CVHCI Praktikum 2019
pic2kcal

Group 3 - Final presentation
Lukas, Robin, Verena

Motivation

- Food is life 🍕
- fully-automatic food calorie estimation is still an unsolved problem 🤔

Related Literature

- 2 directions
  - Image → Category + Size / Volume → Calories [Chokr et al., 2017]
  - Image → Calories:
    - Multi-task CNN: Simultaneous learning of calories, categories, ingredients and cooking direction [Ege et al., 2017]

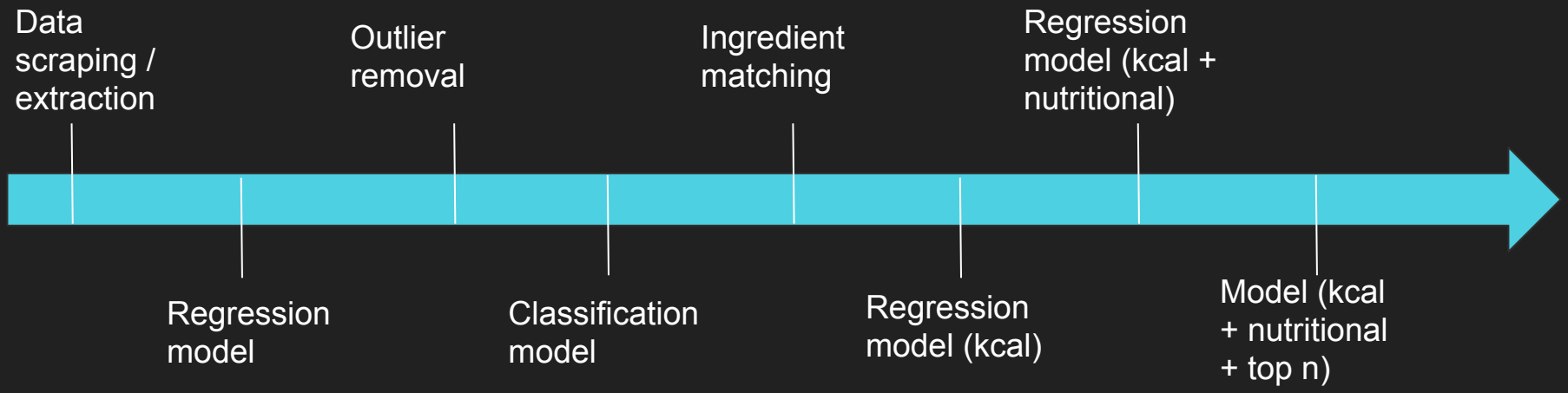
CALORIE MAMA

Calorie Mama: https://caloriemama.ai/

[Chokr et al.,2017] Chokr, M., & Elbassuoni, S. (2017, February). Calories prediction from food images. In Twenty-Ninth IAAI Conference.

[Ege et al., 2017] Takumi Ege and Keiji Yanai. 2017. Image-Based Food Calorie Estimation Using Knowledge on Food Categories, Ingredients and Cooking Directions. In Proceedings of Thematic Workshops '17, Mountain View, CA, USA, October 23–27, 2017, 9 pages. https://doi.org/10.1145/3126686.3126742

Overview


Data scraping / extraction
Regression model
Outlier removal
Classification model
Ingredient matching
Regression model (kcal)
Regression model (kcal + nutritional)
Model (kcal + nutritional + top n)

Data

320k recipes

390k ingredients

8k recipes

40k ingredients

60k recipes

Chefkoch Logo: https://www.chefkoch.de/

Essen und Trinken Logo: https://www.essen-und-trinken.de/

Fddb Logo: https://fddb.info/

Die Nährwerttabelle: https://www.beck-shop.de/heseker-dipl-oec-troph-heseker-naehrwerttabelle/product/27851725

Lecker Logo: https://www.lecker.de/einfacher-apfelkuchen-69347.html

Data

CHEFKOCH

320k recipes

FDDB

390k ingredients

LECKER

8k recipes

Die Nährwerttabelle

40k ingredients

essen & trinken

60k recipes

Chefkoch Logo: https://www.chefkoch.de/

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Fddb Logo: https://fddb.info/

Die Nährwerttabelle: https://www.beck-shop.de/heseker-dipl-oec-troph-heseker-naehrwerttabelle/product/27851725

Lecker Logo: https://www.lecker.de/einfacher-apfelkuchen-69347.html

Data

CHEFKOCH

» Startseite » Rezepte » Kategorien » Backen & Süßspeisen » Kuchen

Speichern

Drucken

Rhabarber - Marzipan - Gugelhupf

Bewertung

★★★★★ (82) Ø4,64

Rezept bewerten

Rezeptstatistik anzeigen

Verfasser

genovefa56

Mitglied seit 02.02.2003

7.337 Beiträge (ø1,22/Tag)

Zutaten

1 Portionen Umrechnen

300 g	Rhabarber, gewürfelt
250 g	Butter
250 g	Zucker
1 Paket	Vanillezucker
350 g	Mehl
1 Pkt.	Backpulver
5	Ei(er)
150 g	Marzipan - Rohmasse, gewürfelt.
125 ml	Schlagsahne, (Obers)
2 EL	Amaretto
2 EL	Zucker
	Zum Verzieren:
	Marmelade (Rhabarber-)
	Puderzucker

Video-Tipps

- 4 einfache Dekorationen aus Fondant oder Marzipan
- Backpulver im Rezept ersetzen
- Butter schmelzen und klären
- Figuren aus Fondant oder Marzipan modellieren
- Marzipan modellieren oder ausrollen
- Sahne steif schlagen

FDDB

Butter, Durchschnittswert

Butter | Hochgeladen von: tina a (Problem

Nährwerte für 100 g

Brennwert	3102 kJ
Kalorien	741 kcal
Protein	0,7 g
Kohlenhydrate	0,6 g
davon Zucker	0,6 g
Fett	83 g
Ballaststoffe	0 g
Broteinheiten	0,1
Cholesterin	221 mg
Wassergehalt	15%

1 Teelöffel (15 g)

Brennwert: 465 kJ, Kalorien: 111 kcal

Jetzt gegessen | Mahlzeit wählen

Zu einer Liste hinzufügen

1 Esslöffel (20 g)

Brennwert: 620 kJ, Kalorien: 148 kcal

Jetzt gegessen | Mahlzeit wählen

Zu einer Liste hinzufügen

Data

CHEFKOCH


```
{
  "id": "1006031205754875",
  "date": "17.03.2008",
  "canonical_url": "https://www.chefkoch.de/rezepte/1006031205754875/Rhabarber-Marzipan-Gugelhupf.html",
  "title": "Rhabarber - Marzipan - Gugelhupf",
  "subtitle": "",
  "tags": [
  ],
  "rating": 4.5,
  "rating_count": 80,
  "portions": 1,
  "ingredients": [
    {"amount": "350 g"...},
    {"amount": "1 Pkt."...},
    {"amount": "5"...},
    {"amount": "150 g"...},
    {"amount": "125 ml"...},
    {"amount": "2 EL"...},
    {"amount": "2 EL"...},
    {
      "subtitle": "Zum Verzieren:"
    },
    {
      "amount": "",
      "ingredient": "Marmelade (Rhabarber-)"
    },
    {
      "amount": "",
      "ingredient": "Puderzucker"
    },
    {
      "amount": "",
      "ingredient": "Kompott, (Rhabarberkompott)"
    }
  ],
  "author": "genovefa56",
  "difficulty": "normal",
  "picture_urls": [
    "https://img.chefkoch-cdn.de/ck.de/rezepte/100/100603/455692-960x720-rhabarber-marzipan-gugelhupf.jpg",
    "https://img.chefkoch-cdn.de/ck.de/rezepte/100/100603/373092-960x720-rhabarber-marzipan-gugelhupf.jpg",
    "https://img.chefkoch-cdn.de/ck.de/rezepte/100/100603/564962-960x720-rhabarber-marzipan-gugelhupf.jpg",
    "https://img.chefkoch-cdn.de/ck.de/rezepte/100/100603/486747-960x720-rhabarber-marzipan-gugelhupf.jpg"
  ],
  "picture_files": [
    "100/100603_455692-960x720-rhabarber-marzipan-gugelhupf.jpg",
    "100/100603_914435-960x720-rhabarber-marzipan-gugelhupf.jpg",
    "100/100603_252795-960x720-rhabarber-marzipan-gugelhupf.jpg",
    "100/100603_152464-960x720-rhabarber-marzipan-gugelhupf.jpg",
    "100/100603_1020403-960x720-rhabarber-marzipan-gugelhupf.jpg",
    "100/100603_486747-960x720-rhabarber-marzipan-gugelhupf.jpg"
  ]
}
```


FDDB


```
{
  "Bewertungen": "40",
  "Bilder": [...],
  "Hersteller": "Durchschnittswert",
  "Id": "https://fddb.info/db/de/lebensmittel/durchschnittswert_butter_durchschnittswert/index.html",
  "Lebensmittelgruppe": "Tierische Fette, Öle und Fette",
  "Spezifische Nährwerte": {...},
  "Standard Nährwerte": {
    "Mineralstoffe": {...},
    "Nährwerte für 100 g": {
      "Ballaststoffe": {"Einheit": "g"...},
      "Brennwert": {"Einheit": "kJ"...},
      "Broteinheiten": {"Einheit": ""...},
      "Cholesterin": {"Einheit": "mg"...},
      "Fett": {
        "Einheit": "g",
        "Menge": 83
      },
      "Kalorien": {
        "Einheit": "kcal",
        "Menge": 741
      },
      "Kohlenhydrate": {
        "Einheit": "g",
        "Menge": 0.6
      },
      "Protein": {
        "Einheit": "g",
        "Menge": 0.7
      },
      "Wassergehalt": {"Einheit": "%"...},
      "davon Zucker": {
        "Einheit": "g",
        "Menge": 0.6
      }
    },
    "Vitamine": {...}
  },
  "name": "Butter, Durchschnittswert"
}
```

Data

CHEFKOCH

FDDB

```
{
  "amount": "250 g",
  "ingredient": "Butter"
},
```

match?

Butter, Durchschnittswert

Butter | Hochgeladen von: tina a (Problem

Nährwerte für 100 g

Brennwert	3102 kJ
Kalorien	741 kcal
Protein	0,7 g
Kohlenhydrate	0,6 g
davon Zucker	0,6 g
Fett	83 g
Ballaststoffe	0 g
Broteinheiten	0,1
Cholesterin	221 mg
Wassergehalt	15%

Data

First Approach

- Levenshtein Distance

Second Approach: Embeddings

- FastText
- Google Universal Sentence Encoder [Cer et al., 2018]

Glasierte Karotten

	inp amount	inp ing		paredd
0	1,4 kg	Karotte(n)	=	(92%) [1400.0g] of Ur-Karotte = 364 kcal
1	60 g	Butter	=	(100%) [60g] of Butter, streichfein, gesalzen = 407 kcal
2	50 g	Zucker	=	(100%) [50g] of Zucker = 200 kcal
3	wenig	Salz	=	[unimportant]
4	etwas	Wasser	=	[unimportant]

Toffee - Torte

	inp amount	inp ing		paredd
0	100 g	Haselnüsse	=	(100%) [100g] of Haselnüsse = 705 kcal
1	100 g	Löffelbiskuits	=	(100%) [100g] of Löffelbiskuits = 378 kcal
2	3	Ei(er)	=	(100%) [3 Stück = 405.0g] of Ei, von der Gans / Gänseei = 725 kcal
3	150 g	Zucker	=	(100%) [150g] of Zucker = 600 kcal
4	25 g	Mehl	=	(100%) [25g] of Mehl = 87 kcal
5	1 TL, gestr.	Backpulver	=	[unimportant]
6	6 Blätter	Gelatine	=	(87%) [6 Blätter = 10.0g] of Blatt Gelatine = 35 kcal
7	100 g	Süßigkeiten (Schoko-Toffee-Bonbons oder Noisette-Schokolade)	=	(100%) [100g] of Süßigkeiten = 360 kcal
8	12 Stück(e)	Konfekt (Toffifee)	=	(100%) [12 Stück = 120.0g] of Konfekt = 278 kcal
9	n. B.	Schokostreusel zum Bestreuen	=	[unimportant]
10	750 ml	Sahne	=	(100%) [750ml] of Sahne = 2588 kcal

matched ingredients & units

Final Dataset

- 220k recipes with images
- 900k images total
- 23k recipes with user-given kcal per portion
- 85k recipes matched with fddb

After processing:

270k data samples (70% train, 15% each val/test)

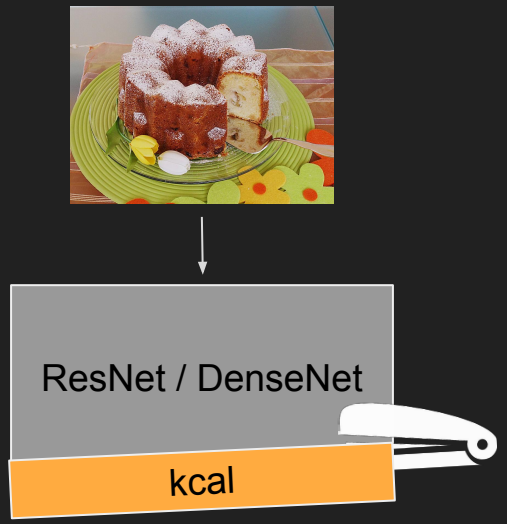
photo → kcal, protein, fat, carbohydrates; ingredients

```
Top 20 Ingredients
["Salz",
 "Zucker",
  "Ei(er)",
  "Mehl",
  "Butter",
  "Zwiebel(n)",
  "Milch",
  "Vanillezucker",
  "Zucker",
  "Öl",
  "Paprikaschote(n),
rot",
  "Knoblauchzehe(n)",
  "Wasser",
  "Knoblauch",
  "Pfeffer",
  "Olivenöl",
  "Backpulver",
  "Sahne",
  "Zitrone(n)",
  "Paprikapulver"]
```

Model Architectures

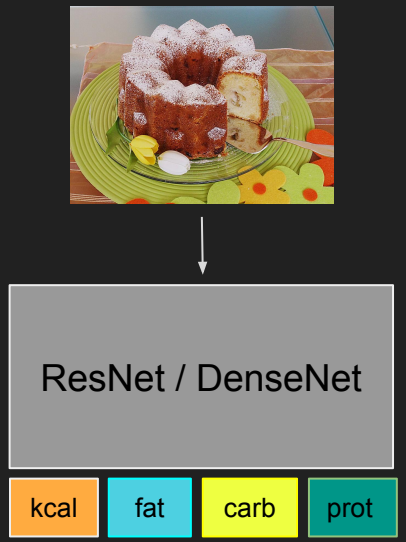
[He et al., 2016], [Huang et al., 2017]

Model Architectures



[He et al., 2016], [Huang et al., 2017]

Model Architectures



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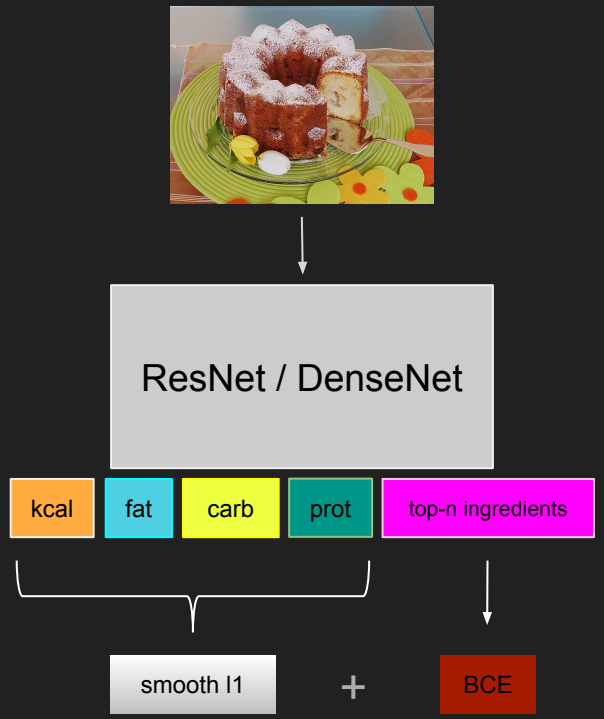
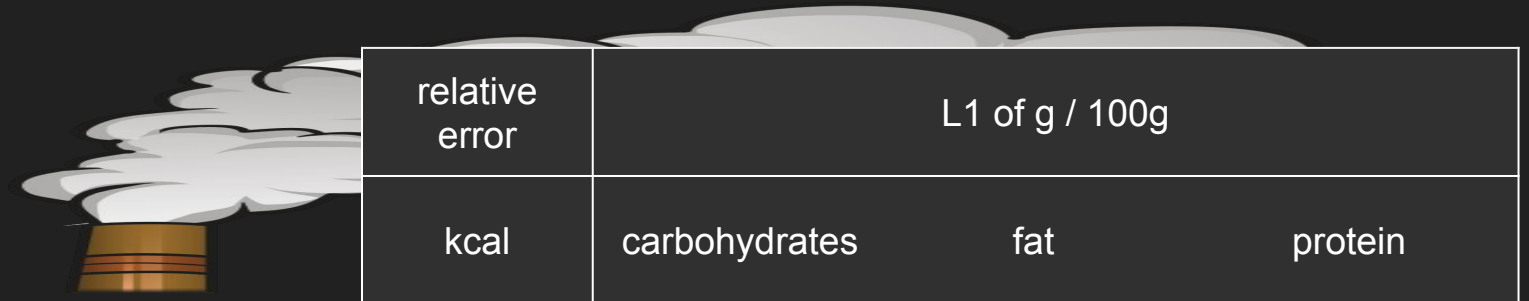
Model Architectures



[He et al., 2016], [Huang et al., 2017]

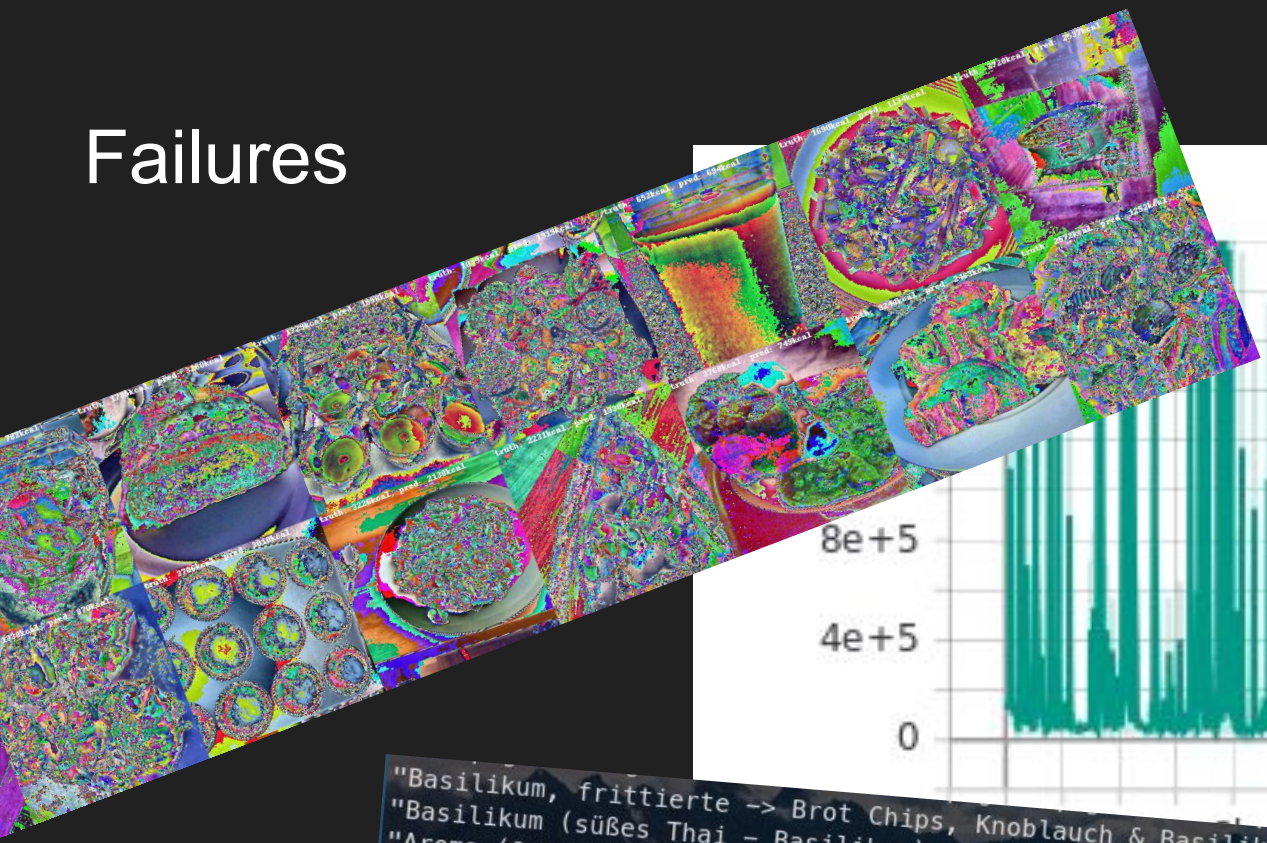
Results (predicted per 100g raw mass)

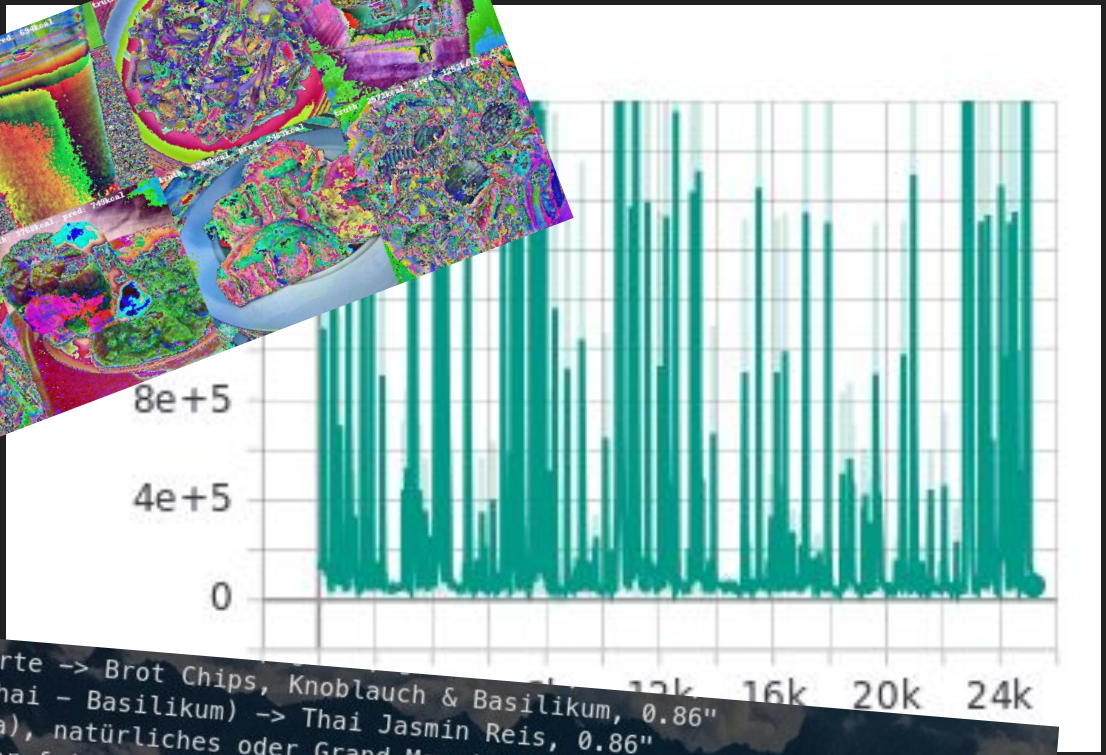


	relative error	L1 of g / 100g		
	kcal	carbohydrates	fat	protein
baseline	0.464	10.5g	4.5g	3.1g
ours (kcal only)	0.361	---	---	---
ours (w/ macros)	0.352	7.9g	4.1g	2.7g
ours (w/ macros+ings)	0.328	7.1g	3.9g	2.5g

(validation set, not test set)

Failures





"Basilikum, frittierte -> Brot Chips, Knoblauch & Basilikum, 0.86"
"Basilikum (süßes Thai - Basilikum) -> Thai Jasmin Reis, 0.86"
"Aroma (Orangenaroma), natürliches oder Grand-Marnier -> Orangen, 0.9"
"Chili, gemahlen oder frisch, oder auch Chillipaste -> Chio Chips, X-treme Chili, 0.86"

Results


truth: 147kcal, pred: 168kcal
truth: 3g protein, pred: 4g protein
truth: 9g fat, pred: 9g fat
truth: 13g carbs, pred: 18g carbs
ings truth: Zucker, Vanillezucker
ings pred: Zucker, Vanillezucker


truth: 74kcal, pred: 72kcal
truth: 2g protein, pred: 2g protein
truth: 3g fat, pred: 2g fat
truth: 10g carbs, pred: 10g carbs
ings truth: Milch
ings pred:


truth: 275kcal, pred: 270kcal
truth: 5g protein, pred: 5g protein
truth: 8g fat, pred: 11g fat
truth: 42g carbs, pred: 37g carbs
ings truth: Zucker, Ei(er), Mehl, Vanillezuc
ings pred: Zucker, Ei(er), Mehl, Butter, Mil


truth: 288kcal, pred: 286kcal
truth: 7g protein, pred: 7g protein
truth: 15g fat, pred: 14g fat
truth: 30g carbs, pred: 34g carbs
ings truth: Zucker, Ei(er), Mehl, Vanillezuc
ings pred: Zucker, Ei(er), Mehl, Butter, Va


truth: 181kcal, pred: 126kcal
truth: 6g protein, pred: 4g protein
truth: 5g fat, pred: 5g fat
truth: 31g carbs, pred: 13g carbs
ings truth: Knoblauchzehe(n), Öl
ings pred: Paprikaschote(n) rot


truth: 151kcal, pred: 178kcal
truth: 8g protein, pred: 8g protein
truth: 7g fat, pred: 10g fat
truth: 14g carbs, pred: 13g carbs
ings truth: Pfeffer, Olivenöl
ings pred: Kartoffel(n)


truth: 88kcal, pred: 140kcal
truth: 4g protein, pred: 9g protein
truth: 1g fat, pred: 8g fat
truth: 14g carbs, pred: 7g carbs
ings truth: Zwiebel(n), Knoblauchzehe(n),
ings pred: Möhre(n)


truth: 181kcal, pred: 239kcal
truth: 7g protein, pred: 8g protein
truth: 2g fat, pred: 6g fat
truth: 31g carbs, pred: 36g carbs
ings truth: Wasser
ings pred: Wasser

Summary & Outlook

- dataset cleaning important for regression
- built food dataset
- kcal/portion, kcal/recipe, kcal/100 g — per 100g works best
- multi-task learning performed best

Next steps:

- little overfitting → investigate in different architectures
- Improve dataset / preprocessing
- try other tasks (predict e.g. low-carb, vegan)

References

- [Cer et al., 2018] Daniel Cer, Yinfei Yang, Sheng-yi Kong, Nan Hua, Nicole Limtiaco, Rhomni St. John, Noah Constant, Mario Guajardo-Céspedes, Steve Yuan, Chris Tar, Yun-Hsuan Sung, Brian Strope, Ray Kurzweil. Universal Sentence Encoder. arXiv:1803.11175, 2018.

- [Chokr et al.,2017] Chokr, M., & Elbassuoni, S. (2017, February). Calories prediction from food images. In Twenty-Ninth IAAI Conference.

- [Ege et al., 2017] Takumi Ege and Keiji Yanai. 2017. Image-Based Food Calorie Estimation Using Knowledge on Food Categories, Ingredients and Cooking Directions. In Proceedings of Thematic Workshops '17, Mountain View, CA, USA, October 23–27, 2017, 9 pages. https://doi.org/10.1145/3126686.3126742

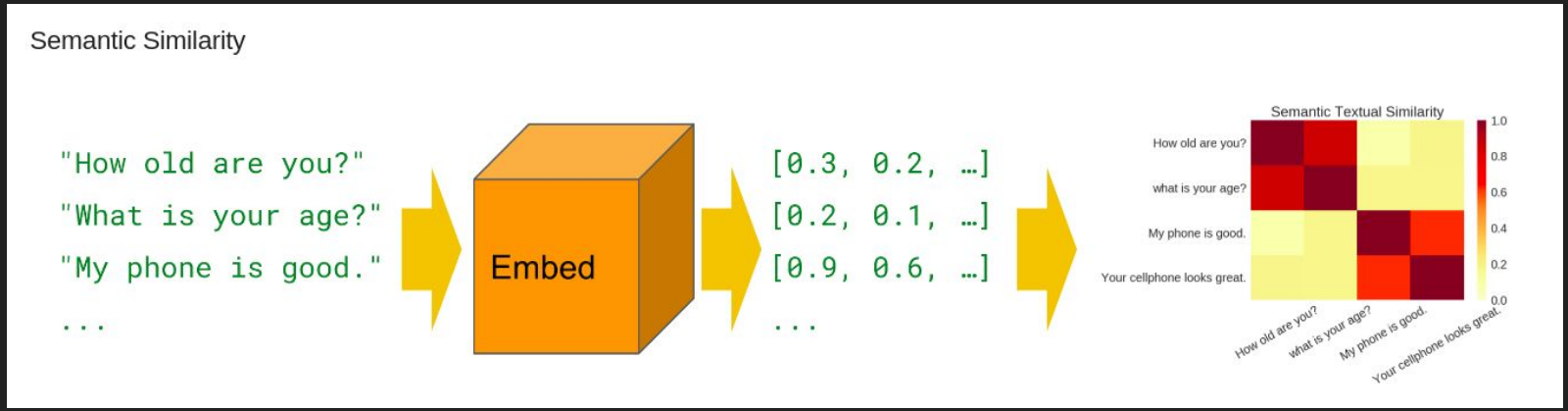
- [He et al., 2016] He, K., Zhang, X., Ren, S., & Sun, J. (2016). Deep residual learning for image recognition. In Proceedings of the IEEE conference on computer vision and pattern recognition (pp. 770-778).

- [Huang et al., 2017]]Huang, G., Liu, Z., Van Der Maaten, L., & Weinberger, K. Q. (2017). Densely connected convolutional networks. In Proceedings of the IEEE conference on computer vision and pattern recognition (pp. 4700-4708).

Image Sources

- [Chefkoch Logo]
- [Essen und Trinken Logo] https://www.essen-und-trinken.de/
- [Fddb Logo] https://fddb.info/
- [Die Nährwerttabelle] https://www.beck-shop.de/heseker-dipl-oec-troph-heseker-naehrwerttabelle/product/27851725
- [Lecker.de Logo] https://www.lecker.de/einfacher-apfelkuchen-69347.html

Universal Sentence Encoder

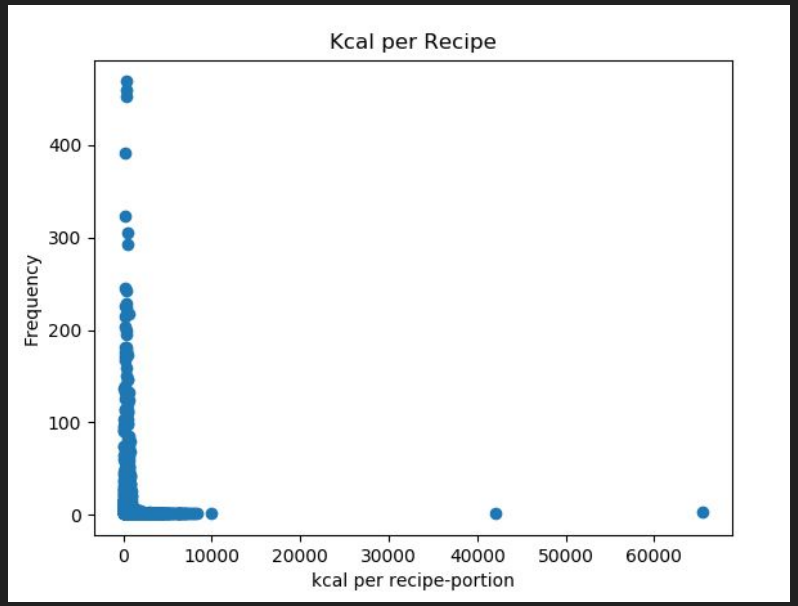


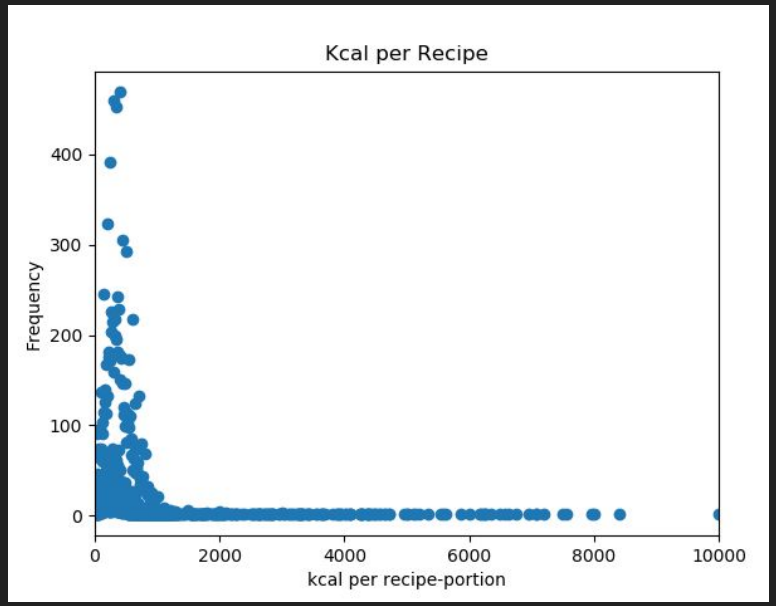
[Cer et al., 2018] Daniel Cer, Yinfei Yang, Sheng-yi Kong, Nan Hua, Nicole Limtiaco, Rhomni St. John, Noah Constant, Mario Guajardo-Céspedes, Steve Yuan, Chris Tar, Yun-Hsuan Sung, Brian Strope, Ray Kurzweil. Universal Sentence Encoder. arXiv:1803.11175, 2018.

baseline_v2 100g:

kcal mean: 189.2
kcal std: 73.2
kcal l1_train: 61.6
kcal l1_val: 60.5
kcal rel_error_val 0.464
protein mean: 6.6
protein std: 3.9
baseline.py:20: RuntimeWarning: divide by zero encountered in true_divide
  ret = torch.abs(1 - pred / truth)
protein l1_train: 3.1
protein l1_val: 3.1
protein rel_error_val inf
fat mean: 9.2
fat std: 5.7
fat l1_train: 4.6
fat l1_val: 4.5
fat rel_error_val inf
carbohydrates mean: 19.0
carbohydrates std: 13.1
carbohydrates l1_train: 10.6
carbohydrates l1_val: 10.5
carbohydrates rel_error_val inf

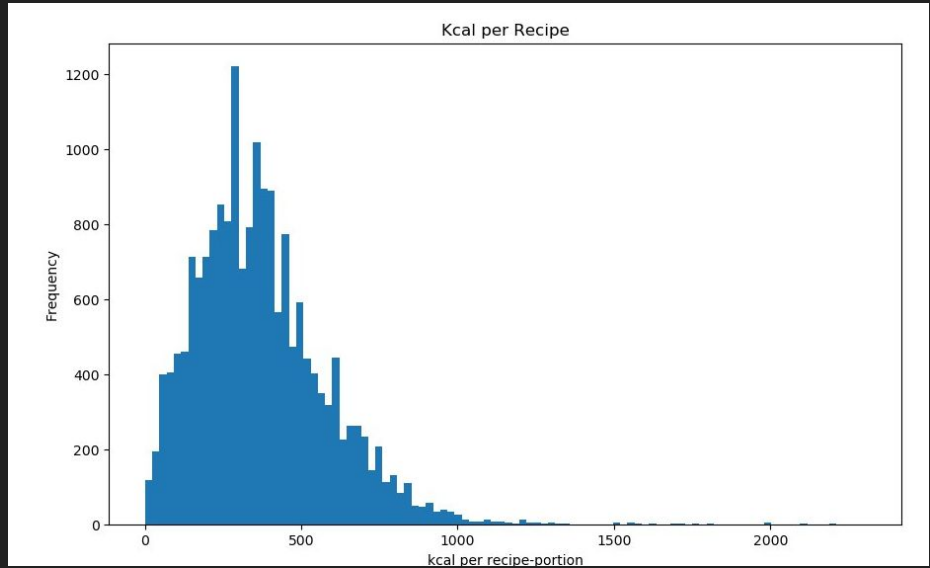
Data


Kcal per Recipe
Frequency
0
100
200
300
400
0
10000
20000
30000
40000
50000
60000
kcal per recipe-portion


Kcal per Recipe
Frequency
0
100
200
300
400
0
2000
4000
6000
8000
10000
kcal per recipe-portion

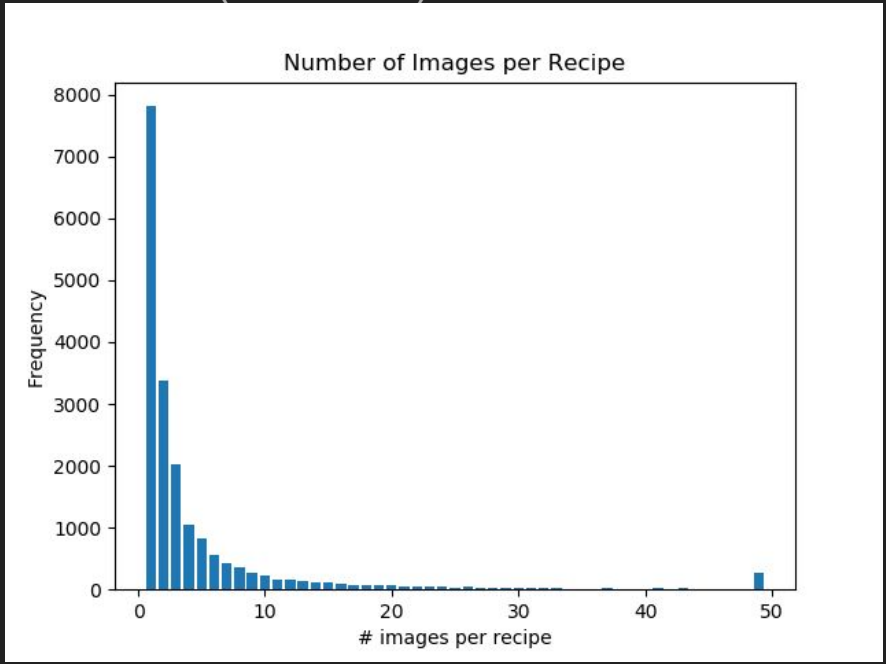
Data Filtering

- Original data distribution:
  - range [1, 65535]
- Filter all data points outside of +-2σ
  - new range: [1, 2302]
  - removed 128 of 18843 samples

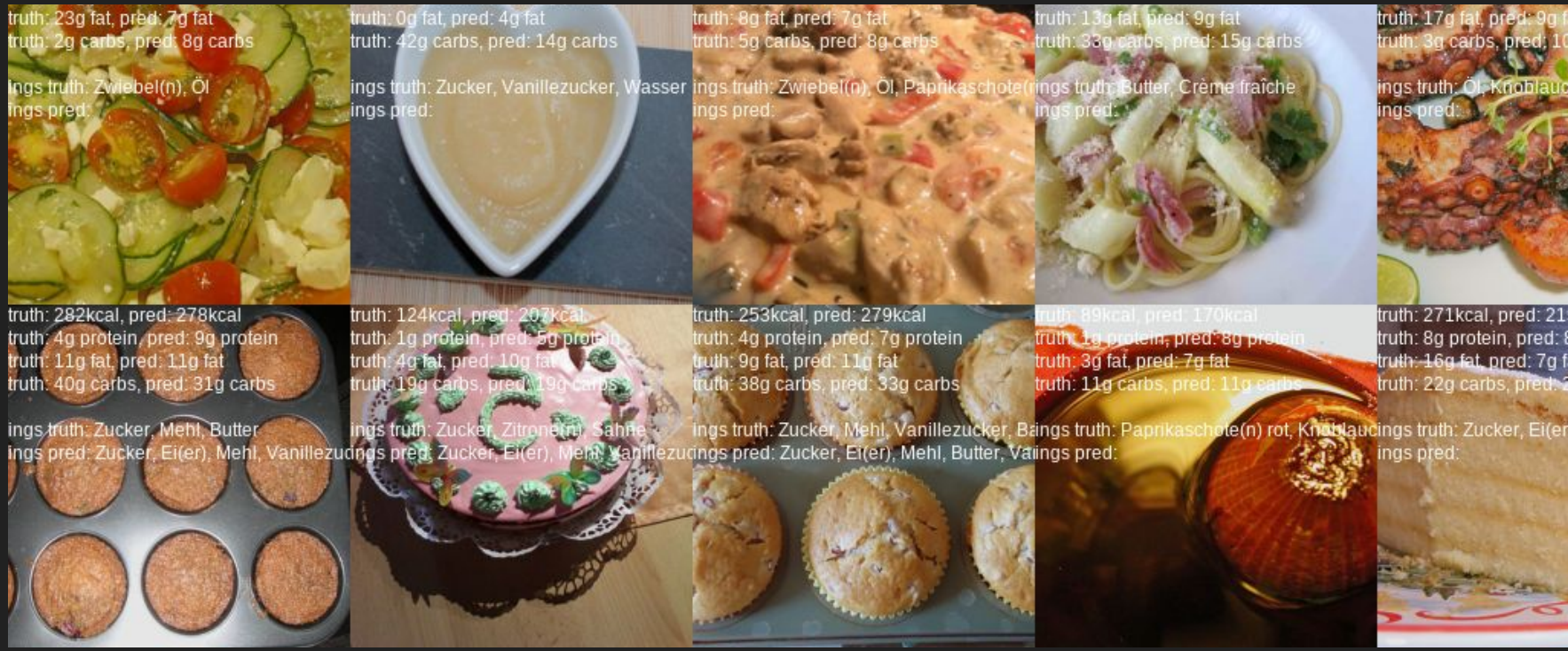


Data

- Recipes from Chefkoch (with kcal)



Results


truth: 23g fat, pred: 7g fat
truth: 2g carbs, pred: 8g carbs
ings truth: Zwiebel(n), Öl
ings pred:
truth: 0g fat, pred: 4g fat
truth: 42g carbs, pred: 14g carbs
ings truth: Zucker, Vanillezucker, Wasser
ings pred:
truth: 8g fat, pred: 7g fat
truth: 5g carbs, pred: 8g carbs
ings truth: Zwiebel(n), Öl, Paprikaschote(
ings pred:
truth: 13g fat, pred: 9g fat
truth: 33g carbs, pred: 15g carbs
ings truth: Butter, Crème fraîche
ings pred:
truth: 17g fat, pred: 9g f
truth: 3g carbs, pred: 10
ings truth: Öl, Knoblauc
ings pred:
truth: 282kcal, pred: 278kcal
truth: 4g protein, pred: 9g protein
truth: 11g fat, pred: 11g fat
truth: 40g carbs, pred: 31g carbs
ings truth: Zucker, Mehl, Butter
ings pred: Zucker, Ei(er), Mehl, Vanillezu
truth: 124kcal, pred: 207kcal
truth: 1g protein, pred: 5g protein
truth: 4g fat, pred: 10g fat
truth: 19g carbs, pred: 19g carbs
ings truth: Zucker, Zitrone(n), Sahne
ings pred: Zucker, Ei(er), Mehl, Vanillezu
truth: 253kcal, pred: 279kcal
truth: 4g protein, pred: 7g protein
truth: 9g fat, pred: 11g fat
truth: 38g carbs, pred: 33g carbs
ings truth: Zucker, Mehl, Vanillezucker, B
ings pred: Zucker, Ei(er), Mehl, Butter, Va
truth: 89kcal, pred: 170kcal
truth: 1g protein, pred: 8g protein
truth: 3g fat, pred: 7g fat
truth: 11g carbs, pred: 11g carbs
ings truth: Paprikaschote(n) rot, Knoblauc
ings pred:
truth: 271kcal, pred: 21
truth: 8g protein, pred: 8
truth: 16g fat, pred: 7g f
truth: 22g carbs, pred: 2
ings truth: Zucker, Ei(er
ings pred: