

# Model Deployment: Monitoring, Diagnostics, and Predictive Concepts

## WELCOME TO OUR WEBINAR



**Mikhail Golovnya**  
*Senior Advisory Data Scientist*



**David Peralta**  
*Area Marketing Manager*

### WEB-AUDIO:

Please make sure you have your computer audio system activated and your speakers turned up.

### QUESTIONS:

You can enter your questions at any time in the questions section.

About Our Speakers:

# Mikhail Golovnya

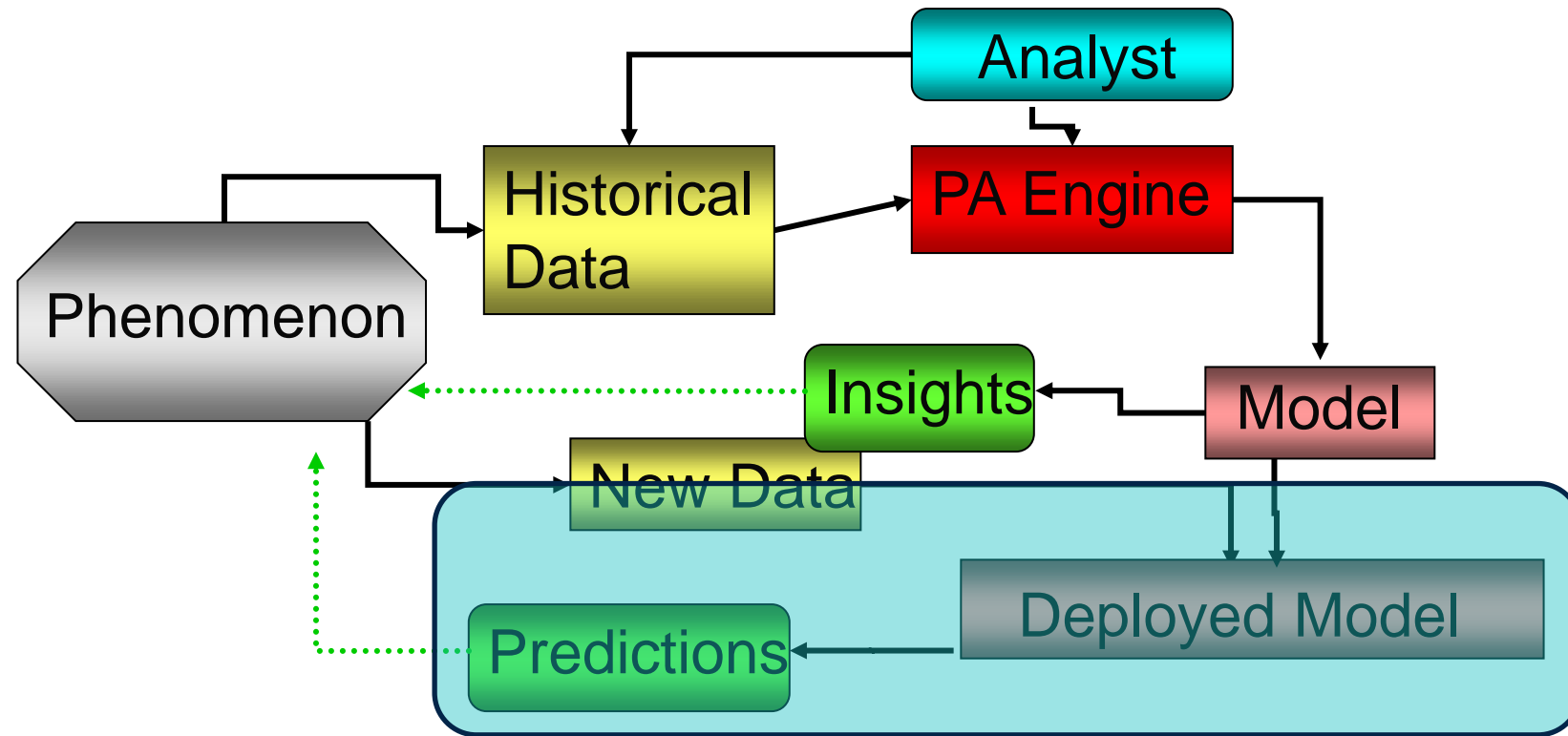
Senior Advisory Data Scientist

Mikhail is a Senior Advisory Data Scientist at Minitab. He has been prototyping new machine learning algorithms and modeling automation for the past twenty years.

Mikhail has been a major contributor to Minitab's on-going search for technological improvements among the most important algorithms in Machine Learning.



# Predictive Analytics: The Big Picture



Use historical data to **gain insights** and **make predictions** on the new data

# Predictive Analytics Workflow



# Survey 1

- ▶ What models would you like to deploy?
  - Models only available in Minitab Statistical Software (CART, TreeNet, Random Forest, Regression, MARS)
  - Models available in Python, R, etc.
  - I do not need to deploy models

# Deployment Using Minitab Connect

# Delinquency Prediction Model

- **Delinquency Prediction in Banking (Kaggle)**
  - Predict who will experience at least 90-days past due or other delinquency within the next 2 years (about 6% of the accounts)
  - 108,376 instances and 6 predictors

## Model Selection

	Average Area Under Misclassification		
Best Model within Type	-Loglikelihood	ROC Curve	Rate
TreeNet®*	0.2140	0.6997	0.0608
Random Forests®	0.2871	0.6717	0.0606
CART®	0.2357	0.6700	0.3705
Logistic Regression	0.2212	0.6496	0.0606



# Setting up a Dataset for Scoring

Navigation bar with icons for home, Minitab Product Development C..., In Development, Mikhail Golovnya, and Delinquency Prediction 1. Includes a search icon and a notification bell.

**DATASET**    **SETUP**    **ADVANCED**

Name\*

Description

Folder\*

Tagging









Status\*

Order By

Order Direction

Click to add a field.

Search Fields

Field Name*	Type*		
ID	Number		
Actual	Number		
AGE	Number		
DEBT_RATIO	Number		

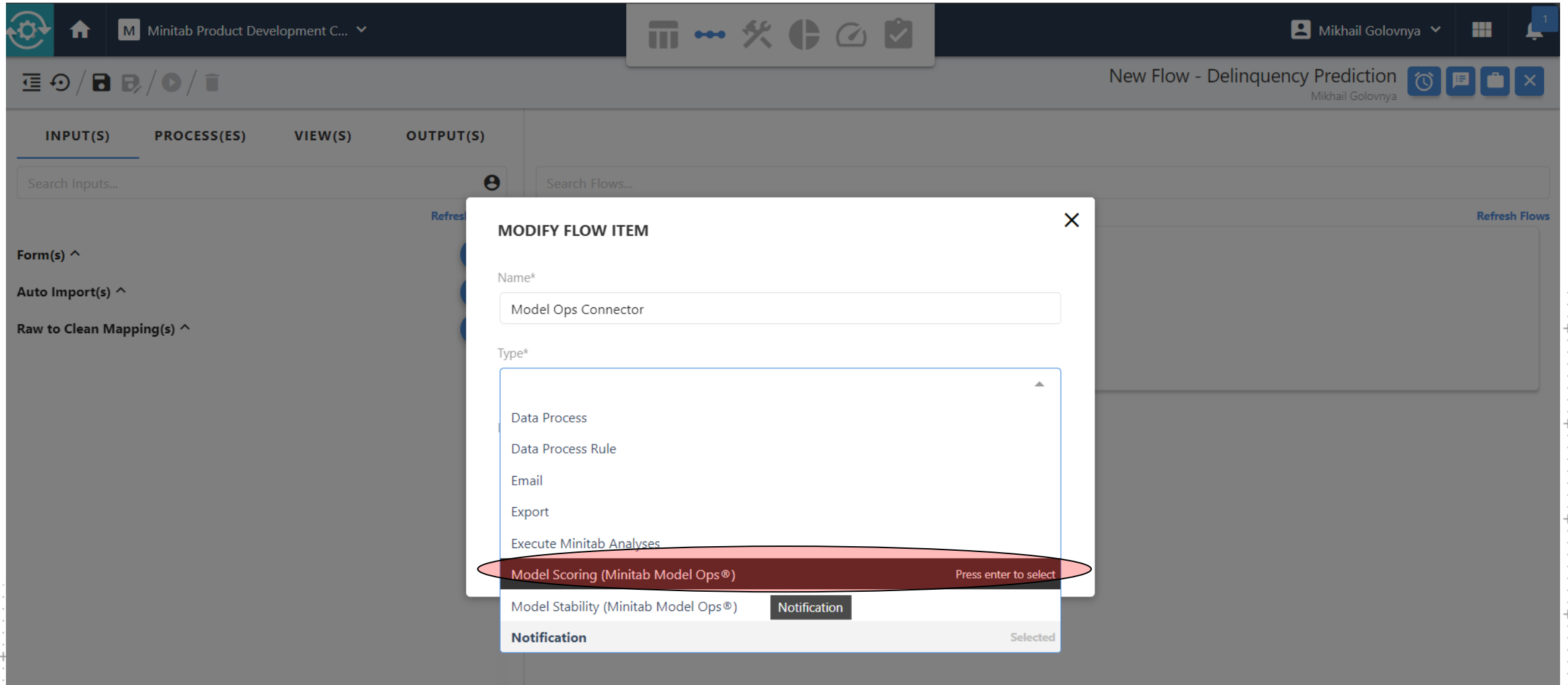
Click to add a field.



# Setting up a Dataset for Scoring

FIELD(S)	FILTER(S)	SORT(S)	SAVE(S)	<input type="checkbox"/> ID	Actual	AGE	DEBT_RATIO	MONTH_INCOME	N_OPEN_LINES	N_MORTGAGES
<input type="checkbox"/>				<input type="checkbox"/>	1358	0	57	0.00133289	3000	1
<input type="checkbox"/>				<input type="checkbox"/>	1357	0	32	0.37043826	6000	11
<input type="checkbox"/>				<input type="checkbox"/>	1356	0	30	0.26280480	7750	9
<input type="checkbox"/>				<input type="checkbox"/>	1355	0	59	0.36511946	9500	8
<input type="checkbox"/>				<input type="checkbox"/>	1353	0	42	0.38165496	11250	11
<input type="checkbox"/>				<input type="checkbox"/>	1352	0	27	0.08701765	6400	7
<input type="checkbox"/>				<input type="checkbox"/>	1351	0	47	0.75436554	11166	18
<input type="checkbox"/>				<input type="checkbox"/>	1349	0	56	0.28793495	8362	8
<input type="checkbox"/>				<input type="checkbox"/>	1348	0	53	0.32306769	10000	14
<input type="checkbox"/>				<input type="checkbox"/>	1347	0	49	0.30017496	4000	14
<input type="checkbox"/>				<input type="checkbox"/>	1346	0	39	0.05591553	4166	5
<input type="checkbox"/>				<input type="checkbox"/>	1345	0	32	0.28897773	1750	8
<input type="checkbox"/>				<input type="checkbox"/>	1343	0	74	0.37567161	9305	8
<input type="checkbox"/>				<input type="checkbox"/>	1341	0	77	0.23847126	3165	13
<input type="checkbox"/>				<input type="checkbox"/>	1340	1	69	0.27998082	14600	15
<input type="checkbox"/>				<input type="checkbox"/>	1339	1	26	0.16091282	3417	5

# Creating a Model Ops Scoring Flow in Connect



The screenshot shows the Minitab Connect interface with a 'MODIFY FLOW ITEM' dialog box open. The dialog box contains the following elements:

- Name\***: A text input field containing 'Model Ops Connector'.
- Type\***: A dropdown menu with the following options:
  - Data Process
  - Data Process Rule
  - Email
  - Export
  - Execute Minitab Analyses
  - Model Scoring (Minitab Model Ops®)** (highlighted with a red oval and 'Press enter to select' next to it)
  - Model Stability (Minitab Model Ops®)
  - Notification
- Notification**: A label at the bottom of the dropdown menu, with 'Selected' written to its right.

# Executing Scoring Flow in Connect

Day 1 Records - Delinquency Predic...  
Mikhail Golovnya

FIELD(S)	FILTER(S)	SORT(S)	SAVE(S)	<input type="checkbox"/>	N_MORTGAGES	N_DEPENDENTS	TEST1000	PREDICTED	Prob0	Prob1	
			Search Saves...	<input type="checkbox"/>	13	6	2	1	0.0000	0.8564	0.1436
			Show Default Save	<input type="checkbox"/>	4	0	1	1	0.0000	0.9255	0.0745
			Refresh Save(s)	<input type="checkbox"/>	2	0	0	1	0.0000	0.8900	0.1100
			Day 1 Records	<input type="checkbox"/>	5	0	0	1	0.0000	0.9197	0.0803
			Day 10 Records	<input type="checkbox"/>	3	1	1	1	0.0000	0.9592	0.0408
			Day 11 Records	<input type="checkbox"/>	8	0	0	1	0.0000	0.9362	0.0638
			Day 12 Records	<input type="checkbox"/>	5	0	0	1	0.0000	0.9123	0.0877
			Day 13 Records	<input type="checkbox"/>	7	2	2	1	0.0000	0.9331	0.0669
			Day 2 Records	<input type="checkbox"/>	13	2	2	1	0.0000	0.9541	0.0459
			Day 3 Records	<input type="checkbox"/>	9	1	2	1	0.0000	0.9232	0.0768

# Model Monitoring in Model Ops

# Model Monitoring

Any predictive analytics model is based on a **snapshot in time** (historical data)

As time goes on, **things change!**

**Data Drift** – the data no longer represents the original time window

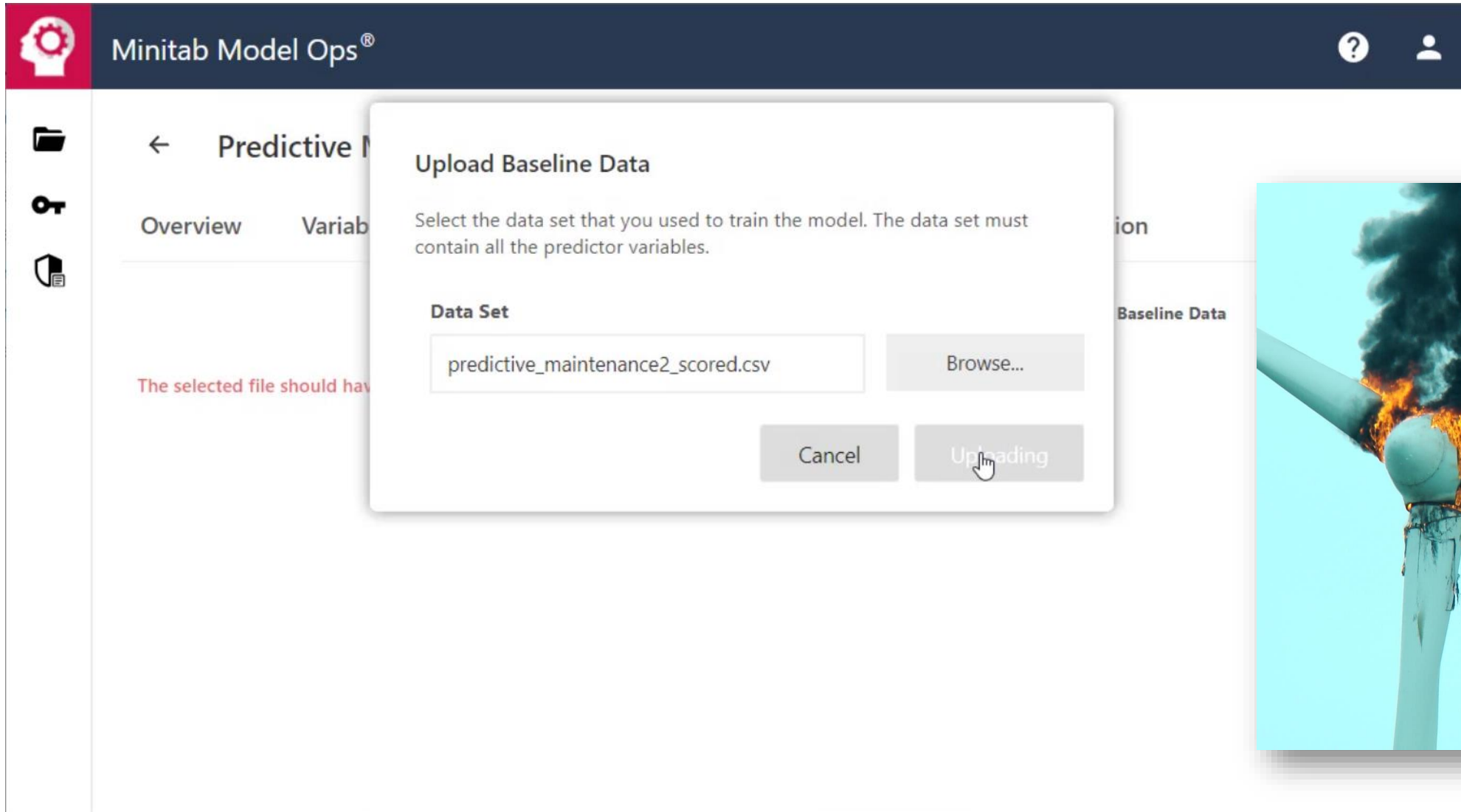
**Model Drift** – the model no longer performs as expected



# Survey 2

- ▶ Do you need to monitor deployed models?
  - Yes
  - No

# Uploading Baseline Data



The screenshot shows the Minitab Model Ops interface. At the top, there is a dark blue header with the Minitab logo and the text "Minitab Model Ops". Below the header, there is a navigation bar with a back arrow and the text "Predictive M". Underneath, there are two tabs: "Overview" and "Variable". A red error message is visible: "The selected file should have". A central dialog box titled "Upload Baseline Data" is open. It contains the following text: "Select the data set that you used to train the model. The data set must contain all the predictor variables." Below this text is a section labeled "Data Set" with a text input field containing "predictive\_maintenance2\_scored.csv" and a "Browse..." button. At the bottom of the dialog box are two buttons: "Cancel" and "Uploading", with a mouse cursor hovering over the "Uploading" button.



# Example of Minimal Data Drift

Minitab Model Ops®

Production Data Period: Daily

August 9, 2023 (last updated on August 9, 2023, 21:00:39Z)

+ Replace Baseline Data    Save as PDF

Response Varia...	Status	Baseline Data	Production Data	Prediction Drif...	Drift Over Time
> Machine_fail...	✓ minimal ...			0.000575	

↓ Predictor Va...	Status	Baseline Data	Production Data	Data Drift (PSI)	Drift Over Time
> Air temp	✓ minimal ...			0.006591	
> Rotate_speed	✓ minimal ...			0.011890	
> Torque	✓ minimal ...			0.013260	
> p_temp	✓ minimal ...			0.004456	



# Example of Severe Data Drift

Minitab Model Ops®


Overview Variables **Drift** Stability Settings Audit Log Integration

Production Data Period: Daily + Replace Baseline Data Save as PDF

**August 9, 2023** (last updated on August 9, 2023, 21:30:23Z)




Response Varia...	Status	Baseline Data	Production Data	Prediction Drif...	Drift Over Time
> Machine_fail...	! severe drift			1.954950	
↓ Predictor Va...	Status	Baseline Data	Production Data	Data Drift (PSI)	Drift Over Time
> Air temp	✓ minimal ...			0.006591	
> Rotate_speed	✓ minimal ...			0.011890	
> Torque	! severe drift			3.767565	


# Severe Data Drift: Response

**Minitab Model Ops** ? 


Production Data Period: **Daily** + Replace Baseline Data Save as PDF

**August 9, 2023** (last updated on August 9, 2023, 21:30:23Z)

Response Varia...	Status	Baseline Data	Production Data	Prediction Drif...	Drift Over Time
Machine_fail...	<span>!</span> severe drift			1.954950	

**Data = Production**  
**Machine\_failure = 1**  
**Production = 50.3%**



# Severe Data Drift: Torque



# Monitoring Model Stability/Performance in Model Ops

- ▶ **Model stability/performance monitoring** (unlike the data drift) does require knowing of the actual response
  - In many cases, the actual **RESPONSE** is known at some point later in relation to the scoring
  - Record matching is done via a specially supplied **ID** variable
- ▶ Model Ops allows to keep track of up to three different models built on the same dataset
  - Only one model is designated as the production model (**champion**)
  - The other two models (**challengers**) are competing with the production model
  - The models are monitored in terms of performance (stability)
  - A challenger model can be promoted into champion based on the results of monitoring



# Adding Challenger Models in Model Ops

The screenshot shows the Minitab Model Ops interface. A modal dialog titled "Add Model" is open in the center. The dialog has a "Model" dropdown menu with the text "Choose model from repository..." and two buttons at the bottom: "Cancel" and "OK".

The background interface shows a deployment page for "Untitled Deployment 23". It includes a sidebar with navigation icons, a top navigation bar with "Models", "Performance", "Settings", and "Audit" tabs, and a main content area with a "Models" section. The "Models" section contains two entries: "Delinquency Prediction" and "Delinquency Prediction 2", both using TreeNet Classification. Below the models is an "Add Model" button.

On the right side of the deployment page, there is a status indicator "Active (0.75 days)" and a "Pause" button.

Below the "Add Model" dialog, there is a section for "Response" and "Predictors".

**Response**

Name	Type	Data Type	Classes
DELINQUENT	categorical	numeric	0, 1

**Predictors**

Name ↑	Type	Data Type	Classes	Models
AGE	continuous	numeric		All
DEBT_RATIO	continuous	numeric		All
MONTH_INCOME	continuous	numeric		All
N_DEPENDENTS	continuous	numeric		All
N_MORTGAGES	continuous	numeric		All
N_OPEN_LINES	continuous	numeric		All

# Adding Challenger Models in Model Ops

Minitab Model Ops®

Predict Delinquency Edit

The deployment is offline.
Activate Deployment

Created By: Mikhail Golovnya  
 Created: 2024-04-19 18:13:17Z  
 Last Updated: 2024-04-19 18:39:56Z  
 Champion Model: Delinquency Prediction (Additive)

Models
Performance
Settings
Audit Log
Service Metrics
Integration

### Models

Each deployment must include one champion and up to two challenger models. To monitor drift, upload or replace baseline data for each model.

TreeNet® Classification  
Delinquency Prediction (Additi...

CART® Classification  
Delinquency (CART)

Binary Logistic Regression  
Delinquency (Logistic)

+
Add Model

### Variables

Each deployment has a single response variable and can have shared or different predictors in each model.

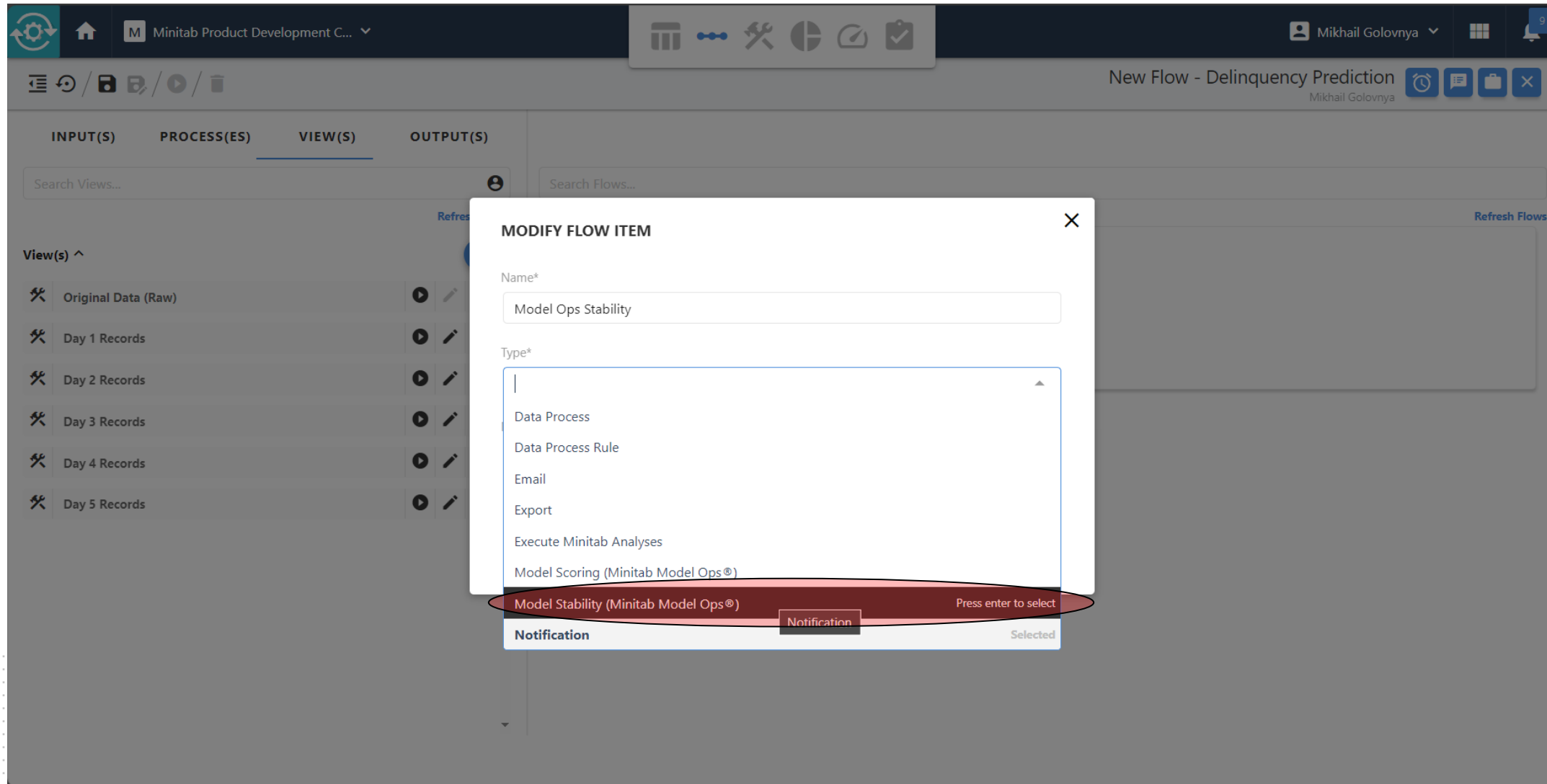
### Response

Name	Type	Data Type	Classes
DELINQUENT	categorical	numeric	0, 1

### Predictors

Name ↑	Type	Data Type	Classes	Models
AGE	continuous	numeric		All
DEBT_RATIO	continuous	numeric		All
MONTH_INCOME	continuous	numeric		All
N_DEPENDENTS	continuous	numeric		All
N_MORTGAGES	continuous	numeric		All
N_OPEN_LINES	continuous	numeric		All

# Creating a Model Ops Stability Flow in Connect



The screenshot displays the Minitab Connect interface for creating a flow. A modal dialog titled "MODIFY FLOW ITEM" is open, allowing for the configuration of a flow item. The "Name\*" field is populated with "Model Ops Stability". The "Type\*" dropdown menu is expanded, listing various flow item types. The "Model Stability (Minitab Model Ops®)" option is highlighted with a red oval, and a "Notification" label is placed below it. The background interface shows a flowchart with tabs for "INPUT(S)", "PROCESS(ES)", "VIEW(S)", and "OUTPUT(S)". The "VIEW(S)" tab is active, showing a list of views: "Original Data (Raw)", "Day 1 Records", "Day 2 Records", "Day 3 Records", "Day 4 Records", and "Day 5 Records". The top right of the interface shows the user "Mikhail Golovnya" and a notification icon with the number "9".

# Creating a Model Ops Stability Flow in Connect

The screenshot displays the Minitab Connect interface with a 'MODIFY FLOW ITEM' dialog box open. The dialog box is titled 'MODIFY FLOW ITEM' and contains the following fields and options:

- Name\***: Model Ops Stability
- Type\***: Model Stability (Minitab Model Ops®)
- View\***: Stability View
- API Key**: API Key is valid. A blue button labeled 'CHANGE API KEY' is visible.
- Deployment\***: Untitled Deployment 23

Below the deployment field, there are two configuration sections:

- ID Variable**: ID (Text input) and **Column**: ID (Dropdown menu)
- Response**: DELINQUENT (Text input) and **Column**: DELINQUENT (Dropdown menu)

The background shows a blurred view of the Minitab Connect interface, including a search bar for outputs and a 'Refresh' button.



# Model Stability Report



## Predict Delinquency [Edit](#)

Active (10.99 days)

[Pause](#)

Created By: Mikhail Golovnya   Created: 2024-04-19 18:13:17Z   Last Updated: 2024-04-23 17:17:51Z    Champion Model: **Delinquency Prediction (Additive)**

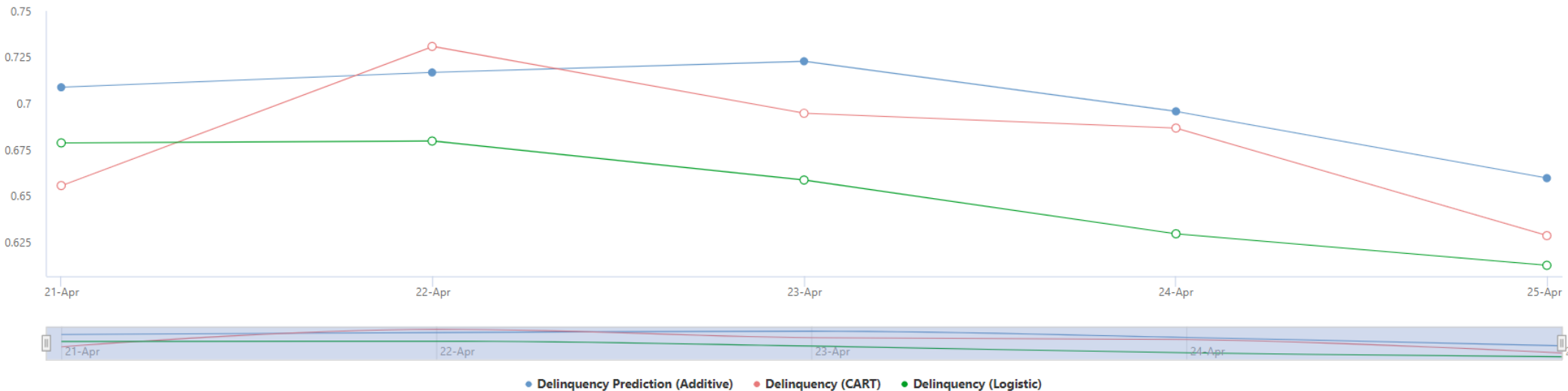
[Models](#)   [Performance](#)   [Settings](#)   [Audit Log](#)   [Service Metrics](#)   [Integration](#)

Period: Daily   Start Date: 2024-04-19   End Date: 2024-04-25

Report is current (Updated 2024-04-29 16:19:55Z)  

Drift   [Stability](#)

Metric: Area Under Curve   Response Level: 1    Show Promotions



# The Future of AI: A Philosophical Inquiry

# Different Types of AI

- **Reactive Machines:**

- These are basic rule-based systems that operate based on predefined rules.

- **Expert Systems:**

- These are computer systems that mimic the decision-making ability of a human expert in a specific domain.

- **Machine Learning (ML) Systems:**

- ML is a subset of AI that focuses on developing algorithms and models that enable computers to learn from data.
- Types of ML systems include supervised learning, unsupervised learning, and reinforcement learning.

- **Neural Networks:**

- Inspired by the human brain, neural networks are a key component of many AI systems.

- **Narrow AI (Weak AI):**

- These AI systems are designed and trained for a specific task or a narrow set of tasks.
- Examples include virtual personal assistants, image recognition software, and language translation services.

- **Limited Memory:**

- These AI systems can learn from historical data to make better decisions.
- Self-driving cars often use limited memory AI to navigate based on past experiences.

- **Self-aware AI:**

- This refers to hypothetical AI systems with self-awareness and consciousness.

- **Theory of Mind:**

- This is a more advanced form of AI that can understand human emotions, beliefs, intentions, and thoughts.

- **General AI (Strong AI):**

- General AI systems can understand, learn, and apply knowledge across diverse domains.
- They can perform any intellectual task that a human being can do.

- **Superintelligent AI:**

- This is a theoretical AI that surpasses human intelligence in every aspect.

- **Robotics AI:**

- AI is often integrated into robots to enable them to perceive, learn, and interact with the environment.

# Survey 3

- ▶ AI will one day rival and may even surpass human intelligence
  - Yes, definitely
  - Not sure
  - Never

# Artificial Intelligence – Should We Be Concerned?

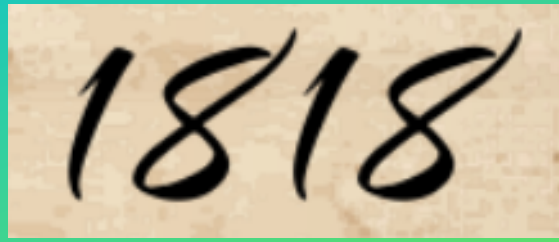


“It’s likely that machines will be smarter than us before the end of the century—not just at chess or trivia questions but at just about everything, from mathematics and engineering to science and medicine.” –Gary Marcus

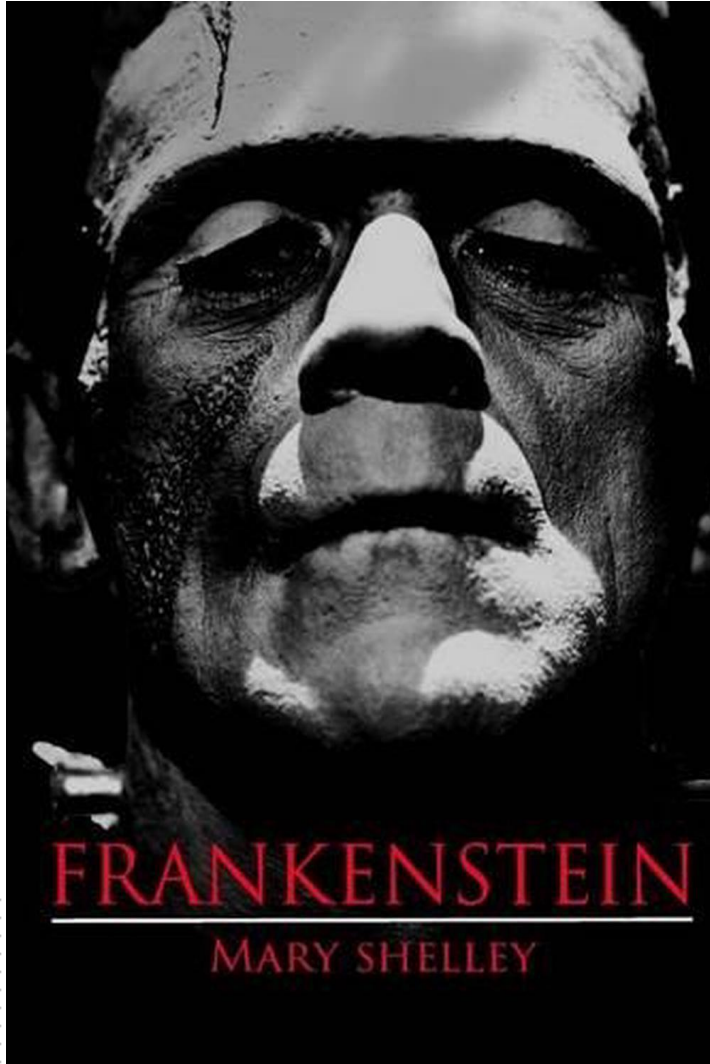
“I am in the camp that is concerned about super intelligence.” –Bill Gates

“You want to know how super-intelligent cyborgs might treat ordinary flesh-and-blood humans? Better start by investigating how humans treat their less intelligent animal cousins. It’s not a perfect analogy, of course, but it is the best archetype we can actually observe rather than just imagine.” –Yuval Noah Harari

“It’s not artificial intelligence I’m worried about, it’s human stupidity.” –Neil Jacobstein



# Artificial Intelligence – Should We Be Concerned?



“Nothing is so painful to the human mind as a great and sudden change.”

– Mary Wollstonecraft Shelley, Frankenstein

“Beware; for I am fearless, and therefore powerful.”

– Mary Shelley, Frankenstein

“Man," I cried, "how ignorant art thou in thy pride of wisdom!”

– Mary Shelley, Frankenstein

“If I cannot inspire love, I will cause fear!”

– Mary Shelley, Frankenstein

# Fundamental Premise of Strong AI

## Prevalent Metaphysical Assumption

- ▶ Human intelligence is reduced to a set of self-evolving survival algorithms and subroutines running on top of chemo-electric (carbon based) pathways in human brain
- ▶ Similarly, Strong AI is a set of self-evolving survival algorithms and subroutines running on top of electric (silicon based) pathways in silicon brain
- ▶ Thus, with sufficient complexity AI can rival human intelligence
- ▶ Therefore, AI will evolve on its own, surpass human intelligence and may eventually eradicate human beings



# Is AI Actually Intelligence?

## Alternative Metaphysical Assumption

- ▶ Human intelligence cannot be reduced to a set of subroutines in the human brain
- ▶ The fundamental piece that characterizes us as intelligent agents (self-awareness) is beyond our grasp and likely resides beyond the boundaries of natural science
- ▶ Our brain is simply a sophisticated, albeit necessary, quantum interface binding human agency to the natural world: an autonomous car still needs a driver/director to achieve set goals!
- ▶ AI cannot become self-aware; it cannot think on its own; it cannot experience feelings or emotions
- ▶ AI cannot create something genuinely new; it can only present an illusion of creation by presenting interesting permutation/recombination of what was already created by human intelligence
- ▶ AI cannot initiate an agency-based (free will) chain of events, its actions are based on either pre-determined fixed rules or purely random triggers



“

I am superior, sir, in many ways, but I would gladly give it up to be human.

– *Lt. Cmdr. Data*

Star Trek: The Next Generation,  
'Encounter at Farpoint'.



# The True Dangers of AI

- ▶ Giving control over various aspects of our daily lives to AI may create a **bureaucratic quagmire** surpassing everything we have experienced before (automated tech support, medical clearance, security clearance, hackers, identity theft, deep fakes, slander, etc.)
- ▶ Humanization/Deification of AI creates very tempting possibilities for a small group of individuals or governing entities **to control** entire societies to achieve their pernicious agendas (propaganda, political and social control, cyber tyranny, the brave new world)



## Great Quotes of Old

“

Gravity explains the motions of the planets but it cannot explain who sets the planets in motion.

- *Isaac Newton*

The only thing more **dangerous** than ignorance is **arrogance**.

- *Albert Einstein*

“**Imagination is more important than knowledge**”

Albert Einstein

# Q&A



# Upcoming In-Person Events

## Dates and Location in the US

- Rosemont, IL – June 18<sup>th</sup>
- Columbus, OH – August 15<sup>th</sup>
- Dallas, TX – September 10<sup>th</sup>
- Anaheim, CA – October 10<sup>th</sup>



Minitab   
**EXCHANGE**

# You have data. We have solutions. Imagine the possibilities.

At Minitab, we help customers around the world leverage the power of data analysis to gain insights and make a significant impact on their organizations. By unlocking the value of data, Minitab enables organizations to improve performance, develop life changing innovations and meet their commitments of delivering high quality products and services and outstanding customer satisfaction.



# thank you

Gracias

ευχαριστώ

Danke

Grazie

благодаря

Hvala

Obrigado

Kiitos

شكراً

Tak

Ahsante

Teşekkürler

متشكراً

Salamat Po

감사합니다

Cám ơn

شكريه

Terima Kasih

Dank u Wel

Děkuji

நன்றி

Köszönöm

ありがとう  
ございます

ขอขอบคุณครับ

Dziękuję

谢谢

Tack

Mulțumesc

спасибо

Merci

תודה

多謝晒

дядкую

Ďakujem