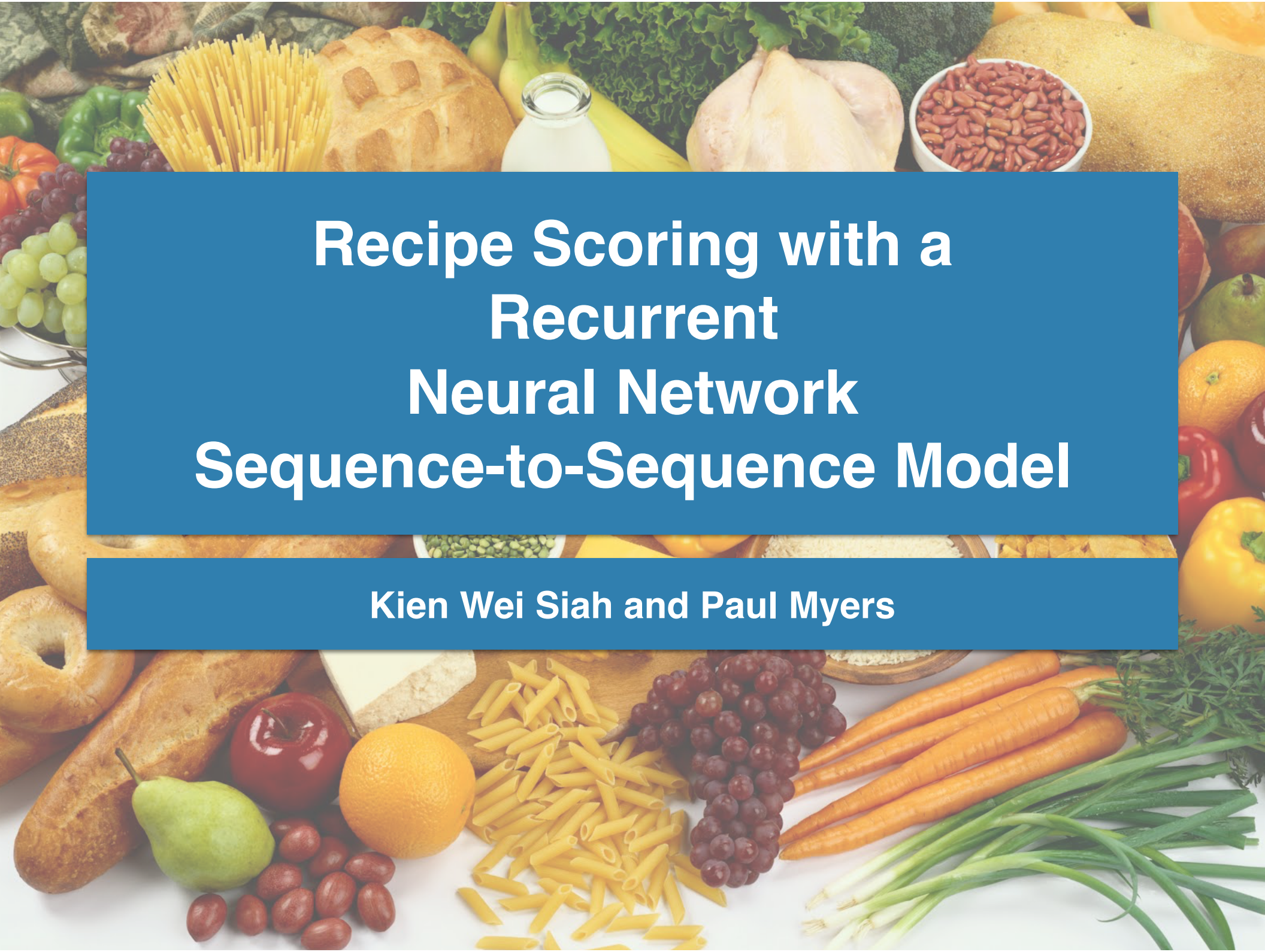


Recipe Scoring with a Recurrent Neural Network Sequence-to-Sequence Model

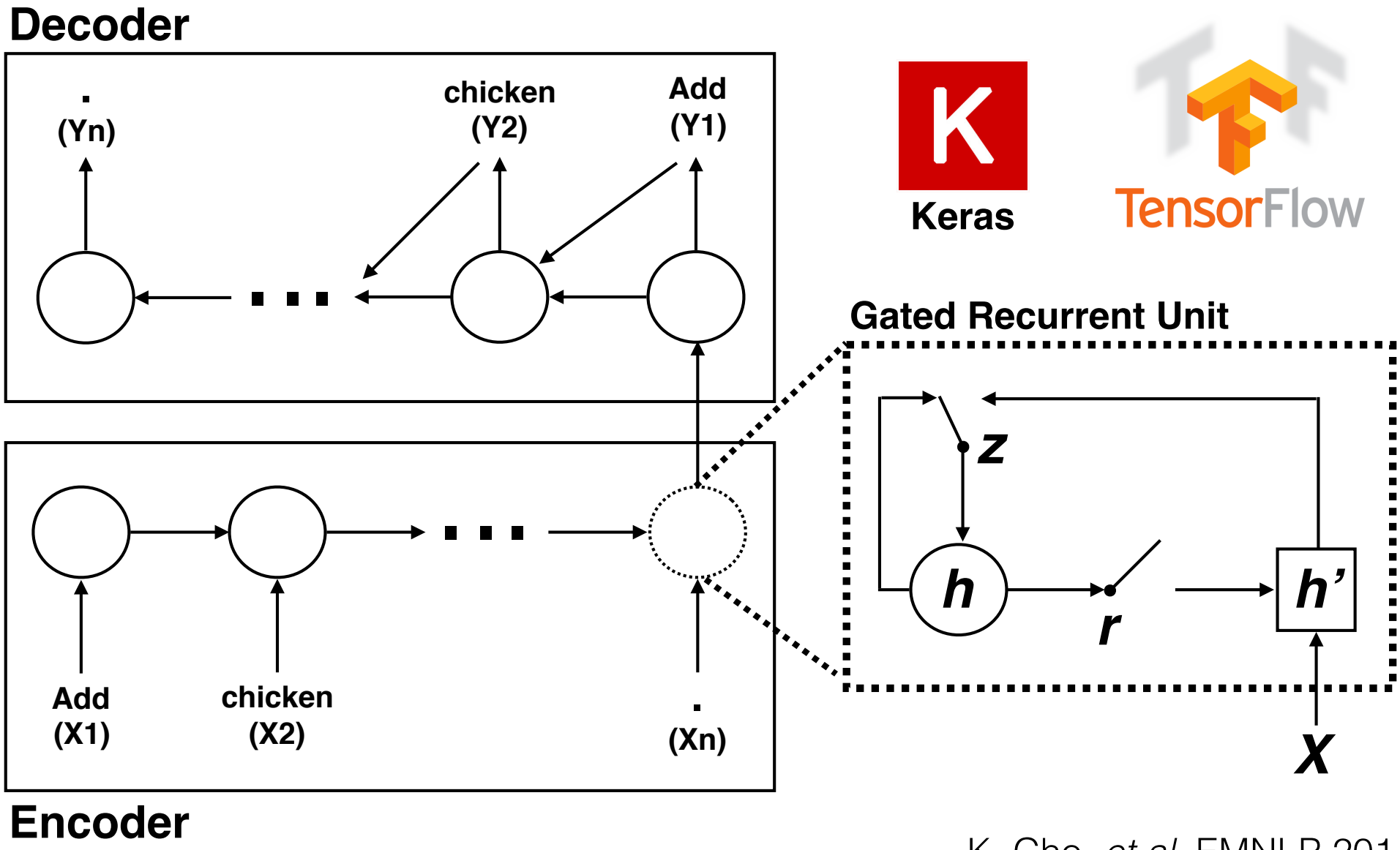
Kien Wei Siah and Paul Myers

Objective

For a given recipe:

1. **Choose an ingredient to replace**
2. **Choose a replacement criterion**
3. **Rank the possible substitutes**
4. **Generate a modified recipe**

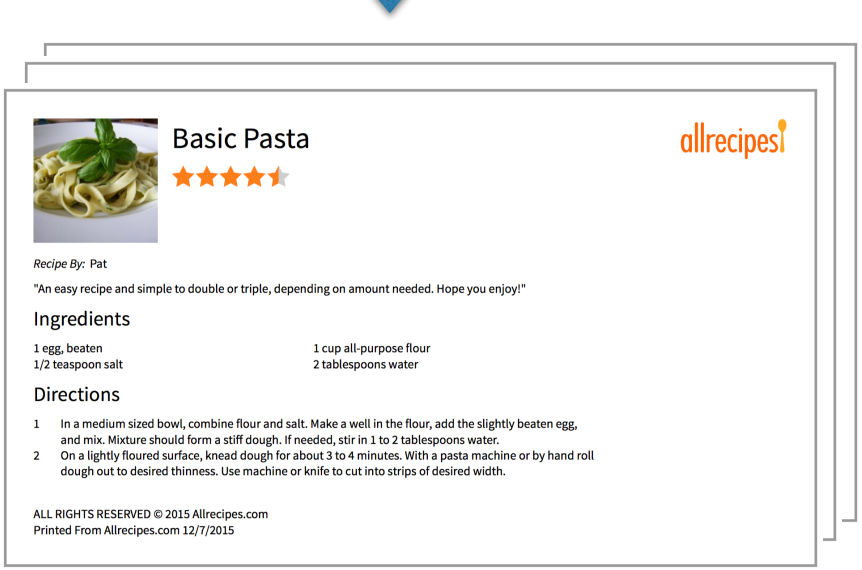
Sequence-to-Sequence Model



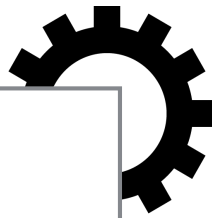
K. Cho, *et al*, EMNLP 2014.

Data Collection

Web Crawling

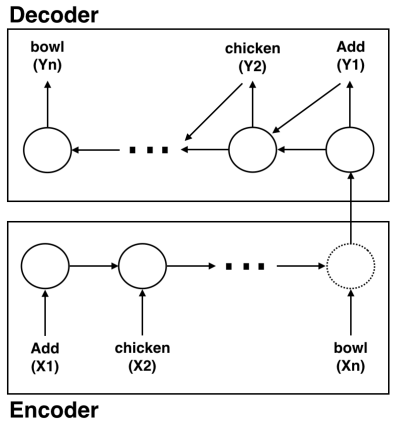


Text Preprocessing



```
heat oil in a large pot over medium heat until hot.
add onion and garlic to oil.
saute for 5 minutes or until onion is tender.
stir in tomatoes with liquid
in an 8 quart pot
combine mayonnaise
melt butter and add garlic in a medium saucepan.
cook over medium for 1 minute.
add flour and cook 1 minute
place chicken and cajun seasoning in a bowl and toss to coat.
in a large skillet over medium heat
cook pasta according to directions
saute onions
```

Training Procedure



Epoch 1

In: add chicken to the bowl.
Out: **add salmon to the pasta**.

Epoch N

In: add chicken to the bowl.
Out: **add chicken to the bowl**.

Procedure:

1. **Tokenize recipes into sentences**
2. **Input each sentence to the model**
3. **Repeat until model outputs the input sentence**

Model was trained on ~19,000 sentences, validated on ~6,500 sentences, and tested on ~6,500 sentences

Example Run of Model

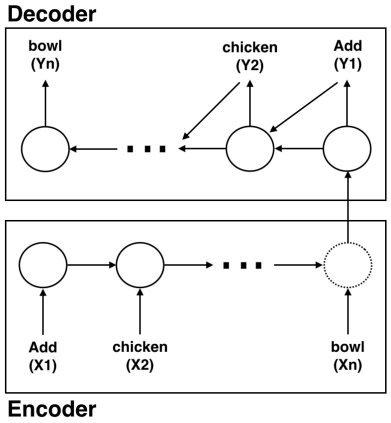
1. Chop <WORD> and place in a bowl.
2. Toss in seasoning mix.
3. Saute <WORD> in butter.
4. Reduce heat.
5. Add pepper to <WORD> mixture.
6. Heat thoroughly.
7. Pour <WORD> mixture over hot pasta.
8. Serve <WORD> and pasta with cheese.

Template Recipe

+

Chicken
Beef
Salmon
Broccoli
Turkey
Onions
▪
▪

List of All Ingredients in Corpus



Chicken: 5.01
Beef: 7.04
Salmon: 10.11
Broccoli: 25.21
Turkey: 6.11
Onions: 11.22
▪
▪

Average Perplexity Scores

Procedure:

1. **Replace all occurrences of chosen ingredient with <WORD>**
2. **For each ingredient in the test corpus, replace all occurrences of <WORD> with the current ingredient**
3. **Calculate the average perplexity of the recipe with the given ingredient in place**

Results

1. Chop **chicken** and place in a bowl.
2. Toss in seasoning mix.
3. Saute **chicken** in butter.
4. Reduce heat.
5. Add pepper to **chicken** mixture.
6. Heat thoroughly.
7. Pour **chicken** mixture over hot pasta.
8. Serve **chicken** and pasta with cheese.

Original Recipe

1. Chop **broccoli** and place in a bowl.
2. Toss in seasoning mix.
3. Saute **broccoli** in butter.
4. Reduce heat.
5. Add pepper to **broccoli** mixture.
6. Heat thoroughly.
7. Pour **broccoli** mixture over hot pasta.
8. Serve **broccoli** and pasta with cheese.

Baseline: Bigram Language Model

Other suggestions: Onions, beef, turkey

Average accuracy: **54.5%**

1. Chop **beef** and place in a bowl.
2. Toss in seasoning mix.
3. Saute **beef** in butter.
4. Reduce heat.
5. Add pepper to **beef** mixture.
6. Heat thoroughly.
7. Pour **beef** mixture over hot pasta.
8. Serve **beef** and pasta with cheese.

Proposed: RNN Model

Other suggestions: Broccoli, onions, turkey

Average accuracy: **45.5%**

Note: Results are preliminary and are expected to improve with more test data

Ongoing and Future Work

Optimize network parameters:

1. **Number of layers**
2. **Number of hidden units**
3. **Word vector dimensions**
4. **Batch size**
5. **Initialization methods (Word2Vec)**

Continue to test model with larger test set