

Parsons Problems

Barbara Ericson and her PhD students have been developing and testing several types of Parsons problems: adaptive, micro, and personalized. In Parsons problems the student puts blocks into order to solve a problem. The problem can have extra blocks called distractors. The distractors can either be shown paired with the correct code block (shown with purple edges in the following figure) or distractors that are randomly mixed in with the correct code blocks.

There are two types of adaptation: intra-problem and inter-problem. In intra-problem adaptation if the user is struggling to solve the current problem it can dynamically be made easier by removing distractions, providing indentation, or combining blocks. In inter-problem adaptation the difficulty of the next problem is dependent on the learner's performance on the last problem. If the learner solved the last problem easily the next problem is made harder by increasing the number of distractors used and/or by unpairing distractors. If the learner struggled to solve the last problem then the next problem is made easier by removing distractors and pairing distractors and the correct code.

In micro Parsons problems a student puts blocks in order to create a single statement.

Construct a regex that matches both `cat` and `cats` .

Drag or click the blocks below to form your code:

*

Your code (click on a block to remove it):

cat

s

?

Perfect! It took you only one try to solve this. Great job!

Activity: 12.11.1 MicroParsons (hp-optional_cats)

In a personalized Parsons problem, if the student asks for help after writing some incorrect code to solve a problem we use an LLM to generate a Parsons problem from the closest correct code.

Available Domains

We have been creating ebooks that use Python, Java, and C. Hundreds of Parsons problems are available in each ebook. The Parsons software could be used for any language (including English).

Supported integration protocols for sign-on and data logging

The Runestone platform supports LTI. It also logs all interaction in the ebook including page views, practice problem answers, and code submissions. It logs every move of a block in a Parson problem as well as any adaptation.

Parsons Problems Publications

Hou, X., Wu, Z., Wang, X., & Ericson, B. J. (2024, July). Codetailor: Llm-powered personalized parsons puzzles for engaging support while learning programming. In *Proceedings of the Eleventh ACM Conference on Learning@ Scale* (pp. 51-62).

Wu, Z., & Ericson, B. J. (2024, May). SQL Puzzles: Evaluating Micro Parsons Problems With Different Feedbacks as Practice for Novices. In *Proceedings of the CHI Conference on Human Factors in Computing Systems* (pp. 1-15).

Hou, X., Ericson, B. J., & Wang, X. (2023, November). Understanding the Effects of Using Parsons Problems to Scaffold Code Writing for Students with Varying CS Self-Efficacy Levels. In *Proceedings of the 23rd Koli Calling International Conference on Computing Education Research* (pp. 1-12).

Wu, Z., Ericson, B. J., & Brooks, C. (2023, June). Using Micro Parsons Problems to Scaffold the Learning of Regular Expressions. In *Proceedings of the 2023 Conference on Innovation and Technology in Computer Science Education V. 1* (pp. 457-463).

Ericson, B., & Haynes-Magyar, C. (2022, July). Adaptive Parsons Problems as Active Learning Activities During Lecture. In *Proceedings of the 27th ACM Conference on Innovation and Technology in Computer Science Education Vol. 1* (pp. 290-296).

Ericson, B. J., Denny, P., Prather, J., Duran, R., Hellas, A., Leinonen, J., Miller, C., Morrison, B., Pearce, J. & Rodger, S. H. (2022). Parsons Problems and Beyond: Systematic Literature Review and Empirical Study Designs. In *Proceedings of the 2022 Working Group Reports on Innovation and Technology in Computer Science Education* (pp. 191-234).

Haynes-Magyar, C., & Ericson, B. (2022, November). The Impact of Solving Adaptive Parsons Problems with Common and Uncommon Solutions. In *Proceedings of the 22nd Koli Calling International Conference on Computing Education Research* (pp. 1-14).

Hou, X., Ericson, B. J., & Wang, X. (2022, August). Using Adaptive Parsons Problems to Scaffold Write-Code Problems. In *Proceedings of the 2022 ACM Conference on International Computing Education Research Vol. 1* (pp. 15-26).

Haynes, C. & Ericson B. (2021, May). Problem-Solving Efficiency and Cognitive Load for Adaptive Parsons Problems vs. Writing the Equivalent Code. In *Proceedings of the CHI Conference on Human Factors in Computing Systems (CHI '21)*. Association for Computing Machinery, New York, NY, USA, Article 60, 1-15.: <https://doi.org/10.1145/3411764.3445292>

Ericson, B., McCall, A. & Cunningham, K. (2019, November). Investigating the Affect and Effect of Adaptive Parsons Problems. In *Proceedings of the 19th Koli Calling International Conference on Computing Education Research* (pp. 1-10).

Barbara J. Ericson, James D. Foley, and Jochen Rick. 2018. Evaluating the Efficiency and Effectiveness of Adaptive Parsons Problems. In *Proceedings of the 2018 ACM Conference on International Computing Education Research (ICER '18)*. ACM, New York, NY, USA, 60-68. DOI: <https://doi.org/10.1145/3230977.3231000>

Barbara J. Ericson, Lauren E. Margulieux, and Jochen Rick. 2017. Solving parsons problems versus fixing and writing code. In *Proceedings of the 17th Koli Calling International Conference on Computing Education Research (Koli Calling '17)*. ACM, New York, NY, USA, 20-29. DOI: <https://doi.org/10.1145/3141880.3141895>

Barbara J. Ericson, Kantwon Rogers, Miranda Parker, Briana Morrison, and Mark Guzdial. 2016. Identifying Design Principles for CS Teacher Ebooks through Design-Based Research. In *Proceedings of the 2016 ACM Conference on International Computing Education Research (ICER '16)*. ACM, New York, NY, USA, 191-200. DOI: <https://doi.org/10.1145/2960310.2960335>

Briana B. Morrison, Lauren E. Margulieux, Barbara Ericson, and Mark Guzdial. 2016. Subgoals Help Students Solve Parsons Problems. In *Proceedings of the 47th ACM Technical Symposium on Computing Science Education (SIGCSE '16)*. ACM, New York, NY, USA, 42-47. DOI: <https://doi.org/10.1145/2839509.2844617>

Barbara J. Ericson, Mark J. Guzdial, and Briana B. Morrison. 2015. Analysis of Interactive Features Designed to Enhance Learning in an Ebook. In *Proceedings of the eleventh annual International Conference on International Computing Education Research (ICER '15)*. ACM, New York, NY, USA, 169-178. DOI: <https://doi.org/10.1145/2787622.2787731>

Links

<https://github.com/RunestoneInteractive/rs> - source for Runestone

The source for the ebooks is also available on github. See

<https://github.com/RunestoneInteractive>.