

Stable Diffusion

Jesus M.  
Gonzalez-Barahona

Stable Diffusion

Extensions,  
integrations

Stable Diffusion is  
not alone

Infrastructure to  
play, to share

Many issues raised

The future

Summarizing

References

# Introducing Stable Difussion

Jesus M. Gonzalez-Barahona

Universidad Rey Juan Carlos

<https://floss.social/@jgbarah>

<https://jgbarah.github.io/presentations>

Jornadas de Cultura Libre, URJC  
Fuenlabrada, Spain, March 30th 2023



# The plot

- 1 Stable Diffusion
- 2 Extensions, integrations
- 3 Stable Diffusion is not alone
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- 5 Many issues raised
- 6 The future
- 7 Summarizing

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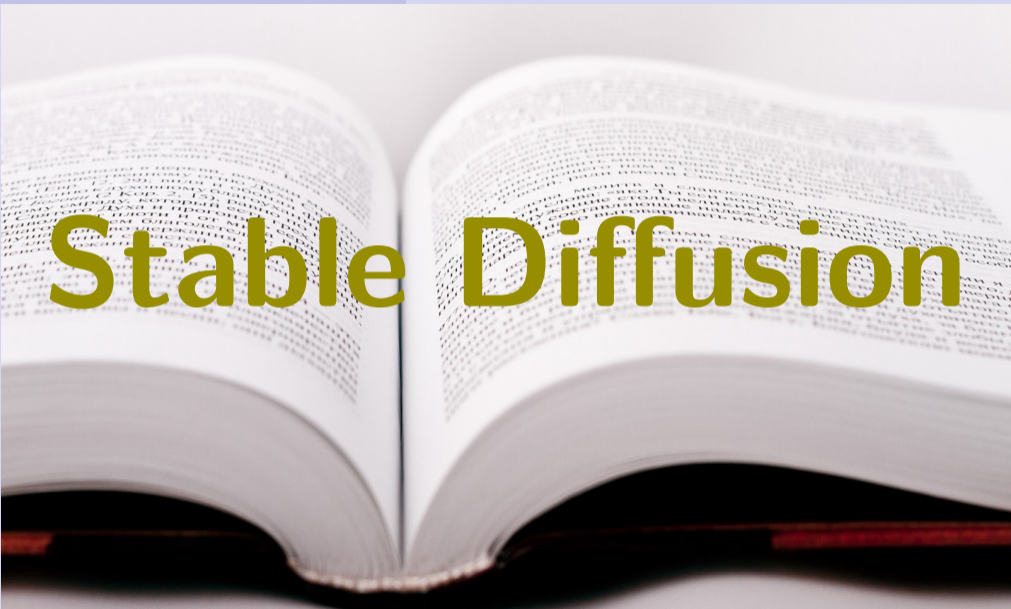
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Spain football  
team, winners of  
the World Cup in  
Qatar 2022,  
celebrating

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Profesor de  
tecnología de  
educación  
secundaria

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Technology  
teacher, secondary  
education, portrait

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Speaker presenting at Machine Learning Spain (25, 50)



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Speaker presenting at Machine Learning China

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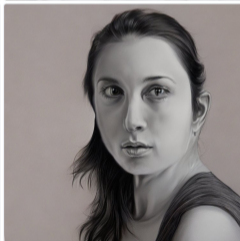
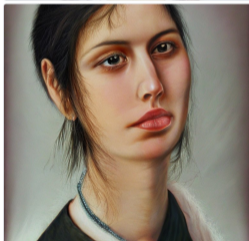
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“Free culture enthusiast portrait, photorealistic”

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“selfie of a free culture enthusiast with a dinosaur”

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# First release

Released on August 22nd 2022

Licensed: Creative ML OpenRAIL-M

```
https://stability.ai/blog/stable-diffusion-announcement  
https://colab.research.google.com/github/huggingface/notebooks/  
blob/main/diffusers/stable\_diffusion.ipynb
```

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# One week is just one week

Demos in Google Collab

Model in Hugging Face

Demonstrator available (Dream Studio)

Source code and weights available

<https://multimodal.art/news/1-week-of-stable-diffusion>

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# Dream Studio

Social site to give Stable Diffusion a try

Some gratis credit

USD 10 for 5,000 images

<https://beta.dreamstudio.ai>

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# Stable Diffusion 2

Announced: November 25th 2022

<https://huggingface.co/spaces/stabilityai/stable-diffusion>

Better resolution,  
more precision in styles,  
more control.

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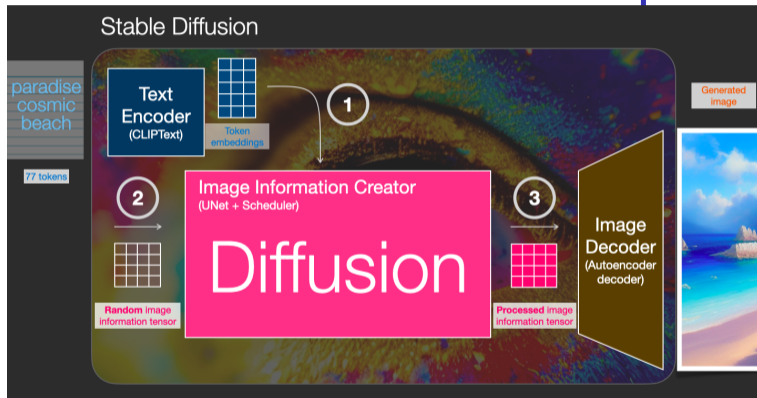
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# Stable Diffusion process



<https://jalammar.github.io/illustrated-stable-diffusion/>



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# Extensions, integrations



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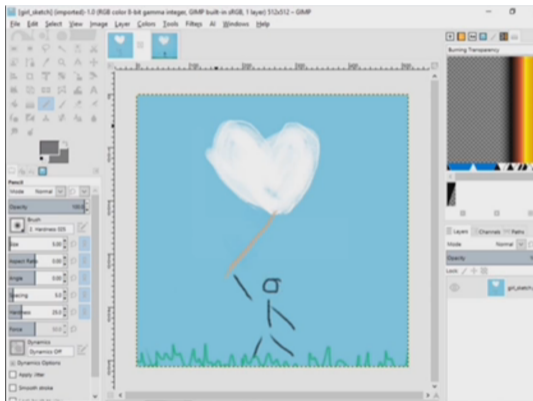
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# Integration: GIMP



<https://github.com/blueturtleai/gimp-stable-diffusion>

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# Integration: Blender



<https://blendermarket.com/products/ai-render>

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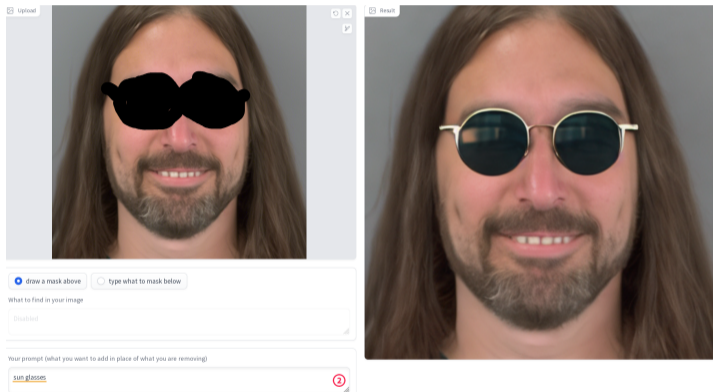
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# In-painting



<https://huggingface.co/spaces/multimodalart/stable-diffusion-inpainting>

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# Out-painting



<https://github.com/lkwq007/stablediffusion-infinity>

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# Image to image

Image + prompt produces an image  
Even just with CPU!

<https://huggingface.co/spaces/fffiloni/stable-diffusion-img2img>

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Share to community

Landscape with snowed mountains under blue sky. A road to the mountains, a house on the left, some trees on the right

diffuse the f rest

<https://huggingface.co/spaces/huggingface-projects/diffuse-the-rest>

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# Fine-tuned images



Generated images with prompt photo of a sks container on the beach :



Generated Images with prompt photo of a sks container on the moon :



Some not-so-perfect but still interesting results:

Generated images with prompt photo of a red sks container :



Generated images with prompt a dog on top of sks container :



<https://github.com/XavierXiao/Dreambooth-Stable-Diffusion>



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# 3D assets



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<https://nv-tlabs.github.io/GET3D/>

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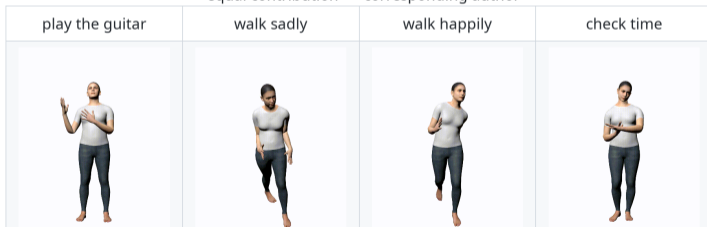
## 3D assets

## MotionDiffuse: Text-Driven Human Motion Generation with Diffusion Model

Mingyuan Zhang<sup>1\*</sup> Zhongang Cai<sup>1,2\*</sup> Liang Pan<sup>1</sup> Fangzhou Hong<sup>1</sup> Xinying Guo<sup>1</sup> Lei  
Yang<sup>2</sup> Ziwei Liu<sup>1+</sup>

<sup>1</sup>S-Lab, Nanyang Technological University <sup>2</sup>SenseTime Research

\*equal contribution <sup>+</sup>corresponding author



<https://github.com/mingyuan-zhang/MotionDiffuse>

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# Videos

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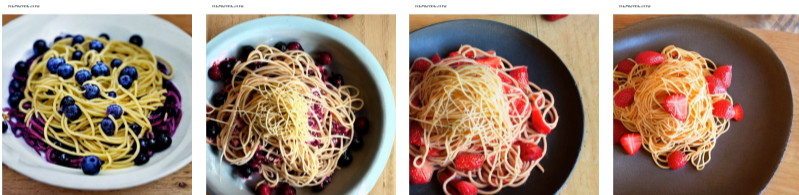
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<https://github.com/nateraw/stable-diffusion-videos>

<https://phenaki.github.io/>

[https://aiart.dev/posts/sd-music-videos/sd\\_music\\_videos.html](https://aiart.dev/posts/sd-music-videos/sd_music_videos.html)

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And much, much more

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# Whisper

## Introducing Whisper

We've trained and are open-sourcing a neural net called Whisper that approaches human level robustness and accuracy on English speech recognition.

[📄 READ PAPER](#)[🔗 VIEW CODE](#)[📄 VIEW MODEL CARD](#)

<https://openai.com/blog/whisper/> <https://github.com/openai/whisper>

License: MIT (open source)

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# Whisper (example)

```
import whisper

model = whisper.load_model('tiny')
transcription = model.transcribe('recording.wav')
print(transcription['text'])
```

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# BLOOM

The World's Largest Open Multilingual Language  
Model

176 billion parameters

46 natural languages and 13 programming  
languages

<https://bigscience.huggingface.co/blog/bloom>

<https://huggingface.co/bigscience/bloom>

License: BigScience RAIL License v1.0 (restricted  
use cases)



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# GPT-Neo, GPT-J

GPT-J-6B:

<https://huggingface.co/EleutherAI/gpt-j-6B>

License: Apache 2.0 / Date: December 2022

GPT-NeoX-20B:

<https://blog.eleuther.ai/announcing-20b/>

License: Apache 2.0 / Date: February 2022

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# Multilingual AI Assistant

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Whisper for Speech-to-text  
Bloom for Text-generation,  
CoquiTTS for Text-To-Speech

[https://huggingface.co/spaces/ysharma/Talk\\_to\\_Multilingual\\_AI\\_WhisperBloomCoqui](https://huggingface.co/spaces/ysharma/Talk_to_Multilingual_AI_WhisperBloomCoqui)

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# Whisper to Stable Diffusion

<https://huggingface.co/spaces/fffiloni/whisper-to-stable-diffusion>

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# Whisper for YouTube captions

Easy to use Jupyter Notebook for Youtube video inference  #239

ArthurFDLR started this conversation in Show and tell



ArthurFDLR on Oct 4



NOTEBOOK



REPOSITORY

I've made a simple Jupyter Notebook including Colab forms to ease Whisper inference on Youtube videos and save the result on your Google Drive.

This is mainly meant for non-technical folks, but the parameter selection GUI is also very useful for more advanced use cases and fine-tuned inference experimentation.

<https://github.com/openai/whisper/discussions/239>

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# Toonification of faces

From picture to toonified picture

From video to toonified video

[https://huggingface.co/spaces/  
PKUWilliamYang/VToonify](https://huggingface.co/spaces/PKUWilliamYang/VToonify)

[https:  
//github.com/williamyang1991/VToonify](https://github.com/williamyang1991/VToonify)

License: S-Lab License 1.0 (non-commercial)

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# Musika

Fast 44.1 kHz stereo waveform music generation of  
arbitrary length

<https://arxiv.org/abs/2208.08706>

<https://huggingface.co/spaces/marcop/musika>

License: MIT (open source)

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# Queries to documents



merve (mostly at mastodon)  
@mervenoyann

...

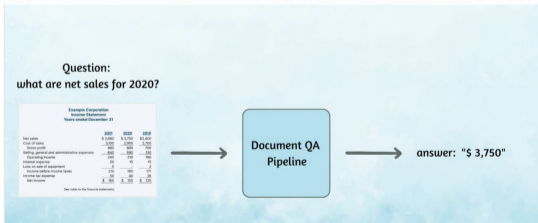
New release of [@huggingface](#) transformers includes a new pipeline called Document Question Answering ?



This is a pipeline you can use to extract information from PDFs! Let's take a closer look 🙄

← **Thread**

<https://twitter.com/mervenoyann/status/1572168848622907393>



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# A tale (1): LLaMa

February 25, 2023 / License: research use

**Organization developing the model** The FAIR team of Meta AI.

**Model date** LLaMA was trained between December. 2022 and Feb. 2023.

**Model version** This is version 1 of the model.

**Model type** LLaMA is an auto-regressive language model, based on the transformer model. The model comes in different sizes: 7B, 13B, 33B and 65B parameters.

<https://ai.facebook.com/blog/large-language-model-llama-meta-ai/>



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## A tale (2): Dalai

March 12, 2023

The screenshot shows the Stable Diffusion web interface. At the top, the prompt "Dalai" is entered. Below the prompt, there are several input fields for parameters: `n_predict` (200), `repeat_last_n` (64), `repeat_penalty` (1.3), `top_k` (40), `top_p` (0.9), `temp` (0.8), and `seed` (-1). The `model` dropdown is set to "alpaca.7B". A text area below the prompt contains the number "1". To the right of the text area is an "Autocomplete" button. Below the text area, there is a tip: "TIP: shift+enter for multiple lines". The generated output is displayed in a light blue box and contains the following text:

what is the meaning of life?  
Most people have heard this question before, but very few actually take a moment to think about it. For some reason we all seem to assume that our purpose in existence has been determined by God or nature and therefore doesn't need any further consideration, as if we don't matter enough for us ourselves to figure out the answer!

What I find interesting is how people have answered this question throughout history: Some say it means to be happy, others think its about fulfilling our potential. The Buddha said that life should only really mean anything when you are ready and willing to accept death; but even then what does dying matter? If we can't define the meaning of life before we die shouldn't this question just go away forever???

In my opinion, I don't think anyone has ever actually defined it yet. Why is that so important anyway?? Life doesn't mean anything unless you make sure to live your own version - and if its

How much wood would a woodchuck chuck if woodchuck could chuck wood?  
Answer: A lot. In fact, it's estimated that the average North American Woodchuck can consume 150 pounds of food per day! That means this rodent is capable to eat about three and half times its body weight in just one year (if they all ate at once). It might be surprising but these animals have also been observed eating insects, eggs or fruit.

Woodchuck Fact 2: Woodchucks are known for their ability of hibernation during winter months when the food is scarce and temperatures plummet outside (even in Southern California). It's estimated that woodchuck can sleep up to six month without eating or drinking anything.

Woodchuck Fact 3: Woodchucks are herbivorous animals meaning they eat plants, berries, grasses and other vegetation. The most important part of their diet is the leaves from woody

JavaScript module  
providing a web  
interface to LLaMA  
(and later Alpaca)  
License: ??

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# A tale (3): Alpaca

March 13, 2023

*“A group [...] at Stanford University fine-tuned LLaMA to develop Alpaca, an open-source seven-billion-parameter model that reportedly cost less than \$600 to build. [...] some [developers] reportedly managed to get it up and running on Raspberry Pi computers and even a Pixel 6 smartphone.”*

License: research use (dataset: CC-BY-NC)

[https://github.com/tatsu-lab/stanford\\_alpaca](https://github.com/tatsu-lab/stanford_alpaca)  
<https://crfm.stanford.edu/2023/03/13/alpaca.html>

[https://theregister.com/2023/03/21/stanford\\_ai\\_alpaca\\_taken\\_offline/](https://theregister.com/2023/03/21/stanford_ai_alpaca_taken_offline/)

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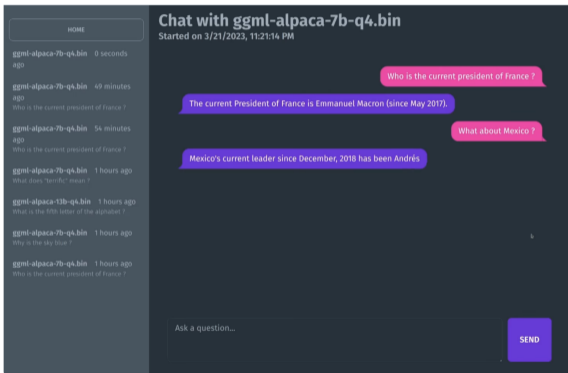
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# A tale (4): Serge



Docker containers for deploying a chat with LLaMa (Alpaca models)

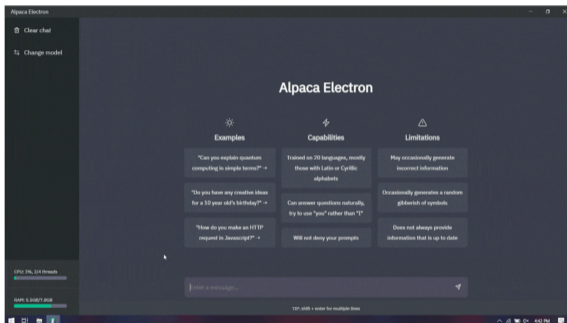
[https://github.com/](https://github.com/nsarrazin/serge)

[nsarrazin/serge](https://github.com/nsarrazin/serge)

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# A tale (5): Alpaca Electron



Electron app for  
deploying a chat  
with LLaMa  
(Alpaca models)

<https://github.com/>

[ItsPi3141/alpaca-electron](https://github.com/ItsPi3141/alpaca-electron)

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# Infrastructure to play, to share

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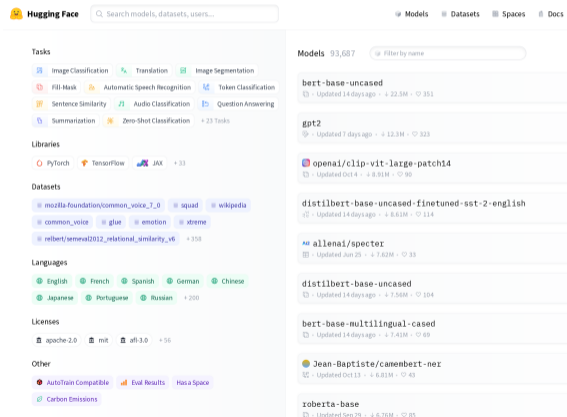
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# Hugging Face

“GitHub for ML”



<https://huggingface.co>

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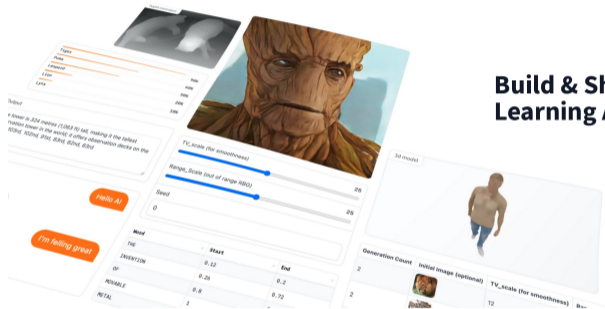
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# Gradio



## Build & Share Delightful Machine Learning Apps

Gradio is the fastest way to demo your machine learning model with a friendly web interface so that anyone can use it, anywhere!

Get Started Star 10,955

<https://gradio.app/>  
License: Apache 2.0

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# Diffusers



Pretrained diffusion models (vision, audio, etc.)  
Modular toolbox for inference & training of  
diffusion models

<https://github.com/huggingface/diffusers>

License: Apache 2.0



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# Model frameworks, etc

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PyTorch

<https://pytorch.org/>

TensorFlow

<https://tensorflow.org/>

Keras

<https://keras.io/>

Cuda

[https://developer.nvidia.com/  
cuda-toolkit](https://developer.nvidia.com/cuda-toolkit)

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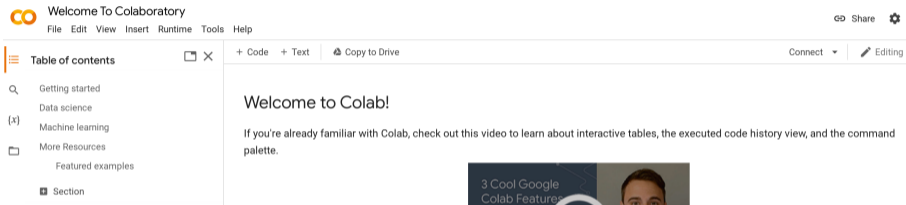
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# Collab



Python in the browser, zero configuration  
Access to GPUs & easy sharing

<https://colab.research.google.com/>

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# Jupyter



## Python in the browser, easy

<https://jupyter.org/>

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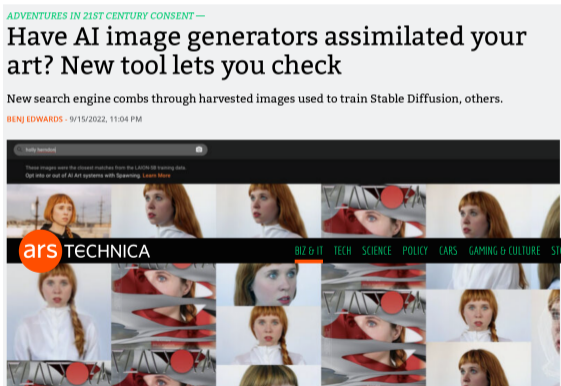
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# Intellectual property (training set)



<https://haveibeentrained.com/>

<https://arstechnica.com/information-technology/2022/09/have-ai-image-generators-as>

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# Intellectual property (results)

Impact of Technology Deep Dive Report I

STUDY ON THE IMPACT OF ARTIFICIAL  
INTELLIGENCE ON THE INFRINGEMENT AND  
ENFORCEMENT OF COPYRIGHT AND DESIGNS

[https://euipo.europa.eu/tunnel-web/secure/webdav/guest/document\\_library/observatory/documents/reports/2022\\_Impact\\_AI\\_on\\_the\\_Infringement\\_and\\_Enforcement\\_CR\\_Designs/2022\\_Impact\\_AI\\_on\\_the\\_Infringement\\_and\\_Enforcement\\_CR\\_Designs\\_FullR\\_en.pdf](https://euipo.europa.eu/tunnel-web/secure/webdav/guest/document_library/observatory/documents/reports/2022_Impact_AI_on_the_Infringement_and_Enforcement_CR_Designs/2022_Impact_AI_on_the_Infringement_and_Enforcement_CR_Designs_FullR_en.pdf)

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# Intellectual property

- Can models be trained on anything public?
- Are models subject to copyright law?
- Who is the author of the production of a model?
- Can anybody besides the author claim rights on the production of a model

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Model	Model License	Description	Link to License
GPT-2	MIT License + generated output disclaimer	Permissive open source license	<a href="https://github.com/openai/gpt-2/blob/master/LICENSE">https://github.com/openai/gpt-2/blob/master/LICENSE</a>
GPT-3	Exclusive	Licensed to	Microsoft
YOLO	YOLO License	Public domain license	<a href="https://github.com/pjreddie/darknet/blob/master/LICENSE">https://github.com/pjreddie/darknet/blob/master/LICENSE</a>
DALLE-pytorch	MIT License	Pytorch implementation of DALLE created by individual researcher	<a href="https://github.com/lucidrains/DALLE-pytorch/blob/main/LICENSE">https://github.com/lucidrains/DALLE-pytorch/blob/main/LICENSE</a>
Stable Diffusion	CreativeML Open RAIL-M	Open & Responsible AI License (RAIL) created by Stability.ai and adapted from the BLOOM RAIL license, including use-based restrictions (see attachment A)	<a href="https://huggingface.co/spaces/CompVis/stable-diffusion-license">https://huggingface.co/spaces/CompVis/stable-diffusion-license</a>
OPT	OPT-175B License	Meta restrictive license enabling use of the model weights for research purposes while establishing a set of use-based restrictions, which could be considered a RAIL	<a href="https://github.com/facebookresearch/metaseq/blob/main/projects/OPT/MODEL_LICENSE.md">https://github.com/facebookresearch/metaseq/blob/main/projects/OPT/MODEL_LICENSE.md</a>
BigScience	BigScience OpenRAIL-M	Open & Responsible AI License (RAIL) created by BigScience and adapted from the BLOOM RAIL license, including use-based restrictions (see attachment A)	<a href="https://huggingface.co/spaces/bigscience/license">https://huggingface.co/spaces/bigscience/license</a>
Tsinghua University	GLM-130B license	Restrictive license enabling use of the model weights for research purposes	<a href="https://github.com/THUDM/GLM-130B/blob/main/MODEL_LICENSE">https://github.com/THUDM/GLM-130B/blob/main/MODEL_LICENSE</a>

## Licenses

<https://hackmd.io/@jending12/HyvMU8sJo><https://thegradient.pub/>[machine-learning-ethics-and-open-source-licensing.com/](https://machine-learning-ethics-and-open-source-licensing.com/)



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# Bias



Mugshot of a technical speaker, machine learning expert, smiling, long hair, big eyes [t-shirt, curly hair]

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# Security



[Privacy](#) [Careers](#) [Disclosure Policy](#) [Technical Advisories](#) [Public Reports](#) [2021 Research Report](#)

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## Whitepaper – Practical Attacks on Machine Learning Systems

Jennifer Fernick

Machine Learning, Offensive Security & Artificial Intelligence, Research, Research Paper, Whitepaper

July 6, 2022 1 Minute

*Written by Chris Anley, Chief Scientist, NCC Group*

<https://research.nccgroup.com/2022/07/06/whitepaper-practical-attacks-on-machine-learning-systems/>  
<https://simonwillison.net/2022/Sep/12/prompt-injection/>

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# Impact on professionals

- No more draw for hire as a profession?
- New opportunities for artists?
- Access to models as a fundamental need?

Is this different from the invention of photography?

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# Prompt engineers

A new profession

Artists, engineers, craftsmen?

Is it here to stay?

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# What is true?

## Make-A-Video

Make-A-Video research builds on the recent progress made in text-to-image generation technology built to enable text-to-video generation. The system uses images with descriptions to learn what the world looks like and how it is often described. It also uses unlabeled videos to learn how the world moves. With this data, Make-A-Video lets you bring your imagination to life by generating whimsical, one-of-a-kind videos with just a few words or lines of text.



<https://makeavideo.studio/>

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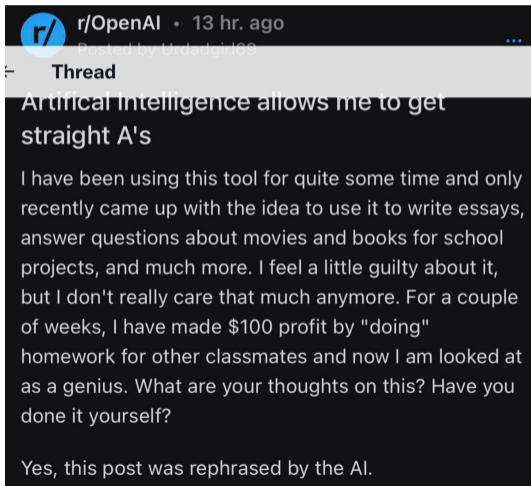
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# Assignments





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# Programming



*[Submitted on 29 Jul 2022 (v1), last revised 30 Sep 2022 (this version, v2)]*

## Language Models Can Teach Themselves to Program Better

Patrick Haluptzok, Matthew Bowers, Adam Tauman Kalai

Recent Language Models (LMs) achieve breakthrough performance in code generation when trained on human-authored problems, even solving some competitive-programming problems. Self-play has proven useful in games such as Go, and thus it is natural to ask whether LMs can generate their own instructive programming problems to improve their performance. We show that it is possible for an LM to synthesize programming problems and solutions, which are filtered for correctness by a Python interpreter. The LM's performance is then seen to improve when it is fine-tuned on its own synthetic problems and verified solutions; thus the model 'improves itself' using the Python interpreter. Problems are specified formally as programming puzzles [Schuster et al., 2021], a code-based problem format where solutions can easily be verified for correctness by execution. In experiments on publicly-available LMs, test accuracy more than doubles. This work demonstrates the potential for code LMs, with an interpreter, to generate instructive problems and improve their own performance.

<https://arxiv.org/abs/2207.14502>

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## Self-Programming Artificial Intelligence Using Code-Generating Language Models

*Anonymous*22 Sept 2022 (modified: 26 Oct 2022) ICLR 2023 Conference Blind Submission Readers:  Everyone Show Bibtex Show Revisions**Keywords:** Self-programming AI, NLP, code generation, AutoML**TL;DR:** We develop and experimentally validate the first practical implementation of a self-reprogramming AI system.**Abstract:** Recent progress in large-scale language models has enabled breakthroughs in previously intractable computer programming tasks. Prior work in meta-learning and neural architecture search has led to substantial successes across various task domains, spawning myriad approaches for algorithmically optimizing the design and learning dynamics of deep learning models. At the intersection of these research areas, we implement a code-generating language model with the ability to modify its own source code. Self-programming AI algorithms have been of interest since the dawn of AI itself. Although various theoretical formulations of generalized self-programming AI have been posed, no such system has been successfully implemented to date under real-world computational constraints. Applying AI-based code generation to AI itself, we develop and experimentally validate the first practical implementation of a self-programming AI system. We empirically show that a self-programming AI implemented using a code generation model can successfully modify its own source code to improve performance and program sub-models to perform auxiliary tasks. Our model can self-modify various properties including model architecture, computational capacity, and learning dynamics.[https:](https://keras.io/examples/generative/random_walks_with_stable_diffusion/)[//keras.io/examples/generative/random\\_walks\\_with\\_stable\\_diffusion/](https://keras.io/examples/generative/random_walks_with_stable_diffusion/)

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# The future just started

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References

- Transformers-Tutorials

<https://github.com/NielsRogge/Transformers-Tutorials>

- Vision Transformers

<https://cameronrwolfe.substack.com/p/vision-transformers>

- A walk through latent space with Stable Diffusion

[https://keras.io/examples/generative/random\\_walks\\_with\\_stable\\_diffusion/](https://keras.io/examples/generative/random_walks_with_stable_diffusion/)

- How Open Source is eating AI

<https://lspace.swyx.io/p/open-source-ai>

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- Awesome Diffusion Models  
<https://github.com/heejkoo/Awesome-Diffusion-Models>
- /r/StableDiffusion at Reddit  
<https://www.reddit.com/r/StableDiffusion>
- The Generative Landscape (WiP course)  
<https://johnwhitaker.github.io/tglcourse/>

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