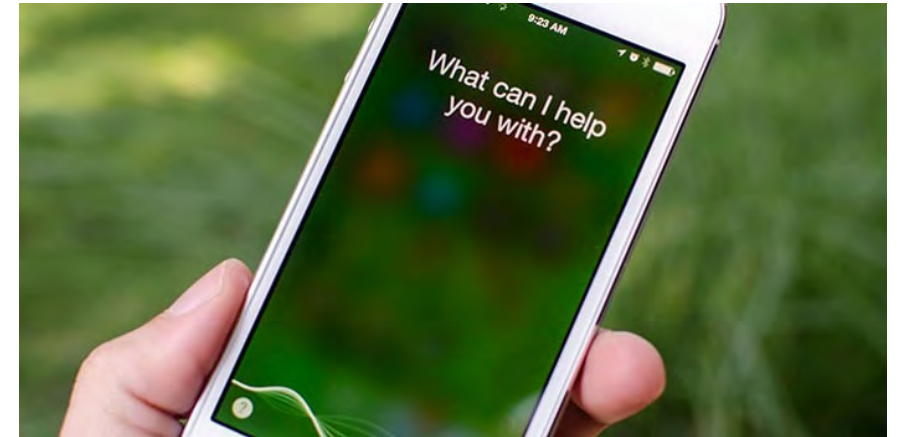


**Machine learns by experiences AKA “DATA” to build neuronal connections to be able to recall**



# Examples of AI and ML in our daily life

- Siri and Alexa
- spam filtering
- photo organizers
- Facebook or LinkedIn people connectors
- Amazon recommendations, etc.





Is there a difference in  
machine learning for medical  
applications?

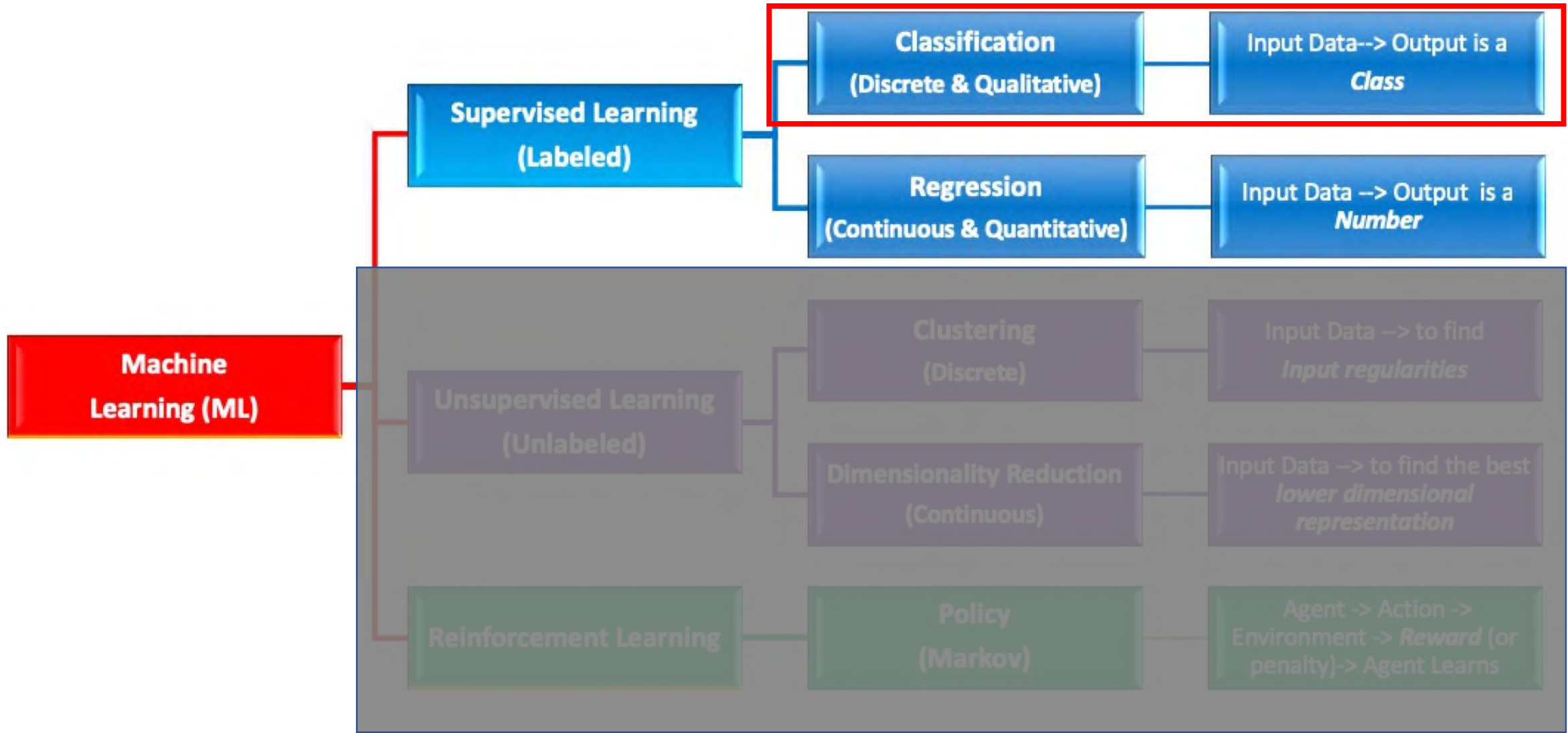
YES, Absolutely !

## What is so different about our field (medicine) ?

- Practice of medicine is still a balance between art and science
  - most fields are experience driven
- Since the gold standard for how we practice is based on expertise that is experience driven, the data collected will have more variations
  - Ultimately increases the chance of interobserver variability
- Hence the data sets used in our fields are not as easily reproducible as in other fields that employ machine learning

# What ML approaches are used the most in medicine / pathology?

- Supervised Machine Learning



# The “real world” can be a tough place!

- PATIENTS & FAMILY 
- PREVENTION & SCREENING 
- DONORS & VOLUNTEERS 
- FOR PHYSICIANS 
- RESEARCH

10 > MD Anderson Taps IBM Watson to Power "Moon Shots" Mission

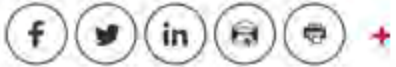


## MD Anderson Taps IBM Watson to Power "Moon Shots" Mission

MD Anderson News Release October 18, 2013

# The “real world” can be a tough place!

10 > MD Anderson Taps IBM Watson to Power “Moon Shots” Mission

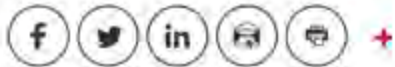


## MD Anderson Taps IBM Watson to Power “Moon Shots” Mission

MD Anderson News Release October 18, 2013

- MD Anderson partners with IBM Watson to use “Oncology Expert Advisor” for targeting cancer therapy.

# The “real world” can be a tough place!



## MD Anderson Taps IBM Watson to Power “Moon Shots” Mission

MD Anderson News Release October 18, 2013

- MD Anderson partners with IBM Watson to use “Oncology Expert Advisor” for targeting cancer therapy.
- *“A new era of computing has emerged, in which cognitive systems “understand” the context within users’ questions, uncover answers from Big Data, and improve in performance by continuously learning from experiences”*

# The “real world” can be a tough place!

EDITOR'S PICK | 212,548 views | Feb 19, 2017, 03:48pm

## MD Anderson Benches IBM Watson In Setback For Artificial Intelligence In Medicine



**Matthew Herper** Forbes Staff

Pharma & Healthcare

*I covered science and medicine, and believe this is biology's century.*



# The “real world” can be a tough place!

EDITOR'S PICK | 212,548 views | Feb 19, 2017, 03:48pm

## MD Anderson Benches IBM Watson In Setback For Artificial Intelligence In Medicine



**Matthew Herper** Forbes Staff

Pharma & Healthcare

*I covered science and medicine, and believe this is biology's century.*

### **\$62 million wasted without achieving goals**

*“Treating cancer is more complex than winning a trivia game, and the “vast universe of medical knowledge” may not be as significant as purveyors of artificial intelligence make it out to be...”*

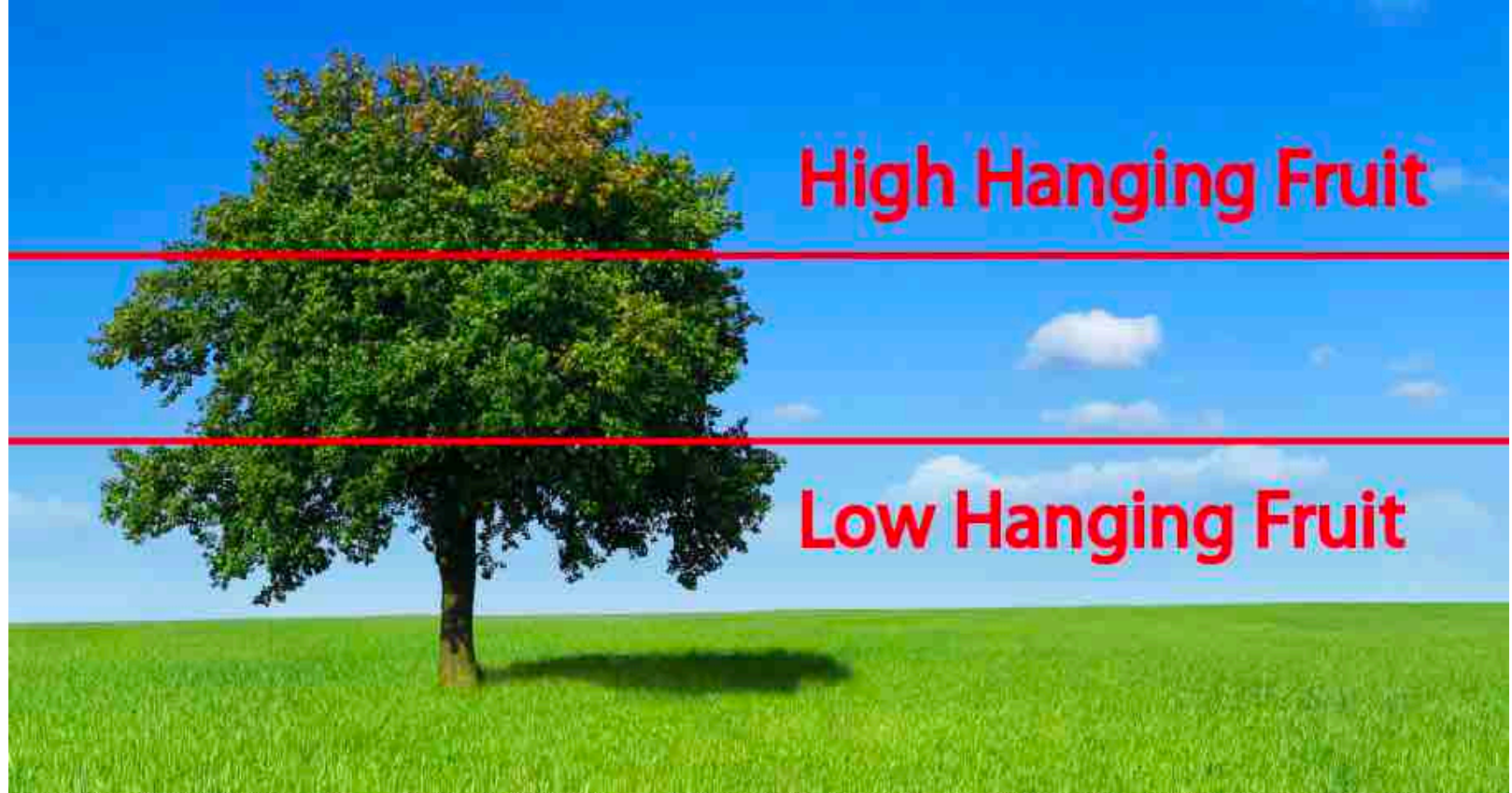
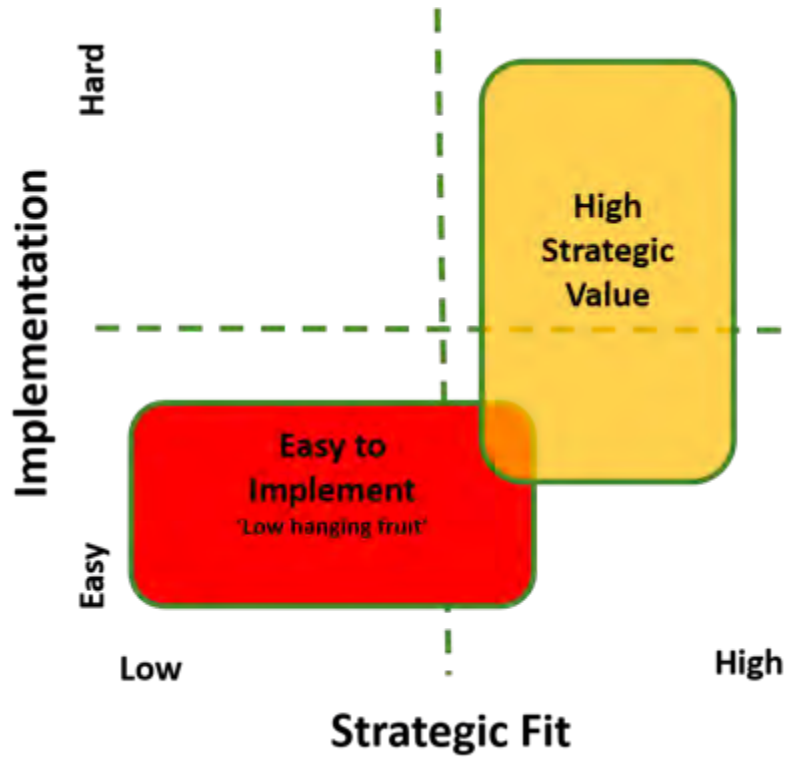
<https://www.healthnewsreview.org/2017/02/md-anderson-cancer-centers-ibm-watson-project-fails-journalism-related/>

# WHERE DO WE GO NOW?

What are some potential "safe" applications of AI/ML in health care?



# Realistic Opportunities for Healthcare AI/ML?



# AI/ML Enhanced Detection of Burn Related AKI: A Proof of Concept

Tran NK, Sen S, Palmieri TL, Lima K, Falwell S, Wajda J, Rashidi H. *Burns* 2019

- Goal: To build Models that predict Acute kidney Injury (AKI)

# Current Standard for AKI diagnosis

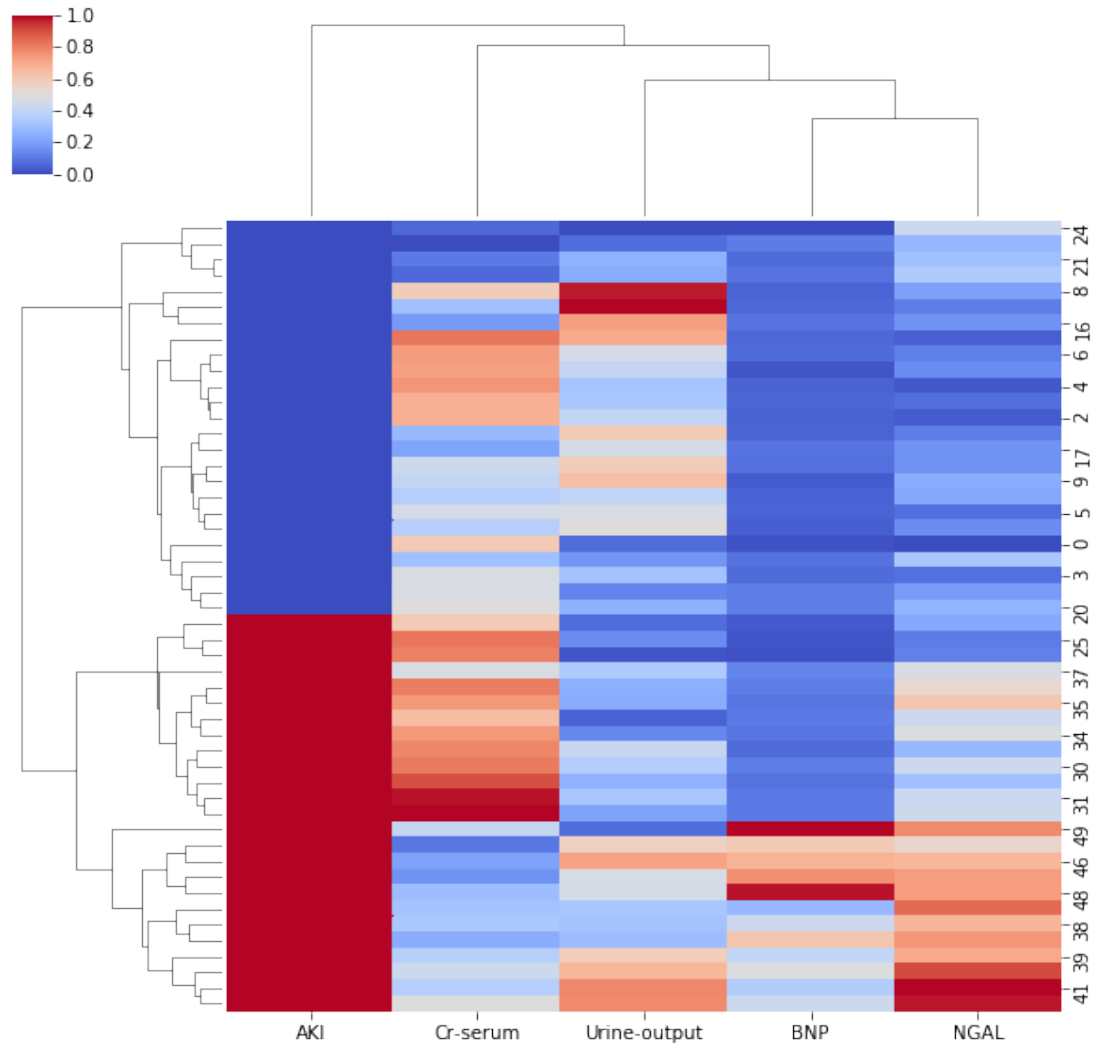
- Kidney Disease and Improving Global Outcome (KDIGO)
- Based on Serial Creatinine (Cr) and Urine Outputs (UOP)
- Takes days (since it's on serial Cr and UOP measurements)
- Sensitivity in 50s

# Here comes NGAL to the rescue

- **NGAL (Neutrophil Gelatinase Associated Lipocalin)**
- **Used in Europe**
- **Reportedly in the process of being FDA cleared in US**

# AI/ML Enhanced Detection of Burn Related AKI: A Proof of Concept

Tran NK, Sen S, Palmieri TL, Lima K, Falwell S, Wajda J, Rashidi H. *Burns* 2019



# The "Burns" population proof of concept

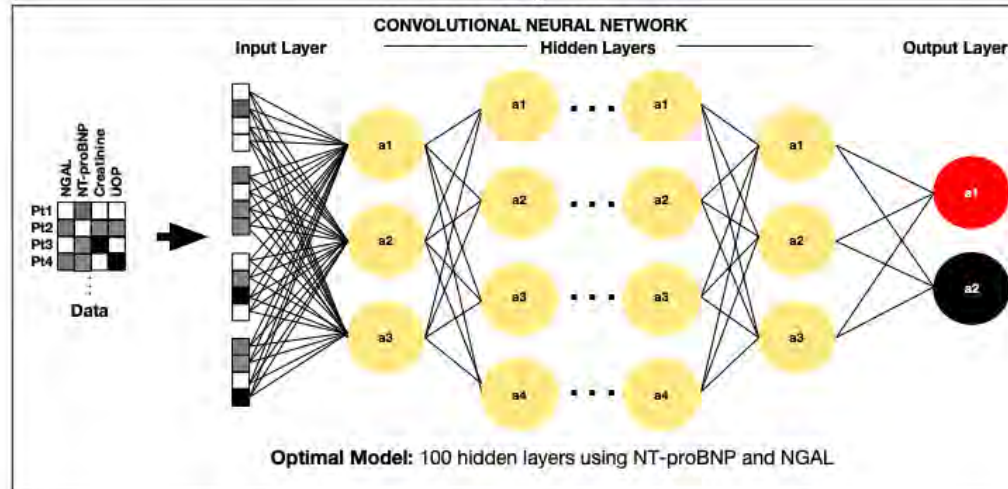
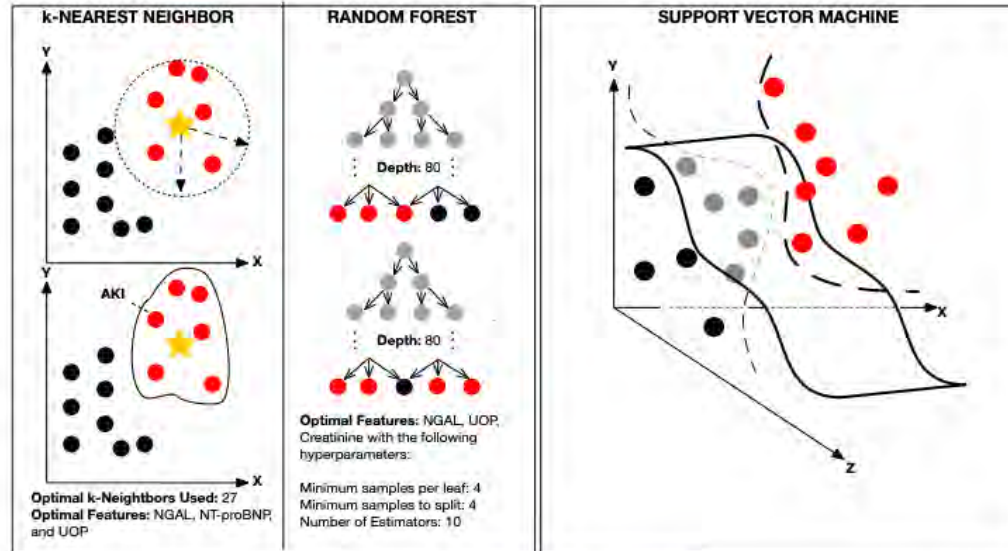
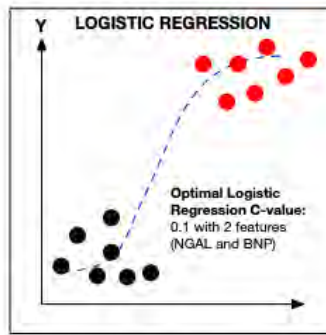
- Showed that ML (specifically a K-NN model) can enhance NGAL's performance for
  - By combining it with other markers
    - BNP
    - Cr
    - UOP
- Sensitivity and accuracy in low 90s



# Our Follow up AKI ML study

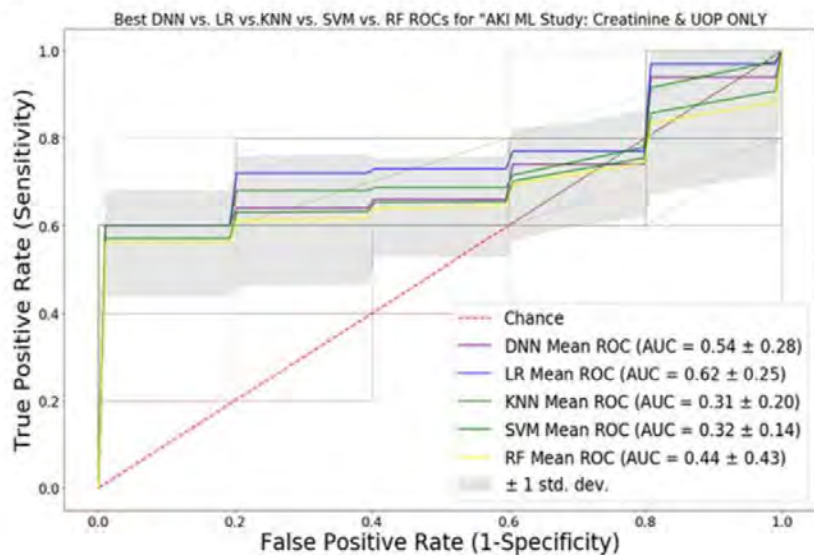
- Can the Burns-derived AKI ML model predict AKI in Non-Burn Trauma patient population

Early Recognition of Burn- and trauma-Related Acute Kidney injury: A pilot comparison of Machine Learning techniques. Hooman H. Rashidi\*, Soman Sen, Tina L. Palmieri, Thomas Blackmon, Jeffery Wajda & Nam K. Tran\*. Nature Scientific Reports Jan 2020

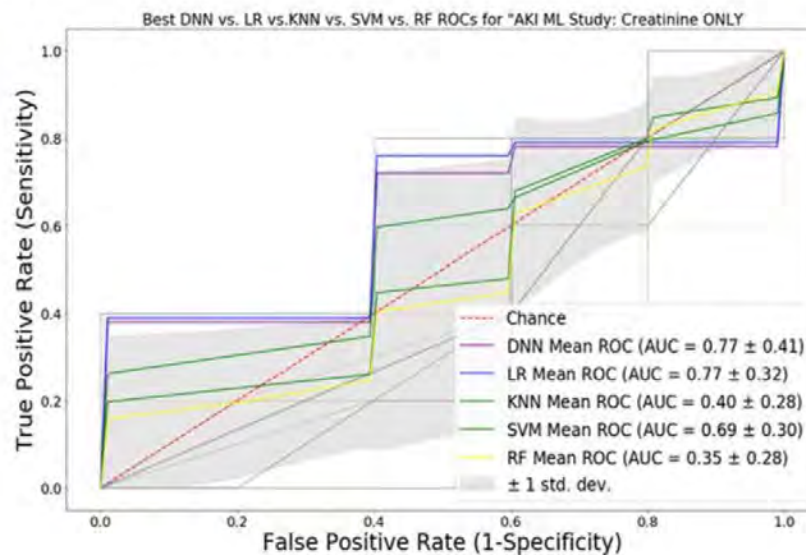


# Creatinine + UOP vs Creatinine Only vs UOP Only

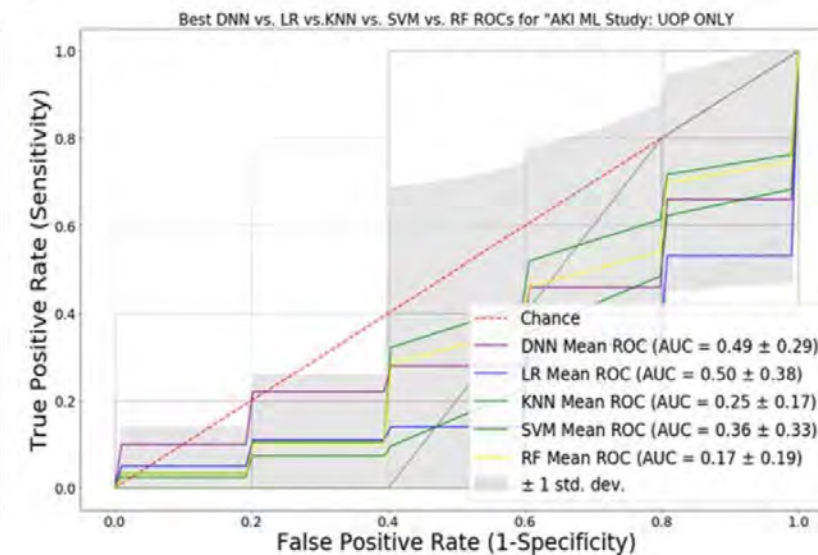
A



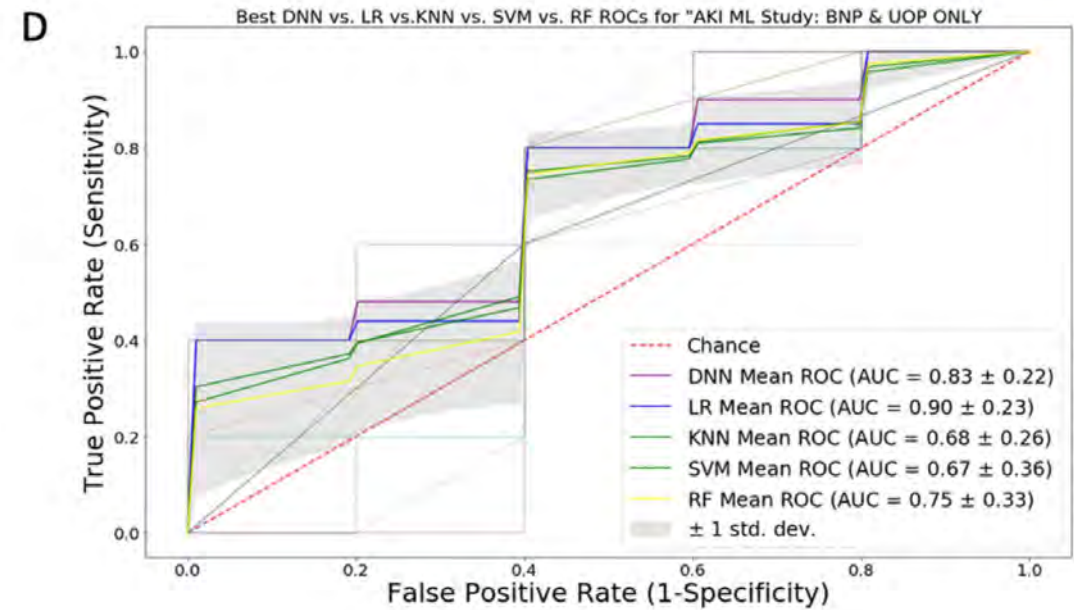
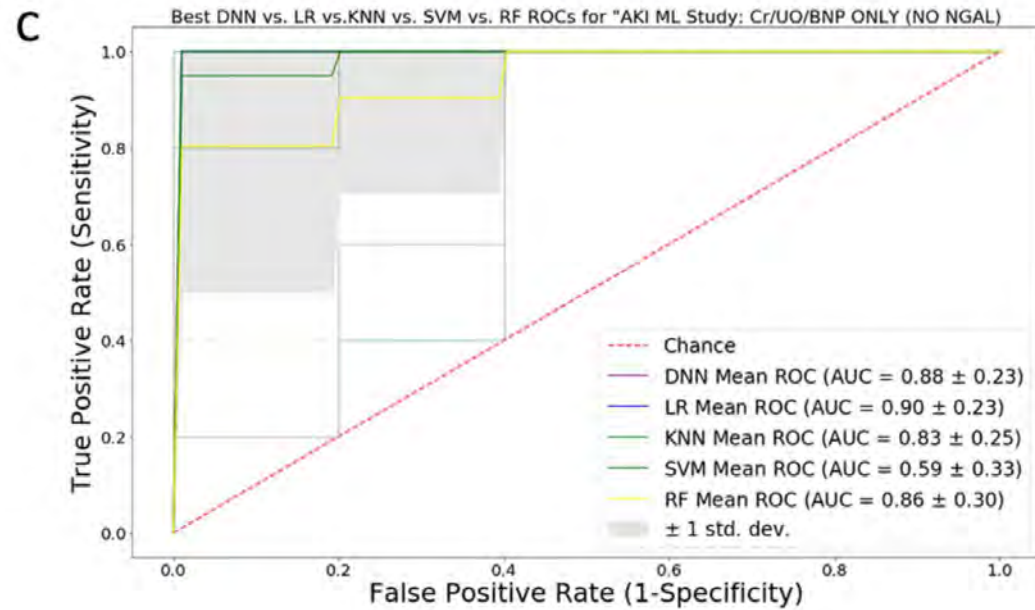
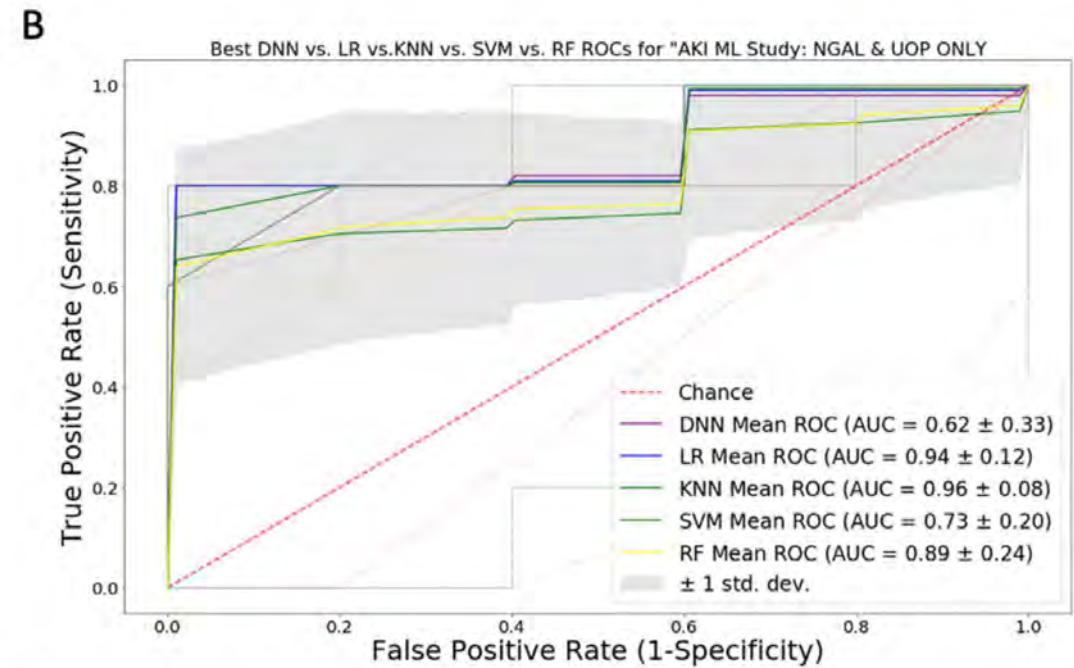
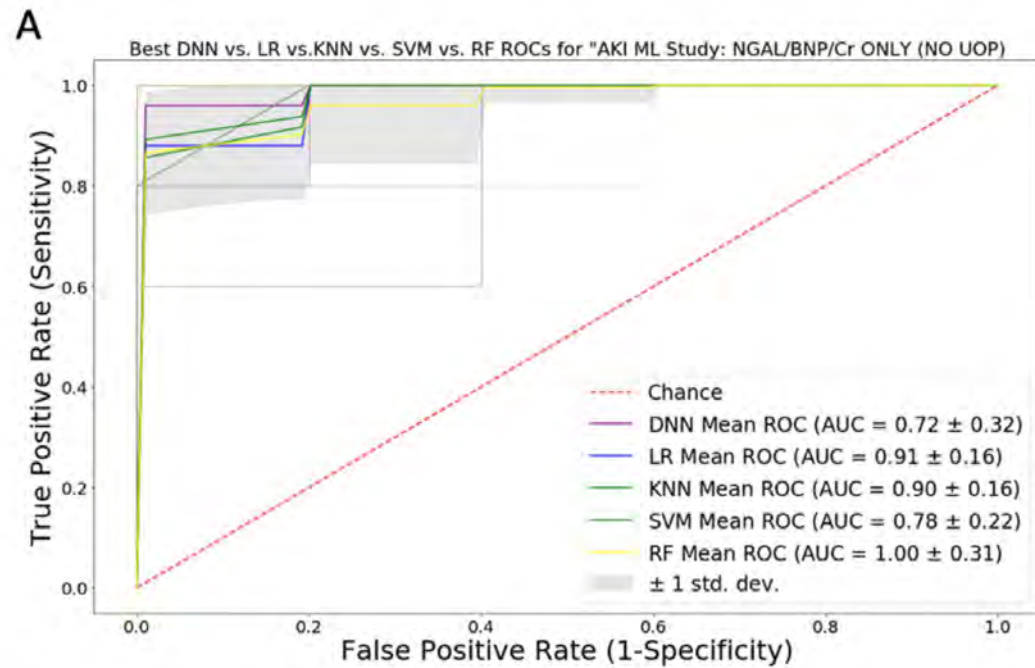
B

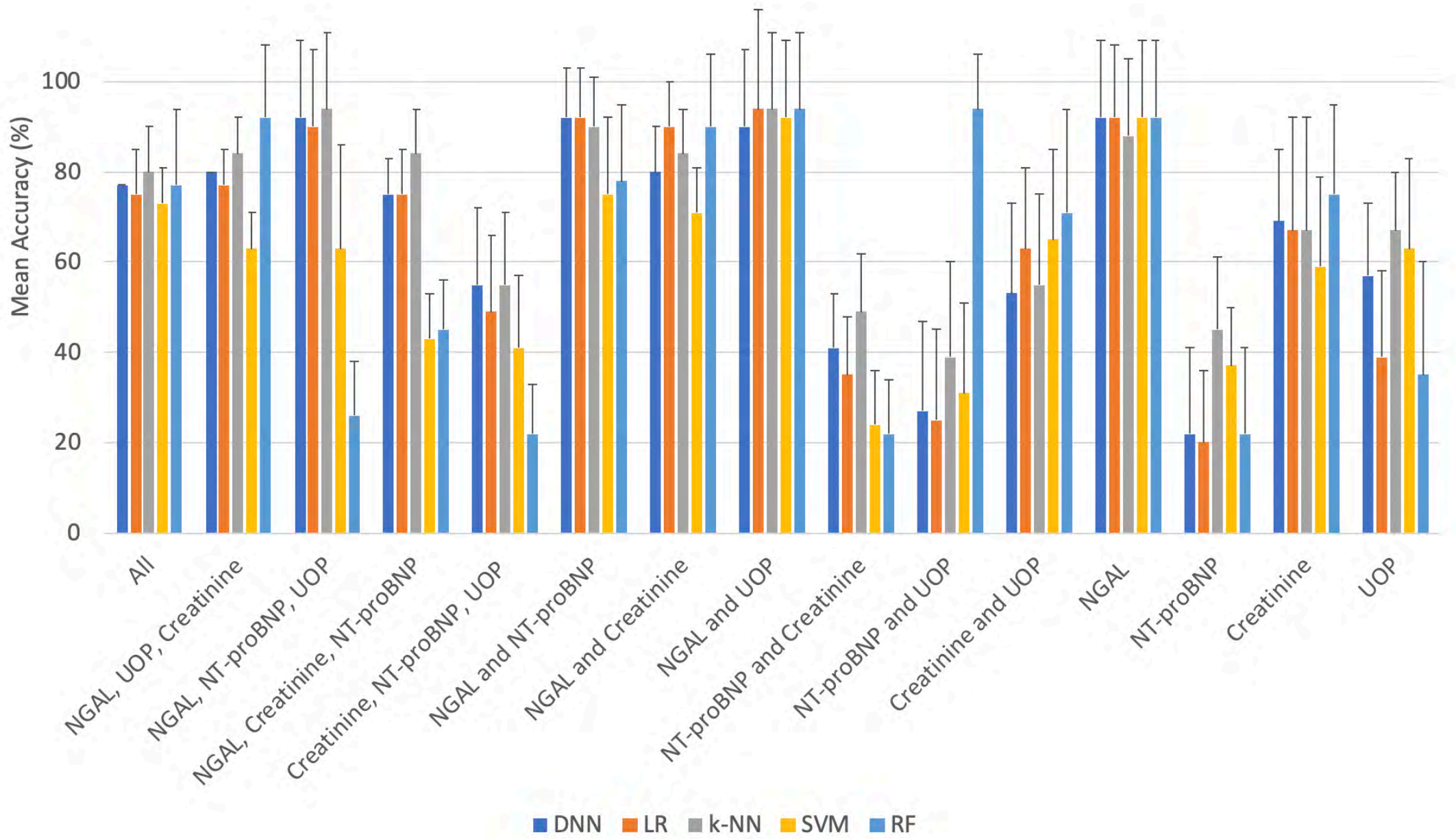


C



What Happens when you Introduce NGAL





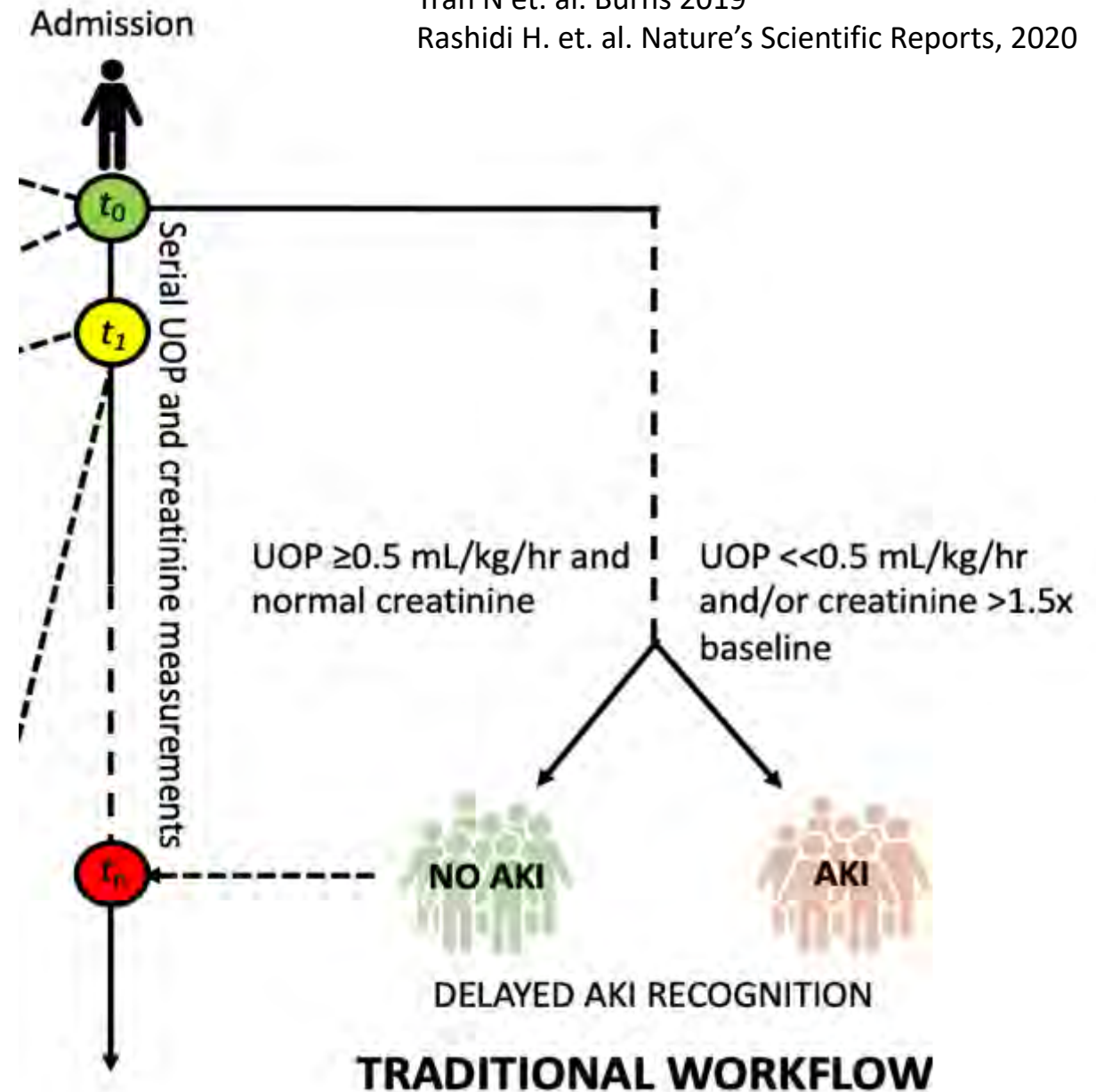
# In summary

- The AKI ML models trained on the Burn Population were able to predict AKI in Non-Burn trauma and Burn patient populations
- ML enhances the predictive capability of NGAL and NGAL combined with other markers (esp. Cr and BNP)
- Most importantly:
  - **The AI/ML algorithm helped predict AKI 61.8 (32.5) hours faster than the KDIGO criteria for burn and non-burned trauma patients**

# AI/ML Real World Application for Burn AKI?

Tran N et. al. Burns 2019

Rashidi H. et. al. Nature's Scientific Reports, 2020

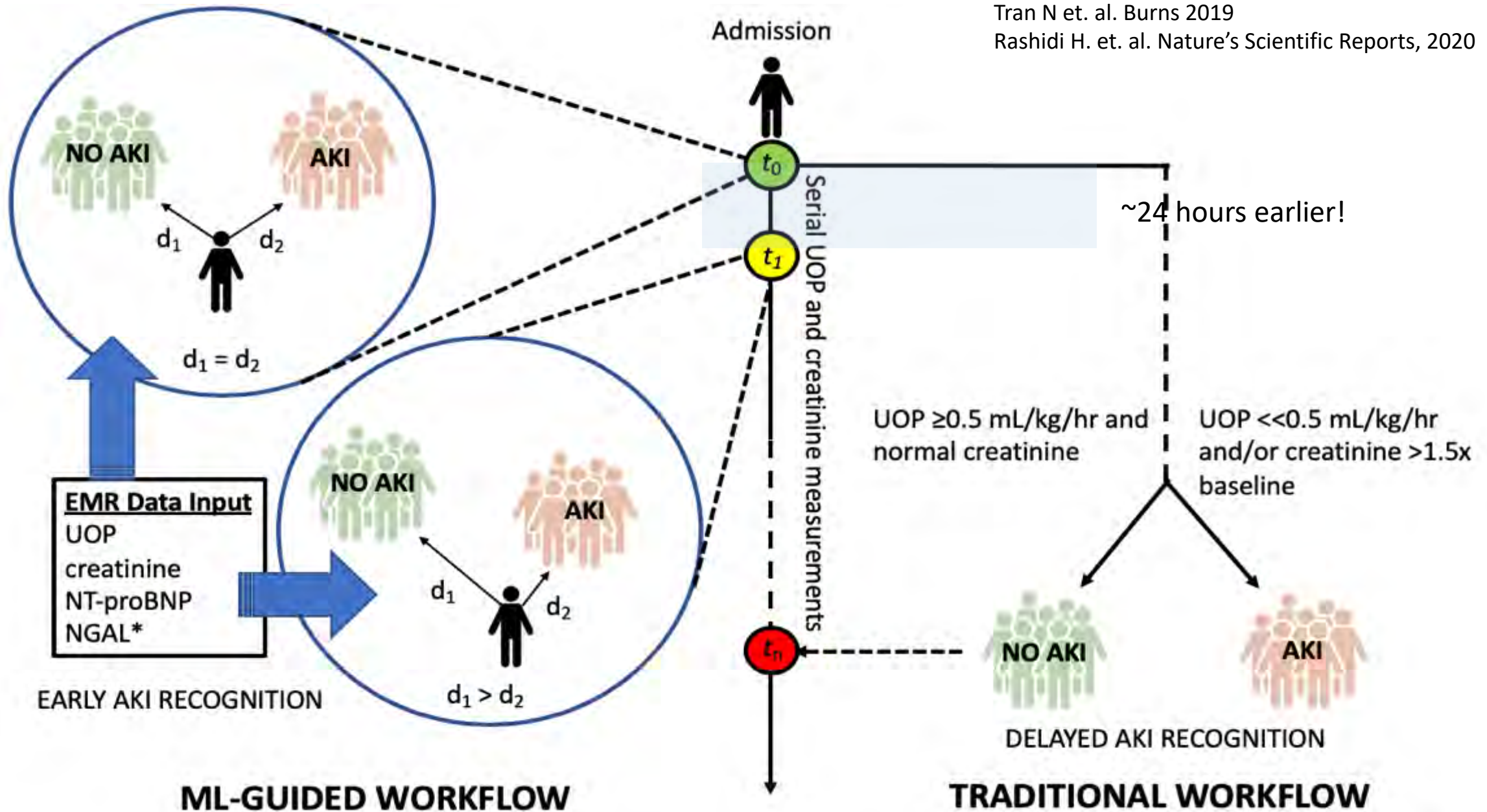




# AI/ML Real World Application for Burn AKI?

Tran N et. al. Burns 2019

Rashidi H. et. al. Nature's Scientific Reports, 2020



Can this Machine Learning process that was used in this study be automated?

- So that ALL investigators can have EASY access to these Machine Learning methods
- How to automate this process so that
  - No ML expertise is required
  - No programming or Software Engineering background is needed

# MILO



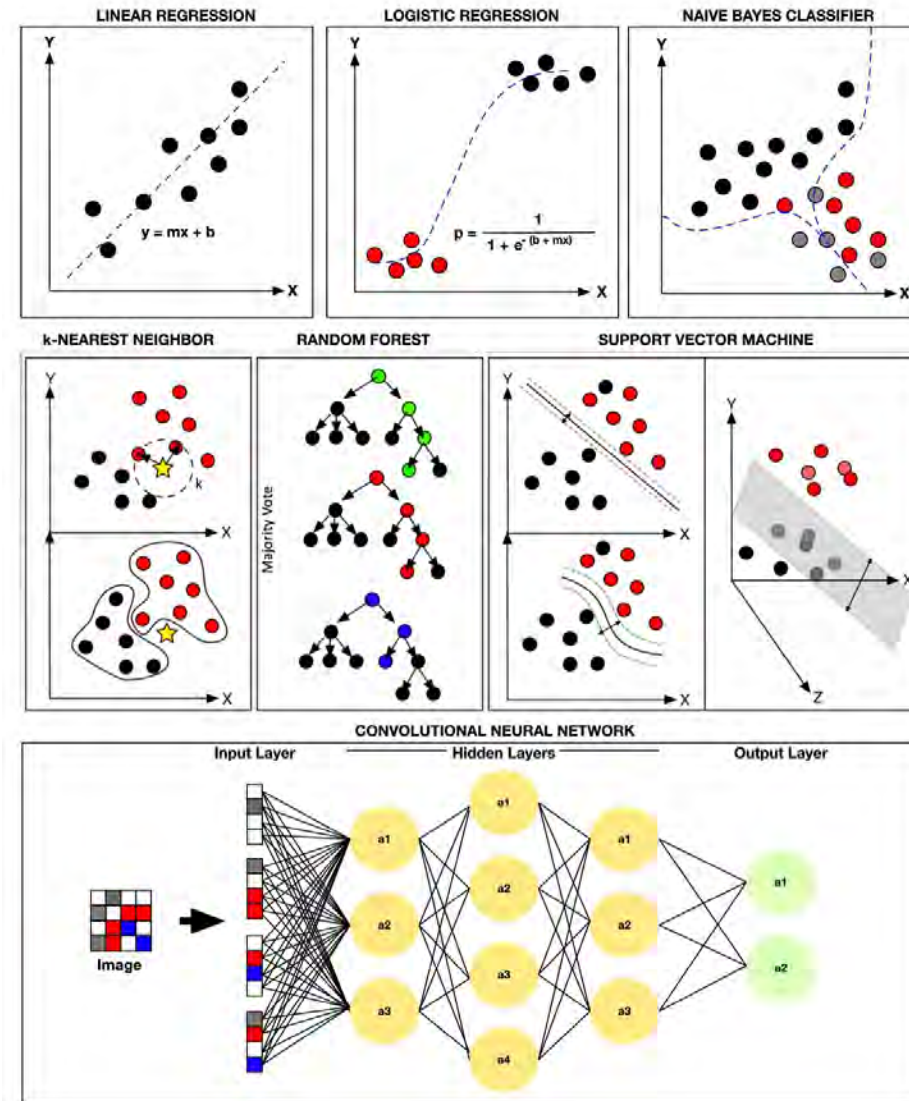
**MACHINE INTELLIGENCE**  
**LEARNING OPTIMIZER**

---

YOUR FULLY AUTOMATED MACHINE LEARNING SOLUTION

# Some Basic Facts:

- Artificial intelligence / Machine learning (ML) is a very powerful tool
- ML is starting to get incorporated into various aspects of health care and health science disciplines





## Current Challenges with ML:

- Can be intimidating
  - requires a team with ML, statistics and programming expertise
- Can be very time consuming and not easily accessible
- Final ML model can be very challenging to deploy
  - requires software engineering expertise to make an App or Website

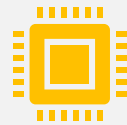
Imagine a world where Artificial Intelligence (AI) / Machine Learning (ML) studies are as EASY as using a website on your laptop or even your smart phone



NO ML or Statistics expertise needed



NO Software engineering expertise needed



NO Programming required



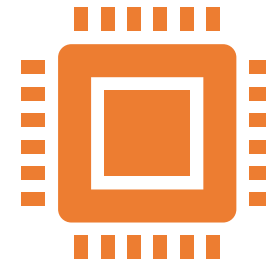
**It's just plain easy to do !!!**

# OUR SOLUTION: MILO



**MILO : Machine Intelligence  
Learning Optimizer**

**Your Fully Automated Machine Learning  
(Auto-ML) Solution**



**MILO makes AI/ML  
accessible for ALL**

**No Coding, No Programming  
No Machine Learning expertise required  
All the heavy lifting is done by MILO!**

# MILO's key highlights?



## Expedites the machine learning process

Drastically reduces the time required to complete an ML project

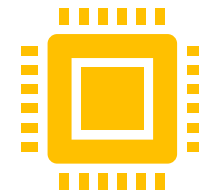
- **Much faster** than the current traditional ML approach



## Improves the performance outcome of the machine learning models

Builds a much **larger number of ML models** compared to the current ML approach

**Finds the best ML model** for a given study compared to the current ML approach



## A very simple User Interface (UI)

MILO's Web-App makes the AI/ML study **super easy** to operate

**All the heavy lifting is done through MILO's UI**



# MILO Expedites the Machine Learning Process

- Traditional ML study approach
  - Acute Kidney Injury (AKI) project required ~400 man hours (4 months) to complete
  - Sepsis project required ~300 man hours (3 months) to complete
- MILO's Auto-ML Approach
  - Acute Kidney Injury (AKI) project through MILO was completed in <20 hours
  - Sepsis project through MILO was completed in <18 hours

**Tran et. al. *Burns* 2019.**

**Rashidi et. al. *Nature's Scientific Reports* 2020.**

# MILO: A Validated Platform

AI/ML Enhanced Detection of Burn Related AKI: A  
Proof of Concept

**Tran et. al. *Burns* 2019**

Early Recognition Of Burn- And Trauma-related  
Acute Kidney Injury: A Pilot Comparison Of  
Machine Learning Techniques

**Rashidi et. al. *Nature's Scientific Reports* 2020**

Validated on 10 different IRB approved  
studies

- Acute kidney injury (AKI) predictor (study 1):
- AKI predictor (study 2): Burns Surgery
- Sepsis predictor: Burns
- Delayed Graft Function predictor: Kidney transplant
- Cath Result - PET predictor: Cardiology
- TB (11 Ag): Global Health Infectious disease
- TB(31 Ag): Global Health Infectious disease
- Massive Transfusion Protocol (MTP): Trauma
- Step 1 Test Early intervention Predictor: Med school
- Step 1 Test Late intervention Predictor: Med School

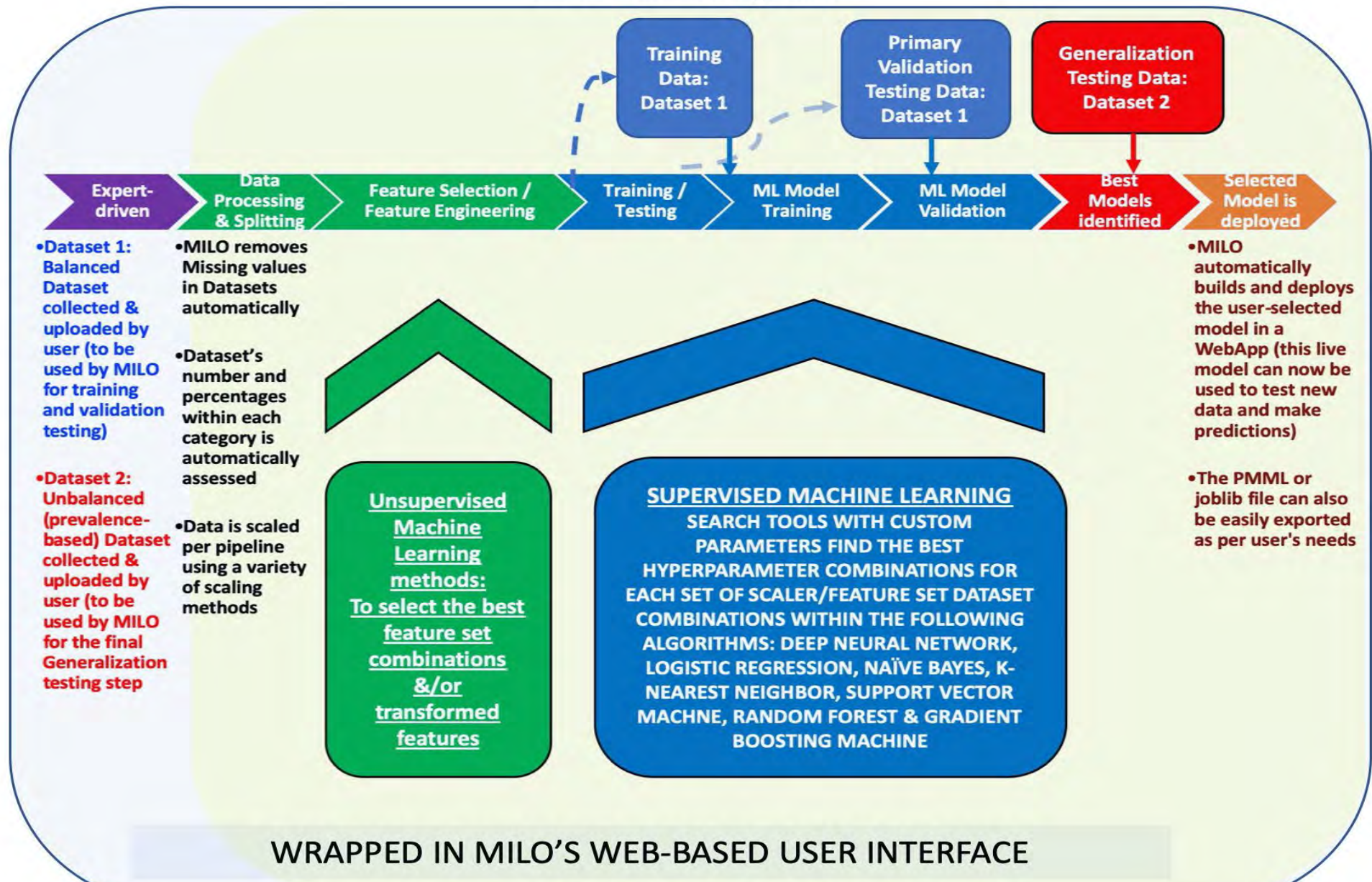
# How does MILO work?

- MILO makes NO Assumptions
  - About your dataset
- **MILO enables each Unique Dataset to find its most suitable ML Algorithm/Model**
  - rather than having a data scientist and their team choosing an ML algorithm that they feel is most suitable for finding the best model for the dataset
  - Follows Industry's CRISP-DM Approach



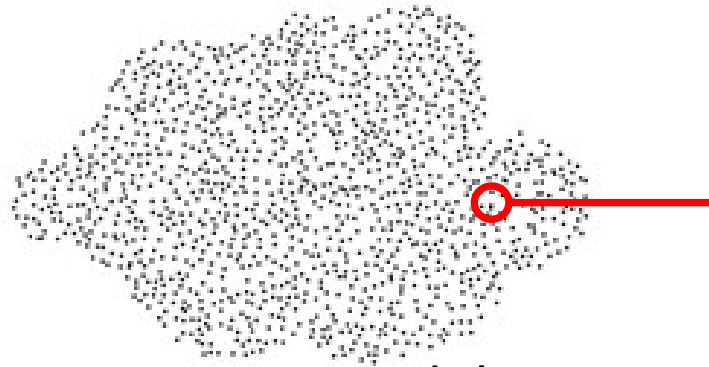
# MILO: Machine Intelligence Learning Optimizer

## Auto-ML Platform

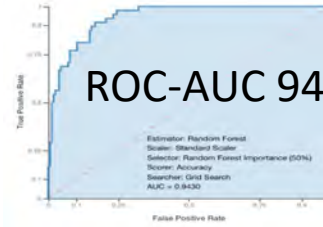


# MORE MODELS – LESS TIME – MORE OPPORTUNITIES

Current ML Approach

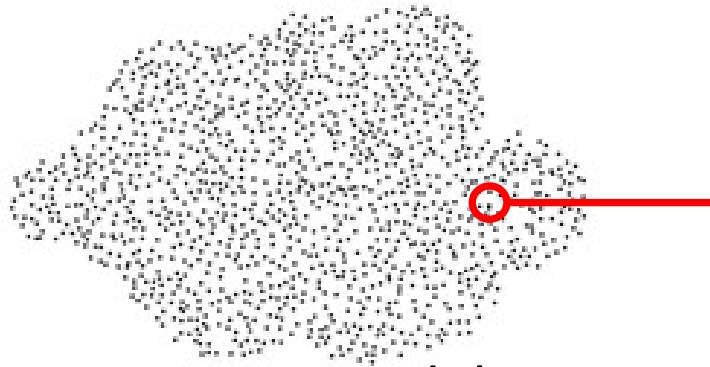


49,940 models  
~400 hours (~4 months)

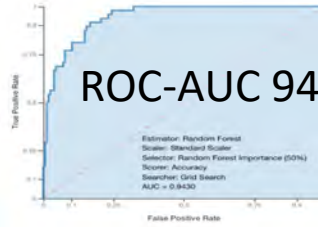


# MORE MODELS – LESS TIME – MORE OPPORTUNITIES

Current ML Approach



49,940 models  
~400 hours (~4 months)



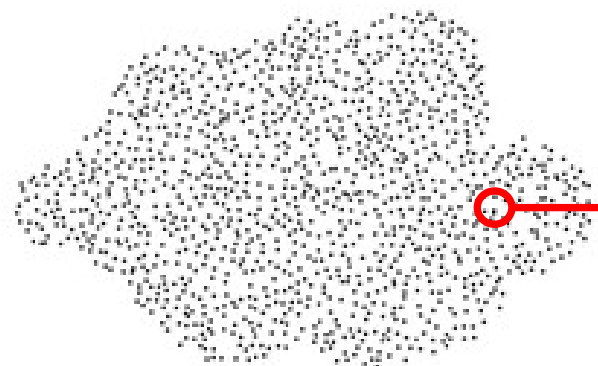
?

?

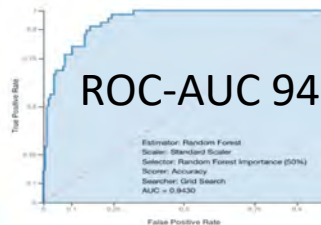
Are there any other potential models?

# MORE MODELS – LESS TIME – MORE OPPORTUNITIES

Current ML Approach



49,940 models  
~400 hours (~4 months)

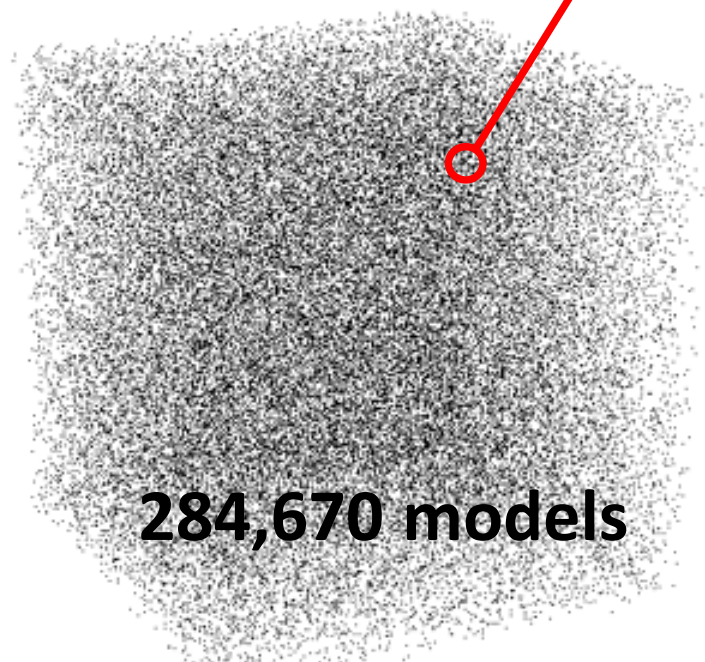


?

?

Are there any other potential models?

MILO

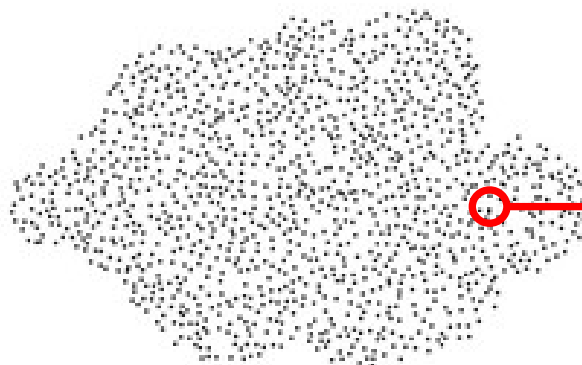


284,670 models

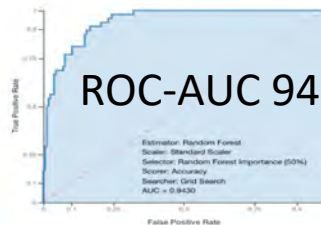
24 hours

# MORE MODELS – LESS TIME – MORE OPPORTUNITIES

Current ML Approach



49,940 models  
~400 hours (~4 months)

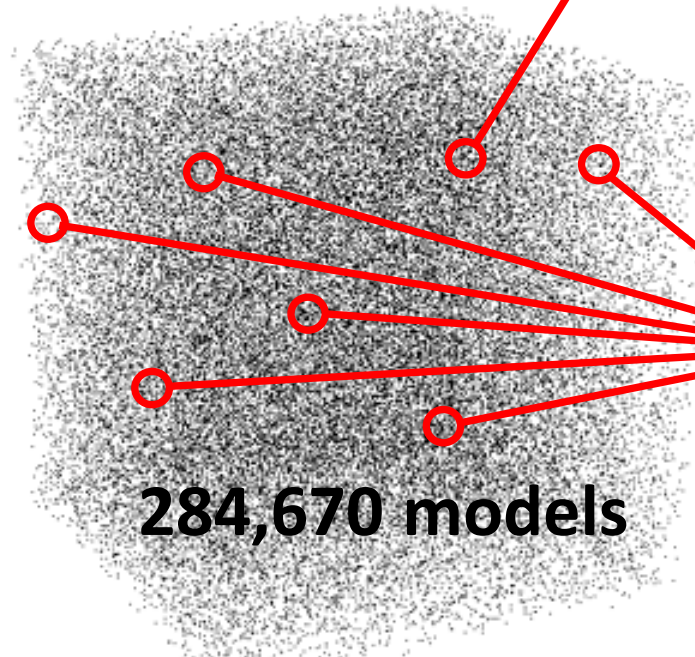


?

?

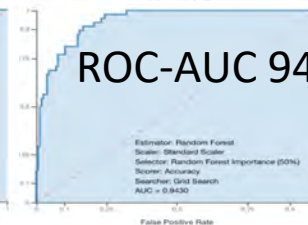
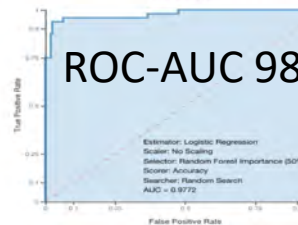
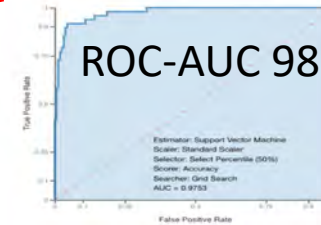
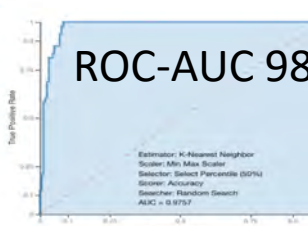
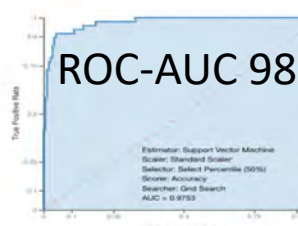
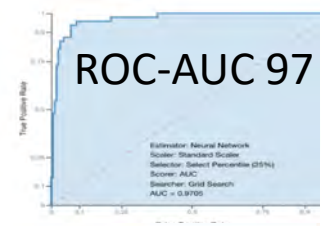
Are there any other potential models?

MILO



284,670 models

<24 hours



**MILO found six additional better models not found by the Current Traditional ML approach**



How does  
MILO  
achieve this?



Builds 300,000+ ML models



Optimized to find the best hyperparameters and feature sets with our proprietary embedded approach & FOLLOWS ML STUDY BEST PRACTICES

(SIMILAR TO THE FOLLOWING RECENT MANUSCRIPTS)

Rashidi et. al. Nature's Scientific Reports Jan 2020

Rashidi, HH et al. Academic Pathology, 2019

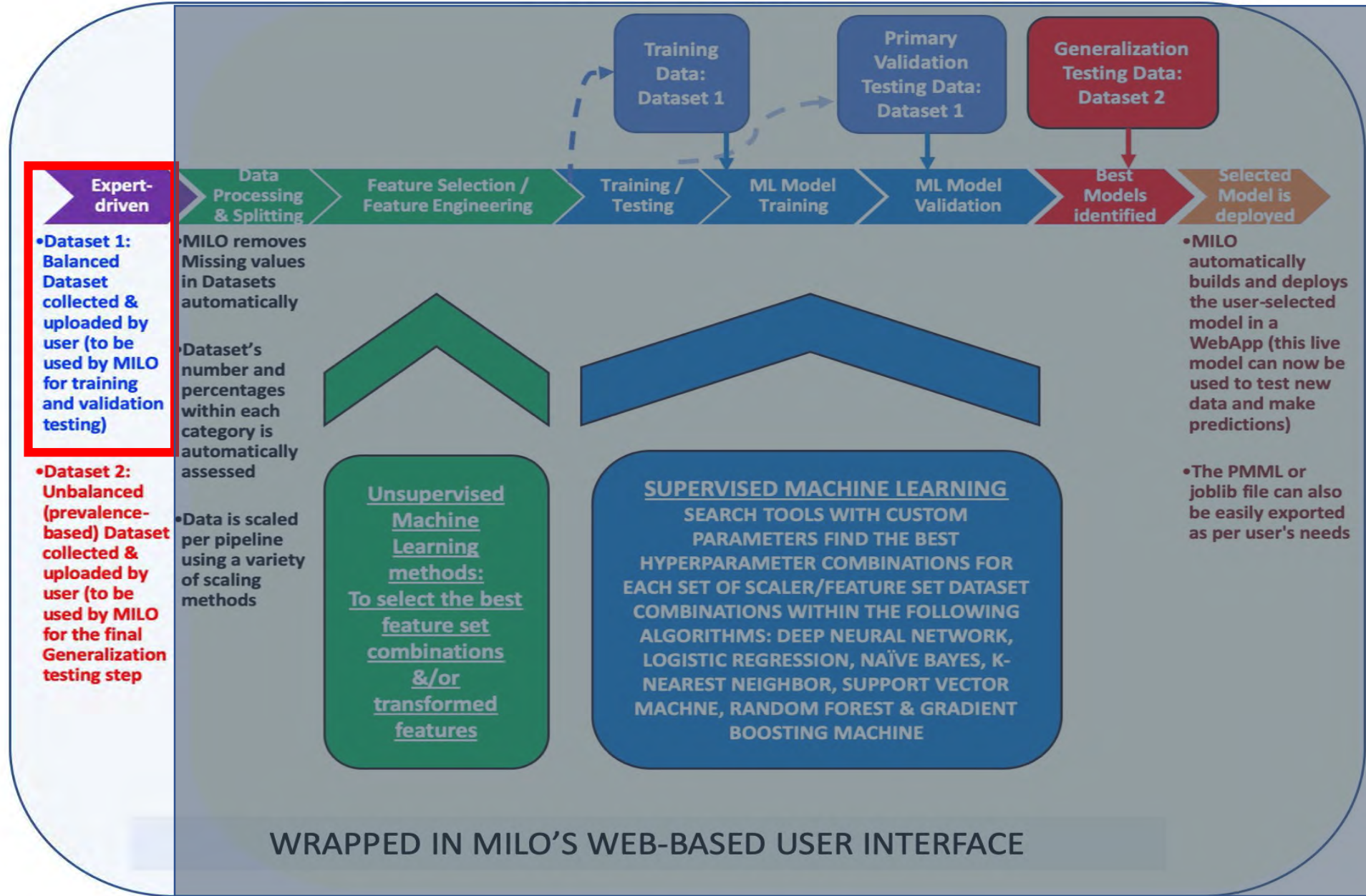
# QUICK DEMO OF MILO

---

# BUILD A MODEL TO PREDICT SEPSIS WITH MILO

# MILO: Machine Intelligence Learning Optimizer

## Auto-ML Platform



# Import in the Balanced Training Dataset (Dataset 1)

The screenshot displays an Excel spreadsheet titled "Sepsis-All-features-Training". The interface includes the standard Excel ribbon (File, Edit, View, Insert, Format, Tools, Data, Window, Help) and the Home tab. The spreadsheet contains a table with the following columns: MAP, HR, RR, TEMP, GCS, O2SAT, VENT, WBC, HGB, HCT, PLT, NA, K, BUN, CREAT, BUN/CREAT, GLU, CL, Anion Gap, TCO2, MODS, and Sepsis. The Sepsis column is highlighted in red in the original image, and two specific rows are also highlighted with red boxes to illustrate the data distribution.

	MAP	HR	RR	TEMP	GCS	O2SAT	VENT	WBC	HGB	HCT	PLT	NA	K	BUN	CREAT	BUN/CREAT	GLU	CL	Anion Gap	TCO2	MODS	Sepsis
1	66	135	21	38.6	11	97	1	18	7.3	21.5	179	133	4.2	11	0.4	27.5	108	105	9.2	23	0	
2	99	102	13	36.3	15	95	0	17.3	13.8	38.6	98	134	3.8	11	1.15	9.56521739	133	98	8.8	31	0	
3	110	112	14	38.6	8	99	1	19.3	14.5	42.5	246	137	3.9	18	1.76	10.2272727	143	105	17.9	18	0	
4	76	118	19	38.9	14	100	0	17.8	8.1	23.4	438	135	4.3	9	0.7	12.8571429	115	105	12.3	22	0	
5	70	109	12	38	13	100	0	7.9	10.7	30.3	323	133	4.1	11	0.56	19.6428571	164	104	11.1	22	0	
6	75	116	24	39.6	15	100	1	16.5	7.3	22.5	476	134	4.4	20	0.85	23.5294118	108	103	11.4	24	0	
7	70	116	16	37.3	7	97	1	17.4	10.2	30.4	215	145	4.2	10	0.46	21.7391304	117	113	12.2	24	0	
8	86	125	30	37.8	6	100	1	14.6	7.5	22.7	105	141	3	20	0.83	24.0963855	128	108	16	20	0	
9	84	128	20	38.5	15	98	1	6	10.7	31.9	75	140	5.2	15	1.57	9.55414013	91	109	9.2	27	0	
10	60	114	20	38.5	10	100	1	8.1	7.5	22.4	802	137	4.1	7	0.36	19.4444444	119	106	13.1	22	0	
11	108	149	28	39.7	15	94	0	11.5	10.1	30.5	614	135	4.9	8	0.59	13.559322	119	95	13.9	31	0	
492	85	97	20	38.3	11	99	1	8.18	7	22	388	142	3.8	25	0.45	55.5555556	140	106	5.8	34	1	
493	68	115	24	39.5	10	100	1	12.3	8.7	28	287	142	3.3	17	1.01	16.8316832	104	109	7.3	29	1	
494	62	102	17	39.1	9	98	1	3.84	8.2	25	264	142	4.5	12	0.93	12.9032258	129	102	9.5	35	1	
495	68	162	26	39.7	11	100	1	12	7.1	21.6	401	142	3.6	7	0.37	18.9189189	120	105	13.6	27	1	
496	71	122	16	38.1	14	98	0	17.6	9.7	32	645	142	3.3	26	0.57	45.6140351	331	112	9.3	24	1	
497	68	113	16	38.3	15	97	0	23.9	6.9	23	732	142	3.6	25	0.48	52.0833333	122	112	9.6	24	1	
498	109	123	17	38.2	11	99	1	13.5	6.8	21	174	142	3.4	22	0.75	29.3333333	102	108	7.4	30	1	
499	62	74	19	38.1	11	97	1	7.56	7.5	25	288	142	3.6	44	1.38	31.884058	189	111	7.6	27	1	
500	56	78	26	37.9	14	95	0	14.7	8.7	26.7	497	142	4.3	20	0.41	48.7804878	129	115	3.3	28	1	
501	80	104	24	38.7	11	99	1	8.26	7.2	24	496	143	4.4	29	0.47	61.7021277	103	110	5.4	32	1	

# MILO: Machine Intelligence Learning Optimizer

1 Select Data

2 Explore  
Optional

3 Train

4 View Results

Please provide a training test set and a separate test set used for generalization. Both data sets must have the same columns.

## Data Upload

Select Training Data

Select Testing Data (Generalization)

NEXT

Listed are models you have already published. You may manage your published models below.

## Published Models

TB-Good-GBM-Model



Alternatively, you may select previously uploaded data sets.  
Jobs are listed by target along with either a unique ID or the job completion time.

## Previous Data Set

TB - Feb 5, 2020, 7:04:04 AM

TRAIN

VIEW RESULTS



1 Select Data

localhost

Sepsis-MILO-Full-run

Search

Name	Date Modified	Size	Kind
ABA-features-MILO-run	Jan 10, 2020 at 4:26 PM	--	Folder
ABA-features-Sepsis-MILO-run-results	Jan 10, 2020 at 4:29 PM	--	Folder
OLD-ABA-Sepsis-features-RF1350-results	Jan 2, 2020 at 8:32 AM	--	Folder
Sepsis-ABA-features-Generalization.csv	Dec 31, 2019 at 9:48 PM	5 KB	Comm...et (.csv)
Sepsis-ABA-features-Training.csv	Dec 31, 2019 at 9:47 PM	11 KB	Comm...et (.csv)
Jupyter-test-of-top5-features	Jan 9, 2020 at 9:43 AM	--	Folder
OLDER-Sepsis-FULL-RUN-RESULTS	Jan 10, 2020 at 6:42 AM	--	Folder
Sepsis-FULL-RUN-Results-1-10-2020	Jan 10, 2020 at 6:47 AM	--	Folder
SOFA-Sepsis-features-MILO-run-results	Jan 10, 2020 at 4:18 PM	--	Folder
Traditional-run-results	Jan 6, 2020 at 10:57 AM	--	Folder
Sepsis-All-features-Batch1.csv	Dec 16, 2019 at 9:35 AM	19 KB	Comm...et (.csv)
Sepsis-All-features-Batch2.csv	Dec 16, 2019 at 9:44 AM	19 KB	Comm...et (.csv)
Sepsis-All-features-Generalization-data.csv	Jul 16, 2019 at 5:05 PM	19 KB	Comm...et (.csv)
<b>Sepsis-All-features-Training.csv</b>	<b>Jul 16, 2019 at 5:05 PM</b>	<b>47 KB</b>	<b>Comm...et (.csv)</b>
SEPSIS TRADITIONAL vs MILO Best Models-Results	Dec 14, 2019 at 8:06 AM	17 KB	Micros...(.docx)

Cancel Choose

4 View Results

Alternatively, you may select previously uploaded data sets.  
Jobs are listed by target along with either a unique ID or the job completion time.

### Previous Data Set

TB - Feb 5, 2020, 7:04:04 AM

TRAIN VIEW RESULTS X

# MILO: Machine Intelligence Learning Optimizer

1 Select Data

2 Explore  
Optional

3 Train

4 View Results

Please provide a training test set and a separate test set used for generalization. Both data sets must have the same columns.

## Data Upload

Select Training Data

Select Testing Data (Generalization)

Cancel

NEXT

Listed are models you have already published. You may manage your published models below.

## Published Models

TB-Good-GBM-Model



Alternatively, you may select previously uploaded data sets.  
Jobs are listed by target along with either a unique ID or the job completion time.

## Previous Data Set

TB - Feb 5, 2020, 7:04:04 AM

TRAIN

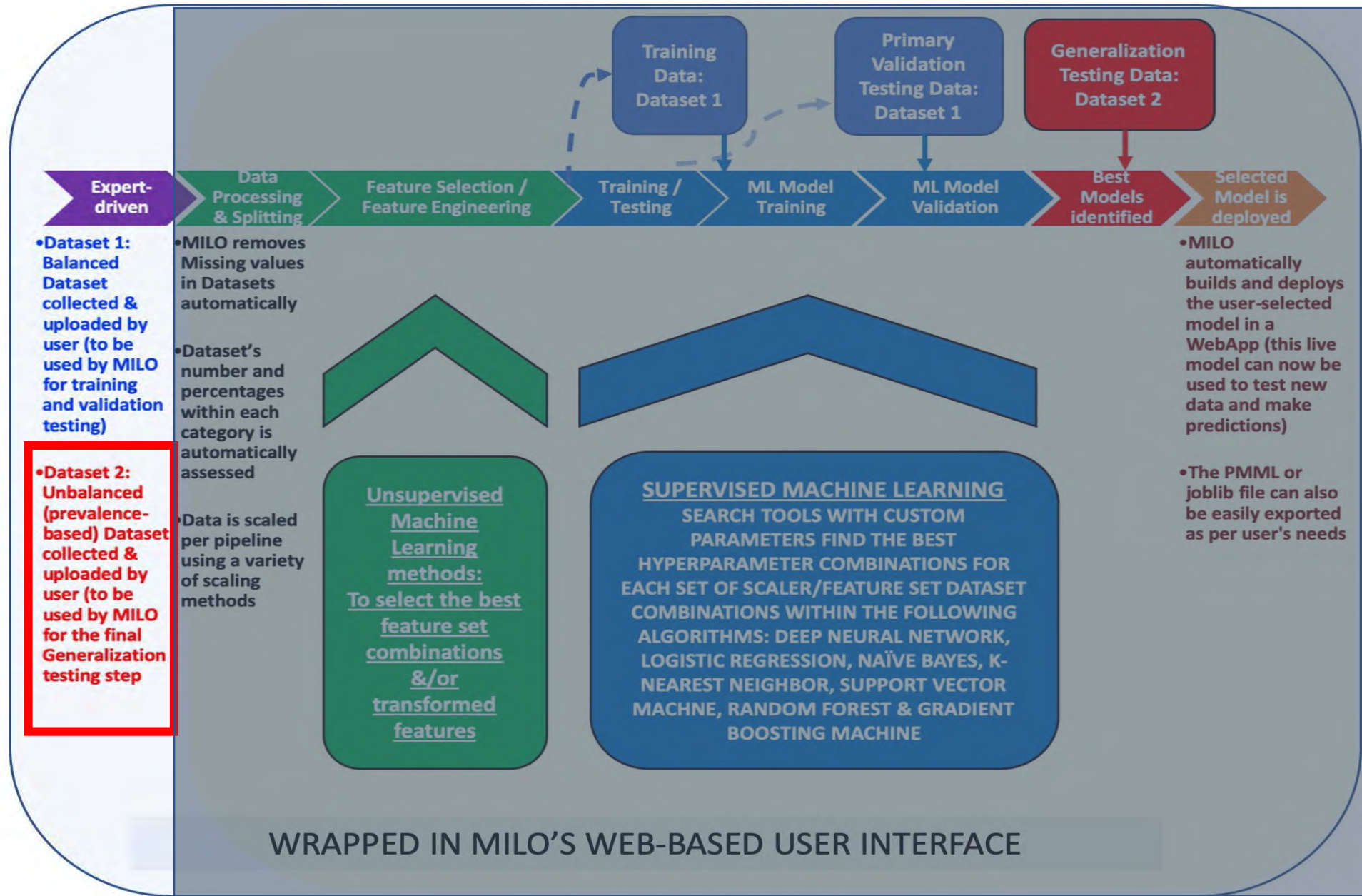
VIEW RESULTS





# MILO: Machine Intelligence Learning Optimizer

## Auto-ML Platform





# MILO: Machine Intelligence Learning Optimizer

1 Select Data

2 Explore  
Optional

3 Train

4 View Results

Please provide a training test set and a separate test set used for generalization. Both data sets must have the same columns.

## Data Upload

Select Training Data

Select Testing Data (Generalization)

Upload Data

NEXT

Listed are models you have already published. You may manage your published models below.

## Published Models

TB-Good-GBM-Model



Alternatively, you may select previously uploaded data sets.  
Jobs are listed by target along with either a unique ID or the job completion time.

## Previous Data Set

TB - Feb 5, 2020, 7:04:04 AM

TRAIN

VIEW RESULTS



1 Select Data

localhost

Sepsis-MILO-Full-run

Search

Name	Date Modified	Size	Kind
ABA-features-MILO-run	Jan 10, 2020 at 4:26 PM	--	Folder
ABA-features-Sepsis-MILO-run-results	Jan 10, 2020 at 4:29 PM	--	Folder
OLD-ABA-Sepsis-features-RF1350-results	Jan 2, 2020 at 8:32 AM	--	Folder
Sepsis-ABA-features-Generalization.csv	Dec 31, 2019 at 9:48 PM	5 KB	Comm...et (.csv)
Sepsis-ABA-features-Training.csv	Dec 31, 2019 at 9:47 PM	11 KB	Comm...et (.csv)
Jupyter-test-of-top5-features	Jan 9, 2020 at 9:43 AM	--	Folder
OLDER-Sepsis-FULL-RUN-RESULTS	Jan 10, 2020 at 6:42 AM	--	Folder
Sepsis-FULL-RUN-Results-1-10-2020	Jan 10, 2020 at 6:47 AM	--	Folder
SOFA-Sepsis-features-MILO-run-results	Jan 10, 2020 at 4:18 PM	--	Folder
Traditional-run-results	Jan 6, 2020 at 10:57 AM	--	Folder
Sepsis-All-features-Batch1.csv	Dec 16, 2019 at 9:35 AM	19 KB	Comm...et (.csv)
Sepsis-All-features-Batch2.csv	Dec 16, 2019 at 9:44 AM	19 KB	Comm...et (.csv)
<b>Sepsis-All-features-Generalization-data.csv</b>	<b>Jul 16, 2019 at 5:05 PM</b>	<b>19 KB</b>	<b>Comm...et (.csv)</b>
Sepsis-All-features-Training.csv	Jul 16, 2019 at 5:05 PM	47 KB	Comm...et (.csv)
SEPSIS TRADITIONAL vs MILO Best Models-Results	Dec 14, 2019 at 8:06 AM	17 KB	Micros...(.docx)

Cancel Choose

4 View Results

Alternatively, you may select previously uploaded data sets.  
Jobs are listed by target along with either a unique ID or the job completion time.

### Previous Data Set

TB - Feb 5, 2020, 7:04:04 AM

TRAIN

VIEW RESULTS



1 Select Data

2 Explore  
Optional

3 Train

4 View Results

Please provide a training test set and a separate test set used for generalization. Both data sets must have the same columns.

### Data Upload

Select Training Data

Select Testing Data (Generalization)

NEXT

Listed are models you have already published. You may manage your p

### Published Models

TB-Good-GBM-Model

Alternatively, you may select previously uploaded data. Jobs are listed by target along with either a unique ID or the job

### Previous Data Set

TB - Feb 5, 2020, 7:04:04 AM

- Sepsis
- MODS
- TCO2
- Anion Gap
- CL
- GLU
- BUN/CREAT
- CREAT
- BUN
- K
- NA
- PLT
- HCT
- HGB

# MILO: Machine Intelligence Learning Optimizer

1 Select Data

2 Explore  
Optional

3 Train

4 View Results

Please provide a training test set and a separate test set used for generalization. Both data sets must have the same columns.

## Data Upload

- Select Training Data
- Select Testing Data (Generalization)
- Sepsis

NEXT

Listed are models you have already published. You may manage your published models.

### Published Models

TB-Good-GBM-Model

Alternatively, you may select previously uploaded data sets. Jobs are listed by target along with either a unique ID or the job name.

### Previous Data Set

TB - Feb 5, 2020, 7:04:04 AM

- Sepsis
- MODS
- TCO2
- Anion Gap
- CL
- GLU
- BUN/CREAT
- CREAT
- BUN
- K
- NA
- PLT
- HCT
- HGB

MILO IN ACTION

Quick Demo

# INSERT MILO MP4 VIDEO 1

MILO: Machine Intelligence Learning Optimizer

+ START NEW SEARCH | EXPORT

Select Data | Explore Optional | Train | View Results

### Pipeline Elements

- Estimators**
  - Gradient Boosting Machine
  - K-nearest Neighbor
  - Logistic Regression
  - Neural Network
  - naive Bayes
  - Random Forest
  - Support Vector Machine
- Scalers**
  - None
  - Standard
  - Min Max
- Feature Selectors**
  - None
  - Principal Component Analysis (80%)
  - Principal Component Analysis (90%)
  - Random Forest Importance (25%)
  - Random Forest Importance (50%)
  - Random Forest Importance (75%)
  - Select Percentile (25%)
  - Select Percentile (50%)
  - Select Percentile (75%)
- Searchers**
  - Grid
  - Random
  - Random 2
- Scorers**
  - ROC AUC
  - Accuracy
  - F1

### Cross Validation Options

- Shuffle per Fold

Estimator	Score 1	Score 2	Score 3	Score 4	Score 5	Score 6	Score 7	Scaler	Feature Selector	Scorer	Searcher
K-Nearest Neighbor	0.926	0.978	0.887	0.864	1	0.853	0.173	Standard Scaler	Select Percentile (50%)	F1	Random Search
K-Nearest Neighbor	0.916	0.974	0.882	0.857	0.979	0.853	0.181	Standard Scaler	Select Percentile (50%)	Accuracy	2nd Random Search
K-Nearest Neighbor	0.916	0.973	0.880	0.853	0.978	0.853	0.181	Standard Scaler	Select Percentile (50%)	F1	2nd Random Search



MILO is also very transparent

# INSERT MILO MP4 VIDEO 2

The screenshot displays the MILO Machine Intelligence Learning Optimizer interface. The main window shows a data table with the following columns: 'id', 'name', 'description', 'status', and 'created\_at'. The table contains multiple rows of data, including entries for 'MILO-1', 'MILO-2', and 'MILO-3'. The interface includes a top navigation bar with 'Home', 'Insert', 'Draw', 'Page Layout', 'Formulas', 'Data', 'Review', and 'View'. A 'Downloads' window is visible in the top right corner, showing a file named 'results.csv'.

id	name	description	status	created_at
1	MILO-1	MILO-1 Description	Active	2023-10-27 10:00:00
2	MILO-2	MILO-2 Description	Active	2023-10-27 10:00:00
3	MILO-3	MILO-3 Description	Active	2023-10-27 10:00:00
4	MILO-4	MILO-4 Description	Active	2023-10-27 10:00:00
5	MILO-5	MILO-5 Description	Active	2023-10-27 10:00:00
6	MILO-6	MILO-6 Description	Active	2023-10-27 10:00:00
7	MILO-7	MILO-7 Description	Active	2023-10-27 10:00:00
8	MILO-8	MILO-8 Description	Active	2023-10-27 10:00:00
9	MILO-9	MILO-9 Description	Active	2023-10-27 10:00:00
10	MILO-10	MILO-10 Description	Active	2023-10-27 10:00:00

# In Summary: MILO

- It's super easy to use
- No Machine Learning (ML) expertise needed
- No Programming or software engineering expertise needed
  - MILO is your personal ML & Software engineering Expert Team
- MILO
  - Follows ML Study Best practices
  - Finds your Best ML Model and does it Much Faster
  - Most importantly it's a validated platform

# Our Studies & Collaborators

## **Our AKI & Sepsis ML Team**

- Nam Tran
- Tina Palmieri
- Soman Sen
- Samer Albahra
- Jeff Wajda
- Hooman Rashidi

## **Collaborators for our other validation studies**

- Joe Galante & Shawn Tejiram: MTP
- Imran Khan : TB
- Kuang yu Jen: DGF (transplant)
- Thomas Smith & William Wung (Cath results: Cardiology)
- Erin Griffin, Sharad Jain & Kristin Olson (USMLE step 1 studies)

# MILO's Core Team

**Samer Albahra MD**

**Hooman H. Rashidi MD MS**

**Nam Tran, PhD**

Thank you for your attention