

Bit bifurcation by cotranscriptional folding^{*}

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Abstract. We demonstrate cotranscriptional folding of a finite part of the Highway dragon, a fractal also-known as the paperfolding sequence $P = LLRLLRRL \dots$ by an oritatami system. The i -th element of P can be obtained by feeding i in binary to a 4-state deterministic finite automaton with output (DFAO). We implement this DFAO and a bit-string bifurcator as modules of oritatami system. Combining them with a known binary counter module yields the target oritatami system.

Keywords: Highway dragon, Fractal, Cotranscriptional folding, Ori-tatami system, Automatic sequence, Bitstring bifurcation

0.1 Verification

Using the simulator developed for [], we have verified that all of the components fold correctly in all possible environments. Figure 1 shows verification of half-adder as an example. It has six environments, but it has four conformation. このようにして全ての環境に対してチェックできる。

0.2 Simulation

These modules can be checked by simulators on our website.

Appendix

0.3 Turner

Turner consists of two parts: bit string bifurcator and steering arm (colored in blue in Fig. 2).

The bifurcator sends binary information as in Fig. ?? while folding into zigzags. For that, it employs four types of module that propagates 1bit vertically (body-rpx, body-lpx1, and body-lpx2 in Fig. 2), that lets 1bit cross another 1bit (body-gx), that forks 1bit vertically and horizontally (body-rgy, body-lgy), and that undergoes transition from a zig to a zag or from a zag to a zig and exposes 1bit outside (turn-rgp, turn-lgp). The first two of them have already been implemented (see, e.g., [?]) so that we shall explain the others.

^{*} This work is in part supported by JST Program to Disseminate Tenure Tracking System, MEXT, Japan, No. 6F36 and JSPS Grant-in-Aid for Young Scientists (A) No. 16H05854 to S. S.

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Fig. 1. The verification of Counter-zig. (left) The possible six environments and four conformations of half-adder. (right) It verifies one of them.

The module body-rgy takes one of the two conformations in Fig. 3 (left) depending on the 1bit encoded in the two beads above. Output below, the 1bit is encoded as a type of the second bead from left, while output right, it is encoded as whether this module ends top or bottom. Its zag-variant, body-lgy, is implemented analogously; for its conformations, see Fig. 3 (right).

The 1bit forked rightward by a body-rgy transfers till the end of the zig without being jammed because all remaining modules in the zig are designed in such a way that they start and end at the same height like the glider. The module turn-rgp receives the 1bit (top or bottom), and exposes it by taking one of the two conformations in Fig. 4 (bottom). The module turn-lgp functions analogously in zags as being holded in Fig. 4 (top).

The bifurcator also propagates a signal, A or O, fed by the DFAO, to tell the steering arm which way it should take. Specifically, the signal has the first module, change-route, of the steering arm take one of the two conformations in Fig. 5, guiding the rest of the steering arm in the ordered direction. The steering arm is provided with move modules, which let the bifurcated bit string pass through. Note that the Turner does not have to bifurcate AO. Indeed, the second Turner is supposed to turn in the same manner as the first one. It hence suffices to append A and O to the bifurcated bit strings on the acute side and obtuse side, respectively, as shown in Fig. 2.

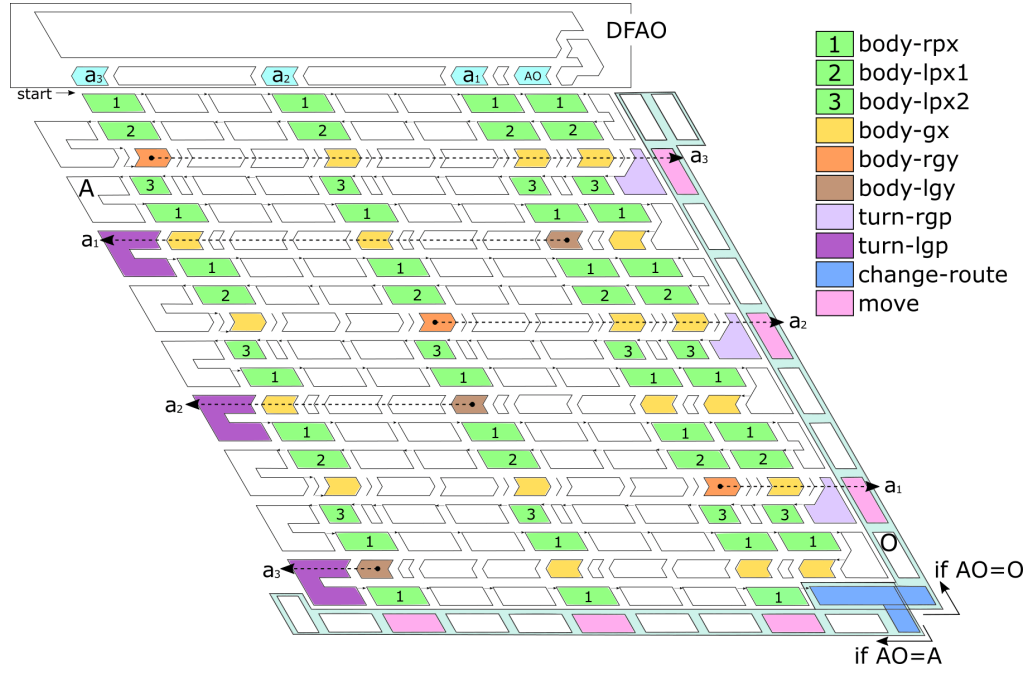


Fig. 2. The module-level abstraction of folding of Turner. All the white modules in the middle are spacers, some of which are implemented in the shape of parallelogram instead of glider.

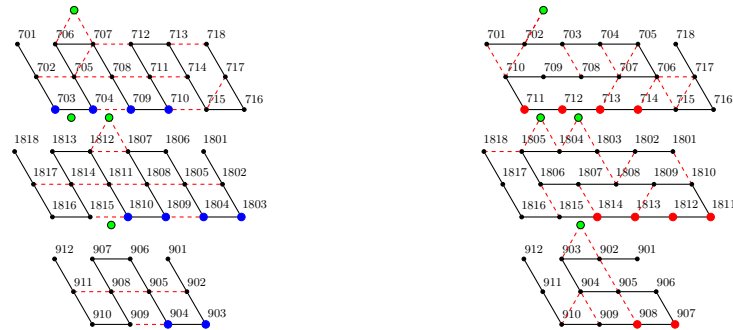


Fig. 6. (top) The possible two conformations of body-rpx, (middle) The possible two conformations of body-lpx1, (bottom) The possible two conformations of body-lpx2.

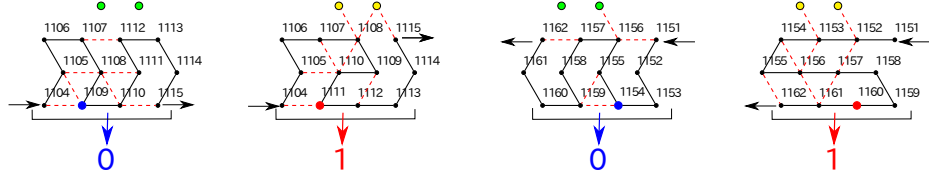


Fig. 3. (left) The possible two conformations of body-rgy and (right) of body-lgy.

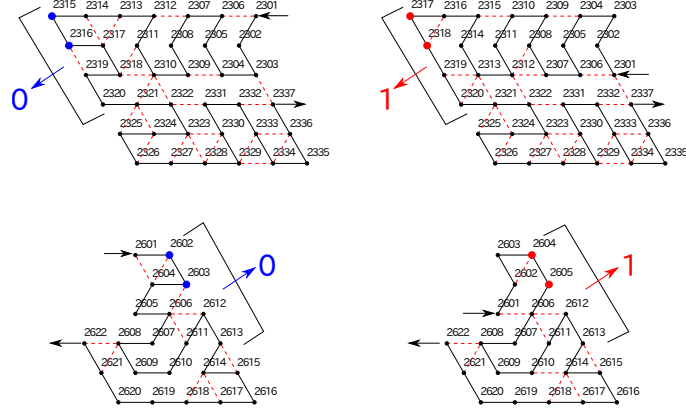


Fig. 4. (top) The possible two conformations of turn-lgp and (bottom) of turn-rgp.

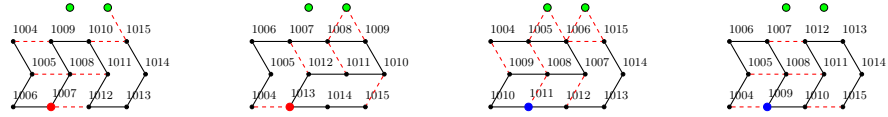


Fig. 7. The possible four conformations of body-gx.

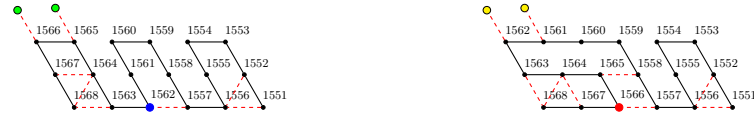


Fig. 8. The possible two conformations of move.

Remark 1. In fact, as suggested in Fig. 2, the bifurcator outputs the bit string also downward. That is, it bifurcates a given bit string into three directions. This provides a more space-efficient way to replicate a bit string many-folds.

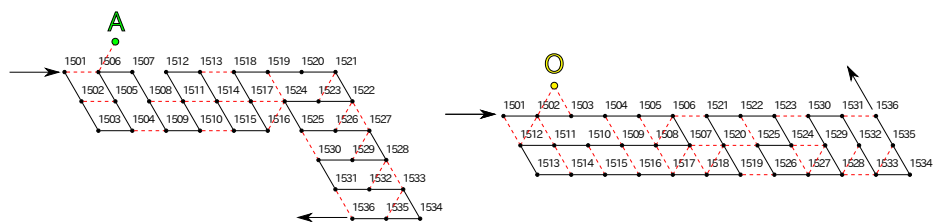


Fig. 5. The possible two conformations of change-route.