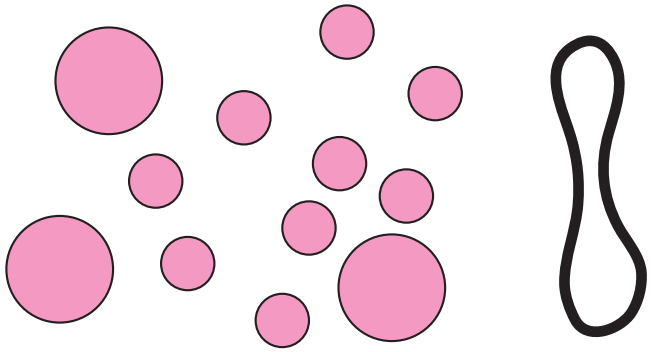
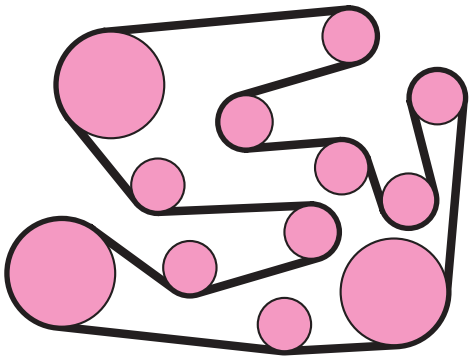
Conveyer Belt Puzzle Font

Erik D. Demaine* Martin L. Demaine* Belén Palop†

Suppose you have a bunch of circular gears glued to a table (disks in the plane), as in Figure 1a. When can you wrap a conveyer belt (or elastic band) around them so that the belt touches every gear and is taut, as in Figure 1b? This open problem was posed by Manual Abellanas in 2001, and recently appeared in [Abe08]. It has been studied by several computational geometers, including the present authors, to no avail. Perhaps the most tantalizing special case is when all the gears have the same size. It appears that it is always possible to wrap a conveyer belt around equal-size gears, but this problem also remains open.



(a) Input



(b) Goal

Figure 1: Conveyer belt open problem.

Recently we designed a font to illustrate this open problem [DDP10], shown in Figure 2. Each letter of the font is a set of equal-size gears with the property that exactly one solution to the conveyer-belt problem outlines a letter.

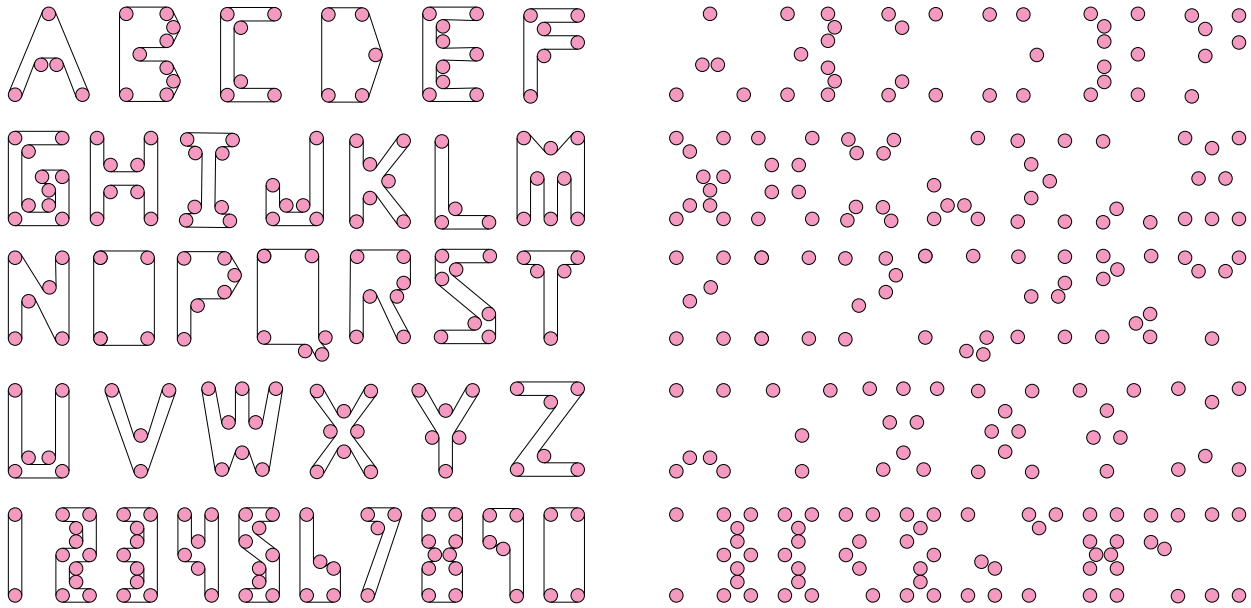
Presented with the belts, as in Figure 2a, the font is easy to read. But presented without the belts, as in Figure 2b, messages written in the font become a puzzle to read. The intended solution to such a puzzle is to solve several instances of the conveyer-belt open problem. Another approach is to treat the pattern as a geometric substitution cipher, look for patterns, and try to match patterns to letters. Likely the best strategy is a combination of both.

In the following pages, we provide a series of such puzzles with hidden messages. These puzzles were created using a freely available web application,[1] which you can use to generate your own puzzles.

*MIT Computer Science and Artificial Intelligence Laboratory, 32 Vassar St., Cambridge, MA 02139, USA, {edemaine,mdemaine,jasonku}@mit.edu

†Departamento de Informática, Universidad de Valladolid, Escuela Técnica Superior de Ingeniera Informática, Campus Miguel Delibes s/n, 47011 Valladolid, Spain.

[1] http://erikdemaine.org/fonts/conveyer/



(a) With belts. (b) Without belts.

Figure 2: Conveyer belt alphabet.

This font is part of a series of *puzzle fonts* where reading the message is a puzzle [DDK10], and part of a series of *mathematical fonts* illustrating a mathematical theorem or open problem [DD03, DDK10].

Puzzle Solutions:

1. G4G9 • 2. I love Martin Gardner • 3. convey via conveyer belts

4. we conjecture that unit disks can always be wrapped by a taut belt that touches every disk

5. open problems are the ultimate form of puzzle • 6. have fun

References

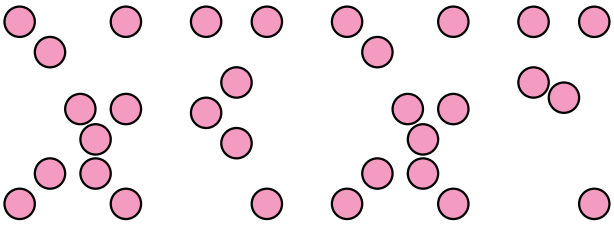
[Abe08] Manuel Abellanas. Conectando puntos: poligonizaciones y otros problemas relacionados. *Gaceta de la Real Sociedad Matematica Española*, 11(3):543–558, 2008.

[DD03] Erik D. Demaine and Martin L. Demaine. Hinged dissection of the alphabet. *Journal of Recreational Mathematics*, 31(3):204–207, 2003.

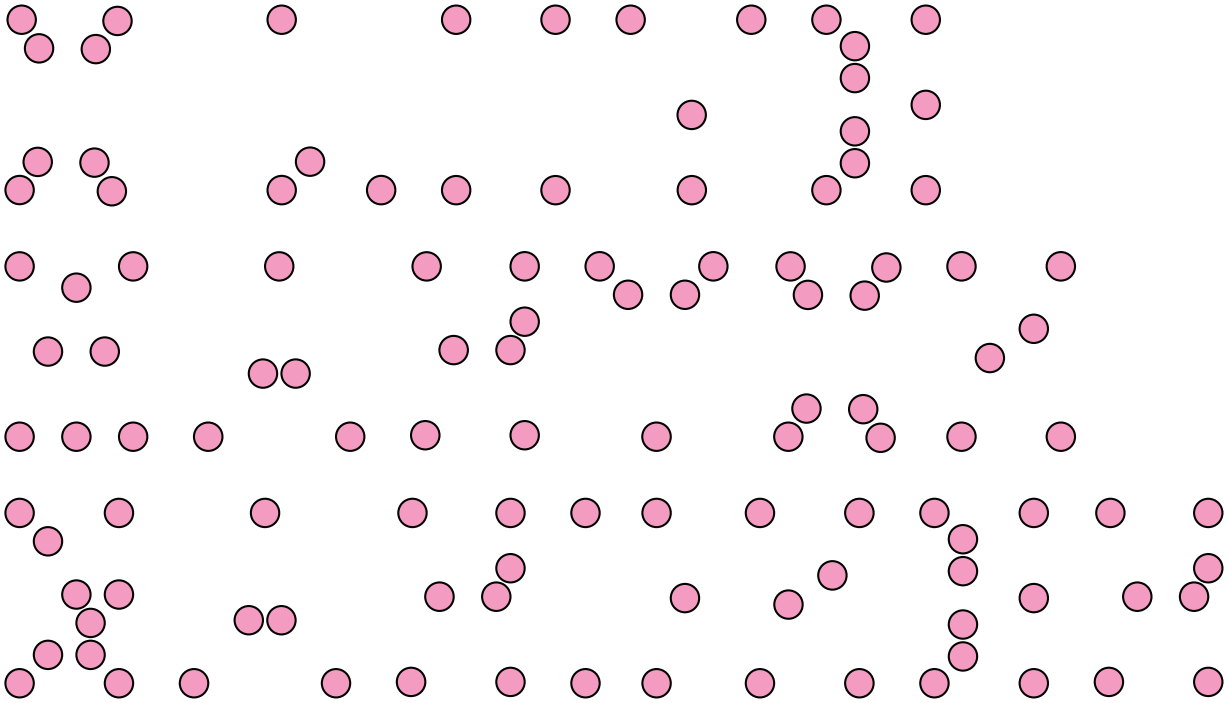
[DDK10] Erik D. Demaine, Martin L. Demaine, and Jason Ku. Origami maze puzzle font. In *Proceedings of the 9th Gathering for Gardner*, 2010.

[DDP10] Erik D. Demaine, Martin L. Demaine, and Belén Palop. Conveyer-belt alphabet. In Pars Foundation, editor, *Findings on Elasticity*. Lars Müller Publishers, 2010.

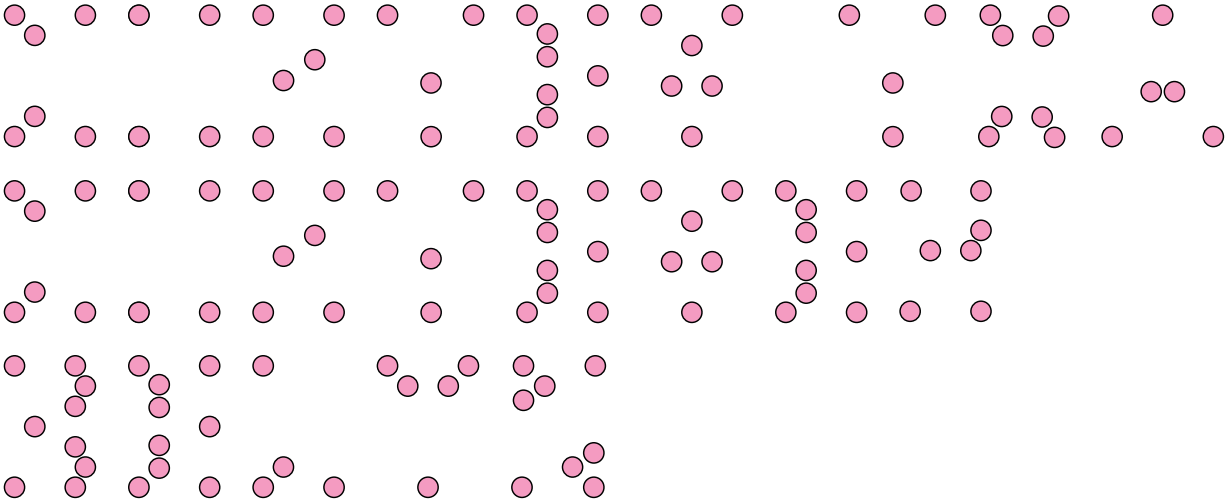
Puzzle 1:



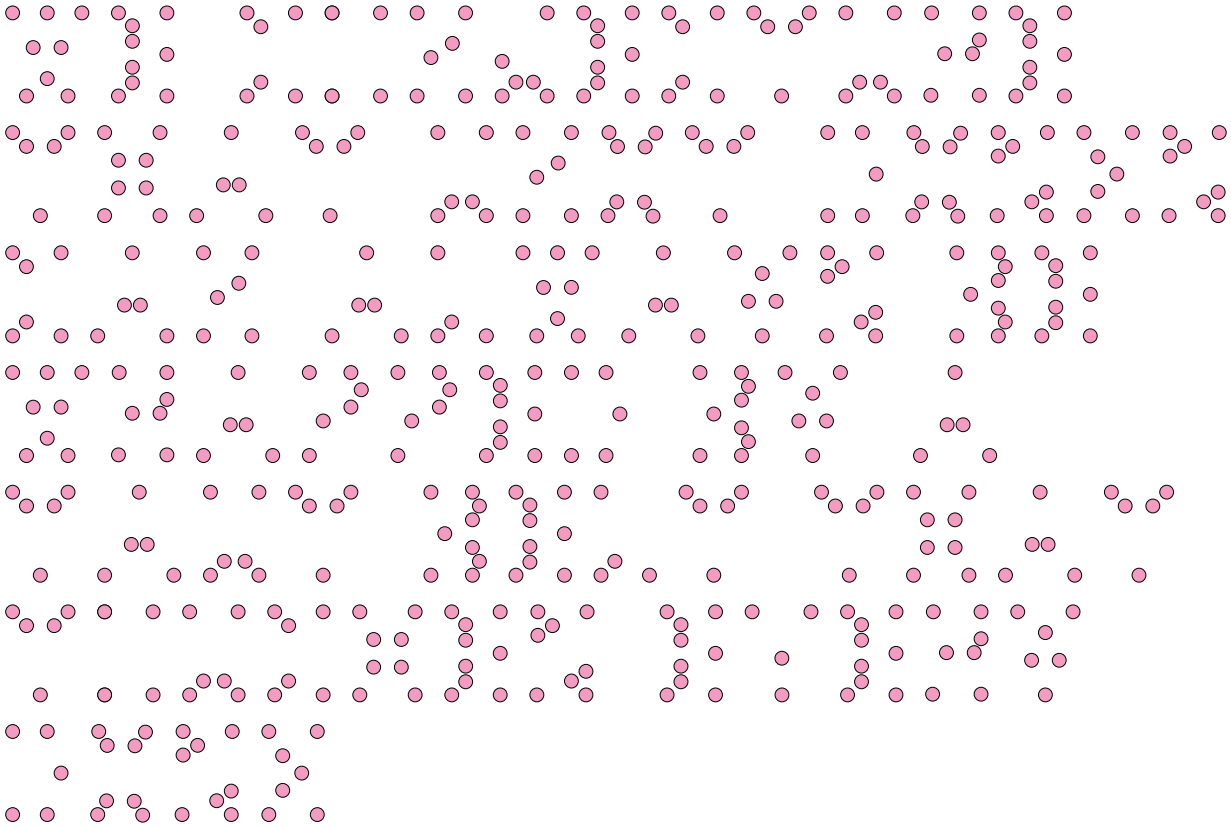
Puzzle 2:



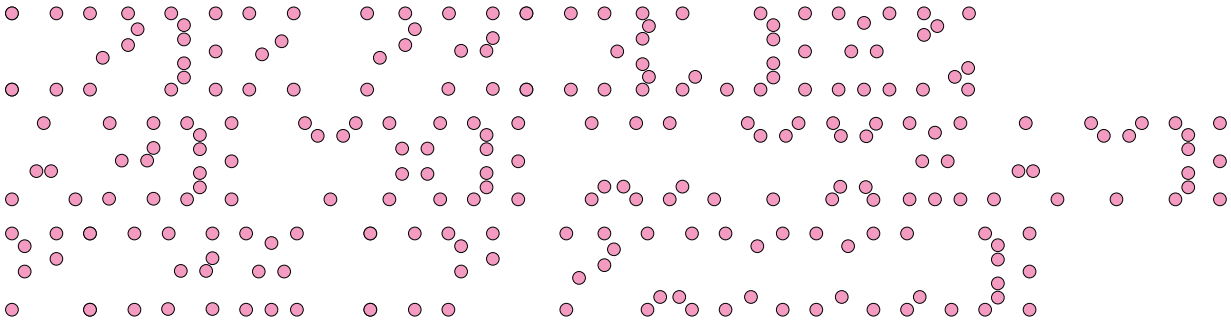
Puzzle 3:



Puzzle 4:



Puzzle 5:



Puzzle 6: