How to move your models from SAS 9.4 to SAS Viya

Melodie Rush

Customer Success Principal Data Scientist

Connect with me:

LinkedIn: https://www.linkedin.com/in/melodierush

Twitter: @Melodie_Rush

AGENDA

What is and Why

SAS 9.4 Enterprise Miner (EM) and
SAS Viya Visual Data Mining and Machine Learning (VDMML)

Comparing

EM versus VDMML

Transitioning

How do they work together?

What is and Why?

SAS 9.4 Enterprise Miner and

SAS Viya Visual Data Mining and Machine Learning

A Very, Very Brief History of SAS Data Mining/Machine Learning Products

SAS Institute began in 1976. It's been a leader in the analytics market ever since and its software is used to solve all kinds of analytical problems.

SAS 9 was the 9th major update of SAS and is a suite of software for a wide variety of tasks including data management, statistics, and operations research.

SAS Viya is the latest update of SAS software. It leverages the latest technologies to enable the powerful analytical techniques SAS is known for.

1976
SAS Institute founded

1998
SAS Enterprise Miner released

2002
SAS 9 released

2016
SAS Viya released

2017
SAS Visual Data Mining & Machine Learning released

SAS 9.4

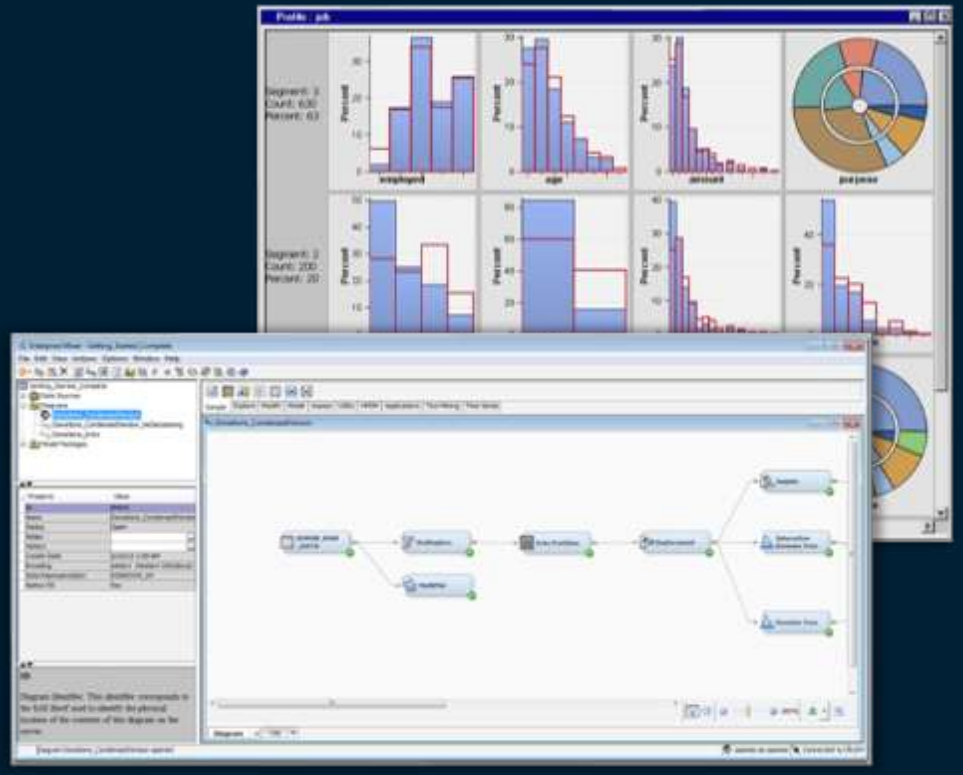
SAS Enterprise Miner

What is SAS® Enterprise Miner™?

- SAS Enterprise Miner is a graphical user interface, designed with the specific needs of data miners.

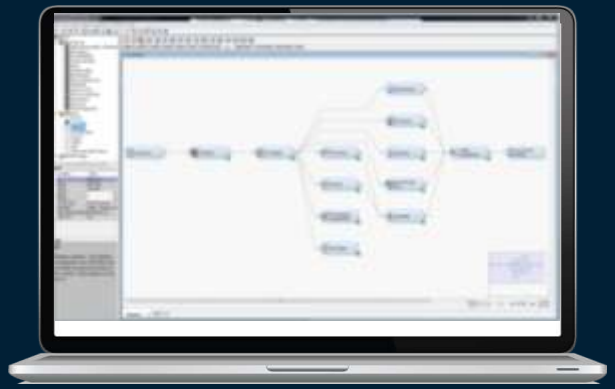
- SAS Enterprise Miner is a data miner's workbench that manages the process and provides a comprehensive set of tools to aid the data miner throughout the essential steps, known by the acronym, SEMMA: Sample, Explore, Modify, Model, Assess.

- SAS Enterprise Miner streamlines the data mining process to create highly accurate predictive and descriptive models based on analysis of vast amounts of data from across an enterprise.

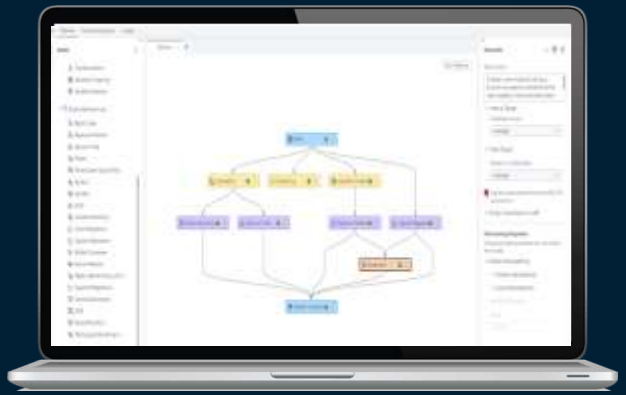


SAS Enterprise Miner

Moving from SAS 9 to SAS Viya



SAS Enterprise Miner on SAS 9



SAS VDMML 8.x on SAS Viya

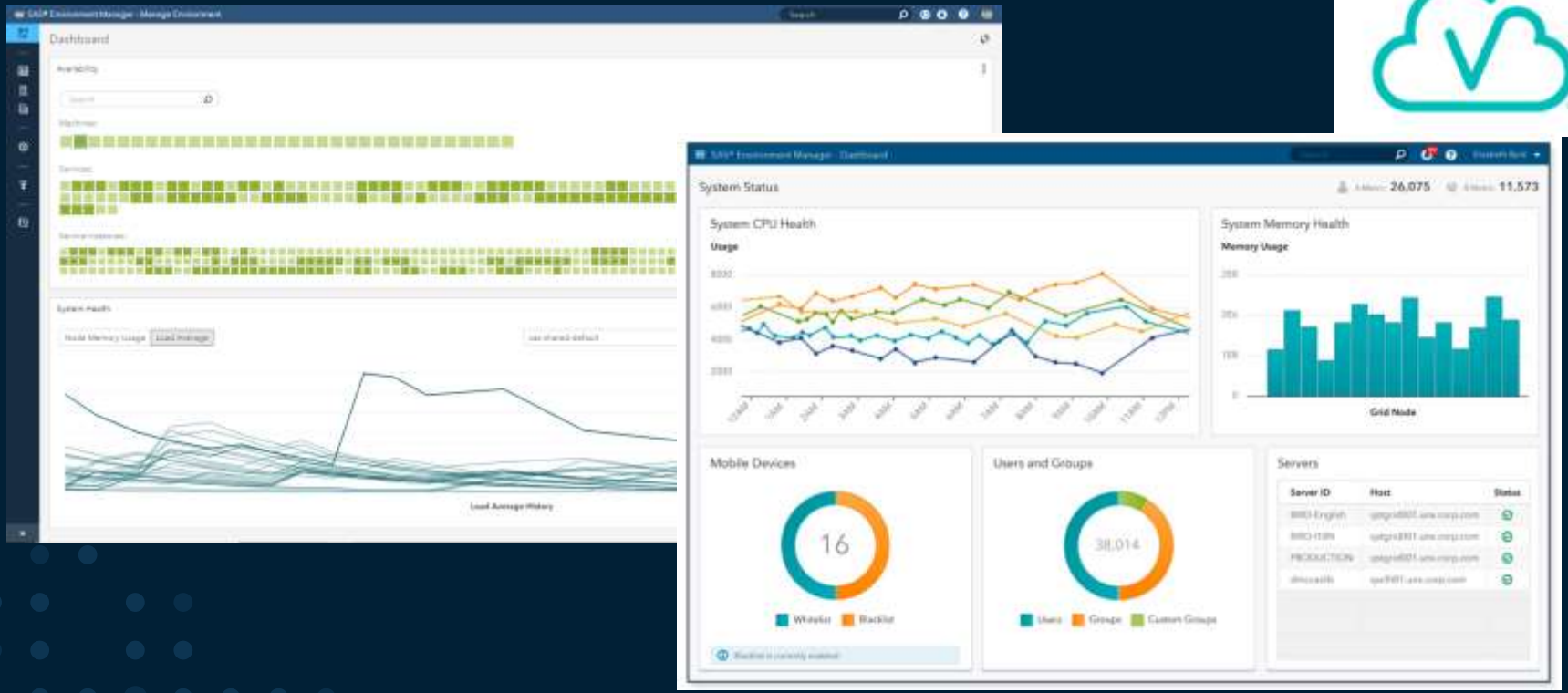
SAS Visual Data Mining and Machine Learning (SAS VDMML) is the equivalent of SAS Enterprise Miner in SAS Viya. VDMML builds models in the same manner following the same pipeline format of SAS Enterprise Miner.

SAS Viya

Visual Statistics and Visual Data Mining and Machine Learning

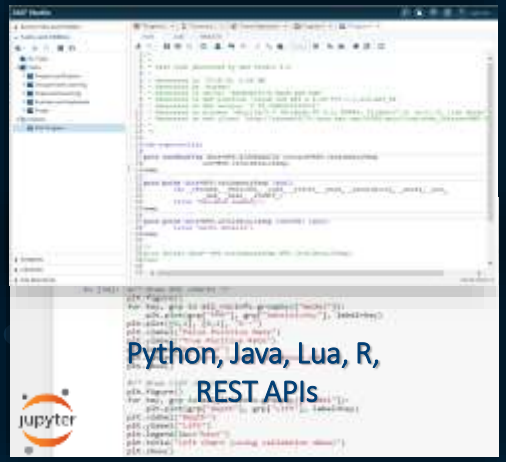
What is SAS Viya?

Viya is a cloud-enabled, in-memory analytics engine that provides quick, accurate and reliable analytical insights.



SAS Viya Analytics

What does it include?

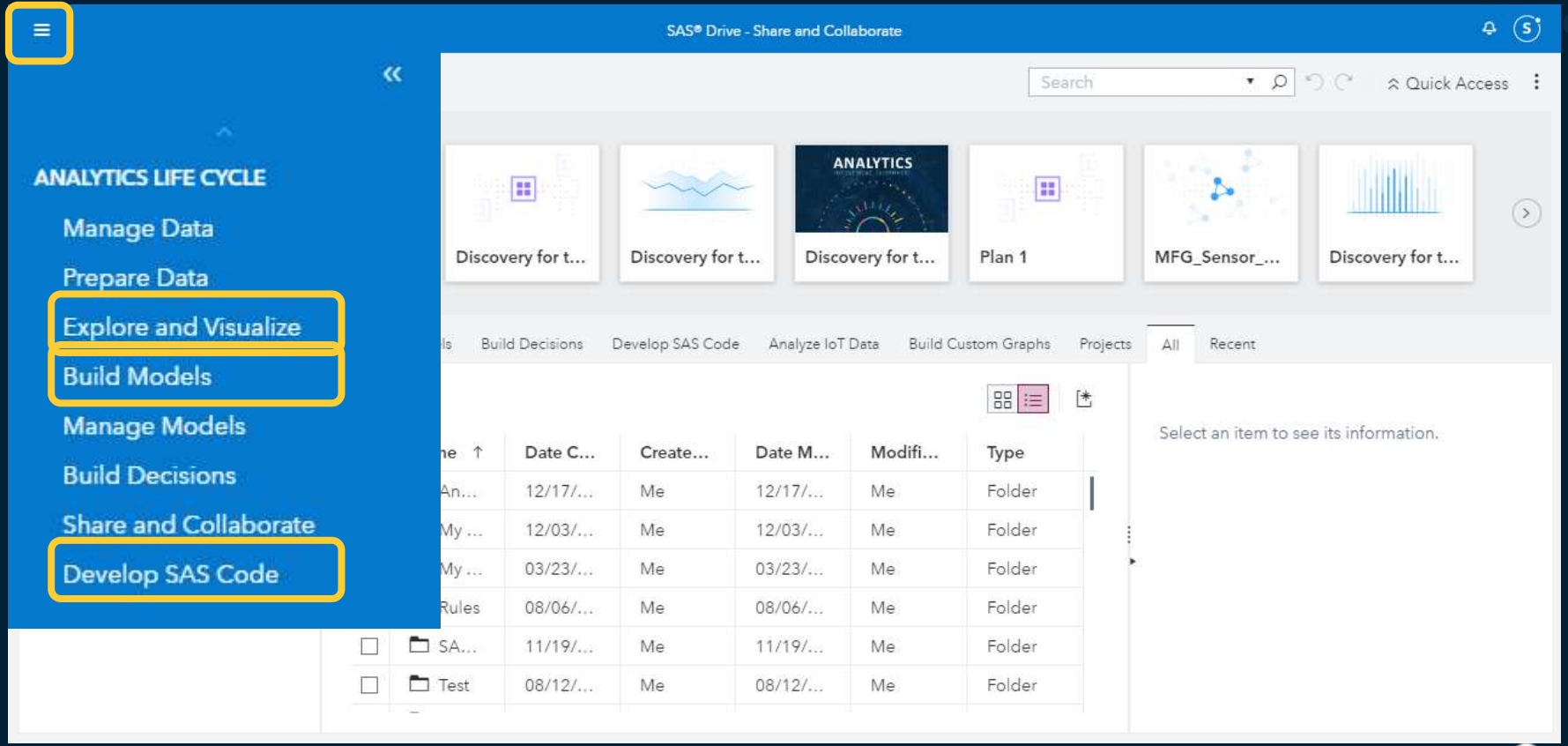


Requires Visual Analytics

Requires Visual Statistics

Visual Analytics	Visual Statistics	Visual Data Mining and Machine Learning
Baseline Procedures	VS Procedures	VDMML Procedures
Baseline Action sets	VS Action sets	VDMML Action sets

SAS Viya Analytics



Build Models

SAS Model Studio allows you to build forecasting, text analytics, and machine learning (ML) model pipelines. You can do everything from data preprocessing to building multiple models to finding your best model all within one pipeline.

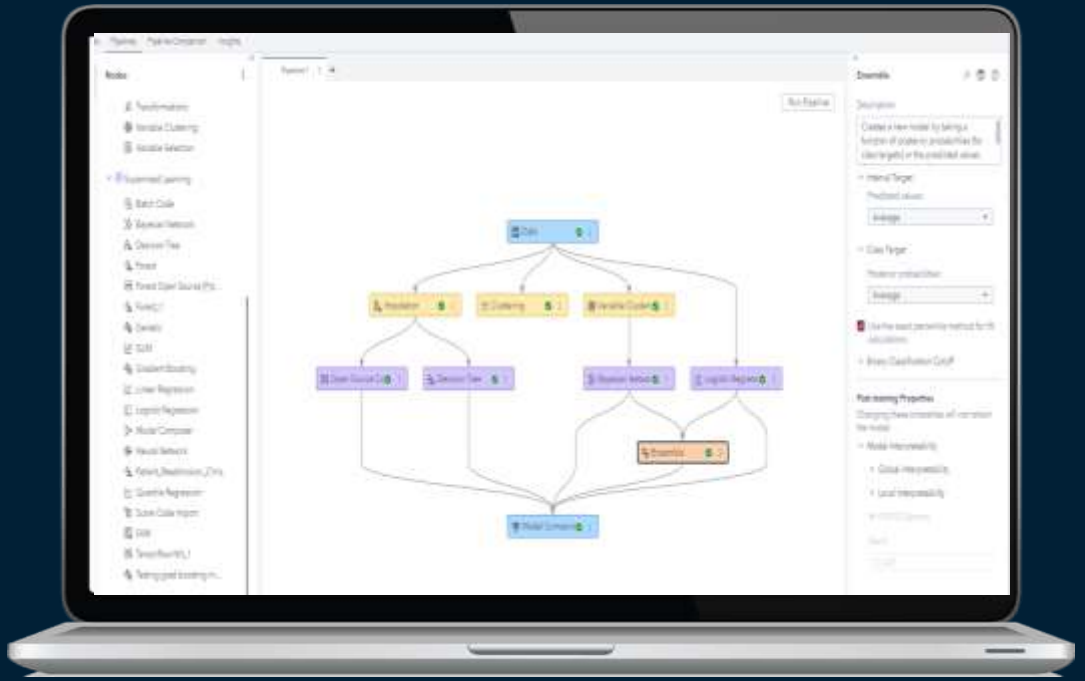
Main Features

Allows for building as many models as you want

Embed open source code within an analysis and call open source as well

Collaborate with others by saving multiple templates and leveraging the same environment

Utilize autotuning and AutoML capabilities to make the ML model building process faster



Explore and Visualize Data

SAS Visual Analytics is the point-and-click visualization tool within SAS Viya and acts as the base visual layer of SAS Viya. Here, you can build interactive dashboards for reporting with added analytical elements.

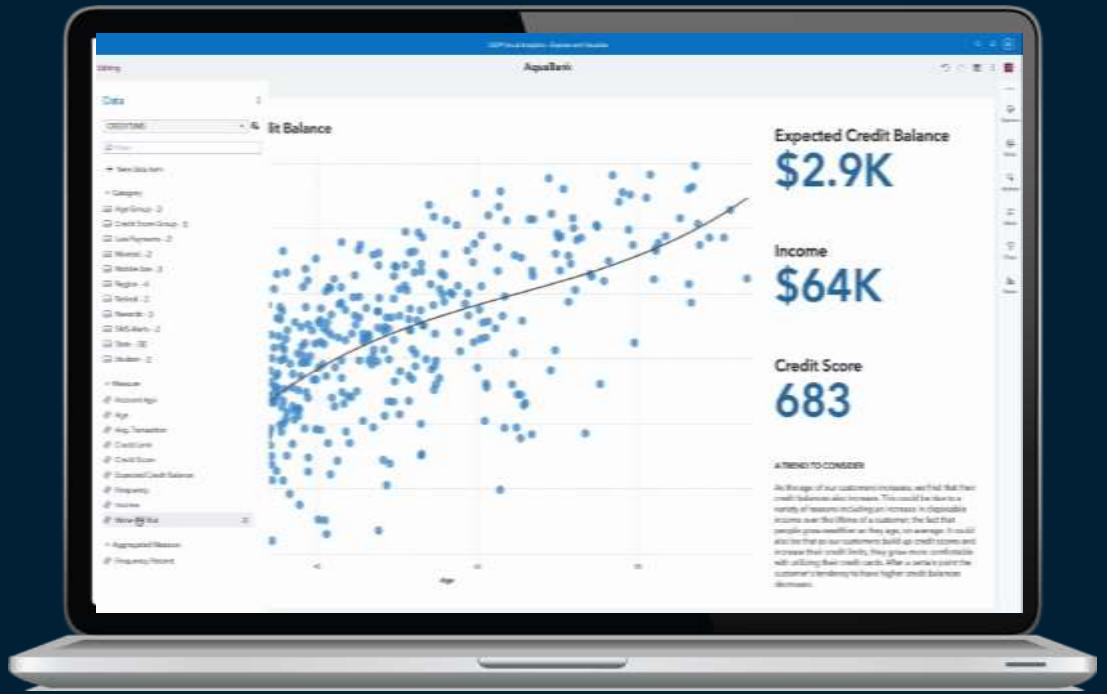
Main Features

Perform ad-hoc exploration of data

Discover relationships, trends and outliers

Leverage smart auto-charting and smart auto- analytics

Analyze a report and identify issues with performance and accessibility



Develop SAS Code

SAS Studio is the programming interface within SAS Viya. You can program in SAS or CASL (CASL is SAS Viya's programming language) to access capabilities including data quality, machine learning, optimization, text analytics, forecasting etc.

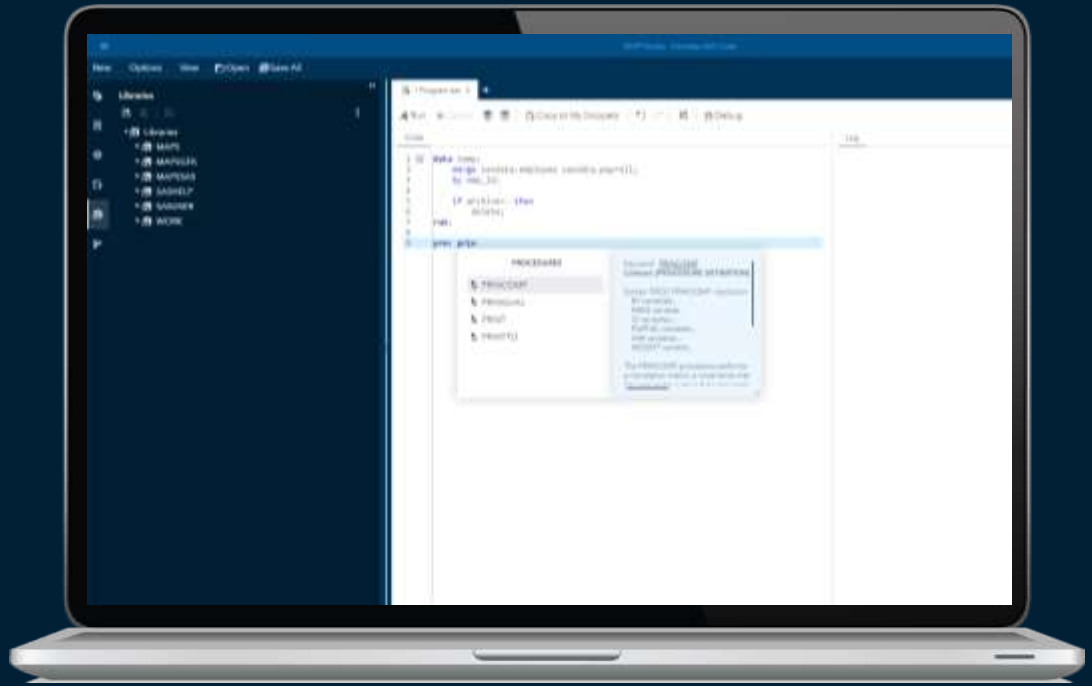
Main Features

Includes autocomplete, syntax help, keyword shortcuts and more for efficient programming

Quickly add prewritten, commonly used SAS code into your program

Create process flow diagrams

Access basic Git features like cloning repositories



SAS 9 and SAS Viya: Main Similarities and Differences

Though there are many similarities and differences between the two solutions, here are the main ones to consider:

What's the Same?

- The ability to write code or do work in a drag-and-drop interface
- The ability to leverage SAS' intellectual property (IP) to accelerate your analytical processes

What's Different?

- The underlying architecture
- SAS Viya products are located centrally and accessed in one central URL whereas SAS 9 has multiple user interfaces to access different products
- Products in SAS Viya have substantial feature improvements. As well, SAS Viya has a modern UI for better end-user experience

Compare

SAS Enterprise Miner and SAS Visual Data Mining and Machine Learning

EM and VDMML

The difficulty in comparing

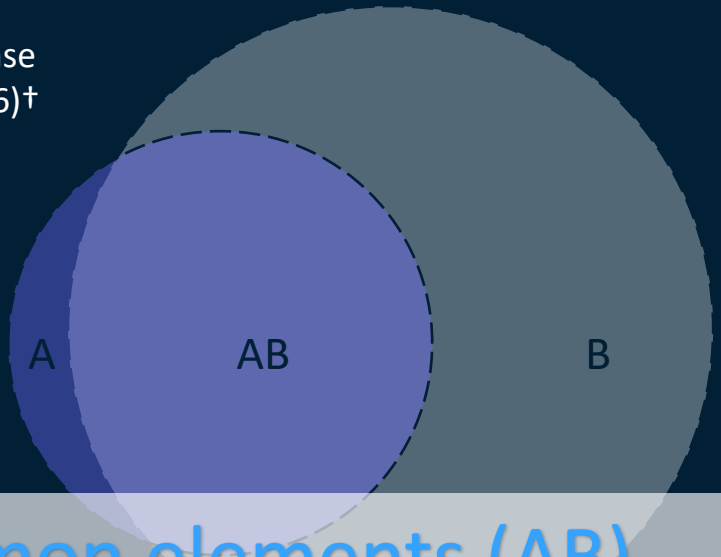
1. EM only has one interface, VDMML has three ways to interact.
2. Some functionality has moved to other packages.
3. VDMML is still growing.
4. Model Studio isn't a product.

EM and VDMML

Analytical Algorithm Differences

A =(EM)

Incremental Response
Time Series Nodes(6)†
Dmine Regression
Rule Induction
Rules Builder
Two Stage
MBR
SOM



Common elements (AB) listed in Appendix

B = (VDMML)

Anomaly Detection
SVDD
RPCA*
MWPCA

Recommendation
FACTMAC*
RECOMMEND

Dimension Reduction*
ICA
Autoencoder
t-SNE
SVD

Network Analysis
Sentiment Analysis

Deep Learning
DNN
RNN
CNN

Modeling
SVM
GLM
Mixed Models
Random Forest
Gaussian Mixed
Multi-task Learning
Quantile Regression
Model-based Clustering
Semi-supervised Learning

† All ETS-like functionality for Viya was moved to VF

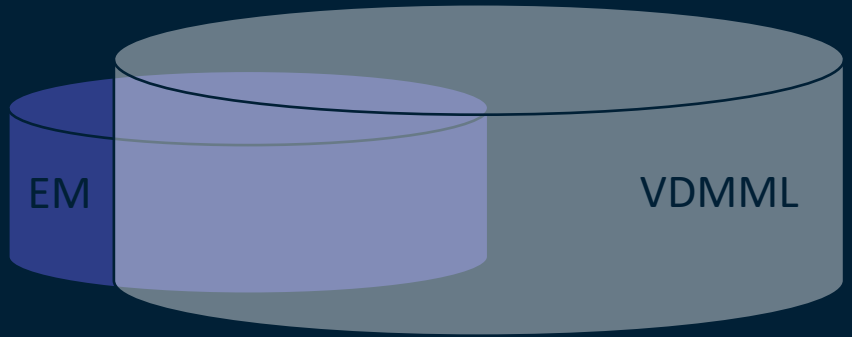
* Also used for Dimension Reduction

EM and VDMML

Feature Differences

EM

- Target profiler
- Decisions node
- Reporter node
- Control point node
- Group-by processing*
- Custom Extension Nodes
- Rapid Predictive Modeler



VDMML

- REST API calls
- Auto-tuning
- The Exchange
- Pipeline templates
- Automatic pipeline generation
- Model interpretability
- Automatically generated natural language to explain results (NLG)
- Deep Learning (DLPy)

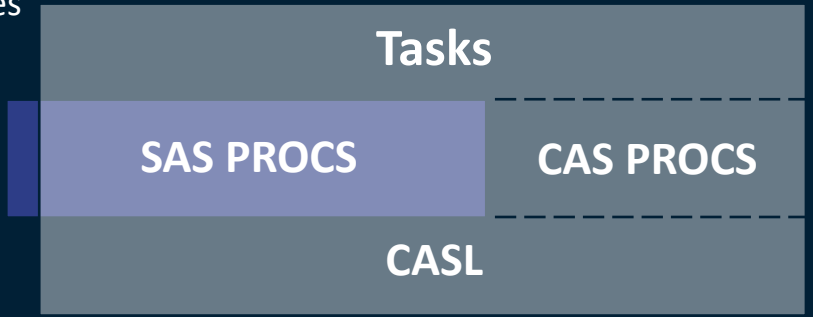
Common elements are listed in Appendix

EM and VDMML

Execution Differences*

Enterprise Miner

Only 1 GUI (Java based)
Only 1 level of execution (PROC)
Supports multiple data sources
Runs SAS Macros



VDMML

3 GUIs (HTML5 based)
- Visual ("VA")
- Model Studio
- SAS Studio

API Interfaces
- Python
- R
- Java

3 levels of execution
- Task level
- PROC level
- Action level

Supports only single data source

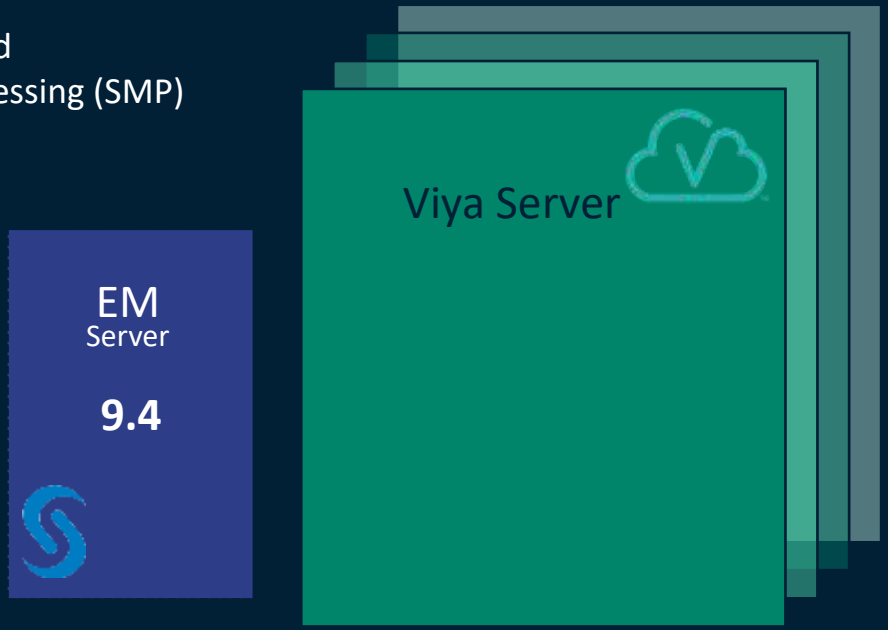
* Most of these are differences between 9.4 and Viya not necessarily EM and VDMML.

EM and VDMML

Architectural Differences*

Enterprise Miner

- Mostly single-threaded
- Symmetric Multi-Processing (SMP)
- Supports MVA
- Desktop client option



VDMML

- Mostly multi-threaded
- Massively Parallel Processing
- Distributed Computing
- Supports concurrency
- Supports multi-tenancy
- Easily deployed in the cloud
- LINUX only

*These are differences between 9.4 and Viya (not including HPA)

SAS® 9.4 and SAS® Viya® Functional Comparison Technical Paper

General Features	EM	VDMML
Audio file analysis		✔
Autotuning		✔
Custom extension nodes	✔	
EM batch code execution (migration)	n/a	✔
Included text mining (lightweight)		✔
Incremental response models	✔	
Integrated coding (code node)	✔	✔
Interactive binning	✔	Incl. w/ Risk
Interactive modeling	minimal	✔
K Fold cross validation	✔	✔
Model lineage view		✔
Multiple-pipeline comparison		✔
Pipeline annotations		✔
REST API Scoring		✔
REST API Retraining		✔
REST API Automated Modeling		✔
Reusable model templates (central storage)		✔
Segment profile		✔
Som/Kohennen	✔	
Start/End Groups (group processing)	✔	
Survival data mining	✔	
Time series data mining	✔	
Two stage models	✔	
Integrated data prep		✔
Interactive model editing (VA models in Model Studio)		✔
Multiple data sources (after data prep)	✔	
Integrated reporting (interactive dashboards)		✔
Model assessment NLG		✔
Model insight reporting		✔

Machine Learning Methods	EM	VDMML
Automated feature engineering package		Node
Automated interpretability action package		✔
Automated model composer (automated modeling)		Node
Bayesian networks	✔	✔
Boolean rules		✔
Convolutional neural networks		✔
Dirichlet Gaussian Mixture Models (GMM)		✔
Ensemble		✔
Factorization machines		✔
Frequent item set mining	✔	✔
Gaussian regression		✔
Gradient boosting	✔	✔
Isolation forest		✔
K nearest neighbor		✔
Kernel PCA		✔
Image (incl. biomedical) processing		✔
Image Object Detection		✔
Image keypoints detection		✔
Image segmentation		✔
Market basket analysis	✔	✔
Model interpretability (LIME, PDP, ICE)		Kernel Shap
Moving windows PCA		✔
Multi-task learning		✔
Network analytics/community detection	✔	✔
Neural networks	✔	✔
Random forest	✔	✔
Recurrent neural network		✔
Reinforcement Learning (Batch)		✔
Robust PCA		✔
Semi-Supervised learning		✔
Sparse Data Machine Learning		✔
Support vector data description		✔
Support vector machines	✔	✔
Support vector regression		✔
Text mining	✔	✔
T-SNE		✔
Variable clustering	✔	✔

Transitioning

Moving from SAS 9 to Viya

Process

Organization of the tools

Models

Including EM models in Pipelines

Including Viya Models in EM Flows

Scoring

Using EM score code in Viya

Using Viya score code in SAS 9.4

Process

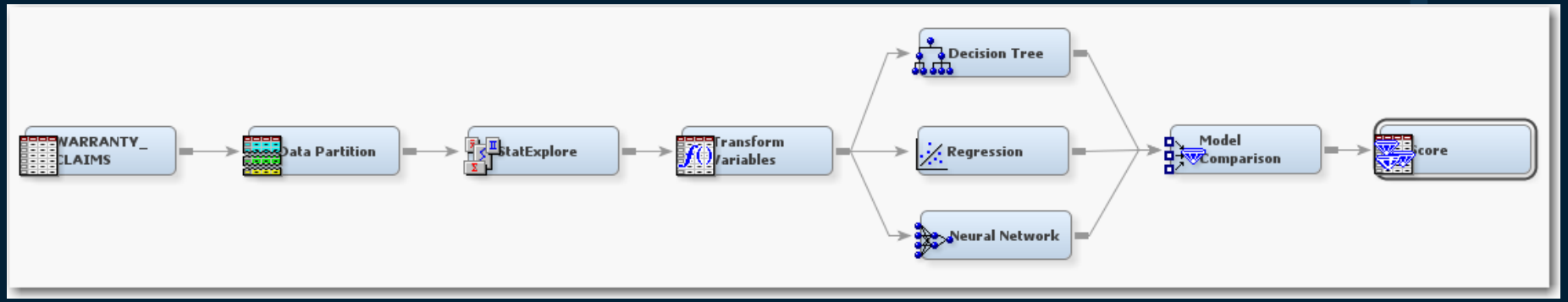
What happened to SEMMA?

List of SAS Enterprise Miner Nodes

SAMPLE	Append	Data Partition	File Import	Filter	Merge	Sample	Input Data				
EXPLORE	Association	Cluster	Graph Explore	Variable Clustering	DMDB	MultiPlot	Market Basket	StatExplore	Link Analysis	Path Analysis	Variable Selection	SOM/Kohonen
MODIFY	Drop	Impute	Interactive Binning	Principal Components	Replacement	Rules Builder	Transform Variables					
MODEL	Decision Tree	AutoNeural	Regression	Neural Network	Partial Least Squares	Dmine Regression	DM Neural	Ensemble	Rule Induction	Gradient Boosting	LARS	MBR	Two Stage	Model Import
	Incremental Response	Survival Analysis	Credit Scoring*	TS Correlation	TS Data Prep	TS Dimension Reduction	TS Decomp.	TS Similarity	TS Exponential Smoothing					
	HP Explore	HP Bayesian Network	HP Regression	HP Transform	HP Impute	HP Variable Selection	HP Neural	HP Forest	HP Decision Tree	HP Data Partition	HP GLM	HP SVM	HP Cluster	HP Principal Components
ASSESS	Cutoff	Decisions	Model Comparison	Score	Segment Profile									
UTILITY	Control Point	End Groups	Start Groups	Open Source Integration	Reporter	Score Code Export	Metadata	SAS Code	Ext Demo	Save Data	Register Metadata	SAS Viya Code		

SAS® Enterprise Miner™

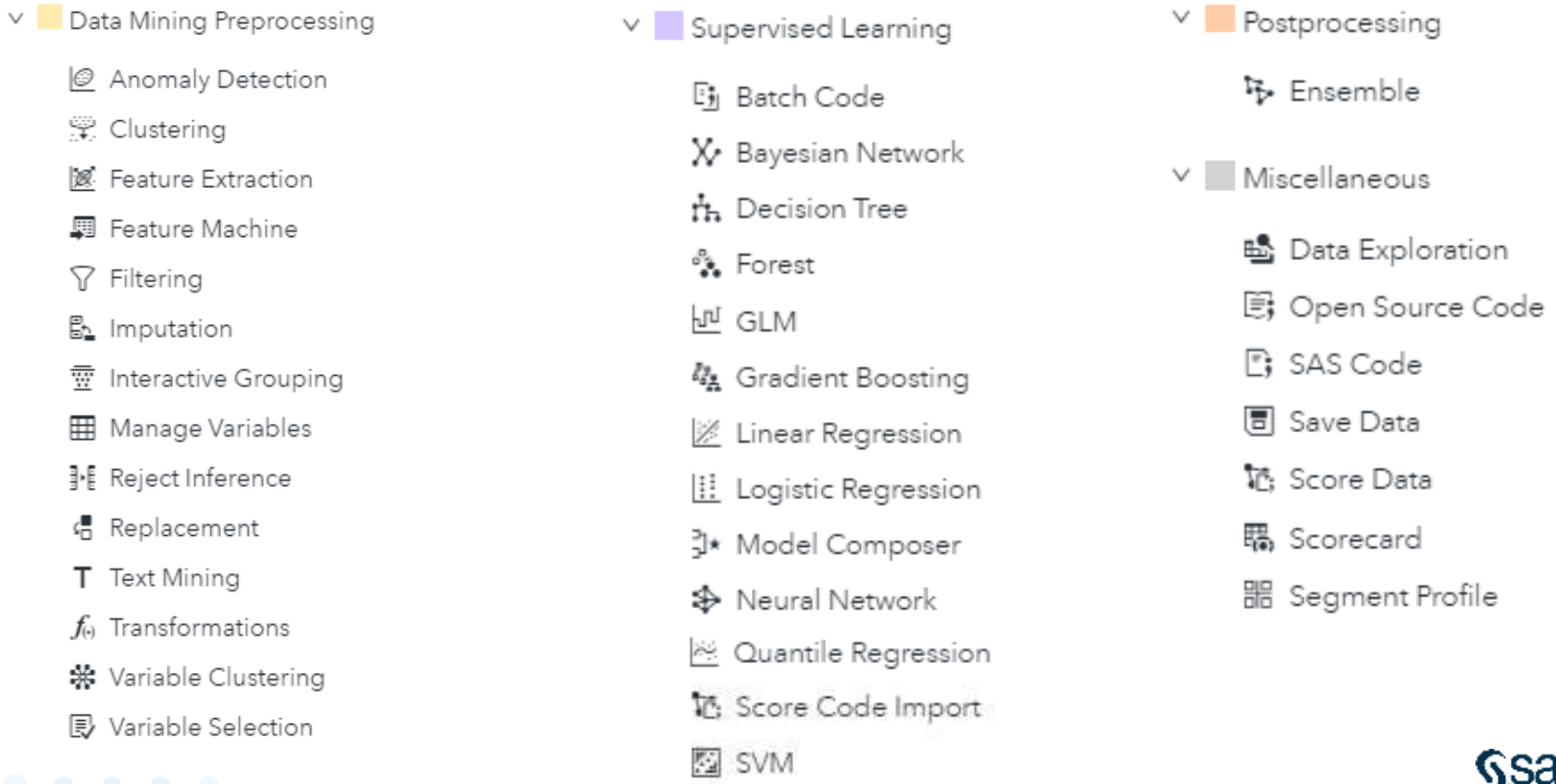
SEMMA Process



SAMPLE EXPLORE MODIFY MODEL ASSESS

SAS® Visual Data Mining and Machine Learning

Pipelines



SAS® Visual Data Mining and Machine Learning

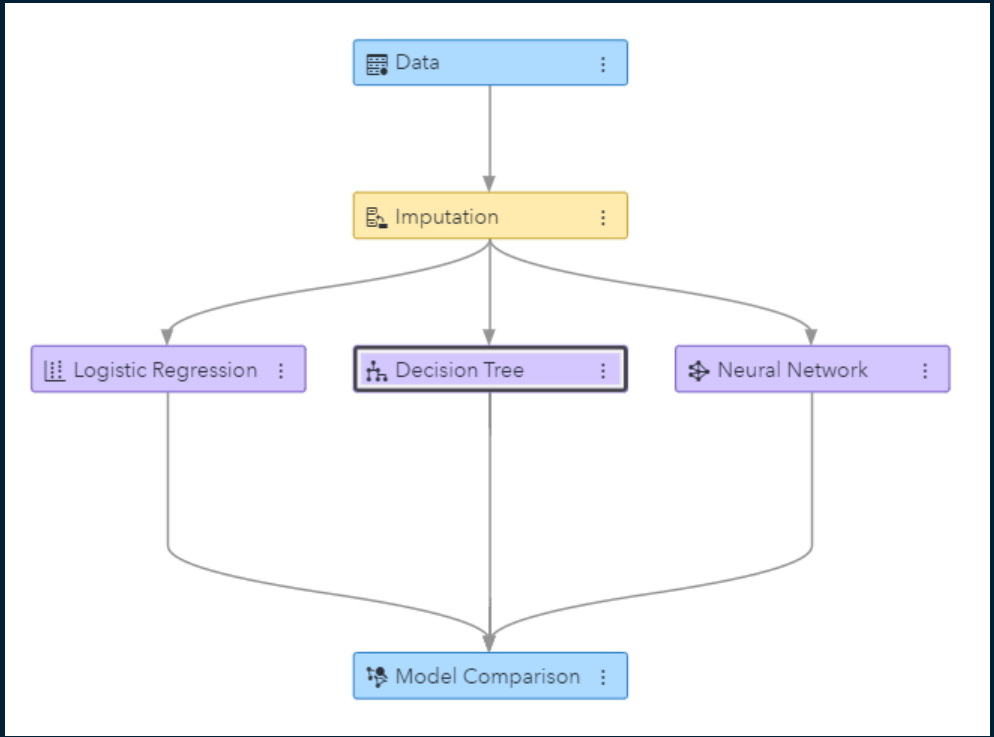
Pipelines

Data

Preprocessing

Supervised Learning

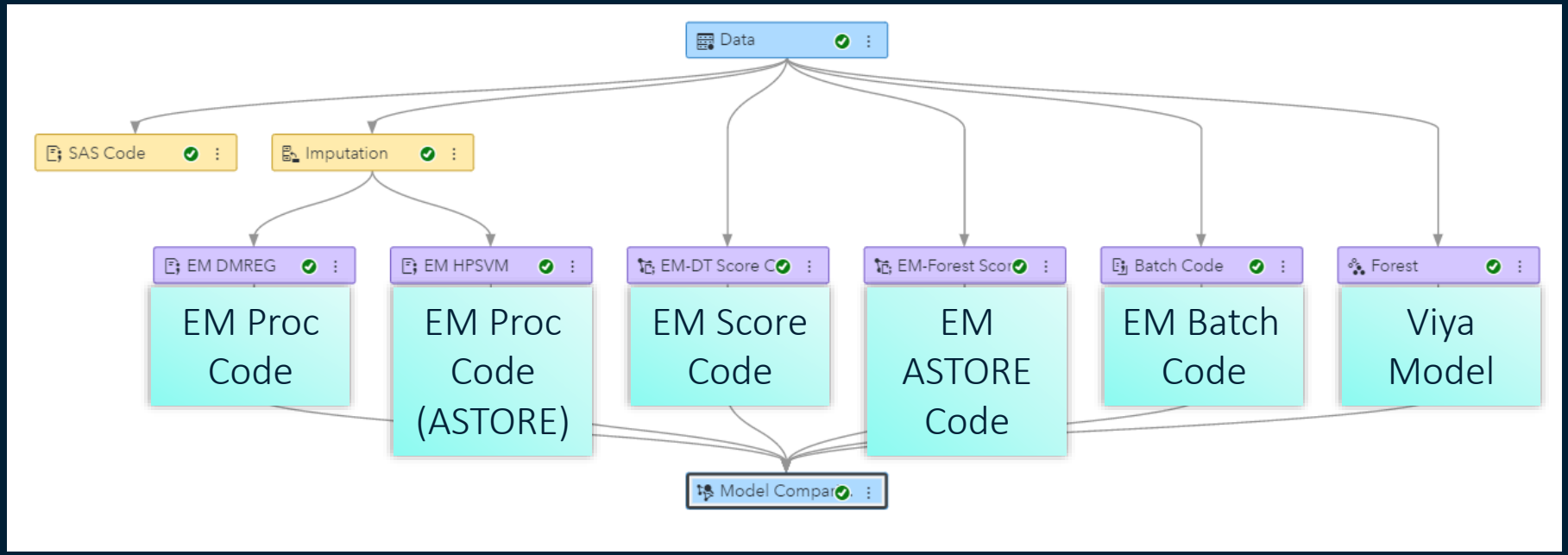
Model Comparison



Models

Including EM Models into Pipelines

Including Existing EM models into Pipelines

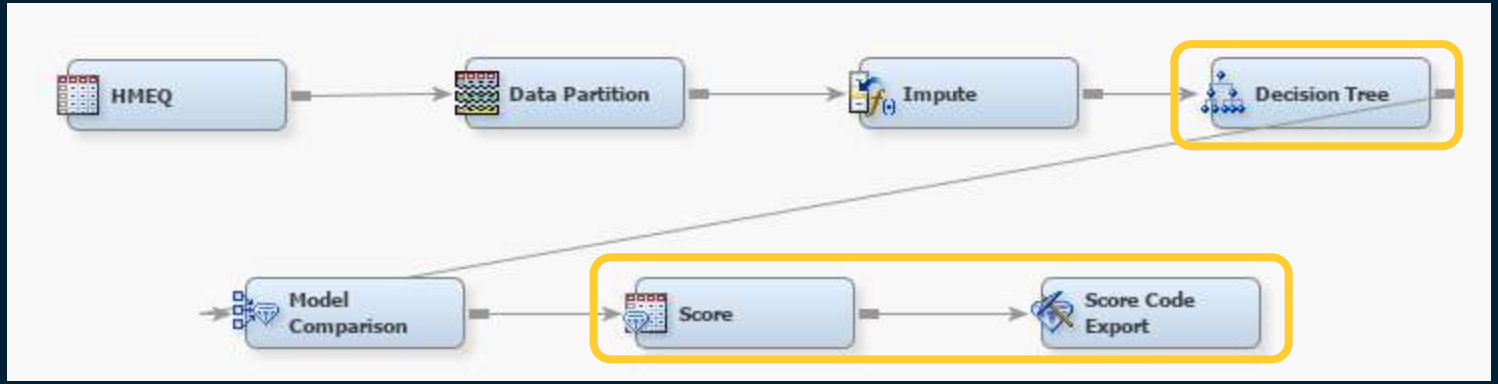


Data Step

Adding Enterprise Miner Score Code to Viya Pipelines

SAS Code Score Code

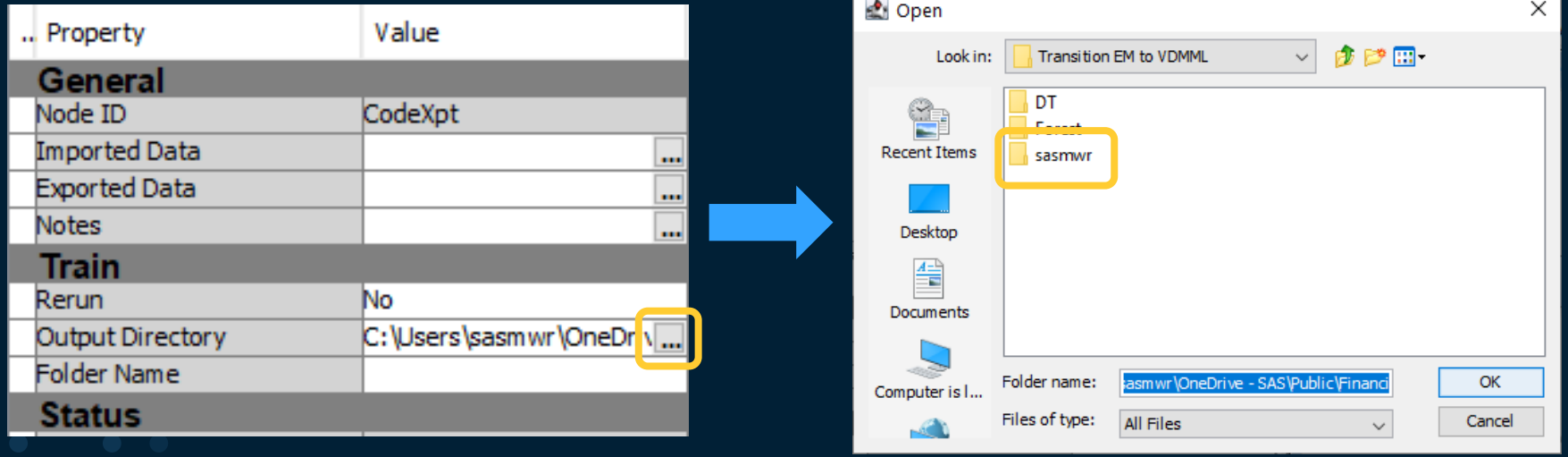
- Create Enterprise Miner Diagram
- Include Score Node and Score Code Export Node



Adding Enterprise Miner Score Code to Viya Pipelines

SAS Code Score Code

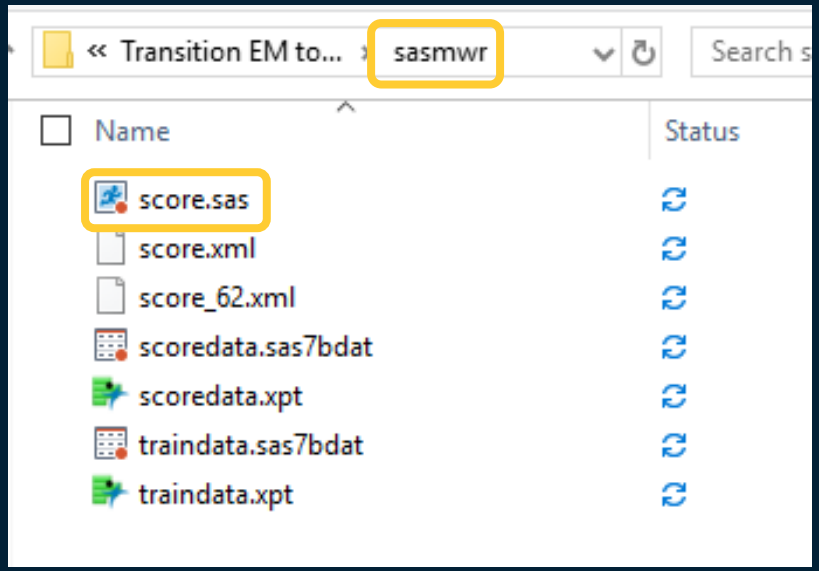
- Select Output Directory for the Score Code Export



Adding Enterprise Miner Score Code to Viya Pipelines

SAS Code Score Code

- Select Output Directory for the Score Code Export



Adding Enterprise Miner Score Code to Viya Pipelines

SAS Code Score Code

```
*-------------------------------------------------------------*
* EM SCORE CODE;
*-------------------------------------------------------------*
*-------------------------------------------------------------*
* TOOL: Input Data Source;
* TYPE: SAMPLE;
* NODE: Ids;
*-------------------------------------------------------------*
*-------------------------------------------------------------*
* TOOL: Partition Class;
* TYPE: SAMPLE;
* NODE: Part;
*-------------------------------------------------------------*
*-------------------------------------------------------------*
* TOOL: Imputation;
* TYPE: MODIFY;
* NODE: Impt;
*-------------------------------------------------------------*
label IMP_CLAGE = 'Imputed CLAGE';
length IMP_CLAGE 8;
IMP_CLAGE = CLAGE;
if missing(CLAGE) then IMP_CLAGE = 180.38465575;
label IMP_CLNO = 'Imputed CLNO';
length IMP_CLNO 8;
```

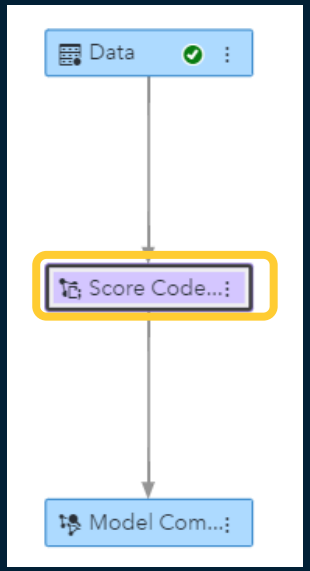
```
*******************************************************************;
******              DECISION TREE SCORING CODE                   ******;
*******************************************************************;

******          LENGTHS OF NEW CHARACTER VARIABLES               ******;
LENGTH I_BAD  $   12;
LENGTH _WARN_  $    4;

******                LABELS FOR NEW VARIABLES                   ******;
label _NODE_ = 'Node' ;
label _LEAF_ = 'Leaf' ;
label P_BAD1 = 'Predicted: BAD=1' ;
label P_BAD0 = 'Predicted: BAD=0' ;
label Q_BAD1 = 'Unadjusted P: BAD=1' ;
label Q_BAD0 = 'Unadjusted P: BAD=0' ;
label V_BAD1 = 'Validated: BAD=1' ;
label V_BAD0 = 'Validated: BAD=0' ;
label I_BAD = 'Into: BAD' ;
label U_BAD = 'Unnormalized Into: BAD' ;
label _WARN_ = 'Warnings' ;


******       TEMPORARY VARIABLES FOR FORMATTED VALUES        ******;
```

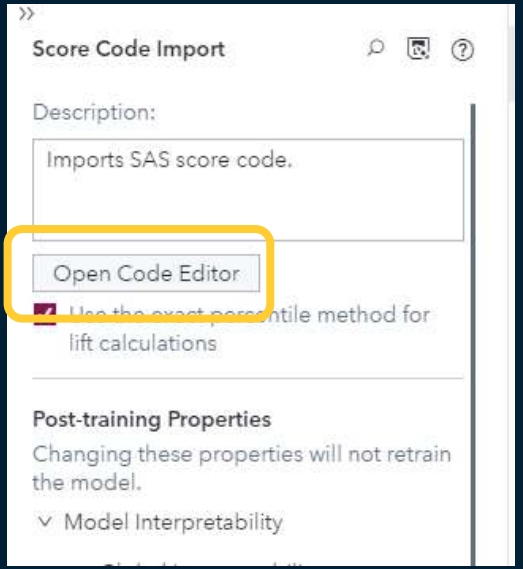
score.sas

Adding Enterprise Miner Score Code to Viya Pipelines

SAS Code Score Code

- In Pipelines add a score code import node (under Supervised Learning)
- Open Code Editor

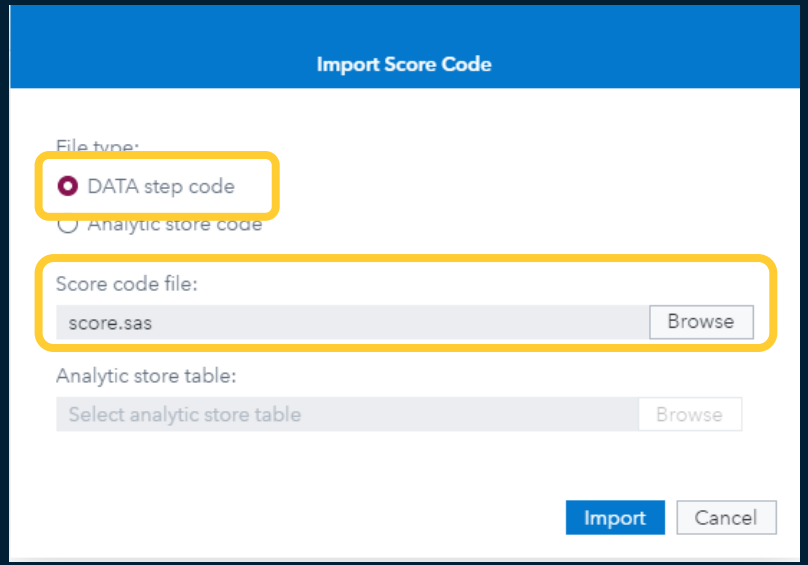




Adding Enterprise Miner Score Code to Viya Pipelines

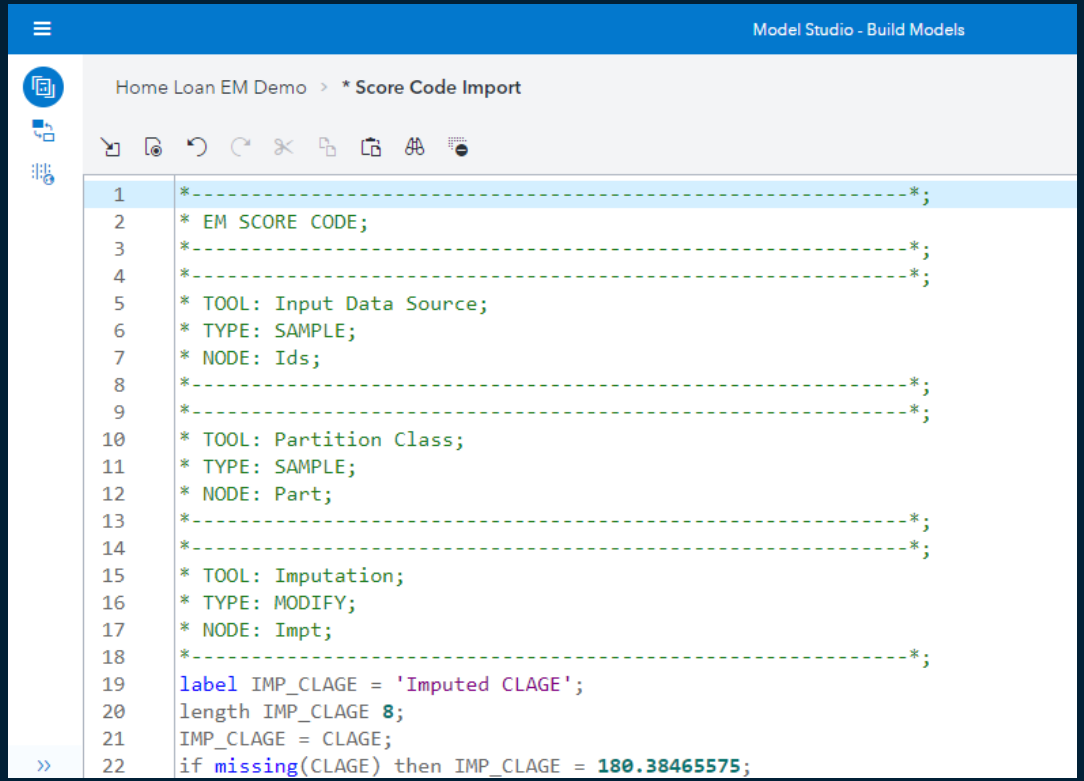
SAS Code Score Code

- Select DATA step code
- Browse and select local code



Adding Enterprise Miner Score Code to Viya Pipelines

SAS Code Score Code



ASTORE

Adding Enterprise Miner Score Code to Viya Pipelines

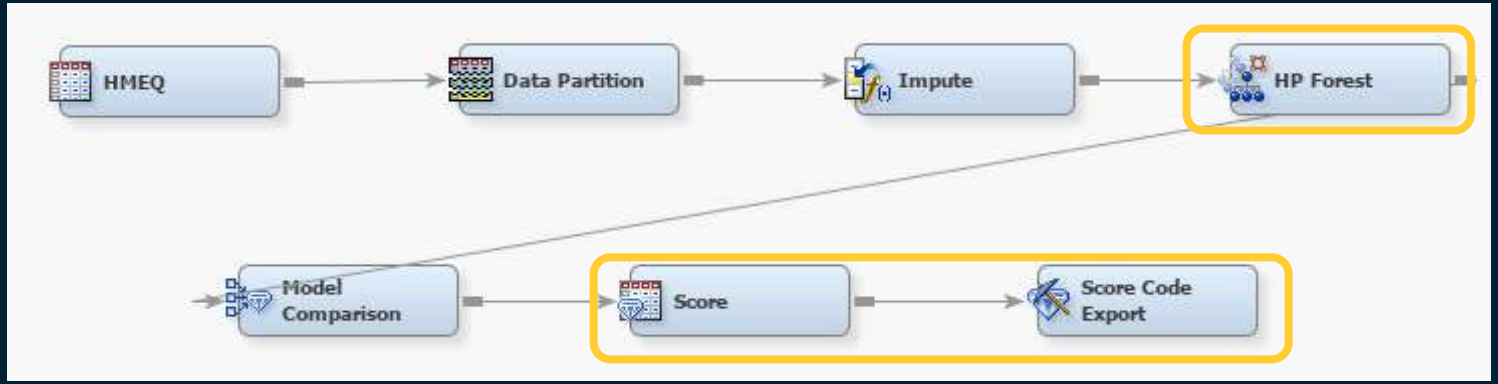
Analytic Store Code (ASTORE)

- What is an ASTORE file?
  - An Analytic Store, or ASTORE, is a system that allows the state of a trained predictive model to be saved in a transportable form.
  - This enables it to subsequently be used to score new data in a variety of environments.
  - A key feature of an ASTORE is that it can be easily transported from one platform to another.
- What models support ASTORE?
  - Many SAS analytical procedures save the results from the training phase of model development as ASTORE models. Nodes in EM that create ASTORE files HP SVM and HP Forest.

Adding Enterprise Miner Score Code to Viya Pipelines

Analytic Store Code (ASTORE)

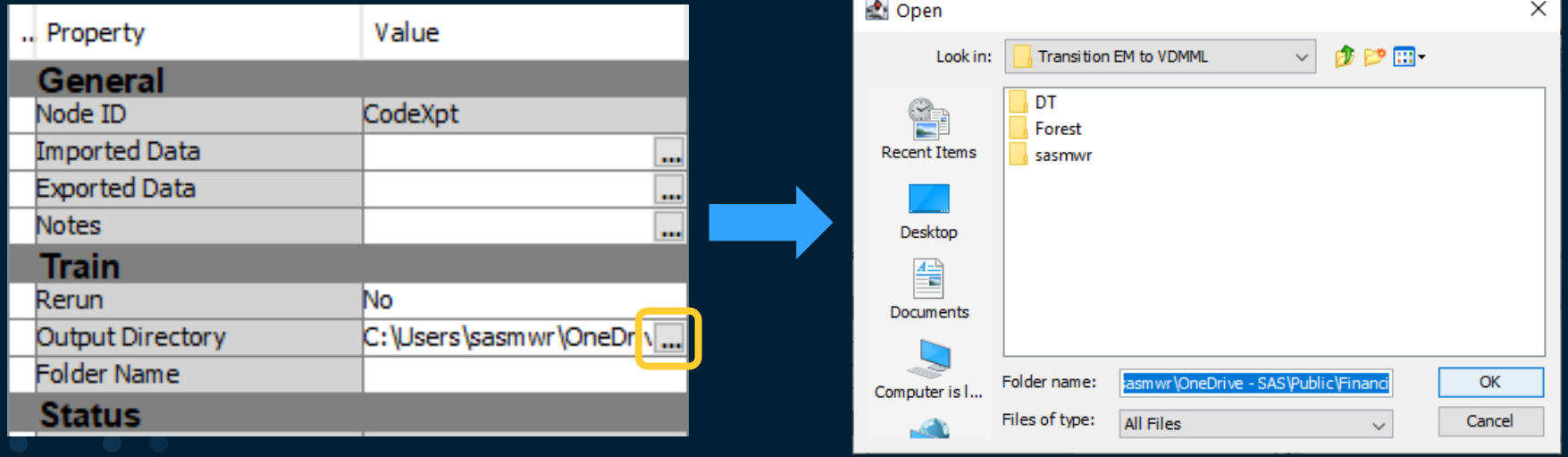
- Create Enterprise Miner Diagram
- Include Score Node and Score Code Export Node



Adding Enterprise Miner Score Code to Viya Pipelines

Analytic Store Code (ASTORE)

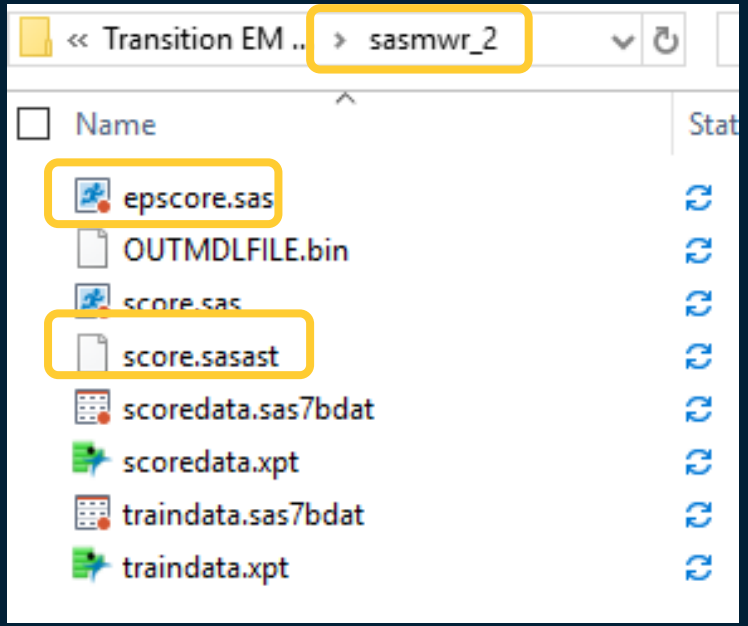
- Select Output Directory for the Score Code Export



Adding Enterprise Miner Score Code to Viya Pipelines

Analytic Store Code (ASTORE)

epscore.sas includes score code and link to ASTORE file

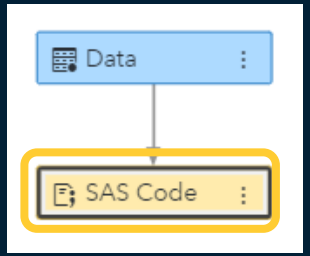


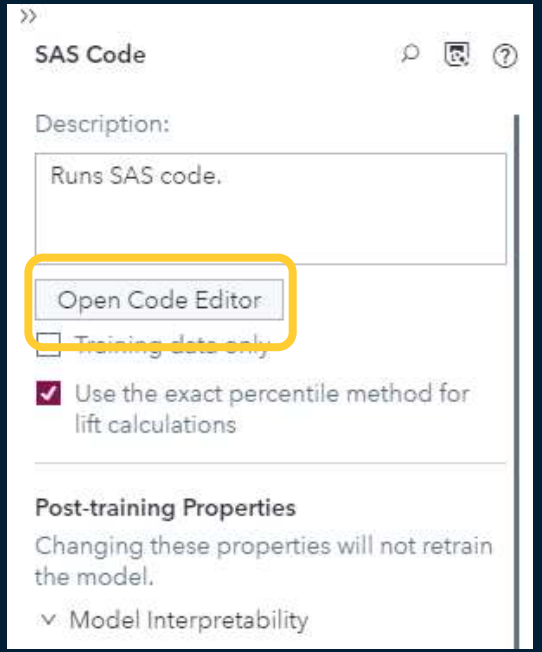
ep = entire pipeline or process

Adding Enterprise Miner Score Code to Viya Pipelines

Analytic Store Code (ASTORE)

- In Pipelines add a SAS code node (under Miscellaneous)
- Open Code Editor

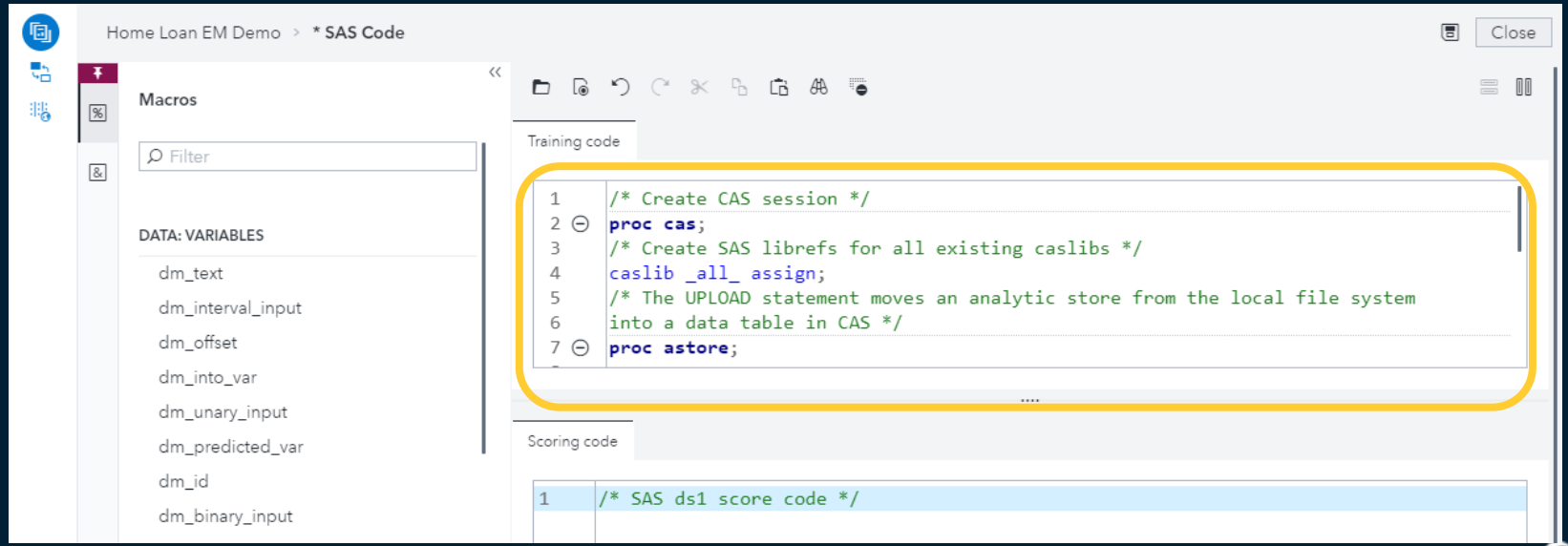




Adding Enterprise Miner Score Code to Viya Pipelines

Analytic Store Code (ASTORE)

- In Pipelines add a SAS code node (under Miscellaneous)
- Open Code Editor – add code to load ASTORE file into memory



Adding Enterprise Miner Score Code to Viya Pipelines

Analytic Store Code (ASTORE)

Training code

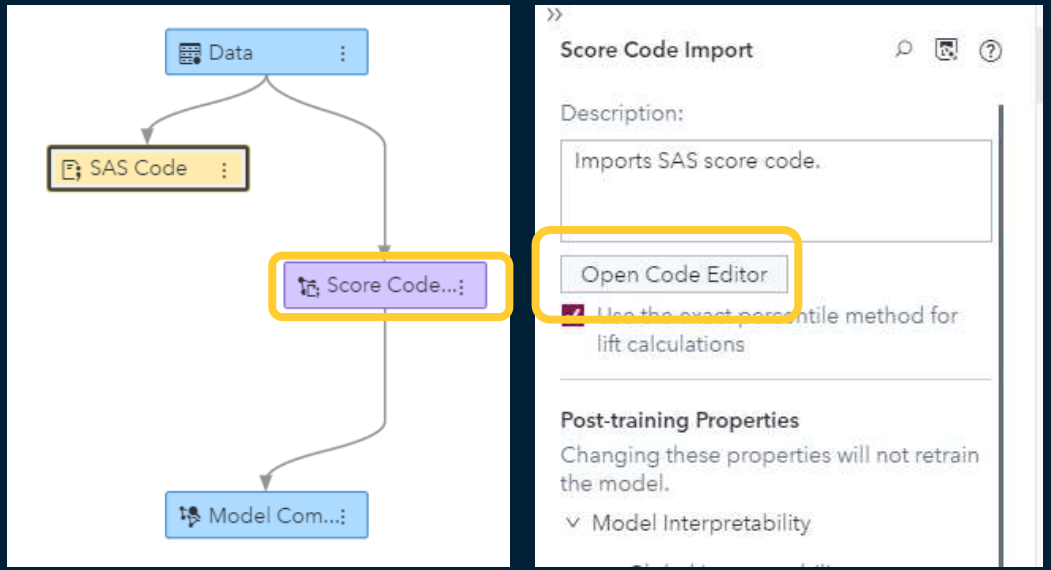
```
1   /* Create CAS session */
2   proc cas;
3   /* Create SAS librefs for all existing caslibs */
4   caslib _all_ assign;
5   /* The UPLOAD statement moves an analytic store from the local file system
6   into a data table in CAS */
7   proc astore;
8    upload store="/home/sasdemo/MelsExamples/score.sasast"
9    rstore=Models.EM_hpforeststore_ast;
10  run;
11  /* Promote the Analytic Store to global scope so that it is available to
12  all sessions */
13  proc casutil;
14   promote casdata="EM_hpforeststore_ast"
15   casout="EM_hpforeststore"
16   incaslib="Models"
17   outcaslib="Public";
18  quit;/* SAS code */
```

Note: that the analytic store does not reside on your client but must reside in a path available to the SAS client (the SAS Viya session).

Adding Enterprise Miner Score Code to Viya Pipelines

Analytic Store Code (ASTORE)

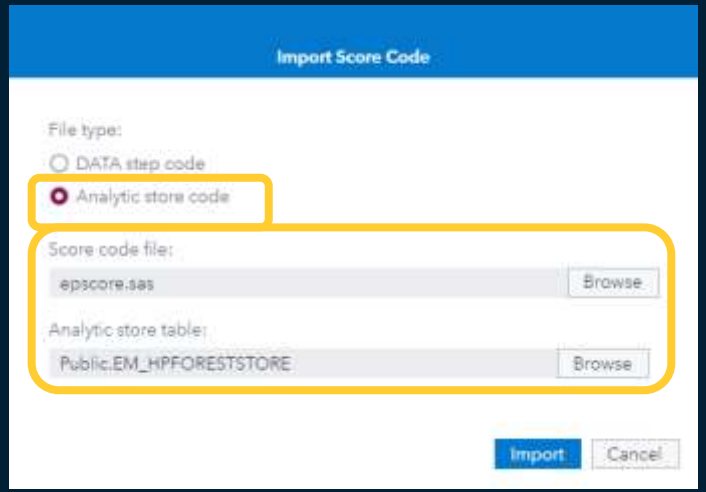
- In Pipelines add a score code import node (under Supervised Learning)
- Open Code Editor



Adding Enterprise Miner Score Code to Viya Pipelines

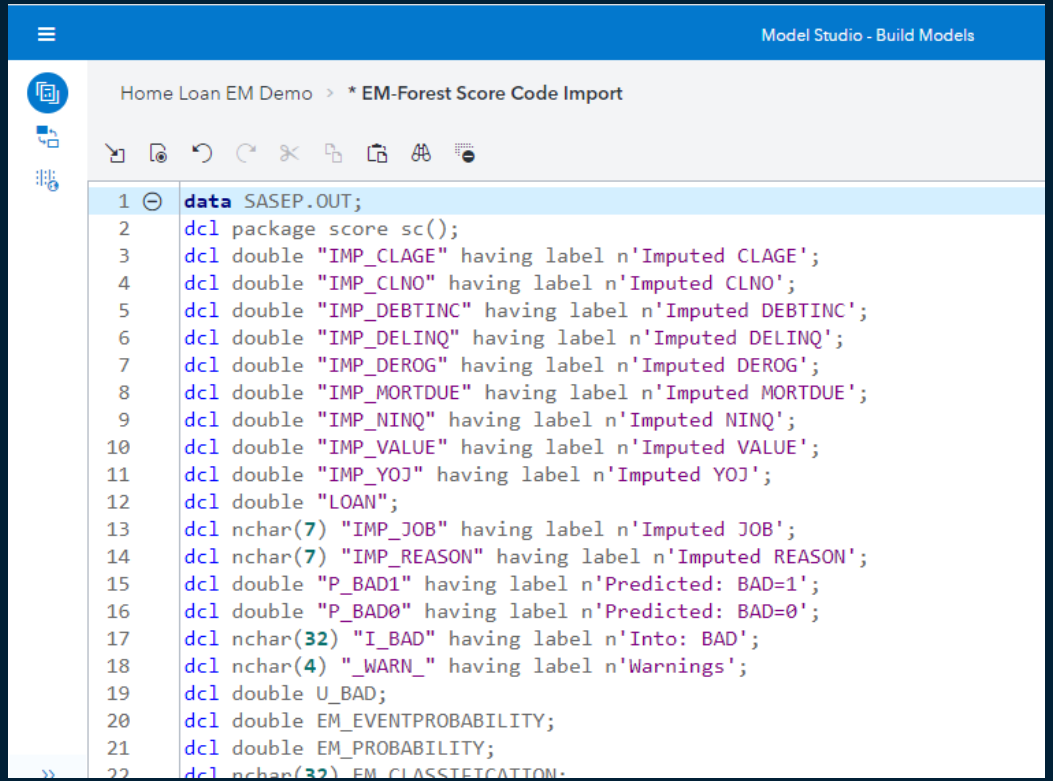
Analytic Store Code (ASTORE)

- Select Analytic store code
- Browse and select local code (epscore.sas)
- Browse and select ASTORE table loaded in Memory



Adding Enterprise Miner Score Code to Viya Pipelines

Analytic Store Code (ASTORE)

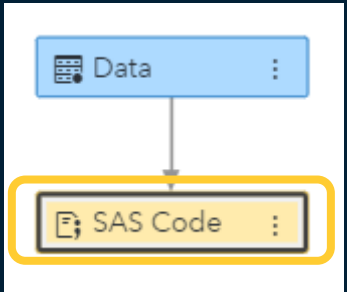


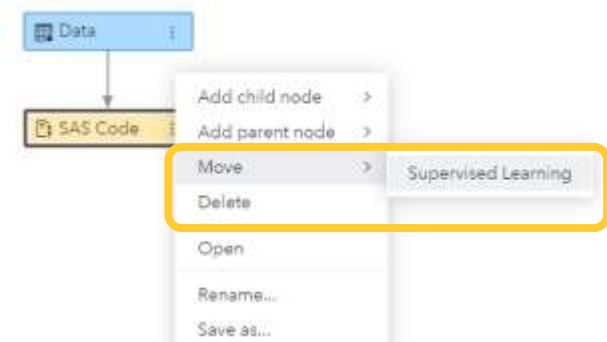
SAS Procedures

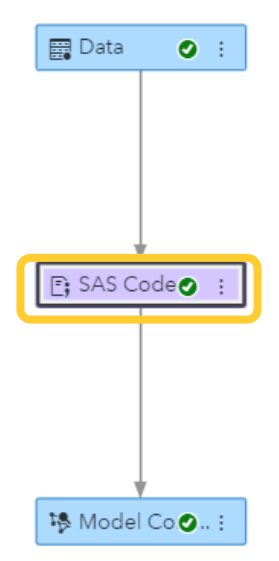
Adding Enterprise Miner Procedure Code to Viya Pipelines

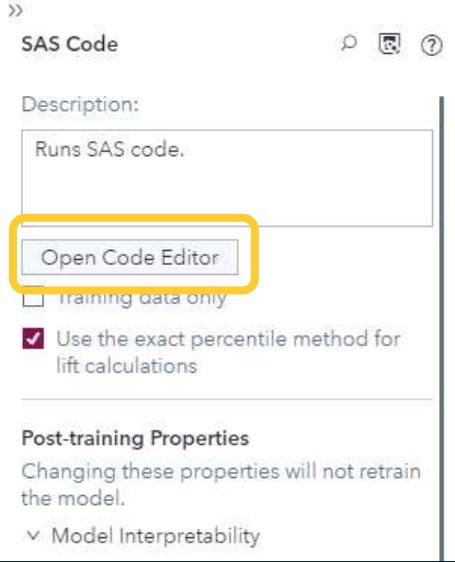
Proc DMREG

- In Pipelines add a SAS code node (under Miscellaneous)
- Right mouse click and move to Supervised Learning
- Open Code Editor









Adding Enterprise Miner Procedure Code to Viya Pipelines

Proc DMREG code – part 1

EM procedures require data to be split into training and validation data sets

```
/* Create the training and validation data sets */
data work.train;
 set &dm_data;
 where &dm_partitionTrainWhereClauseNlit;
run;
data work.validate;
 set &dm_data;
 where &dm_partitionValidWhereClauseNlit;
run;
```

Adding Enterprise Miner Procedure Code to Viya Pipelines

Proc DMREG code – part 2

EM procedures require Data Mining Database (dmdb)

```
/* create Data Mining Database(dmdb) required by EM procs */
proc dmdb batch data=work.train dmdbcat=work.dmdbcat maxlevel = 513;
 class %dm_dec_target %dm_class_input;
 var %dm_interval_input;
 target %dm_dec_target;
run;
```

Adding Enterprise Miner Procedure Code to Viya Pipelines

Proc DMREG code – part 3

Proc DMREG code

```
/* run EM Logistic procedure DMREG */
proc dmreg data=work.train dmdbcat=work.dmdbcat
 validata = work.validate
 outterms = &dm_lib..outterms
 namelen=200;
 class %dm_dec_target %dm_class_input;
 model %dm_dec_target = %dm_interval_input %dm_class_input
 / error=binomial link=LOGIT coding=DEVIATION nodesignprint;
 code file="&dm_file_scorecode" group=_&dm_labelid;
run;
```

Adding Enterprise Miner Procedure Code to Viya Pipelines

Proc DMREG code – part 4

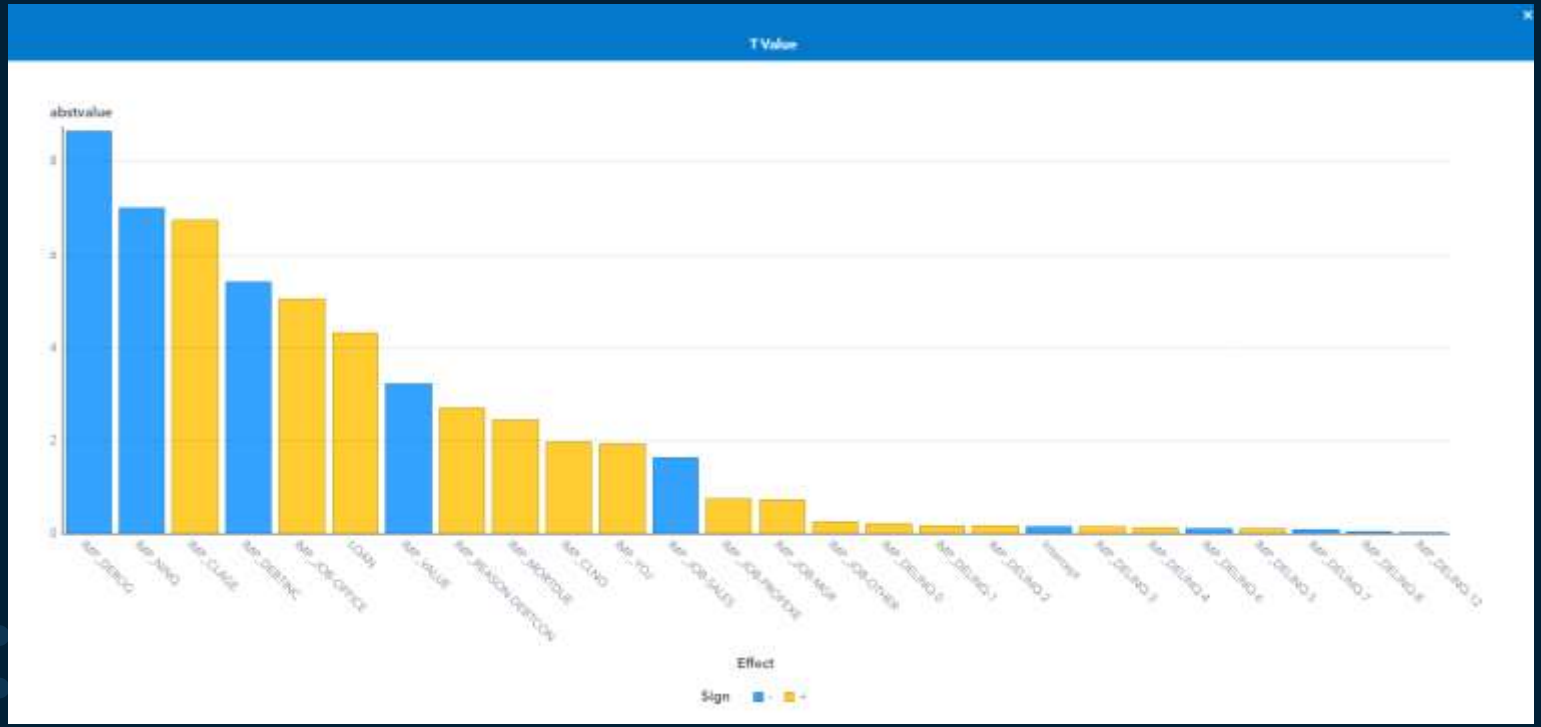
Display plot of parameter estimates

```
/* display plot of parameter estimates */
data &dm_lib..outterms;
 length sign $1 effect $65;
 set &dm_lib..outterms;
 if coefficient<0 then sign='-';
 else sign='+';
 if Variable ne 'Intercept' and classLevel ne '' then
 effect=ktrim(variable)!!'-'!!ktrim(classLevel);
 else
 effect = ktrim(variable);
 abstvalue = abs(tvalue);
run;
%dmcas_report(dataset=outterms, reportType=BarChart, category=Effect,
 Response=abstvalue, sortDirection=descending,
 sortBy=abstvalue, group=sign,
 description=%nrbquote(T Value));
```

Adding Enterprise Miner Procedure Code to Viya Pipelines

Proc DMREG code – Results

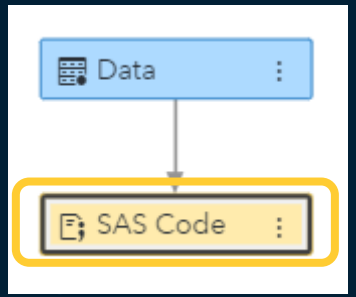
Display plot of parameter estimates

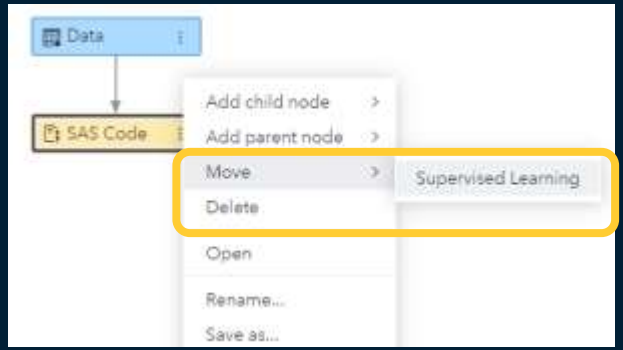


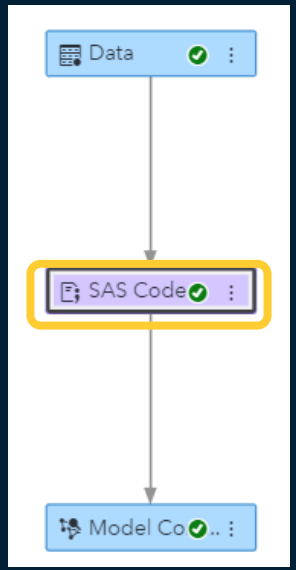
Adding Enterprise Miner Procedure Code to Viya Pipelines

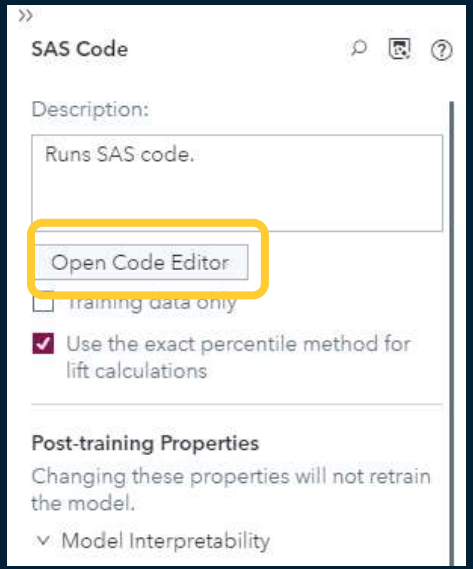
Proc HPSVM (create ASTORE file)

- In Pipelines add a SAS code node (under Miscellaneous)
- Right mouse click and move to Supervised Learning
- Open Code Editor









Adding Enterprise Miner Procedure Code to Viya Pipelines

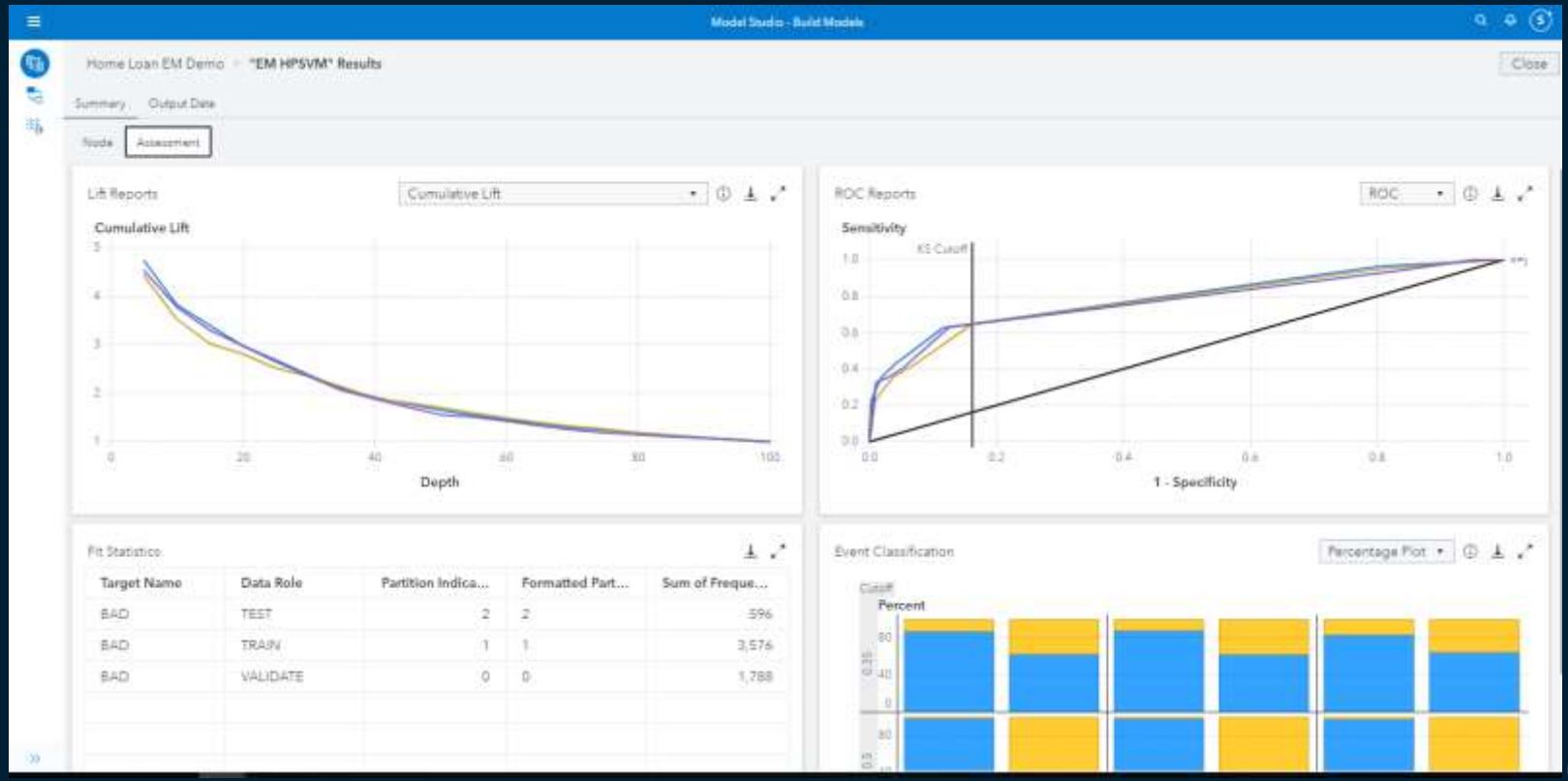
Proc HPSVM

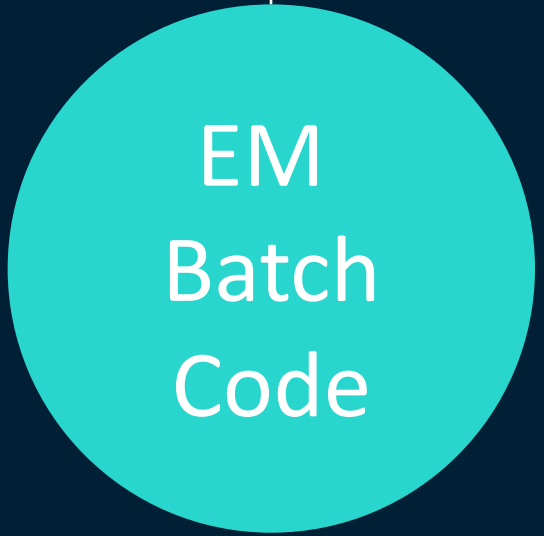
Data already split into Training and Validation data sets and DMDB created in the DMREG code in previous example

```
proc hpsvm data=&dm_data maxiter=25 method=ACTIVESET
 tolerance=0.000001 c=1;
 input %dm_interval_input / level = interval;
 input %dm_nominal_input %dm_binary_input / level = nominal;
 target %dm_dec_target / level = &dm_dec_level;
 kernel polynom / deg = 2;
 &dm_partition_statement;
 PERFORMANCE DETAILS;
 savestate file = "&dm_file_astore";
run;
proc astore;
 upload store="&dm_file_astore" rstore=&dm_data_rstore;
run;
```

Adding Enterprise Miner Procedure Code to Viya Pipelines

Proc HPSVM code – Results



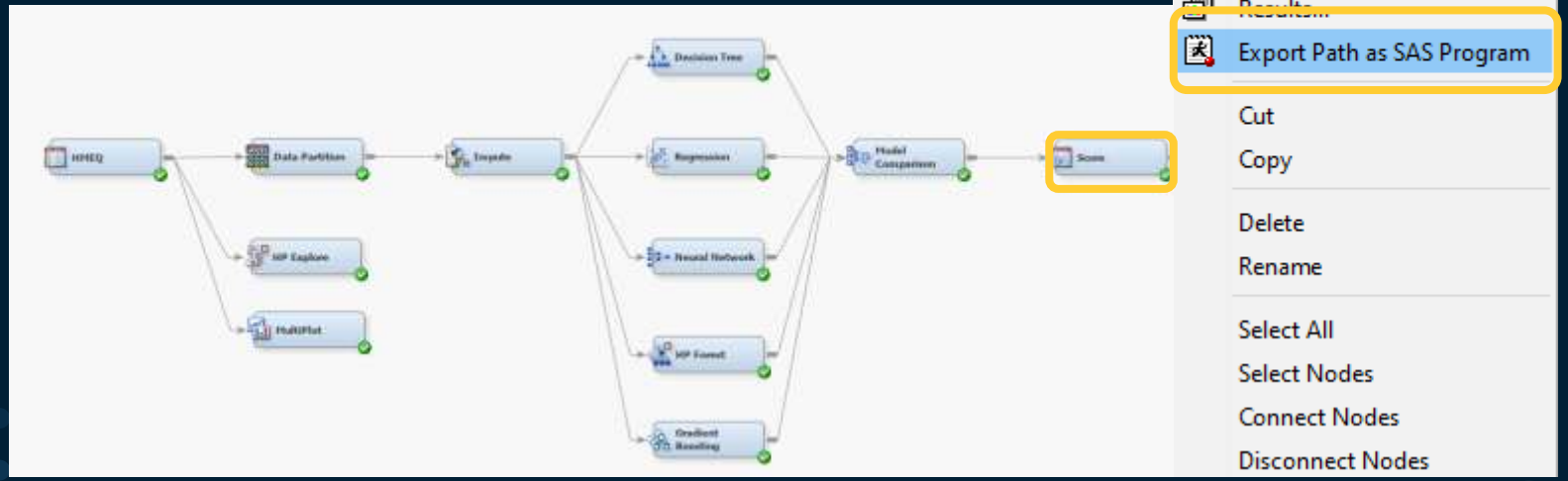


Process Flow Code

Adding Enterprise Miner Batch Code to Viya Pipelines

Batch Code Node

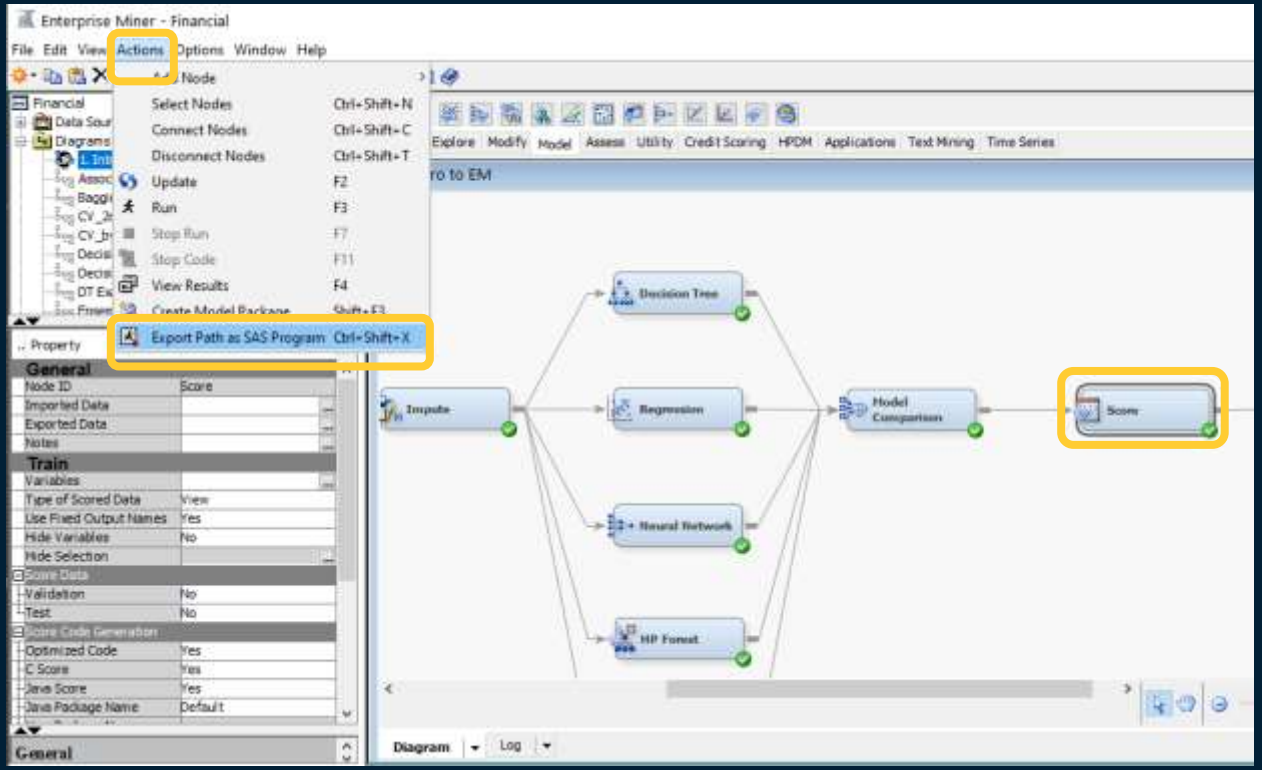
- Create Batch Code from Enterprise Miner Diagram
- Right Mouse Click on the Score Node & Select Export Path as SAS Program



Tip: Save the code where it can be uploaded via your browser to SAS Viya.

Adding Enterprise Miner Batch Code to Viya Pipelines

Batch Code Node

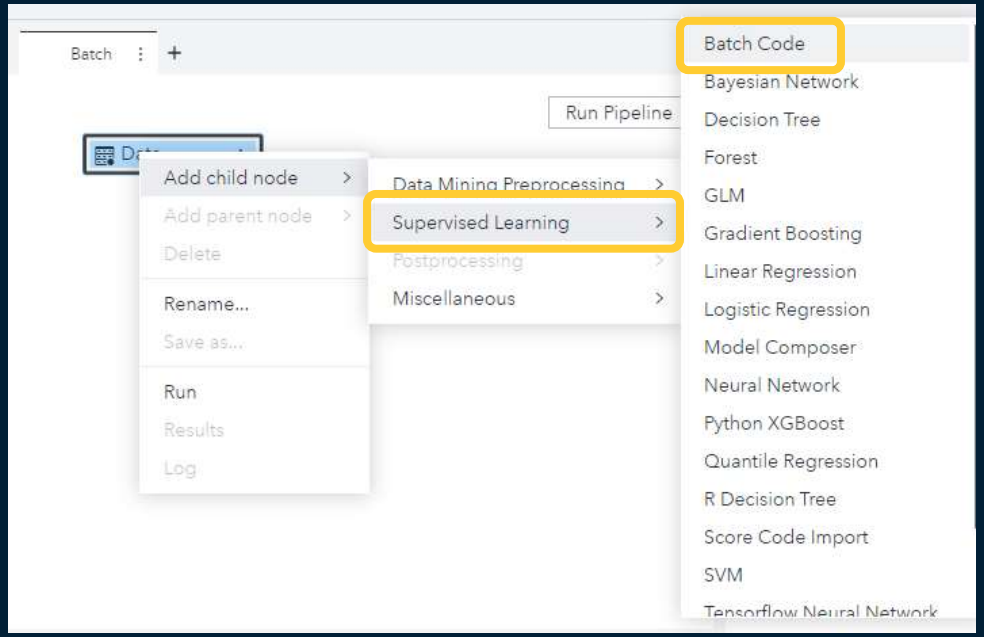


Tip: Save the code where it can be uploaded via your browser to SAS Viya.

Adding Enterprise Miner Batch Code to Viya Pipelines

Batch Code Node

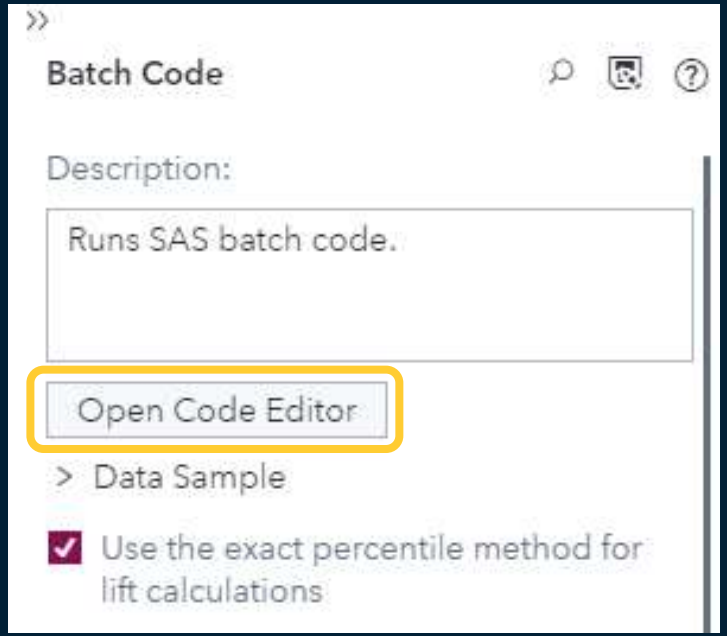
- In Pipelines add a Batch Code Node (under Supervised Learning)



Adding Enterprise Miner Batch Code to Viya Pipelines

Batch Code Node

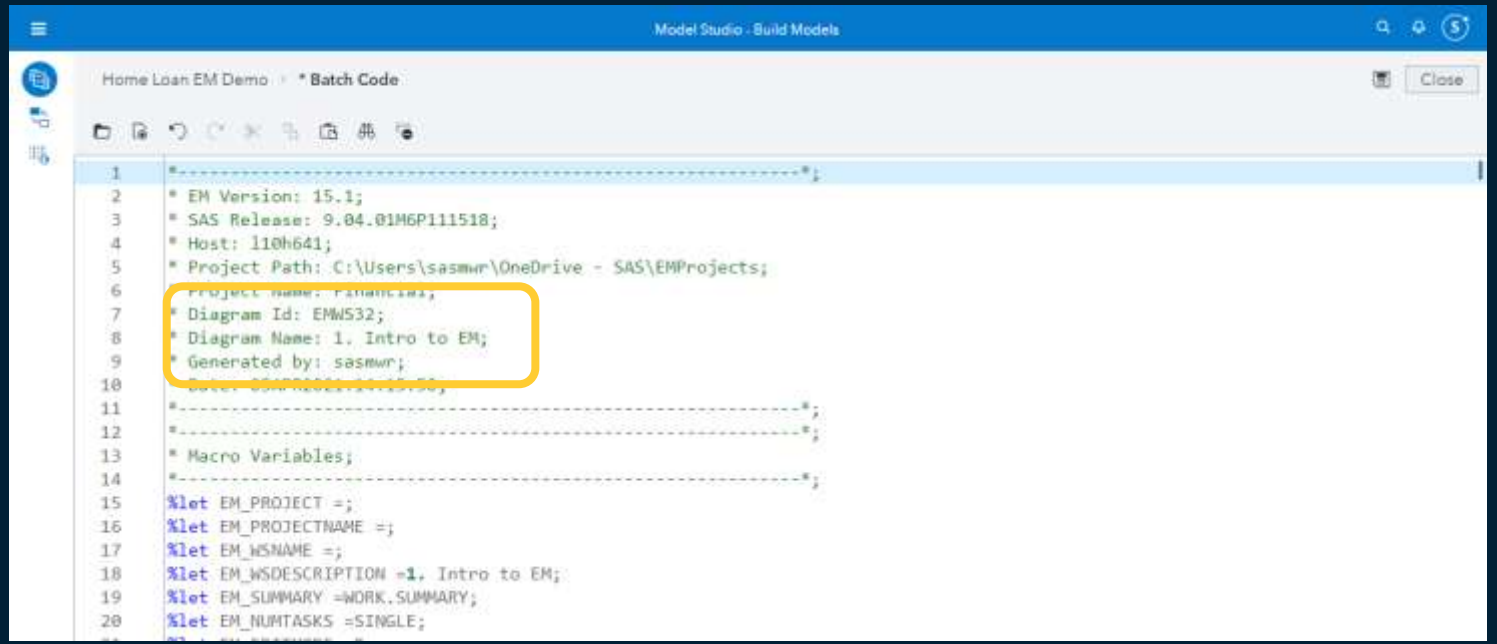
- Open Code Editor



Adding Enterprise Miner Batch Code to Viya Pipelines

Batch Code Node

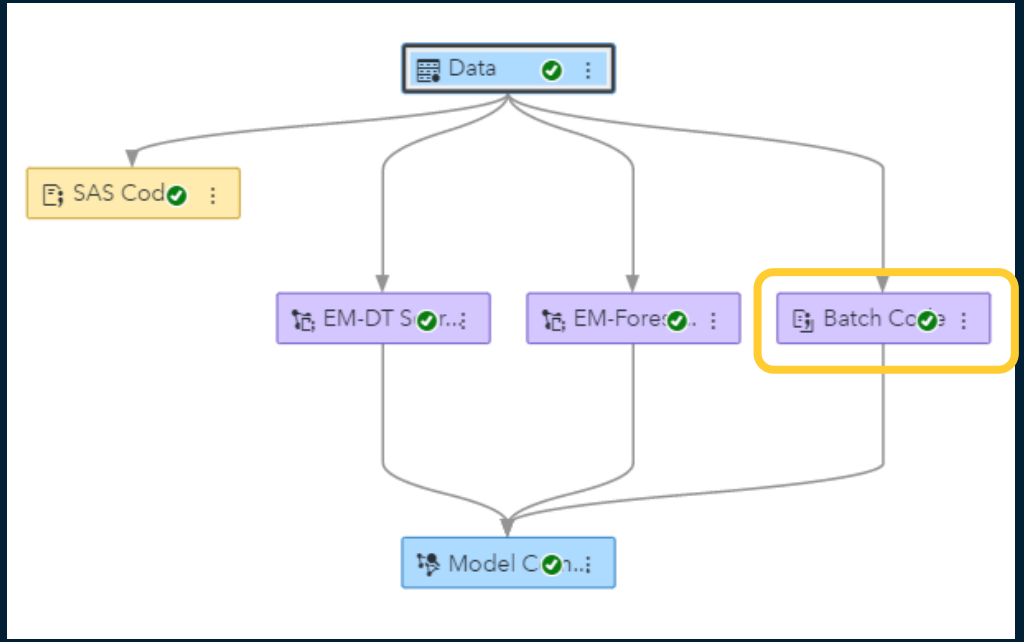
- Select the batch file saved from Enterprise Miner



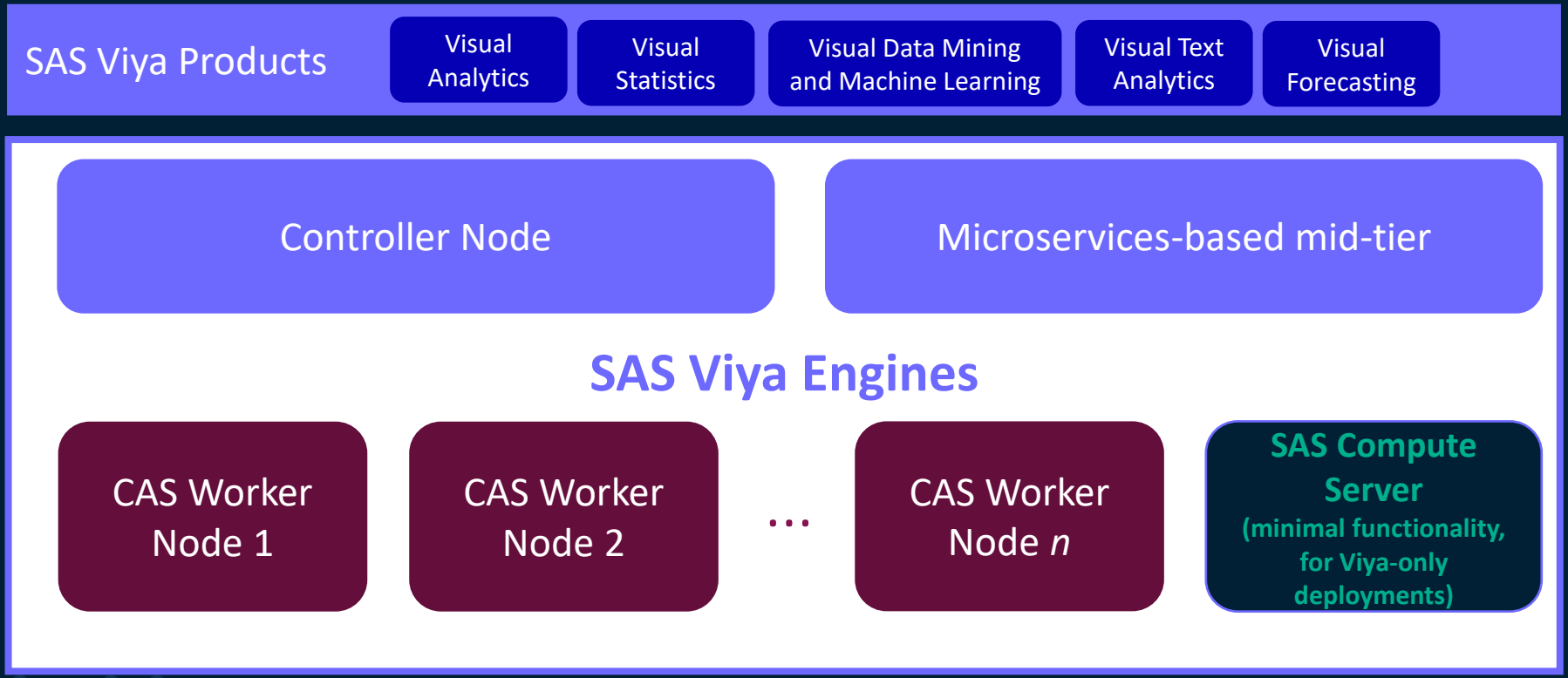
Adding Enterprise Miner Batch Code to Viya Pipelines

Batch Code Node

- Now the Enterprise Miner Diagram winner is part of your pipeline

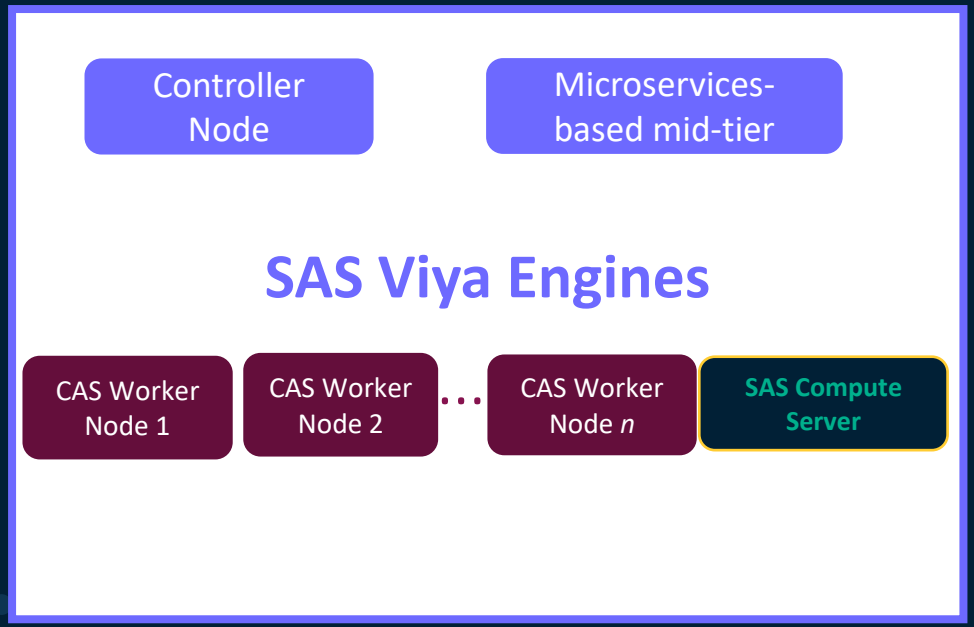


Simplified SAS Viya Architecture



Simplified SAS Viya Architecture

Using Enterprise Miner Batch Code: Considerations



The Enterprise Miner batch code does not execute in CAS.

It executes on the SAS Compute Server.

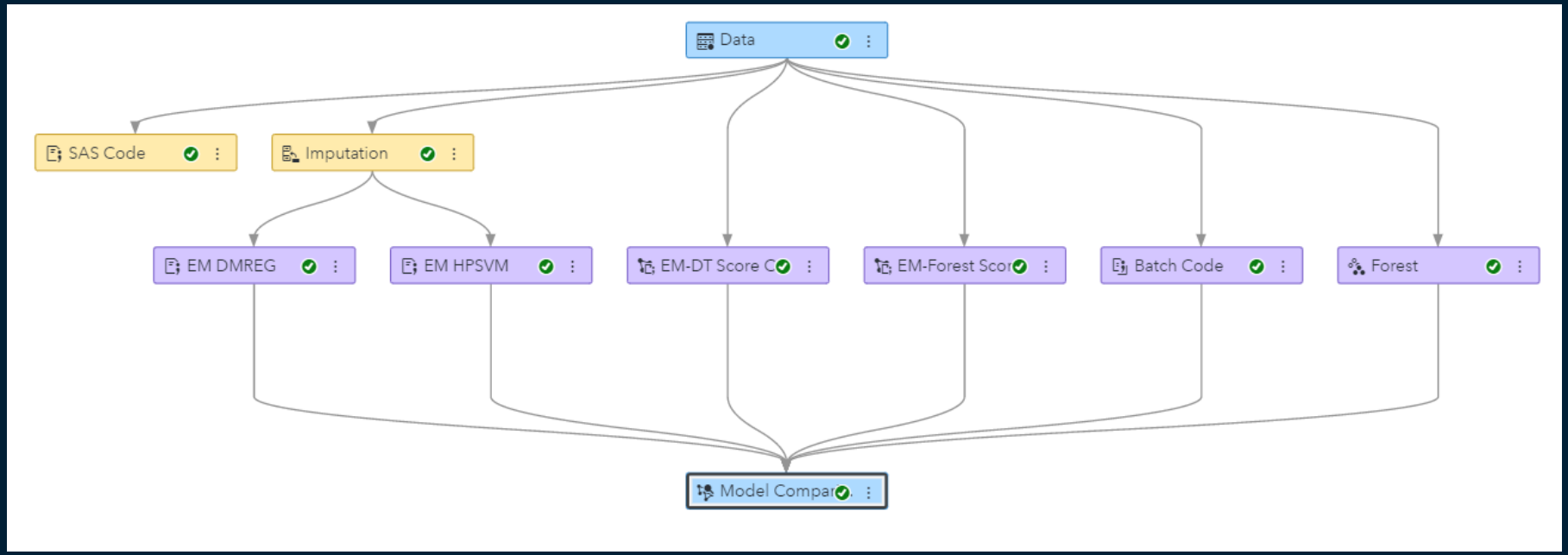
SAS® Visual Data Mining and Machine Learning

Using Enterprise Miner Batch Code: Considerations

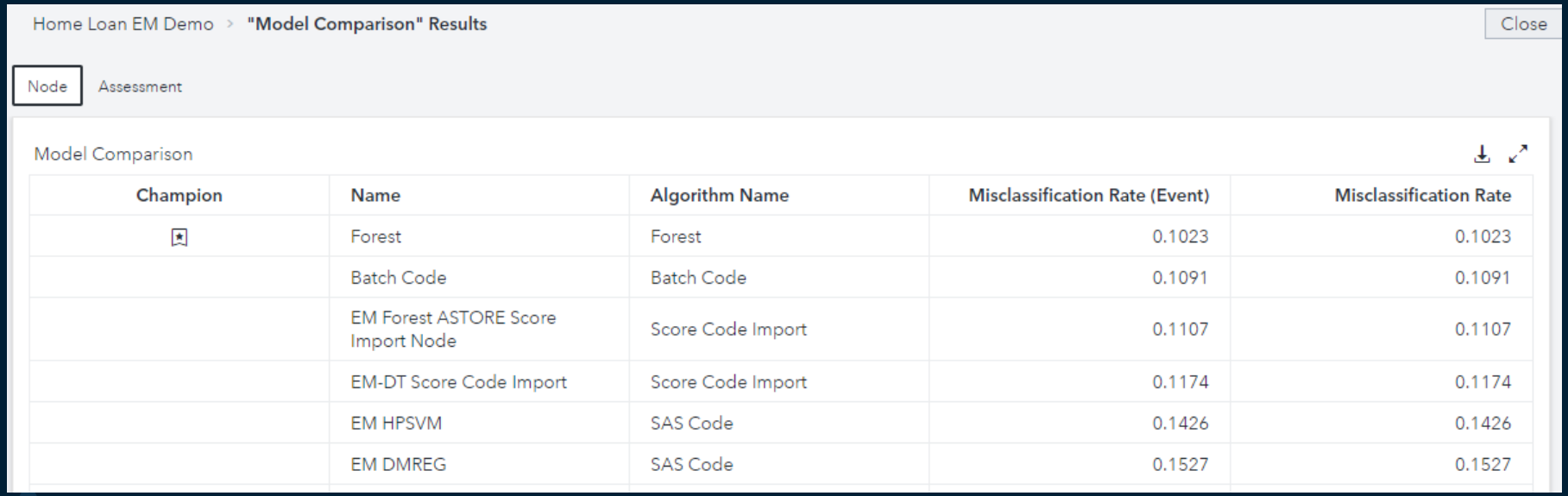
- When invoked from a Model Studio pipeline in Viya, the batch code from SAS® Enterprise Miner® does not execute in CAS, rather in the SAS Viya Workspace Server.
  - A *sample* of the input table loaded into CAS is transferred to the SAS Viya Workspace Server.
  - After the batch code runs, Model Studio retrieves either the model score code or the analytic store and EPCODE.
  - The retrieved code is used to score the original input data in Model Studio. This scored data is used to produce the assessment results.
- Typically, the server with the SAS Viya Workspace Server is within the Viya cluster, so the transfer of the data is limited only by the connection between the nodes.

Documentation

Model Comparison



Model Comparison



Champion	Name	Algorithm Name	Misclassification Rate (Event)	Misclassification Rate
★	Forest	Forest	0.1023	0.1023
	Batch Code	Batch Code	0.1091	0.1091
	EM Forest ASTORE Score Import Node	Score Code Import	0.1107	0.1107
	EM-DT Score Code Import	Score Code Import	0.1174	0.1174
	EM HPSVM	SAS Code	0.1426	0.1426
	EM DMREG	SAS Code	0.1527	0.1527

Scoring

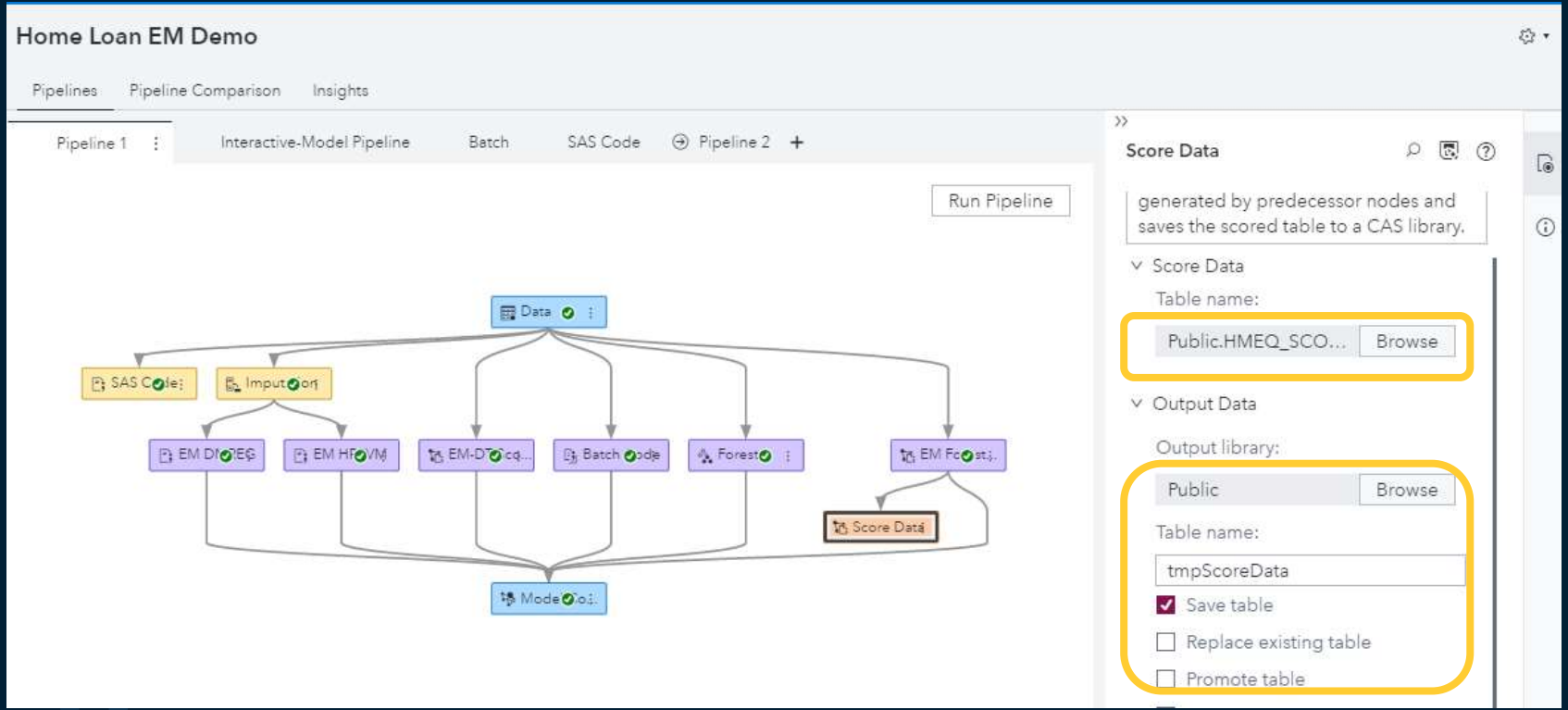
In Viya

Scoring in SAS Viya

- Score Code Import Node in Pipeline (Supervised Learning)
- Score Data Node in Pipelines (Miscellaneous)
- Create Score Code or ASTORE file from
  - modeling nodes
  - champion models
- SAS Studio Scoring Task (SAS Viya Evaluate and Implement Models)

Scoring in SAS Viya

Score Data Node in Pipelines



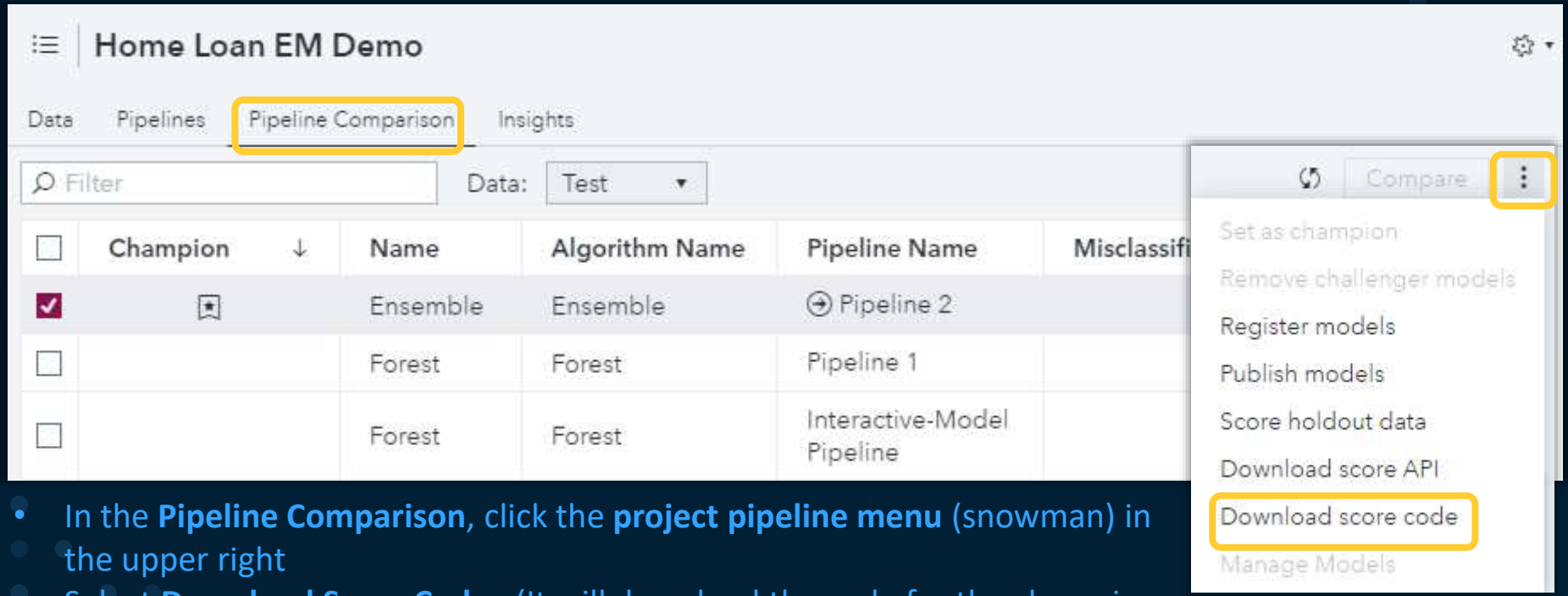
Scoring in SAS Viya

Download Score Code: Any Modeling Node

- To save the score code of a modeling node, right-click the node and select Download Score Code.
- A Zip file will be saved in your browser's Downloads folder.
- Within the Zip file will be a SAS program called **dmcas_epscorecode.sas** that contains the EP score code.

Scoring in SAS Viya

Download Score Code: Champion Model



- In the **Pipeline Comparison**, click the **project pipeline menu** (snowman) in the upper right
- Select **Download Score Code**. (It will download the code for the champion model, which in this example, is the **Ensemble**.)

Score Code in SAS Viya

- Some model types generate score code as an ASTORE. An additional file will also need to be downloaded.
- A comment in the top of the downloaded score code will indicate which ASTORE(s) are referenced and in which CASLIB on the SAS® Viya server they are stored.
- The default location is a CASLIB called Models that by default is located here: /opt/sas/viya/config/data/cas/default/models/

```
/*
 * This score code file references one or more analytic stores that are located in the caslib "Models".
 * This score code file references the following analytic-store tables:
 *    _ANCSDMXFGI6XXOS0P2DPTEOWA_ast
 */
```

Score Code Types

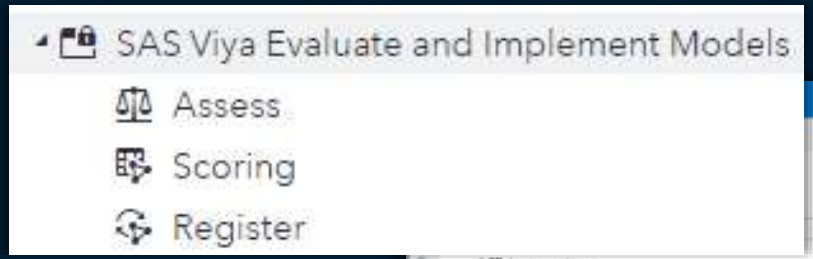
Node Name	Type of Score Code
Anomaly Detection	Analytic store
Bayesian Network	Analytic store
Clustering	DATA step
Decision Tree	DATA step
Ensemble	DATA step (if all models produce DATA step), otherwise one or more analytic stores and the EP score code to combine the models' score code
Feature Extraction	DATA step
Filtering	DATA step
Forest	Analytic store
GLM	DATA step
Gradient Boosting	Analytic store
Imputation	DATA step
Linear Regression	DATA step
Logistic Regression	DATA step
Neural Network	DATA step for networks less than 6 layers, analytic store for networks with 6 or more layers
Replacement	DATA step
SVM	Analytic store
Text Mining	Analytic store
Transformations	DATA step

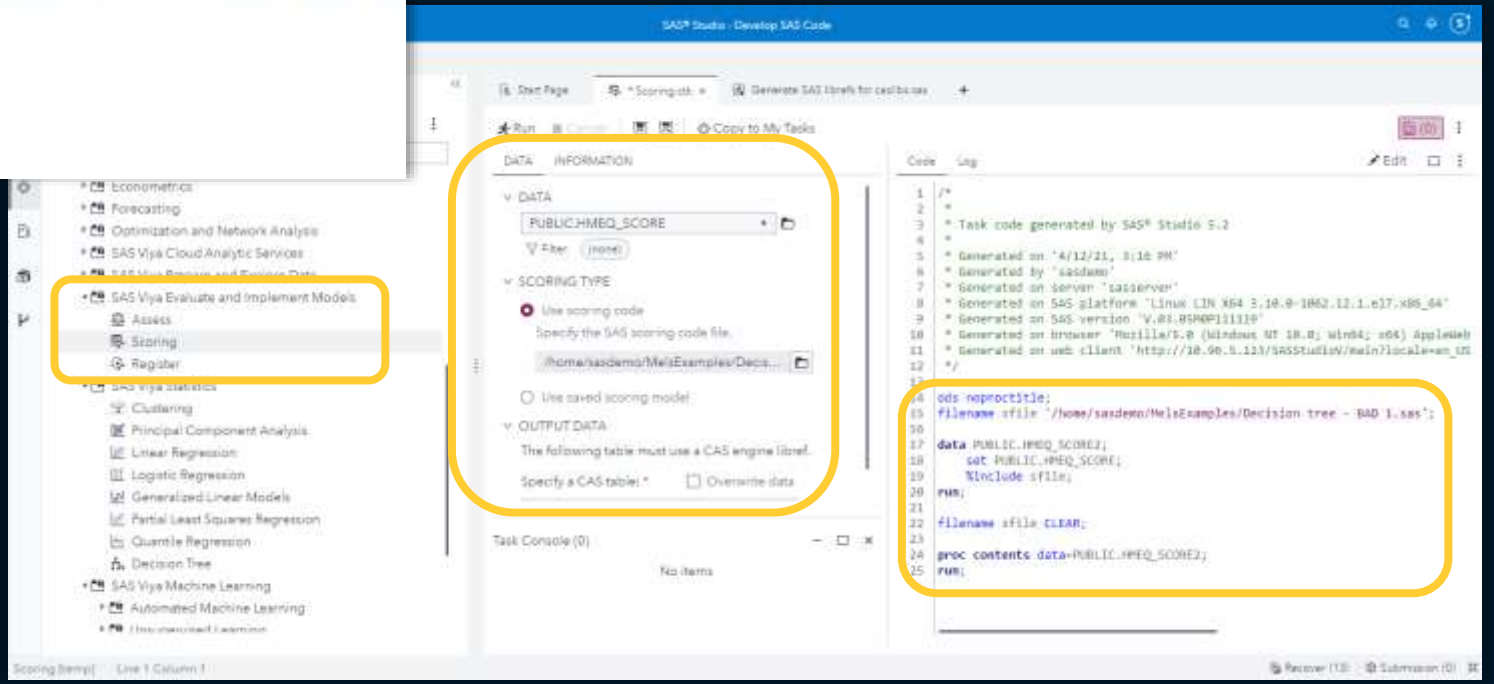
This table demonstrates which Model Studio nodes produce score code, as well as the types of code they produce.

Documentation link

Scoring in SAS Viya

Scoring Task in SAS Studio





Models

Including VDMML models in EM diagrams

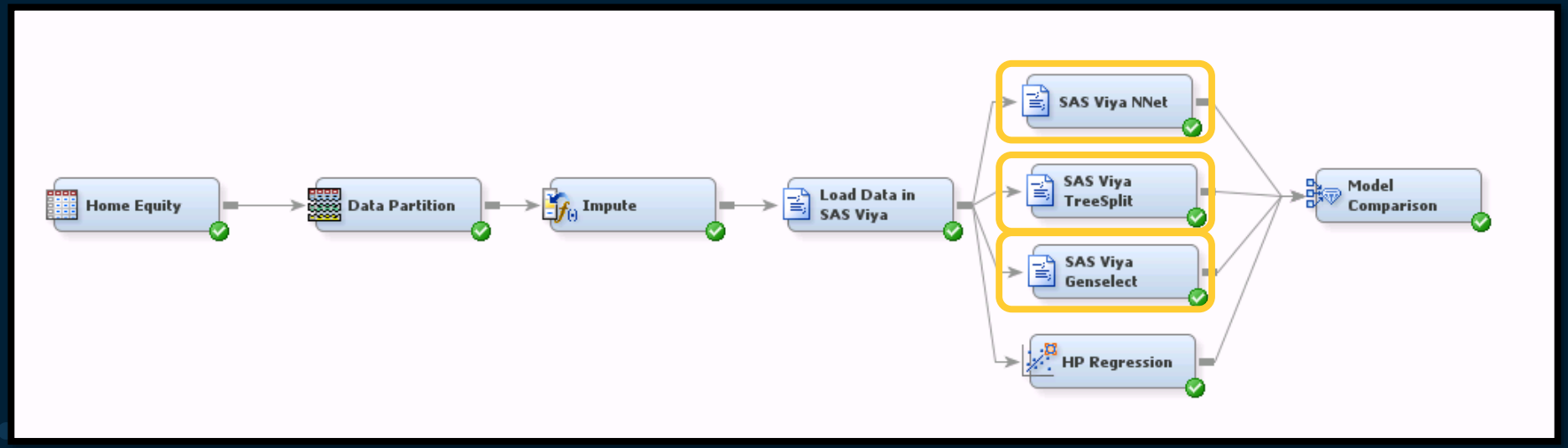
Including SAS Viya Nodes into EM Diagrams

- Viya Code Node
- Scoring Viya Models in SAS 9.4

Adding SAS Viya Nodes to SAS Enterprise Miner

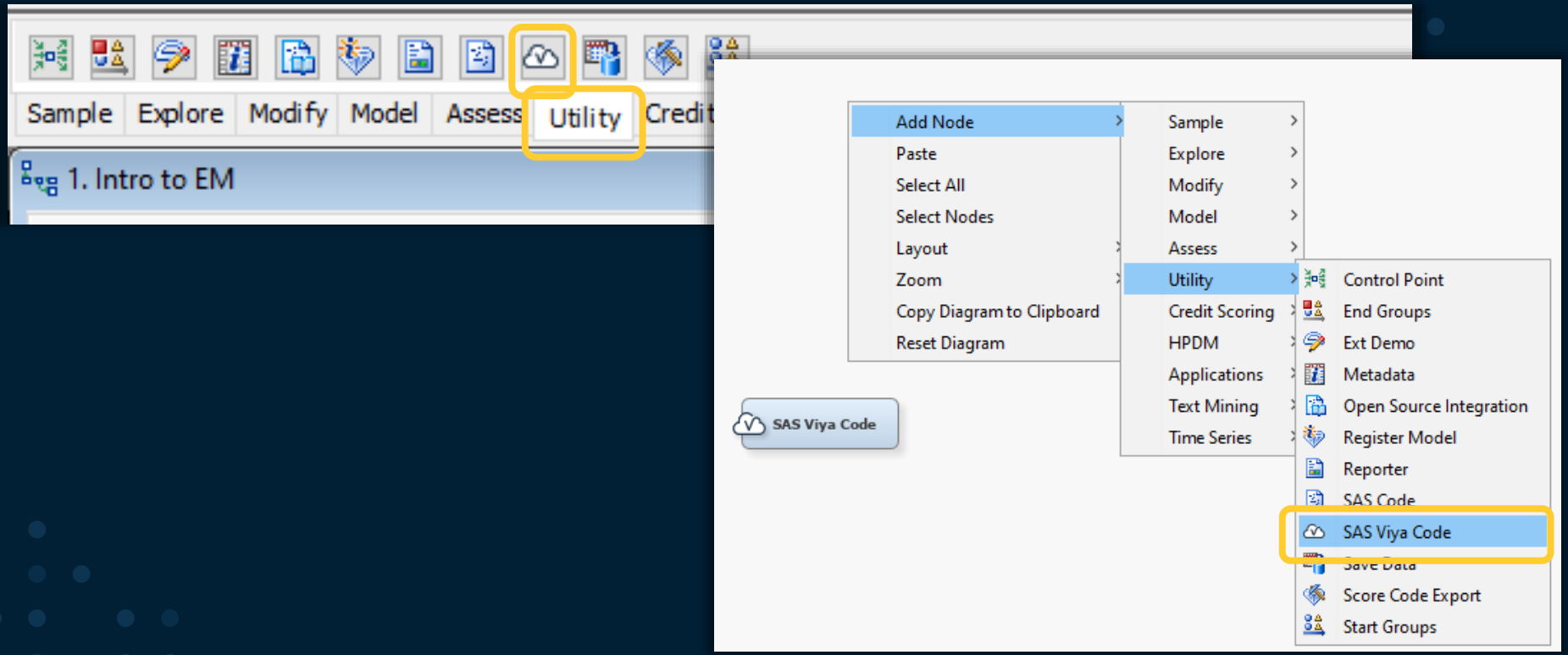
VDMML Models or Viya Procedures

- Allows you to run VDMML Models in CAS within EM diagrams in order to compare models



Adding SAS Viya Nodes to SAS Enterprise Miner

Viya Code Node Under the Utility Tab



SAS® Enterprise Miner™

Viya Code Node

- Just like in the other code nodes (SAS Code, Open Source Integration), several macros and macro variables have already been defined for you and some code has already been included to streamline the process for you. In invokes macros to:
- Streamline the pre-modeling process:
  - Signing into the Viya server
  - Loading your data into CAS
  - Setting up macros and macro variables for your data (target, inputs, rejected, etc.)
- Streamline the post-modeling process:
  - Model assessment
  - Model selection
  - Report generation
  - Viya session termination

SAS® Enterprise Miner™

Considerations

- In order to run Viya algorithms from Enterprise Miner, the input data to the Viya node needs to be transferred to the Viya environment.
- Typically, this isn't a problem when the environments are co-located in the same data center, or data centers with secure, fast connections between them.
- However, when the data is large or the environments are not co-located, the movement of data may not be practical, feasible or allowed (by your corporate network/security policies) depending on your overall architecture.

Scoring

Viya Models In SAS 9.4

Scoring SAS Viya Models in SAS 9.4

- Data Step code can be run directly in SAS 9.4 without any changes (except to add the data step datasets). Using SAS Viya Data Step Code in SAS 9.4
- Analytic store (ASTORE) will need to have the ASTORE files downloaded to your SAS 9.4 environment and use the EP (entire pipeline) score code file. Using SAS Viya ASTORE Score CODE in SAS 9.4

Scoring SAS Viya Models in SAS 9

Data step score code example

Need to insert a Data Step to identify incoming and outgoing data.

```
/*-------------------------------------------------------------
SAS Code Generated by Cloud Analytic Services for Decision Tree
  Date                    : 12Apr2021:19:05:18 UTC
  Number of Nodes         : 25
  Number of Tree Depth    : 6
  Number of Bins          : 50
  Number of Obs           : 1788
  -------------------------------------------------------------*/

length _strfmt_ $7; drop _strfmt_;
 strfmt_ = ' ';

array _tlevname_49_{2} $32 _temporary_ ( '                                0'
'                                1');

array _dt_fi_49_{2} _temporary_;

_node_id_ =  0;
_new_id_  = -1;
nextnode_49:
if _node_id_ eq 0 then do;
      _numval_ = DEBTINC;
      if missing(_numval_) then do;
         _node_id_ = 1;
         goto nextnode_49;
      end;
      if (_numval_ ge 44.5181701141609 and _numval_ lt 144.189001287599) then do;

         _new_id_ = 1;
      end;
      else if (_numval_ ge 0.7202950067447 and _numval_ lt 44.5181701141609) then do;
```

Scoring SAS Viya Models in SAS 9

ASTORE and EP Score code example

```
/*
 * This score code file references one or more analytic stores that are located in the caslib "Models".
 * This score code file references the following analytic store tables:
 *   _ANCSDMXPGI6XXOS0P2DPTEOWA_ast
 */
data sasep.out;
    dcl package score _ANCSDMXPGI6XXOS0P2DPTEOWA();
    dcl double "P_BAD1" having label n'Predicted: BAD=1';
    dcl double "P_BAD0" having label n'Predicted: BAD=0';
    dcl nchar(32) "I_BAD" having label n'Into: BAD';
    dcl nchar(4) "_WARN_" having label n'Warnings';
    dcl double EM_EVENTPROBABILITY;
    dcl nchar(8) EM_CLASSIFICATION;
    dcl double EM_PROBABILITY;
    varlist allvars [_all_];


    method init();
        _ANCSDMXPGI6XXOS0P2DPTEOWA.setvars(allvars);
        _ANCSDMXPGI6XXOS0P2DPTEOWA.setkey(n'A5CE2CC0D09E4B29F75D2EDC86361507DAED4205');
    end;

    method post_ANCSDMXPGI6XXOS0P2DPTEOWA();
        dcl double _P_;

        if "P_BAD0" = . then "P_BAD0" = 0.6005033557;
        if "P_BAD1" = . then "P_BAD1" = 0.1994966443;
        if MISSING("I_BAD") then do ;
        _P_ = 0.0;
        if "P_BAD1" > _P_ then do ;
```

EP Score code file name is dmcas_epscorecode.sas

Resources

Where to learn more

Resources

Where to learn more

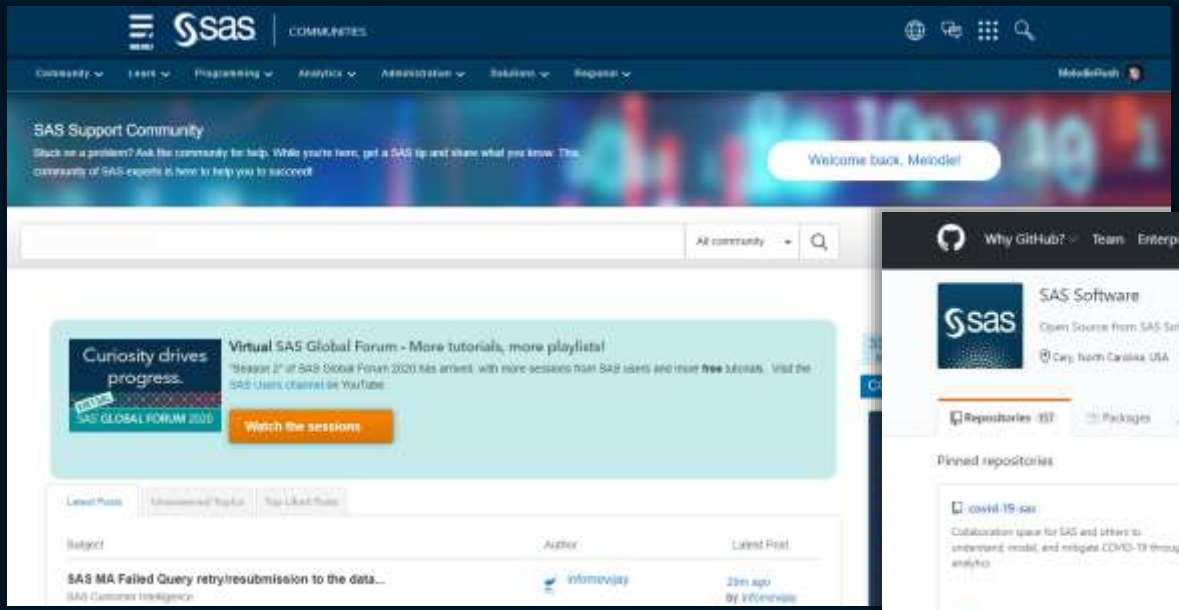
- SAS® Enterprise Miner™ and SAS® Visual Data Mining and Machine Learning Handshake
- Make SAS® Enterprise Miner™ Play Nicely with SAS® Viya®
- SAS9.4 and SAS Viya Functional Comparison Technical Paper
- SAS Viya Overview
- SAS Enterprise Miner Support Page
- SAS Visual Data Mining and Machine Support Page
- Create an ASTORE Using SAS Enterprise Miner

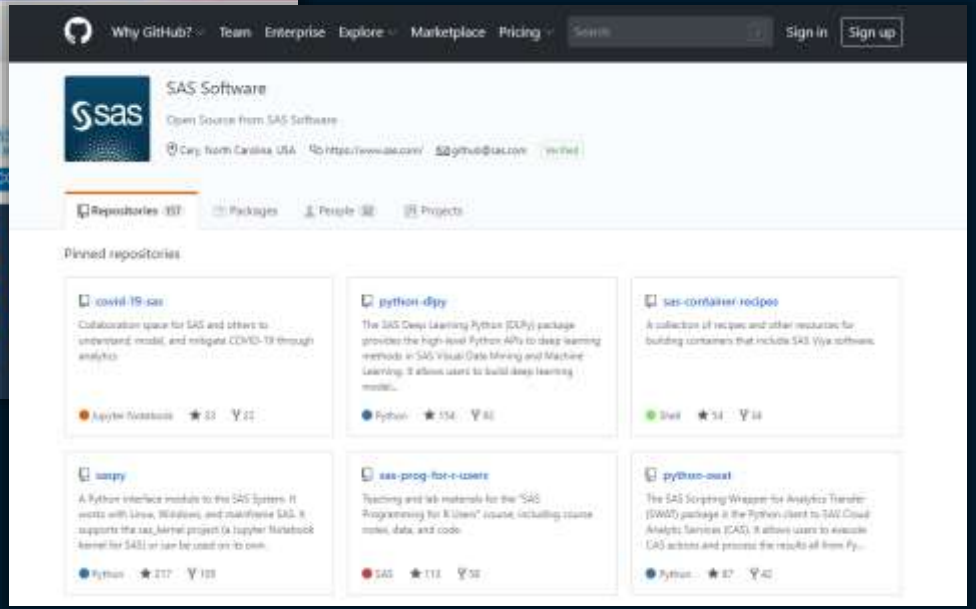
SAS® Enterprise Miner™

Resources for Viya Code Node

- Make SAS® Enterprise Miner™ Play Nicely with SAS® Viya™ https://www.sas.com/content/dam/SAS/support/en/sas-global-forum-proceedings/2018/2204-2018.pdf
- Github examples https://github.com/sassoftware/em-bridge2viya
- YouTube Video Use SAS® Enterprise Miner™ to Run Machine Learning Algorithms in SAS® Viya®

Communities





Communities.sas.com
Github.com/sassoftware
Developer.sas.com

Questions?
Thank you for your time and attention!

Connect with me:
LinkedIn: https://www.linkedin.com/in/melodierush
Twitter: @Melodie_Rush

sas.com