

# Introduce famous models and techniques in deep learning

TRAN TRUNG TRUC

# Table of contents

- 01 **BERT: Pre-training of Deep Bidirectional Transformers for Language Understanding**
- 02 **PointNet++: Deep Hierarchical Feature Learning on Point Sets in a Metric Space**
- 03 **E(n) Equivariant Graph Neural Networks**
- 04 **Multimodal Protein Representation Learning and Target-aware Variational Auto-encoders for Protein-binding Ligand Generation**

# Bert

is a pre-trained deep learning model developed by Google for natural language processing (NLP) tasks. It is designed to understand the context of words in a sentence, which makes it highly effective for tasks like question answering, language inference, and sentiment analysis.



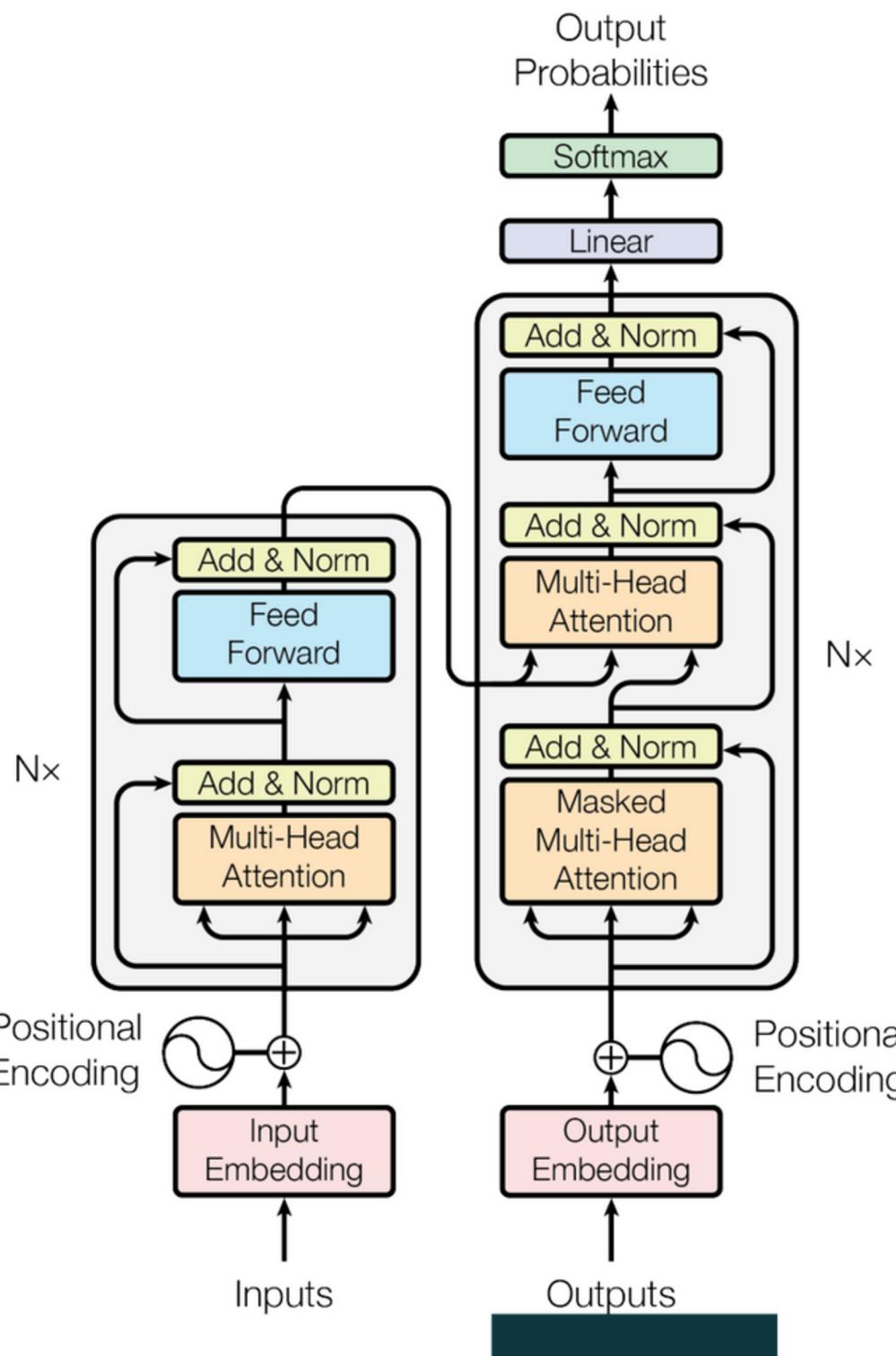
# Transformer

BERT

Encoder

GPT

Decoder



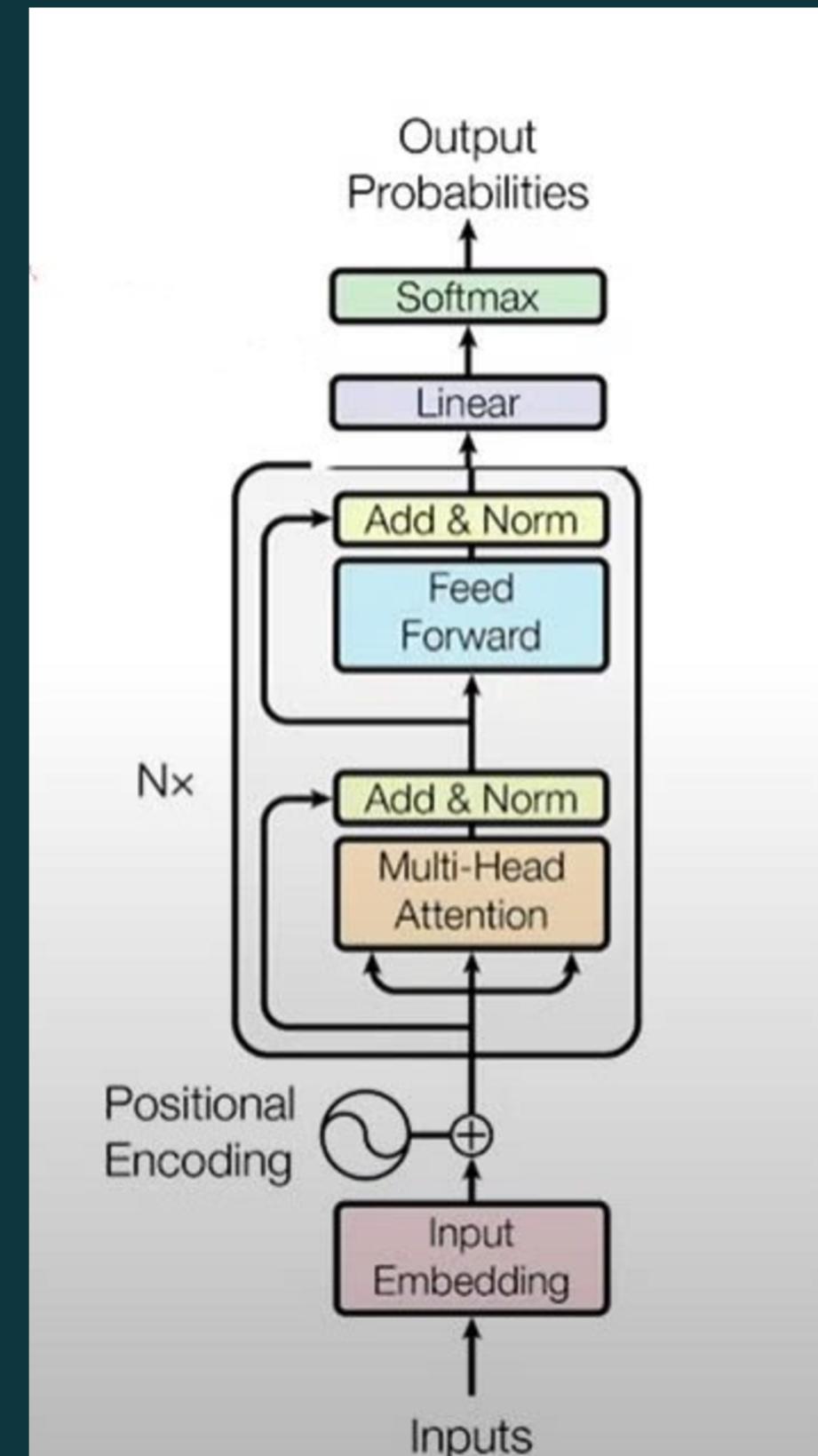
# Bert Model

## Bert Base

- 12 Encoder Layers
- HiddenSize is 786
- 12 self-attention heads

## Bert Large

- 24 Encoder Layers
- HiddenSize is 1024
- 16 self-attention heads



## 4 main tasks

### Pre-Trained

- Masked LM
- Next Sentence Prediction (NSP)

### Fine Tune

- Text Classification
- Question Answering

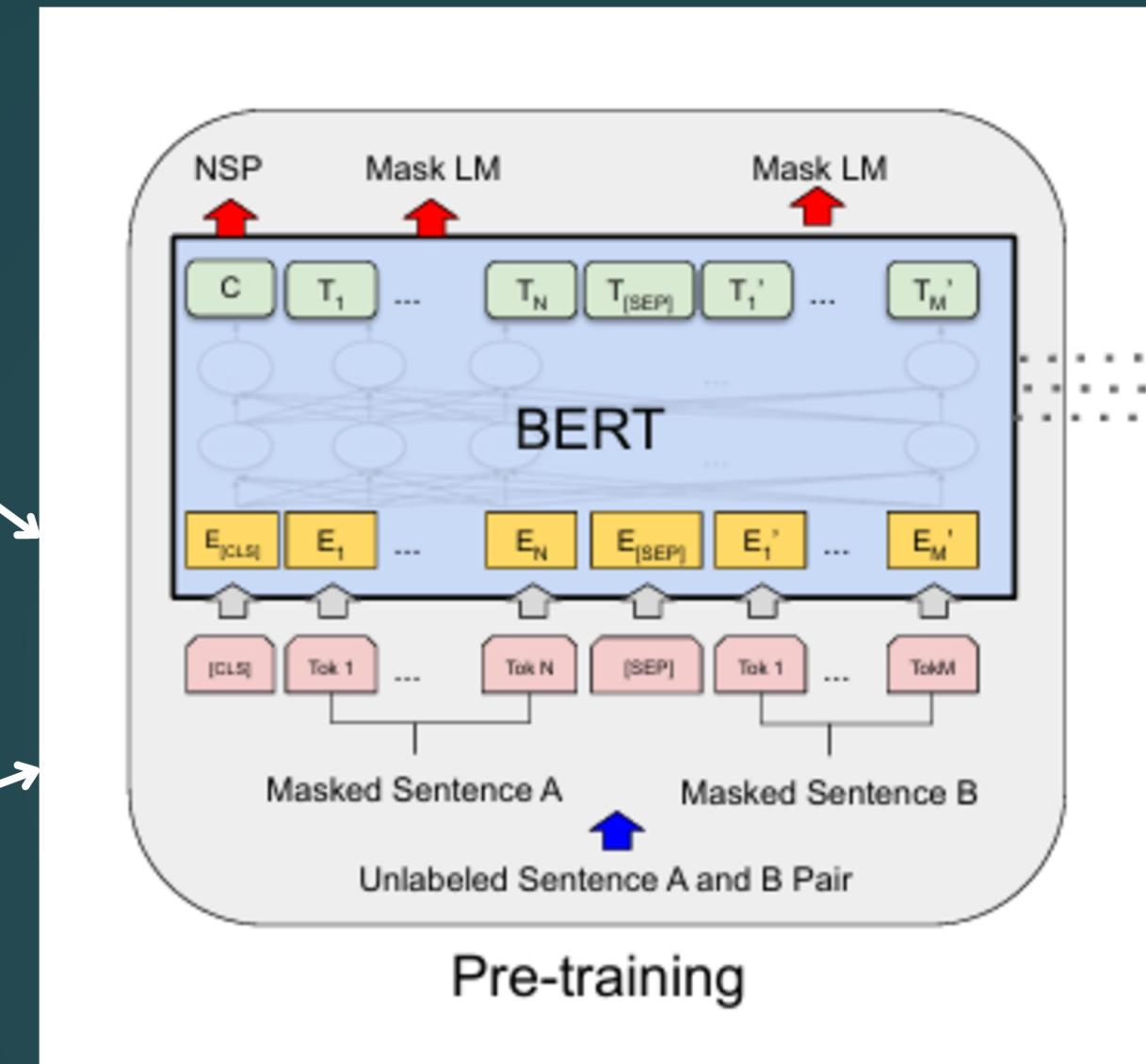
# Pre-Training



# Masked LM

Input Sentences

Mask token



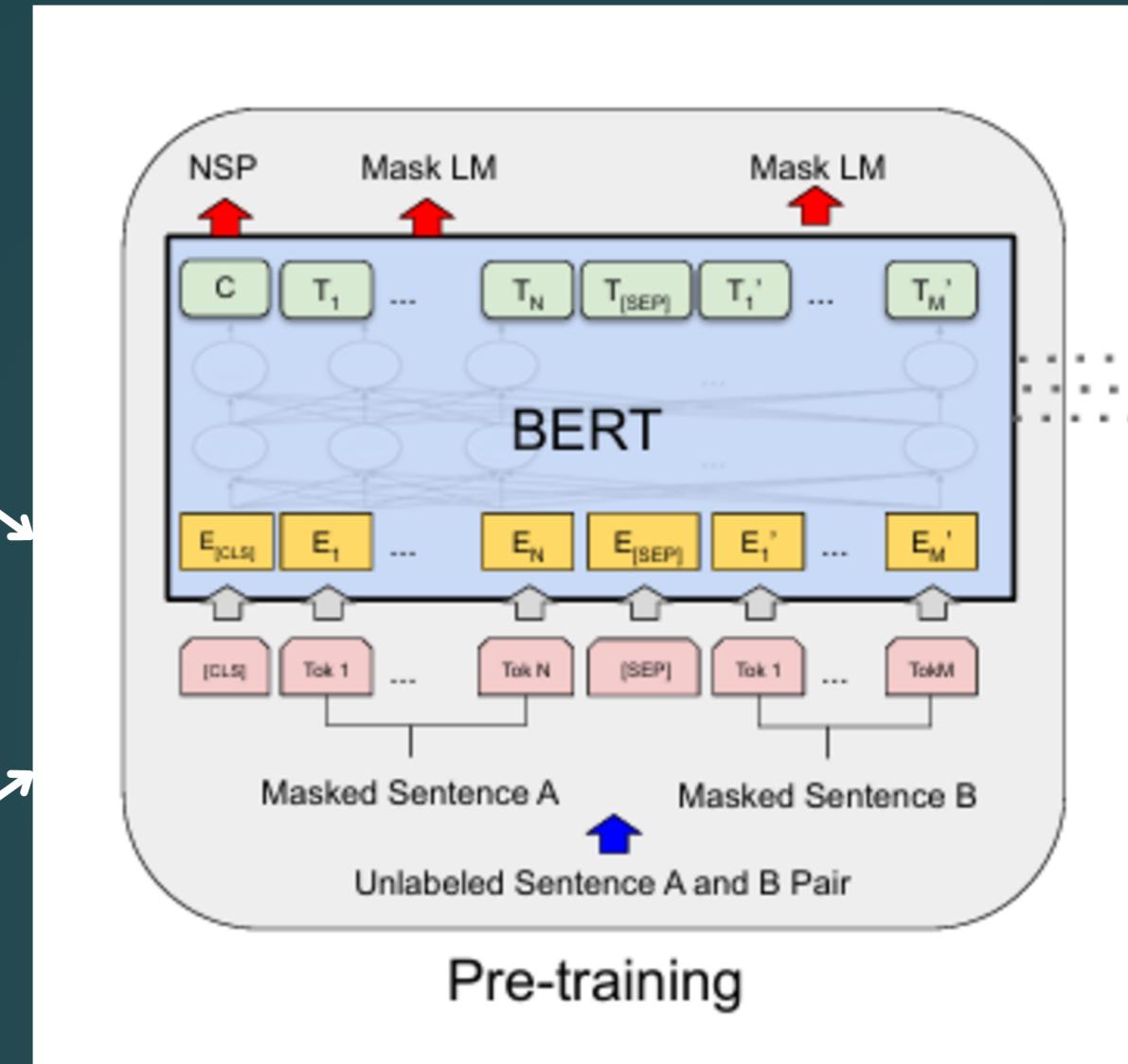
Predict mask token

- (1) the [MASK] token 80% of the time.
- (2) a random token 10% of the time.
- (3) the unchanged token 10% of the time.

# Next Sentence Prediction

Input Sentences

Next/Not Next  
Sentence

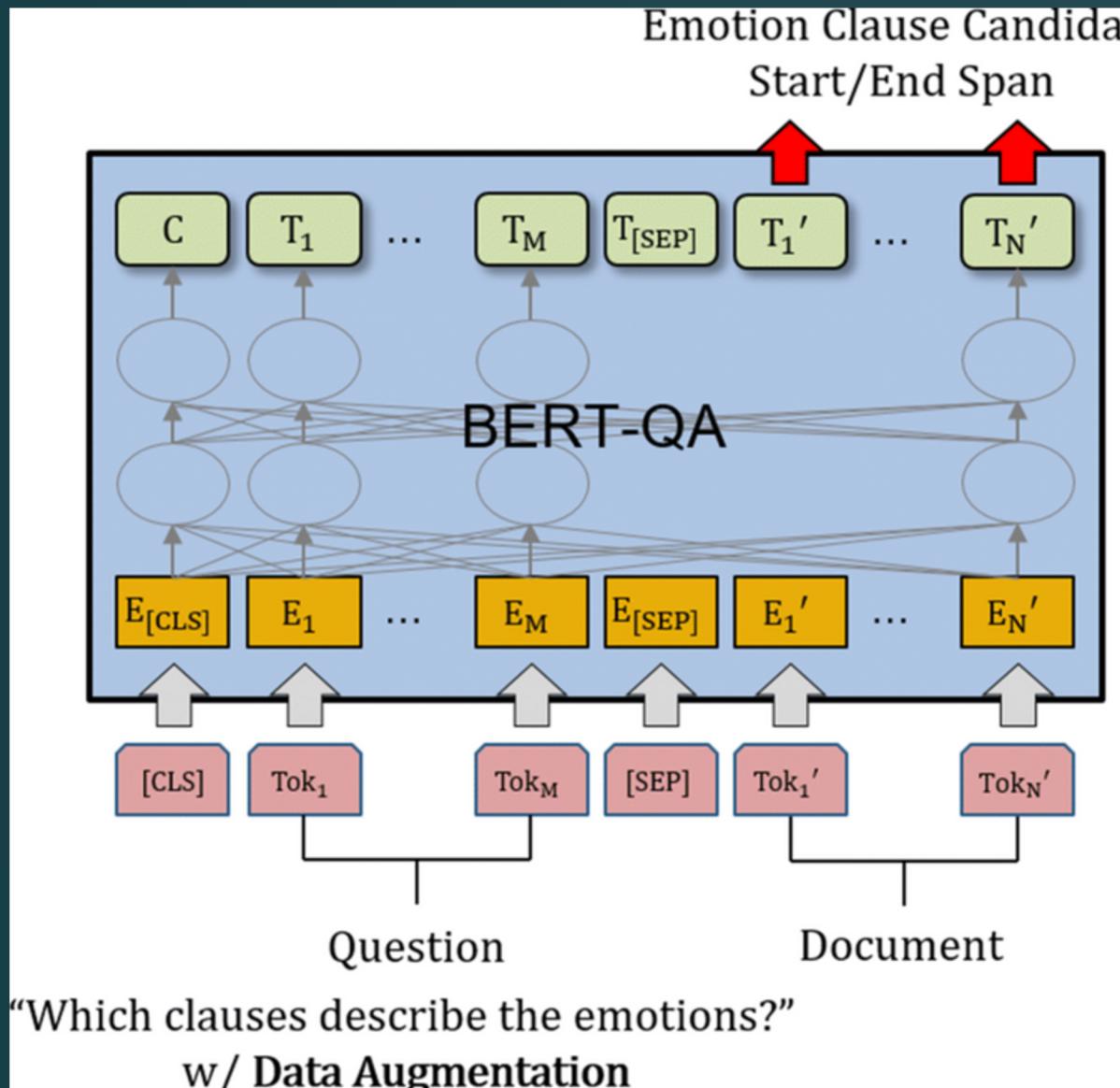


Predict next sentence

50% of the time B is the actual next sentence that follows A (labeled as IsNext), and 50% of the time it is a random sentence from the corpus (labeled as NotNext).

# Fine-Tuning

# Question Answering

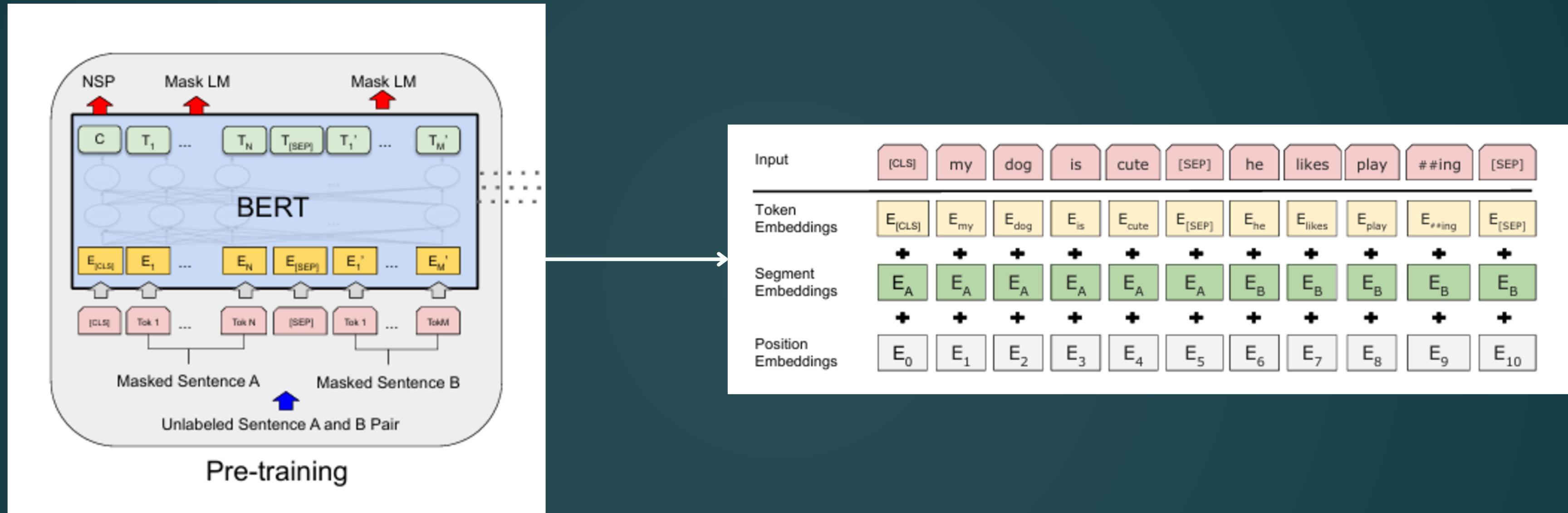


- Input The question and the Document (the Answer).
- Return the start and end token of the answer.

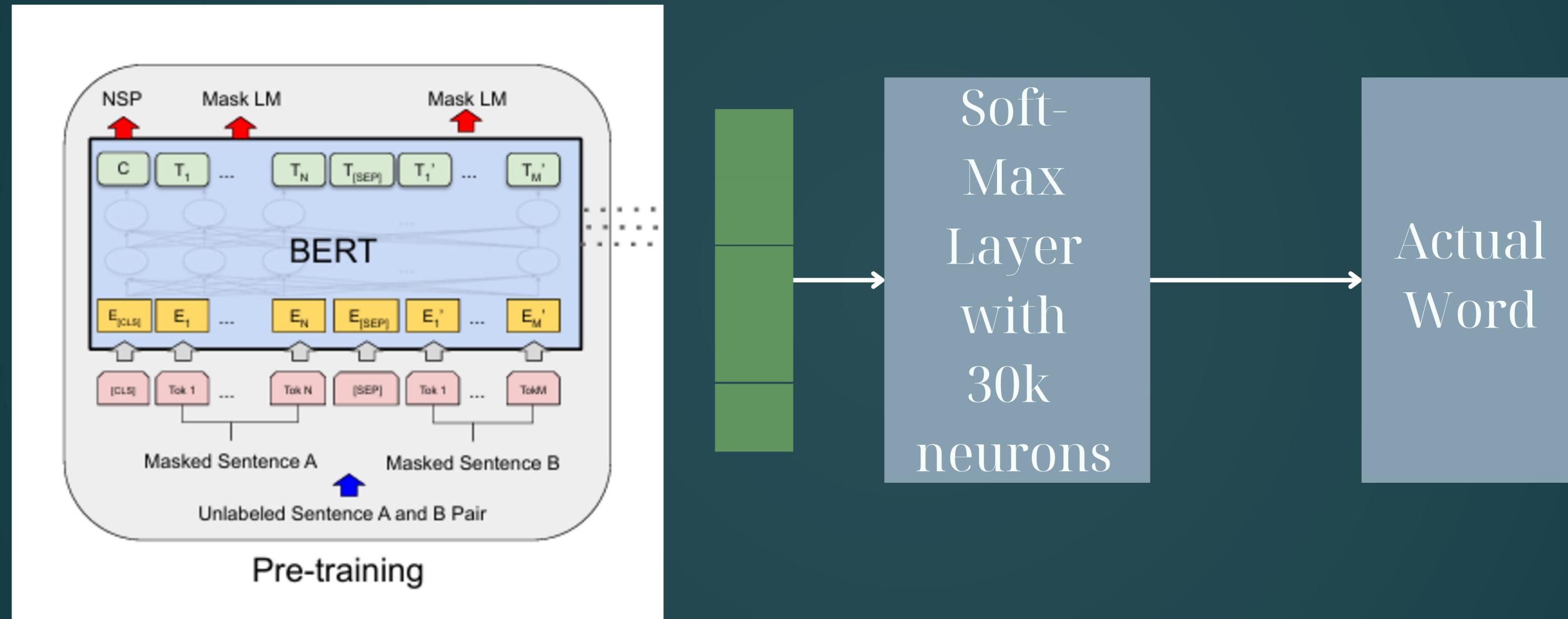
# Summary

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# Summary

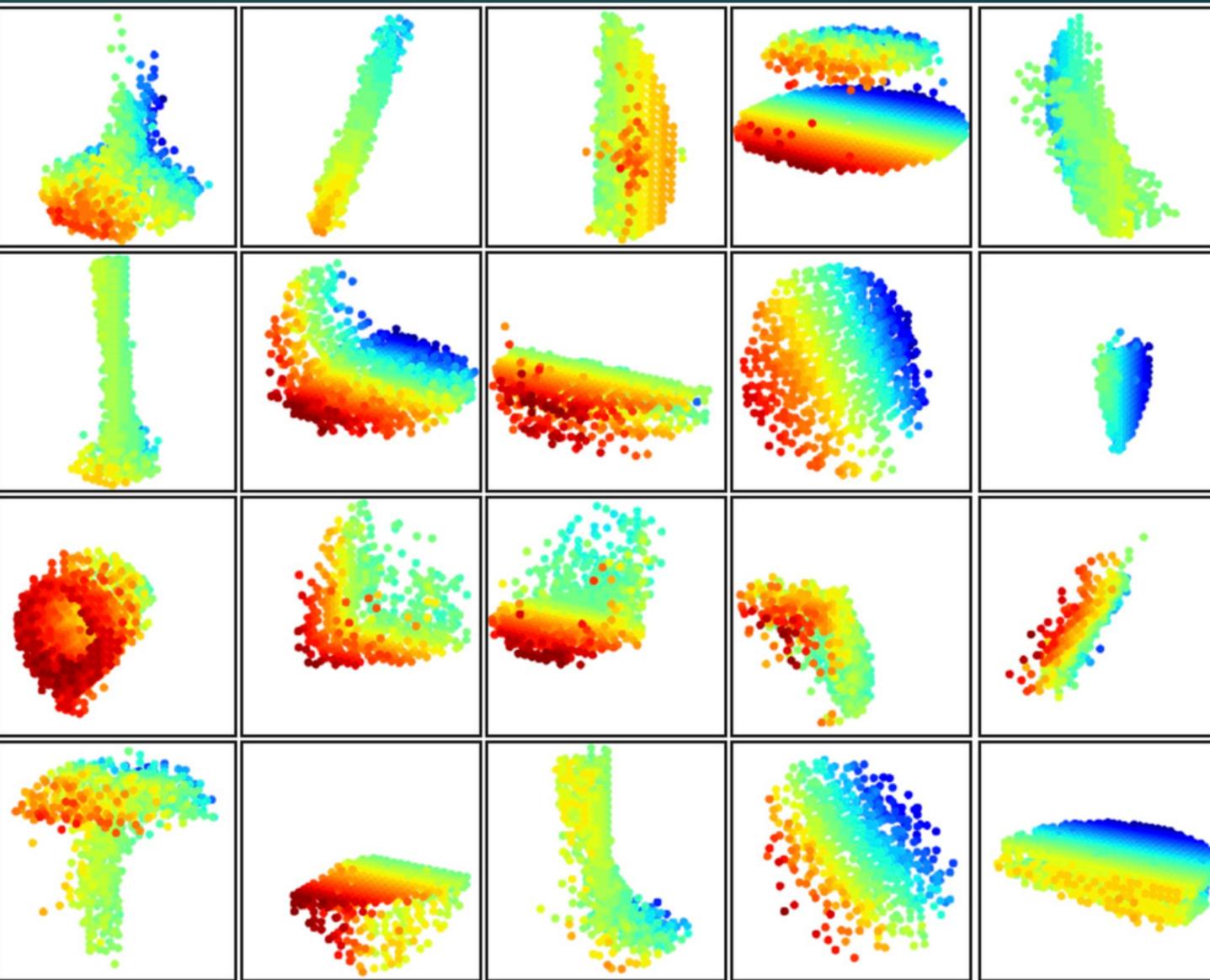


# Summary



# PointNet ++

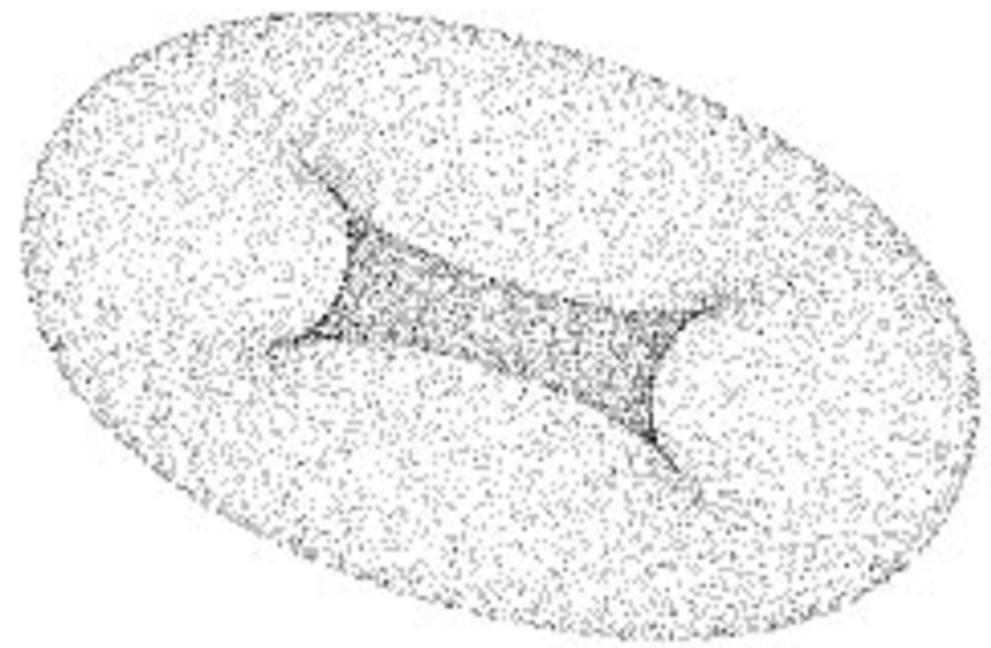
PointNet++ is an advanced neural network architecture designed for 3D point cloud data, building upon the foundation of the original PointNet. While PointNet introduced a groundbreaking method to directly process raw point cloud data without requiring conversion to a regular grid, it had limitations in capturing local geometric features due to its independent point processing approach.



# Point Cloud

A point cloud is a discrete set of data points in space. The points may represent a 3D shape or object. Each point position has its set of Cartesian coordinates (X, Y, Z).

- Widely used in 3D scanning, autonomous vehicles, and robotics.
- Not like images, point cloud is unordered.



# Challenges in Point Cloud Analysis

- Irregular & Unordered Data: Points have no inherent order.
- Varying Density: Different regions have different point densities.
- Local Structure Capture: Difficulty in detecting fine local patterns.

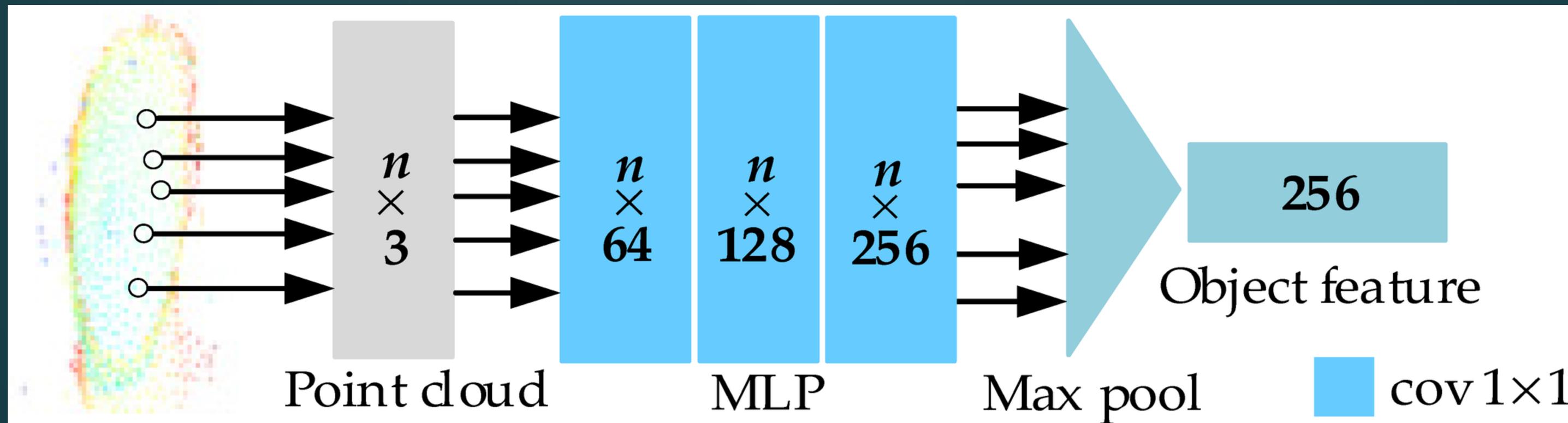
## Solution?



# PointNet

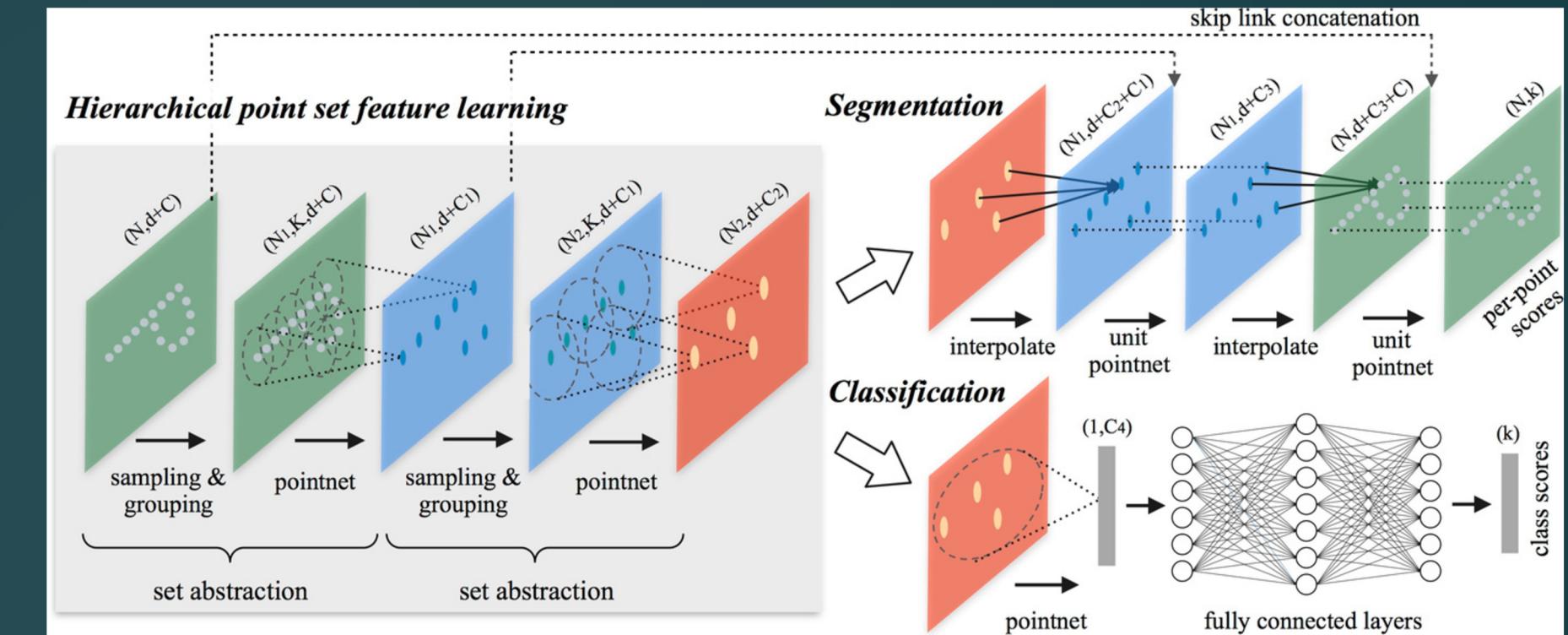
PointNet is designed to process unordered point clouds directly, making it groundbreaking for 3D data processing.

- Input Invariance: The model is invariant to the order of input points, meaning it treats the same set of points identically, regardless of the order.
- Global Feature Aggregation: Uses a symmetric function (max-pooling) to aggregate point features into a global signature.
- Architecture: Processes each point independently through shared MLPs (Multi-Layer Perceptrons) and aggregates features to capture the overall shape of the object.



# PointNet++

PointNet++ extends PointNet by capturing local structures in point clouds using hierarchical learning.



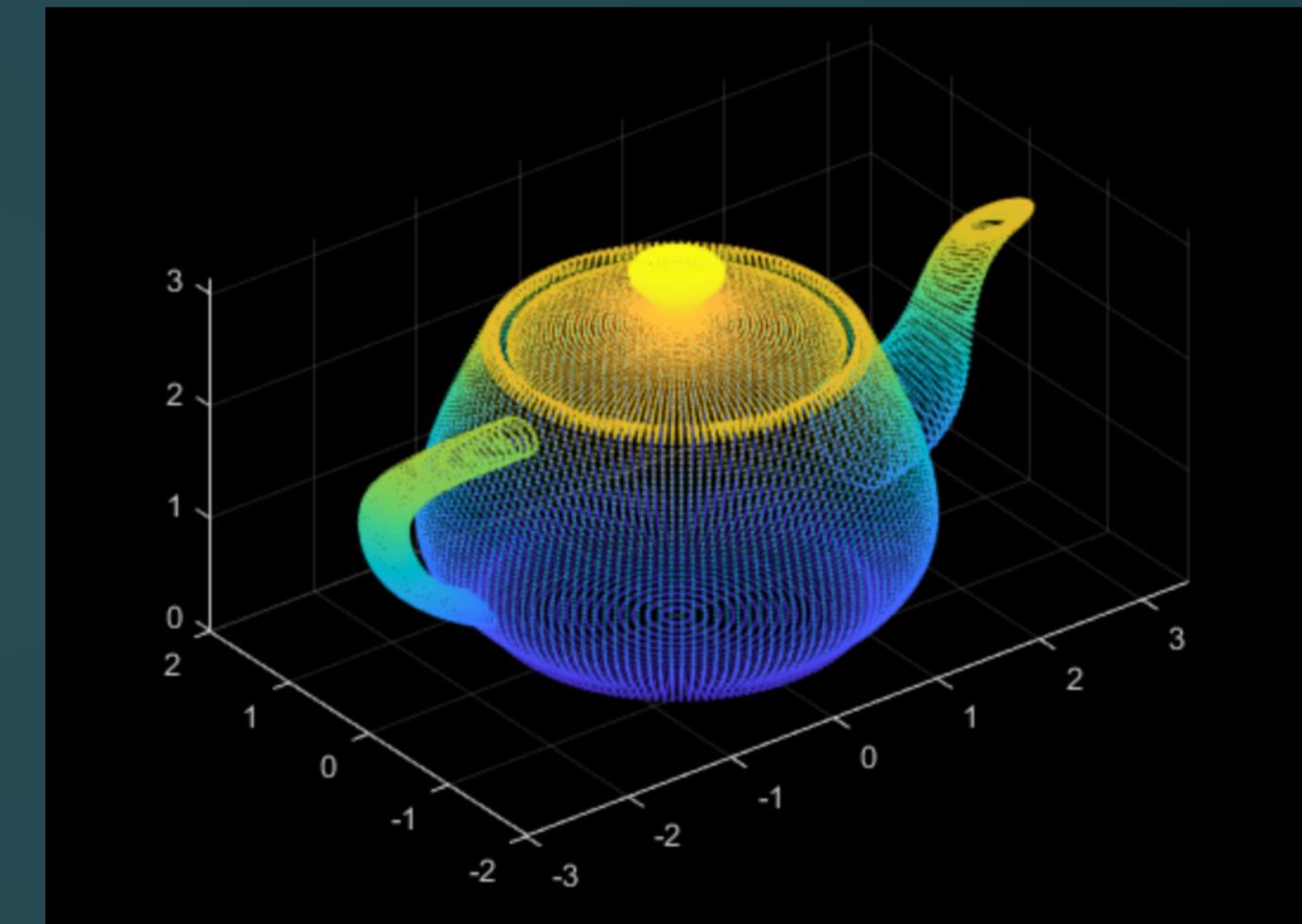
## Key Features:

- Hierarchical Learning: Captures features at different scales.
- Local & Global Context: Combines local details with global structures.
- Handling Varying Densities: Adapts to different point densities.

# Hierarchical Learning

PointNet++ uses its hierarchical structure to capture fine-grained local features and combine them into global features, ensuring both local and global context are utilized effectively.

- Nested Regions: PointNet++ organizes points into nested regions, processing small local neighborhoods first and then combining them into larger ones.
- Feature Aggregation: It aggregates features from these local regions progressively to build a global understanding of the point cloud.



# Handling Varying Point Densities

Both Multi-Scale Grouping (MSG) and Multi-Resolution Grouping (MRG) play crucial roles in effectively managing non-uniform point cloud data. Together, they enhance the model's ability to process and analyze complex, unevenly distributed data with greater accuracy and flexibility.

## Multi-Scale Grouping (MSG)

- Utilizes multiple radii to group points at different scales.
- Captures features from both fine-grained small regions and broader large regions.
- Enhances the model's ability to understand detailed and structural information simultaneously.

## Multi-Resolution Grouping (MRG)

- Combines features from various layers of the neural network.
- Balances detailed information from lower layers with broader context from higher layers.
- Improves the model's flexibility in dealing with regions of varying point densities, enhancing overall robustness.

# Result

## MNIST Digit Classification:

- Error Rate: 0.51% (compared to 1.30% for vanilla PointNet and 0.80% for LeNet5).

## ModelNet40 Shape Classification:

- Accuracy: 90.7% with only point cloud coordinates.
- Accuracy: 91.9% with normals as additional features (compared to 89.2% for PointNet).

## ScanNet Semantic Scene Labeling:

- Accuracy: 84.5% with MSG+DP (Multi-Scale Grouping with Dropout).

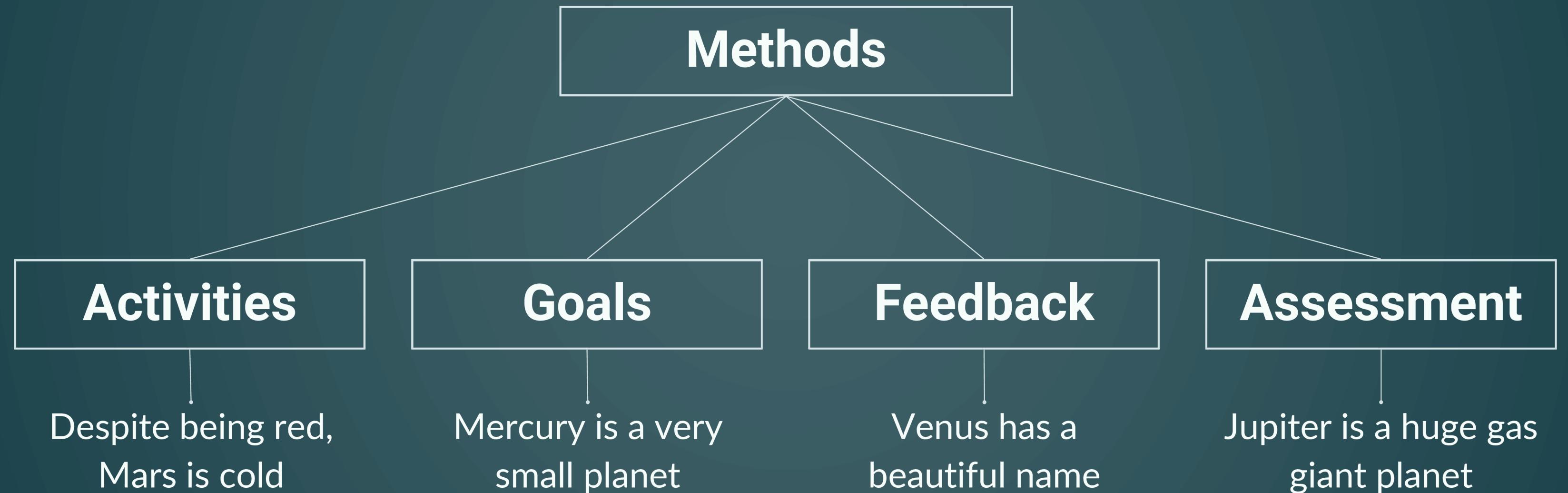
## SHREC15 Non-Rigid Shape Classification:

- Accuracy: 96.09% using non-Euclidean metric space with intrinsic features.

# Conclusion

PointNet++ marks a major advancement in point cloud processing by introducing hierarchical feature learning, which allows the model to capture both local and global features effectively. Its robustness to varying sampling densities ensures that the model can handle complex, non-uniform data with high accuracy. These strengths make PointNet++ a powerful tool, delivering promising results in a wide range of challenging 3D tasks, including classification, segmentation, and more.

# Our teaching method



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# Our success

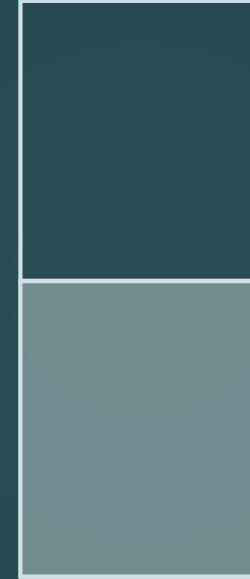
25%



## Academic

Mercury is the closest planet to the Sun and the smallest of them all

50%



## Innovation

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

75%



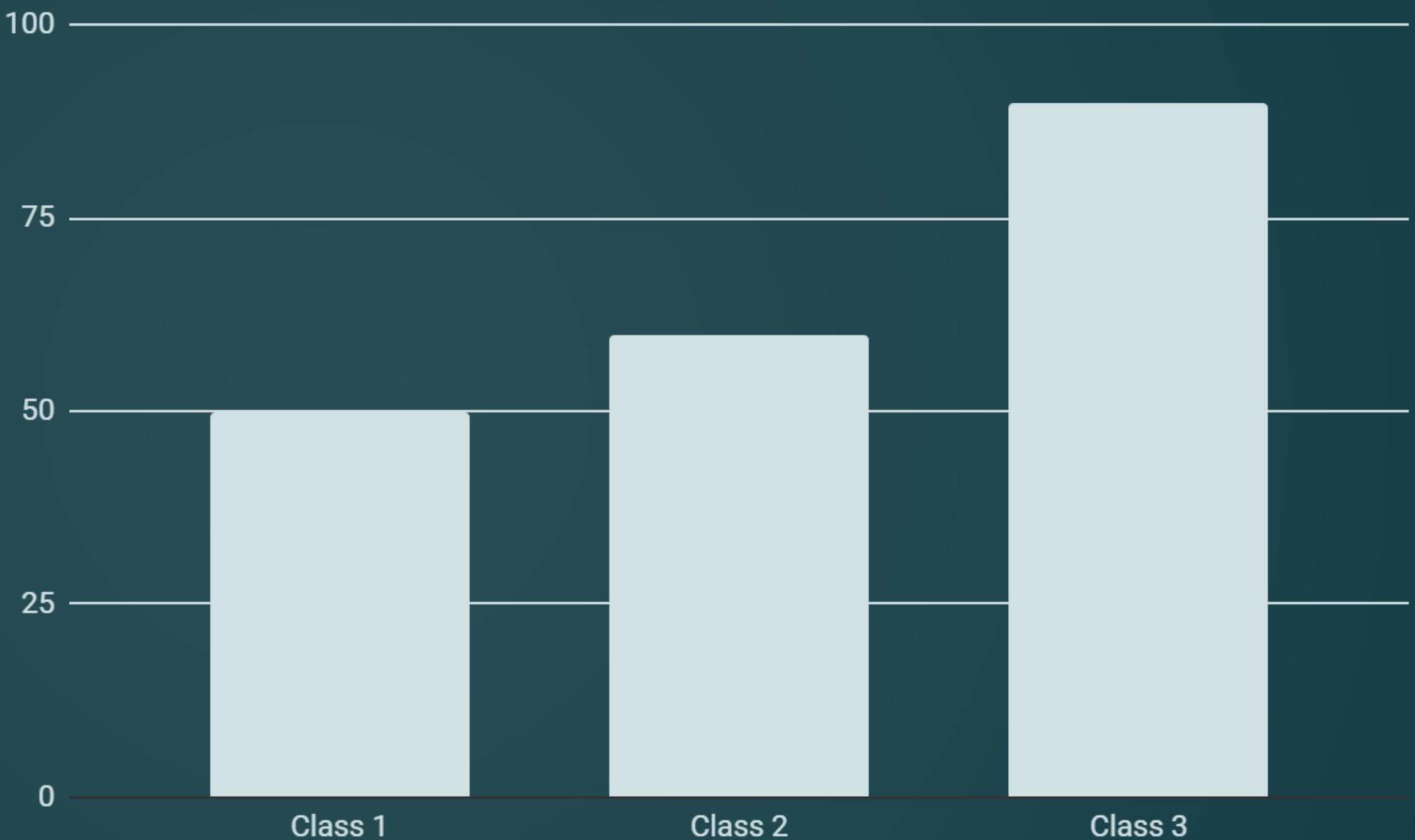
## Attendance

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

# Class progress

## ■ Mercury

Mercury is the closest planet to the Sun and the smallest one in the Solar System—it's only a bit larger than the Moon



Follow the link in the graph to modify its data and then paste the new one here. [For more info, click here](#)

# Where are we located?

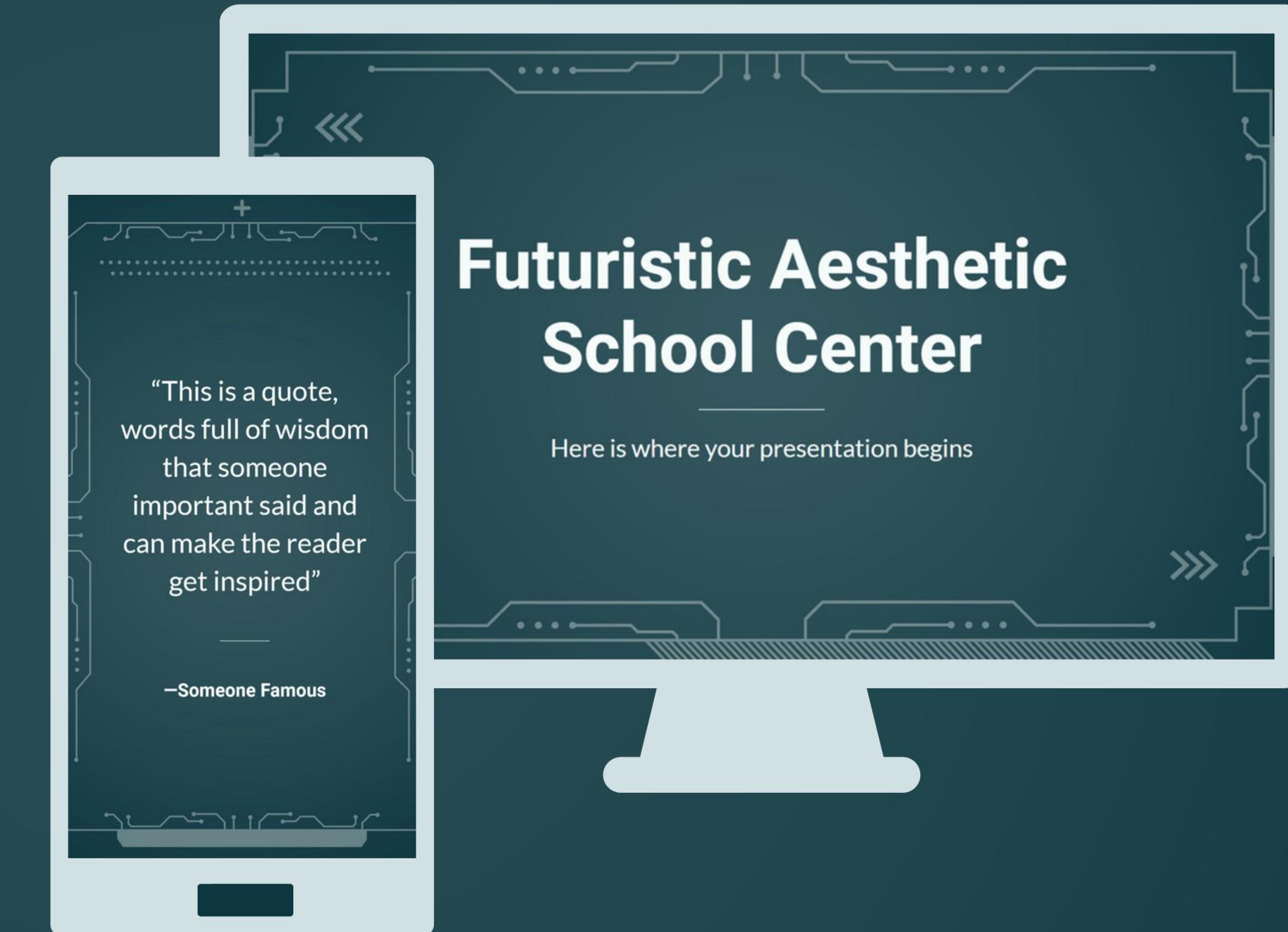


## Mercury

Mercury is the closest planet to the Sun and the smallest one in the Solar System—it's only a bit larger than the satellite Moon

# Mockups

You can replace the images on the screen with your own work. Just right-click on it and select “Replace images”



# Our teachers



**Sofia Hill**

You can speak a bit about this person here



**Kaliyah Harris**

You can speak a bit about this person here

# Our goals

Mercury is the closest planet to the Sun

Mars is actually a very cold place

Venus is the second planet from the Sun

Jupiter is the biggest planet of them all

Saturn is composed of hydrogen and helium

Neptune is the farthest planet from the Sun

# Student progress



**1st term**

**Assistance**

Saturn is a gas giant and has several rings

**Summary**

Mercury is the closest planet to the Sun

**2nd term**



**3rd term**

**Study**

Despite being red, Mars is a cold planet

**Test**

Venus is the second planet from the Sun

**4th term**



# Enrollment process

01

Venus is the second planet  
from the Sun

02

Despite being red, Mars is  
actually a cold place

03

Jupiter is the biggest planet  
of them all

04

Saturn is composed of  
hydrogen and helium

05

Neptune is the farthest  
planet from the Sun

# Special reminders

Do you know what helps you make your point clear?

Lists like this one:

- They're simple
- You can organize your ideas clearly
- You'll never forget to buy milk!

And the most important thing: the audience  
won't miss the point of your presentation



# Thanks!

Do you have any questions?

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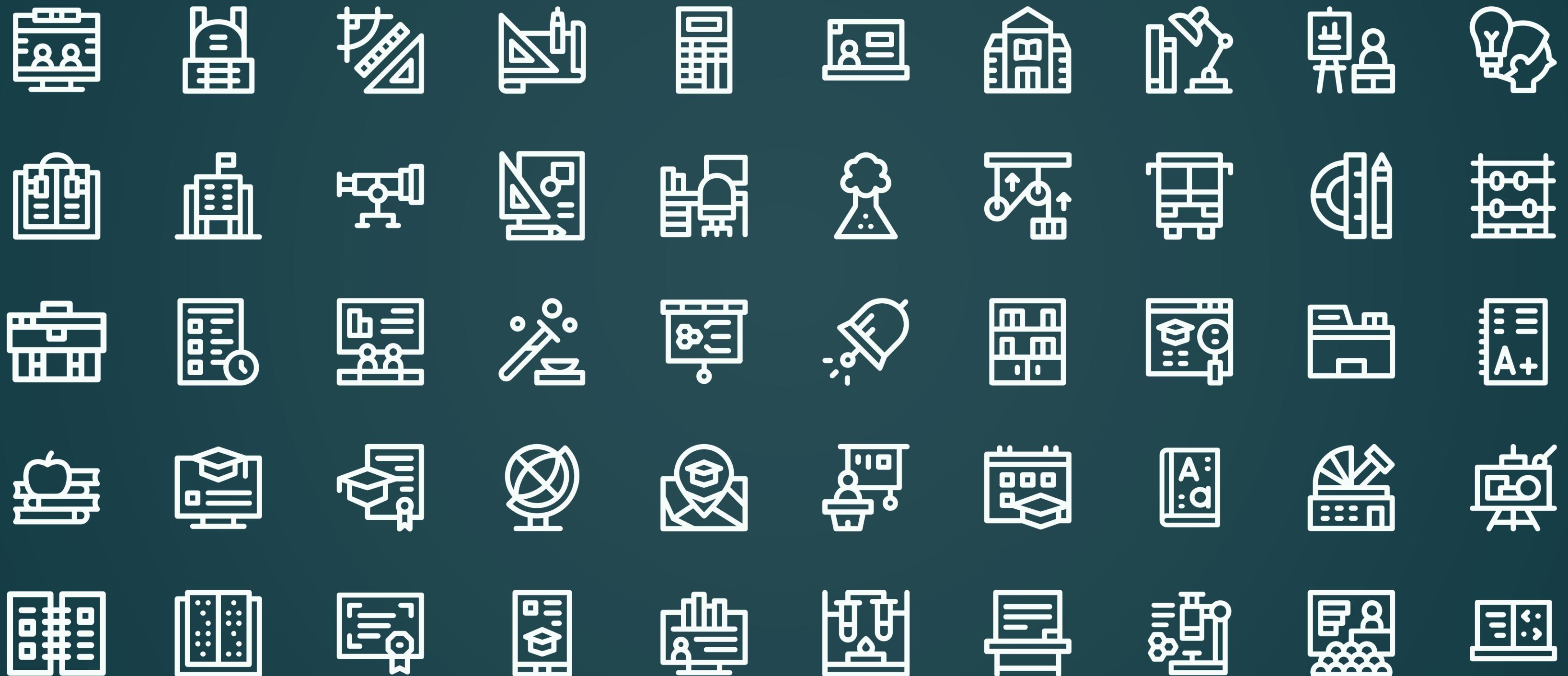
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