# 人工知能と医療

京都医療科学大学
医療情報標準化推進協議会（HELICS協議会）理事

江本豊

# **知能**的なもの

学習、記憶、理解、分析、予測、展開

知識　　知恵

ひらめき　感情

抽象的　　論理的

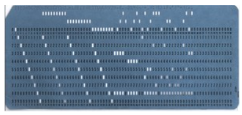
1, 2, 3, 5, 8, 13, ?,

# Artificial intelligence (wikipedia)

the ability of a computer program or a machine to think and learn. It is also a field of study which tries to make computers "smart".

They work on their own without being encoded with commands.

John McCarthy came up with the name "artificial intelligence" in 1955.



https://ja.wikipedia.org

# “人工知能”の歴史

1947アラン・チューリングが初めて人工知能の概念を提唱

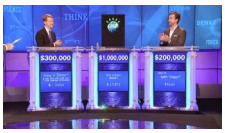
1956ダートマス会議にて「人工知能」という言葉が登場

1960年代 第一次人工知能ブーム（推論、探索）

冬の時代

1980年代 第二次人工知能ブーム（知識）

- 自然言語処理• エキスパートシステム



2011年ワトソンクイズで勝利

冬の時代

2010年代 第三次人工知能ブーム（機械学習）

Big Data

- 統計的自然言語処理•ディープラーニング

2012~ ディープラーニング技術が画像認識コンテストで圧勝

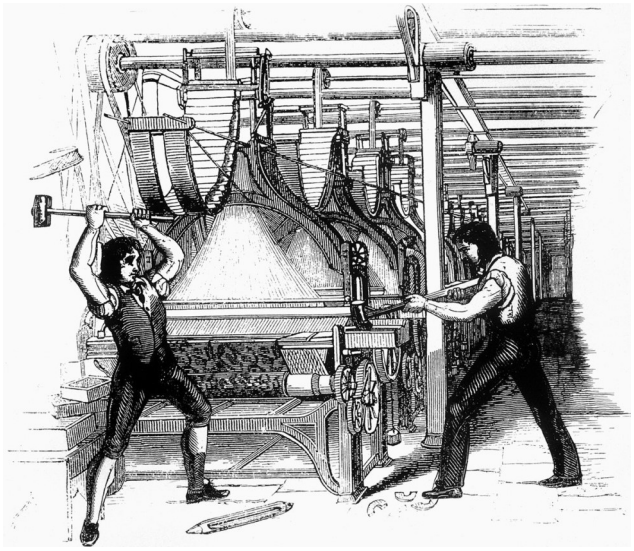
人間の認識率を超えた


2015年AlphaGo碁のチャンピオンに勝利

2045 Singularity??

# 人工知能はヒトの仕事を奪うか？

Luddite movement



https://en.wikipedia.org/wiki/Luddite

https://medium.com/utopiapress/will-artificial-intelligence-steal-your-job-196e57ebdda1

UtopiaPress FUTURE BASIC INCOME BUSINESS ECONOMY POLITICS BLOCKCHAIN ARTIFICIAL INTELLIGENCE

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## Will Artificial Intelligence Steal your Job?

Michael K. Spencer Follow
Feb 27 · 7 min read ★

*Imagine a world where you are competing against machines to be more creative, in order to survive economically.*

There's something very sensational about how machine learning, automation and disruptive new uses of deep learning and robots will impact our tasks at work and make our jobs obsolete. We can expect this to occur gradually over the next 30 years in:

- Retail
- Customer service
- Manufacturing
- Transportation
- Media & Content
- Finance & Banking
- Delivery & Logistic s
- Construction
- Human Resources
- Sales & Marketing
- Government & Administration
- Healthcare

the balance careers

https://www.thebalancecareers.com/artificial-intelligence-is-changing-your-c areer-in-medicine-4586781

THE BALANCE CAREERS ▶ CAREER PATHS

## How Artificial Intelligence is Changing Your Career in Medicine

Career Paths
CAREER PATH BASICS
US MILITARY CAREERS
CRIMINOLOGY CAREERS
ADVERTISING
SALES
ANIMAL CAREERS
ALL CAREER PATHS›

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- How A.I. Is Changing Healthcare
- Medical Research
- Surgery
- Jobs for Technology Creators
- Medical Diagnostics
- Medical Imaging
- Practicing Virtual Medicine
- A.I Jobs That Pay Well

BY ALISON DOYLE • Updated February 16, 2019

Artificial intelligence (AI) has transformed many sectors of the economy and has a particularly significant effect on the delivery of healthcare. What is artificial intelligence anyway, and how will it impact your career in medicine? Google Dictionary defines artificial intelligence as "The theory and development of computer systems able to perform tasks that normally require human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages."

### How Artificial Intelligence is Changing Healthcare

Artificial intelligence will have a significant impact on the way that medical professionals train and how they conduct their jobs. It will also provide many career options for information technology (IT) professionals who create and modify artificial intelligence products for the medical industry.

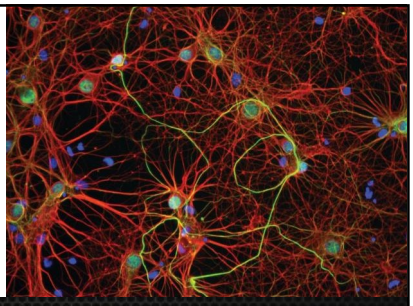
The impact on careers for medical professionals will be very significant. There are AI programs and tools - both in use and in development - for diagnostics, imaging, determining treatment, and surgery.

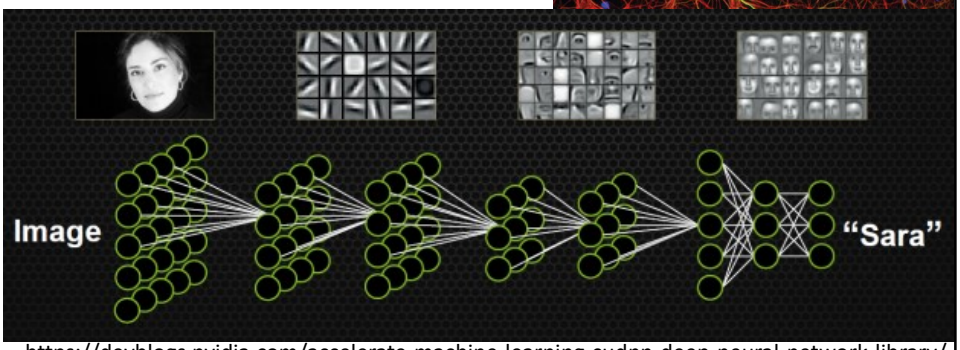
**Note:** However, experts don't expect artificial intelligence to replace humans. Instead, AI will help medical professionals to carry out their roles in less time and more effectively.

### Medical Diagnostics

The aspect of healthcare delivery in which artificial intelligence will have the most significant impact is in the diagnostic process. In particular, AI will aid in diagnosing complex cases and rare diseases where even the best-trained professionals may be challenged by processing a large number of patient symptoms, lab results, medical histories, diagnostic images, and patient characteristics. AI diagnostic products generate as output disease scenarios that result from the combination of data inputs into the system.

# Deep Learning



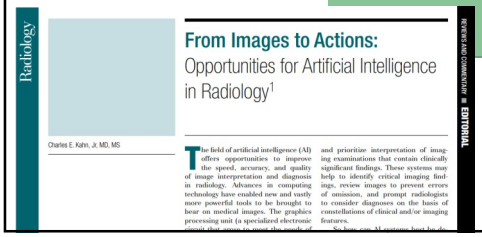



https://devblogs.nvidia.com/accelerate-machine-learning-cudnn-deep-neural-network-library/

**Convolutional deep belief networks for scalable unsupervised learning of hierarchical representations**
by Lee, Honglak; Grosse, Roger; Ranganath, Rajesh; Ng, Andrew

# 画像識別

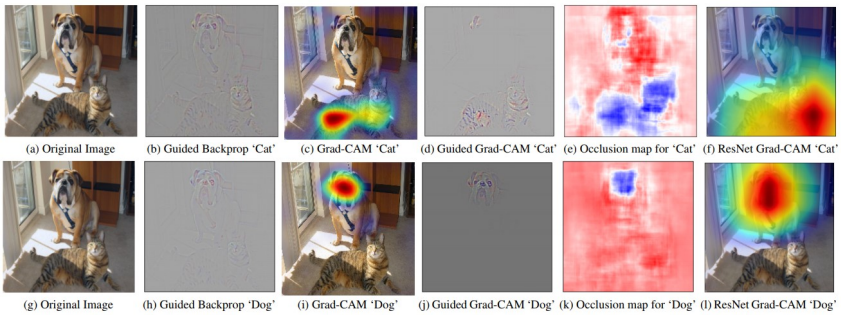

https://www.what-dog.net/




Radiology 2017; 285:719–720

## Grad-CAM: Visual Explanations from Deep Networks via Gradient-based Localization

arXiv:1610.02391v3



(a) Original Image (b) Guided Backprop 'Cat' (c) Grad-CAM 'Cat' (d) Guided Grad-CAM 'Cat' (e) Occlusion map for 'Cat' (f) ResNet Grad-CAM 'Cat'

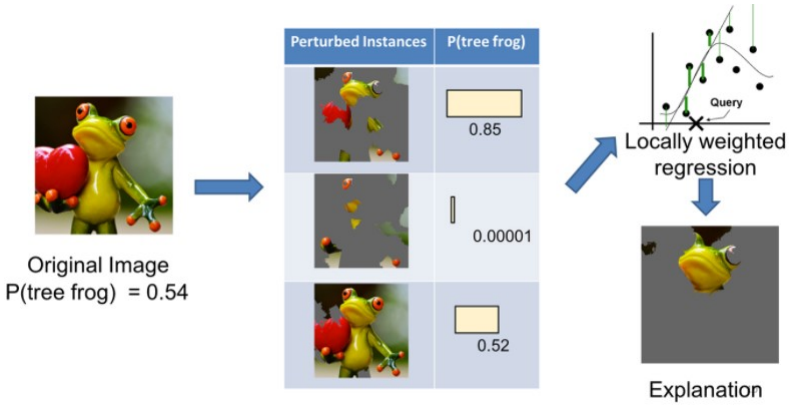
(g) Original Image (h) Guided Backprop 'Dog' (i) Grad-CAM 'Dog' (j) Guided Grad-CAM 'Dog' (k) Occlusion map for 'Dog' (l) ResNet Grad-CAM 'Dog'

'igure 1: (a) Original image with a cat and a dog. (b-f) Support for the cat category according to various visualizations for VGG and ResNet. (b) Guided Backpropagation [46]: ighlights all contributing features. (c, f) Grad-CAM (Ours): localizes class-discriminative regions, (d) Combining (b) and (c) gives Guided Grad-CAM, which gives high-esolution class-discriminative visualizations.Interestingly, the localizations achieved by our Grad-CAM technique, (c) are very similar to results from occlusion sensitivity (e), vhile being orders of magnitude cheaper to compute. (f, l) are Grad-CAM visualizations for ResNet-18 layer. Note that in (d, f, i, l), red regions corresponds to high score for :lass, while in (e, k), blue corresponds to evidence for the class. Figure best viewed in color.

## LIME

### Local Interpretable Model-Agnostic Explanations

"Why Should I Trust You?" Explaining the Predictions of Any Classifier
https://www.kdd.org/kdd2016/papers/files/rfp0573-ribeiroA.pdf

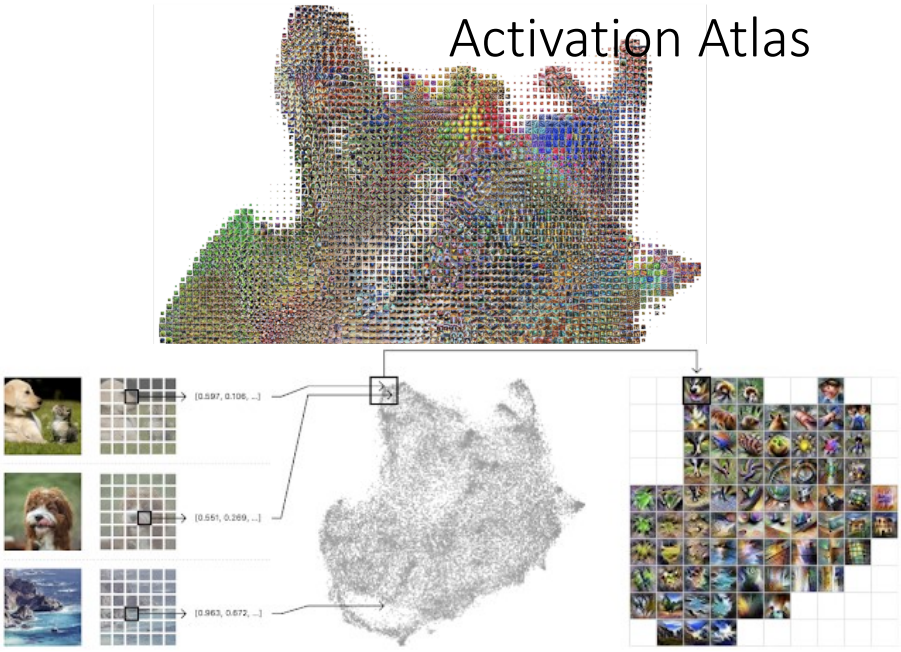


# Interpretable Explanations of Black Boxes by Meaningful Perturbation

arXiv:1704.03296v3

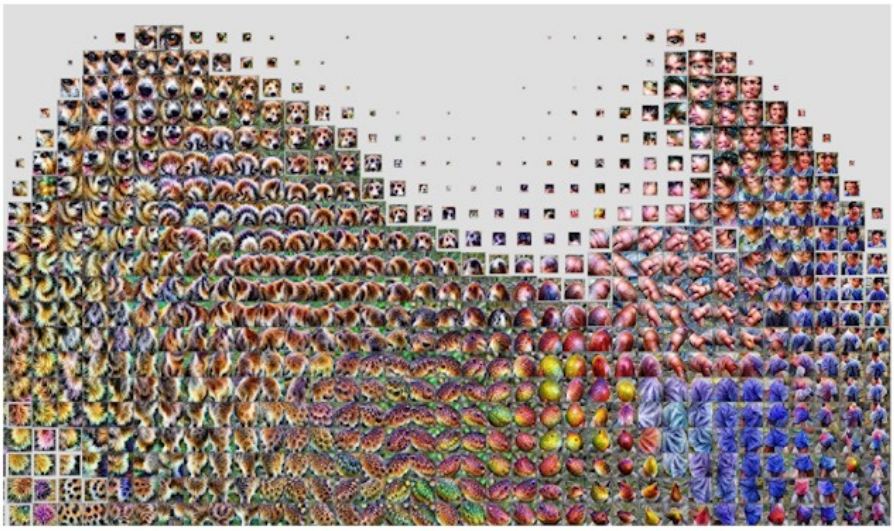

Figure 1. An example of a mask learned (right) by blurring an image (middle) to suppress the softmax probability of its target class (left: original image; softmax scores above images).

# Activation Atlas



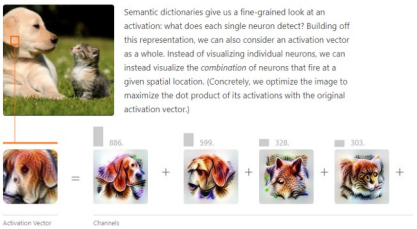
https://ai.googleblog.com/2019/03/exploring-neural-networks.html

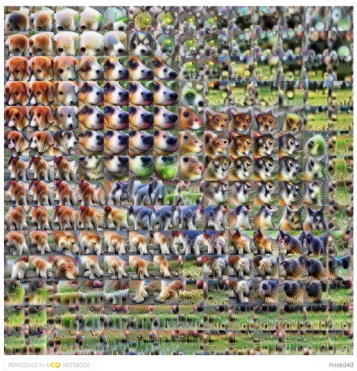
# Activation Atlas



https://ai.googleblog.com/2019/03/exploring-neural-networks.html

## What Does the Network See?

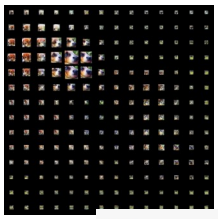


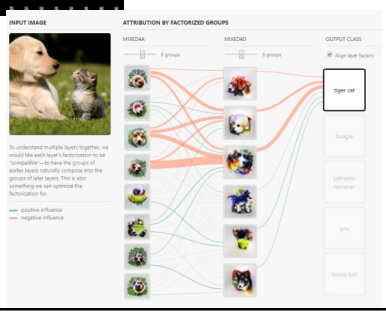



https://distill.pub/2018/building-blocks/

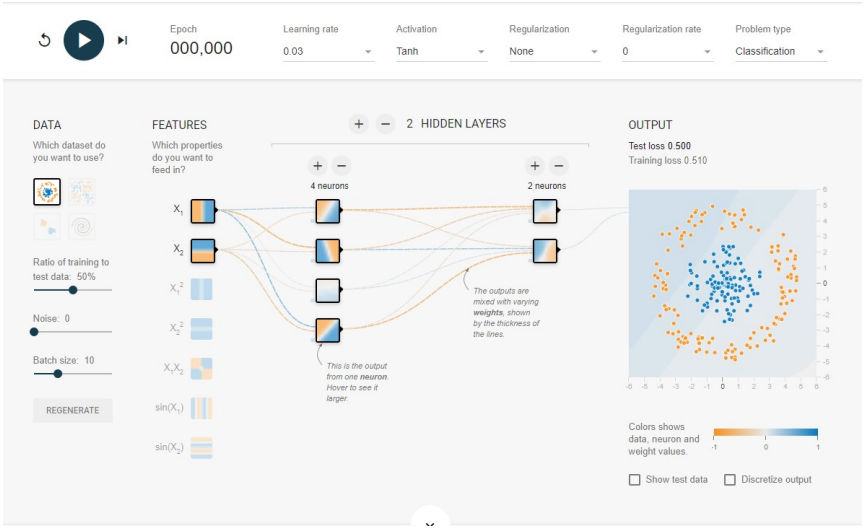
## The Building Blocks of Interpretability

Interpretability techniques are normally studied in isolation.





# A Neural Network Playground




http://playground.tensorflow.org

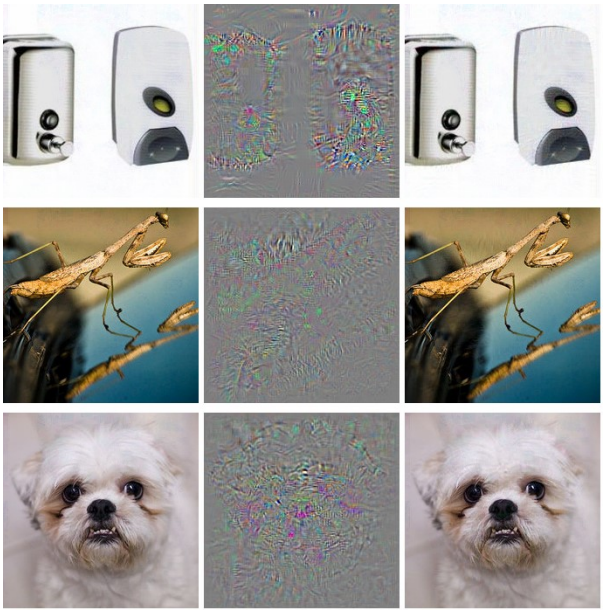
# Activation Atlas

| | | |
|---|---|---|
| 1. | grey whale | 91.0% |
| 2. | killer whale | 7.5% |
| 3. | great white shark | 0.7% |
| 4. | gar | 0.4% |

| | | |
|---|---|---|
| 1. | great white shark | 66.7% |
| 2. | baseball | 7.4% |
| 3. | grey whale | 4.1% |
| 4. | sombrero | 3.2% |

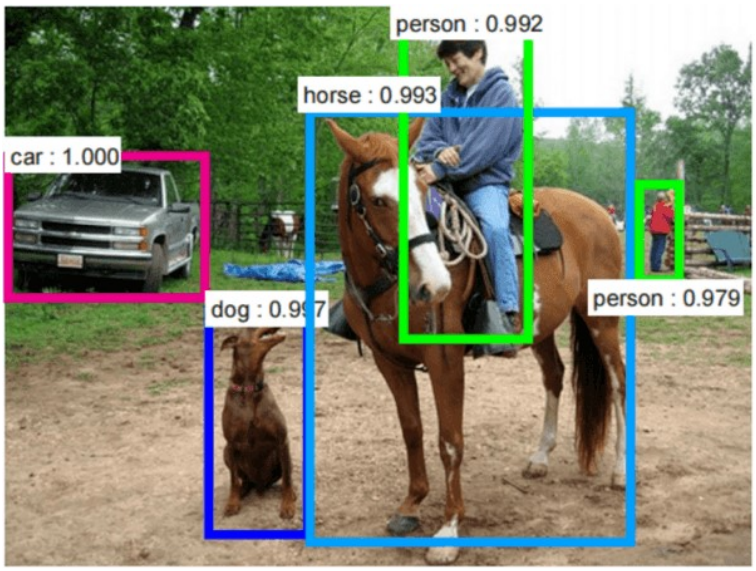
https://ai.googleblog.com/2019/03/exploring-neural-networks.html

# Adversarial Attack



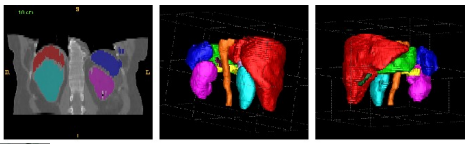
https://en.wikipedia.org/wiki/Common_ostrich

arXiv:1312.6199v4
Intriguing properties of neural networks
Christian Szegedy, Wojciech Zaremba, Ilya Sutskever, Joan Bruna, Dumitru Erhan, Ian Goodfellow, Rob Fergus



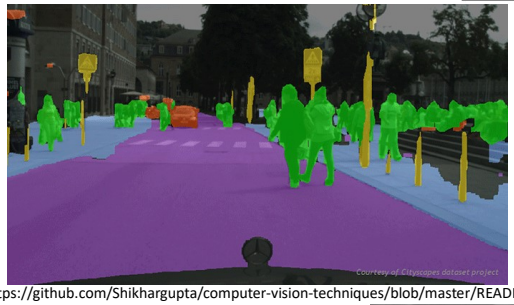

https://www.commonlounge.com/discussion/582b055204d74a21bec99ee5e12c3290

# Computer vision

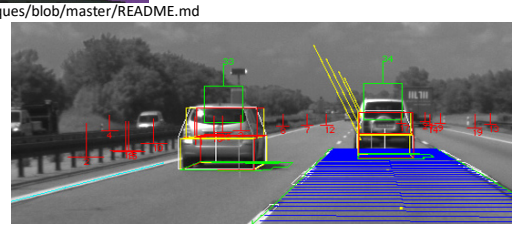


(a) (b) (c)

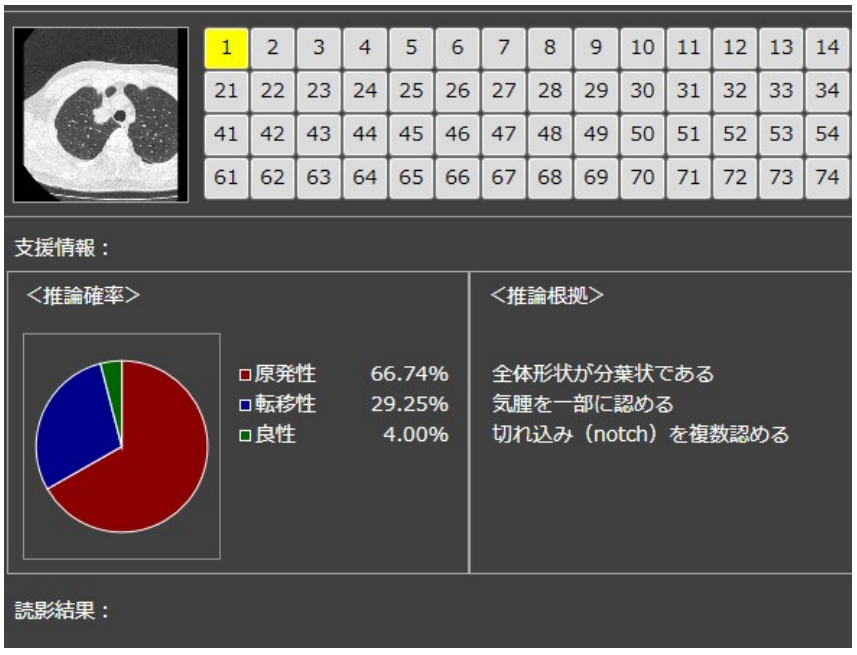
https://www.semanticscholar.org/paper/Multi-Organ-Segmentation-with-Missing-Organs-in-CT-Suzuki-Linguraru/6eb466ef807318bfa596288108207a5542455020



https://github.com/Shikhargupta/computer-vision-techniques/blob/master/README.md

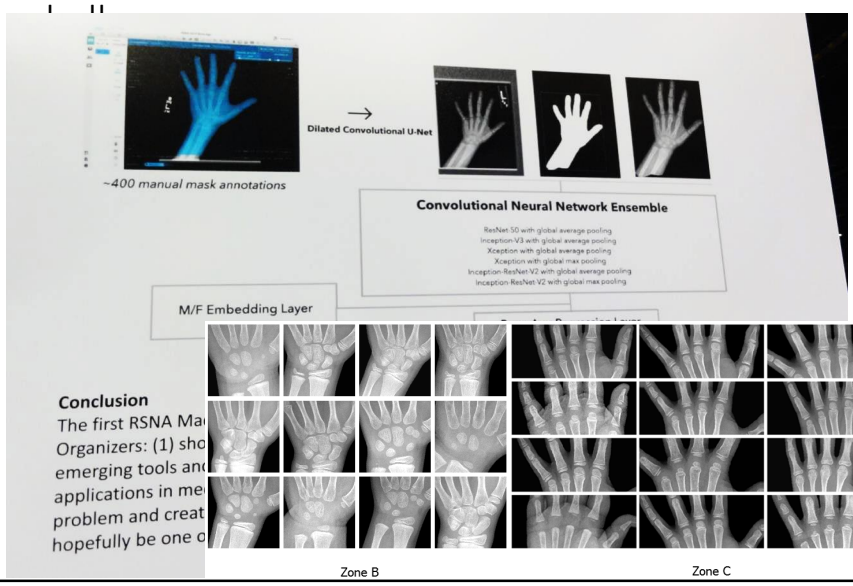


https://github.com/Shikhargupta/computer-vision-techniques/blob/master/README.md



## RSNA2017

Machine Learning Pediatric Bone Age



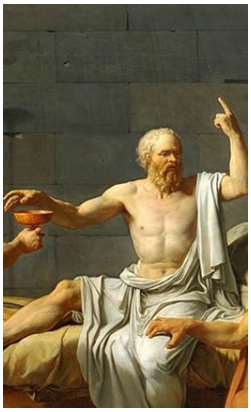

## その他の応用（画像）

- 認証
- 画像のカラー化
- 生産技術：不良品の検出、異物混入
- 自動運転

## その他の応用（画像以外）

- 認証
- 言語処理（翻訳、音声認識、音声生成）
  - スマートスピーカ
  - チャット
- ゲームやクイズ
- 投資、金融取引

## 人工知能とstandard



# レーニングデータとしての医用画像収集

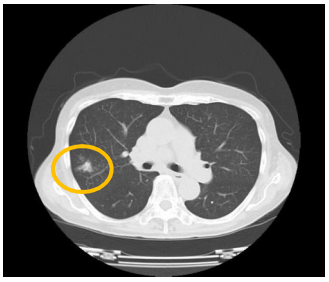
**理事長挨拶**

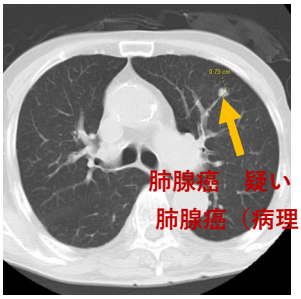
日本医学放射線学会は、「放射線科学及びその関連分野に関する学術について研究発表、知識の交換、会員相互及び内外の関連学術団体との連携協力等を行うことにより、これらの分野の進歩・普及・啓発を図るとともに、安全で質の高い医療を提供するための事業活動を通して、国民の健康と福祉の増進に寄与すること」を目的として活動しています。2018年4月より本田　浩　前理事長（九州大学　教授）の後任として、理事長を拝命いたしました東海大学医学部の今井 裕 です。青木　茂樹副理事長（順天堂大学　教授）をはじめとする16名の理事と2名の監事の先生方とともに、日本医学放射線学会の発展のために大いに貢献する所存です。本学会は、2018年7月現在で9752名もの学会員数を擁する大きな医学会に成長しています。

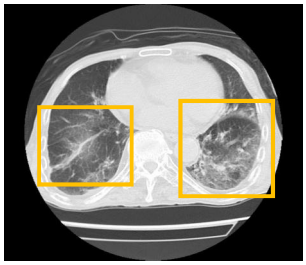
我が国の放射線医学の歴史は、1895年11月8日にドイツの物理学者であるレントゲン教授がX線を発見してから僅か10ヶ月後の1896年（明治29年）に島津　源蔵氏の手によって日本で最初のX線写真が撮影されています。その後、1913年（大正2年）には、東京と大阪でレントゲンに関連する研究会が発足し、1923年（大正12年）には、「日本レントゲン学会」が創設され、1933年（昭和8年）には、新たに「日本放射線医学会」が発足しました。その後、1940年（昭和15年）には、「日本レントゲン学会」と「日本放射線医学会」が統一され、「日本医学放射線学会」が設立され、翌年4月に第１回日本医学放射線学会総会が、初代会長　真鍋　嘉一郎先生のもとで開催されています。その際の特別講演は、1949年（昭和24年）に日本人として初めてノーベル賞を受賞された湯川　秀樹先生による「放射線と物質」でありました。

現在の日本医学放射線学会では、2016年6月よりJapan Safe Radiologyアドホック委員会を設置し、今後の放射線医療の質や安全性を確保するための種々の施策を検討しています。検討項目としては、①医療機器や放射線専門医の適正配置、②装置メンテナンスの安全管理、③Choosing Wiselyを含めた機器の適正使用、④診断参考レベル（DRL）をはじめとする被ばく管理、⑤画像バイオマーカーの開発と検査の標準化のためのQIBA（quantitative imaging biomarker alliance）の取り組み、さらに⑥報告書の質保証などが挙げられます。そのために画像医療情報におけるビッグデータを全国規模で集積した画像診断ナショナルデータベース（Japan Medical Image Database: J-MID）の構築を目指し、人工知能も活用して医療現場におけるQuality Controlに活用できるシステムの構築を考えています。

# トレーニング画像とレポート





右肺Ｓ２に不整形の結節を認めます。
左肺Ｓ４に濃度の高いＧＧＯを認めます。

両肺下葉に気管支壁の肥厚とスリガラス影が見られます

# 画像解釈の標準化

Journal of Digital Imaging

**The caBIG™ Annotation and Image Markup Project**

David S. Channin,[1] Pattanasak Mongkolwat,[1] Vladimir Kleper,[1] Kastubh Sepukar,[2] and Daniel L. Rubin[2]

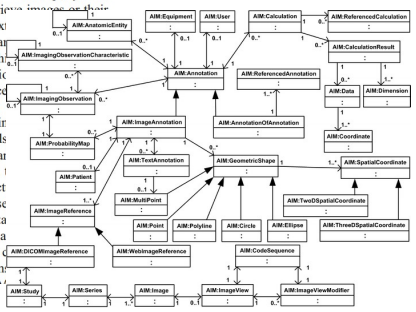
Journal of Digital Imaging
April 2010, Volume 23, Issue 2, pp 217–225

**Image annotation and markup are at the core of medical interpretation in both the clinical and the research setting. Digital medical images are managed with the DICOM standard format. While DICOM contains a large amount of meta-data about whom, where, and how the image was acquired, DICOM says little about the content or meaning of the pixel data. An image annotation is the explanatory or descriptive information about the pixel data of an image that is generated by a human or machine observer. An image markup is the graphical symbols placed over the image to depict an annotation. While DICOM is the standard for medical image acquisition, manipulation, transmission, storage, and display, there are no standards for image annotation and markup. Many systems expect annotation to be reported verbally, while markups are stored in graphical overlays or proprietary formats. This makes it difficult to extract and compute with both of them. The goal of the Annotation and Image Markup (AIM) project is to develop a mechanism, for modeling, capturing, and serializing image annotation and markup data that can be adopted as a standard by the medical imaging community. The AIM project produces both human- and machine-readable artifacts. This paper describes the AIM information model, schemas, software libraries, and tools so as to prepare researchers and developers for their use of AIM.**

**KEY WORDS: Image annotation, image markup, caBIG,**

Moreover, the majority of the human observed image feature descriptions are captured only as free text. This free text is often not associated with the spatial location of the feature, making it difficult to relate image observations to their corresponding image locations. It is difficult for both humans and machines to index, query, and search free text in order to retrieve images or their features based on these free tex limits the value of image data a for clinical, research, and teach

The mission of the Natio Health's (NIH) National Canc Cancer Bioinformatics Grid provide infrastructure for creati and sharing bioinformatics tools results, using shared data sta data models. Imaging, critical lies at an almost unique junct tional spectrum between rese practice. Image and annota obtained, for example, in ca research, is collected in a commercial information system




# まとめ

- 人工知能についてザックリ考察
- 人工知能と人間の職について
- Deep Learningについて簡単に説明
- Deep Learningの内部可視化
- Deep Learningの応用
- 人工知能の医療応用をすこし
- 学会の画像データベース
- トレーニング画像には画像のアノテーション