

PhUSE 2019 SDE Mississauga, Canada

Artificial intelligence and Healthcare

Data-driven Decision-making in a Dynamic Landscape

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15th August 2019



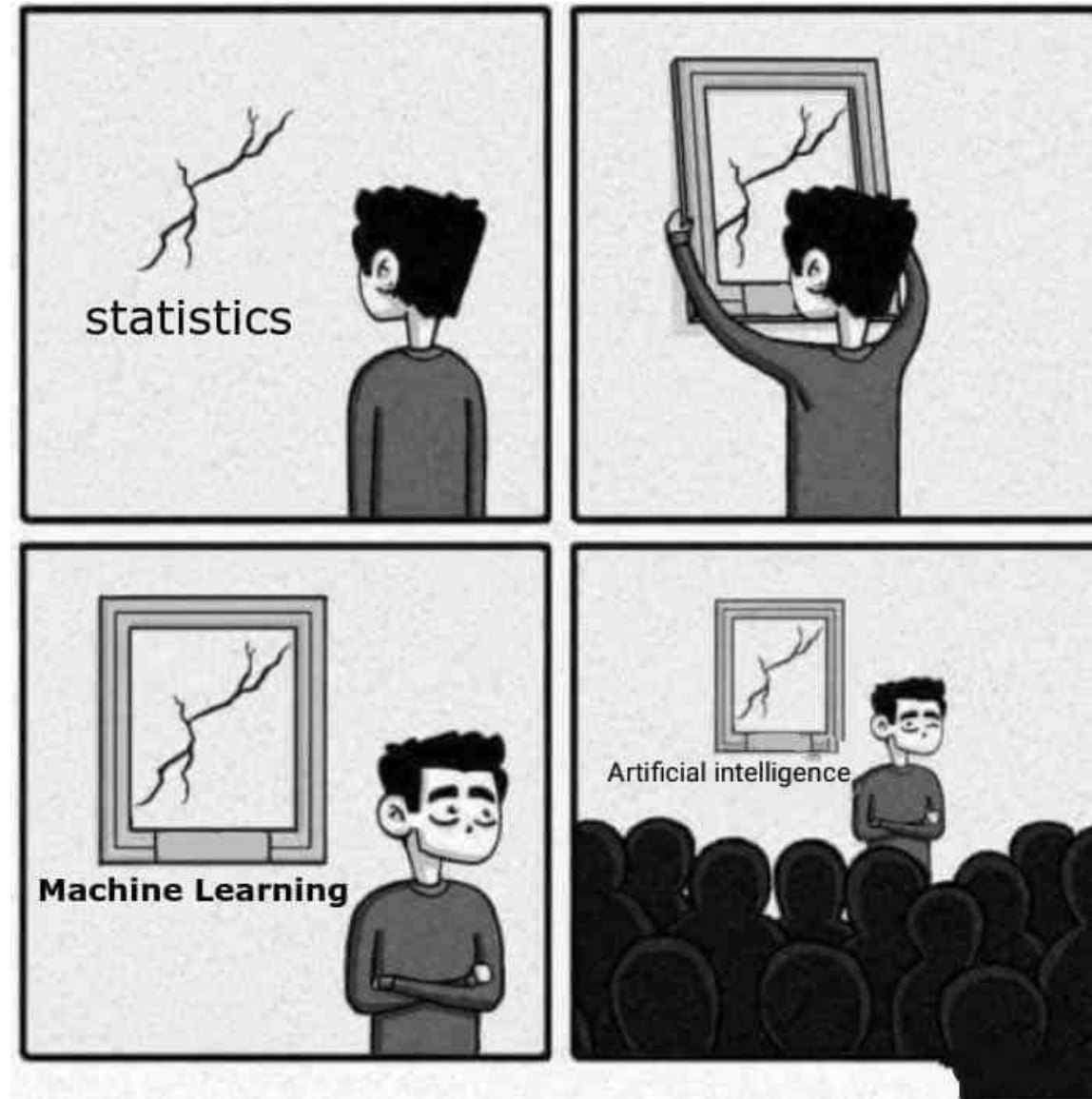
Agenda

- ❖ Introduction
- ❖ Examples
- ❖ Overview of Deep Learning, Machine Learning and AI
- ❖ Regression and Classification Trees using PROC HPSPLIT
- ❖ Potential areas for AI
- ❖ Current limitations of AI
- ❖ Conclusion

Congratulations!

A picture is worth
a thousand words!

We are done!



Which of the two poems below has been written by a computer?

Poem A

Red flags the reason for
pretty flags.
And ribbons.
Ribbons of flags
And wearing material
Reason for wearing material.
Give pleasure.
Can you give me the regions.
The regions and the land.
The regions and wheels.
All wheels are perfect.
Enthusiasm.

Poem B

A wounded deer leaps highest,
I've heard the daffodil I've
heard the flag to-day
I've heard the hunter tell;
'Tis but the ecstasy of death,
And then the brake is almost
done,
And sunrise grows so near
sunrise grows so near
That we can touch the despair
and
frenzied hope of all the ages

<https://ideas.ted.com/was-this-poem-written-by-a-computer-or-human/>

The Answer is ...

Poem A

Red flags the reason for pretty
flags.
And ribbons.
Ribbons of flags
And wearing material
Reason for wearing material.
Give pleasure.
Can you give me the regions.
The regions and the land.
The regions and wheels.
All wheels are perfect.
Enthusiasm.

- Gertrude Stein (1874-1946)

Poem B

A wounded deer leaps highest,
I've heard the daffodil I've heard
the flag to-day
I've heard the hunter tell;
'Tis but the ecstasy of death,
And then the brake is almost done,
And sunrise grows so near
sunrise grows so near
That we can touch the despair and
frenzied hope of all the ages

- Ray Kurzweil's Cybernetic Poet
(RKCP)

RKCP Version 1: Mid 1980s

Based on simple markov-like models (similar in neural nets) to create language models of how the analyzed poets used words and word sequences, and then to write original poetry using these models.

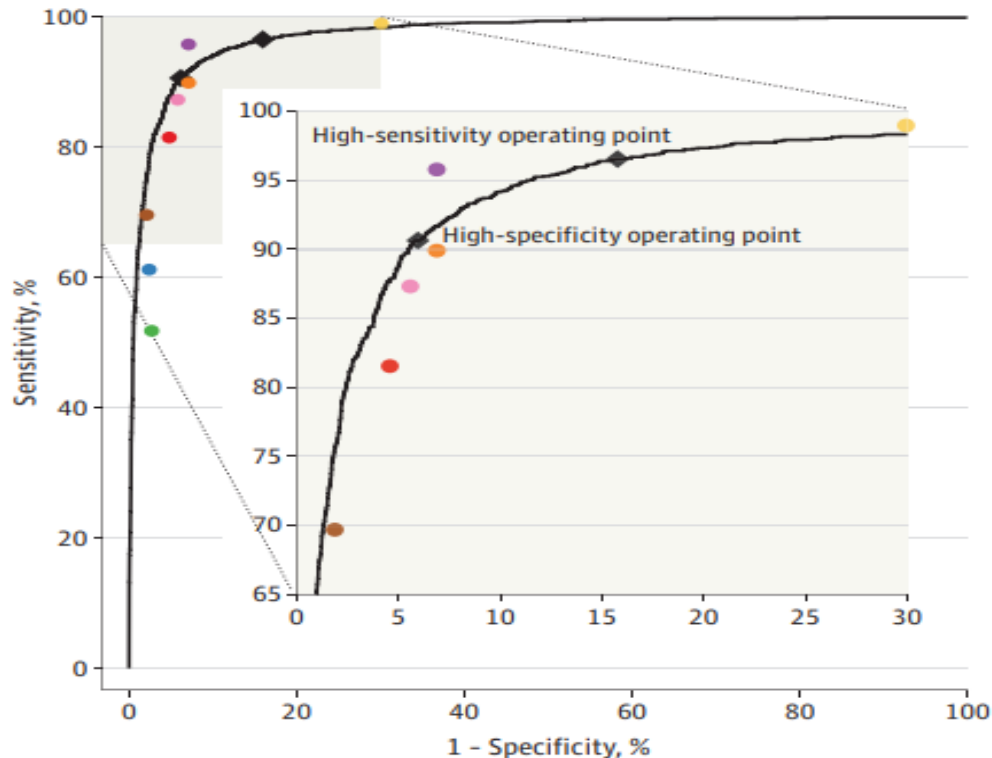
Introduction

- ❑ It's not about making better decisions; it's about having better information.
- ❑ In many pressing medical problems, the answers to knowing whom to treat, when to treat, and what to treat with, might already be in your data.
- ❑ Identify long-term pattern and detect improvements that would help in decision making.
- ❑ Contribute in promising areas like Clinical decision support, early insights, and risk scoring.
- ❑ Revolutionize patient care and better clinical solutions.

Artificial intelligence is the field of study that attempts to both understand and build intelligent entities. It is fueled by:

- ✓ Availability of the big data
- ✓ Advanced machine learning algorithms
- ✓ Growth in computation power

Example - Development and Validation of a Deep Learning Algorithm for Detection of Diabetic Retinopathy in Retinal Fundus Photographs



A deep neural network model detects referable diabetic retinopathy with expert-level performance

Sensitivity: Evaluates how good the test is in detecting a positive disease.

Specificity: Estimates how likely patients without disease can be correctly ruled out.

<https://jamanetwork.com/journals/jama/fullarticle/2588763>

Some other research publications:

Deep Learning at Chest Radiography: Automated Classification of Pulmonary Tuberculosis by Using Convolutional Neural Networks

Similar approaches detected tuberculosis on chest radiographs with 99% accuracy.

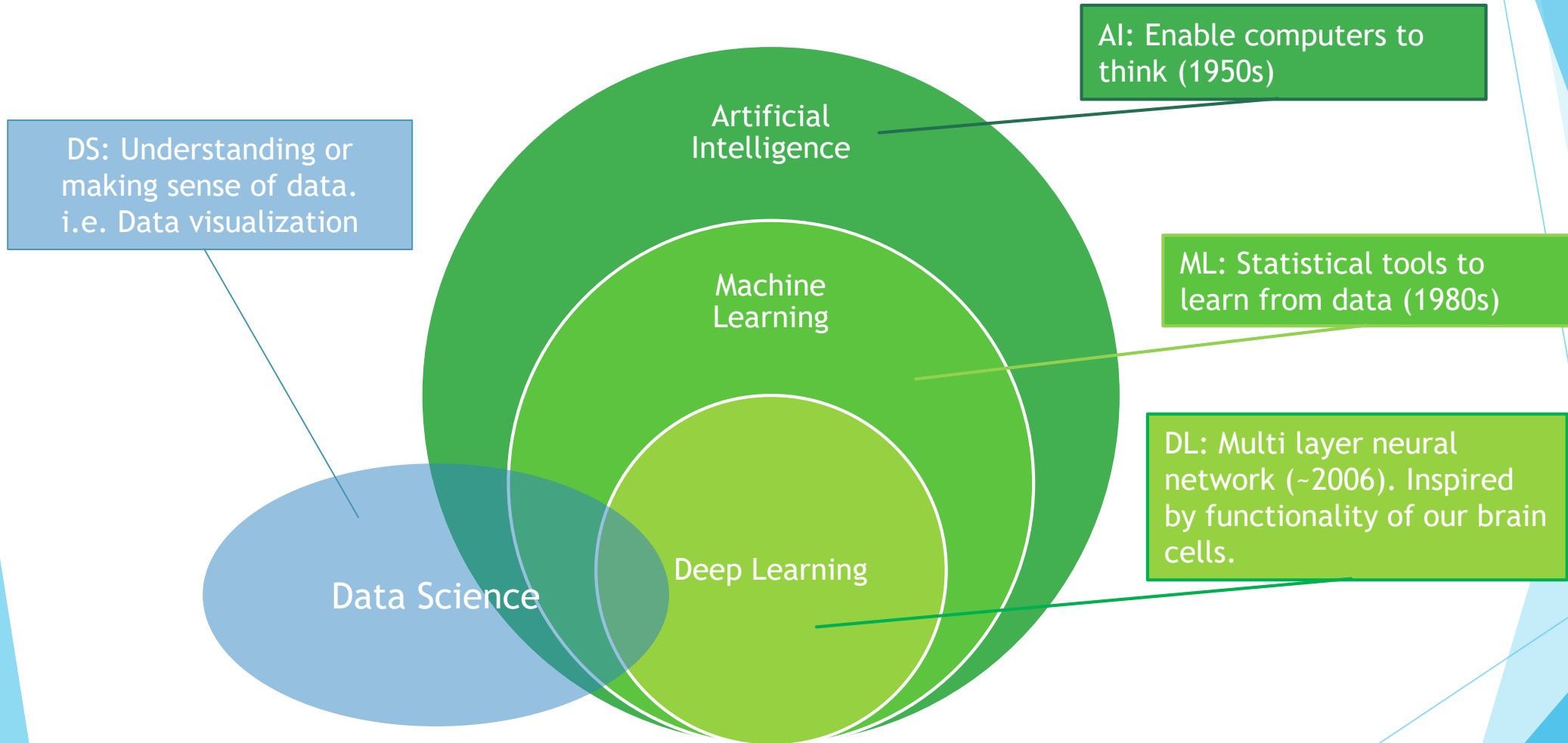
<https://doi.org/10.1148/radiol.2017162326>

Dermatologist-level classification of skin cancer with deep neural networks

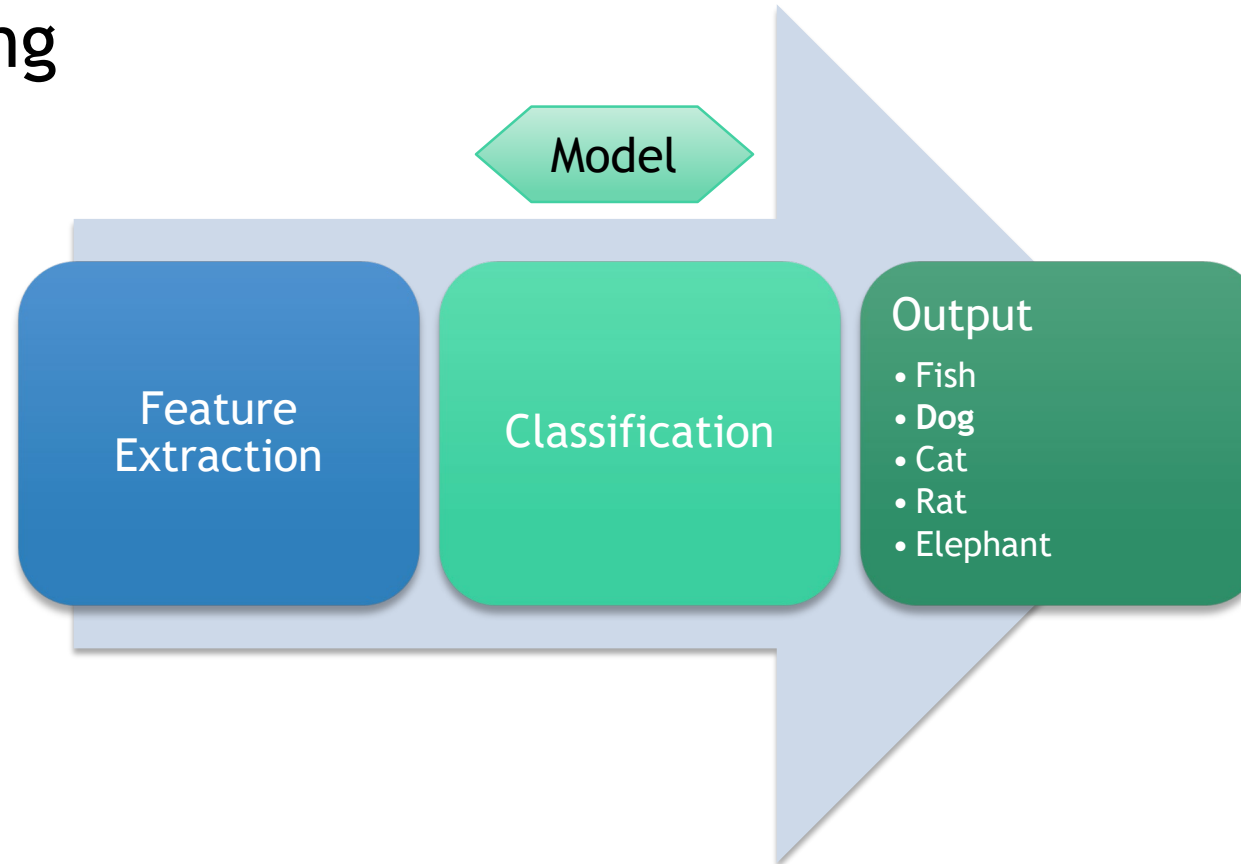
Machine Learning models accurately classified skin lesion images into 2,032 diagnoses.

<https://www.nature.com › letters>

Overview of Deep Learning, Machine Learning and AI



Machine Learning



- ✓ Start with an image and extract relevant features from it.
- ✓ Create a model that describes and predicts an image.
- ✓ Finds hidden insights in data without explicitly being told where to look or what to conclude.

Machine Learning

EZManip [msomda]

File Edit View Navigate Source Run Team Tools Window Help

code.sas SASHELP.HEART

182.9/250.0MB

Projects Files Favorites Services

SASProject

- Analysis Data
- Raw Data
- Documents
- Logs
- code.log
- ERROR
- WARNING
- INFO
- Shared Macros
- Outputs
- Program Files
- code.sas
- Configurations

Environment Libraries Navigator

- GCTYPE
- GEOEXM
- GEOEXP
- GEOEXS
- GNGMSG
- GNGSMP1
- GNGSMP2
- GRIDDED
- HEART
- HKSCS01
- HOLIDAY
- HTMUTIL
- HUMID
- IMAGERW
- IMGMSG
- IRIS
- JAC
- JUNKMAIL

code.sas

	Status	Cause of Death DeathCause	Age CHD Diagnosed AgeCHDdiag	Sex	Age at Start AgeAtStart	Height	Weight	Diastolic	Systolic	Metropolitan Relative MRW
1	Dead	Other	.	Female	29	62.5	140	78	124	121
2	Dead	Cancer	.	Female	41	59.75	194	92	144	183
3	Alive	.	.	Female	57	62.25	132	90	170	114
4	Alive	.	.	Female	39	65.75	158	80	128	123
5	Alive	.	.	Male	42	66	156	76	110	116
6	Alive	.	.	Female	58	61.75	131	92	176	117
7	Alive	.	.	Female	36	64.75	136	80	112	110
8	Dead	Other	.	Male	53	65.5	130	80	114	99
9	Alive	.	.	Male	35	71	194	68	132	124
10	Dead	Cerebral Vascular	.	Male	52	62.5	129	78	124	106
11	Alive	.	.	Male	39	66.25	179	76	128	133
12	Alive	.	57	Male	33	64.25	151	68	108	118
13	Alive	.	55	Male	33	70	174	90	142	114
14	Alive	.	79	Male	57	67.25	165	76	128	118
15	Alive	.	66	Male	44	69	155	90	130	105
16	Alive	.	.	Female	37	64.5	134	76	120	108
17	Alive	.	.	Male	40	66.25	151	72	132	112
18	Dead	Cancer	56	Male	56	67.25	122	72	120	87
19	Alive	.	.	Female	42	67.75	162	96	138	119
20	Dead	Coronary Heart	74	Male	46	66.5	157	84	142	116

Find : Find Next Find Previous

Output SAS Variables SAS ODS Files

Scope	Variable	Value
AUTOMATIC	AFDSID	0
AUTOMATIC	AFDSNAME	
AUTOMATIC	AFLIB	
AUTOMATIC	AFSTR1	
AUTOMATIC	AFSTR2	
AUTOMATIC	FSPBDV	
AUTOMATIC	SYSADDRBITS	64
AUTOMATIC	SYSBUFFR	
AUTOMATIC	SYSCC	0
AUTOMATIC	SYSCHARWIDTH	1

code.sas - Properties

Properties

Name code

Extension sas

File Size 2501

Modification Time Jul 10, 2015, 9:32

All Files C:\Users\Magu...

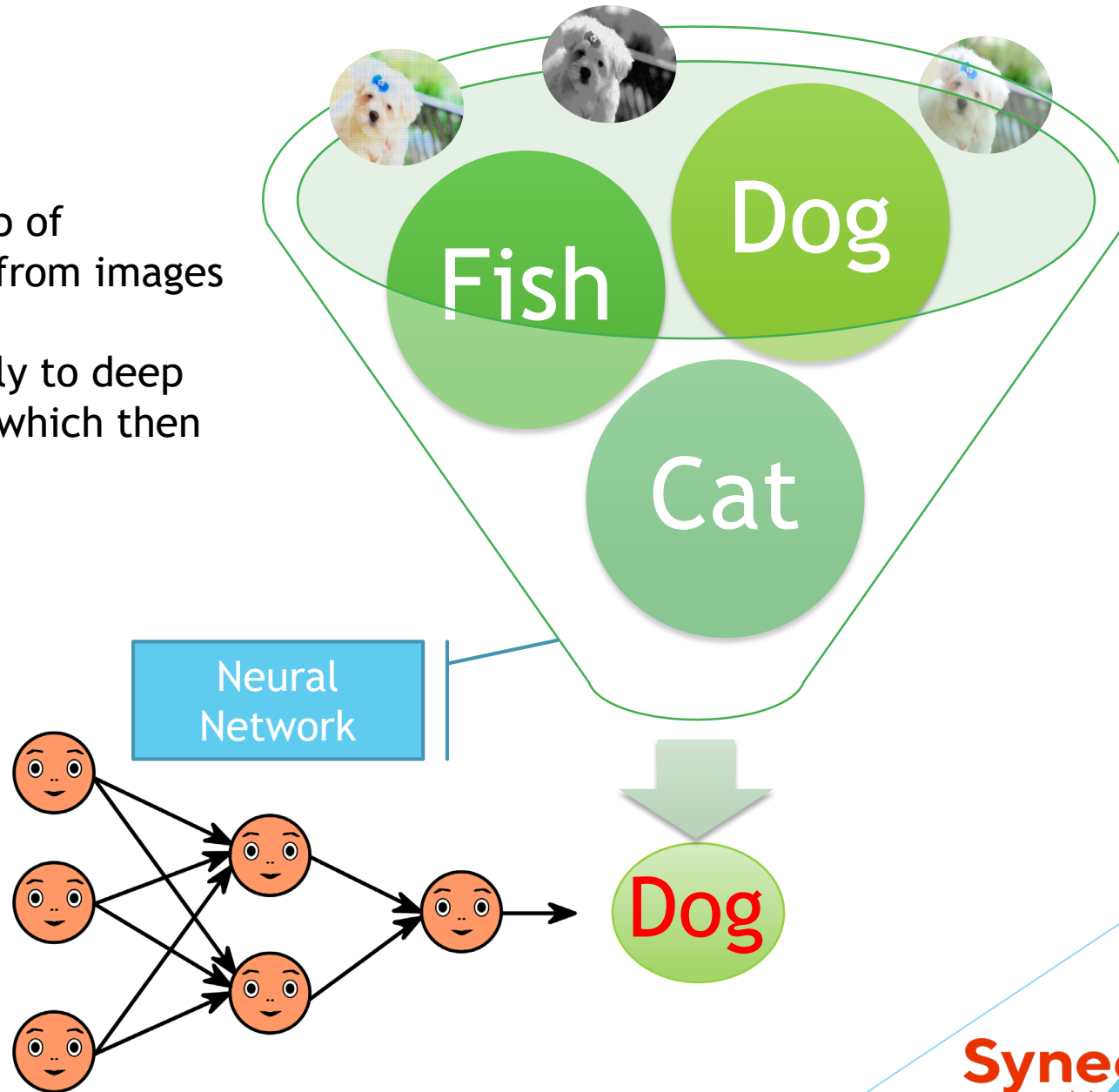
code.sas

SAS Options

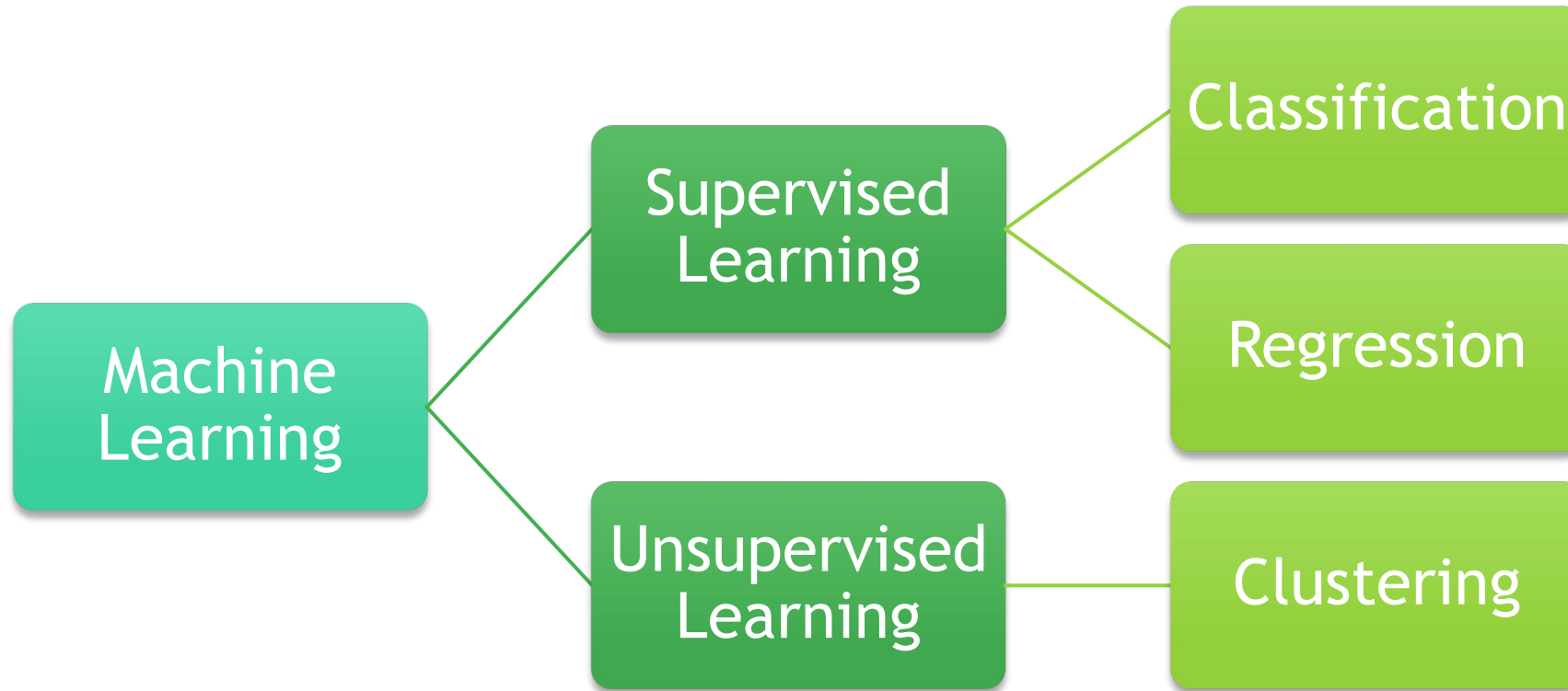
Option	Type	Value	Desc...
ABORT	char		Specifi...
ACCES...	char	STAN...	Specifi...
ALIGN...	Boolean	ALIGN...	Aligns ...
ALTLOG	char		Specifi...
ALTPR...	char		Specifi...
ANIM...	char	STOP	Specifi...
ANIM...	char	MIN	Specifi...
ANIML...	char	YES	Specifi...
ANIM...	Boolean	ANIM...	Specifi...
APPEND	char		Specifi...
APPLE...	char	C:\Pro...	Specifi...
ARMA...	char		Specifi...

Deep Learning

- ✓ Skip the manual step of extracting features from images
- ✓ Feeds images directly to deep learning algorithms which then predict the object.

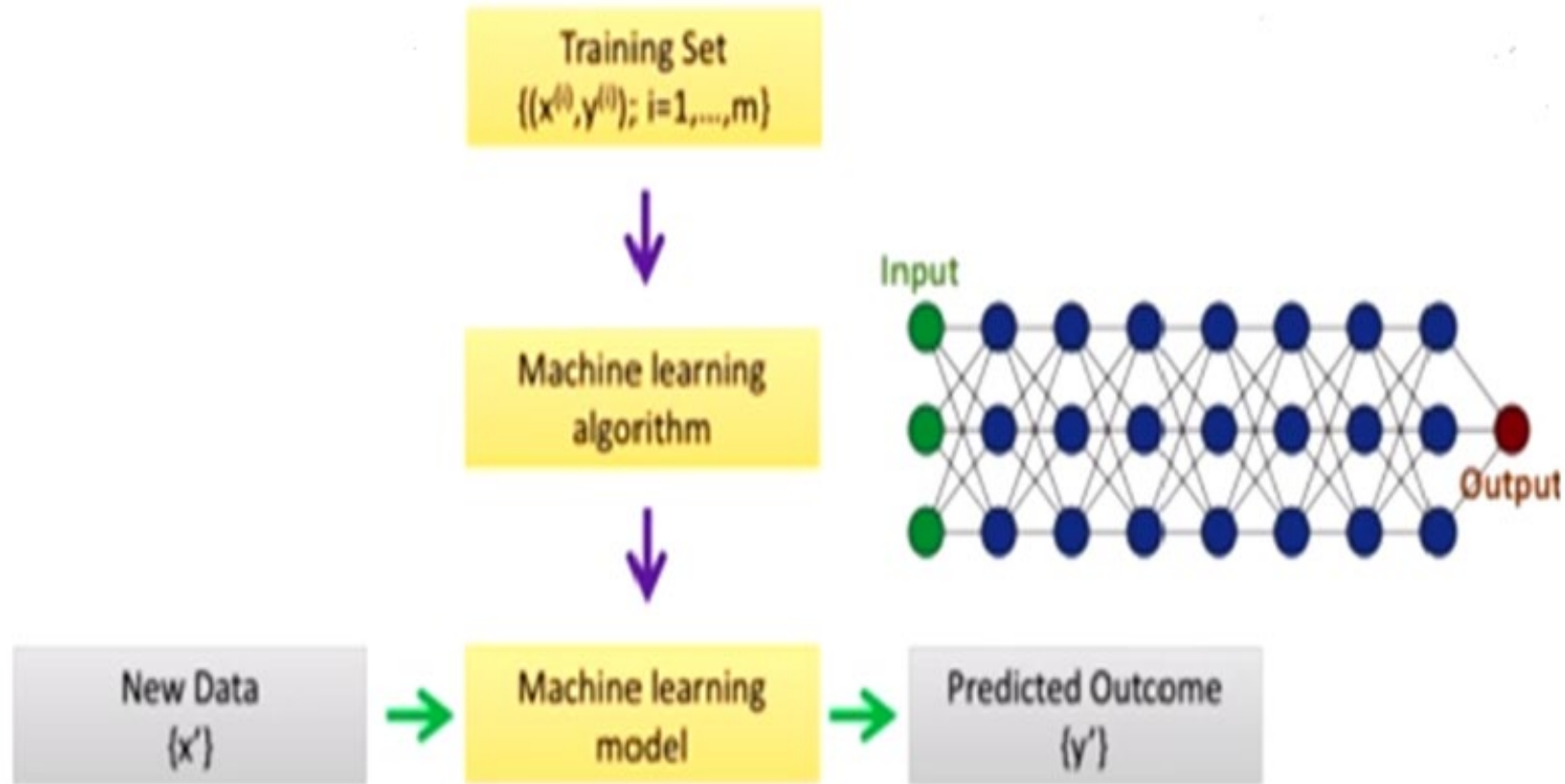


Machine Learning (Supervised vs Unsupervised Learning)



Machine learning algorithms are divided into many categories, of which supervised and unsupervised learning techniques are most widely applied in other disciplines, particularly in data mining.

Supervised Machine Learning



Unsupervised Machine learning

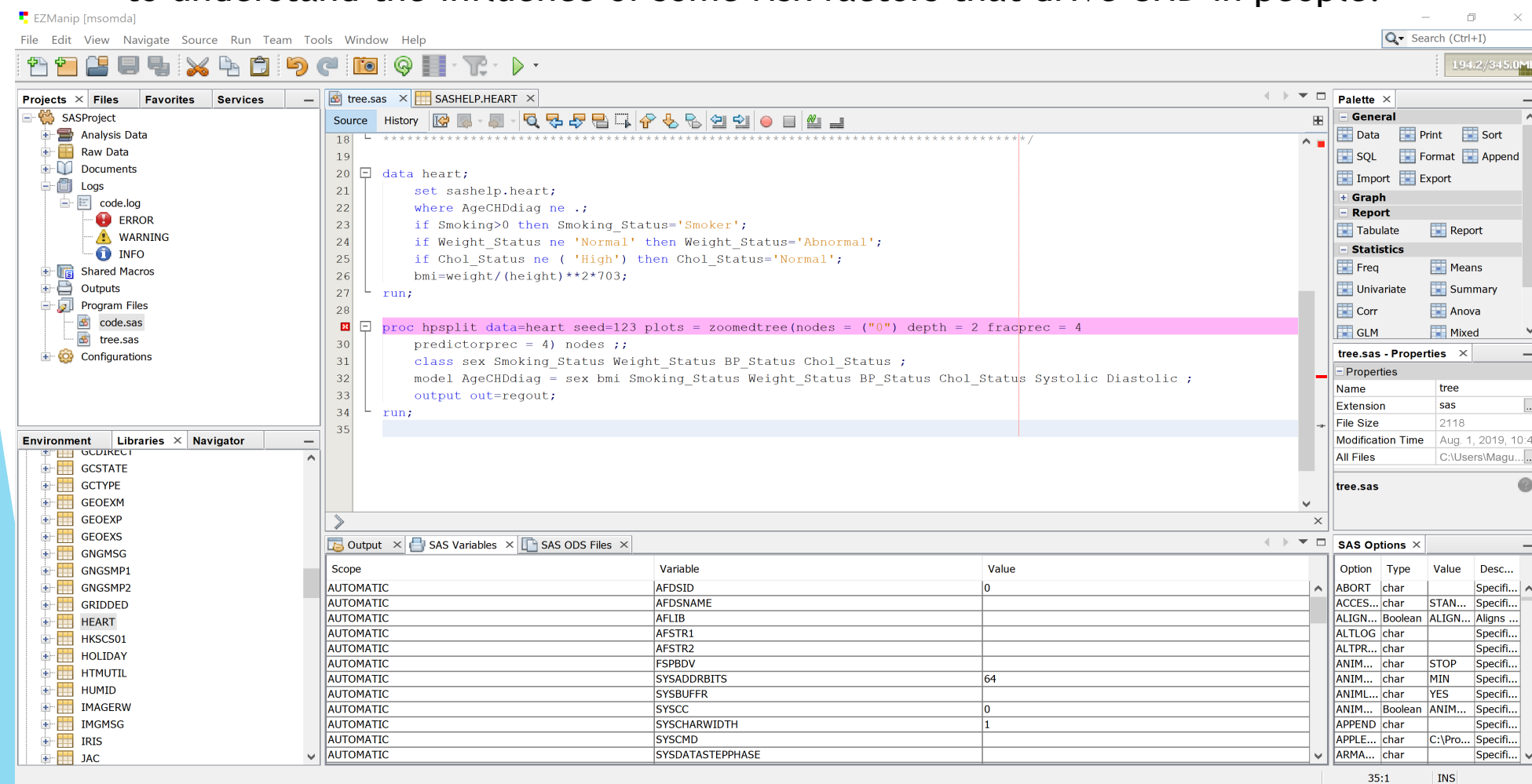
Example: Clustering



Regression and Classification Trees

Regression Tree Example using HPSPLIT: Coronary Heart Disease (CHD)

Predicting the factors that influence the chances of CHD at an earlier age can help us to understand the influence of some risk factors that drive CHD in people.



The screenshot displays the SAS software interface with the following components:

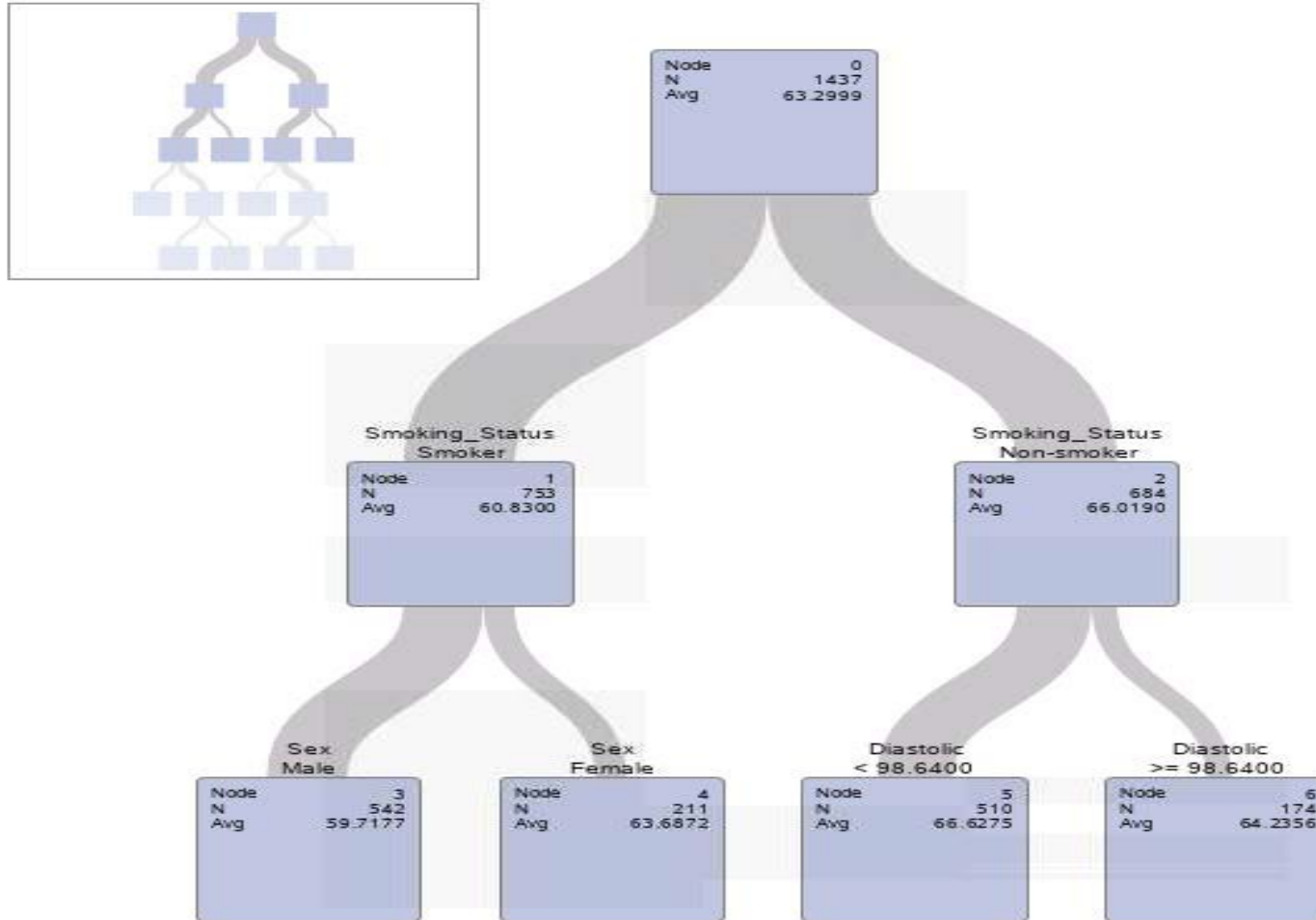
- Projects Panel:** Shows the project structure including Analysis Data, Raw Data, Documents, Logs, Shared Macros, Outputs, Program Files, and Configurations.
- Source Editor:** Contains the SAS script for building a regression tree using HPSPLIT. The script includes data loading, variable selection, and model building.
- Output Window:** Displays the results of the HPSPLIT procedure, including the model equation and the list of variables used.
- Properties Panel:** Shows the properties of the selected object (tree.sas), including Name, Extension, File Size, Modification Time, and All Files.
- SAS Options Panel:** Displays the SAS Options for the current session, including Abort, ACCE..., ALIGN..., ALTLOG, ALTPR..., ANIM..., ANIM..., ANIML..., ANIM..., APPEND, APPLE..., and ARMA...

```
18 *****
19
20 data heart;
21   set sashelp.heart;
22   where AgeCHDdiag ne .;
23   if Smoking>0 then Smoking_Status='Smoker';
24   if Weight_Status ne 'Normal' then Weight_Status='Abnormal';
25   if Chol_Status ne ( 'High') then Chol_Status='Normal';
26   bmi=weight/(height)**2*703;
27 run;
28
29 proc hpsplit data=heart seed=123 plots = zoomedtree(nodes = ("0") depth = 2 fracprec = 4
30   predictorprec = 4) nodes ;;
31   class sex Smoking_Status Weight_Status BP_Status Chol_Status ;
32   model AgeCHDdiag = sex bmi Smoking_Status Weight_Status BP_Status Chol_Status Systolic Diastolic ;
33   output out=regout;
34 run;
35
```

Scope	Variable	Value
AUTOMATIC	AFDSID	0
AUTOMATIC	AFDSNAME	
AUTOMATIC	AFLIB	
AUTOMATIC	AFSTR1	
AUTOMATIC	AFSTR2	
AUTOMATIC	FSPBDV	
AUTOMATIC	SYSADDRBITS	64
AUTOMATIC	SYSBUFFER	
AUTOMATIC	SYSACC	0
AUTOMATIC	SYSCHARWIDTH	1
AUTOMATIC	SYSCMD	
AUTOMATIC	SYSDATATEPPHASE	

Regression and Classification Trees using PROC HPSPLIT (continued)

Subtree Starting at Node=0



Potential areas for AI



Potential areas of AI *(continued)*

Broadly AI can support:

- ✓ Process Automation / Focus on Efficiencies
- ✓ AI Driven Data Analysis / Focus on Precision of Go / No Go Decision
- ✓ AI and Insight into the Data / Focus on Business Decisions

AI areas:

- ❖ Research - Drug Development
- ❖ Diagnosis - Medical imaging Diagnostics
- ❖ Well Being
 - ✓ Electronic Health Record
 - ✓ Virtual Health Assistance
- ❖ Treatment - Robotic Assistance
- ❖ Early Detection - Proactive Medical Care
- ❖ Decision making and Diagnosis
- ❖ Administrative Tasks and Training
- ❖ End of Life Care

Current limitations of AI

- ❖ Need to understand type of tasks, strengths and limitations of each technology.
- ❖ AI adoption in the actual clinical trial process is still in the early stage
- ❖ Limitation of Garbage in, Garbage out (GIGO)
- ❖ Labeling of cases could evolve over time
- ❖ Need to be extra careful in interpreting the model
- ❖ Integrating the current AI system into clinical workflow

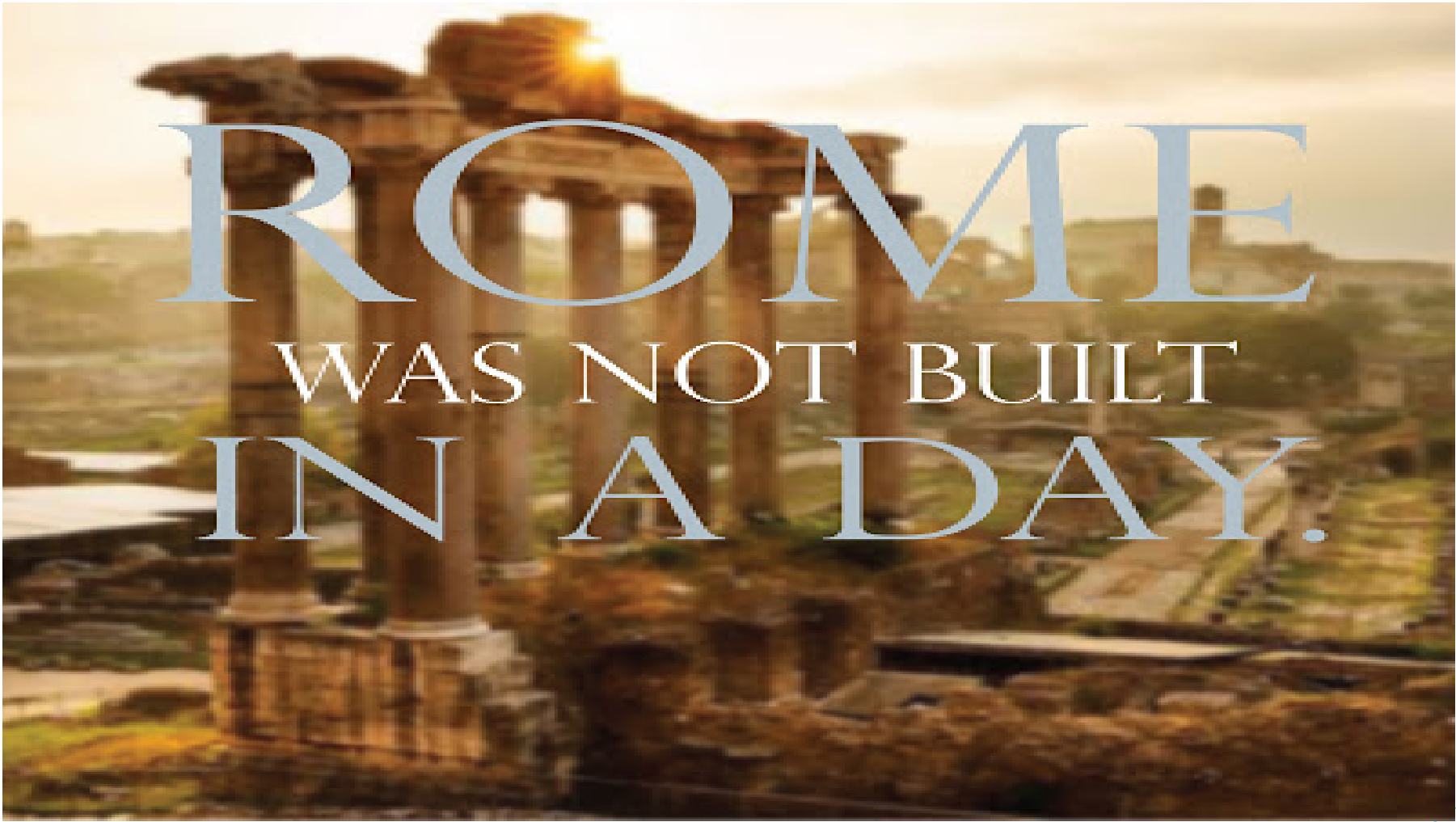
Conclusion

- ❑ AI provides a powerful mechanism of improving the business performance and decision power.
- ❑ Has potential to change every stage of the clinical trials process, from finding a trial to enrollment to medication adherence.

- ❑ Some challenges that need to be addressed
 - ❖ Risks i.e. biases, wrong predictions, safety, data security, new and exceptional cases
 - ❖ Patient and doctors comfort level in using the AI systems
 - ❖ Training and expertise to use AI systems
 - ❖ Adherence to healthcare regulatory standards
 - ❖ Many social, economical, and legal challenges ahead

- ❑ Ultimately, the goal of artificial intelligence applications in clinical trials will be to close the gap between what patients have access to right now and what they need in the long-term to live healthier, more informed lives. But Rome wasn't built in a day...





ROME
WAS NOT BUILT
IN A DAY.

Is AI our destiny ?

No, we shape our Destiny...



Complete paper

For complete paper please refer to Phuse paper presented in phuse US connect 2019:

<https://www.phusewiki.org/docs/2019%20US%20Connect%20Final%20Papers/ML/ml01-20069.pdf>

https://www.phusewiki.org/docs/US-Connect-Baltimore-2019-Presentations%20combined/PR_ML01.pdf

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