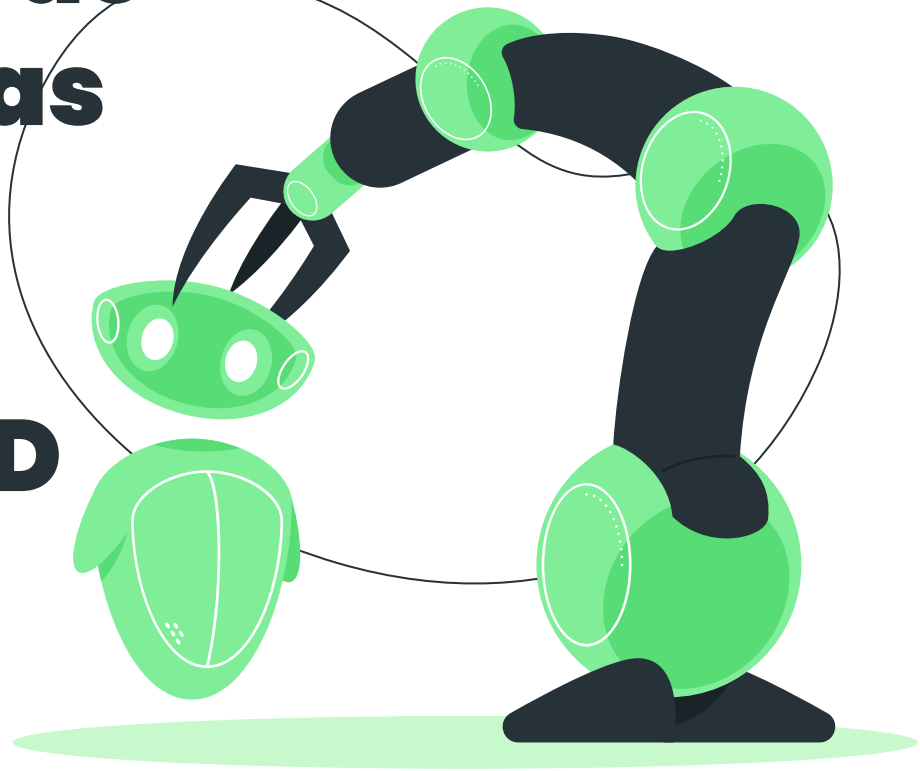
Reconocimiento de Lenguaje de Señas con una Red Neuronal Convolucional 3D

Loana Beltran Cardozo
Santiago Florez Carranza



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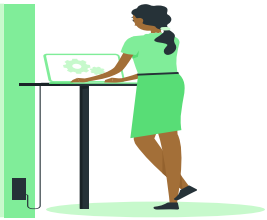
LENGUA DE SEÑAS COLOMBIANA

Una lengua de señas es un sistema **gesto-espacial** el cual utiliza movimientos de manos, expresiones faciales y corporales para transmitir mensajes.

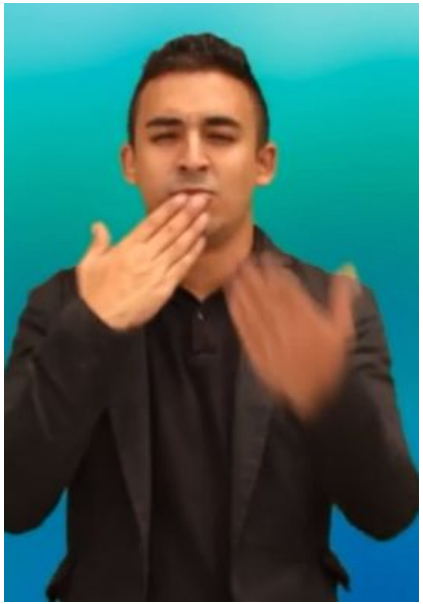
Las personas sordas suelen usar este lenguaje para establecer un canal de comunicación con su entorno social, sea conformado por otras personas sordas o por cualquier persona que conozca la lengua de señas empleada.

Datos

Los datos o entradas, corresponden a señas, **no** a palabras del español. Muchas veces sí coinciden, pero otras no; algunas veces una sola seña hace alusión a varias palabras del español.

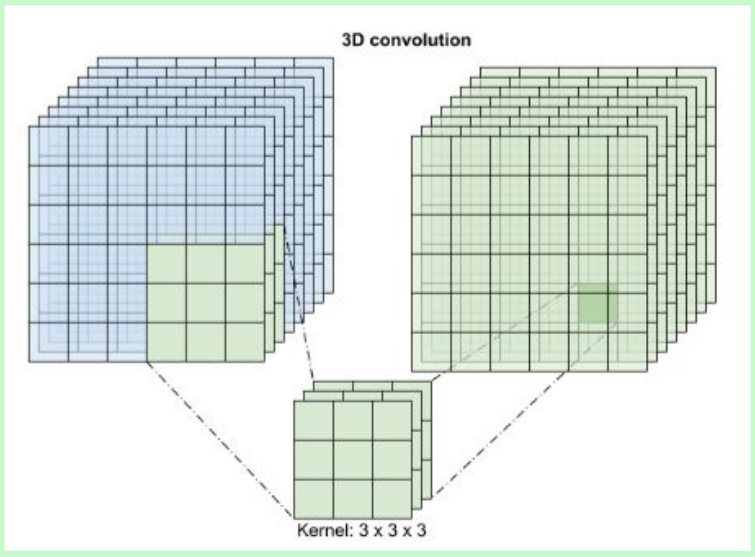


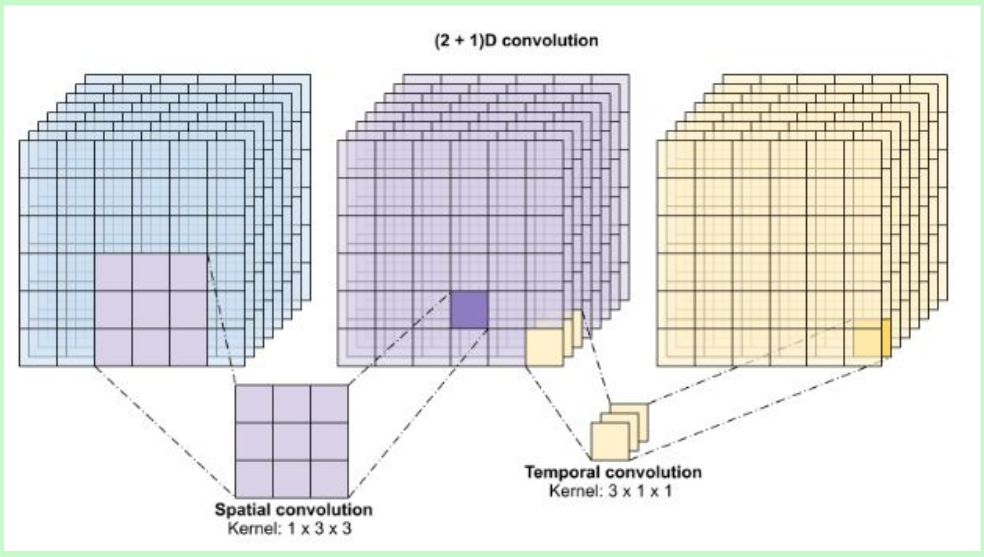
Preprocesamiento



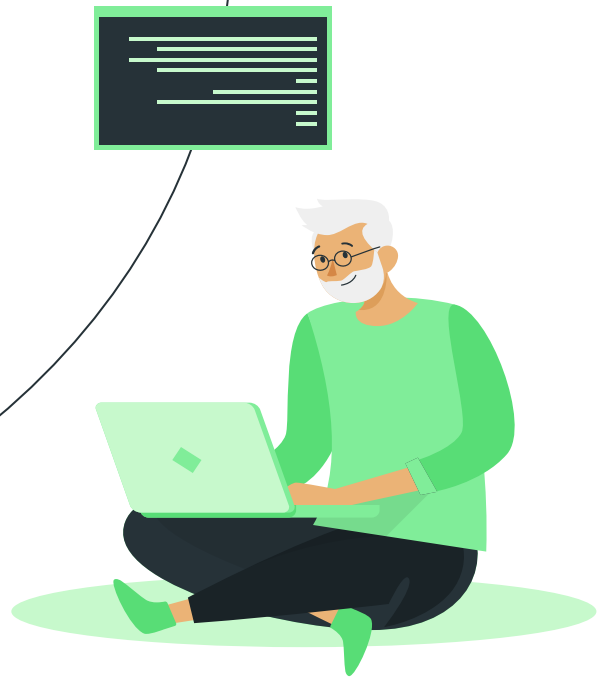
Convolución 3D

Una red neuronal convolucional (Convolutional Neural Network CNN) 3D utiliza un filtro tridimensional para realizar circunvoluciones. El núcleo puede deslizarse en tres direcciones, mientras que en una CNN 2D puede deslizarse en dos dimensiones





Entrenamiento y ajuste del modelo



Modelo

Conv2Dplus1D

Factorización de las convoluciones en espacial y en temporal

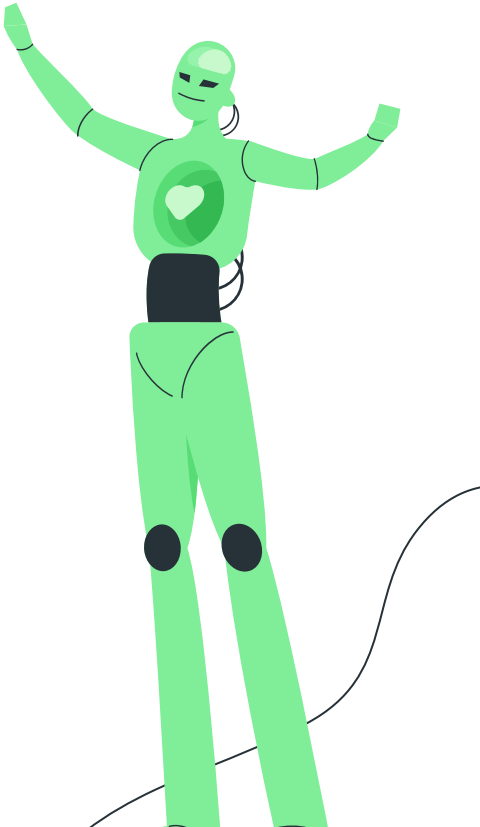
ResNet18

Redes residuales. Capas densas seguidas de capas de normalización

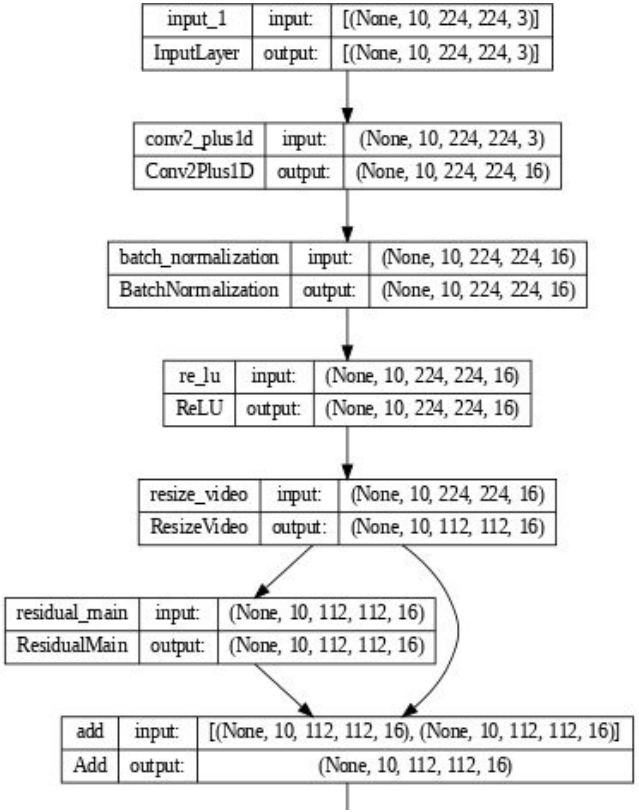
Resize_video

Reducción de dimensionalidad

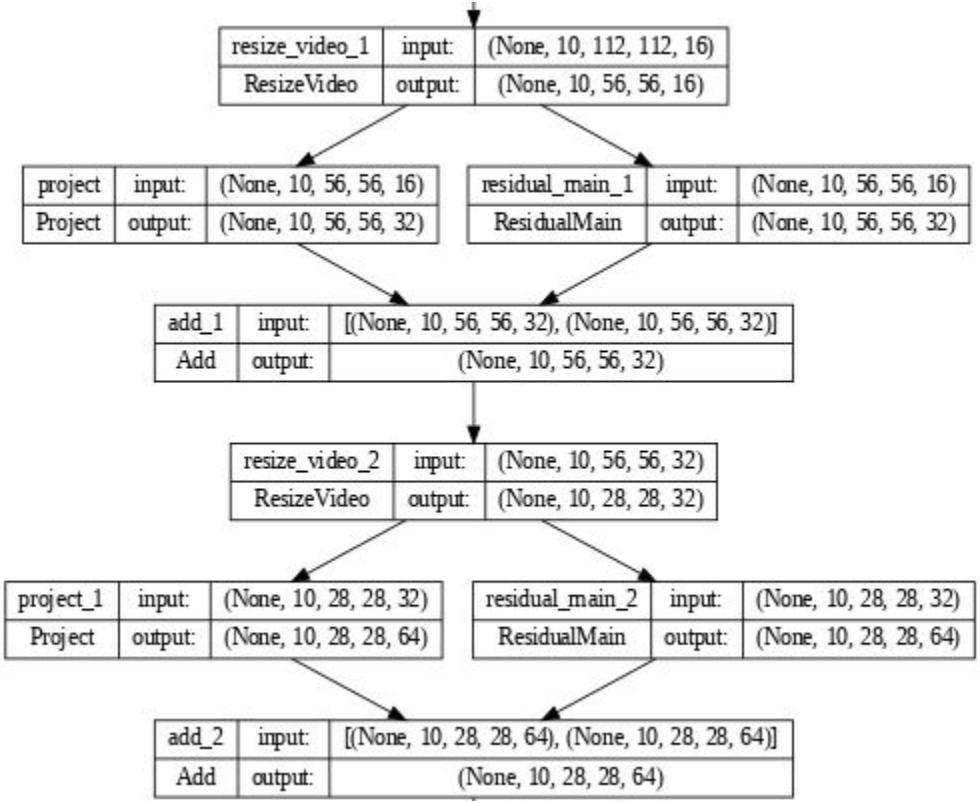
Global average pooling3d



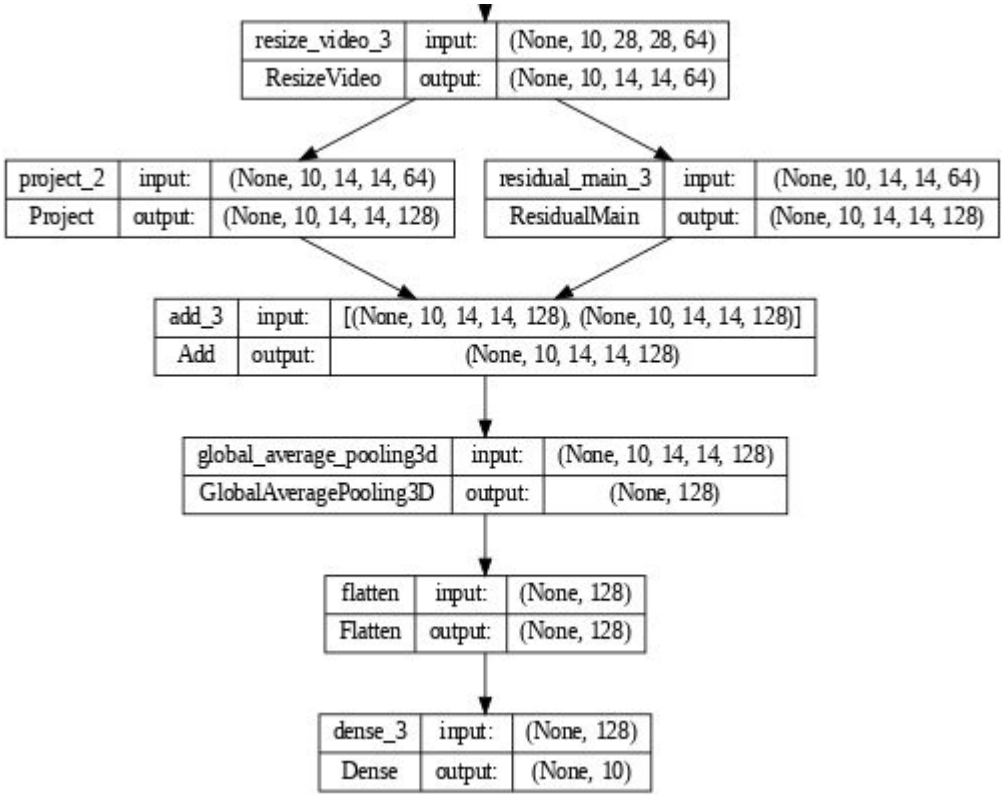
Modelo


input_1 | input: | [(None, 10, 224, 224, 3)]
InputLayer | output: | [(None, 10, 224, 224, 3)]
conv2_plus1d | input: | (None, 10, 224, 224, 3)
Conv2Plus1D | output: | (None, 10, 224, 224, 16)
batch_normalization | input: | (None, 10, 224, 224, 16)
BatchNormalization | output: | (None, 10, 224, 224, 16)
re_lu | input: | (None, 10, 224, 224, 16)
ReLU | output: | (None, 10, 224, 224, 16)
resize_video | input: | (None, 10, 224, 224, 16)
ResizeVideo | output: | (None, 10, 112, 112, 16)
residual_main | input: | (None, 10, 112, 112, 16)
ResidualMain | output: | (None, 10, 112, 112, 16)
add | input: | [(None, 10, 112, 112, 16), (None, 10, 112, 112, 16)]
Add | output: | (None, 10, 112, 112, 16)

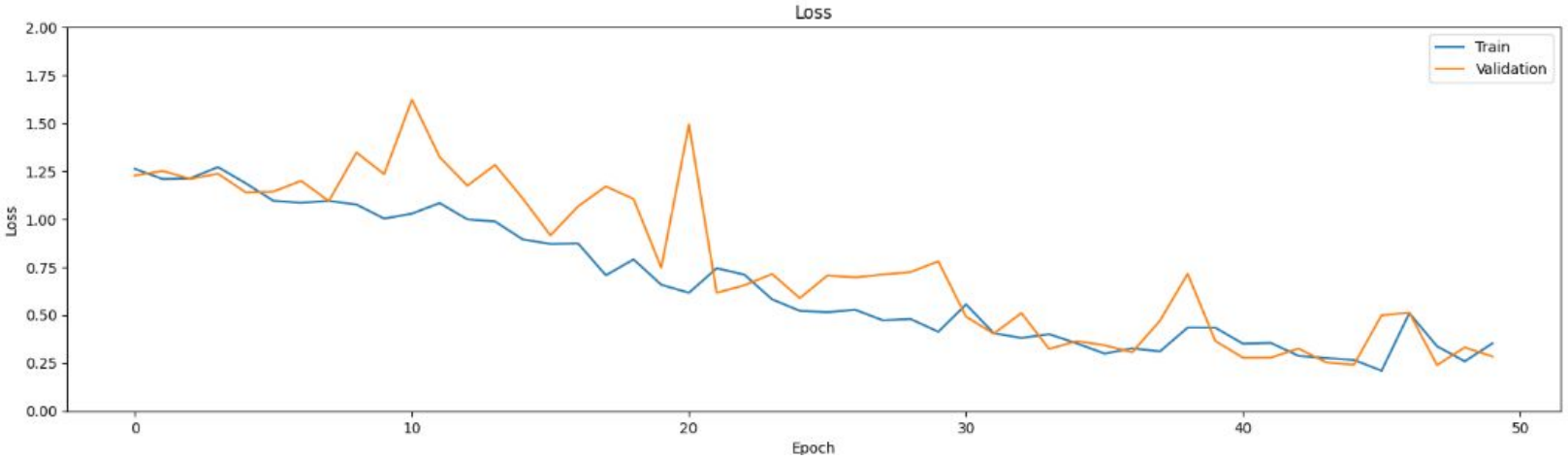
Modelo


resize_video_1 | input: | (None, 10, 112, 112, 16)
ResizeVideo | output: | (None, 10, 56, 56, 16)
project | input: | (None, 10, 56, 56, 16)
Project | output: | (None, 10, 56, 56, 32)
residual_main_1 | input: | (None, 10, 56, 56, 16)
ResidualMain | output: | (None, 10, 56, 56, 32)
add_1 | input: | [(None, 10, 56, 56, 32), (None, 10, 56, 56, 32)]
Add | output: | (None, 10, 56, 56, 32)
resize_video_2 | input: | (None, 10, 56, 56, 32)
ResizeVideo | output: | (None, 10, 28, 28, 32)
project_1 | input: | (None, 10, 28, 28, 32)
Project | output: | (None, 10, 28, 28, 64)
residual_main_2 | input: | (None, 10, 28, 28, 32)
ResidualMain | output: | (None, 10, 28, 28, 64)
add_2 | input: | [(None, 10, 28, 28, 64), (None, 10, 28, 28, 64)]
Add | output: | (None, 10, 28, 28, 64)

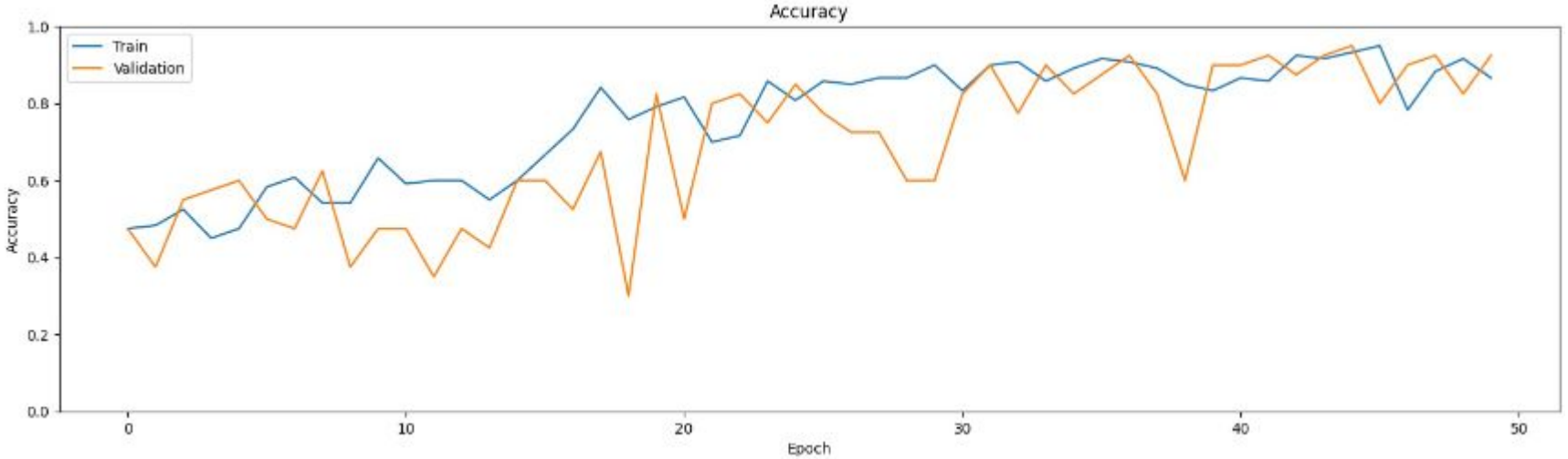
Modelo


resize_video_3 | input: | (None, 10, 28, 28, 64)
ResizeVideo | output: | (None, 10, 14, 14, 64)
project_2 | input: | (None, 10, 14, 14, 64)
Project | output: | (None, 10, 14, 14, 128)
residual_main_3 | input: | (None, 10, 14, 14, 64)
ResidualMain | output: | (None, 10, 14, 14, 128)
add_3 | input: | [(None, 10, 14, 14, 128), (None, 10, 14, 14, 128)]
Add | output: | (None, 10, 14, 14, 128)
global_average_pooling3d | input: | (None, 10, 14, 14, 128)
GlobalAveragePooling3D | output: | (None, 128)
flatten | input: | (None, 128)
Flatten | output: | (None, 128)
dense_3 | input: | (None, 128)
Dense | output: | (None, 10)

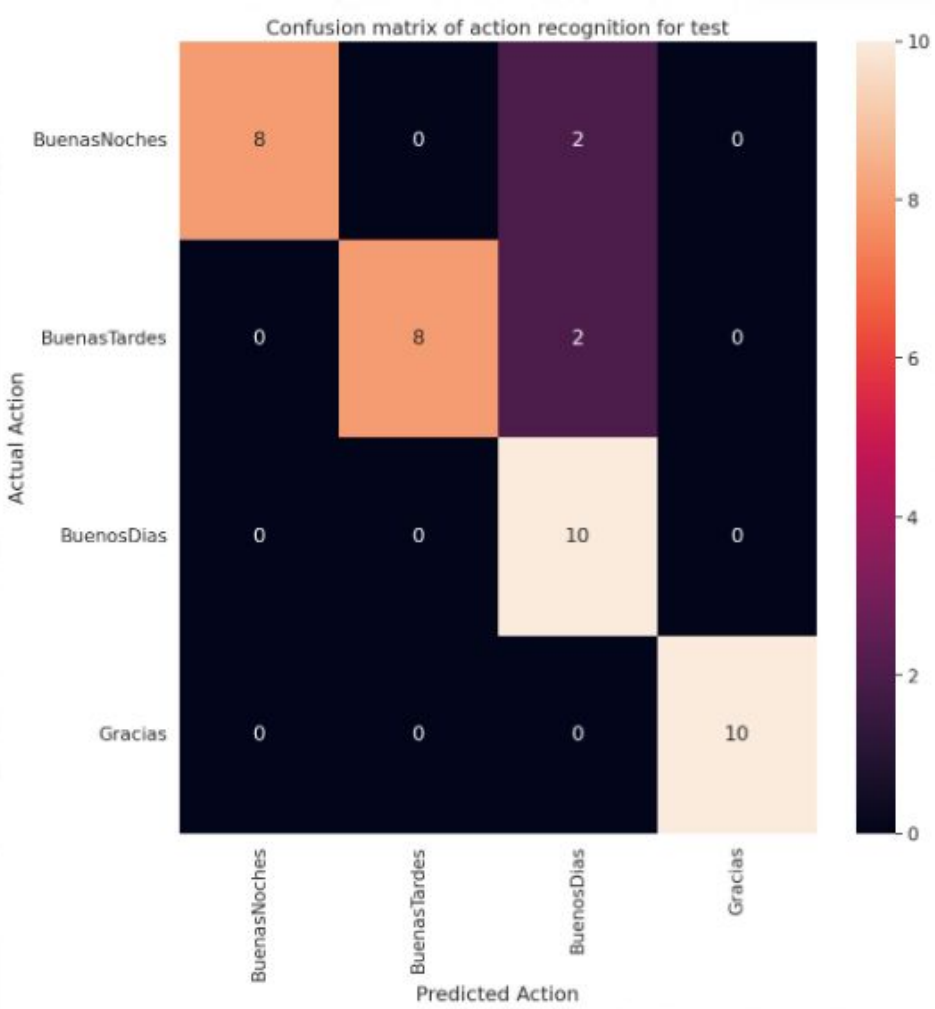
Función de pérdida



Precisión

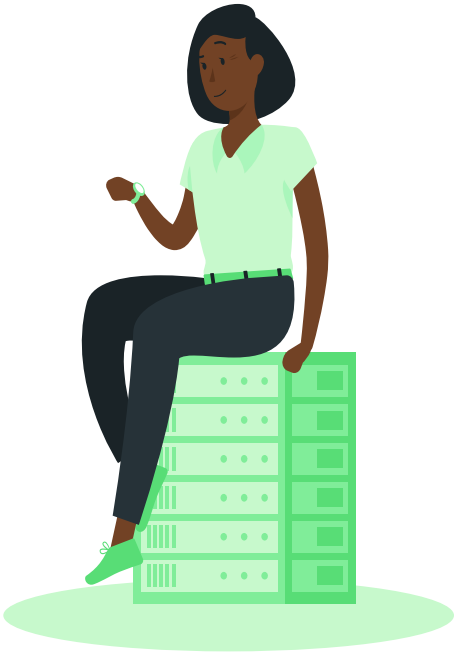

Accuracy
Train
Validation
Accuracy
Epoch
1.0
0.8
0.6
0.4
0.2
0.0
0
10
20
30
40
50

Matriz de confusión



Resultados

	Precisión	Recuperación
Buenas Noches	1.0	0.8
Buenas Tardes	1.0	0.8
Buenos Días	0.71	1.0
Gracias	1.0	1.0



Limitaciones

El lenguaje de señas colombiana (LSC) no se define por un número fijo de señas, ya que puede variar según la región. Al igual que con cualquier idioma, el LSC evoluciona y se adapta constantemente a medida que se desarrolla y se utilizan nuevas formas de comunicación.

El entrenamiento del modelo requiere una gran cantidad de datos de lenguaje de señas. La disponibilidad es limitada y esto puede afectar la precisión y el rendimiento del modelo.

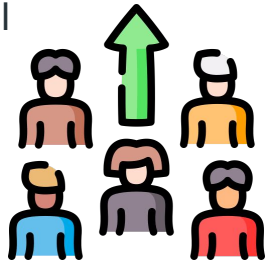
Son modelos computacionalmente intensivos y requieren una potencia de cálculo significativa para su entrenamiento y ejecución.

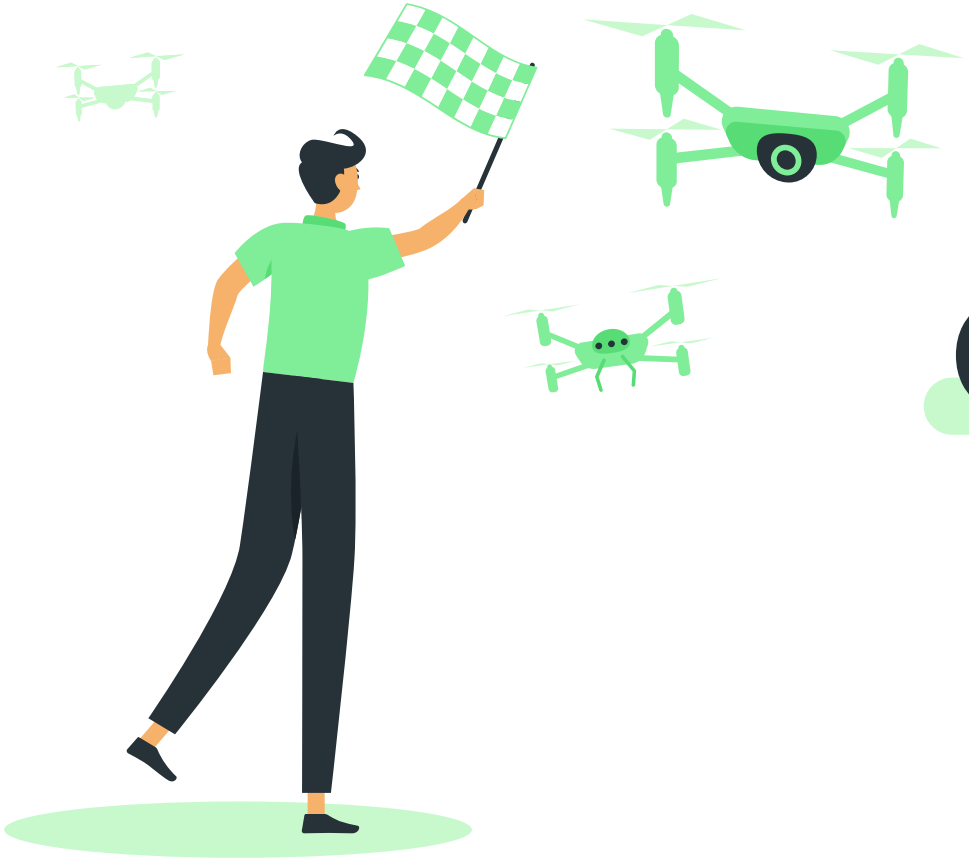
Conclusiones

Un modelo bien entrenado puede lograr una precisión aceptable en el reconocimiento de gestos de lenguaje de señas. Sin embargo, se deben realizar pruebas exhaustivas y evaluaciones del rendimiento de este.

El reconocimiento de lenguaje de señas depende en gran medida de la calidad y la diversidad del conjunto de datos de entrenamiento. La recopilación de datos precisos y representativos es esencial para mejorar el rendimiento del modelo.

Los avances en el modelamiento tienen el potencial de mejorar significativamente la comunicación y accesibilidad para las personas sordas, ya sea en una aplicación de traducción en tiempo real o en el aprendizaje y enseñanza de este lenguaje.





Gracias

1

Theory Lesson

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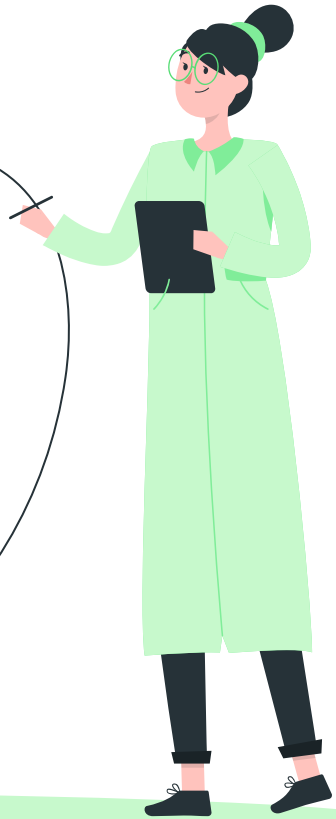
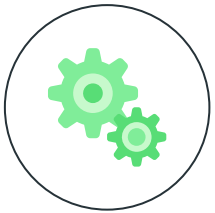
here if you need it



Concepts

Concept 1

Mercury is the closest planet from the Sun and the smallest one



Concept 2

Venus has a beautiful name and is the second planet from the Sun

What Is This Topic About?

1

Mercury

Mercury is the closest planet to the Sun and the smallest one

2

Venus

Venus has a beautiful name and is the second from the Sun

3

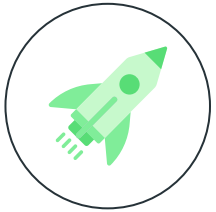
Mars

Despite being red, Mars is a cold place. It’s full of iron oxide

Features Of The Topic

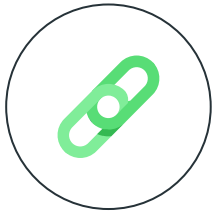
Mars

Despite being red, Mars is actually a cold place



Mercury

Mercury is the closest planet and the smallest



Jupiter

Jupiter is a gas giant and the biggest planet

Saturn

Saturn is composed of hydrogen and helium

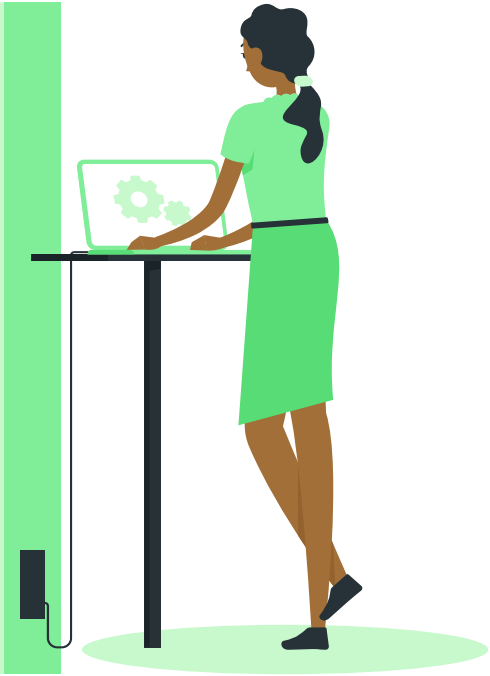
Examples

35% Venus has a beautiful name

65% Mars is a very cold place

85% Jupiter is the biggest planet

50% Mercury is the closest planet



Recommendations

Mercury

Mercury is the closest planet to the Sun

Venus

Venus is the second planet to the Sun

Mars

Despite being red, Mars is a cold place

Jupiter

It’s a gas giant and the biggest planet

Saturn

Saturn is the ringed one and a gas giant

Neptune

Neptune is the farthest planet from the Sun

Practical Exercise

A

Mercury

Mercury is the closest to the Sun

B

Jupiter

It’s a gas giant and the biggest planet

C

Venus

Venus is the second planet to the Sun

D

Saturn

Saturn is the ringed one and a gas giant

Share Your Practice

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A Picture Is Worth A Thousands Words

Awesome Words

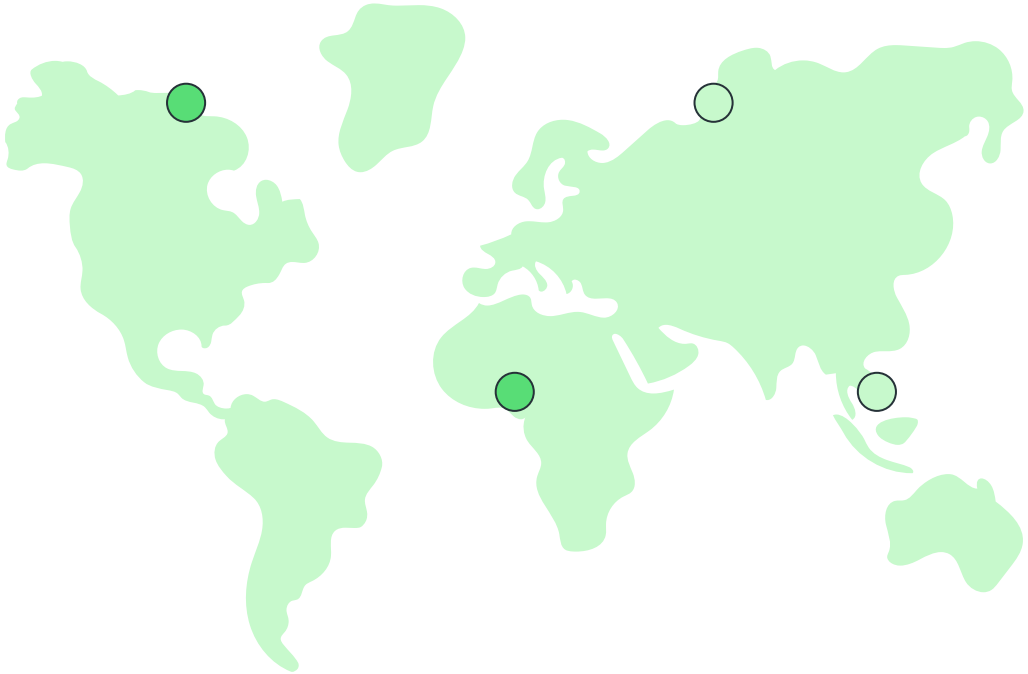
Location Of Robots

Mercury

Mercury is the closest planet to the Sun

Jupiter

It’s a gas giant and the biggest planet



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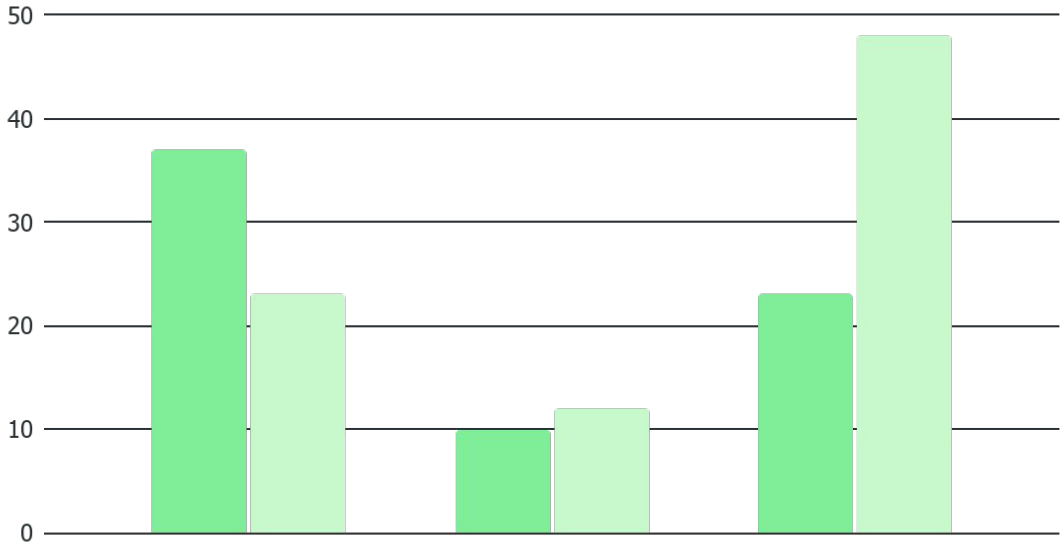


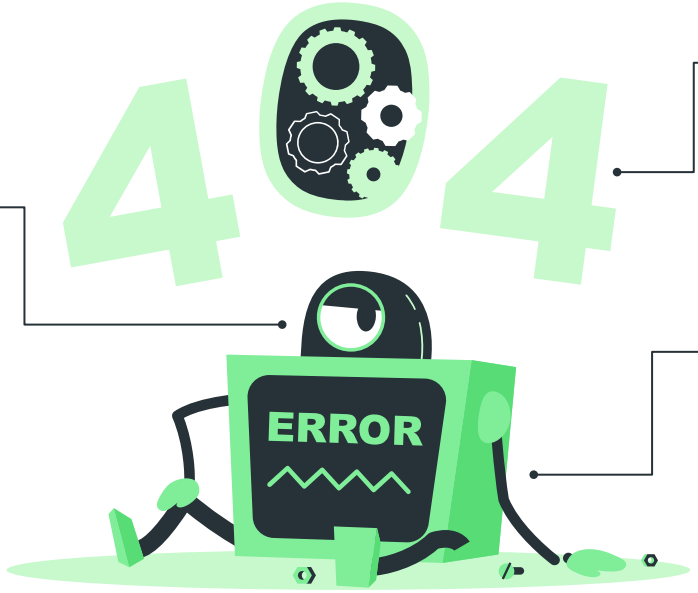
Mercury

Mercury is the closest planet to the Sun

Jupiter

It’s a gas giant and the biggest planet

Anatomy Of The Error



Saturn

Saturn is the ringed and a gas giant

Mercury

Mercury is the closest to the Sun

Jupiter

It’s a gas giant and the biggest planet

Project Timeline

Day 1

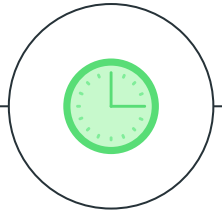
Mercury is the closest planet to the Sun

Day 2

It’s a gas giant and the biggest planet

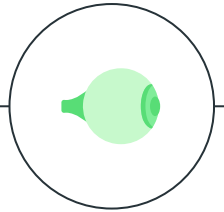
Day 3

Saturn is the ringed one and a gas giant



Day 4

Venus is the second planet to the Sun



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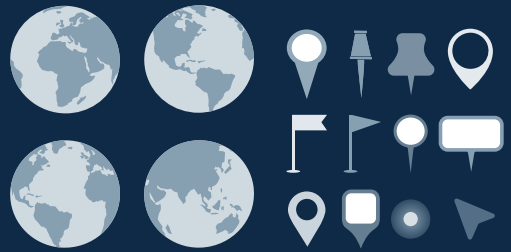

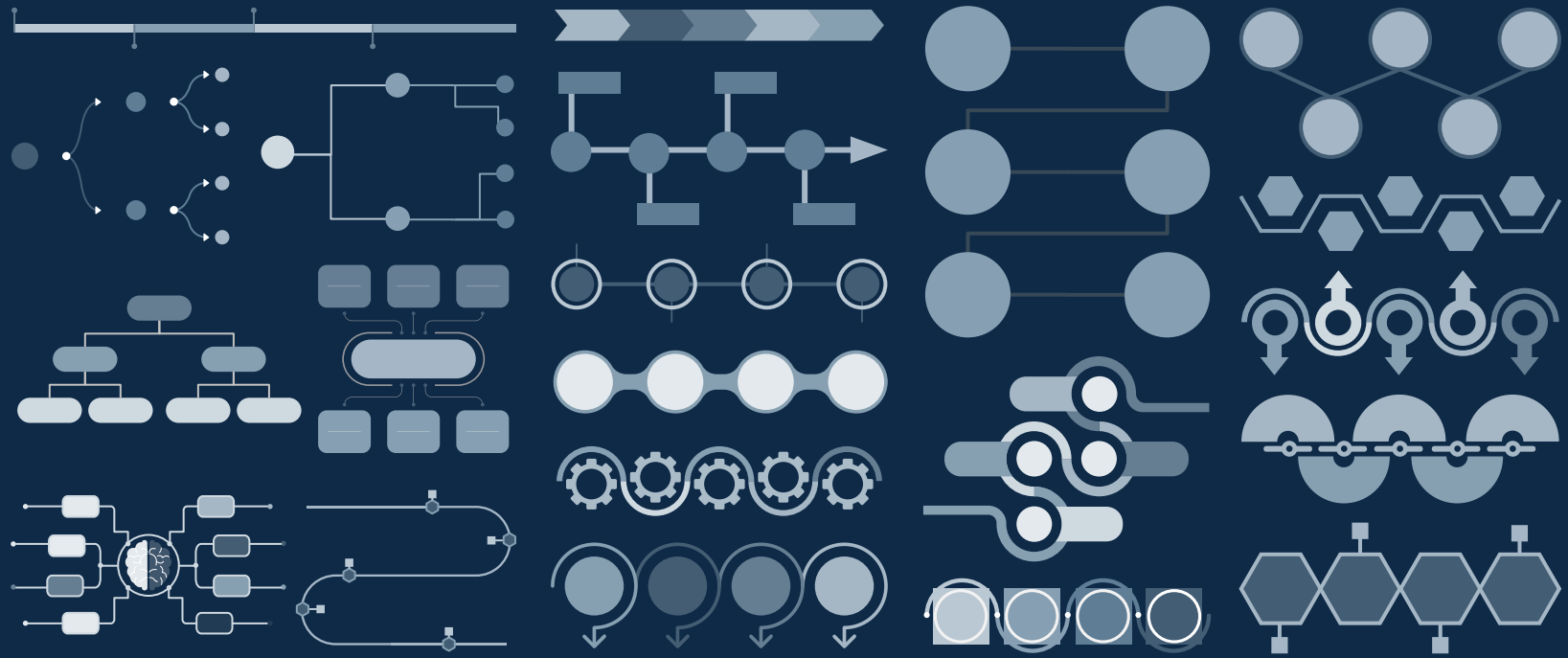

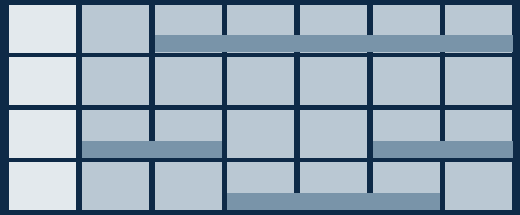

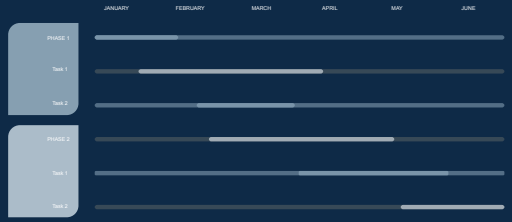
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FEBRUARY
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JUNE
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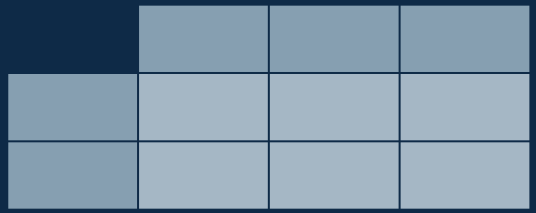
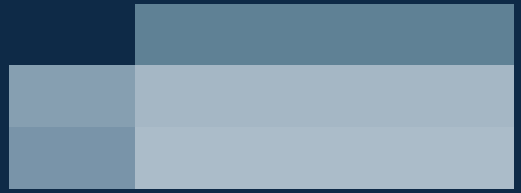
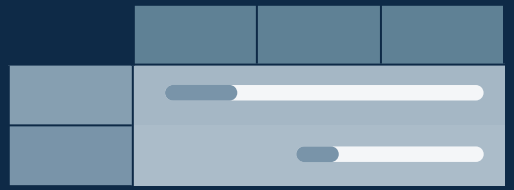
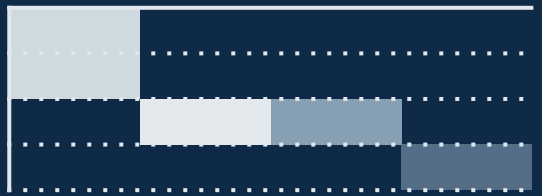
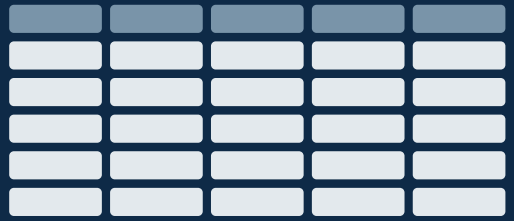
Task 2

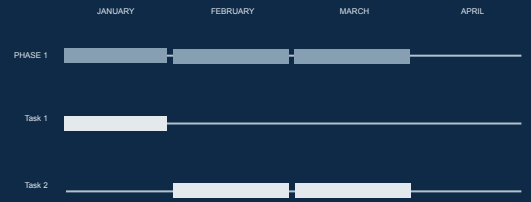


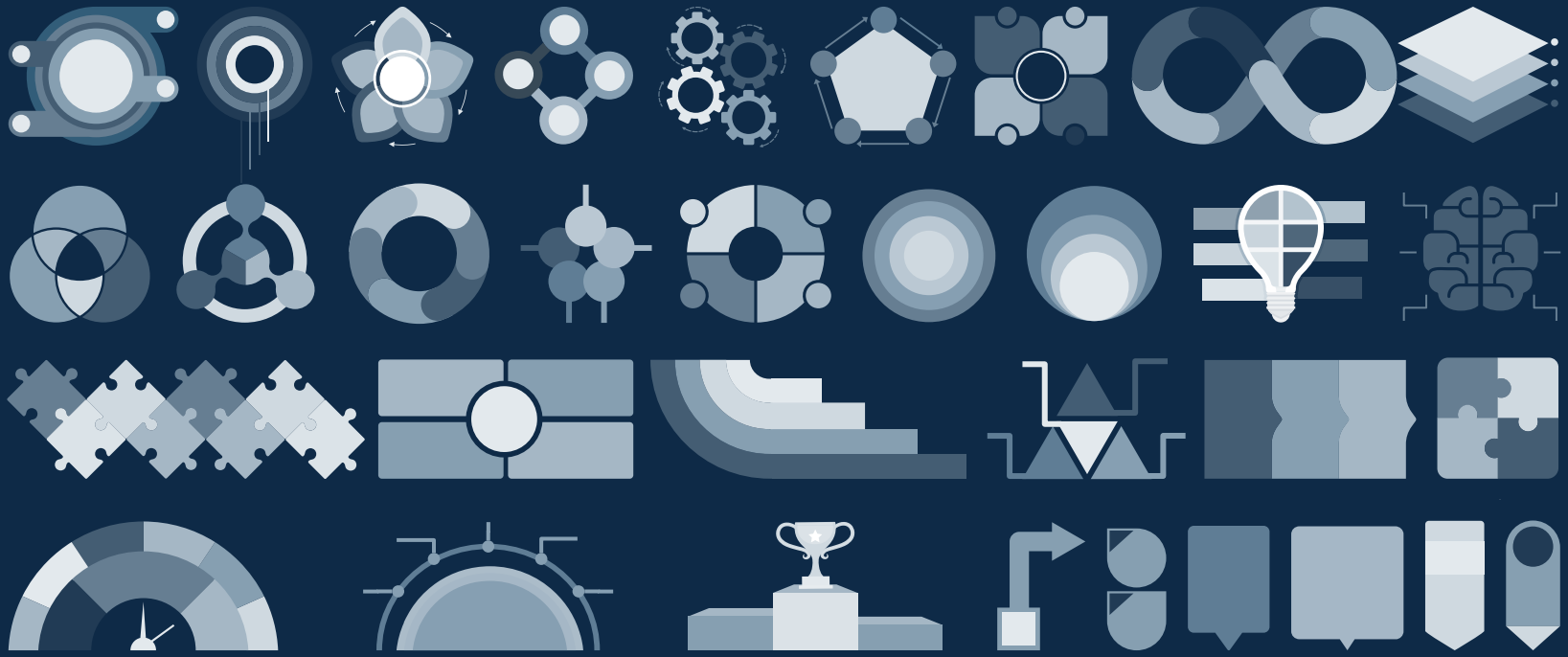


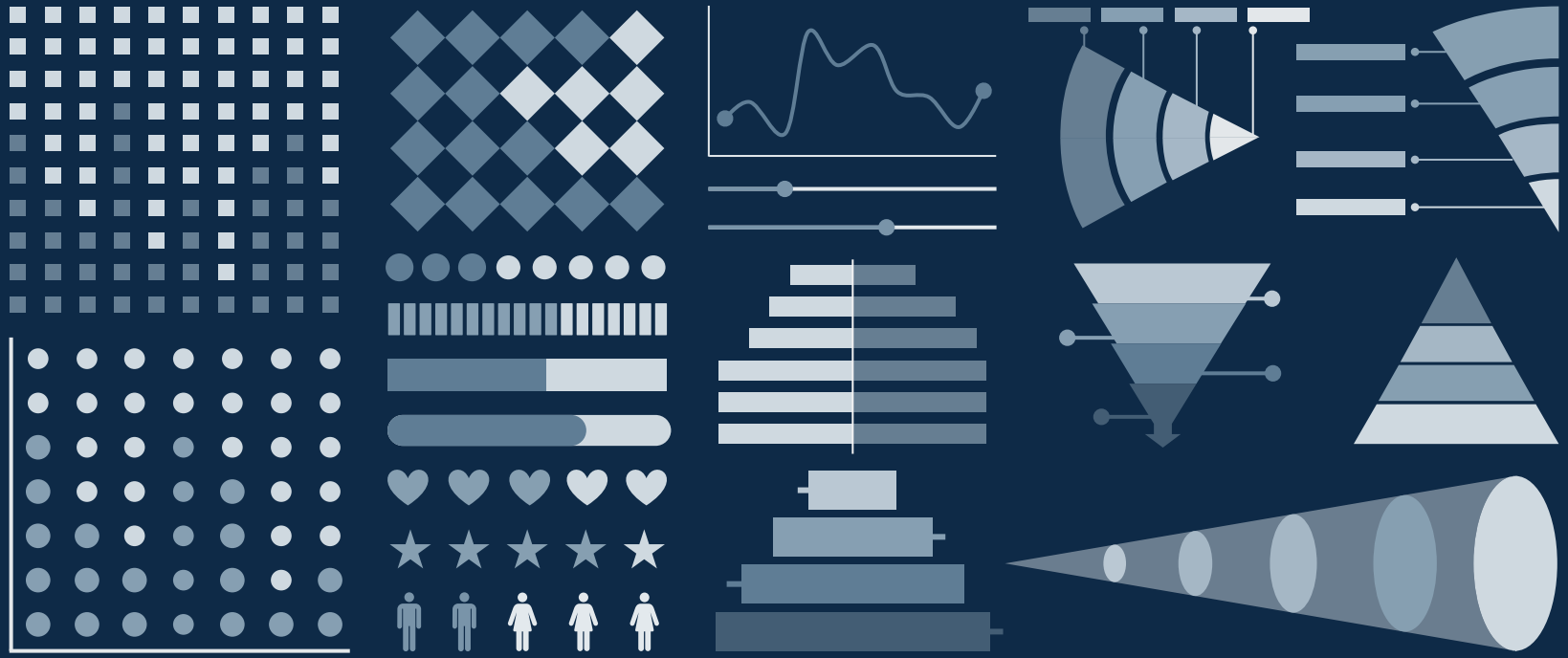







JANUARY
FEBRUARY
MARCH
APRIL
PHASE 1
Task 1
Task 2





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