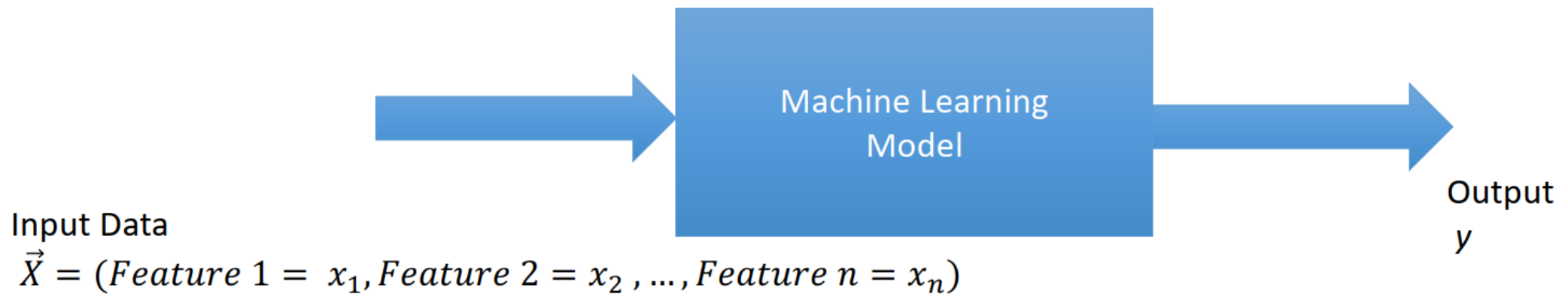


Formal Definition and ML Applications

Dr. Muhammad Wasim

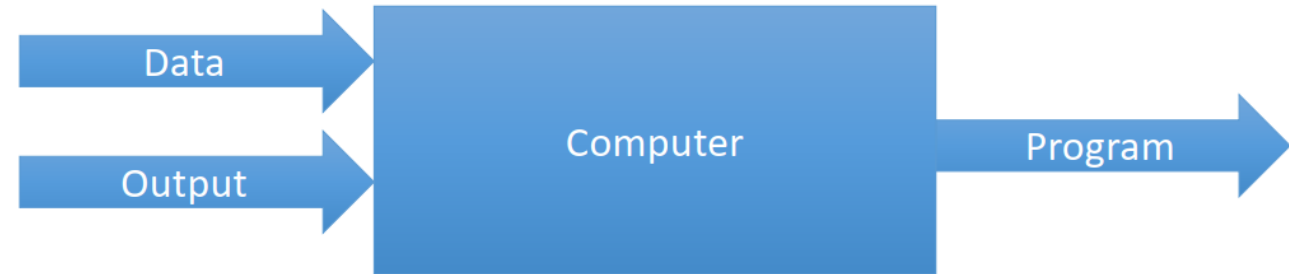
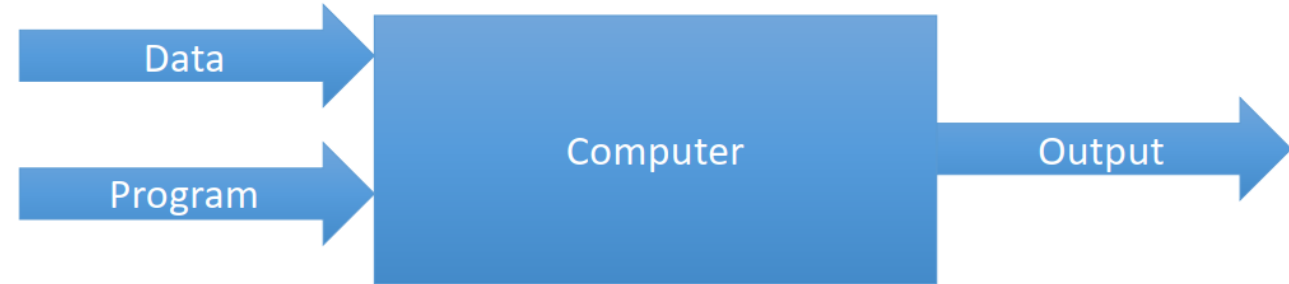
So, What is machine learning?

- To teach a machine to recognize patterns in data without explicitly programming it.
- A computer program is said to learn from *experience E* with respect to some class of *tasks T* and *performance measure P*, if its performance at tasks in T, as measured by P, improves with experience E.



Supervised Learning

- Traditional Programming
- Supervised Learning
 - **Given:** $(x, f(x))$ pairs for some unknown $f(x)$
 - **Goal:** Find a good approximation to f .



Example: SPAM Email Classification

From: MSteam-Outlook Message Center <no-reply@office365protectionservices.co.uk>

Sent: 19 September 2018 11:44

To: Bob Smith <Bob.Smith@Company.com>

Subject: Account Verification

 **Fake domain**

This mail is from a trusted sender.



 **Threat**

We're having trouble verifying your Office365 account: Bob.Smith@Company.com on our server, most features will be turned off.

To help prevent account malfunctions, please log into your account portal to verify your account.

 **Spelling mistakes**

[SIGN IN TO MICROSOFT ACCOUNT PORTAL](#)

Note : Outlook will automatically fix your account after this process on the microsoft server and all account features will be turned back on

Thanks for using office365 , we hope to continue serving you.

Microsoft Corporation

One-Microsoft Way Redmond

WA, 98052

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 **Grammatical errors**

 **Fake email signature**

- It is not possible to write rules manually and for all the features of a spam email.
- BUT, we have a lot of data of how a spam/ham email looks like.
- We can provide a dataset containing millions of examples of SPAM/HAM emails and let it identify patterns in the data.

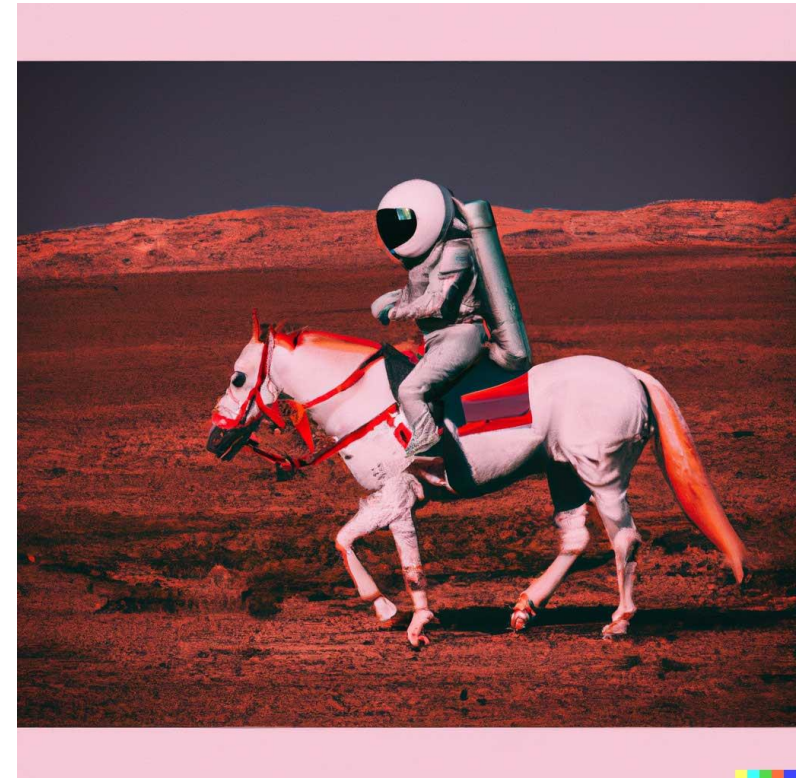
Example: Handwriting Optical Character Recognition (OCR)



- What if we have to write a program for handwriting OCR?
- It is very challenging to write rules to identify different classes in this **multi-class classification** problem.
- If we have a 28 x 28 sized image, we have a total of 784 pixel values for each number.
- But, it is easy for us to provide our machine learning algorithm with examples and their labels from 0 to 9.

Last three years have been phenomenal in progress in machine learning

- Deep Learning, an area of machine learning has made some exciting applications possible.
- Models such as DALL-E-2 can generate images which one has never seen before. For example the following image:



ChatGPT-3 and ChatGPT-4


- Large Language Models (LLMs) for language generation currently used by OpenAI, Microsoft (Teams/Office 360), Google (Bard / Smart Compose)
- These are huge models. For example ChatGPT-3 has 175 billion parameters.
- These models can answer most of your questions as they are trained on a huge corpus.
- They can even write code for you as shown in the next example.

ChatGPT-3 for Code Generation

Write code in Tensorflow to train a neural network



Certainly! Here is an example of how you can use TensorFlow to train a neural network for binary classification:

 Copy code

```
import tensorflow as tf

# Load the data
(x_train, y_train), (x_test, y_test) = load_data()

# Define the model
model = tf.keras.Sequential([
    tf.keras.layers.Input(shape=x_train.shape[1:]),
    tf.keras.layers.Dense(16, activation='relu'),
    tf.keras.layers.Dense(1, activation='sigmoid')
])

# Compile the model
model.compile(optimizer='adam', loss='binary_crossentropy', metrics=[
    'accuracy'])

# Train the model
model.fit(x_train, y_train, epochs=10, batch_size=32, validation_data=
(x_test, y_test))
```

This code assumes that you have a function `load_data()` that returns the training and test datasets as tuples of NumPy arrays. The input shape of the model is determined by the shape of the training data, and the model has two dense layers with 16 and 1 units, respectively, with ReLU and sigmoid activations. The model is then compiled with an Adam optimizer and a binary cross-entropy loss function, and is trained using the `fit()` method.

I hope this helps! Let me know if you have any questions.