

Michigan SAS Users Group (MSUG)

SAS ModelOPs:

From Decisions to Recommendations

June 9, 2022

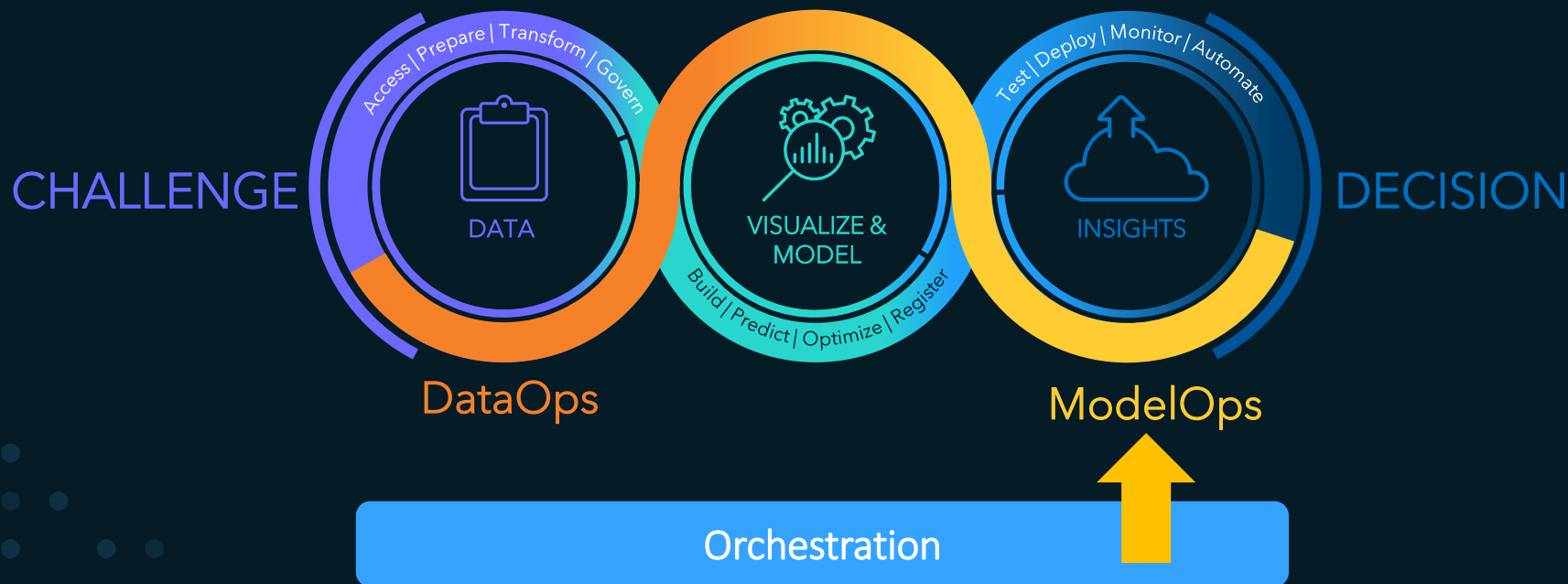
Gene Grabowski, Jr.

SAS Institute

Advisory Solutions Architect & Data Scientist

What SAS Hears from Customers.....

The Analytics Lifecycle



How SAS Viya Accelerates The Analytic Lifecycle

Integrate SAS & Open-Source Analytics

1

Architecture

- High-Performance Computing
- Microservices



2

Democratization

- Leverage many languages
- Utilize code or GUI



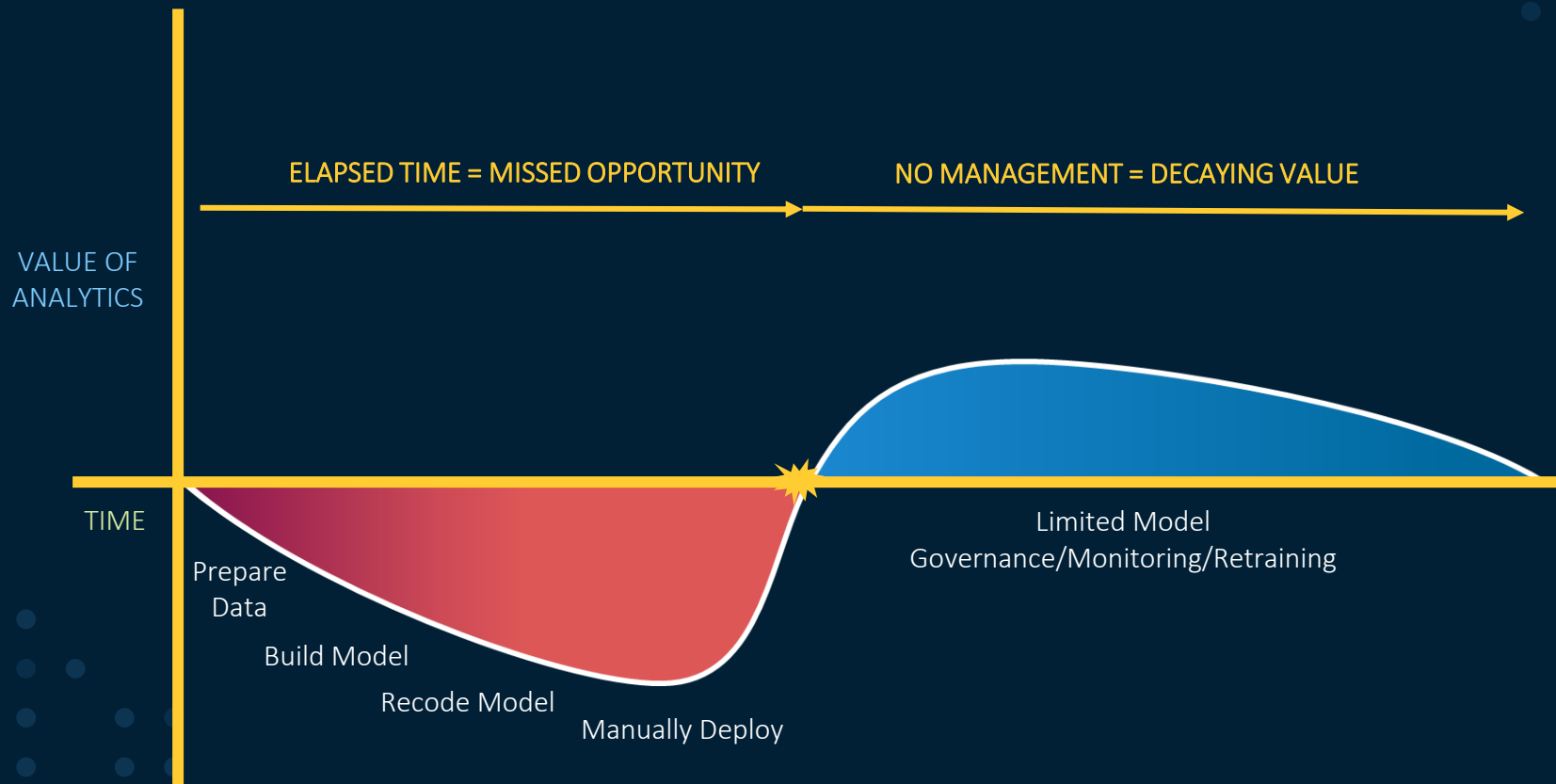
3

ModelOps

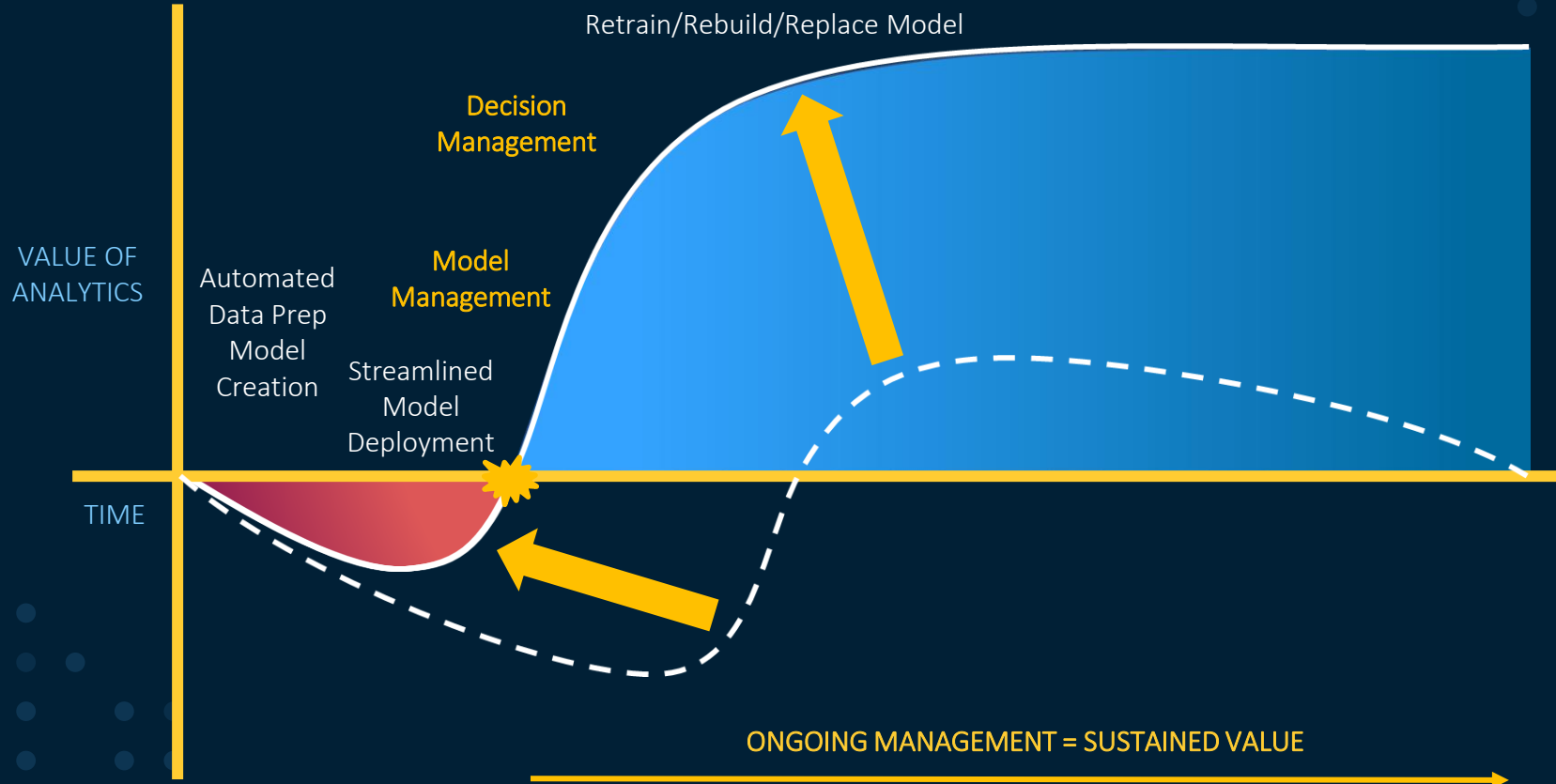
- Model Management
- Decision Management
- Operationalize



Challenges of ModelOps



How The SAS Platform Can Improve ModelOps



The SAS Viya Approach for ModelOps

“Start with the End in Mind”

Flexibility



Added-Value/ Enhanced Control



SAS Model Manager

SAS Intelligent Decisioning

Faster Operationalization

In-Database

REST
APIs/Apps

Containers

In-Stream

SAS Event Stream
Processing (ESP)

sas viya



ModelOps – SAS Model Management

Integrate SAS and Open-Source Models



Register



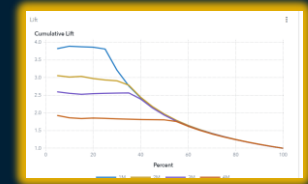
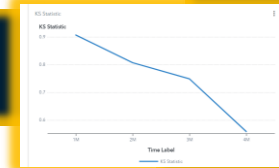
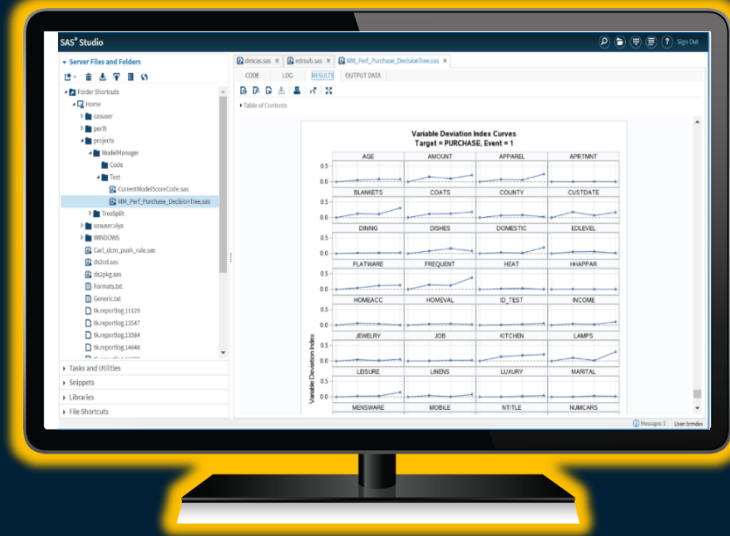
Test



Publish



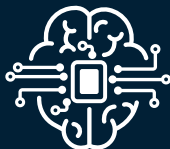
Monitor



Performance Reports for Both
Model Results and Inputs

Decision Management Goals

Combine Analytical Insights with Data and Rules



Analytical Insights



Business Rules

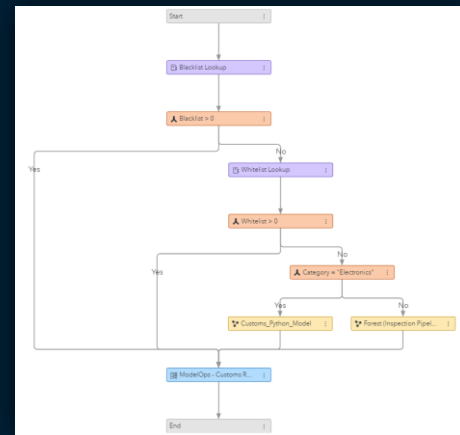


Flow Logic

| custID | prob | origin |
|--------|------|----------------|
| 1 | 0.54 | Cayman Islands |
| 2 | 0.45 | Belgium |
| 3 | 0.14 | South-Africa |
| 4 | 0.06 | Germany |
| 5 | 0.08 | Cayman Islands |

```
if prob > 0.65:  
    then 'Inspect'  
else:  
    then 'No Inspection'
```

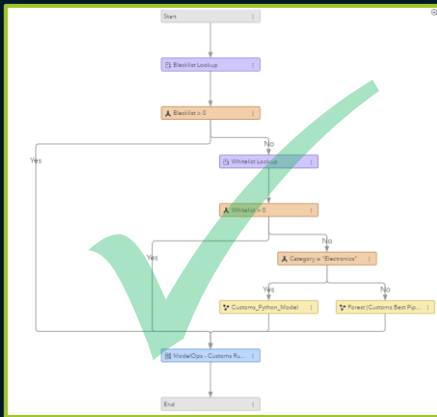
```
if Origin = 'Cayman Islands':  
    then 'No Inspection'
```



Combine Analytical Insights with Data and Rules

- Improve the Decision-Making Process:

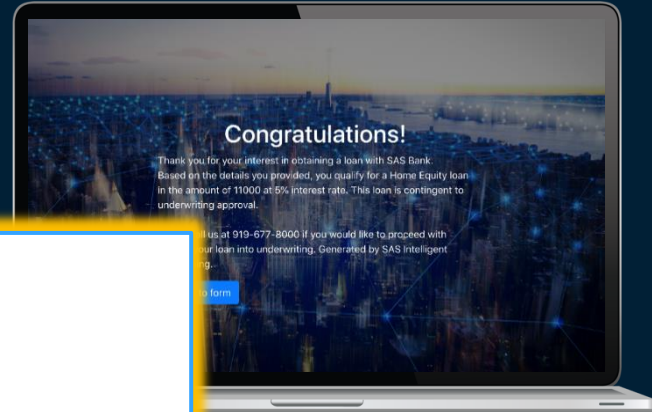
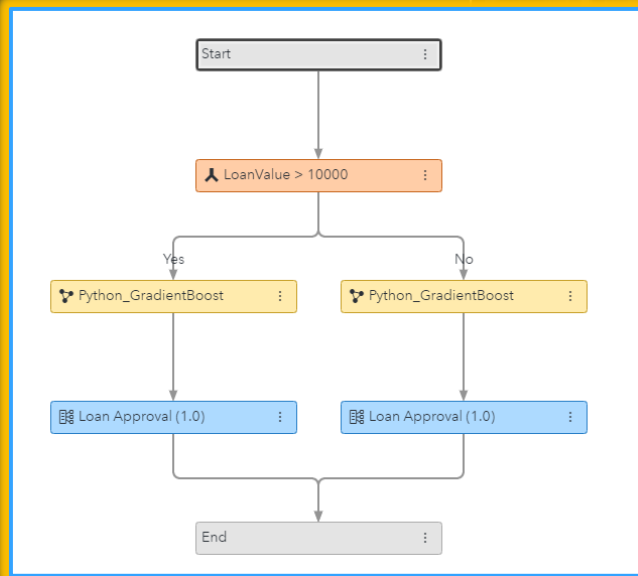
- ✓ More Adaptable
- ✓ More Automated
- ✓ More Visual
- ✓ More Consistent
- ✓ More Transparent

[illegible]

ModelOps– SAS Decision Management

Real-Time or Batch Interactions

- Customize Decision Flows for “Next Best Action”
- Leverage Business Rules
- Easily call machine learning models
- Robotic Process Automation (RPA)
- Integrate with Recommender Systems

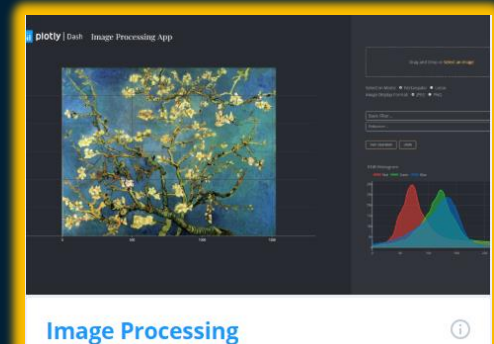
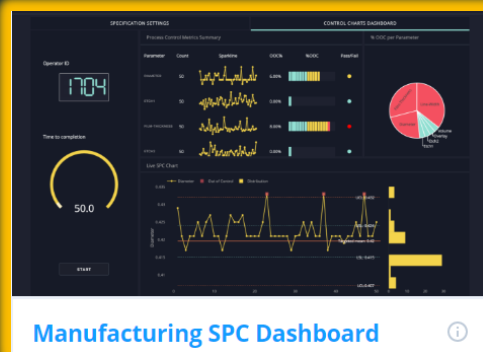
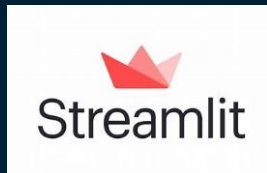
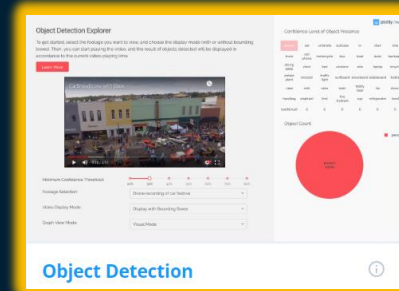
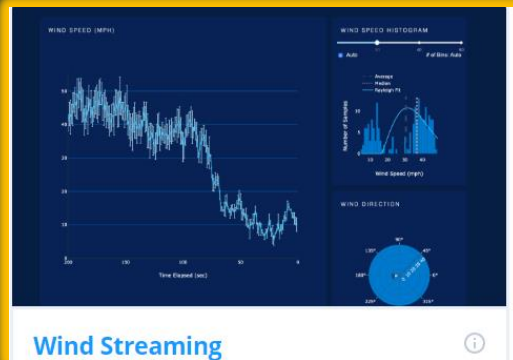
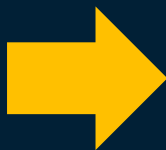


ModelOps - Operationalize

Machine Learning and Application Development

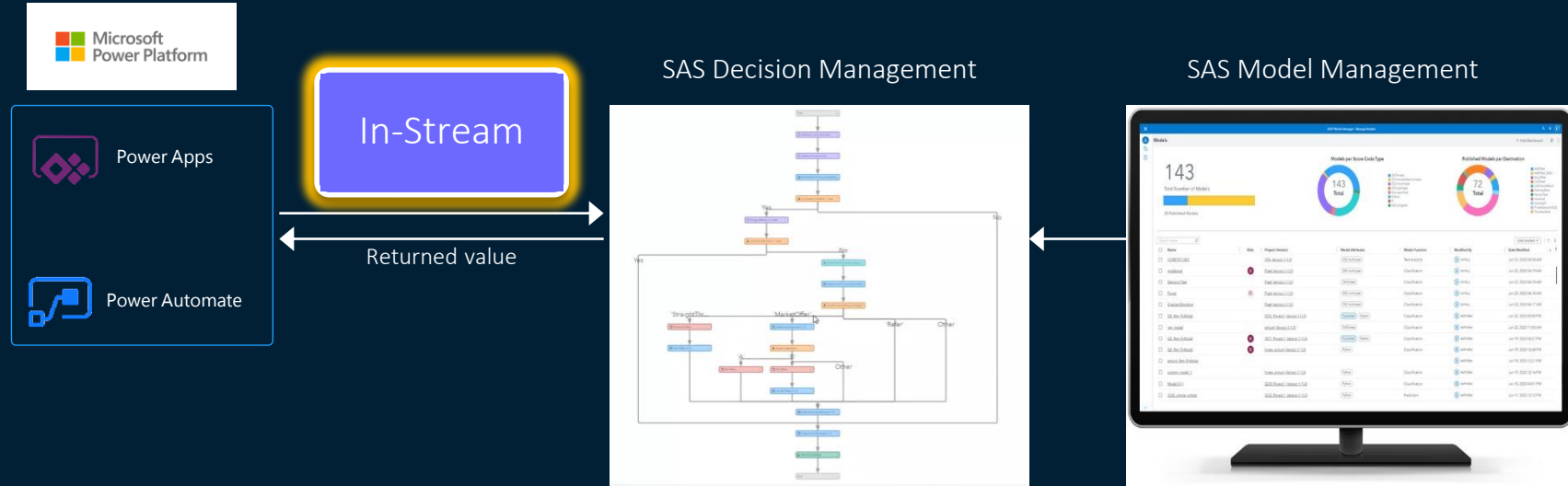


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Putting It All Together.....

Microsoft Power Platform with SAS ModelOps



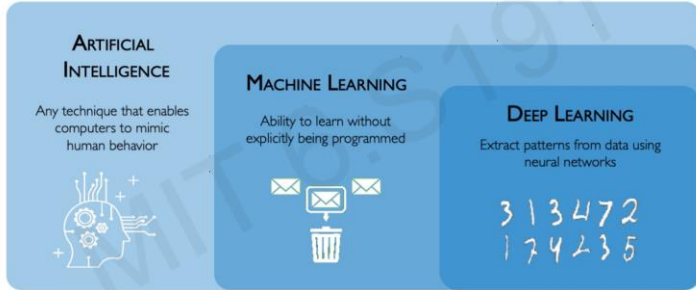
Benefits

- Easily embed models, decisions and **RECOMMENDATIONS** in web and mobile apps
- Automate business processes with intelligent decisioning
- Manage business rules centrally

“True” Artificial Intelligence

From MIT

What is Deep Learning?



MIT Massachusetts Institute of Technology 6.S191 Introduction to Deep Learning intro.todeeplearning.com @MITDeepLearning 1/18/21



AI From Microsoft Azure

Categories of Cognitive Services

The catalog of cognitive services that provide cognitive understanding are categorized into five main pillars:

- Vision
- Speech
- Language
- **Decision**
- Search



Recommender Systems

“True” Artificial Intelligence

- Typical application in retail operations:
 - Amazon, Google or Netflix
 - Analyze historical behavior and make recommendations in real time
 - Identify patterns in behavior: machines, processes, customers
 - Relevant, Novel, Diverse, Serendipitous
- Value:
 - Recommend resolutions, products, services, next steps
 - Reduce waste, costs
 - Improve quality, yields, customer satisfaction
- Cross-industry applicability
 - Retail, Manufacturing, Oil/Gas, Utilities, etc.

“Community”

“Individual”

Collaborative
Filtering

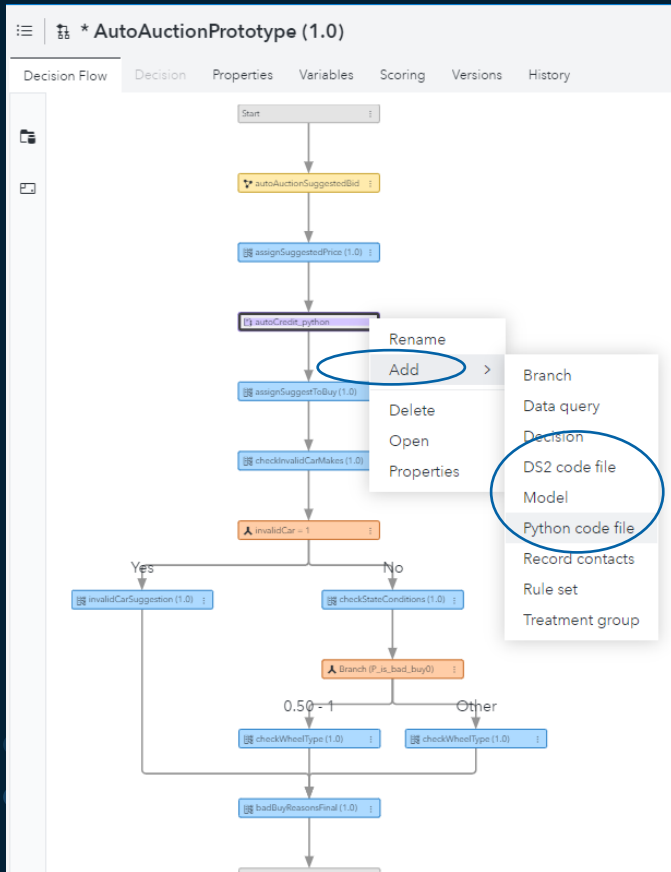
Content-Based
Filtering

Deep Learning

Transfer Learning

ModelOps – SAS Decision Management

Consume the Recommender Model



PROC RECOMMEND supports different types of methods:

- Memory-based algorithms
 - Slope one (slope1)
 - K nearest neighbors (knn)
- Model-based algorithms
 - Matrix factorization (svd)
- Market basket analysis
 - Association rule (arm)
- Mixture of different methods
 - Clustering (cluster)
 - Ensemble (ensemble)



```
proc factmac data=mycas.weighted_factmac outmodel=mycas.factors_out;  
  autotune maxtime=3600 objective=MSE  
  TUNINGPARAMETERS=(nfactors(init=20) maxiter(init=200) learnstep(init=0.001) );  
  input user_uid conversation_uid /level=nominal;  
  target rating /level=interval;  
  savestate rstore=mycas.sascomm_rstore;  
run;
```



```
import tensorflow_datasets as tfds  
import tensorflow_recommenders as tfrs  
  
# Load data on movie ratings.  
ratings = tfds.load("movielens/100k-ratings", split="train")  
movies = tfds.load("movielens/100k-movies", split="train")  
  
# Build flexible representation models.  
user_model = tf.keras.Sequential([...])  
movie_model = tf.keras.Sequential([...])  
  
# Define your objectives.  
task = tfrs.tasks.Retrieval(metrics=tfrs.metrics.FactorizedTopK(  
  movies.batch(128).map(movie_model)  
))  
  
# Create a retrieval model.  
model = MovieLensModel(user_model, movie_model, task)  
model.compile(optimizer=tf.keras.optimizers.Adagrad(0.5))  
  
# Train.  
model.fit(ratings.batch(4096), epochs=3)  
  
# Set up retrieval using trained representations.  
index = tfrs.layers.ann.BruteForce(model.user_model)  
index.index(movies.batch(100).map(model.movie_model), movies)
```



SAS ModelOps

Key Takeaways

- Leverages SAS and Open-Source Machine Learning
- Best-in-Class
 - Model Management + Decision Management + Streaming Analytics
- Allows recommendations for “Next Best Action”



SAS ModelOps Demo

- Model Management
- Decision Management
- Open-Source Integration
- Use Case:
 - Predict Likelihood to Default on Home Equity Line of Credit (HELOC)
 - Recommend Remediation to Application
 - Inputs: Debt-to-income, years employed, loan value, etc.
 - Techniques: Gradient Boosting, Neural Networks, Random Forests, etc.

| Loan ID | BAD | LOAN | MORTDUE | VALUE | REASON | JOB | YOJ | DEROG | DELINQ | CLAGE | NINQ | CLNO | DEBTINC |
|---------|-----|------|---------|--------|---------|--------|------|-------|--------|-------------|------|------|-------------|
| 772418 | 1 | 1100 | 25860 | 39025 | HomeImp | Other | 10.5 | 0 | 0 | 94.36666667 | 1 | 9 | |
| 477724 | 1 | 1300 | 70053 | 68400 | HomeImp | Other | 7 | 0 | 2 | 121.8333333 | 0 | 14 | |
| 150746 | 1 | 1500 | 13500 | 16700 | HomeImp | Other | 4 | 0 | 0 | 149.4666667 | 1 | 10 | |
| 108584 | 1 | 1500 | | | | | | | | | | | |
| 321534 | 0 | 1700 | 97800 | 112000 | HomeImp | Office | 3 | 0 | 0 | 93.33333333 | 0 | 14 | |
| 874921 | 1 | 1700 | 30548 | 40320 | HomeImp | Other | 9 | 0 | 0 | 101.4660019 | 1 | 8 | 37.11361356 |