Interactive Technologies Institute
LARSyS

arditi — agência regional para o desenvolvimento da investigação tecnologia e inovação

UNIVERSIDADE da MADEIRA

MADEIRA INTERNATIONAL WORKSHOP IN MACHINE LEARNING

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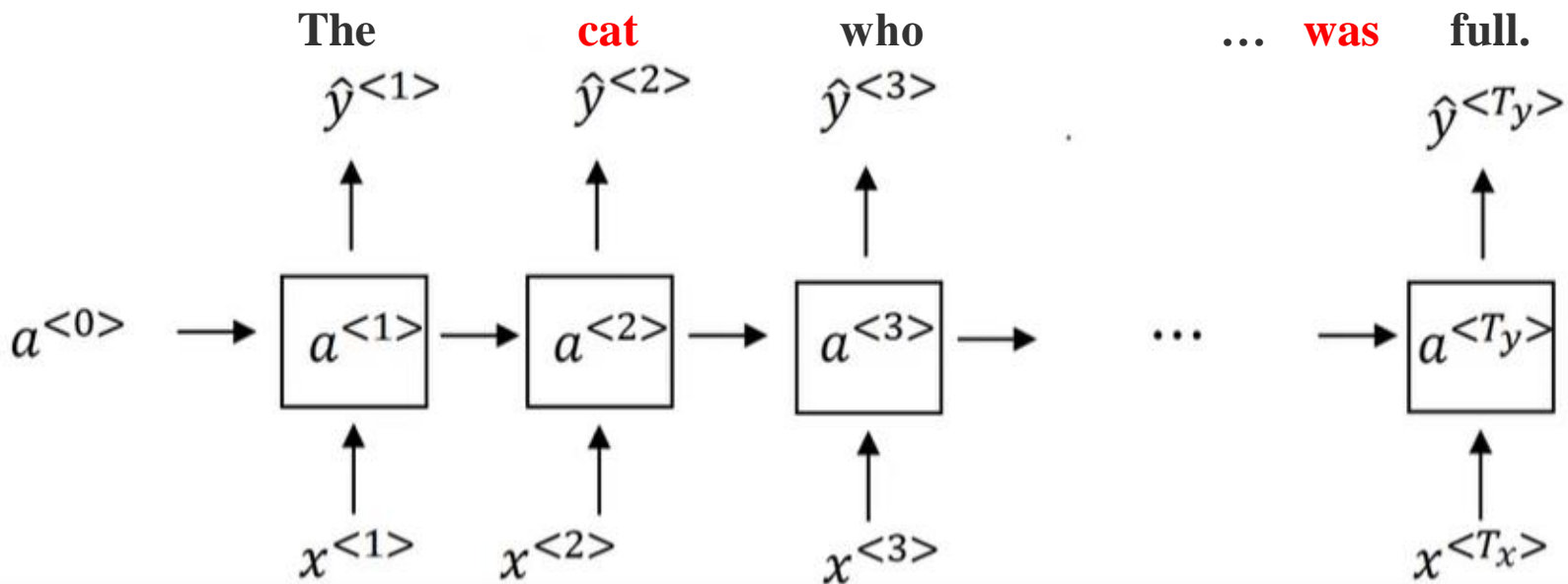
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MEO

2022

CONTENTS

- Problems with RNN Recap

- Gated Recurrent Unit

- Difference between LSTMs and GRUs

- GRUs in Practice

PROBLEMS WITH RNN

- Unable to learn **long term dependencies.**

- **E.g. The cat who already ate a bunch of food, was full.**

The   **cat**   **who**   **… was**   **full.**

$\hat{y}^{<1>}$ $\hat{y}^{<2>}$ $\hat{y}^{<3>}$ $\hat{y}^{<T_y>}$

$a^{<0>} \rightarrow$ $a^{<1>} \rightarrow$ $a^{<2>} \rightarrow$ $a^{<3>} \rightarrow$ $\cdots \rightarrow$ $a^{<T_y>}$

$x^{<1>}$ $x^{<2>}$ $x^{<3>}$ $x^{<T_x>}$

3

PROBLEMS WITH RNN

- **Vanishing gradient problem.**

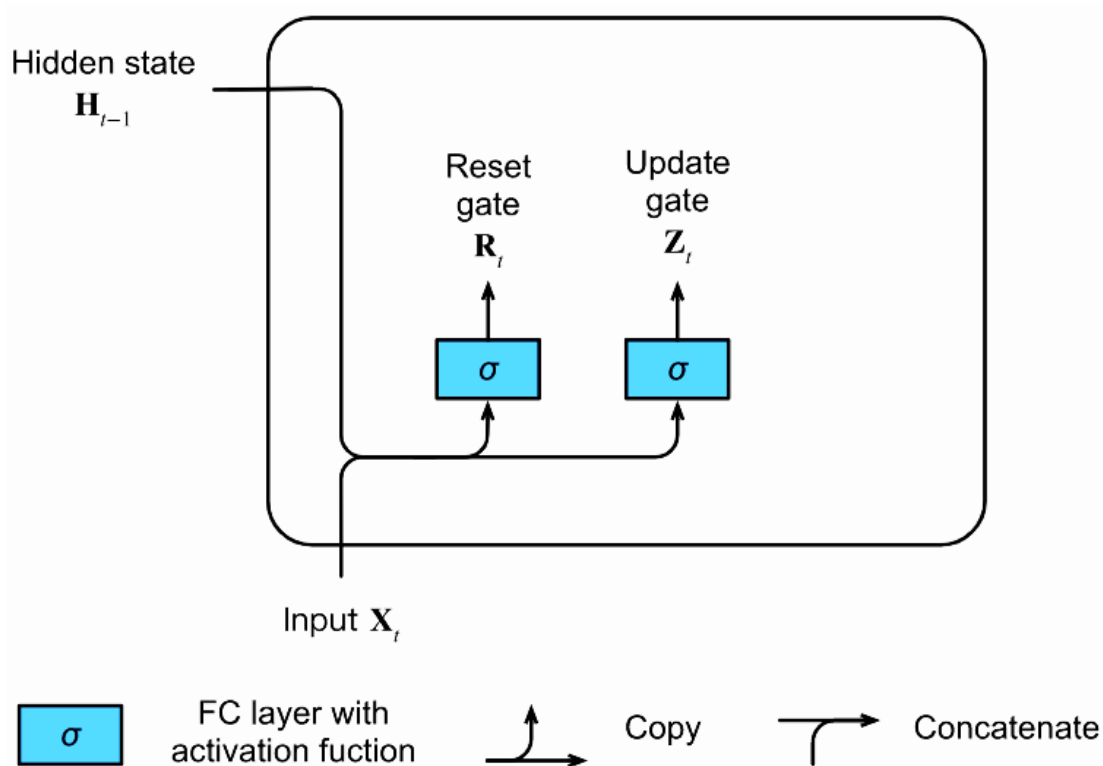Loss(pred, ground truth)

GATED RECURRENT UNIT (GRU)
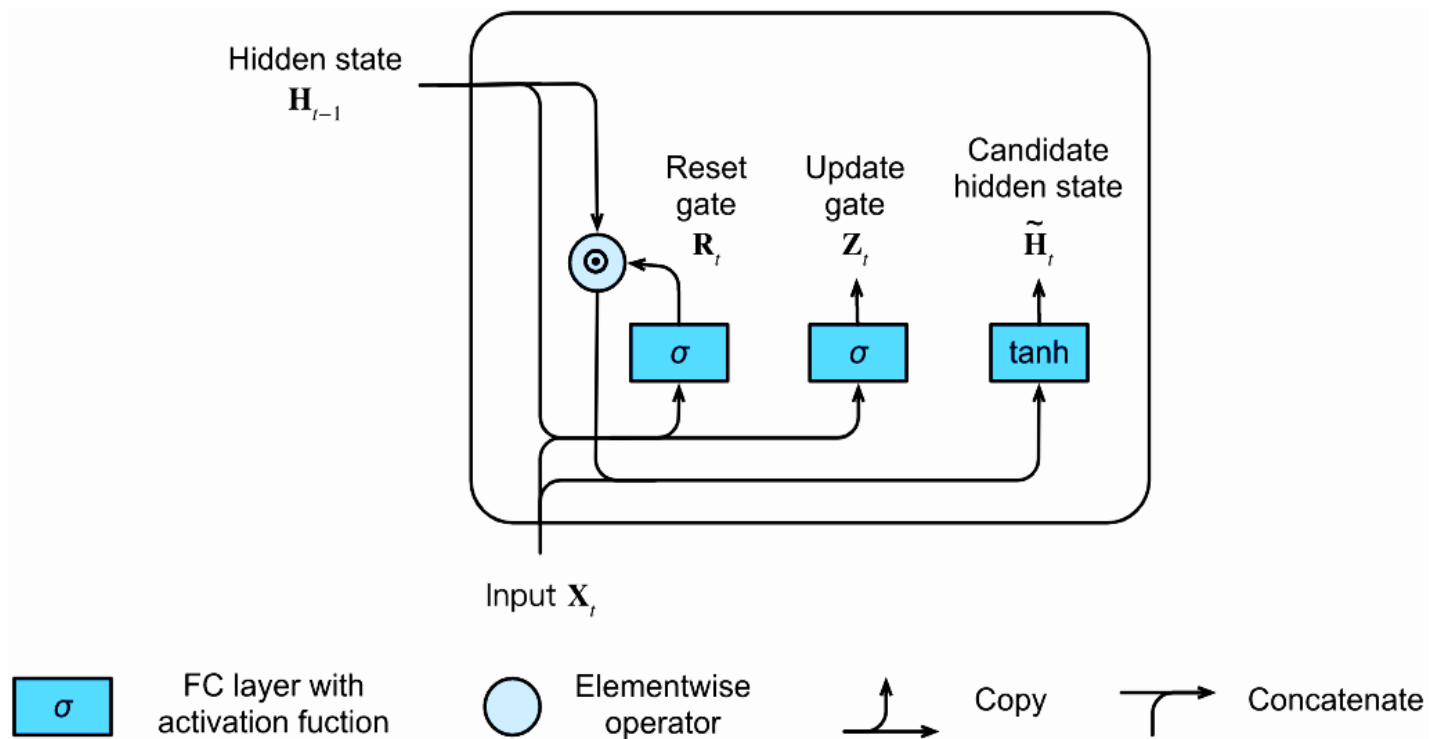
- Three main components:
  - Hidden state-responsible for preserving long term dependencies.
  - Update Gate-For deciding when to update the memory cell.
  - Reset Gate-relevancy of the previous memory cell (state=current hiddens state).
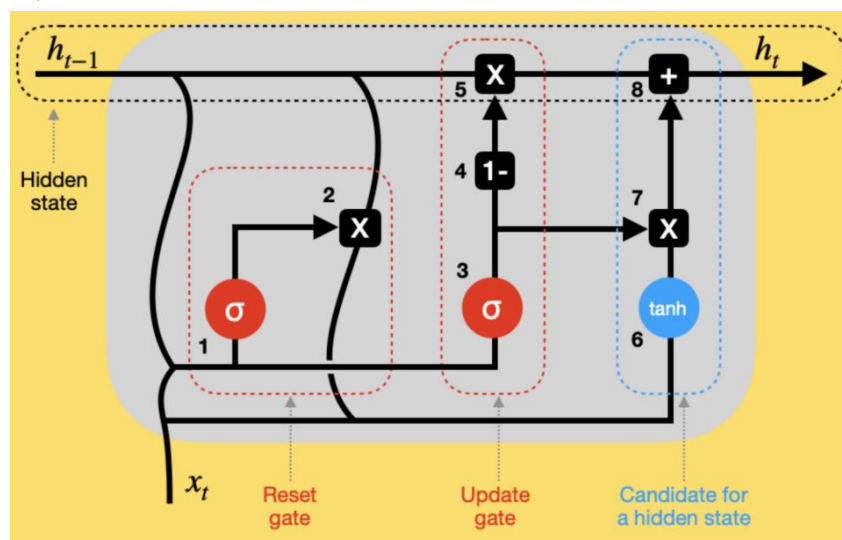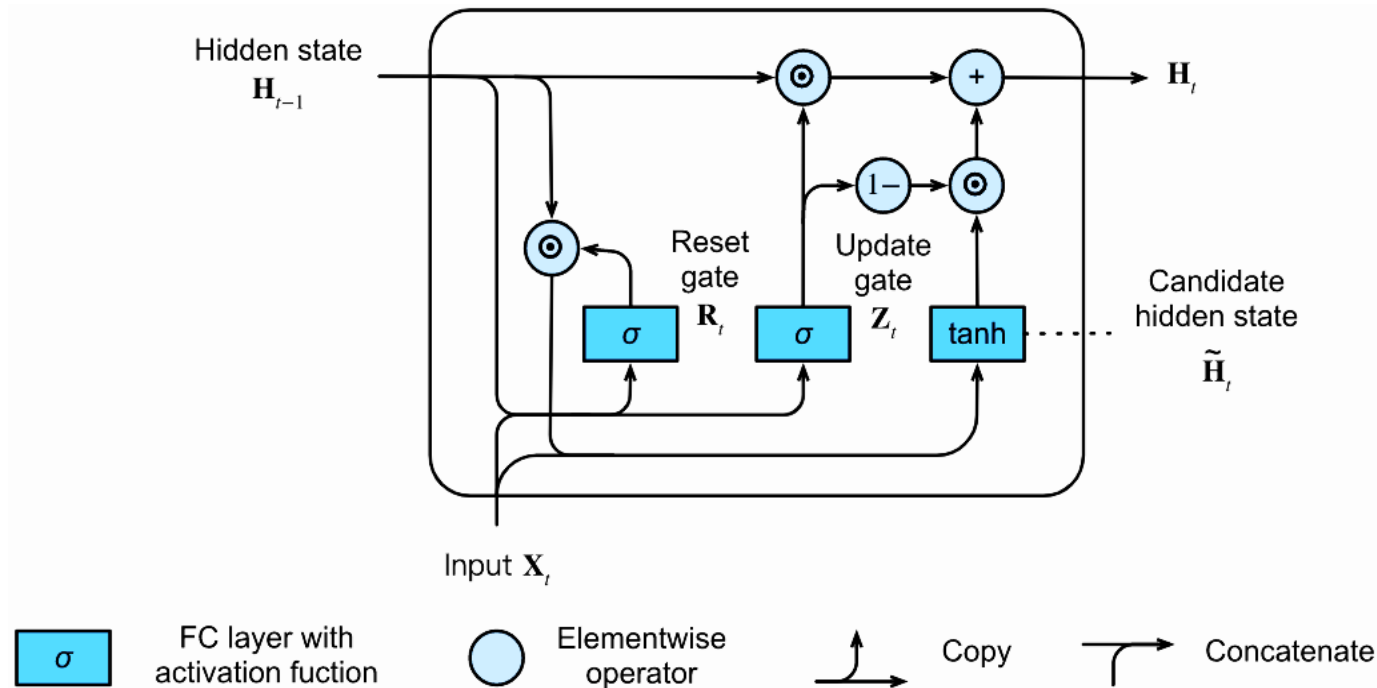
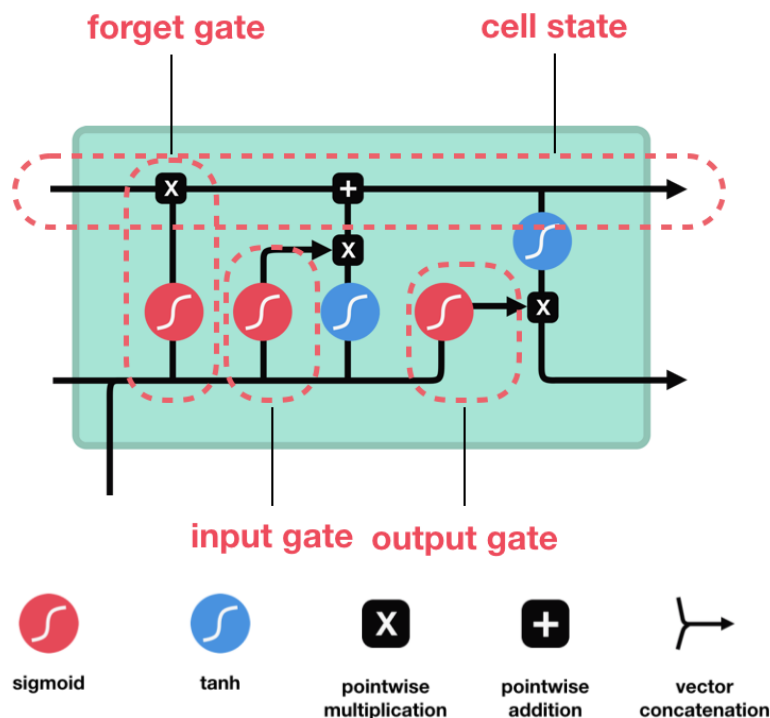# GRU (UPDATE AND RESET GATES)

GRU (CANDIDATE HIDDEN STATE)

GRU (FULL WORKFLOW)

$$current\ hidden\ state = \begin{cases} candidate\ hidden\ state, & if\ update\ gate = 1 \\ previous\ hidden\ state, & if\ update\ gate = 0 \end{cases}$$
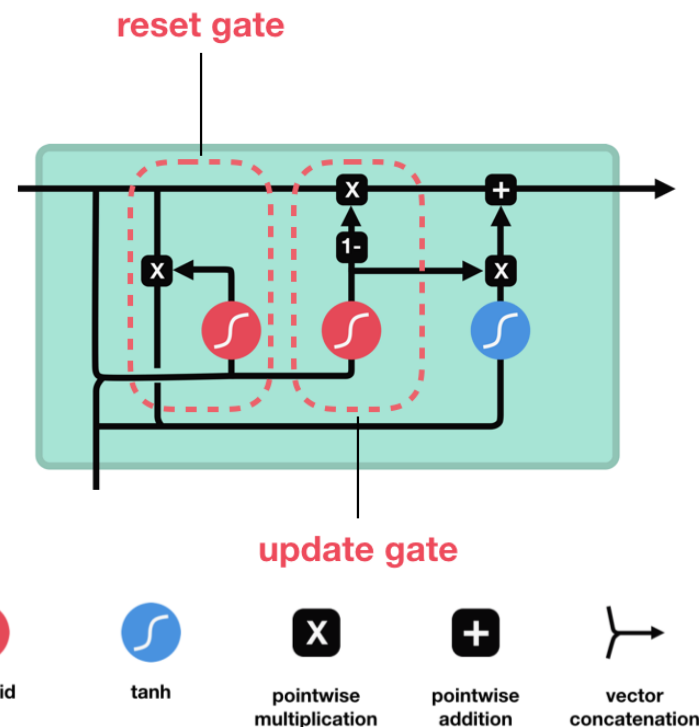
GRU AND LSTM COMPARISON

LSTM

Three gates: input, forget, and output

GRU

Two gates: update and reset

GATE ANALOGIES (GRU, LSTMS)

LSTM

- Input Gate

- Forget Gate

- Output Gate

GRU

- Input Gate (hidden state=cell state)

- Forget Gate (1-update gate)

- Output gate (Not required)
(Cell state=current hidden state)

GATED RECURRENT UNIT IN PRACTICE

Thank You