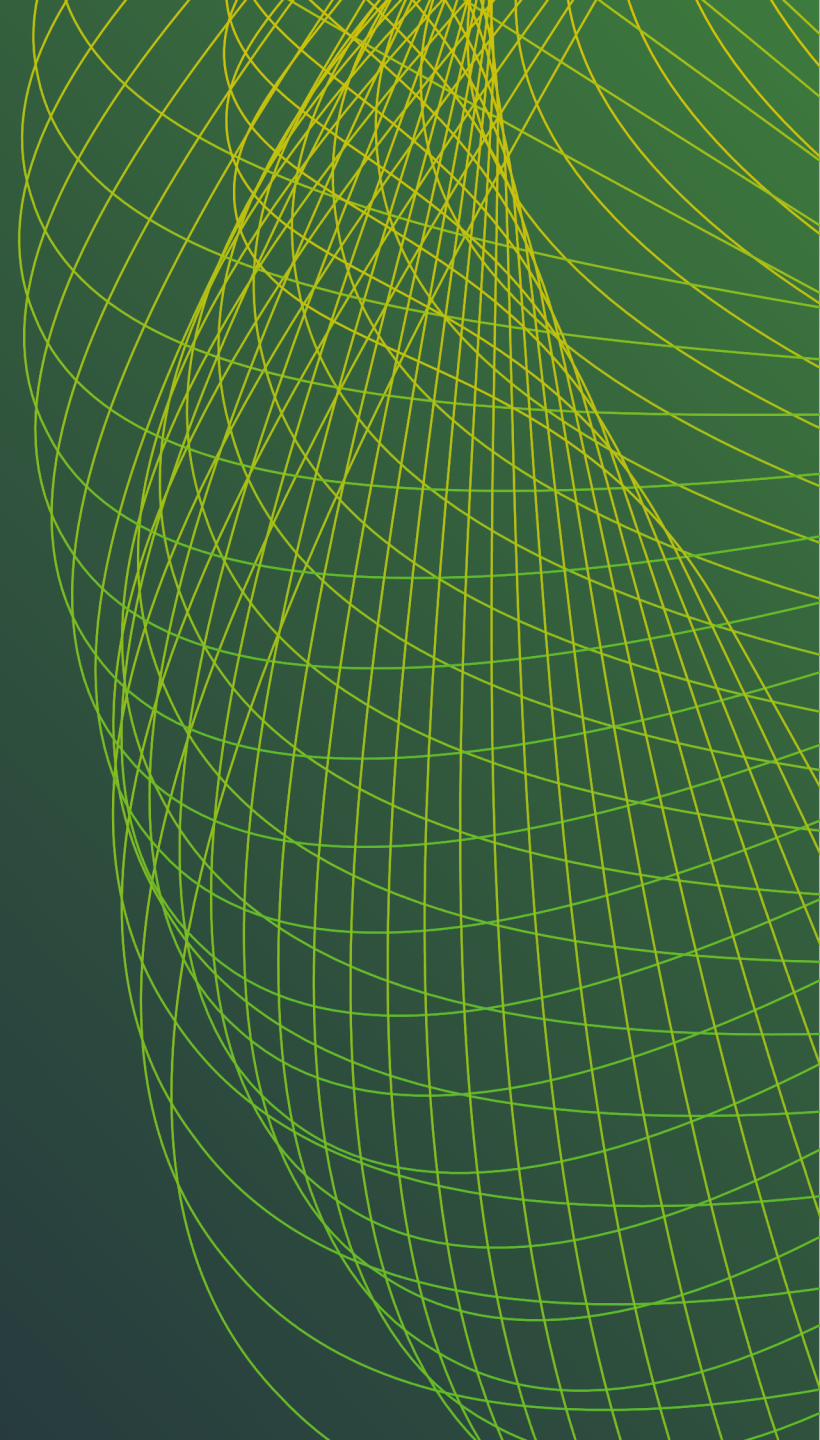




FINANCIAL SERVICES
CLOUD SYMPOSIUM

MAY 4, 2021





FINANCIAL SERVICES
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FSI302

Planning FINRA's Future Search Powered by Amazon Kendra and Neptune

Blayze Stefaniak

Senior Solutions Architect
AWS

Technology Leaders

FINRA



Agenda

- ❖ Challenges enterprises face with search
- ❖ Reinventing enterprise search with Amazon Kendra
- ❖ How customers are integrating with Kendra
- ❖ Customer spotlight: FINRA
 - Vision and architecture
 - Proof of concept scenarios
 - Lessons learned and next steps
- ❖ How AWS can help

Critical information is getting harder to find



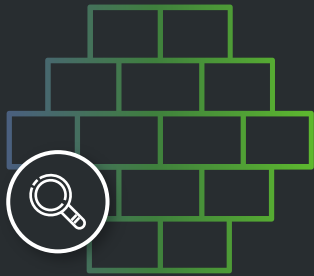
Data at the enterprise is proliferating, and it's often scattered and inaccessible

80% of all data will be **unstructured** by 2025

<https://www.capgemini.com/2018/08/reorganizing-unstructured-data/>

Creating great search is costly and complex

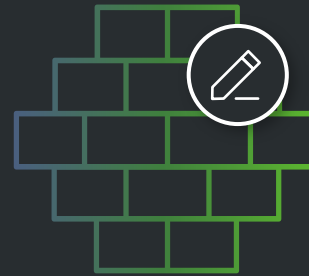
Inaccurate keyword search



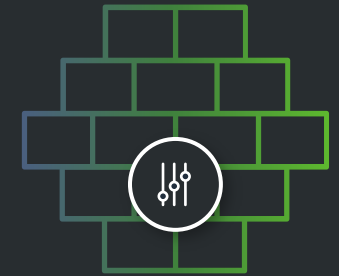
Scattered content repositories



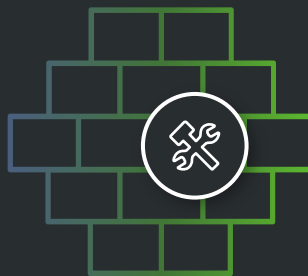
Unstructured data



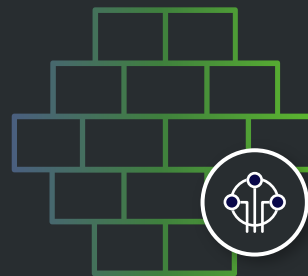
Manual tuning



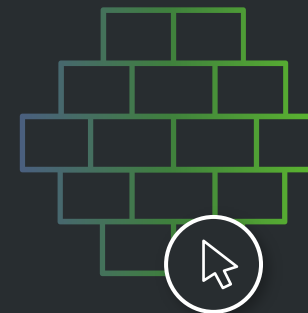
Ongoing maintenance



Keeping content up-to-date



Sub-optimal user experience



Employees and customers want answers, not choices

Conventional Search

Intranet Search

it support desk

Your recent searches ▾ Not finding relevant r

SEARCH IN: Displaying results 1 - 10 of 21

Everything (21)
Wiki (17)
Email List Archive (3)
Show more...

REFINE:

CATEGORIES

Service (1)
Team (1)

CREATOR

admin (1)
abcde (1)
it (1)
corp (1)

IT_Support_Training_Program.Wiki
18px"%) Linux desktop * (% style="font-size:13.5px"%)**Afternoon
https://w.co.com/bin/view/IT_Support

Com_Support_Wiki.Web
Communication has three differ
Com sign-in flow>>url:https://d
<https://w.co.com/bin/view/Com>

OperationalBestPractices.EventM...
as a basic service. It is owned by [https
*Dial into both calls: If you're at your d
<https://w.co.com/bin/view/BestPracti>

Corp_Wiki_Pending.Web
Light~",sans-serif; font-size:9pt; height
Videoconference desk issues from Reg
<https://w.co.com/bin/view/Corp/Pend>

RESULTS PAGE

Where is the it support desk?

Kendra's suggested answer

1st floor

... our IT help desk, deskside, which are located all around our buildings and open for support at most hours. The one in Seattle is on the 1st floor and is open from 12:30 to 5 p.m. daily.

WEB | <https://w.organization.com/bin/view/ILDRTEST/>

What is Kendra's suggested answer? Info

Frequently asked questions

Where do I get IT help? ▶

What are the IT support hours? ▶

Where can I get IT help corporate campus? ▶

What are frequently asked questions? Info

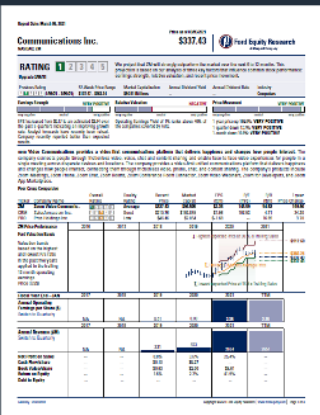
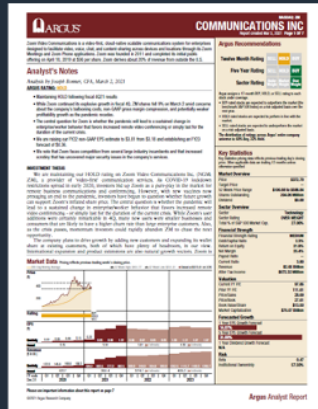
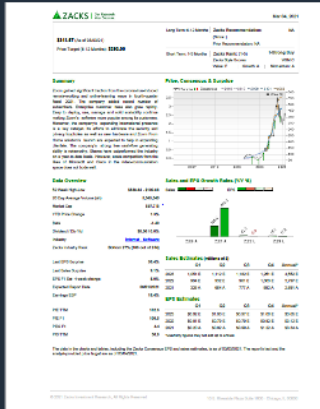
Intelligent Search



Machine learning in the hands of every
developer, data scientist, and business user

What is Amazon Kendra?

Amazon Kendra is an intelligent search service powered by machine learning that allows users to intuitively search unstructured data using natural language search.



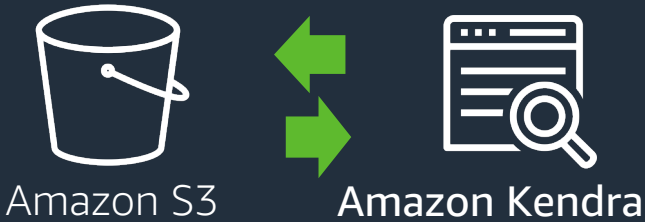
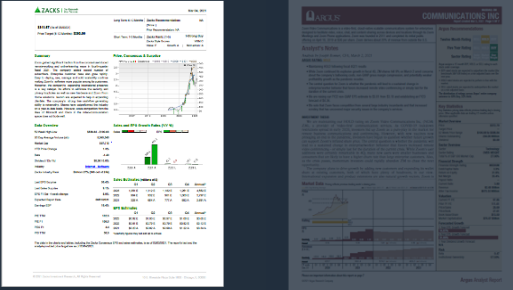
Amazon S3



Amazon Kendra

What is Amazon Kendra?

Amazon Kendra is an intelligent search service powered by machine learning that allows users to intuitively search unstructured data using natural language search.



What is [redacted] target price for [redacted]?

Amazon Kendra suggested answers

03.04.2021

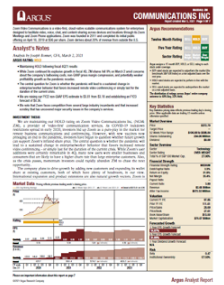
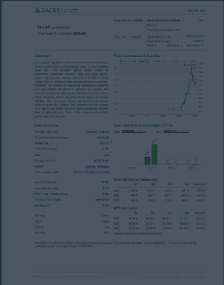
\$393.00

Price Target (6-12 Months): \$393.00 Long Term: 6-12 Months Recommendation: (Since:) NA Prior Recommendation: NA Short Term: 1-3 Months Rank: (1-5) Style Scores: 1-Strong Buy VGM:C Value: F Growth: A Momentum: A Summary gained significant traction from the coronavirus-induced remote-working and online-learning wave in fourth-quarter fiscal 2021. The company added record number of subscribers. Enterprise customer base also grew rapidly. Easy to deploy, use, manage and solid scalability continue making software more popular among its customers.



What is Amazon Kendra?


Amazon Kendra is an intelligent search service powered by machine learning that allows users to intuitively search unstructured data using natural language search.




Amazon S3

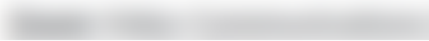







Amazon Kendra

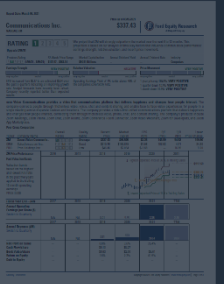
What are the usage trends of [redacted] ? 

Amazon Kendra suggested answers

 - Credit Suisse 02.25.2021

 Survey Suggests Upside, But Valuation Too Rich Considering the Real Growth  Target price (12M, US\$) 340.00 Underperform[V] Software | Pre Results Comment We surveyed ~1,600 individuals in the US to better understand paid **usage trends** of ; the results substantiate continued paid adoption of  Video signaling upside to F4Q revenue. The survey suggests 17.5% of total respondents are currently paying customers, with 20% of those becoming paid customers in the last 3 months. 4Q upside will likely drive positive revisions to FY22 on a revenue/revenue growth basis given the exit revenue run rate, though our survey suggests a slowing pace of new paid adds, limiting upside to new business metrics as we progress through the year.



Advantages of intelligent search

How companies are using amazon kendra



Accelerate research and development

Finding relevant information in highly technical research and engineering documents



Minimize regulatory and compliance risks

Enhancing regulatory intelligence, correspondence, and access to up-to-date compliance data



Boost contact center efficiency

Assist call center agents to answer questions quickly and accurately, in call centers and via chatbots (without bot training)



Enhance customer search experiences

Create interactions that delight, and give customers the answers they're looking for whether it's a product search, return policy details, or a news article



Increase employee productivity

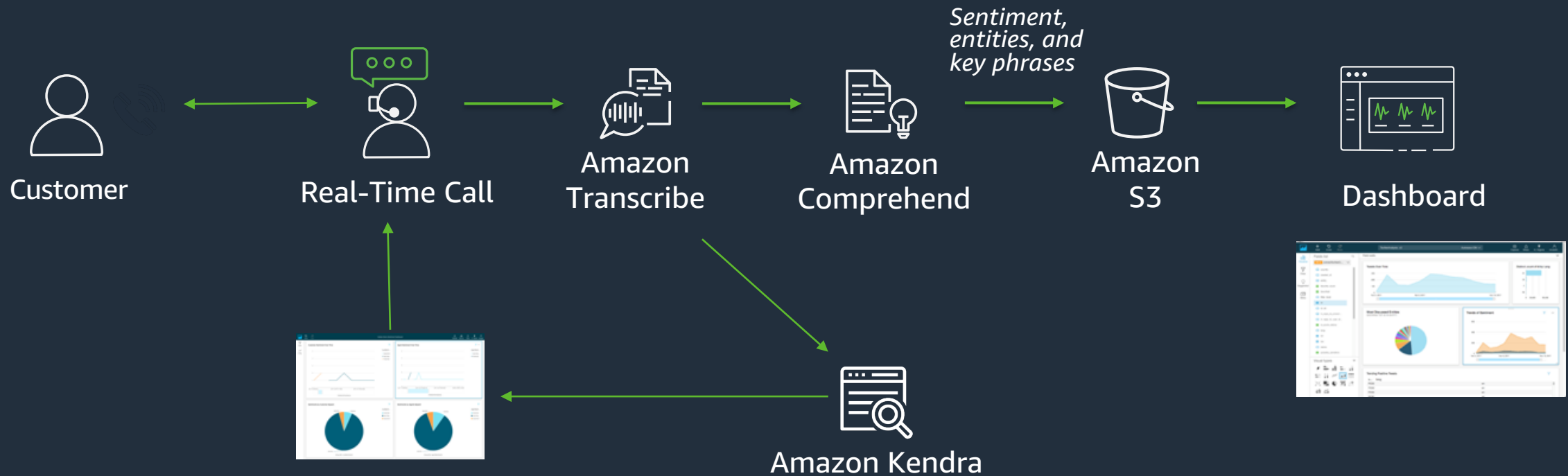
Create a unified search and discovery experience to equip employees with the information they need to do their jobs

Self-service FAQ chatbots with Intelligent Search



Lex Standard Intent + Search Intent + Fallback Intent = Control

Agent assisted with Intelligent Search





Empowering users with Natural Language Search

DOW JONES

Output

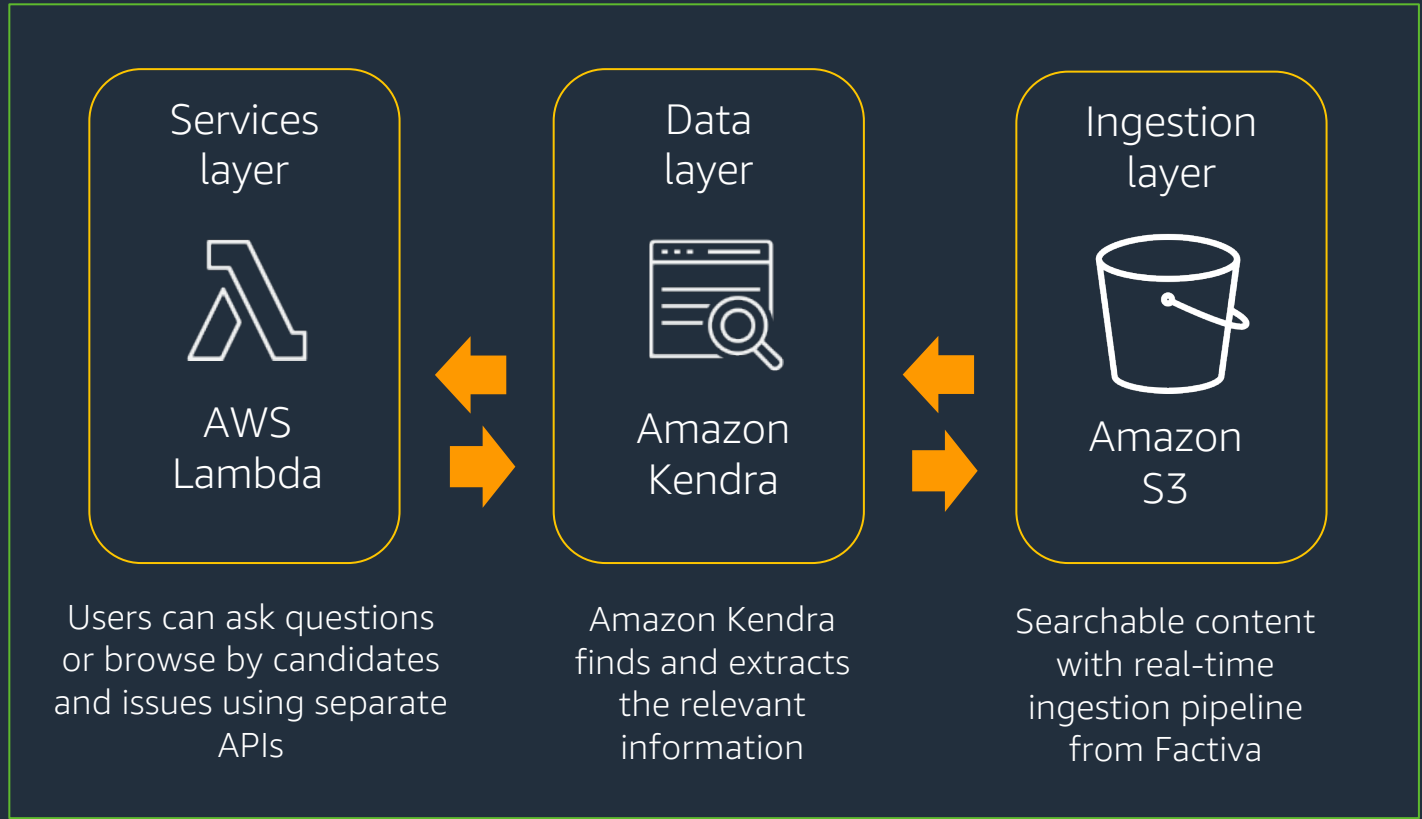
Transcripts of what the candidate has said



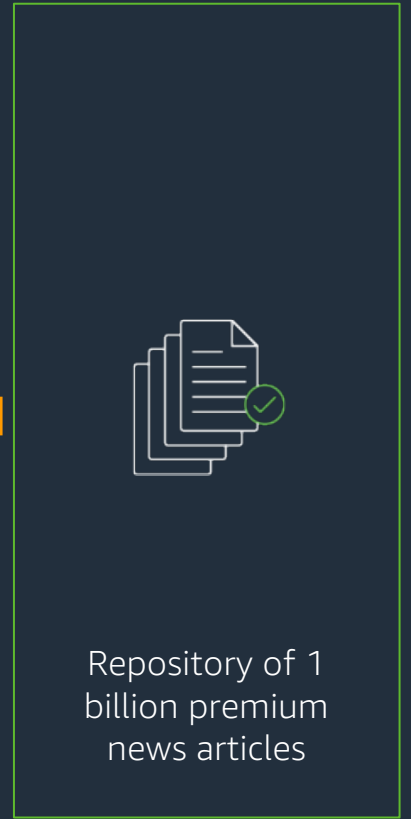
Input

What has Biden said about China?

Dow Jones – Wall Street Journal



Dow Jones - Factiva



Amazon Kendra

QUICKLY AND EASILY FIND ACCURATE INFORMATION

EASY TO FIND WHAT YOU ARE LOOKING FOR



Natural language queries

Contextual search in unstructured content



NLU & machine learning core

Reading comprehension
FAQ matching
Document ranking



Broad domain expertise

Pre-trained for 14 domains and industries



Continuous improvement

Incrementally learns from user feedback

QUICK SETUP



Native & partner connectors

Automate ingestion
Find the best answer wherever it is

SECURE



Secure search

Encrypted in transit & rest
Token-based access control



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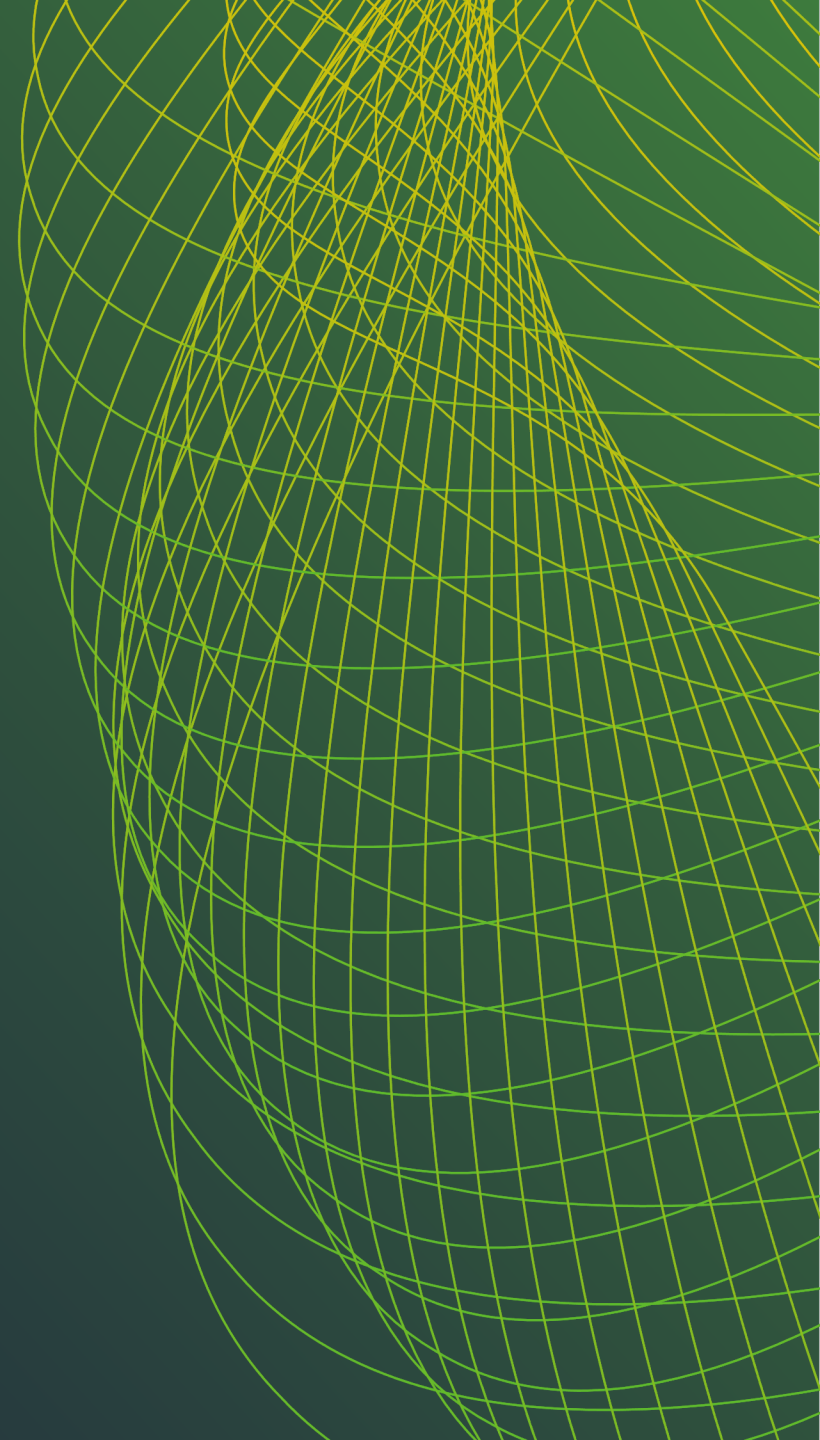
FINRA®

Dmytro Dolgoplov

Senior Director
FINRA

Daniel O'Brien

Director of Analytics
FINRA



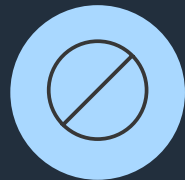
Who is FINRA ?

FINRA[®]

A Self Regulatory Organization

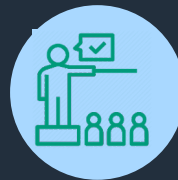


Mission : Investor Protection and Market Integrity



Deter

misconduct by
enforcing rules



Detect

and prevent
wrongdoing in the U.S.
markets



Discipline

those who break the
rules

Enterprise Search at FINRA

- Important part of regulatory toolkit since 2009
- Dozens of sources, millions of structured and unstructured records
- 70% of regulatory staff uses Enterprise Search daily
- Current challenges
 - Keyword search is not enough
 - Lack of personalization
 - Imperfect relevancy of results
 - Independent from FINRA knowledge graph
 - Lack of support for natural language search



Vision: Future Enterprise Search

The dashboard features a top navigation bar with the 'Connected Intelligence' logo, a search bar with the placeholder text 'Search firms, reps, keywords etc.', and utility icons for print, list, notifications, and help. Below the navigation bar are tabs for 'Overview', 'Associates', 'Graph View', 'Agg. Events', and 'Ext Search'. The main content area is divided into several panels:

- STORIES:** A list of narrative snippets. The first snippet states: 'worked for 23 years in the industry at 8 firms. FINRA status is Inactive with regulatory status showing as Terminated (since Jul 25, 2012). was a respondent in 5 matters and 1 formal action. There are 30 other reps associated with'. The second snippet states: 'worked for 28 years in the industry at 9 firms. FINRA status is Inactive with regulatory status showing as Terminated No Registration (since Apr 28, 2014). has 2 sanctions including SUSPENSION and FINE, also Principle was a respondent in 6 matters and 2 formal actions. There are 49 other reps associated with'.
- EMPLOYMENT OVERLAP:** A timeline chart from 1992 to 2022. The top bar shows '15 Aggregated Events, 8 Formal Actions' with a color-coded bar. The bottom bar shows '8 Aggregated Events, 3 Formal Actions' with a color-coded bar. A legend on the right lists 'Firms' with corresponding colored squares.
- CONNECTION GRAPH:** A network diagram showing relationships between entities. A central node is labeled 'NEW YORK NY, 2009'. Other nodes include 'NEW YORK NY' and 'NEW YORK NY'. Edges are labeled 'DIRECT-LESS THAN 5%'.
- COMMON ASSOCIATES:** A list of shared associates between the entities, with names and details blurred.

Vision: Future Enterprise Search

Connected Intelligence | Search firms, reps, keywords etc.

Overview | Firm Profile | Graph View | Agg. Events | Ext Search

STORY

“ [Redacted] is a [Redacted] firm located in [Redacted] with FINRA registration status indicating as **Approved** (since Oct 16, 1936). This firm has **9 registered reps** and **1 branch**. There is **1 open matter** and a total of **3 Formal Actions** for this firm. ”

RECORDS

Sources: 4530 Complaints, 4530 Disclosures, ACMS Cases, CRD Firm Disclosures, CRD Rep Disclosures, Disciplinary Actions, Dispute Res. Cases, Exam Reports, Formal Complaints, Post-complaint Settlement, RAD Rep Regulatory Notes

Refine Search | PAST 5 YEARS | PAST 3 YEARS | PAST YEAR | CUSTOM RANGE

STAR Matters Date: 4/9/2018
REG SIGNIFICANCE: [Redacted] CATEGORY: CAUSE TYPE: Disclosure DISTRICT/SECTION: Front End Cause PRODUCT(S): Non-Specific

STAR Matters Date: 5/18/2017
REG SIGNIFICANCE: [Redacted] CATEGORY: CAUSE TYPE: Form U5 DISTRICT/SECTION: Front End Cause PRODUCT(S): Non Specific

QUICK LOOK

FIRM: [Redacted]

Firm Risk Level: **Med Low** Firm Impact Level: Low

CRD # [Redacted]
FINRA STATUS: Approved (Since Oct 16, 1936)
FIRM TYPE: BDIA
MSRB # [Redacted]
MPID # RMPI (Primary)
REGISTRATIONS: N/A
BRANCHES: 1
REG. REPS: 9
Current HRRs at this firm: 0
REP NETWORKS: 1
MAIN ADDRESS: [Redacted]

REVENUE vs REG. REPS (17-Q3, 19-Q1, 20-Q)

View Profile

AGGREGATED EVENTS (By Event Type)

Research: Future Enterprise Search

Using Amazon Services



Amazon Kendra



Amazon Neptune



Amazon Comprehend



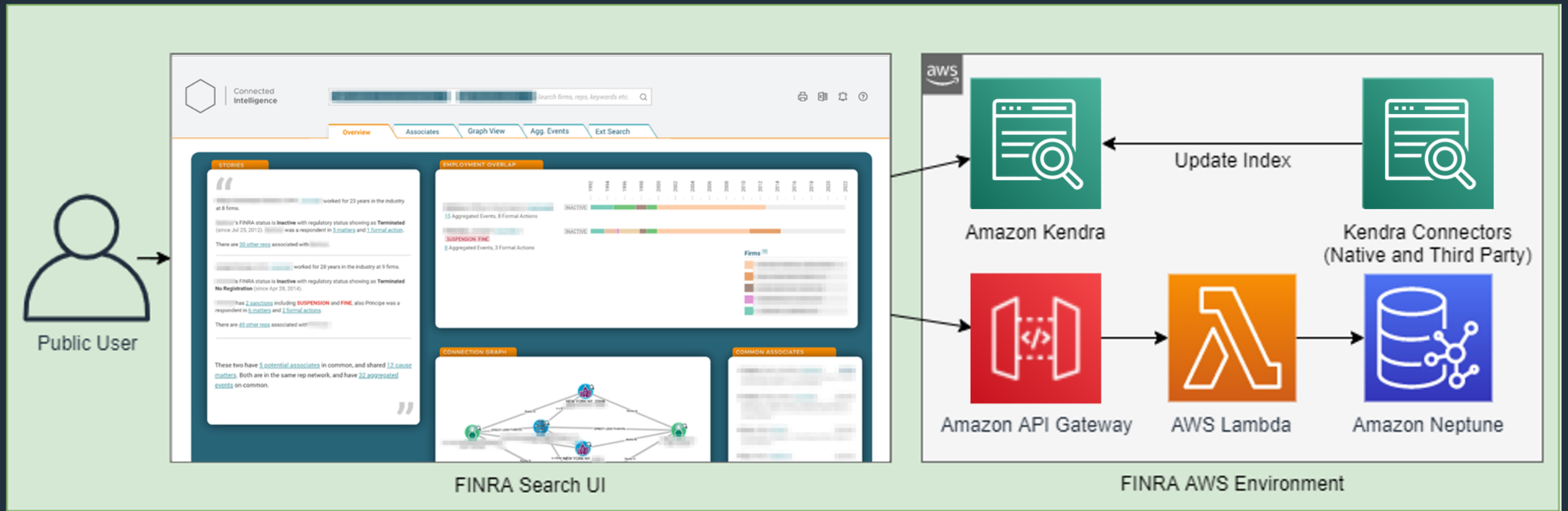
Amazon S3 Standard



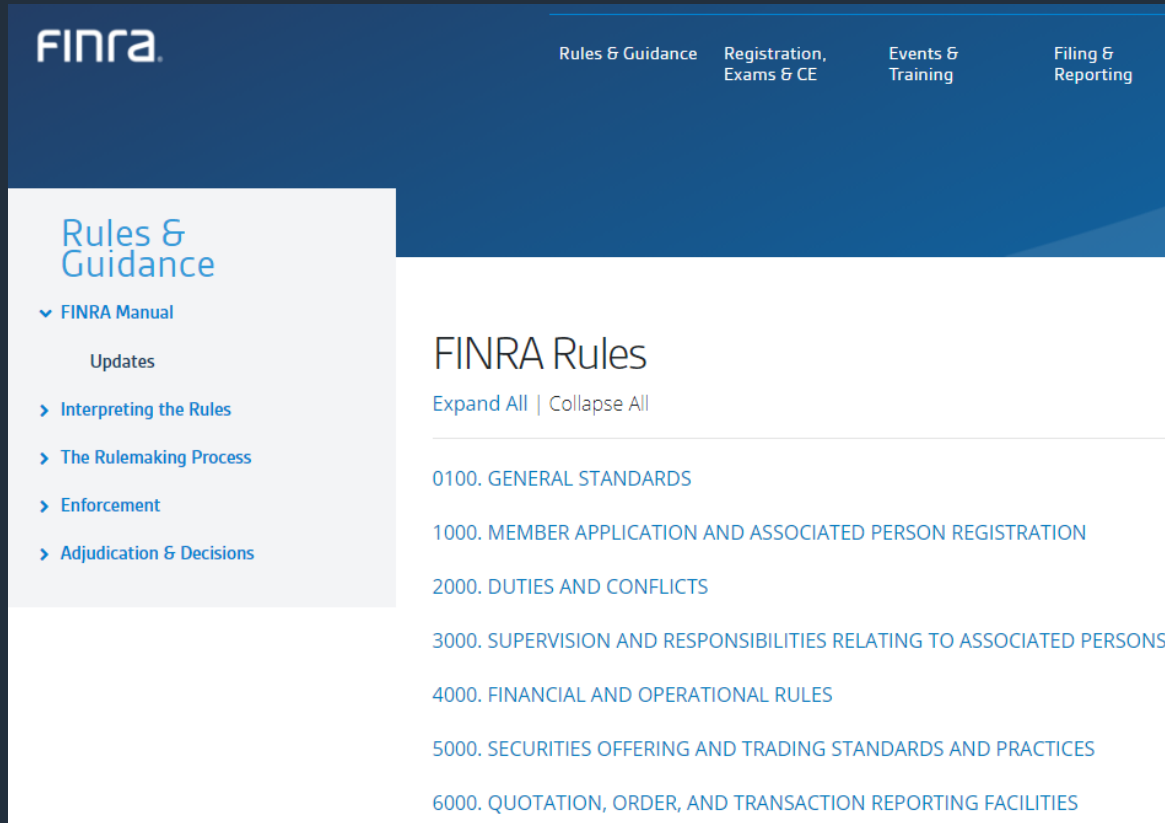
Amazon Textract

- Implement Natural Language Search
- Integrate with FINRA Knowledge Graph
- Support semantic search
- Improve relevancy of results
- Create foundation for connected intelligence platform

Architecture: Future Enterprise Search



Scenario 1: FINRA Rulebook Search



The screenshot shows the FINRA website's navigation menu. The top navigation bar includes 'Rules & Guidance', 'Registration, Exams & CE', 'Events & Training', and 'Filing & Reporting'. The 'Rules & Guidance' section is expanded, showing a sidebar with 'FINRA Manual', 'Updates', 'Interpreting the Rules', 'The Rulemaking Process', 'Enforcement', and 'Adjudication & Decisions'. The main content area displays 'FINRA Rules' with 'Expand All | Collapse All' options and a list of rule categories: 0100. GENERAL STANDARDS, 1000. MEMBER APPLICATION AND ASSOCIATED PERSON REGISTRATION, 2000. DUTIES AND CONFLICTS, 3000. SUPERVISION AND RESPONSIBILITIES RELATING TO ASSOCIATED PERSONS, 4000. FINANCIAL AND OPERATIONAL RULES, 5000. SECURITIES OFFERING AND TRADING STANDARDS AND PRACTICES, and 6000. QUOTATION, ORDER, AND TRANSACTION REPORTING FACILITIES.

Enable search of website content

What we did

- Crawl rulebook pages
- Breakdown sections into subsections
- Extract metadata
- Create S3 bucket as a data source
- Setup Kendra index
- Create Kendra custom attributes
- Repeat steps above for rulebook FAQ

Scenario 1: FINRA Rulebook Search

What is the supervisory system requirements for members?

1-10 of about 1,390 results

Filter search results

version

- 2020 (159)
- 2017 (130)
- 2015 (126)
- 2019 (86)
- 2018 (80)
- 2014 (78)
- [Show more...](#)

subsection

- (a) (136)
- (intro) (114)
- (b) (110)
- Supplementary Material (76)
- (c) (73)
- (d) (35)
- [Show more...](#)

Amazon Kendra suggested answers

Supervision: (a) Supervisory System

A member's **supervisory system** shall provide, at a minimum, for the following: (1) **The establishment and maintenance of written procedures as required by this Rule.** (2) The designation, where applicable, of an appropriately registered principal(s) with authority to carry out the **supervisory** responsibilities of the member for each type of business in which it engages for which registration as a broker-dealer is required. (3) The registration and designation as a branch office or an office of **supervisory** jurisdiction (OSJ) of each location, including the main office, that meets the definitions contained in paragraph (f) of this Rule.

<https://www.finra.org/rules-guidance/rulebooks/finra-rules/3110>

What are Amazon Kendra suggested answers? [Info](#)

Supervision: (a) Supervisory System

...a) **Supervisory System** Each member shall establish and maintain a **system** to supervise the activities of each associated person that is reasonably designed to achieve compliance with...

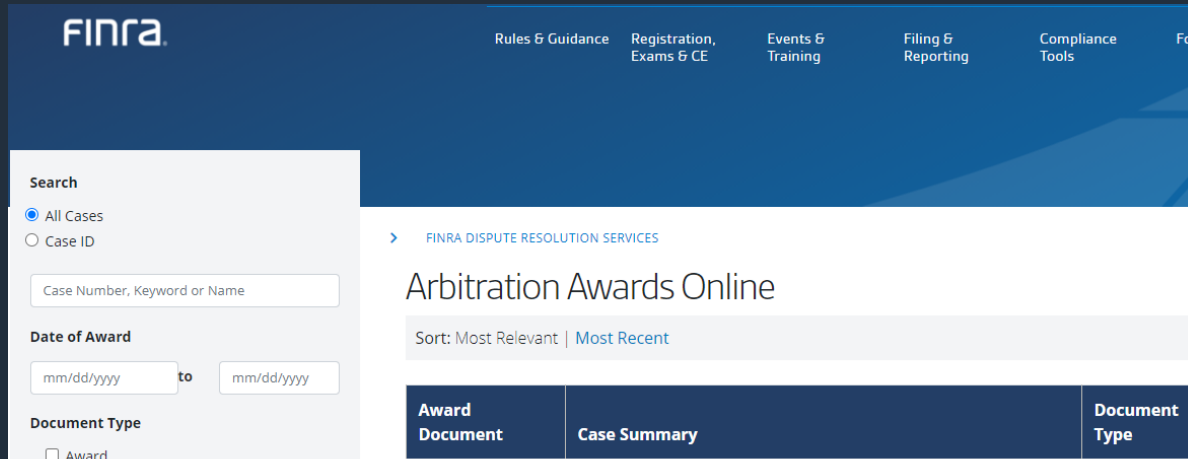
<https://www.finra.org/rules-guidance/rulebooks/finra-rules/3110>

Enable search of website content

What we achieved

- Natural language to query rulebook
- Many scenarios search queries provided high fidelity results
- Mean Reciprocal Rank (MRR) of .67 vs .53 compared to another popular search engine

Scenario 2: Arbitration Awards Online Search

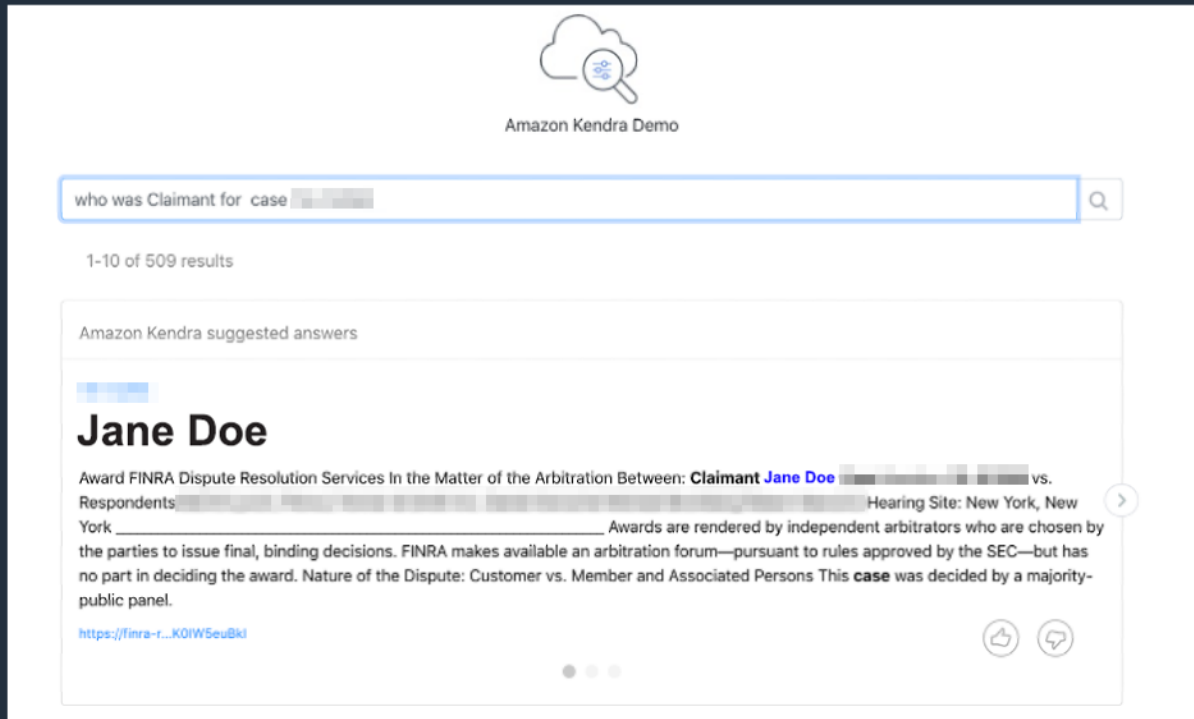


Get answers from content, not more content

What we did

- Sourced publicly available arbitration awards from FINRA.org
- Indexed, onboarded, and trained Kendra

Scenario 2: Arbitration Awards Online Search

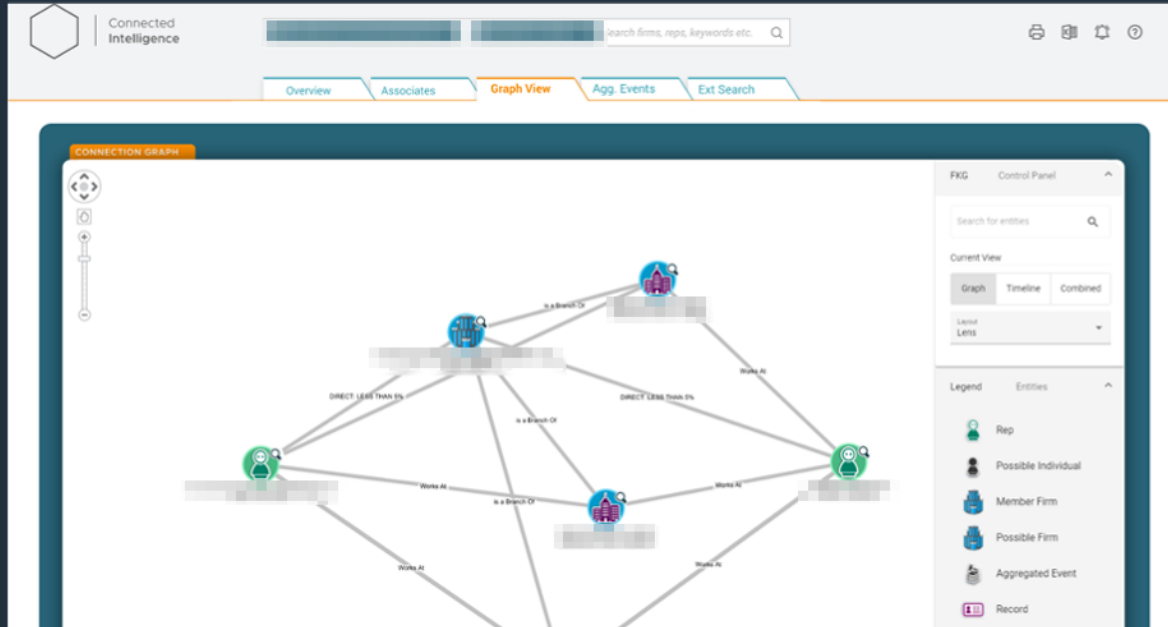


Get answers from content, not more content

What we achieved

- Use Case confirmation that enhanced search capabilities using Natural Language Understanding (NLU) can reduce time to value for an examiner
- Semantic Search - contextualized and enhanced search results over traditional lexical search
- Boundary definitions for conversant search

Scenario 3: FINRA Knowledge Graph Integration

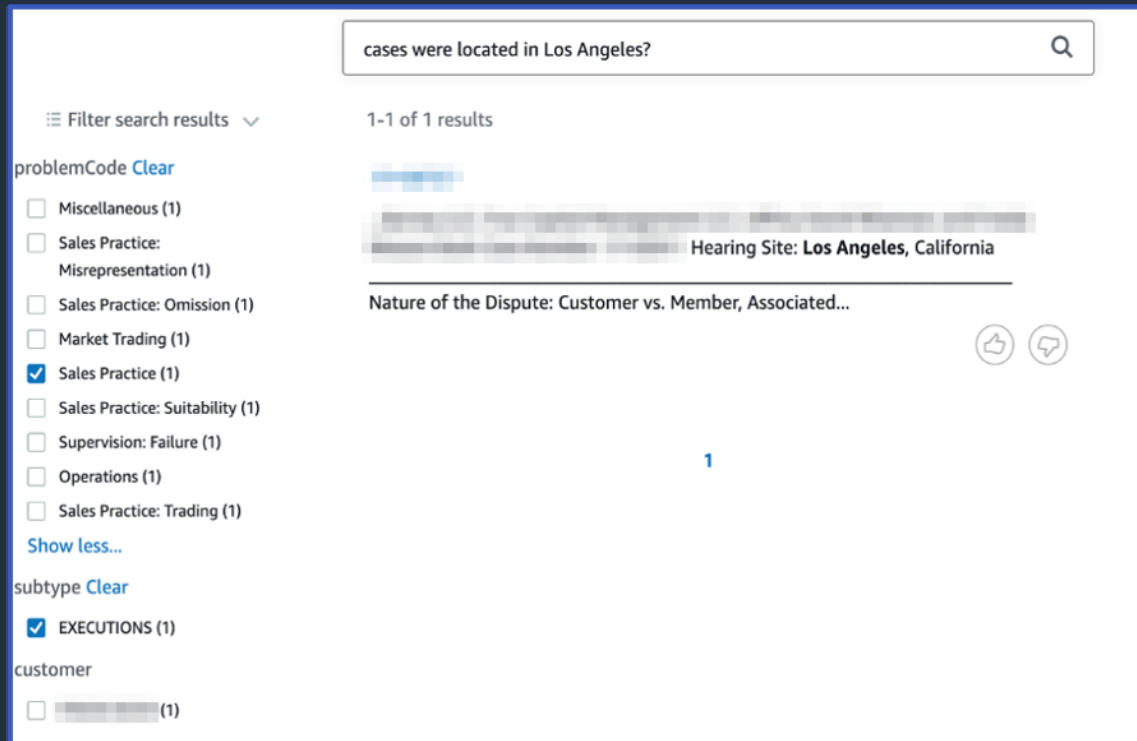


Enrich content results leveraging enterprise knowledge

What we did

- Setup and configure Amazon Neptune
- Populate Neptune with data from FINRA's Knowledge Graph
- Extend Kendra to leverage Graph data inputs for enterprise insights

Scenario 3: FINRA Knowledge Graph Integration



Enrich content results leveraging enterprise knowledge

What we achieved

- Enriched relevance tuning with additional dimensions of data to tune result relevancy
- Leveraged firm knowledge outside the individual document
- Dynamic facet selection based on Kendra + Graph metadata

Lessons Learned

1. The combined power of machine learning capabilities is far greater than the sum of its parts
 - A. The most engaging search experience will combine multiple technologies including Search, Graph, NLU, and UI/UX
 - B. Composability of these services is key to success
 - C. Orchestration of these services together is an emerging challenge
2. Users want answers, not more data
3. The interoperability and availability of the AWS services was key to R&D success.
4. Invest in your Data Assets

Next Steps

1. Graph Ontology and Taxonomy Development
2. Related Search and Recommended Search based on graph capabilities
3. Further research on NLU technologies as the hub between lexical and semantic search capabilities
4. Further research on orchestration among analytical services, granularity definition, and fit-for-purpose

FINRA Kendra Feature Requests



Custom Synonyms

Extend Amazon Kendra's understanding of our specific business vocabulary



Semantic Search

Further enhancement of semantic context awareness with FINRA domain specific learning



Incremental Learning

Learn how users interact with search results and adapt its models to re-rank information, so the most commonly sought content is presented first.



Query Expansion

Support for domain specific query expansion capabilities, for Financial Services abbreviations



Enhanced Dashboard

Support for fine-grained usage monitoring and administrative tuning

How we can help

Solution Architects



- Engage with a solution architect dedicated to your account
- Brainstorm use cases and get support for solution implementation

AWS Partner Network



- Let AWS certified partners help you with the POC and build integrations with your current systems to productionize

ML Solutions Lab



- Identify key areas where machine learning could help you with an AWS AI expert
- Let AWS experts build POCs and custom solutions for your use case

Immersion day, workshops, training, and certification



- Conduct training workshops and hackathons for builders in your organization
- Practical education on ML for new and experienced practitioners
- Based on the same material used to train Amazon developers





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Thank you!

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Dmytro.Dolgopolov@finra.org



Daniel O'Brien
Daniel.O'Brien@finra.org





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Please complete
the session survey

