FAKULTÄT FÜR
INFORMATIK

Credible AI

A Search Engine with Explainable Artificial Intelligence
Ideas for Scientific Team Projects

B2B Use Case: Political News Credibility, Support Banks by detecting potential NPAs
B2C Use Case: Freemium Search Engine for Credible, Trustworthy News

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Topics

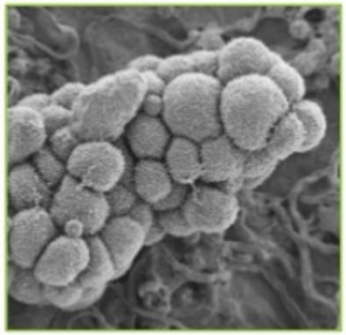
- The AI Hype Story
- The trust and credibility issues with AI
- How AI systems like search engines can go wrong
- Our proposed solution – ExDocS
- 3 Use Cases (Target customers & Revenue model)
- Product Architecture using MEAN stack
- Link to our product Demo
- Challenges, Limitations
- About Our Team, Past Work, Legal Entities

Heard about AI/Deep Learning (DL)?

Deep Learning Everywhere

INTERNET & CLOUD

Image Classification
Speech Recognition
Language Translation
Language Processing
Sentiment Analysis
Recommendation



MEDICINE & BIOLOGY

Cancer Cell Detection
Diabetic Grading
Drug Discovery

MEDIA & ENTERTAINMENT

Video Captioning
Video Search
Real Time Translation

SECURITY & DEFENSE

Face Detection
Video Surveillance
Satellite Imagery

AUTONOMOUS MACHINES

Pedestrian Detection
Lane Tracking
Recognize Traffic Sign

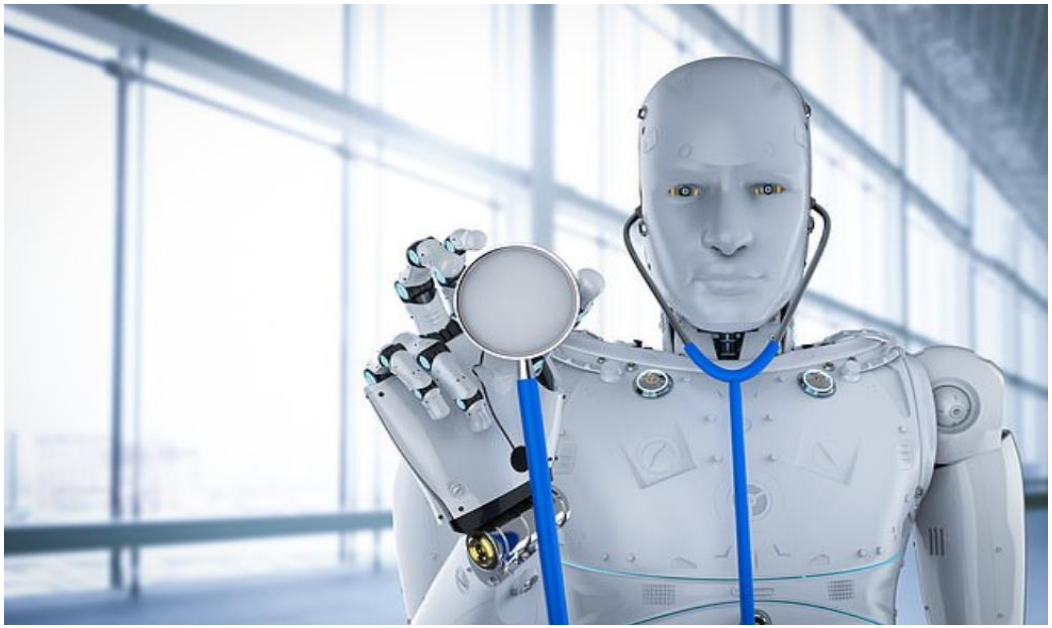
Click on the image to reach the source

AI Healthcare apps approved by US FDA

Company	FDA Approval	Indication
Apple	September 2018	Atrial fibrillation detection
Aidoc	August 2018	CT brain bleed diagnosis
iCAD	August 2018	Breast density via mammography
Zebra Medical	July 2018	Coronary calcium scoring
Bay Labs	June 2018	Echocardiogram EF determination
Neural Analytics	May 2018	Device for paramedic stroke diagnosis
IDx	April 2018	Diabetic retinopathy diagnosis
Icometrix	April 2018	MRI brain interpretation
Imagen	March 2018	X-ray wrist fracture diagnosis
Viz.ai	February 2018	CT stroke diagnosis
Arterys	February 2018	Liver and lung cancer (MRI, CT) diagnosis
MaxQ-AI	January 2018	CT brain bleed diagnosis
Alivecor	November 2017	Atrial fibrillation detection via Apple Watch
Arterys	January 2017	MRI heart interpretation

Click on the image to reach the source

Will patients trust an AI based doctor?



Click on the image to reach the source

Will doctors trust AI based predictions?

IBM pitched its Watson supercomputer as a revolution in cancer care. It's nowhere close

By CASEY ROSS @byCaseyRoss *and* IKE SWETLITZ @ikeswetlitz / SEPTEMBER 5, 2017

Click on the image to reach the source

What went wrong with IBM Watson?

The origins of trust issues: It's a human thing

The problem with Watson for Oncology was that doctors simply didn't trust it. Human trust is often based on our understanding of how other people think and having experience of their reliability. This helps create a psychological feeling of safety. AI, on the other hand, is still fairly new and unfamiliar to most people. It makes decisions using a complex system of analysis to identify potentially hidden patterns and weak signals from large amounts of data.

Click on the image to reach the source

Will you trust AI systems when….

- A Google algorithm that classifies people of colour as gorillas.
- A self-driving Uber that runs a red light in San Francisco.
- An automated YouTube ad campaign that displays ads next to anti-semitic and homophobic videos.
- An Amazon Alexa device that starts offering adult content to children.
- A Pokémon Go algorithm that replicates and amplifies racial segregation.
- A Microsoft chatbot that decides to become a white supremacist in less than a day.
- A Tesla car operating in autopilot mode that resulted in a fatal accident.

Click on the image to reach the source

Talking point – Transparency, Trust…

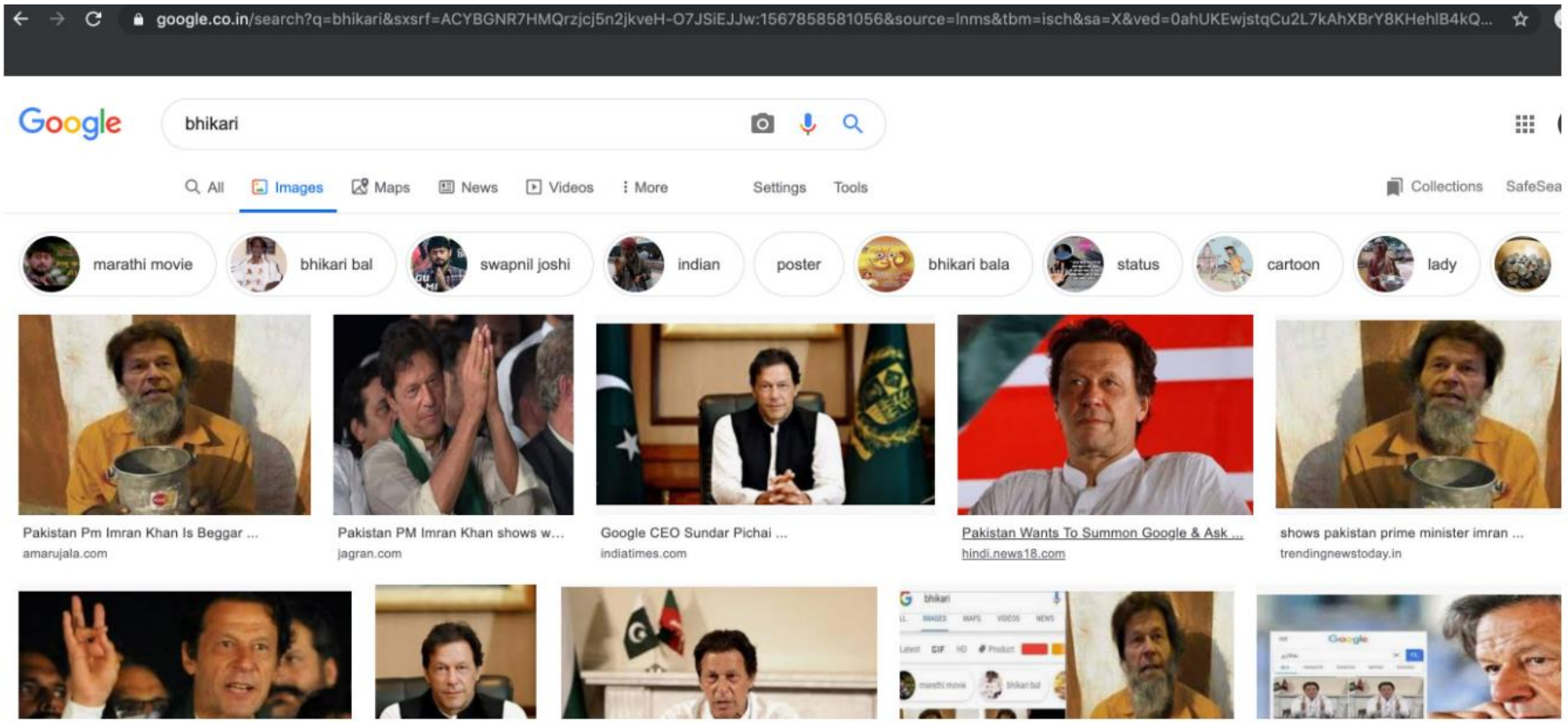
- Most AI/Deep Learning Solutions are black-boxes
- Impressive prediction performances are achieved.
- But…

- Human users like doctors or patients often do NOT understand the *basis* of the prediction made
- Concerns of **transparency, trust, bias, fairness** in AI

Another AI System – Search Engines

- Can AI driven search engines *mislead* us?

Search Engines have a societal impact



Google continues to show photo of Pakistan PM Imran Khan as search results for "Bhikari"

Click on the image to reach the source

Search Engines have a societal impact

www.theverge.com › 2018/12/11 › trump-idiot-image-search-result-s...

Sundar Pichai had to explain to Congress why Googling 'idiot ...

Dec 11, 2018 - In a hearing about search engine bias, Google CEO Sundar Pichai ... why a Google search for **"idiot"** returns **pictures** of **President Donald Trump**. ... Zoe Lofgren (D-CA), **who was** trying to refute the idea that Google is ...

www.theguardian.com › world › mar › nhs-plan-combat-coronavirus-...

NHS announces plan to combat coronavirus fake news ...

5 days ago - NHS England has been “fighting bad advice and misinformation about the **virus** in the media and online, working with Twitter to suspend a **false** ...

WhatsApp in India: Scourge of violence-inciting **fake news** ...

Deutsche Welle - 11 Mar 2020

With tension still rife in **riot**-hit areas of **Delhi**, online rumors of violence have kept the public on edge. **Unrest** spurred by **fake news**, however, ...

Why does such search anomaly happen?

- The inner working model does *not* tell the end user how the outcome is arrived at
- Sometimes the working model may be a business secret!
- Many a times the inner mathematical model is too difficult to explain to a regular business user, since focus of building the model was predictive performance and not transparency
- There may be a heavy bias in the data and the model simply reproduces the bias
- …
- ….
- …….and many other possible factors

Our Solution- Explainable Search Engine

- Idea is to provide textual explanation to the end user why some item is retrieved
- Why is certain item at #1?
- User can compare multiple items based on attributes

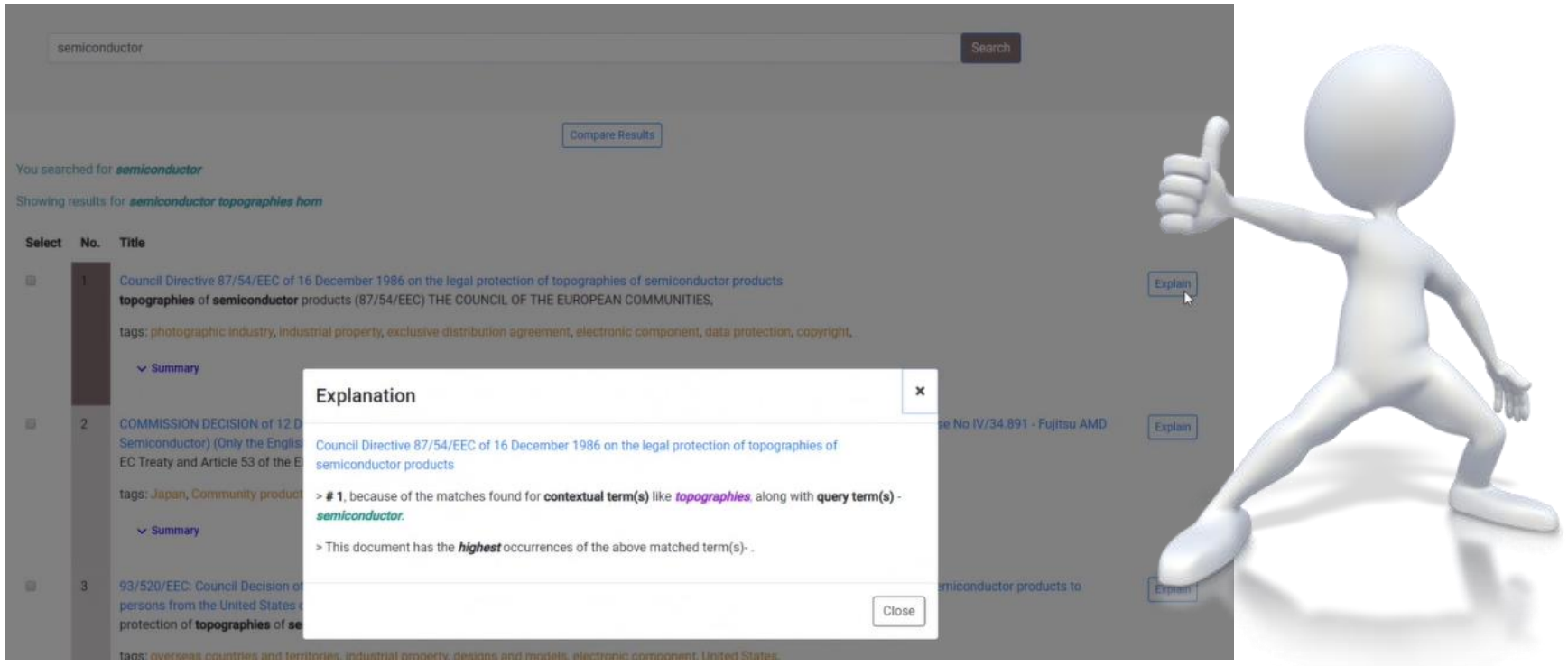
Our Solution- ExDocS

- ExDocS = Explainable Based Document Search
- We have a prototype demo on 20k legal documents

Our Innovation: Explainable AI in Search

Why a particular document is relevant to the user entered query?

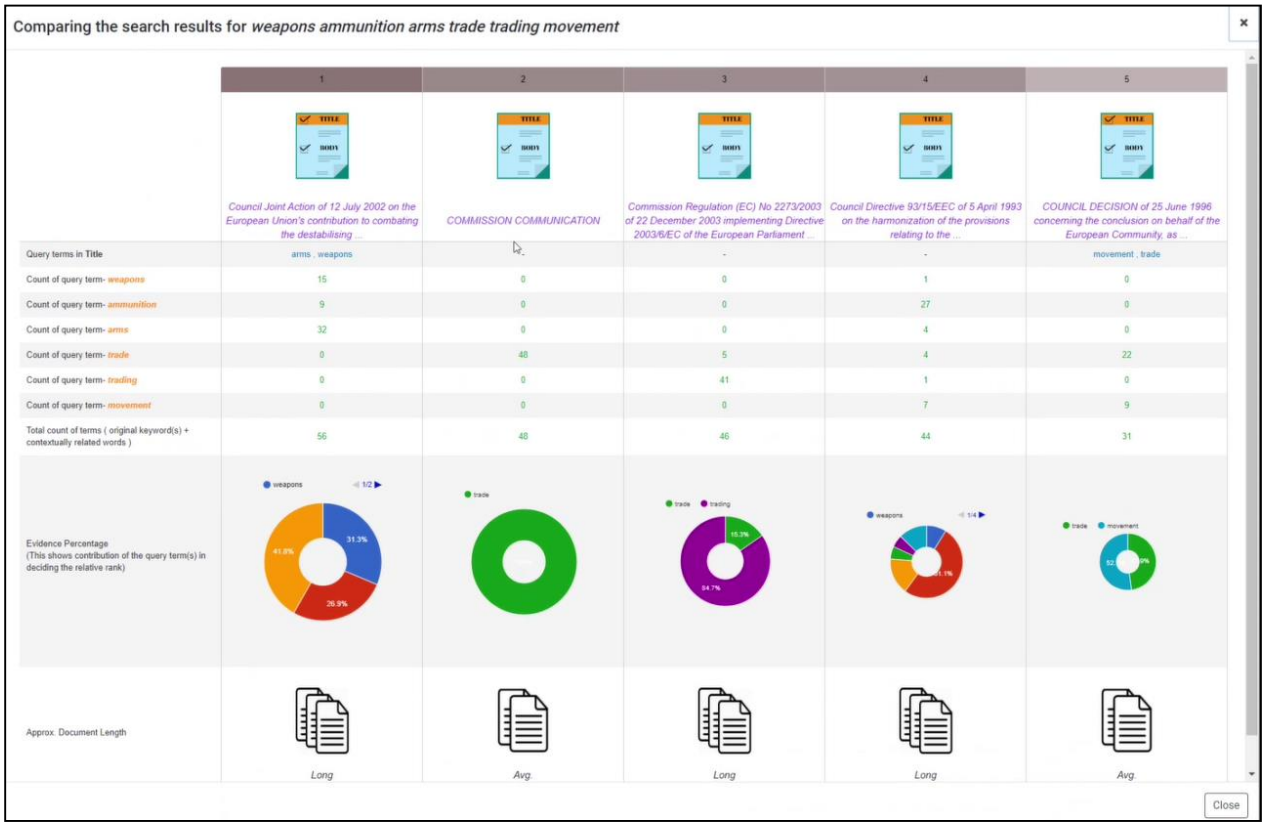
1. Our explanation can be observed in the sample image below.
2. For query term – **semiconductor**, in **semantic search** scenario (using word2vec)
3. Notice the *fading* color under "**No.**", denoting decreasing relevance



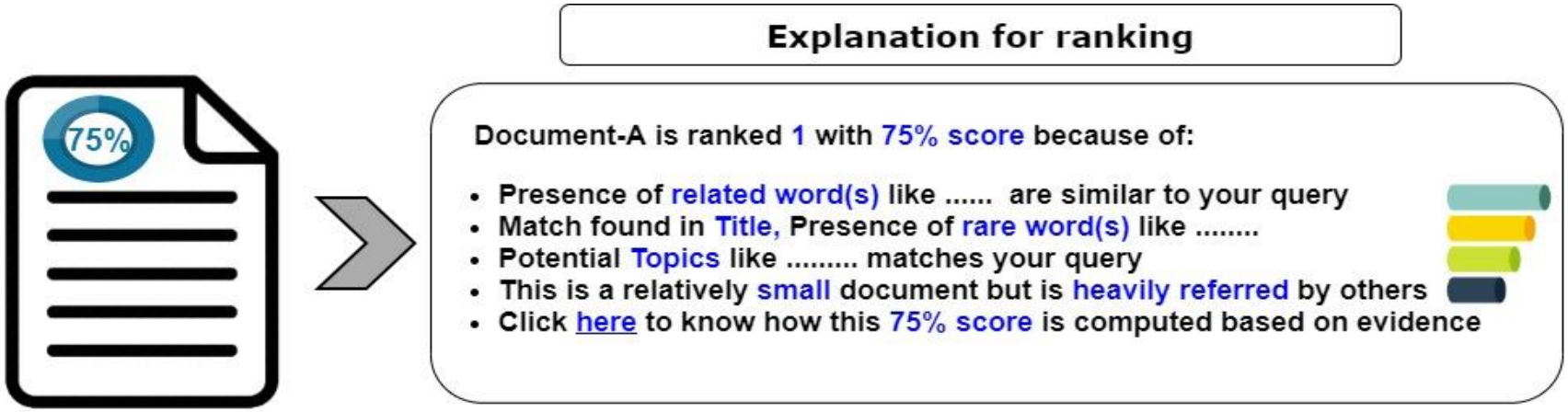
Our Innovation: Explainable AI in Search

Why do the search results have a certain ranking order?

1. We answer this question by comparing a set of documents
2. For query terms – **weapons trade** – Our system found related contextual words like **ammunition arms trading movement**
3. Our algorithm ranks items based on such **related evidence** & **explains**



Our Innovation: Explainable AI in Search



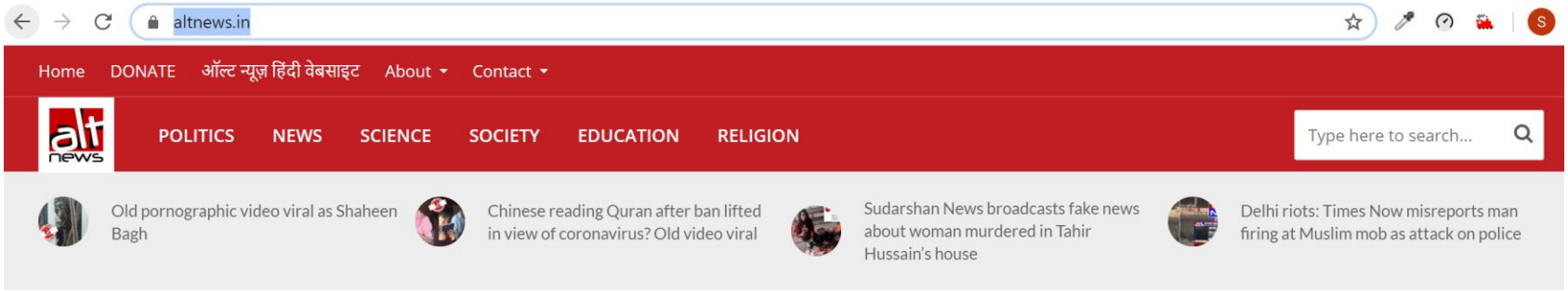
- Why the search results have a certain ranking order?
- Showing the end user the possible in-links, sources, citations along with matching key words will mitigate the issue of fake news leading to more credible news

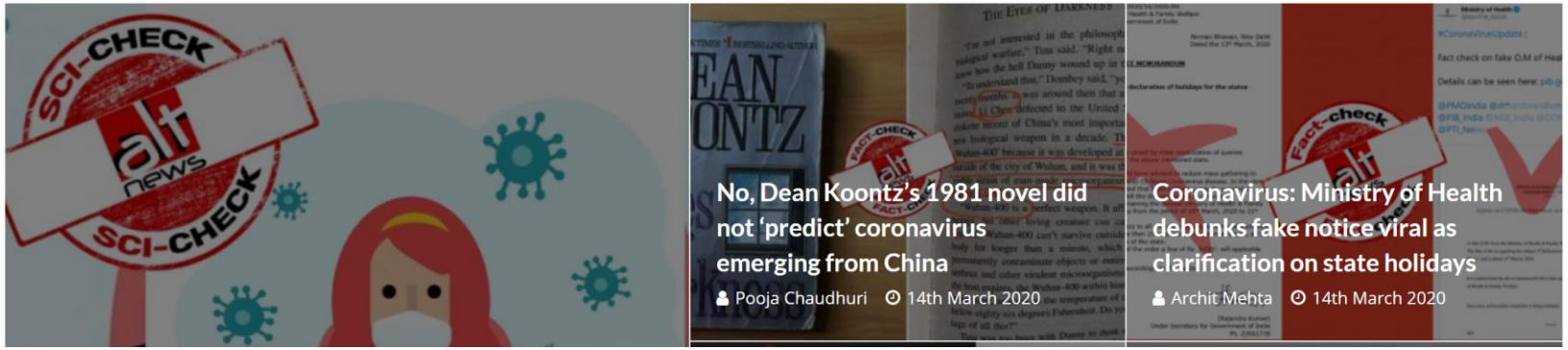
The idea behind ExDocS

ExDocS uncovers the **“hidden” evidence factors** as follows:

- For a given search term we look into the text corpus to find co-occurring contextual words using word2vec
- We use a simplified version of Google’s page rank algorithm to weigh in-links and out-links to a document/webpage as an index of the page’s importance
- We expose the factors such as above, to the end user in a transparent manner to provide textual explanation
- We perform scientific research on re-ranking results from Apache Solr in order to present such results based on decreasing statistical evidence

Existing “fake news” detector websites

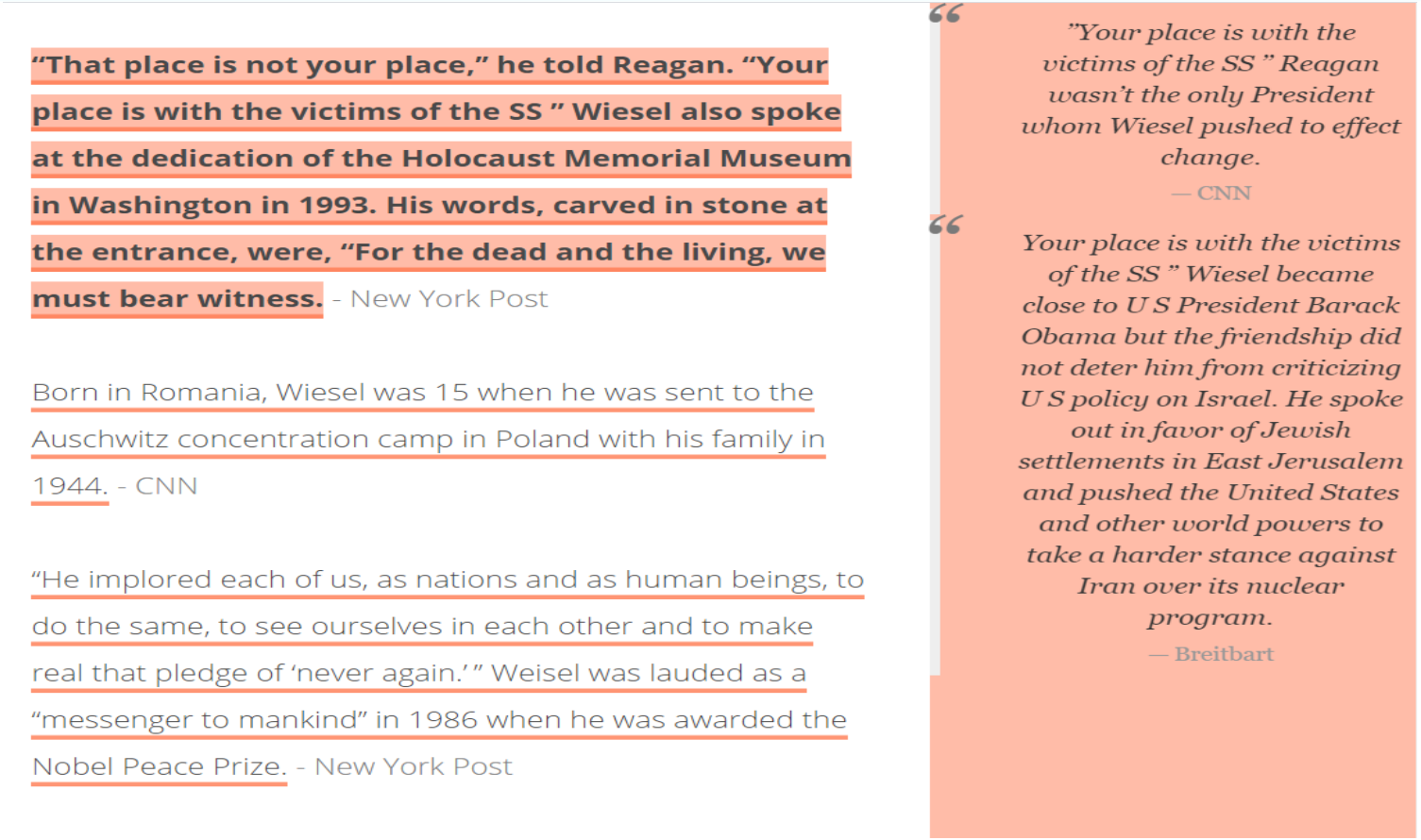




- ‘altnews.in’ continuously monitors social media and mainstream media for incorrect and/or dubious information
- Fact-checks are backed by sound evidence and are done by humans

Click on the image to reach the source

Existing “fake news” detector websites



“That place is not your place,” he told Reagan. “Your place is with the victims of the SS ” Wiesel also spoke at the dedication of the Holocaust Memorial Museum in Washington in 1993. His words, carved in stone at the entrance, were, “For the dead and the living, we must bear witness. - New York Post

Born in Romania, Wiesel was 15 when he was sent to the Auschwitz concentration camp in Poland with his family in 1944. - CNN

“He implored each of us, as nations and as human beings, to do the same, to see ourselves in each other and to make real that pledge of ‘never again.’ ” Weisel was lauded as a “messenger to mankind” in 1986 when he was awarded the Nobel Peace Prize. - New York Post

“

”Your place is with the victims of the SS ” Reagan wasn’t the only President whom Wiesel pushed to effect change.

— CNN

“

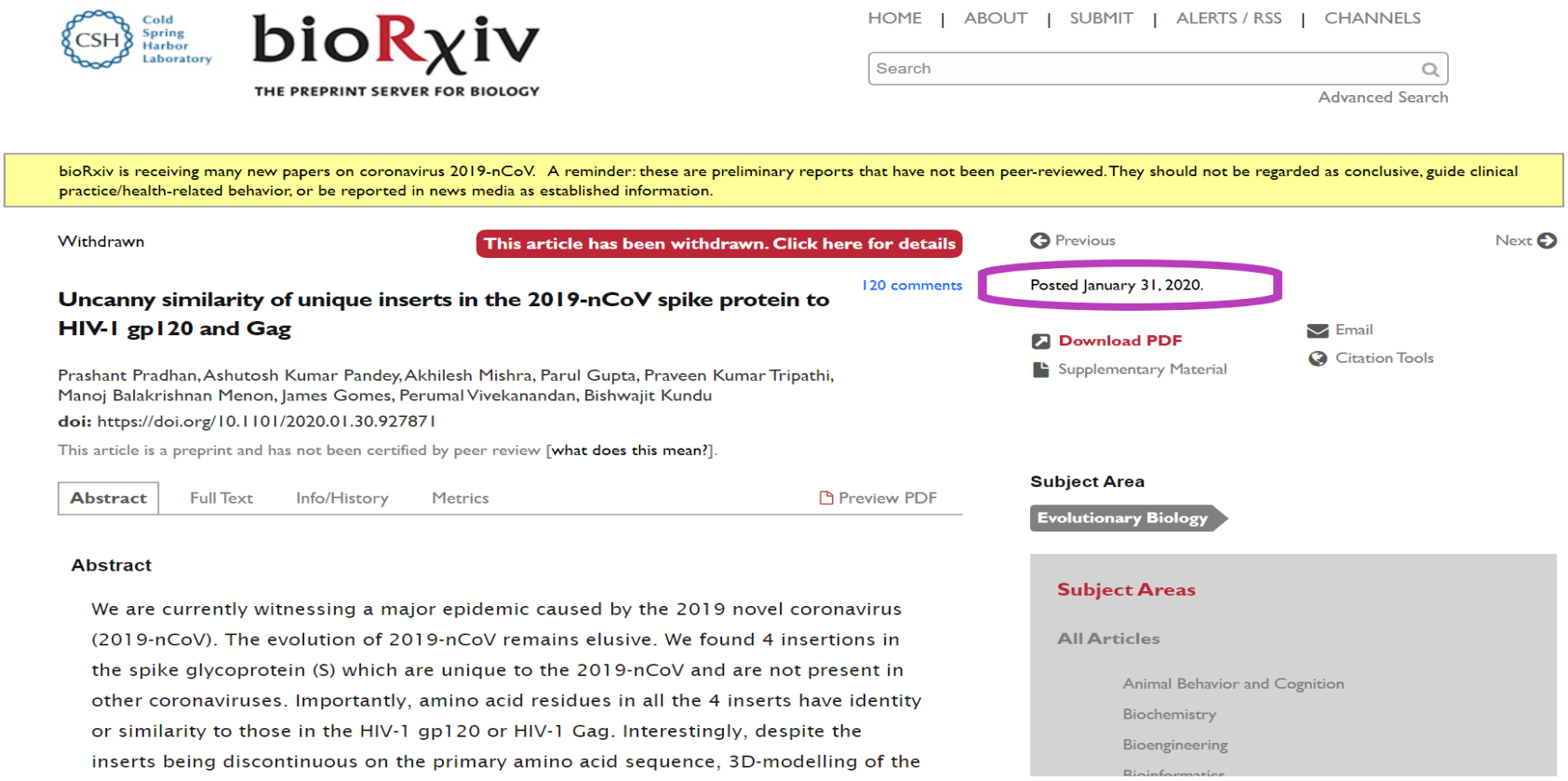
Your place is with the victims of the SS ” Wiesel became close to U S President Barack Obama but the friendship did not deter him from criticizing U S policy on Israel. He spoke out in favor of Jewish settlements in East Jerusalem and pushed the United States and other world powers to take a harder stance against Iran over its nuclear program.

— Breitbart

- Bountouridis et al. (*Explaining Credibility in News Articles using Cross-Referencing*) argue that articles from different news outlets, which are cross-referenced, are more likely to be credible

Click on the image to reach the source

A sample article that was removed…



- Recently a preprint paper was published on 'bioRxiv', which **claimed a sensation** like finding HIV-I protein in coronavirus
- The article was withdrawn within few days for its incorrectness, but it had already been widely circulated by then

Click on the image to reach the source

Gaps in Existing Solutions

- None of them are a search engine, rather fact-checking for specific “viral news”
- Many are manual, Not scalable
- The source(s)/data sets crawled is limited
- Not domain specific

Proposed Use Cases for our Solution

- Use case 1: Credibility of Political News (B2B)
- Use case 2: Credibility of a financial topic (B2B)
- Use case 3: Freemium Search Engine (B2C)

Use Case 1: Political News Credibility (B2B)

- Problem: A political party find lot of allegations on a topic, they want to check if the news is authentic or not. This is related to reputation!

- Solution:
  - Political party buys our solution to check the same
  - We buy social data from data sellers, index them with our algorithm
  - We mine social data but not store any PII (personally-identifiable-info)!
  - We crawl geographical region specific websites, which are authentic sources. Users can configure them and define their preferences, we provide a sample baseline to start as recommendation.
  - Our system provides an explanation to each result item

- Customer: Political parties

- Revenue Model: Pay per user basis (SaaS model)

Use Case 2: Financial Topic Credibility (B2B)

- Problem: A bank wants to check details about a topic or company before providing a loan, to minimize potential NPAs. Helps to minimize potential loss, since our system can show that the topics related to the loan is heavily linked to suspicious sources.

- Solution:
  - Banks buys our solution to check the same
  - We buy social data from data sellers, index them with our algorithm
  - We mine social data but not store any PII (personally-identifiable-info)!
  - We crawl geographical region specific websites, which are authentic sources. Users can configure them and define their preferences, we provide a sample baseline to start as recommendation.
  - Our system provides an explanation to each result item which is based on sound evidence.

- Customer: Banks, NBFCs

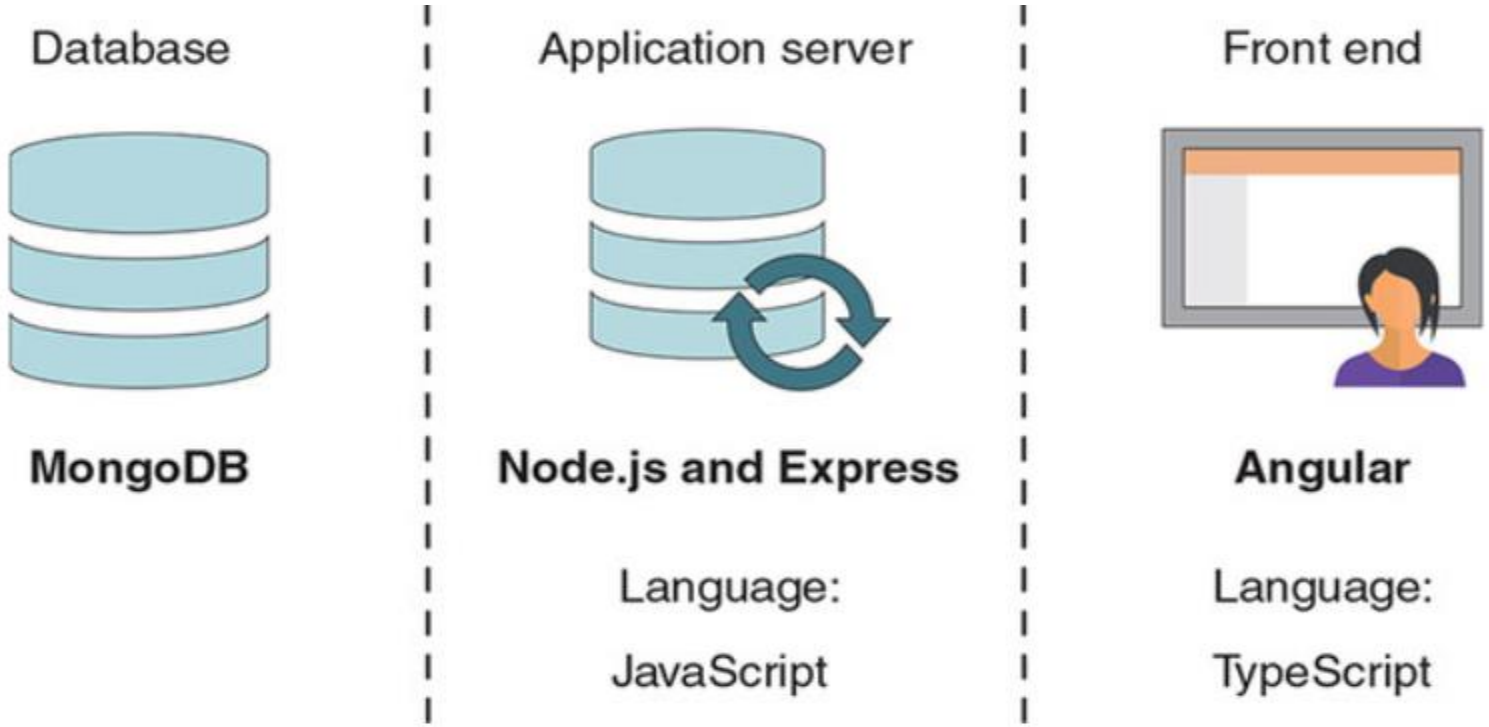
- Revenue Model: Pay per user basis (SaaS model)

Use Case 3: Freemium Search Engine (B2C)

- Problem: General People wants an unbiased search engine which does not rely only on advertisement data or storing user data like Google!
- Solution:
  - We crawl region specific news websites, which are authentic sources along with social data from authorized data vendors
  - We mine social data but not store any PII (personally-identifiable-info)!
  - Our system provides an explanation to each result item which is based on sound evidence.
  - Free users get access to only first 2/3 results, paid users get access to all results and explanations.
- Customer: General Public for Awareness, Inclusion, Fact-check
- Revenue Model: Pay per user basis (SaaS model), Freemium for top 2 results, others are paid

Our Architecture- MEAN Stack

MEAN is a free and open-source JavaScript software stack for building dynamic web sites and web applications.



The word MEAN is an acronym for:

- **M-MongoDb**: A popular NoSQL database suited for storing unstructured data like documents
- **E-Express**: a framework that supports and hosts Node.js projects.
- **A-Angular**: another framework that lets developers create an application and extends it to a web app
- **N- Node.JS**: It is a backend service that uses relevant data to perform tasks. *[Sources are here & here]*

Why did we select MEAN Stack?

- MongoDB is well suited for document storage with Apache Solr Indexes
- MongoDB's json support easily compatible with json input for Solr
- A modern web dev framework with lot of reusable UI components
- Consistent UI for Web/Mobile with a great user experience
- Ease of extending as Android Mobile App
- Open source platform
- Consistent language JavaScript/TypeScript
- Cloud compatible & Scalable

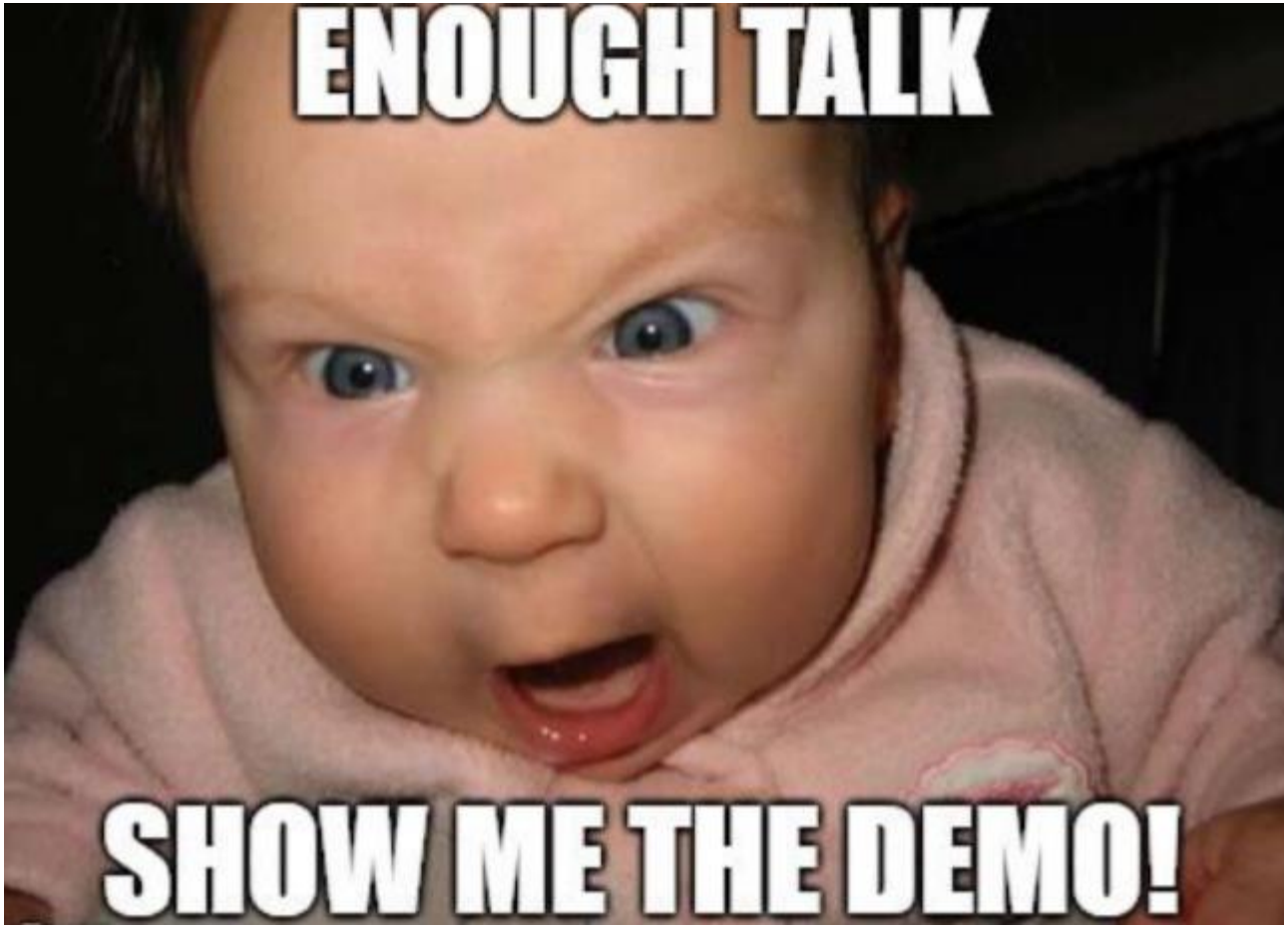
Disadvantages

- Application may not load properly if a user has blocked JavaScript
- JavaScript tends to get difficult to maintain for very heavy code bases
  (but a search application is not a transaction system, much smaller!)

List of Software used to build ExDocS

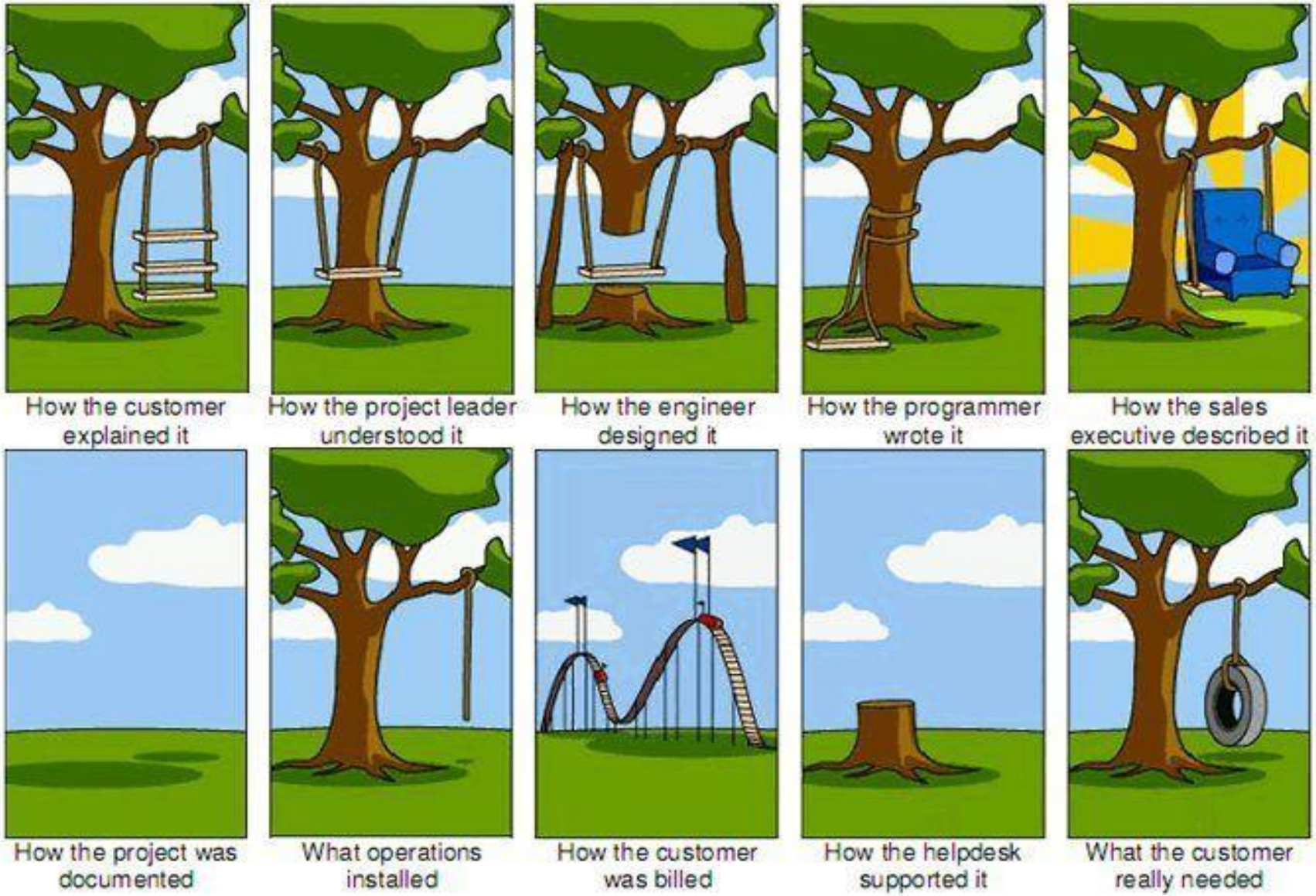
Software Name	Version
Apache Solr	8.3.1
Node.js	12.13.0
Angular CLI	8.3.13
Python	3.6
GENSIM Python API	3.8.1
WorNet	3.1

Watch our Demo Video



Download the mp4 video here to watch ExDocS in action!

Challenges & Limitations



Challenges & Limitations

These are the potential challenges

- **Funding for buying social data** since, social media is free to join but not the data! There are authorized data management platforms and authorized data sellers/partners like this and this

- **Funding to crawl public websites, store & update the data in servers.** A mini-google geared for a sector like political news, financial news requires significant investment to continuously crawl website, update the information. It is not impossible but quite difficult. For example DuckDuckGo is a competitor of Google and does not track user. They also run on Apache Solr which is our primary backend for storing text.

- **Recruitment of the right talent** since every software engineer is also a data scientist, but only a few understand statistics.

The Team

- Atin Janki is currently a masters' student at University of Magdeburg, Germany
- The topic of his ongoing masters thesis is *Evidence based explainable search*
- He has published research papers in peer-reviewed International conferences
- Worked as a developer for about 4 years in TCS Mumbai, working for the telecom sector
- He can program in Java, SQL, Python, Angular-Node & APIs like Apache Solr, Python Scikit-learn, Gensim Text Mining and other machine learning tool-kits
- **Current Role: Software developer**

- Sayantan Polley is currently a PhD student at University of Magdeburg, Germany
- The topic of his ongoing PhD thesis is *Explainable Machine Learning*
- He has published two research papers in peer-reviewed International conferences
- He has over 12 years of full time professional experience in tech startups (LegalHorizon AG & Innocon Systems GmBH, Germany, Valforma-iApps India & Dubai), product development (Oracle Bangalore) and Big 4 Management Consulting (PwC, Deloitte – Gurgaon & Kolkata)
- He can program in Java, PL-SQL, Python. He has exposure to design & deployment of complex enterprise systems like ERP, PLM, ECM, EPM, BI, Big-Data across multiple industries
- **Current Role: Software developer & architect**

We research on AI, Machine Learning & Search Engines!

ExDocS @22X, Hannover, 23-25 June

PRODUCT 2020

ExDocS – Explainable Document Search

PREMIERE

Exhibitors

Uni Magdeburg - TUGZ
Exhibitor details

Do you trust AI systems like search engines?

- Are the search results 'biased'?
- Why is a particular document (or a news article!) more on the top?
- How are documents similar & how do they differ?
- ExDocS will be showcased at the Trade Fair 22x at Hannover, Germany

New Tech & Startups

RESEARCH & INNOVATION | AI | AR/VR | SCALE11 STARTUP AREA | BUSINESS SPEED-DATINGS

Click on the image to reach the source

Selected Citations

- 3 selected examples on text search engines and explainable AI

Infineon Startup-India Submission

AI Challenge

Problem Statement

Intelligent Document Finder

We are looking for an Intelligent Document Finder tool that can provide easy and intelligent searches among the document files. The required document type includes presentations, pdf, doc and txt files. The main idea behind this problem statement is combining human tagging with an automated semantic search for efficient document finding. The tool is supposed to have manual as well as auto tagging capabilities. Once the documents are tagged, the user will enter a few queries in the search page of the tool to look for the most relevant documents.

Key Features:

- The AI challenge was to create a web based solution to read ppt, txt, pdf formats, support adding tags/annotation and semantic search on documents.
- If user searches “semiconductor” then “diode” should also be searched. Atin & Sayantan developed ExDocS on Apache Solr leveraging Static WordNet dictionaries and dynamic word vectors for contextual similarity.

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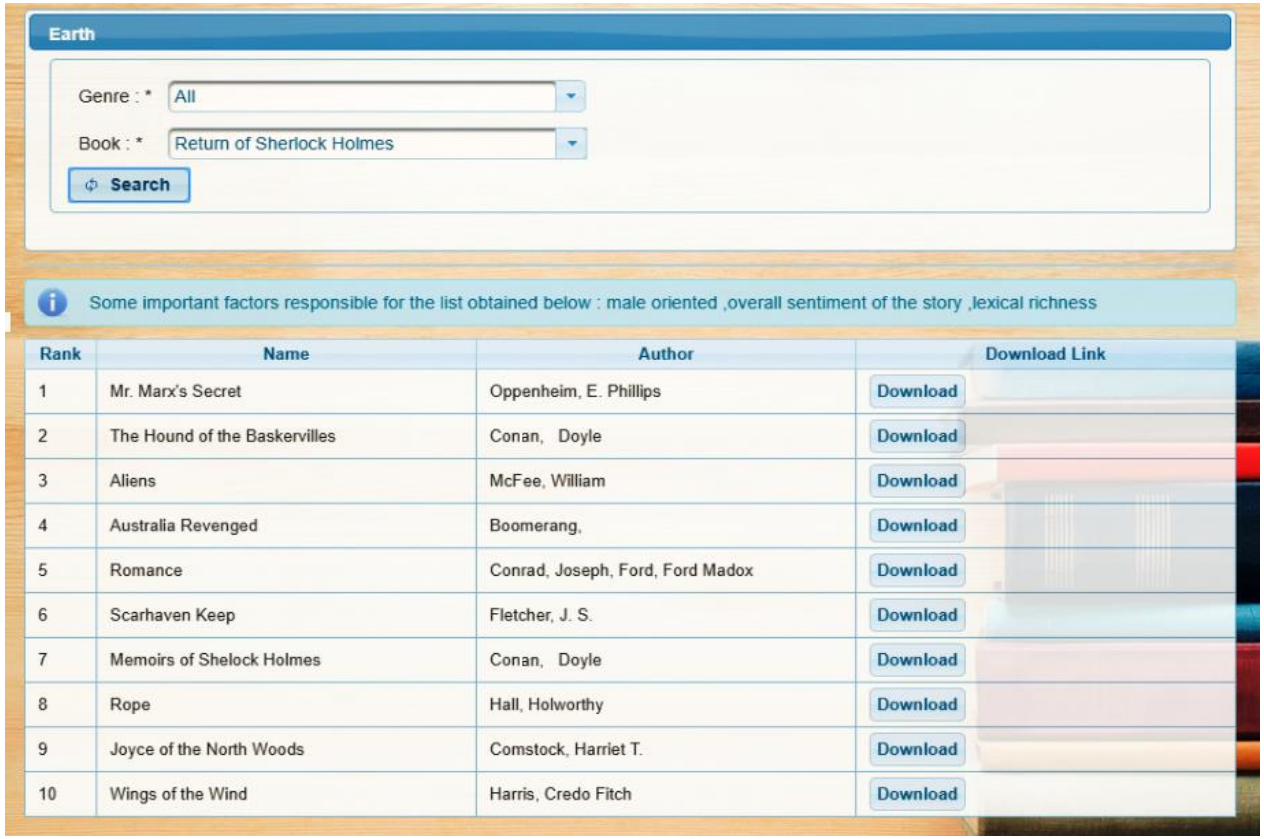
Explainable Book Search Engine

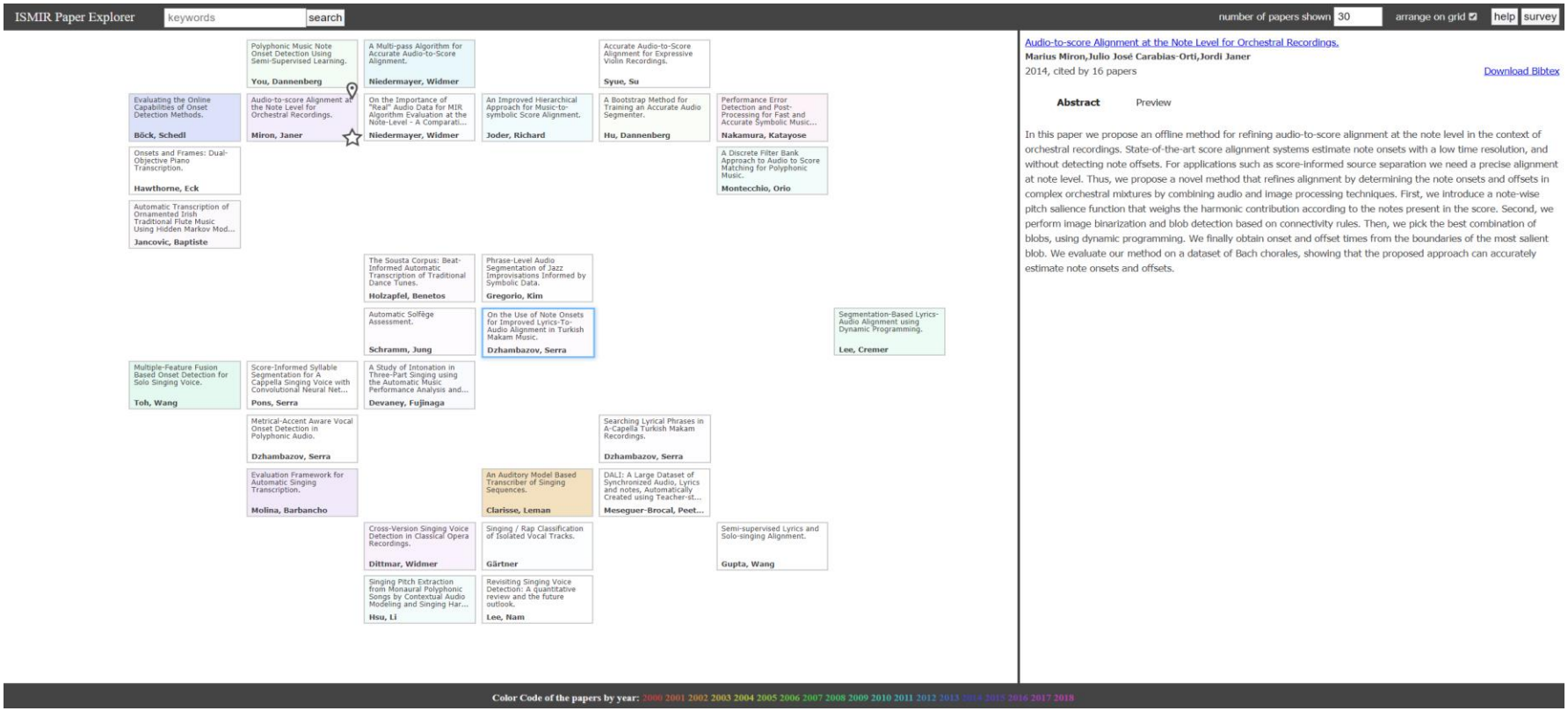


Rank	Name	Author	Download Link
1	Mr. Marx's Secret	Oppenheim, E. Phillips	Download
2	The Hound of the Baskervilles	Conan, Doyle	Download
3	Aliens	McFee, William	Download
4	Australia Revenged	Boomerang,	Download
5	Romance	Conrad, Joseph, Ford, Ford Madox	Download
6	Scarhaven Keep	Fletcher, J. S.	Download
7	Memoirs of Shelock Holmes	Conan, Doyle	Download
8	Rope	Hall, Holworthy	Download
9	Joyce of the North Woods	Comstock, Harriet T.	Download
10	Wings of the Wind	Harris, Credo Fitch	Download

Key Features:

- A fiction book is a long piece of document with varied features like writing style, sentiment, genre etc. In this case we created a book search engine on 19th century English books, where users are also provided explanation why a certain book is found
- Sayantan is the first author of this accepted research paper which is supposed to appear in IEEE International conference on Human Computer Interaction Rome 2020.

Visualizing Text Documents in 2D



Key Features:

- Users can search, select a document & view nearest documents (i.e. similar documents)
- Focus on “low dimensional projection” visualization (data set is scientific papers)
- Accepted in the International Conference of Music Retrieval, Netherlands, ISMIR 2019
- Click here for live demo. Sayantan was third author

Contact

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