

AlphaGo

Как думает
машина



 **Google DeepMind**
Challenge Match
8 - 15 March 2016

 AlphaGo



В чем интерес

- Исторический контекст
- Подходы к решению задач
- Внутри AlphaGo

Компьютеры vs Человеки

1 The accelerating pace of change ...



2 ... and exponential growth in computing power ...

Computer technology, shown here climbing dramatically by powers of 10, is now progressing more each hour than it did in its entire first 90 years

COMPUTER RANKINGS

By calculations per second per \$1,000

Analytical engine
Never fully built, Charles Babbage's invention was designed to solve computational and logical problems



Colossus
The electronic computer, with 1,500 vacuum tubes, helped the British crack German codes during WW II



UNIVAC I
The first commercially marketed computer, used to tabulate the U.S. Census, occupied 943 cu. ft.

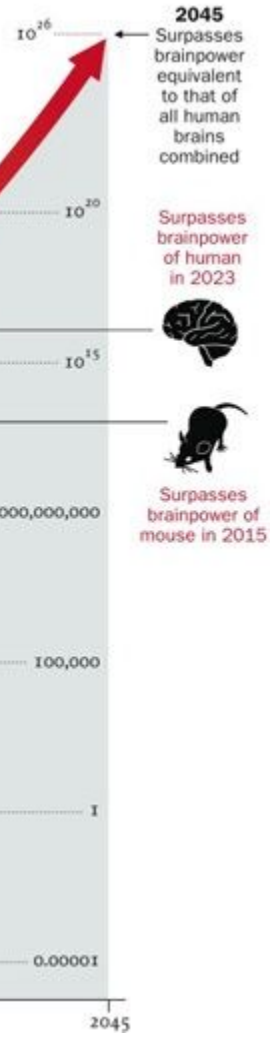


Apple II
At a price of \$1,298, the compact machine was one of the first massively popular personal computers



Power Mac G4
The first personal computer to deliver more than 1 billion floating-point operations per second

3 ... will lead to the Singularity



КОГДА ПОЛЬЗОВАТЕЛЬ ДЕЛАЕТ ФОТО,
ПРИЛОЖЕНИЕ ДОЛЖНО ПРОВЕРИТЬ,
НАХОДИТСЯ ЛИ ОН В ЗАПОВЕДНИКЕ...

Угу, просто запрос к ГИС.
СДЕЛАЮ ЗА НЕСКОЛЬКО ЧАСОВ.

...и проверить, что на
фотографии ПТИЦА.

МНЕ ПОНАДОБИТСЯ
КОМАНДА И ПЯТЬ ЛЕТ
НА ИССЛЕДОВАНИЯ.

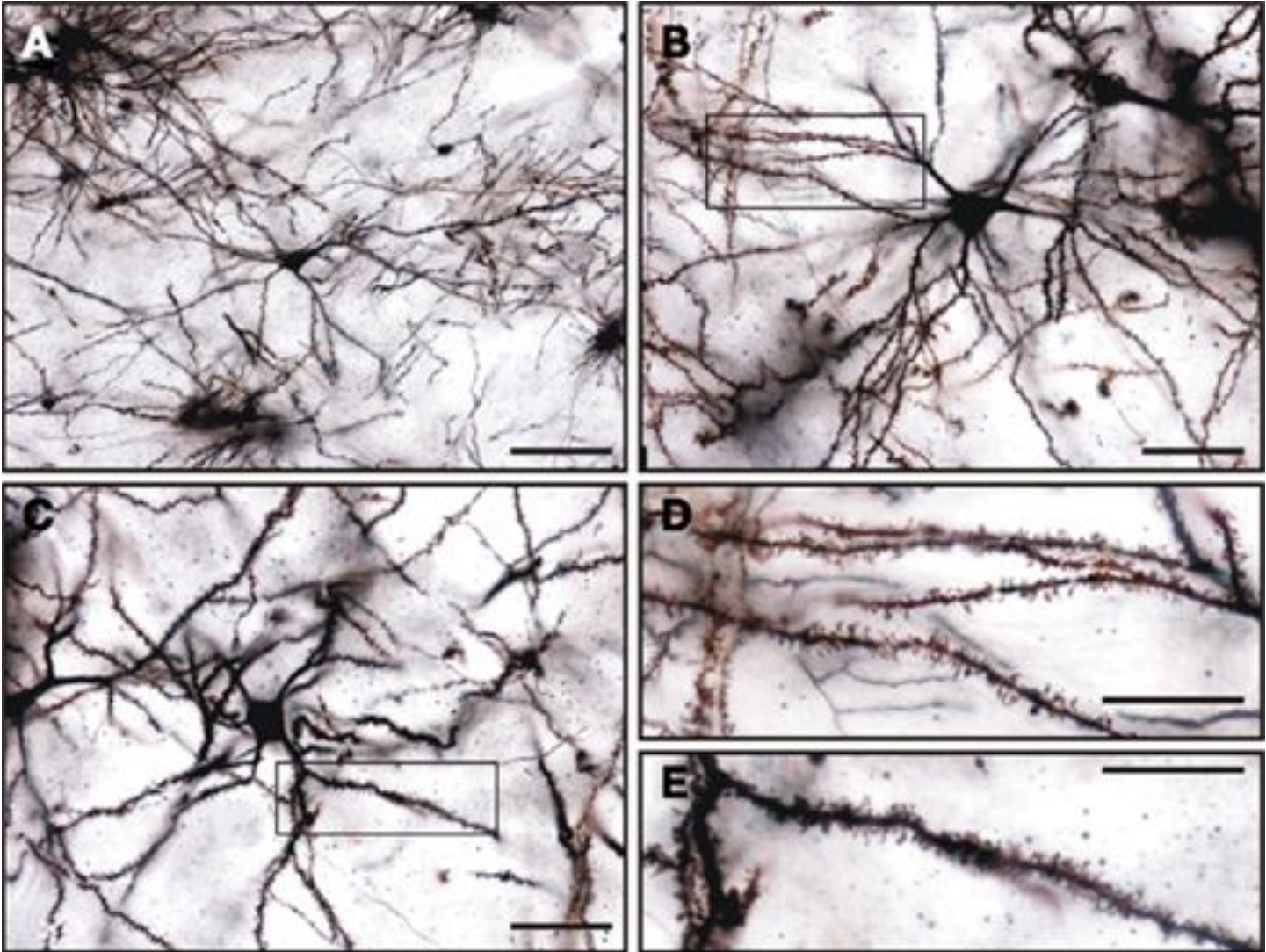


В ИНФОРМАТИКЕ БЫВАЕТ ТРУДНО
ОБЪЯСНИТЬ РАЗНИЦУ МЕЖДУ ПРОСТЫМ
И ПРАКТИЧЕСКИ НЕВОЗМОЖНЫМ.

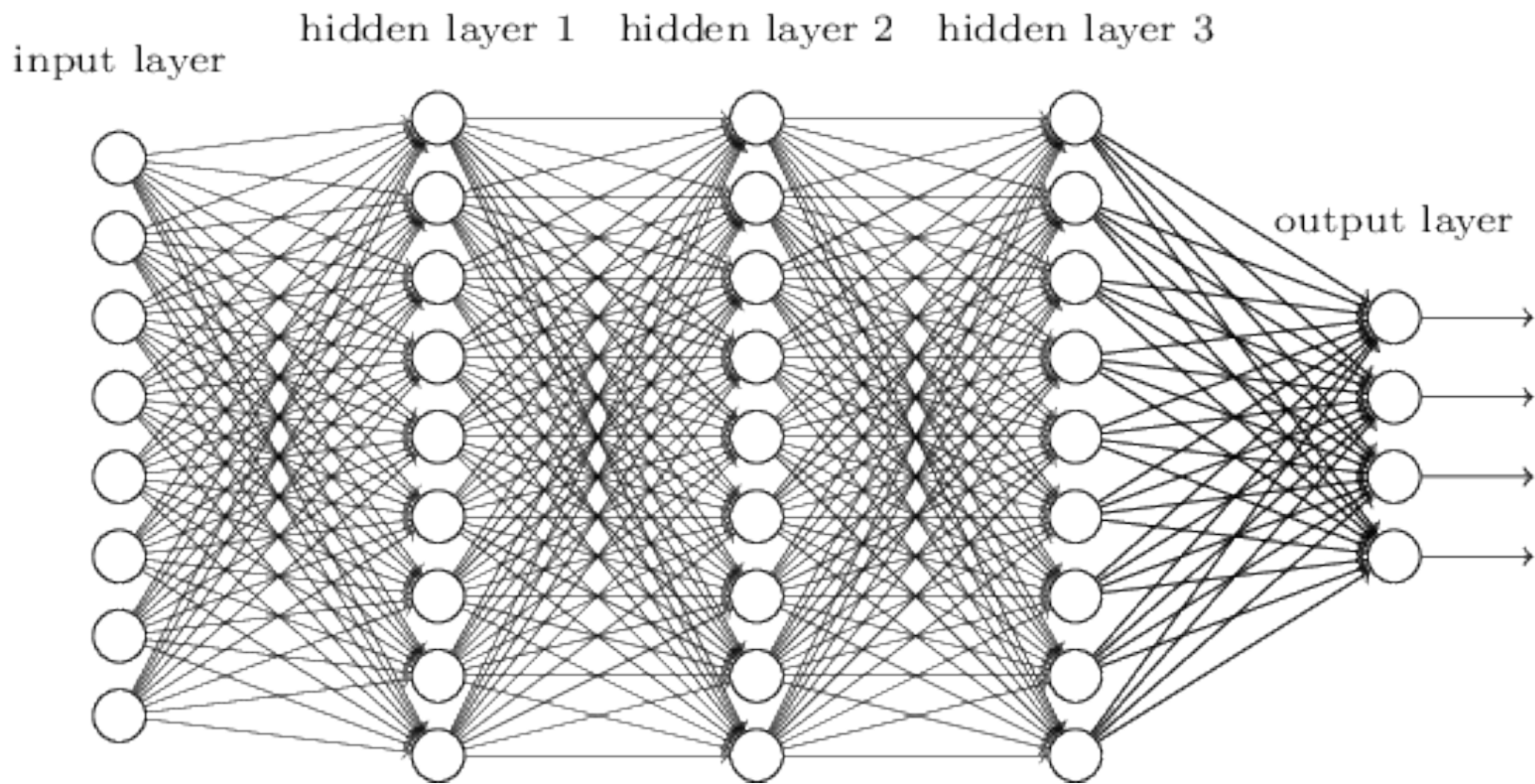
Способ решения задач

- Грубая сила — перебор
- Умная сила — тайные знания
 - вручную (алгоритмы)
 - автоматически
 - машинное обучение
 - нейронные сети

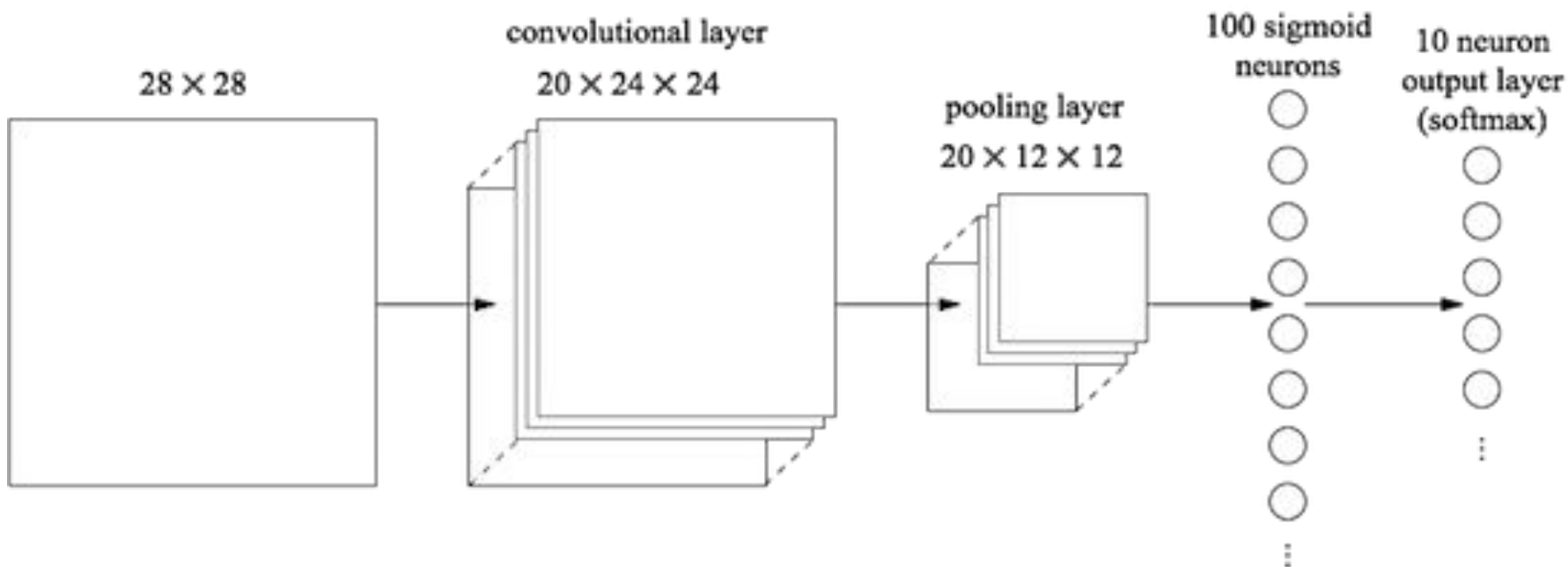
Нейронная сеть — Человек



Нейронная сеть – Программа



Свёрточная глубокая нейронная сеть

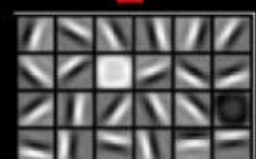
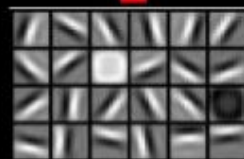
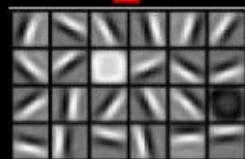
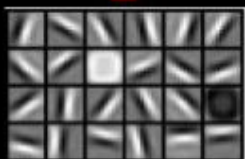
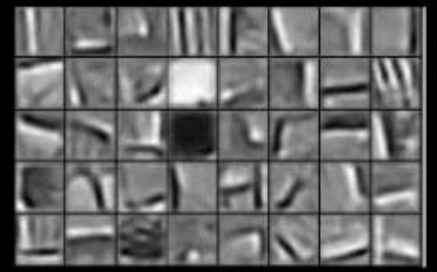
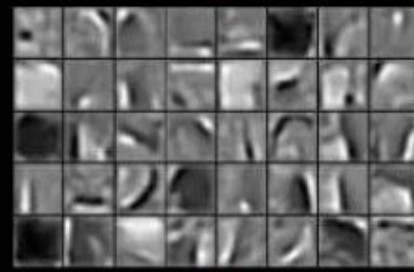
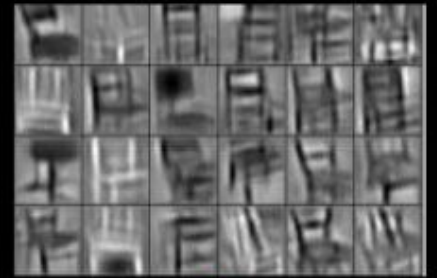


Faces

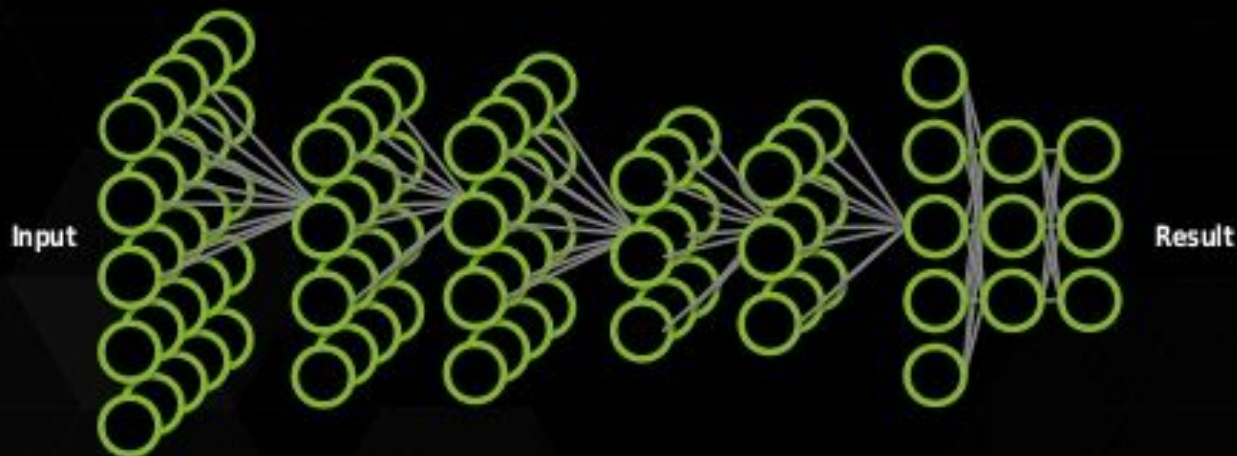
Cars

Elephants

Chairs



WHAT MAKES DEEP LEARNING DEEP?



Today's Largest Networks

- 10 layers
- 1B parameters
- 10M images
- 30 Exaflops
- 30 GPU days

Human brain has trillions of parameters - only 1,000 more.

MACHINE LEARNING USE CASES

...machine learning is pervasive

Image Classification, Object
Detection, Localization



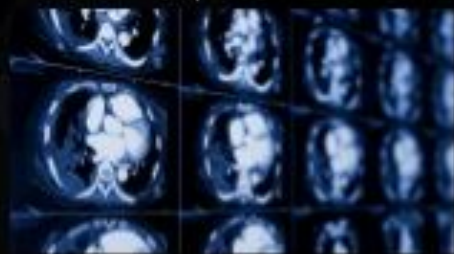
Face Recognition



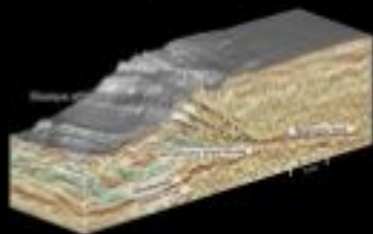
Speech & Natural Language
Processing



Medical Imaging &
Interpretation



Seismic Imaging &
Interpretation



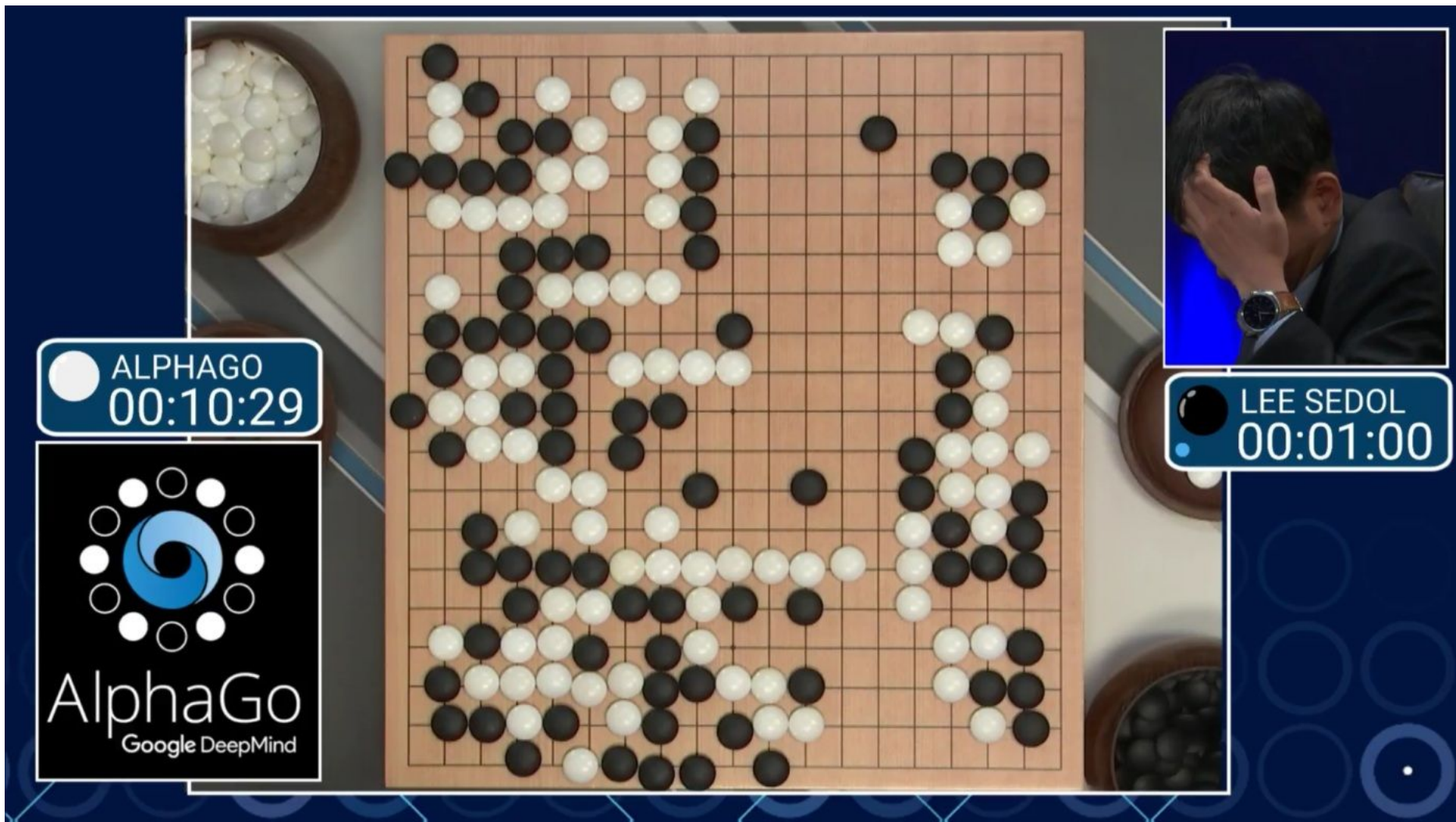
Recommendation



Внутри DeepBlue (1997)

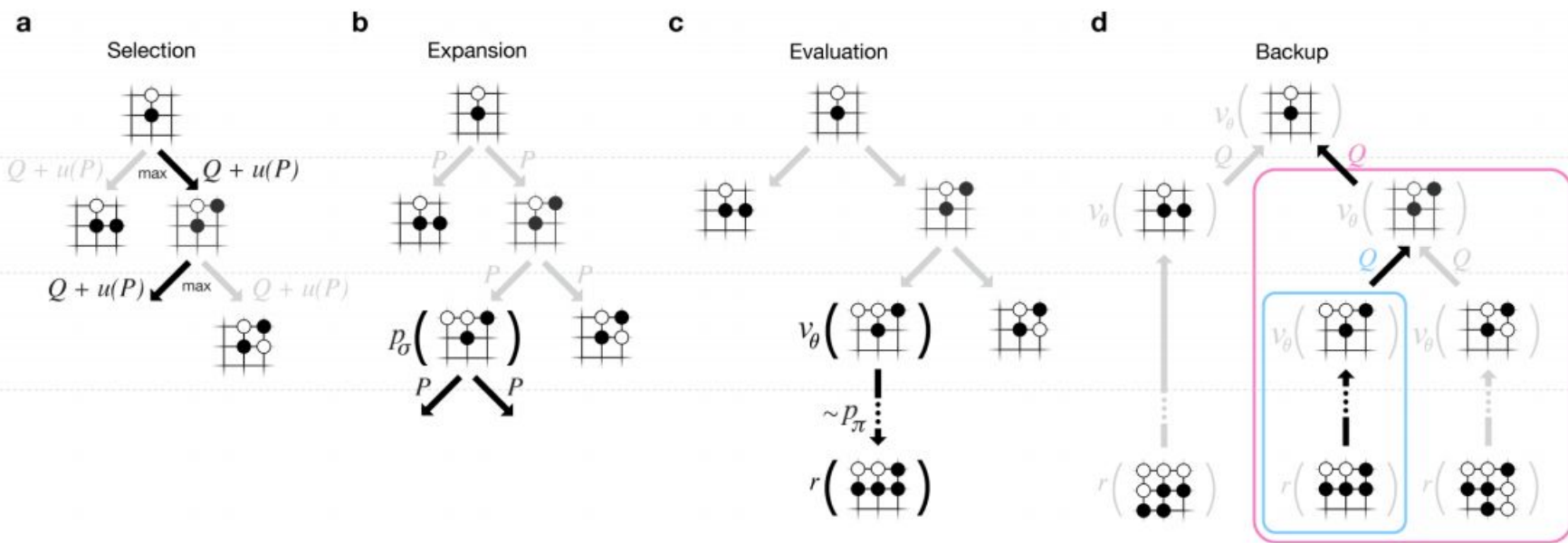
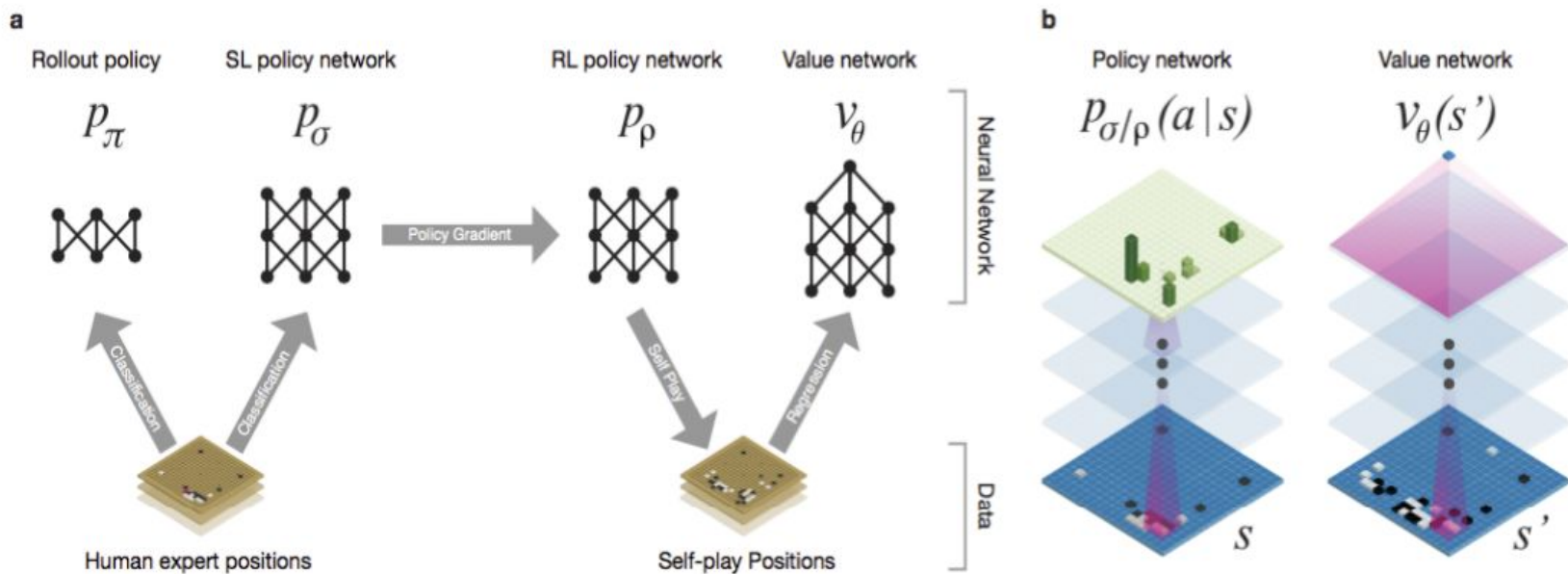
- 200,000,000 позиций в секунду
- Материал, позиция, сохранность
Короля, темп
- 11.38 GFLOPS
- Специализированное железо

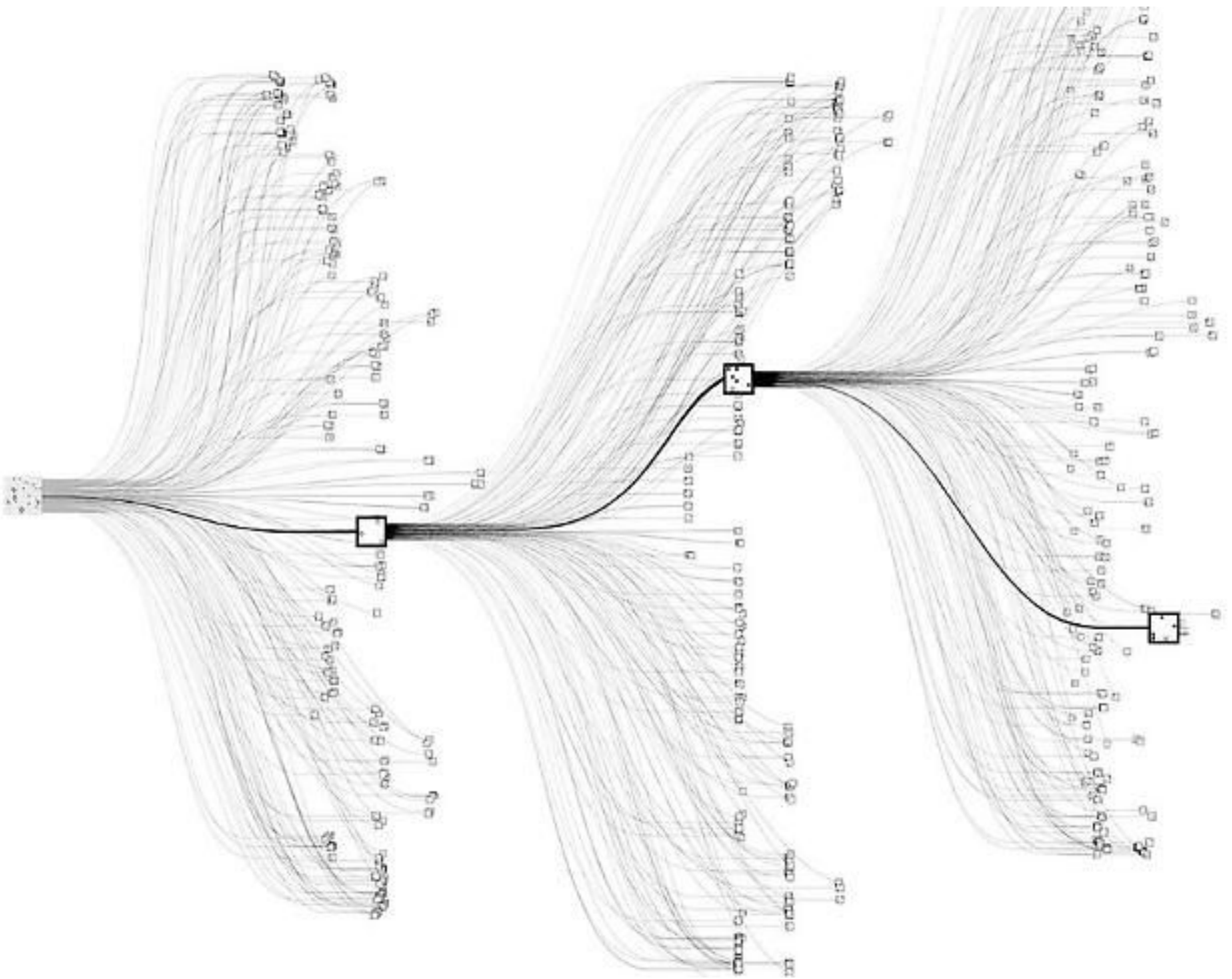
Go



Внутри Alpha Go

- Features
 - 46 bits for slow
 - $\approx 140,000$ patterns for fast
- Value networks to evaluate board positions
- Policy networks to select moves
- Fast value network for rollout
- Monte-Carlo tree search
- “machine learning techniques” for time management





Компьютеры vs Человеки: Go

- AlphaGo
 - 1920 CPUs, 280 GPUs
 - 1 MW
 - \approx 4 недели, 160,000 записей игр, 3,000,000 позиций
- Lee Sedol
 - 1 мозг (+ команда)
 - 100 W
 - 25+ лет карьеры

Тест Тьюринга, будущее

- If no one told me, maybe I would think the player was a little strange, but a very strong player, a real person.
- Планы по обучению сети «с нуля»

Центр управления полетами



Ресурсы

- <https://habrahabr.ru/post/279071/>
- <http://neuralnetworksanddeeplearning.com/chap6.html>
- <http://www.cs.toronto.edu/~fritz/absps/imagenet.pdf>
- <http://www.slideshare.net/DataScienceMD/deep-learning-with-gpus>
- <https://gogameguru.com/i/2016/03/deepmind-mastering-go.pdf>
- <http://jacquesmattheij.com/another-way-of-looking-at-lee-sedol-vs-alpha-go>