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Ailon et al.: Preference-Based Learning to Rank **ailon10**

N. Ailon and M. Mohri. "Preference-Based Learning to Rank." In: *Machine Learning* 80.2–3 (2010), pp. 189–211. Springer.

- useful keywords for future search: prefence-learning to rank, prefernce-based, score-based
- some pointers to other learning to rank literature
- otherwise based on binary classification, thus probably not relevant here

Ayaz et al.: Tangram Solved? Prefrontal Cortex Activation Analysis During Geometric Problem Solving **ayaz12**

H. Ayaz, P. A. Shewokis, M. Izzetoglu, M. Cakir, and B. Onaral. "Tangram Solved? Prefrontal Cortex Activation Analysis During Geometric Problem Solving." In: *Engineering in Medicine and Biology Society (EMBC), 2012 Annual International Conference of the IEEE*. IEEE. 2012, pp. 4724–4727.

- experiment to measure brain activity during solving of a tangram
- right hemisphere is more active
- increase in brain activity similar to other cognitive tasks
- difference to arithmetic tasks with linguistic representation?

Baran et al.: How Do Adults Solve Digital Tangram Problems? Analyzing Cognitive Strategies Through Eye Tracking Approach **baran07**

B. Baran, B. Dogusoy, and K. Cagiltay. "How Do Adults Solve Digital Tangram Problems? Analyzing Cognitive Strategies Through Eye Tracking Approach." In: *Human-Computer Interaction. HCI Intelligent Multimodal Interaction Environments*. Ed. by J. A. Jacko. Vol. 4552. LNCS. Springer, 2007, pp. 555–563.

- comparision of solution approaches for tangrams with vayring difficulty
- differences shown in fixation cound, task completion duration and transition number, part of the screen most focused on

Bell: Solving Tangrams Using JTS **bell12**

B. Bell. *Solving Tangrams Using JTS*. Sept. 24, 2012. URL: `https://bjbell.wordpress.com/2012/09/24/solving-tangrams-using-jts/` (visited on 02/01/2015).

- difficulties when using floating point arithmetic
- take advantage of symmetry of the tangram pieces (e.g. use only one line segment of the sqare and only 2 of the 3 line segments of trianges)

- use heuristitcs when deciding which piece to fit first (e.g. use bigger pieces first and skip pieces when an identical piece has already failed to fit into a space (could this be relevant in generation)

Cai et al.: The Research on the Difficulty Grade and the Piecing Skills of Tangram cai08

S. Cai, Y. Jiang, and M. Zeng. *The Research on the Difficulty Grade and the Piecing Skills of Tangram*. Shenzheng Foreign Languages School. 2008. URL: `http://www.yau-awards.org/Notice.php` (visited on 1/19/2015).

- description of three ways to calculate the probability of the pattern, each requires to know all possible solutions to the pattern
- 1. way: probability based on correct placement of a piece and number of ways it could be placed (number of rotations that result into a different piece) - measure should result in the same probability for each solution and is just scaled by number of solutions (which is later scaled according to experiments again?)
- 2. way: probabilty based on possibilites to reach a certain length, unclear which length are being taken into account
- 3. way: probability based on cutting of basic shapes
- overall:
- patterns that are more regular are harder, patterns where there is only one possibilty to place a piece a easier.
- seems computationally costly to automate (full solution computation and multiple orders of placement)
- (very bad English, should this be cited?)

Cheng et al.: An Algorithm for Automatic Difficulty Level Estimation of Multimedia Mathematical Test Items cheng08

I. Cheng, R. Shen, and A. Basu. "An Algorithm for Automatic Difficulty Level Estimation of Multimedia Mathematical Test Items." In: *ICALT '08 Proceedings of the 2008 Eighth IEEE International Conference on Advanced Learning Technologies*. IEEE. 2008, pp. 175–179.

- automatic difficulty estimation for computer-adaptive testing
- somehow based on response time
- more about how to construct the optimal test for each student using Item Responce Theory (more difficult when correct answer, easier when wrong answer)

Cocchini: Wanderings Around Tangram cocchini10

F. Cocchini. *Wanderings Around Tangram*. Lulu.com, 2010.

- hard patterns have as many matched edges and vertices as possible
- percentage X of how far of the patters is from being convex

- not written very good, only 3 chapters available

Coffin: The Puzzling World of Polyhedral Dissections - Chapter 1 - Two-Dimensional Dissections **coffin98**

S. T. Coffin. *The Puzzling World of Polyhedral Dissections - Chapter 1 - Two-Dimensional Dissections*. Ed. by J. Rausch. 1998. URL: `http://www.johnrausch.com/PuzzlingWorld/chap01.htm` (visited on 02/01/2015).

- tangram pieces arise when putting a diagonal square grid over the sqare -> each dissection line either follows the grid or diagonals of the grid (Figure 7)
- pieces made up of unit triangles, three of them "made up of two unit triangles joined all possible ways"
- figures created by arranging the pieces artistically are usually not considered to be true geometrical constructions since they to not conform to a regular grid
- examples for paradoxes (Figure 11)
- mentions multiple other dissection puzzles similar to the tangram, e.g. formed by using a finer grid, or cutting differently along the original square grid
- geometrical dissection usually refers to something else: "two different polygons being formed from the same set of pieces"

Cohene et al.: The Making of the Tangrambler **cohene02**

T. Cohene, S. Dack, O. Dufourmantelle, and M. Saunders. "The Making of the Tangrambler." In: *Human-Computer Interaction* 304 (2002), 424B.

- description of the design of a physical imlementation of a Tangram game in several steps
- much analysis and evaluation based on HCI principles (as development of the prototype was part of an HCI course)
- Tangram also called "seven shapes of cleverness"

Deutsch et al.: A Heuristic Solution to the Tangram Puzzle **deutsch72**

E. S. Deutsch and K. C. Hayes Jr. "A Heuristic Solution to the Tangram Puzzle." In: *Machine Intelligence* 7.Bernard Meltzer and Donald Michie (1972), pp. 205–240. Edinburgh University Press.

- pieces are either three
- or four-sided $\rightarrow$ reduces the number of common edges two or more pieces can share
- proposed solution does not work for every tangram (puzzles with holes for example)
- combinatorics approach involves large amount of computation

– heuristic approach uses number of rules that are applied successively in a certain order
– based on splitting the puzzle in easier subpuzzles
– "number of corners or vertices of a tangram shape contains considerable information" $\rightarrow$ less corners give less information about the structure and how pieces are placed $\rightarrow$ solution for puzzles for 11 corners or more
– save tangram (Figure 4) as vertices' numbers and edge links (node
– (x,y) cords
– linked to node, edge length, direction)
– computation of so-called extension lines $\rightarrow$ convex (location of a piece) and concave (location of a line connecting two pieces) type vertices $\rightarrow$ disregard lines that are too short to support a puzzle piece or extension lines that are too close to a parallel edge
– multiple matching rules $\rightarrow$ direct, trying to fit multiple pieces all at once (composites also only three
– or four-sided)
– possible hints on how to find all possible location for one puzzle piece (?)

Duh et al.: Learning to Rank with Partially-Labeled Data **duh08**

K. Duh and K. Kirchhoff. "Learning to Rank with Partially-Labeled Data." In: *Proceedings of the 31st Annual International ACM SIGIR Conference on Research and Development in Information Retrieval*. ACM. 2008, pp. 251–258.

– usage of unlabeled test data to improve ranking, generating better features and incoorporating those features
– unsupervised learning algorithm to find pattern, then project training data onto these patterns and use resulting numerical values as new features
– keyword: Learning to Rank with missing labels

Eberle: The Role of Children's Mathematical Aesthetics: The Case of Tessellations **eberle14**

R. S. Eberle. "The Role of Children's Mathematical Aesthetics: The Case of Tessellations." In: *The Journal of Mathematical Behavior* 35 (2014), pp. 129–143.

– study of children's aesthatics concering tessellations and comparison of mathematician's view on them
– critia usually mentioned by mathematicians when evaluating theorems or proofs: significance or depth, surprice, simplicity (clarity or elegance), connectedness and visual appeal
– "aesthetic judgment depends on one's background knowledge"

- "mathematical aesthetics serves three roles in education: a motivational role, a generative role, and an evaluative role"
- experiment: let chilren create tessellations and talk about them and given ones (partially in groups); then analyze what they have been saying
- number of aestetic themes (in total 18) emerge from analysis, most often mentioned: Real World Connection, Color, Complexity, Uniqueness, Energy, Interconnectedness → "neither too simple nor too complex were usually the most interesting"
- additionally often mentioned by mathematicians (but not so often by children): Dimensionality, Symmetry, Surprise, Randomness
- children more confident when creating symmetric patterns, preferring convex shapes

Eisenman et al.: Aesthetic Preferences of Art Students and Mathematics Students **eisenman64**

R. Eisenman and S. Coffee. "Aesthetic Preferences of Art Students and Mathematics Students." In: *Journal of Psychology* 58 (1964), pp. 375–378.

- create art-students prefer complex, often asymmartical polygons, while math-students prefer symmetrical ones
- Birgkhoff as mathematicians may have been biased towards simpler shapes when devising his formula
- results are "inconsistentwith an abjectivist viewpoint which maintains that there is something inherent within objects that makes them universally beautiful

Elffers: Tangram. Das alte chinesische Formenspiel **elffers76**

J. Elffers. *Tangram. Das alte chinesische Formenspiel*. Du Mont, 1978.

- in Chinese: "Weisheitsbrett" or "Sieben-Schlau-Brett" or "Ch'i Ch'ae pan, where Ch'i Ch'ae refers to an ancient chinese custom where on the seventh day of the seventh month a thread is put through a needle with seven eyes for good luck
- convexity of tangrams and why there are only 13 convex tangram shapes (with formulas)
- mathematical grid-tangrams have a convexity-number (how many base triangles have to be added to a tangram shape in order to make it convex in the best case)
- many examples

Faria et al.: Learning to Rank for Content-Based Image Retrieval **faria20**

F. F. Faria, A. Veloso, H. M. Almeida, E. Valle, R. d. S. Torres, M. A. Gonçalves, and W. Meira Jr. "Learning to Rank for Content-Based Image Retrieval." In: *Proceedings of the International Conference on Multimedia Information Retrieval*. ACM. 2010, pp. 285–294

. Filonik et al.: Measuring Aesthetics for Information Visualization **filonik09**

D. Filonik and D. Baur. "Measuring Aesthetics for Information Visualization." In: *Information Visualisation, 2009 13th International Conference*. IEEE. 2009, pp. 579–584

. Fox-Epstein et al.: The Convex Configurations of "Sei Shonagon Chie no Ita" and Other Dissection Puzzles **foxepstein14**

E. Fox-Epstein and R. Uehara. "The Convex Configurations of "Sei Shonagon Chie no Ita" and Other Dissection Puzzles." In: (2014). arxiv preprint: `arxiv:1407.1923v1[cs.CG]`

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P. Galanter. "Computational Aesthetic Evaluation: Past and Future." In: *Computers and Creativity*. Springer, 2012, pp. 255–293

. Galanter: Computational Aesthetic Evaluation: Steps Towards Machine Creativity **galanter12a**

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C. A. Garabedian. "Birkhoff on Aesthetic Measure." In: *Bulletin of the American Mathematical Society* 40.1 (1934), pp. 7–10. American Mathematical Society

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D. Goldberg, C. Malon, and M. Bern. "A Global Approach to Automatic Solution of Jigsaw Puzzles." In: *Proceedings of the Eighteenth Annual Symposium on Computational Geometry*. ACM. 2002, pp. 82–87

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K. Haraguchi, Y. Abe, and A. Maruoka. "How to Produce BlockSum Instances with Various Levels of Difficulty." In: *Journal of Information Processing* 20.3 (2012), pp. 727–737

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C. He, C. Wang, Y.-X. Zhong, and R.-F. Li. "A Survey on Learning to Rank." In: *2008 International Conference on Machine Learning and Cybernetics*. Vol. 3. IEEE. 2008, pp. 1734–1739

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M. Hunt, C. Pong, and G. Tucker. “Difficulty-Driven Sudoku Puzzle Generation.” In: *UMAP Journal* (2007), pp. 343–362

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P. Jarušek and R. Pelánek. “Difficulty Rating of Sokoban Puzzle.” In: *STAIRS 2010: Proceedings of the Fifth Starting AI Researchers’ Symposium*. IOS Press. 2010, p. 140

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D. Joshi, R. Datta, E. Fedorovskaya, Q.-T. Luong, J. Z. Wang, J. Li, and J. Luo. “Aesthetics and Emotions in Images.” In: *Signal Processing Magazine* 28.5 (2011), pp. 94–115

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S. Z. Kovalsky, D. Glasner, and R. Basri. “A Global Approach for Solving Edge-Matching Puzzles.” In: (2014). arXiv preprint: `arXiv:1409.5957v1[cs.CV]`

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E. V. Perez, L. M. R. Santos, M. J. V. Perez, J. P. de Castro Fernandez, and R. G. Martin. "Automatic classification of question difficulty level: Teachers' estimation vs. students' perception." In: *Frontiers in Education Conference (FIE), 2012*. IEEE. 2012, pp. 1–5

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P. Scott. "Convex Tangrams." In: *Australian Mathematics Teacher* 62.2 (2006), pp. 2–5. ERIC

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M. Siqueira Júnior, R. M. Alves, E. W. G. Clua, E. B. Passos, C. R. d. Silva, A. A. Montenegro, and J. C. Oliveira. “A Novel Algorithm to Verify the Solution of Geometric Puzzle Games.” In: *Proceedings of the 2009 VIII Brazilian Symposium on Games and Digital Entertainment*. IEEE Computer Society. 2009, pp. 9–16

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J. Slocum. *The Tangram Book*. Sterling Publishing, 2003.

- Sam Loyds book full of errors (7)
- mention of Japanese dissection puzzle (Sei Shonagon) (12)
- proof of pythagoran theorem as origin of tangrams? (15)
- name not originally chinese (23)
- found original, mostly later, dates to published tangrams claimed to have other publishing dates (60)
- paradoxal tangrams (100)
- many tangram examples

Spencer et al.: An Introduction to the Golden Tangram and its Tiling Properties **spencer05**

S. Spencer et al. “An Introduction to the Golden Tangram and its Tiling Properties.” In: *Renaissance Banff: Mathematics, Music, Art, Culture*. Canadian Mathematical Society. 2005, pp. 31–36

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