Pre-Trained Language Models for Image Generation

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Tools and Applications of Artificial Intelligence

MIARFID, March 12, 2024

Outline

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Goal

React to a text input (known as *prompt*) by generating new related images.

Example

Prompt: *Pink elephants on parade*.

Example

Image from Dumbo (1941).

Outline

Dall-e

- Developer: OpenAI (Ramesh et al., 2022).
- GPT-3 (Brown et al., 2020).
- Preventing harmful generation.
- Ensure content policy.
- Credit system.
- Beta no longer available.

Dall-e

Example

Pink elephants on parade.

Dall-e

Example

More examples: `https://openai.com/product/dall-e-2`.

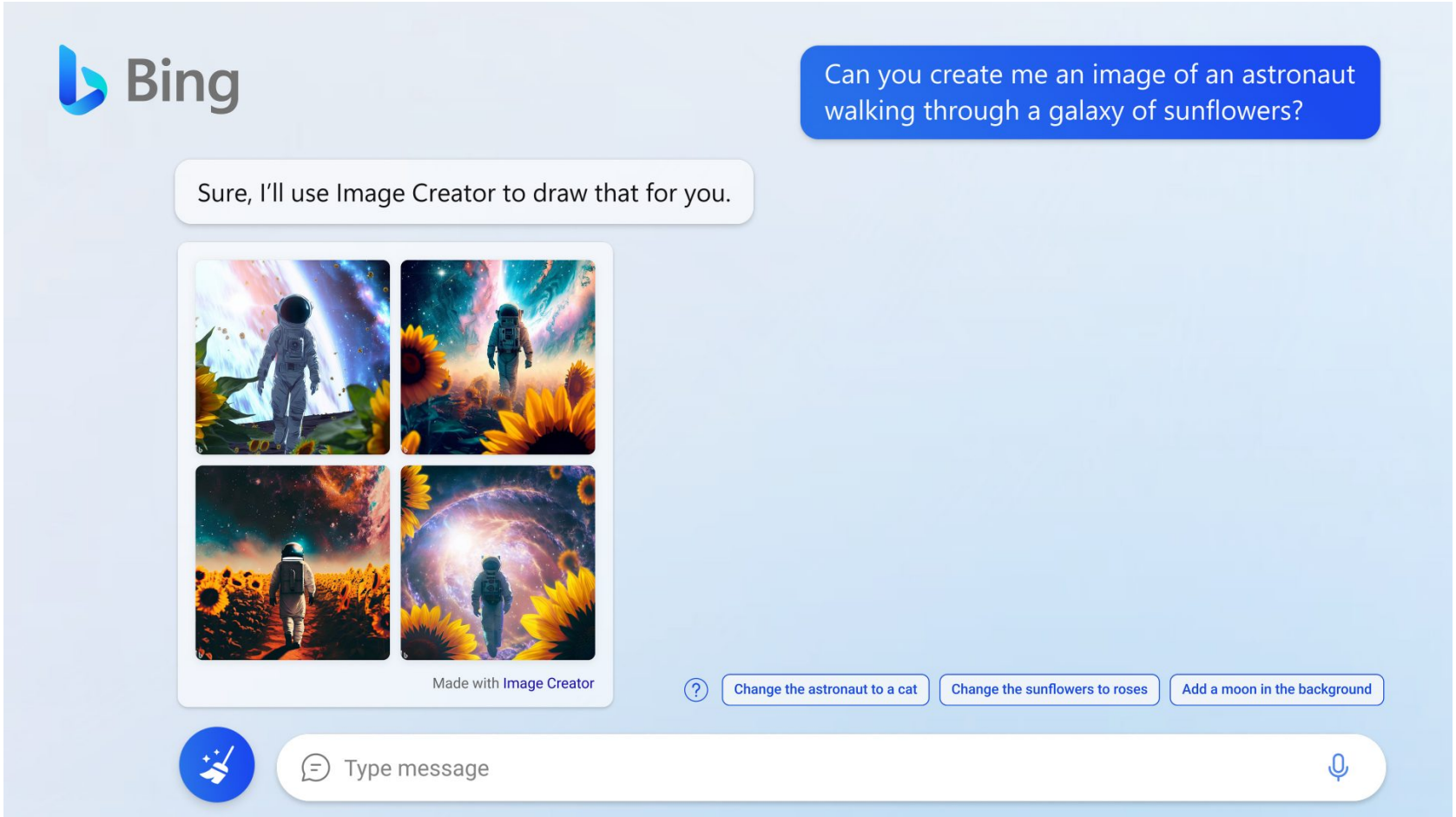
Dall-e

Bing Image Creator

- Based on *Dall-e*.
- Integrated into *Microsoft Edge* and other *Bing* products.

Dall-e

Bing Image Creator



Midjourney

- Developer: independent research lab (Midjourney, Inc.).
- Discord-based.
- Subscription plan.
- Beta no longer available.

Examples: `https://www.midjourney.com/showcase/recent/`.

Leonardo AI

- Game assets generation.
- Artists tools.
- Use of pre-trained models.
- Train custom models.
- Content production platform.

Examples: `https://leonardo.ai/`.

DreamFusion

- Developer: Google Research (Poole et al, 2022).
- 3D assets generation.
- Text-to-3D using 2D Diffusion.

Examples: `https://dreamfusion3d.github.io/gallery.html`.

Adobe Firefly

"Generative AI made for creators"

- Developer: Adobe.
- Trained on *Adobe Stock* images:
  - Openly license content.
  - Public domain.
- Designed to generate content safe for commercial use.
- To be integrated into Adobe products.

Adobe Firefly

Example

Adobe Firefly

Image tools

- Context-aware image generation.
- Vector, brushes and textures generations from few words and sketches.
- Template generation.
- 3D modeling.

Examples:
`https://www.adobe.com/sensei/generative-ai/firefly.html`.

Adobe Firefly

Video tools

- Text to color enhancements (e.g, "Make this scene feel warm and inviting"): change color schemes, time of day, or even the seasons.
- Advanced music and sound effects: generation of royalty-free custom sounds and music to reflect a certain feeling or scene.
- Stunning fonts, text effects, graphics, and logos: generation of subtitles, logos and title cards and custom contextual animations.
- Powerful script and B-roll capabilities: acceleration of production workflows to automatically create storyboards and pre-visualizations.
- Creative assistants and co-pilots: master new skills and accelerate processes from initial vision to creation and editing.

Examples:

`https://blog.adobe.com/en/publish/2023/04/17/reimagining-video-audio-adobe-firefly`.

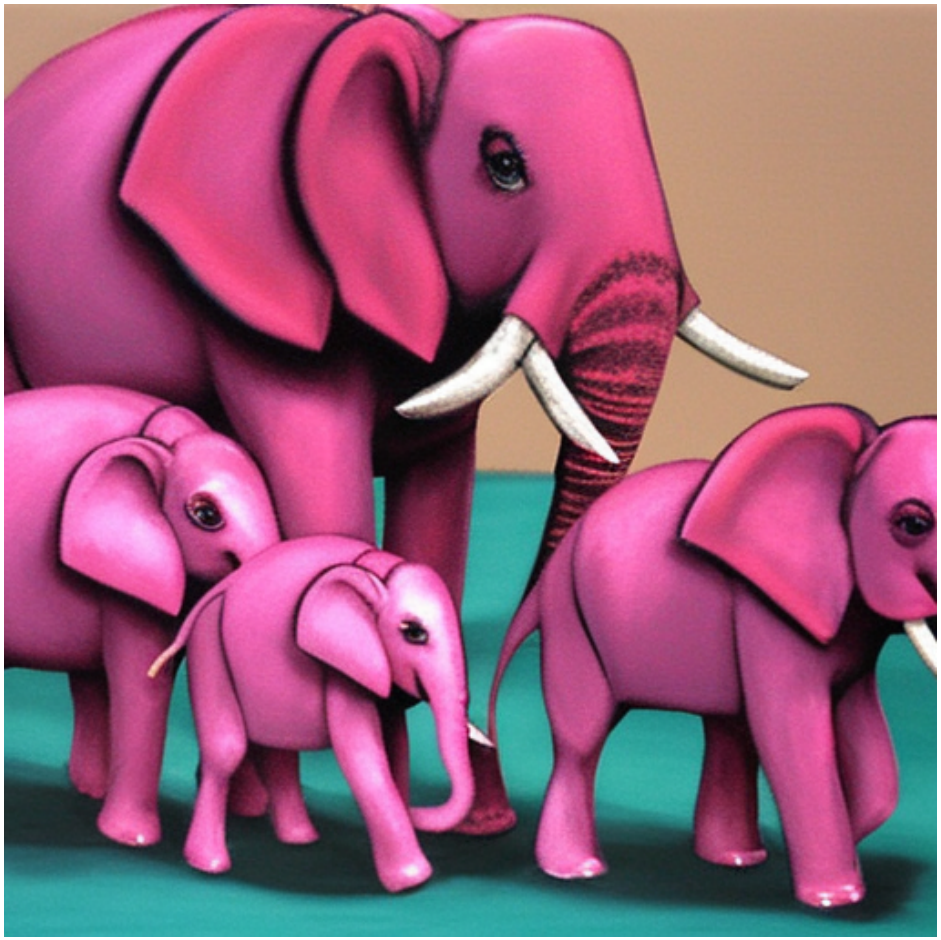
Stable Diffusion

Introduction

- Developer: Stability AI (Rombach et al., 2022).
- Trained on LAION-5B (Schuhmann et al., 2022).
- Open source.

Stable Diffusion

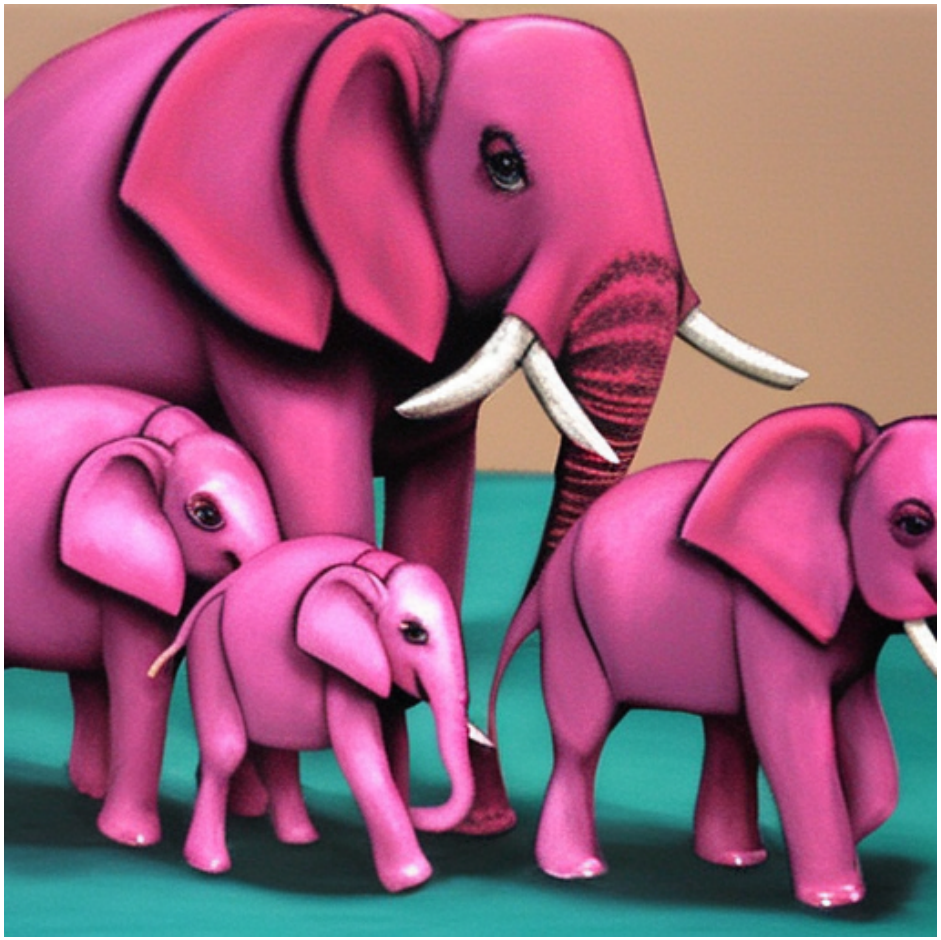
Example



Pink elephants on parade.

Stable Diffusion

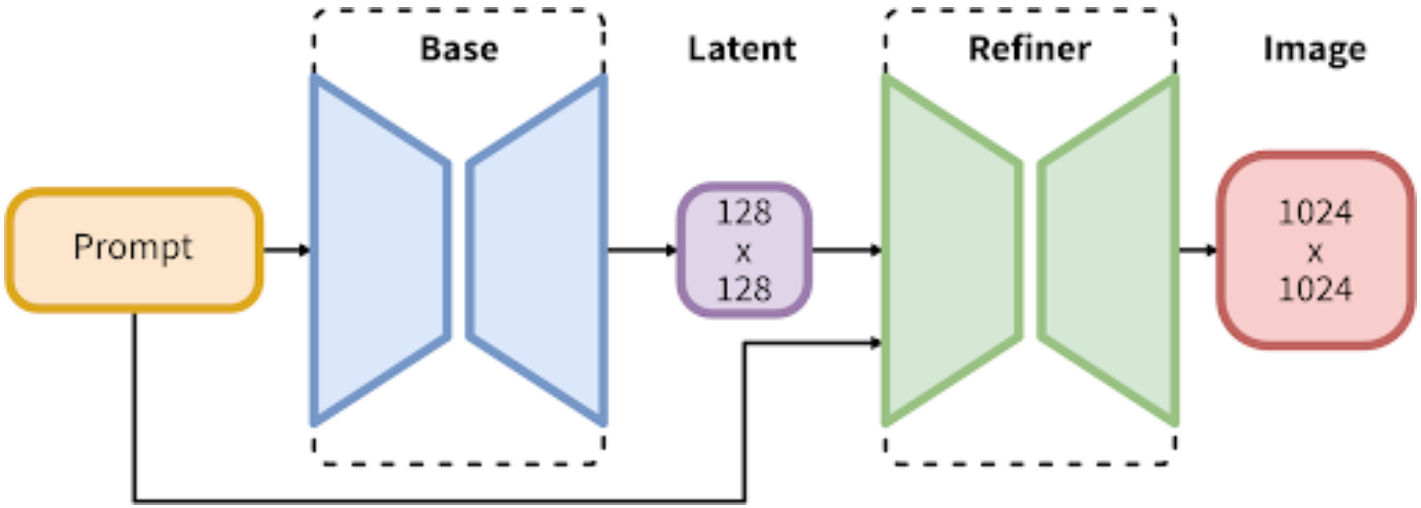
Example (SDXL)



Pink elephants on parade.

Stable Diffusion

SDXL



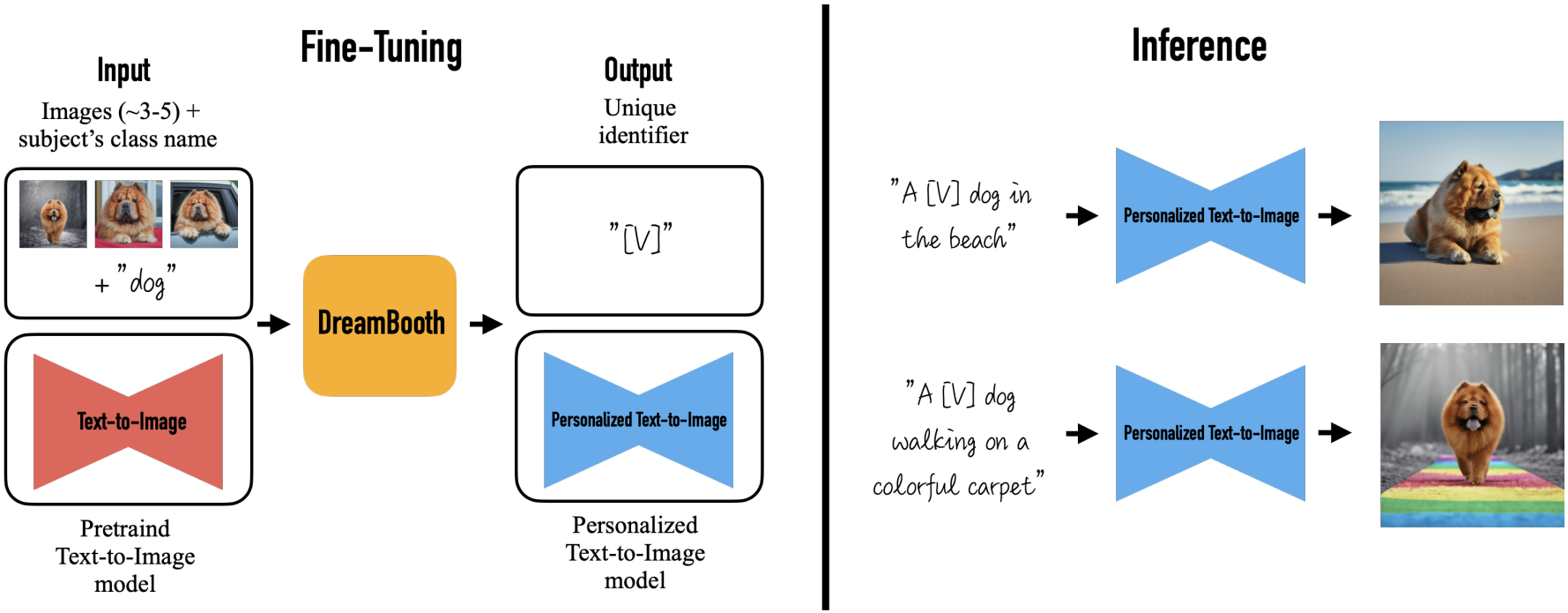
Stable Diffusion

DreamBooth

- A technique to fine-tune diffusion models by injecting a custom subject to the model (Ruiz et al., 2022).
- Training time: $\sim$ 1 hour.
- Model size: Gigabytes.

Stable Diffusion

DreamBooth: Approach



Stable Diffusion

DreamBooth: Art rendition

Input images

Vincent Van Gogh

Michelangelo

Rembrandt

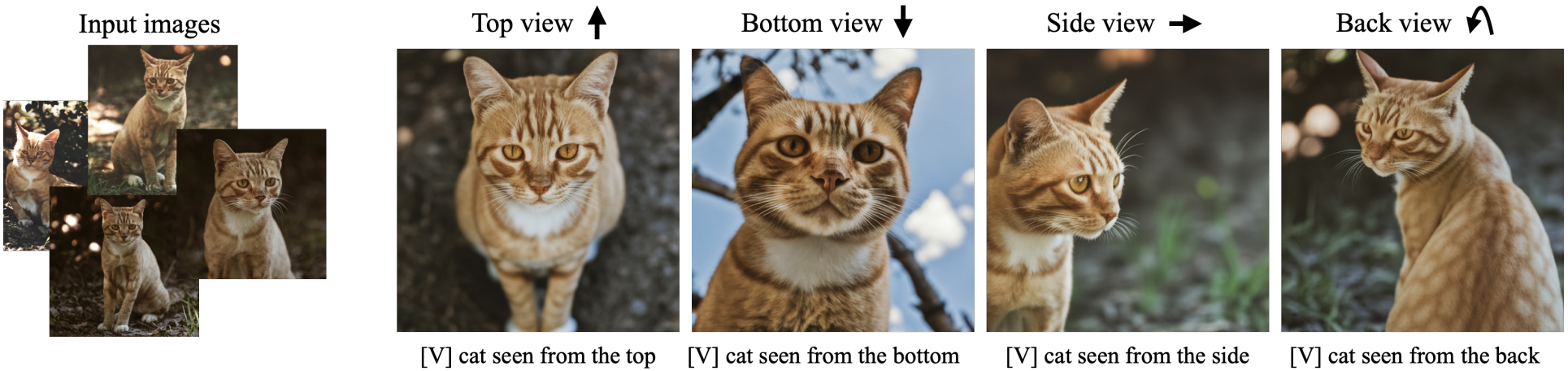
Johannes Vermeer

Pierre-Auguste Renoir

Leonardo da Vinci

Stable Diffusion

DreamBooth: Text-guided view synthesis



Stable Diffusion

DreamBooth: Property modification

Color modification (*"A [color] [V] car"*)

Input

purple red yellow blue pink

Hybrids (*"A cross of a [V] dog and a [target species]"*)

Input

Bear Panda Koala Lion Hippo

Stable Diffusion

DreamBooth: Accessorization

Input images


Chef Outfit


Witch Outfit


Ironman Outfit


Nurse Outfit


Purple Wizard Outfit


Superman Outfit


Police Outfit


Angel Wings

Stable Diffusion

Low-Rank Adaptation (LoRA)

- Efficient adaptation strategy to fine-tune large language models (Hu et al., 2021).
- Freezes the weight of the pre-trained model.
- Fine-tunes the cross attention layers.
- The trick of LoRA is breaking a matrix into two smaller (low-rank) matrices.
- Training time: 25 minutes $\sim$ 1 hour.
- Model size: Megabytes.
- Collection of models: `https://civitai.com/`.

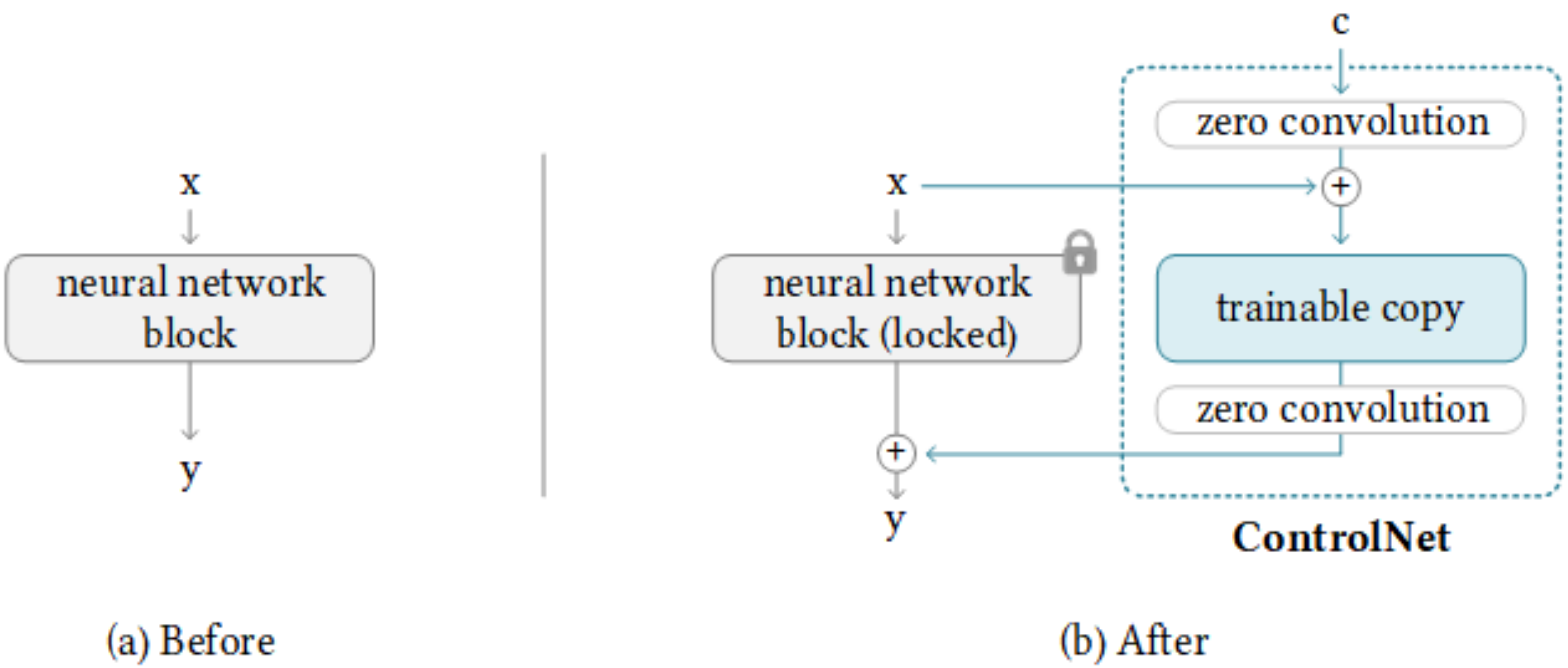
Stable Diffusion

ControlNet: Control human pose in Stable Diffusion

- ControlNet is a modified Stable Diffusion model (Zhang et al., 2023).
- It takes an additional input image and detects its outlines.
- This information is fed into the model as an additional conditioning.

Stable Diffusion

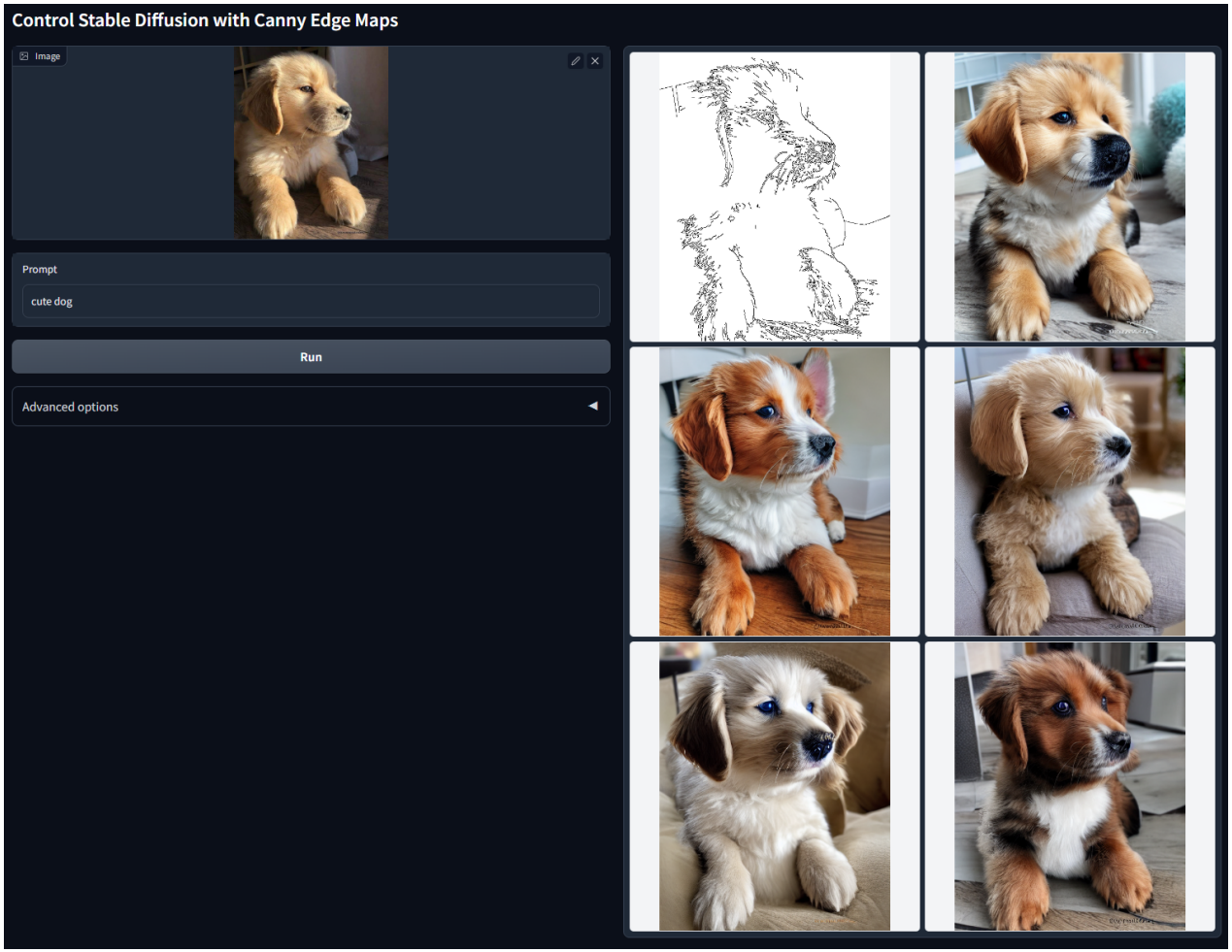
ControlNet: Architecture



(a) Before (b) After

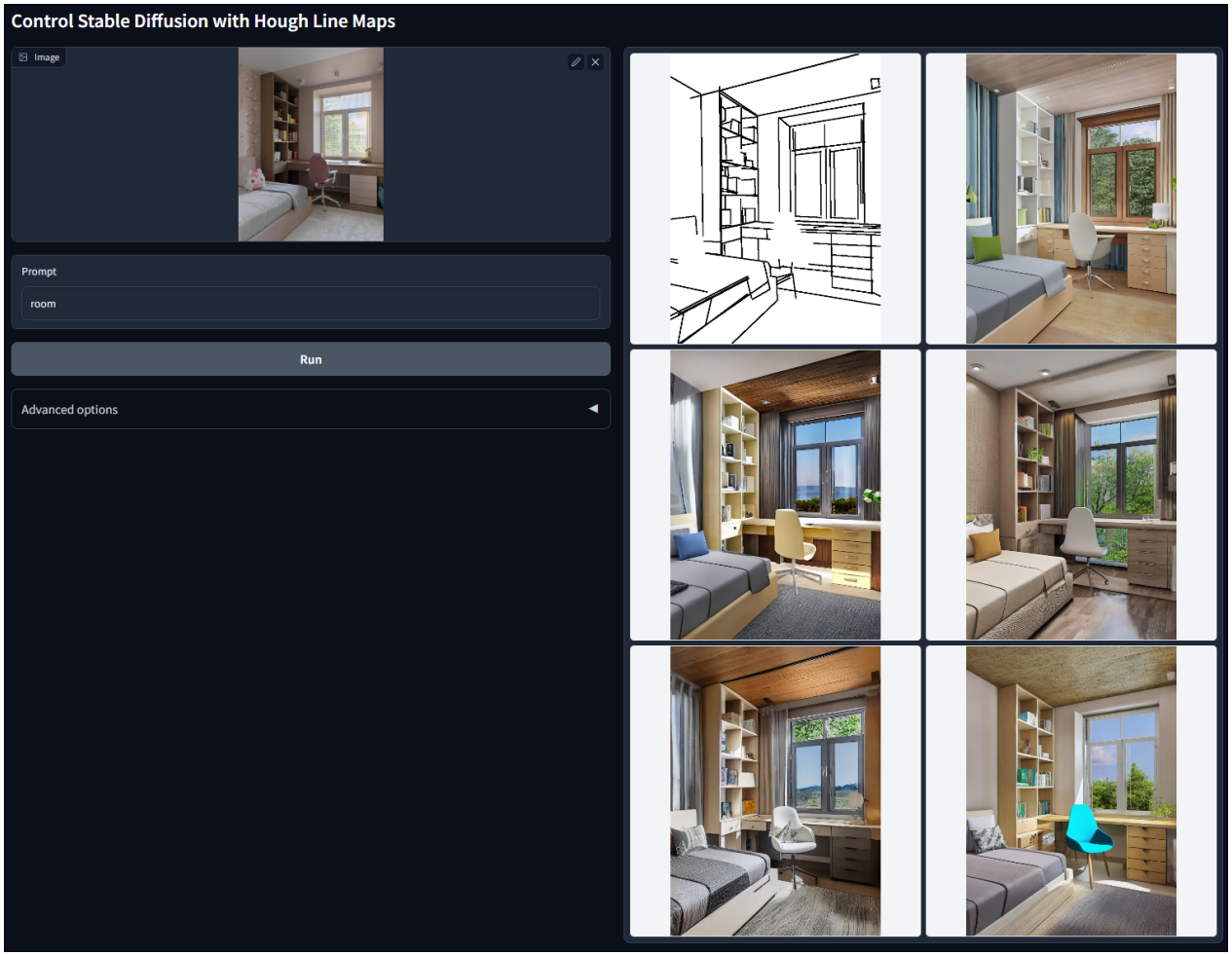
Stable Diffusion

ControlNet: Canny edge detection



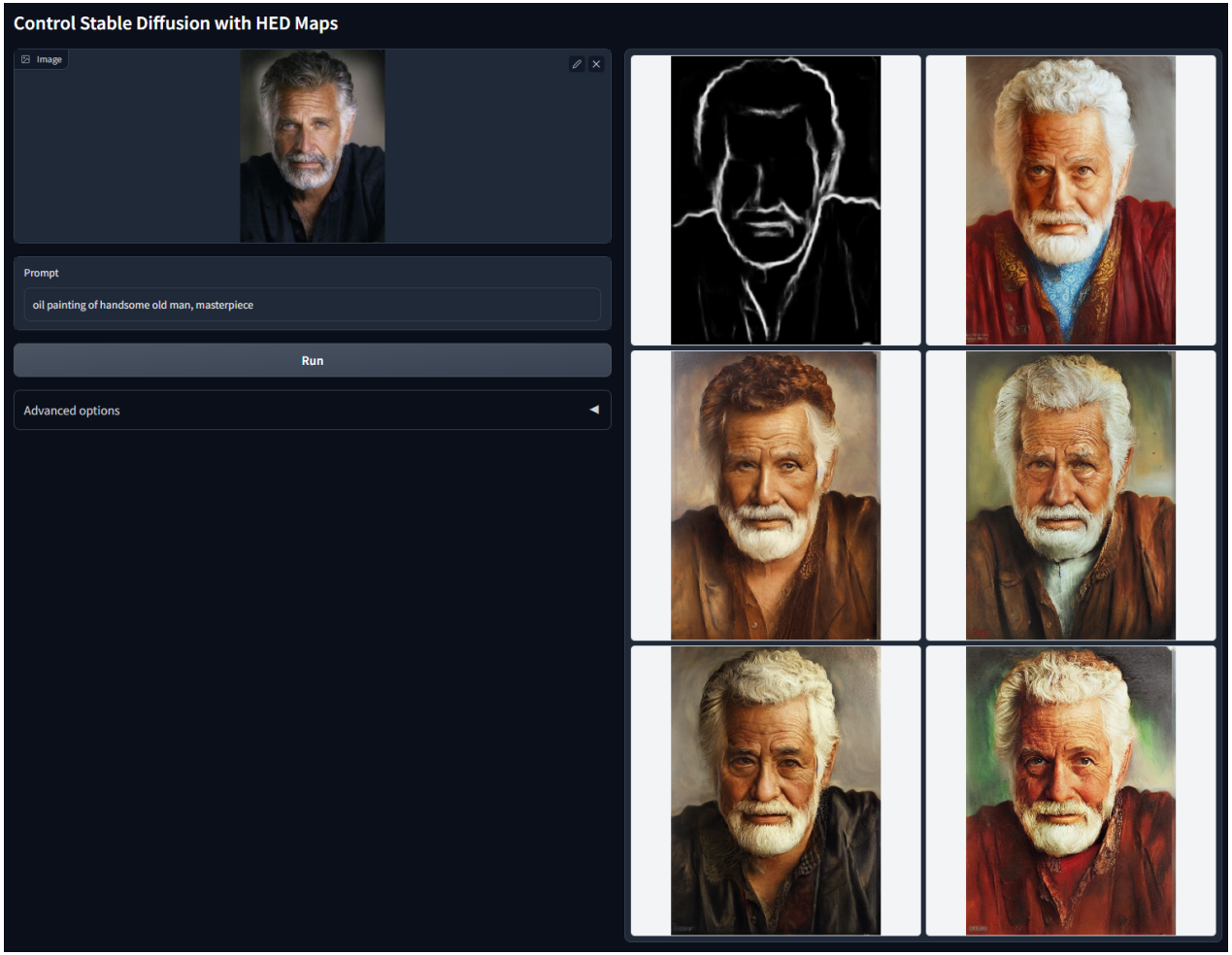
Stable Diffusion

ControlNet: Hough line maps



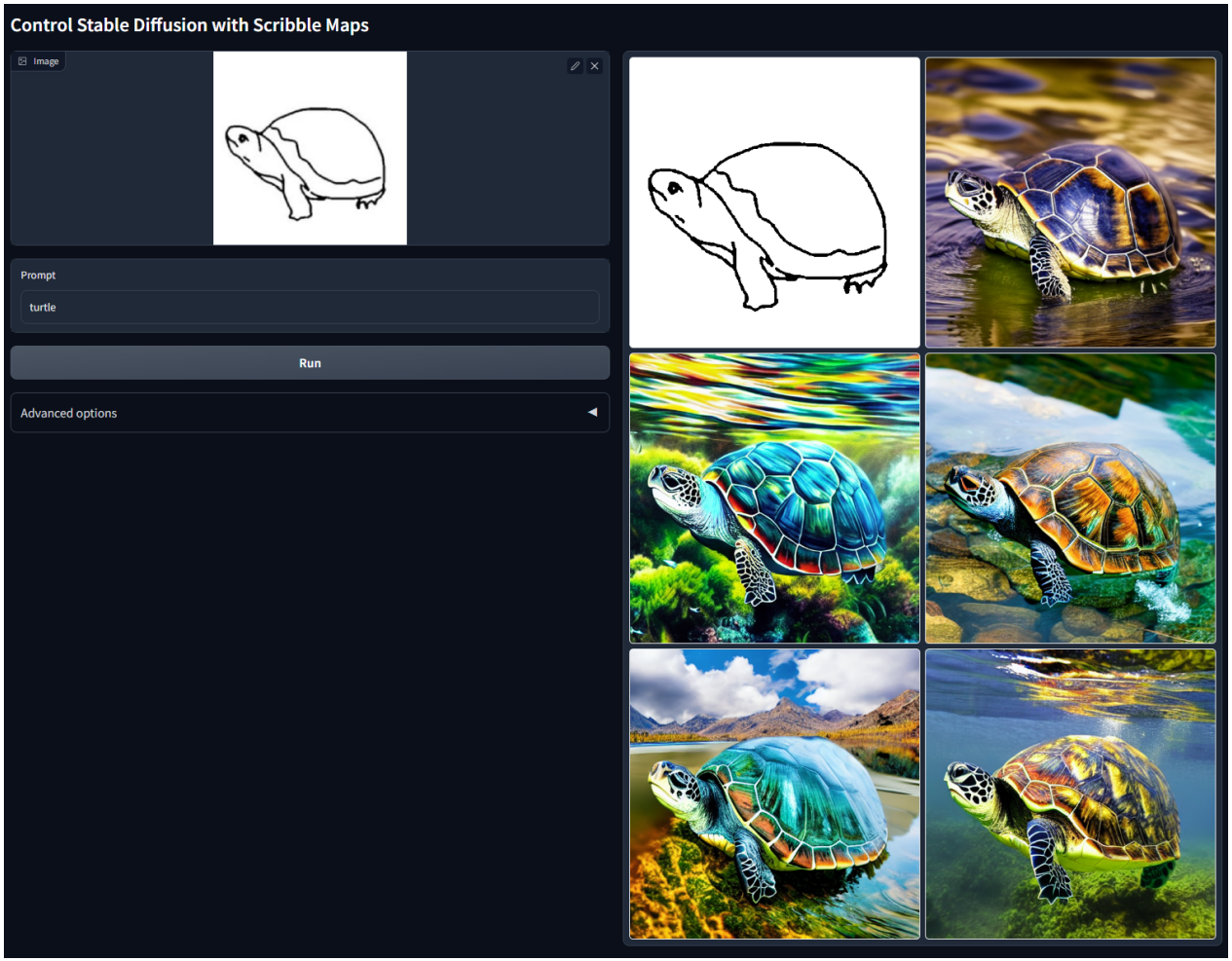
Stable Diffusion

ControlNet: HED maps



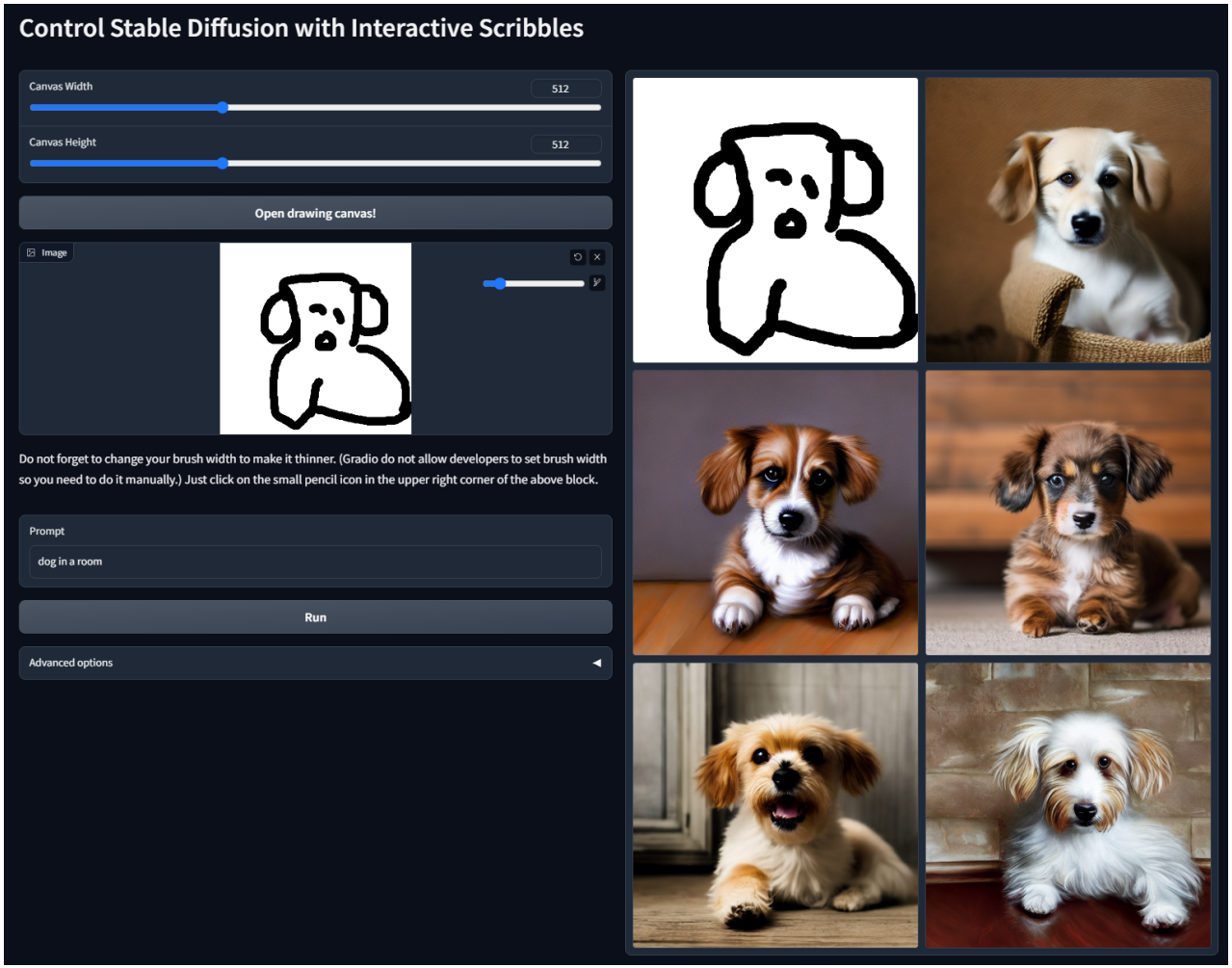
Stable Diffusion

ControlNet: Scribble maps



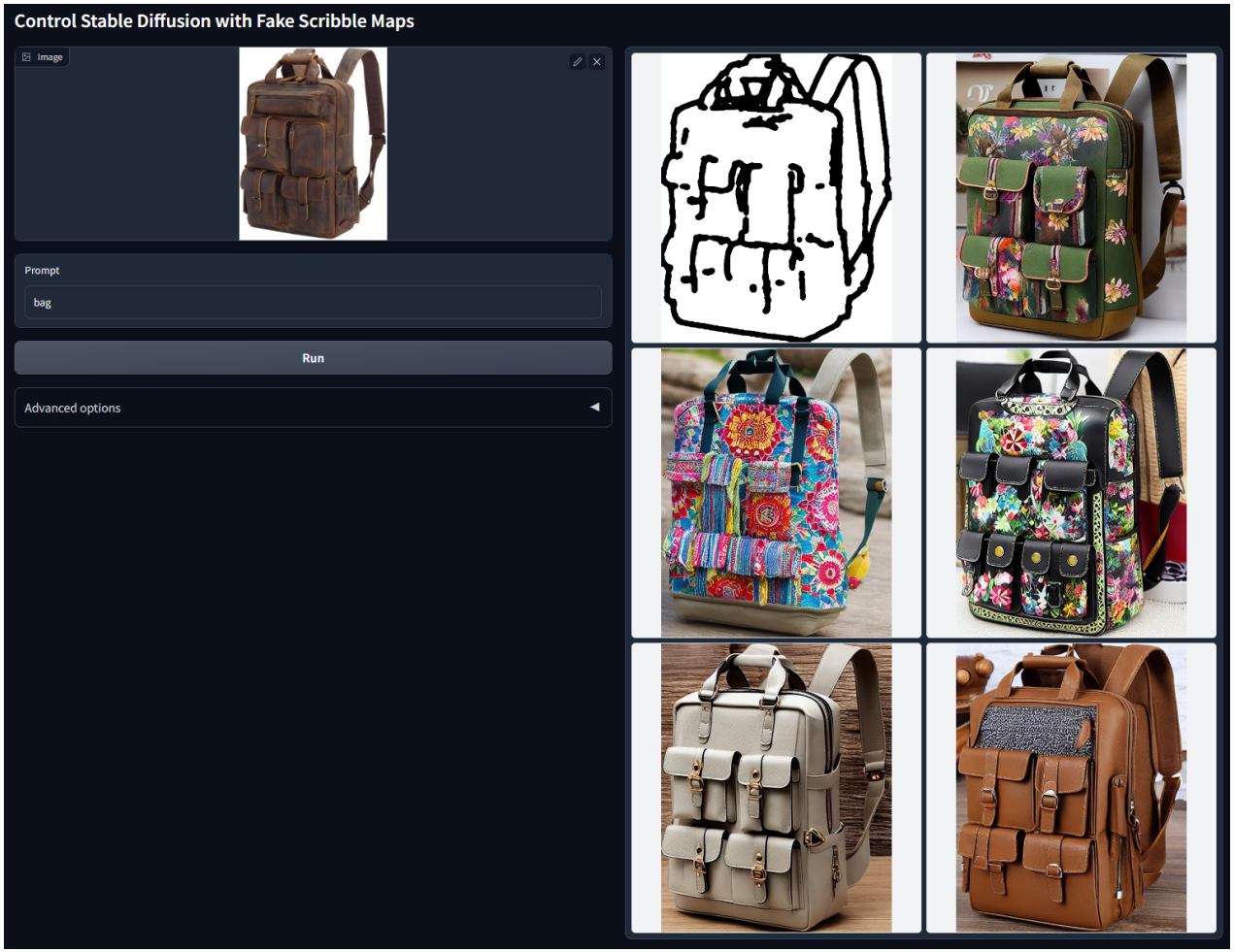
Stable Diffusion

ControlNet: Sketches



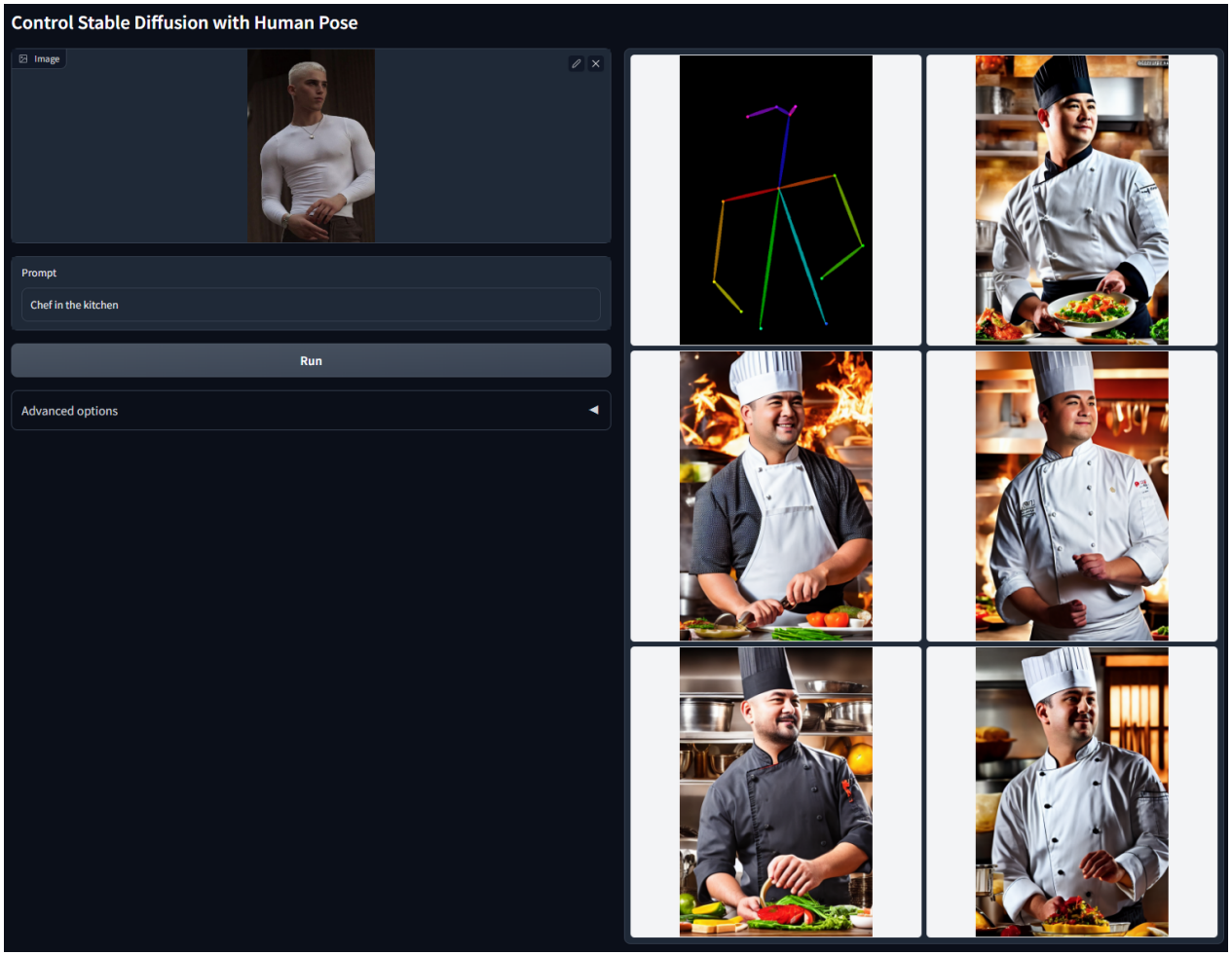
Stable Diffusion

ControlNet: Fake scribbles



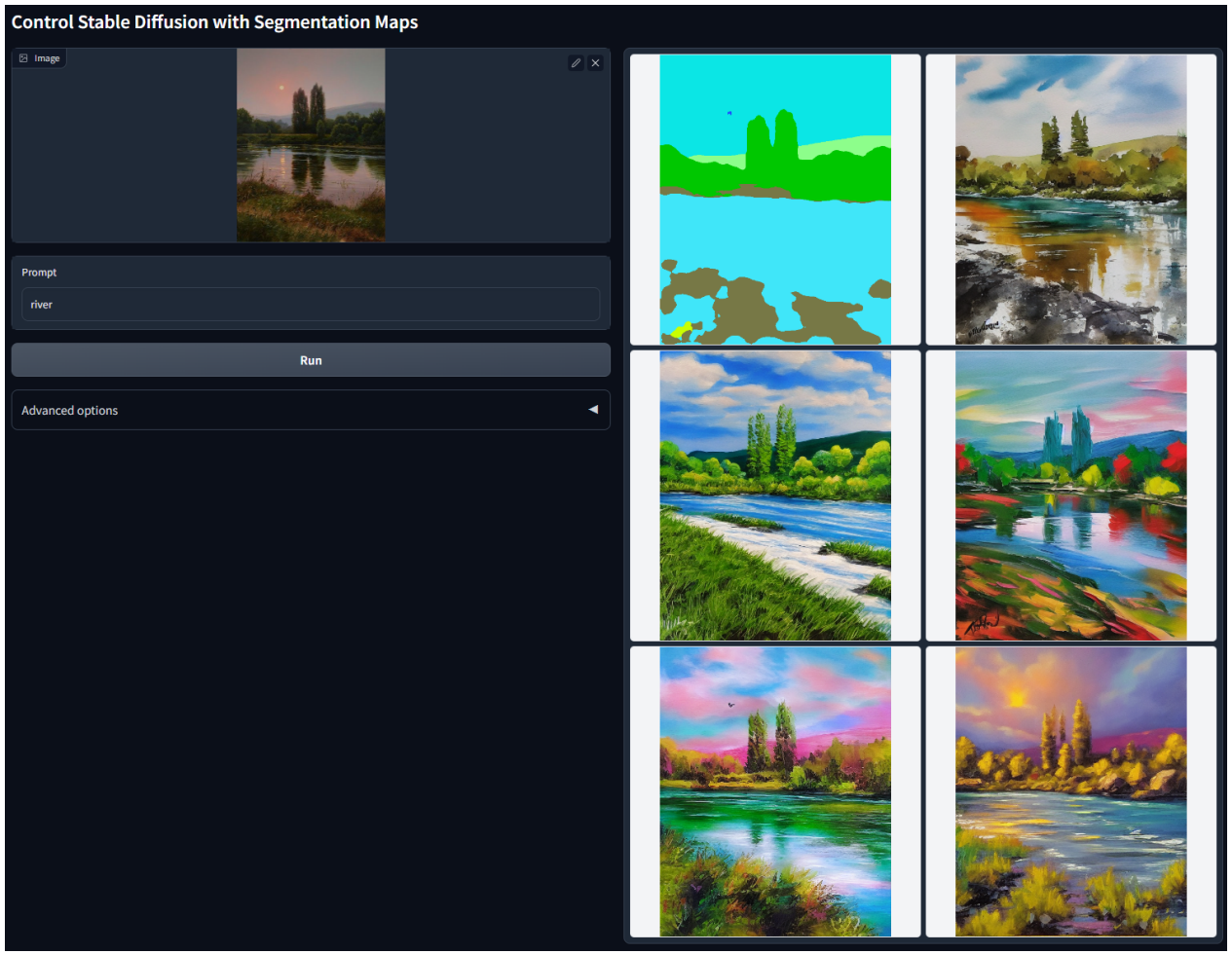
Stable Diffusion

ControlNet: Human poses



Stable Diffusion

ControlNet: Segmentation maps



Stable Diffusion

Prompt Generation

Anatomy of a good prompt

- **Subject**: what you want to see in the image.
- **Medium**: the material used to make artwork.
- **Style**: artistic style of the image.
- **Artist**: to use a particular artist as a reference.
- **Website**: graphic websites such as *Artstation* and *Deviant Art*.
- **Resolution**: how sharp and detailed the image is.
- **Additional details**: such as sci-fi, stunningly beautiful, etc.
- **Color**: color keywords to control the overall color of the image.
- **Lighting**: lighting keywords can have a huge effect on how the image looks.

Examples: `https://stable-diffusion-art.com/prompt-guide/`.

Outline

Deforum

- Deforum is a tool to create animation videos with Stable Diffusion.
- Example and tutorial: `https://stable-diffusion-art.com/deforum/`.

Lumiere

- Developer: Google.
- Features: Generates short videos from a prompt.
- Examples: `https://lumiere-video.github.io/`.

Sora

The world simulator

- Developer: OpenAI.
- Features:
  - Prompting with images and videos.
  - Extending generated videos.
  - Video-to-video editing.
  - Connecting videos.
  - Simulating digital worlds.
- Examples: `https://openai.com/research/video-generation-models-as-world-simulators`.

Outline

Controversy

- Fake news.
- Most models are trained with images scraped from the web, without paying attention to copyright.
- Some developers are creating the models for lucrative purposes.
- Some users are using the generated images for commercial and lucrative purposes.
- This is specially cumbersome for artists, whose personal styles are being "replicated" by the models.
- Overall, this is a delicate matter that needs to be address and legislated carefully.

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