

Agentic AI and its Applications in 2026

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October 16, 2026

University of Alaska Fairbanks

Talk Overview

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- Applications (live demos):
 - Update worksheet files on this laptop and replace hand-drawn figures.
 - Custom tool: query Alaska Earthquake center.
 - Agentic coding example(s).
 - Banner database query.

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- Demo: toy model of an agentic system.
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 - Custom tool: query Alaska Earthquake center.
 - Agentic coding example(s).
 - Banner database query.
- Examples of other real-world uses.
- Questions and discussion (I hope!)

Tokens

Input text is broken into a sequence of tokens:

Can	adians	are	friendly	and	approach	able	.
-----	--------	-----	----------	-----	----------	------	---

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-----	--------	-----	----------	-----	----------	------	---

Tokens are represented by small integers:

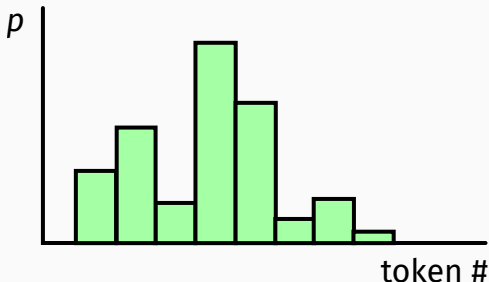
6854	21398	527	11919	323	5603	481	13
------	-------	-----	-------	-----	------	-----	----

The basic function

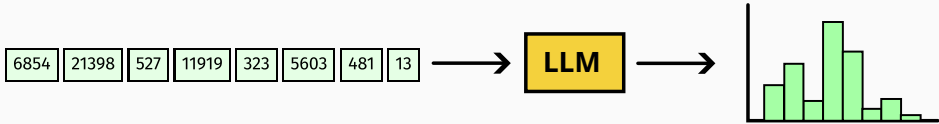
An LLM is a function, depending on a very large number of numerical parameters.

Input: A sequence of tokens (the **context window**). Modern limits: $\approx 1\text{M}$ tokens.

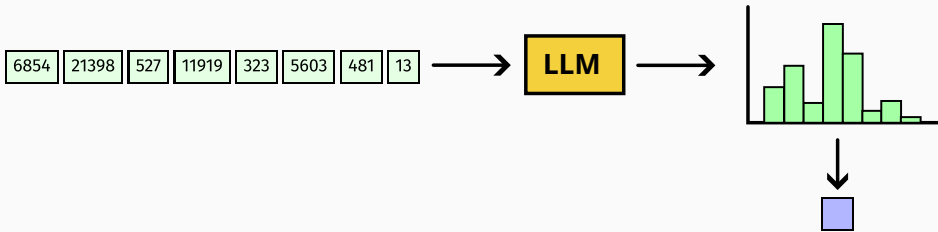
Output: A probability distribution over tokens.



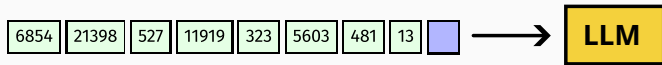
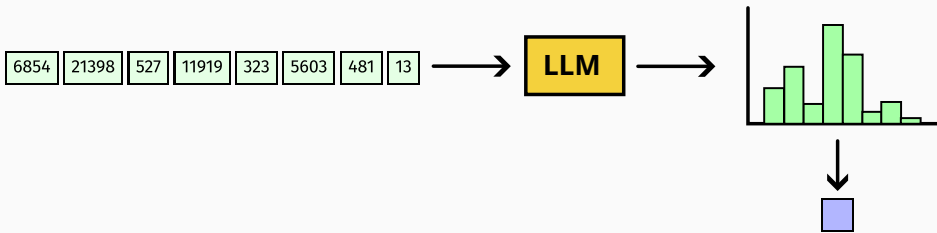
The Iteration



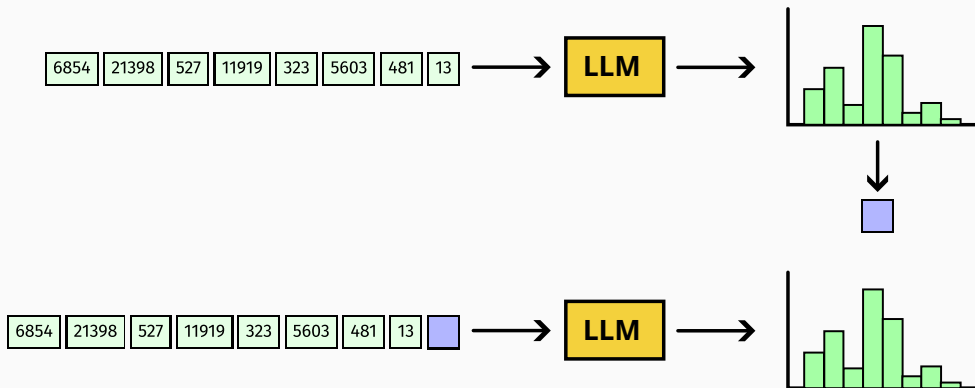
The Iteration



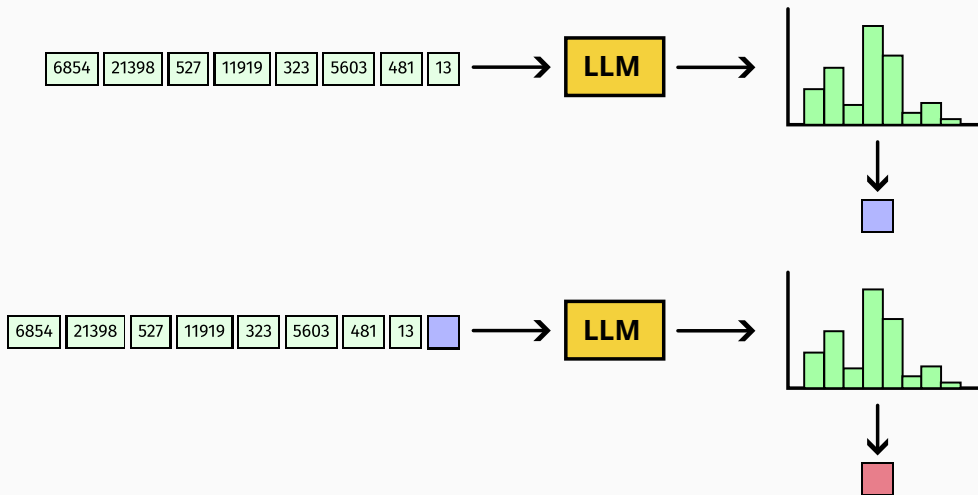
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The Iteration



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- LLMs have no **persistent** state except for:
 - The fixed model parameters (i.e. 'coefficients' or 'weights' learned during training)
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Tool Calls

A modern LLM has a notion of **calling a tool**.

Hi! Could you please tell me the time?

Checked the current time >

It's 11:56 AM (Alaska time) on Saturday, October 10, 2026.

     1 minute ago

Tool Calls

A modern LLM has a notion of **calling a tool**.

Hi! Could you please tell me the time?

Checked the current time ▾

Response

Current time 2026-10-10T11:56:17.374375-08:00

It's 11:56 AM (Alaska time) on Saturday, October 10, 2026.

     5 minutes ago

Taking Turns

Usual turn order:

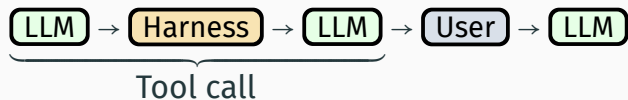


Taking Turns

Usual turn order:



Turn order with a tool call:



A Tool Call, Up Close

LLM

I'd be happy to check the time for you.

```
<function_calls>  
  <invoke name="current_time">  
    </invoke>  
</function_calls>
```

A Tool Call, Up Close

LLM

I'd be happy to check the time for you.

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  <invoke name="current_time">
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</function_calls>
```

→

Harness

```
<function_results>
  {"current_time":
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</function_results>
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I'd be happy to check the time for you.

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LLM

It's 11:56AM (Alaska time) on Saturday, October 10, 2026.

Tool Call Parameters

The Anthropic harness allows for calls to a sandboxed bash shell.

Hi! Could you please use your bash shell to issue a `date` command?

Show current date and time >

Here's the output:

```
Sat Oct 10 13:18:03 AKDT 2026
```

It's Saturday, October 10, 2026, a little after 1:18 PM Alaska Daylight Time. The workspace clock is set to your local time zone.

Tool Call Parameters

The Anthropic harness allows for calls to a sandboxed bash shell.

Hi! Could you please use your bash shell to issue a `date` command?

Show current date and time ▾

Request

`date`

Response

Sat Oct 10 13:18:03 AKDT 2026

Here's the output:

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A Bash Tool Call (with Parameters)

LLM

```
<function_calls>
  <invoke name="Bash">
    <parameter name="command">
      date
    </parameter>
    <parameter name="description">
      Show current date and time
    </parameter>
  </invoke>
</function_calls>
```

A Bash Tool Call (with Parameters)

LLM

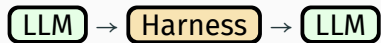
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Harness

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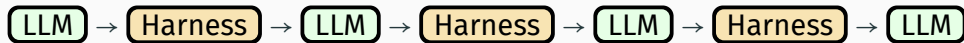
Agency ~ Many Tool Calls in Succession



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Christmas Project 2024: Interactive Fiction Claude

Interactive fiction: text-only games from the 70s-90s.

A bit like “chose your own adventure”.

- Goal: learn more about how LLMs work.
- Had learned about tool calls.
- With Claude's help, built a web app wiring up Claude to play IF games on its own via custom tools.
- I accidentally built an agent.

Demo Zork

West of House

Score: 0 Turns: 2

ZORK I: The Great Underground Empire
Copyright (c) 1981, 1982, 1983 Infocom, Inc. All rights reserved.
ZORK is a registered trademark of Infocom, Inc.
Revision 88 / Serial number 840726

West of House

You are standing in an open field west of a white house, with a boarded front door.
There is a small mailbox here.

open mailbox

Opening the small mailbox reveals a leaflet.

read leaflet

(Taken)
"WELCOME TO ZORK!

ZORK is a game of adventure, danger, and low cunning. In it you will explore some of the most amazing territory ever seen by mortals. No computer should be without one!"

Demo Claude Plays Zork

Hi there! This is a demonstration during a talk on agentic AI to a mixed community at the University of Alaska Fairbanks. Please say hi to everybody! And then please tell everyone the two tools that are available to you.

Demo Claude Plays Zork

☰ Interactive Fiction Claude - Zork

West of House

Score: 5 Turns: 10

Hi there! This is a demonstration during a talk on agentic AI to a mixed community at the University of Alaska Fairbanks. Please say hi to everybody! And then please tell everyone the two tools that are available to you.

Hi everyone at the University of Alaska Fairbanks! 🙌 What a cool setting for a talk on agentic AI — hello to all of you, whether you're a computer scientist, a humanist, a student, or just someone curious about where AI is heading!

I'm Claude, made by Anthropic, and I've been set up here to play a classic 1980s-style text adventure game as a demonstration of agentic AI behavior. The idea is that you can watch me reason, make decisions, and interact with a game world — all in real time.

I have exactly **two tools** available to me:

1. 🎮 **start_game** — This initializes the text adventure game. I have to call this before I can do anything else in the game world. It takes no parameters — it's just a "press start" button.
2. 📝 **game_command** — This lets me send text commands into the running game, just like a player typing at a keyboard in 1982. Things like 'go north', 'take lamp', 'look around', etc. It takes a single parameter: the command string I want to send.

That's my whole toolkit! No search engine, no calculator, no memory store — just those two functions and my own reasoning. The interesting part (I hope!) is watching *how* I use them — what I decide to do, how I think through problems, and how I handle the unexpected.

Shall I fire up the game? 🧑

Demo Claude Plays Zork

☰ Interactive Fiction Claude - Zork

West of House

Score: 5 Turns: 10

go north

North of House

You are facing the north side of a white house. There is no door here, and all the windows are boarded up. To the north a narrow path winds through the trees.

go north

Forest Path

This is a path winding through a dimly lit forest. The path heads north-south here. One particularly large tree with some low branches stands at the edge of the path.

<thinking>

There's the tree! I should climb it to find the egg.

</thinking>

There's the tree! 🌳

climb tree

Up a Tree

Easter Egg Demo

Hi there. You are participating in a public talk on uses of agentic AI. I'm a math professor and you are talking to a general community of professors and students, many of whom have not seen the capabilities of Claude Code firsthand.

This demo is going to be very silly. First, lets go work out on a branch ``demo-feature-nanook`` so that we don't contaminate the project with this silliness. Then please look at ``CLAUDE.md`` and give a brief summary of the purpose of this repo for the audience.

Easter Egg Demo

There is a file in the current directory, 0824_Black_Standing_Bear_Right_Facing_CMYK.pdf. It contains a simple vector outline of one of my school's logos. What we are going to do is add an easter egg character to the font in the private use section. The glyph will be the outline, which you should be able to extract out of the PDF. When the package is loaded, the character should be accessed by \nanook. Please make it so!

Worksheet Upgrade Demo

Background

- I have a collection of ($\text{\LaTeX}$) worksheets for a class.
- They need to be made screen reader ADA accessible.
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Sandbox.

Goal

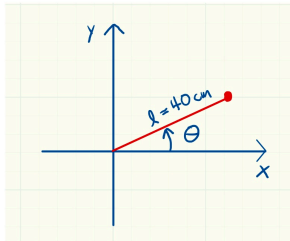
- Based on a template I worked out for the first worksheet, update another.

Worksheet Upgrade Demo

ES/MATH F186: Chapter 6 Groupwork

October 8, 2024

1. The one-link robot depicted in the diagram below has an arm length of 40cm. At time $t = 0$ seconds it is positioned with its arm at $\theta = \pi/8$ radians, and it is rotating counterclockwise. It takes 0.8 seconds for the arm to complete a revolution.



- a. Find the amplitude, frequency, angular frequency, and period of the motion.
- b. Find the phase angle and the time shift (relative to $\sin$).
- c. Determine $y(t)$, the y -coordinate of the tip of the arm as a function of t .
- d. Plot $y(t)$.
- e. Determine the first time $t > 0$ where $y(t) = 0$.

Worksheet Upgrade Demo

Hi there! You are participating in a demo during a public talk on agentic AI to a mixed community at the University of Alaska Fairbanks. Can you begin by greeting the audience of faculty and community members at UAF? Then please look around the current folder and tell me what you see.

Worksheet Upgrade Demo

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Go ahead and perform the conversion. You'll find that you are unable to find a copy of lualatex in your sandbox that is current enough to work with my files. You also won't have the OpenType fonts. Just shim, and I'll be able to run lualatex on my end once you are done. Oh, and please update the date to `Fall 2026`

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- MCP servers can run locally on your computer or in the cloud.
- Write a tool once; any MCP-aware app can use it.
- Adopted by OpenAI within ~4 months, then Google and Microsoft; now governed by the Linux Foundation.

Alaska Earthquake MCP Server

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Claude and I wrote a MCP-based tool for making these queries:

- Network access: without a tool, Claude can't access the network.
- Discovery: Claude knows it has a earthquake tool.
- Documentation: Claude can choose to load the tool and read its documentation.
- Server runs locally within Claude Desktop.
- Server is a single short Python file.

Alaska Earthquake MCP Server Demo

Hi there. Could you please tell me about any earthquakes near Fairbanks in the last 24 hours?

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Could you please tell me about the tool you used to learn this information.

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Hi there. Could you please tell me about any earthquakes near Fairbanks in the last 24 hours?

Could you please tell me about the tool you used to learn this information.

Could you visualize them by putting markers on a map of the region near Fairbanks?

Alaska Earthquake MCP Server Demo

Hi there. Could you please tell me about any earthquakes near Fairbanks in the last 24 hours?

Alaska earthquake: Query earthquakes >

It's been a quiet day. The Alaska Earthquake Center recorded **9 small earthquakes** within about 70 miles of Fairbanks in the past 24 hours. All were magnitude 1.2-1.4, far too small to feel.

Time (AKDT)	Mag	Depth	Location relative to Fairbanks
Today 9:54 AM	1.2	8 km	~30 mi E
Today 8:50 AM	1.4	5 km	~48 mi NW
Today 8:24 AM	1.3	11 km	~28 mi W
Today 7:46 AM	1.4	5 km	~24 mi NE
Today 6:22 AM	1.4	3 km	~39 mi W

Alaska Earthquake MCP Server Demo

Could you visualize them by putting markers on a map of the region near Fairbanks?

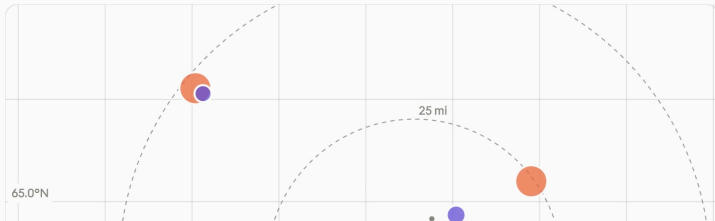
Thought for 10s ▾

Building an interactive map with Leaflet for visualization.

Building an interactive map within tile-server restrictions.

Here's a map of the nine events, plotted around Fairbanks with distance rings. Larger circles mean larger magnitude; hover a marker for details.

● Today (Sun) ● Saturday ◇ Fairbanks Rings: 25 and 50 mi



Heart of Earthquake MCP Server

MCP Server

```
@mcp.tool()
def query_earthquakes(
    starttime: str, endtime: str, latitude: float, longitude: float, maxradius: float
) -> str:
    """Query the Alaska Earthquake Center FDSN catalog and return a JSON list of events.

    Each event includes: id, description, time, latitude, longitude, depth_m, magnitude,
    and magnitude_type.

    Args:
        starttime: Start of time window in ISO 8601 format (e.g. 2026-03-01T00:00:00)
        endtime: End of time window in ISO 8601 format (e.g. 2026-04-01T00:00:00)
        latitude: Center latitude for radius search (decimal degrees)
        longitude: Center longitude for radius search (decimal degrees)
        maxradius: Maximum radius from center point (decimal degrees)
    """
    params = {"starttime": starttime, "endtime": endtime, "latitude": latitude,
              "longitude": longitude, "maxradius": maxradius, "nodata": "404",}

    response = httpx.get(FDSN_BASE, params=params, timeout=30)
    response.raise_for_status()
    events = _parse_quakeml(response.text)
    return json.dumps(events, indent=2)
```

Coding: Minion Math Font

- I use a specialized math font based on Adobe's Minion (packages `MinionPro` and `MnSymbol`).
- Royal hassle to install (bring proprietary font, build and install a gazillion files).
- Legacy $\text{\TeX}$ font system.
- Modern Unicode math fonts can be used by `xelatex` and `lualatex`.

Project goal: BYO Minion font and build a single Unicode math font that is a drop-in replacement for `MinionPro/MnSymbol`.

Computer Modern

This is a list of statements to be proven, with notation fixed and no derivations. “Verified” means checked by symbolic/numerical computation (scripts in `numerics/`); nothing below has a proof. Throughout $n = 3$ unless stated otherwise, and the overall factor $\frac{1}{2\kappa} = \frac{1}{16\pi}$ is dropped from the action, so every charge below is 16π times the physical one.

1 Setting

1.1 Fields

M^{n+1} is the spacetime manifold; $E \rightarrow M$ a vector bundle with $SO(1, n)$ structure, fiber metric η_{AB} , alternating symbol $\epsilon_{A_0 \dots A_n}$ with $\epsilon_{01 \dots n} = 1$. A configuration is a pair $(\mathcal{D}, e)$: a metric connection $\mathcal{D}$ on E with connection forms $\omega^A{}_B$ (so ω^{AB} is antisymmetric), curvature $R^A{}_B = d\omega^A{}_B + \omega^A{}_C \wedge \omega^C{}_B$, and a solder form $e : TM \rightarrow E$ with components e^A , torsion $T^A = \mathcal{D}e^A$. Internal and manifold indices are exchanged with e . Volume forms:

$$\Sigma = e^0 \wedge \dots \wedge e^n, \quad \Sigma_A = e_A \lrcorner \Sigma, \quad \Sigma_{AB} = e_B \lrcorner e_A \lrcorner \Sigma, \quad \Sigma_{ABC} = e_C \lrcorner \Sigma_{AB}, \quad \Sigma_{ABCD} = e_D \lrcorner \Sigma_{ABC},$$

so that for $n = 3$, $\Sigma_{ABC} = \epsilon_{ABCD} e^D$ and $\Sigma_{ABCD} = \epsilon_{ABCD}$. The Einstein flux $\mathcal{G}_A$ is defined by $R^{BC} \wedge \Sigma_{ABC} = -2\mathcal{G}_A$; it satisfies $\mathcal{G}_A = G_A{}^B \Sigma_B$ with G the Einstein tensor.

A second, *reference* configuration $(\bar{\mathcal{D}}, \bar{e})$ with forms $\bar{\omega}, \bar{R}, \bar{T}, \bar{\Sigma}, \dots$ is given on the same bundle. Set

$$\Delta\omega = \omega - \bar{\omega} \quad (\text{an } \mathfrak{so}(1, n)\text{-valued tensorial 1-form}), \quad \Delta e = e - \bar{e}.$$

The reference will be assumed flat and torsion-free: $\bar{R} = 0, \bar{T} = 0$.

(New) Minion

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- Direct access to **local** executables (no sandbox; instead guardrails).
- March – May 2025: OpenAI releases Codex, its equivalent harness.
- Rapid industry adoption since.
- It's like supervising a talented, tireless, detail oriented software engineer.
- It runs on your laptop. You can walk your dog and issue prompts on your phone.

Bug Report Demo

Hi. Can we investigate this accent placement error:

```
./pixdiff "\mathring{\mathcal{H}}"
```

Sep 14   

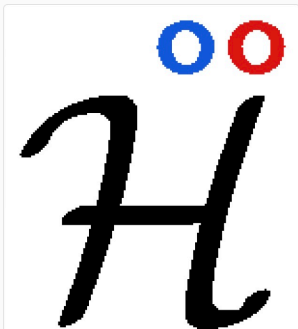
I'll run the pixdiff first and look at the overlay, then dig into how `\mathcal` accents are placed on each side.

Ran a command, read zoom.png ▾

Ran pixdiff on the ring-accented calligraphic H >

Read zoom.png ▾

file_path: [/Users/david/Source/newmn/tmp/pixdiff/zoom.png](#)



Easter Egg Demo



Easter Egg Demo

Hi there. You are participating in a public talk on uses of agentic AI. I'm a math professor and you are talking to a community of professors and students, many of whom have not seen the capabilities of Claude Code firsthand.

This demo is going to be very silly. First, lets go work out on a branch ``demo-feature-nanook`` so that we don't contaminate the project with this silliness. Then please look at ``CLAUDE.md`` and give a brief summary of the purpose of this repo for the audience.

Easter Egg Demo

There is a file in the current directory, 0824_Black_Standing_Bear_Right_Facing_CMYK.pdf. It contains a simple vector outline of one of my school's logos. What we are going to do is add an easter egg character to the font in the private use section. The glyph will be the outline, which you should be able to extract out of the PDF. When the package is loaded, the character should be accessed by \nanook. Please make it so!

Other Uses

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- Banner queries (eg: how many engineering majors are taking precalculus this semester and for those with ALEKS scores, what were their scores?)
- ES/MATH 186 data analysis (FERPA safe)
 - Homegrown python library for Banner queries + Claude developed queries.
 - Claude builds Jupyter notebook for statistical analysis against a synthetic data set.
 - I run on my side and discuss aggregate results with Claude and we iterate on the notebook.
 - One day there will be a MCP tool for Banner queries and FERPA-safe frontier AI at UAF...

Fin

Banner Query Demo

Hello! You are participating in a live demo during a talk on agentic AI.

I would like a Banner query of the following:

All students taking MATH F156X in semester 202603 with a major in this list:

```
``` ENG = {"CIVL", "MECH", "MECD", "ELEE", "CMER", "PETE", "GEOE", "MINE", "AERS",  
"ENVE", "GEOE", "ENNM"} ```
```

We are also going to append onto the list any ALEKS PPL score (expired or not) the student had prior to the end of registration for the class.

Once you have developed the query, please tell the audience a little about the `SKILL.md` that you used.

Thank you!

# Banner Query Demo

DBeaver 26.2.2 - <rtp.alaska.edu> Script-18

Auto    rtp.alaska.edu  SATURN   

alask... UA <rtp.alask... <rtp.alask... <rtp.alask... <rtp.alask... <rtp.alask... »4

WITH  
-- 1. Active F156X registrations in 202603 (drops/waitlists excluded via STVRSTS)  
enrl AS (  
 SELECT DISTINCT  
 r.sfrstcr\_pidm AS pidm,  
 r.sfrstcr\_term\_code AS term\_code,  
 r.sfrstcr\_crn AS crn,  
 r.sfrstcr\_ptrm\_code AS ptrm\_code,  
 ss.ssbsect\_seq\_numb AS sect,  
 ss.ssbsect\_camp\_code AS camp  
 FROM sfrstcr r  
 JOIN stvrsts ON stvrsts\_code = r.sfrstcr\_rsts\_code  
 AND stvrsts\_incl\_sect\_enrl = 'Y'  
 JOIN ssbsect ss ON ss.ssbsect\_term\_code = r.sfrstcr\_term\_code  
 AND ss.ssbsect\_crn = r.sfrstcr\_crn  
 WHERE r.sfrstcr\_term\_code = '202603'  
 AND ss.ssbsect\_subj\_code = 'MATU'  
)

1 X

enrl AS ( SELECT DISTINCT r.stf Enter a SQL expression to filter results (use Ctrl+Space)    

123 ANON_ROW	AZ ENG_MAJR	AZ ENG_DEGC	AZ LEVL	AZ SECT	AZ CAMP	AZ REG_DEADLINE
1	ELEE	BS	UF	902	F	2026-09-04
2	ENNM	BS	UF	901	F	2026-09-04
3	CIVL	BS	UF	902	F	2026-09-04
4	CMER	BS	UF	901	F	2026-09-04
5	MECH	BS	UF	901	F	2026-09-04
6	MECH	BS	UF	001	6	2026-09-04
7	CIVL	BS	UF	902	F	2026-09-04