UNetWithAttention Class Documentation

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1 Class UNetWithAttention

The UNetWithAttention class implements a U-Net architecture with attention mechanisms and configurable skip connections.

Attributes

- input_shape (tuple): The shape of the input image, e.g., (128, 128, 1) for grayscale images.
- timestamp_dim (int): The dimension of the timestamp input.
- filter_list (list): A list of integers representing the number of filters for each encoder/decoder block.
- num_skip_connections (int): The number of skip connections from the deepest layer.
- num_heads (int): The number of attention heads in the multi-head attention layers.
- **key_dim** (int): The dimensionality of the key space for the multi-head attention.
- use_bias (bool): Whether to include biases in the layers.
- activation (str): The activation function to use in the convolutional layers.
- model (Model): The Keras model instance.

Methods

Constructor: __init__

__init__(input_shape, timestamp_dim, filter_list, num_skip_connections, num_heads=4, key_dimentializes the UNetWithAttention class.

input_shape (tuple): The shape of the input images.

timestamp_dim (int): The dimensionality of the timestamp input.

filter_list (list): A list of filters for each encoder and decoder block.

num_skip_connections (int): The number of skip connections to include, starting from the deepest layer.

num_heads (int): The number of heads for the multi-head attention layers.

key_dim (int): The dimensionality of the key vectors for multi-head attention.

use_bias (bool): Whether to use biases in convolutional layers and attention mechanisms.

activation (str): The activation function to use in the convolutional layers. Default is 'swish'.

Private Methods

These methods are intended for internal use within the class.

_conv_block(x, filters) Creates a convolutional block consisting of Conv2D, BatchNormalization, and the specified activation.

_residual_block(x, filters) Creates a residual block with a skip connection.

_multihead_attention_block(x) Applies a multi-head attention mechanism followed by a residual connection and layer normalization.

_positional_embedding(x) Adds positional embeddings to the input tensor.

_encoder_block(x, filters) Creates an encoder block consisting of a residual block followed by a downsampling operation.

_decoder_block(x, skip_features, filters) Creates a decoder block consisting of upsampling, concatenation with skip connections, and a residual block.

Public Methods

These methods are available for external use.

build_model() Builds the U-Net model with attention mechanisms and stores it in the model attribute.

print_model() Prints the summary of the built model.

 ${\tt save_model_plot(filename='unet_model.png')} \quad {\rm Saves} \ a \ plot \ of \ the \ model \ architecture \ to \ a \ file.$