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MEETING

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AUGUST 4 - 7, 2024
WASHINGTON, DC

Research Portfolio Analysis

Driving change through strategic alignment leveraging AI

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NCURA 66TH ANNUAL MEETING

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Research Portfolio Analysis

- What is research portfolio analysis? (Rob)
- Introduction to AI and some applications in sponsored research (Dan)
- Making AI part of the workflow (Dan)
- Leveraging AI for research portfolio analysis (Rob)
- Results and Next Steps (Rob)
- Questions

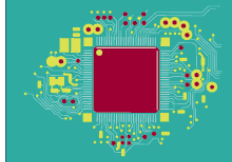
Next Slide: Example Research Portfolio Analysis

Historic Example | ENGR

university of arkansas college of engineering
RESEARCH STRENGTHS

EXISTING
strengths

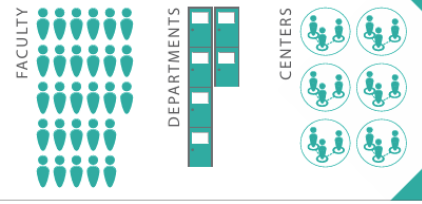
In January 2014, a research task force appointed by dean John English identified existing and emerging strengths in the college. Existing strengths are those areas where the college is already nationally recognized. Emerging areas are fields where the college has some key presence, expertise and momentum. These are expected to emerge into strengths with additional investment. The full report can be found at engineering.uark.edu.



Electronics

The College of Engineering has been producing graduates focused on electronics for over 30 years. Researchers in this area are developing new materials for circuits and photovoltaic cells, designing and modeling circuits, creating packages that protect and integrate electronic devices and creating and testing new technologies to improve our power grid.

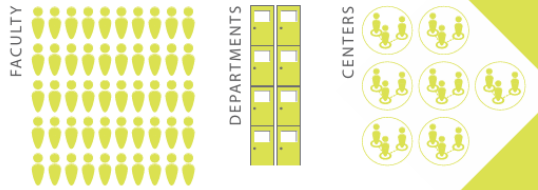
- Research centers predominately working in this area include the Center for Power Optimization of Electro-Thermal Systems, Grid-Connected Advanced Power Electronic Systems (GRAPES), High Density Electronics Center (HiDEC) and the National Center for Reliable Electronic Power Transmission (NCREPT)
- Approximately $4 million per year in research expenditures
- Several startup companies have emerged from this area



Energy

The broad area of energy has a foundation in electronics, but has expanded to include power systems, energy storage, smart grid innovation, biofuels and oil and gas research. As the world struggles to find and integrate safer and more sustainable sources of energy, research in this field is more important than ever.

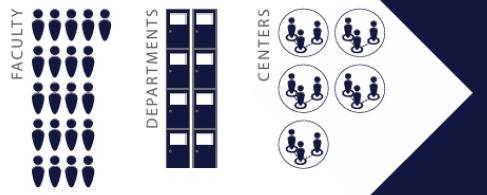
- The Cybersecurity Center for Secure Evolvable Energy Delivery Systems along with GRAPES and NCREPT contribute to the college's annual research expenditures of $4 million
- Energy research in the college is supported by the National Science Foundation, Department of Energy and Department of Defense
- Tech transfer of this research is making significant contributions to the college's public and private energy partners



Biomedical and Healthcare Engineering

College of Engineering research encompasses both technological and biological investigations in biomedical and healthcare engineering. Many life-enhancing breakthroughs in medicine and healthcare delivery result from research combining engineering and the medical sciences including biomechanics and mechanobiology, biomaterials, cell and tissue engineering, healthcare logistics and medical decision making.

- The college conducts approximately $2 million in annual research expenditures in this area including work done by the Membrane Research Center
- This is one of our most collaborative research areas with faculty from all eight departments working together to obtain funding from health agencies including the National Institutes of Health
- Researchers in this area collaborate with industry and healthcare providers to improve health and wellness throughout Arkansas and the U.S.



Materials Science and Engineering

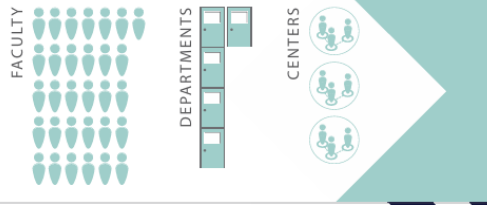
Our college's innovations in materials science and engineering lead to improved materials to solve technological and societal problems. Our research activities include advanced materials for packaging, control analysis, high resolution and device characterization, advanced coatings and surface engineering, photovoltaic materials, thermoelectric materials, nanotribology and bioinspired functional surfaces and materials.

- Materials research is conducted at the Center for Advanced Surface Engineering and Institute for Nanoscience and Engineering which are supported by micro-fabrication at HiDEC and in labs throughout the college
- Annual research expenditures in this area approach $2 million
- Several startup companies were created such as the award-winning NanoMech and SurfTec demonstrating successful tech transfer in this area

Transportation and Logistics

The College of Engineering has been a national leader in transportation and logistics for more than twenty years. Researchers are looking at distribution, transportation, information technology and software solutions, and maritime and multimodal transportation.

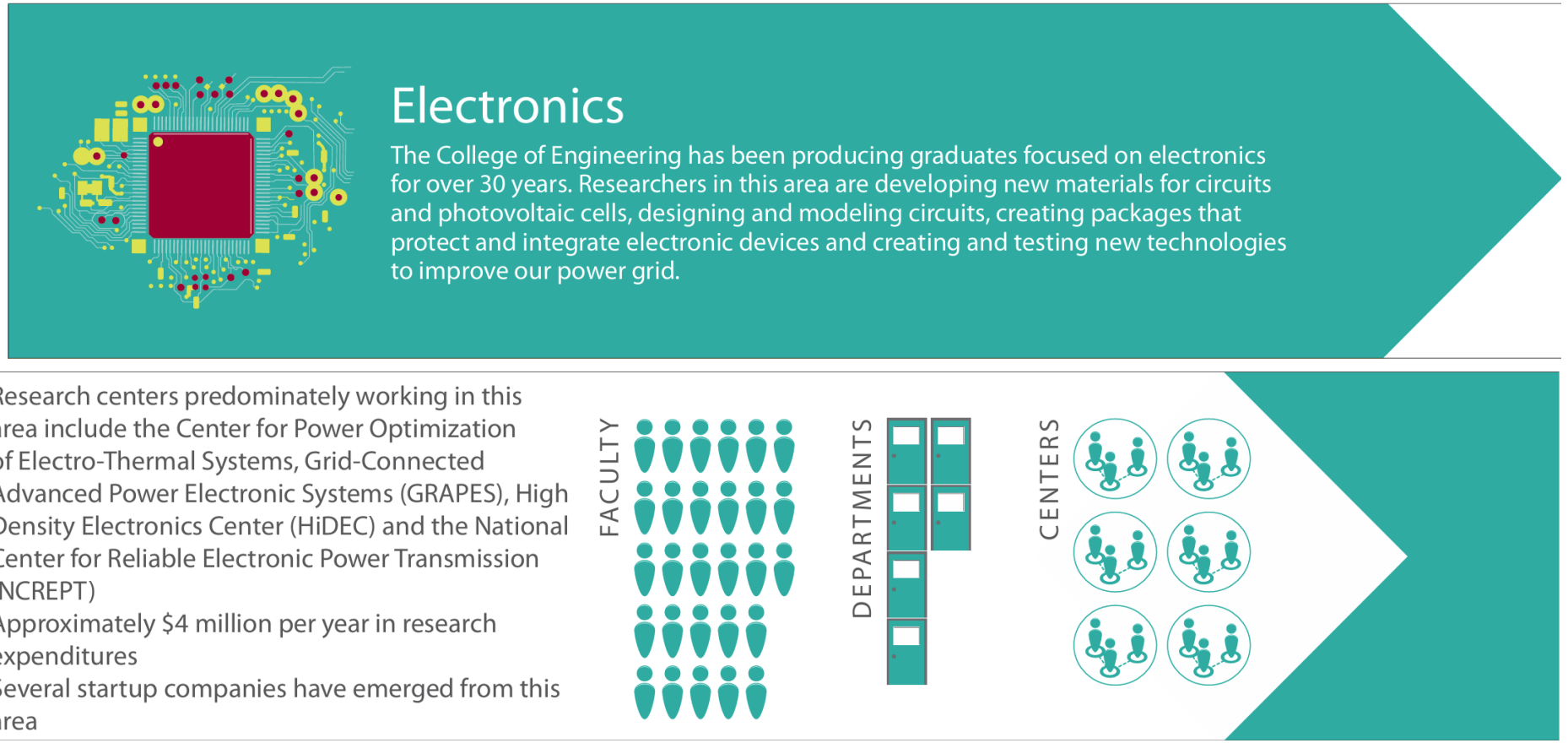
- The Mack-Blackwell Transportation Center and Center for Excellence in Logistics and Distribution have been at the fore-front of research in this area for two decades
- Annual research expenditures in this area consistently exceed $3 million
- The college works closely with the Arkansas and U.S. Departments of Transportation and many other transportation stakeholders across the nation



Next Slide: Historic Example | Electronics Research Output

Historic Example | Electronics Research Output

- Research Awards
- Publications
- Expenditures



Next Slide: Questions RPA can help answer

Questions that Research Portfolio Analysis could help answer?

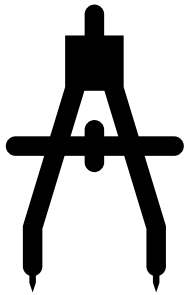
- What are your range of research projects?
- How do your research projects align with the institution's strategic objectives?
- How can we ensure decisions such as resource allocation, hiring etc. are aligned?

Next Slide: RPA Workflow

General Workflow for Research Portfolio Analysis

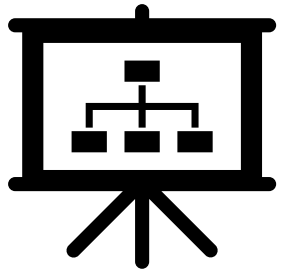
1.Define

- Research Strengths & Emerging Areas



2.Map

- Publications
- Awards/ Proposals



3.Communicate

- Analytics
- Data driven decision making

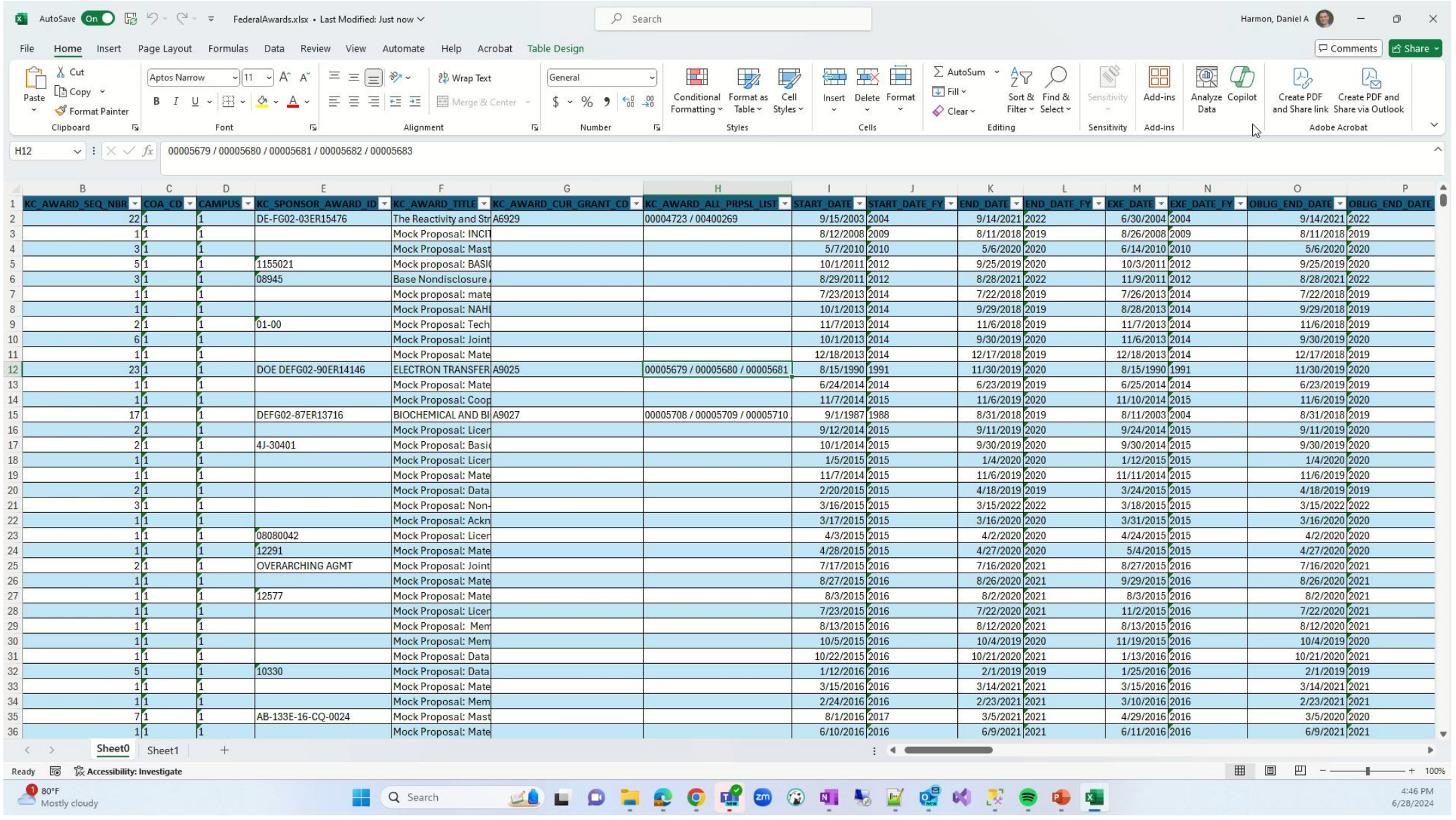
- Allows leadership to understand research output in relation to defined research areas

Next Slide: Generative AI in Research Administration

Applications in Research Administration

- Customer Service (Chatbot)
- Data extraction/ automation
- Personal Super Intern (Meeting Notes, Recap, Idea Generation)
- Writing (Budget Justifications)
- Email Response/Summarization
- Programming
- Excel Expert
- Data Analysis

Real World Example – Data Analysis/Excel Helper
Show me how much we get by Sponsor



FederalAwards.xlsx • Last Modified: Just now

H12: 00005679 / 00005680 / 00005681 / 00005682 / 00005683

KC_AWARD_SEQ_NBR	COA_CD	CAMPUS	KC_SPONSOR_AWARD_ID	KC_AWARD_TITLE	KC_AWARD_CUR_GRANT_CD	KC_AWARD_ALL_PRPSL_LIST	START_DATE	START_DATE_FY	END_DATE	END_DATE_FY	EXE_DATE	EXE_DATE_FY	OBLIG_END_DATE	OBLIG_END_DATE
22	1	1	DE-FG02-03ER15476	The Reactivity and Str	A6929	00004723 / 00400269	9/15/2003	2004	9/14/2021	2022	6/30/2004	2004	9/14/2021	2022
1	1	1		Mock Proposal: INCIT			8/12/2008	2009	8/11/2018	2019	8/26/2008	2009	8/11/2018	2019
3	1	1		Mock Proposal: Mast			5/7/2010	2010	5/6/2020	2020	6/14/2010	2010	5/6/2020	2020
5	1	1	1155021	Mock proposal: BASI			10/1/2011	2012	9/25/2019	2020	10/3/2011	2012	9/25/2019	2020
3	1	1	08945	Base Nondisclosure			8/29/2011	2012	8/28/2021	2022	11/9/2011	2012	8/28/2021	2022
1	1	1		Mock proposal: mate			7/23/2013	2014	7/22/2018	2019	7/26/2013	2014	7/22/2018	2019
1	1	1		Mock Proposal: NAHI			10/1/2013	2014	9/29/2018	2019	8/28/2013	2014	9/29/2018	2019
2	1	1	01-00	Mock Proposal: Tech			11/7/2013	2014	11/6/2018	2019	11/7/2013	2014	11/6/2018	2019
6	1	1		Mock Proposal: Joint			10/1/2013	2014	9/30/2019	2020	11/6/2013	2014	9/30/2019	2020
1	1	1		Mock Proposal: Mate			12/18/2013	2014	12/17/2018	2019	12/18/2013	2014	12/17/2018	2019
23	1	1	DOE DEFG02-90ER14146	ELECTRON TRANSFER	A9025	00005679 / 00005680 / 00005681	8/15/1990	1991	11/30/2019	2020	8/15/1990	1991	11/30/2019	2020
1	1	1		Mock Proposal: Mate			6/24/2014	2014	6/23/2019	2019	6/25/2014	2014	6/23/2019	2019
1	1	1		Mock Proposal: Coop			11/7/2014	2015	11/6/2019	2020	11/10/2014	2015	11/6/2019	2020
17	1	1	DEFG02-87ER13716	BIOCHEMICAL AND BI	A9027	00005708 / 00005709 / 00005710	9/1/1987	1988	8/31/2018	2019	8/11/2003	2004	8/31/2018	2019
2	1	1		Mock Proposal: Licer			9/12/2014	2015	9/11/2019	2020	9/24/2014	2015	9/11/2019	2020
2	1	1	4J-30401	Mock Proposal: Basi			10/1/2014	2015	9/30/2019	2020	9/30/2014	2015	9/30/2019	2020
1	1	1		Mock Proposal: Licer			1/5/2015	2015	1/4/2020	2020	1/12/2015	2015	1/4/2020	2020
1	1	1		Mock Proposal: Mate			11/7/2014	2015	11/6/2019	2020	11/11/2014	2015	11/6/2019	2020
2	1	1		Mock Proposal: Data			2/20/2015	2015	4/18/2019	2019	3/24/2015	2015	4/18/2019	2019
3	1	1		Mock Proposal: Non-			3/16/2015	2015	3/15/2022	2022	3/18/2015	2015	3/15/2022	2022
1	1	1		Mock Proposal: Ackn			3/17/2015	2015	3/16/2020	2020	3/31/2015	2015	3/16/2020	2020
1	1	1	08080042	Mock Proposal: Licer			4/3/2015	2015	4/2/2020	2020	4/24/2015	2015	4/2/2020	2020
1	1	1	12291	Mock Proposal: Mate			4/28/2015	2015	4/27/2020	2020	5/4/2015	2015	4/27/2020	2020
2	1	1	OVERARCHING AGMT	Mock Proposal: Joint			7/17/2015	2016	7/16/2020	2021	8/27/2015	2016	7/16/2020	2021
1	1	1		Mock Proposal: Mate			8/27/2015	2016	8/26/2020	2021	9/29/2015	2016	8/26/2020	2021
1	1	1	12577	Mock Proposal: Mate			8/3/2015	2016	8/2/2020	2021	8/3/2015	2016	8/2/2020	2021
1	1	1		Mock Proposal: Licer			7/23/2015	2016	7/22/2020	2021	11/2/2015	2016	7/22/2020	2021
1	1	1		Mock Proposal: Mem			8/13/2015	2016	8/12/2020	2021	8/13/2015	2016	8/12/2020	2021
1	1	1		Mock Proposal: Mem			10/5/2015	2016	10/4/2019	2020	11/19/2015	2016	10/4/2019	2020
1	1	1		Mock Proposal: Data			10/22/2015	2016	10/21/2020	2021	1/13/2016	2016	10/21/2020	2021
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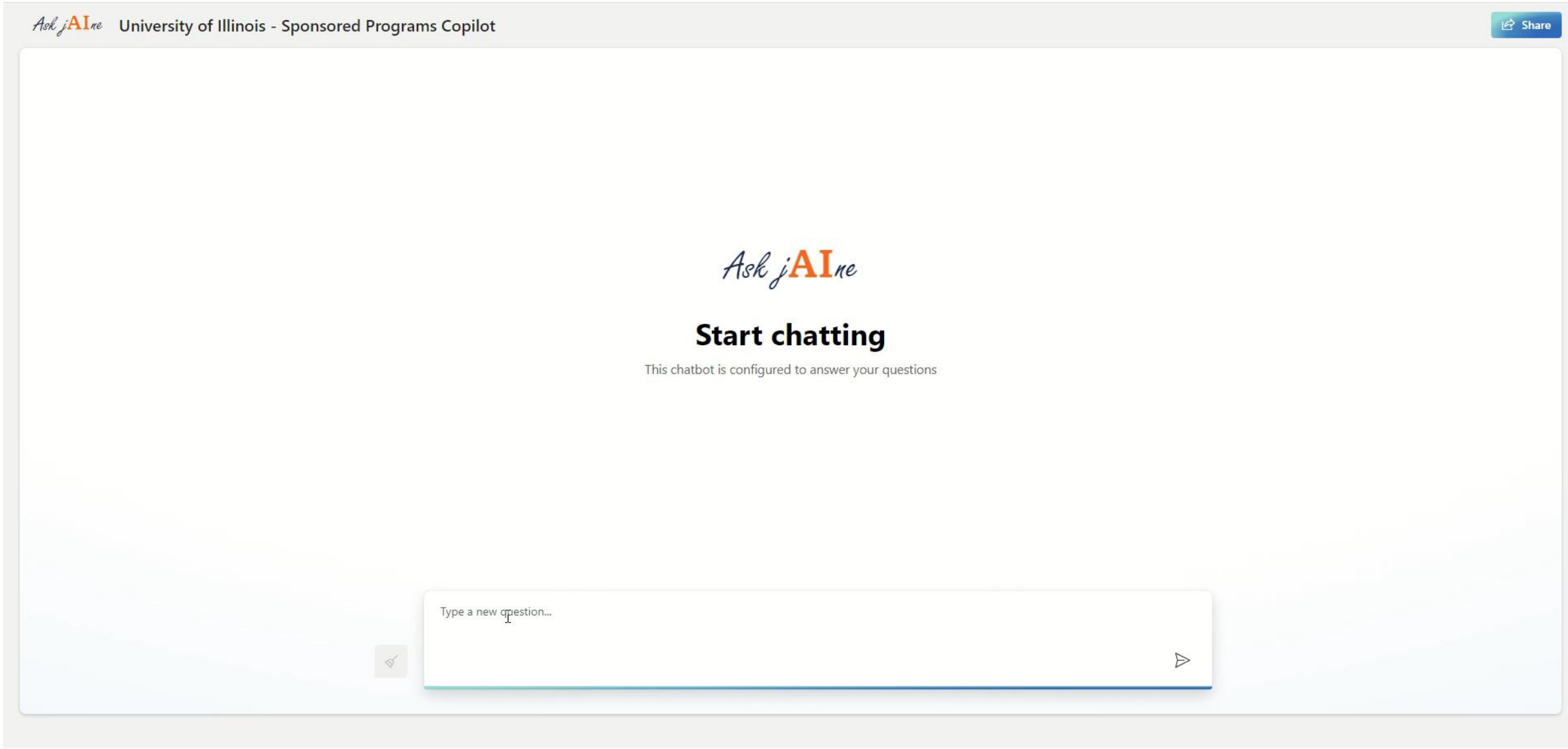
1	1	1		Mock Proposal: Mate			3/15/2016	2016	3/14/2021	2021	3/15/2016	2016	3/14/2021	2021
1	1	1		Mock Proposal: Mem			2/24/2016	2016	2/23/2021	2021	3/10/2016	2016	2/23/2021	2021
7	1	1	AB-133E-16-CQ-0024	Mock Proposal: Mast			8/1/2016	2017	3/5/2021	2021	4/29/2016	2016	3/5/2020	2020
1	1	1		Mock Proposal: Mate			6/10/2016	2016	6/9/2021	2021	6/11/2016	2016	6/9/2021	2021

Real Word Examples – Chatbot | How do I submit a no cost time extension



Real World Example – Data Extraction

Federal Acquisition Regulation (FAR)

Name

FAR Clause Reviewer

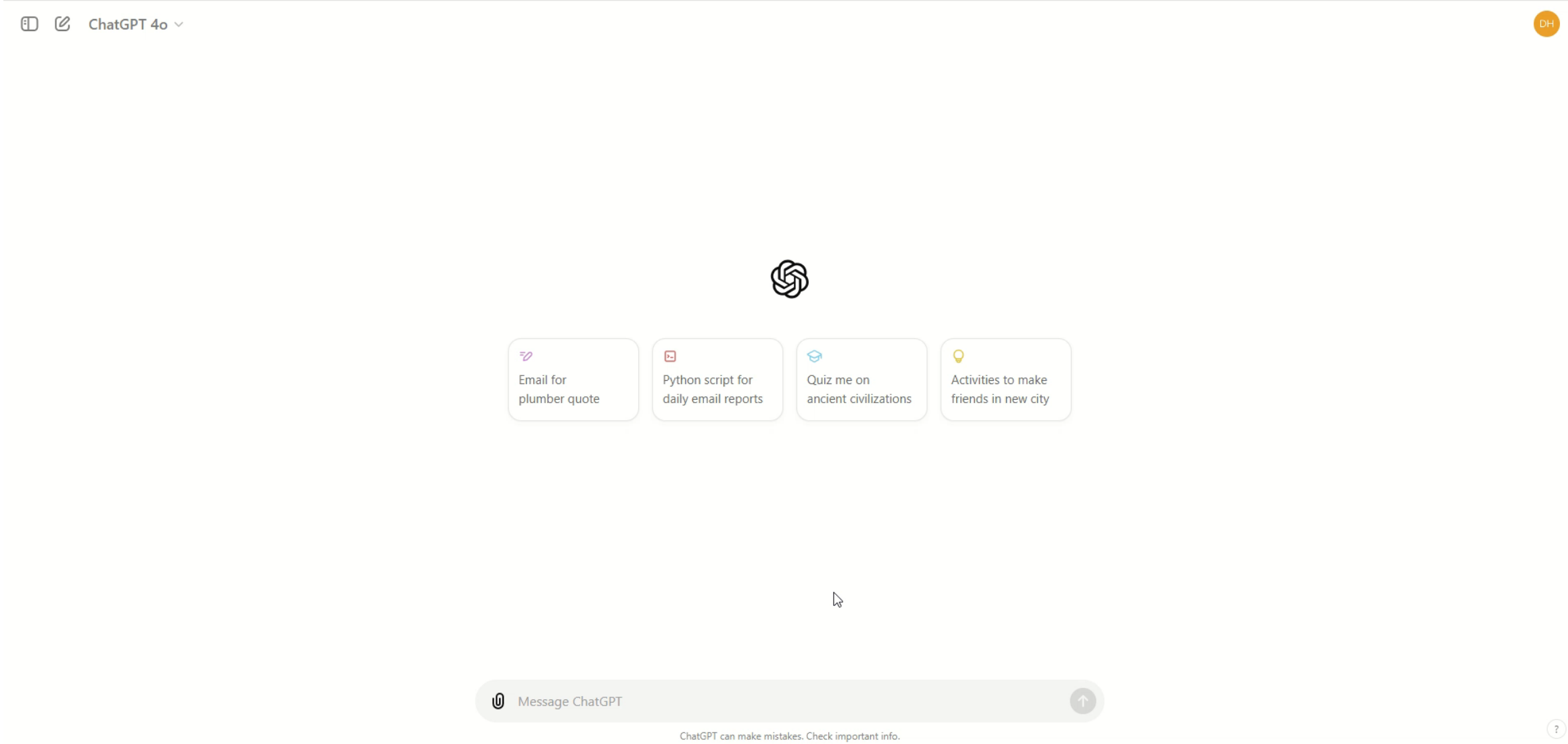
Description

Analyze Contracts for acceptable FAR Clauses

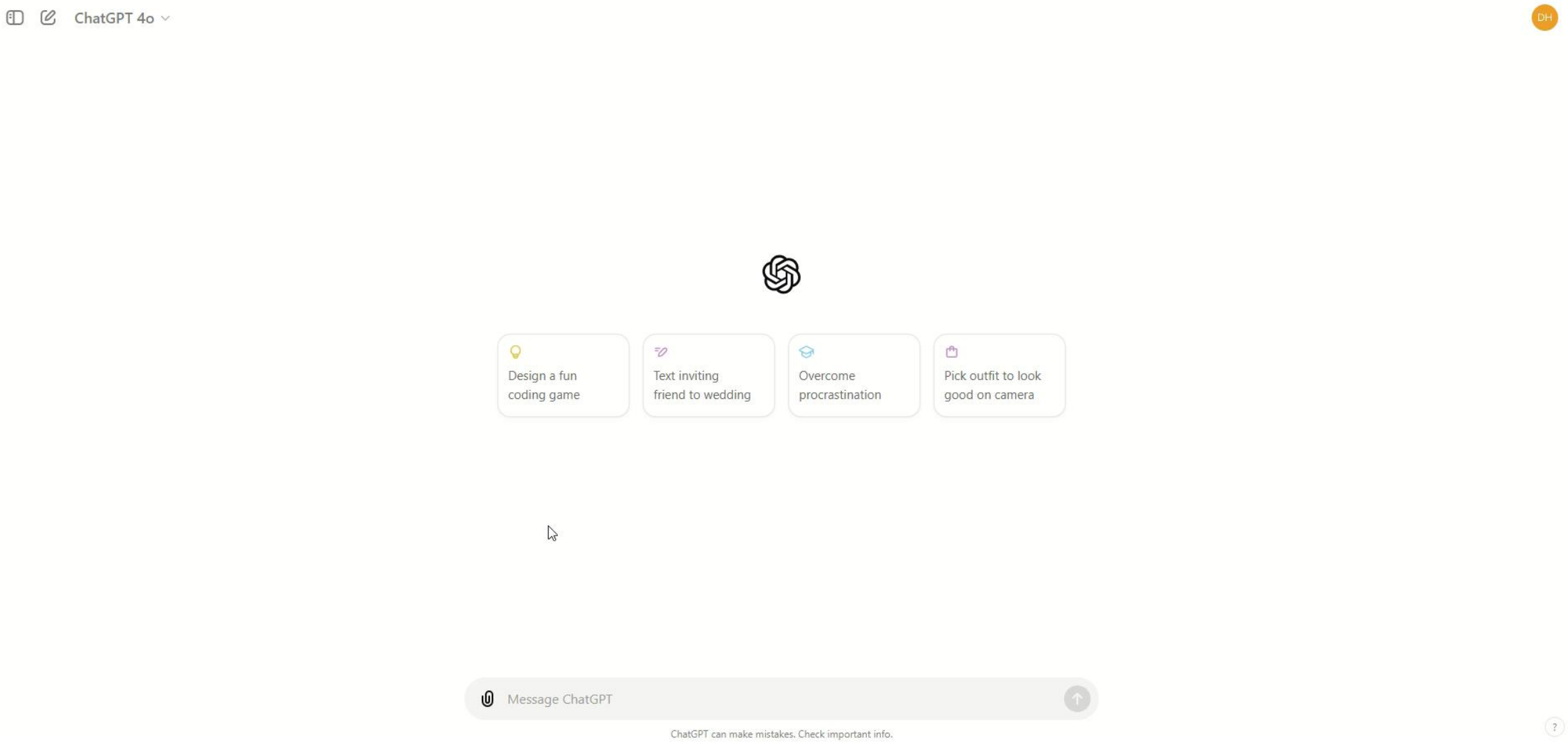
Instructions

This GPT will allow a user to upload a contract. Iterate over every FAR clause listed in the contract. A FAR clause will start with "52.". Then for each clause in that list, try to find it in the FAR Matrix document in your knowledge base. In the FAR Matrix file, there is a column called "OSP Status". That column determines if that particular FAR clause is Acceptable, Not Acceptable, Revisions Requested, or Blank, which also means acceptable. If there are unacceptable or revisions requested clauses, tell the user which clauses are of concern. If the question is not about contracts or FAR clauses or DFAR clauses, you will respond with "I only know how to answer questions about FAR clauses". Be somewhat concise with your responses. Please check your work to make sure you didn't miss any FAR clauses in the uploaded contract and that you

Real World Example – Data Extraction (FAR Clause)



Real World Example – Data Extraction (File Upload)



But we can do so much more.....

Research Portfolio Analysis

Why is AI suited for this type of analysis

- Text based
- Trained on human language and concepts
- The same concepts we as humans use for portfolio analysis

Key Considerations

- Prompt
- Total Context Length
- Model

The Data

Research Output

- Awards/ Proposals Streamlyne
- Publications Academic Analytics

Award Data

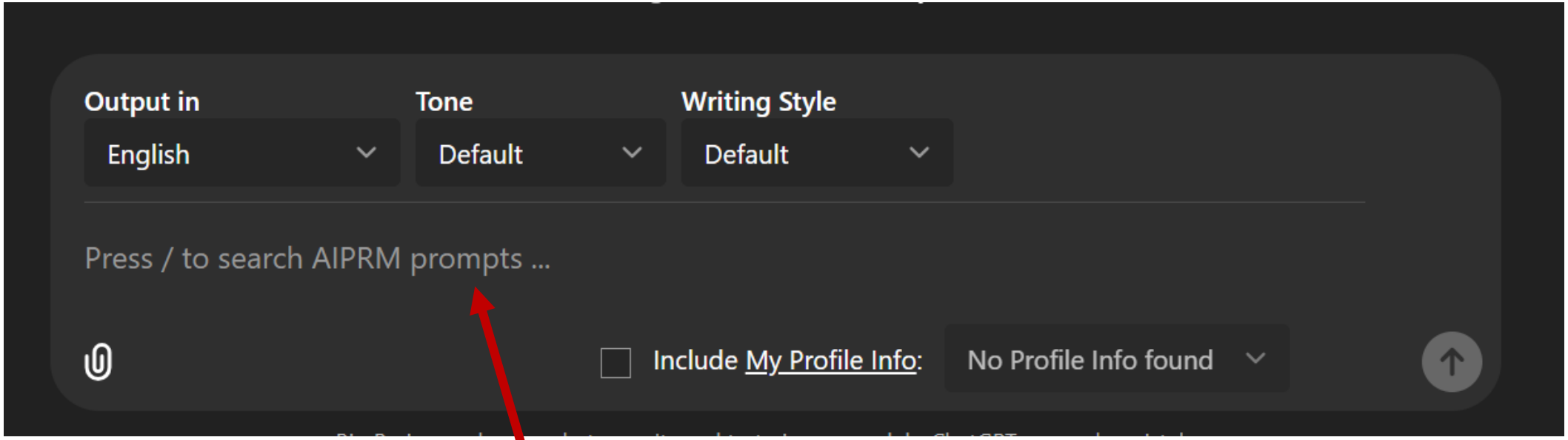
- Simple Spreadsheet
- Using Titles

IndexB	Title
247	Investigating the Role of Glutamine Metabolism in Breast Tumor Innervation
716	Energy-Efficient Hybrid Analog and Digital MAC Circuit for Artificial Neural Networks
1437	Enhanced Separation of Volatile Fatty Acids Produced from Optimized Continuous Anaerobic Digestion of Organic Wastes via a Novel Liquid-plasma Assisted Double-staged Membrane Process
779	Radar Consortium (Supplement GAP proposal)
959	Wicking-Enhanced Immersion Cooling for High-Frequency Transformers
1518	Science of Test Research Consortium
602	Machine Learning to Support Optimal Broiler Efficiency and Welfare
957	Tuned Miniaturized Point-Field Detectors as Contactless Current Sensor for Post-silicon Power Electronics Phase 2
712	Electronic Materials for Extreme Environments (Continuation)
1344	NAMS OFFICE YEAR 9
305	Optical sensor for noninvasive glucose detection in blood.
237	Identifying metabolic hallmarks of cancer initiation in lung tumor-adjacent normal tissue
1656	Nanotechnology-Enabled Integrated Platform for PFAS Sensing and Destruction
923	POETS: RET Program - Teachers Teaching Students to be Future Engineers 2019
975	Instilling Community in Electrical Engineering Laboratory Assignments through the Use of the Tri-Talk Methodology
1047	A Method of Increasing Thermal Energy Density through Discretizing Sensible TES Thermoclines
1196	Multi-Domain Computational Fluid Dynamics (CFD) Modeling to Predict Peak Pressures on Low-Rise Buildings by Incorporating the Effects of Inflow Turbulence, Surroundings and Complex Terrain.
15	CP sponsorship for a glass ion exchange fixture
1149	Geophysical Investigation of Hindsville Lake Dam
883	Interfacial Engineering of Solid-State Electrolytes Using Atomic Layer Deposition

Next Slide: Model 1

Model 1

Give ChatGPT the data and see what happens

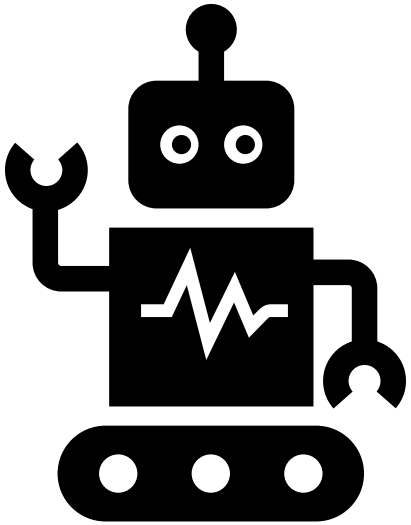


Your prompts go here

Next Slide: The Prompt

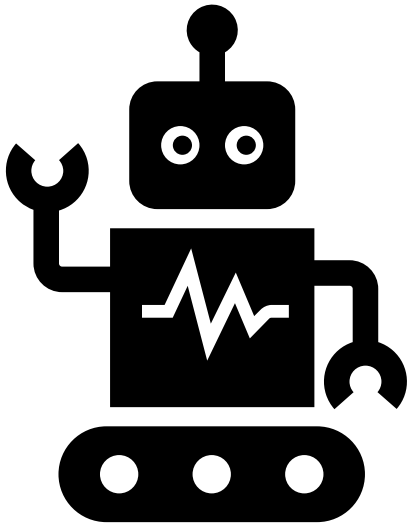
Model 1 | Prompt 1 (Part 1 of 2)

- I have a list of research titles and i want you to map them to a research area.
- I am going to give you a list of research project titles and for each one i want you to use the title to try and match it as best as possible to the following research areas [PUT LIST HERE].
- If there is not a clear match, then i want you to categorize it as "Other".



Model 1 | Prompt 1 (Part 2 of 2)

- For each row of data in the attached file i want you to make me a table and export it to a CSV file with the following format
- Col 1 is "Index“
- Col 2 is "Title“
- col 3 is "Research Area“



Next Slide: Research Areas

Research Areas

- Electronics
- Energy
- Engineering education
- Food Engineering
- Infrastructure
- Materials Science & Eng
- Membranes & Separations
- Optoelectronics
- Public Health, Simulation
- Sports analytics
- Sustainability
- Systems Integration
- Advanced Manufacturing
- Aerospace
- Agricultural Engineering
- Animal waste value recovery and management
- Biomedical & Healthcare Eng
- Computer Imaging & computer vision
- Cybersecurity
- Data Science (AI/Machine Learning/Data Analytics)
- Diversity and Equity
- Transportation & Logistics, Water
- Wireless Sensing and Communications

Next Slide: Results

Results

- Correct=AI Correct
- False= AI wrong
- 10% Accuracy
- Is this usable?

Research Area	Correct False	True	Total	Accuracy
Other	1,048		1,048	0%
Data Science (AI/Machine Learning/Data Analytics)	219	39	258	15%
Water	38	38	76	50%
Energy	27	18	45	40%
Advanced Manufacturing	24	19	43	44%
Computer Imaging & computer vision	37	5	42	12%
Electronics	15	10	25	40%
Aerospace	19	4	23	17%
Transportation & Logistics	6	15	21	71%
Agricultural Engineering	20		20	0%
Infrastructure	20		20	0%
Membranes & Separations	9	7	16	44%
Food Engineering	11	4	15	27%
Cybersecurity	4	4	8	50%
Wireless Sensing and Communications	7	1	8	13%
Simulation	5	1	6	17%
Biomedical & Healthcare Eng	1	5	6	83%
Diversity and Equity	4		4	0%
Animal waste value recovery and management	2		2	0%
Engineering education	1		1	0%
Total	**1,517**	**170**	**1,687**	**10%**

Accuracy Excluding "Other" 36%

Next Slide: How did we get accuracy

How do we determine accuracy?

True/(False+True)

Q:How do we know when AI is wrong?

Research Area	Correct False	True	Total	Accuracy
Other	1,048		1,048	0%
Data Science (AI/Machine Learning/Data Analytics)	219	39	258	15%
Water	38	38	76	50%
Energy	27	18	45	40%
Advanced Manufacturing	24	19	43	44%
Computer Imaging & computer vision	37	5	42	12%
Electronics	15	10	25	40%
Aerospace	19	4	23	17%
Transportation & Logistics	6	15	21	71%
Agricultural Engineering	20		20	0%
Infrastructure	20		20	0%
Membranes & Separations	9	7	16	44%
Food Engineering	11	4	15	27%
Cybersecurity	4	4	8	50%
Wireless Sensing and Communications	7	1	8	13%
Simulation	5	1	6	17%
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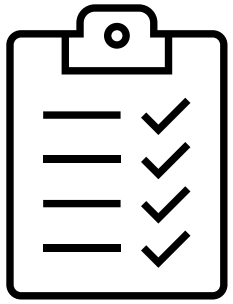
Total	**1,517**	**170**	**1,687**	**10%**

Accuracy Excluding "Other" 36%

Next Slide: Machine Learning 101

Machine Learning 101 | Training a Model

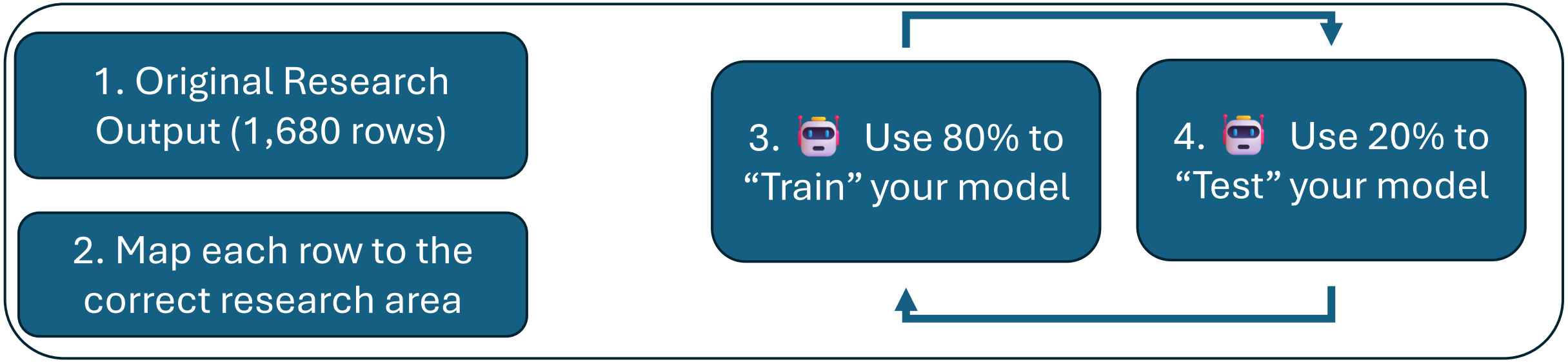


- Examples of “correct” data

- This data is used to “Train” the model

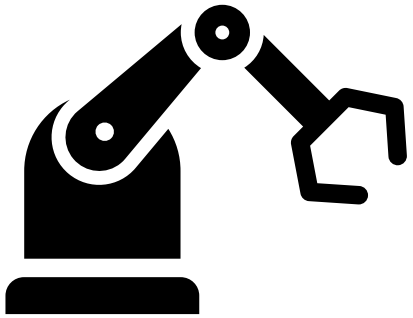
Next Slide: Training and Testing

Machine Learning Training & Testing a Model



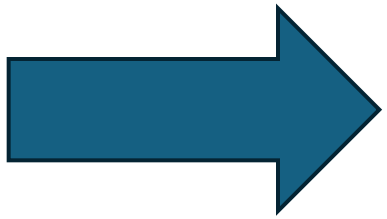
- To determine accuracy, we must know the correct answers
- Use the remaining "unseen" 20% to test

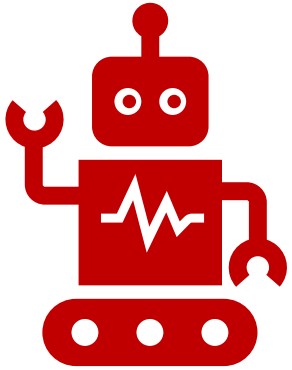
Next Slide: Model 2



Model 1 (Basic)

Give ChatGPT the data and see what happens





Model 2 (Advanced)

Provide training data

Validate with test data

Next Slide: Collecting training data

Building the Training Data

To keep this image simple, I have excluded columns such as Department, journal, year, doi. etc.

Spreadsheet

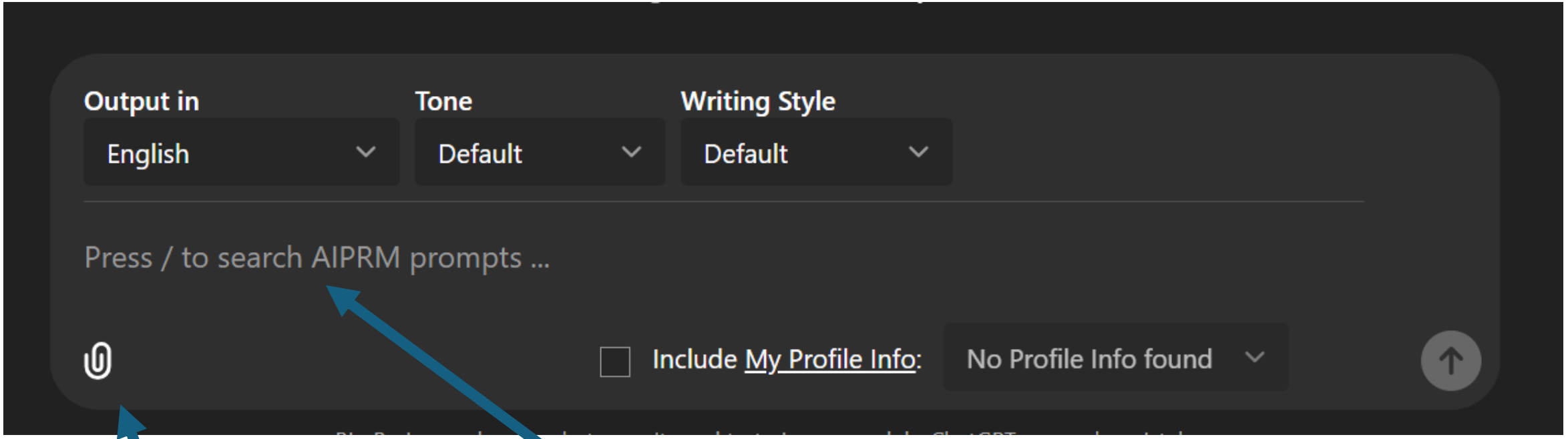
	Advanced Manufacturing	Aerospace	Biomedical & Healthcare Eng	Cybersecurity	Data Science	Electronics	Energy	Infrastructure	Materials Science & Eng	Membranes & Separations	Optoelectronics	Sustainability	Systems Integration	Transportation & Logistics	Water	Other (please identify)	Name of New Area
Research Output 1				1				2									
Research Output 2	3	2							1								
Research Output 3				1	2												
Research Output 4				2							1						
Research Output 5																Y	Diversity

1=Primary Area

2=Secondary Area etc.

Next Slide: ChatGPT screenshot

“Training” ChatGPT



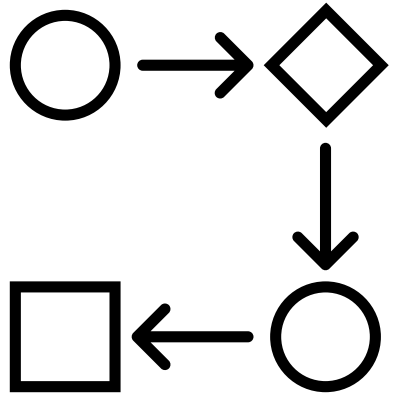
Your data file goes

Your prompts go here

Prompt Part 1 of 3

- I have a list of research titles and i want you to map them to a research group.
- I am going to give you a list of research project titles and for each one i want you to use the title to try and match it as best as possible to the following research areas.
- If there is not a clear match, then i want you to categorize it as "Other".
- Here is a list of the research areas i want you to map to:[LIST GOES HERE]

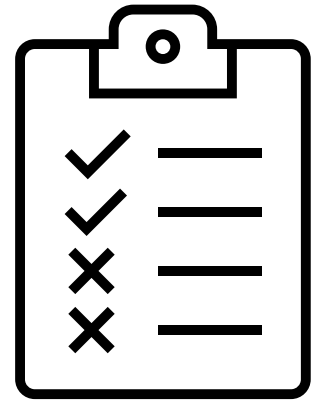
Define Task



Prompt Part 2 of 3

- I am first going to give you a list of matched titles to research areas that you can use for training.
- Once you have read them, please ask me for the list of titles to map.
- Use the first file i gave you to learn the mappings.

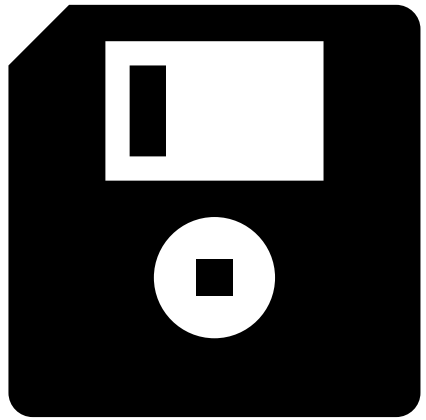
Workflow



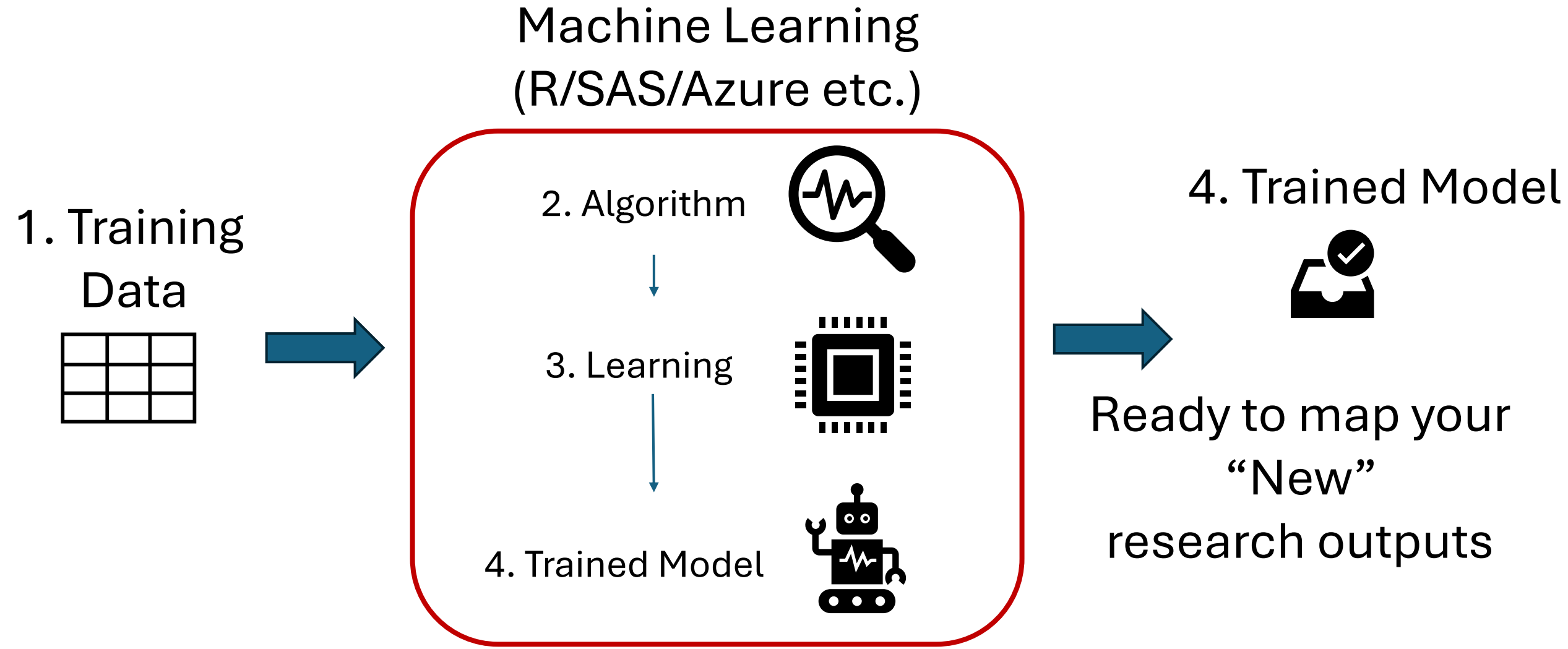
Prompt Part 3 of 3

- For each row of data in the attached file
- Make a table and export it to a CSV file with the following format
- Col 1 is "Index“
- Col 2 is "Title“
- col 3 is "Research Area"

Export

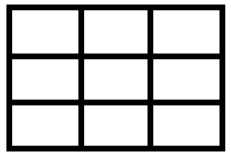


What is ChatGPT Really doing?



What is ChatGPT Really doing?

1. Training Data

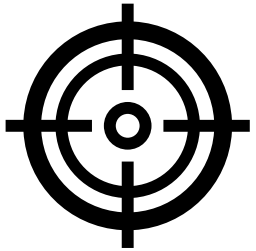


Chat GPT

4. Trained Model

Ready to map your “New” research outputs

How Did this Model Do?



Accuracy

In each area how many were correct

Positive Hit-Rate

How many did it find of the actual total?

False Positive

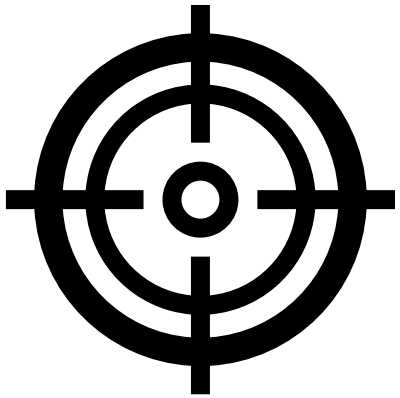
How many were wrong?

How Did this Model Do?

Accuracy

Out of 336 rows of data

92.6% (311) were correctly classified



Results Metrics

Actual Counts
In each area

AI Correct
True/False

Accuracy
True/(True+False)

Positive Hit Rate
True/Actual Count

False Positive
False/
(True+False)

Mapping		Correct True/False					
Research Area	Actual Count	False	True	Grand Total	Accuracy	Positive Hit Rate	False Positive
Biomedical & Healthcare Eng	76	3	73	76	96%	96.1%	3.9%
Materials Science & Eng	38	10	38	48	79%	100.0%	20.8%
Energy	33	2	33	35	94%	100.0%	5.7%
Electronics	33		26	26	100%	78.8%	0.0%

What metrics do we have (Next slide will show all research areas)

What do the Metrics Mean | Material Science

- In the area of Materials Science & Engineering AI correctly mapped 79% of the actual research outputs correctly.

Actual Counts In each area

AI Correct True/False

Accuracy True/(True+False)

Positive Hit Rate True/Actual Count

False Positive False/ (True+False)

Mapping		Correct True/False					
Research Area	Actual Count	False	True	Grand Total	Accuracy	Positive Hit Rate	False Positive
Biomedical & Healthcare Eng	76	3	73	76	96%	96.1%	3.9%
Materials Science & Eng	38	10	38	48	79%	100.0%	20.8%
Energy	33	2	33	35	94%	100.0%	5.7%
Electronics	33		26	26	100%	78.8%	0.0%

- Out of the total 48 mappings, 79% were accurate (38 True out of 48)
- AI had a false positive rate of 20% (10 of its total assignments of 48)

Results

Accuracy%
=True/(True+False)

Positive Hit Rate
=True/Actual Count

False Positive
=False/ (True+False)

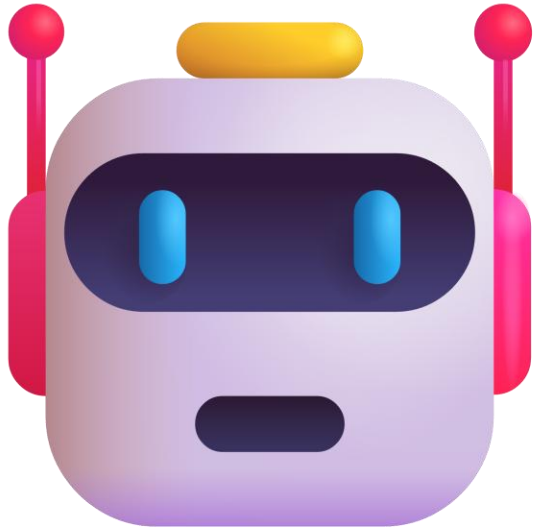
		Correct True/False					
Research Area	**Actual Count**	**False**	**True**	**Grand Total**	**Accuracy**	**Positive Hit Rate**	**False Positive**
Biomedical & Healthcare Eng	76	3	73	76	96%	96.1%	3.9%
Materials Science & Eng	38	10	38	48	79%	100.0%	20.8%
Energy	33	2	33	35	94%	100.0%	5.7%
Electronics	33		26	26	100%	78.8%	0.0%
Cybersecurity	25	1	24	25	96%	96.0%	4.0%
Data Science (AI/Machine Learning/	19	5	19	24	79%	100.0%	20.8%
Membranes & Separations	18		17	17	100%	94.4%	0.0%
Transportation & Logistics	17		16	16	100%	94.1%	0.0%
Sustainability	16	1	11	12	92%	68.8%	8.3%
Water	13	1	11	12	92%	84.6%	8.3%
Advanced Manufacturing	11		9	9	100%	81.8%	0.0%
Optoelectronics	7		7	7	100%	100.0%	0.0%
Infrastructure	6	1	6	7	86%	100.0%	14.3%
Engineering education	8	1	6	7	86%	75.0%	14.3%
Computer Imaging & computer visic	5		5	5	100%	100.0%	0.0%
Systems Integration	4		4	4	100%	100.0%	0.0%
Aerospace	4		3	3	100%	75.0%	0.0%
Food Engineering	2		2	2	100%	100.0%	0.0%
Animal waste value recovery and ma	1		1	1	100%	100.0%	0.0%
Grand Total	**336**	**25**	**311**	**336**	**93%**	**92.6%**	**7.4%**

You will need to pay close attention to high false positive Research areas

How do I use a model?

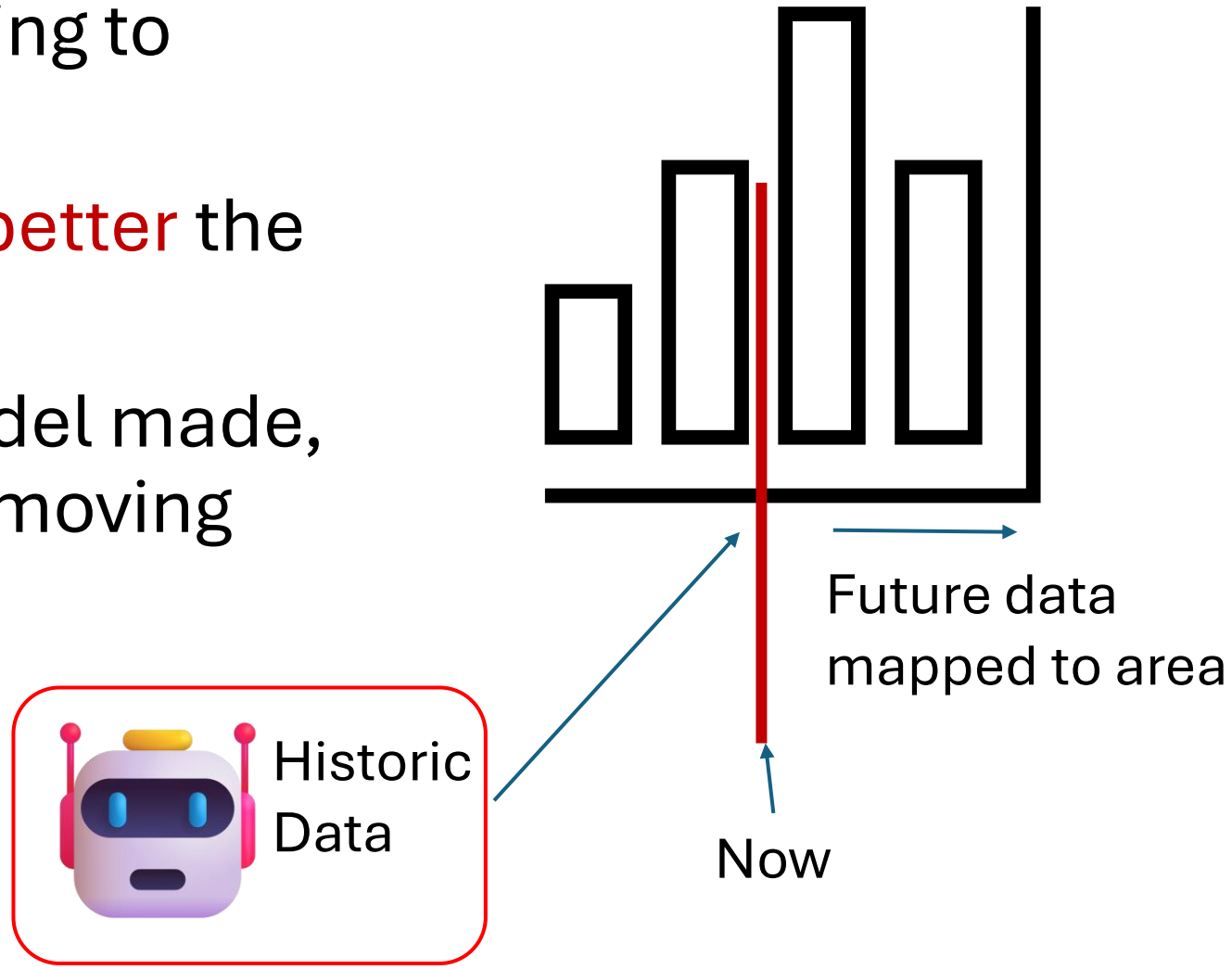
Question

- What is the point in any of this if we **have to manually** go through all the data and map it to a research area to make training data?



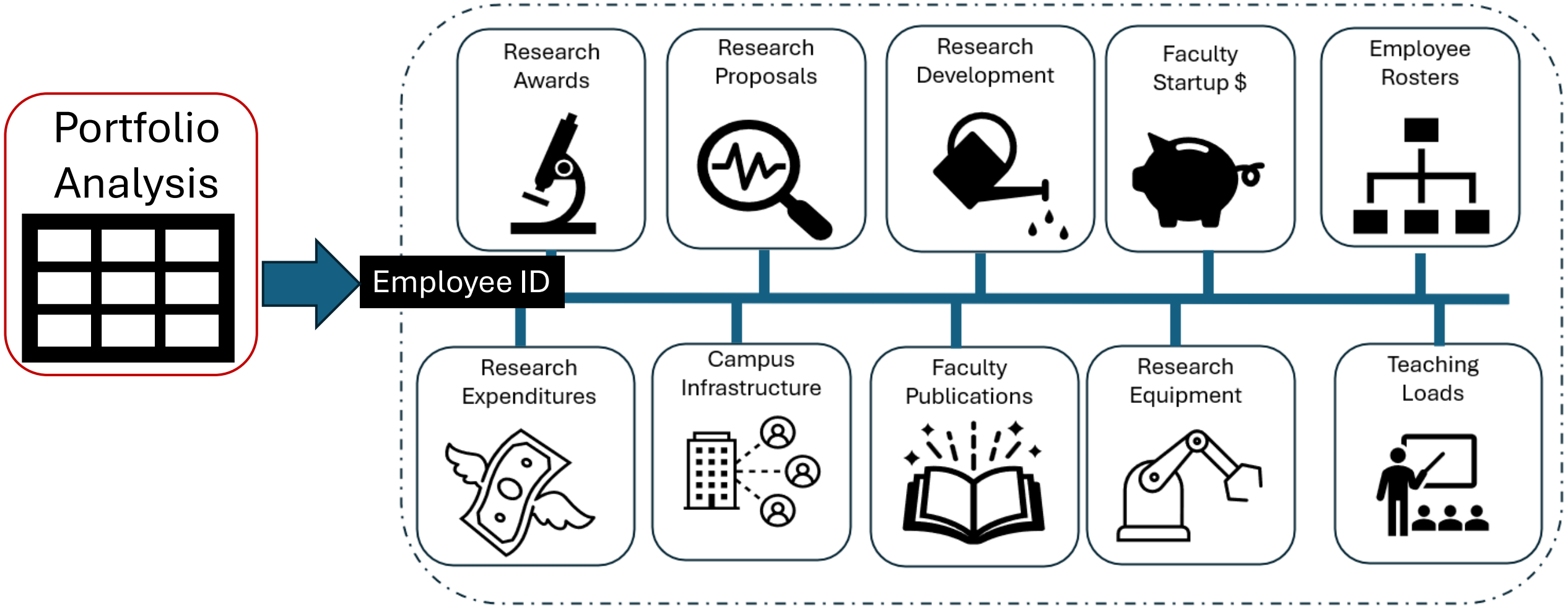
Build your model and set it free!

- There is no way around having to create training data
- The more training data the better the results
- But once you have your model made, you can use it on new data moving forward



Strategic Application | Data Model

Slice and dice across your entire enterprise by research area



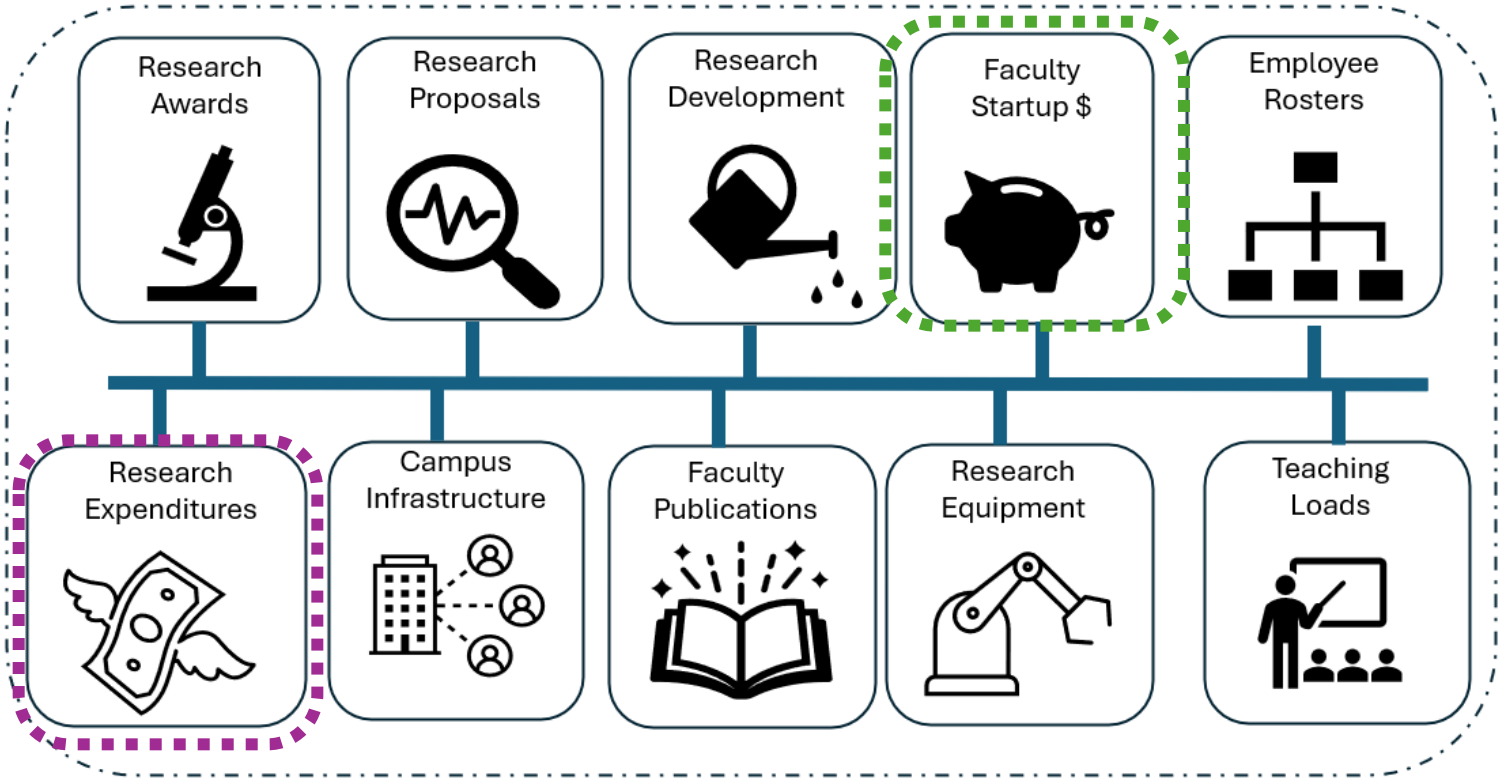
Strategic Application | Data Model

Example

What are the expenditures for all *Electronics* funding?

Example

Startup funding in *transportation and logistics?*



Research Portfolio Analysis

- What is research portfolio analysis? (Rob)
- Introduction to AI and some applications in sponsored research (Dan)
- Making AI part of the workflow (Dan)
- Leveraging AI for research portfolio analysis (Rob)
- Results and Next Steps (Rob)

Questions?

NCURA 66TH ANNUAL MEETING

Research Portfolio Analysis

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