FRONTEO

RESEARCH & DEVELOPMENT REPORT 2016

Basic Policy

FRONTEO has been conducting research and development into proprietary artificial intelligence (AI) technologies for many years, based on real-world experience in the unforgiving and high-stakes fields of cross-border litigation and fraud investigation. Our AI-based engine KIBIT, which can function on just a single laptop, learns the subtle nuances of human thought not readily expressed through language, such as an expert's tacit knowledge. This requires only a small volume of training data. KIBIT then uses that learning to identify potential links between data and events, making it possible to sort out big data resources. FRONTEO continues to expand its range of data analysis solutions by introducing this AI technology into various markets with real growth potential.

We see opportunities in the following three fields: the healthcare field, where medical and welfare service provision needs to step up to the challenges of aging societies; the digital marketing field, where radical new approaches are required to pinpoint the information we really want from the ever more pervasive internet; and the business intelligence field, where companies constantly need new solutions to stay one step ahead of the competition. Targeting a wide range of fields, we deliver solutions that can uncover hidden connections even people could not see – the core value of our AI technology.

Outstanding technology can change the world. That belief is motivating our efforts to develop new applications and rapidly create new products, underpinned by groundbreaking new research, so we too can change the world by creating a society where AI understands and supports people on a daily basis.

FRONTEO's AI

KIBIT is FRONTEO's own AI-based engine created in Japan. The name KIBIT is derived from the Japanese word "kibi" (meaning subtlety) and "bit", the smallest unit of information in computing. KIBIT thus incorporates our desire to develop AI that can understand the subtle nuances of human thought.

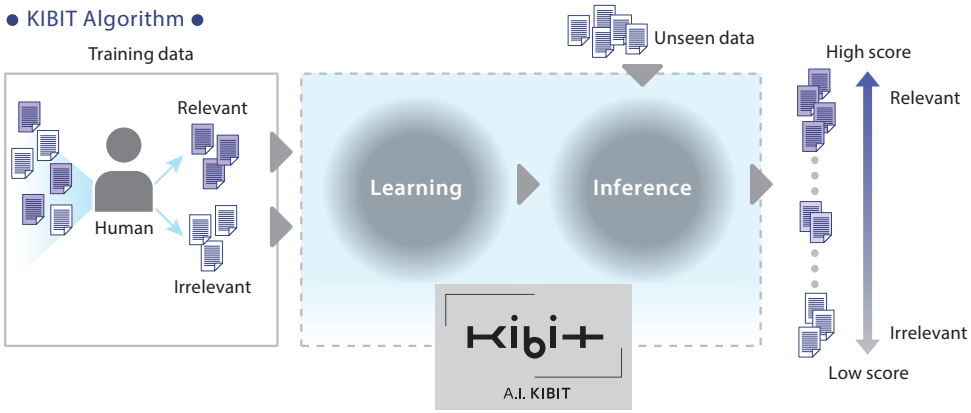
Our AI has been integrated into a variety of products across all business domains, and is capable of applying its high level of perceptiveness in diverse situations. Further, KIBIT offers universal functionalities and people with no particular skill can easily utilize them.

KIBIT

KIBI : the subtleties of human behavior
BIT : the smallest unit of information in computing

KIBIT Algorithm

KIBIT executes its primary function through the following two phases: The Learning phase, which optimizes its predictive ability based on training data; and the Inference phase, which applies the predictive ability acquired from training to a large set of unseen data. More specifically, KIBIT performs the procedures described below:



(1) Learning phase

KIBIT performs morphological analysis of the paragraphs in a training document, which were pre-coded as relevant/non-relevant by humans, and extracts morphemes from each paragraph. Next, it calculates how often each morpheme occurs in the relevant/non-relevant documents and, based on a concept known as Trans-Information, generates a value called "weight," which quantifies the relevance of each morpheme to the matter at hand.

For example, KIBIT may learn from a training set in which a human expert has labeled each document as relevant/non-relevant with regard to cases of fraud, such as cartel activity. If the phrase "private room" appears only in the relevant documents and not in non-relevant ones, this phrase serves as the basic on which to estimate that unseen documents containing this phrase are "relevant" to the fraud. In effect, KIBIT puts a larger weight on the phrase "private room."

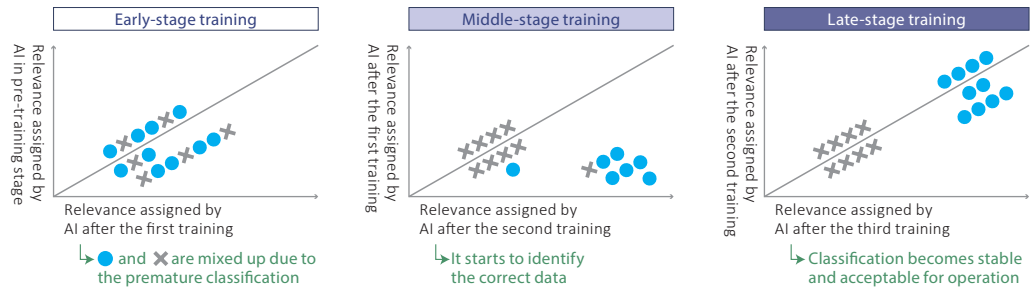
By contrast, if a morpheme (for instance, the word "discuss") occurs in both relevant and non-relevant documents, this morpheme is less likely a factor to determine that unseen documents containing this phrase are "relevant." Hence, KIBIT will assign a smaller weight to this morpheme. In this step, morphemes which do not improve the scoring are filtered out according to their weights. Following this logic, KIBIT can evaluate, with high accuracy, the morphemes that occur in relevant documents.

Quantification of weights based on Trans-Information

Term	No. of time the term occurs		Trans-information (= weight)
	Relevant docs	Irrelevant docs	
private room	High	Low	High
discuss	High	High	Low

Image of AI learning process Ex. discover important emails from daily email communication

● ··· Judged to be "important" by humans
× ··· Judged to be "irrelevant" by humans



(2) Inference phase

KIBIT performs morphological analysis to the collection of unseen documents and extracts morphemes from each paragraph. Next, it computes the score of each unseen document based on the weights assigned to morphemes. This score represents the confidence in the relevance judgment per unseen document.

As described above, KIBIT convolutes the morpheme occurrence with weights, and based on them, aggregates the confidence in relevance judgment as the value called "score." This process enables KIBIT to ingeniously overcome the difficulty in analyzing unstructured text and, with only a small volume of data, promptly deliver decision making support to the people in frontline roles struggling to resolve issues.

Behavior Informatics

We have created a unique approach to big data analysis called Behavior Informatics. Behavior Informatics sees big data (information) as intrinsically linked to the thought patterns and behavior of individuals. By parsing this fruitful resource, it generates knowledge useful for data analysis.
In order to properly train KIBIT in any given case, creating a goal-oriented perspective is necessary. This requires an expert in the matter to select a training set on the basis of robust and consistent criteria. Unfortunately, such perspectives easily become inconsistent as they build on the tacit knowledge of the expert. However, FRONTEO can properly cultivate the perspectives while handling operations and incorporate KIBIT in the most effective workflow, thanks to the massive knowledge accumulated from comprehensive previous data analyses.
When a company faces problems, this nimble and lightly-structured AI, KIBIT, will promptly deliver the results of analysis with the help of human practitioners, achieving the goal of "human-AI collaboration."

The Universal Functionalities of KIBIT

One of the characteristics of KIBIT is the broad range of its solution domain. If there is a process in which a human reads textual data and makes decisions based on an inexpressible insight, which is called tacit knowledge, KIBIT can support this process in all ways. When using KIBIT in a new domain, the domain-specific implementation is relatively small in volume, as only the core engine needs to be installed.
FRONTEO has established the business model that eliminates such domain specific integration. We are developing and operating applications in different domains on the unified, standardized platform KIBIT.

A comparison between KIBIT and other AI systems

	KIBIT	Other AI systems
Integration	Not required Immediately usable with an application installed onto client's machine	Required Task specific integration is necessary
Data volume required for training AI	Small A text with approx. 200 letters alone will do	Large From thousands to tens of thousands of units of training data required
Computer resources required for operation	Small Functional on a single laptop alone	Large Machines capable of parallel computing are desirable
Time needed to train AI	From 5 to 10 minutes	From several hours to several days
Processable data format	Only text	Unlimited Theoretically, every format can be processed

* In-house comparison

A New Approach Provision of Reasoning

If the process of inference for unseen data is not clearly explained to users, the users may hesitate to make decisions based on the results of inference alone, even though the result itself is deemed to be reasonable.
FRONTEO has newly developed a next-generation interface that allows KIBIT to deliver the reason or grounds for inference by showing the user precisely how the training data is linked to the results of inference.
This capability will allow users to streamline their decision making processes and enable KIBIT to be used in a wider variety of business fields.
We are developing the technologies that satisfy the clients' frontline needs, which become evident in the course of real-world operations of KIBIT.

Research & Development Organization

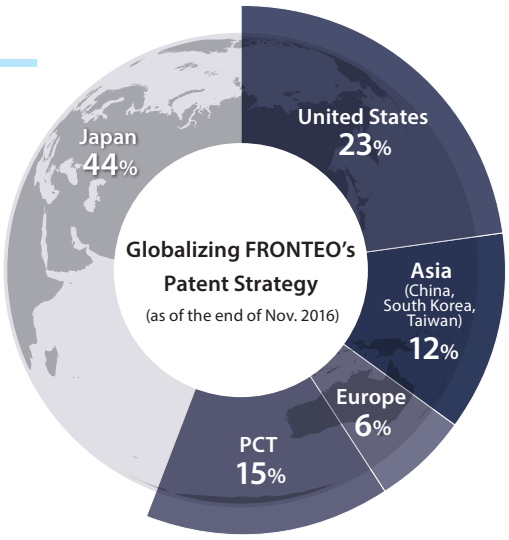
One technology after another is gaining attention in today's information technology. Among them, the development of AI-based technology is especially an area of fierce competition. FRONTEO believes that the rapid cycle of releasing new products and services is paramount to compete with heavily funded players. To expedite the product release cycle, we have established Behavior Informatics Laboratories which play the following roles:

- Strategy Team: plans out strategies based on market needs
- Research Team: generates technologies that satisfy clients' needs
- Development Team: develops products underpinned by the technologies
- Operation Team: establishes robust operations of the developed products and draws out feedback from clients

Among others, the operation team has analysis specialists, who listen to clients and give clear shape to their issues, and then work out solutions with them. As well as conducting operation and support, the operation team deals with product promotion and implementation.
Essentially, the product release cycle breaks down into the following: establishing strategies; creating new technologies; incorporating them into products; and improving the products through lessons learned from real-world operations. This real-world implementation scheme allows us to further refine our AI product suite.

Intellectual Property

FRONTEO puts considerable emphasis on protecting our proprietary technologies, unique brands and other intangible assets as intellectual property through the use of patents and trademarks.
Specifically, as a technology company, we have been accelerating our patent registration processes around the world in order to protect and gain the exclusive use of our data analysis business that is expanding worldwide. Overseas applications and registrations account for 56 percent of the FRONTEO's total patent portfolio as of the end of November in 2016. In addition, we have acquired trademarks that are incorporated across all our products and services, including the new company name FRONTEO which reflects our resolution to expand into various AI-driven business areas; KIBIT, the name of our proprietary AI engine; and Lit i View, the data analysis platform powered by KIBIT.



Overseas patent applications/registrations **56%**

Company Profile

Name:	FRONTEO, Inc.
Established:	August 8, 2003
Head Office:	2-12-23 Kounan, Minato-ku, Tokyo 108-0075, Japan
Representative Director:	Masahiro Morimoto
Capital:	JPY 1,764,965,000 (as of September 30, 2016)
Net Sales:	JPY 10,553 million (consolidated sales, fiscal year ended March 2016)
Stock Market Listings:	Mothers Market, Tokyo Stock Exchange (code: 2158) NASDAQ Stock Market (ticker symbol: FTEO)
Contact:	+81-3-5463-6344

FRONTEO, Inc.
2-12-23 Kounan, Minato-ku, Tokyo 108-0075, Japan TEL : +81-3-5463-6344
www.fronteo.com