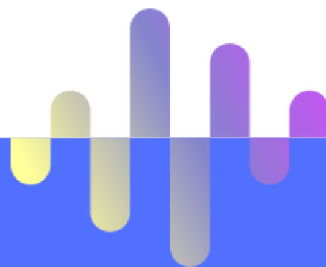ACHIEVING

CONVERSATIONAL INTELLIGENCE

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SAM.ai

Introduction

This document outlines challenges that decision makers face when interfacing with software to extract data. It discusses technical challenges for machines to understand natural human language and provides an overview of how Sam.ai leverages a combination of mathematical algorithms, coding frameworks, artificial intelligence (AI) libraries along with its proprietary classification methodologies to achieve speed and accuracy in conversational intelligence. Utilization of specific Natural Language Processing (NLP), Natural Language Understanding (NLU) combined with deep learning and machine learning libraries to achieve conversational intelligence are discussed. We also outline results and use cases of our technologies in the conclusion of this document.

Business Challenges

Enterprises have access to enormous amounts of data, but that data is often not easily accessible to decision makers on demand. Currently, the workflow for business intelligence and reports resembles the functionality of a search engine: numerous results are displayed, but these results are not curated to be readily usable.

Since Windows 95 we've been interfacing with computers with clicks, taps, and keystrokes. This process is not only cumbersome for the end-user but inefficient and costly due to required software training, support tickets, and loss of productivity. For example it takes a Physician more than 3 minutes and over 15 sequential steps to know what the last result was of a given lab test of a patient.

This friction in interfacing with data inhibits human creativity, limits flow of inquiries, and increases the potential for human error. When a given task requires multiple sequential sub-tasks the end-user would less likely be willing to pursue more inquiries, uncover hidden patterns, and make an informative decision. Additionally, a task that can be achieved with a single command (i.e. "what was the last LDL test result for John Doe" via voice or chat) vs. 15 steps greatly reduces the chance of human error.

Technical Challenges

The field of Natural Language Processing (NLP) is complex and active, with key challenges including syntactic and semantic ambiguity, context-dependent meaning, and the vast variability of natural languages. To overcome these challenges, NLP researchers and practitioners use a combination of rule-based and machine learning-based approaches.

Lack of available labeled data is a challenge for companies hoping to develop NLP systems. We were fortunate to acquire a large amount of labeled data over the years, which we used to create our machine learning approaches to NLP. Without proper data and training, it can be difficult and time-consuming to create and annotate large datasets for all the languages and tasks that NLP systems need to handle.

Chatbot vs. Conversational Intelligence

Chatbots are computer programs designed to simulate conversation with human users. They are often used for customer service and information retrieval, but can also perform simple tasks. Chatbots use a variety of techniques, such as rule-based systems, decision trees, and artificial neural networks.

Conversational intelligence, on the other hand, refers to the ability of a system to engage in intelligent and natural conversations with humans. It involves understanding the context and intent of the conversation, generating appropriate responses, and adapting to the needs and preferences of the user.

Chatbots are designed to provide information and perform simple tasks, whereas conversational intelligence has advanced language processing and decision-making capabilities. Chatbots can be seen as a subset of conversational intelligence, as they are designed to engage in conversation with users but may not have the same level of intelligence or adaptability as systems with true conversational intelligence.

Achieving Conversational Intelligence

Sam.ai was formed in late 2016 in New York City, our team started utilizing NLP/NLU in early 2017. After 74,880 + hours of research, coding, testing, training, and re-coding we delivered our first production ready version of conversational intelligence, called SAM HQ, in late 2019. The team at Sam.ai built all of our AI engines from the group up without any dependencies on third-party AI plug-ins or web services. Additionally, from day one we decided to generate our own data by building a suite of essential business applications in addition to data from other widely used client applications to test and train our models.

We were fortunate to leverage a large number of live data from a global user base to further optimize our results for accuracy. Below is an outline of some of the specific frameworks and libraries we're using to achieve conversational intelligence.

Natural language processing (NLP) involves using algorithms and statistical models to process and analyze human language. Below are some of the algorithms and techniques used in sam.ai:

- **Tokenization:** This involves dividing a piece of text into smaller units called "tokens," which can include words, phrases, and punctuation.

- **Part-of-speech tagging:** This involves labeling each token in a piece of text with its part of speech (e.g. noun, verb, adjective).

- **Named entity recognition:** This involves identifying and labeling named entities (e.g. people, organizations, locations) in a piece of text.

- **Stemming and lemmatization:** These techniques involve reducing words to their base form (e.g. running -> run) in order to facilitate analysis.

- **Dependency parsing:** This involves analyzing the grammatical structure of a sentence and identifying the relationships between the words (e.g. subject, object, modifier).

Natural language understanding (NLU) is a subfield of natural language processing (NLP) that focuses on enabling computers to understand and interpret human language. NLU involves extracting meaning and understanding from human language input, and can be used to build language-based applications

Some of the libraries and tools used by sam.ai for natural language understanding, including:

- **NLTK (Natural Language Toolkit):** This is a popular open-source library for NLP in Python that includes tools for tokenization, stemming, lemmatization, part-of-speech tagging, and more.

- **spaCy:** This is a fast, open-source library for NLP in Python that includes tools for tokenization, part-of-speech tagging, dependency parsing, and named entity recognition.

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Sam.ai leverages supervised machine learning in which a model is trained on labeled data, meaning that the data used to train the model includes both input data and corresponding correct output labels. Supervised learning allows us to build a model that can make predictions or decisions based on new, unseen input data Sam.ai utilizes an aspect of deep learning known as Stochastic gradient descent (SGD) to train deep learning models. It is an iterative algorithm that adjusts the model's parameters based on the gradient of the loss function with respect to the model's parameters, using only a small, randomly selected subset of the training data to compute the gradient at each iteration.

In deep learning, the model is typically a neural network with many layers and a large number of parameters, and the goal is to find the values of these parameters that minimize the loss function, which measures how well the model is able to make predictions on the training data. The loss function is typically a non-convex function, meaning that it has multiple local minima and the global minimum may not be easy to find.

Nuance Reporting

Sam.ai offers nuance reporting that captures specificity and insights at many levels deeper than any existing engine. Nuance reporting goes beyond the limitations of sort, filter, and search options in typical software UI and offer insights that are contextual and curated for the decision maker.

Examples:

- "How many female founders do we have in our investment portfolio in California"
- "How many meetings did we have with c-suite executives in the last 6 months in New York"

Unified Holistic Data (UHD)

Deriving meaning from multiple perspectives, in this case, multiple databases is something we term "Unified Holistic Data". Curating data from multiple sources to the end user has been an elusive undertaking for several years. Sam.ai has limited (unifying data from up to 2 different databases) capabilities that allows for data to be pre-processed from multiple sources and then curated for bite-sized decision maker's consumption. Simply put, sam.ai is able to understand and offer additional insights to the decision maker that is otherwise not available from their application and would need to be manually generated by their in-house data or software team.

- "Who do I know that can introduce me to someone who is a published Author"
  (Data source: Google/Outlook Contacts, FullContact)
- "How many inbound sales calls did we get from our leads in the last 6 months"
  (Data source: Phone.com, CRM Suite)

The use cases are endless, it can be a physician asking for the results of the patient's last CT scan by using their voice instead of wasting precious minutes sequentially clicking on the software interface and menu to get to a page that loads all of the patient's medical results, and then selecting the last one manually. Or a VP of Sales asking SAM via chat when the contract is up for renewal with their major client while they are in a live conference call. The difference between insightful reporting and a lack of insightful reporting can translate into economic decisions that can have millions of dollars of impact in a revenue driven enterprise.
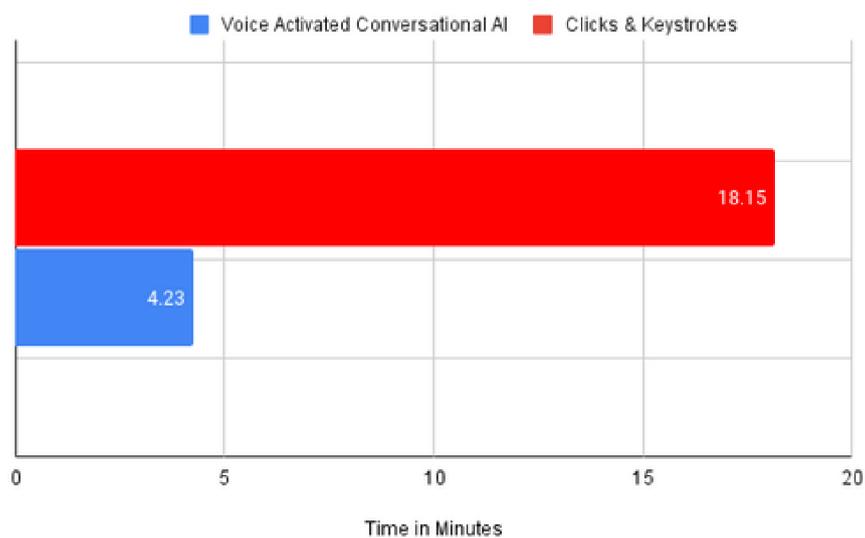
We firmly believe that delivering intelligence to decision makers at nearly the speed of thought can unlock human creativity and ingenuity by eliminating existing frictions that currently exist in accessing data.

RESULTS & USE CASES

Our clients can use Sam's conversational intelligence on any existing data that their enterprise currently has or data generated from sam.ai's own suite of software. This allows for a wide range of use cases across various industries and market segments.

On average Sam.ai's conversational intelligence is able to deliver a productivity improvement of 402%. The speed comparison of using conversational intelligence via voice/chat vs. clicks/taps and keystrokes is further illustrated in this online video: https://youtu.be/3XYWvsK7uxs

Sam.ai Conversational Intelligence vs. Clicks & Keystrokes

■ Voice Activated Conversational AI   ■ Clicks & Keystrokes

Clicks & Keystrokes	18.15
Voice Activated Conversational AI	4.23

Time in Minutes

Phone.com Case Study

Over 30,000 organizations depend on Phone.com for their VOIP Communications needs. Phone.com offers deep analytics on call engagements for customer success, sales, and management teams across various verticals. However, decision makers needed a faster and easier way to access business communications data with specificity and variables that are difficult to achieve on an User Interface.

Sam.ai leveraged Phone.com's existing API libraries to harness user specific analytics data and make all existing reports conversational.   Businesses that use Phone.com's cloud-based phone system to keep their remote teams connected are now able to use Sam's Conversational AI feature to gain access to key operational intelligence to make better, more informed decisions and improve their customers' experiences.

The offering makes use of Natural Language Process (NLP) and Natural Language Understanding (NLU) to continuously learn how best to process, analyze and present business data 4 times faster than clicks and keystrokes. This saves important time and allows managers to focus on other important tasks pertaining to their role.

"Successful sales-driven organizations are always looking for an edge to stay one step ahead of competitors, and SAM is a conduit for communicating business intelligence,"

CEO
Ari Rabban
Phone.com