ARISA Learning Material

Educational Profile and EQF level: DATA SCIENTIST – EQF 6

PLO: 1, 2, 3, 4, 5

Learning Unit (LU): MACHINE LEARNING: SUPERVISED

Topic: LINEAR MODELS AND LOGISTIC REGRESSION

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ARISA Learning Material 2024

This material is a draft version and is subject to change after review coordinated by the European Education and Culture Executive Agency (EACEA).

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Disclaimer: This learning material has been developed under the Erasmus+ project ARISA (Artificial Intelligence Skills Alliance) which aims to skill, upskill, and reskill individuals into high-demand software roles across the EU.

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- About ARISA

- The Artificial Intelligence Skills Alliance (ARISA) is a four-year transnational project funded under the EU's Erasmus+ programme. It delivers a strategic approach to sectoral cooperation on the development of Artificial Intelligence (AI) skills in Europe.
- ARISA fast-tracks the upskilling and reskilling of employees, job seekers, business leaders, and policymakers into AI-related professions to open Europe to new business opportunities.
- ARISA regroups leading ICT representative bodies, education and training providers, qualification regulatory bodies, and a broad selection of stakeholders and social partners across the industry.

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- CODE

- EN AMAZON CLOUD ARISA 1 – ANN
- EN LOCAL TUTORIAL_DEEP_LEARNING_basics

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Software de aprendizaje profundo para Python

- **Keras** https://keras.io/
  - (alto nivel) – parte de tensorflow. Interfaz de alto nivel
- PyTorch – principalmente NLP
- **TensorFlow** https://www.tensorflow.org/ (bajo nivel)

Ejemplo con Keras

```python
from keras.models import Sequential
from keras.layers import Dense

model = Sequential([
    Dense(64, activation='relu', input_shape=(100,)),
    Dense(10, activation='softmax')
])
```

Source: F. Chollet. Deep Learning with Python.

```
(train_images, train_labels), (test_images, test_labels) = mnist.load_data(
train_images = train_images.reshape((60000, 28 * 28))
train_images = train_images.astype('float32') / 255
test_images = test_images.reshape((10000, 28 * 28))
test_images = test_images.astype('float32') / 255
train_labels = to_categorical(train_labels)
test_labels = to_categorical(test_labels)
```

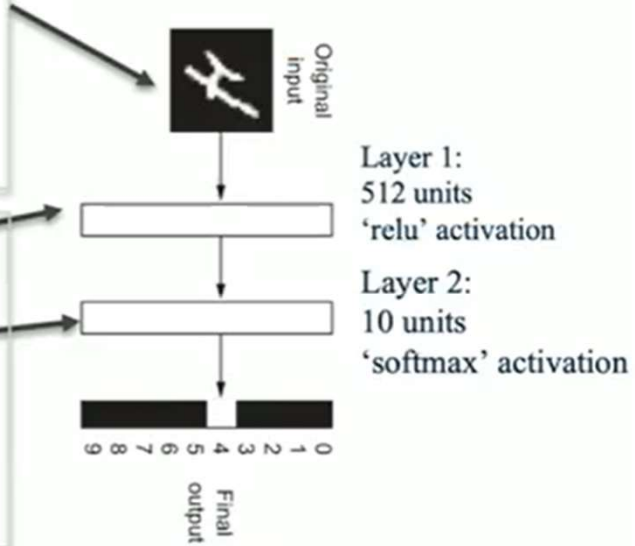
1. Data preparation

```
network = models.Sequential()
network.add(layers.Dense(512, activation='relu', input_shape=(28 * 28,)))
network.add(layers.Dense(10, activation='softmax'))
```

```
network.compile(optimizer='rmsprop',
                loss='categorical_crossentropy',
                metrics=['accuracy'])
```

2. Model definition

```
network.fit(train_images, train_labels, epochs=5, batch_size=128)
test_loss, test_acc = network.evaluate(test_images, test_labels)
```



3. Model training

4. Model evaluation

layer

Tipo de capa	Uso principal	Ejemplo de uso
Dense	Capa totalmente conectada	Dense(64, activation='relu')
Conv2D	Procesamiento de imágenes (visión por comp.)	Conv2D(32, kernel_size=(3, 3), activation='relu')
MaxPooling2D	Reducción de dimensiones en imágenes	MaxPooling2D(pool_size=(2 , 2))
Flatten	Aplana tensores antes de capas Dense	Flatten()
Dropout	Regularización para evitar sobreajuste	Dropout(0.5)
LSTM / GRU	Procesamiento de secuencias (texto, series)	LSTM(128), GRU(128)
Embedding	Representación vectorial de palabras (NLP)	Embedding(input_dim=100 00, output_dim=128)
BatchNormalization	Estabiliza y acelera el entrenamiento	BatchNormalization()

optimizer

- Define el **algoritmo de optimización** que ajusta los pesos del modelo para minimizar la función de pérdida.
- Optimizadores comunes:
  - 'sgd': Gradiente descendente clásico
  - 'adam': Muy popular, rápido y robusto
  - 'rmsprop', 'adagrad', 'nadam', etc.

loss

- Define la **función de pérdida** que mide el error entre las predicciones y las etiquetas reales.
- Clasificación:
  - 'binary_crossentropy' → 2 clases
  - 'categorical_crossentropy' → multiclase con one-hot
  - 'sparse_categorical_crossentropy' → multiclase con enteros
  - Regresión:
    - 'mse' (error cuadrático medio)
    - 'mae' (error absoluto medio)
    - 'huber' (mezcla de MSE y MAE, robusto)

Hardware stack

- Las redes neuronales realizan operaciones matriciales en pasos hacia adelante y hacia atrás
- Muchas de estas operaciones se pueden realizar en forma de elemento o en fragmentos
- Estos elementos / fragmentos se pueden asignar a varios núcleos
- Las GPU modernas tienen 1000 núcleos, que son mucho más rápidos en el cálculo paralelo que las CPU con unos pocos 100 núcleos.

GPU de consumo

- Bueno para proyectos pequeños y para un número limitado de GPU
- Funciones limitadas y RAM de GPU
- Optimizado para el rendimiento visual
- Refrigeración activa
- La serie A0B0 más popular, donde A = 1,2,3,4 y B = 6,7,8,9
- Por ejemplo, la mejor elección en 2023: NVIDIA RTX 4090 24GB
- Más información:https://www.nvidia.com/en-eu/geforce/graphics-cards/

- **GPUs semiprofesionales**

- Bueno para proyectos pequeños y para un número limitado de GPU
- Optimizado para el rendimiento visual, 64 bits
- Refrigeración activa
- Ada Lovelace y la arquitectura de Ampere
- Por ejemplo, RTX 6000, 5000, 4500, 4000, A6000, A5000, etc.
- Más información:https://www.nvidia.com/en-us/design-visualization/desktop-graphics/

- **GPU de nivel de servidor**

- Seamless” integration
  - PCIe 6.0 16 lanes: 128 Gb/s
  - In-GPU: 3.35/2/7.8 TB/s (SMX/PCIe/NVL)
  - Multi GPU: NVSwitch 900 Gb/s
  - Multi node: Infiniband/Ethernet 400Gb/s
  - Passive cooling
- Servidor listo para usar DGX H100
- More info:
  - GPU: https://www.nvidia.com/en-us/data-center/h100/
  - Server: https://www.nvidia.com/en-us/data-center/dgx-h100/

- **NVIDIA DGX H100 SuperPod**

- Off-the-shelf solution for AI infrastructure
- Built from 31…127 DGX H100 systems
- Important requirements:
  - Dry-Bulb temperature: 18-27 C
  - Humidity range: 5.5 °C to 60% RH and 15 °C DP
- More details: https://docs.nvidia.com/nvidia-dgx-superpod-data-center-design-dgx-h100.pdf

GPUs en la nube

- Google Cloud, AWS, MS Azure, Oracle, NVIDIA DGX Cloud.
- Flexible, bueno para escalar
- Los entrenamientos a gran escala no son triviales
- Excelente para opciones de inferencia
- Comparaciones:https://fullstackdeeplearning.com/cloud-gpus/
  - https://cloud-gpus.com/

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