

```
!pip install --upgrade diffusers transformers accelerate torch

Requirement already satisfied: diffusers in
/usr/local/lib/python3.12/dist-packages (0.36.0)
Requirement already satisfied: transformers in
/usr/local/lib/python3.12/dist-packages (4.57.3)
Collecting transformers
  Downloading transformers-4.57.5-py3-none-any.whl.metadata (43 kB)
  ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 44.0/44.0 kB 2.0 MB/s eta
0:00:00
Requirement already satisfied: accelerate in /usr/local/lib/python3.12/dist-
packages (1.12.0)
Requirement already satisfied: torch in
/usr/local/lib/python3.12/dist-packages (2.9.0+cu126)
Collecting torch
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Requirement already satisfied: importlib_metadata in
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Requirement already satisfied: filelock in
/usr/local/lib/python3.12/dist-packages (from diffusers) (3.20.2)
Requirement already satisfied: httpx<1.0.0 in
/usr/local/lib/python3.12/dist-packages (from diffusers) (0.28.1)
Requirement already satisfied: huggingface-hub<2.0,>=0.34.0 in
/usr/local/lib/python3.12/dist-packages (from diffusers) (0.36.0)
Requirement already satisfied: numpy in
/usr/local/lib/python3.12/dist-packages (from diffusers) (2.0.2)
Requirement already satisfied: regex!=2019.12.17 in
/usr/local/lib/python3.12/dist-packages (from diffusers) (2025.11.3)
Requirement already satisfied: requests in
/usr/local/lib/python3.12/dist-packages (from diffusers) (2.32.4)
Requirement already satisfied: safetensors>=0.3.1 in
/usr/local/lib/python3.12/dist-packages (from diffusers) (0.7.0)
Requirement already satisfied: Pillow in
/usr/local/lib/python3.12/dist-packages (from diffusers) (11.3.0)
Requirement already satisfied: packaging>=20.0 in
/usr/local/lib/python3.12/dist-packages (from transformers) (25.0)
Requirement already satisfied: pyyaml>=5.1 in
/usr/local/lib/python3.12/dist-packages (from transformers) (6.0.3)
Requirement already satisfied: tokenizers<=0.23.0,>=0.22.0 in
/usr/local/lib/python3.12/dist-packages (from transformers) (0.22.2)
Requirement already satisfied: tqdm>=4.27 in
/usr/local/lib/python3.12/dist-packages (from transformers) (4.67.1)
Requirement already satisfied: psutil in
/usr/local/lib/python3.12/dist-packages (from accelerate) (5.9.5)
Requirement already satisfied: typing-extensions>=4.10.0 in
/usr/local/lib/python3.12/dist-packages (from torch) (4.15.0)
Requirement already satisfied: setuptools in
/usr/local/lib/python3.12/dist-packages (from torch) (75.2.0)
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Requirement already satisfied: sympy>=1.13.3 in
/usr/local/lib/python3.12/dist-packages (from torch) (1.14.0)
Requirement already satisfied: networkx>=2.5.1 in
/usr/local/lib/python3.12/dist-packages (from torch) (3.6.1)
Requirement already satisfied: jinja2 in
/usr/local/lib/python3.12/dist-packages (from torch) (3.1.6)
Requirement already satisfied: fsspec>=0.8.5 in
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  Downloading nvidia_cuda_nvrtc_cu12-12.8.93-py3-none-
manylinux2010_x86_64.manylinux_2_12_x86_64.whl.metadata (1.7 kB)
Collecting nvidia-cuda-runtime-cu12==12.8.90 (from torch)
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manylinux2014_x86_64.manylinux_2_17_x86_64.whl.metadata (1.7 kB)
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Requirement already satisfied: nvidia-cudnn-cu12==9.10.2.21 in
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manylinux2014_x86_64.manylinux_2_17_x86_64.whl.metadata (1.7 kB)
Collecting nvidia-curand-cu12==10.3.9.90 (from torch)
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manylinux_2_27_x86_64.whl.metadata (1.7 kB)
Collecting nvidia-cusolver-cu12==11.7.3.90 (from torch)
  Downloading nvidia_cusolver_cu12-11.7.3.90-py3-none-
manylinux_2_27_x86_64.whl.metadata (1.8 kB)
Collecting nvidia-cusparse-cu12==12.5.8.93 (from torch)
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Requirement already satisfied: nvidia-cusparselt-cu12==0.7.1 in
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Requirement already satisfied: nvidia-nccl-cu12==2.27.5 in
/usr/local/lib/python3.12/dist-packages (from torch) (2.27.5)
Requirement already satisfied: nvidia-nvshmem-cu12==3.3.20 in
/usr/local/lib/python3.12/dist-packages (from torch) (3.3.20)
Collecting nvidia-nvtx-cu12==12.8.90 (from torch)
  Downloading nvidia_nvtx_cu12-12.8.90-py3-none-
manylinux2014_x86_64.manylinux_2_17_x86_64.whl.metadata (1.8 kB)
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manylinux2014_x86_64.manylinux_2_17_x86_64.whl.metadata (1.7 kB)
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Collecting triton==3.5.1 (from torch)
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manylinux_2_27_x86_64.manylinux_2_28_x86_64.whl.metadata (1.7 kB)
Requirement already satisfied: anyio in
/usr/local/lib/python3.12/dist-packages (from httpx<1.0.0->diffusers)
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Requirement already satisfied: certifi in
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(2026.1.4)
Requirement already satisfied: httpcore==1.* in
/usr/local/lib/python3.12/dist-packages (from httpx<1.0.0->diffusers)
(1.0.9)
Requirement already satisfied: idna in /usr/local/lib/python3.12/dist-
packages (from httpx<1.0.0->diffusers) (3.11)
Requirement already satisfied: h11>=0.16 in
/usr/local/lib/python3.12/dist-packages (from httpcore==1.*-
>httpx<1.0.0->diffusers) (0.16.0)
Requirement already satisfied: hf-xet<2.0.0,>=1.1.3 in
/usr/local/lib/python3.12/dist-packages (from huggingface-
hub<2.0,>=0.34.0->diffusers) (1.2.0)
Requirement already satisfied: mpmath<1.4,>=1.1.0 in
/usr/local/lib/python3.12/dist-packages (from sympy>=1.13.3->torch)
(1.3.0)
Requirement already satisfied: zipp>=3.20 in
/usr/local/lib/python3.12/dist-packages (from importlib_metadata-
>diffusers) (3.23.0)
Requirement already satisfied: MarkupSafe>=2.0 in
/usr/local/lib/python3.12/dist-packages (from jinja2->torch) (3.0.3)
Requirement already satisfied: charset_normalizer<4,>=2 in
/usr/local/lib/python3.12/dist-packages (from requests->diffusers)
(3.4.4)
Requirement already satisfied: urllib3<3,>=1.21.1 in
/usr/local/lib/python3.12/dist-packages (from requests->diffusers)
(2.5.0)
Downloading transformers-4.57.5-py3-none-any.whl (12.0 MB)
12.0/12.0 MB 156.8 MB/s eta
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anylinux_2_28_x86_64.whl (899.7 MB)
899.7/899.7 MB 1.8 MB/s eta
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anylinux_2_27_x86_64.whl (594.3 MB)
594.3/594.3 MB 2.3 MB/s eta
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e_cu12-12.8.90-py3-none-manylinux2014_x86_64.manylinux_2_17_x86_64.whl  
(954 kB) ━━━━━━━━ 954.8/954.8 kB 74.8 MB/s eta  
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0:00:00  
e-cu12, nvidia-cuda-nvrtc-cu12, nvidia-cuda-cupti-cu12, nvidia-cublas-  
cu12, nvidia-cusparse-cu12, nvidia-cufft-cu12, nvidia-cusolver-cu12,  
transformers, torch  
    Attempting uninstall: triton  
        Found existing installation: triton 3.5.0  
        Uninstalling triton-3.5.0:  
            Successfully uninstalled triton-3.5.0  
    Attempting uninstall: nvidia-nvtx-cu12  
        Found existing installation: nvidia-nvtx-cu12 12.6.77  
        Uninstalling nvidia-nvtx-cu12-12.6.77:  
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    Attempting uninstall: nvidia-nvjitlink-cu12  
        Found existing installation: nvidia-nvjitlink-cu12 12.6.85  
        Uninstalling nvidia-nvjitlink-cu12-12.6.85:  
            Successfully uninstalled nvidia-nvjitlink-cu12-12.6.85  
    Attempting uninstall: nvidia-curand-cu12  
        Found existing installation: nvidia-curand-cu12 10.3.7.77  
        Uninstalling nvidia-curand-cu12-10.3.7.77:  
            Successfully uninstalled nvidia-curand-cu12-10.3.7.77  
    Attempting uninstall: nvidia-cufile-cu12  
        Found existing installation: nvidia-cufile-cu12 1.11.1.6
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Uninstalling nvidia-cufile-cu12-1.11.1.6:
  Successfully uninstalled nvidia-cufile-cu12-1.11.1.6
Attempting uninstall: nvidia-cuda-runtime-cu12
  Found existing installation: nvidia-cuda-runtime-cu12 12.6.77
Uninstalling nvidia-cuda-runtime-cu12-12.6.77:
  Successfully uninstalled nvidia-cuda-runtime-cu12-12.6.77
Attempting uninstall: nvidia-cuda-nvrtc-cu12
  Found existing installation: nvidia-cuda-nvrtc-cu12 12.6.77
Uninstalling nvidia-cuda-nvrtc-cu12-12.6.77:
  Successfully uninstalled nvidia-cuda-nvrtc-cu12-12.6.77
Attempting uninstall: nvidia-cuda-cupti-cu12
  Found existing installation: nvidia-cuda-cupti-cu12 12.6.80
Uninstalling nvidia-cuda-cupti-cu12-12.6.80:
  Successfully uninstalled nvidia-cuda-cupti-cu12-12.6.80
Attempting uninstall: nvidia-cublas-cu12
  Found existing installation: nvidia-cublas-cu12 12.6.4.1
Uninstalling nvidia-cublas-cu12-12.6.4.1:
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Attempting uninstall: nvidia-cusparse-cu12
  Found existing installation: nvidia-cusparse-cu12 12.5.4.2
Uninstalling nvidia-cusparse-cu12-12.5.4.2:
  Successfully uninstalled nvidia-cusparse-cu12-12.5.4.2
Attempting uninstall: nvidia-cufft-cu12
  Found existing installation: nvidia-cufft-cu12 11.3.0.4
Uninstalling nvidia-cufft-cu12-11.3.0.4:
  Successfully uninstalled nvidia-cufft-cu12-11.3.0.4
Attempting uninstall: nvidia-cusolver-cu12
  Found existing installation: nvidia-cusolver-cu12 11.7.1.2
Uninstalling nvidia-cusolver-cu12-11.7.1.2:
  Successfully uninstalled nvidia-cusolver-cu12-11.7.1.2
Attempting uninstall: transformers
  Found existing installation: transformers 4.57.3
Uninstalling transformers-4.57.3:
  Successfully uninstalled transformers-4.57.3
Attempting uninstall: torch
  Found existing installation: torch 2.9.0+cu126
Uninstalling torch-2.9.0+cu126:
  Successfully uninstalled torch-2.9.0+cu126
ERROR: pip's dependency resolver does not currently take into account
all the packages that are installed. This behaviour is the source of
the following dependency conflicts.
torchaudio 2.9.0+cu126 requires torch==2.9.0, but you have torch 2.9.1
which is incompatible.
torchvision 0.24.0+cu126 requires torch==2.9.0, but you have torch
2.9.1 which is incompatible.
Successfully installed nvidia-cublas-cu12-12.8.4.1 nvidia-cuda-cupti-
cu12-12.8.90 nvidia-cuda-nvrtc-cu12-12.8.93 nvidia-cuda-runtime-cu12-
12.8.90 nvidia-cufft-cu12-11.3.3.83 nvidia-cufile-cu12-1.13.1.3
nvidia-curand-cu12-10.3.9.90 nvidia-cusolver-cu12-11.7.3.90 nvidia-
```

```
cusparse-cu12-12.5.8.93 nvidia-nvjitlink-cu12-12.8.93 nvidia-nvtx-
cu12-12.8.90 torch-2.9.1 transformers-4.57.5 triton-3.5.1

import torch
from diffusers import StableDiffusionPipeline
import os
import matplotlib.pyplot as plt

model_id = "runwayml/stable-diffusion-v1-5"

print("Loading the model... this may take a minute.")
pipe = StableDiffusionPipeline.from_pretrained(model_id,
torch_dtype=torch.float16)

pipe = pipe.to("cuda")
print("Model loaded successfully!")

prompts = [
    "A futuristic city with flying cars and neon lights, cyberpunk
style",
    "A cute astronaut cat exploring Mars, high detail, 4k",
    "A serene lake surrounded by snowy mountains at sunset",
    "A robot painting a canvas in an art studio, oil painting style",
    "A medieval castle floating on a cloud, fantasy art"
]

output_folder = "synthetic_dataset"
os.makedirs(output_folder, exist_ok=True)

generated_images = []

print(f"\nStarting generation of {len(prompts)} images...")

for i, prompt in enumerate(prompts):
    print(f"Generating sample {i+1}: {prompt}")

    generator = torch.Generator("cuda").manual_seed(1024 + i)
    image = pipe(prompt, generator=generator).images[0]

    file_path = f"{output_folder}/generated_sample_{i+1}.png"
    image.save(file_path)

    generated_images.append((prompt, image))
```

```
print(f"\nAll images have been saved to the '{output_folder}'\ndirectory.")

plt.figure(figsize=(20, 5))

for i, (prompt, img) in enumerate(generated_images):
    plt.subplot(1, 5, i+1)
    plt.imshow(img)
    plt.axis('off')
    plt.title(f"Sample {i+1}")

plt.show()

# Print the text mapping
for i, prompt in enumerate(prompts):
    print(f"Sample {i+1}: {prompt}")
```

Flax classes are deprecated and will be removed in Diffusers v1.0.0.
We recommend migrating to PyTorch classes or pinning your version of
Diffusers.

Flax classes are deprecated and will be removed in Diffusers v1.0.0.
We recommend migrating to PyTorch classes or pinning your version of
Diffusers.

Loading the model... this may take a minute.

```
/usr/local/lib/python3.12/dist-packages/huggingface_hub/utils/_auth.py:94: UserWarning:
The secret `HF_TOKEN` does not exist in your Colab secrets.
To authenticate with the Hugging Face Hub, create a token in your
settings tab (https://huggingface.co/settings/tokens), set it as
secret in your Google Colab and restart your session.
You will be able to reuse this secret in all of your notebooks.
Please note that authentication is recommended but still optional to
access public models or datasets.
    warnings.warn(
{"model_id": "03da776bc07a45a3ba0682995d6d79cd", "version_major": 2, "version_minor": 0}
{"model_id": "cd7be2b741b940edbcb1cac283e83c1c", "version_major": 2, "version_minor": 0}
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```

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{"model_id": "ee03de3a3a134353b44fe613702329cd", "version_major": 2, "version_minor": 0}

`torch_dtype` is deprecated! Use `dtype` instead!

Model loaded successfully!

Starting generation of 5 images...
Generating sample 1: A futuristic city with flying cars and neon
lights, cyberpunk style

{"model_id": "99d6f355c46e47fd825f6a95c9b0d1fc", "version_major": 2, "version_minor": 0}

Generating sample 2: A cute astronaut cat exploring Mars, high detail,
4k

{"model_id": "3ffa530d217b4f7f89cf1b1dae6af589", "version_major": 2, "version_minor": 0}
```

```
Generating sample 3: A serene lake surrounded by snowy mountains at sunset
```

```
{"model_id": "1068abef2f624fae85878c6126603be4", "version_major": 2, "version_minor": 0}
```

```
Generating sample 4: A robot painting a canvas in an art studio, oil painting style
```

```
{"model_id": "d7873b904c01479883b8424f48526952", "version_major": 2, "version_minor": 0}
```

```
Generating sample 5: A medieval castle floating on a cloud, fantasy art
```

```
{"model_id": "30d78e1b00aa48acbd73b950ea769731", "version_major": 2, "version_minor": 0}
```

```
All images have been saved to the 'synthetic_dataset' directory.
```



```
Sample 1: A futuristic city with flying cars and neon lights, cyberpunk style
```

```
Sample 2: A cute astronaut cat exploring Mars, high detail, 4k
```

```
Sample 3: A serene lake surrounded by snowy mountains at sunset
```

```
Sample 4: A robot painting a canvas in an art studio, oil painting style
```

```
Sample 5: A medieval castle floating on a cloud, fantasy art
```

```
import torch
from diffusers import StableDiffusionPipeline
import os
import shutil

model_id = "runwayml/stable-diffusion-v1-5"
pipe = StableDiffusionPipeline.from_pretrained(model_id,
torch_dtype=torch.float16)
pipe = pipe.to("cuda")

data_categories = {
    "Normal_Anatomy": "A high quality medical chest X-ray of healthy
```

```
lungs, PA view, clear diaphragm, sharp bony structures, monochrome,
radiography",

    "Infectious_Patterns": "A chest X-ray showing bacterial pneumonia
with lobar consolidation, medical imaging, black and white
radiograph",

    "Lung_Opacities": "A chest X-ray showing ground-glass opacities in
the lungs, diffuse haziness, medical diagnosis image",

    "Pleural_Conditions": "A chest X-ray showing pleural effusion,
fluid accumulation at the lung base, blunted costophrenic angle",

    "Structural_Lesions": "A chest X-ray showing a pulmonary nodule in
the right upper lobe, medical screening, high contrast",

    "Cardiac_Findings": "A chest X-ray showing cardiomegaly, enlarged
heart silhouette, vascular congestion, medical imaging",

    "Medical_Devices": "A chest X-ray showing a pacemaker implanted in
the chest wall with leads extending to the heart, medical device
artifact",

    "Imaging_Artifacts": "A low quality chest X-ray with motion blur
and noise, poor exposure, medical imaging artifact",

    "View_Positioning": "A chest X-ray, AP view, patient in supine
position, portable X-ray machine quality",

    "Domain_Shift": "A chest X-ray scanned from a film, different
hospital protocol, slightly different contrast resolution"
}

base_folder = "synthetic_xray_dataset"

if os.path.exists(base_folder):
    shutil.rmtree(base_folder)
os.makedirs(base_folder)

print(f"Generating data for {len(data_categories)} categories...\n")

for label, prompt_text in data_categories.items():

    class_folder = os.path.join(base_folder, label)
    os.makedirs(class_folder, exist_ok=True)

    print(f"Processing Category: {label}...")
```

```
for i in range(2):

    generator = torch.Generator("cuda").manual_seed(2024 + i +
len(label))

        full_prompt = f"{prompt_text}, photorealistic, medical x-ray
style, high definition"

        image = pipe(full_prompt, generator=generator).images[0]

        filename = f"{label}_{i+1}.png"
        image.save(os.path.join(class_folder, filename))

print(f"\nSuccess! Dataset created at: {base_folder}")

import matplotlib.pyplot as plt

display_labels = list(data_categories.keys())[:5]

plt.figure(figsize=(20, 5))
for i, label in enumerate(display_labels):
    img_path = os.path.join(base_folder, label, f"{label}_1.png")
    if os.path.exists(img_path):
        img = plt.imread(img_path)
        plt.subplot(1, 5, i+1)
        plt.imshow(img, cmap='gray')
        plt.title(label)
        plt.axis('off')

plt.show()

{"model_id":"076aa16667234ee8b7d84049d29042c4","version_major":2,"vers
ion_minor":0}

Generating data for 10 categories...

Processing Category: Normal_Anatomy...

{"model_id":"93d80bb5f0fe4e6e9457cd124ca10f94","version_major":2,"vers
ion_minor":0}

 {"model_id":"5a77174635da464ca44559cbba0f0e67","version_major":2,"vers
ion_minor":0}

Processing Category: Infectious_Patterns...

 {"model_id":"40aa728f19dc48aa8be82c64936c2b60","version_major":2,"vers
ion_minor":0}
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{"model_id": "ca6cd16bbb744fa493285948078e7db5", "version_major": 2, "version_minor": 0}

Processing Category: Lung_Opacities...

{"model_id": "8201523570cb4cce85c40cdc2c9ac0d0", "version_major": 2, "version_minor": 0}

 {"model_id": "795469aba5824b2f87369d2363864e80", "version_major": 2, "version_minor": 0}

Processing Category: Pleural_Conditions...

 {"model_id": "9f4e19e25e8c45c89ce02ae7c04e3369", "version_major": 2, "version_minor": 0}

 {"model_id": "ff021d04ed474825af66e6933c65bcd", "version_major": 2, "version_minor": 0}

Processing Category: Structural_Lesions...

 {"model_id": "976293bbd3ab4124b136ea6a070b7f4e", "version_major": 2, "version_minor": 0}

 {"model_id": "7555d5868c4a4db28b20fcab0401d58e", "version_major": 2, "version_minor": 0}

Processing Category: Cardiac_Findings...

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 {"model_id": "a82bf72595e14c15863a897d680706c8", "version_major": 2, "version_minor": 0}

Processing Category: Medical_Devices...

 {"model_id": "137e5b82d67f49128e56370c43153173", "version_major": 2, "version_minor": 0}

 {"model_id": "3cda6a48aa184be5ade7f27b61c88bfc", "version_major": 2, "version_minor": 0}

Processing Category: Imaging_Artifacts...

 {"model_id": "57e2648904564acfbd5a4d5636b447b7", "version_major": 2, "version_minor": 0}

 {"model_id": "84af6d0e409a417d954d75fbc2ab0346", "version_major": 2, "version_minor": 0}

Processing Category: View_Positioning...
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{"model_id": "13c80eb1d400445bb1d40b143cd208f7", "version_major": 2, "version_minor": 0}
```

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{"model_id": "d3b0e7560e34419c9e25a80695e77fad", "version_major": 2, "version_minor": 0}
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Processing Category: Domain_Shift...

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{"model_id": "34ac3fb2ceca4e39ac9f8fa03519d84c", "version_major": 2, "version_minor": 0}
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{"model_id": "7405419e414c450a9b7d06f043c6eefc", "version_major": 2, "version_minor": 0}
```

Success! Dataset created at: synthetic_xray_dataset

