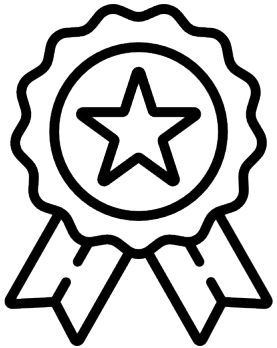
# Exploring Stack Augmented Neural Networks for Transduction

Sarah Davis, Delaney Lothian, Henry Tang
University of Alberta




CMPUT 651 - Deep Learning for Natural Language Processing

# Motivation & Background



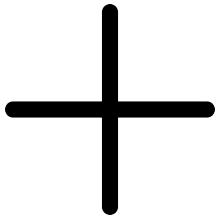
Recognition

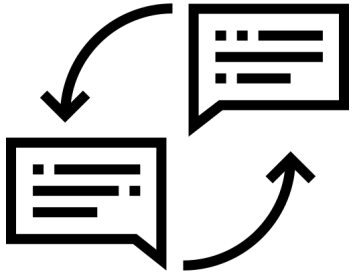
Hello, how are you?



Hello, how is you?







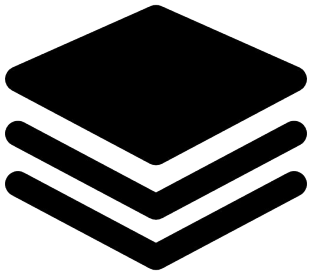
Translation

Bonjour, comment vas-tu?



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# Methodology



Stack

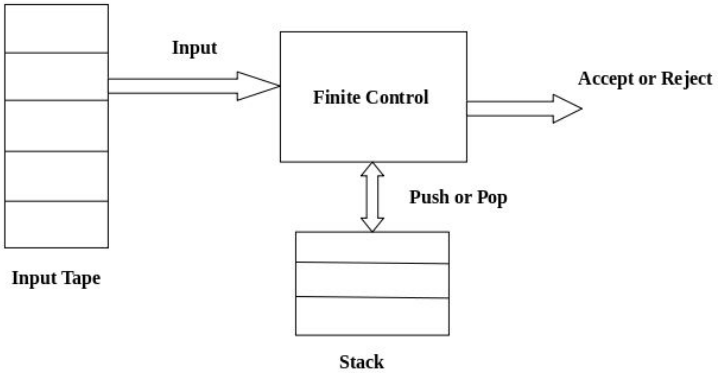
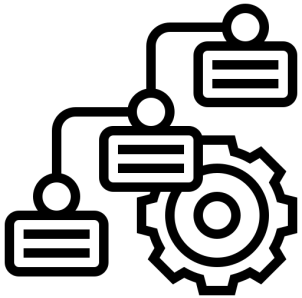
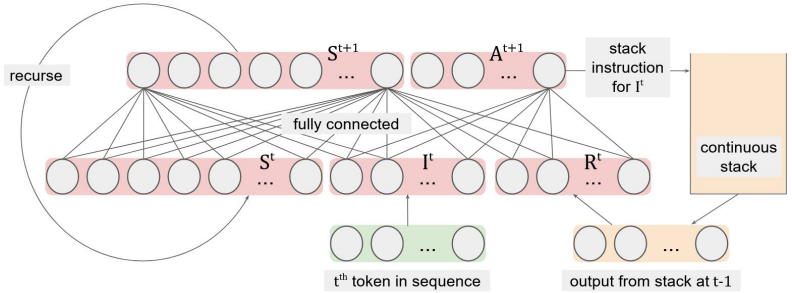
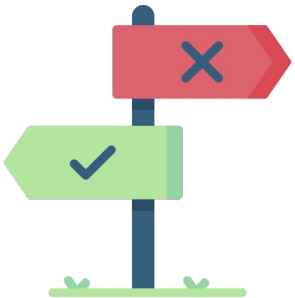



Fig: Pushdown Automata



Seq2Seq



Classifier

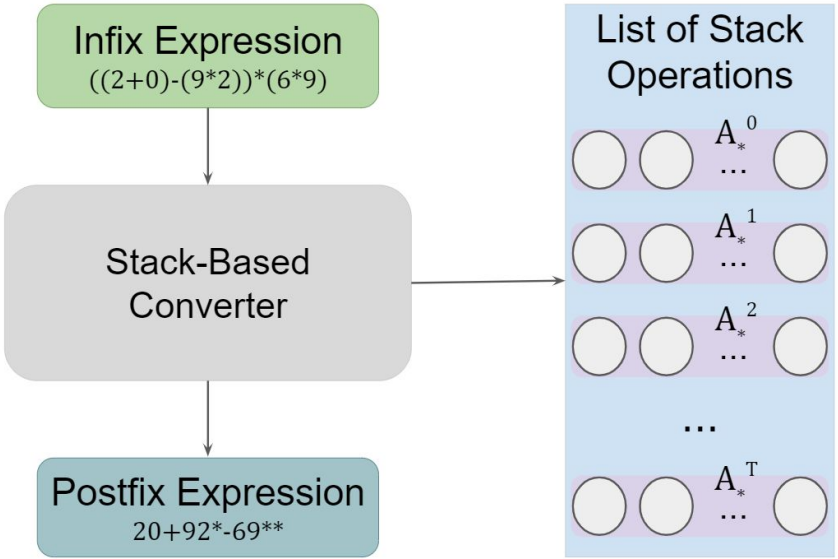
Icons made by Freepik, Eucalyp from www.flaticon.com. Creative Commons BY 3.0
https://static.javatpoint.com/tutorial/automata/images/pushdown-automata.png

# Datasets

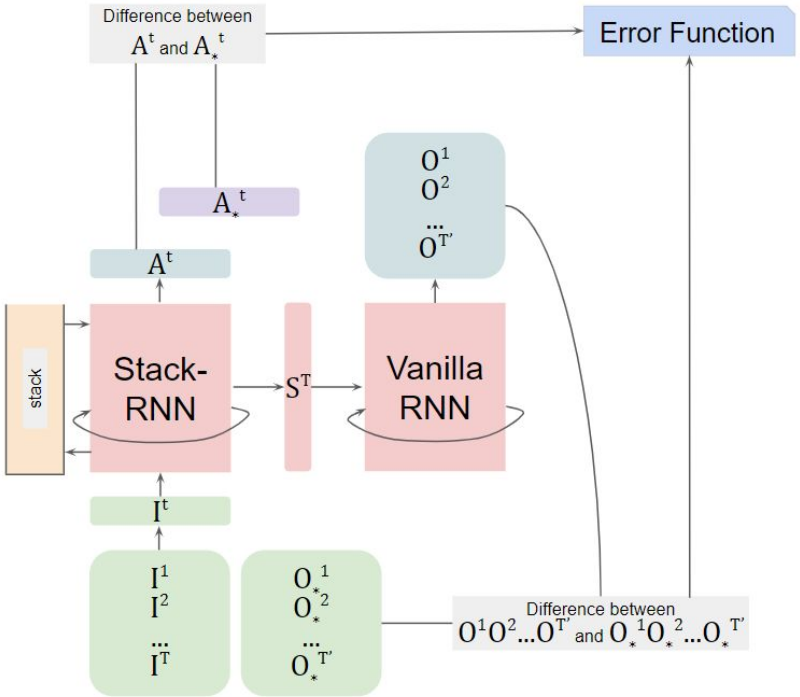
- Created nine datasets
- 5-10, 10-15, 15-20, …, 45-50

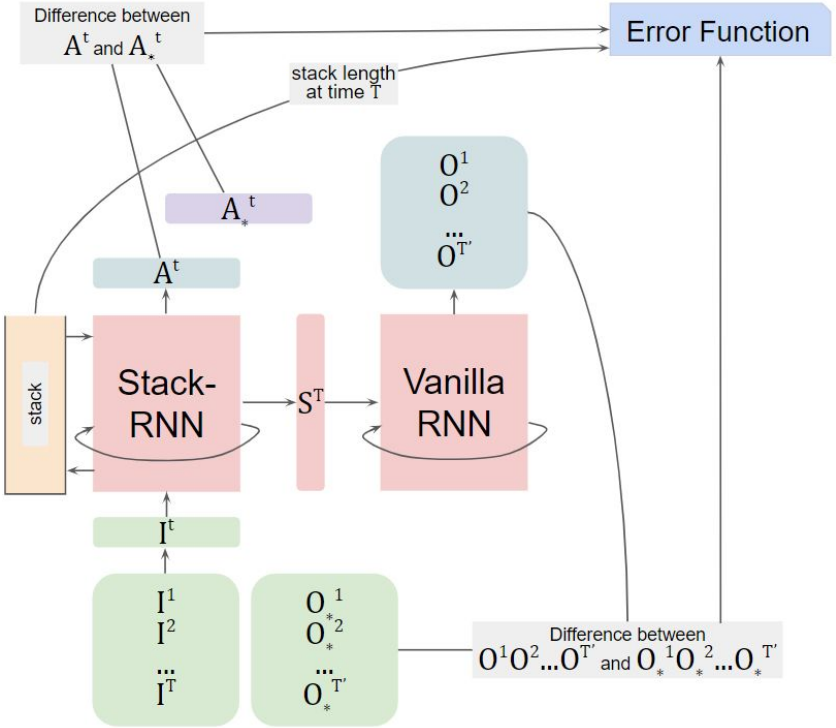
Infix: ((3-0)/8)
Postfix: 30-8/

Infix: (3+((4/(2-5))+(5/((1*8)/(6+(0+6))))))
Postfix: 3425-/518*606++//++

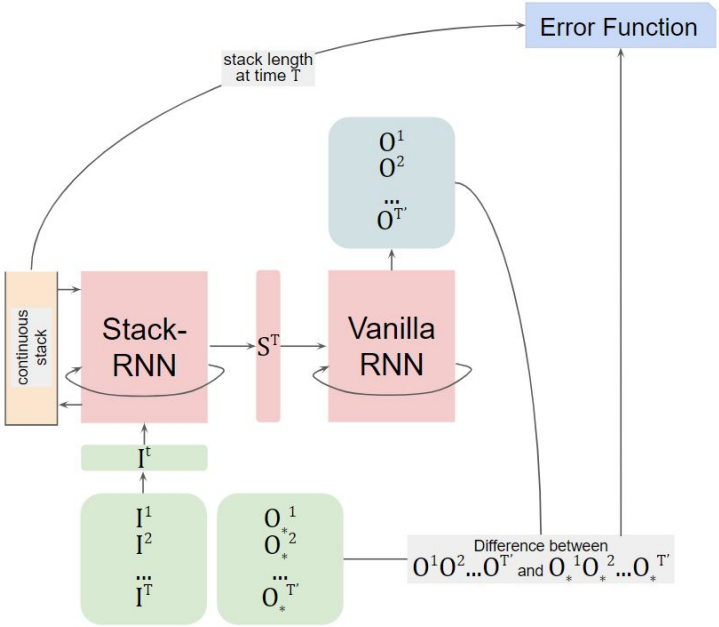


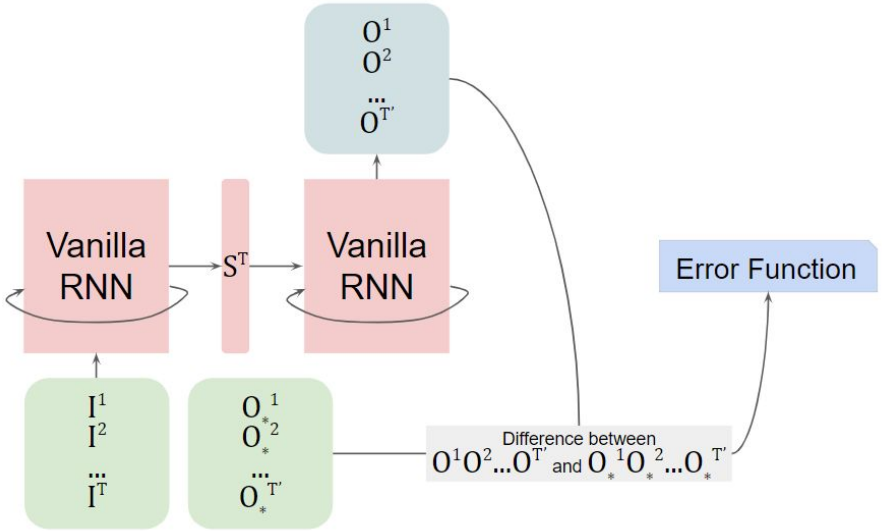
# Supervised Learning Starting Point



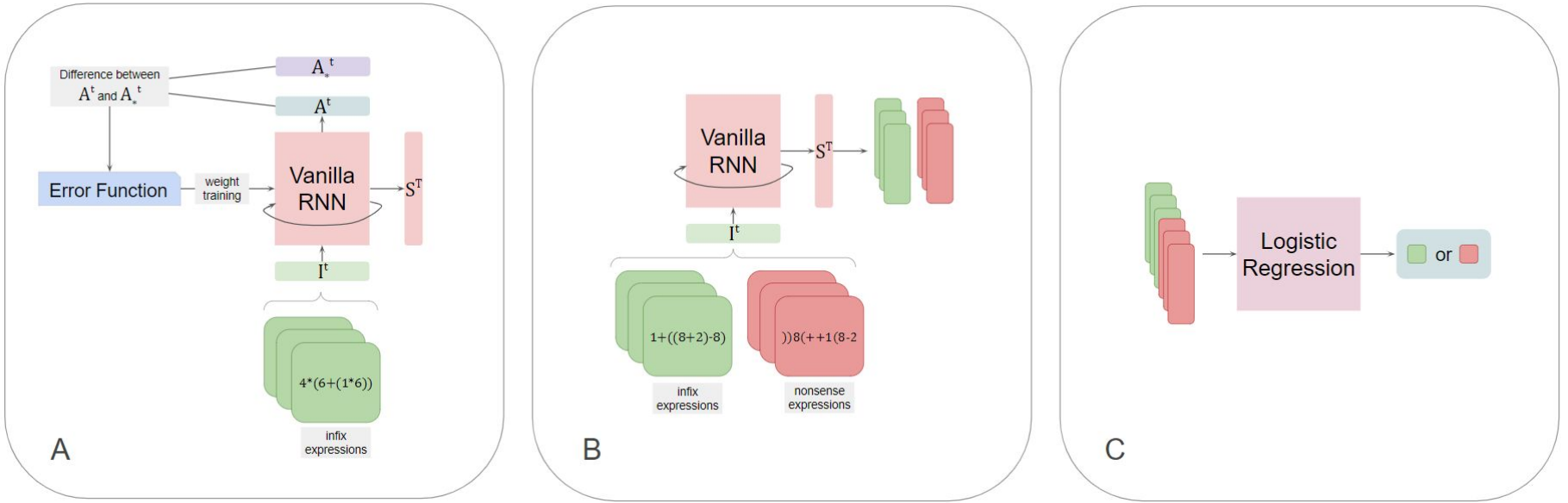



# RL Approach vs. Baseline



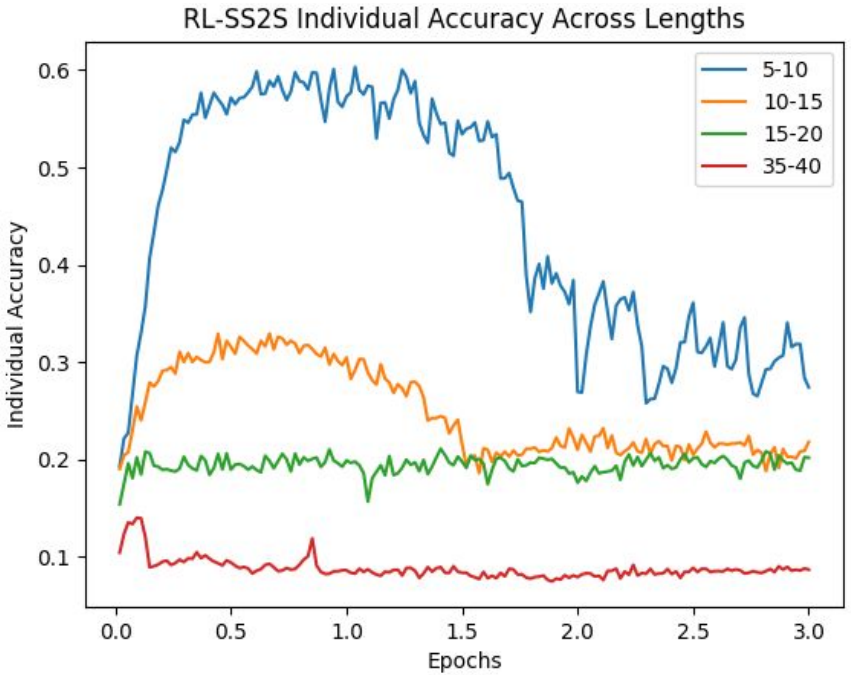
# Neural Sequence Accepting

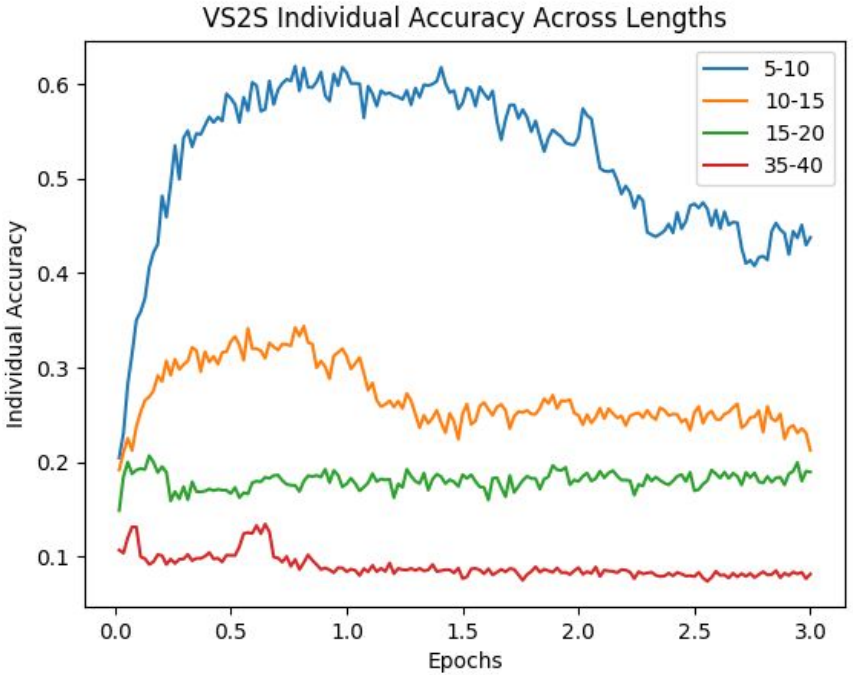


# Results: Neural Sequence Accepting

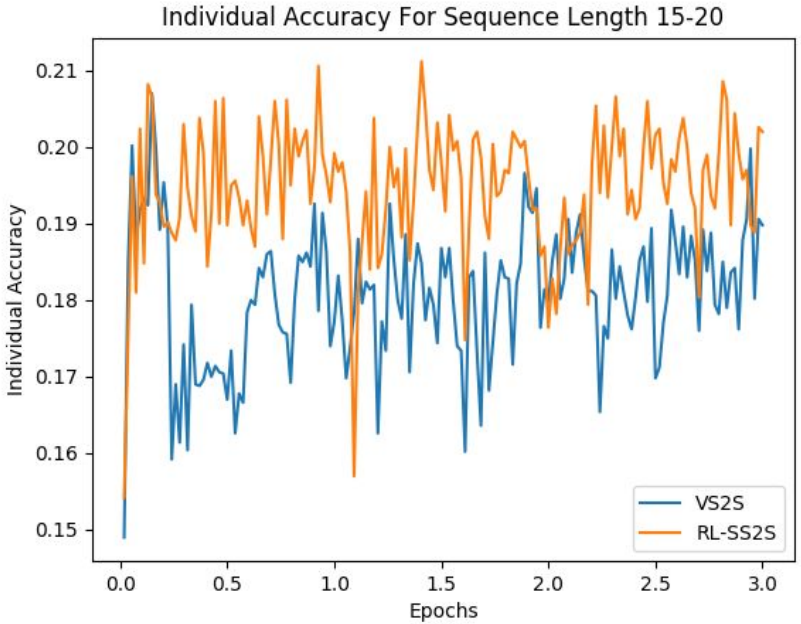
| | Vanilla RNN | | | Stack RNN | | |
|---|---|---|---|---|---|---|
| **Sequence Length** | **Stack Axn Train Acc** | **Stack Axn Test Acc** | **LogReg Test Acc** | **Stack Axn Train Acc** | **Stack Axn Test Acc** | **LogReg Test Acc** |
| **5-10** | 1.00 | 1.00 | 0.9565 | 1.00 | 1.00 | 0.9555 |
| **10-15** | 1.00 | 1.00 | 0.959 | 1.00 | 1.00 | 0.961 |
| **15-20** | 1.00 | 1.00 | 0.9495 | 1.00 | 1.00 | 0.9505 |
| **20-25** | 1.00 | 1.00 | 0.9445 | 1.00 | 1.00 | 0.941 |
| **45-50** | 1.00 | 1.00 | 0.938 | 1.00 | 1.00 | 0.934 |

# Results: Language Translation

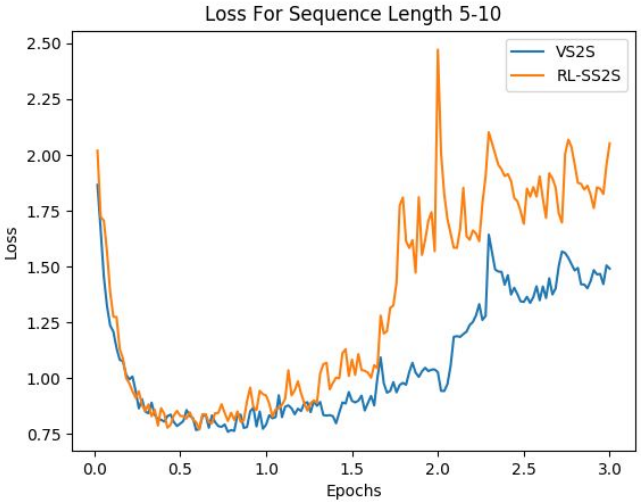


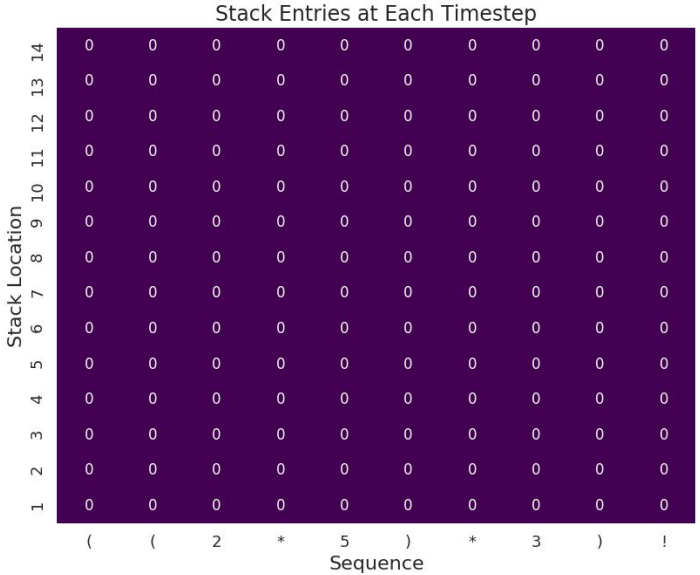



# Results: Sequence Lengths 15-20

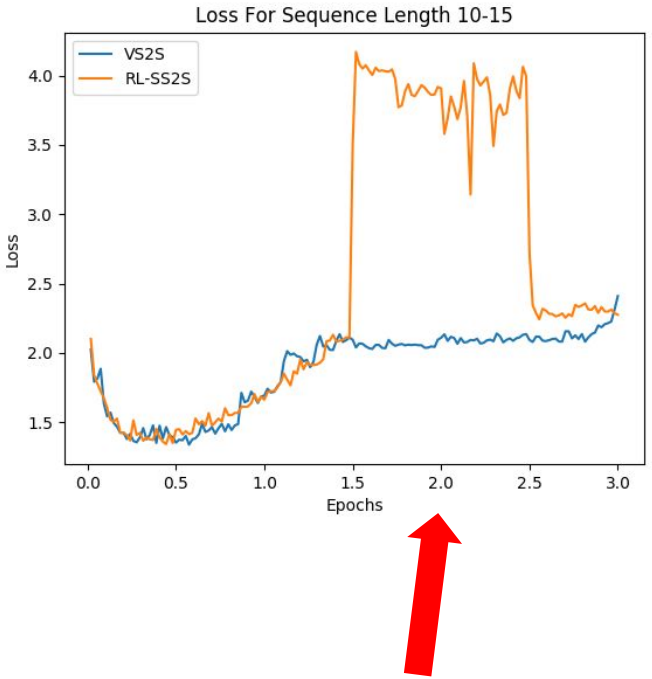


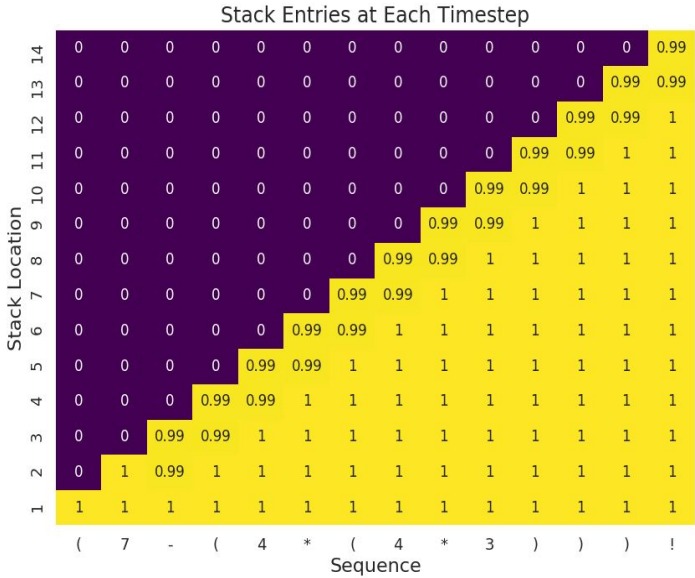
# Results


Loss For Sequence Length 5-10
VS2S
RL-SS2S
Loss
Epochs
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0.75
0.0
0.5
1.0
1.5
2.0
2.5
3.0

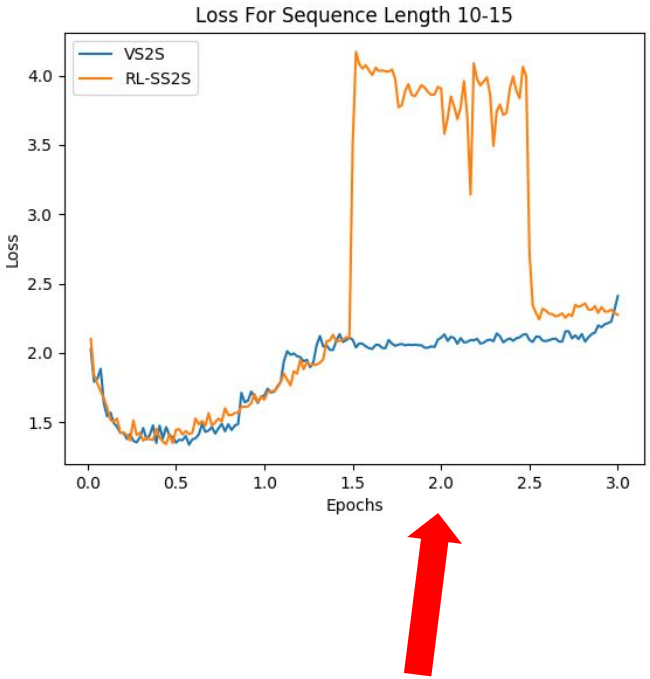

Stack Entries at Each Timestep
Stack Location
Sequence
( ( 2 * 5 ) * 3 ) !

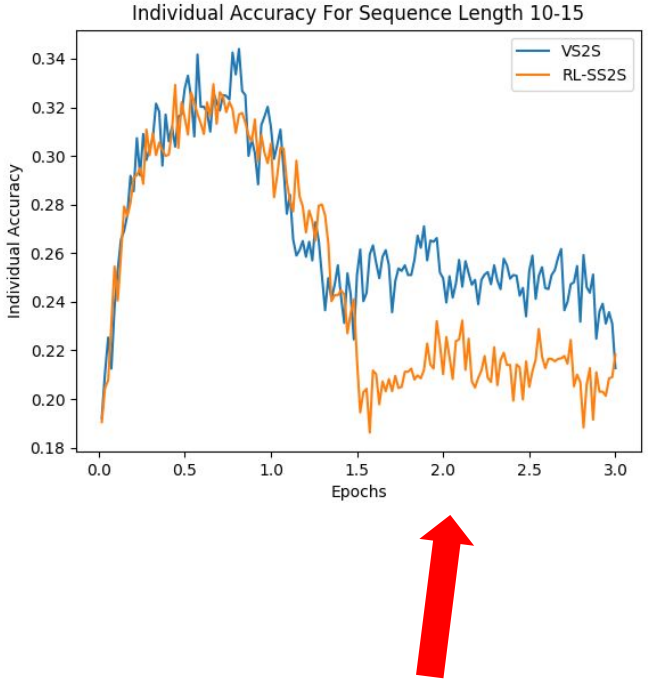
# Results


Loss For Sequence Length 10-15
VS2S
RL-SS2S
Loss
Epochs
4.0
3.5
3.0
2.5
2.0
1.5
0.0
0.5
1.0
1.5
2.0
2.5
3.0

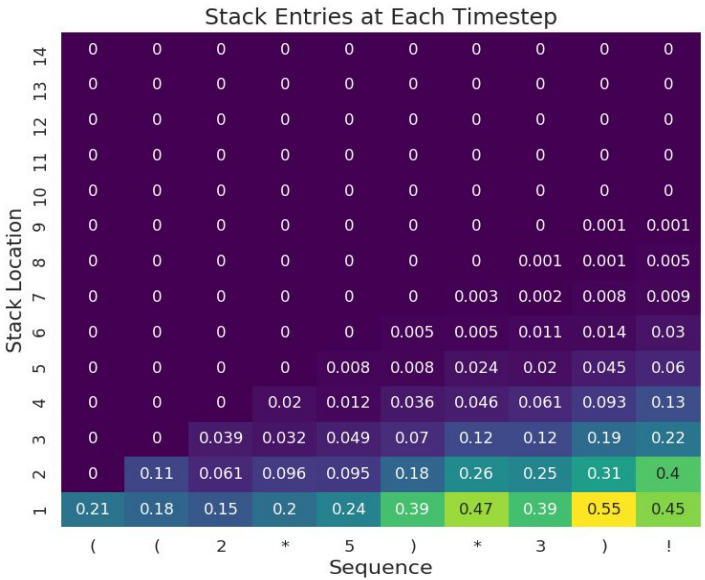

Stack Entries at Each Timestep
Stack Location
Sequence
( 7 - ( 4 * ( 4 * 3 ) ) ) !

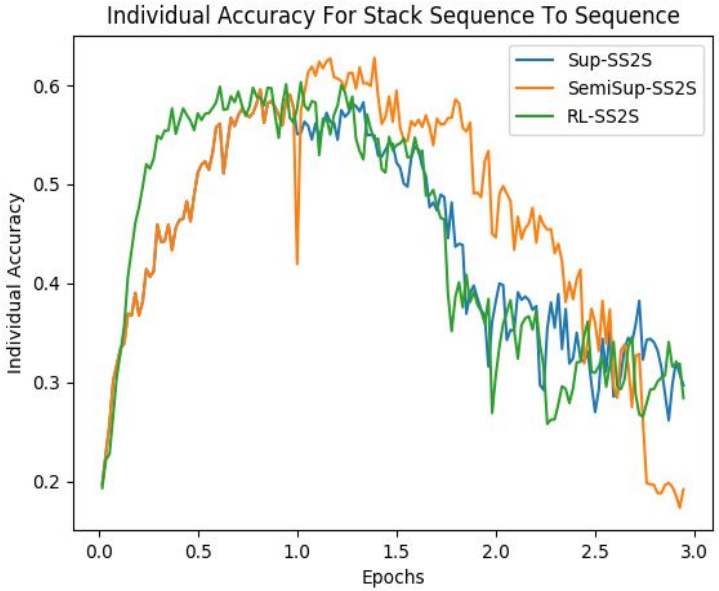
# Results


Loss For Sequence Length 10-15
VS2S
RL-SS2S
Loss
Epochs
4.0
3.5
3.0
2.5
2.0
1.5
0.0
0.5
1.0
1.5
2.0
2.5
3.0

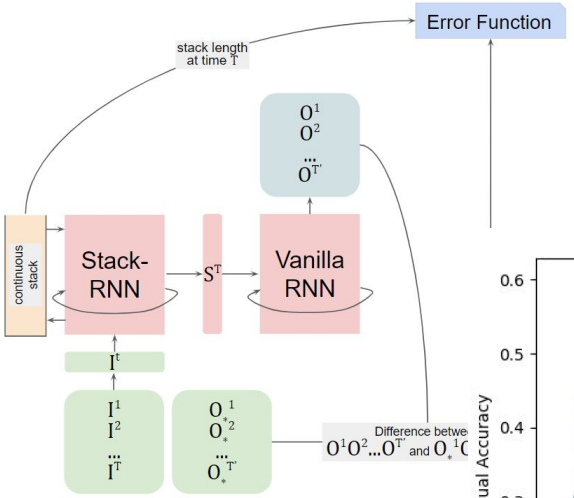

Individual Accuracy For Sequence Length 10-15
VS2S
RL-SS2S
Individual Accuracy
Epochs
0.34
0.32
0.30
0.28
0.26
0.24
0.22
0.20
0.18
0.0
0.5
1.0
1.5
2.0
2.5
3.0

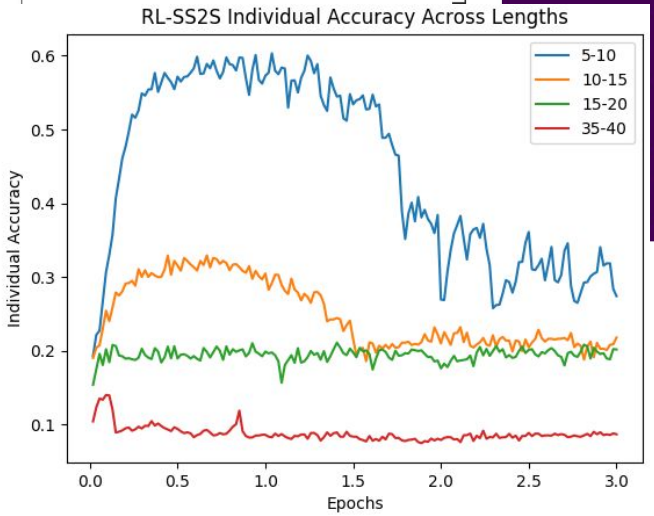
# Semi-supervised attempt

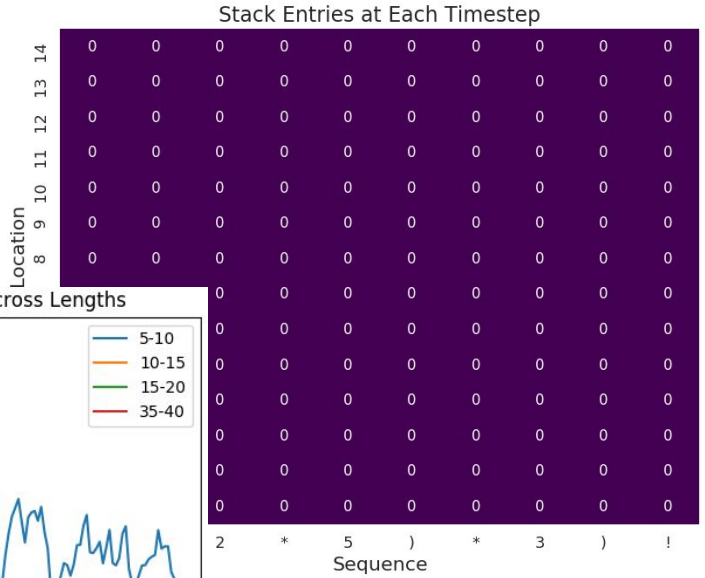


# Summary

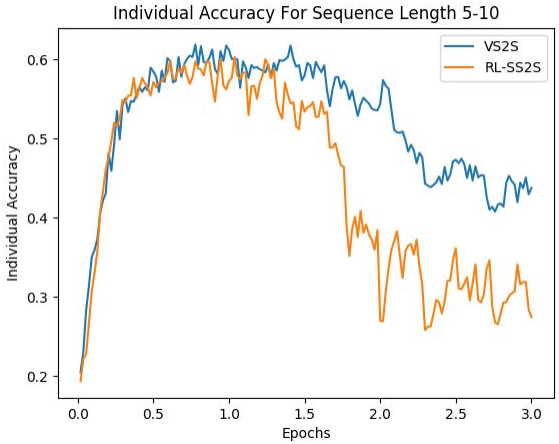

Error Function
stack length at time T
continuous stack
Stack-RNN
Vanilla RNN
Difference betwe
and

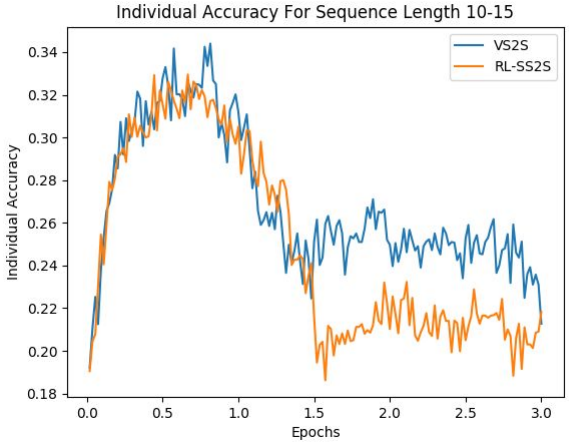

RL-SS2S Individual Accuracy Across Lengths
5-10
10-15
15-20
35-40
Individual Accuracy
Epochs

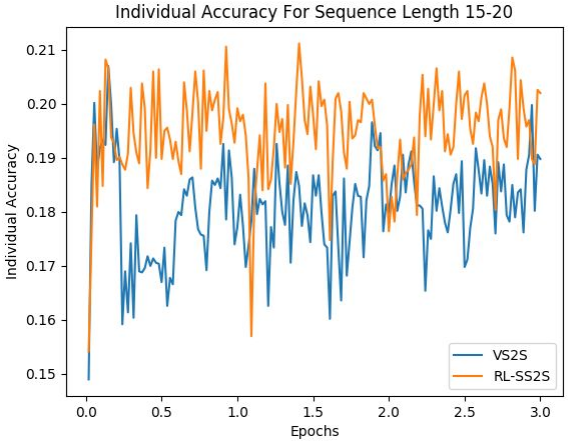

Stack Entries at Each Timestep
Location
Sequence
2 * 5 ) * 3 ) !

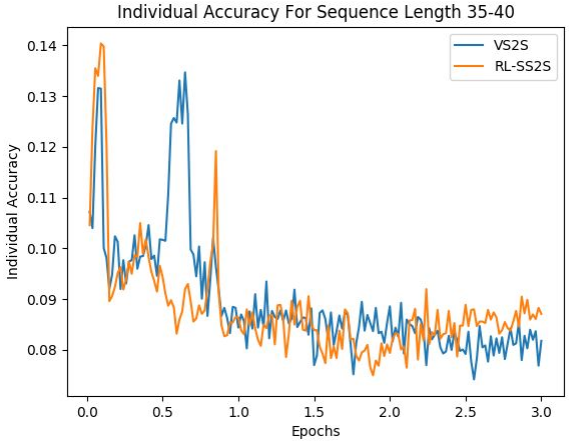
# Extra Slides

# Accuracy Comparison Between Models

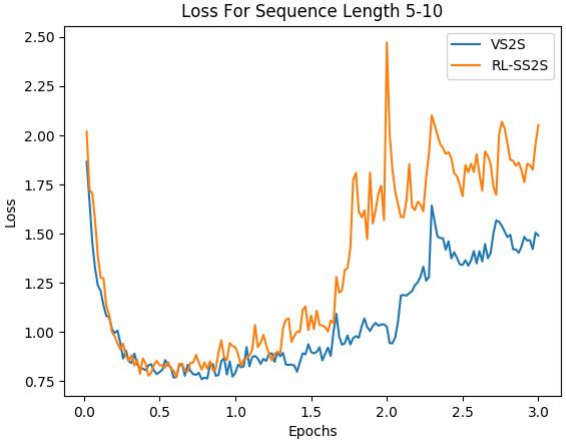


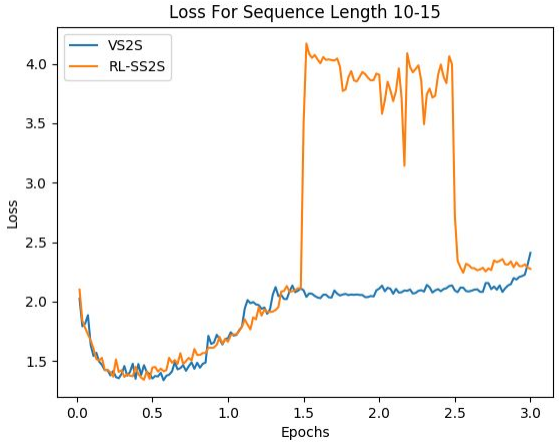



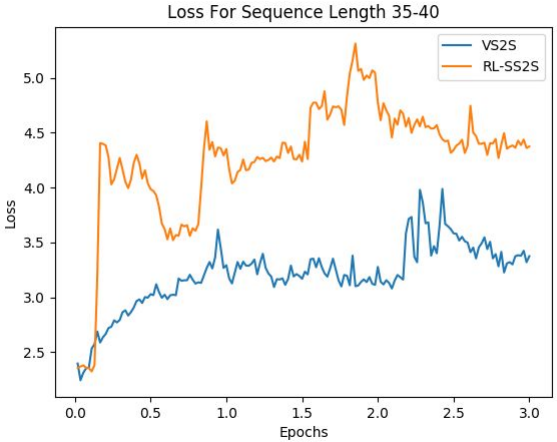



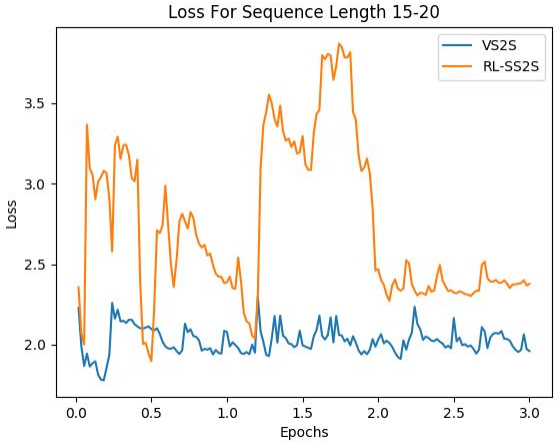



# Loss Comparison Between Models



# BLEU Scores Comparison Between Models

