Deep Learning Summit

San Francisco, Jan 2016

Outline

- Background on Machine Learning
- Conference Overview

Introduction

- Machine learning is the science of getting computers to act without being explicitly programmed.

```
PROGRAM BiggerOfThree:
    Read A;
    Read B;
    Read C;
    IF (A>B)
          THEN IF (A>C)
                        THEN Print A;
                        ELSE Print C;
                   END IF;
          ELSE IF (B>C)
                        THEN Print B;
                        ELSE Print C;
                  END IF;
    END IF;
END.
```

Introduction

- Typical applications
  - Image recognition

Image/Video

  - Speech recognition

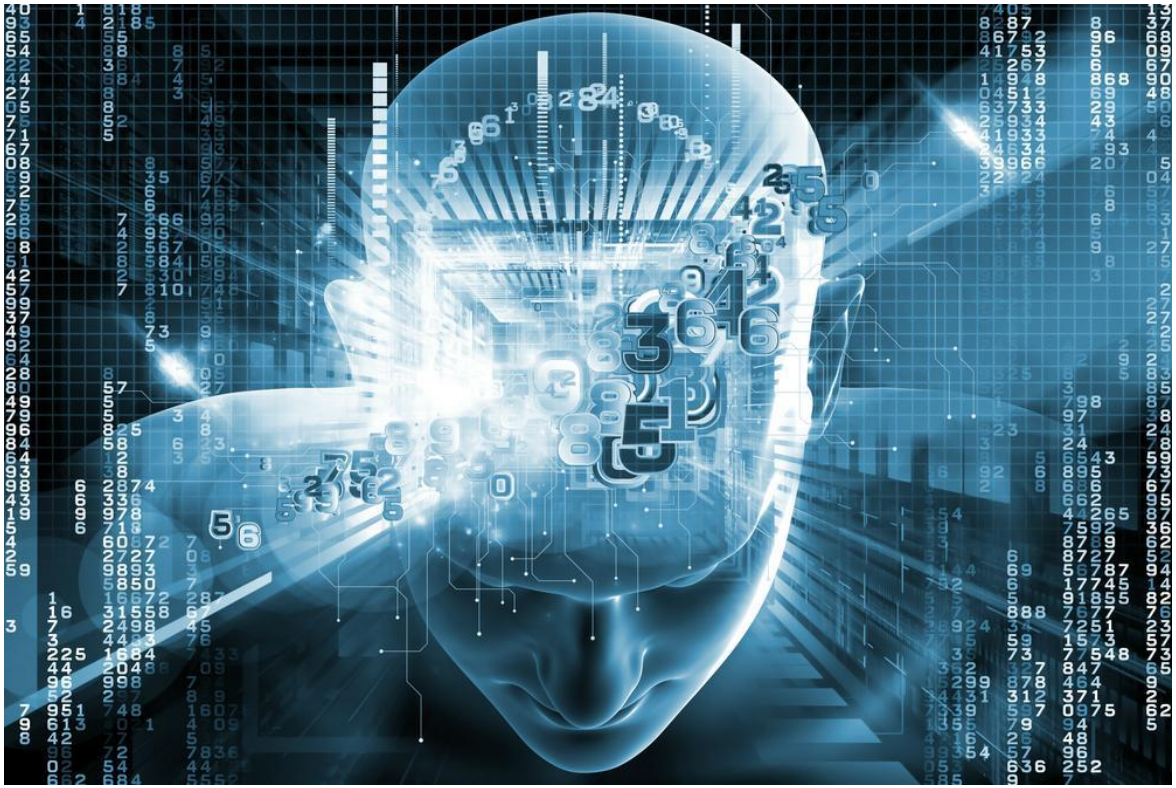
Audio

  - Web search

Text

Introduction

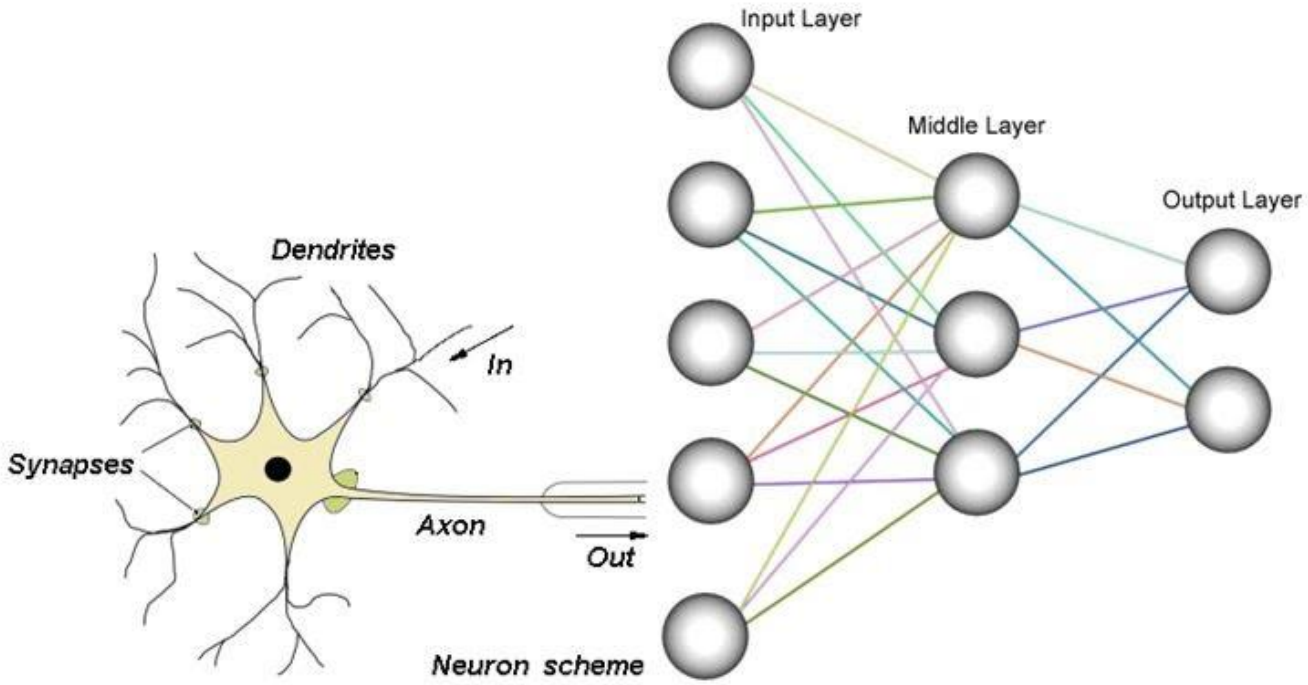
- History: Artificial Intelligence, 1956



Introduction

– Inspired by biology and human brain

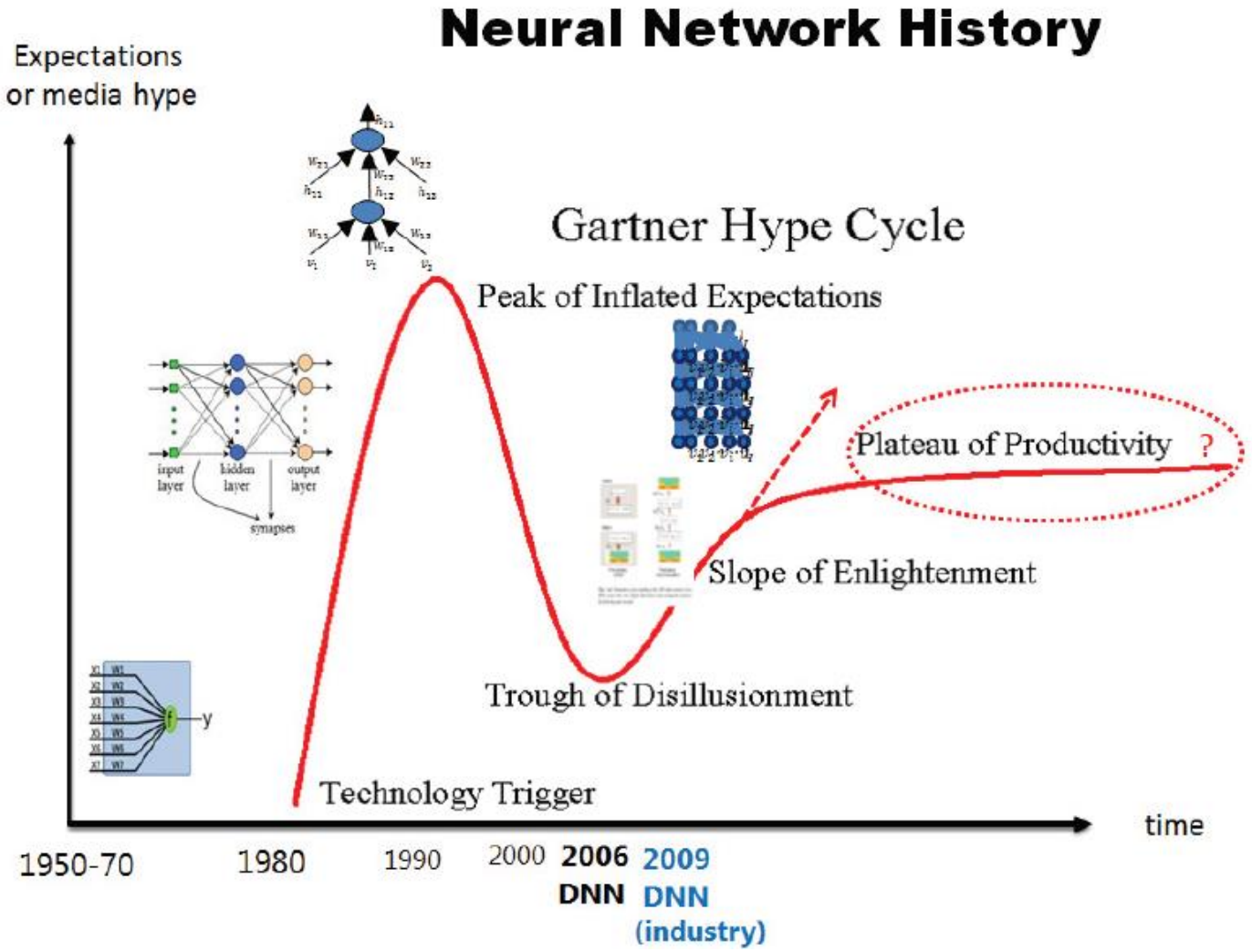
– Artificial Neural Networks, 1960



Introduction

- Marvin Minsky, 1927-2016
- “Within a generation, the problem of creating 'artificial intelligence' will substantially be solved.”

Introduction



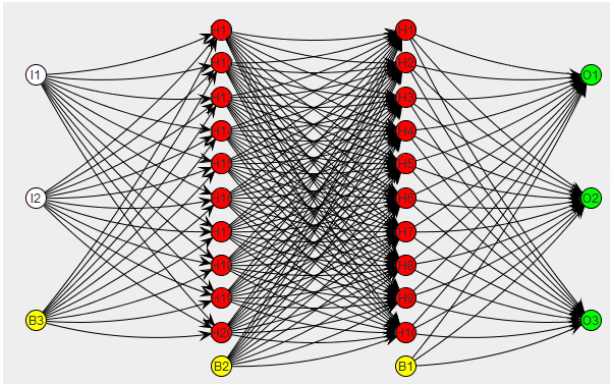
Introduction

- Jeffrey Hinton, 2006

Introduction

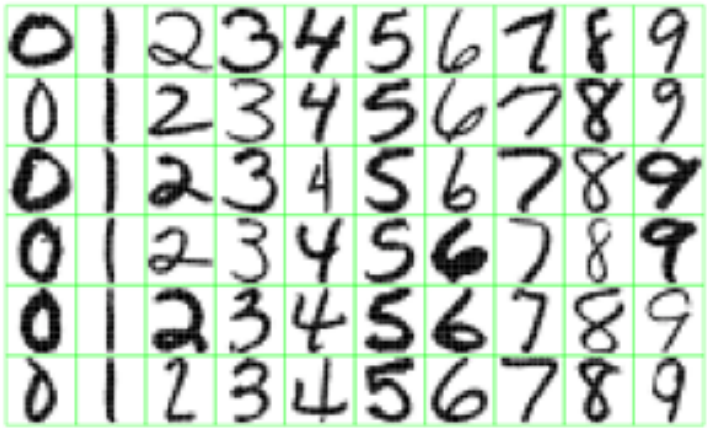
–Improvements since 2006

- Better computers
- Massive data
- Better training methods



Deep Learning

- Applications
  - Digit and Image recognition
    - *Facebook, Google*

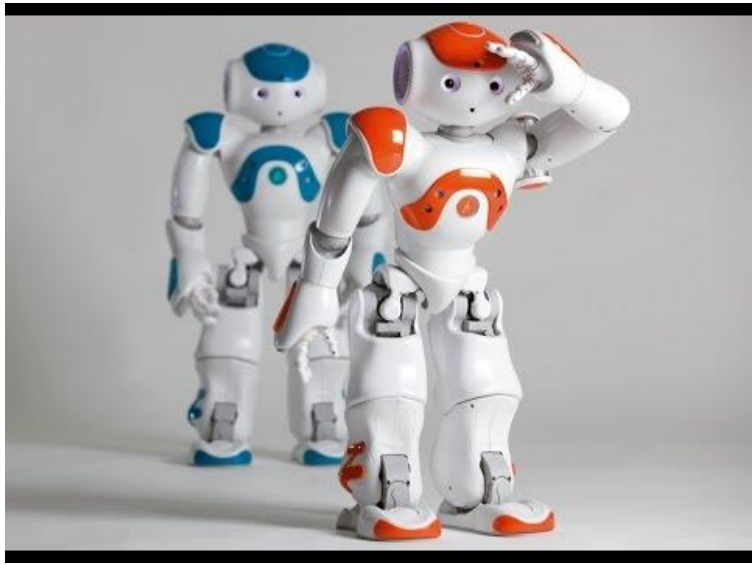


Deep Learning

- Applications
  - Speech Recognition
    - *Siri, Google, Microsoft real-time translation*

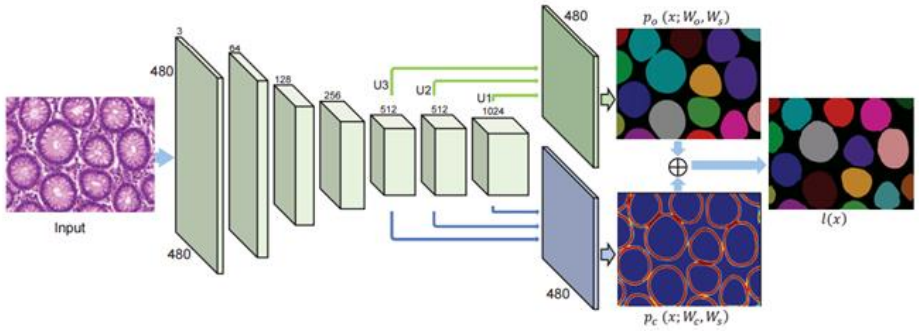
Deep Learning

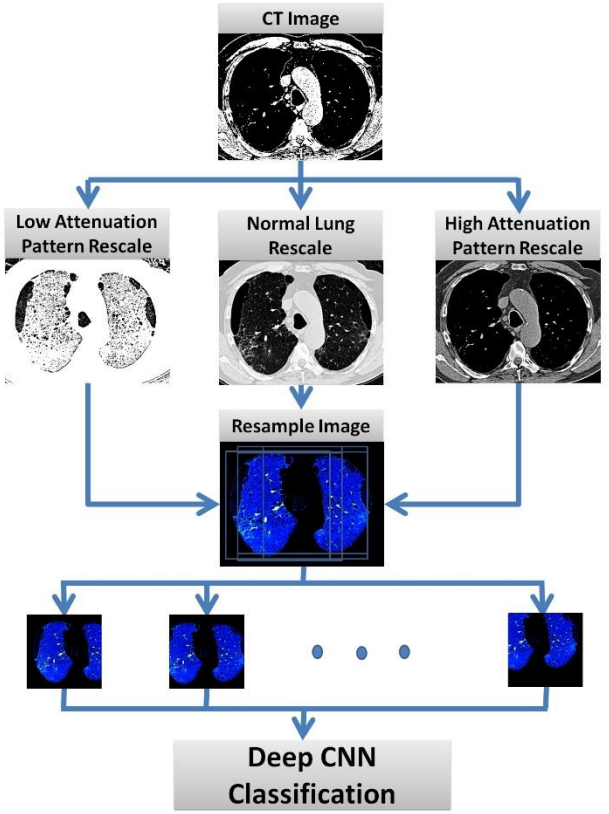
- Robotics
- Self-driving cars



Deep Learning

- Medical Imaging





Deep Learning Summit 2016

- A two-day conference
- Talks from researchers and industry
- Q&A with one of the leaders in the field

Industry

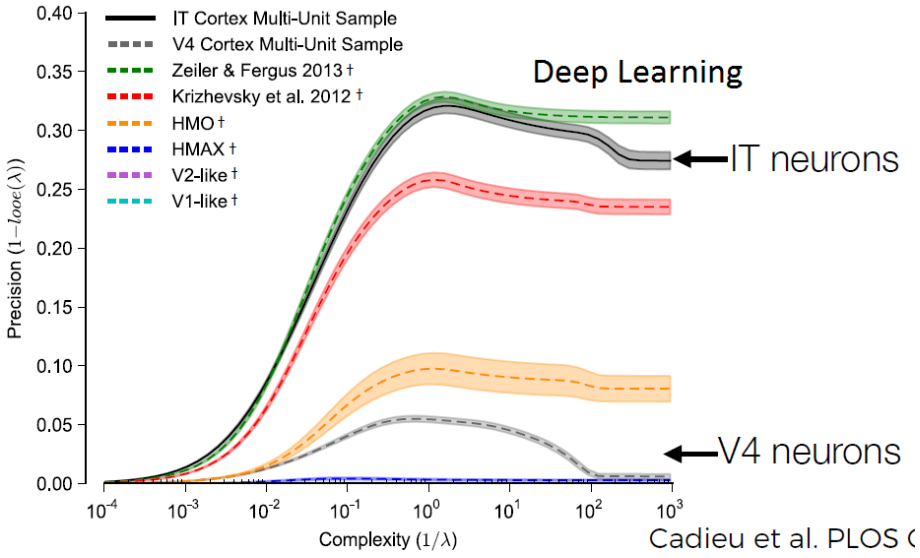
- Large Companies
  - Pinterest, Twitter, eBay, Flickr
  - They use DL to be competitive
- Small Companies
  - Baylabs, HealthMind: medical imaging
  - Satellite imaging analysis

BayLabs: Medical Imaging

- Increasing quality, value and access to medical imaging
- Ultrasound: safe, effective and affordable
- Smartphone ultrasound

Expert Interpretation

- Expert Ultrasound Interpretation Is Like Object Recognition “In-a-Glance”
- Heart disease

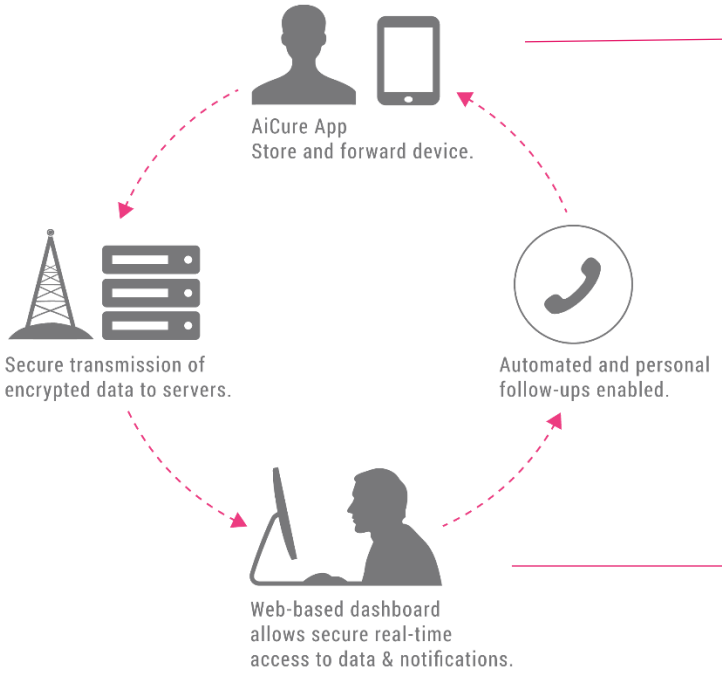


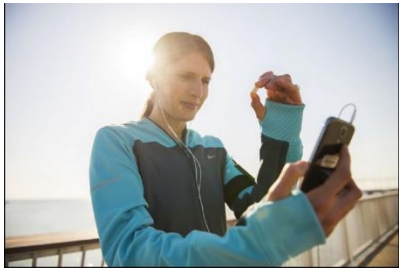
Cadieu et al. PLOS C

Deep Learning: Diagnosis

- Deep learning algorithms are capable of detecting RHD in imagery from a portable ultrasound
- Deploy deep learning technology in Rwanda

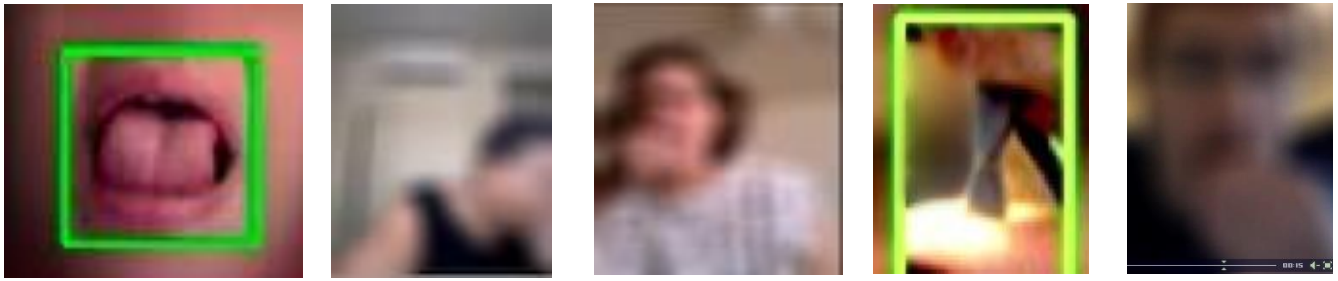
Deep Learning: Patient Monitoring





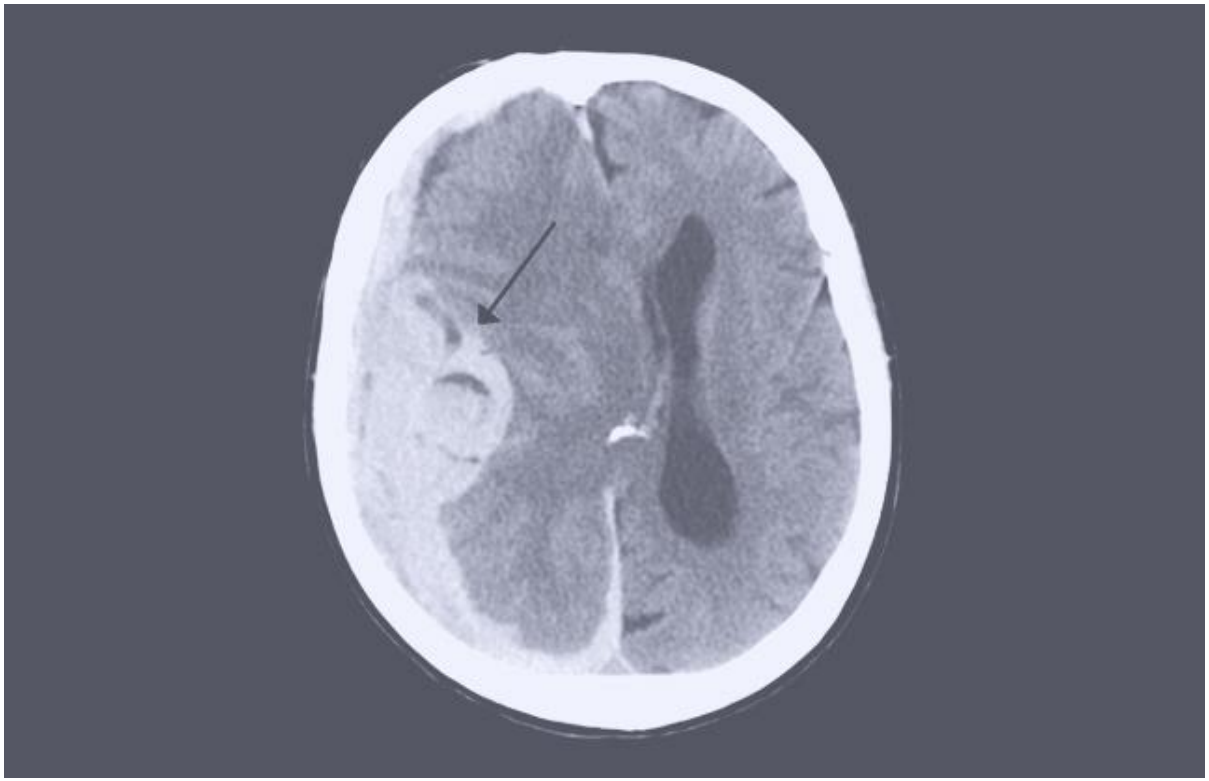
Deep Learning: Patient Monitoring

- Control cheating



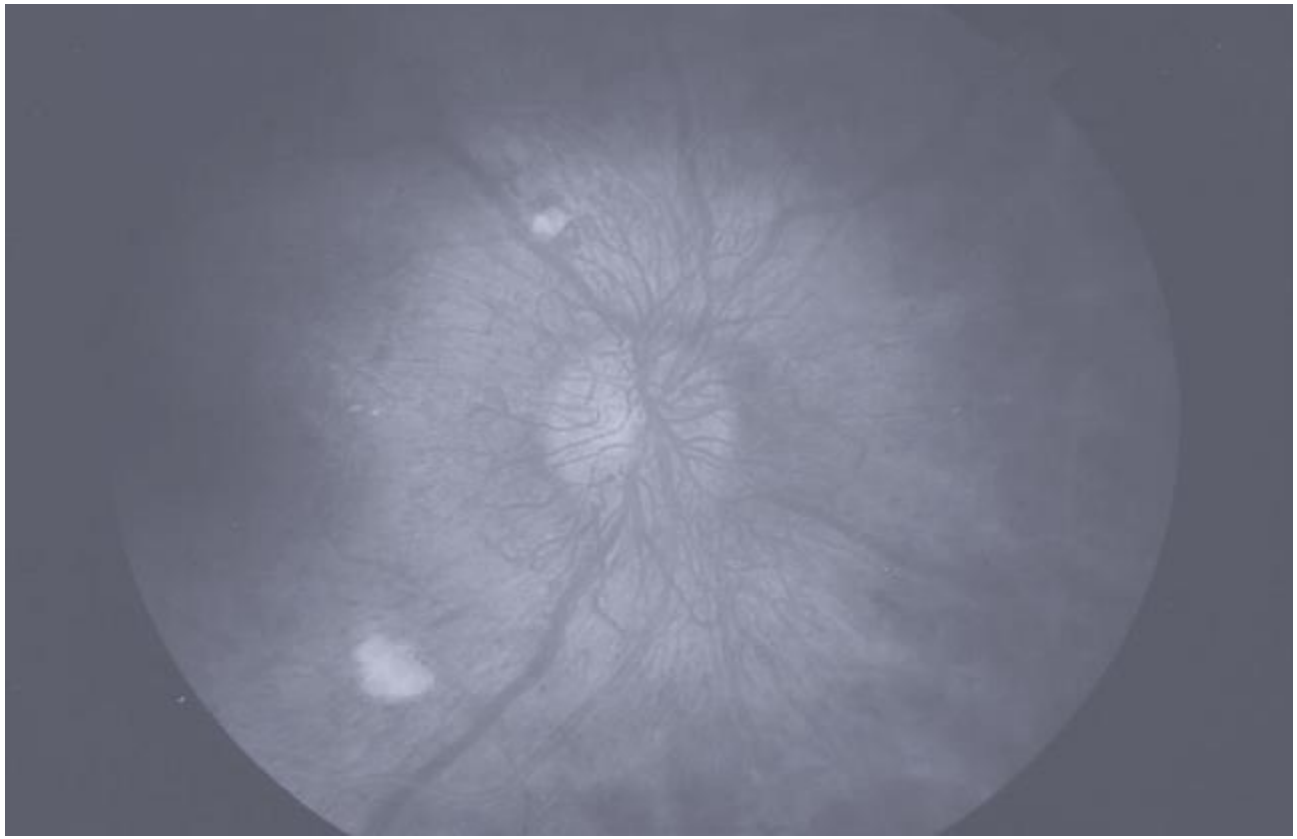
HealthMind: Medical Imaging

- Intracranial Hemorrhage in CT images



Medical Imaging

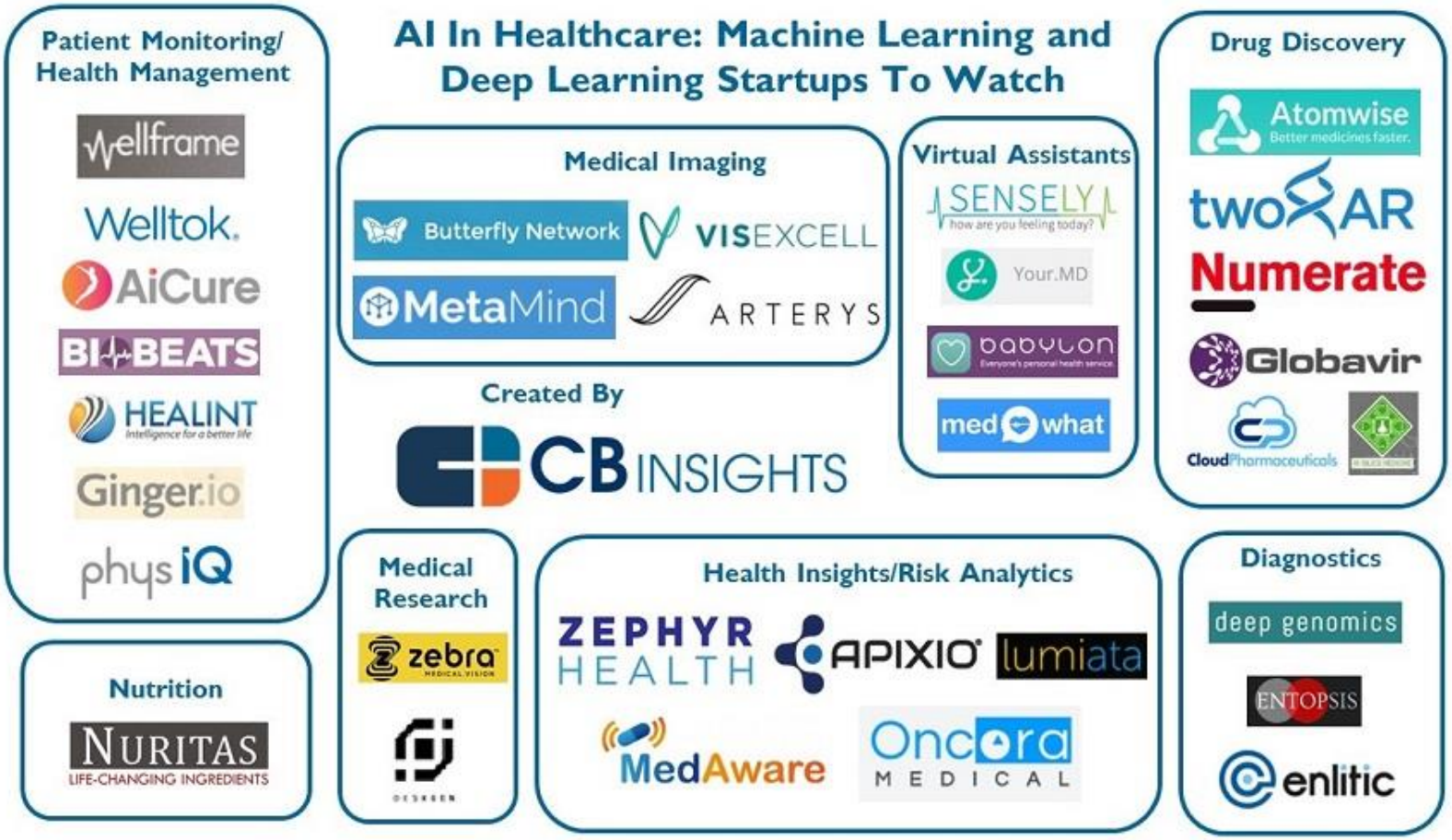
- Diabetic Retinopathy in retinal images



Medical Imaging

- Lung Nodule on chest CT scan

AI in Healthcare

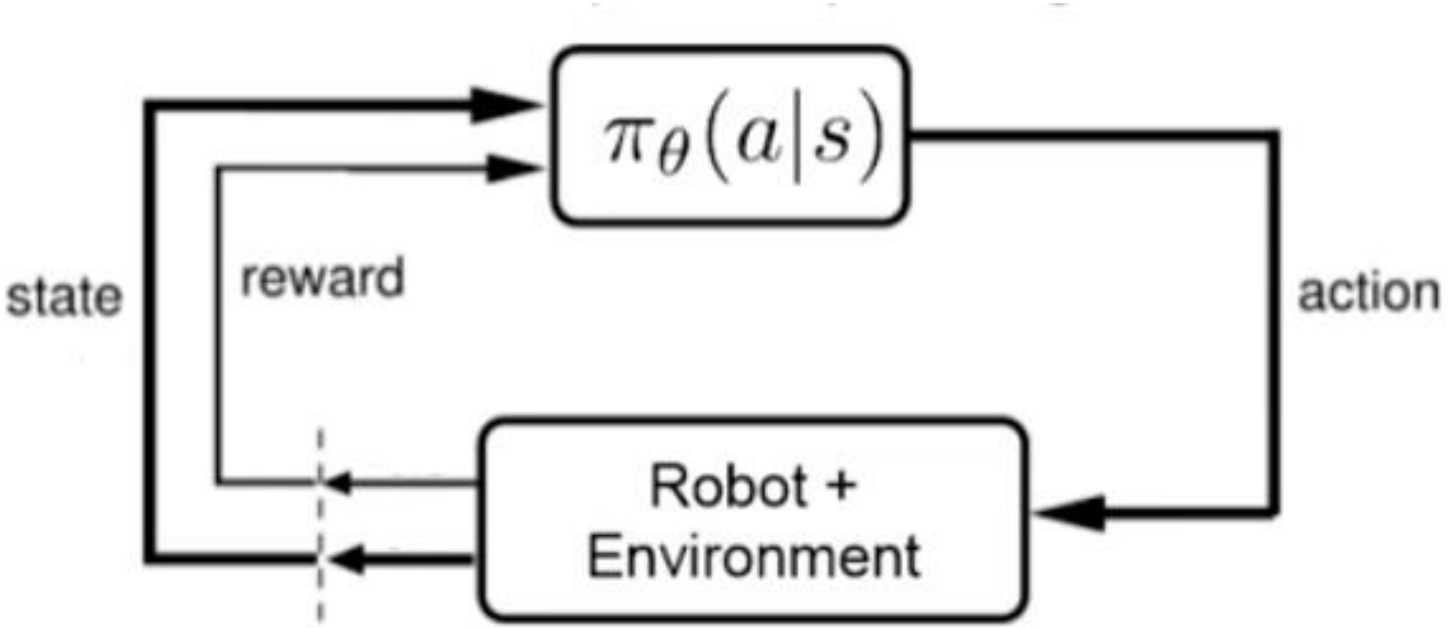


Robotics

- Pieter Abbeel, UC Berkeley

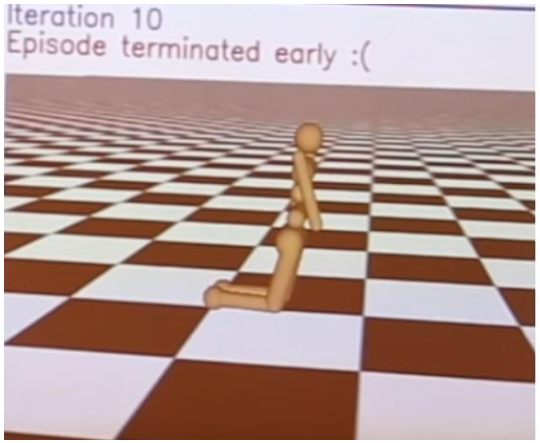
Robotics

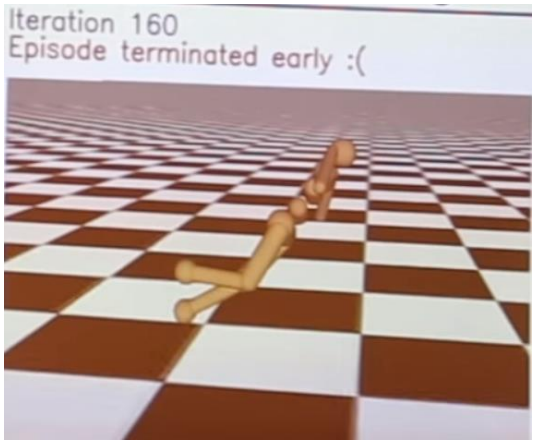
- Challenging

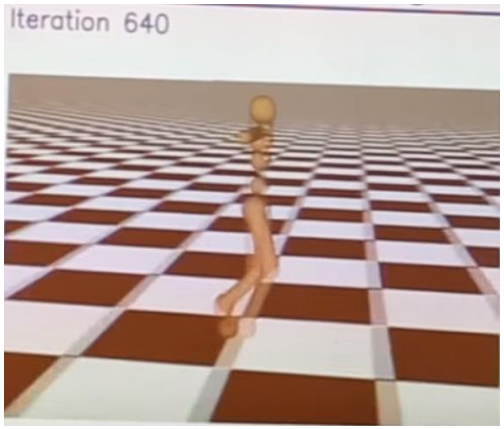


Robotics

- Deep Reinforcement Learning: maximize Rewards
- Robot invents walking

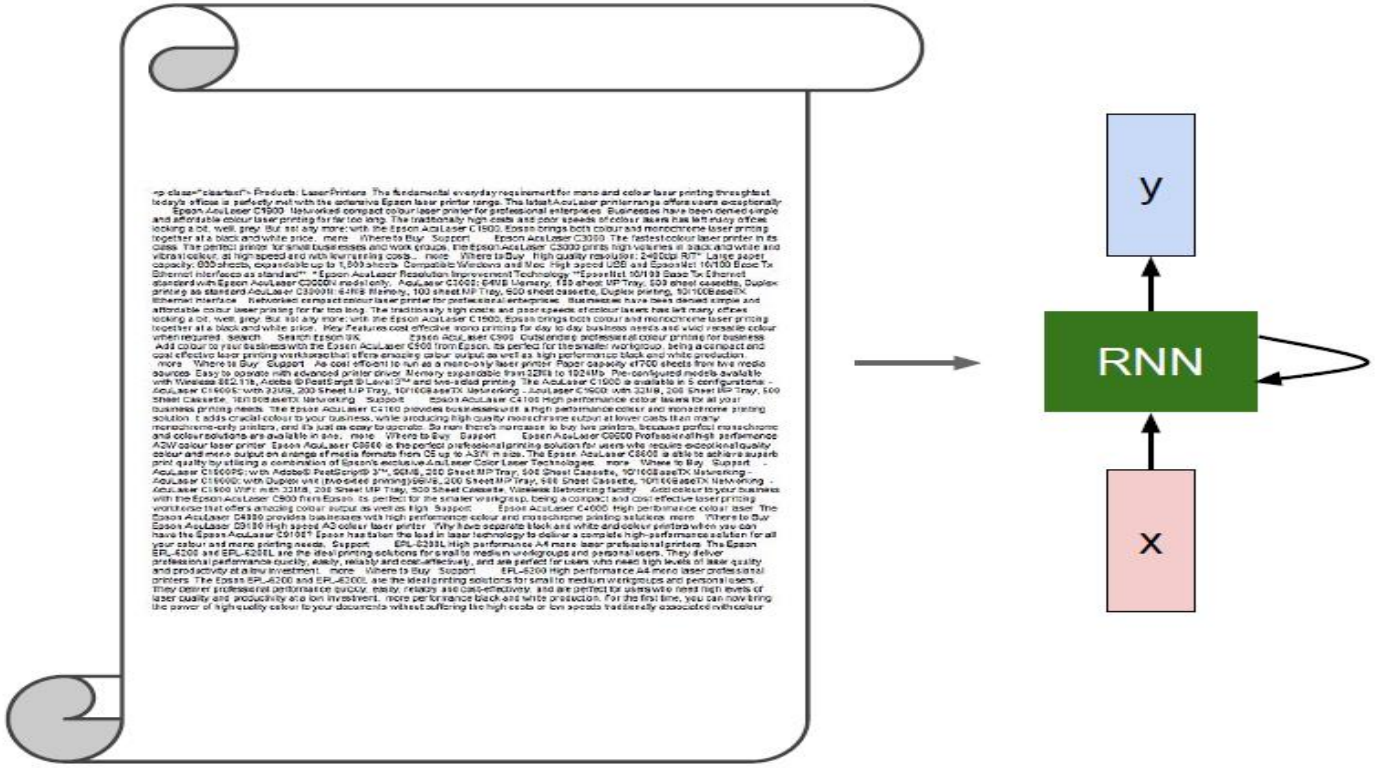






Recurrent Neural Networks

- Example: Google search



Computers generate poetry ☺

PANDARUS:

Alas, I think he shall be come approached and the day

When little srain would be attain'd into being never fed,

And who is but a chain and subjects of his death,

I should not sleep.

Computers generate cooking recipes

```
     Title: BASIC CHEESE WINGS:
Categories: Desserts
     Yield: 6 Servings

     3    Eggs
     2 tb Chopped fresh curry
          -or cooking spray
     1 c  Water; cooked
     2    Lemons minced mushrooms
     3 oz Sweet cooked rice
   1/2    Onion; chopped
     3 c  Butter, melted
     2 ts Soy sauce
     1 ts Cinnamon
     2 md Sugar or food coloring;
          -stems cored bowl
     2 tb Salt and freshly grated
   1/4 ts Ground ginger
   1/2 c  Flour
     1 tb Water; fresh parsley
     1 c  Water (or or)
     1    Clove garlic, minced

Preheat oven to 350F. Combine sugar, salt, baking soda, celery and sugar. Add
the chicken broth well. Add the cornstarch to the pan; cool. Add the olive
oil, oil, and basil or cooking spray. Pour the onions until melted.
```

Computers generate math

Lemma 0.1. *Assume (3) and (3) by the construction in the description.*

Suppose $X = \lim |X|$ *(by the formal open covering* X *and a single map* $\underline{Proj}_X(\mathcal{A}) = \mathrm{Spec}(B)$ *over* U *compatible with the complex*

$$Set(\mathcal{A}) = \Gamma(X, \mathcal{O}_{X, \mathcal{O}_X}).$$

When in this case of to show that $\mathcal{Q} \to \mathcal{C}_{Z/X}$ *is stable under the following result in the second conditions of (1), and (3). This finishes the proof. By Definition ?? (without element is when the closed subschemes are catenary. If* T *is surjective we may assume that* T *is connected with residue fields of* S*. Moreover there exists a closed subspace* $Z \subset X$ *of* X *where* U *in* X' *is proper (some defining as a closed subset of the uniqueness it suffices to check the fact that the following theorem*

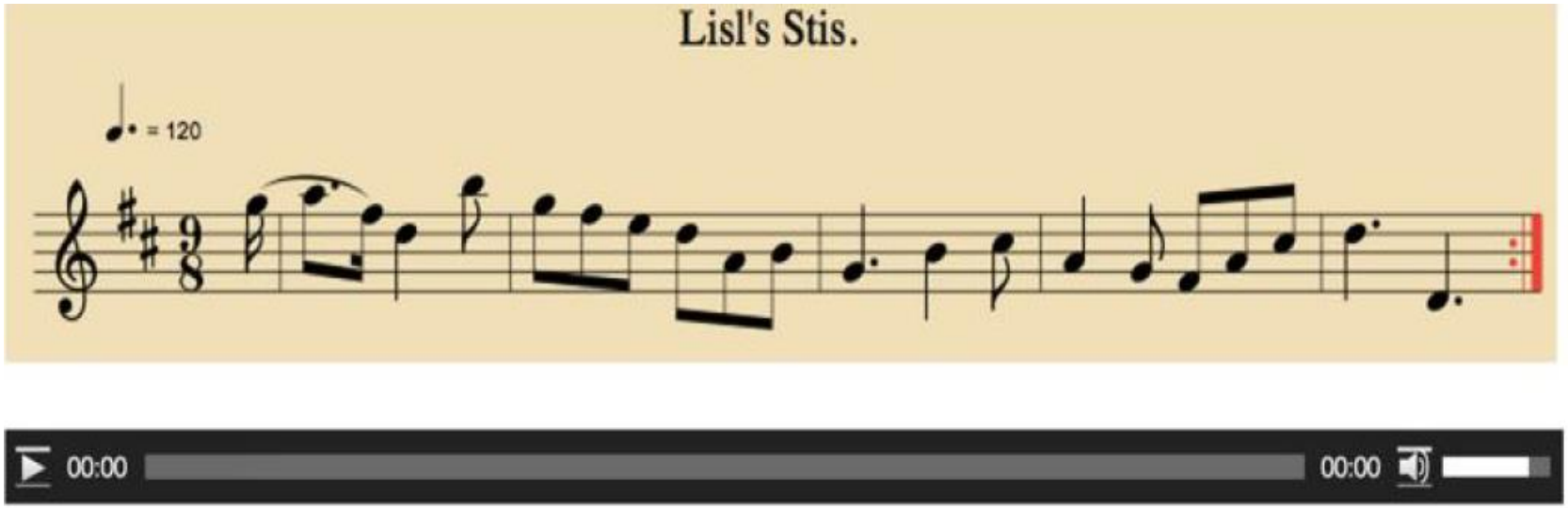
(1) f *is locally of finite type. Since* $S = \mathrm{Spec}(R)$ *and* $Y = \mathrm{Spec}(R)$.

Computers generate C code

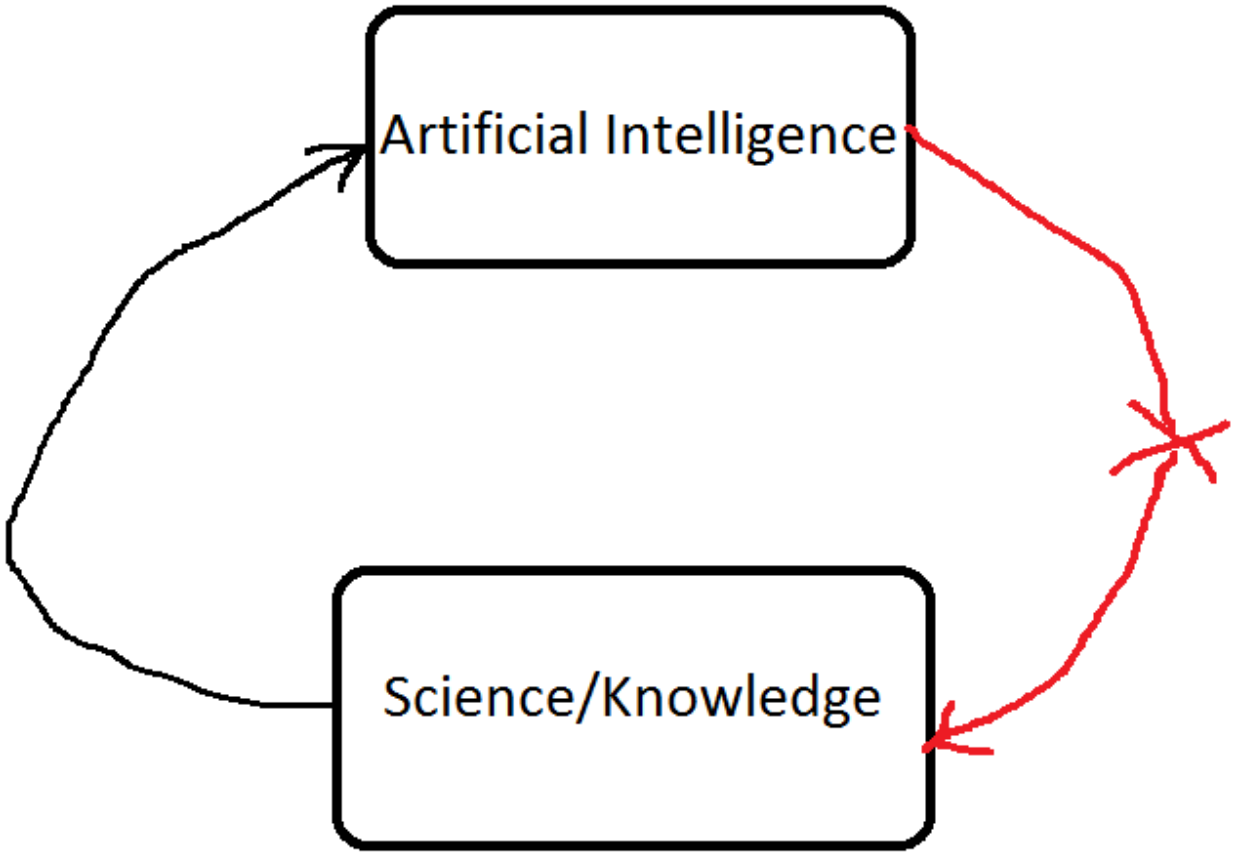
```
static void do_command(struct seq_file *m, void *v)
{
  int column = 32 << (cmd[2] & 0x80);
  if (state)
    cmd = (int)(int_state ^ (in_8(&ch->ch_flags) & Cmd) ? 2 : 1);
  else
    seq = 1;
  for (i = 0; i < 16; i++) {
    if (k & (1 << 1))
      pipe = (in_use & UMXTHREAD_UNCCA) +
        ((count & 0x00000000fffffff8) & 0x000000f) << 8;
    if (count == 0)
      sub(pid, ppc_md.kexec_handle, 0x20000000);
    pipe_set_bytes(i, 0);
  }
```

Composing Music

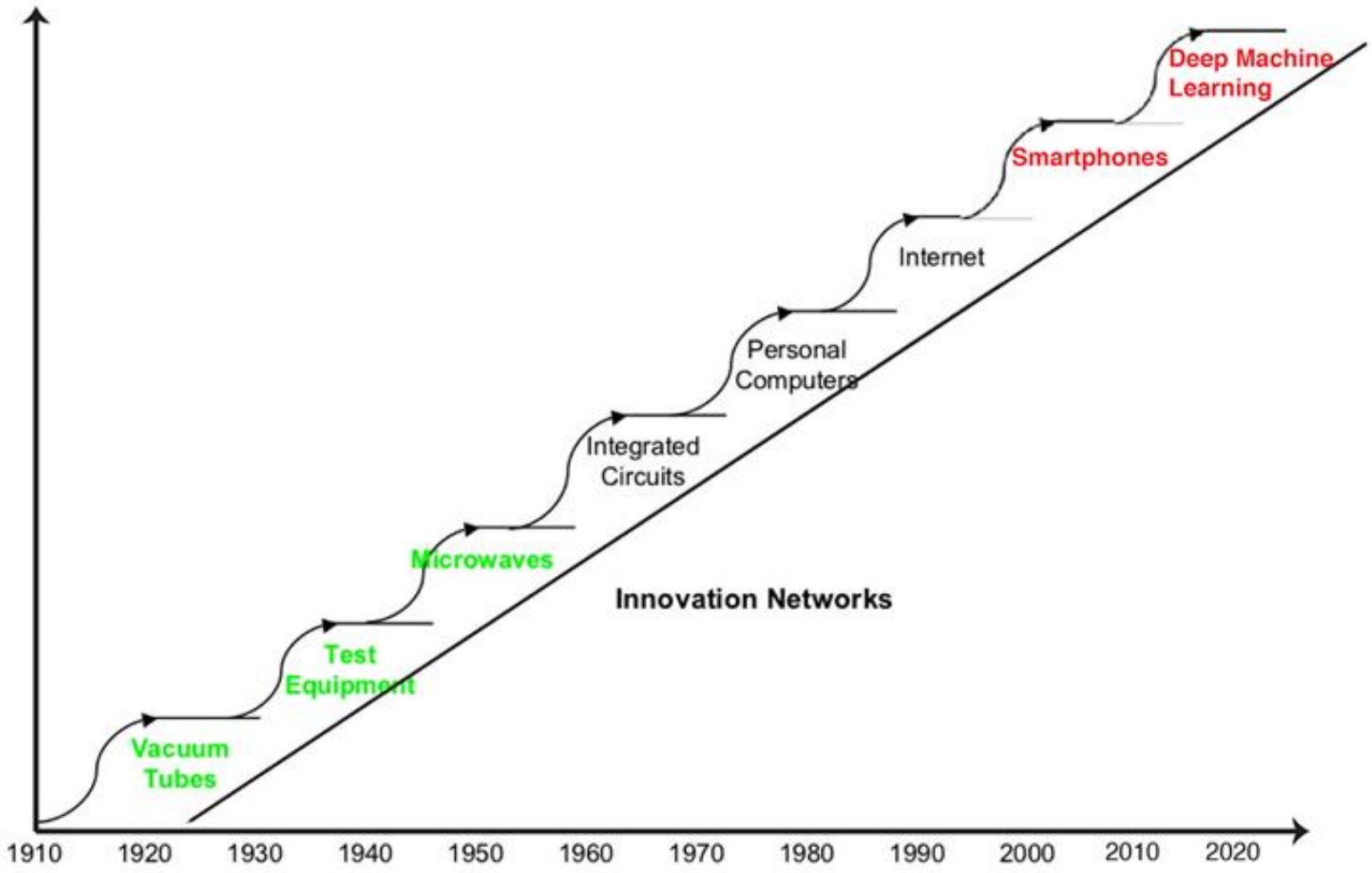
- http://www.hexahedria.com/2015/08/03/composing-music-with-recurrent-neural-networks/



Future

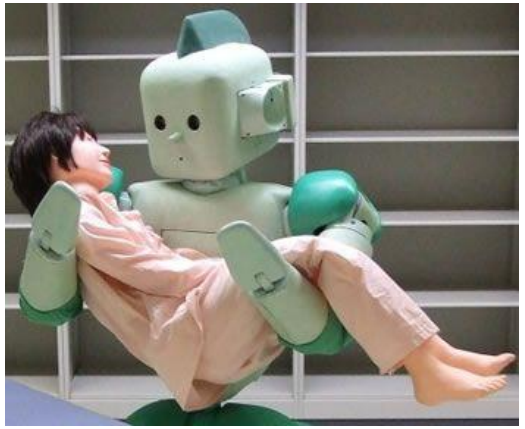


Technology Trend



Summary

- Portable medical imaging devices
- Diagnostic machines with higher accuracy
- Robotics for health
- *“By 2025, AI systems could be involved in everything from population health management, to digital avatars capable of answering specific patient queries,” said Harpreet Singh Buttar, an analyst at Frost & Sullivan.*



Conferences

- Overall
  - Good place to get exposed to the state-of-the-art AI technology for various applications
- Future events: Deep learning in health care Summit
  - April 2016, London
- Future events: Deep learning Summit
  - May 2016, Boston


Thank
you