



FALL CONFERENCE 2023

Walt Disney World Swan – Orlando, FL
November 14-16





NCREIF FALL CONFERENCE 2023

GENERAL
SESSION

Is AI About to Unleash an Incoming Storm of Innovation & Efficiency in Real Estate?*

Ron Singh, *VP - PGIM Real Estate*

Scott Dunphy, *Director – Assistant Portfolio Manager, Real Estate Equity Investments – MetLife Investment Management*

Kyle Walker, Ph.D., *Director of Research - The Linnaean Company, Associate Professor - Texas Christian University*

**Title produced by ChatGPT*

AGENDA

1. Welcome & Introductions – Ron Singh (~5 mins)
2. What is AI? – Ron Singh (~10 mins)
3. Demos – Kyle Walker (~20 mins)
4. Demos – Scott Dunphy (~20 mins)
5. Q&A (~5 mins)

WELCOME & INTRODUCTIONS

Information Management Committee Mission Statement

The mission of the NCREIF Information Management Committee is to provide leadership and guidance in the administration and use of real estate investment information to improve decision-making through:

- 1. Education*
- 2. Effective data management and governance*
- 3. Recommendation on standards for data elements*
- 4. Collaboration with other NCREIF committees*

Today's session is a preview for our Artificial Intelligence themed conference in Phoenix next March.

We will level-set our understanding of AI with a baseline introduction and of course include the hot topic of the day, ChatGPT. The session will also include a few short demos with use cases applicable to the commercial real estate sector.

PLANNING COMMITTEE

Ron Singh, PGIM (NCREIF IMC 1st Chair)

Brad Hammer, Heitman (NCREIF IMC 2nd Chair)

Manuel Gonzalez, Goldman Sachs (NCREIF IMC 1st Vice-Chair)

Ainun Ayub, Citco

Chris Boatfield-Bell, 33 Floors

Simone Cascilli, LaSalle

Scott Dunphy, MetLife Investment Management

Rob Fitzsimmons, The Linnaean Company

Barbara Flusk, Citco

Lisa Grant, TA Realty

Jake Hartwell, NCREIF

Benay Kirk, Alter Domus

Ben Neil, NCREIF

Jason Robisch, SitusAMC

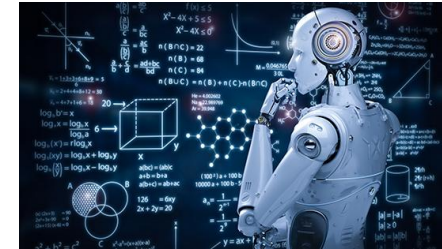
Pete Schow, Affinius Capital

Sozan Shea, Citco

Lana Sokolov, Blackrock

Kyle Walker, The Linnaean Company

HISTORY OF AI⁵



TIMELINE OF ARTIFICIAL INTELLIGENCE

When was AI founded?

- i. 2022: ChatGPT?
- ii. 2000s?
- iii. 1980s?
- iv. 1950s?
- v. 1930s?
- vi. 1900s?
- vii. Pre-1900?

Advances in artificial intelligence (AI) have people at chess and "Jeopardy!," as well as the progress of AI are still years away from self-aware. Some believe the resulting technology will eradicate poverty and disease, while others believe it will lead to human survival.

1950: Isaac Asimov publishes the influential sci-fi collection "I, Robot" (Left: 2004 film version of "Robot")

Summer of 1956: Dartmouth conference launches the field of AI and **coins the term "artificial intelligence."** (Right: room-filling IBM-702 computer, as used by first AI researchers)

1968: "2001: A Space Odyssey," the book by Arthur C. Clarke and film by Stanley Kubrick, features the sentient and deadly computer **HAL 9000.**

1970s

1978: "Battlestar Galactica" introduces robots

1984: The first **"Terminator"** film depicts a near-future world overtaken by killing machines run by the artificial intelligence Skynet.

1980s

September 28, 1987: The TV series "Star Trek: The Next Generation" introduces the self-aware android **Lieutenant Commander Data.**

1990s

June 29, 2001: Steven Spielberg releases his version of a film – originally developed by Stanley Kubrick – about a robot boy: **"A.I.: Artificial Intelligence."**

2000s

June 29, 2001: Steven Spielberg releases his version of a film – originally developed by Stanley Kubrick – about a robot boy: **"A.I.: Artificial Intelligence."**

2005: A Stanford vehicle wins the **DARPA grand challenge**, driving autonomously across the desert for 131 miles (211 kilometers).

2005: Inventor and futurist Ray Kurzweil predicts an event he calls the **Singularity** will occur around 2045, when the intelligence of artificial minds exceeds that of the human brain.

2010s

2011: **IBM's Watson wins "Jeopardy!,"** beating former champions Brad Rutter and Ken Jennings. (Credit: "Jeopardy!" screengrab from Wikimedia)

October 14, 2011: Apple introduces intelligent personal assistant **Siri** on the iPhone 4S.

June 2012: A Google Brain computer cluster **trains itself to recognize a cat** from millions of images in YouTube videos. (Credit: Shutterstock)

December 18, 2013: The movie "Her" (left), stars Joaquin Phoenix as a man who **falls in love with his artificially intelligent computer operating system**, voiced by Scarlett Johansson.

April 10, 2014: The film "Transcendence" (below) stars Johnny Depp as an AI researcher whose **mind is uploaded to a computer** and develops into a super-intelligence.

June 7, 2014: Chatbot Eugene Goostman is said to have **passed the Turing test**

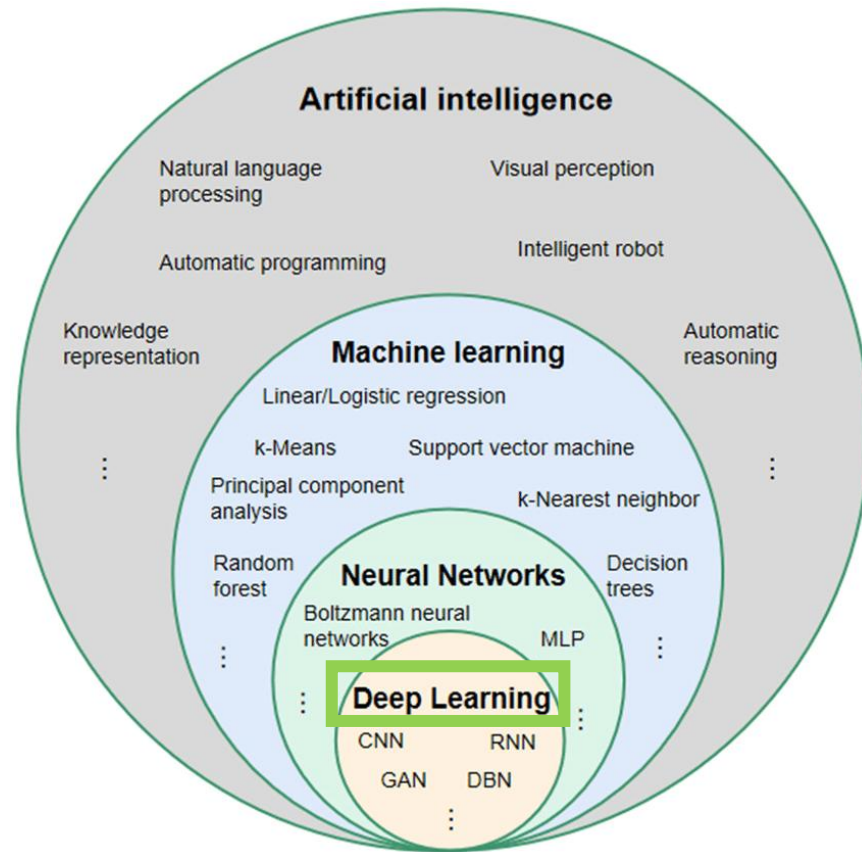
2022: ChatGPT unleashed
Will there be a third **Winter of AI?**

WHAT IS AI?



- Leverages computers and machines to mimic the problem-solving and decision-making capabilities of the human mind¹
- Machine-displayed intelligence that simulates human behavior or thinking and can be trained to solve specific problems
- Intelligence—perceiving, synthesizing, and inferring information—demonstrated by machines, as opposed to intelligence displayed by non-human animals or by humans. Example tasks in which this is done include speech recognition, computer vision, translation between (natural) languages, as well as other mappings of inputs²
- It is the science and engineering of making intelligent machines, especially intelligent computer programs. It is related to the similar task of using computers to understand human intelligence, but AI does not have to confine itself to methods that are biologically observable³ – John McCarthy
- "AI is the new electricity" ⁴ (~2016) - Dr. Andrew Ng, Founder of DeepLearning.AI, Founder & CEO of Landing AI, General Partner at AI Fund, Chairman and Co-Founder of Coursera and an Adjunct Professor at Stanford University's Computer Science Department

WHAT IS AI?



Artificial intelligence (AI) is a computer science discipline focused on the theory and development of systems that are able to perform tasks normally requiring human intelligence

Machine Learning (ML) involves training models to

- **Recommendation Systems**
Example: Netflix, Amazon, and YouTube
- **Demand Forecasting**
Example: Amazon, Walmart, large retailers
- **Credit Scoring**
Example: FICO Score

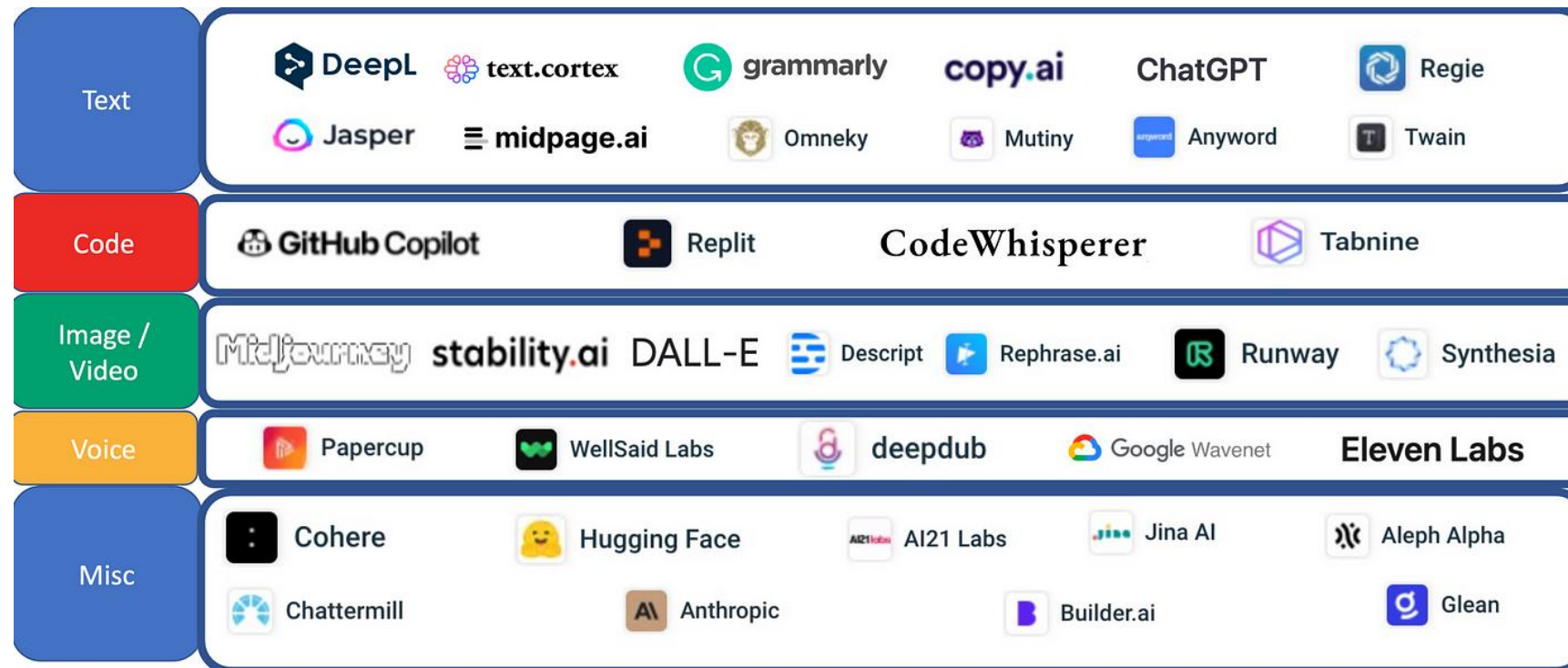
Deep Learning focuses on training neural networks (NN) to learn from data and make predictions or generate outputs. The fundamental principle behind deep learning is to enable the NNs to learn and extract meaningful patterns and features of the input data.

Generative AI (GenAI) refers to a branch of

- **Text-to-Text Generator**
Example: ChatGPT, Google Bard
- **Text-to-Image Generator**
Example: Midjourney, OpenArt

The GenAI Application Landscape

The GenAI Market Map



Common Hurdles in GenAI

Output Quality and Realism

This can include issues such as generating unrealistic or implausible outputs (hallucination), artifacts or distortions in generated images, or failure to capture fine-grained details accurately.

Interpretability Explainability

GenAI and more broadly ML models are often considered as "black boxes" due to their complex internal workings. Interpreting and explaining the decision-making or content generation process of these models remains a challenge.

**Note: One of the demos you will see today provides an approach to solving this problem*

Ethical & Social Considerations

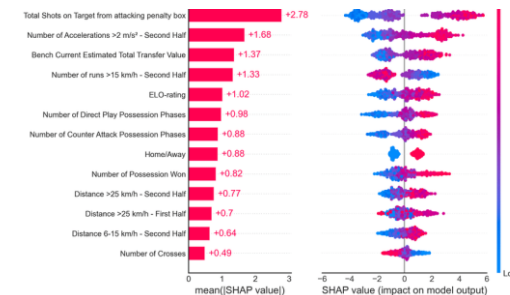
Protecting privacy, confidentiality and intellectual property, avoiding bias, and potential misuse of the technology are some of ethical issues of the GenAI models. Social, e.g. collaboration, workforce displacement, etc.

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ChatGPT Examples

1. User: Can you recommend a good restaurant in Paris?
ChatGPT: Yes, I recommend the restaurant "Le Petit Chat Noir." It's a cozy spot with delicious seafood dishes and an extensive wine list.
"Le Petit Chat Noir" is not a restaurant in Paris
2. **Two NY lawyers sanctioned by judge for submitting a legal brief that included six fictitious case citations generated by ChatGPT.**

SHAP Approach



DEMOS!

■ Kyle Walker

- Demographic mapping
- Site descriptions for underwriting
- Unpacking rent-prediction models

■ Scott Dunphy

- Chat with Your CRE Documents (leases, JVAs, property updates, etc.)
- AI NCREIF Query Tool
- Code in English or An Excel Formula for Carried Interest

AI FOR LOCATION INTELLIGENCE IN REAL ESTATE

Identified use-cases:

- Allowing analysts to explore and visualize real estate data by “asking questions,” without the need for specialized software skills
- Automate the production of location reports for underwriting in a way that matches corporate templates / styles
- “Explaining” the results of a predictive model in an intuitive way to stakeholders

WHAT AI CAN – AND CANNOT – DO

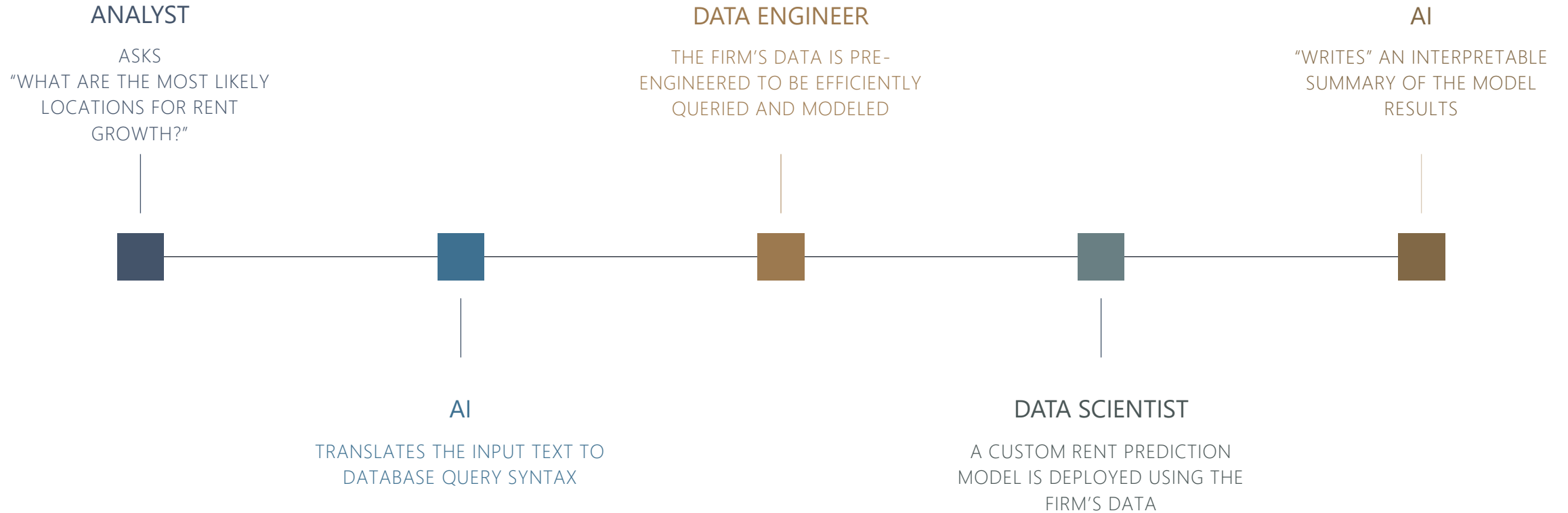
Generative AI is good for...

- Translating user questions in “natural language” to computer syntax (e.g. Excel formulas, SQL / database queries).
- Producing written summaries of analytical outputs, saving analysts time

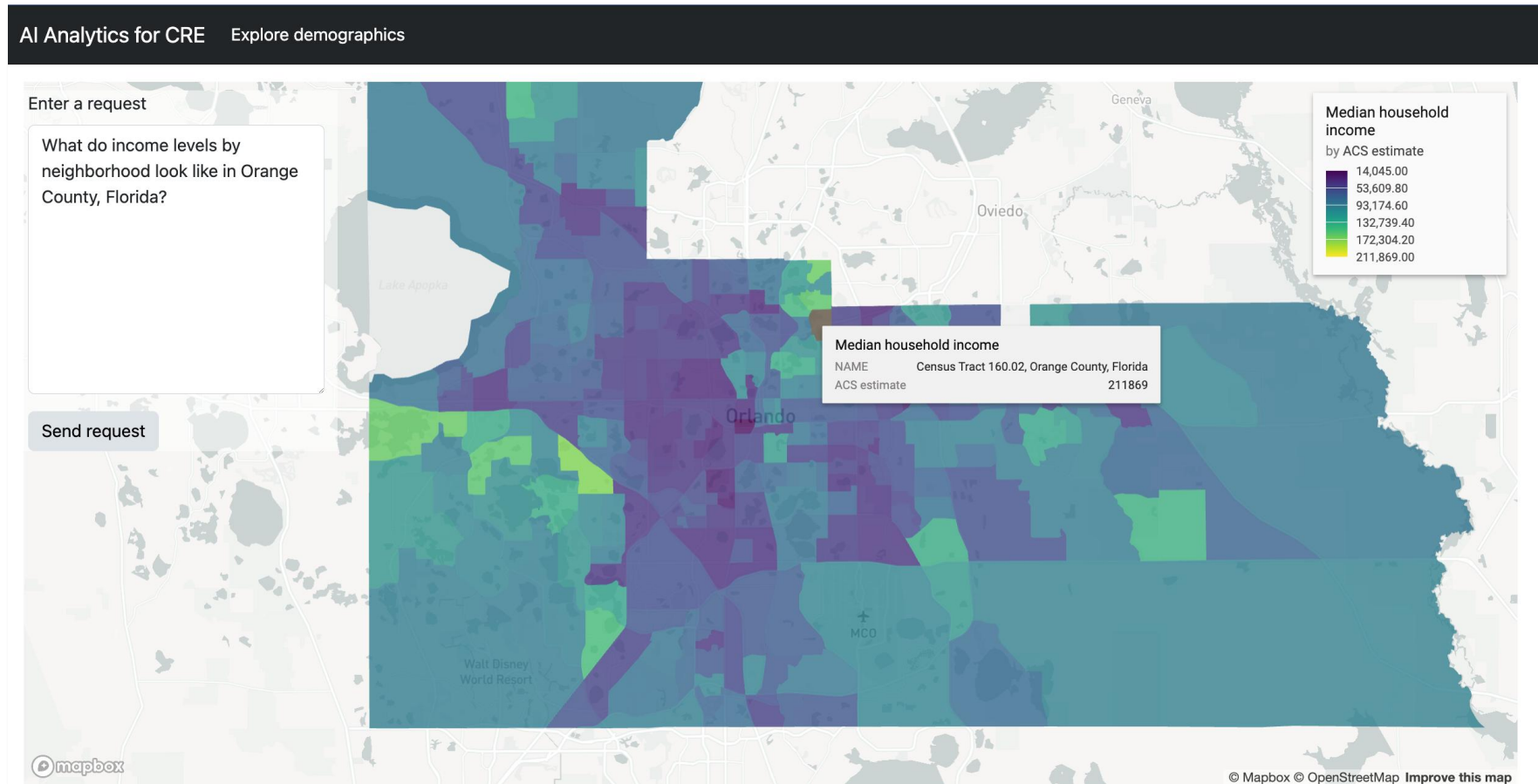
But a “human in the loop” is needed to...

- Identify, prepare, and engineer public and proprietary data sources relevant to commercial real estate
- Train and back-test models to make predictions or forecasts
- Audit results generated by AI for inaccuracies and “train” the AI with rules to produce guided output

EXAMPLE AI INPUT / OUTPUT PIPELINE FOR CRE



USE-CASE 1: DEMOGRAPHIC MAPPING

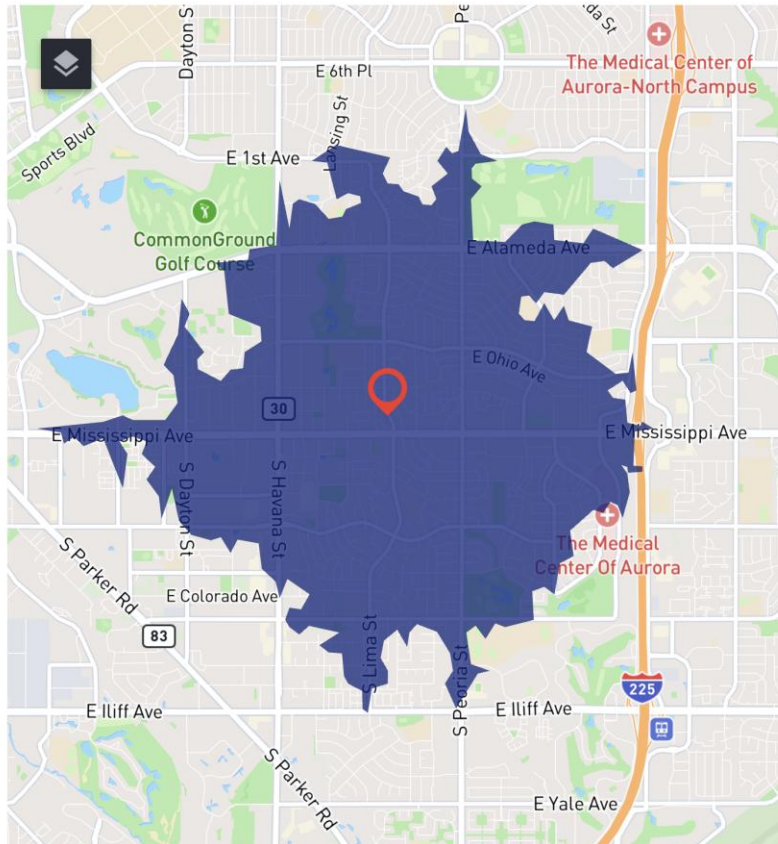


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https://youtu.be/SpW_snTM_ZI

USE-CASE 2: SITE DESCRIPTIONS FOR UNDERWRITING

AI Analytics for CRE Site reporting



Describe the location

1037 South Moline Street, Aurora, Colorado 80012, United States

The multifamily property landscape within a 5-minute drive of our potential investment site presents an average analyst rating of approximately 3.04, suggesting a moderate level of confidence in the area's investment prospects. These properties typically feature around 239 units, which could indicate a well-established residential density that could be beneficial for community dynamics and rental demand. The average year of construction for these properties is dated to around 1983, pointing towards a potential need for renovations or modernization investments to enhance property values and attract tenants seeking more contemporary accommodations. Additionally, the average effective rent per square foot is calculated to be approximately \$1.89, which may offer insight into the local rental market's pricing and could influence our rent strategy for the investment site to ensure competitive positioning.

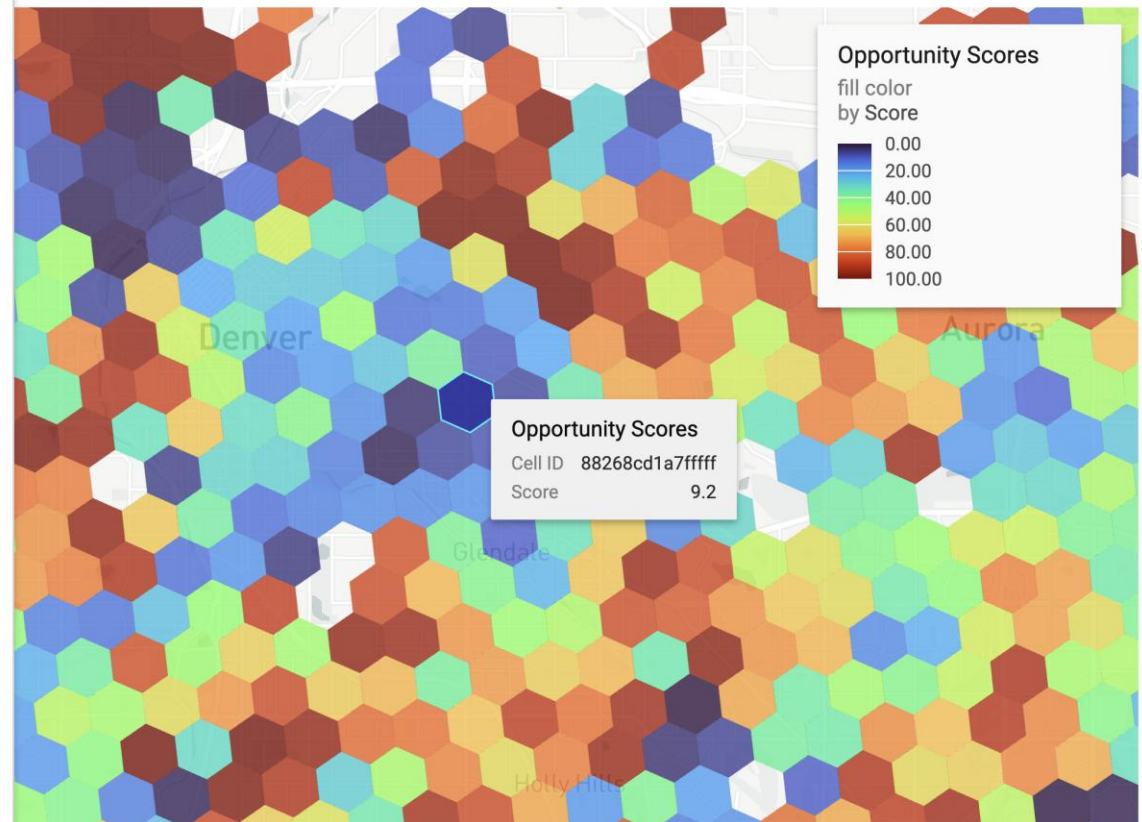
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<https://youtu.be/KPWW0DE24q8>

USE-CASE 3: UNPACKING RENT-PREDICTION MODELS

AI Analytics for CRE Explain model results

The grid cell has an average predicted effective rent per square foot of \$2.07. The most important model features in making this prediction are the mean year the buildings were built and the percentage of residents with a college degree. The mean year built, at 2004.83, suggests that newer buildings may command higher rents, contributing an additional 3.42 cents to the rent prediction. Similarly, a college-educated population of 59.03% indicates an area with potentially higher-income residents, which contributes an extra 3.17 cents to the rent prediction. Retail presence related to car parts and machinery (retail_PC2) with a value of -1.4 and the number of



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<https://youtu.be/ic-SdsxcBGg>

AI FOR THE REAL ESTATE MASSES

1. ChatCRE - Chat with Your CRE Documents (leases, JVAs, property updates, etc.)
2. Code in English or An Excel Formula for Carried Interest
3. Solving the Accountant Shortage
4. Super Secret Project

CHATCRE

CONVERSATIONS WITH YOUR DOCUMENTS

ChatCRE

Ask questions about the leases, property updates, and loan agreement. Be patient while it runs.

I

Try this prompt: Is there anything concerning in the property updates?

<https://www.youtube.com/watch?v=yGEMPKQTjI0>

This demo is for illustrative purposes only and uses fake/synthetic data. MetLife Investment Management does not endorse the underlying technology or software used in this demo.

AI-CODED CARRIED INTEREST FORMULA

CODE WITH ENGLISH

Calculation of Simple Carried Interest Model Using Excel and Custom VBA Function

Created by: [Scott Dunphy](#)

Note: See cell comments for additional description around how the model works.

The function, called CarriedInterest, is entered in cell N6. The inputs are dealDates, dealCashFlows, hurdleRate, lpDistRatio1, gpDistRatio1, lpDistRatio2, and gpDistRatio2). The function returns all the summary statistics shown below in a 6 x 4 matrix. To view the code behind the custom function press Alt + F11 to enter the VBA code editor.

Tier	Hurdle Rate	Distributions Ratios		
		LP Split	GP Split	Daily Hurdle Rate
First Tier	8%	80%	20%	0.0210874%
Second Tier	10%	80%	20%	0.0261158%
Third Tier	12%	80%	20%	N/A

MANUAL CALC OUTPUT			
	Deal	LP	GP
Investor Profit	\$89,000,000	\$71,200,000	\$17,800,000
XIRR	16.19%	16.19%	16.19%
Contributions	\$91,000,000	\$72,800,000	\$18,200,000
Distributions	\$180,000,000	\$144,000,000	\$36,000,000
Multiple	1.98	1.98	1.98

CARRIED INTEREST FUNCTION OUTPUT			
#VALUE!			

Cash Flow Date	6/30/2023	7/25/2023	10/29/2023	3/15/2024	3/14/2025	9/10/2025	3/3/2026	7/7/2026	4/7/2027	5/16/2027	1/30/2028	7/22/2028
Property Cash Flows	(\$50,000,000)	(\$30,000,000)	(\$1,000,000)	\$0	(\$10,000,000)	\$5,000,000	\$5,000,000	\$5,000,000	\$5,000,000	\$5,000,000	\$5,000,000	\$150,000,000
LP Contribution	(\$40,000,000)	(\$24,000,000)	(\$800,000)	\$0	(\$8,000,000)	\$0	\$0	\$0	\$0	\$0	\$0	\$0
GP Contribution	(\$10,000,000)	(\$6,000,000)	(\$200,000)	\$0	(\$2,000,000)	\$0	\$0	\$0	\$0	\$0	\$0	\$0
First Hurdle												
Day Count	0	25	96	138	364	180	174	126	274	39	259	174
Beginning Balance	\$0	\$40,000,000	\$64,211,409	\$66,324,408	\$68,282,641	\$81,729,704	\$80,891,239	\$79,914,113	\$78,065,675	\$78,708,630	\$75,358,538	\$75,588,367
Contributions	\$40,000,000	\$24,000,000	\$800,000	\$0	\$8,000,000	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Return Accrual	\$0	\$211,409	\$1,312,999	\$1,958,233	\$5,447,064	\$3,161,535	\$3,022,873	\$2,151,562	\$4,642,955	\$649,908	\$4,229,829	\$2,824,707
Tier 1 Distribution	\$0	\$0	\$0	\$0	\$0	(\$4,000,000)	(\$4,000,000)	(\$4,000,000)	(\$4,000,000)	(\$4,000,000)	(\$4,000,000)	(\$78,413,074)
Ending Balance	\$40,000,000	\$64,211,409	\$66,324,408	\$68,282,641	\$81,729,704	\$80,891,239	\$79,914,113	\$78,065,675	\$78,708,630	\$75,358,538	\$75,588,367	\$0
LP Tier 1 Cash Flow	(\$40,000,000)	(\$24,000,000)	(\$800,000)	\$0	(\$8,000,000)	\$4,000,000	\$4,000,000	\$4,000,000	\$4,000,000	\$4,000,000	\$4,000,000	\$78,413,074
GP Tier 2 Cash Flow	(\$10,000,000)	(\$6,000,000)	(\$200,000)	\$0	(\$2,000,000)	\$1,000,000	\$1,000,000	\$1,000,000	\$1,000,000	\$1,000,000	\$1,000,000	\$19,603,269
LP IRR Check	8.000000%	0.000000%										
GP IRR Check	8.000000%	0.000000%										
Remaining Cash Flow	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$51,983,657

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KNOW WHAT YOU'RE DOING AND BE DETAILED

CHATGPT PROMPT

Write an Excel VBA function to calculate carried interest for the LP and GP in a real estate deal with specific dates for cash flows. The inputs will be as follows: dealDate range, dealCashFlows range, hurdleRate, lpDistRatio1, gpDistRatio1, lpDistRatio2, gpDistRatio2. Follow these steps to calculate the final output.

1. Calculate an lpCashFlow array by looping over the dealCashFlows and multiply any negative deal cash flows by lpDistRatio1. If a deal cash flow is greater than 0 then the cash flow in lpCashFlow should be 0.
2. Repeat Step 1 for gpCashFlow using gpDistRatio1.
3. Loop through the lpCashFlows.
 - a. At each step calculate the XNPV of the lpCashFlow using dealDate range as the dates, lpCashFlow as the cash flows, and the hurdleRate as the rate. Multiply the result of the XNPV calculation by -1 and call it lpXNPV. Be sure to only use the cash flows from the beginning of the index to the current index in the loop. Calculate XNPV manually with a loop.
 - b. Calculate the future value (lpFV) of lpXNPV using the hurdleRate as the rate. Nper in the formula will be the difference between the first date in the dealDate range and the date in the same index location as the current loop.
 - c. If the deal cash flow in the same index location as the current loop is positive or 0, multiply it by lpDistRatio1 and call it lpCF.
 - d. If the dealCashFlows at the same index is greater than 0 then set the lpCashFlows value to the minimum of lpFV and lpCF.
 - e. Set gpCashFlow at the same index location as the current loop equal to $lpCashFlow / lpDistRatio1 * gpDistRatio1$.
 - f. Calculate remaining deal cash in the step by subtracting the lpCashFlow and gpCashFlow at this index location from the dealCashFlow at the same index location.
 - g. Multiply the remaining deal cash by lpDistRatio2 and add it to the lpCashFlows in the current index location.
 - h. Multiply the remaining deal cash by gpDistRatio2 and add it to the gpCashFlows in the current index location.
4. Sum dealCashFlows, lpCashFlows, and gpCashFlows and return them in a spill.

AI ACCOUNTANT ASSISTANT

The screenshot displays the ChatGPT Plus interface. At the top, the text 'ChatGPT PLUS' is visible. Below this, there are four prompt cards arranged in a 2x2 grid:

- Make up a story**: about Sharky, a tooth-brushing shark superhero
- Suggest fun activities**: to do indoors with my high-energy dog
- Recommend a dish**: to impress a date who's a picky eater
- Write a thank-you note**: to a guest speaker for my class

The main chat area contains two uploaded files:

- ABC Property - 1Q 2023 QTD TB.xlsx
- ABC Property - 2Q 2023 QTD TB.xlsx

The chat message reads:

You are an accountant reviewing the sequential quarterly trial balances for a commercial real estate property. I want you to analyze the trial balances and summarize any errors or mistakes.

Please be sure to check for the following:

1. Ensure the sum of each balance and activity column is equal to 0.
2. Any new or deleted accounts.

The interface includes a plus sign icon on the left and a purple send button on the right.

[AI Accountant Link](#)

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AI-POWERED NCREIF QUERY TOOL

QUERY WITH ENGLISH

AI-POWERED NCREIF QUERY TOOL

Enter your query:

What are returns by property type and quarter in Phoenix?

Example: What are historical office returns in Dallas?

<https://youtu.be/j4cfBb0ZIH0>

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AI BUT MAKE IT EXPLAINABLE

Enter your query:

What are office returns in Phoenix by subtype?

API URL and Parameters

[http://www.ncreif-api.com/API.aspx?KPI>Returns&Where=NPI=1%20and%20\[CBSAName\]=%27AZ-Phoenix-Mesa-Scottsdale%27%20and%20\[PropertyType\]=%27O%27&GroupBy=\[PropertySubType\],\[YYYYQ\]&Format=json&UserName=sdunphy@metlife.com&password=password](http://www.ncreif-api.com/API.aspx?KPI>Returns&Where=NPI=1%20and%20[CBSAName]=%27AZ-Phoenix-Mesa-Scottsdale%27%20and%20[PropertyType]=%27O%27&GroupBy=[PropertySubType],[YYYYQ]&Format=json&UserName=sdunphy@metlife.com&password=password)

KPI Parameter: Returns

Where Statement Parameters:

- NPI=1
- [CBSAName]='AZ-Phoenix-Mesa-Scottsdale'
- [PropertyType]='O'

GroupBy Statement Parameters:

- [PropertySubType],[YYYYQ]

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CONCLUSIONS

1. AI is fallible! Humans must remain in the loop
2. AI will augment your team but not replace it (do more with less)
3. There is no AI silver bullet. There is an opportunity to improve ALL processes
4. AI will democratize coding and data/geospatial analysis
5. Don't conflate AI with automation. AI can automate but automation doesn't always need AI

Disclosures

This presentation has been prepared (in part) by and in conjunction with, MetLife Investment Management (“MIM”)¹ solely for informational purposes and does not constitute a recommendation regarding any investments or the provision of any investment advice, or constitute or form part of any advertisement of, offer for sale or subscription of, solicitation or invitation of any offer or recommendation to purchase or subscribe for any investments or investment advisory services. The views expressed herein do not necessarily reflect, nor are they necessarily consistent with, the views held by, or the forecasts utilized by, the entities within the MetLife enterprise that provide insurance products, annuities and employee benefit programs. Subsequent developments may materially affect the information contained in this presentation. Affiliates of MIM may perform services for, solicit business from, hold long or short positions in, or otherwise be interested in the investments (including derivatives) of any company mentioned herein. This presentation may contain forward-looking statements, as well as predictions, projections and forecasts of the economy or economic trends of the markets, which are not necessarily indicative of the future. Any or all forward-looking statements may turn out to be wrong. All investments involve risks including the potential for loss of principle. The views expressed in this presentation containing those of parties unrelated to MIM do not necessarily reflect, nor are they necessarily consistent with, the views held by MIM. As a result, MIM hereby disclaims responsibility for such content.

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SURVEY QUESTION

- What would you like to see more/less of at the AI themed conference in Phoenix?

TAKEAWAYS?



- The power of GenAI provides many (new) capabilities. Along with those come many considerations on responsible use.
- The trajectory of AI will depend on the ethical, regulatory, and social frameworks that guides its development and usage
- What are use cases for GenAI in our industry? At your firm?

Come explore with us at the NCREIF AI-Themed Spring 2024 Conference in Phoenix, AZ!



THANK YOU!


Questions?




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Resources

References:

1. <https://www.ibm.com/topics/artificial-intelligence>
2. https://en.wikipedia.org/wiki/Artificial_intelligence
3. McCarthy, J (2007) What is Artificial Intelligence  ← Click to access)
4. <https://www.youtube.com/watch?v=21EiKfQYZXc>
5. <https://www.livescience.com/47544-history-of-a-i-artificial-intelligence-infographic.html>

Other Resources:

- Li, Song & Deng, Yu-Qin & Zhu, Zhi-Ling & Hua, Hong-Li & Tao, Ze-Zhang. (2021). A Comprehensive Review on Radiomics and Deep Learning for Nasopharyngeal Carcinoma Imaging. Diagnostics. 11. 1523. 10.3390/diagnostics11091523.
- <https://mitsloan.mit.edu/ideas-made-to-matter/machine-learning-explained>
- <https://chat.openai.com/>
- <https://github.com/features/copilot>
- <https://openai.com/>
- <https://bard.google.com/>
- <https://aws.amazon.com/bedrock/>
- <https://www.techrepublic.com/article/chatgpt-cheat-sheet/>
- https://en.wikipedia.org/wiki/Artificial_neural_network
- Turing, A.M. (1950) Computing Machinery and Intelligence. Mind, 59, 433-460.  ← Click to access the paper)