# Deep Learning

## FOR THE REST OF US

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# UPMC Enterprises

As an organization dedicated to Life Changing Medicine, UPMC has defined a bold mission: to shape the future of health care through innovation. At UPMC Enterprises, we help bring this mission to life by turning innovative ideas into growing, thriving businesses.

# UPMC Enterprises: Focus Areas

***Translational Science:***
Accelerate the application of discoveries to deliver new models of care, narrowing the gap between bench science and bedside practice.

***Improving Outcomes:***
Connect and coordinate the health system to empower clinicians to provide high-quality care in any setting.

***Consumer:***
Develop solutions that allow consumers to access medical services and information anytime, anywhere, and to engage in all steps in their health care journey.

***Infrastructure and Efficiencies:***
Deliver health care with fewer resources in a fiscally sound manner.

UPMC LIFE CHANGING MEDICINE

# Portfolio Companies


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# Goal

To demonstrate that deep learning is not too complicated to be practically useful to a reasonably technical person with some machine learning knowledge.


It is deep!!!


But not too deep.

# Agenda



- Key concepts
- Deep Learning in 7 slides
- Transferring Learning – From one machine to another
- Teaching Machines – Help me help you (Demo)

# Key Concepts

| Term | Description |
|---|---|
| Machine Learning (ML) | Algorithms that improve when trained with data (not explicit programming) |
| Deep Learning (DL) | ML algorithms that learn representations of data using multiple layers |
| Model | Digital output of the ML training process |
| Deep Neural Networks (DNN) | Deep learning model consisting of multiple layers of "digital" neurons. |
| Supervised Learning | Algorithms that improves using labeled examples |
| Target Variable | Data point that you are trying to predict |
| Feature | Measurable property of used by ML algorithm to predict the target variable |
| Classification | Predicting a categorical target variable |

*DEEP LEARNING IN 8 SLIDES*

# Machine Learning

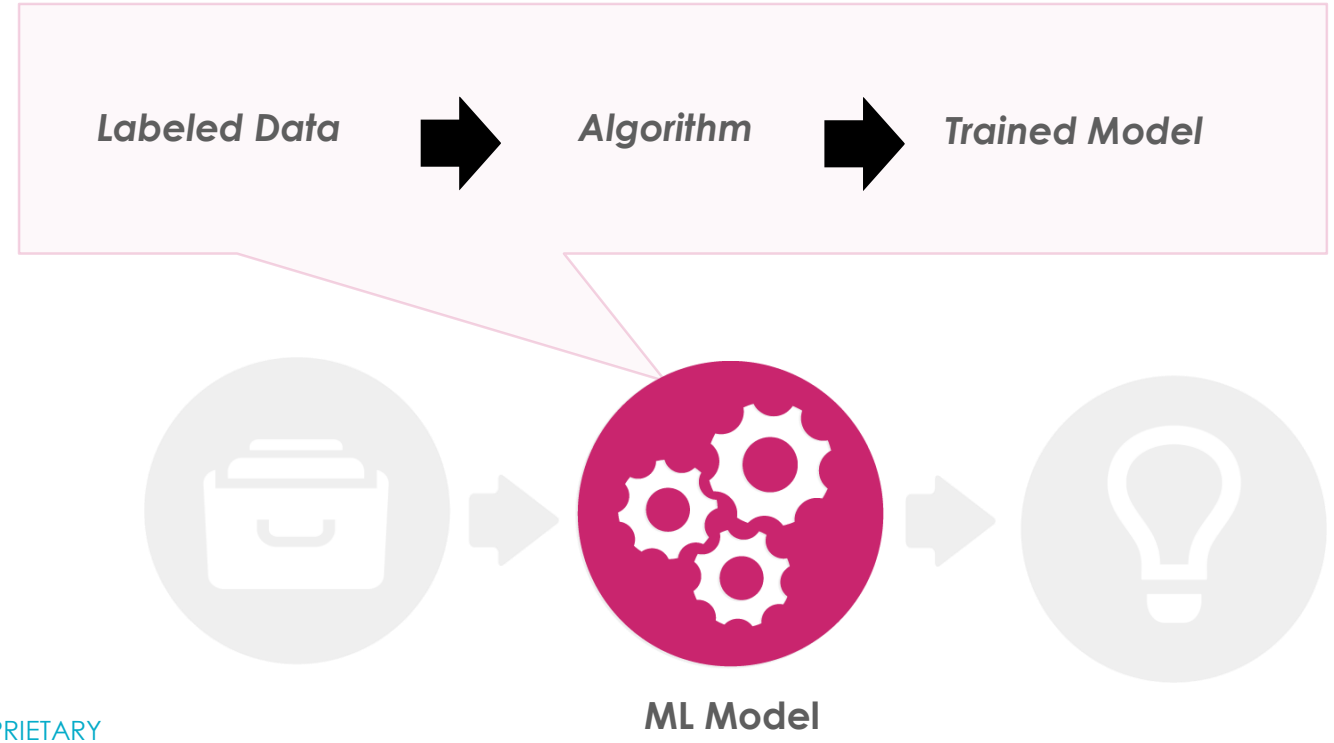

- ML algorithms process "unseen" data to give predictions
- A model is a statistical representation of the algorithms experiences/training

How do you get a model?

# Supervised Models



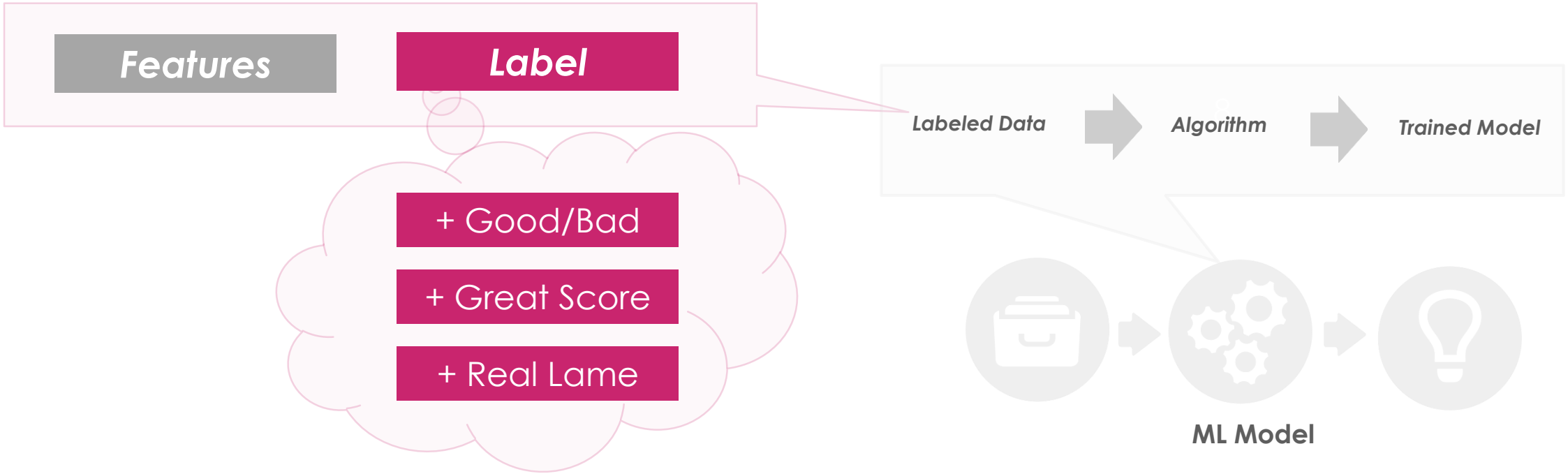
- Supervised ML algorithms get their name because they learn with help
- You have to provide them experience in labeled examples
- The algorithm translates that data into a representation called a model
- The more data the better



# Labels & Features

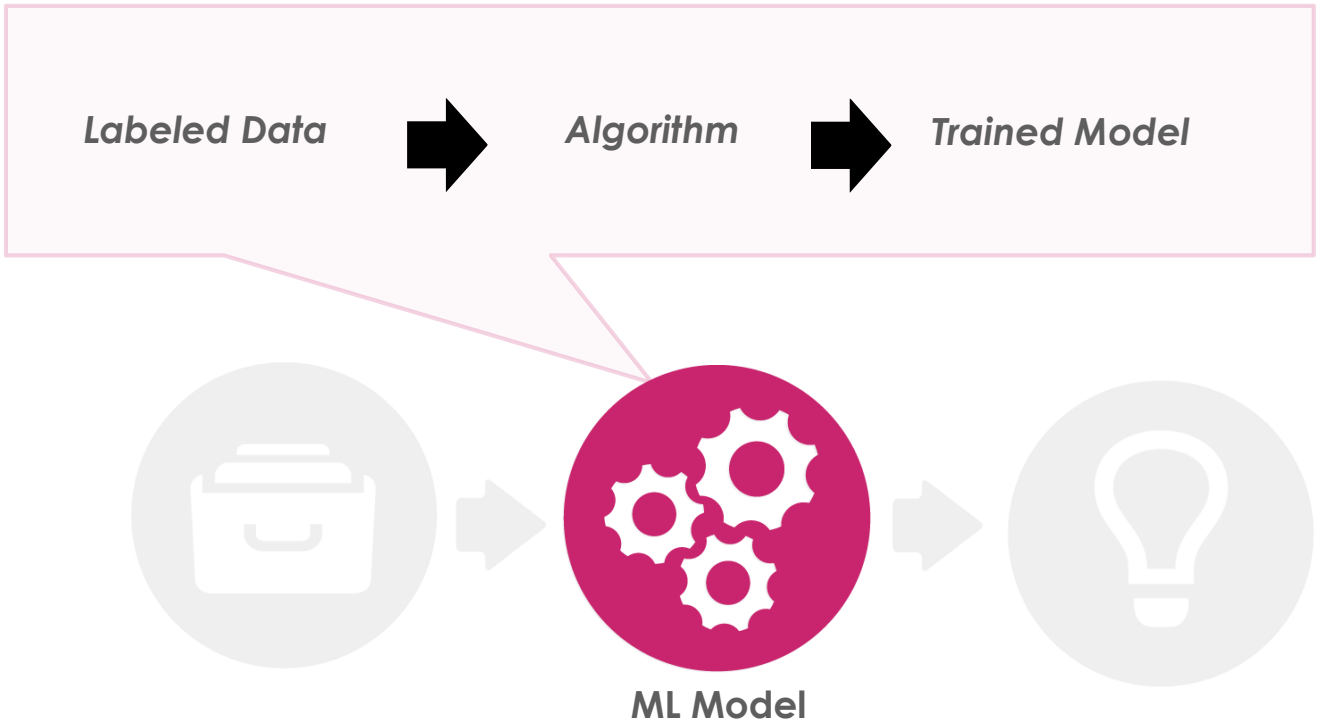


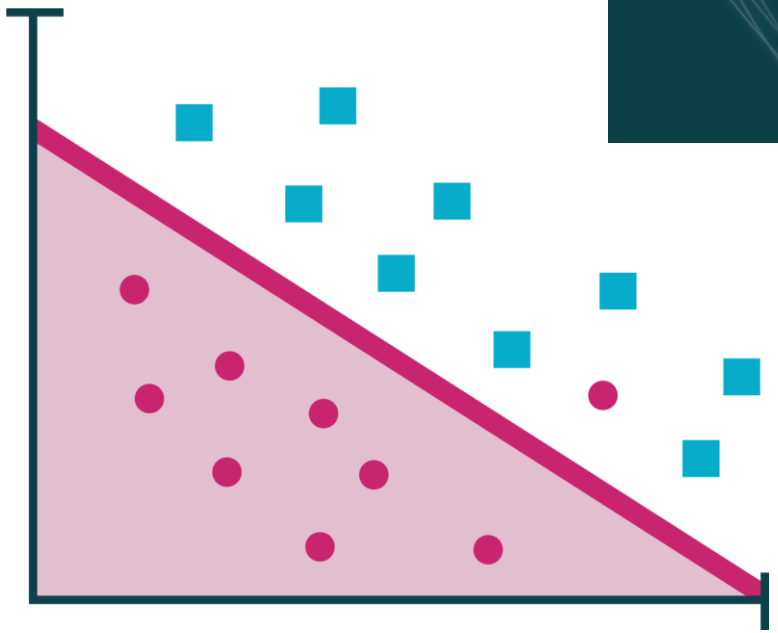
- During training features with labels are given to the algorithm to generate the model
- Both features and labels can be categorical or continuous
- The type of your target affects the flavor of algorithm you chose



# Simple Models





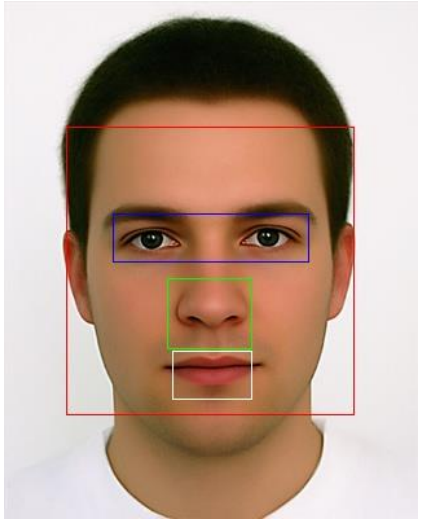



Linear Classification

# Media & Features



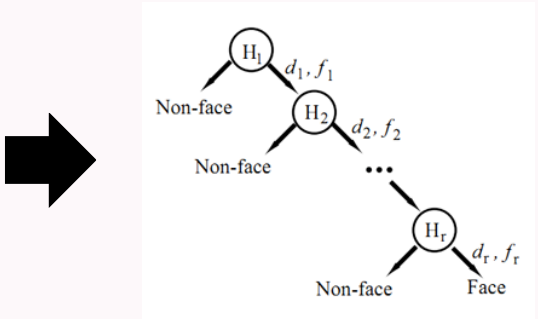
Facial Recognition



ML Model

Predictions

Geometric features called “Haars”




Linear Classifiers

Is this a face?

# Deep Learning

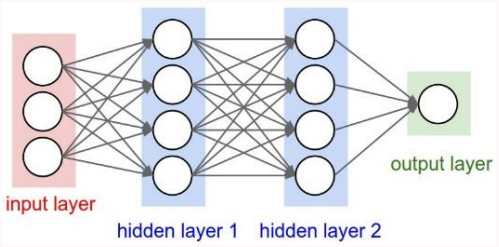


Facial Recognition

ML Model

Predictions

Raw Image




Is this a face?

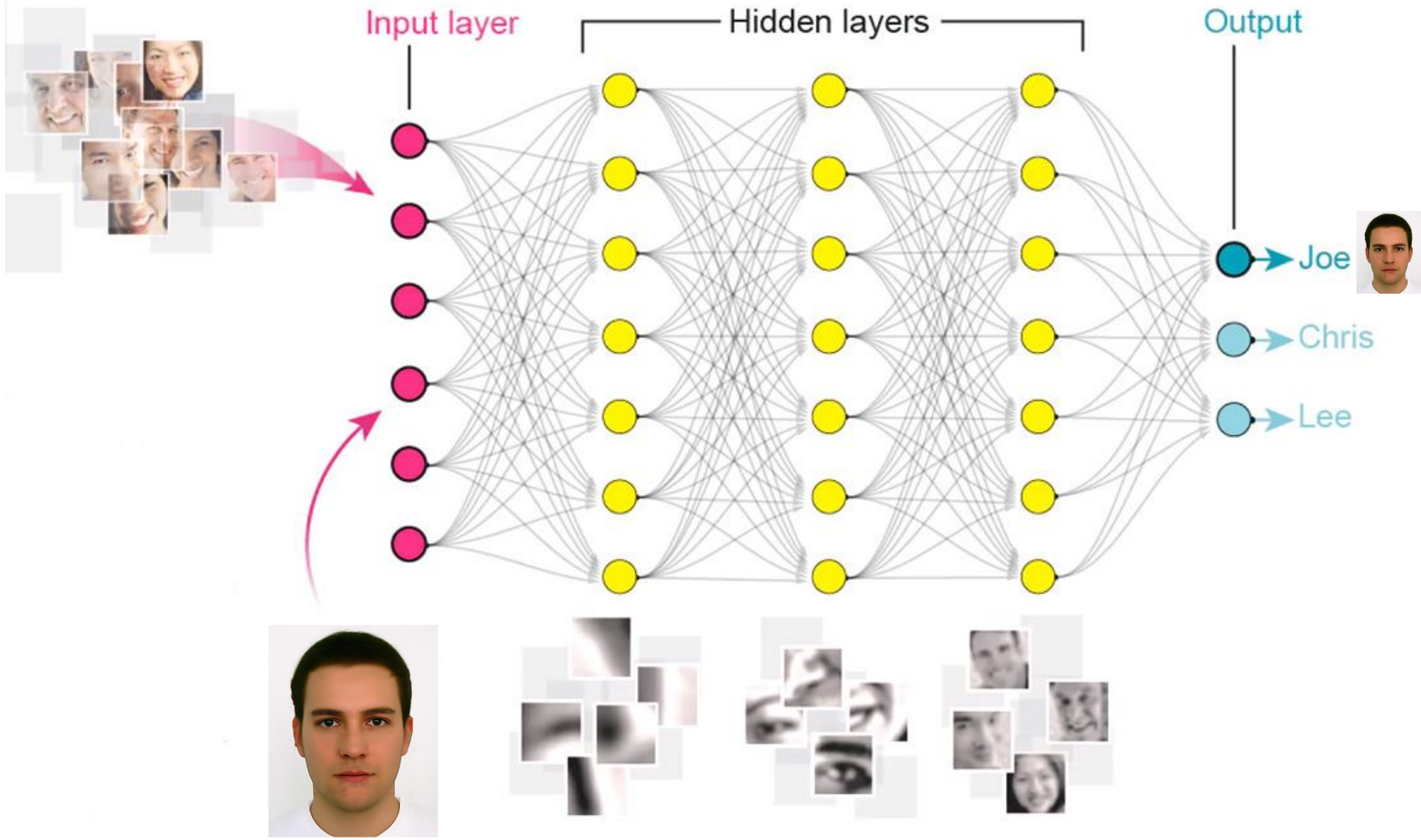
Convolution NN



***Image source***: http://cs231n.github.io/neural-networks-1/

*DEEP LEARNING IN 8 SLIDES*

# Deep Learning



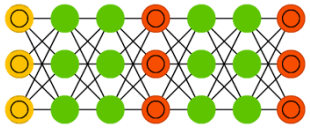

Each layer identifies progressively more complex features



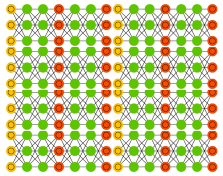
Image source: https://blogs.scientificamerican.com/sa-visual/unveiling-the-hidden-layers-of-deep-learning/

# Deep Learning

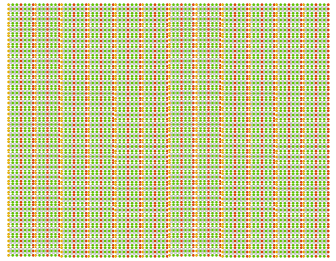




AlexNet
~8 layers, < 1 million neurons



Inception
~48 layers, < 10 million neurons



Human Brain
~100 Billion neurons, Trillions of connections

# Key Concepts (Revisited)

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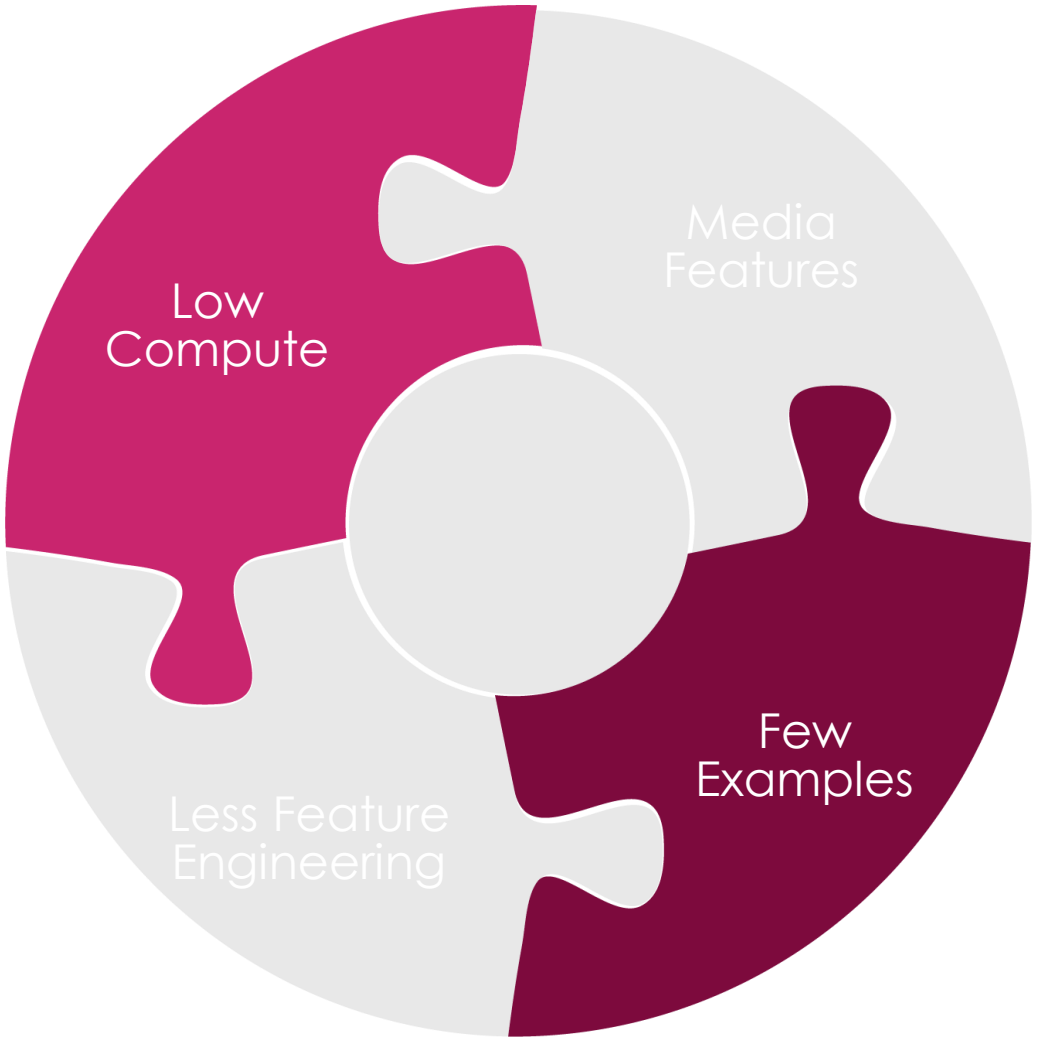
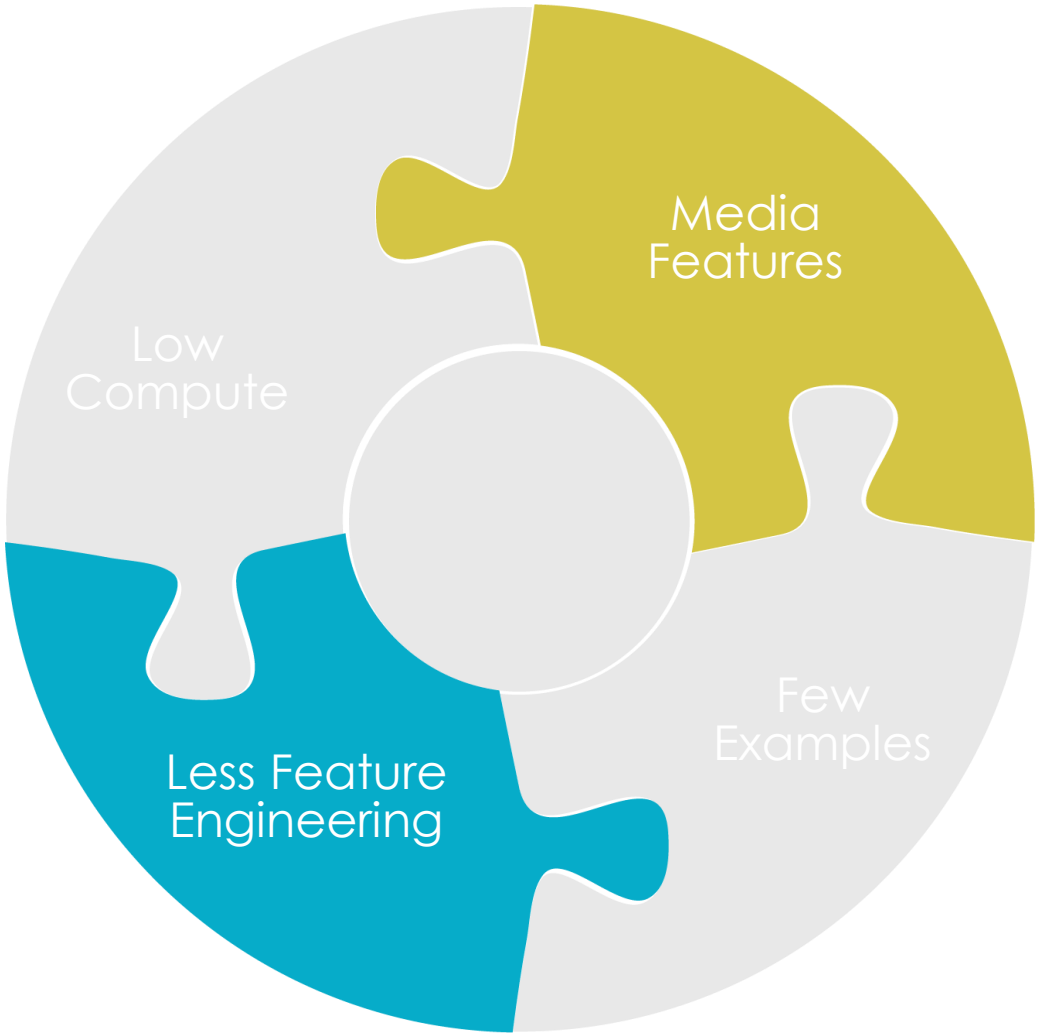
# Transfer Learning

| Criteria | Deep Learning | Traditional ML |
|---|---|---|
| Low Compute Power | N | Y |
| Few observations needed | N | Y |
| Automatic Features | Y | N |
| High Accuracy | Y | N |

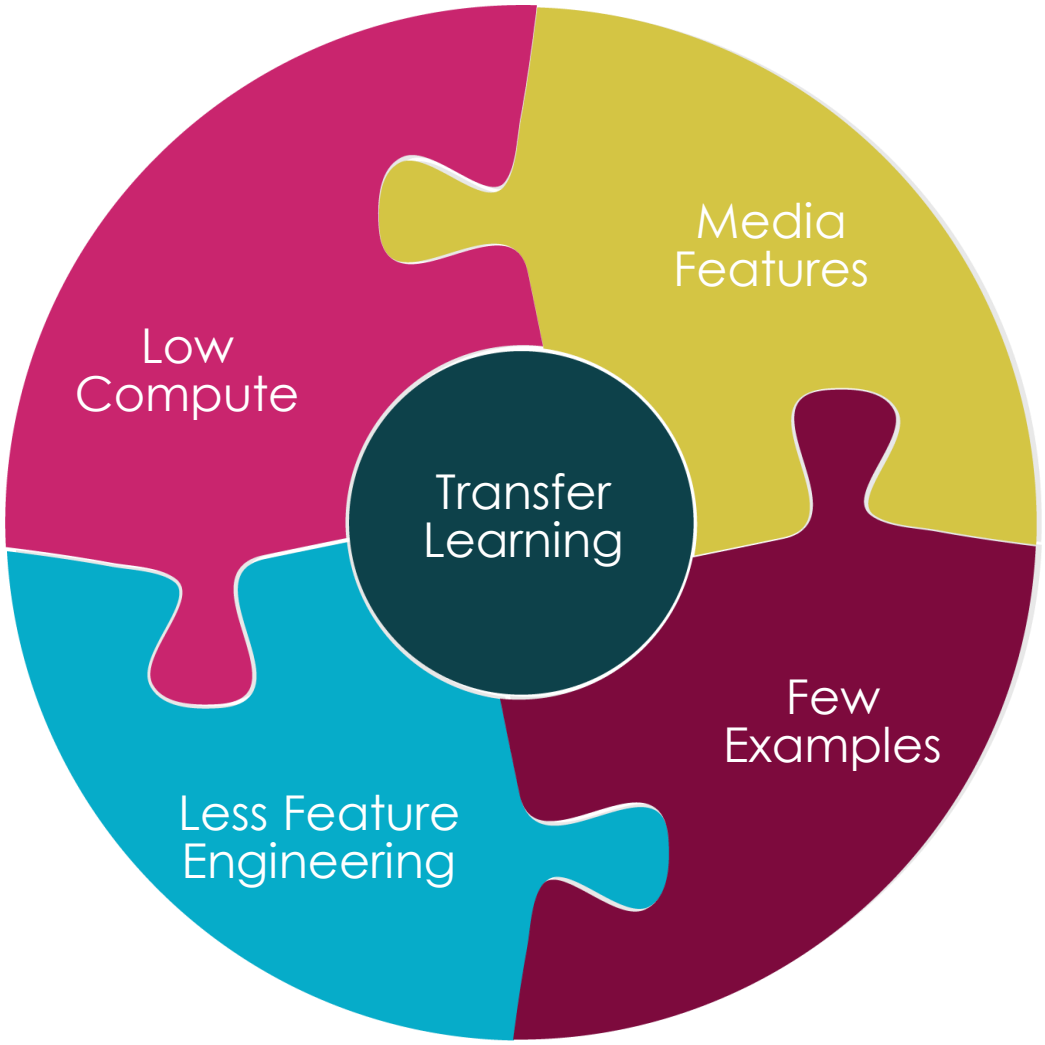
# Transfer Learning – Machine Learning



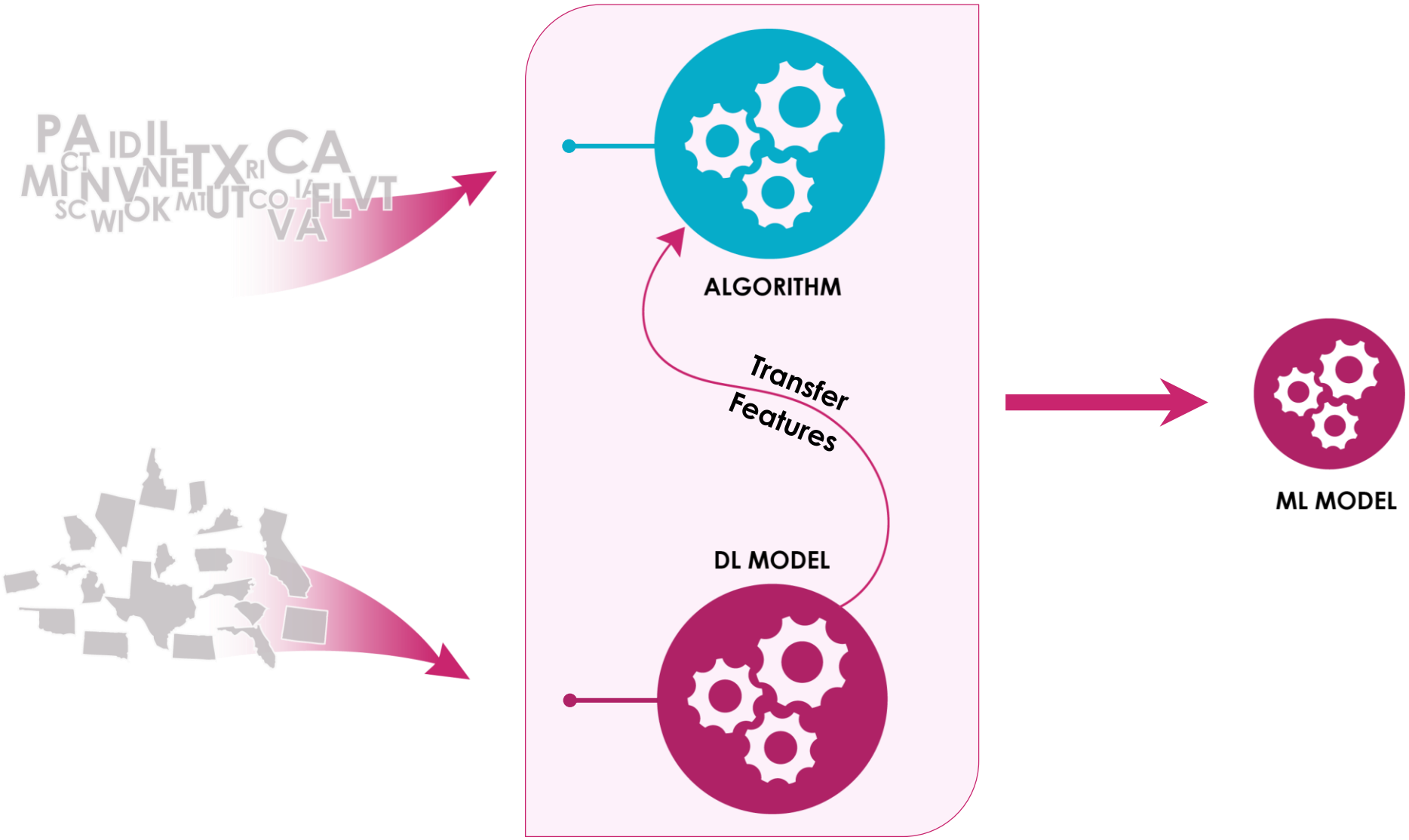
# Transfer Learning – Deep Learning



# Transfer Learning – Complete Puzzle



# Transfer Learning – How it works



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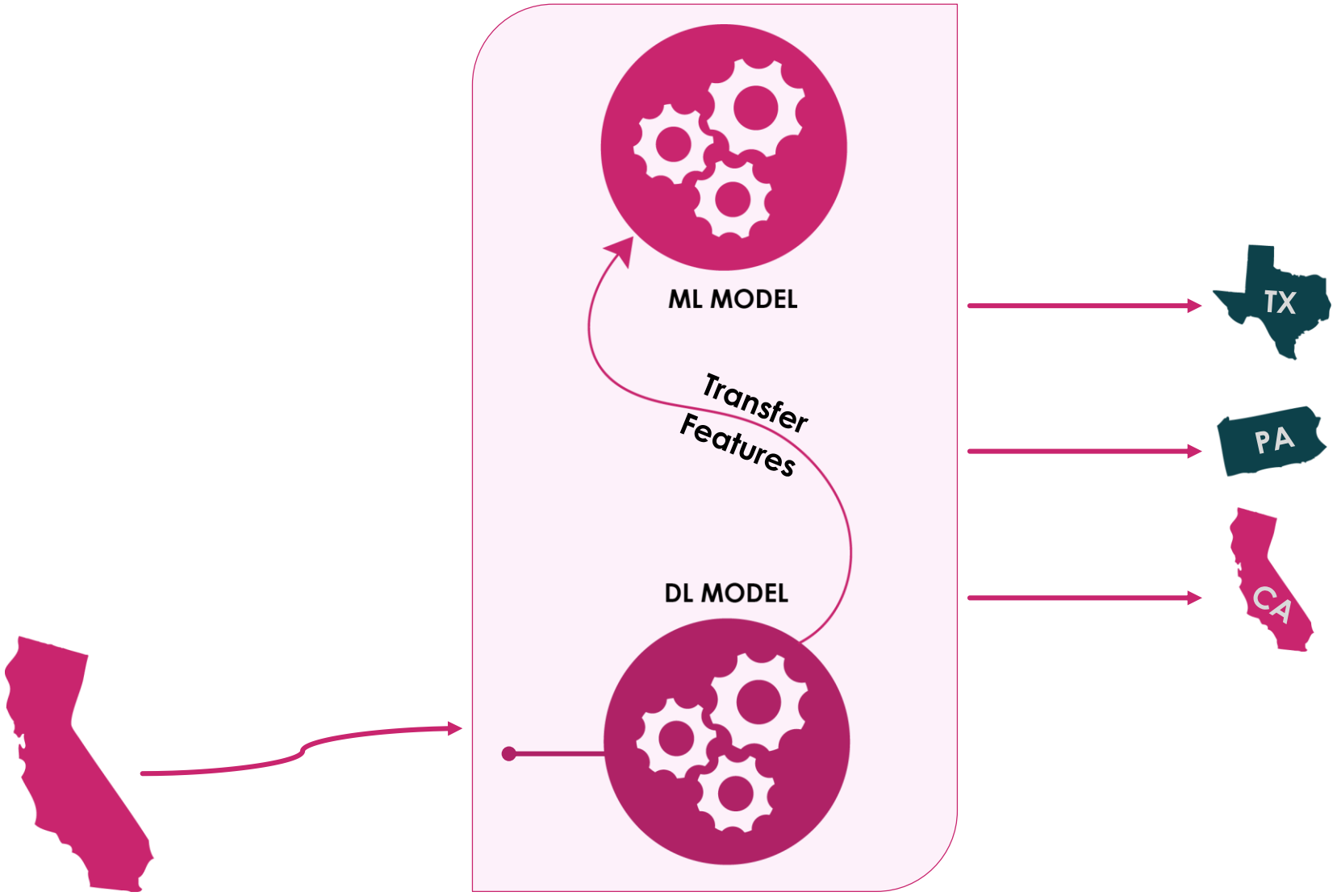

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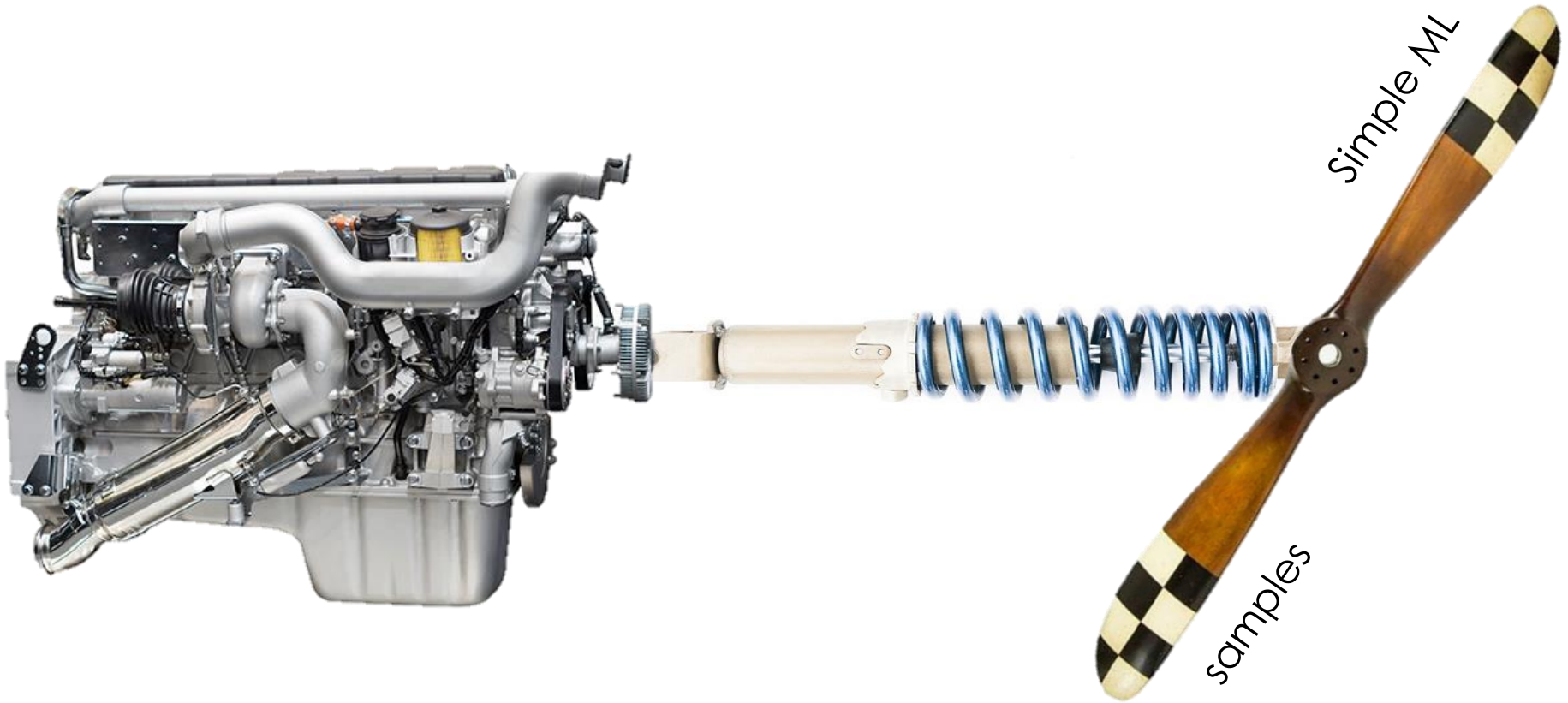
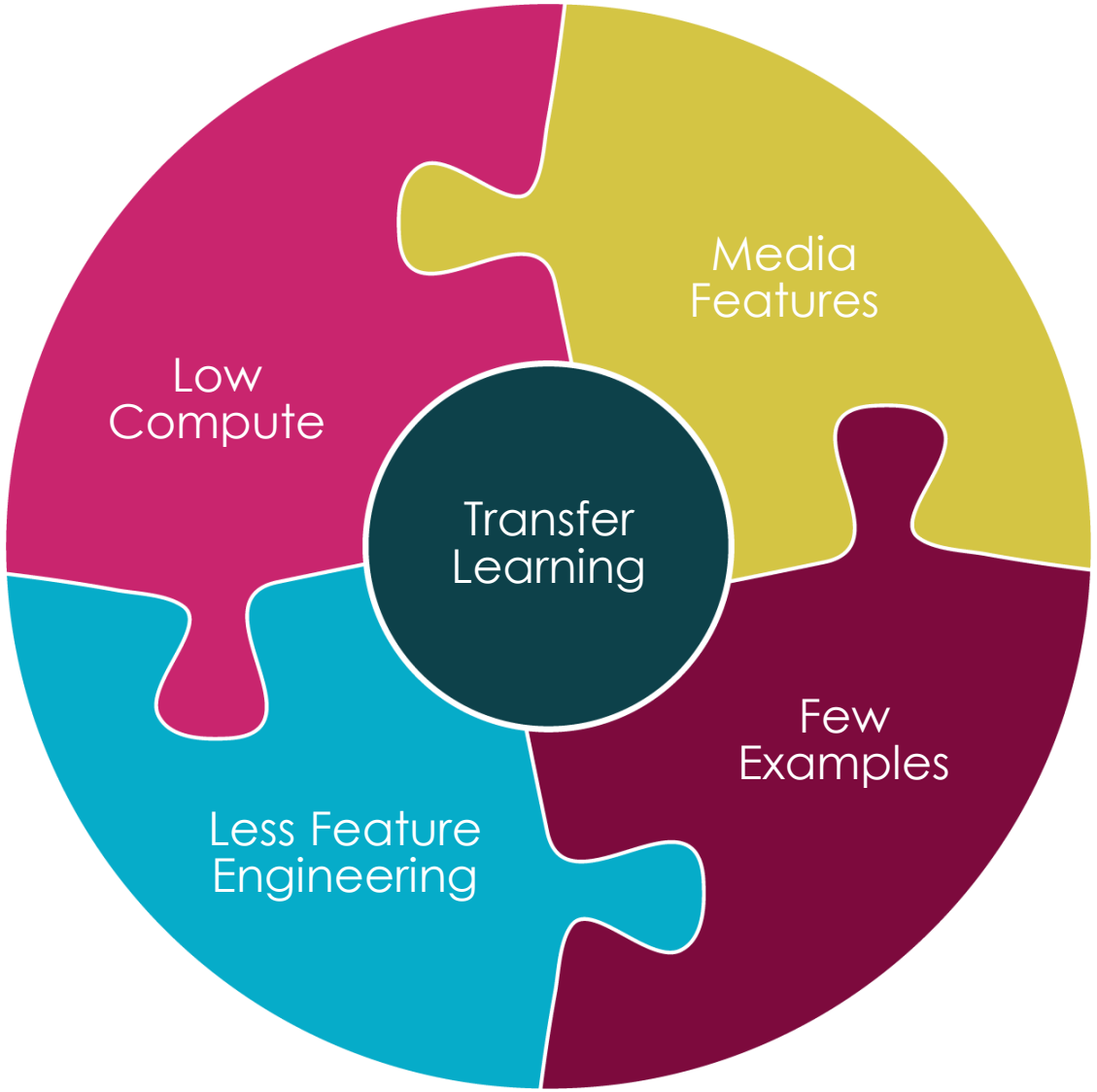


# Transfer Learning – How it works

- Python Programing
- TensorFlow – Deep learning
- Scikit Learn for ML
- OpenCV – Image processing




# Transfer Learning – How it works



# References

| Resource | Location |
|---|---|
| Demo Source Code | http://bit.ly/2rVCkR2 |
| Transfer Learning in eCommerce | http://bit.ly/2pHaA0T |
| Introduction to Machine Learning | http://bit.ly/2s6J8xt |
| Real-time Object Detection | http://bit.ly/2scVhS1 |
| Inception V3 Model for Computer Vision | https://arxiv.org/abs/1512.00567 |
| Coursera Data Science Courses | http://bit.ly/2sMy5af |
| Python Library Installation | http://docs.continuum.io/anaconda/install |
| OpenCV Documentation | http://docs.opencv.org/3.2.0/index.html |
| TensorFlow install instructions | https://www.tensorflow.org/install/ |
| Computer Vision Docker Container | mobyware/inception_opencv |