



Single Day Event

Nurturing Technologies Transforming Clinical Trials Intelligence!

Surendar Sekar / Rijesh Parammal
ICON

Disclaimer

The views, thoughts, and opinions expressed in this presentation belong solely to the authors, and not necessarily to the author's employer, organization, committee or other group or individual.

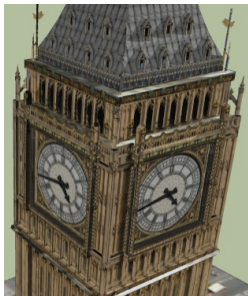
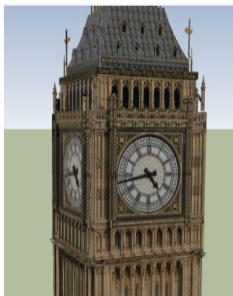
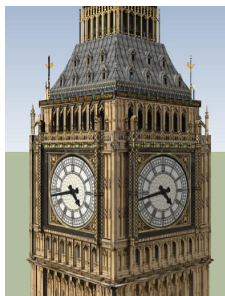
The Famous Clock Tower





BIG Data

- Having more relevant data leads to better decisions and create inferences.





Machine Learning (Deep Learning\Neural Networks)

- Capability of a machine to imitate intelligent human behavior.

Human Intelligence



Data is the DNA of Machine Learning

What's Inside?

Why Artificial Intelligence?

Machine Learning & NLP in real time

Resources, Tools, Package

Utility using NLP

Metaverse in Healthcare – New Era to begin

To become great we should 'Start'



Nurturing Technologies Transforming Clinical Trials Intelligence!



Abstract

Artificial Intelligence - Whole world is talking about it! Over the last few decades, we have seen a significant growth in the use of AI that improve our quality of life. Clinical research industry started to use the terminologies NLP, ML and DL more frequently as those are no longer limited for translators, form filling and image recognition. In clinical research there are multiple barriers right from patient recruitment, data management, data Analysis and decisions making where AI may able to contribute significantly. In this discussion, we will explore how AI can expedite up the Biostatistics and programming area such as creating robust test data, data review and effective medical writing using ML/NLP technologies, while maintaining data reliability. Future, more emerging concepts such as Metaverse, can open up new possibilities for clinical trials?

Why Artificial Intelligence?

Conversation during Performance review between Employee and Manager

So what's
Next?



Worked on utility Macros
Complex Efficacy
Figure development
Initiatives.....etc

Why Artificial Intelligence?

- Artificial intelligence (AI) makes it possible for machines to learn from experience, adjust to new inputs and perform human-like tasks.
- AI works by combining large amounts of data with fast, iterative processing and intelligent algorithms, allowing the software to learn automatically from patterns or features in the data.
- AI automates repetitive learning and discovery through data.
- AI analyzes more and deeper data
- AI adds intelligence
- AI achieves incredible accuracy
- AI adapts through progressive learning algorithms
- AI gets the most out of data

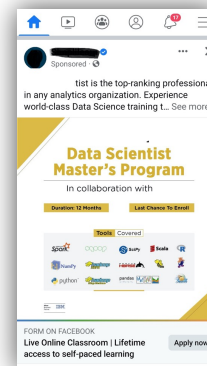
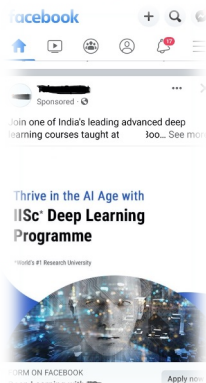
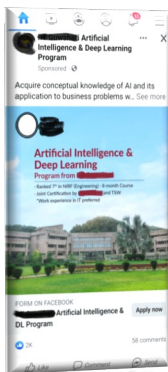
Why Artificial Intelligence?

- Importance to FDA - AI solutions have the potential to improve automation and learning of medical devices, the efficiency of diagnostic/therapeutic development and commercial manufacturing, regulatory assessment, and postmarket surveillance etc. These improvements increase the accuracy of predictive modeling, enable efficient automation of medical devices and manufacturing processes, leverage knowledge management resources to improve regulatory review, and focus and improve postmarket surveillance.
- FDA advances the use of AI to support a diverse set of needs related to FDA-regulated products, including, exploring the use of machine learning (ML) algorithms to:
 - Detect adverse events in different data sets, including post market data
 - Study the effects of using synthesized data sets for training and testing in both pre-market testing and the FDA-regulated product lifecycle
- Evaluating the potential impact of natural language processing (NLP) systems to automatically identify MedDRA code adverse events mentioned in product labels. The labeled status of the MedDRA-coded adverse events in product labels facilitate the triaging and review of the adverse events described in individual case safety reports (ICSRs) submitted to the FDA Adverse Event Reporting System (FAERS).

Resources, Tools, Package

- **How to start?**

- Making a start is the hardest aspect of studying machine learning.
- Too many programming languages.
- Compatibility
- Pros and cons
- Package downloader\Programming Editor



Resources, Tools, Package

- **Packages**

- Reduces Programming efforts
- Easy to focus on the Purpose
- Various sources for AI and its Machine Learning
- Programmers life made easy.

- **Open Source Platform**

- Cost effective, Agility, Variety
- Programming – Python, R, Java, Julia...,etc
- Packages



Utility using NLP

Creating a summary or an abstract of a vast data set in order to extract and consolidate the essential information.



Python Packages

Utility using NLP

- To read the external word document File.
- Pandas package incase of excel, csv file

DOCX\PANDAS

- Tokenization
- String - Punctuation
- Corpus – Stopwords
- Probability - distribution

NLTK

- Priority queue algorithm.
- To get the most frequently used words

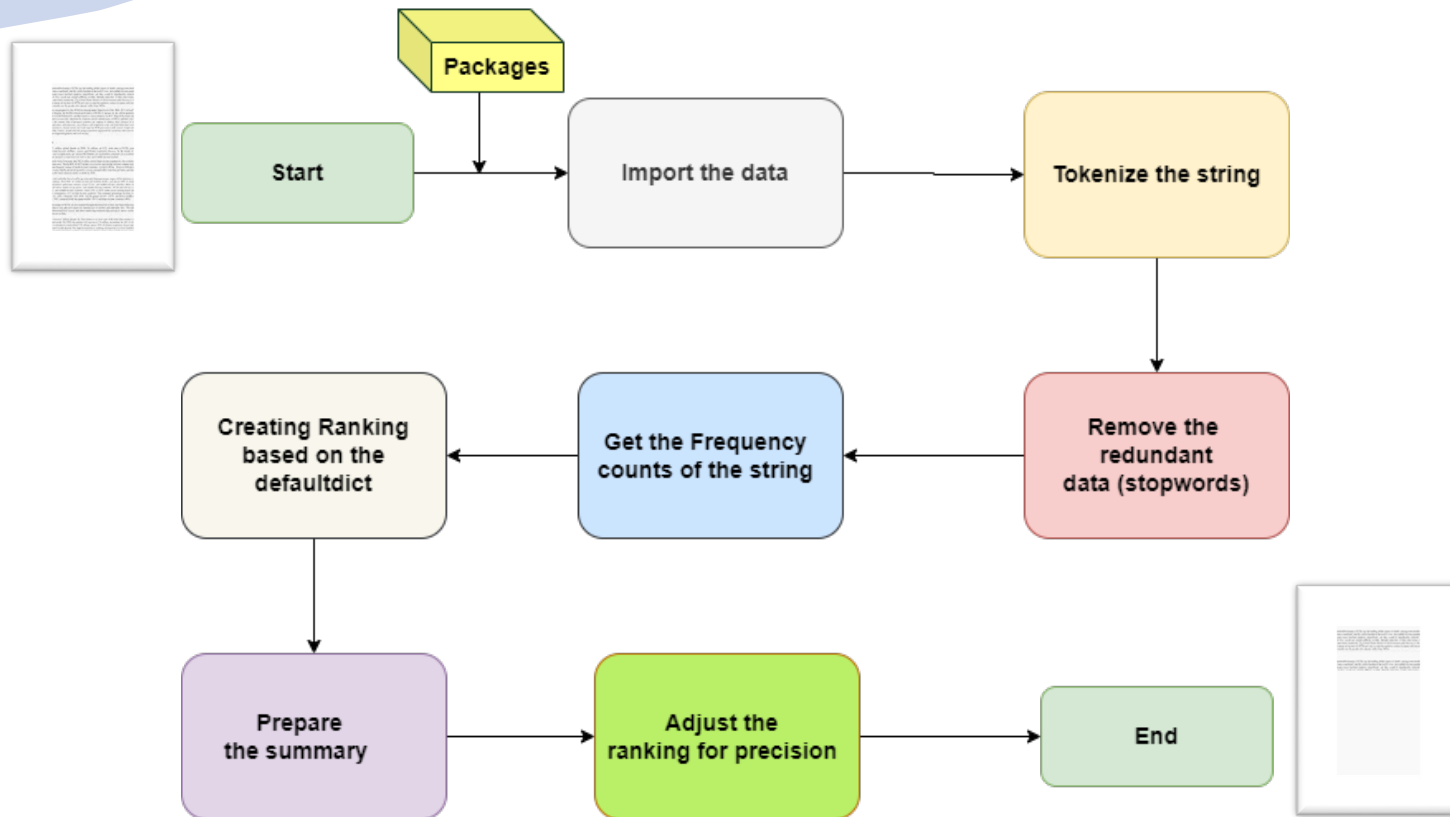
HEAPQ

- Use of defaultdict
- Prioritizing the data

COLLECTIONS

Data flow

Utility using NLP



Programming flow

Utility using NLP

Include the required Packages

```
import nltk
from nltk.tokenize import word_tokenize, sent_tokenize
from nltk.corpus import stopwords
from string import punctuation
```

```
from nltk.probability import FreqDist
from heapq import nlargest
```

```
from nltk.probability import FreqDist
from heapq import nlargest
```

Download the tokenizer and stopwords

```
In [11]: import nltk
nltk.download('punkt')
```

```
[nltk_data] Downloading package punkt to
[nltk_data] C:\Users\Admin\AppData\Roaming\nltk_data...
[nltk_data] Unzipping tokenizers\punkt.zip.
```

```
In [5]: import nltk
nltk.download('stopwords')
```

```
[nltk_data] Downloading package stopwords to
[nltk_data] C:\Users\Admin\AppData\Roaming\nltk_data...
[nltk_data] Package stopwords is already up-to-date!
```

```
Out[5]: True
```


Programming flow

Utility using NLP

Code to import data into python

```
In [3]: import docx
def read_file(filename):
    doc=docx.Document(filename)
    completedText=[]
    for paragraph in doc.paragraphs:
        completedText.append(paragraph.text)
    return '\n' .join(completedText)

doc=read_file('drug_approval.docx')

#print(doc)
```

The screenshot shows a web browser window with the title "drug_approval (Protected View) - W...". The address bar shows a URL starting with "File". The page content is a news article titled "BMS receives US FDA approval for CAR T cell therapy to treat B-cell lymphoma". The article text includes: "Breyanzi's indication will include people whose LBCL is refractory to initial chemo immunotherapy or relapse within a year.", "Breyanzi showed 80% of overall response rate in the PILOT study. Credit: Bristol Myers Squibb.", "Bristol Myers Squibb (BMS) has received approval from the US Food and Drug Administration (FDA) for its CD19-directed chimeric antigen receptor (CAR) T cell therapy Breyanzi (lisocabtagene maraleucel) to treat relapsed or refractory large B-cell lymphoma (LBCL) in adult patients.", "Breyanzi is given as a defined composition for reducing the variability of the CD8 and CD4 component dose.", "It is indicated for the treatment of LBCL, including diffuse large B-cell lymphoma (DLBCL), high-grade B-cell lymphoma, primary mediastinal large B-cell lymphoma, and follicular lymphoma grade 3B in adult patients.", "The regulatory approval expands Breyanzi's indication to include people whose LBCL is refractory to initial chemo immunotherapy or relapse within a year, as well as those with relapsed or refractory disease who are not eligible for hematopoietic stem cell transplant (HSCT) due to comorbidities or age.", "The company stated that the therapy has the broadest patient eligibility of any CAR T cell therapy in relapsed or refractory LBCL, with the two new indications.", "BMS US Hematology senior vice-president and general manager Ester Rankine said: "As part of our commitment to developing innovative cancer treatments for patients with critical unmet need, Breyanzi offers a potentially curative option for more patients.", "Based on the demonstrated clinical benefit, this approval of Breyanzi underscores the significant advances we are making to deliver on the promise of cell therapy.", "The expanded regulatory approval for Breyanzi is based on data obtained from the Phase III TRANSFORM study and Phase II PILOT study.", "In the PILOT study, Breyanzi showed 80% of overall response rate and 54% of CR rate.", "The therapy demonstrated a well-established safety profile along with low grade CRS occurrences and neurologic events which were mostly resolved quickly.", "Recently, BMS and Immatics expanded their strategic partnership to develop multiple allogeneic off-the-shelf T cell receptor-based therapy (TCR-T) and/or CAR-T programmes.", "Cell & Gene Therapy coverage on Pharmaceutical Technology is supported by Cytiva.", "Editorial content is independently produced and follows the highest standards of journalistic integrity. Topic sponsors are not involved in the creation of editorial content."

Programming flow

Utility using NLP

Tokenize the document and remove stopwords and punctuation

```
In [10]:
sents=sent_tokenize(doc)

In [6]: stopwords= stopwords.words('english')+ list(punctuation)

In [21]: word_sent = [word for word in word_sent if word not in stopwords]
```

Tokenize on rules

Let	's	tokenize	!	Is	n't	this	easy	?
-----	----	----------	---	----	-----	------	------	---

Tokenize on punctuation

Let	'	s	tokenize	!	Isn	'	t	this	easy	?
-----	---	---	----------	---	-----	---	---	------	------	---

Tokenize on white spaces

Let's	tokenize!	Isn't	this	easy?
-------	-----------	-------	------	-------

Let's tokenize! Isn't this easy?

Find the largest occurrence from the tokens

```
In [32]: freq=FreqDist(word_sent)

In [34]:
nlargest(10, freq, key=freq.get)

Out[34]: ['breyanzi',
          'cell',
          'therapy',
          'lymphoma',
          'ibcl',
          'refractory',
          'approval',
          'b-cell',
          'study',
          'patients']

In [35]: from collections import defaultdict
         ranking = defaultdict(int)
         for i, sent in enumerate(sents):
             for w in word_tokenize(sent.lower()):
                 if w in freq:
                     ranking[i] += freq[w]

In [36]: ranking
```



Programming flow

Utility using NLP

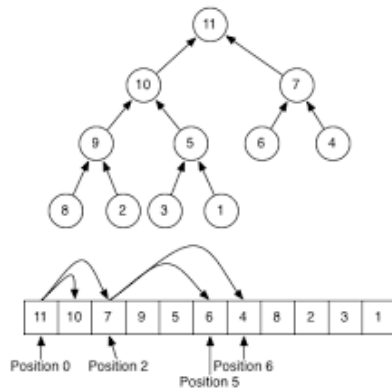
Output results

```
In [20]: sent_idx = nlargest(5, ranking, key=ranking.get)
         sent_idx
```

```
Out[20]: [3, 0, 9, 6, 5]
```

```
In [21]: [sents[j] for j in sorted(sent_idx)]
```

```
Out[21]: ['BMS receives US FDA approval for CAR T cell therapy to treat B-cell lymphoma\nBreyanzi's indication will include people whose LBCL is refractory to initial chemoimmunotherapy or relapse within a year.',
          'Bristol Myers Squibb (BMS) has received\ from the US Food and Drug Administration (FDA) for its CD19-directed chimeric antigen receptor (CAR) T cell therapy Breyanzi (lisocabtagene maraleucel) to treat relapsed or refractory large B-cell lymphoma (LBCL) in adult patients.',
          'It is indicated for the treatment of LBCL, including diffuse large B-cell lymphoma (DLBCL), high-grade B-cell lymphoma,\ and follicular lymphoma grade 3B in adult patients.',
          'The regulatory approval expands Breyanzi's indication to include people whose LBCL is refractory to initial chemoimmunotherapy or relapse within a year, as well as those with relapsed or refractory disease who are not eligible for hematopoietic stem cell transplant (HSCT) due to comorbidities or age.',
          '"Based on the demonstrated clinical benefit, this approval of Breyanzi underscores the significant advances we are making to deliver on the promise of cell therapy."\n\nThe expanded regulatory approval for Breyanzi is based on data obtained from the Phase III TRANSFORM study and Phase II PILOT study.']
```



Create Output

```
In [41]: doc_out.add_heading('Summary of Breyanzi FDA Approval', 0)
         doc_para = doc_out.add_paragraph(sents)
         doc_out.save('drug_approval_summary.doc')
```

Programming flow

Utility using NLP

BMS receives US FDA approval for CAR T cell therapy to treat B-cell lymphoma

Breyenz's indication will include people whose LBCL is refractory to initial chemo immunotherapy or relapse within a year.

Breyenz showed 10% of overall response rate in the PILOT study. Credit: Bristol Myers Squibb

Bristol Myers Squibb (BMS) has received approval from the US Food and Drug Administration (FDA) for its CD19-directed chimeric antigen receptor (CAR) T cell therapy Breyenz (lisocabtagene maraleucel) to treat relapsed or refractory large B-cell lymphoma (LBCL) in adult patients.

Breyenz is given as a defined composition for reducing the variability of the CD3 and CD4 component dose.

It is indicated for the treatment of LBCL, including diffuse large B-cell lymphoma (DLBCL), high-grade B-cell lymphoma, primary mediastinal large B-cell lymphoma, and follicular lymphoma grade 1B in adult patients.

The regulatory approval expands Breyenz's indication to include people whose LBCL is refractory to initial chemo immunotherapy or relapse within a year, as well as those with relapsed or refractory disease who are not eligible for hematopoietic stem cell transplant (HSCT) due to comorbidities or age.

The company stated that the therapy has the broadest patient eligibility of any CAR T cell therapy in relapsed or refractory LBCL, with the fewest side effects.

BMS US Hematology senior vice-president and general manager Peter Brange said, "As part of our commitment to developing innovative cancer treatments for patients with critical unmet need, Breyenz offers a potentially curative option for more patients."

"Based on the demonstrated clinical benefit, this approval of Breyenz underscores the significant advances we are making to deliver on the promise of cell therapy."

The expanded regulatory approval for Breyenz is based on data obtained from the Phase III TRANSFORM study and Phase I PILOT study.

In the PILOT study, Breyenz showed 10% of overall response rate and 54% of CR rate.

The therapy demonstrated a well-established safety profile along with low grade CRS occurrences and neurologic events which were mostly resolved quickly.

Recently, BMS and Immatics expanded their strategic partnership to develop multiple allogeneic off-the-shelf CAR receptor-based therapy (CD19-T) and/or CAR-T programmes.

Cell & Gene Therapy coverage on Pharmaceutical Technology is supported by Qeios.

Editorial content is independently produced and follows the highest standards of journalistic integrity. Type queries are not provided in the location of editorial content.

BMS receives US FDA approval for CAR T cell therapy to treat B-cell lymphoma

BMS receives US FDA approval for CAR T cell therapy to treat B-cell lymphoma

Breyenz's indication will include people whose LBCL is refractory to initial chemo immunotherapy or relapse within a year.

Bristol Myers Squibb (BMS) has received approval from the US Food and Drug Administration (FDA) for its CD19-directed chimeric antigen receptor (CAR) T cell therapy Breyenz (lisocabtagene maraleucel) to treat relapsed or refractory large B-cell lymphoma (LBCL) in adult patients.

The regulatory approval expands Breyenz's indication to include people whose LBCL is refractory to initial chemo immunotherapy or relapse within a year, as well as those with relapsed or refractory disease who are not eligible for hematopoietic stem cell transplant (HSCT) due to comorbidities or age.

Based on the demonstrated clinical benefit, this approval of Breyenz underscores the significant advances we are making to deliver on the promise of cell therapy.

The expanded regulatory approval for Breyenz is based on data obtained from the Phase III TRANSFORM study and Phase I PILOT study.

- It is a simple beginning that prepares text data for subsequent analysis, such as with ML models for starters.
- Along with NLTK which offers a number of algorithms, spaCy provides the quickest and most accurate syntactic analysis for NLPs.
- Deep learning enhances natural language processing accuracy without requiring considerable human input.

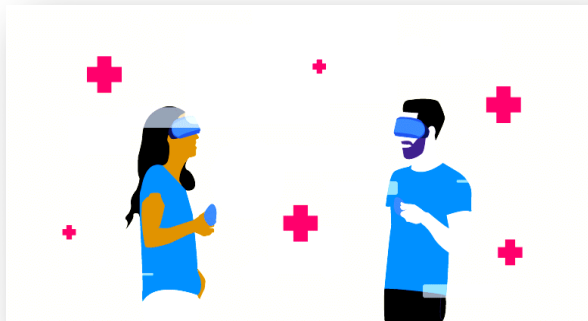
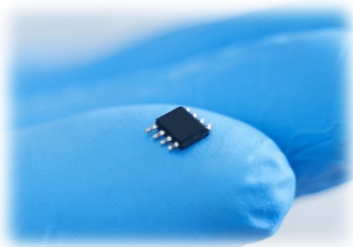


Metaverse in Healthcare – New Era to begin

Fantasy to Reality

Tomorrow Never Dies

Its technology endures



Metaverse in Healthcare

The **Metaverse** is essentially a whole virtual environment that simulates aspects of reality. It employs a variety of technologies such as,

- Artificial intelligence
- Virtual reality
- Augmented reality 3D animation
- Blockchain

AI enables computers to make autonomous decisions, largely through machine learning.



Healthcare practitioners will be able to provide more collaborative treatment options in the health Metaverse.

Global COVID-19 pandemic had accelerated the development of Metaverse technologies.

Imagine having a follow up meeting with your doctor in virtual clinic.

Better converse with the patient and collect precise health records

Metaverse in Healthcare

Evidence suggests that **Virtual Reality Exposure Therapy (VRET)** may be effective in treating symptoms of **Post Traumatic PTSD**. There are a number of studies that have shown that VRET is linked to reduced symptom severity in both PTSD and depression, and that as the number of VRET sessions increases, the effectiveness of symptom reduction also increases.

Historically, up to **80% of delays in clinical trial** timelines are due to challenges with **patient recruitment and retention**, with 37% of sites under-enrolling and 11% failing to recruit a single participant. The latest research suggests around 40% of those who sign up for a study drop out before it completes.

Global Metaverse in Healthcare Market is anticipated to exhibit a stunning **CAGR of 33.7%** to reach a market size of US\$ 7453.6 Million by the end of 2028 during the forecast period of 2022-2028. The global market size for metaverse in healthcare worth **US\$ 5056.4 Million in 2021**.

What we may expect?

- Enhances decentralized clinical trials and .
- Promotes eConsenting, Electronic Health Records and Wearable devices in different clinical trials.
- Better Patient retention and lower drop out
- Minimize the missing data information in the analysis.
- Acquire more data from a wider range of sources.

To become great we have to 'Start'

- Artificial Intelligence term originated in 1950s.
- Machine Learning coined in 1960s
- Deep Learning and Neural Networks in 1980s
- Metaverse discussion started in 1990s

Better Later than Never

- The Role of artificial intelligence in clinical trials isn't just a passing trend in fact it will enhance a better and quality analysis.
- The machine learning algorithms can deliver critical insights that aid in improved decision-making, with Deep learning leveraging to next level.
- NLP has been most successful in improving the health records by effectively interpreting clinical data and extracts key information.
- The availability of these open source tools and package enhances the technology growth and innovation faster.
- Big data and right AI algorithm accelerate the speed of the clinical trial and increases accuracy of the results.

References

AI & Machine Learning

<https://www.fda.gov/science-research/focus-areas-regulatory-science-report/focus-area-artificial-intelligence>

https://www.sas.com/en_in/insights/analytics/what-is-artificial-intelligence.html

<https://www.springboard.com/blog/data-science/best-language-for-machine-learning/>

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6616181/>

<https://www.edureka.co/blog/machine-learning-applications/>

<https://healthitanalytics.com/news/machine-learning-can-help-predict-severe-covid-19>

<https://www.brookings.edu/research/why-is-ai-adoption-in-health-care-lagging/>

<https://www.iconplc.com/insights/digital-disruption/ai-and-clinical-trials/>

<https://mdgroup.com/blog/the-ultimate-guide-to-the-future-of-clinical-research>

NLP\ Machine Learning

<https://www.businesswire.com/news/home/20220823005608/en/Artificial-Intelligence-enabled-Drug-Discovery-Report-2022-Artificial-Intelligence-AI-is-Set-to-Transform-Industry-Landscape---ResearchAndMarkets.com>

<https://www.analyticssteps.com/blogs/8-applications-neural-networks>

References(contd.)

Stats vs AI\ML\DL Meme

https://www.linkedin.com/posts/erelt_machinelearning-deeplearning-datascience-activity-6971768313932599296-lfk9?utm_source=share&utm_medium=member_android

Metaverse

<https://healthcarebusinessclub.com/articles/healthcare-provider/technology/metaverse-in-healthcare/>

<https://timesofindia.indiatimes.com/blogs/voices/benefits-of-metaverse-in-the-healthcare-industry/>

<https://www.statista.com/statistics/1302264/metaverse-acceleration-due-to-covid-19/>

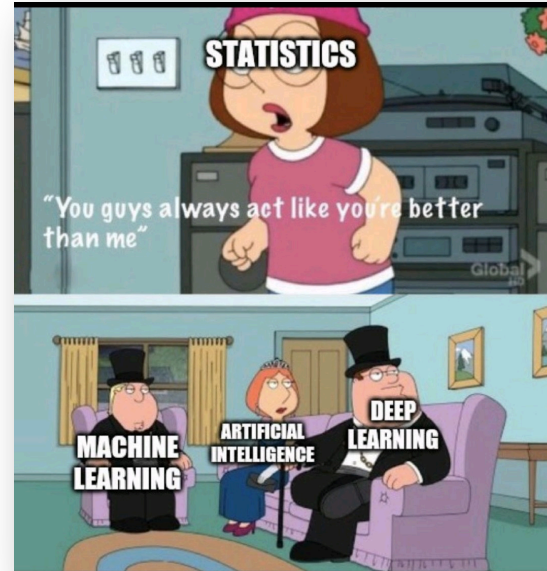
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6713125/>

<https://www.unite.ai/how-ai-is-bringing-the-metaverse-to-life/>

Thank you!

Questions

Discussions





The Global Healthcare Data Science Community

Contact Channels

- UK +44 1843 609600
- office@phuse.global
- phuse.global

Social Media

- @phusetwitta
- /phusebook
- /phusetube
- /company/phuse