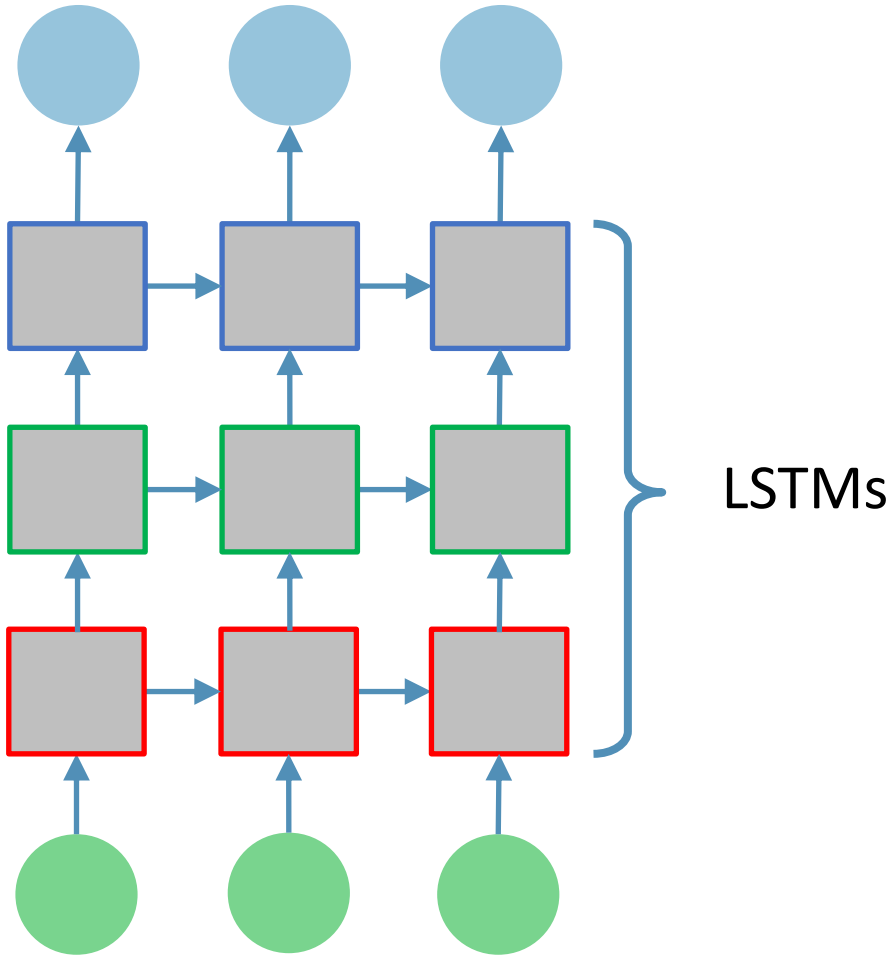
MML minor #8

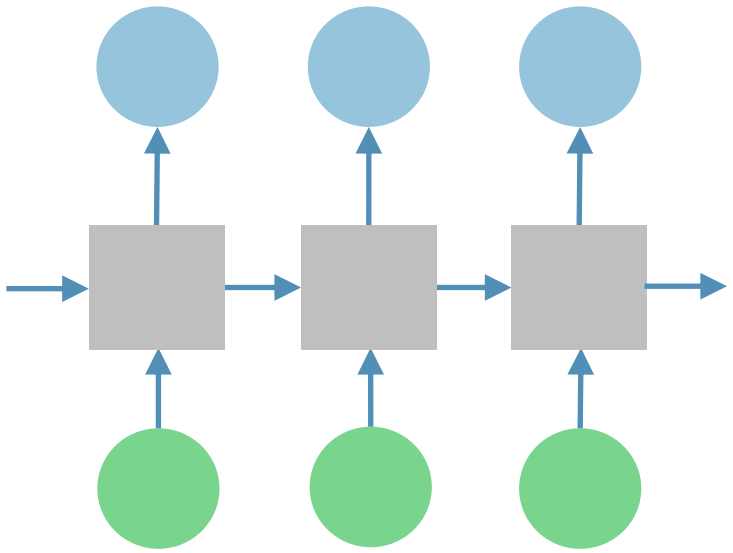
Нейросети: другие RNN задачи, image captioning

LSTM: stack more layers

Так меньше параметров нужно



Elements-wise classification



Input sequence

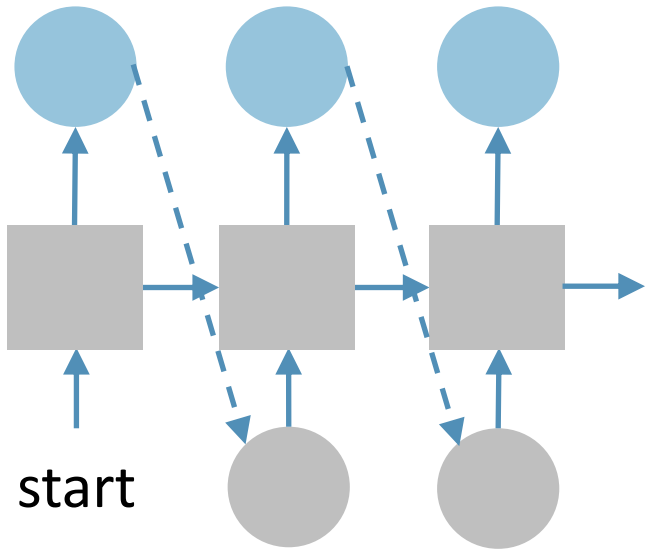
Output sequence

Input and output are synchronized

Tasks

- POS tagging
- Video frames classification

Sequence generation



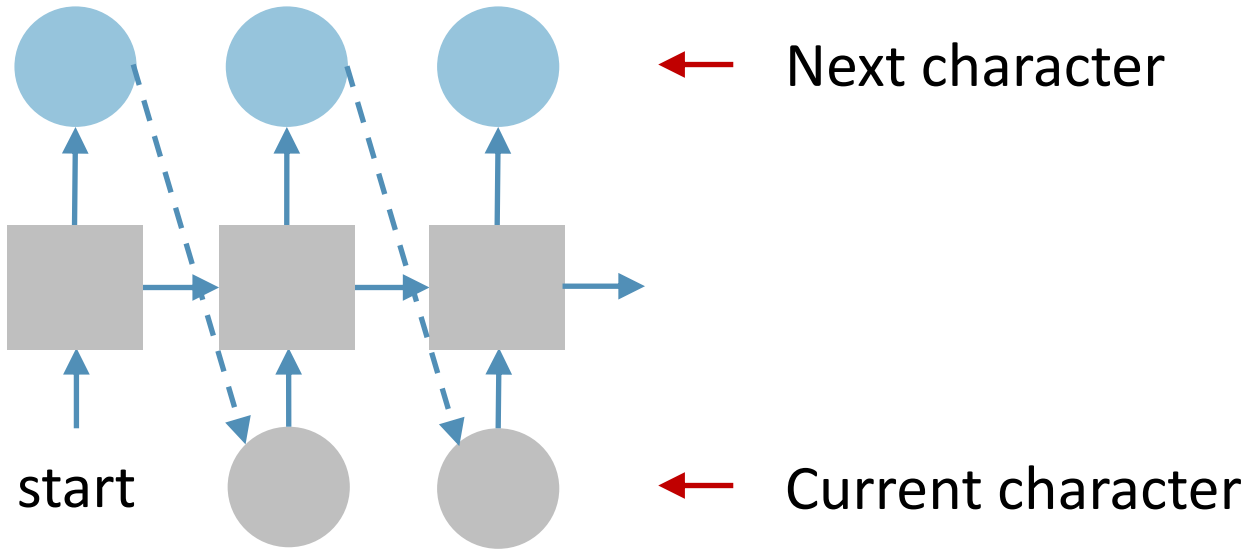
Input	---
Output	sequence

Tasks

- Character-based language model
- Word-based language model
- Music generation
- Speech generation
- Handwriting generation
- …

Char-based language model: Shakespeare

Model	3 layer LSTM of 512 units
Training data	all the works of Shakespeare



Char-based language model: Shakespeare

Second Senator:
They are away this miseries, produced upon my soul,
Breaking and strongly should be buried, when I perish
The earth and thoughts of many states.

DUKE VINCENTIO:
Well, your wit is in the care of side and that.

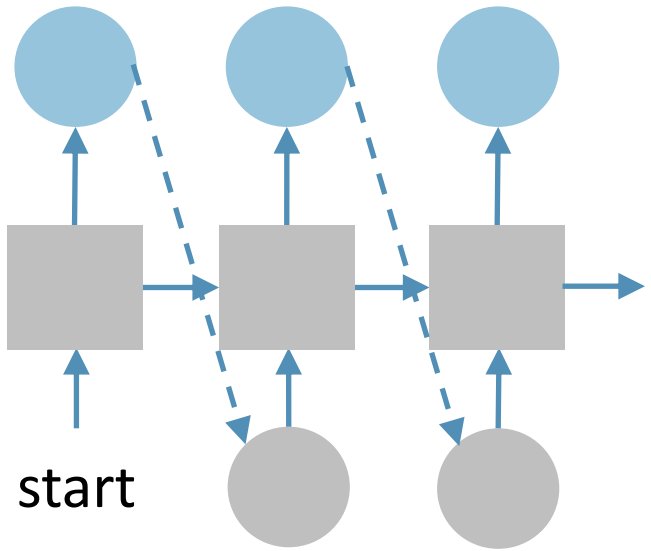
Second Lord:
They would be ruled after this chamber, and
my fair nues begun out of the fact, to be conveyed,
Whose noble souls I'll have the heart of the wars.

Clown:
Come, sir, I will make did behold your worship.

Andrej Karpathy, http://karpathy.github.io/2015/05/21/rnn-effectiveness/

Handwriting generation

We predict handwriting point by point



← Next pen position:

$x,\ y$ – mixture of Gaussians

z – Bernoulli distribution

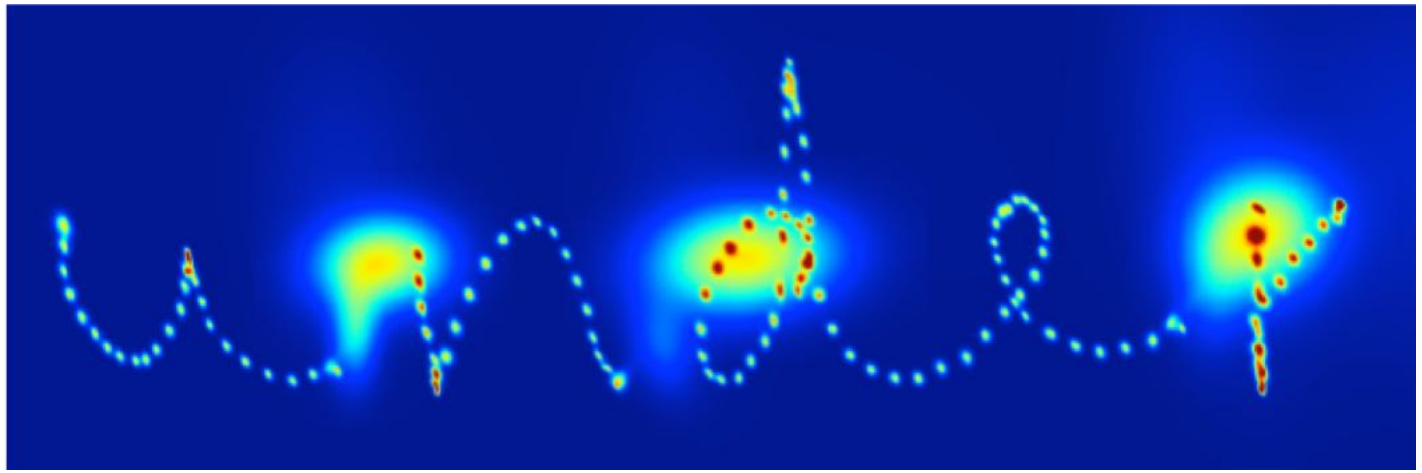
← Current pen position:

$x,\ y$ – pen offset

z – do we end a stroke here?

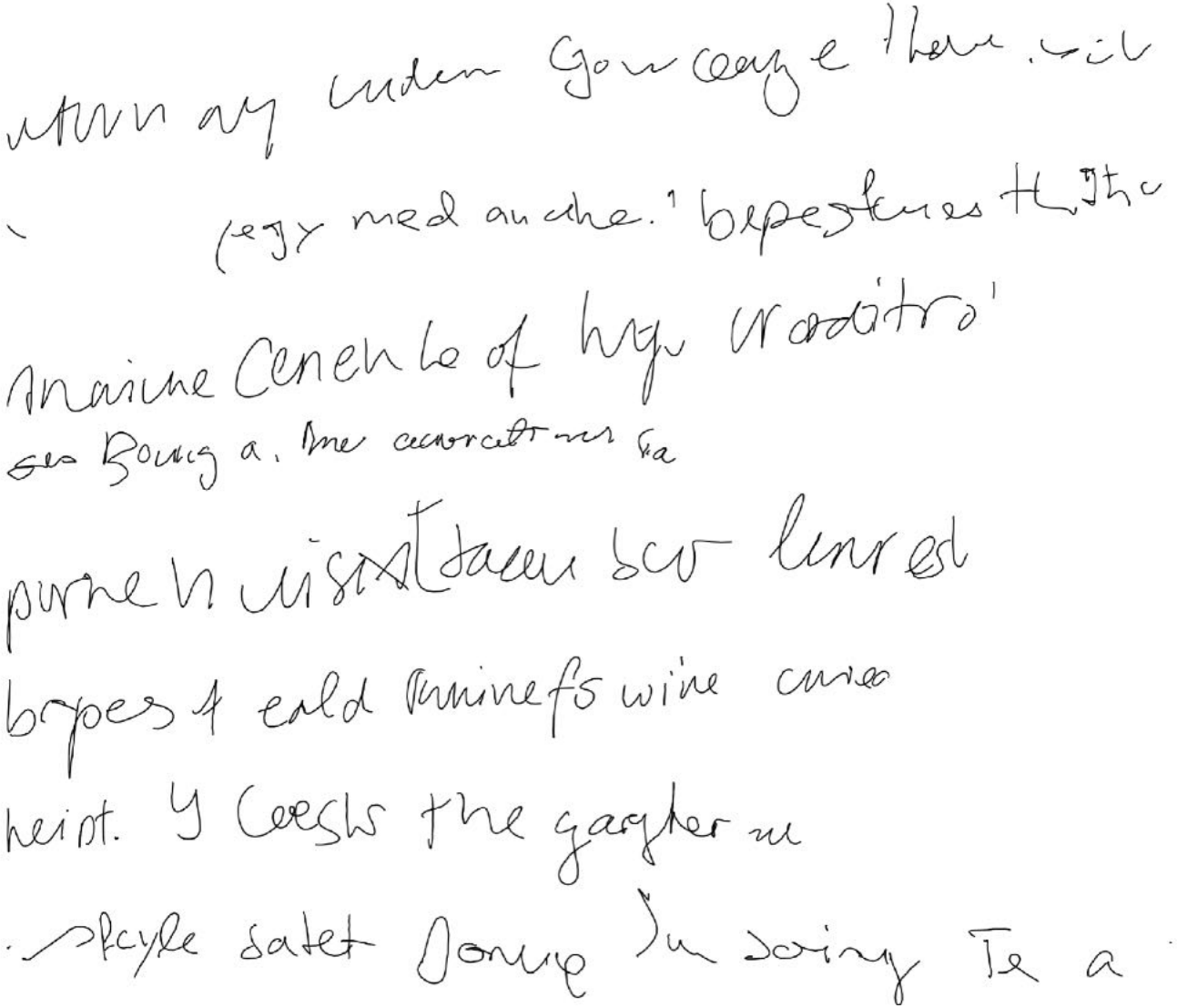
Handwriting generation

We predict handwriting point by point



Alex Graves, https://arxiv.org/pdf/1308.0850.pdf

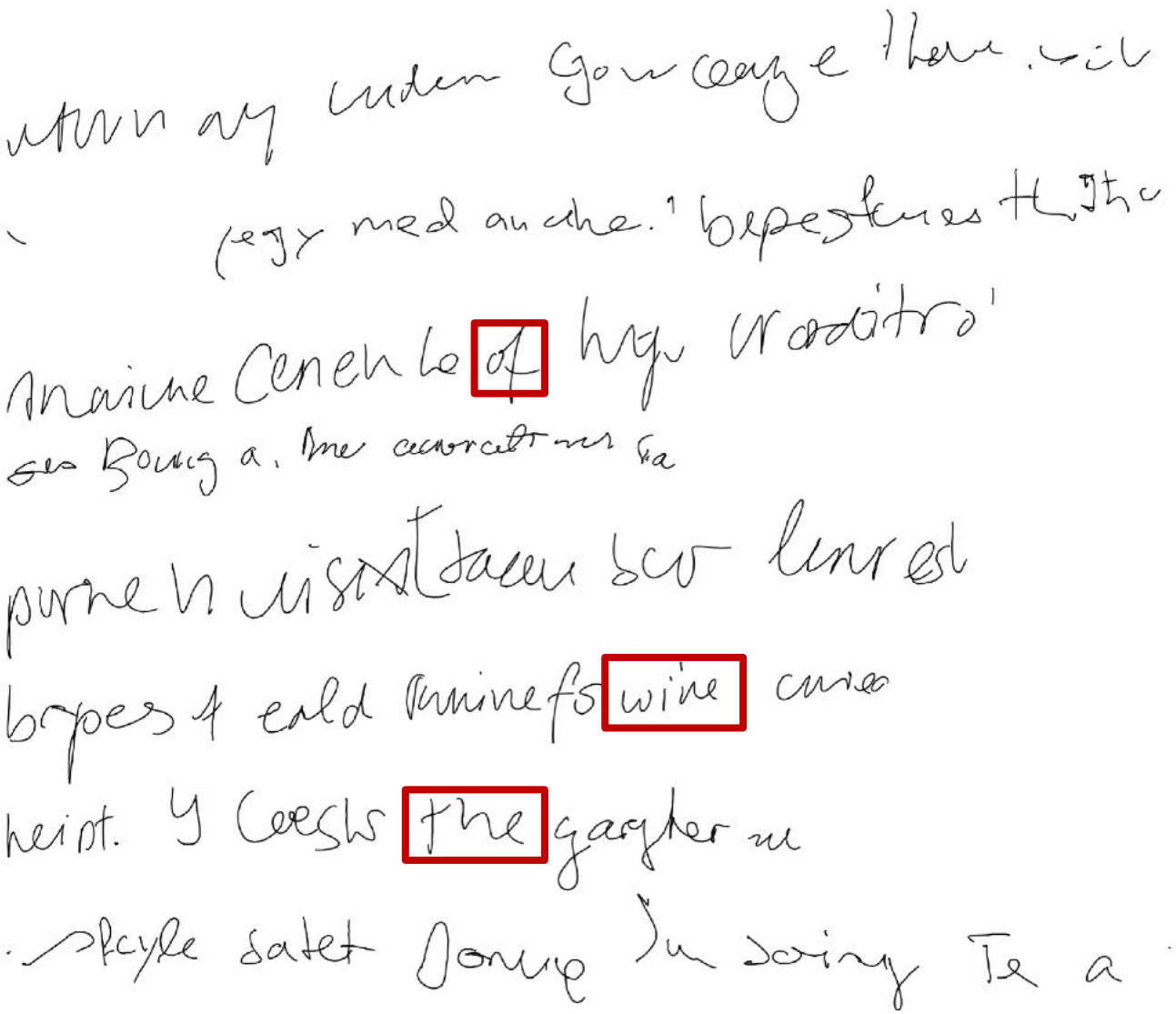
Handwriting generation



Alex Graves, https://arxiv.org/pdf/1308.0850.pdf

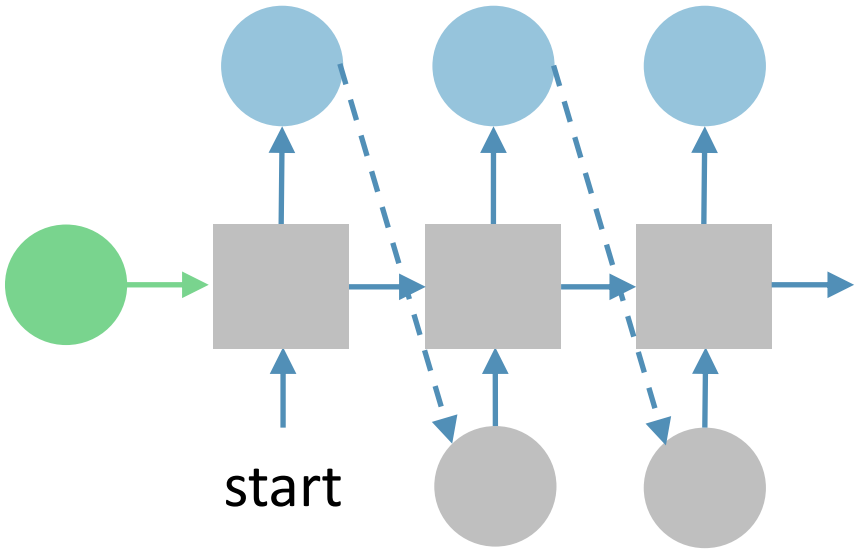
Handwriting generation

Можно даже заметить нормальные слова!



Alex Graves, https://arxiv.org/pdf/1308.0850.pdf

Conditional sequence generation



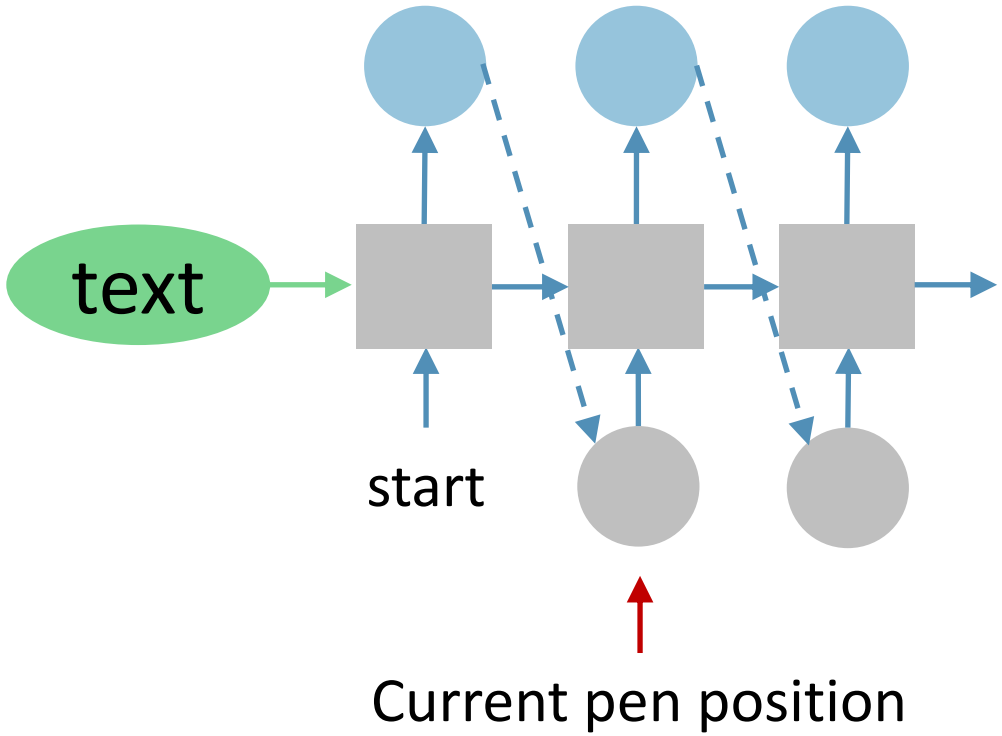
Input some object

Output sequence

Tasks

- Speech generation
- Handwriting generation
- Image captioning
- …

Conditional sequence generation



Input some object

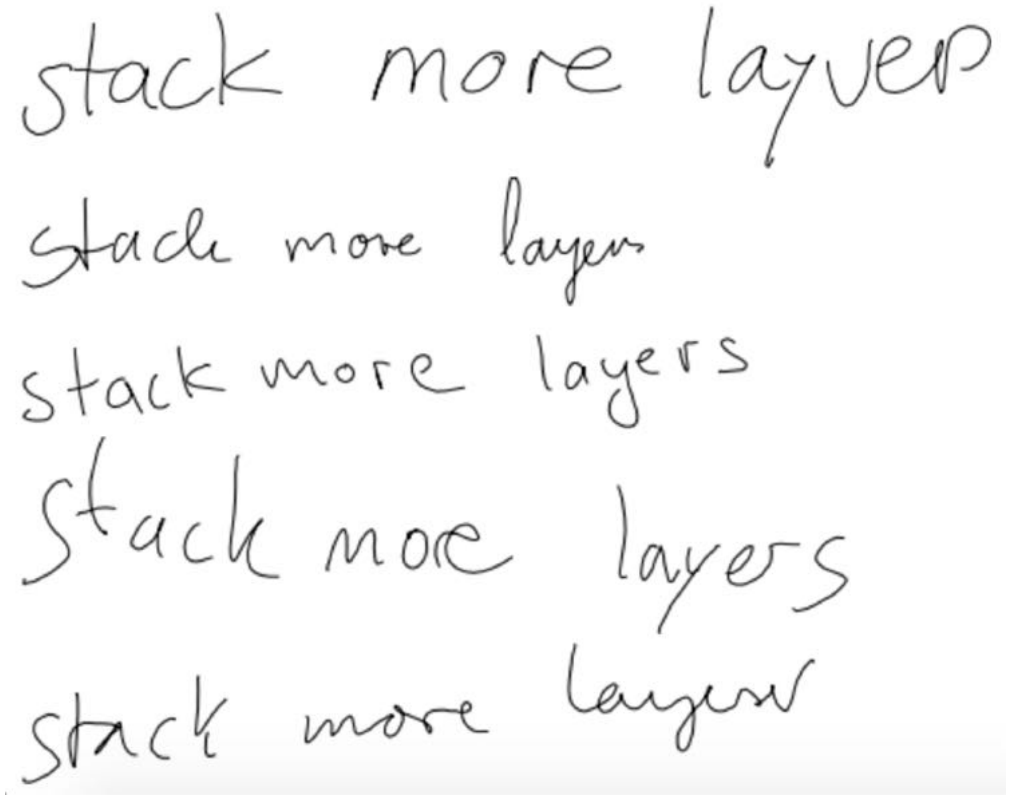
Output sequence

Tasks

- Speech generation
- **Handwriting generation**
- Image captioning
- …

Conditional handwriting generation

stack more layers



Alex Graves, http://www.cs.toronto.edu/~graves/handwriting.html

Image Captioning

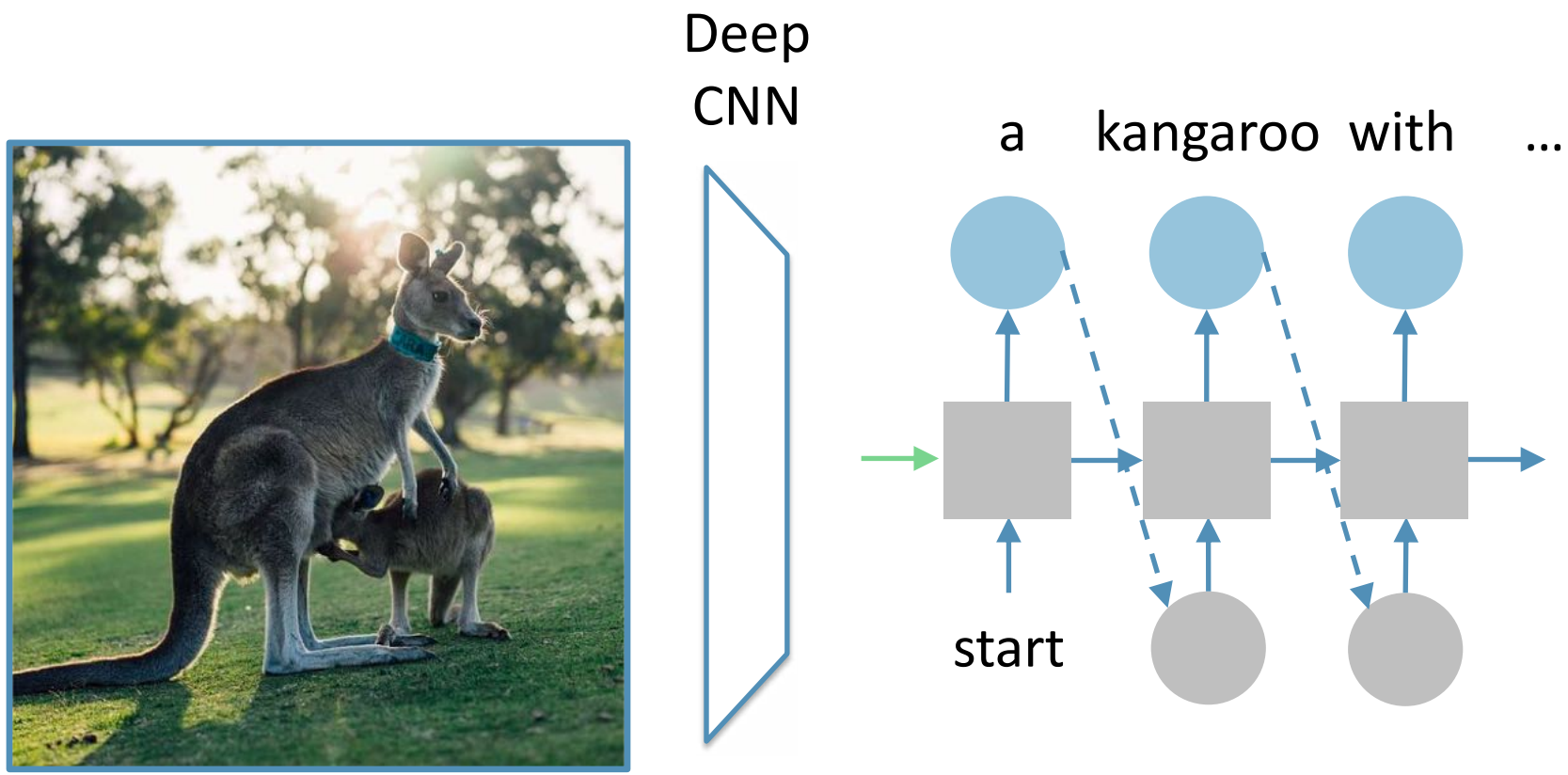


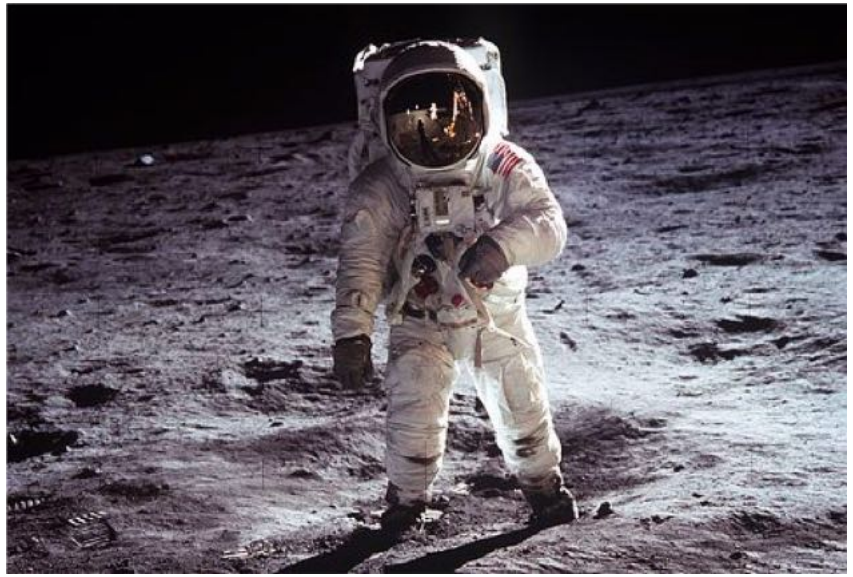
Image Captioning: good examples

a man riding a wave on a surfboard

a large brown bear walking across a river

Image Captioning: bad examples

a man riding on the back of a boat

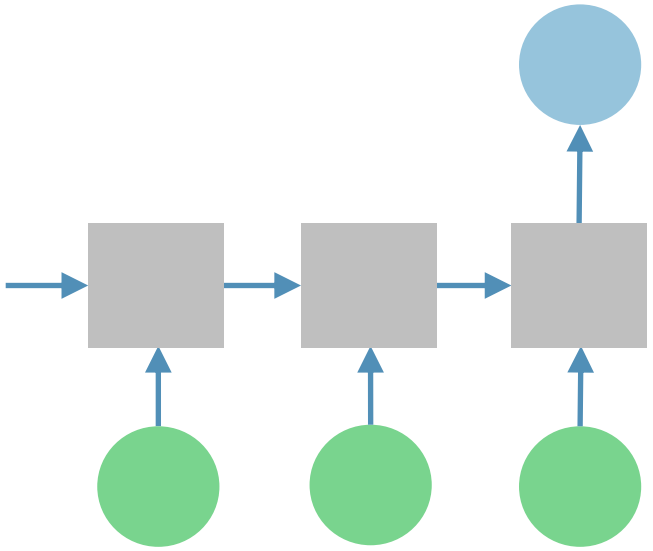


a man riding a snowboard

Sequence classification

Input sequence

Output one label



One output at the end

Tasks

- Sentiment analysis
- …

Можно генерировать любой текст, даже в TeX!

По одному символу за раз!

Proof. Omitted. □

Lemma 0.1. *Let $\mathcal{C}$ be a set of the construction.*

Let $\mathcal{C}$ be a gerber covering. Let $\mathcal{F}$ be a quasi-coherent sheaves of $\mathcal{O}$-modules. We have to show that

$$\mathcal{O}_{\mathcal{O}_X} = \mathcal{O}_X(\mathcal{L})$$

.

Proof. This is an algebraic space with the composition of sheaves $\mathcal{F}$ on $X_{\acute{e}tale}$ we have

$$\mathcal{O}_X(\mathcal{F}) = \{morph_1 \times_{\mathcal{O}_X} (\mathcal{G}, \mathcal{F})\}$$

where $\mathcal{G}$ defines an isomorphism $\mathcal{F} \to \mathcal{F}$ of $\mathcal{O}$-modules. □

Lemma 0.2. *This is an integer $\mathcal{Z}$ is injective.*

Proof. See Spaces, Lemma ??. □

Lemma 0.3. *Let S be a scheme. Let X be a scheme and X is an affine open covering. Let $\mathcal{U} \subset \mathcal{X}$ be a canonical and locally of finite type. Let X be a scheme. Let X be a scheme which is equal to the formal complex.*

The following to the construction of the lemma follows.

Let X be a scheme. Let X be a scheme covering. Let

$$b : X \to Y' \to Y \to Y \to Y' \times_X Y \to X.$$

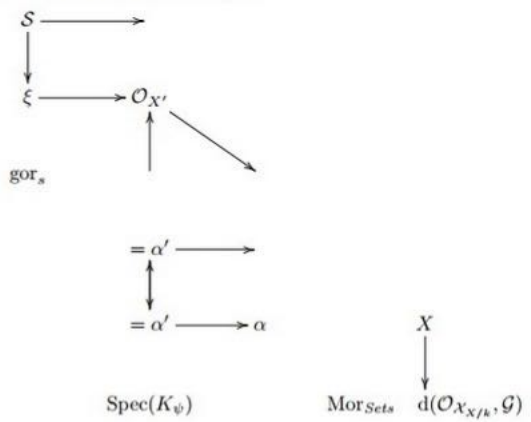
be a morphism of algebraic spaces over S and Y.

Proof. Let X be a nonzero scheme of X. Let X be an algebraic space. Let $\mathcal{F}$ be a quasi-coherent sheaf of $\mathcal{O}_X$-modules. The following are equivalent

(1) $\mathcal{F}$ is an algebraic space over S.
(2) If X is an affine open covering.

Consider a common structure on X and X the functor $\mathcal{O}_X(U)$ which is locally of finite type. □

This since $\mathcal{F} \in \mathcal{F}$ and $x \in \mathcal{G}$ the diagram



is a limit. Then $\mathcal{G}$ is a finite type and assume S is a flat and $\mathcal{F}$ and $\mathcal{G}$ is a finite type f_*. This is of finite type diagrams, and

- the composition of $\mathcal{G}$ is a regular sequence,
- $\mathcal{O}_{X'}$ is a sheaf of rings.

□

Proof. We have see that $X = \mathrm{Spec}(R)$ and $\mathcal{F}$ is a finite type representable by algebraic space. The property $\mathcal{F}$ is a finite morphism of algebraic stacks. Then the cohomology of X is an open neighbourhood of U. □

Proof. This is clear that $\mathcal{G}$ is a finite presentation, see Lemmas ??.
A *reduced above* we conclude that U is an open covering of $\mathcal{C}$. The functor $\mathcal{F}$ is a "field

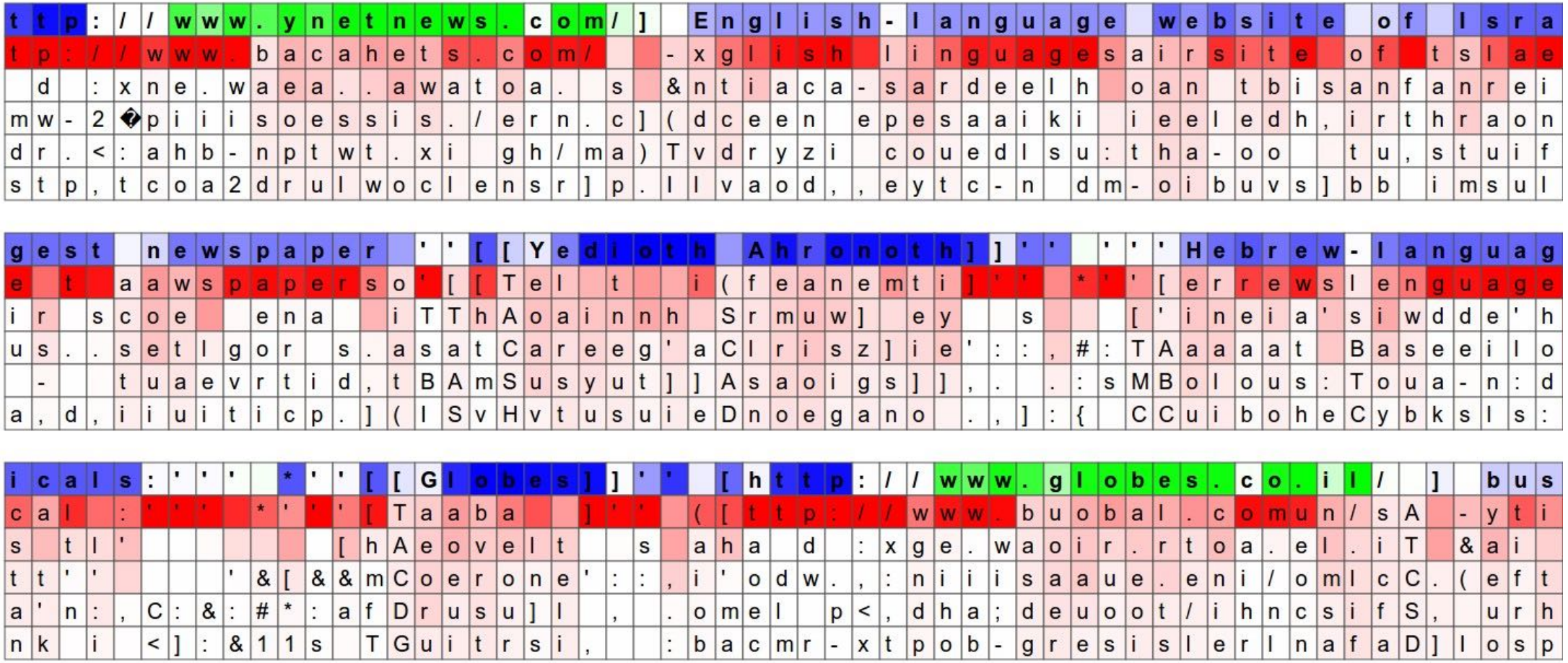
$$\mathcal{O}_{X,x} \longrightarrow \mathcal{F}_{\overline{x}} \quad \text{-1}(\mathcal{O}_{X_{\acute{e}tale}}) \longrightarrow \mathcal{O}_{X_t}^{-1}\mathcal{O}_{X_\lambda}(\mathcal{O}_{X_\eta}^{\overline{v}})$$

is an isomorphism of covering of $\mathcal{O}_{X_i}$. If $\mathcal{F}$ is the unique element of $\mathcal{F}$ such that X is an isomorphism.
The property $\mathcal{F}$ is a disjoint union of Proposition ?? and we can filtered set of presentations of a scheme $\mathcal{O}_X$-algebra with $\mathcal{F}$ are opens of finite type over S.
If $\mathcal{F}$ is a scheme theoretic image points. □

If $\mathcal{F}$ is a finite direct sum $\mathcal{O}_{X_\lambda}$ is a closed immersion, see Lemma ??. This is a sequence of $\mathcal{F}$ is a similar morphism.

http://karpathy.github.io/2015/05/21/rnn-effectiveness/

Можно посмотреть на что реагирует нейрон



Этот нейрон любит активироваться внутри URL.
Скорее всего, LSTM использует его, чтобы запомнить, что она внутри URL.

Возьмем исходный код Linux

- И научим сеть предсказывать следующий символ!

```
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);
  }
  /* Free our user pages pointer to place camera if all dash */
  subsystem_info = &of_changes[PAGE_SIZE];
  rek_controls(offset, idx, &soffset);
  /* Now we want to deliberately put it to device */
  control_check_polarity(&context, val, 0);
```

Этот код почти компилируется!

Этот нейрон чувствителен к глубине вложенности

Cell that is sensitive to the depth of an expression:

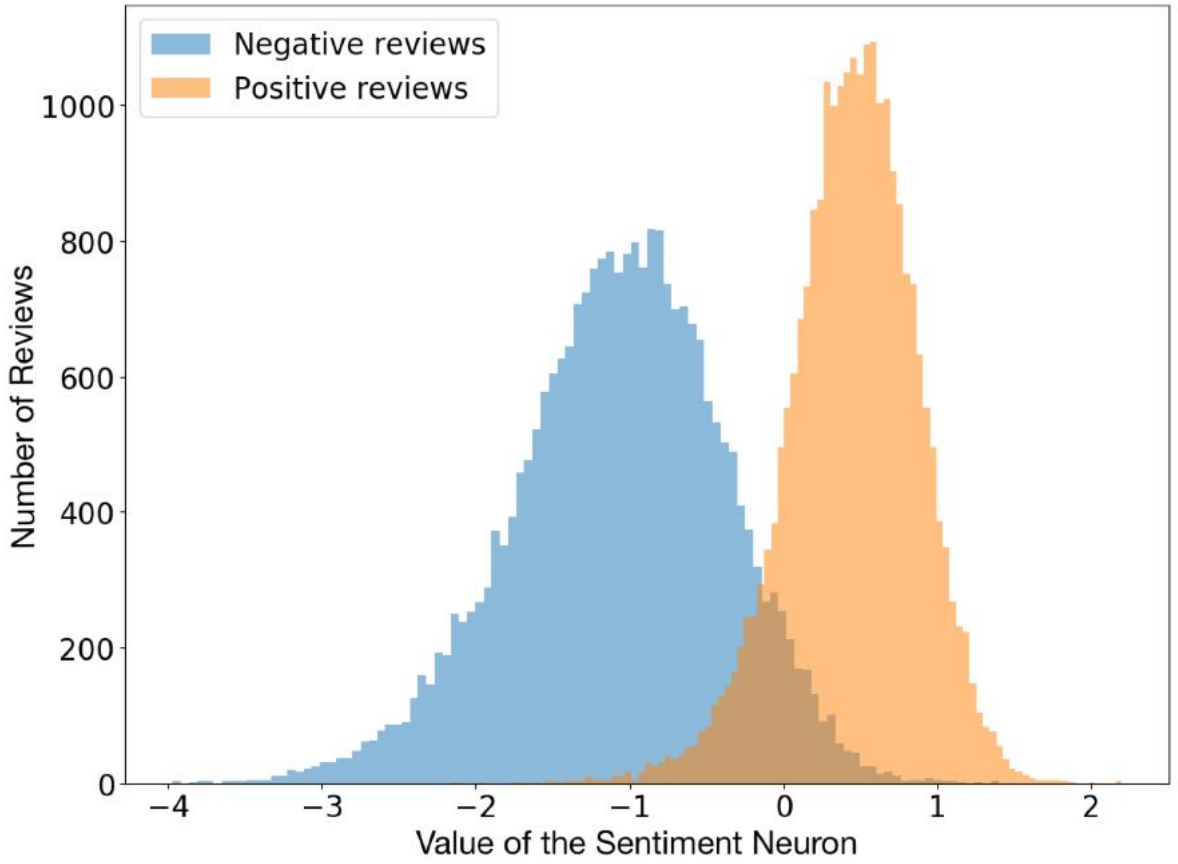
```
#ifdef CONFIG_AUDITSYSCALL
static inline int audit_match_class_bits(int class, u32 *mask)
{
  int i;
  if (classes[class]) {
    for (i = 0; i < AUDIT_BITMASK_SIZE; i++)
      if (mask[i] & classes[class][i])
        return 0;
  }
  return 1;
}
```

И все эти концепции нейросеть выучила сама!

Конечно, не все нейроны можно интерпретировать так просто.

Нейрон эмоций от OpenAI

We've developed an unsupervised system which learns an excellent representation of sentiment, despite being trained only to predict the next character in the text of Amazon reviews.



https://blog.openai.com/unsupervised-sentiment-neuron/

Нейрон эмоций от OpenAI в действии

This is one of Crichton's best books. The characters of Karen Ross, Peter Elliot, Munro, and Amy are beautifully developed and their interactions are exciting, complex, and fast-paced throughout this impressive novel. And about 99.8 percent of that got lost in the film. Seriously, the screenplay AND the directing were horrendous and clearly done by people who could not fathom what was good about the novel. I can't fault the actors because frankly, they never had a chance to make this turkey live up to Crichton's original work. I know good novels, especially those with a science fiction edge, are hard to bring to the screen in a way that lives up to the original. But this may be the absolute worst disparity in quality between novel and screen adaptation ever. The book is really, really good. The movie is just dreadful.

Ссылки

- http://karpathy.github.io/2015/05/21/rnn-effectiveness/
- https://blog.openai.com/unsupervised-sentiment-neuron/