

Aug 12th, 12:00 AM

Workshop: AI and Deep Learning Using SAS Viya

Vijayan Sugumaran
Oakland University, sugumara@oakland.edu

James Harroun
SAS Institute, james.harroun@sas.com

Follow this and additional works at: <https://aisel.aisnet.org/amcis2020>

Recommended Citation

Sugumaran, Vijayan and Harroun, James, "Workshop: AI and Deep Learning Using SAS Viya" (2020).
AMCIS 2020 Proceedings. 8.
[https://aisel.aisnet.org/amcis2020/select_recordings_from_conference/
select_recordings_from_conference/8](https://aisel.aisnet.org/amcis2020/select_recordings_from_conference/select_recordings_from_conference/8)

This material is brought to you by the Americas Conference on Information Systems (AMCIS) at AIS Electronic Library (AISeL). It has been accepted for inclusion in AMCIS 2020 Proceedings by an authorized administrator of AIS Electronic Library (AISeL). For more information, please contact elibrary@aisnet.org.

SIGODIS/SIGDSA Workshop: AI & Deep Learning Using SAS Viya

Vijayan Sugumaran, Ph.D.

Chair, Department of Decision and Information Sciences
School of Business Administration
Oakland University
sugumara@oakland.edu

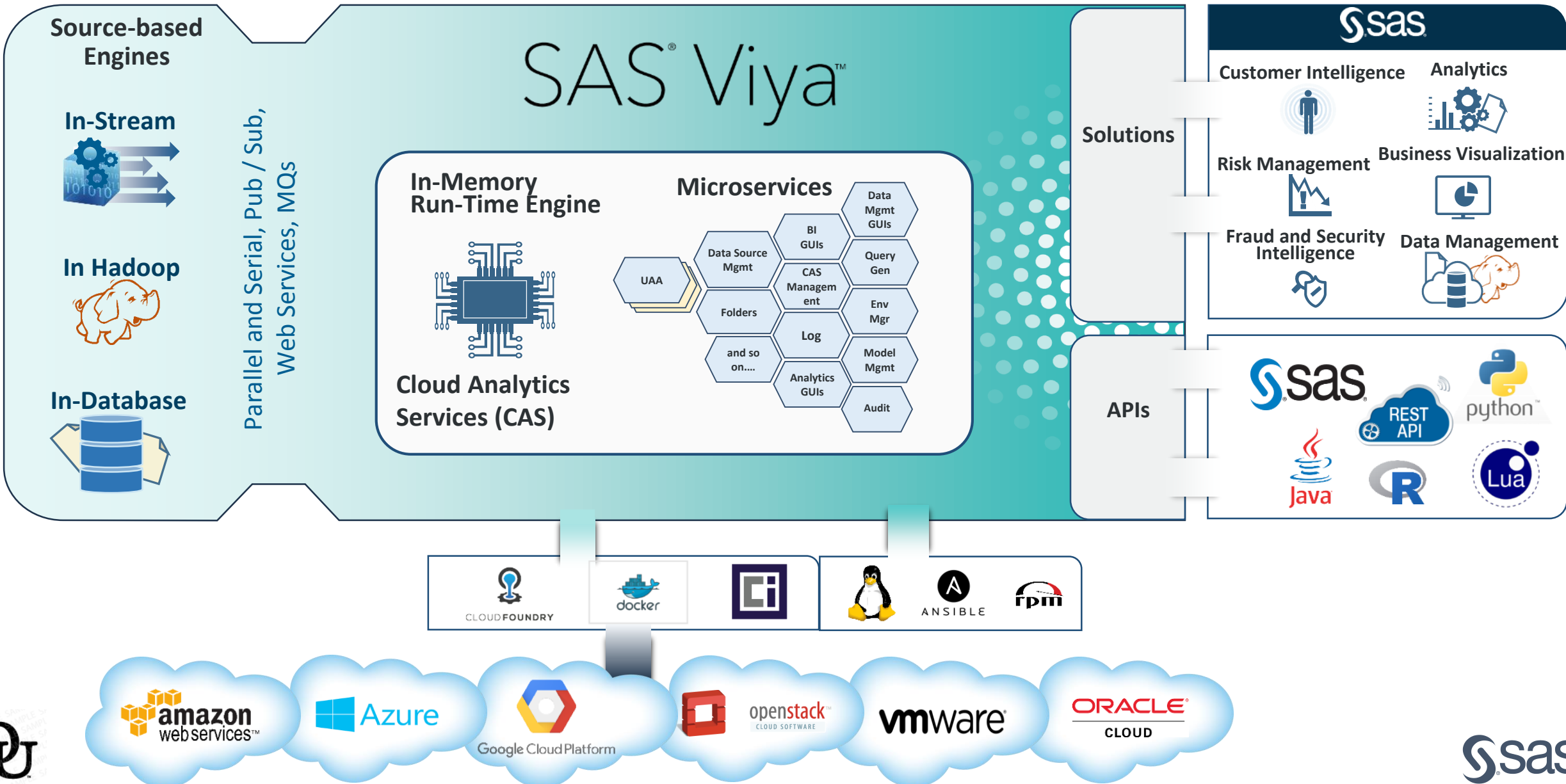
James Harroun

Data Science Initiatives Manager
SAS Institute
James.Harroun@sas.com



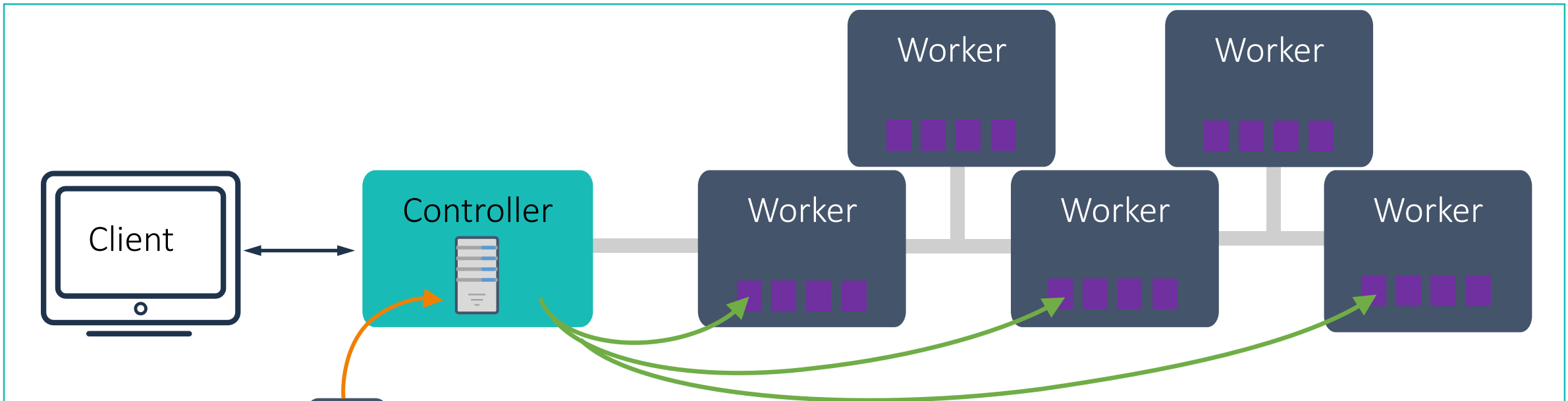
Agenda

- Welcome and General Introduction/Procedures
- First Hour – Machine Learning and SAS Viya for Learners
 - Overview of SAS Viya and SAS Viya for Learners
 - Basics of Neural Networks
 - Demo
 - SAS Visual Data Mining and Machine Learning Neural Network
 - Model Comparison, and Model Deployment
- Break (30 second)
- Second Hour – Deep Learning and Open Source Integration
 - Deep Learning and Basic Architectures
 - Overview of Convolutional Neural Network
 - SAS and Open Source Integration
 - Demo
 - Python Jupyter Notebook and Convolutional Neural Network Example
- Academic Resources Available





 CAS Distributed Environment



Data persist in memory and can be processed quickly across worker nodes.

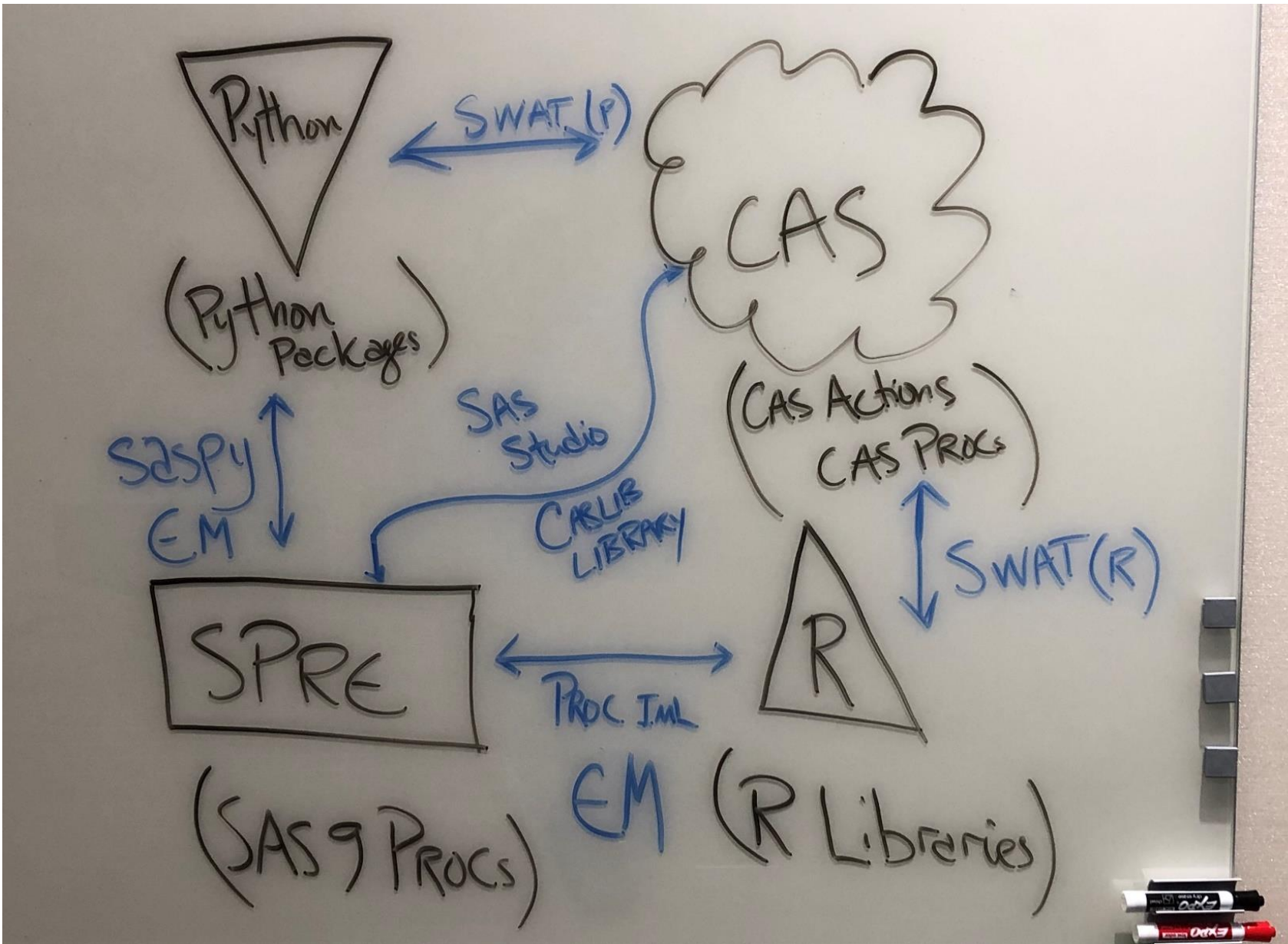


SAS Viya algorithms are designed for distributed environments.



What is SAS[®] Viya[®] for Learners (VFL)?

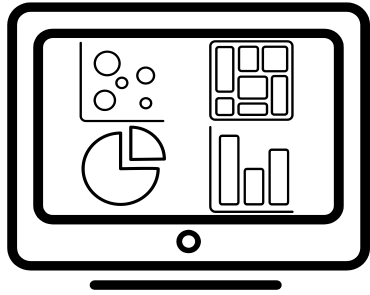
- SAS[®] Viya[®] for Learners is a cloud-based offering that provides Academic Institutions and On-Line Learning Platforms access to advanced analytics SAS[®] Viya[®] software coupled with Jupyter Notebook to enable coding in their language of choice: R, Python, SAS.
- No downloads.
- No cost.
- For academic, noncommercial use only.
- Educators are provided access to SAS courses and materials for use in their classrooms.



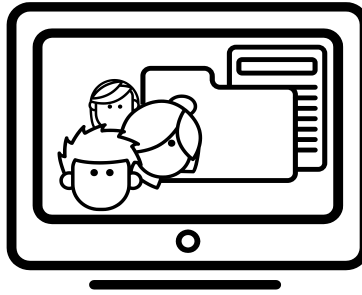


SAS Visual Analytics Applications

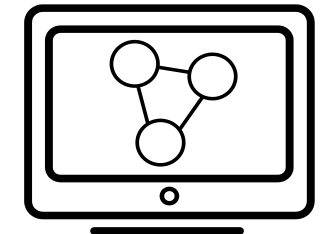
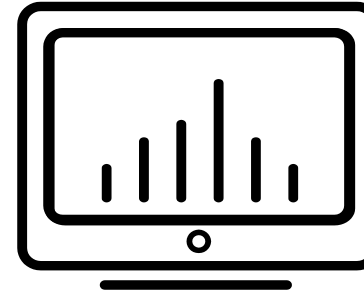
SAS Report Viewer



SAS Drive

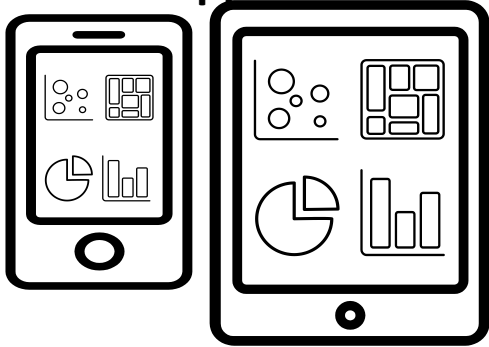


SAS Visual Analytics

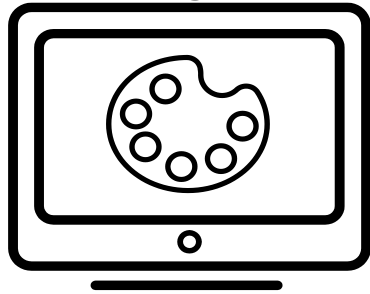


SAS Visual Statistics

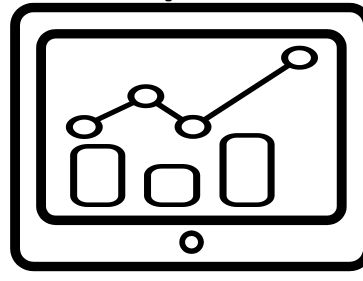
SAS Visual Analytics App



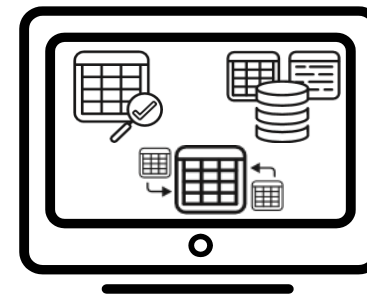
SAS Theme Designer



SAS Cloud Analytic Services (CAS)
SAS Graph Builder



SAS Data Studio

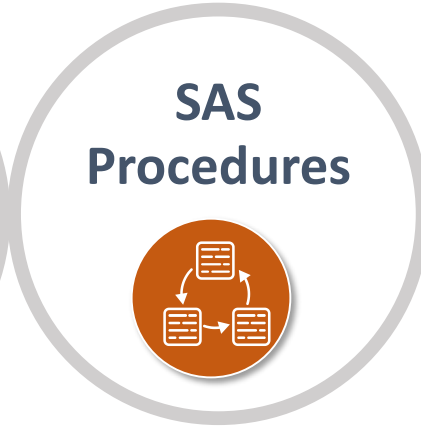
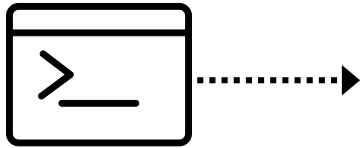


SAS Visual Data Mining and Machine Learning

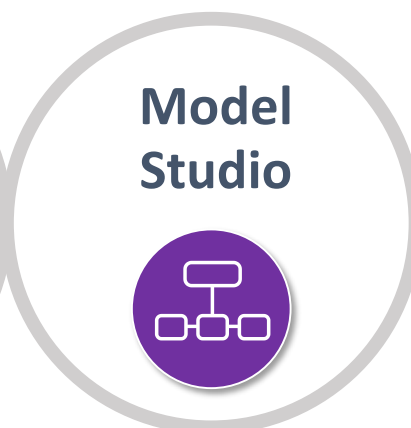
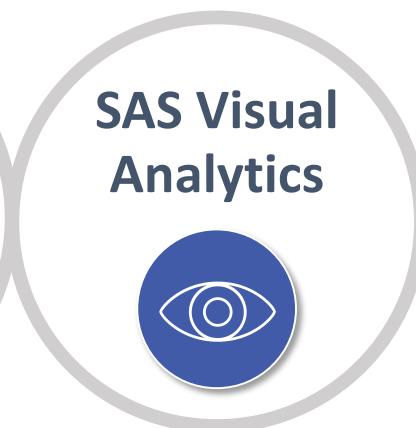
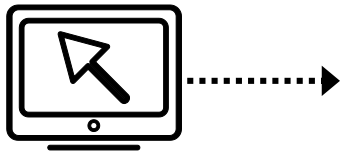


SAS Visual Data Mining and Machine Learning

Programming Approach

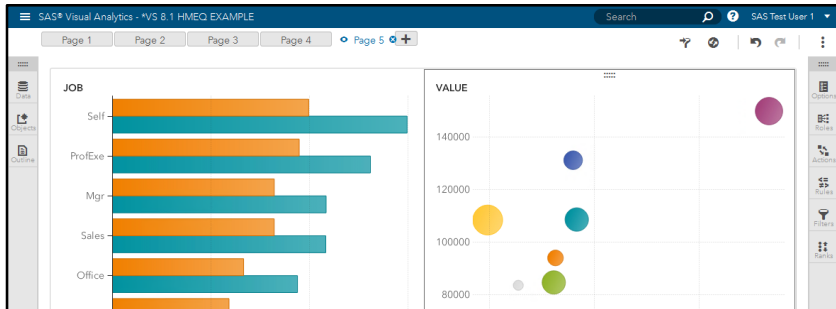


Visual Drag-and-Drop Approach



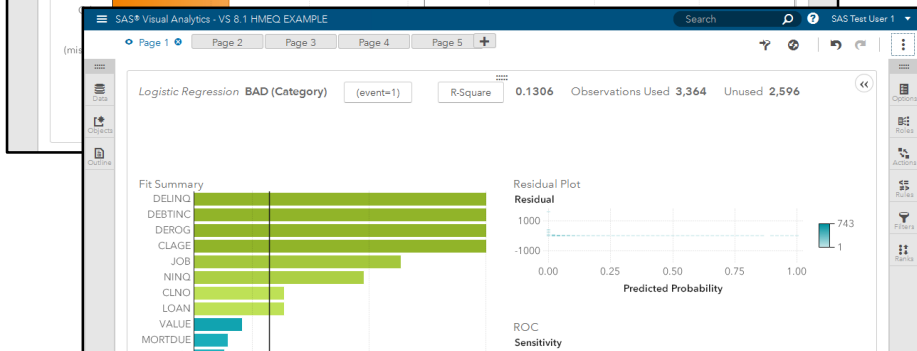


SAS Viya Functionality



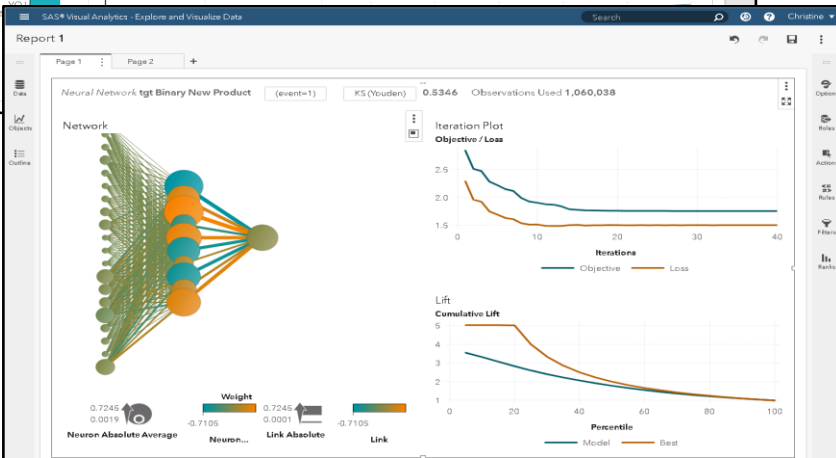
← SAS Visual Analytics

- Explore data and discovery relationships
- Examine distributions and summary statistics
- Perform post-model analysis and reporting



← SAS Visual Statistics

- SAS Visual Statistics
 - Build unsupervised and supervised models
 - Interactively refine candidate models
 - Compare models and generate score code



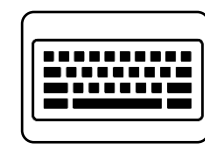
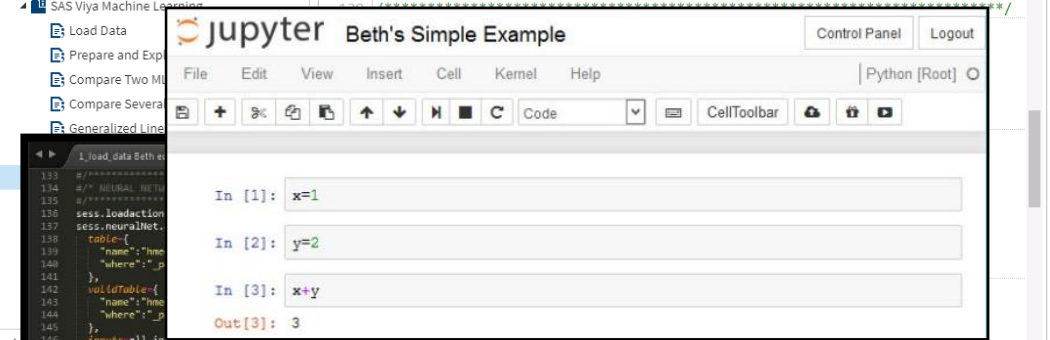
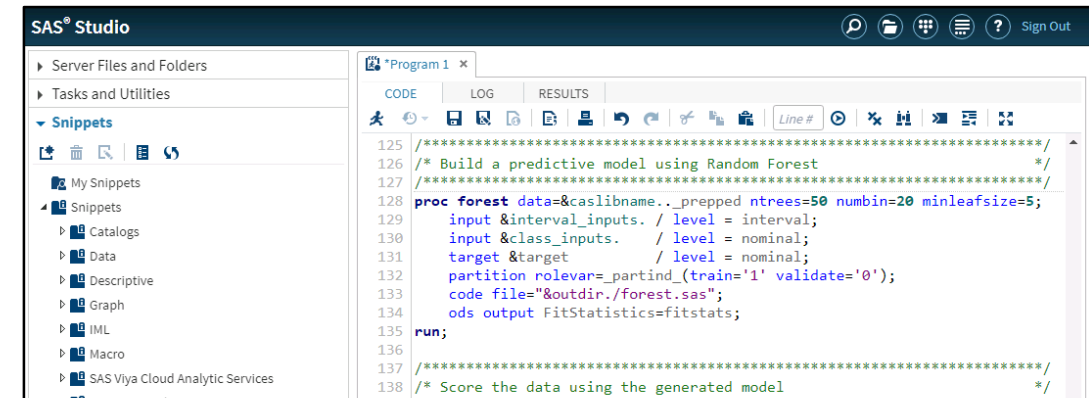
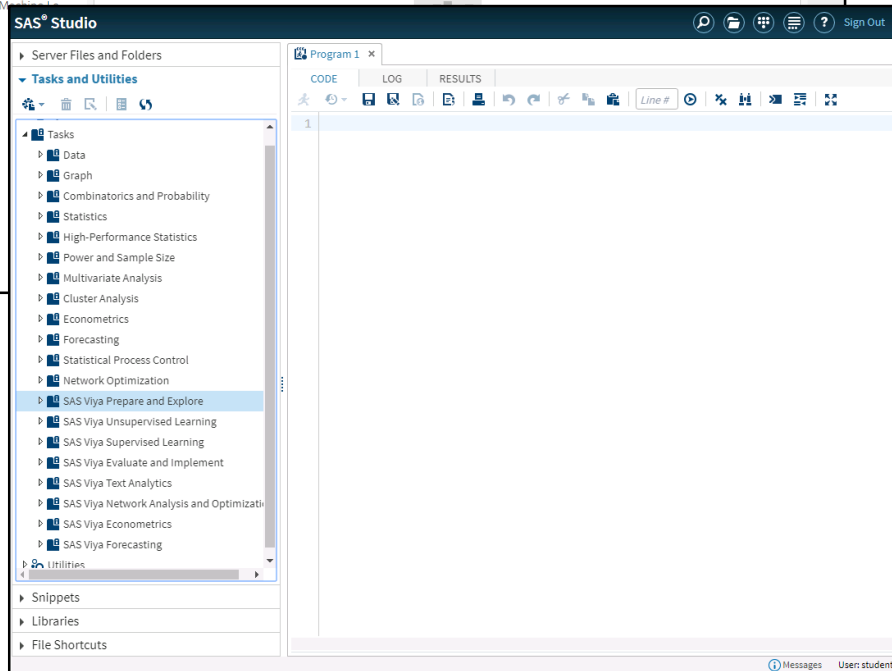
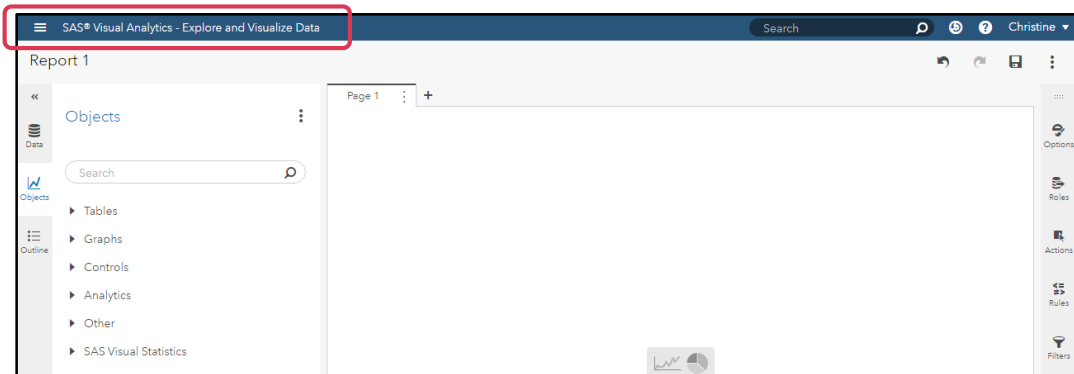
← SAS Visual Data Mining and Machine Learning

- Six additional machine learning models



SAS Viya Interfaces

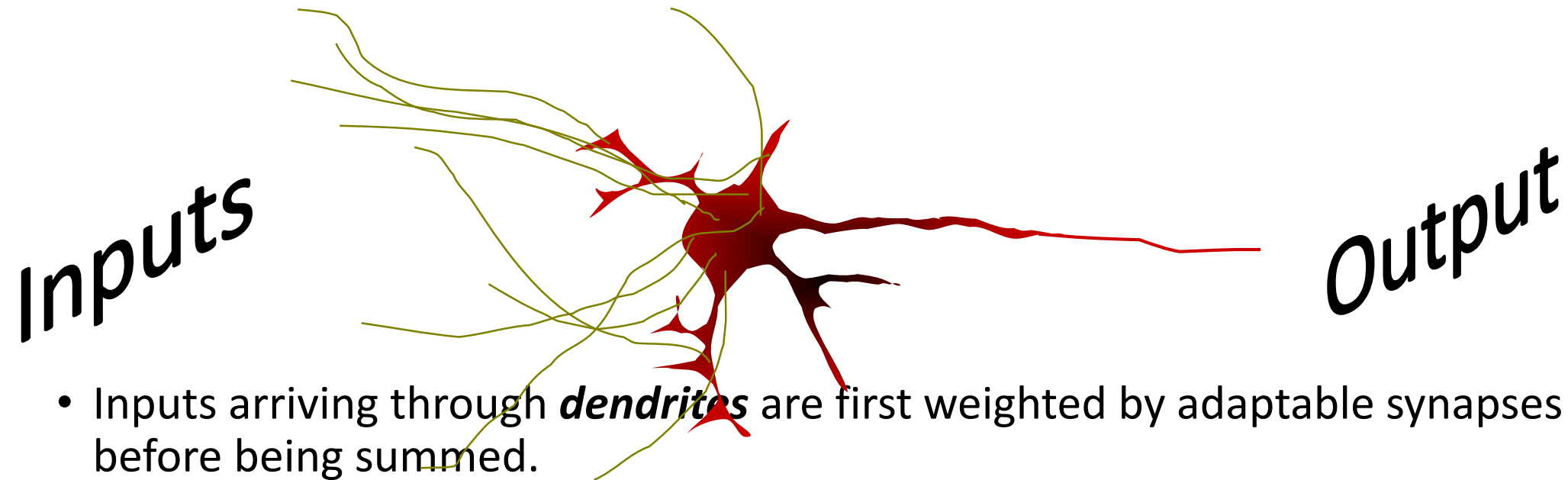
Multiple Interfaces, Including Visual and Programmatic



Neural Network Basics



The Biological Neuron



- Inputs arriving through **dendrites** are first weighted by adaptable synapses before being summed.
- If the sum is greater than an adaptable **bias**, the neuron sends a signal down its axon to other neurons.

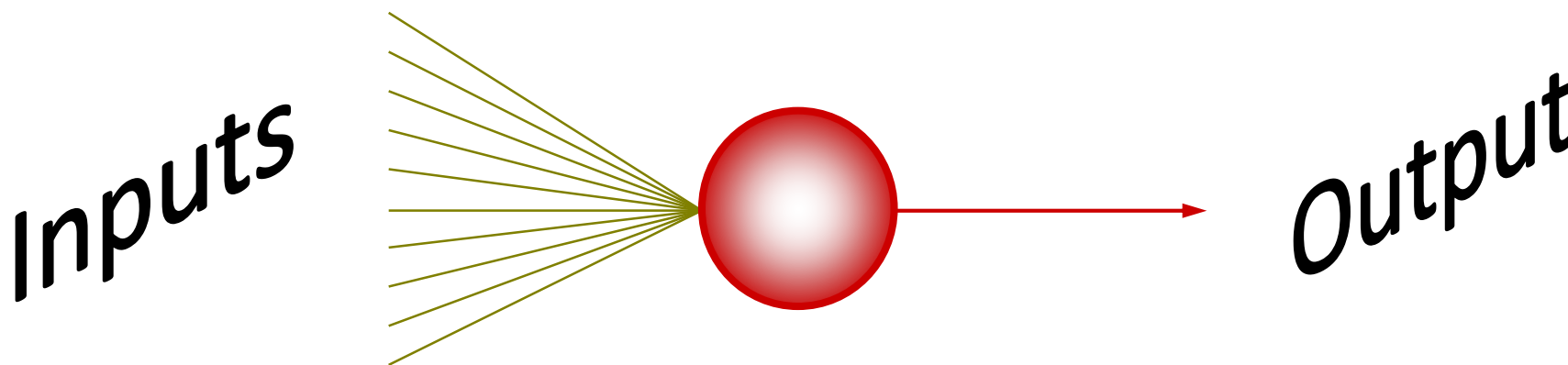


The Mathematical Neuron

- The mathematical neuron has two parts:
 - combination function (pre-activation)
 - activation function

$$H = f \left(w_0 + \sum_{i=1}^d w_i x_i \right)$$

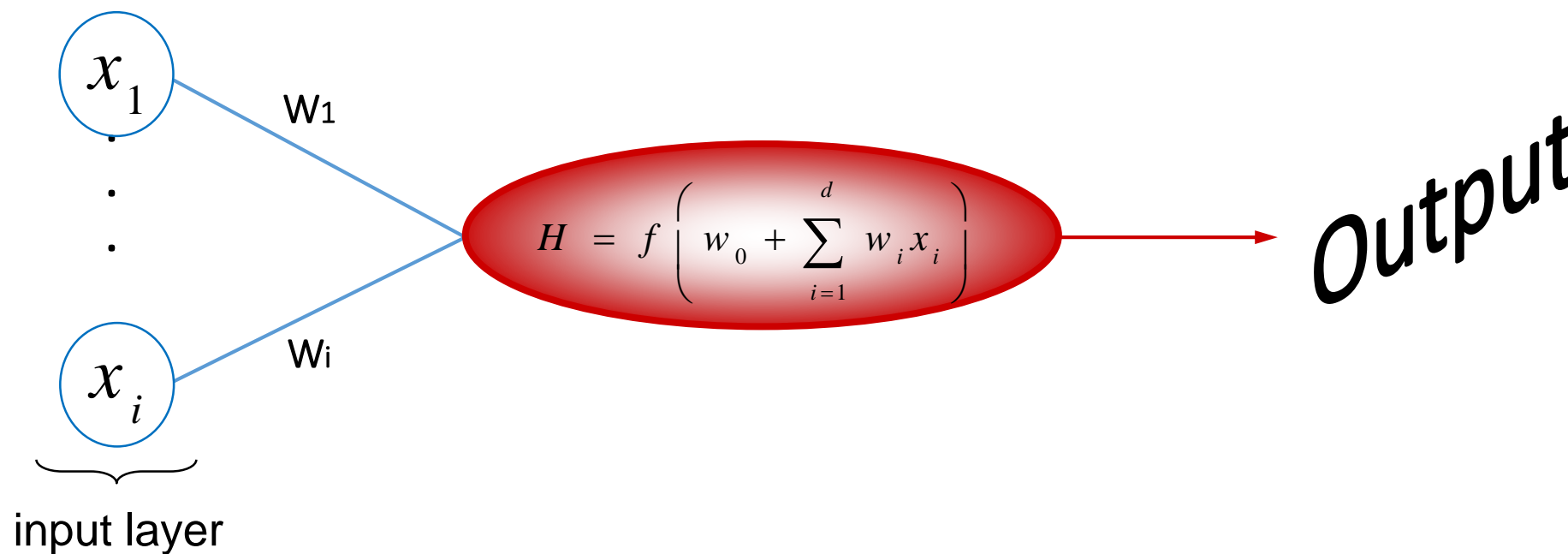
Bias Value





A Single Layer Perceptron

- A single layer perceptron with a linear activation function resembles a generalized linear model.



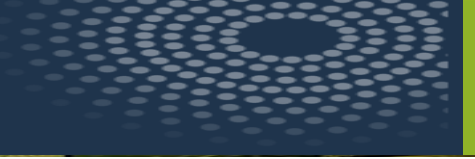


Perceptron

- A simplified representation is,

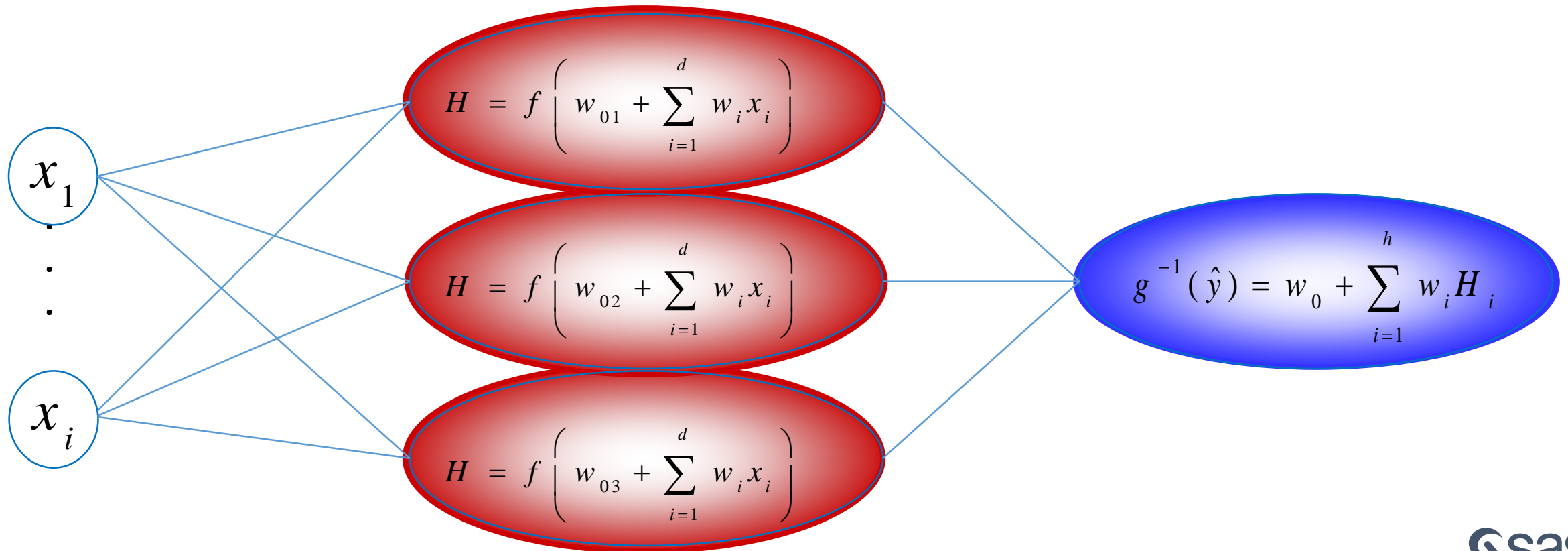
$$\text{output} = \begin{cases} 0 & \text{if } w \cdot x + b \leq 0 \\ 1 & \text{if } w \cdot x + b > 0 \end{cases}$$

1. w and x are vectors whose components are the weights and inputs, respectively
2. Moving the threshold to the other side of the inequality in the previous equation and replacing it by perceptron's bias, $b \equiv -\text{threshold}$



Multilayer Perceptron

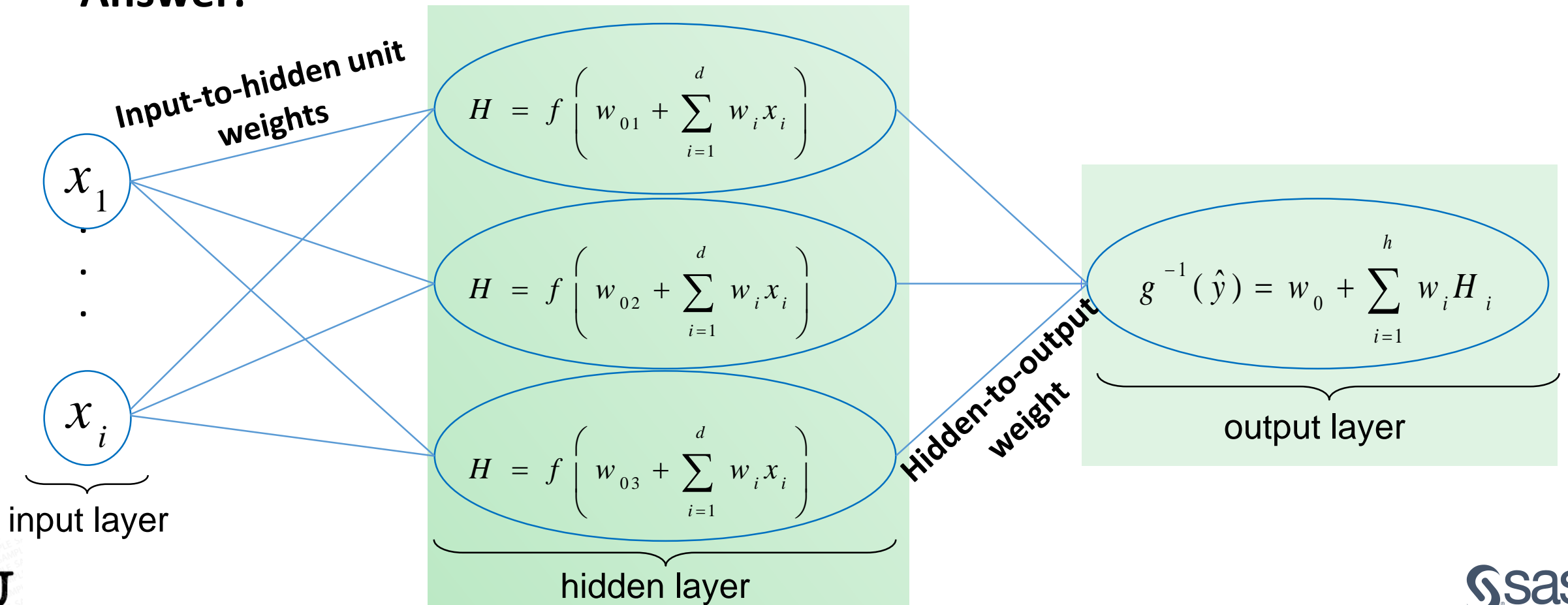
$$g^{-1}(\hat{y}) = w_0 + \sum_{i=1}^h w_i f_i \left(w_{0i} + \sum_{j=1}^d w_{ij} x_j \right)$$





Where Are Activation Functions Typically Used?

• Answer:





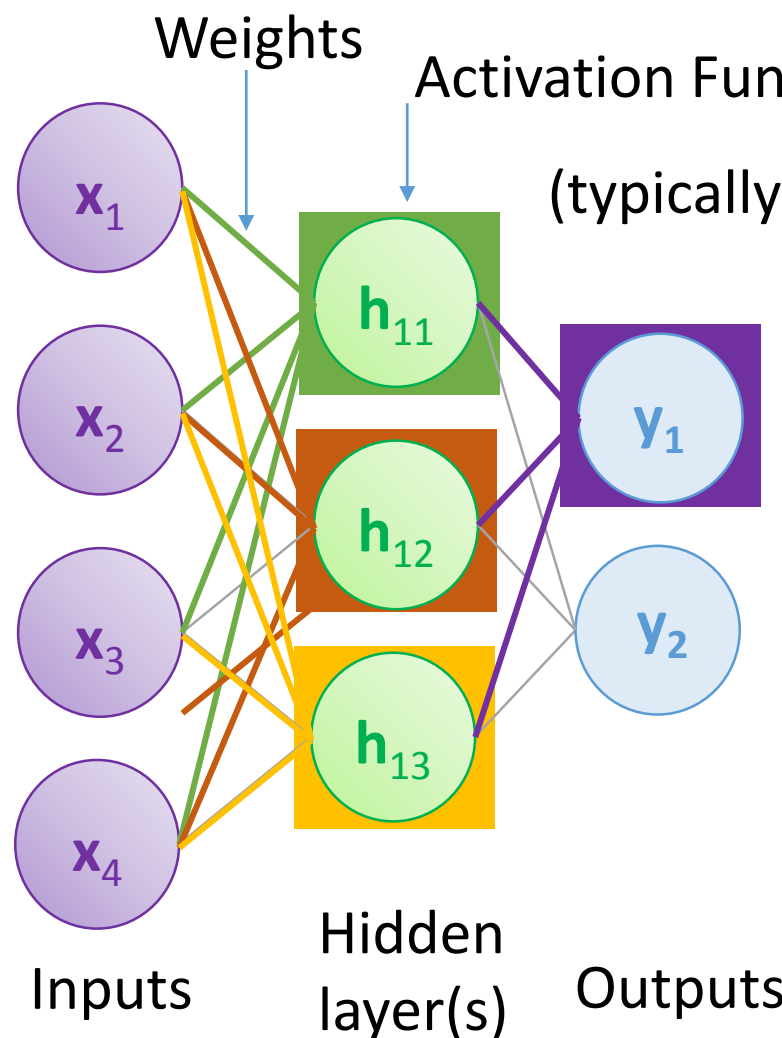
Activation Functions

Activation Function	Function	Range	Plot	Typical Usage
IDENTITY	t	$(-\infty, +\infty)$		Output Layer
Exponential	\exp^t	$(0, \infty)$		Output Layer
SOFTMAX	$\frac{e^i}{\sum \text{exponentials}}$	$(0, 1)$	none	Output Layer
TANH (hyperbolic tangent)	$1 - \frac{2}{1 + e^{(2t)}}$	$(-1, 1)$		Hidden Layer
ReLU (rectified linear)	$\begin{cases} t & \text{if } t \geq 0 \\ 0 & \text{if } t < 0 \end{cases}$	$(0, \infty)$		Hidden Layer
ELU (exponential linear)	$\begin{cases} t & \text{if } t > 0 \\ \alpha (\exp(t) - 1) & \text{if } t \leq 0 \end{cases}$	$(-\alpha, \infty)$		Hidden Layer
SOFTPLUS	$\ln(1 + e^t)$	$(0, \infty)$		Hidden Layer
SINe	$\sin(t)$	$(-1, 1)$		Hidden Layer

Default
→



Neural Networks



Activation Function $f\left(\sum_i w_i x_i + b\right)$
(typically logistic, tanh, etc.)



Example:

$$\tilde{y}_1 = \tanh(w_{30} + w_{31} * \tanh(w_{10} + w_{11}x_1 + w_{12}x_2 + w_{13}x_3 + w_{14}x_4) + w_{32} * \tanh(w_{20} + w_{21}x_1 + w_{22}x_2 + w_{23}x_3 + w_{24}x_4) + w_{33} * \tanh(w_{30} + w_{31}x_1 + w_{32}x_2 + w_{33}x_3 + w_{34}x_4))$$

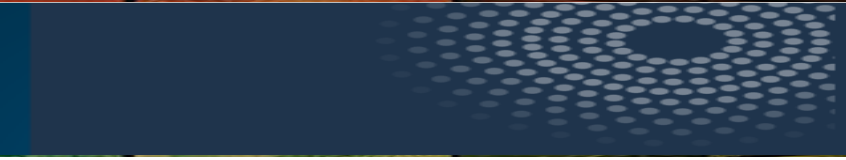
$$\tilde{y}_1 \neq y_1 ?$$

Weights adjusted to train the network in an iterative fashion through **back-propagation** (ie, using gradient of error with respect to weights)



Assessment Methods for Classification

- . Predictive accuracy
 - Hit rate
- . Speed
 - Model building versus predicting/usage speed
- . Robustness
- . Scalability
- . Interpretability
 - Transparency, explainability



Accuracy of Classification Models

In classification problems, the primary source for accuracy estimation is the **confusion matrix**

Accuracy: Overall, how often is the classifier correct?

True Negative Rate: When it is actually negative, how often does it predict negative?

Misclassification: Overall, how often is the classifier wrong?

F Score: Harmonic mean of Precision and Recall

True Positive Rate: When it is actually positive, how often does it predict positive?

Precision: When it predicts positive, how often is it correct?

False Positive Rate: When it is actually negative, how often does it predict positive?

Prevalence: How often does the positive condition actually occur in the sample?

		True/Observed Class	
		Positive	Negative
Predicted Class	Positive	True Positive Count (TP)	False Positive Count (FP)
	Negative	False Negative Count (FN)	True Negative Count (TN)

$$Accuracy = \frac{TP + TN}{TP + TN + FP + FN}$$

$$Misclassification = \frac{FP + FN}{TP + TN + FP + FN}$$

(Error Rate: 1 - Accuracy)

$$True\ Positive\ Rate = \frac{TP}{TP + FN}$$

(Sensitivity, Recall)

$$False\ Positive\ Rate = \frac{FP}{FP + TN}$$

$$True\ Negative\ Rate = \frac{TN}{TN + FP}$$

$$F\ Score = \frac{TP}{TP + \frac{FN + FP}{2}} = \left(2 \times \frac{Precision \times Recall}{Precision + Recall} \right)$$

$$Precision = \frac{TP}{TP + FP} \quad Recall = \frac{TP}{TP + FN}$$

$$Prevalence = \frac{TP + FN}{TP + TN + FP + FN}$$

Demo Using SAS Viya for Learners

<https://vfe.sas.com/portal/home>

Stretch Break (30 Sec)

After the Break:

Moving Beyond Basic Neural Networks:
Deep Learning and
Open Source Integration (Python API)



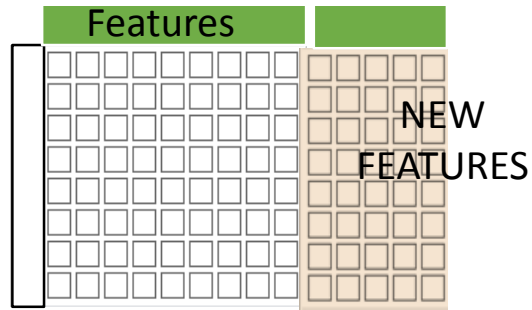
Deep Learning vs. Conventional Neural Network

- Differences in methodologies
 - strengths and weaknesses of conventional NN
 - strengths and weaknesses of Deep Learning
- Differences in Applications objectives
 - Neural Network: input and output provided
 - Deep Learning, identifying new features and feature engineering occur within the architecture
- Various Architectures:
 - CNN
 - RNN
 - LSTM



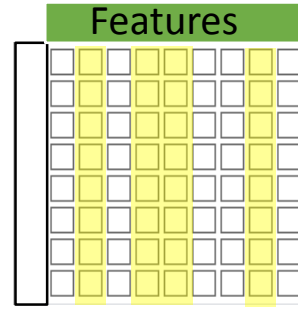
Types of Feature Engineering

Feature Construction



- Cleansing
- Brainstorming
- Aggregation
- Decomposition

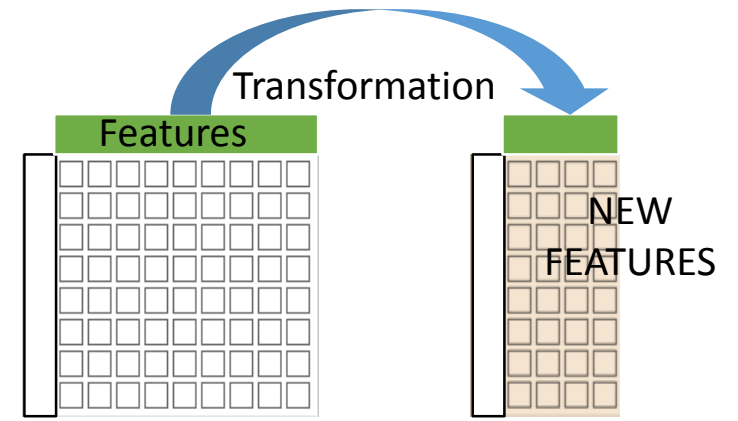
Feature Selection



- MIC, information gain, chi-square...
- Stepwise regression, LASSO, elastic net...
- Decision tree

Consider using several methods and create a pool of features chosen by many

Feature Extraction

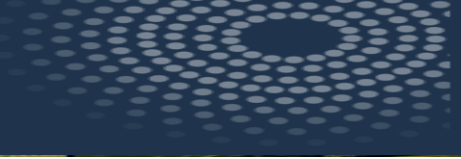


- PCA, SVD
- Nonnegative matrix factorization
- Autoencoding neural networks

Loss of interpretability

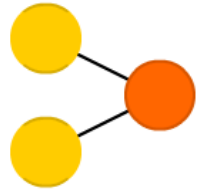


Simpler models, shorter training times, improved accuracy

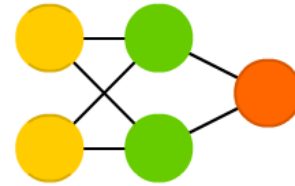


SAS Neural Network Types

Perceptron

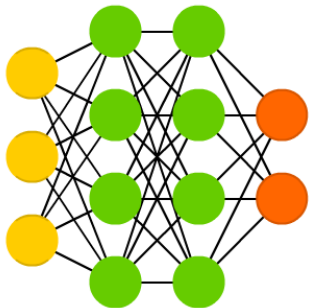


Feed Forward Networks (FF)

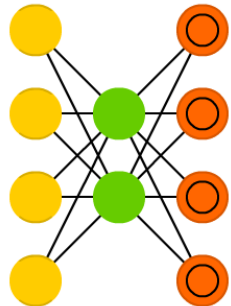


SAS Deep Learning Architecture Types

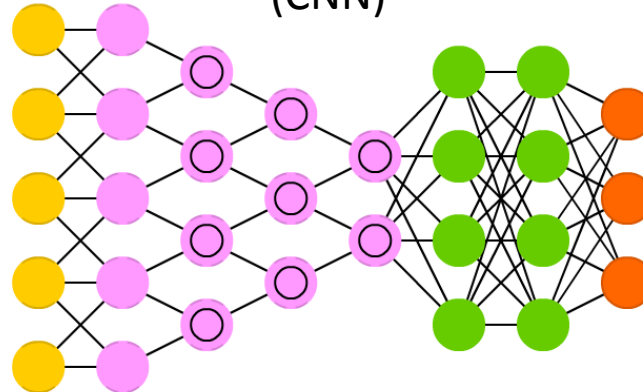
Deep FF Neural Network (DNN)



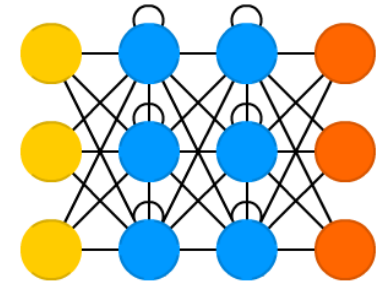
Auto Encoder* (AE)



Convolutional Neural Networks (CNN)

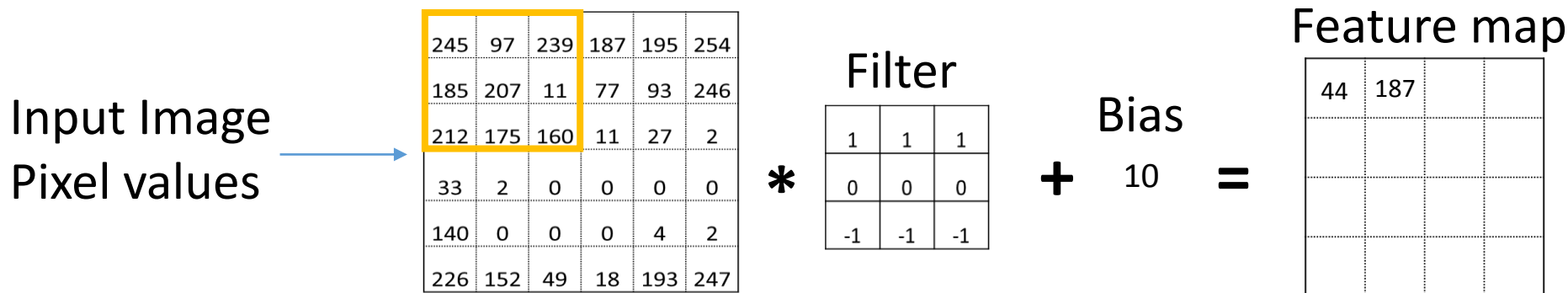
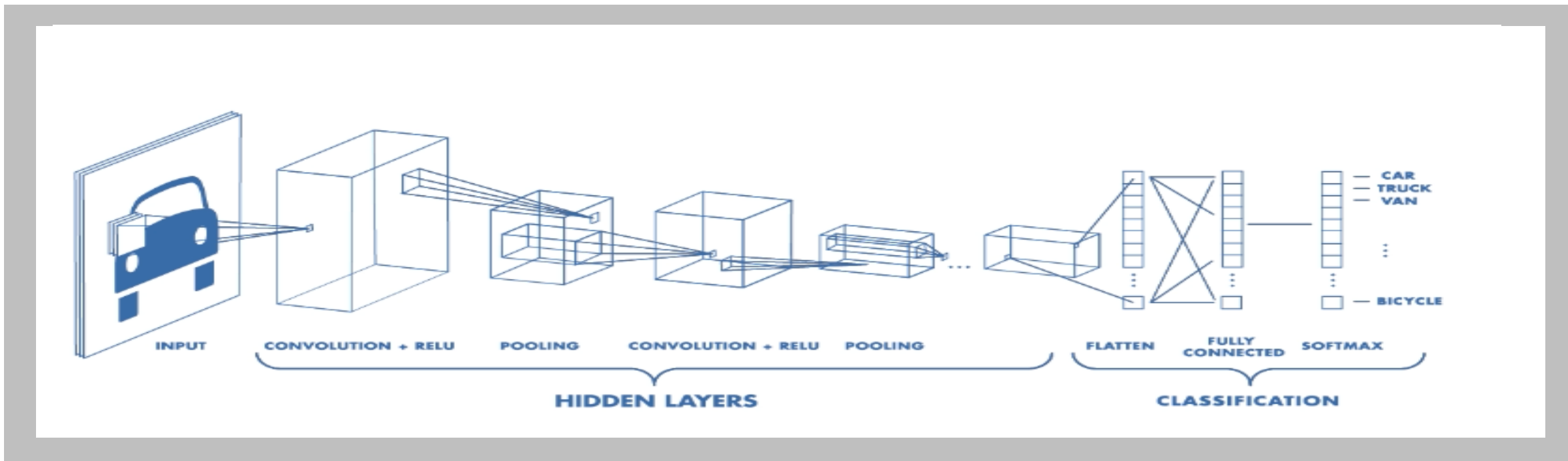


Recurrent Neural Networks (RNN)





Convolutional Neural Networks





Computer Vision

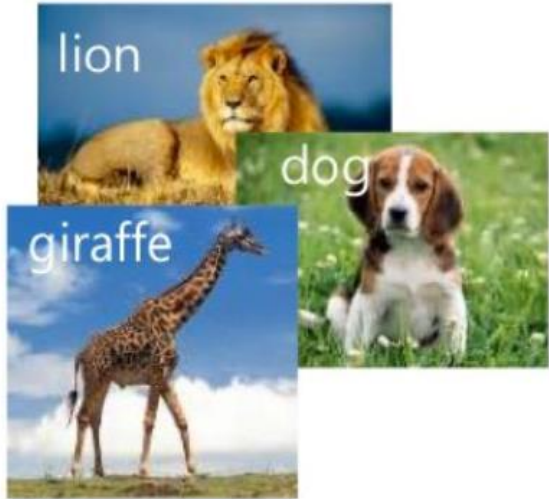
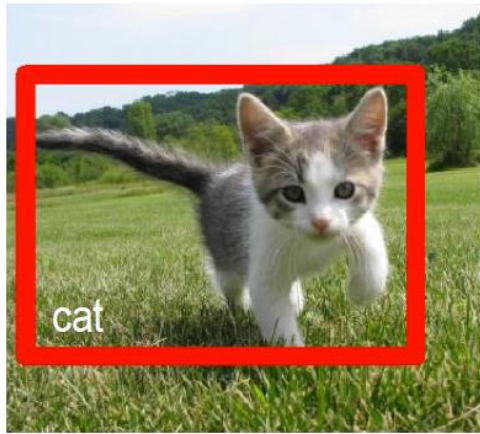
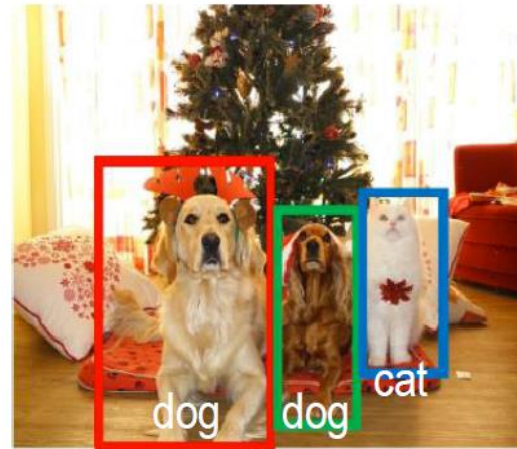


Image Classification



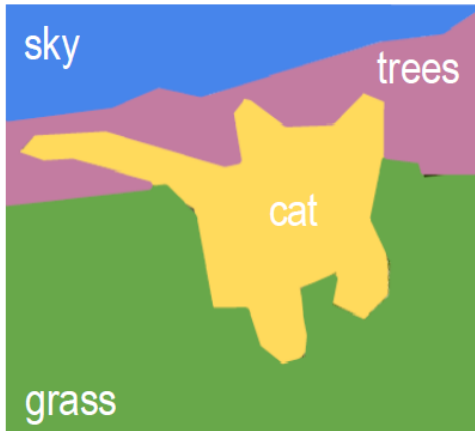
Object Localization



Object Detection



Face Recognition and Key Point Detection



Semantic Segmentation

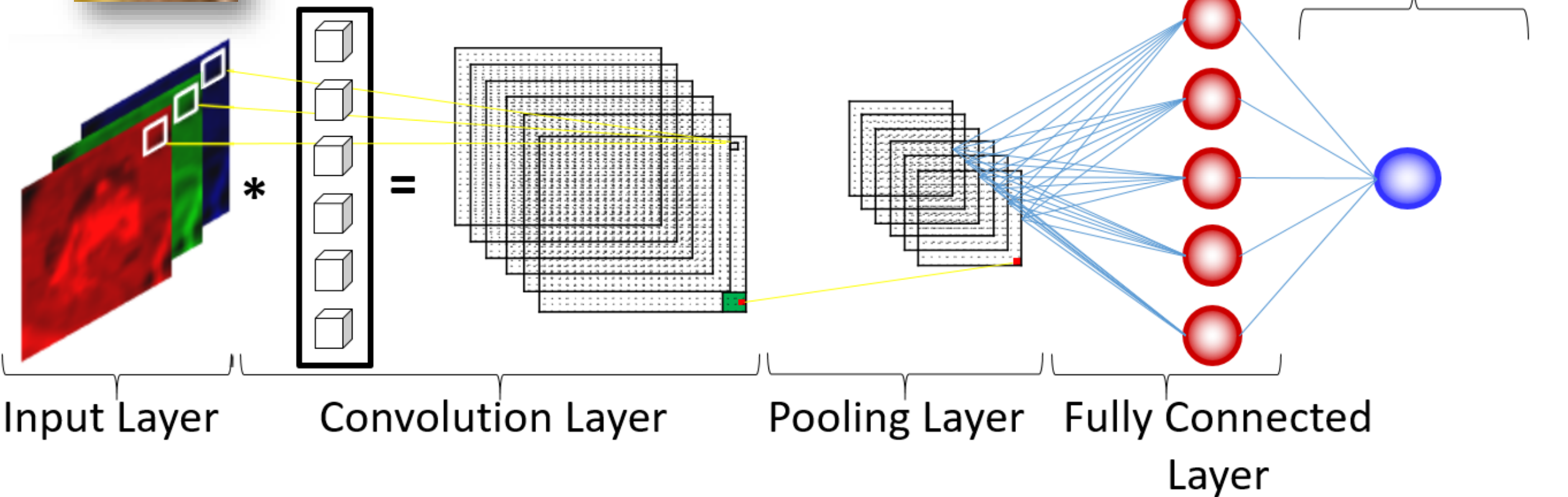
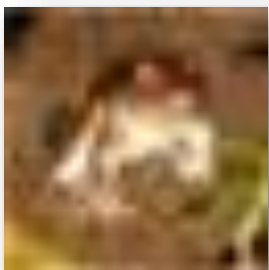


Object Segmentation



Convolutional Neural Network

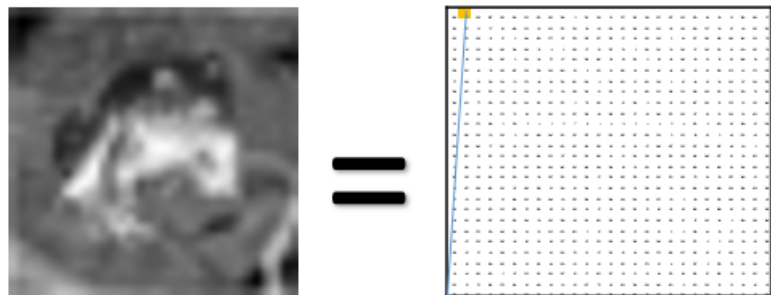
Image





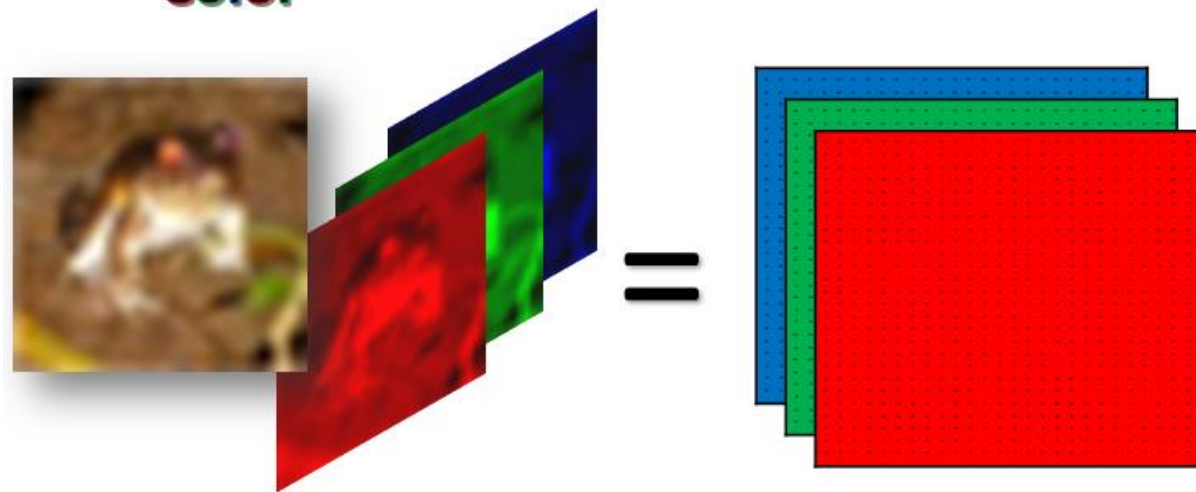
Input Layer

Grayscale



Label	Column 1	Column 2	...	Column N
Frog	223	225	...	82

Color



Label	Column 1	Column 2	...	Column N
Frog	144	37	...	180



SAS Deep Learning Actions

▶ Deep Fully Connected Neural Network (DNN)

```
BuildModel / modeltable={name="< Model table name >"}  
type = "DNN";
```

▶ Convolutional Neural Network (CNN)

```
BuildModel / modeltable={name="< Model table name >"}  
type = "CNN";
```

▶ Recurrent Neural Network (RNN)

```
BuildModel / modeltable={name="< Model table name >"}  
type = "RNN";
```




Build a Deep Neural Network

```
PROC CAS < exc > < noqueue >;  
  BuildModel / modeltable={name="< model table name >"} type = "DNN";  
  
  AddLayer /  
    modeltable="< model table name >"  
    name="< name of layer >"  
    layer={type="layer type"  
      n="< number of hidden units >"  
      act="< type of activation transformation >"  
      init="< weight initialization method >"  
      srcLayers={"< previous layer name >"};  
  RUN;
```



SAS Deep Learning

- DeepLearn action set for programming in CAS
 - Custom-built, VGG, ResNet, InceptionV3, YOLOv2, etc.
 - Transfer learning, GPU training/scoring
- DLPy – easy-to-use python wrapper <https://github.com/sassoftware/python-dlpy>



README.md

DLPy - SAS Viya Deep Learning API for Python



An efficient way to apply deep learning methods to image, text, and audio data.



SAS VIYA

3.4

PIP INSTALL SAS DLPY

PYTHON

3+



SAS and Open Source Integration

Base SAS

- Execute open source code using system commands via the DATA step.

Interactive Matrix Language (IML)

- Submit R code within IML from SAS Code Editor.
- Pass data between R and SAS.

Enterprise Miner

- Execute R code from the open source integration node.
- Execute Python code using a system command.

SAS Viya

- Use open source software to take control of analytical tools.

CAS Actions

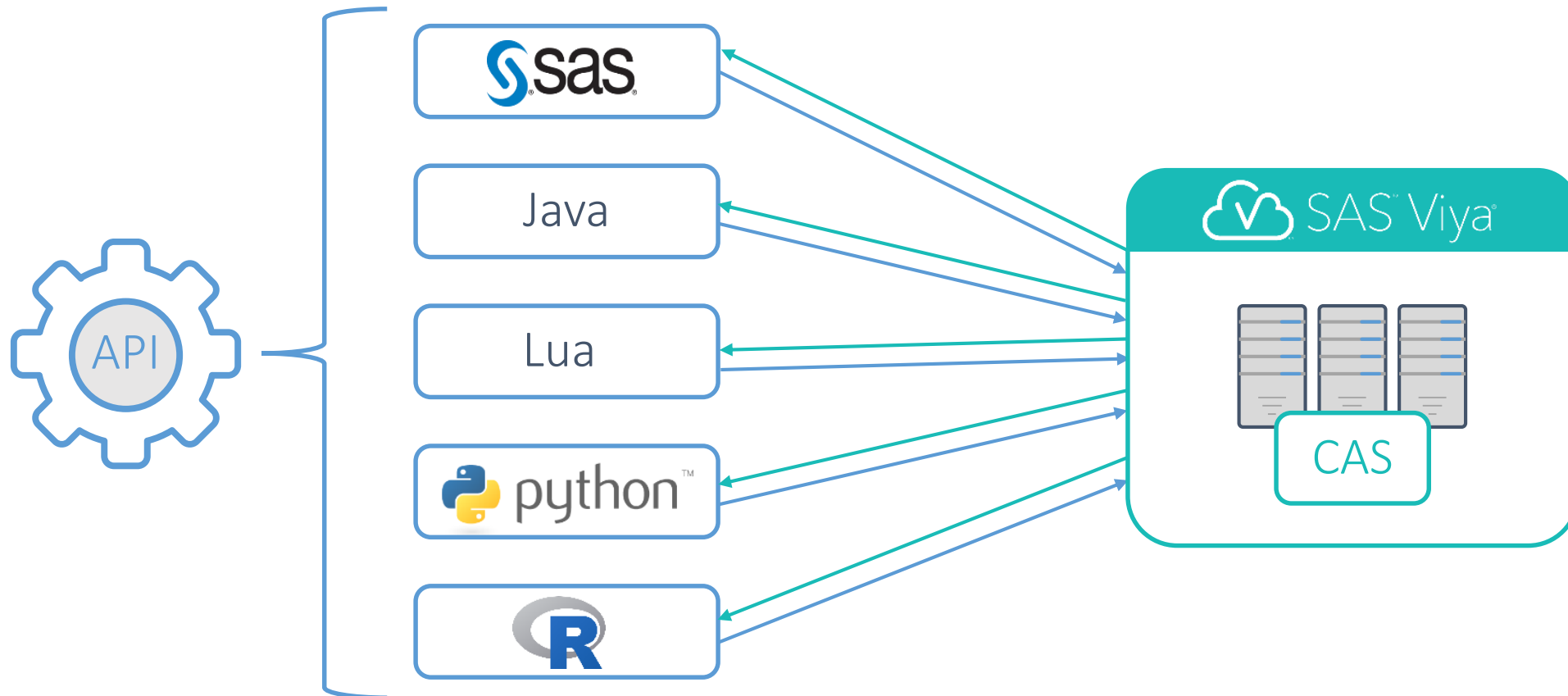
- The tools used to interact with data on the CAS server
- Act as wrappers for parallel processing algorithms
- Load data, transform data, compute statistics, perform analytics, and create output

Open Source Functions \equiv SAS Procedures \equiv CAS Actions



Interfaces to SAS Viya

- Although SAS Viya can be used by various SAS applications, it also enables you to access analytic methods from SAS, Python, Lua, and Java, as well as through a REST interface that uses HTTP or HTTPS.





Jupyter Notebook

Toolbar



Markdown Cell



Code Cell



jupyter Untitled Last Checkpoint: 2 hours ago (unsaved changes) R

File Edit View Insert Cell Kernel Help | R O

📁 + ✂ 📄 📄 ⬆ ⬇ ⏪ ⏹ ⏩ Code ▾ 🗑 CellToolbar

Linear Model Example with R and Jupyter Notebook

Equations

$$Y = X\beta + \epsilon, \quad \epsilon \sim N(0, \sigma^2)$$

$$\hat{\beta} = (X^T X)^{-1} X^T Y$$

$$\hat{\sigma}^2 = \frac{(Y - X\hat{\beta})^T (Y - X\hat{\beta})}{n-p}$$

```

In [1]: ## Create Linear Model Data ##
set.seed(802)
n = 50
x = runif(n, min=10, max=30)
beta0 = 2
beta1 = 3
error = rnorm(n, mean=0, sd=5)
y = beta0 + x*beta1 + error

In [2]: ## Fit Model ##
mod1 = lm(y~x)
summary(mod1)
...

In [3]: ## Plot Model ##
plot(y~x, col="blue")
abline(mod1, col="red", lwd=2)
...
                
```



Jupyter Notebook Results

Results



```
In [1]: ## Create Linear Model Data ##
set.seed(802)
n = 50
x = runif(n, min=10, max=30)
beta0 = 2
beta1 = 3
error = rnorm(n, mean=0, sd=5)
y = beta0 + x*beta1 + error
```

```
In [2]: ## Fit Model ##
mod1 = lm(y~x)
summary(mod1)
```

```
Call:
lm(formula = y ~ x)

Residuals:
    Min       1Q   Median       3Q      Max
-9.3360 -2.7005 -0.2983  2.9151  8.9333

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) -0.6977     2.5214  -0.277   0.783
x             3.1214     0.1183  26.390 <2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 4.446 on 48 degrees of freedom
Multiple R-squared:  0.9355,    Adjusted R-squared:  0.9342
F-statistic: 696.4 on 1 and 48 DF,  p-value: < 2.2e-16
```

Results



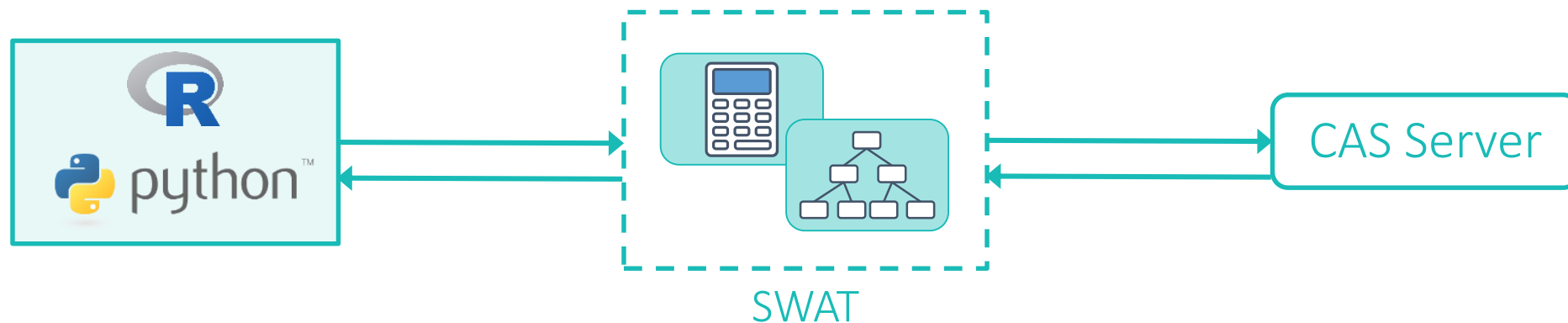
```
In [3]: ## Plot Model ##
plot(y~x, col="blue")
abline(mod1, col="red", lwd=2)
```





Scripting Wrapper for Analytics Transfer (SWAT)

- The SWAT package enables you to interface with CAS from R or Python.
- You can write an R or Python program that connects to a CAS server, load data into CAS, analyze large in-memory data sets quickly and efficiently using CAS actions, and work with results of your analyses using familiar data wrangling techniques in the open source language.





SAS GitHub Page

- Download the SWAT package from the SAS GitHub page.
- View system requirements, prerequisite packages required, and example notebooks.

R-swat

The SAS Scripting Wrapper for Analytics Transfer (SWAT) package is the R client to SAS Cloud Analytic Services (CAS). It allows users to execute CAS actions and process the results all from R.

● R ★ 14 🍴 7

[python-swat](#)

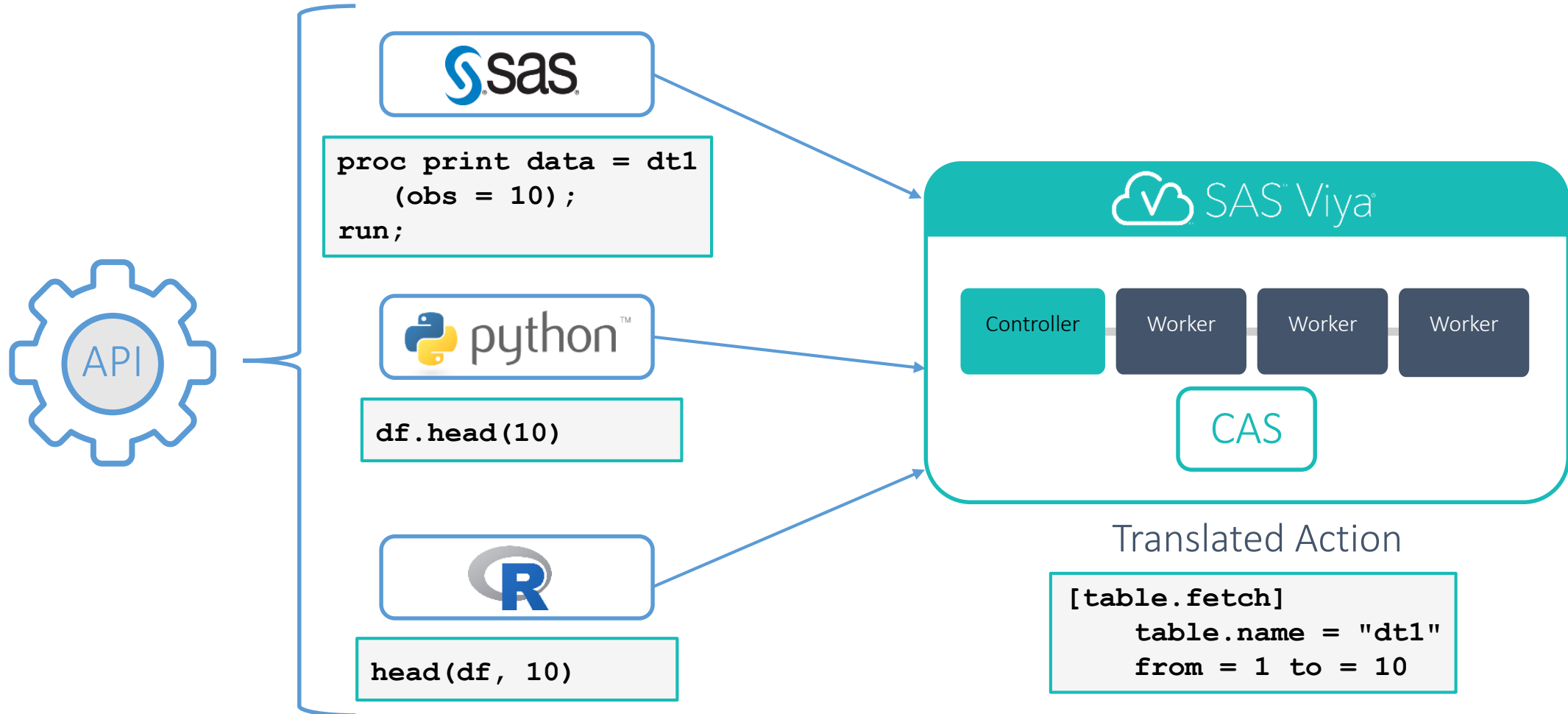
The SAS Scripting Wrapper for Analytics Transfer (SWAT) package is the Python client to SAS Cloud Analytic Services (CAS). It allows users to execute CAS actions and process the results all from Python.

python sas sas-swat

● Python ★ 52 🍴 25



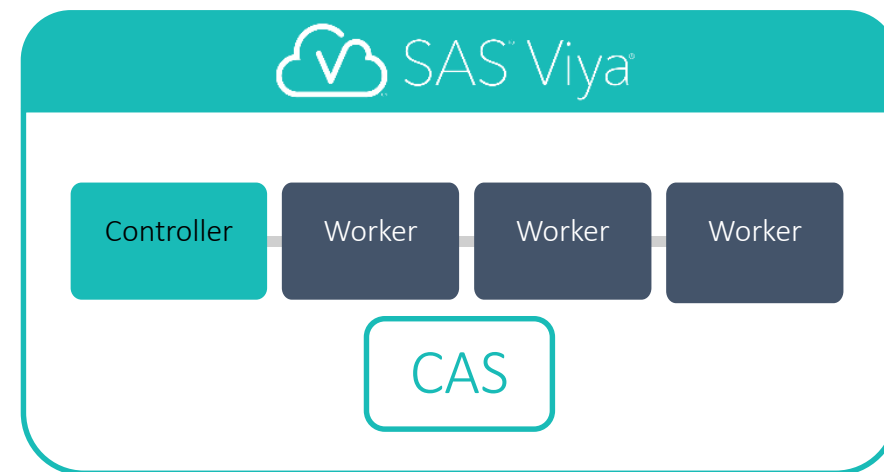
Same CAS Action, Different Interface





Open Architecture Advantage

- The same CAS action is used regardless of the interface and API.
- Results are equivalent (given seeds).
- Information can easily be passed between different languages.



SAS Viya for Learners Image Classification Jupyter Notebook Demo

<https://v4e008.vfe.sas.com/JupyterHub/user/sugumara@oakland.edu/lab?redirects=1>

Academic Collaboration with SAS, Resources for Academics, Syllabus

<https://vfe.sas.com/portal/home>



Accessing VFL

https://www.sas.com/en_us/software/viya-for-learners.html

SAS

SAS® Viya for Learners [Apply for Access](#)

SAS® VIYA® FOR LEARNERS

Teach and learn leading-edge data science skills.

[Apply for Access](#)

Only for educators and their students.



Access to VFL

Educators

- Submit an online [Educator Access Request Form](#)
- Global SAS Education Approvers verify and approve the Educators.

Students

- Gain access when their instructor adds them to their course.

Apply for access: SAS Viya for Learners

About SAS Viya for Learners

SAS Viya for Learners is a suite of free, cloud-based software for teaching and learning in-demand data science skills, including:

- Preparing data for analysis.
- Visually exploring data to discover new insights.
- Creating models in an integrated environment.
- Deploying and managing models.

Sign up now; we'll verify your information and notify you when SAS Viya for Learners is available in your area.*

*For academic, noncommercial use only.

Have a SAS profile?
To complete this form automatically [Sign In](#)

First Name *

Last Name *

Academic Institution Email Address *

Academic Institution *

Country/Region *
United States ▼

State *
Please select ▼

Phone

Title *
Instructor ▼

Course Level
(Please identify the level that best represents your course) *
Course not for credit ▼

Discipline
(Please select the discipline that most closely aligns with your program) *
Computer & Information Sciences & Support Services ▼

Number of Students *
< 50 ▼

Program Start Date (mm/dd/yyyy) *

Program End Date (mm/dd/yyyy) *

All personal information will be handled in accordance with the SAS Privacy Statement.

[Sign me up](#)



Why SAS® Viya® for Learners?

SAS® Viya for Learners

Apply for Access

For Educators

For Students

A screenshot of the SAS Viya for Learners website. The main image shows three people (two women and one man) looking at a laptop screen. The text on the page reads: 'SAS VIYA FOR LEARNERS', 'Teach and learn leading edge data science skills.', 'Apply for Access', 'Only for educators and their students.', 'No downloads. No cost. Unlimited potential.', and 'Educators can sign up for free access to advanced analytics software for teaching and learning leading edge data science skills. SAS Viya for Learners is a full suite of cloud based software that supports the entire...'. The SAS logo is in the bottom right corner. A vertical green bar on the right side of the screenshot contains the word 'TUTORIAL' in white capital letters.

Discover how SAS Viya for Learners makes it easy for you to create and manage your course section so you can spend more time working with and teaching students.

Advantages for Educators

- **Free suite of SAS Analytics software.** Build a complete advanced analytics program - from entry-level to doctorate - with a single software environment.
- **More time to spend teaching analytics.** We'll provide the tools your students need to learn the software - including SAS courses online chat, web tutorials, e-learning opportunities, documentation, communities and world-class technical support - leaving you free to actually teach analytics and critical thinking skills.
- **Curriculum support.** Get curriculum support for using SAS in the classroom and building an advanced analytics curriculum.

We'll help you build an advanced analytics curriculum and delivery platform that will boost graduate career placement rates.



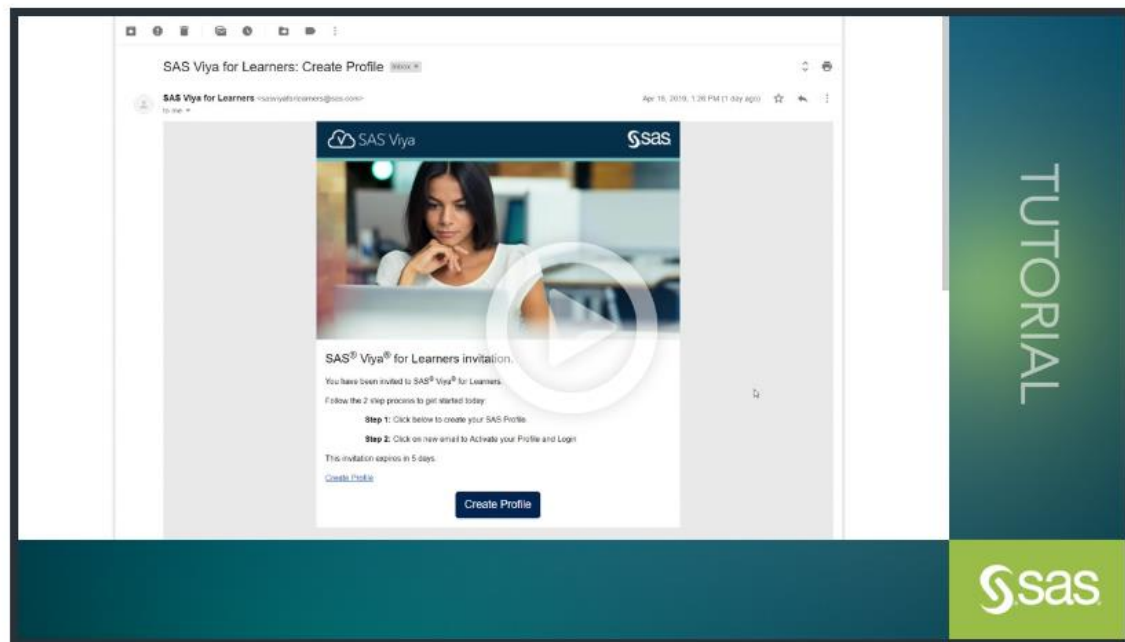
Why SAS[®] Viya[®] for Learners?

SAS[®] Viya for Learners

Apply for Access

For Educators

For Students



Find out how easy it is to get started with SAS Viya for Learners as part of a course requirement.

Advantages for Students

- **Free SAS advanced analytics software.** Program in your language of choice - SAS, Python, R. Easily create visualizations to explain your work.
- **Marketable skills.** Explore data, discover insights and deploy models within a single, free software offering. And show off your skills with badges and certification opportunities.
- **Real-world practice.** Work with true business use cases using the same SAS software used by 92 of the top 100 companies on the Fortune Global 500.
- **Free help when you need it.** Access easy-to-digest learning materials - from basic programming through advanced deep learning, artificial intelligence and machine learning.



VFL Portal

Browser address bar: vfe.sas.com/portal/home

Navigation: Apps Search Vanguard Project Ape Agile Education SAS Apps

SAS® Viya® for Learners

My Sections

[New Section](#) [Access Teaching Materials](#)

Section Name	Code	Start date	End date	Days	Launch
VFL Test Access	VFLTESTING123	May 28, 2019	May 28, 2020	Mon, Wed, Fri	Launch
VFL Access ML	ABC123	October 3, 2019	July 10, 2020	Mon, Wed, Fri	Launch
TEST VDMML	SASVDMML	October 9, 2019	February 9, 2020	Mon, Wed, Fri	Launch
TEST for Project Creation Bug-Fi...	TEST Oct 18	October 18, 2019	February 17, 2020	Fri	Launch
Intro to Jessica	JESSICA 101	October 31, 2019	May 8, 2020	Mon, Wed, Fri	Launch
Intro to VA	VA123	November 15, 2019	March 15, 2020	Mon, Wed, Fri	Launch
TEST Nov 15 2019 Create Project	ABC123	November 15, 2019	March 15, 2020	Mon, Wed, Fri	Launch
Model Building	MB100	November 18, 2019	March 18, 2020	Mon, Wed, Fri	Launch
VDMML	VDMML100	November 18, 2019	March 18, 2020	Mon, Wed, Fri	Launch
Testing Project Creation	TEST02	December 10, 2019	April 10, 2020	Mon, Wed, Fri	Launch



VFL Instructor Portal VLE

<https://vle.sas.com/course/view.php?id=3697>

The screenshot shows the SAS Viya For Learners Instructor Portal. At the top, there is a navigation bar with the SAS logo and the text "Virtual Learning Environment". The user is identified as "April Stauber" and the language is set to "English - United States (en_us)".

The main content area is titled "SAS Viya For Learners Instructor Portal" and includes a breadcrumb trail: "Dashboard / My courses / SAS Viya For Learners Instructor Portal".

On the left, there is a sidebar menu with the following items:

- SAS Viya For Learners Instructor Portal
- General
- Data Management Courses
- Programming Courses
- Visualization Courses
- Open Sources Courses
- Advanced Analytics Courses
- Dashboard
- Home
- Calendar
- Learner Dashboard
- My courses
- SAS Programming 1: Essentials
- SAS Visual Analytics 1 for SAS Viya: Basics (VFL)
- SAS Viya For Learners Instructor Portal

The main content area features a "Service Level Agreement" section with a green checkmark indicating agreement. Below this, there are four course categories, each with a "Learn" icon and a list of resources:

- Data Management Courses**: Self-Service Data Preparation on SAS Viya (DIDP22). Resources include Course Notes (DIDP22), Course Slides (DIDP22), and Addendum for SAS Viya for Learners (DIDP22).
- Programming Courses**: Programming for SAS Viya (PGVY34). Resources include Course Notes (PGVY34), Course Slides (PGVY34), and Addendum for SAS Viya for Learners (PGVY34).
- Visualization Courses**
- Advanced Analytics Courses**

On the right side, there is a "Your progress" section with a green checkmark and a "Free eLearning" section with links to "Try Machine Learning on SAS Viya", "Try Visual Analytics on SAS Viya: Basics", and "Try Visual Analytics on SAS Viya: Advanced". Below that is a "Frequently Asked Questions" section with a link to "Viya for Learners".





SAS Courses Available in VFL



Data Management Courses

- Self-Service Data Preparation on SAS Viya (DIDP22)



Visualization Courses

- SAS Visual Analytics 1 for SAS Viya: Basic (YVA13V)
- SAS Visual Analytics 2 for SAS Viya: Advanced (YVA23V) – added (1/8/20)



Open Source Courses

- SAS Viya and Open Source Integration with R and Python (EVMLOPR)



Programming Courses

- Programming for SAS Viya (PGVY34)



Advanced Analytics Courses

- SAS Visual Statistics on SAS Viya: Interactive Model Building (SVSO83)
- SAS Visual Data Mining and Machine Learning on SAS Viya: Interactive Machine Learning (VDMO83)
- Supervised Machine Learning Procedures Using SAS Viya in SAS Studio (DMML34)
- Machine Learning Using SAS Viya (CPML83)
- SAS® Visual Text Analytics in SAS® Viya® (SVTA34)

SAS Academic Specialization

https://www.sas.com/en_us/learn/academic-programs/specializations/academic-specializations.html



Academic Specialization in SAS Analytics

- Started in Fall 2019
- Three Courses to be taken where SAS is used
 - MIS 5560 – Introduction to Data Science
 - MIS 6900 – Deep Learning and Text Analytics
 - QMM 5520 - Forecasting
- Capstone Project
 - Use SAS in capstone project for analysis in addition to other tools



[Additional Details](#)

SAS - Oakland University Academic Specialization in SAS Analytics

Issued by [SAS](#)

Graduates of the Master of Science in Information Technology Management with Business Analytics concentration (MSITM-BA) at Oakland University earn a Tier 2 Academic Specialization in SAS Analytics recognizing their ability to leverage SAS analytical tools for statistical analysis, data mining, forecasting, machine learning, text mining, and visual data analytics.

Skills

Big Data Management

Data Mining

Data Preparation

Data Visualization

Forecasting

Machine Learning

Neural Networks And Deep Learning

Open Source Integration

Statistical Analysis

Text Analytics

Time Series Analysis

Questions/Comments

Thank You for your Attention!

Vijayan Sugumaran: sugumara@oakland.edu

James Harroun: James.Harroun@sas.com

OU School of Business Administration

(<http://www.oakland.edu/business>)

