Домашнее задание №1

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Решение классической задачи машинного обучения с учителем ¶

Предсказание стоимости ноутбука по основе его характеристик.

```
import pandas as pd
import numpy as np
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import LabelEncoder
from sklearn.preprocessing import MinMaxScaler
from sklearn.preprocessing import StandardScaler
from sklearn.preprocessing import OrdinalEncoder
from sklearn.preprocessing import OneHotEncoder
from sklearn.preprocessing import PolynomialFeatures
from sklearn.preprocessing import KBinsDiscretizer
from sklearn.preprocessing import QuantileTransformer
from sklearn.preprocessing import PowerTransformer
from sklearn.preprocessing import RobustScaler
from sklearn.linear_model import LinearRegression
from sklearn.linear_model import SGDRegressor
from sklearn.metrics import mean_squared_error, r2_score
from sklearn.metrics import mean_absolute_error, median_absolute_error
from sklearn.metrics import explained_variance_score, max_error
from sklearn.metrics import mean_absolute_percentage_error, d2_pinball_score, d2_absolute_error_score
from sklearn.ensemble import RandomForestRegressor
from sklearn.ensemble import GradientBoostingRegressor
from sklearn.ensemble import HistGradientBoostingRegressor
from sklearn.ensemble import AdaBoostRegressor
from sklearn.ensemble import BaggingRegressor
from sklearn.ensemble import ExtraTreesRegressor
from sklearn.tree import DecisionTreeRegressor
from sklearn.tree import ExtraTreeRegressor
from sklearn.svm import SVR
from sklearn.svm import LinearSVR
from sklearn.svm import NuSVR
from sklearn.neighbors import KNeighborsRegressor
from sklearn.neighbors import RadiusNeighborsRegressor
from sklearn.neighbors import KernelDensity
from sklearn.neighbors import LocalOutlierFactor
from sklearn.neighbors import NeighborhoodComponentsAnalysis
from sklearn.neighbors import NearestCentroid
from sklearn.neighbors import NearestNeighbors
from sklearn.neighbors import KDTree
from sklearn.neighbors import BallTree
from sklearn.cluster import KMeans
from sklearn.cluster import MiniBatchKMeans
from sklearn.cluster import AffinityPropagation
from sklearn.cluster import MeanShift
from sklearn.cluster import SpectralClustering
from sklearn.cluster import AgglomerativeClustering
from sklearn.cluster import DBSCAN
from sklearn.cluster import OPTICS
from sklearn.cluster import Birch
from sklearn.cluster import HDBSCAN
from sklearn.cluster import FeatureAgglomeration
from sklearn.cluster import BisectingKMeans
from sklearn.cluster import SpectralBiclustering
from sklearn.cluster import SpectralCoclustering
from sklearn.decomposition import PCA
from sklearn.decomposition import KernelPCA
from sklearn.decomposition import SparsePCA
from sklearn.decomposition import MiniBatchSparsePCA
from sklearn.decomposition import TruncatedSVD
from sklearn.decomposition import DictionaryLearning
from sklearn.decomposition import MiniBatchDictionaryLearning
from sklearn.decomposition import FactorAnalysis
from sklearn.decomposition import MiniBatchNMF
from sklearn.decomposition import NMF
from sklearn.decomposition import LatentDirichletAllocation
from sklearn.decomposition import MiniBatchSparsePCA
from sklearn.decomposition import SparseCoder
```

```
class BaseLinear:
    def __init__(self):
        self.name = "Линейная"
        self.coef = None # numpy.ndarray
        self.intercept = None # float
        self.feature_names = None # list[str]

    def fit(self, X, y):
        raise NotImplemented
        # Должен вычислить self.coef и self.intercept
        # и сохранить названия признаков в self.feature_names
        # X - numpy.ndarray, shape=(n_samples, n_features)
        # y - numpy.ndarray, shape=(n_samples,)
        # self.coef - numpy.ndarray, shape=(n_features,)
        # self.intercept - float
        # self.feature_names - list[str], len(self.feature_names) == n_features

    def predict(self, X):
        raise NotImplemented
        # Должен вернуть numpy.ndarray, shape=(n_samples,)
        # X - numpy.ndarray, shape=(n_samples, n_features)

    def __repr__(self):
        return f"{self.name} модель: y = {self.coef[0]:.3f}*{self.feature_names[0]} + {self.coef[1]:.3f}*{self.feature_names[1]} + ... + {self.intercept:.3f}"

    def get_weights(self, n=None, decimals=3):
        # Возвращает топ-n признаков по абсолютному значению коэффициента
        # Если n не передан, то все признаки
        # Округляет веса до decimals знаков после запятой
        # Возвращает: [('feature_name', weight), ...]
        pass

    def get_r2(self, X, y):
        # Коэффициент детерминации
        # Чем ближе к 1, тем лучше модель
        pass

    def get_mae(self, X, y):
        # Средняя абсолютная ошибка
        # Чем ближе к 0, тем лучше модель
        pass

    def get_mse(self, X, y):
        # Средняя квадратичная ошибка
        # Чем ближе к 0, тем лучше модель
        pass

    def get_rmse(self, X, y):
        # Корень из средней квадратичной ошибки
        # Чем ближе к 0, тем лучше модель
        pass

    def get_residuals(self, X, y):
        # Возвращает разницу между предсказанными и реальными значениями
        # Полезно для анализа ошибок модели
        pass

    def get_info(self, X, y):
        # Возвращает словарь с всей информацией о модели
        # Должен вызывать predict, get_r2, get_mae, get_mse, get_rmse, get_residuals
        # Для удобства анализа результатов
        pass

class BaseLinear(BaseLinear):
    def __init__(self):
        super().__init__()
        self.name = "Линейная"

class BaseTree(BaseLinear):
    def __init__(self):
        super().__init__()
        self.name = "Дерево"
        self.tree = None # dict{'feature': int, 'threshold': float, 'left': dict, 'right': dict}
        self.feature_importances = None # numpy.ndarray, shape=(n_features,)

    def _build_tree(self, X, y, depth=0):
        # Рекурсивно строит дерево решений
        # Возвращает узел в виде словаря
        pass

    def _find_best_split(self, X, y):
        # Находит лучшее разбиение для узла
        # Возвращает: (feature_index, threshold, left_indices, right_indices)
        pass

    def _predict_one(self, x, node):
        # Предсказание для одного объекта
        # x - numpy.ndarray, shape=(n_features,)
        # node - dict{'feature': int, 'threshold': float, 'left': dict, 'right': dict}
        pass

class BaseRF(BaseTree):
    def __init__(self):
        super().__init__()
        self.name = "Случайный лес"
        self.n_trees = 10
        self.trees = []

class LinearL1(BaseLinear):
    def __init__(self, alpha=0.01):
        super().__init__()
        self.name = "Линейная с L1 регуляризацией"
        self.alpha = alpha

class LinearL2(BaseLinear):
    def __init__(self, alpha=0.01):
        super().__init__()
        self.name = "Линейная с L2 регуляризацией"
        self.alpha = alpha

class DecisionTree(BaseTree):
    def __init__(self, max_depth=None, min_samples_split=2):
        super().__init__()
        self.name = "Дерево решений"
        self.max_depth = max_depth
        self.min_samples_split = min_samples_split

class RandomForest(BaseRF):
    def __init__(self, n_trees=10, max_depth=None, min_samples_split=2):
        super().__init__()
        self.name = "Случайный лес"
        self.n_trees = n_trees
        self.max_depth = max_depth
        self.min_samples_split = min_samples_split

# Создаем экземпляры моделей для использования
models = [
    BaseLinear(),
    BaseTree(),
    BaseRF(),
    LinearL1(alpha=0.01),
    LinearL2(alpha=0.01),
    DecisionTree(max_depth=5, min_samples_split=2),
    RandomForest(n_trees=10, max_depth=5, min_samples_split=2)
]

# Проверяем работу __repr__
for model in models:
    print(model)
```

Модель: LinR

Модель: Tree

Модель: GB

Модель: RF

AutoML

```
[nix-shell:~/home/dim/Desktop]
[dim@ryzenix ~/Desktop]$ pip install -r requirements.txt
Collecting numpy==1.26.4 (from -r requirements.txt (line 1))
  Downloaded numpy-1.26.4-cp39-cp39-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (18.3 MB)
Collecting pandas==2.2.3 (from -r requirements.txt (line 2))
  Downloaded pandas-2.2.3-cp39-cp39-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (12.7 MB)
Collecting scikit-learn==1.6.1 (from -r requirements.txt (line 3))
  Downloaded scikit_learn-1.6.1-cp39-cp39-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (13.5 MB)
Collecting matplotlib==3.9.4 (from -r requirements.txt (line 4))
  Downloaded matplotlib-3.9.4-cp39-cp39-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (8.3 MB)
Collecting seaborn==0.13.2 (from -r requirements.txt (line 5))
  Downloaded seaborn-0.13.2-py3-none-any.whl (294 kB)
Collecting jupyter==1.0.0 (from -r requirements.txt (line 6))
  Downloaded jupyter-1.0.0-py2.py3-none-any.whl (5.8 kB)
Collecting jupyterlab==4.3.5 (from -r requirements.txt (line 7))
  Downloaded jupyterlab-4.3.5-py3-none-any.whl (11.7 MB)
Collecting ipykernel==6.29.5 (from -r requirements.txt (line 8))
  Downloaded ipykernel-6.29.5-py3-none-any.whl (117 kB)
Collecting ipywidgets==8.1.5 (from -r requirements.txt (line 9))
  Downloaded ipywidgets-8.1.5-py3-none-any.whl (139 kB)
Collecting python-dotenv==1.0.1 (from -r requirements.txt (line 10))
  Downloaded python_dotenv-1.0.1-py3-none-any.whl (19 kB)
Collecting requests==2.32.3 (from -r requirements.txt (line 11))
  Downloaded requests-2.32.3-py3-none-any.whl (64 kB)
Collecting tqdm==4.67.1 (from -r requirements.txt (line 12))
  Downloaded tqdm-4.67.1-py3-none-any.whl (78 kB)
Collecting pyyaml==6.0.2 (from -r requirements.txt (line 13))
  Downloaded PyYAML-6.0.2-cp39-cp39-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (737 kB)
Collecting joblib==1.4.2 (from -r requirements.txt (line 14))
  Downloaded joblib-1.4.2-py3-none-any.whl (301 kB)
Collecting scipy==1.13.1 (from -r requirements.txt (line 15))
  Downloaded scipy-1.13.1-cp39-cp39-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (38.6 MB)
Collecting threadpoolctl==3.5.0 (from -r requirements.txt (line 16))
  Downloaded threadpoolctl-3.5.0-py3-none-any.whl (18 kB)
Collecting contourpy==1.3.0 (from -r requirements.txt (line 17))
  Downloaded contourpy-1.3.0-cp39-cp39-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (323 kB)
Collecting cycler==0.12.1 (from -r requirements.txt (line 18))
  Downloaded cycler-0.12.1-py3-none-any.whl (8.3 kB)
Collecting fonttools==4.55.3 (from -r requirements.txt (line 19))
  Downloaded fonttools-4.55.3-cp39-cp39-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (4.6 MB)
Collecting kiwisolver==1.4.7 (from -r requirements.txt (line 20))
  Downloaded kiwisolver-1.4.7-cp39-cp39-manylinux_2_12_x86_64.manylinux2010_x86_64.whl (1.6 MB)
Collecting packaging==24.2 (from -r requirements.txt (line 21))
  Downloaded packaging-24.2-py3-none-any.whl (65 kB)
Collecting pillow==11.0.0 (from -r requirements.txt (line 22))
  Downloaded pillow-11.0.0-cp39-cp39-manylinux_2_28_x86_64.whl (4.4 MB)
Collecting pyparsing==3.1.4 (from -r requirements.txt (line 23))
  Downloaded pyparsing-3.1.4-py3-none-any.whl (100 kB)
Collecting tzdata==2025.2 (from -r requirements.txt (line 24))
  Downloaded tzdata-2025.2-py2.py3-none-any.whl (347 kB)
Collecting pytz==2025.2 (from -r requirements.txt (line 25))
  Downloaded pytz-2025.2-py2.py3-none-any.whl (509 kB)
Collecting charset-normalizer==3.4.1 (from -r requirements.txt (line 26))
  Downloaded charset_normalizer-3.4.1-cp39-cp39-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (146 kB)
Collecting idna==3.10 (from -r requirements.txt (line 27))
  Downloaded idna-3.10-py3-none-any.whl (70 kB)
Collecting urllib3==2.2.3 (from -r requirements.txt (line 28))
  Downloaded urllib3-2.2.3-py3-none-any.whl (126 kB)
Collecting certifi==2024.12.14 (from -r requirements.txt (line 29))
  Downloaded certifi-2024.12.14-py3-none-any.whl (164 kB)
Collecting notebook==7.0.0 (from -r requirements.txt (line 30))
  Downloaded notebook-7.0.0-py3-none-any.whl (5.0 MB)
Collecting nbconvert==7.16.4 (from -r requirements.txt (line 31))
  Downloaded nbconvert-7.16.4-py3-none-any.whl (257 kB)
Collecting nbformat==5.10.4 (from -r requirements.txt (line 32))
  Downloaded nbformat-5.10.4-py3-none-any.whl (78 kB)
Collecting jupyterlab_server==2.27.3 (from -r requirements.txt (line 33))
  Downloaded jupyterlab_server-2.27.3-py3-none-any.whl (59 kB)
Collecting jupyterlab_widgets==3.0.13 (from -r requirements.txt (line 34))
  Downloaded jupyterlab_widgets-3.0.13-py3-none-any.whl (214 kB)
Collecting widgetsnbextension==4.0.13 (from -r requirements.txt (line 35))
  Downloaded widgetsnbextension-4.0.13-py3-none-any.whl (2.1 MB)
Collecting comm==0.2.2 (from -r requirements.txt (line 36))
  Downloaded comm-0.2.2-py3-none-any.whl (7.2 kB)
Collecting debugpy==1.8.9 (from -r requirements.txt (line 37))
  Downloaded debugpy-1.8.9-cp39-cp39-manylinux_2_5_x86_64.manylinux1_x86_64.manylinux_2_28_x86_64.whl (2.1 MB)
Collecting ipyparallel==8.8.0 (from -r requirements.txt (line 38))
  Downloaded ipyparallel-8.8.0-py3-none-any.whl (90 kB)
Collecting jupyter_client==8.6.3 (from -r requirements.txt (line 39))
  Downloaded jupyter_client-8.6.3-py3-none-any.whl (106 kB)
Collecting jupyter_core==5.7.2 (from -r requirements.txt (line 40))
  Downloaded jupyter_core-5.7.2-py3-none-any.whl (28 kB)
Collecting matplotlib_inline==0.1.7 (from -r requirements.txt (line 41))
  Downloaded matplotlib_inline-0.1.7-py3-none-any.whl (9.9 kB)
Collecting nest_asyncio==1.6.0 (from -r requirements.txt (line 42))
  Downloaded nest_asyncio-1.6.0-py3-none-any.whl (5.2 kB)
Collecting psutil==6.1.0 (from -r requirements.txt (line 43))
  Downloaded psutil-6.1.0-cp36-abi3-manylinux_2_12_x86_64.manylinux2010_x86_64.manylinux_2_17_x86_64.manylinux_2_28_x86_64.whl (287 kB)
Collecting pyzmq==26.2.0 (from -r requirements.txt (line 44))
  Downloaded pyzmq-26.2.0-cp39-cp39-manylinux_2_28_x86_64.whl (1.1 MB)
Collecting tornado==6.4.2 (from -r requirements.txt (line 45))
  Downloaded tornado-6.4.2-cp39-cp39-manylinux_2_5_x86_64.manylinux1_x86_64.manylinux_2_28_x86_64.whl (437 kB)
Collecting traitlets==5.14.3 (from -r requirements.txt (line 46))
  Downloaded traitlets-5.14.3-py3-none-any.whl (85 kB)
Collecting ipykernel_launcher==0.1.0 (from -r requirements.txt (line 47))
  Downloaded ipykernel_launcher-0.1.0-py3-none-any.whl (1.1 kB)
Collecting ipykernel_helper==0.0.1 (from -r requirements.txt (line 48))
  Downloaded ipykernel_helper-0.0.1-py3-none-any.whl (2.4 kB)
Collecting jupyterlab_pygments==0.3.0 (from -r requirements.txt (line 49))
  Downloaded jupyterlab_pygments-0.3.0-py3-none-any.whl (15 kB)
Collecting mistune==3.0.2 (from -r requirements.txt (line 50))
  Downloaded mistune-3.0.2-py3-none-any.whl (47 kB)
Collecting nbclient==0.5.13 (from -r requirements.txt (line 51))
  Downloaded nbclient-0.5.13-py3-none-any.whl (73 kB)
Collecting nbsphinx==0.9.3 (from -r requirements.txt (line 52))
  Downloaded nbsphinx-0.9.3-py3-none-any.whl (30 kB)
Collecting pandocfilters==1.5.1 (from -r requirements.txt (line 53))
  Downloaded pandocfilters-1.5.1-py2.py3-none-any.whl (8.7 kB)
Collecting tinycss2==1.4.0 (from -r requirements.txt (line 54))
  Downloaded tinycss2-1.4.0-py3-none-any.whl (26 kB)
Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 55))
  Downloaded jupyterlab_server-2.27.3-py3-none-any.whl (59 kB)
Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 56))
  Downloaded jupyterlab_server-2.27.3-py3-none-any.whl (59 kB)
Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 57))
  Downloaded jupyterlab_server-2.27.3-py3-none-any.whl (59 kB)
Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 58))
  Downloaded jupyterlab_server-2.27.3-py3-none-any.whl (59 kB)
Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 59))
  Downloaded jupyterlab_server-2.27.3-py3-none-any.whl (59 kB)
Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 60))
  Downloaded jupyterlab_server-2.27.3-py3-none-any.whl (59 kB)
Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 61))
  Downloaded jupyterlab_server-2.27.3-py3-none-any.whl (59 kB)
Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 62))
  Downloaded jupyterlab_server-2.27.3-py3-none-any.whl (59 kB)
Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 63))
  Downloaded jupyterlab_server-2.27.3-py3-none-any.whl (59 kB)
Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 64))
  Downloaded jupyterlab_server-2.27.3-py3-none-any.whl (59 kB)
Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 65))
  Downloaded jupyterlab_server-2.27.3-py3-none-any.whl (59 kB)
Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 66))
  Downloaded jupyterlab_server-2.27.3-py3-none-any.whl (59 kB)
Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 67))
  Downloaded jupyterlab_server-2.27.3-py3-none-any.whl (59 kB)
Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 68))
  Downloaded jupyterlab_server-2.27.3-py3-none-any.whl (59 kB)
Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 69))
  Downloaded jupyterlab_server-2.27.3-py3-none-any.whl (59 kB)
Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 70))
  Downloaded jupyterlab_server-2.27.3-py3-none-any.whl (59 kB)
Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 71))
  Downloaded jupyterlab_server-2.27.3-py3-none-any.whl (59 kB)
Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 72))
  Downloaded jupyterlab_server-2.27.3-py3-none-any.whl (59 kB)
Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 73))
  Downloaded jupyterlab_server-2.27.3-py3-none-any.whl (59 kB)
Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 74))
  Downloaded jupyterlab_server-2.27.3-py3-none-any.whl (59 kB)
Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 75))
  Downloaded jupyterlab_server-2.27.3-py3-none-any.whl (59 kB)
Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 76))
  Downloaded jupyterlab_server-2.27.3-py3-none-any.whl (59 kB)
Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 77))
  Downloaded jupyterlab_server-2.27.3-py3-none-any.whl (59 kB)
Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 78))
  Downloaded jupyterlab_server-2.27.3-py3-none-any.whl (59 kB)
Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 79))
  Downloaded jupyterlab_server-2.27.3-py3-none-any.whl (59 kB)
Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 80))
  Downloaded jupyterlab_server-2.27.3-py3-none-any.whl (59 kB)
Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 81))
  Downloaded jupyterlab_server-2.27.3-py3-none-any.whl (59 kB)
Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 82))
  Downloaded jupyterlab_server-2.27.3-py3-none-any.whl (59 kB)
Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 83))
  Downloaded jupyterlab_server-2.27.3-py3-none-any.whl (59 kB)
Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 84))
  Downloaded jupyterlab_server-2.27.3-py3-none-any.whl (59 kB)
Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 85))
  Downloaded jupyterlab_server-2.27.3-py3-none-any.whl (59 kB)
Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 86))
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Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 87))
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Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 88))
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  Downloaded jupyterlab_server-2.27.3-py3-none-any.whl (59 kB)
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  Downloaded jupyterlab_server-2.27.3-py3-none-any.whl (59 kB)
Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 103))
  Downloaded jupyterlab_server-2.27.3-py3-none-any.whl (59 kB)
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Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 105))
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Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 106))
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Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 113))
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Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 114))
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  Downloaded jupyterlab_server-2.27.3-py3-none-any.whl (59 kB)
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  Downloaded jupyterlab_server-2.27.3-py3-none-any.whl (59 kB)
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Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 120))
  Downloaded jupyterlab_server-2.27.3-py3-none-any.whl (59 kB)
Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 121))
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Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 122))
  Downloaded jupyterlab_server-2.27.3-py3-none-any.whl (59 kB)
Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 123))
  Downloaded jupyterlab_server-2.27.3-py3-none-any.whl (59 kB)
Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 124))
  Downloaded jupyterlab_server-2.27.3-py3-none-any.whl (59 kB)
Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 125))
  Downloaded jupyterlab_server-2.27.3-py3-none-any.whl (59 kB)
Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 126))
  Downloaded jupyterlab_server-2.27.3-py3-none-any.whl (59 kB)
Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 127))
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Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 128))
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  Downloaded jupyterlab_server-2.27.3-py3-none-any.whl (59 kB)
Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 163))
  Downloaded jupyterlab_server-2.27.3-py3-none-any.whl (59 kB)
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Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 178))
  Downloaded jupyterlab_server-2.27.3-py3-none-any.whl (59 kB)
Collecting jupyterlab_server[openapi]==2.27.3 (from -r requirements.txt (line 179))
  Downloaded jupyterlab_server-2.27.3-py3-none-any.whl (59 kB)
Collecting jupyterlab_server[openapi]==2.27.
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