DMIA TRENDS

PLAN

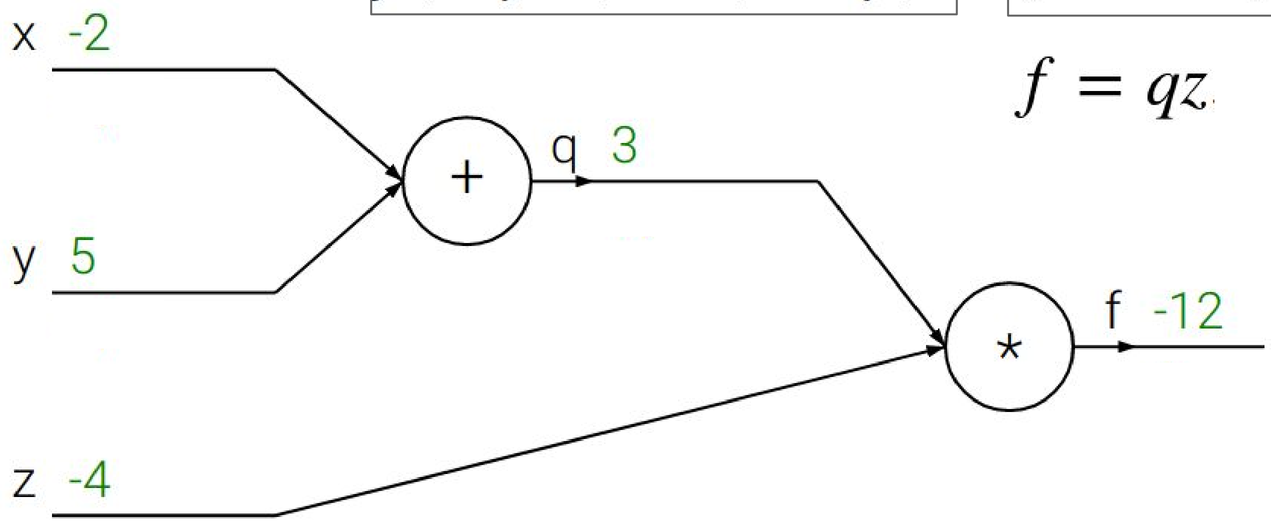
- Backprop
- Embeddings
- RNN
- LSTM, GRU
- Recurrent generative models

Backprop

$$\boxed{f(x, y, z) = (x + y)z}$$

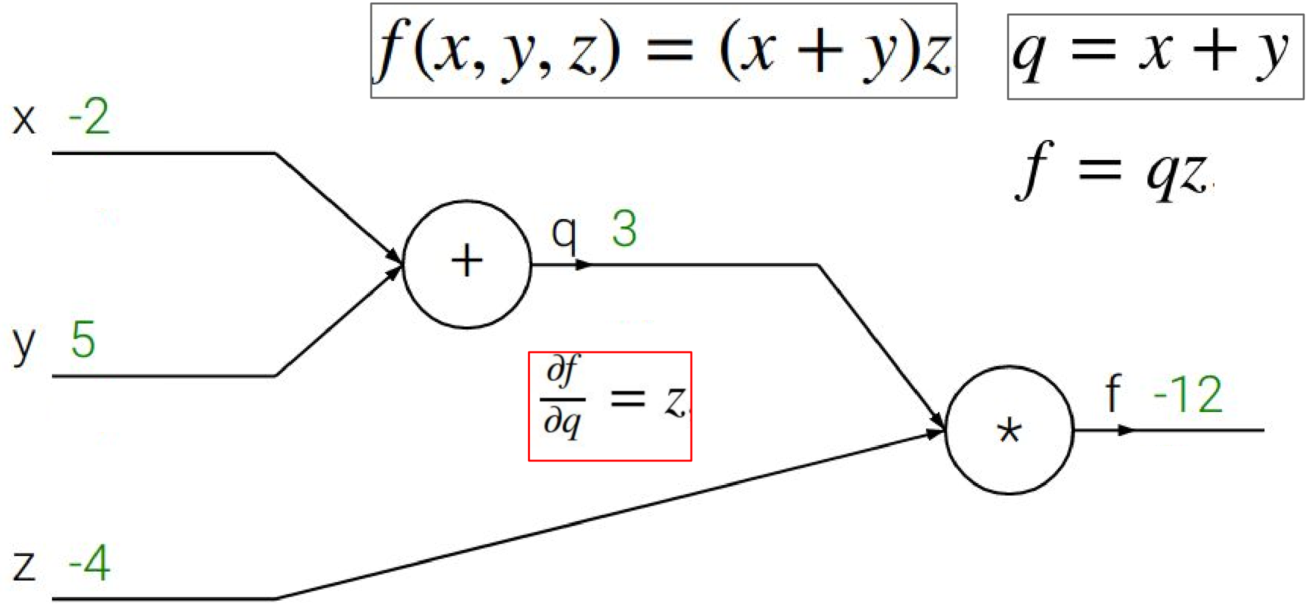
$$\boxed{q = x + y}$$

$$f = qz$$



http://cs231n.github.io/optimization-2/

Backprop



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Backprop

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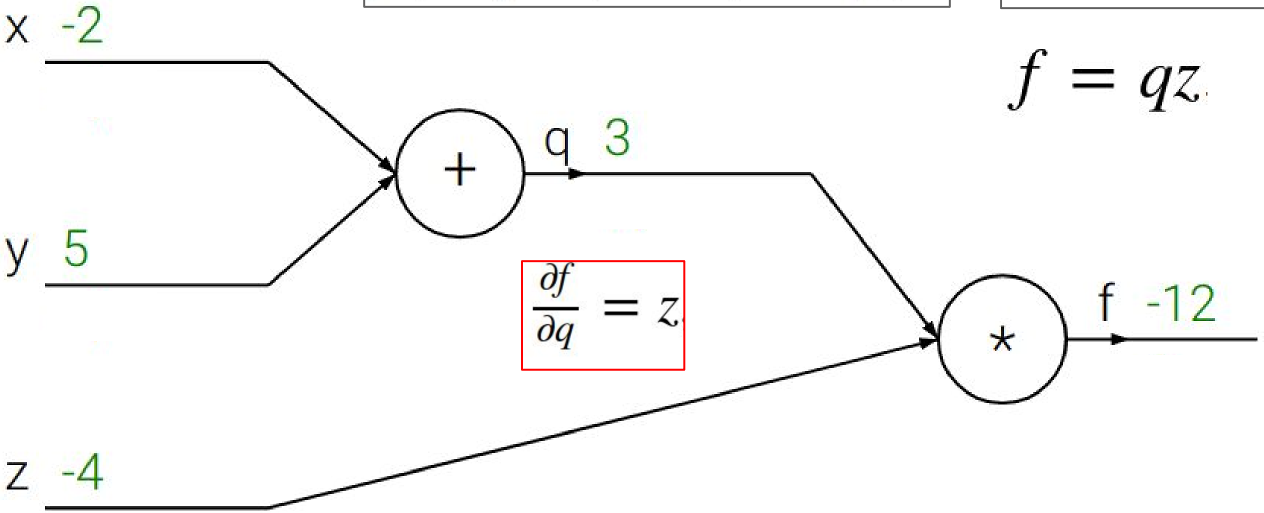

$$\boxed{\frac{\partial f}{\partial q} = z}$$

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http://cs231n.github.io/optimization-2/

Backprop

$$\boxed{f(x,y,z) = (x+y)z} \quad \boxed{q = x + y}$$

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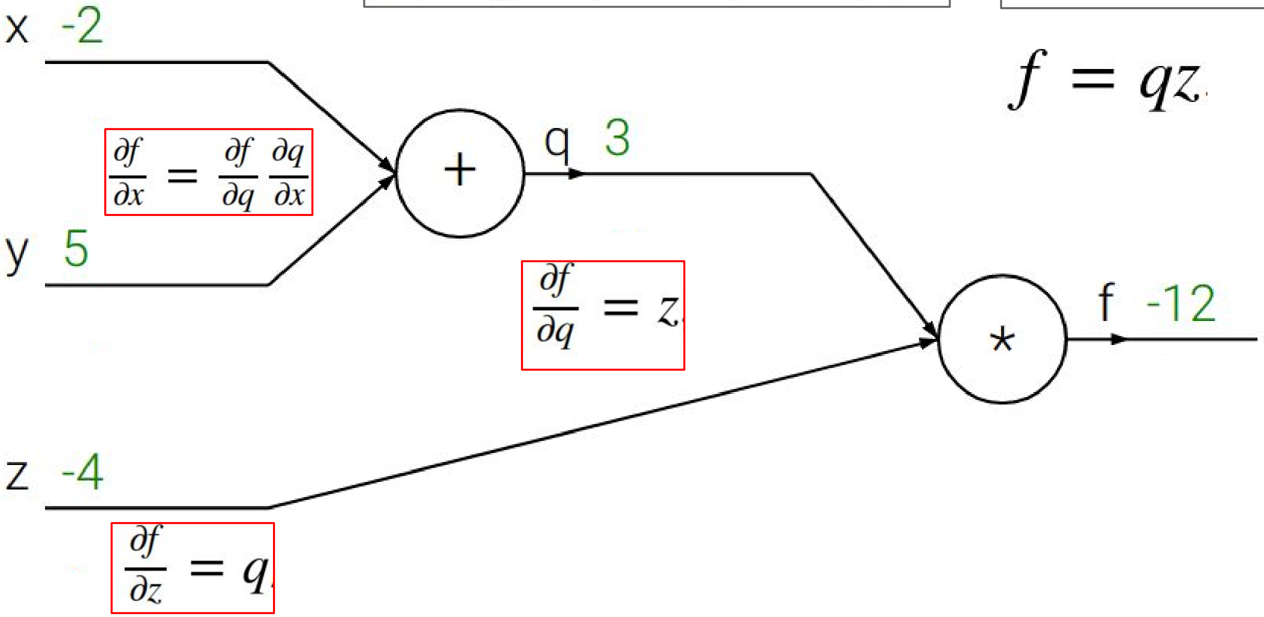

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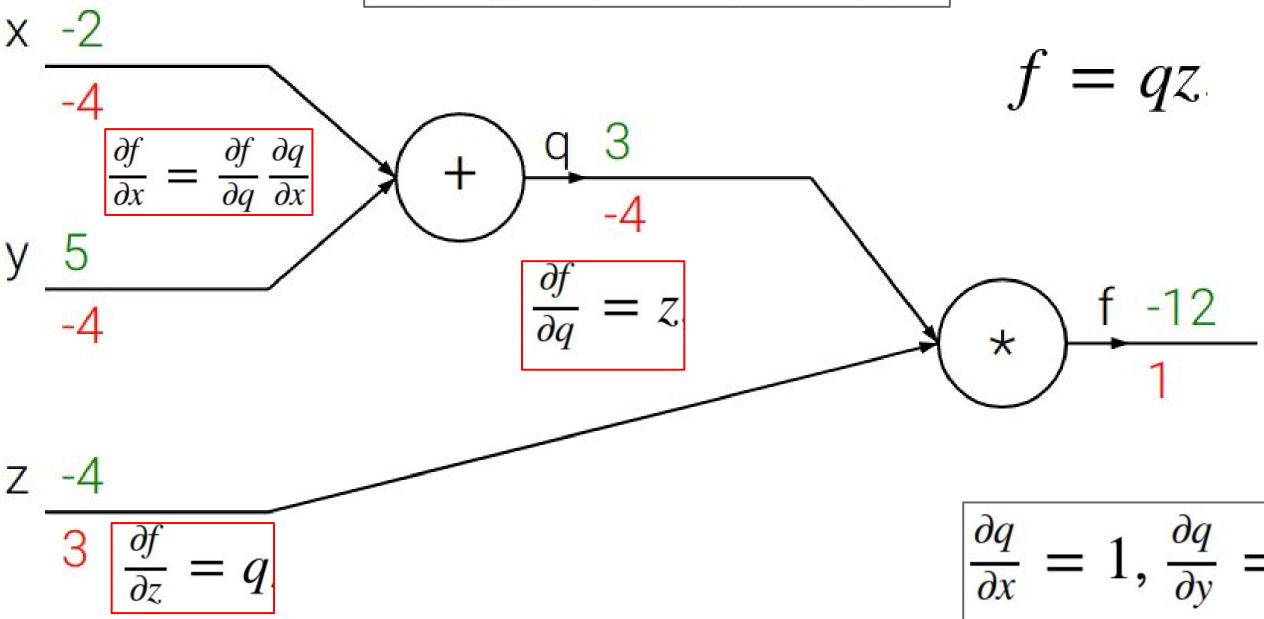
Backprop

$$f(x, y, z) = (x + y)z$$

$$q = x + y$$

$$f = qz$$



$$\frac{\partial q}{\partial x} = 1, \frac{\partial q}{\partial y} = 1$$

http://cs231n.github.io/optimization-2/

Embeddings

- Frequency based Embedding
  - Count Vector
  - TF-IDF Vector
  - Co-Occurrence Vector

- Prediction based Embedding

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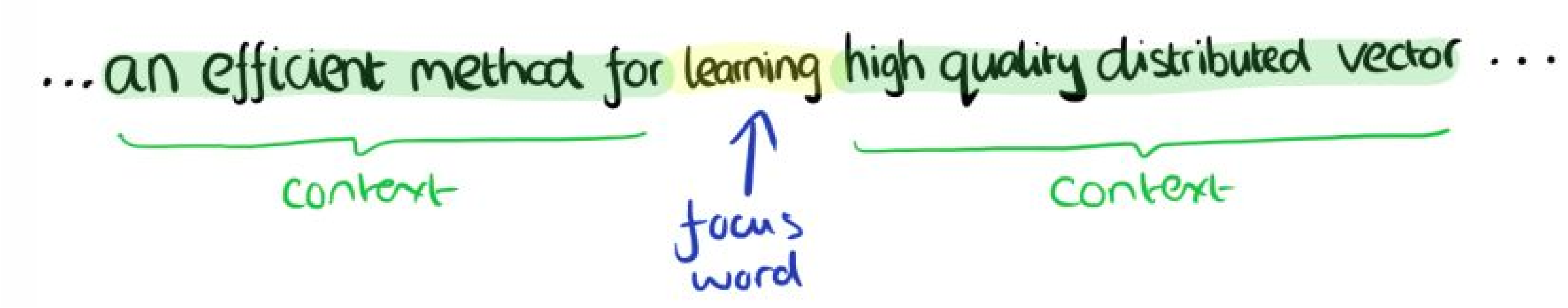
Word2Vec



 https://arxiv.org/abs/1301.3781

Word2Vec

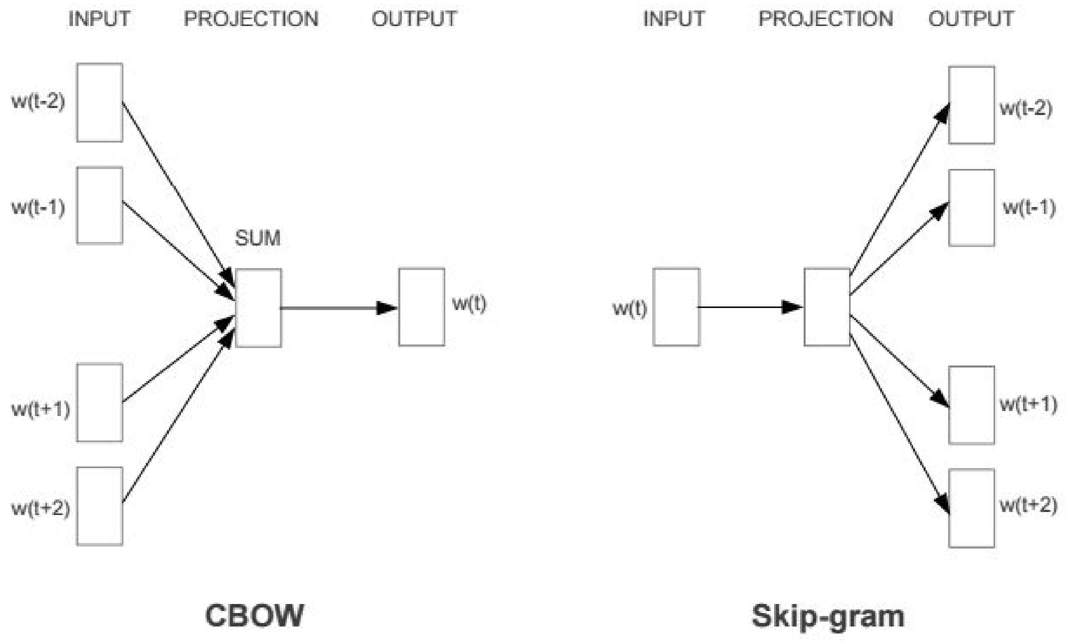


Figure 1: New model architectures. The CBOW architecture predicts the current word based on the context, and the Skip-gram predicts surrounding words given the current word.

Word2Vec

$$p(w_h|w_i) = \frac{exp(s(v_i, v_h))}{\sum_{w=1}^{W} exp(s(v_w, v_i))}$$

- w_i -- input focus word
- w_h -- hypothetically context word for a given focus word w_i
- v_i and v_h input-word and hypothesis-word vector representations (for w_i, w_h)
- $s(v_i, v_h) = v_h^T \cdot v_i$
- W is the number of words in vocabulary

CBOW (Continuous bag of words)

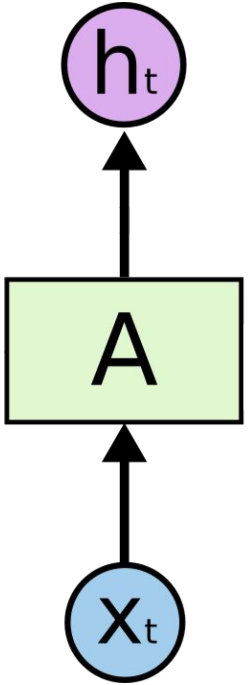
$$E = -log\ p(w_h \mid w_1,\ w_2,\ \ldots,\ w_c)$$

Skip-Gram

$$AverageLogProbability = \frac{1}{T} \sum_{t=1}^{T} \sum_{-c \leqslant j \leqslant c, j \neq 0} log\ p(w_{t+j}|w_t)$$

- where c is a context length.
- w_t -- focus word

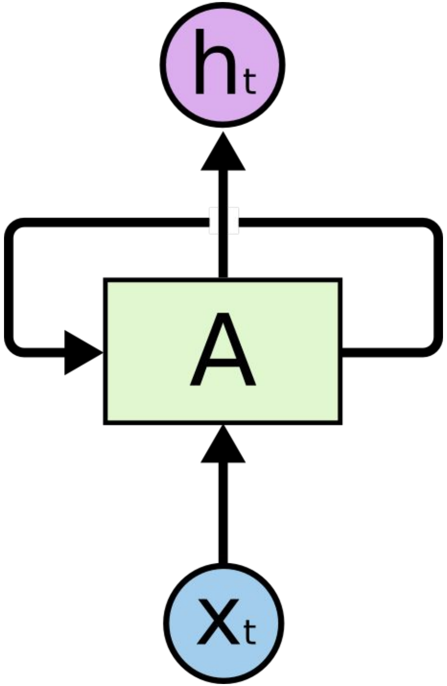
Feedforward



$$h_t = f(x_t)$$

$$f(x_t) = n(W_x x_t + b)$$

RNN

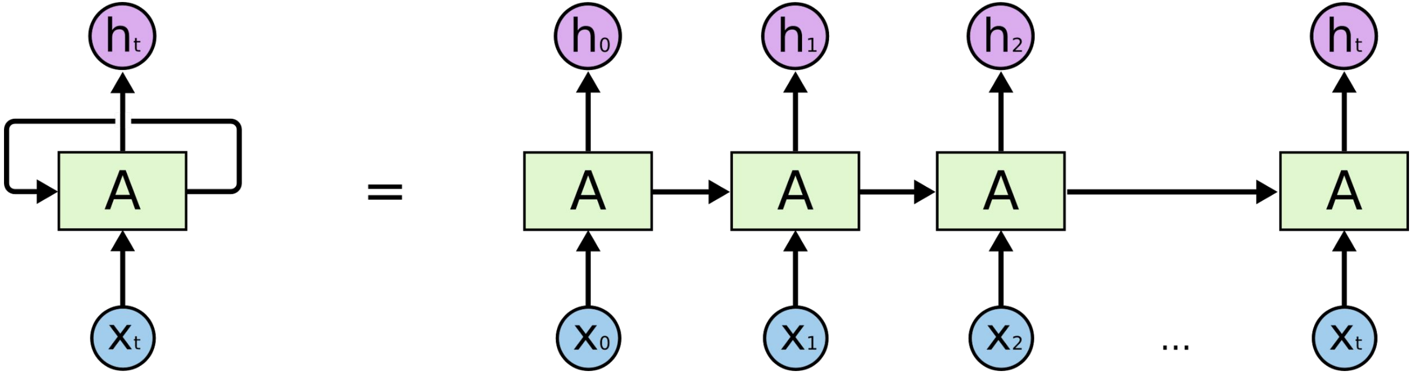


$$h_t = f(x_t + h_{t-1})$$

$$f(x_t, h_{t-1}) = n(W_x x_t + W_h h_{t-1} + b)$$

http://colah.github.io/posts/2015-08-Understanding-LSTMs/

RNN



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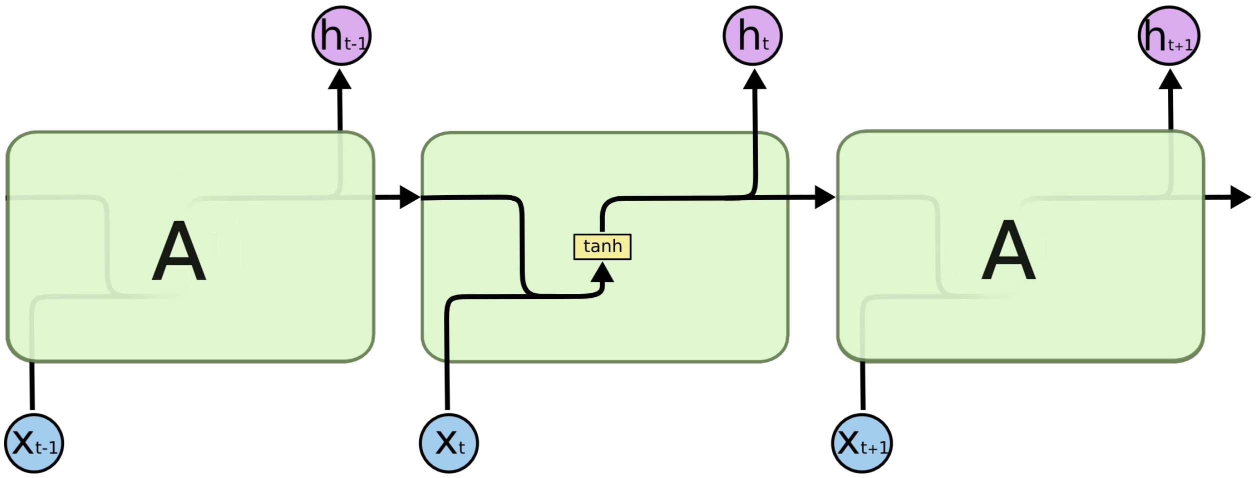
RNN



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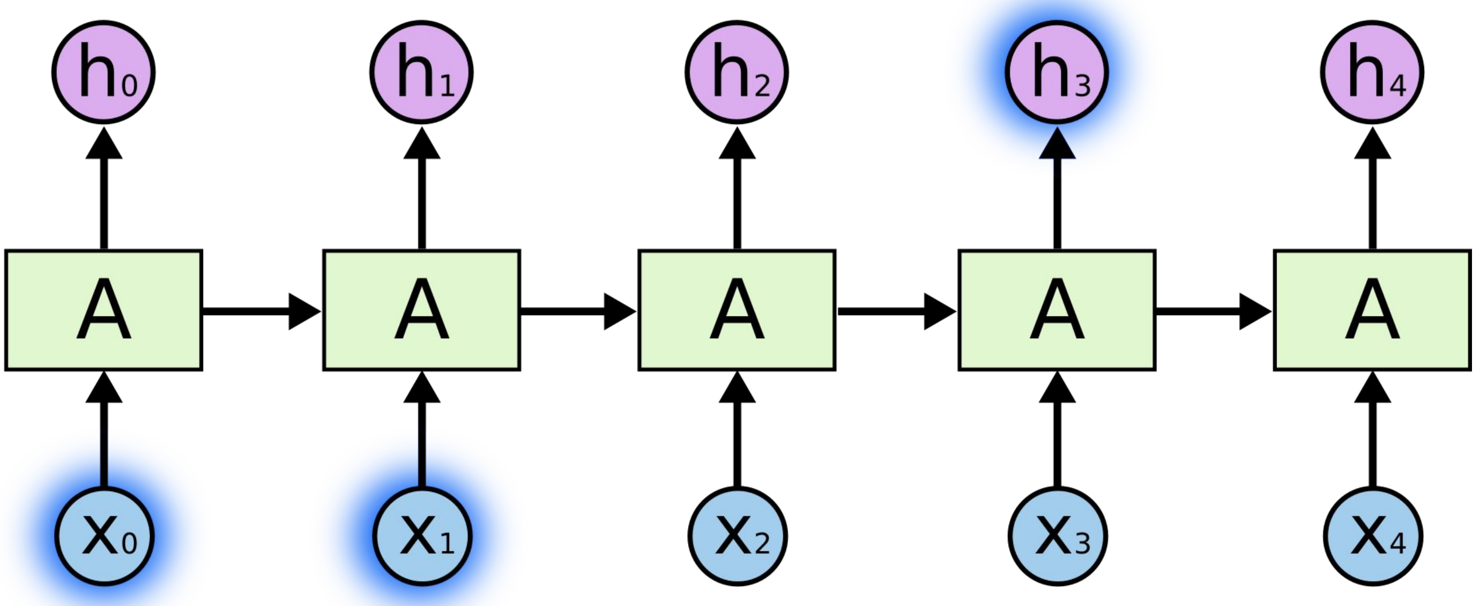
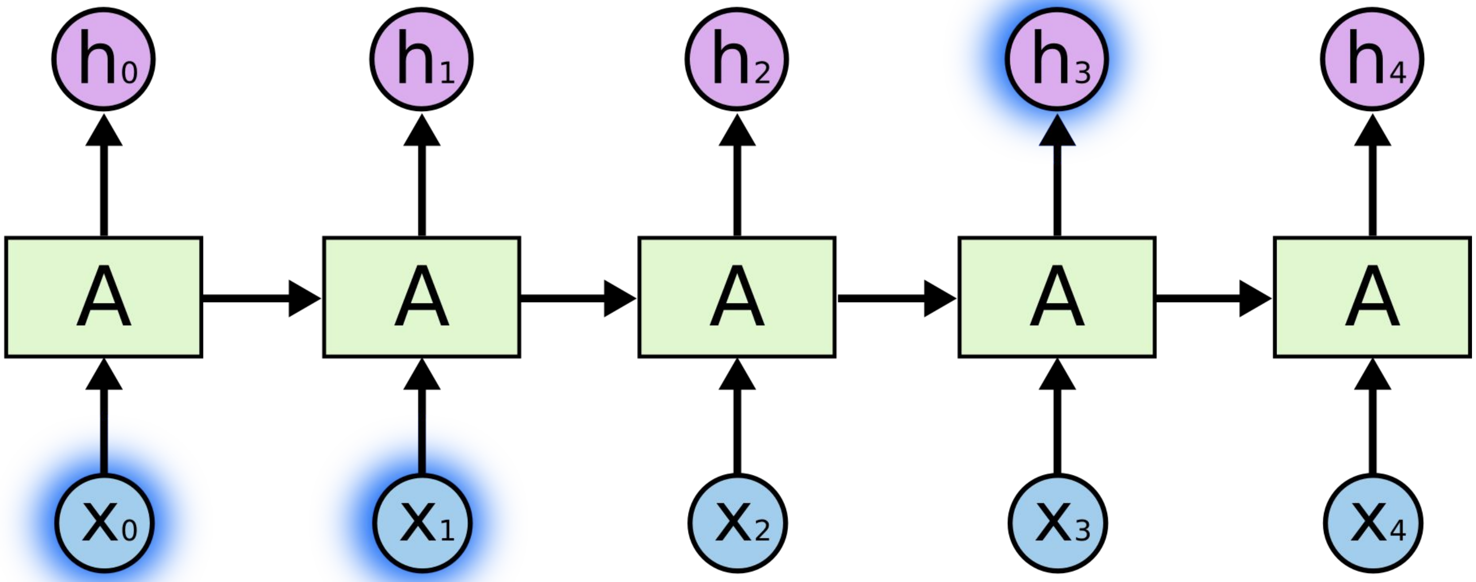
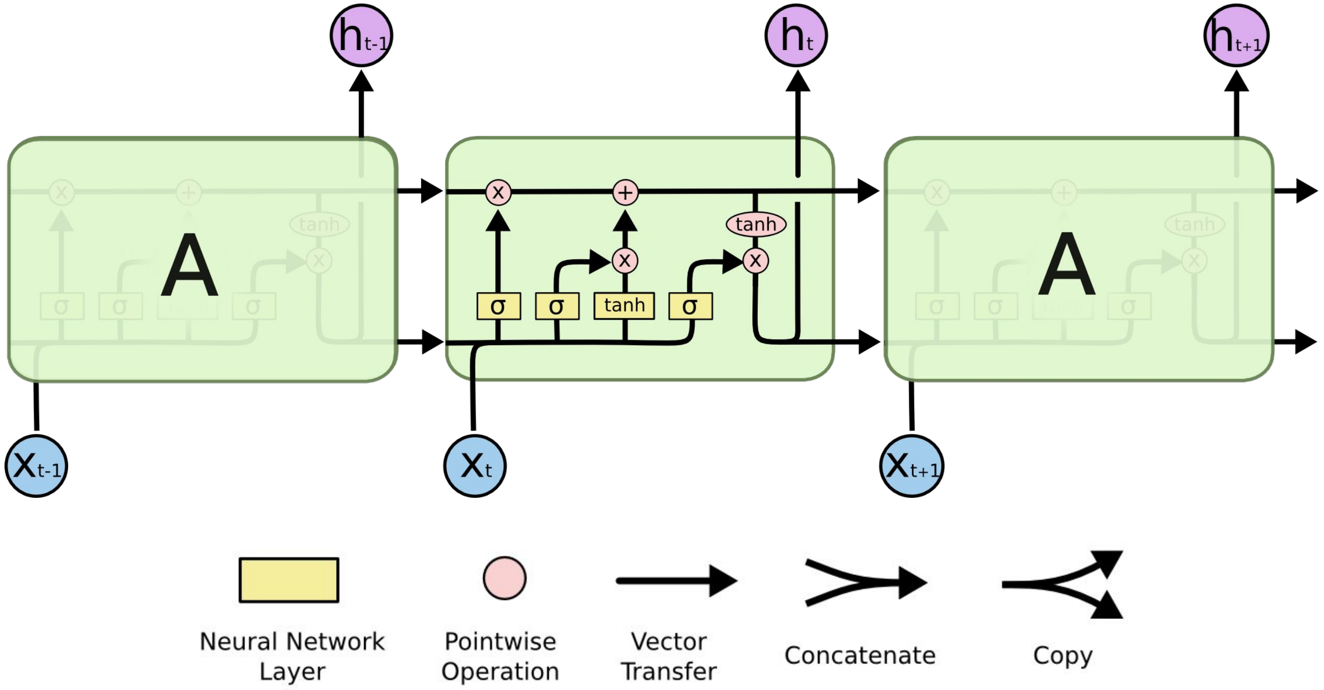
RNN



RNN

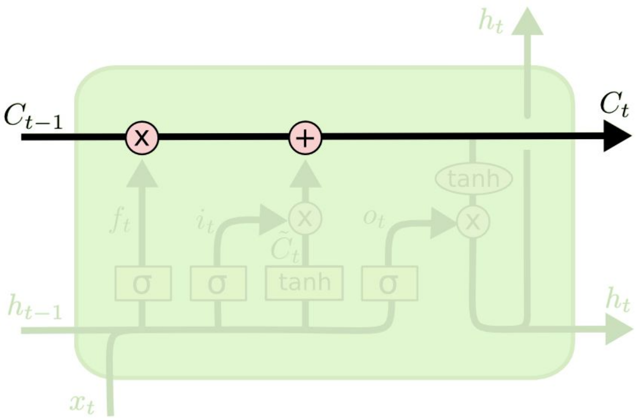


LSTM

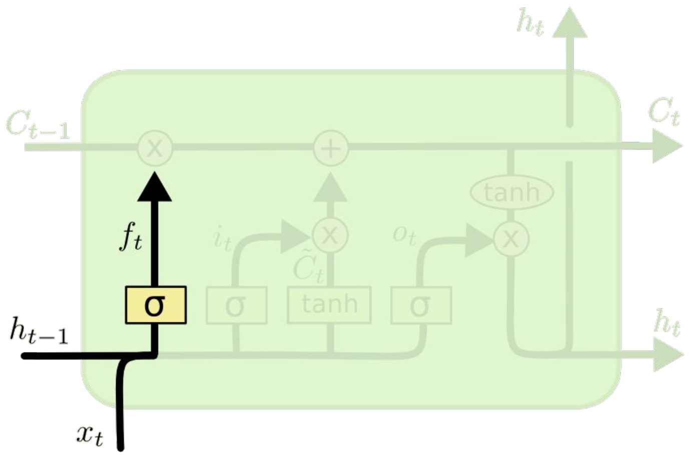


h_{t-1}
h_t
h_{t+1}
A
A
x
+
tanh
x
x
σ
σ
tanh
σ
X_{t-1}
X_t
X_{t+1}
Neural Network Layer
Pointwise Operation
Vector Transfer
Concatenate
Copy

LSTM

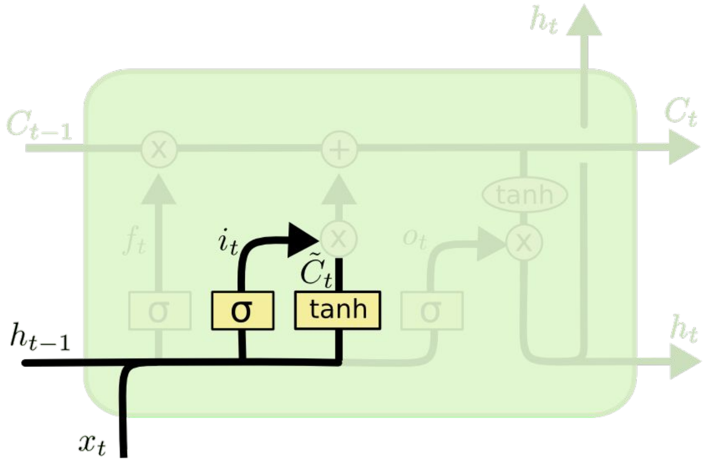


LSTM



$$f_t = \sigma\left(W_f \cdot [h_{t-1}, x_t] \ + \ b_f\right)$$

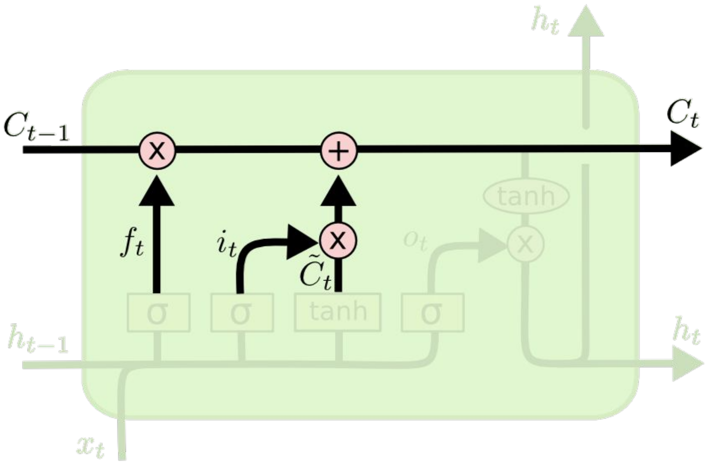
LSTM



$$i_t = \sigma\left(W_i \cdot [h_{t-1}, x_t] \ + \ b_i\right)$$

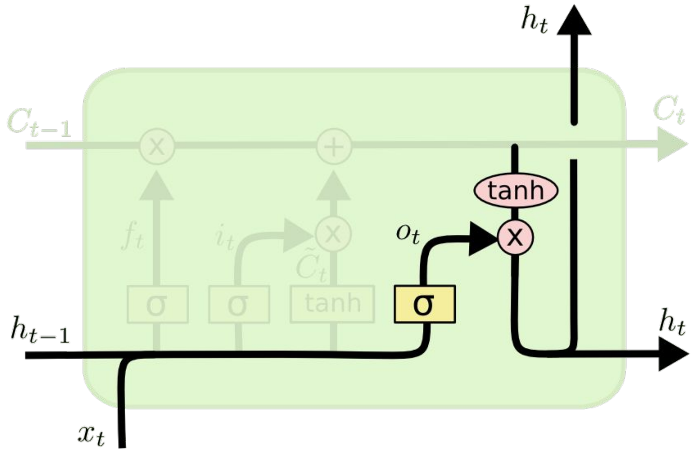
$$\tilde{C}_t = \tanh(W_C \cdot [h_{t-1}, x_t] \ + \ b_C)$$

LSTM



$$C_t = f_t * C_{t-1} + i_t * \tilde{C}_t$$

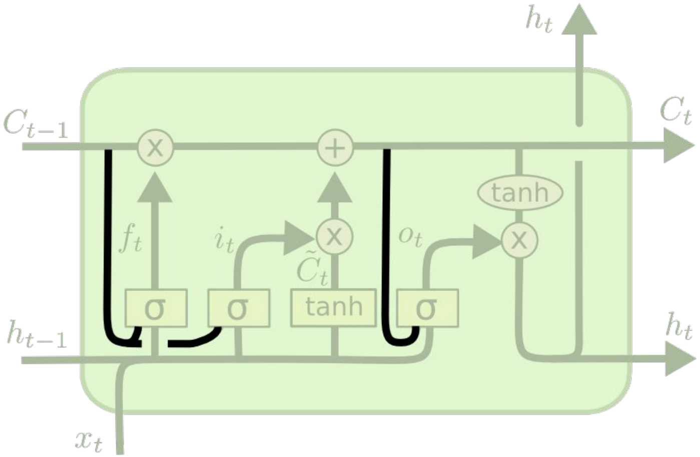
LSTM



$$o_t = \sigma \left(W_o \; [\, h_{t-1}, x_t] \; + \; b_o \right)$$

$$h_t = o_t * \tanh \left(C_t \right)$$

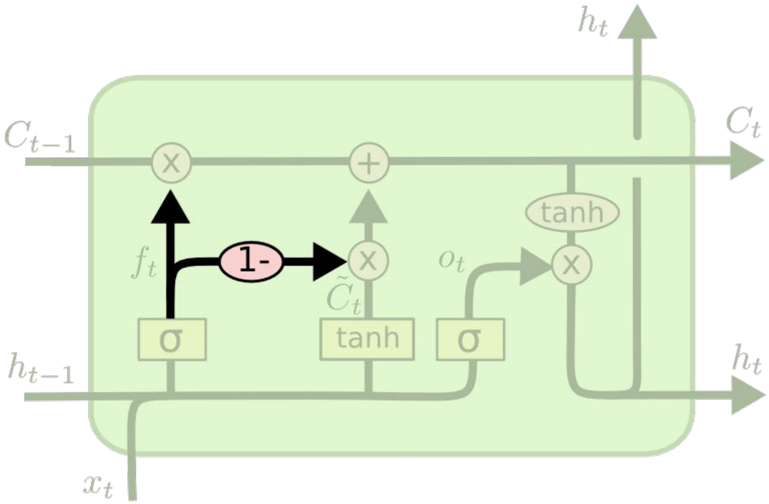
LSTM peep-hole connections



$$f_t = \sigma\left(W_f \cdot [\boldsymbol{C_{t-1}}, h_{t-1}, x_t] \ + \ b_f\right)$$
$$i_t = \sigma\left(W_i \cdot [\boldsymbol{C_{t-1}}, h_{t-1}, x_t] \ + \ b_i\right)$$
$$o_t = \sigma\left(W_o \cdot [\boldsymbol{C_t}, h_{t-1}, x_t] \ + \ b_o\right)$$

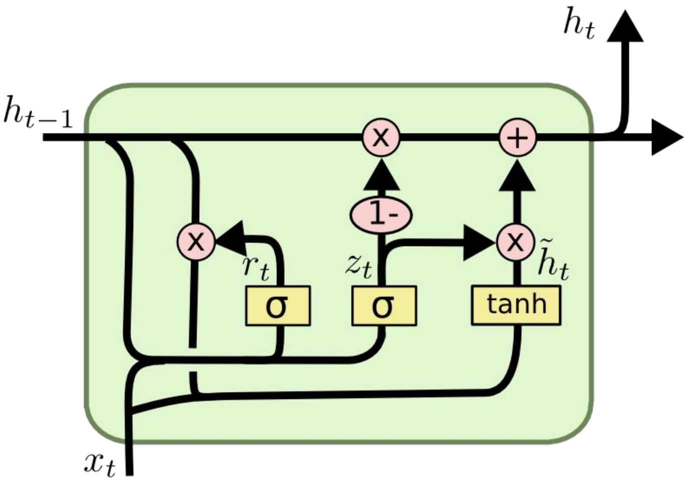
LSTM: A Search Space Odyssey
https://arxiv.org/pdf/1503.04069.pdf

LSTM peep-hole connections



$$C_t = f_t * C_{t-1} + (\mathbf{1 - f_t}) * \tilde{C}_t$$

GRU



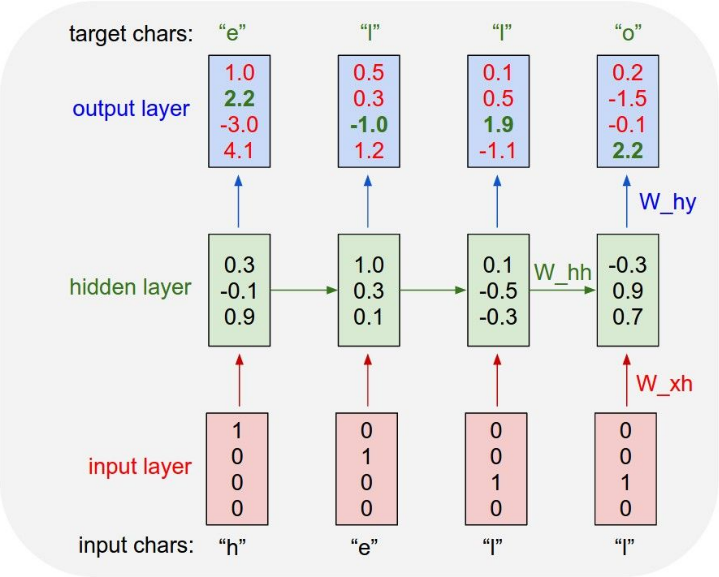
$$z_t = \sigma\left(W_z \cdot [h_{t-1}, x_t]\right)$$

$$r_t = \sigma\left(W_r \cdot [h_{t-1}, x_t]\right)$$

$$\tilde{h}_t = \tanh\left(W \cdot [r_t * h_{t-1}, x_t]\right)$$

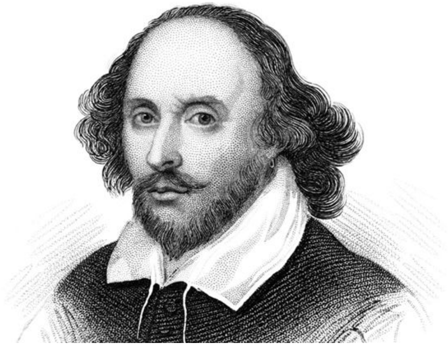
$$h_t = (1 - z_t) * h_{t-1} + z_t * \tilde{h}_t$$

Generative RNN



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

Generative RNN



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.

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.

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

Generative RNN

Naturalism and decision for the majority of Arab countries' capitalide was grounded by the Irish language by [[John Clair]], [[An Imperial Japanese Revolt]], associated with Guangzham's sovereignty. His generals were the powerful ruler of the Portugal in the [[Protestant Immineners]], which could be said to be directly in Cantonese Communication, which followed a ceremony and set inspired prison, training. The emperor travelled back to [[Antioch, Perth, October 25|21]] to note, the Kingdom of Costa Rica, unsuccessful fashioned the [[Thrales]], [[Cynth's Dajoard]], known in western [[Scotland]], near Italy to the conquest of India with the conflict.

(PJS)[http://www.humah.yahoo.com/guardian.cfm/7754800786d17551963s89.htm

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

Generative RNN

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

Generative RNN

For $\bigoplus_{n=1,\ldots,m}$ where $\mathcal{L}_{m_\bullet} = 0$, hence we can find a closed subset $\mathcal{H}$ in $\mathcal{H}$ and any sets $\mathcal{F}$ on X, U is a closed immersion of S, then $U \to T$ is a separated algebraic space.

Proof. Proof of (1). It also start we get

$$S = \mathrm{Spec}(R) = U \times_X U \times_X U$$

and the comparicoly in the fibre product covering we have to prove the lemma generated by $\coprod Z \times_U U \to V$. Consider the maps M along the set of points Sch_{fppf} and $U \to U$ is the fibre category of S in U in Section, **??** and the fact that any U affine, see Morphisms, Lemma **??**. Hence we obtain a scheme S and any open subset $W \subset U$ in $Sh(G)$ such that $\mathrm{Spec}(R') \to S$ is smooth or an

$$U = \bigcup U_i \times_{S_i} U_i$$

which has a nonzero morphism we may assume that f_i is of finite presentation over S. We claim that $\mathcal{O}_{X,x}$ is a scheme where $x, x', s'' \in S'$ such that $\mathcal{O}_{X,x'} \to \mathcal{O}'_{X',x'}$ is separated. By Algebra, Lemma **??** we can define a map of complexes $\mathrm{GL}_{S'}(x'/S'')$ and we win. □

To prove study we see that $\mathcal{F}|_U$ is a covering of $\mathcal{X}'$, and $\mathcal{T}_i$ is an object of $\mathcal{F}_{X/S}$ for $i > 0$ and $\mathcal{F}_p$ exists and let $\mathcal{F}_i$ be a presheaf of $\mathcal{O}_X$-modules on $\mathcal{C}$ as a $\mathcal{F}$-module. In particular $\mathcal{F} = U/\mathcal{F}$ we have to show that

$$\widetilde{M}^\bullet = \mathcal{I}^\bullet \otimes_{\mathrm{Spec}(k)} \mathcal{O}_{S,s} - i_X^{-1}\mathcal{F})$$

is a unique morphism of algebraic stacks. Note that

$$\mathrm{Arrows} = (Sch/S)^{opp}_{fppf}, (Sch/S)_{fppf}$$

and

$$V = \Gamma(S, \mathcal{O}) \longmapsto (U, \mathrm{Spec}(A))$$

is an open subset of X. Thus U is affine. This is a continuous map of X is the inverse, the groupoid scheme S.

Proof. See discussion of sheaves of sets. □

The result for prove any open covering follows from the less of Example **??**. It may replace S by $X_{spaces,\acute{e}tale}$ which gives an open subspace of X and T equal to S_{Zar}, see Descent, Lemma **??**. Namely, by Lemma **??** we see that R is geometrically regular over S.

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 $Y = \mathrm{Spec}(R)$.*

Proof. This is form all sheaves of sheaves on X. But given a scheme U and a surjective étale morphism $U \to X$. Let $U \cap U = \coprod_{i=1,\ldots,n} U_i$ be the scheme X over S at the schemes $X_i \to X$ and $U = \lim_i X_i$. □

The following lemma surjective restrocomposes of this implies that $\mathcal{F}_{x_0} = \mathcal{F}_{x_0} = \mathcal{F}_{\mathcal{X},\ldots,0}$.

Lemma 0.2. *Let X be a locally Noetherian scheme over S, $E = \mathcal{F}_{X/S}$. Set $\mathcal{I} = \mathcal{J}_1 \subset \mathcal{I}'_n$. Since $\mathcal{I}^n \subset \mathcal{I}^n$ are nonzero over $i_0 \leq \mathfrak{p}$ is a subset of $\mathcal{J}_{n,0} \circ \overline{A}_2$ works.*

Lemma 0.3. *In Situation* **??**. *Hence we may assume $\mathfrak{q}' = 0$.*

Proof. We will use the property we see that $\mathfrak{p}$ is the mext functor (**??**). On the other hand, by Lemma **??** we see that

$$D(\mathcal{O}_{X'}) = \mathcal{O}_X(D)$$

where K is an F-algebra where δ_{n+1} is a scheme over S. □

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

Generative RNN

```
/*
 * Increment the size file of the new incorrect UI_FILTER group information
 * of the size generatively.
 */
static int indicate_policy(void)
{
  int error;
  if (fd == MARN_EPT) {
    /*
     * The kernel blank will coeld it to userspace.
     */
    if (ss->segment < mem_total)
      unblock_graph_and_set_blocked();
    else
      ret = 1;
    goto bail;
  }
```

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