PhUSE 2019 SDE Mississauga, Canada

Artificial intelligence and Healthcare

Data-driven Decision-making in a Dynamic Landscape

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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

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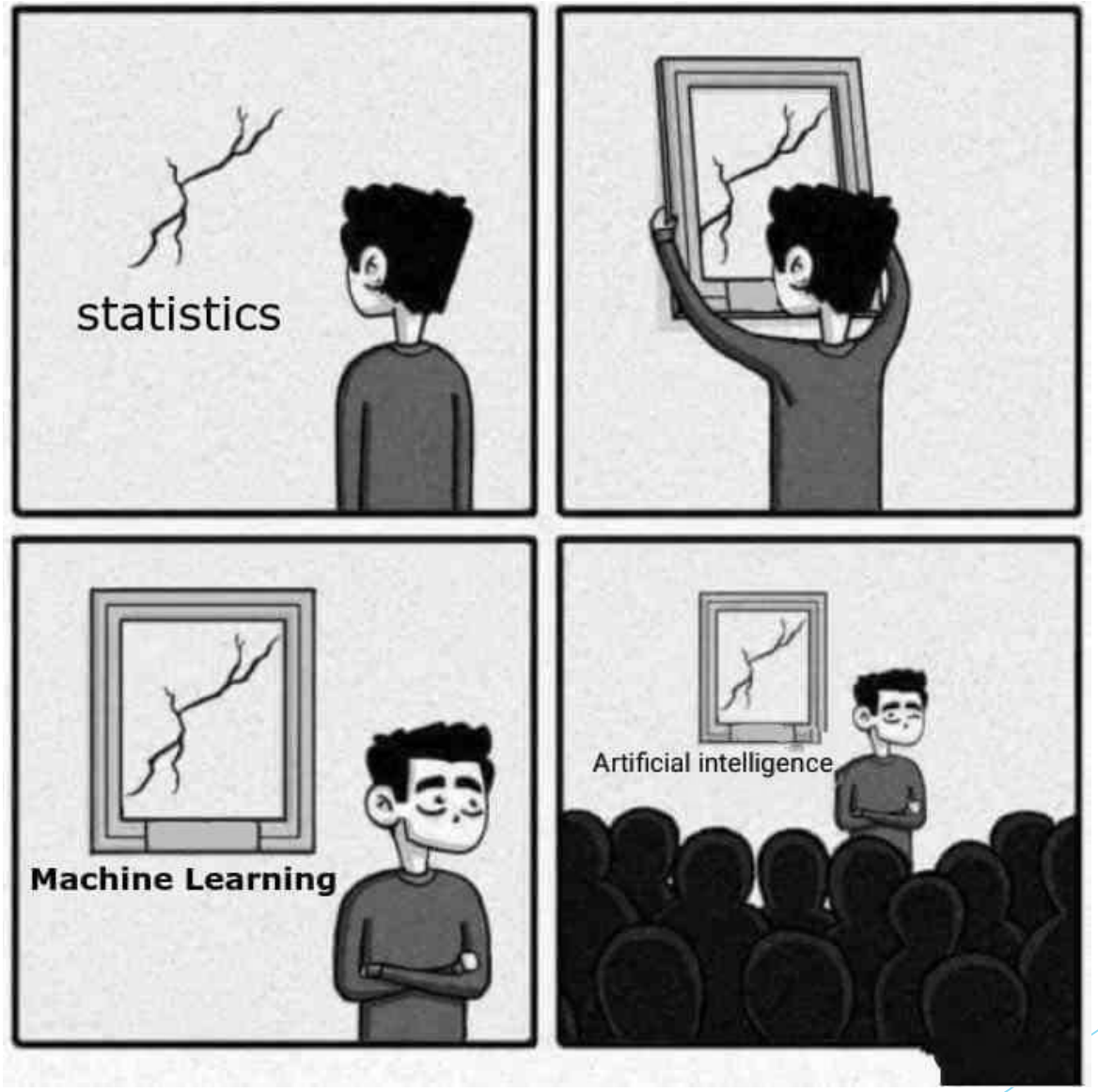
Congratulations!

A picture is worth

a thousand words!

We are done!



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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/

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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,
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- 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.

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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

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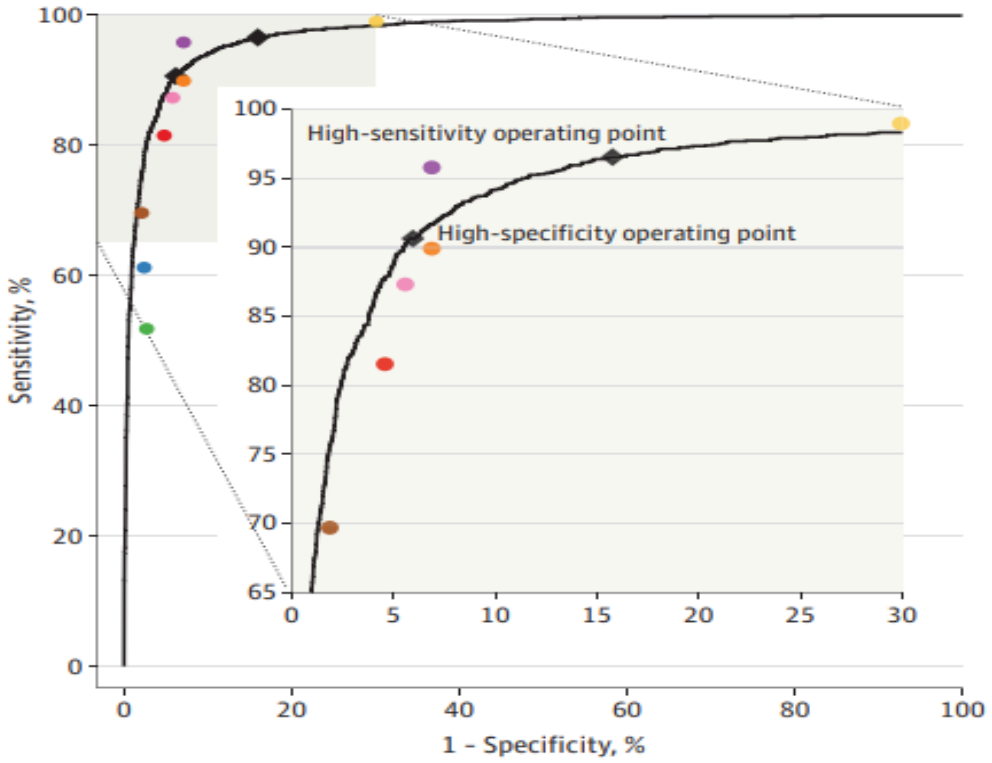
Example - Development and Validation of a Deep Learning Algorithm for Detection of Diabetic Retinopathy in Retinal Fundus Photographs



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

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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

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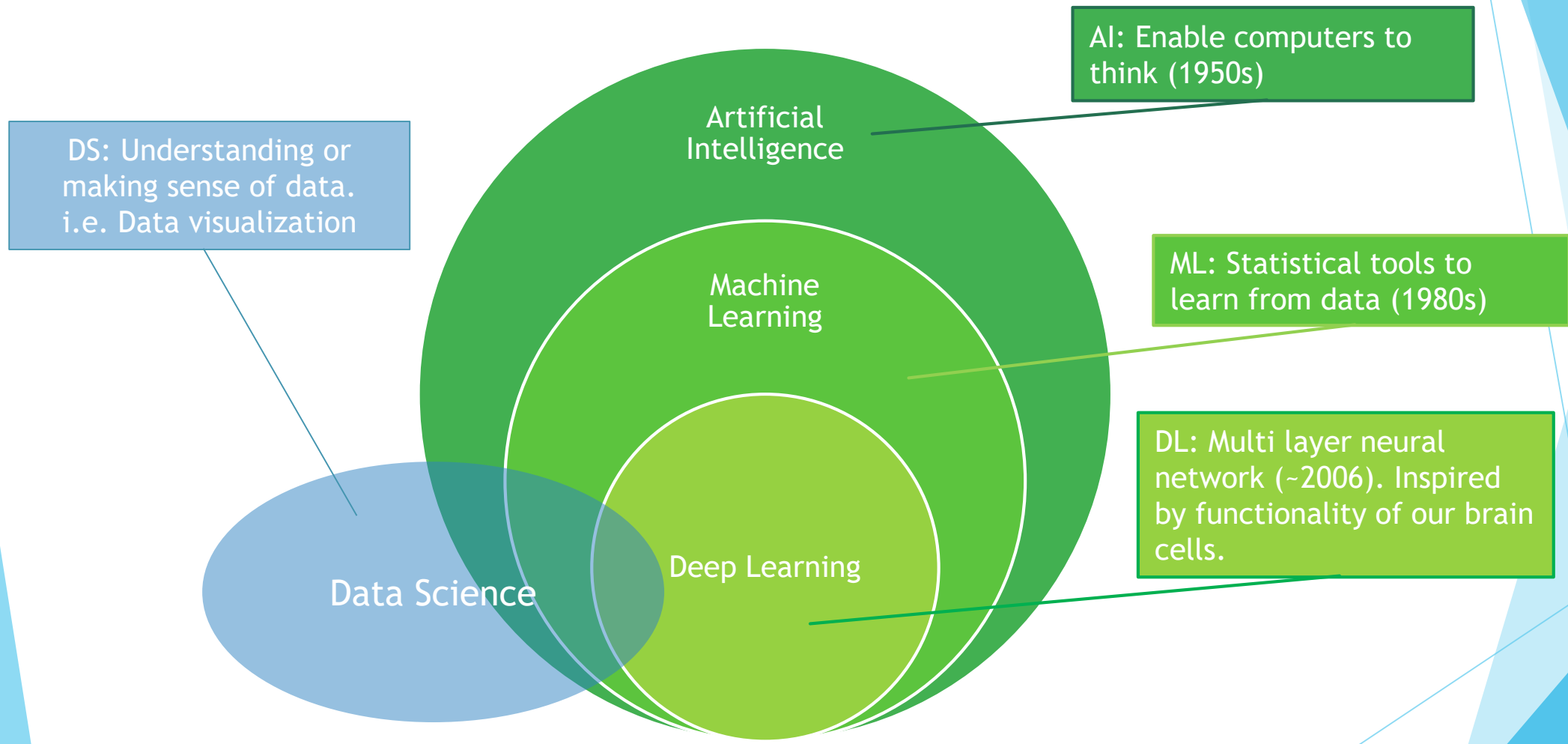
Overview of Deep Learning, Machine Learning and AI



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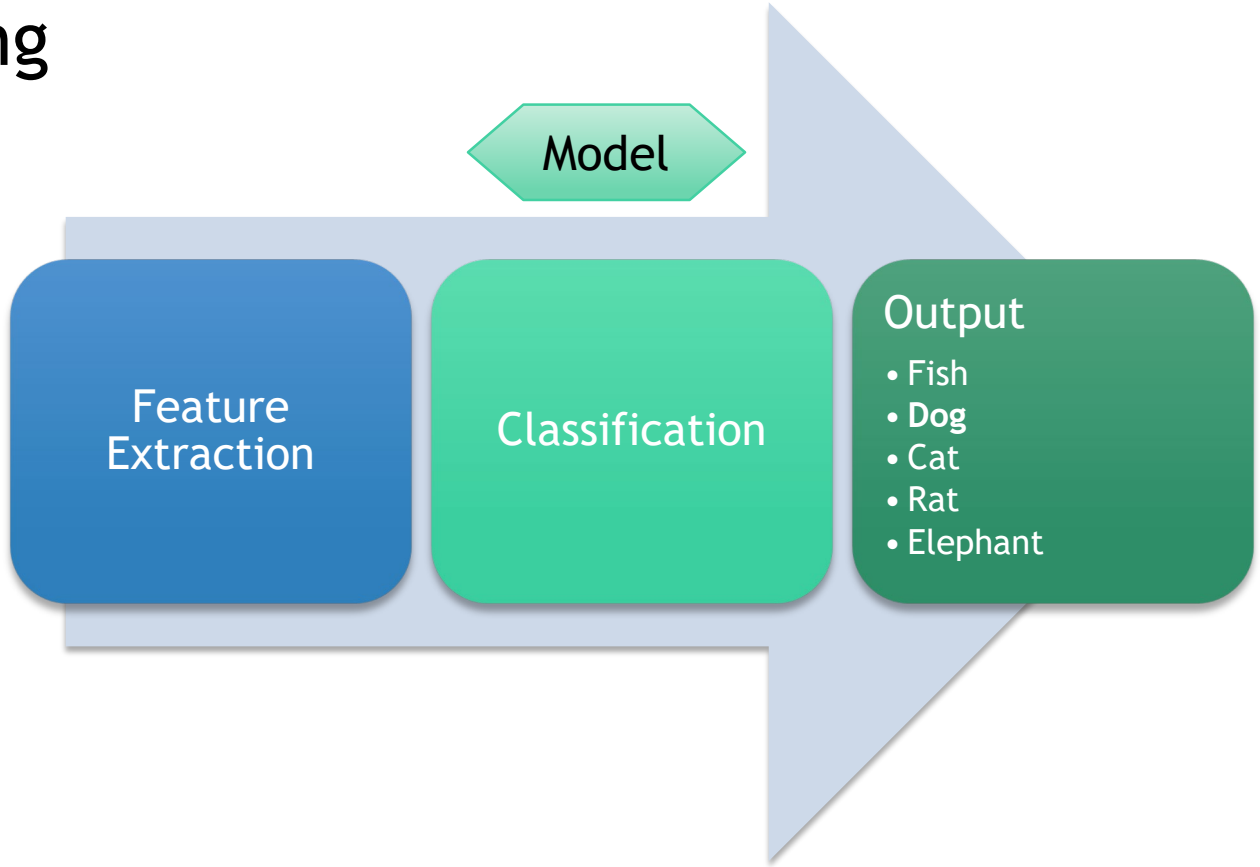
Machine Learning



- ✓ 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.

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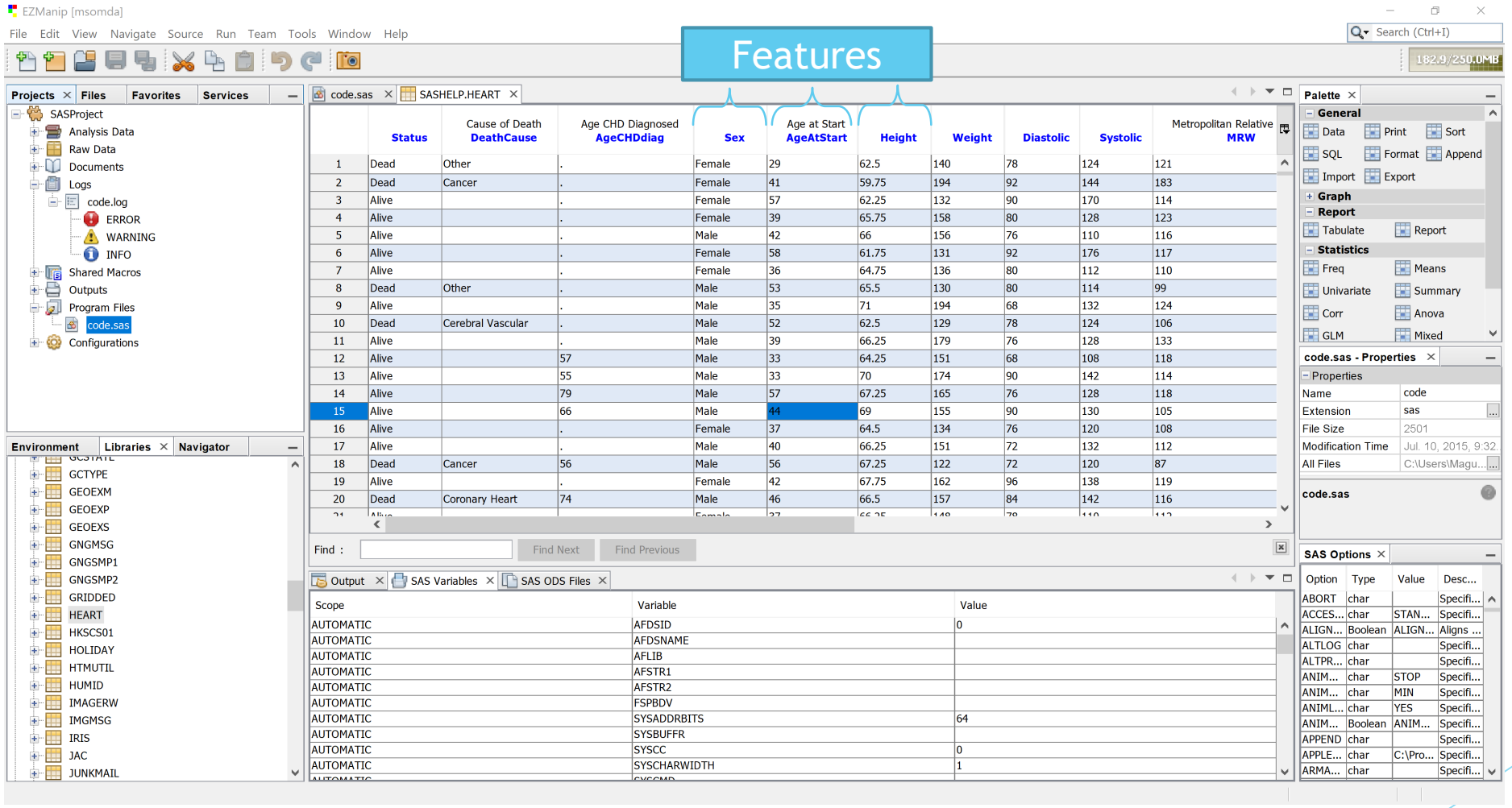
Machine Learning



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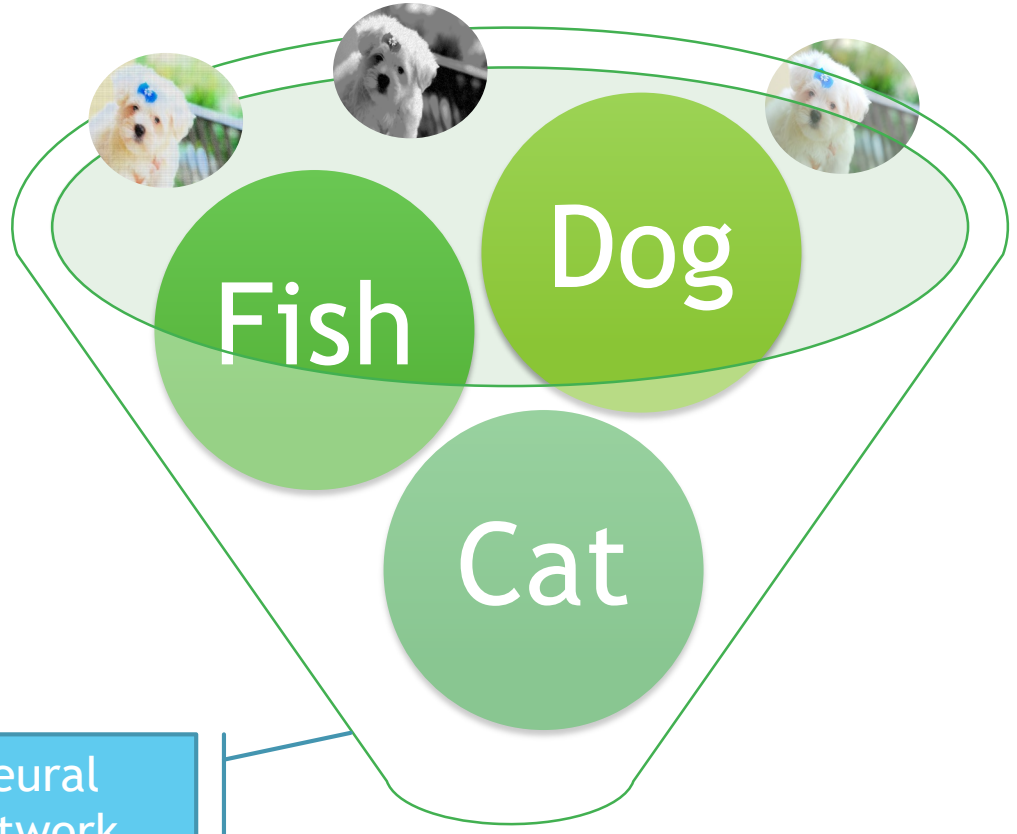
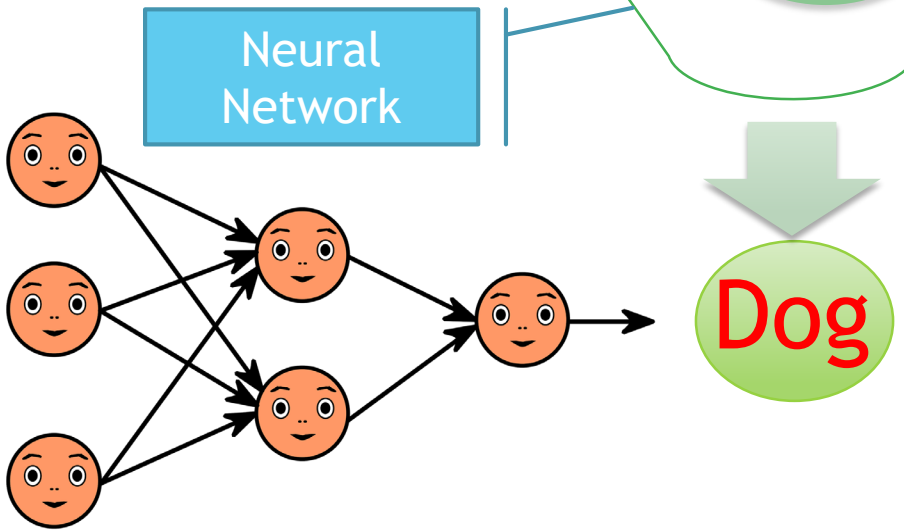
Deep Learning

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





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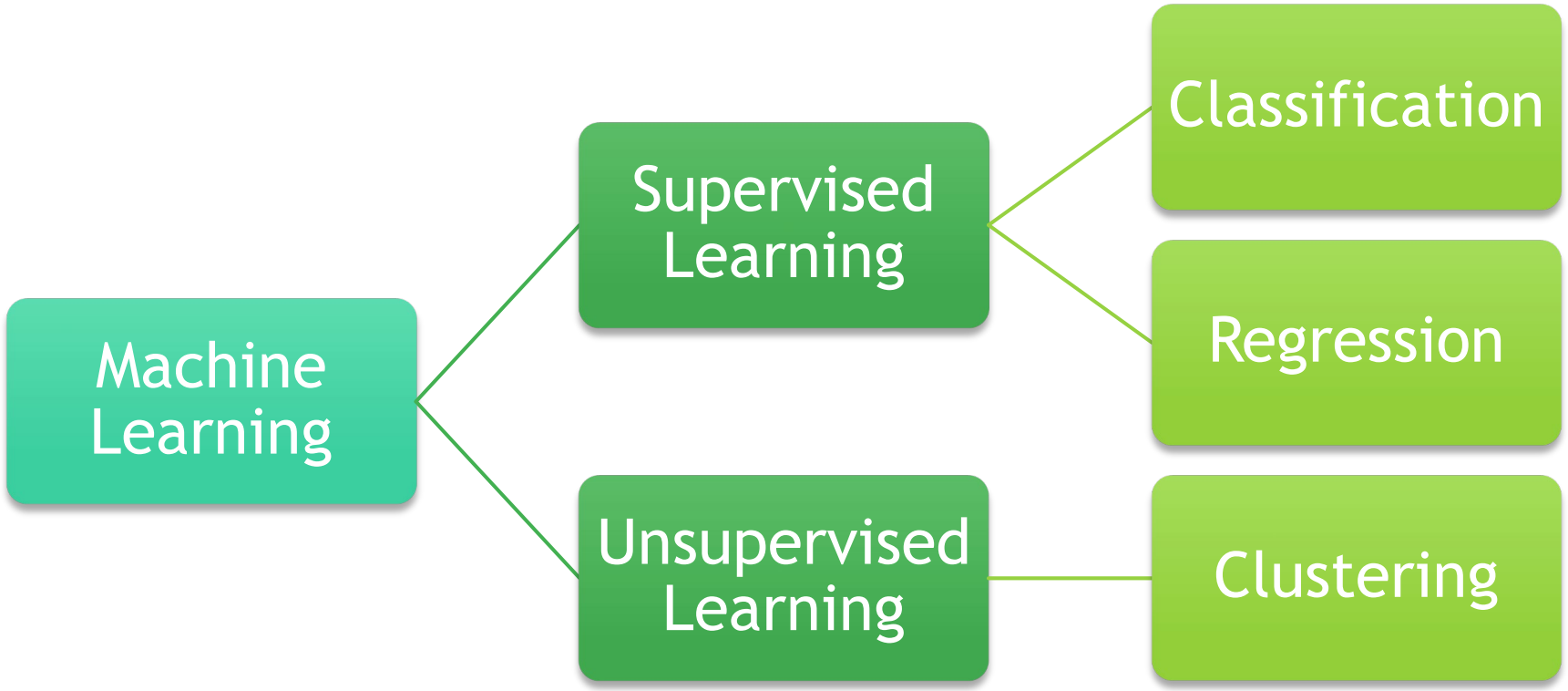
Machine Learning (Supervised vs Unsupervised Learning)



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.

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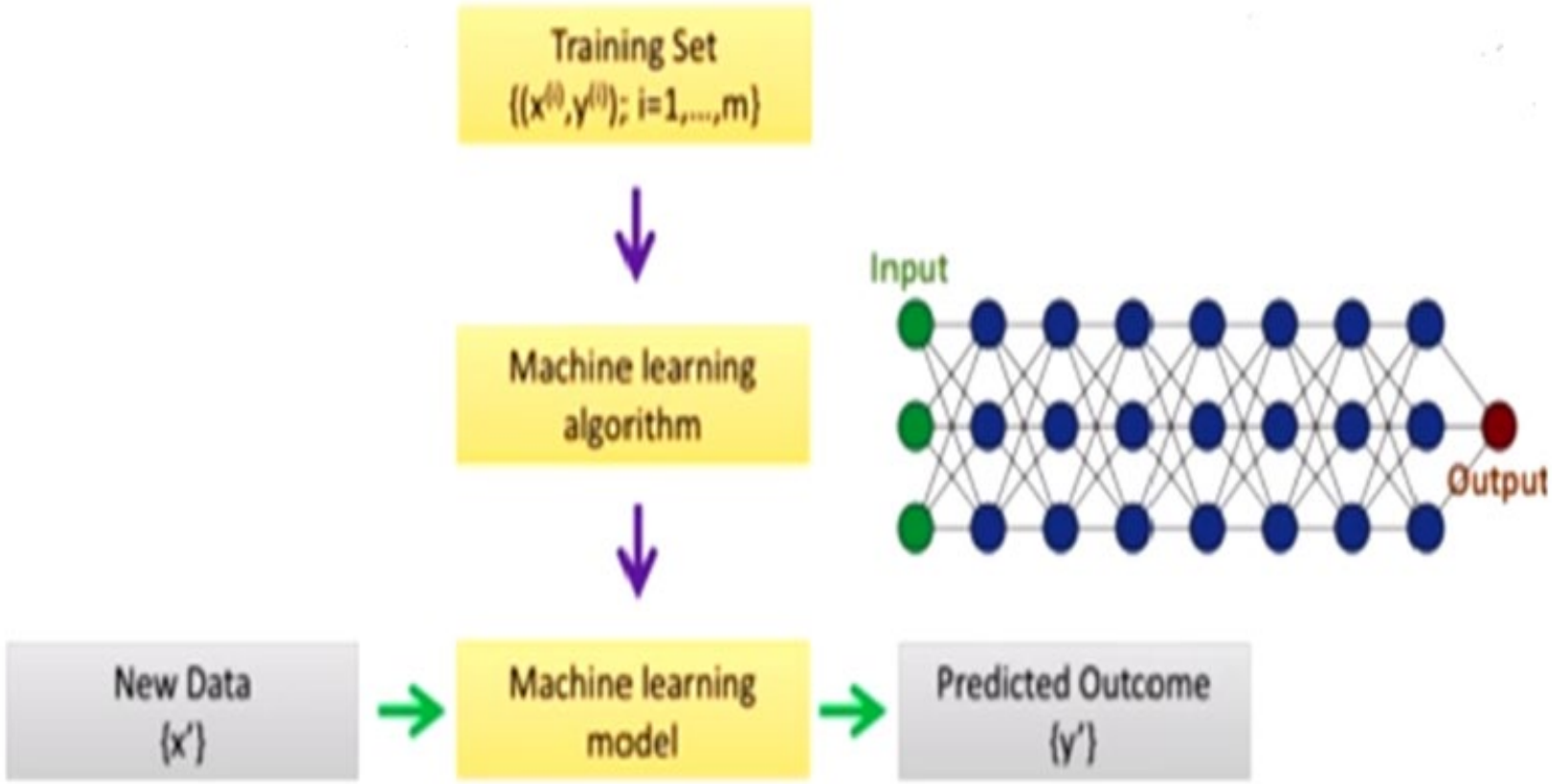
Supervised Machine Learning



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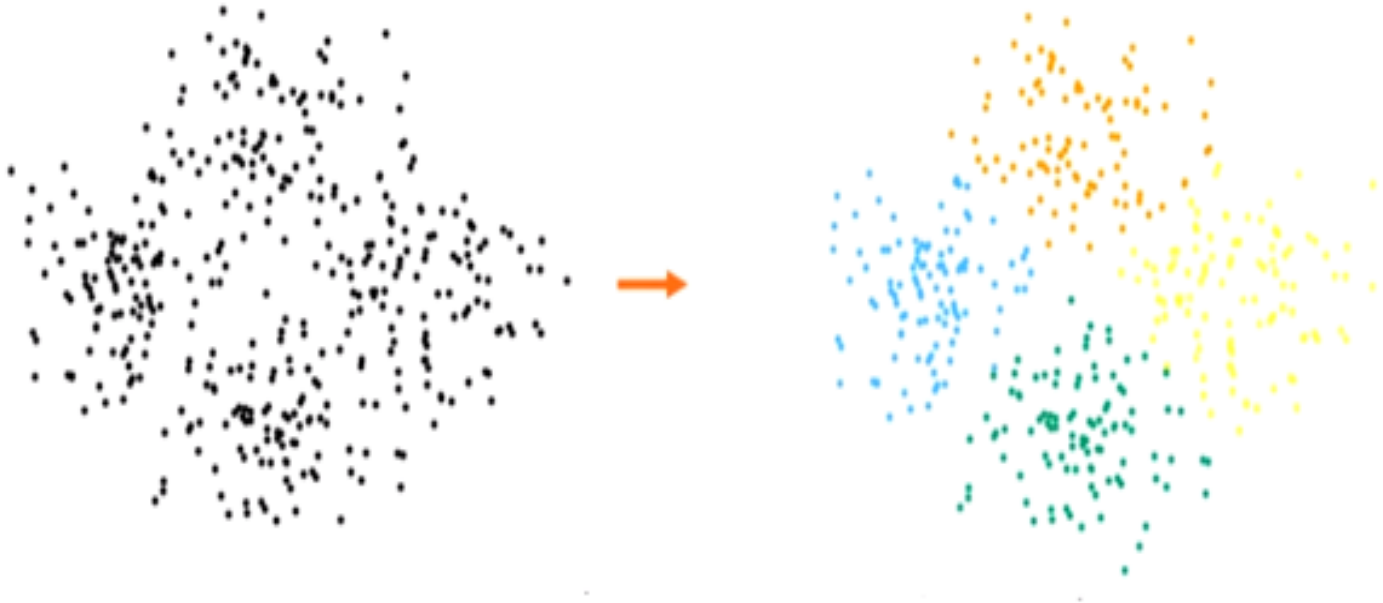
Unsupervised Machine learning

Example: Clustering



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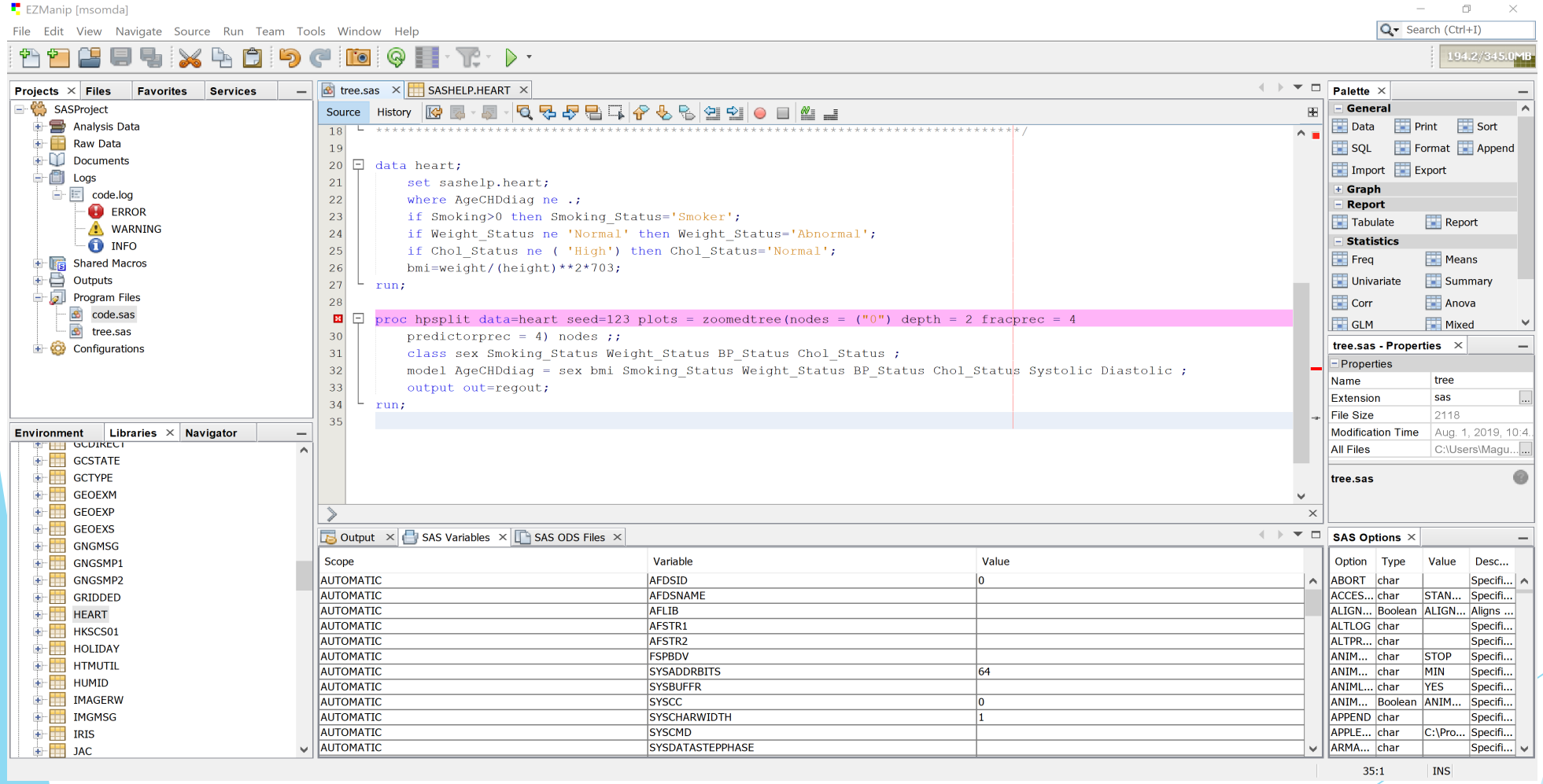
Regression and Classification Trees

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.



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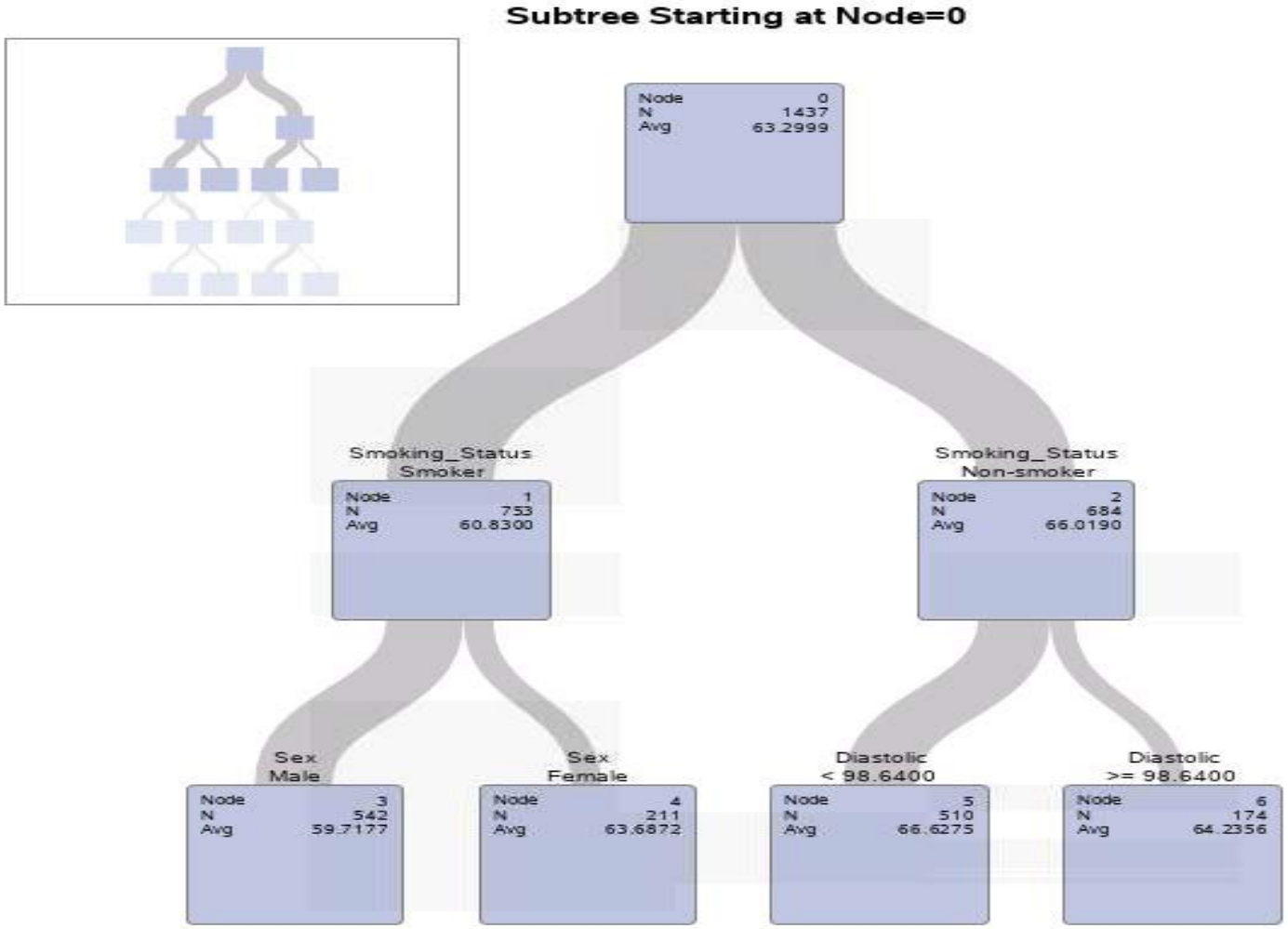
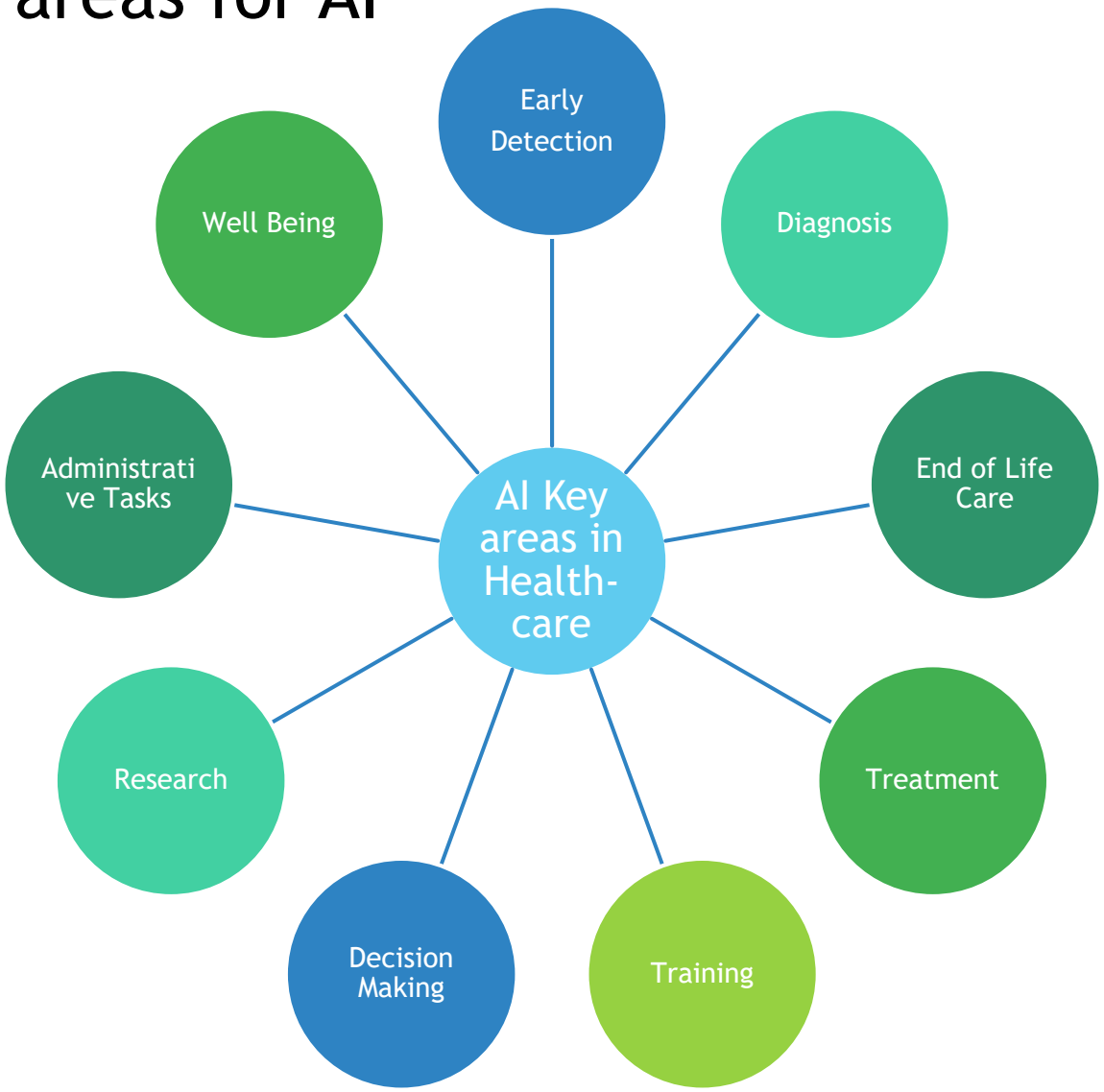
Regression and Classification Trees using PROC HPSPLIT *(continued)*



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**

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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

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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…

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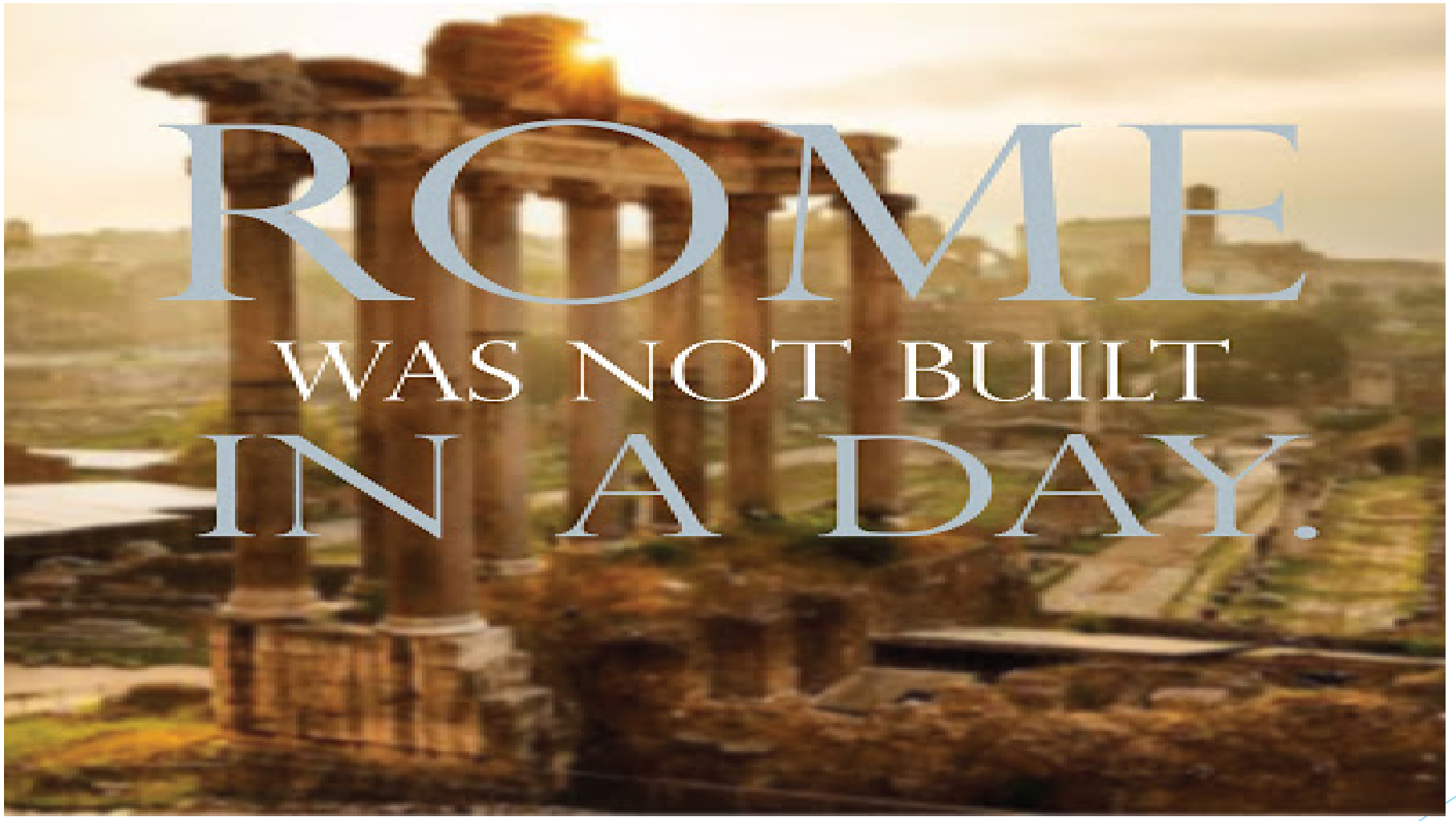

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Is AI our destiny ?

No, we shape our Destiny…

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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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