SIGGRAPH 2020 S2020.SIGGRAPH.ORG THINK BEYOND

Walt Disney ANIMATION STUDIOS

JUNE 2020 WEBINAR

Hands-on Workshop: Machine Learning and Neural Networks

SIGGRAPHNOW

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Machine Learning

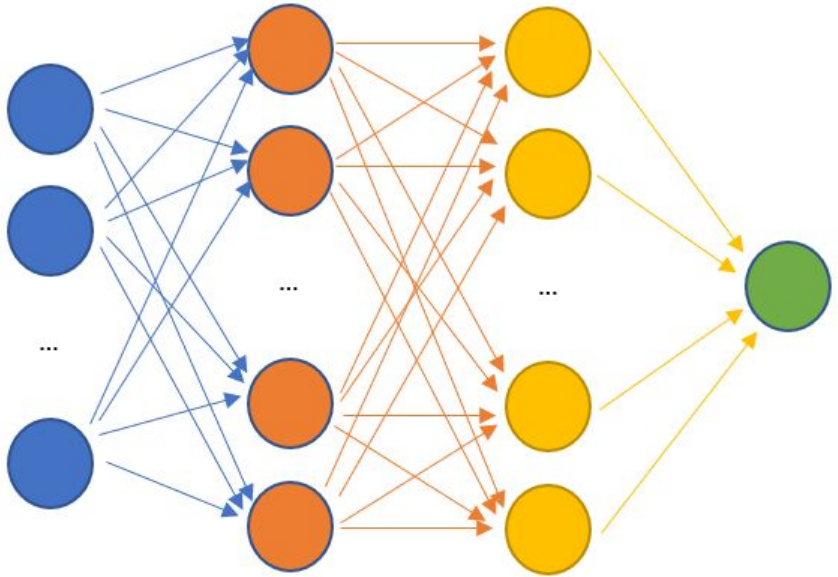
Rajesh Sharma

Today

- Quick Recap & Questions
- Classification
- Maximum Likelihood Estimation
- Autoencoder

Recap

Neural Network for regression



Recap - Questions

Why those specific numbers of layers and nodes?
Why that specific batch size? What's an epoch?
Strings and Categorical values
Normalization vs Standardization
If this is a Linear Regression why are we using a Neural Net?
When we are classifying images, will we only have one input/feature?
Is there anything extra happening at the end of each epoch?
How much data is needed?

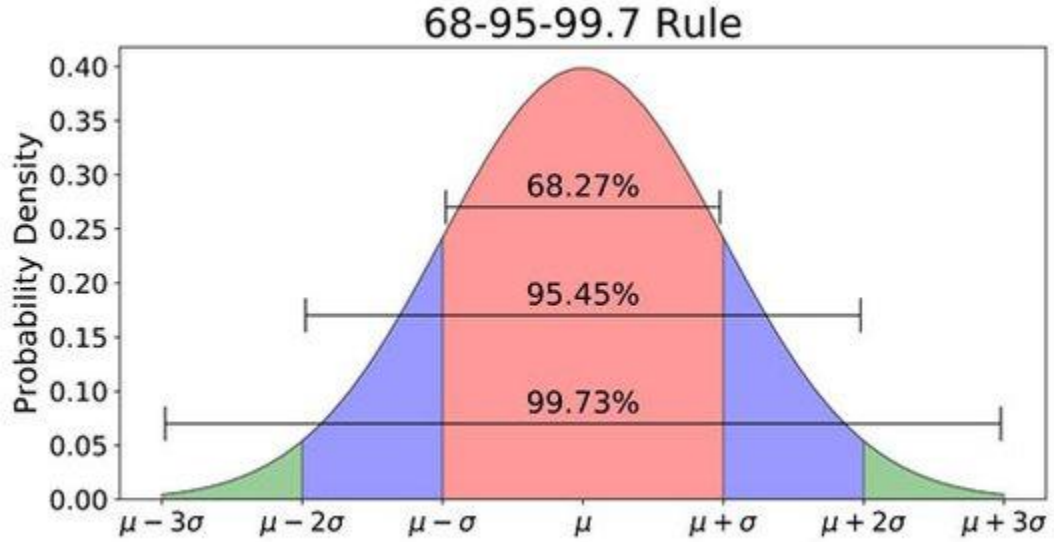
Classification

Given some pre-classified data:

Q: How do we find which class the new data belongs to?

A: By finding the maximum likelihood

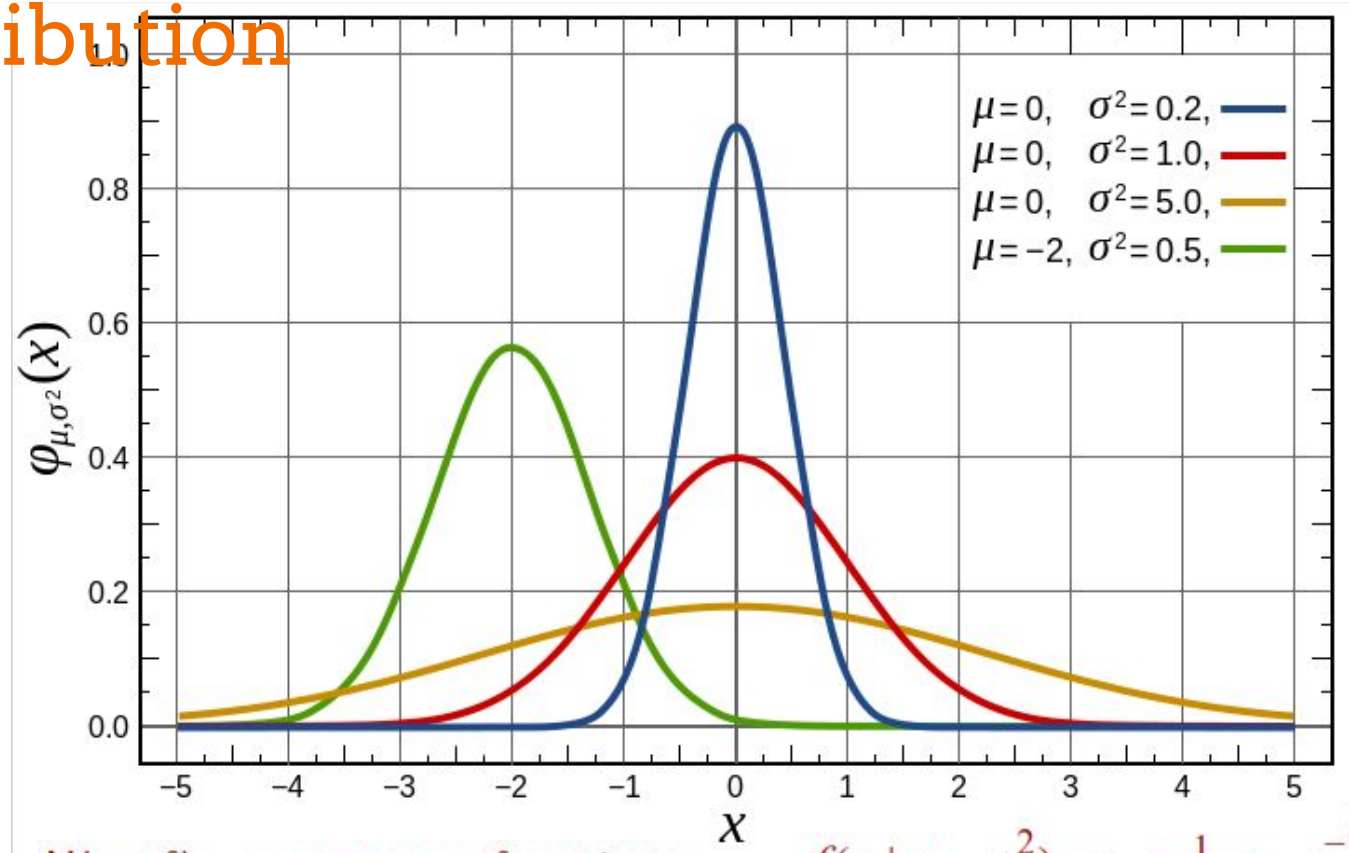
Probability & Statistics: Normal Distribution



$N(\mu, \sigma^2)$; μ - mean , σ^2 - variance

$$f(x \mid \mu, \sigma^2) = \frac{1}{\sqrt{2\pi\sigma^2}} \cdot e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

Probability & Statistics: Normal Distribution



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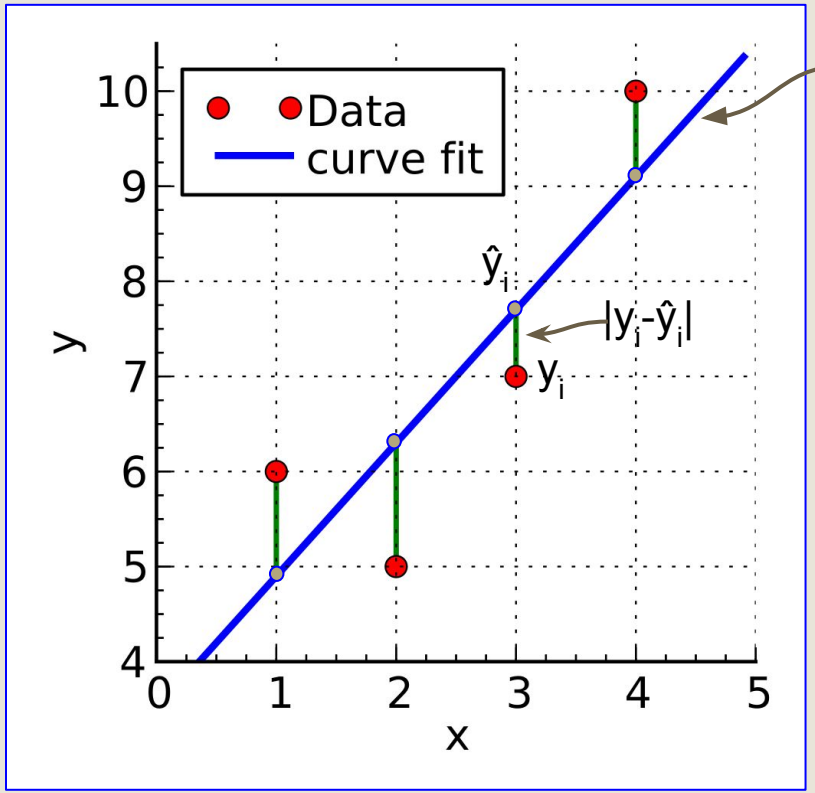
Regression → Maximum Likelihood Estimation



Prediction: $\hat{y} = ax + b$

Actual: y_i

Error: $|y_i-\hat{y}_i|$

Total Squared Error:

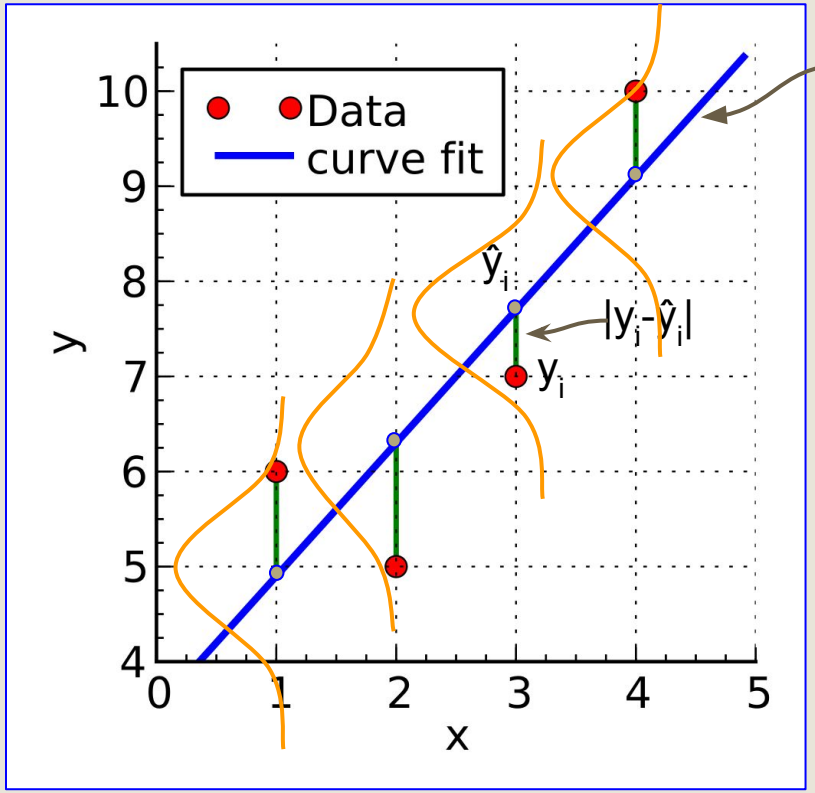
$\sum (y_i-\hat{y}_i)^2$, for i=(1, n)

Minimize Total Squared Error:

$E(a,b) = \sum(y_i - ax_i - b)^2$

(a,*b*) are the parameters (weights)

Regression → Maximum Likelihood Estimation



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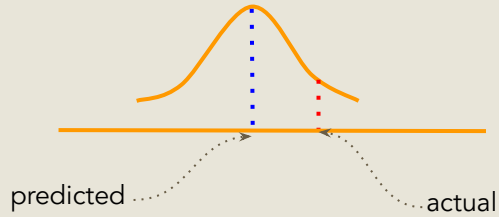


Maximum Likelihood Estimation vs MSE

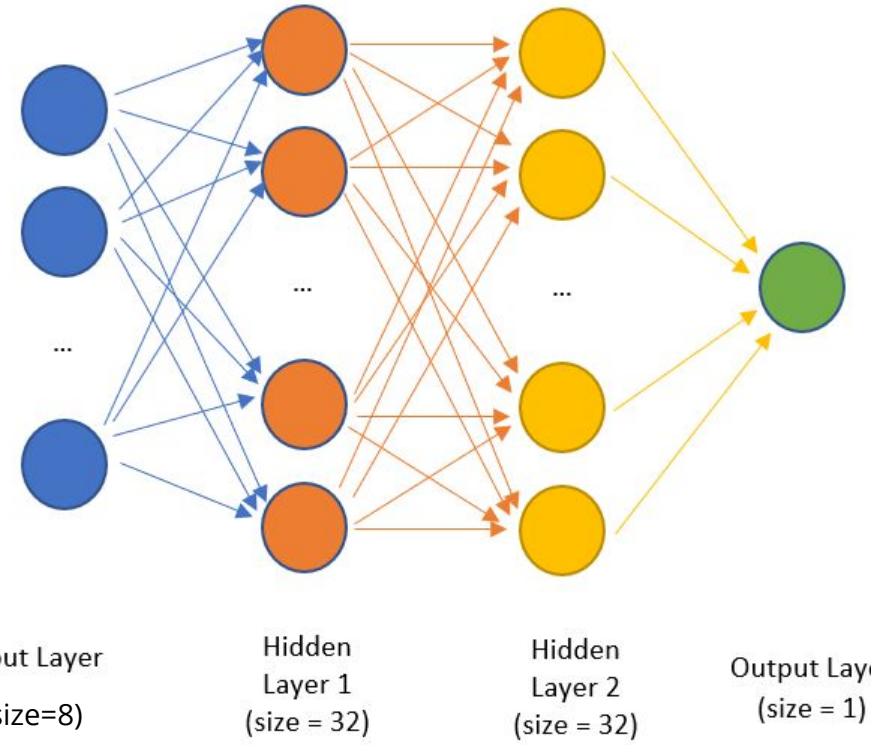
$$f(x \mid \mu, \ \sigma^2) = \frac{1}{\sqrt{2\pi\sigma^2}} \cdot e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

$$f(x_1, \ldots, x_n \mid \mu, \sigma^2) = \prod_{i=1}^{n} f(x_i \mid \mu, \sigma^2) = \left(\frac{1}{2\pi\sigma^2}\right)^{n/2} \exp\left(-\frac{\sum_{i=1}^{n}(x_i - \mu)^2}{2\sigma^2}\right).$$

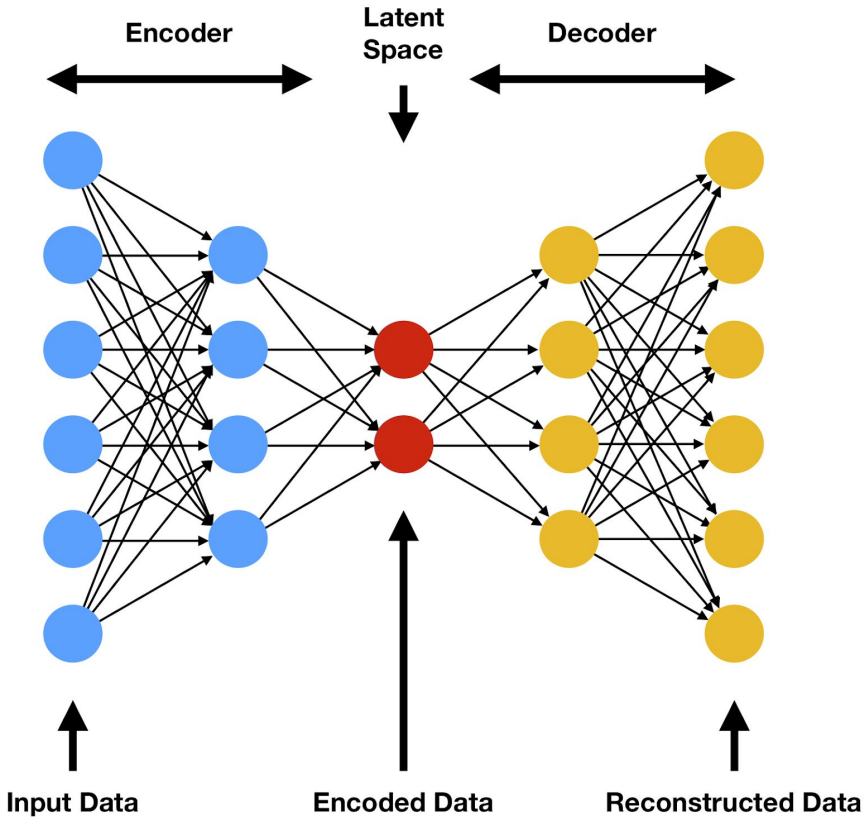
$$\log\Big(\mathcal{L}(\mu, \sigma)\Big) = -\frac{n}{2}\log(2\pi\sigma^2) - \frac{1}{2\sigma^2}\sum_{i=1}^{n}(x_i - \mu)^2$$

Autoencoder

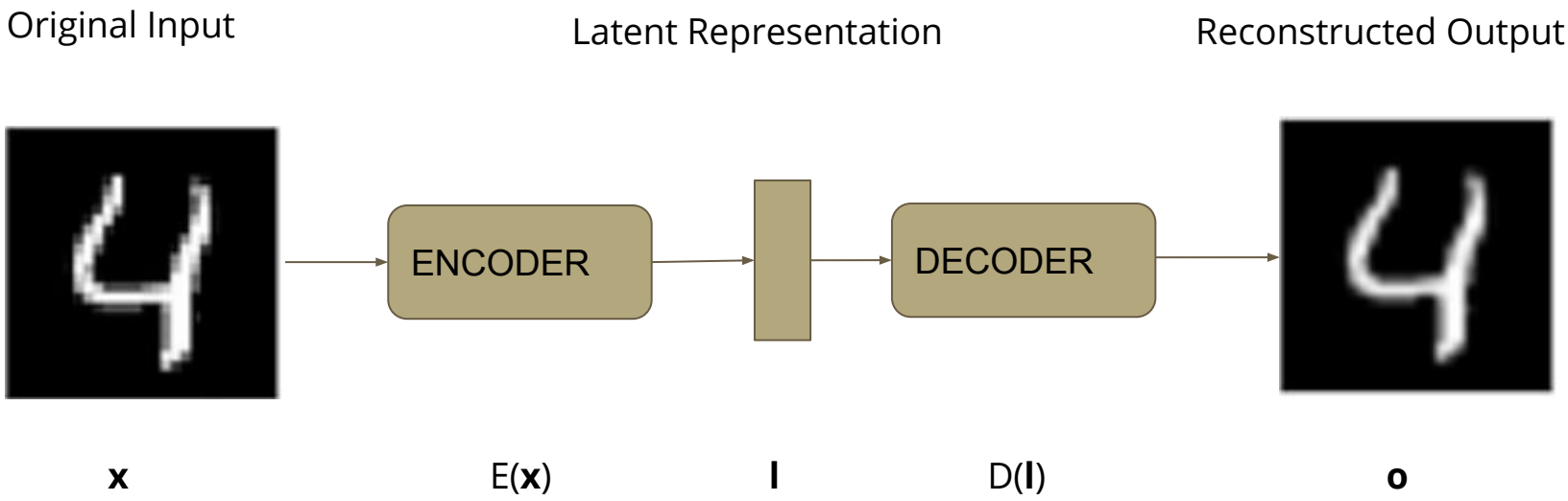
For regression, we had a fully-connected network, output layer size=1



Autoencoder



Autoencoder



Hands-on

- ★ *Log in to your google drive*
- ★ Find the shared folder 'Disney Machine Learning Webinar'
- ★ Make a copy of:
  - AutoEncoder.ipynb,

Autoencoder - Model

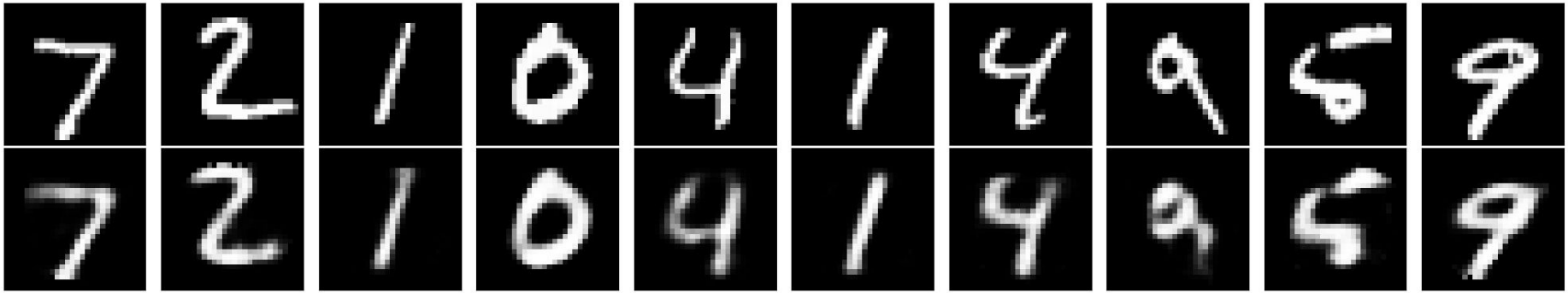
```
# build an autoencoder
model = tf.keras.models.Sequential([
    tf.keras.layers.InputLayer(IMG_SHAPE),
    tf.keras.layers.Flatten(),
    # encoder
    tf.keras.layers.Dense(128, activation='relu'),
    tf.keras.layers.Dense(64, activation='relu'),
    tf.keras.layers.Dense(32, activation='relu'),
    # decoder
    tf.keras.layers.Dense(64, activation='relu'),
    tf.keras.layers.Dense(128, activation='relu'),
    tf.keras.layers.Dense(784, activation='sigmoid'),
    tf.keras.layers.Reshape(IMG_SHAPE)
    ])

# compile
model.compile(optimizer='adamax', loss='mse')

# fit
model.fit(x_train, x_train, epochs=17,batch_size=256, shuffle=True, validation_data=(x_test, x_test))

# predict
decoded_imgs = model.predict(x_test)
```

Autoencoder - results



Compression Factor: 28x28/32 ~ 25X

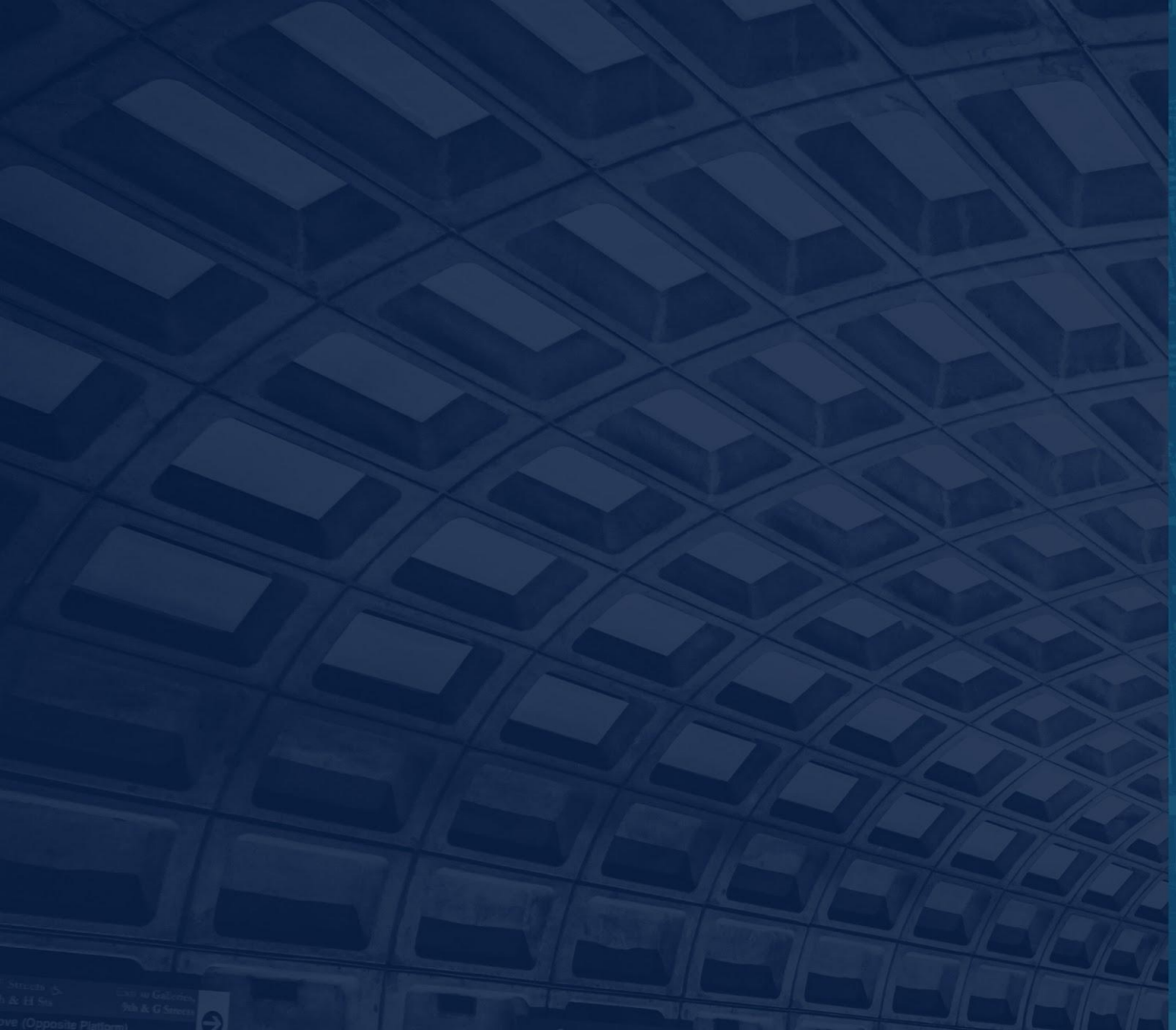
Homework - Classify mnist data

Remarkably Clever

Surprisingly Dumb

Next Class

- Efficient Data Pipeline
- Convolutional Neural Network
- Homework:
  - Use the mnist dataset for classification
  - Extra credit: also show “next likely”
- @xarmalarma, #siggraphNOW



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QUESTIONS?

Submit now!

THANK YOU

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