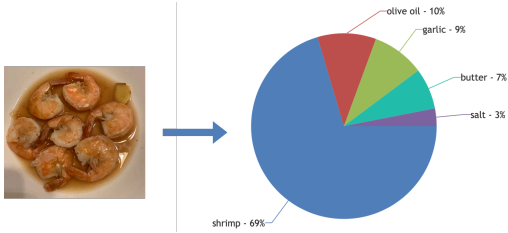


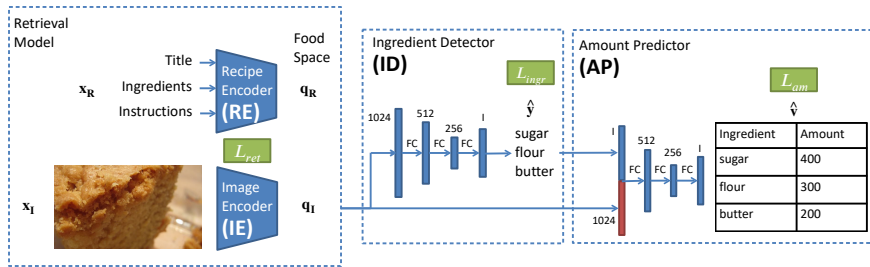
Problem Definition



Contribution

- PITA deep learning framework to solve the problem and improve previous baselines.
- Ingredient substitution groups are constructed for the evaluation metric and loss function.
- Even in the presence of challenging test examples, the methods are still able to yield robust qualitative results.

Method



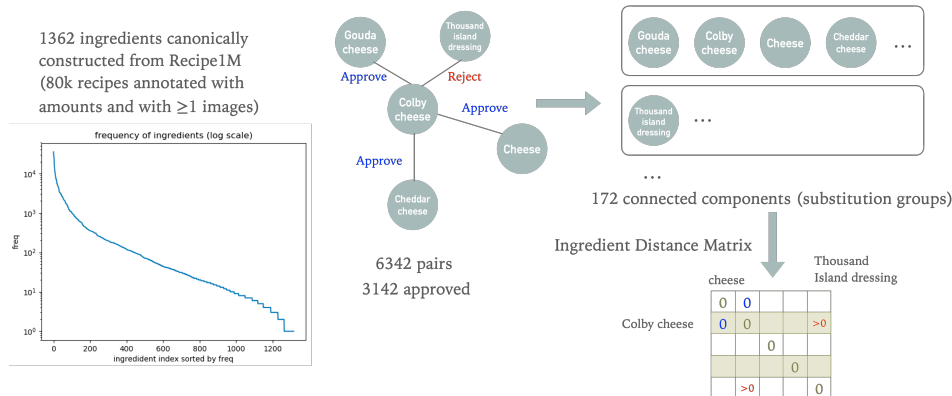
The three parts are trained sequentially.

L_{ret} : triplet hard mining loss.

L_{ingr} : positive sample weighted binary cross entropy loss.

L_{am} : Wasserstein distance using the ingredient distance matrix M .

Dataset



High dimension and long-tail distribution call for the need to reduce the number of ingredients.

Select ingredient pairs according to cosine similarity in Word2vec embedding space.

Human annotators then approve or reject the selected pairs.

Results

Demo at foodai.cs.rutgers.edu

Metrics:

Example:

Predicted: **pasta sauce** (400 g), **cheese** (400 g), **pasta** (100 g), onion (100 g)

GT: **pasta sauce** (440 g), **colby cheese** (400 g), **penne** (150 g), black pepper (10 g)

#common ingredients=3.

• **CVG**: #common/#GT= 3/4=0.75.

• **IOU**: #common/(#GT+#pred-#common) = 3/(4+4-3)=0.6.

• **EMD**: Earth mover's distance between ground truth and predicted amounts with the ingredient distance matrix. 40d(pasta sauce, onion)+50d(penne, onion)+10d(black pepper, onion) in this example.

Results:

Method	CVG	IOU	EMD
Retrieval	0.51	0.34	191.13
ATTEN	0.47	0.32	205.19
ACME	0.48	0.33	199.87
IE+AP	0.45	0.25	193.33
IE+RE+AP(Wass)	0.26	0.13	142.18
IE+RE+AP(CE)	0.50	0.28	145.30
IE+ID+AP	0.46	0.30	220.18
IE+RE+ID+AP(CE)	0.63	0.42	154.35
IE+RE+ID+AP(Wass)	0.63	0.42	147.29

Sample Results and Optimal Ingredient Flows:

• Nodes:

- Ground truth: represented with different colors. Areas represent amounts.
- Predicted ingredients: use sectional color representation.
- The color sections depict predicted ingredients and their relative amounts that are transported to the ground truth ingredient when calculating the optimal earth mover's distance.

• Edges:

- **Olive**: exact ingredient match.
- **Red**: ingredients from different groups. The darker the color, the larger the distance.

