Model & Training Configurations.

Models	Algorithm	Model Configurations	Training time(mins)	Hardware used
Baseline 1	Greedy Algorihm	LSTM for encoder and decoder, hidden_size 256, teacher_forcing_ratio = 1, Optimizer: Adam dropout rate 0.1, maximum length 150.	84	Google Colab
Baseline 2	Greedy Algorihm	LSTM for encoder and decoder, hidden_size 256, teacher_forcing_ratio = 1, Optimizer: Adam dropout rate 0.1, maximum length 150.	126	Google Colab
Extension 1	Greedy Algorihm	LSTM for encoder and decoder, hidden_size 256, teacher_forcing_ratio = 1, Optimizer: Adam dropout rate 0.1, maximum length 150.	102	Google Colab
Extension 2	Greedy Algorihm	LSTM for encoder and decoder, hidden_size 300, teacher_forcing_ratio = 1, Optimizer: Adam dropout rate 0.1, maximum length 150.	115	Google Colab

Data Statistics

Models	Vocab size	Avg. size	Max size	Min size
Ingredients	15154	42.57	148	1
Recipe	29059	71.41	149	1

For each model, only 10000 pairs(around 1%) of ingredients and recipes were used for training due to computational resource limitations.

Data Preprocessing

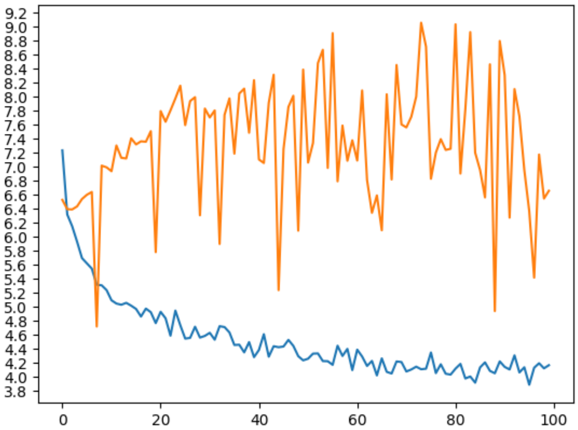
Data has been pre-processed and pruned in different ways depending on the model that was trained. The baseline models lowercased and removed all special characters(eg ;, \t) from the ingredients list. The pre-processing methods used for the extended models are based on the pre-processing methods and ideas used by in the optional readings by (Yinhong Liu, Yixuan Su et al.) and (Ximing Lu, Peter West et al.), namely, pruning off recipes with more than 15 sentences or under 3 words and removing non-noun words in the ingredients list, so that model will be mostly trained using actual ingredients.

Analysis

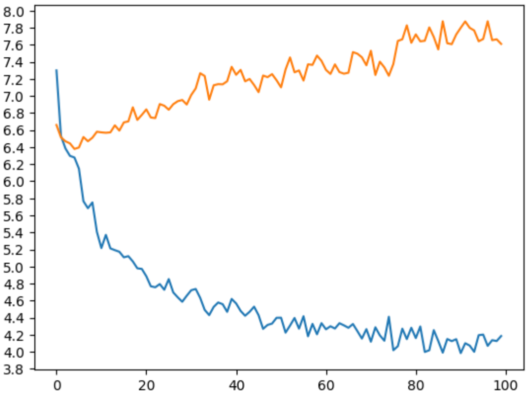
Orange: Validation loss

Blue: Training Loss

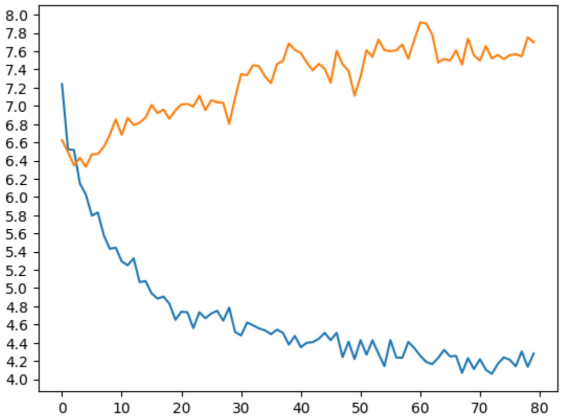
(1) Baseline 1
(2) Baseline 2
(3) Extended 1
(4) Extended 2



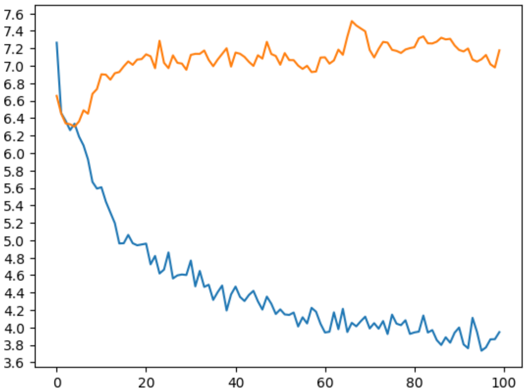
(1)



(2)



(3)



(4)

Baseline 1 seems to have the lowest validation loss, although it is not consistent throughout, whereas Extended 4 has a more consistently lower validation loss, possible due to its pre trained embeddings. All 4 models perform similarly: 3.9 – 4.1 range for training error and mostly above 7 in the test. A very low training score showing signs of underfitting, as well as overfitting as the validation plots show.

Quantitative Evaluation

	BLEU-4	METEOR	Avg % of given items	Avg. extra items
Baseline 1	0.0041132442216330395	0.08874832028403982	0.1945295752213848	19.854755784061698
Baseline 2	0.002678930944107098	0.10677849234136354	0.22861709633913505	27.08611825192802
Extension 1	0.0025616172274081765	0.09578565340288475	0.2165560865369011	22.89974293059126
Extension 2	0.001687846941083022	0.08897064441860937	0.1910007629729495	77.04884318766067

	BLEU-4	METEOR	Avg % of given items	Avg. extra items
Gold v sample	0.11770400167201682	0.5736654804270463	0.7721518987341772	60

All the model results perform similarly to each other, and not well for any metric(compared to the gold v sample) due to limited training. The models may also need more hidden layers for the encoder and decoder, as they try to predict with limited information.

Qualitative Evaluation

Ingredients: 2 c sugar, 1/4 c lemon juice, 1 c water, 1/3 c orange juice, 8 c strawberries			
Baseline 1	Baseline 2	Extended 1	Extended 2
in a large bowl combine all ingredients in a large bowl combine all ingredients except the flour and salt and pepper to taste and serve immediately <EOS>	in a large bowl combine flour and salt in a bowl combine flour and salt and pepper to taste and chill until firm about 1 hour or until firm <EOS>	preheat oven to 350 degrees f combine all ingredients in a large bowl combine flour baking powder and salt add eggs and vanilla and mix well pour over mixture and bake at 350 degrees for 30 minutes or until golden brown <EOS>	preheat oven to 350 degrees f combine all ingredients in a bowl and blend until smooth add eggs and vanilla stir in flour and vanilla stir in flour and vanilla stir in flour and vanilla stir in flour and vanilla stir in flour and vanilla stir in flour and vanilla stir in flour and vanilla stir in flour and vanilla stir in flour and vanilla stir in flour and vanilla stir

			in flour and vanilla stir in flour and vanilla stir in flour and vanilla stir in nuts and vanilla pour into prepared pan bake in preheated oven for 25 minutes or until golden brown <EOS>

Likely due to lack of training examples, none of the 4 models have predicted a recipe relevant to the ingredients chosen. All of them hallucinate ingredients that do not exist. The last model(trained using word2vec embeddings) in particular constantly repeats the same instructions till the maximum output is reached. All 4 models predict ‘combine all ingredients’, presumably the most common instruction in these recipes. All of this is consistant with the low scores given to them by the quantitative metrics

In the future, it would probably be more effective to train each individual ingredient with specific sentences that explain how to use them, with similar words being used as a substitute. This would require accounting for non-ingredient words in the ingredients training list(eg. Brand names, outliers, etc.). Also will require more computational units for more trainning.

Note: ChatGPT was used in multiple section of the code