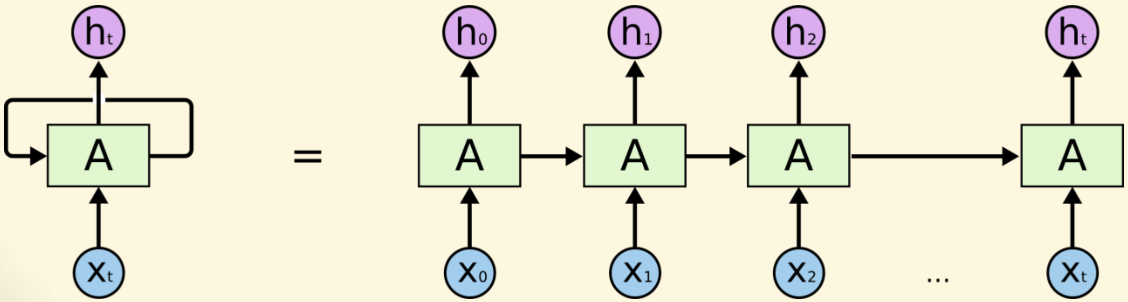
CentraleSupélec

OPENCLASSROOMS

Parcours Data Scientist

Projet 8 :
Veille Technologique
Recurrent Neural Networks



31/01/2018

MINE Nicolas

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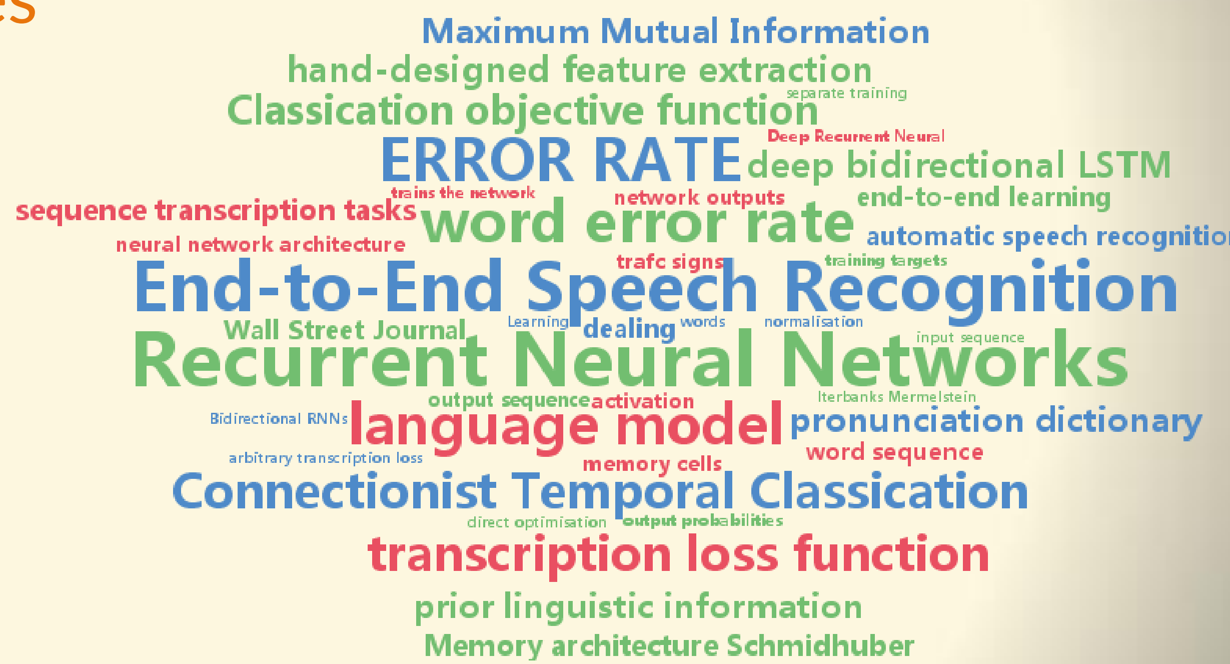
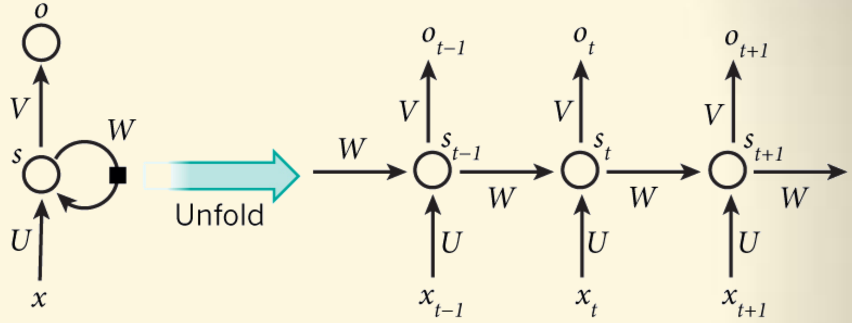
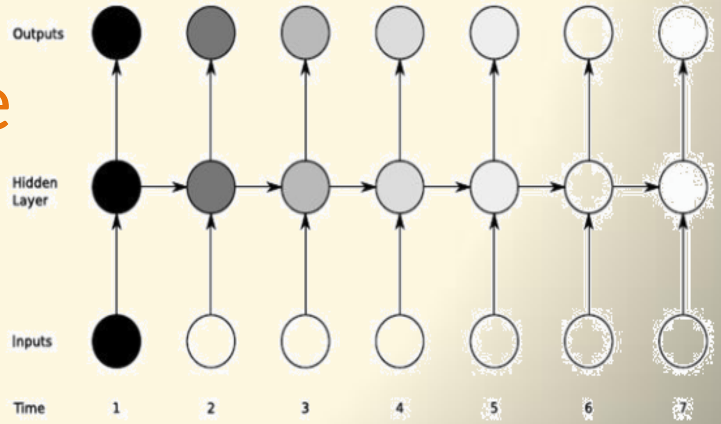


Principe du RNN

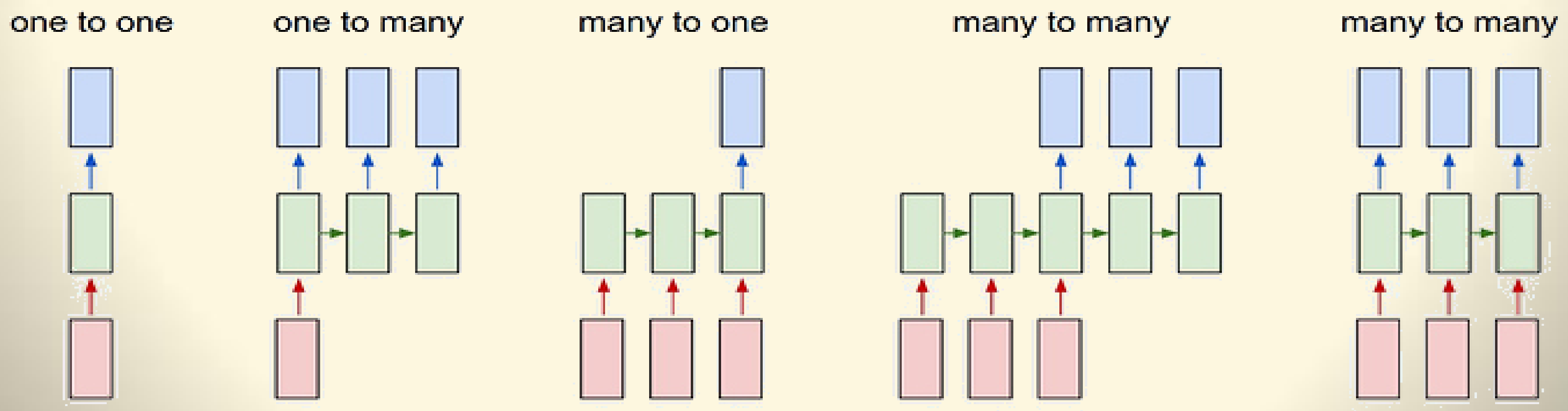
- Prédictions sur des données temporelles
  - Sorties récurrentes
- Utilisation multiples
  - Retards
  - analyse de texte
  - Traduction
  - …
- Back propagation différente
  - BP dans le temps et l'espace
- Problème
  - Vanishing Gradient





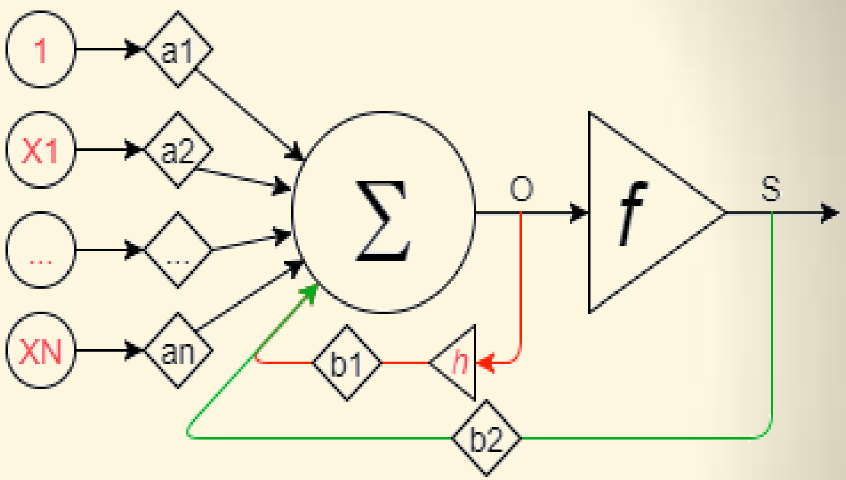
Principe du RNN

- Utilisation
  - 1-to-1 : Classification simple
  - 1-to-N : Générateur
  - N-to-1 : Classification « complexe »
  - N-to-N : Traduction / multi Classification



Etat de l'art

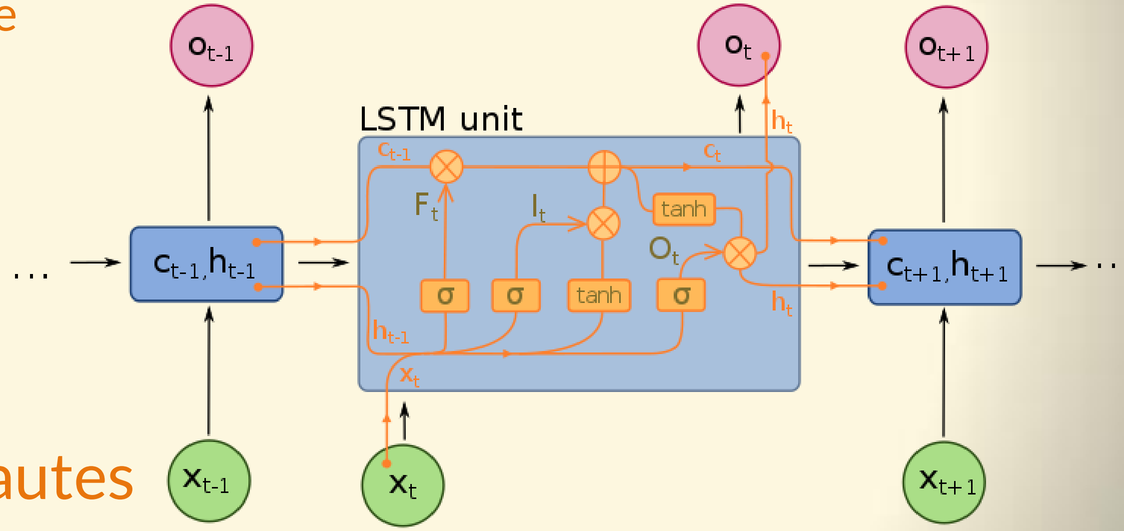
- Simple RNN
  - 1970's
  - Pb Vanishing Gradient
  - Rapide (calcul simple)
  - Peu utilisé



- $S(t) = f\left(\sum_{inputs} a_i * x_i(t) + h\left(\sum_{inputs} a_i * x_i(t-1)\right)\right)$
- $S(t) = f\left(\sum_{inputs} a_i * x_i + b2 * (S(t-1))\right)$

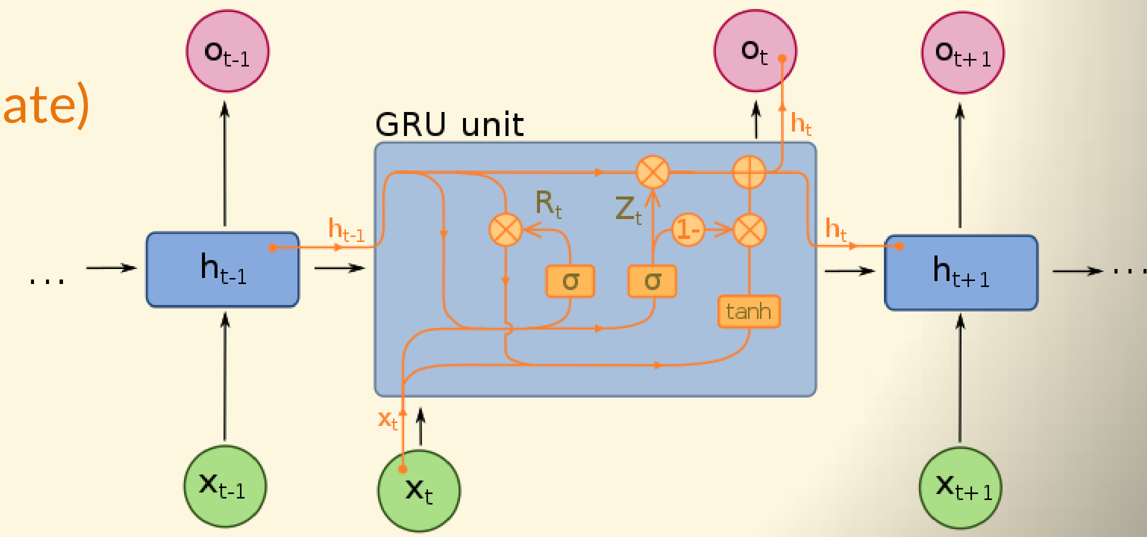
Etat de l'art

- LSTM 1997
  - 2 portes + 2 Etats
    - Hidden & Cell State
    - Input & Output Gate
- LSTM 2000
  - 3ème porte
    - Forget Gate
- Performances très hautes
- Gourmant en calcul
- Nombreuses variations



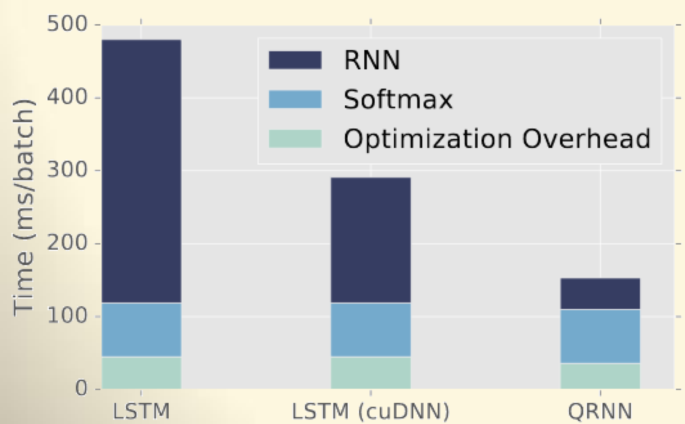
Etat de l'art

- GRU
  - 2014
  - Plus rapide que LSTM
  - Même performances
  - Basé sur LSTM
    - 1 état (Hidden State)
    - 2 portes
      - Update Gate
      - Reset Gate



Etat de l'art

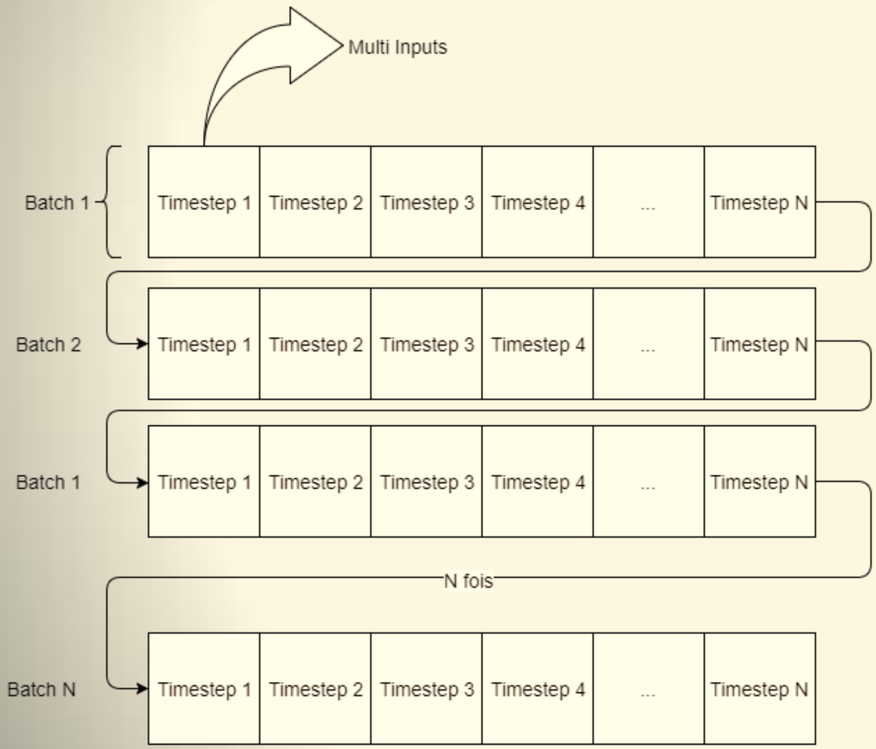
- QRNN
  - 2016/2017 (https://arxiv.org/abs/1611.01576)
  - Nouvelle architecture (Parallélisme des calculs)
  - Plus rapide que LSTM/GRU
  - Performances encore basses



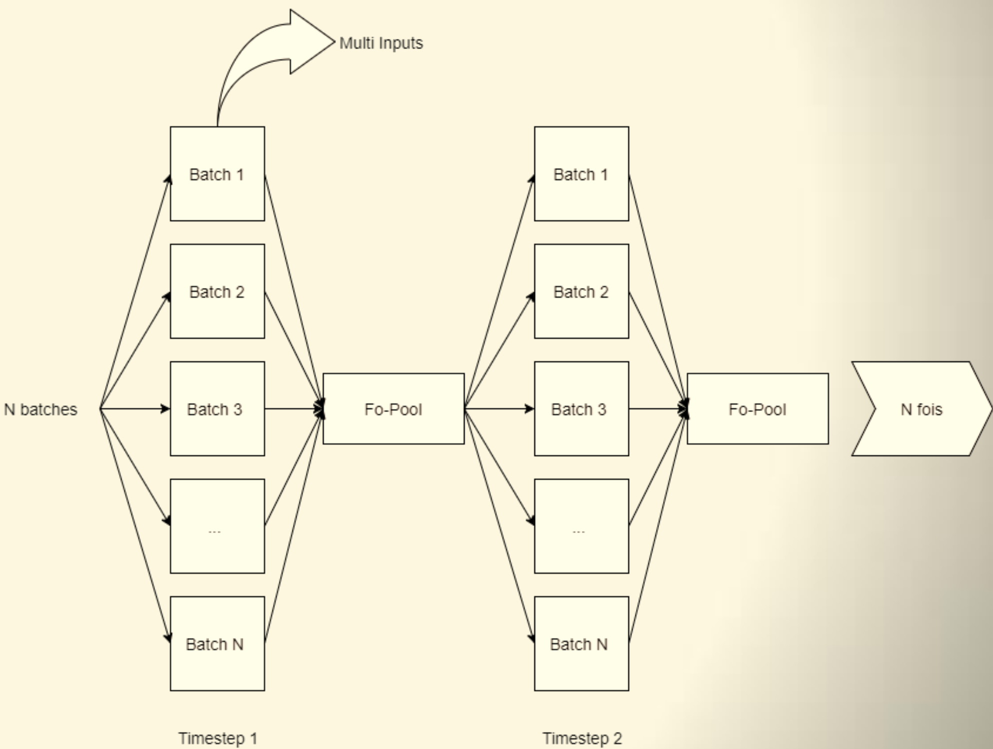
		Sequence length				
		32	64	128	256	512
Batch size	8	**5.5x**	**8.8x**	**11.0x**	**12.4x**	**16.9x**
	16	**5.5x**	**6.7x**	**7.8x**	**8.3x**	**10.8x**
	32	**4.2x**	**4.5x**	**4.9x**	**4.9x**	**6.4x**
	64	**3.0x**	**3.0x**	**3.0x**	**3.0x**	**3.7x**
	128	**2.1x**	**1.9x**	**2.0x**	**2.0x**	**2.4x**
	256	**1.4x**	**1.4x**	**1.3x**	**1.3x**	**1.3x**

Etat de l'art

- QRNN



SRNN/LSTM/GRU



QRNN

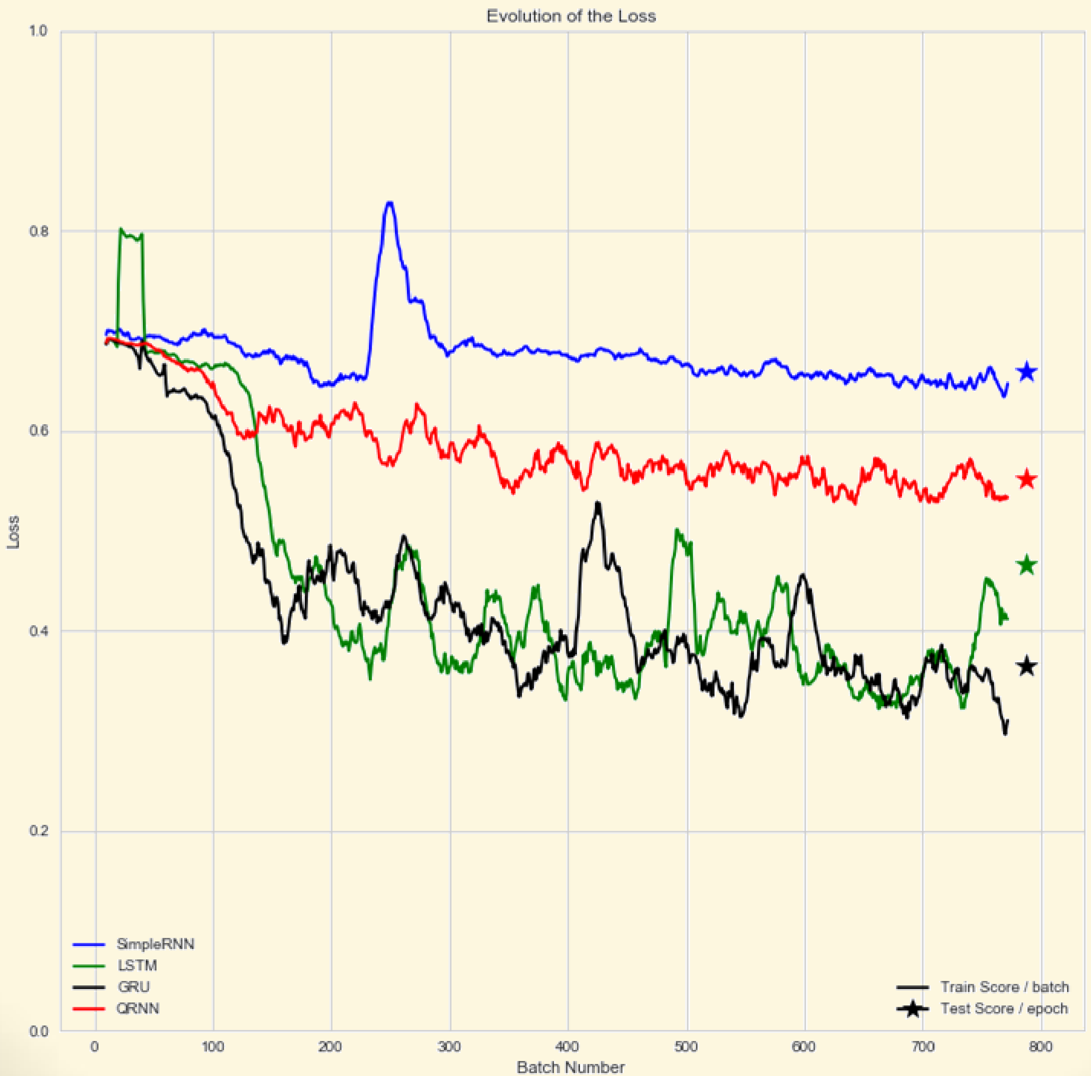
Evaluation

- Dataset : Large Movie Review Dataset
- Type : Analyse de Sentiments
- Contenu : 25k commentaires train + 25k test
  - (50 % positifs et Négatifs)
  - Longueur de la séquence à choisir
  - Dataset préparé
- Evaluation à topologie identique
  - 1 Embedding Layer (1 -> 128 dimensions)
  - 1 Cellule SRNN/LSTM/GRU/QRNN
  - 1 Layer FC + Sigmoïde
  - Optimiser : Adam
  - Metriques : Accuracy, Loss, Temps
  - 1 Epoch (Overfitting)

Evaluation

Evolution of the Loss
1.0
0.8
0.6
0.4
0.2
0.0
Loss
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0
Epochs
SimpleRNN
LSTM
GRU
QRNN
Train Set
Test Set

Evaluation



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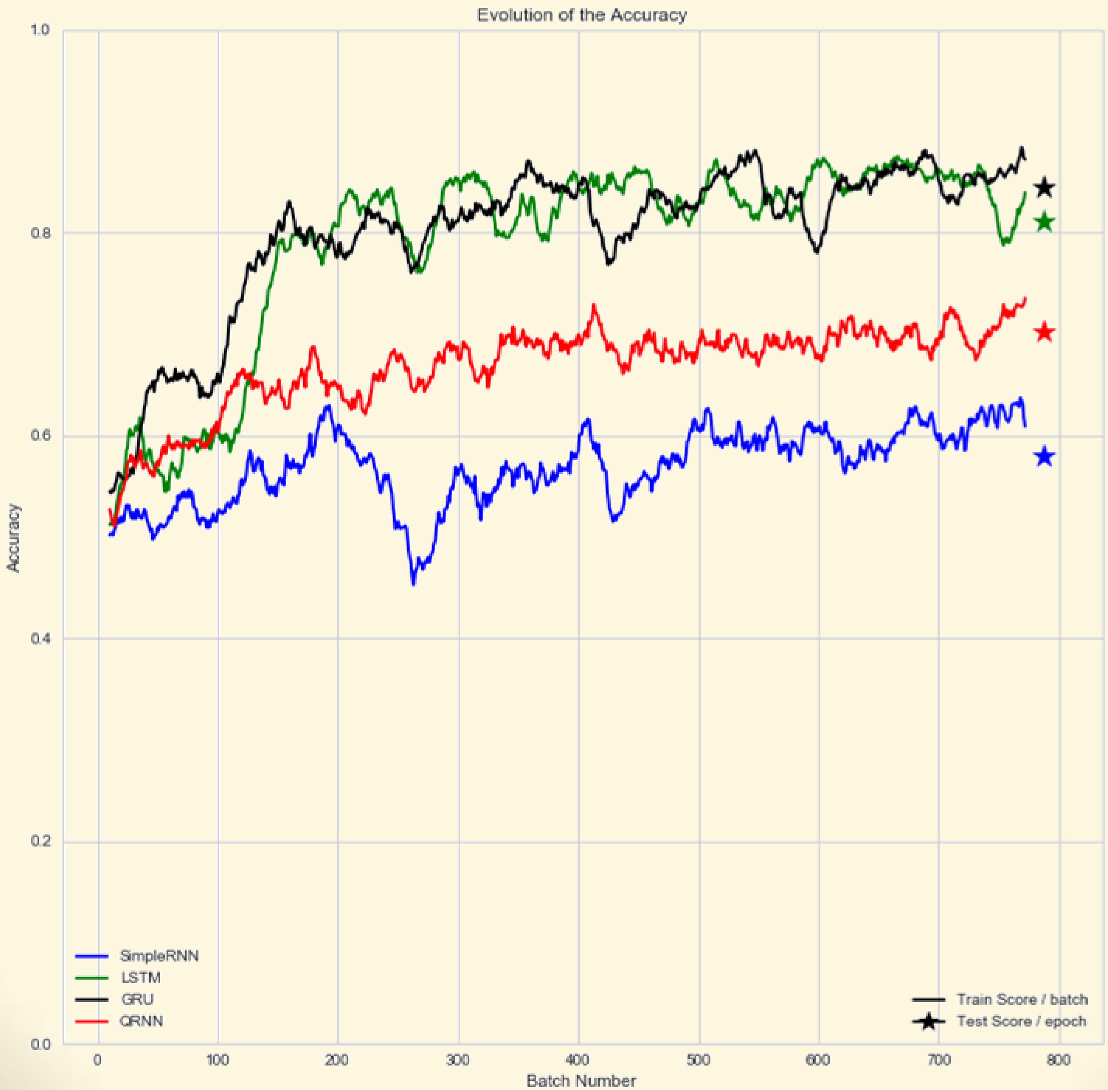
Evaluation

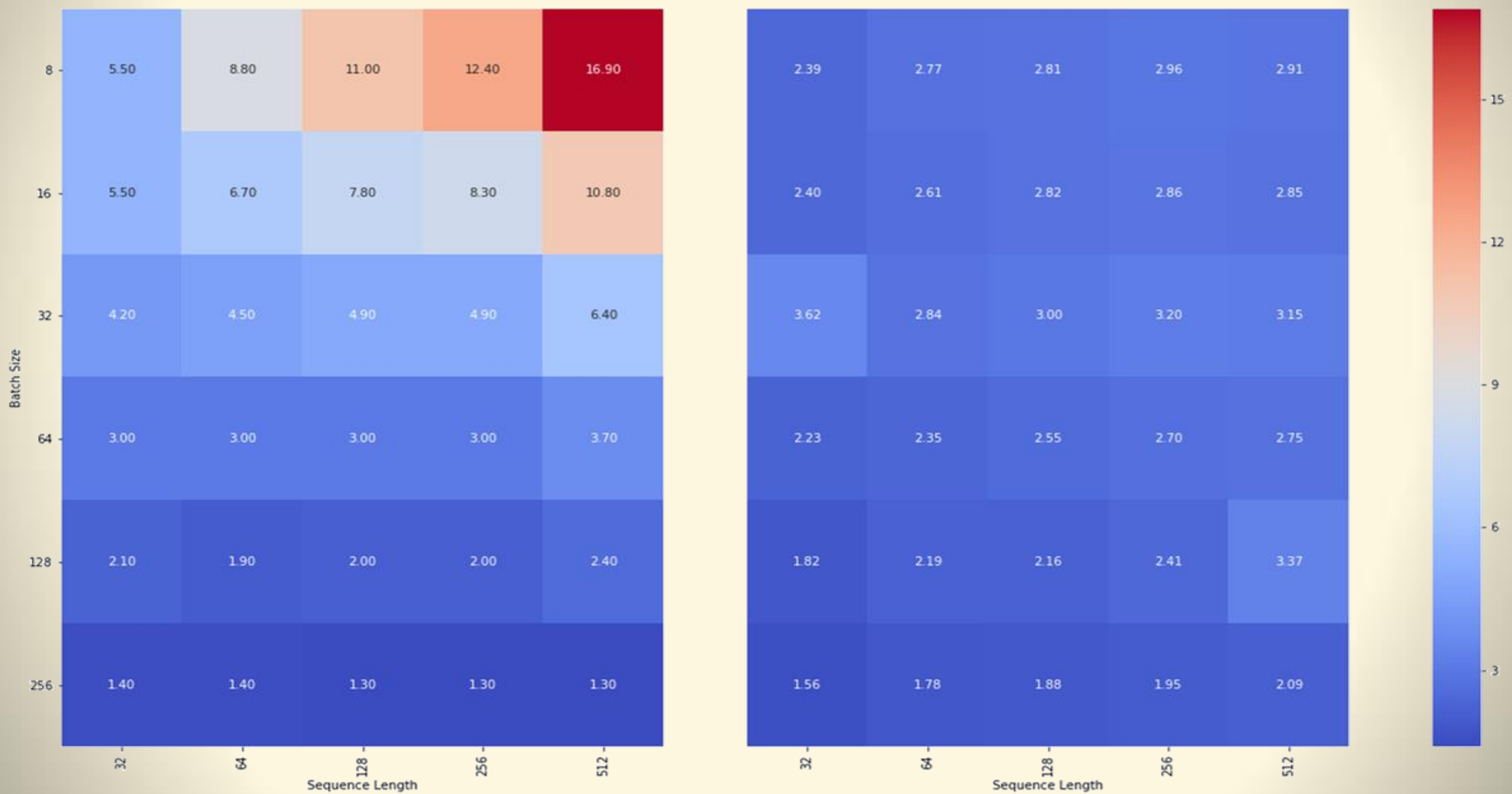


Evolution of the Accuracy
1.0
0.8
0.6
0.4
0.2
0.0
Accuracy
0
100
200
300
400
500
600
700
800
Batch Number
SimpleRNN
LSTM
GRU
QRNN
Train Score / batch
Test Score / epoch

Evaluation

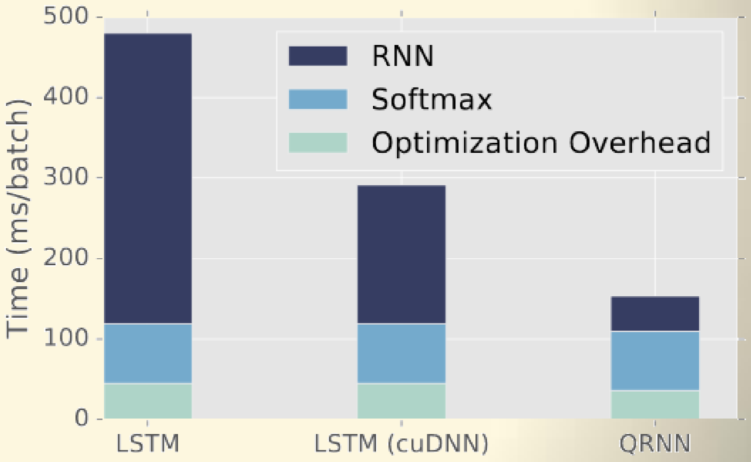
Evolution of the Accuracy
1.0
0.8
0.6
0.4
0.2
0.0
Accuracy
0
50
100
150
200
Time(s)
SimpleRNN
LSTM
GRU
QRNN
Train Score / batch
Test Score / epoch

Evaluation


Batch Size
Sequence Length
8 16 32 64 128 256
32 64 128 256 512
5.50 8.80 11.00 12.40 16.90
5.50 6.70 7.80 8.30 10.80
4.20 4.50 4.90 4.90 6.40
3.00 3.00 3.00 3.00 3.70
2.10 1.90 2.00 2.00 2.40
1.40 1.40 1.30 1.30 1.30
2.39 2.77 2.81 2.96 2.91
2.40 2.61 2.82 2.86 2.85
3.62 2.84 3.00 3.20 3.15
2.23 2.35 2.55 2.70 2.75
1.82 2.19 2.16 2.41 3.37
1.56 1.78 1.88 1.95 2.09
15 12 9 6 3

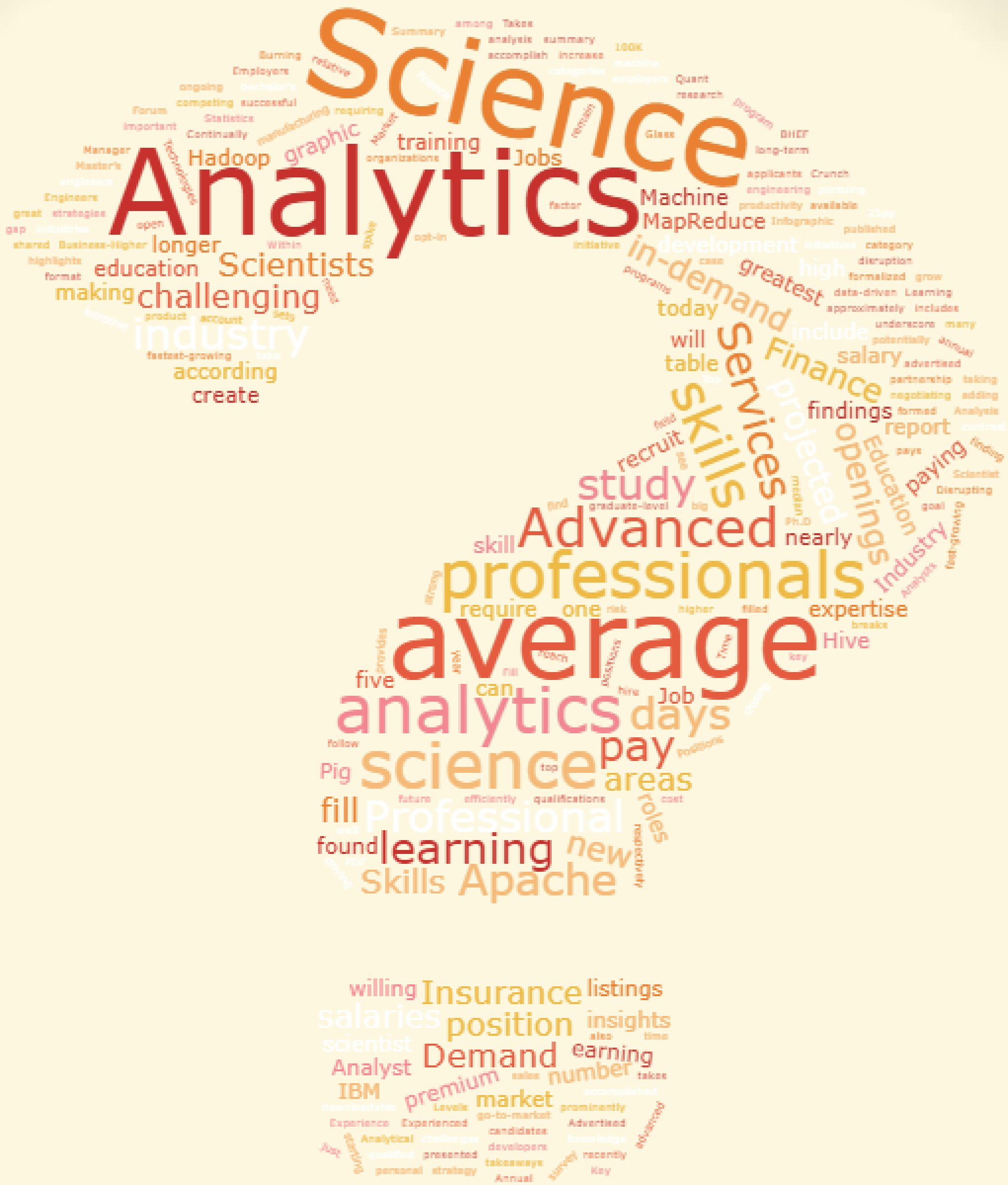
Evaluation

- Pas les Performances souhaitées
  - Possibilité d'optimisations importantes
    - Régularisations
    - Stride/Kernel
    - Dropout (1D)
    - Gradient Clipping
  - Modèles récent
    - Evolutions possible (LSTM)
- Pas le gain de temps évalué
  - Différents critères
  - Différents GPU ?
  - Modèle non optimisé (Github) ?



Conclusion

- Forte évolutions en 50 ans
- Champ d'application très large
- Très démocratisé (traduction, Analyse de sentiments, classification)
- 30 ans de flottements
- Encore limite (musique : GANs)
- LSTM très majoritaire
- QRNN encore un peu jeune mais prometteur
- Le synthetic gradient : novateur contre VG/EG ?


Science
Analytics
Hadoop
graphic
training
Jobs
Machine
MapReduce
longer
education
Scientists
making
challenging
industry
according
create
development
in-demand
greatest
high
today
include
will
Services
Finance
salary
table
skills
projected
findings
openings
report
Education
paying
recruit
study
Advanced
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Hive
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Analyst
Demand
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premium
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market