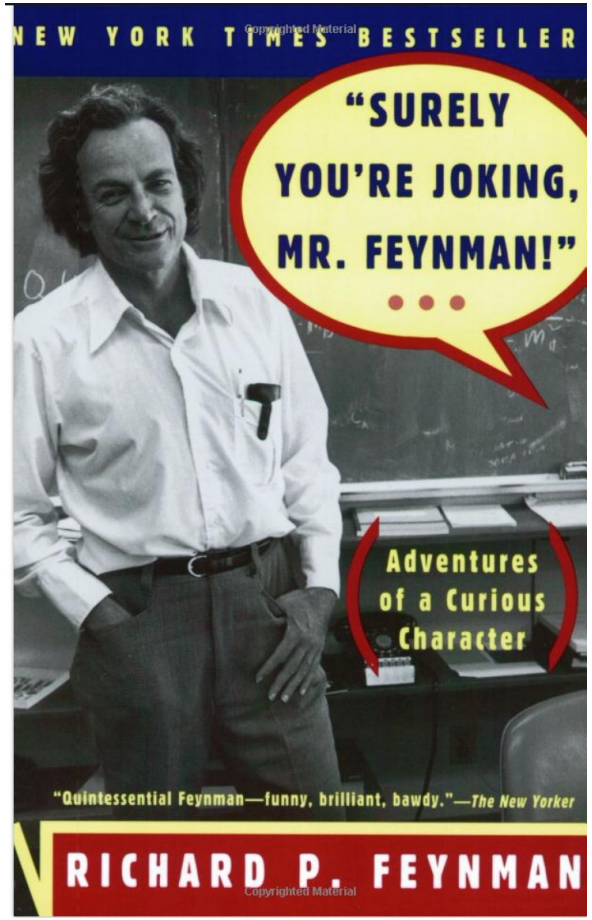
Homework 1

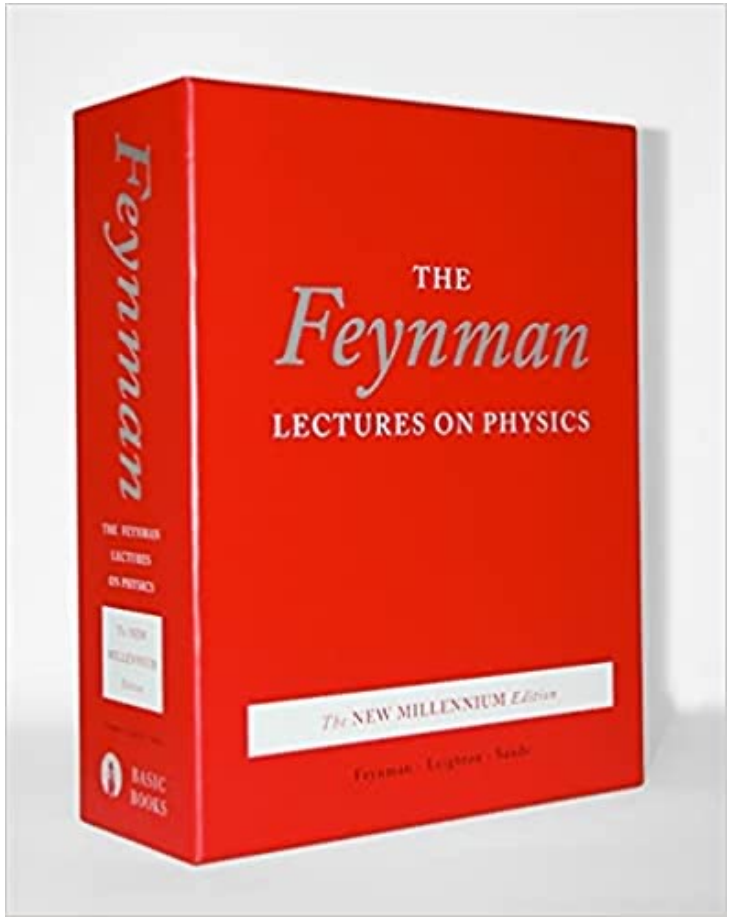
Homework 2: Feynman

- In 1979, Richard Feynman delivered four famous lectures on quantum electrodynamics at Auckland University.
- Based on the four lectures, the book QED:
  - The Strange Theory of Light and Matter,
- which presents a readable account of the theory of quantum electrodynamics *for general audience*, was published in 1985.
- This video was the first of the four lectures.

- Citation counts of QED:
  - The Strange Theory of Light and Matter
  - 3296 citations from Google Scholar (2006 Edition)
  - 800 citations from Semantic Scholar (1985 Edition)

for general audience





Feynman

- Although Richard Feynman was an extremely successful physicist worthy of a Nobel Prize,
  - one of his greatest accomplishments is the development of diagrams simple enough for the average person to comprehend quantum mechanics,
  - but without loss of information.
- Combined with his humor and minimal use of highly technical terms, his presentation becomes more convincing and plausible.
  - Suddenly, quantum theory is not some mysterious and elusive idea anymore.

Hamming

- “Those who cannot remember the past are condemned to repeat it”
- history doesn’t repeat itself, but…
- accepting that some problems are unsolvable

- Learning to Learn
- Importance of meta issues
- Strategic Vision
- Predictions: Physics vs. CS
- Context: Hamming & Feynman
- Healthy disrespect for authority

Citations: Our instructions are underspecified

Feynman

- Google Scholar: 3296
- Semantic Scholar: 800

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Hamming

- Google Scholar: 102
- Semantic Scholar: 50

Hero Worship: Fads come and fads go

- While there are great minds such as
  - Yoshua Bengio, Geoffrey Hinton, and Yann LeCun,
  - who have been deemed the “Godfathers of Artificial Intelligence”,
  - they are not the only ones who have significantly contributed to progress in this discipline.

Pendulum Swung Too Far

http://languagelog.ldc.upenn.edu/myl/ldc/swung-too-far.pdf

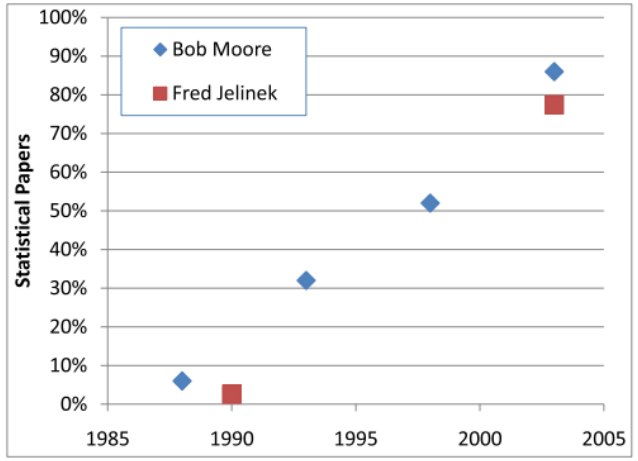


FIGURE 1 The shift from Rationalism to Empiricism is striking (and no longer controversial). This plot is based on two independent surveys of ACL meetings by Bob Moore and Fred Jelinek (personal communication).

present.[3]

However, if we consider a larger time window that goes back well before the ACL Anthology, as illustrated in Figure 2, we see a very different picture. The more salient trend is the oscillation between Rationalism and Empiricism and back with a switch every couple decades:

- 1950s: Empiricism (Shannon, Skinner, Firth, Harris)
- 1970s: Rationalism (Chomsky, Minsky)
- 1990s: Empiricism (IBM Speech Group, AT&T Bell Labs)
- 2010s: A Return to Rationalism?

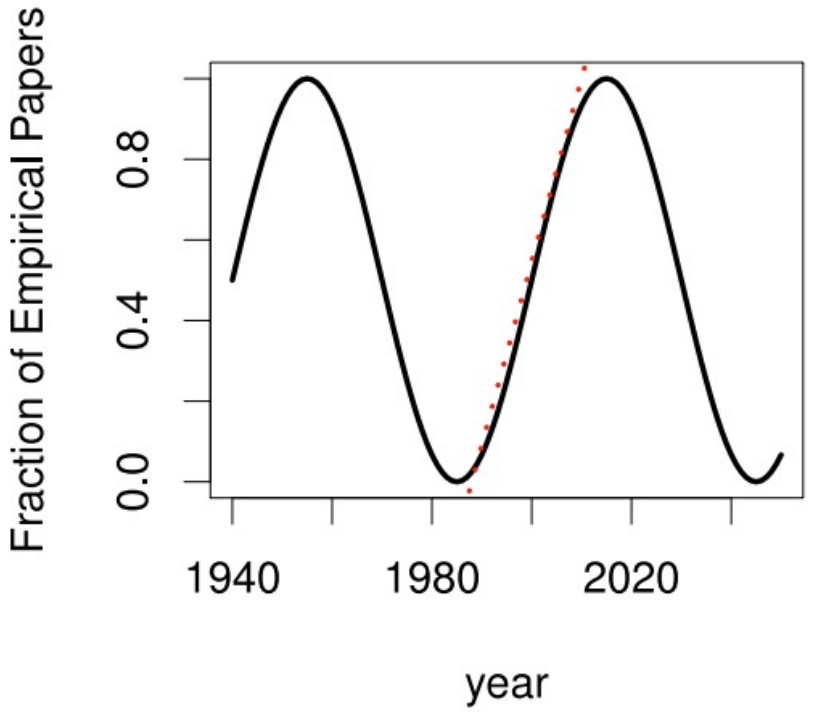


FIGURE 2 An extreme view of the literature, where the trend in Figure 1 (denoted by a dashed red line) is dominated by the larger oscillation every couple of decades. Note that that line is fit to empirical data, unlike the oscillation which is drawn to make a point.

Meta-Issues

- wave-particle duality

- bureaucracy: pro & cons
- implications for Navy
  - relevance to audience

Proposals

Two Questions

Do-able (painful)

- Evidence that you can deliver
  - on-time & on-budget
  - with available resources
- Circumscribe problem
  - WordNet vs. Cyc
- Identify Steps (Bottlenecks)
- Goals, Metrics/Evaluation, Milestones
- Timeline:
  - MVP (minimum viable product)
  - Midpoint evaluation
  - Final report

Worth Doing (painless)

- For-profit:
  - Business Case
- Non-profit:
  - If successful, how will your project make the world a better place?

NSF Proposals

- Summary
  - Need
  - Current Status
  - Approach

1. Intellectual Merit
2. Broader Impacts
   - NSF has a mandate to do more than just science
   - Education, Diversity, etc.

https://beta.nsf.gov/science-matters/nsf-101-five-tips-your-broader-impacts-statement

- How does your research impact society?
- Scientists and engineers funded by the U.S. National Science Foundation are
  - accountable to taxpayers for conducting research,
  - and collectively moving their research beyond the lab to impact the public good,
  - thereby benefitting the economy, society and discovery itself.
- This is what NSF defines as "Broader Impacts."

https://beta.nsf.gov/science-matters/nsf-101-five-tips-your-broader-impacts-statement

- Full participation of women, persons with disabilities and underrepresented minorities in STEM.
- Improved STEM education and educator development at any level.
- Increased public scientific literacy and public engagement with science and technology.
- Improved well-being of individuals in society.
- Development of a diverse, globally competitive STEM workforce.
- Increased partnerships between academia, industry and others.
- Improved national security.
- Increased economic competitiveness of the U.S.
- Enhanced infrastructure for research and education.

Project Suggestions

Enterprise Search

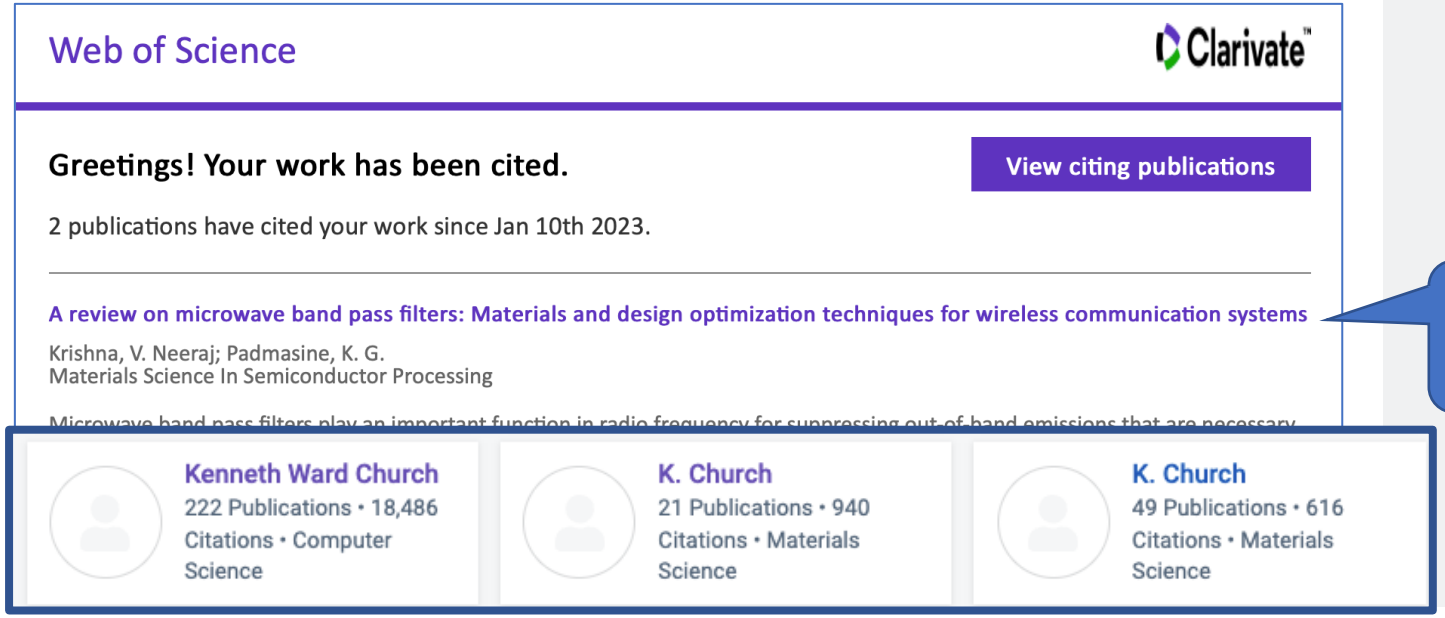
- Omar's pitch on the 1st class
  - People in industry (usually) don't talk about stuff they are really working on
  - But there is more talk than you might expect
    - https://www.amazon.com/Regional-Advantage-Culture-Competition-Silicon/dp/0674753402
- Enterprise Search: Some history of failures
  - https://en.wikipedia.org/wiki/Google_Search_Appliance
  - Enterprise search is harder than web search because of network effects
    - https://en.wikipedia.org/wiki/Metcalfe%27s_law
    - When benefits scale with edges (links between pages)
      - and costs scale with nodes (web pages)
      - then rich get richer (easier to find good stuff in larger graphs than smaller graphs)
      - (There are more links to good stuff in larger graphs)

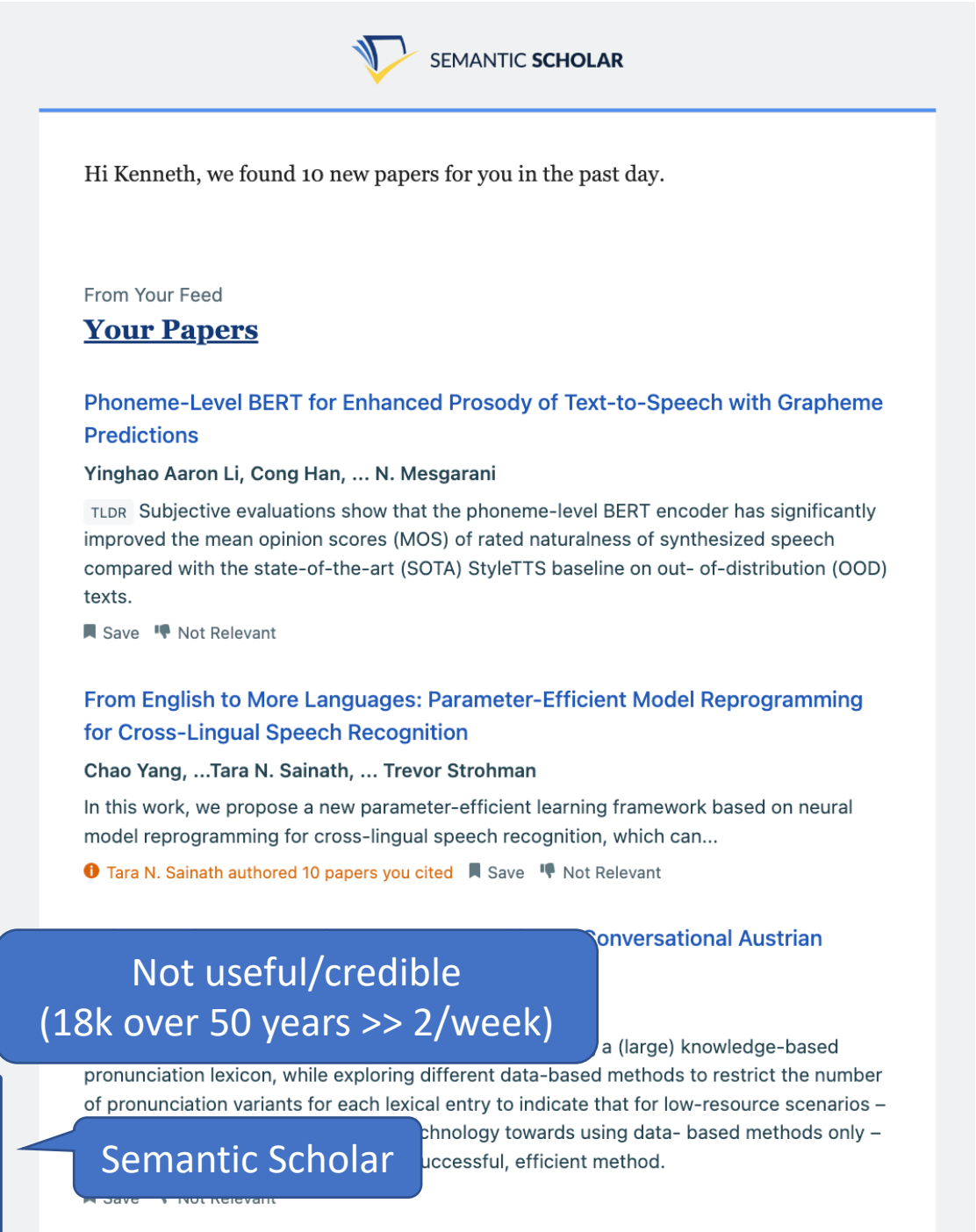
Conference Automation

- Routing of submissions to reviewers
  - https://blog.allenai.org/conference-peer-review-with-the-semantic-scholar-api-24ab9fce2324
- Current status:
  - Many venues use routing tools:
    - https://openreview.net/
    - https://easychair.org/
    - https://www.softconf.com/
    - https://cmt3.research.microsoft.com/
  - Not clear these tools are safe and effective (better than manual routing)
  - Tools are too hard for program committees (see blog above)

Recommender Systems

- I regularly receive spam suggestions
  - Rarely credible
  - At best, recommendations are
    - recent,
    - buzz-word compliant
    - but not credible
  - Credible (Seminal) >> Recent



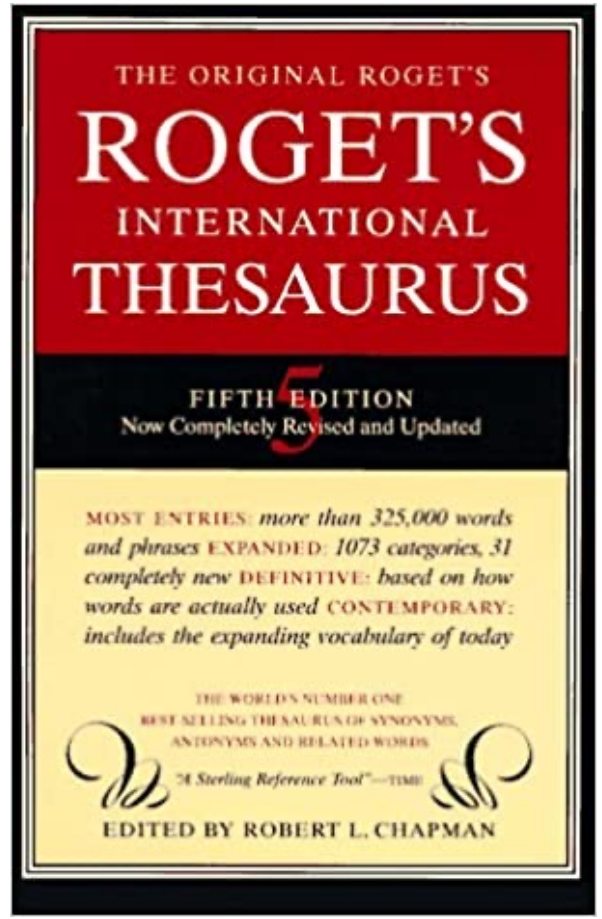


Not useful/credible
(18k over 50 years >> 2/week)

Semantic Scholar

Thesaurus → Deep Nets (ChatGPT)

- Good writers use resources
  - Dictionaries, Thesauruses, etc.
- Active vocab << Passive vocab
  - Hard to find the right word,
  - But easier when prompted
  - (Especially in 2nd language)
- So too, there may be a role for deep nets
  - https://www.npr.org/2023/01/24/1151160196/how-to-stop-worrying-and-love-or-at-least-live-with-chatgpt
- Deep nets are better on fluency than truth
  - https://www.cambridge.org/core/journals/natural-language-engineering/article/gpt3-whats-it-good-for/0E05CFE68A7AC8BF794C8ECBE28AA990
  - "Unreliable doesn't mean useless"



Nanny Cameras for Young and Old

- In China, massive migration from rural areas to cities
  - Cities are not designed for families
  - Workers move to cities, and leave children with their parents in rural areas
  - Children miss their parents (might see them just once a year at New Year)
  - Workers can do 30 minutes of homework per day before calling home
  - Can we summarize a day of video down to 30 minutes?
- In much of the world, seniors are living alone, far from their children
  - Children would like to know that their parents are ok
  - If parents fall, or need help, could nanny cam take appropriate action
    - No need for wake-up words
    - My father couldn't remember ``Alexa''
    - If he fell, he wouldn't think to ask for help (because that wasn't a thing in his day)

Where is my phone? My kid? My father?

- Where did I leave my keys?
- Where are my eyeglasses?
  - You shouldn’t need your eyeglasses to find your eyeglasses…
- Where is that book I was reading a few years ago?

Where did my day go?

- Can you help me be more productive?
- Time and motion study of my life
- https://en.wikipedia.org/wiki/MyLifeBits

Workflow

- Example scenario: Access to medical expertise
  - Better hospitals in urban areas than rural areas in China (and everywhere)
  - Medical expertise tends to be concentrated near top medical schools
  - Biopsies from rural areas are digitized and sent to experts
  - No need for expertise to be physically near patients
- Traditionally, Amazon Mechanical Turk is used for low-skill tasks
  - Is there a Human-in-the-Loop opportunity for high-skill task?
- If so, can we log workflows to collect data for machine learning?
- Can we create exchanges like Ad exchange, Futures exchange (FTX)
  - https://en.wikipedia.org/wiki/Ad_exchange

BOTUS

https://www.npr.org/transcripts/522897876

- Today on the show PLANET MONEY builds a robot,
  - a bot to trade stocks with real money.
- The official Twitter handle, yeah. BOTUS, bot of the United States.
- Task
  - Input: Trump Tweets
  - Output: Trades

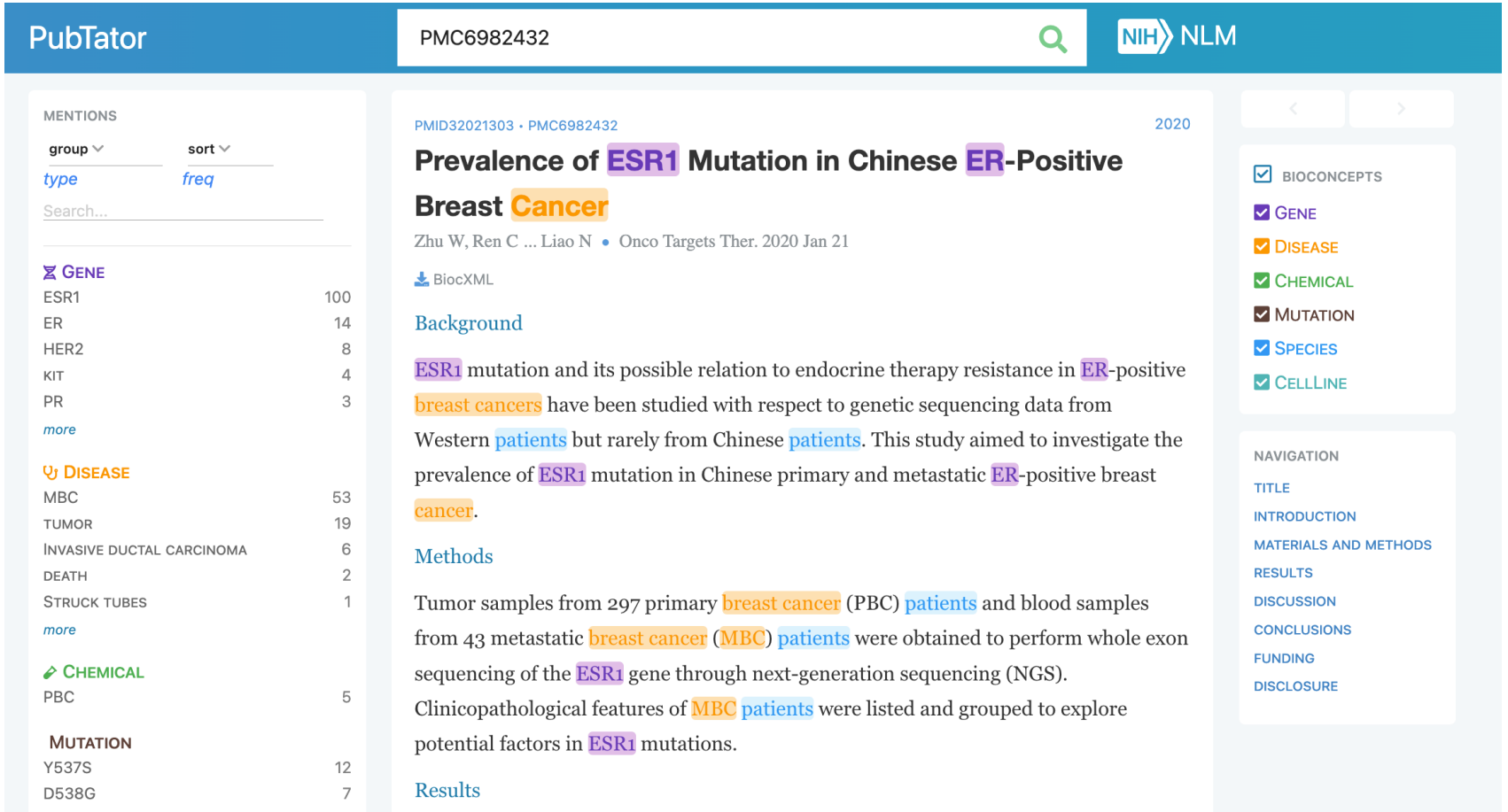
- Technologies
  - Crawl tweets
    - Filter for Trump tweets
  - Sentiment analysis
    - Tweet → Buy / Sell
  - Named Entity Recognition (NER)
    - Tweet → Stock
- Spoiler Alert:
  - They lost $$

HuggingFace Tutorials

- Sentiment Analysis
  - https://huggingface.co/blog/sentiment-analysis-python
- Named Entity Recognition (NER)
  - https://huggingface.co/dslim/bert-base-NER
  - https://huggingface.co/course/chapter7/2
- General Fine-Tuning (GFT)
  - https://github.com/kwchurch/gft

PubTator

https://www.ncbi.nlm.nih.gov/research/pubtator/?view=docsum&query=PMC6982432

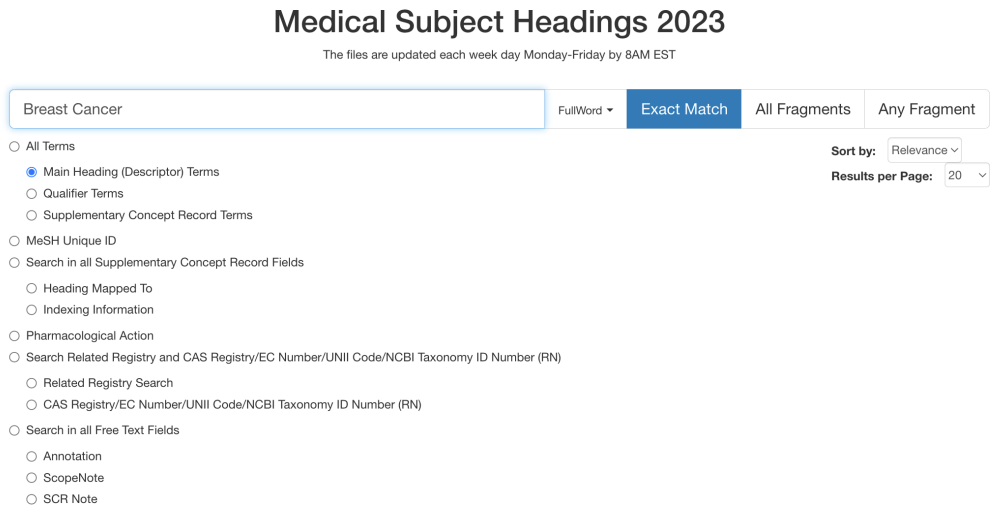


Medical Resources

- PubTator: Abstracts (papers) with annotations (entities)
  - https://www.ncbi.nlm.nih.gov/research/pubtator/?view=docsum&query=PMC6982432
- Pubmed: Abstracts (papers) with annotations (MeSH)
  - https://www.ncbi.nlm.nih.gov/mesh/
- MeSH: Medical Subject Headings (Ontology / Knowledge Graph)
  - https://www.ncbi.nlm.nih.gov/mesh/

MeSH

https://meshb.nlm.nih.gov/search



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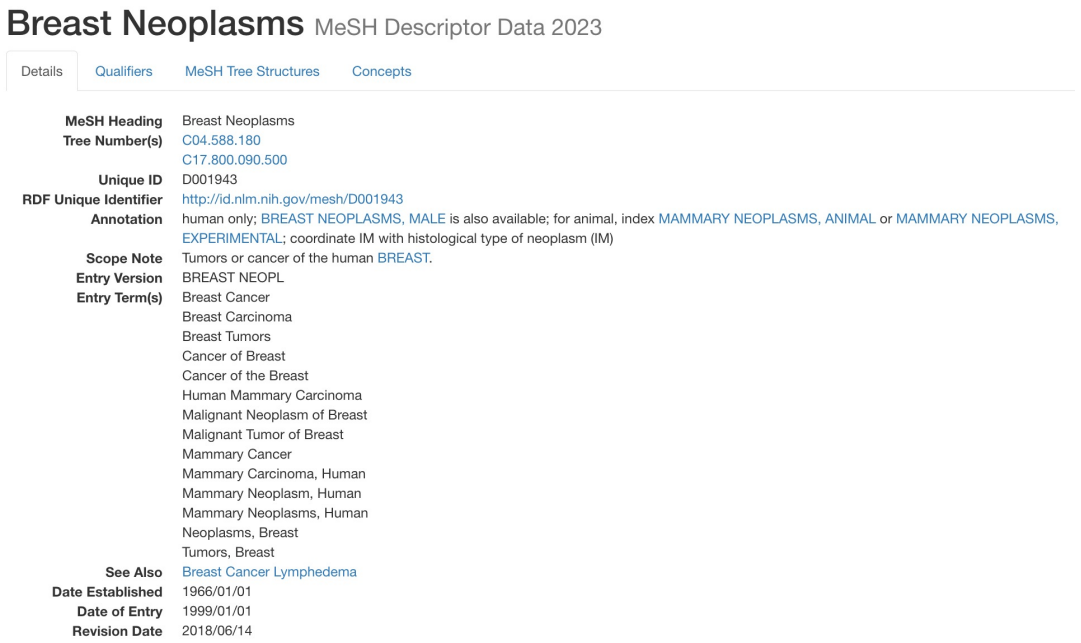

Many start-up companies in this space

- Use cases
  - Personalized medicine:
    - Many rare diseases
    - Literature is large (and growing quickly)
    - Doctors can’t keep up
    - Opportunity to help doctors find papers relevant to patient
  - Bloomberg-terminal for drug companies
  - Electronic Health Records
    - Map records to codes (for insurance purposes)
      - Maximize bills (for doctors)
      - Minimize bills (for insurance companies)

Wikipedia search

- Can we improve Wikipedia search?
- What would be an alternative to 10-blue links for Wikipedia?
- https://en.wikipedia.org/wiki/Wikipedia:Database_download

Q&A systems

- Question-answering system exist from the early days.
- Quora, StackOverflow, etc.
- ChatGPT is a new incarnation
- What to do when there are potentially alternative answers?
- How to organize non-factoid answers

Labeling

- Ground truth is a key component of ML projects
- Current tools like Mechanical Turk are somewhat primitive
- Are there new alternatives for content moderation tasks?
- Further reading
  - https://www.wired.com/2014/10/content-moderation/
  - https://time.com/6247678/openai-chatgpt-kenya-workers/

Exclusive: OpenAI Used Kenyan Workers on Less Than $2 Per Hour to Make ChatGPT Less Toxic

ADRIAN CHEN BACKCHANNEL OCT 23, 2014 6:30 AM

The Laborers Who Keep Dick Pics and Beheadings Out of Your Facebook Feed

Inside the soul-crushing world of content moderation, where low-wage workers soak up the worst of humanity and keep it off your screens.

Reddit

- Lots of interesting content on Reddit
- Not well organized and not easy to find
- Perception that Google’s search is not as good as it used to be
- How would you organize Reddit data for better access?
- https://dkb.io/post/google-search-is-dying
- https://paperswithcode.com/dataset/reddit