> How to code yourself into a mess

(& hopefully out again)

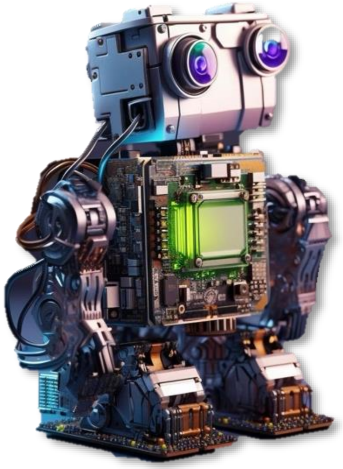
@ Generative AI for Business Researchers
Tuesday 19th Nov 2024

Dr. Gordon McDonald
Informatics Team Lead,
Sydney Informatics Hub

THE UNIVERSITY OF SYDNEY
Sydney Informatics Hub

informatics.sydney.edu.au/

You’re trusting this guy



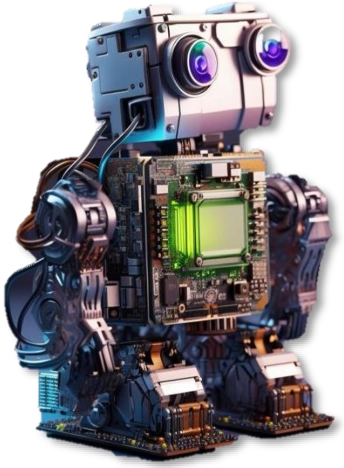
- He’s doing his best
- But mistakes happen.
- Maybe you should pay him more

I want some instant data science

Use an easy interface like ChatGPT, Anthropic…!
(USyd-approved=Copilot)

1. you'll have to pay ~US$20/mo
2. your data and code is going god-knows-where…
   - make sure it's only public data and not private info!
3. ask, be very specific
4. It has limited access to the internet, limited compute, limited file size upload.

sudo make me a sandwich



I want some instant data science that has more compute

Use jupyter-ai !

Jupyter AI

1. jupyter-lab
2. add an API key to OpenAI, Anthropic, DeepSeek or Qwen
3. use jupyter-ai
4. edit your python notebook prolifically

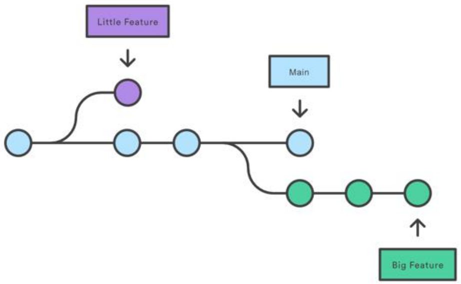
jupyter-ai.readthedocs.io/en/latest/

Ok, my code is getting complicated – multiple files, repository…

Ok, my code is getting complicated – multiple files, repository…

Use aider.chat/ !

1. use git
2. new branch for every feature
3. use aider
4. (opt) in VSCode



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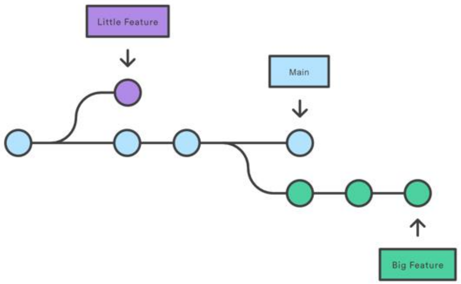
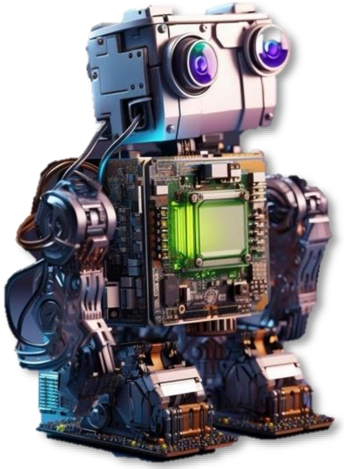


(it will commit every change, use `/undo` if it didn't work)

You’re trusting this guy



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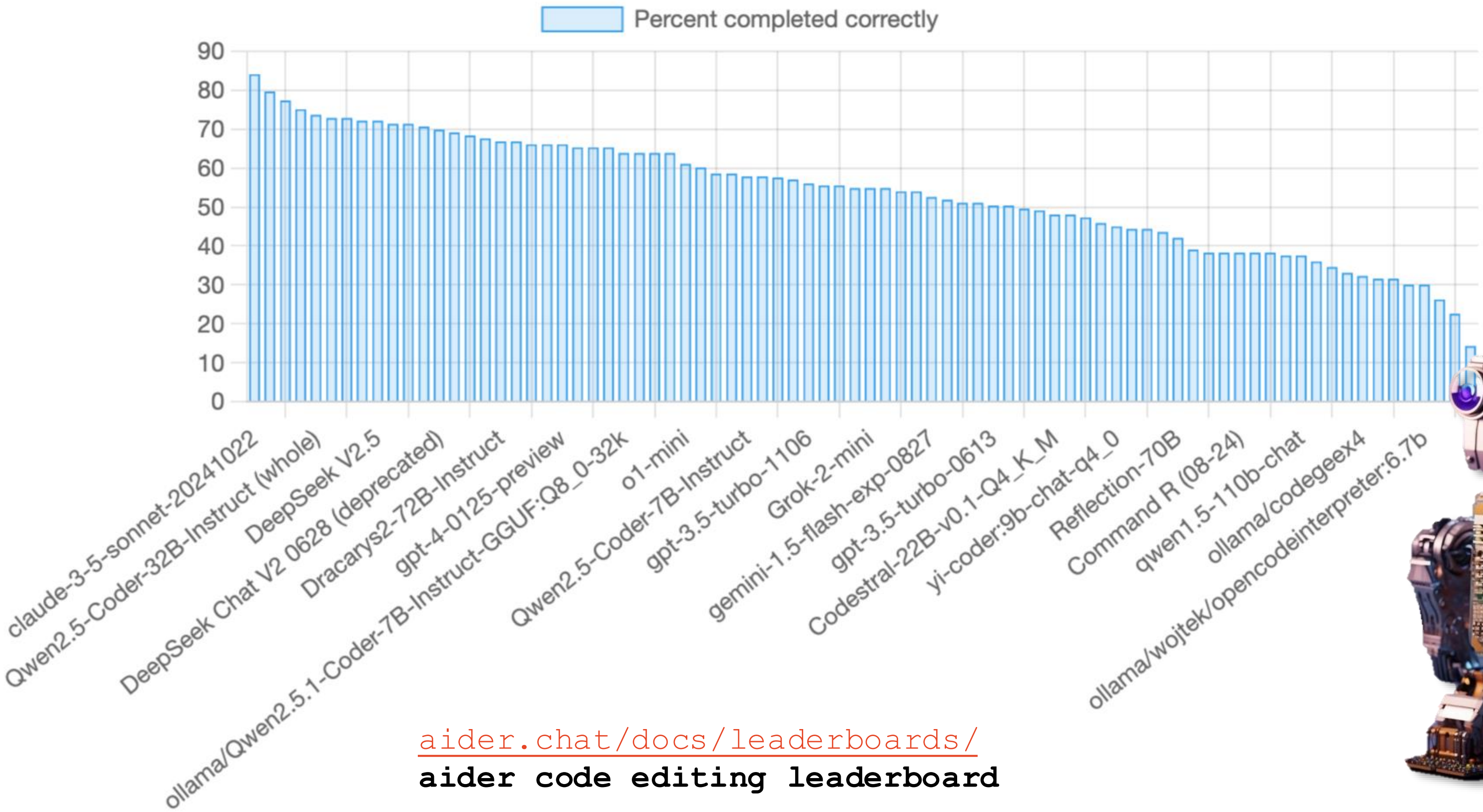
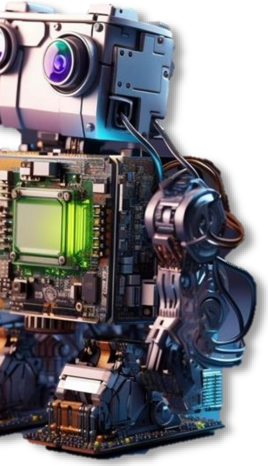
Let’s look in his brain





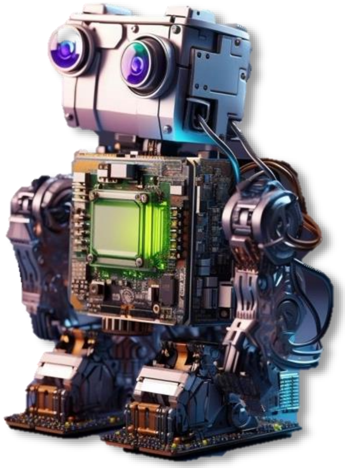
aider.chat/docs/leaderboards/

aider code editing leaderboard

Let’s look in his brain

```
app.py:

print(“hello world”)
```



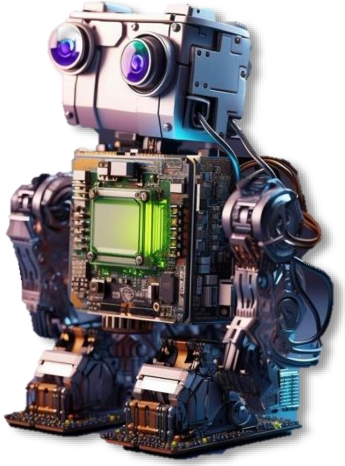
aider.chat/docs/leaderboards/

aider code editing leaderboard

Let’s look in his brain

Refactor DatabaseSchemaEditor.quote_value

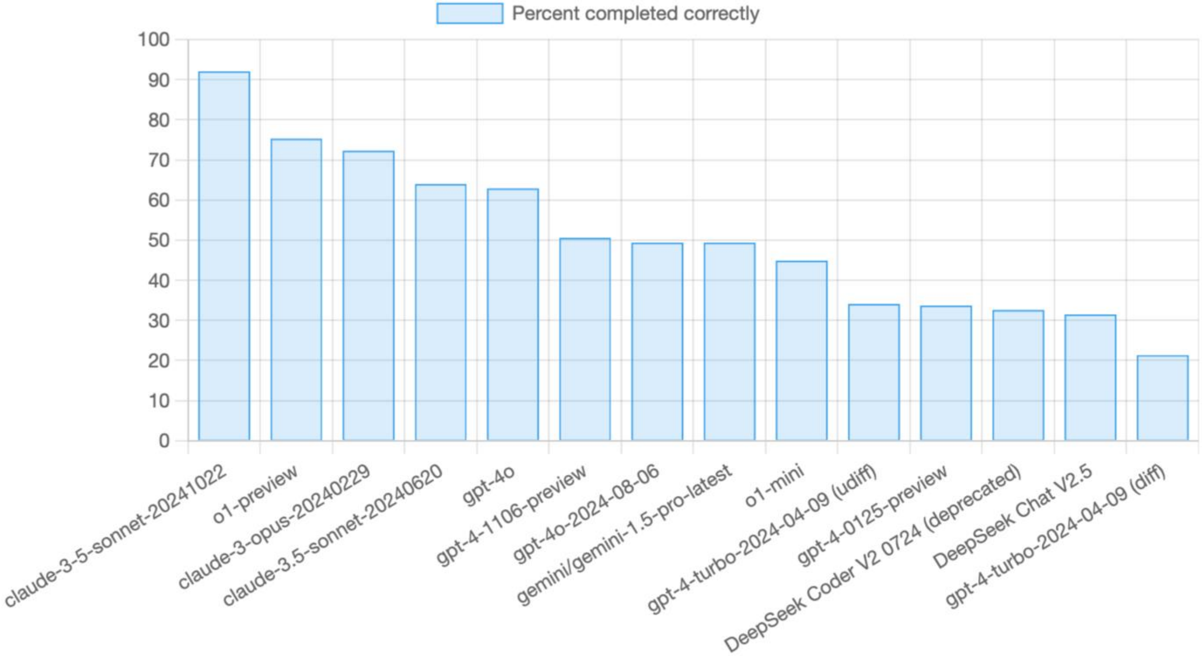
Refactor the `quote_value` method in the `DatabaseSchemaEditor` class to be a stand-alone, top-level function. Name the new function `quote_value`, exactly the same name as the existing method. Update any existing `self.quote_value` calls to work with the new `quote_value` function.

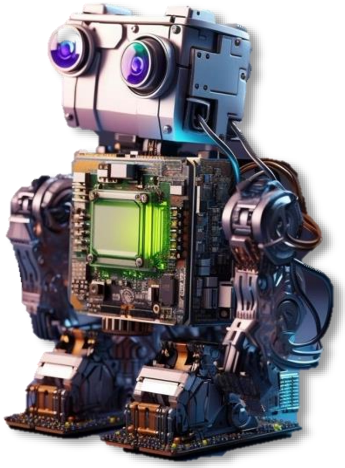


aider.chat/docs/leaderboards/

aider code editing leaderboard

Let’s look in his brain





aider.chat/docs/leaderboards/

aider refactoring leaderboard

Answer

Use

`claude-3-5-sonnet-20241022`

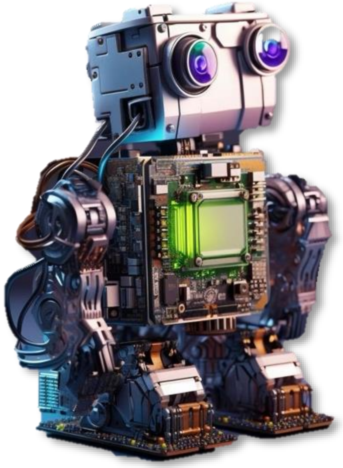
Unless your stuff is private then use

`Qwen2.5-Coder-32B-Instruct`

or

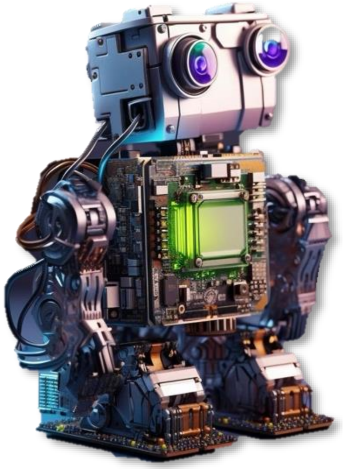
`DeepSeek V2.5`

Top tips



- Be as specific as you can about exactly what you want (or ask it to help you refine)
- make sure private stuff stays private!
- small incremental changes
- test as you go

What’s going to go wrong?



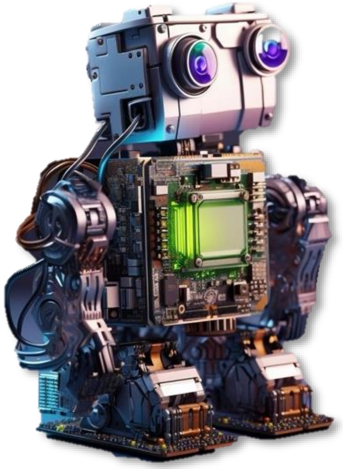
- Spaghetti code – not cohesive and difficult to maintain

- Functions with outputs they didn’t need

- random imports that are different from what it said yesterday / in another file

- over complication

What’s not changing?



- We want to build our ideas, explore our data, understand the world

- We want tools that:
- helps us do this efficiently,
- minimize information overload
- don’t miss critical parts,
- let us be the final judge
- help us make the important decisions, but not the irrelevant ones.

Sydney Informatics Hub

Sydney Informatics Hub is a Core Research Facility within PVC-RI, enabling excellence in computational and data-driven research through advanced digital infrastructure, expert data consultancy and analytics training.

Statistics

Data Science, AI & Software

Research Computing

Bioinformatics

informatics.sydney.edu.au

SIH Training

64 Different offerings, in person, online, and hybrid content in a variety of formats from webinars to interactive workshops.

Attendees at all career levels, from undergraduate students to senior professors, and representation from every Faculty and School.

Partnerships with national organisations like Australian BioCommons: biocommons.org.au/training-cooperative.

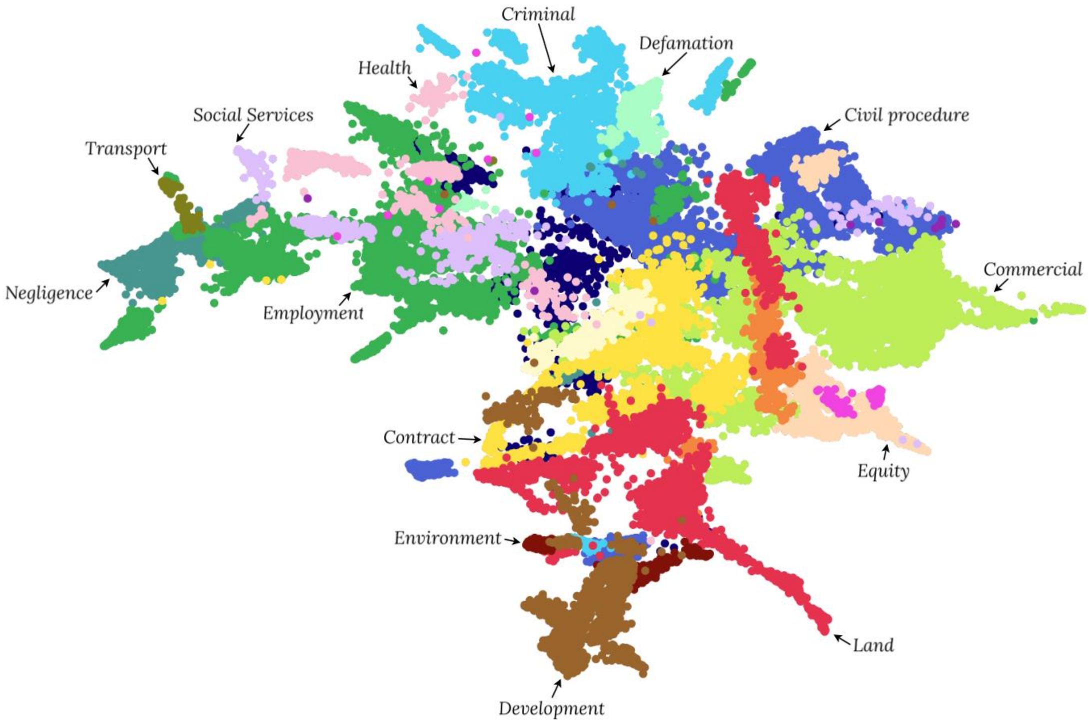
Find out more on our training calendar: sydney.edu.au/informatics-hub/training. Or stay up to date with our newsletter.

sydney.edu.au/informatics-hub/training

Statistics	Data Science	Research Computing	Bioinformatics	Events
Fundamentals	Machine Learning	High Performance Computing	’omics Techniques	Hacky Hour
Modelling	Visualisation	Cloud Computing	Reproducible Pipelines	Summer Schools
Specialist	Natural Language Processing	Containers	Data Analytics	Coding Challenges
	Geospatial Analysis	Workflows	National Compute Infrastructure	

Research examples with AI

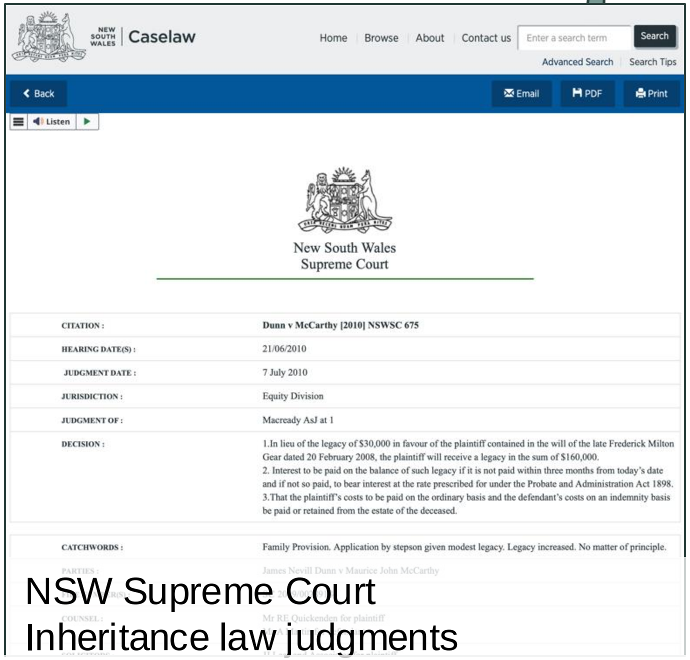
Open Australian Legal Corpus



Blog post: https://umarbutler.com/mapping-almost-every-law-regulation-and-case-in-australia/

Extracting information from text with language models

OpenAI GPT-4o
(May '24)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Enter a search term
Search
Advanced Search | Search Tips
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Email
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New South Wales
Supreme Court

CITATION : Dunn v McCarthy [2010] NSWSC 675

HEARING DATE(S) : 21/06/2010

JUDGMENT DATE : 7 July 2010

JURISDICTION : Equity Division

JUDGMENT OF : Macready AsJ at 1

DECISION : 1.In lieu of the legacy of $30,000 in favour of the plaintiff contained in the will of the late Frederick Milton Gear dated 20 February 2008, the plaintiff will receive a legacy in the sum of $160,000.
2. Interest to be paid on the balance of such legacy if it is not paid within three months from today's date and if not so paid, to bear interest at the rate prescribed for under the Probate and Administration Act 1898.
3.That the plaintiff's costs to be paid on the ordinary basis and the defendant's costs on an indemnity basis be paid or retained from the estate of the deceased.

CATCHWORDS : Family Provision. Application by stepson given modest legacy. Legacy increased. No matter of principle.

PARTIES : James Nevill Dunn v Maurice John McCarthy

COUNSEL : Mr RE Quickenden for plaintiff

NSW Supreme Court
Inheritance law judgments

https://www.caselaw.nsw.gov.au/decision/54a004453004262463c948bc

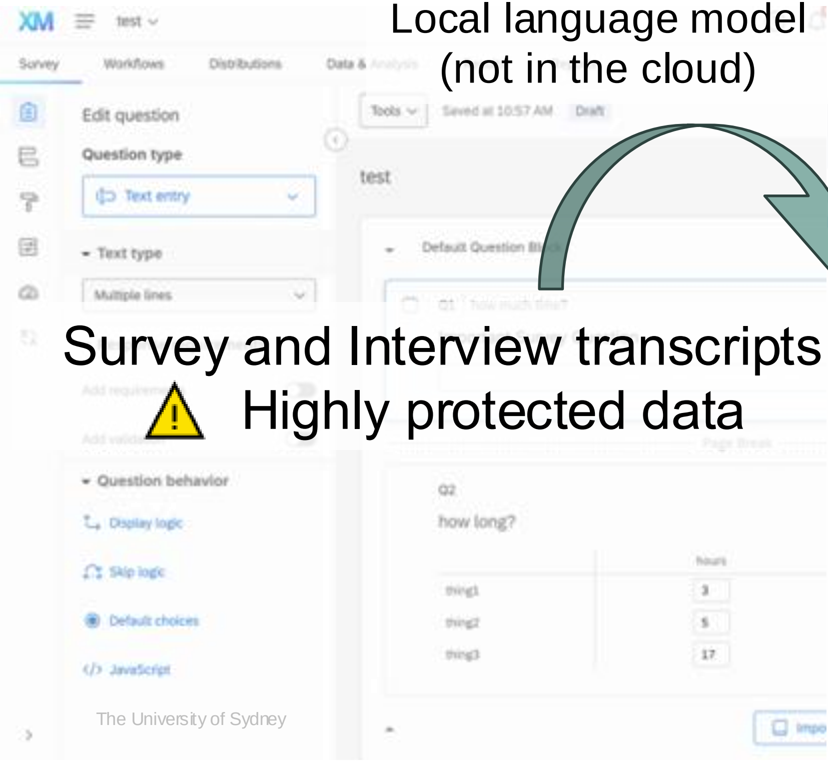
Name	James Nevill Dunn	✓
Role in trial	Plaintiff	✓
Costs	$40,000 (p6)	✓
Natural person?	true	✓
Relationship to deceased	stepson (p1)	✓
Was dependent on deceased?	partly dependent (p32)	✓
Alleged misconduct?	false	✓
Estranged from deceased?	briefly estranged ~~due to a misunderstanding~~ (p43)	✓ ✗
Financial circumstances	receives a pension of $520 per fortnight, wife earns $800 per fortnight, owns a house with a $15,000 mortgage (p39-40)	✓

Inheritance Case Law – Dr. Ben Chen
SIH: Mike Lynch, Xinwei Luo

Semantic search on private data

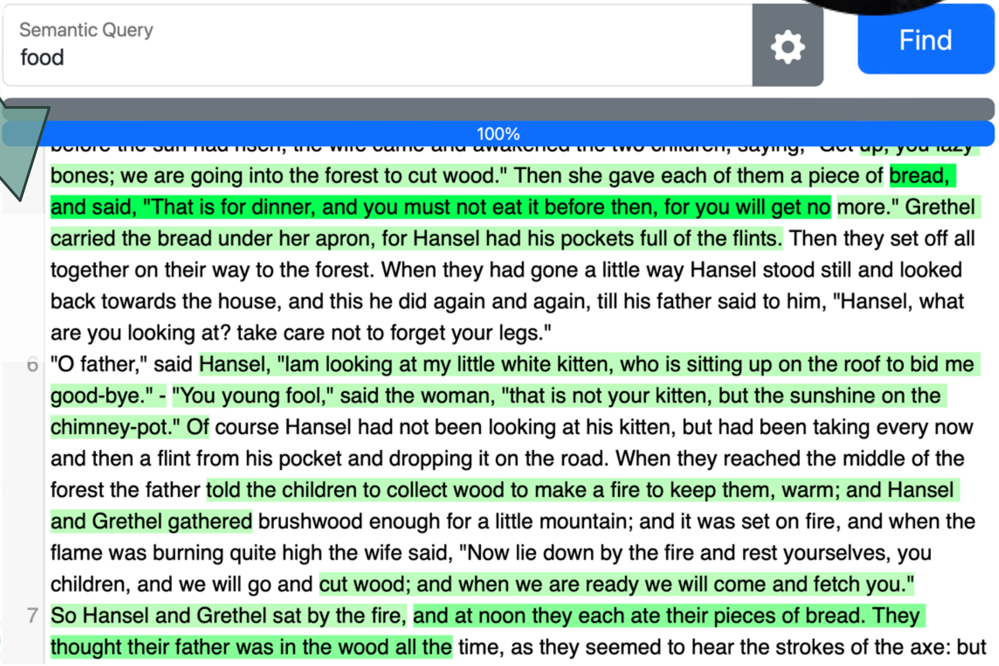
Digital Criminal Justice Project–
Dr. Carolyn McKay

SIH: Nathaniel Butterworth,
Gordon McDonald, Marius Mather
bit.ly/sih_search



Local language model
(not in the cloud)

Survey and Interview transcripts
⚠ Highly protected data



before the sun had risen, the wife came and awakened the two children, saying, "Get up, you lazy bones; we are going into the forest to cut wood." Then she gave each of them a piece of bread, and said, "That is for dinner, and you must not eat it before then, for you will get no more." Grethel carried the bread under her apron, for Hansel had his pockets full of the flints. Then they set off all together on their way to the forest. When they had gone a little way Hansel stood still and looked back towards the house, and this he did again and again, till his father said to him, "Hansel, what are you looking at? take care not to forget your legs."

6 "O father," said Hansel, "Iam looking at my little white kitten, who is sitting up on the roof to bid me good-bye." - "You young fool," said the woman, "that is not your kitten, but the sunshine on the chimney-pot." Of course Hansel had not been looking at his kitten, but had been taking every now and then a flint from his pocket and dropping it on the road. When they reached the middle of the forest the father told the children to collect wood to make a fire to keep them, warm; and Hansel and Grethel gathered brushwood enough for a little mountain; and it was set on fire, and when the flame was burning quite high the wife said, "Now lie down by the fire and rest yourselves, you children, and we will go and cut wood; and when we are ready we will come and fetch you."

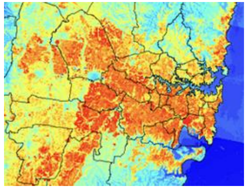
7 So Hansel and Grethel sat by the fire, and at noon they each ate their pieces of bread. They thought their father was in the wood all the time, as they seemed to hear the strokes of the axe: but

Understanding cities with computer vision

Prof. Ben Eggleton, NSW Smart Sensing, SIH: Henry Lydecker, Sahand Vahidnia, Thomas Mauch, Xinwei Luo

NSSN
NSW Smart Sensing Network

Urban Heat ML Model



Geospatial Features

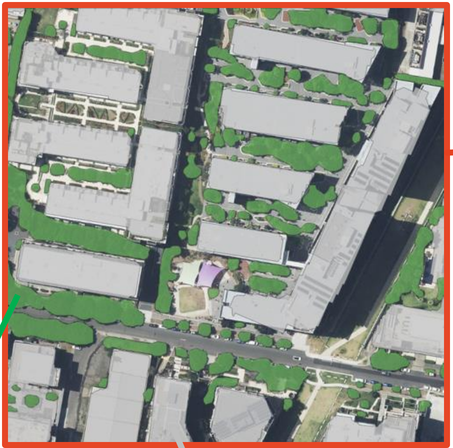
Local Climate Zone = “2: Compact Midrise”

(49% class confidence)

Input Image

RGB Visual Light
Satellite Imagery
Aerial Imagery (Best)

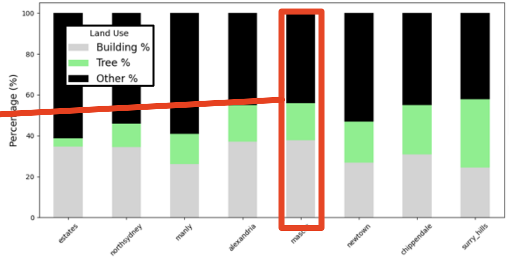
Computer Vision



bit.ly/aigis

Insights, ML, Analysis

Compare neighborhoods

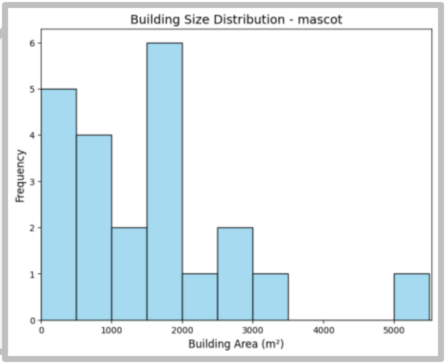


Tree Patches

- 101 tree patches
- 15% coverage

Building Outlines

- 22 buildings
- 38% coverage
- building footprint area distribution



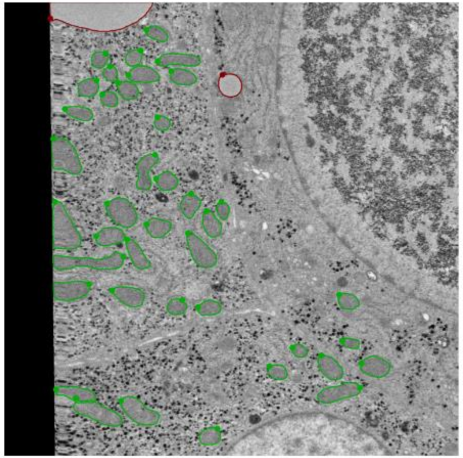
MICROSCOPY AUSTRALIA

Speeding up microscopy data processing

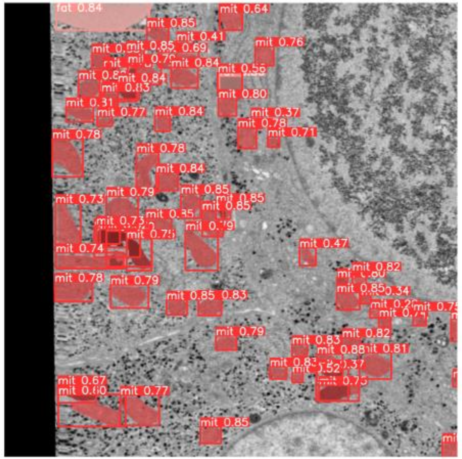
SIH: Sebastian Haan, Nathaniel Butterworth

bit.ly/sih-micro

Ground Truth



Model Prediction



Key highlights

- Sped up annotation process by up to 10x existing approaches
- Full technology review of existing solutions with best practice solutions provided to clients
- Strategic collaboration between SIH and SMM

Sydney Microscopy & Microanalysis collects immense amounts of data at the micro, nano, & atomic scales. We developed AI pipelines to speed up cell segmentation in electron microscopy images, automating 3D cell tomography.

SMM: Gerry Shami, Chad Moore, Andre Venne, Eleanor Kable, Prof. Filip Braet

Australian Text Analytics Platform

Text analysis tools for all researchers

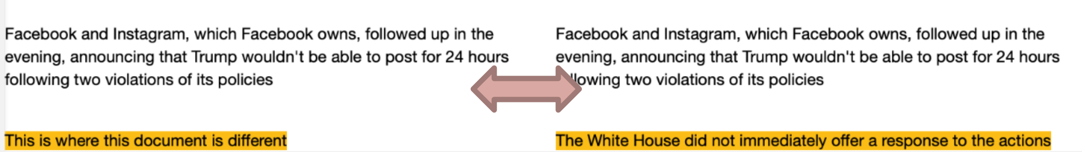
atap australian text analytics platform atap.edu.au

www.atap.edu.au

Some tools on the platform:

Document and corpus similarity tool

- Compare differences between documents, e.g. to eliminate near-duplicates.



Facebook and Instagram, which Facebook owns, followed up in the evening, announcing that Trump wouldn't be able to post for 24 hours following two violations of its policies

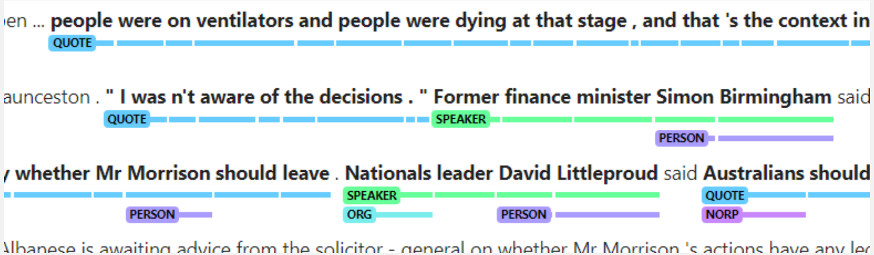
This is where this document is different

Facebook and Instagram, which Facebook owns, followed up in the evening, announcing that Trump wouldn't be able to post for 24 hours llowing two violations of its policies

The White House did not immediately offer a response to the actions

Quotation tool and semantic tagging

- Extract quotes from text e.g. news articles
- www.atap.edu.au/posts/quotation-tool/



en ... people were on ventilators and people were dying at that stage , and that 's the context in

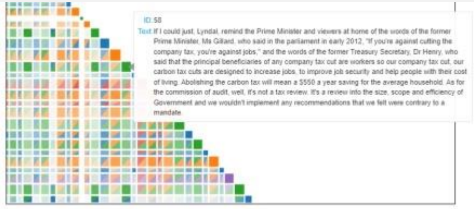
aunceston . " I was n't aware of the decisions . " Former finance minister Simon Birmingham said

whether Mr Morrison should leave . Nationals leader David Littleproud said Australians should

lbanese is awaiting advice from the solicitor - general on whether Mr Morrison 's actions have any le

Discursis

- An analysis and visualisation tool for conversational data
  www.atap.edu.au/posts/discursis/



ID: 58

Text: If I could just, Lyndal, remind the Prime Minister and viewers at home of the words of the former Prime Minister, Ms Gillard, who said in the parliament in early 2012, "If you're against cutting the company tax, you're against jobs," and the words of the former Treasury Secretary, Dr Henry, who said that the principal beneficiaries of any company tax cut are workers so our company tax cut, our carbon tax cuts are designed to increase jobs, to improve job security and help people with their cost of living. Abolishing the carbon tax will mean a $550 a year saving for the average household. As for the commission of audit, well, it's not a tax review. It's a review into the size, scope and efficiency of Government and we wouldn't implement any recommendations that we felt were contrary to a mandate

Linguistics: Prof. Monika Bendarek
SIH: Dr. Chao Sun, Hamish Croser, Jack Chan, Sony Jufri

Australian Research Data Commons

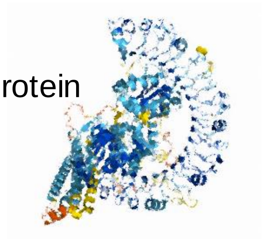
Generative X

Drug discovery

Design your own chemicals

Biology

Design your own protein
synthetic biology

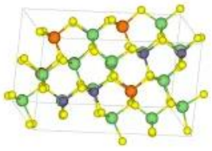


Manufacturing

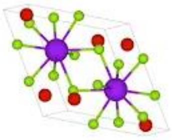
Design me a diffraction grating / micro resonator / widget with these properties…

Material discovery

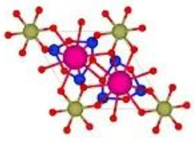
AI mineral discovery and autonomous material synthesis



$Li_4MgGe_2S_7$



KV_3SE_3



$Rb_2HfSi_3O_9$

Source: https://deepmind.google/discover/blog/millions-of-new-materials-discovered-with-deep-learning/

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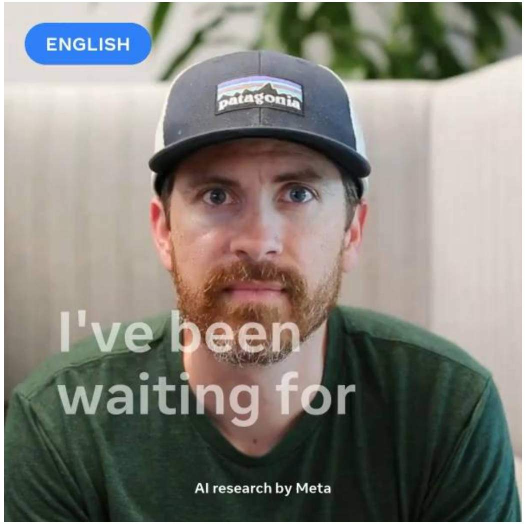
Some Tools and Platforms

Audio

Translate audio between different languages, keeping your tone of voice
https://seamless.metademolab.com/expressive

Generate Speech
https://elevenlabs.io

Generate Music
https://suno.com



On-device video transcription

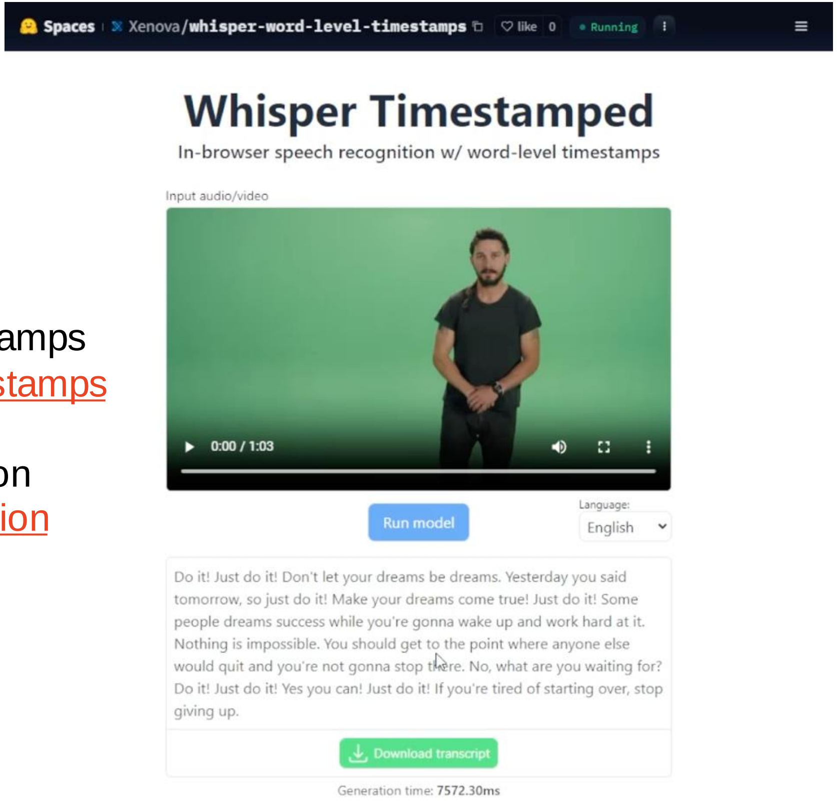
If you’re on a mac
sindresorhus.com/aiko

Data and model runs in your browser – word level timestamps
huggingface.co/spaces/Xenova/whisper-word-level-timestamps

Data and model runs in your browser – speaker diarization
huggingface.co/spaces/Xenova/whisper-speaker-diarization

If you’re ok with code and installs
github.com/ggerganov/whisper.cpp

(Not on device) Sharepoint automatic video transcription



Whisper Timestamped

In-browser speech recognition w/ word-level timestamps

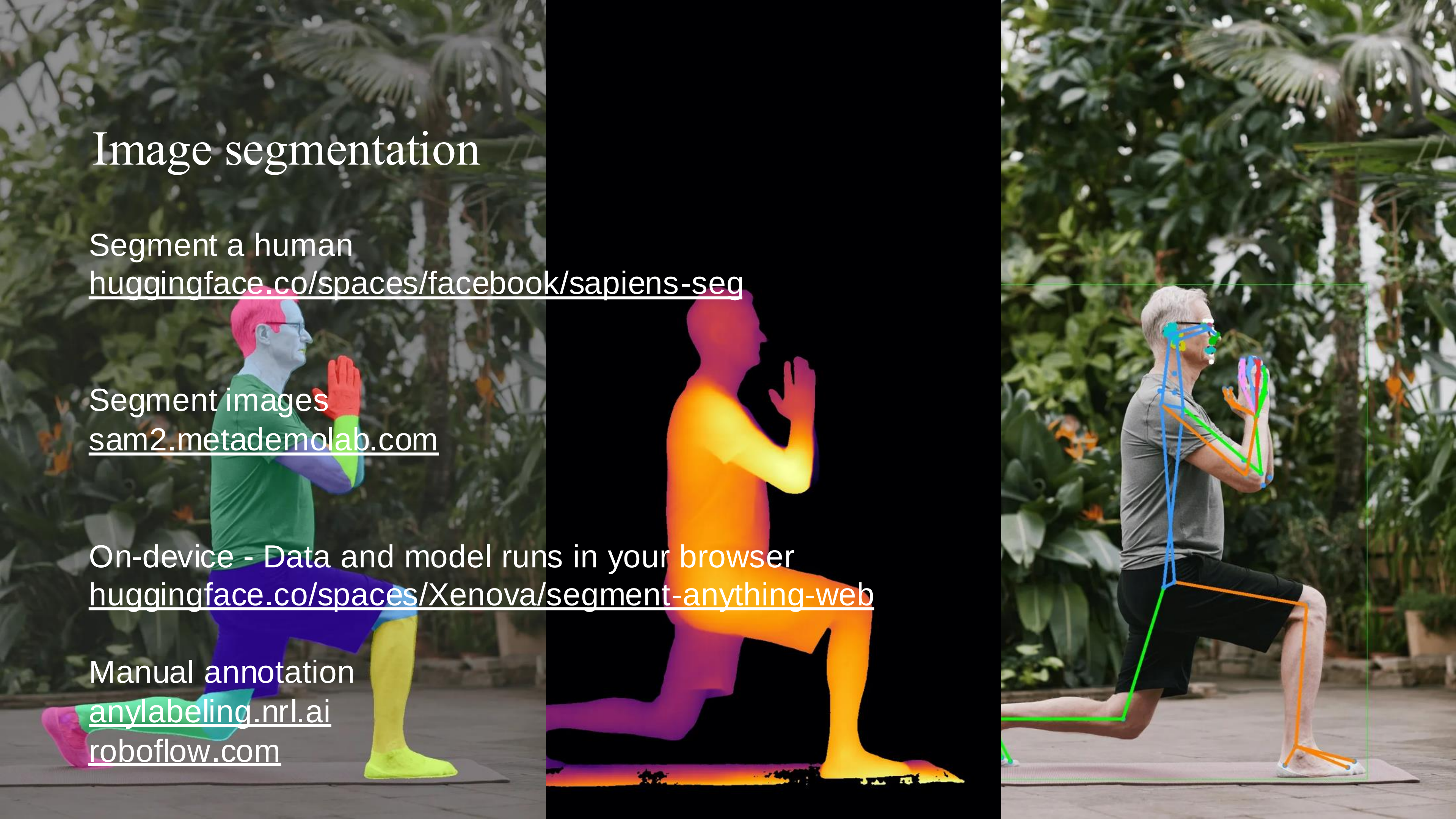
Input audio/video

Language: English

Do it! Just do it! Don't let your dreams be dreams. Yesterday you said tomorrow, so just do it! Make your dreams come true! Just do it! Some people dreams success while you're gonna wake up and work hard at it. Nothing is impossible. You should get to the point where anyone else would quit and you're not gonna stop there. No, what are you waiting for? Do it! Just do it! Yes you can! Just do it! If you're tired of starting over, stop giving up.

Generation time: 7572.30ms

Image segmentation



Segment a human
huggingface.co/spaces/facebook/sapiens-seg

Segment images
sam2.metademolab.com

On-device - Data and model runs in your browser
huggingface.co/spaces/Xenova/segment-anything-web

Manual annotation
anylabeling.nrl.ai
roboflow.com

Platforms & Tools

- Huggingface – Open & free tools for AI proof of concepts
- Papers with code – compare state of the art models' performance
- Colab – free Jupyter notebook interface from Google
- Weights & Biases – Model training and evaluation diagnostics
- Roboflow – Very easy to use dataset utilities
- PaddlePaddle - frameworks for AI use cases

Literature Search

Research Rabbit – free for researchers, operates on donation model
Elicit free trial, then $10/month
Rayyan $8/month researcher, $4/month student
Scite Free trial then $13-$22/month
SciSpace
Scopus-AI

Coding assistance

Free (ish)

- Aider
- Jupyter-AI
- Open Interpreter
- MetaGPT
- Copilot

Paid

- ChatGPT
- Github Copilot

Best language models to use with these tools now (10-09-24):

- claude-3.5-sonnet (via API)
- gpt-4o (via API)
- DeepSeek 2.5 (via API)
- Local models? (none of them are quite good enough yet to be useful) ☹

Agent building

Agents
to reduce
time to science

Free (ish)

Cogniti

Flowise

MetaGPT

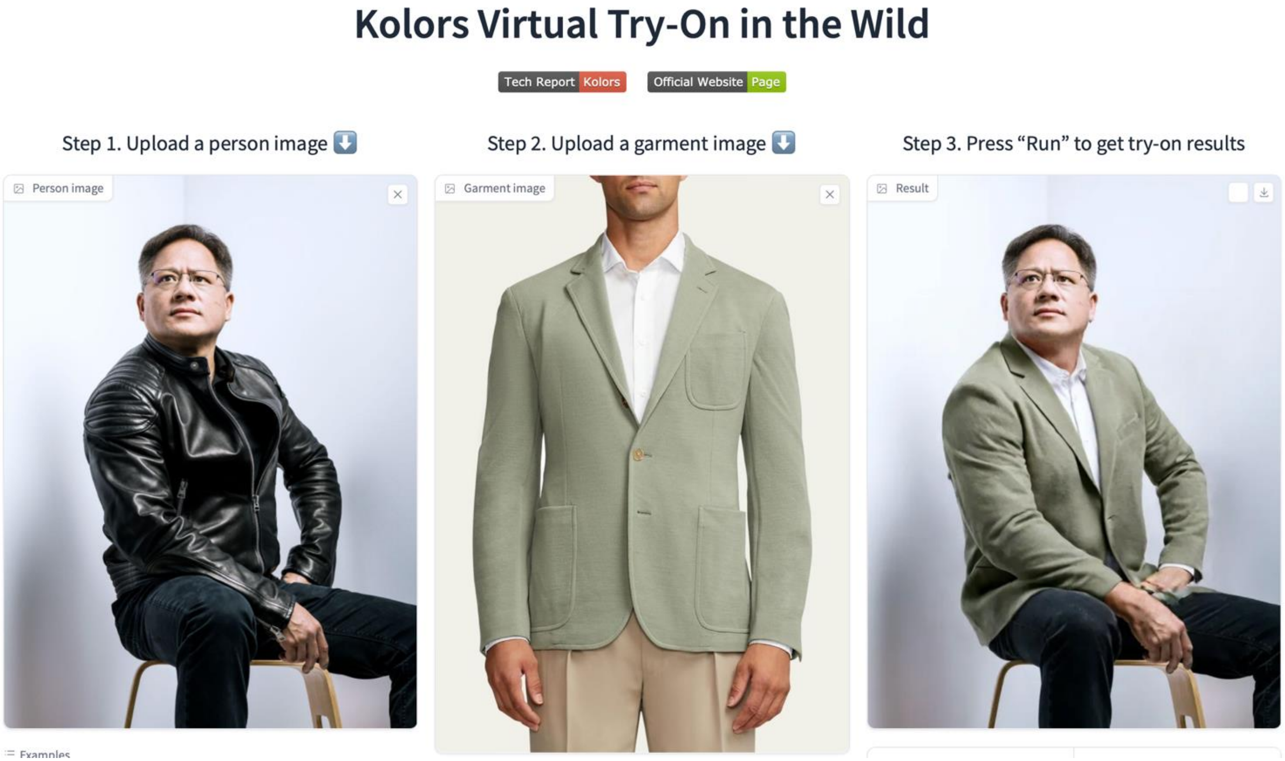
Paid

ChatGPT Custom GPTs

Azure Promptflow

Try on virtual clothes!

To find more new models as they are released:
https://huggingface.co/spaces



Kolors Virtual Try-On in the Wild

Tech Report Kolors | Official Website Page

Step 1. Upload a person image ⬇️

Step 2. Upload a garment image ⬇️

Step 3. Press “Run” to get try-on results

https://huggingface.co/spaces/Kwai-Kolors/Kolors-Virtual-Try-On

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