

Lab 3-4

Applications of machine learning in creating personalized meal recipes.

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Abstract

Short description of the research project

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An introduction of the ideas behind the research project, expected outcomes

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Reference to previous work that has been done in the field

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Detailed presentation of the methods used in the development of the AI and the creation of a UI, proposed user-based studies for analysis of results

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Drawing conclusions from the results, as well as a comparison with the previously expected outcomes

7. References

References to the books and research papers that have been use as a reference

Hypothesis:

The main scope of the research project is to observe the way in which a food recommender system can be implemented such that it provides useful recommendations for the users based on their preferences, food inventory, and dietary needs.

The research project focuses as well on the use of Deep Learning techniques for creating personalized recipes. The deep learning technique that the project would focus on is Reinforcement Learning. This technique revolves around the use of a training algorithm that allows the learning agent to learn and find the best solution (in this case best recommendation) for the given training data.

Methodology:

First of all, the process of the creation of the learning agent involves the creation of a training dataset, using preexisting datasets or by creating new datasets.

Then the learning agent should be created, and it should start its learning process, by repeating the operations as many times as possible it is insured that the learning agent can make the best decisions in its environment.

After the perfection of the agent, a user interface should be provided such that the user can Interact with the AI in as simple and frictionless a manner as possible.

After the interaction with the user base, results can be compiled and conclusions can be drawn as to the accuracy of the learning agent in a real-world environment, as well as the satisfaction of the user base.

Original contribution:

The original part of the contribution is that the developed AI can tailor a recommendation based on multiple factors, such as the users' food inventory, general preferences and or dietary needs. Previous research has focused on only one branch, be it by creating a recipe based on a given dietary need or a recipe based on the food inventory available. This approach should combine these elements such that it provides a more cohesive experience for the user, and ultimately it becomes a more useful tool for daily use.

Experiments to be done:

Some of the experiments to be done are the creation of a learning agent that can provide the best recipe based on the needs of the user, or his food inventory. Second of all, it should be observed just how closely the provided recipe correlates to the result the user expects. Data should be correlated as well between the original aim of the project, the results that were expected from it, and the results after a learning agent has been fully developed and the users have interacted with it and have given their feedback.

Research questions:

- a. How can a learning agent be developed to tailor to dietary needs and preferences?
- b. What is the best deep learning method for the creation of a recommendation system?
- c. How can the dataset influence the behavior of the learning agent?
- d. How can the users' preferences, food inventory, and dietary needs all be used to develop a learning agent?
- e. How can these three prerequisites influence the output of the AI?
- f. How can the interface allow for best insertion of data, with minimal user input?
- g. How can an interface be designed to best bridge the gap between the Ai and the user base?

References

1. M. S. Razzaq, F. Maqbool, M. Ilyas and H. Jabeen, "EvoRecipes: A Generative Approach for Evolving Context-Aware Recipes," in *IEEE Access*, vol. 11, pp. 74148-74164, 2023, doi: 10.1109/ACCESS.2023.3296144.
2. Roither, A.; Kurz, M.; Sonnleitner, E. The Chef's Choice: System for Allergen and Style Classification in Recipes. *Appl. Sci.* **2022**, *12*, 2590. <https://doi.org/10.3390/app12052590>
3. A. Ajami, B Teimourpour, "A Food Recommender System in Academic Environments Based on Machine Learning Models" <https://arxiv.org/pdf/2306.16528.pdf>
4. Singh , T Kaderji, "Recipe Generation From Food Images With Deep Learning" <https://abhivruddhi.mituniversity.ac.in/wp-content/uploads/2023/08/RECIPEGENERATION-FROM-FOOD-IMAGES-WITH-DEEP-LEARNING.pdf>
5. Qing Zhang, David Elswiler, Christoph Trattner, "Understanding and predicting cross- cultural food preferences with online recipe images" <https://www.sciencedirect.com/science/article/abs/pii/S0306457323001802>
6. Teng, C.Y.; Lin, Y.R.; Adamic, L.A. Recipe recommendation using ingredient networks. In *Proceedings of the WebSci '12 4th Annual ACM Web Science Conference Association for Computing Machinery, New York, NY, USA, 22–24 June 2012*; pp. 298–307.

7. Su, H.; Lin, T.W.; Li, C.T.; Shan, M.K.; Chang, J. Automatic recipe cuisine classification by ingredients. In Proceedings of the 2014 ACM International Joint Conference on Pervasive and Ubiquitous Computing: Adjunct Publication; Association for Computing Machinery, New York, NY, USA, 13–17 September 2014; pp. 565–570.
8. Ueda, M.; Takahata, M.; Nakajima, S. User's food preference extraction for personalized cooking recipe recommendation. In Proceedings of the Second International Conference on Semantic Personalized Information Management: Retrieval and Recommendation, Bonn, Germany, 24 October 2011; Volume 781, pp. 98–105.
9. Freyne, J., and Berkovsky, S. Intelligent food planning: personalized recipe recommendation. In *IUI*, ACM (2010), 321--324.
10. Kamieth, F., Braun, A., and Schlehuber, C. Adaptive implicit interaction for healthy nutrition and food intake supervision. "Human-Computer Interaction. Towards Mobile and Intelligent Interaction Environments "(2011), 205--212.
11. Ueda, M., Takahata, M., and Nakajima, S. User's food preference extraction for personalized cooking recipe recommendation. *Proc. of the Second Workshop on Semantic Personalized Information Management: Retrieval and Recommendation* (2011).
12. H. Jabeen, J. Weinz and J. Lehmann, "AutoChef: Automated generation of cooking recipes", *Proc. IEEE Congr. Evol. Comput. (CEC)*, pp. 1-7, Jul. 2020.
13. S. S. Shirai, O. Seneviratne, M. E. Gordon, C.-H. Chen and D. L. McGuinness, "Identifying ingredient substitutions using a knowledge graph of food", *Frontiers Artif. Intell.*, vol. 3, Jan. 2021.
14. A. F. U. R. Khilji, R. Manna, S. R. Laskar, P. Pakray, D. Das, S. Bandyopadhyay, et al., "CookingQA: Answering questions and recommending recipes based on ingredients", *Arabian J. Sci. Eng.*, vol. 46, no. 4, pp. 3701-3712, Apr. 2021.
15. Y. Pan, Q. Xu and Y. Li, "Food recipe alternation and generation with natural language processing techniques", *Proc. IEEE 36th Int. Conf. Data Eng. Workshops (ICDEW)*, pp. 94-97, Apr. 2020.
16. R. D. Lawrence, G. S. Almasi, V. Kotlyar, M. S. Viveros, and S. S. Duri. Personalization of supermarket product recommendations. *Data Min. Knowl. Discov.*, 5(1-2):11--32, 2001.
17. J. Sobecki, E. Babiak, and M. Slanina. Application of hybrid recommendation in web-based cooking assistant. In Proceedings of the Tenth Conference on Knowledge-Based Intelligent Information and Engineering Systems, pages 797--804, 2006.
18. Hammond, Kristian J.. "CHEF: A Model of Case-Based Planning." *AAAI Conference on Artificial Intelligence* (1986).
19. Shihono Karikome and Atsushi Fujii. A System for Supporting Dietary Habits: Planning Menus and Visualizing Nutritional Intake Balance. Proceedings of the 4th International Conference on Ubiquitous Information Management and Communication, pp.386-391. 2009
20. Yoko Mino and Ichiro Kobayashi. Recipe Recommendation for a Diet Considering a User's Schedule and the Balance of Nourishment. Proceedings of IEEE International Conference on Intelligent Computing and Intelligent Systems 2009, pp.383-387. 2009.