Deep Learning　がもたらす産業革命

Preferred Networks
長谷川　順一

Preferred Networks

取締役 COO　長谷川 順一

04 | Monday, August 24, 2015 THE WALL STREET JOURNAL.

WSJ.D TECHNOLOGY @wsjd | wsjd.com

Robot Maker Places Bet On Artificial Intelligence

By Takashi Mochizuki

OSHINO, Japan—Japanese robot maker **Fanuc** Corp. has strengthened a tie-up with an artificial-intelligence venture as part of its effort to develop industrial machines that can learn and repair themselves.

Fanuc said Friday it plans to acquire a 6% stake in **Preferred Networks** Inc., a Tokyo-based startup that is also known as PFN, for ¥900 million ($7.4 million).

The two companies signed a basic partnership agreement in June to develop robots that require less human supervision.

"A couple of our yellow robots have already installed at the PFN's office to collaborate in research and development," Fanuc Chief Executive Yoshiharu Inaba said at a news conference. "We believe the PFN is the world's most advanced in terms of deep-learning expertise."

Preferred Networks is a small developer of AI technology, including "deep learning," a kind of self-study program for machines. Instead of being programmed solely with fixed rules, computers learn by themselves how to achieve a task.

Companies in the business of designing machines used in factory automation are racing to make their robots smarter to improve efficiency.

Fanuc aims to use Preferred Networks' expertise to develop robots that can optimize their own workflow and repair other robots.

"Marrying its own robots with AI technology is a necessary step for Fanuc's long-term strategy to keep its competitive edge," said Kenjin Hotta, an analyst at Macquarie Securities. "[Fanuc's] hardware is great, but it needs to catch up with European rivals on the systems front," he added.

Toru Nishikawa, chief executive of Preferred Networks, said the two companies hope to unveil prototype robots by early next year.

Fanuc produces robots for factories that help assemble products such as Apple Inc.'s iPhones and Tesla Motors Inc.'s electric cars. It has enjoyed hefty profits from the global smartphone boom, but its share price has fallen more than 15% in recent weeks on concerns about the Chinese economy.

Deep learning is one of the hottest investment targets for global tech giants, including **Google** Inc., which acquired a London-based startup for an estimated $500 million last year. Deep-learning technology is used in many ways, including automatically tagging names of people in photographs uploaded to the Internet.

NTT　CISCO

DeNA

NVIDIA　intel

FA&ROBOT&ROBOMACHINE FANUC

国立研究開発法人 国立がん研究センター National Cancer Center Japan

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THE WALL STREET JOURNAL.　1 - 1 of 1

8:47 PM JST Oct 1, 2014

JAPAN
TECHNOLOGY
DEEP LEARNING
NTT
PREFERRED NETWORKS
TOYOTA MOTOR CORP

NTT, Toyota Seek 'Deep Learning' Expertise

By Takashi Mochizuki

Google's Larry Page, Facebook's Mark Zuckerberg and Tesla's Elon Musk aren't the only ones getting passionate about "deep learning"–a kind of self-study technology for machines. Now major Japanese companies are also taking a greater interest in the technology and putting money where that interest lies.

— Getty Images

TOYOTA

DIMO DEEP INTELLIGENCE IN MOTION

Chainer


第３回「日本ベンチャー大賞」
経済産業大臣賞
（ベンチャー企業・大企業等連携賞）
FINANCIAL TIMES
Boldness in Business Awards 2017: Winners
TECHNOLOGY
表彰状
貴殿の会社は第三回日本ベンチャー大賞
において特に優秀と認められました
ファナック株式会社との連携による
貴殿の会社の新事業の創出
のベンチャー企業の範たるものと認め
られますのでここに表彰します
平成二十九年二月
経済産業大臣
西川 徹殿
JEITA
第1回
JEITAベンチャー賞
株式会社 Preferred Networks 殿
WINNER
BOLDNESS IN BUSINESS AWARDS
EXPO AWARD 2014
優秀賞
株式会社 Preferred Networks
ディープラーニングを応用した
映像解析ソリューション
桔梗原 富夫
Forbes
2nd Place

Preferred Networks, Inc. （PFN） https://www.preferred-networks.jp

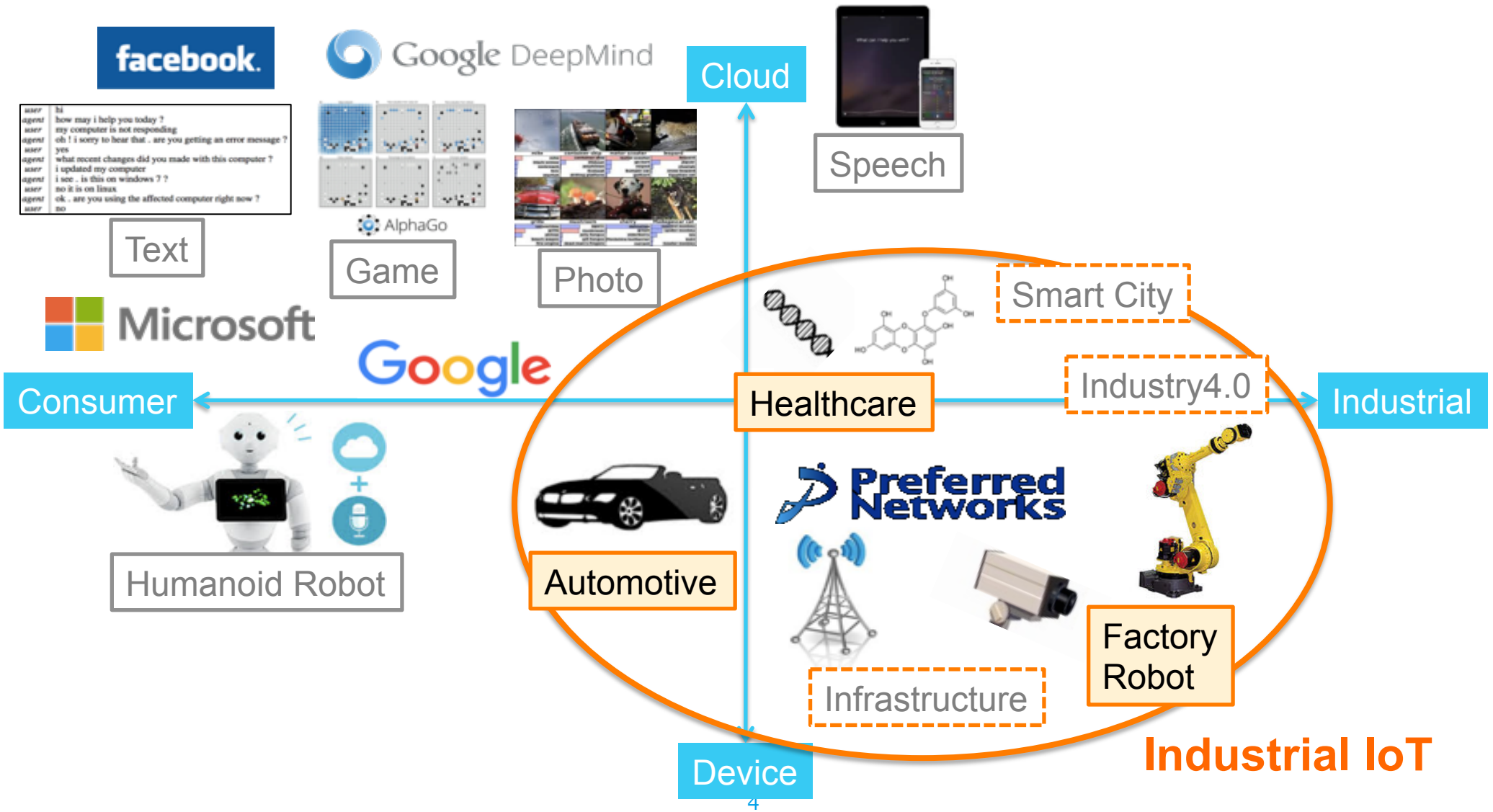
- 設立：2014年3月
- 本社：大手町
- PFN America, Inc. San Mateo
- 社員数　約60名
- ミッション：

IoT時代に向けた新しいコンピュータを創造する

あらゆるモノに知能をもたせ、分散知能を実現する

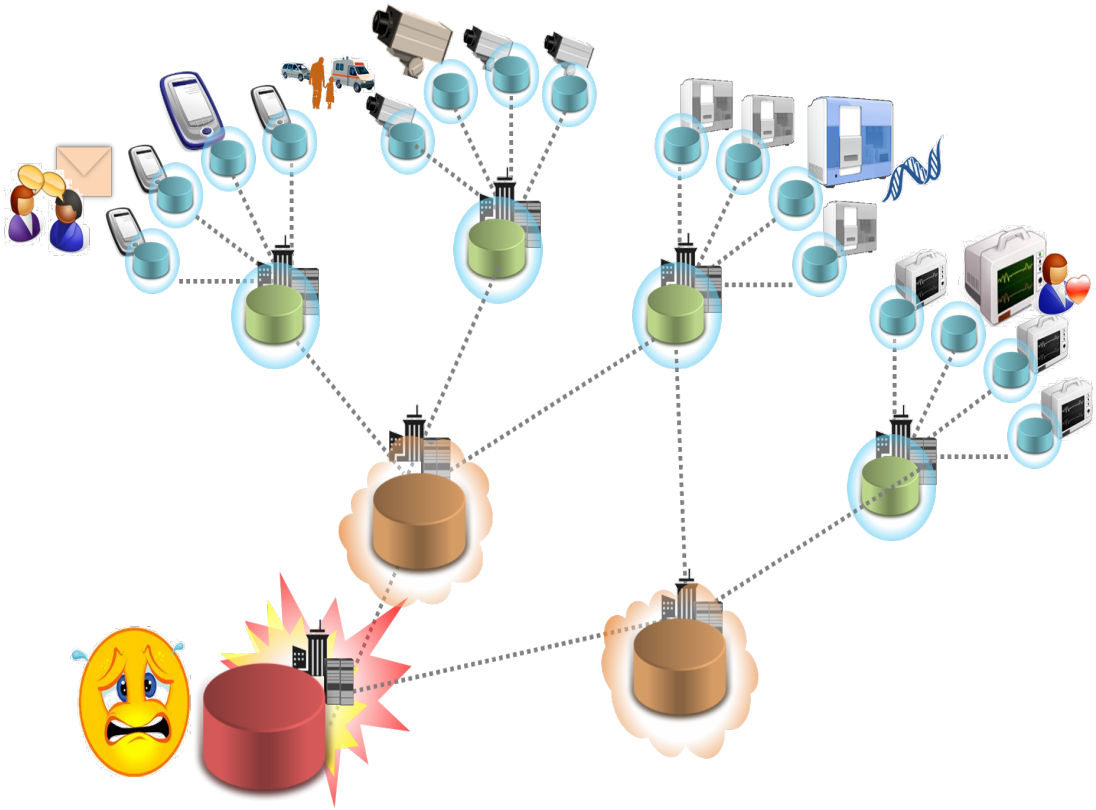
最先端の技術を最速で実用化する

Preferred Networks' positioning in AI: Industrial IoT



データの「量」の爆発とリアルタイム処理

- IoTデータはクラウドに送るのはコスト的に困難
  - データの価値密度が低く、コストに見合わない
- アプリケーションによっては遅延が許されない



Conjecture : “Edge-Heavy Data”
Edge Heavy　アーキテクチャを提案

Krill: An Architecture for Edge-Heavy Data

Daisuke Okanohara*[1], Shohei Hido[1], Nobuyuki Kubota[1], Yuya Unno[1], Hiroshi Maruyama†[2]

[1]Preferred Infrastructure, Inc. Japan.
[2]The Institute of Statistical Mathematics, The Research Organization of Information and Systems, Japan.

Abstract

We argue that most of data will be stored and processed at the edge of the network in the next “BigData” era. We call this phenomenon “Edge-Heavy Data”, and we propose an architecture named Krill[1] *for it. One important characteristic of BigData is its low value-density. If the data are never used, it is wasteful of sending it to the data centers (with a network cost) and storing them into expensive enterprise-grade data servers. Instead, the low value-density data will be stored near where they are generated, that is, the edge of the network.*

This paper discusses requirements and a possible architecture for efficiently dealing with the phenomenon of edge-heavy Data. We first consider a few scenarios where edge-heavy data is desirable, or even inevitable, and identify its requirements. Then we propose an architecture based on the

assume that each camera is allocated 100GB of storage, the total size is 750PB, which is already too large to collect or store into one place.

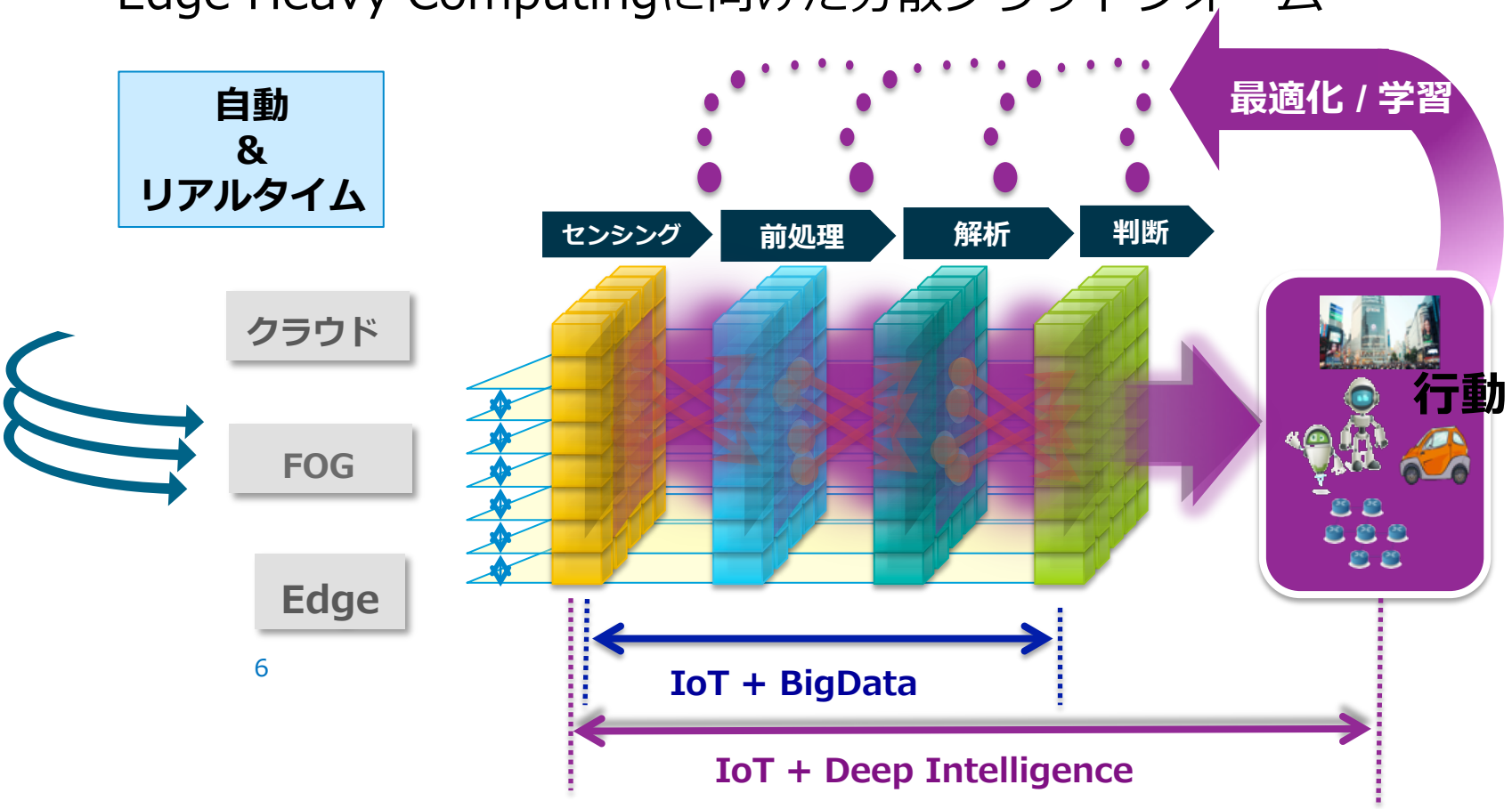
Each camera has its own “value-density,” that is, the value per bit. The data of the front entrance where many people pass by are much more valuable than the data from a camera that monitors the activities of the backyard parking lot where the activities are infrequent and far in between. The value-density can also vary depending on the time of the day, or the day of the week. It is desirable that the data will be distributed among multiple recorders so that the overall storage capacity can be maximally utilized depending on the value-density of the data.

The data of a camera should be associated with those of the cameras nearby. For example, if we want to track a movement of a particular person (e.g., a potential terrorist), this informa-

IEEE Second Workshop on Architectures and Systems for Big Data (ASBD 2013)

データの「種類」も爆発しもはや人手では処理できない

Edge Heavy Computingに向けた分散プラットフォーム



全ての処理をエッジ、FOG、クラウドが協調してシームレスに処理できるように

ディープラーニングで繋いだインテリジェントプラットフォーム

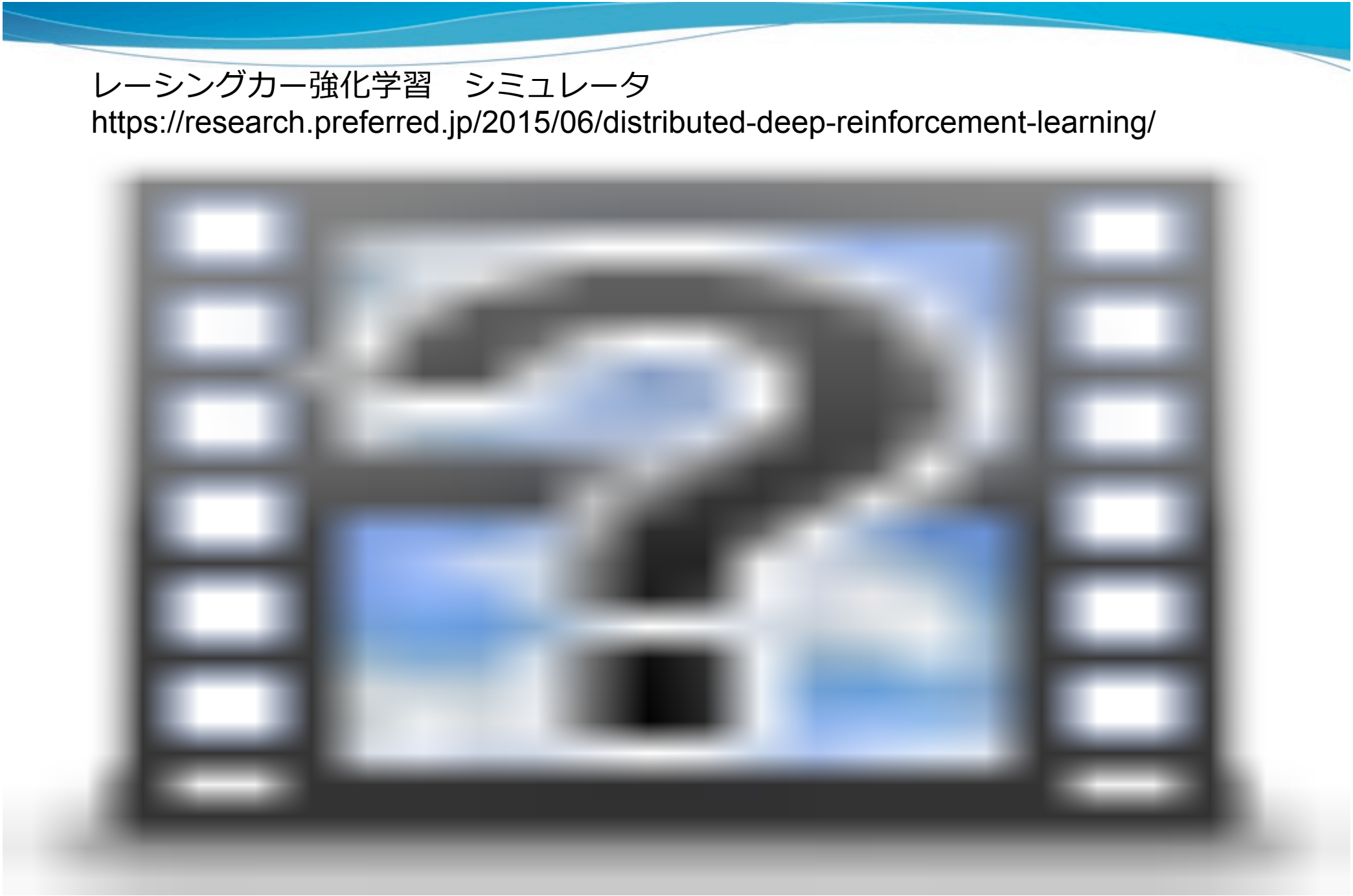
Chainer：ディープラーニングフレームワーク

- ✓ Pythonプログラムで自由にネットワーク記述可能
- ✓ 最新の深層学習の様々なアルゴリズムをネイティブにサポート
- ✓ データごとにオンデマンドでのネットワーク構築が可能
- ✓ マルチGPU対応(Model Parallel / Data Parallel)
- ✓ 2015年6月の公開以降，産業界，研究界で広く使われている

ディープラーニング フレームワーク

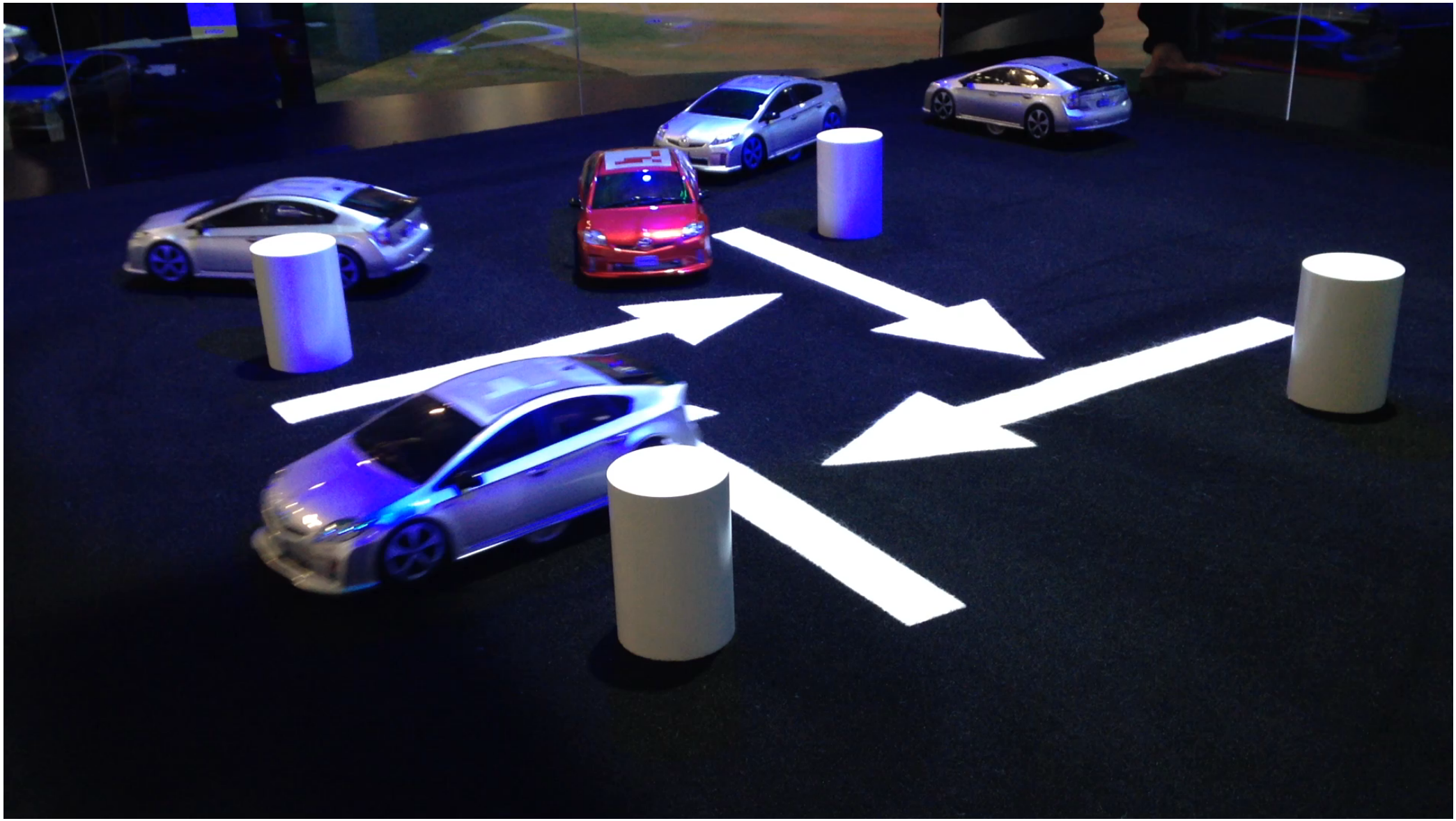
	Chainer	Caffe	torch	theano	TensorFlow
主要実装言語	**Python**	C++	Lua	Python	C++/Python
主要開発者	**Preferred Networks Inc.**	BVLC	Idiap Research Institute, DeepMind	Univ. of Montreal	Google
コミュニティ	△(日本◎)	◎	○	○	○
RNN/LSTM対応	◎	×	○	○	○
動的ネットワーク構築	○	×	×	×	×
拡張性	○	△	○	○	○
ネットワーク設計	**言語内DSL**	設定ファイル (prototxt)	言語内DSL	設定ファイル (YAML)	言語内DSL（Python）
特徴	**ネットワーク動的構築による省リソース**	画像認識が得意	LuaJITによる高速化	自動微分機構	マルチGPU（マルチノード：予定）をサポート

レーシングカー強化学習　シミュレータ
https://research.preferred.jp/2015/06/distributed-deep-reinforcement-learning/



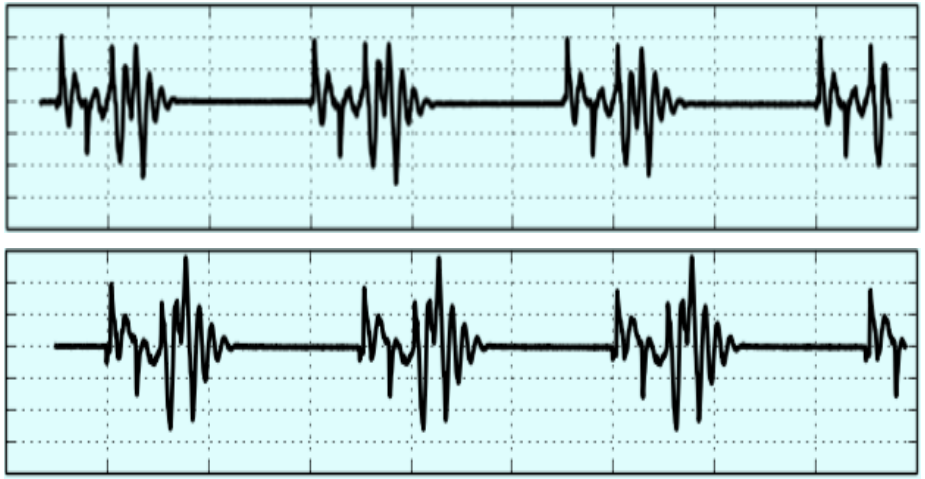
ロボットカーでの強化学習
https://research.preferred.jp/2015/06/distributed-deep-reinforcement-learning/

CES2016　AIを搭載したぶつからない車（分散強化学習）　with　トヨタ
https://research.preferred.jp/2016/01/ces2016/



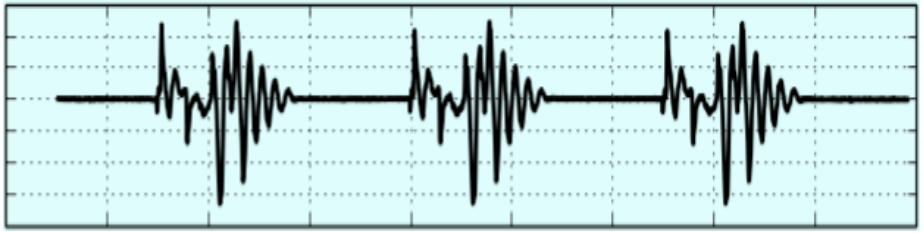
バラ積みロボットの自動ティーチング　with　ファナック
https://research.preferred.jp/2015/12/robot_binpick_deep_learning/

ディープラーニングを使った異常検知



正常時の波形

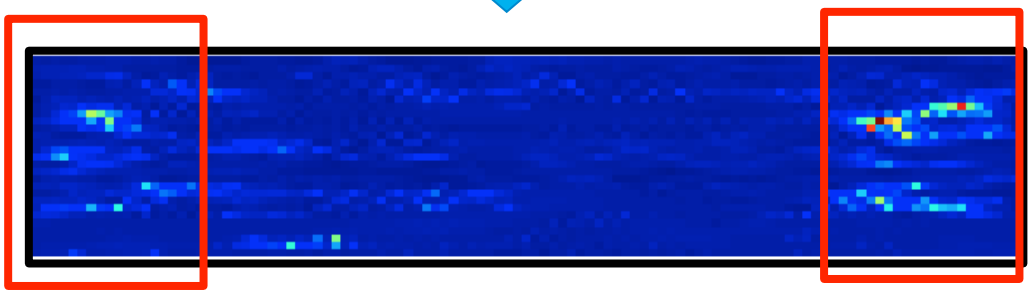
実際の減速機から得られた
センサデータ



異常時の波形

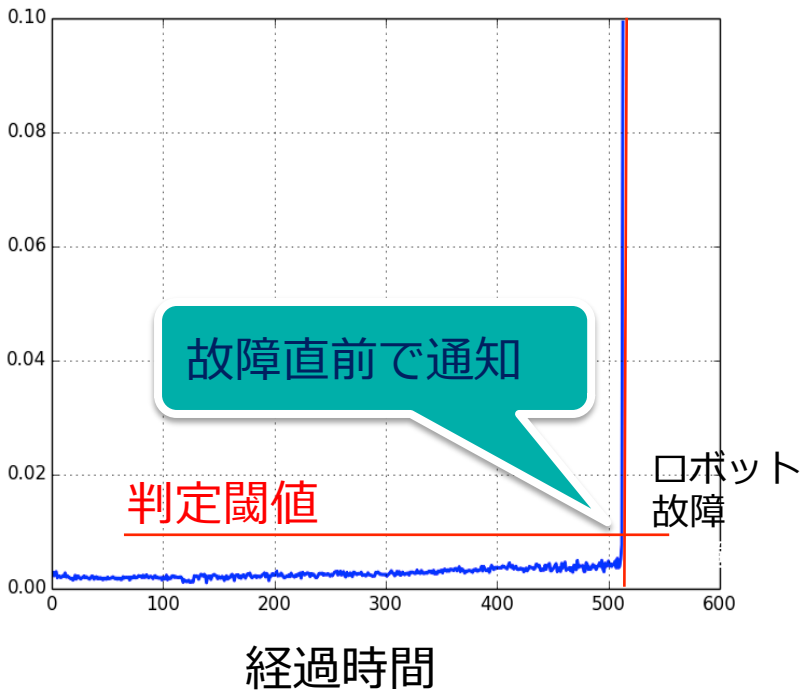
異常な部分を抽出する
ディープラーニング技術

異常は発見されない

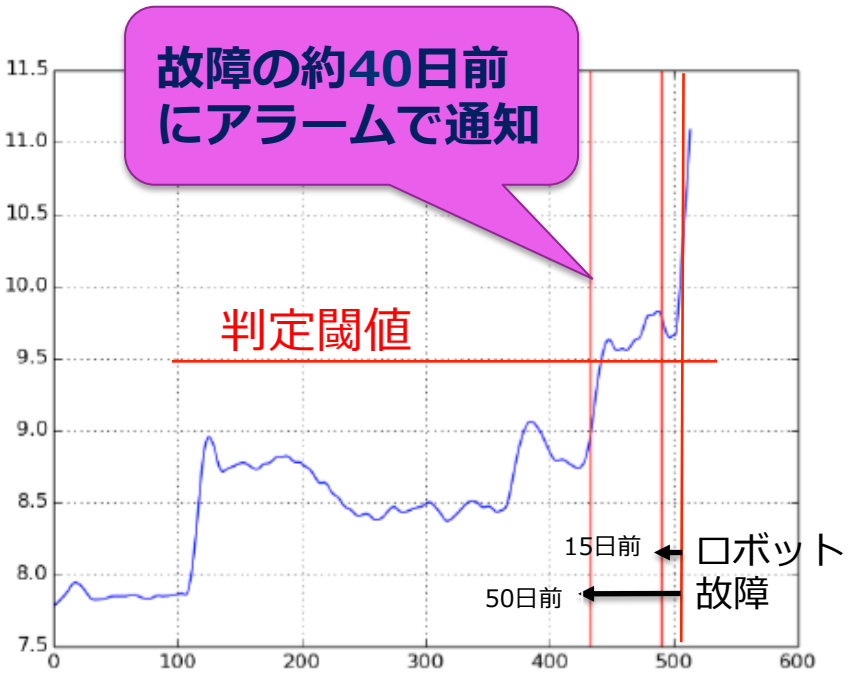


異常を検出

既存手法



新手法



既存手法で検出が遅かった異常を事前に検出

電力需要量予測

- 実際の需要量に応じた発電を行いコストを最小化
- 未来の電力需要量を予測
  - 気象データ、家庭の位置情報を活用
  - ディープラーニングの利用で高精度な予測を実現
- 低圧の需要予測において、従来手法と比較しエラー率半減

ゲノム情報に基づく個々人に最適化された医療 (Precision Medicine)

「人工知能（AI）を活用した統合的がん医療システム開発プロジェクト開始」2016/11/29
with 国立がん研究センター, 産総研AIセンター

臨床情報、マルチオミックスデータ、医用画像,、疫学データを利用しPrecision Medicineの実現を目指す

乳がん検査の精度

マンモグラフィー　**８０%**

↓

リキッドバイオプシー
（血液中のmicroRNA）　**９０%**

↓

リキッドバイオプシー
＋
Deep Learning
(PFN 方式）　**９９%以上**

企業競争力の源泉はデータと計算資源

- いかに高品質なデータを入手するか？
  - 工作機械・ロボット　No.1　ファナック
  - 自動車　No.1　トヨタ
  - 国内がん患者の医療データ　No.1 がんセンター
- いかに効率的に学習するか？
  - Cloud vs. Network Edge
- いかに学習時間を短くするか?
  - 学習時間の差＝計算資源の差　が企業の競争力を左右する
  - 現在　No.1　Nvidia　GPU
    - 消費電力、Deep Learningに最もふさわしいChipの開発競争