The Poetics of a Cyclic Directed Graph

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Abstract

Inspired by various forms of multiple-choice literature, we composed poetry over a balanced directed graph and examined the combinatorics of this poetry. The directed graph poses interesting questions about internal logic in poetry, and offers a number of challenges in construction; it asks us to examine not just *what* the poem means, but *how* it means. The multiple choice theatre of the graph creates multiplicities in the poem's call-and-answer, and challenges readers' ideas of concrete meaning.

Background

Reader interactivity — where the reader directly impacts the trajectory of the story — is not a conventional storytelling device in literature. However, it is well-established. Argentine writer Jorge Luis Borges' 1941 short story "The Garden of Forking Paths" [2] centers on a novel with infinitely-branching narratives, and thus endings. The French collective OULIPO experimented with multiple-choice theatre in 1973 [4]; 1979 heralded the first book of the immensely popular *Choose Your Own Adventure* series by Edward Packer and R.A. Montogomery: *The Cave of Time* [7]; and Ryan North has recently used this form to reimagine Shakespearean tales [5, 6]. Additionally, last year's Bridges poetry anthology [3] features the poem "Decision Tree" by Mike Naylor, which requires the reader to make choices throughout the poem. Inspired by these, we composed poetry over various mathematical structures, and specifically the digraph explored in this paper.

Poetry on a Digraph

The multiple-choice poetry in this paper is composed over a directed graph. A *graph* consists of a set of *vertices* and a set of *edges*, where each element from the edge set is a subset of order two of the vertex set [8]. The graph in Figure 1 is a *directed graph*, or *digraph*, meaning each edge has a direction associated with it. The digraph is *balanced* because each vertex has the same number of edges pointing towards it and away from it.

The correspondence between the poetry and the directed graph is straightforward: each graph vertex represents a stanza or canto of the poem, and each directed edge represents a choice the reader makes at the end of a stanza. For example after reading stanza 4 in a poem written according to Figure 1, the reader may choose the narrative path offered by edge g which will lead to stanza 5, or they may choose the narrative path offered by edge h which will lead to stanza 1. An important feature of poetry written according to Figure 1 is that the reader may start with any of the five stanzas; deciding where to begin is the first choice the reader must make. We include "This is Where You'll Find Her" in Figure 2 and Table 2 as an example of a poem written according to Figure 1.

Figure 1: A balanced directed graph on five vertices.
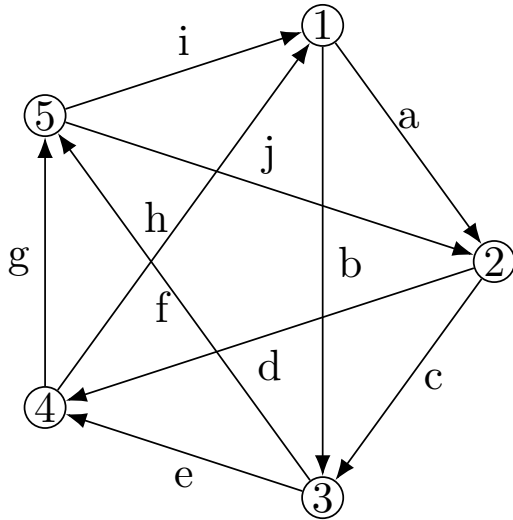
Table 1: Number of poems ending in a k-cycle

k	number of k-cycles	number of inclusions of each k-cycle	k-cycle terminating walks
3	5	8	**40**
4	5	6	**30**
5	2	5	**10**
		total poems:	**80**

How many different poems are actually contained in "This is Where You'll Find Her"? We must first decide what differentiates one poem from another. The concept of a graph walk will be useful for this. A *walk* is an alternating sequence of (possibly repeated) vertices and edges, starting and ending on a vertex, in which each edge originates at the previous vertex. A *directed walk* is a walk on a digraph in which each edge has a direction. Especially useful in counting poems is the concept of a *k-cycle*, which is a walk containing k distinct vertices which begins and ends on the same vertex. In Figure 1, the sequence $5, j, 2, d, 4, h, 1, b, 3, e, 4$ is a directed walk which is not a cycle, but this walk terminates in a 3-cycle on the vertices 4, 1 and 3.

If every directed walk through Figure 2 is considered a different poem, then there are clearly infinitely many poems contained in "This is Where You'll Find Her" because the underlying digraph contains cycles. But we assume a reader may tire of one canto or another upon thousands of repeated readings, so we need to define a distinct poem as some specific type of graph walk.

One possible way to define a distinct poem in "This is Where You'll Find Her" is to assume the reader will stop reading as soon as they encounter a repeated canto. Such a walk through the digraph would be a cycle-terminating walk like the sequence $5, j, 2, d, 4, h, 1, b, 3, e, 4$. We can use the adjacency matrix [1] to count the number of cycles of various lengths in Figure 1; the digraph is also small enough to enumerate its five 3-cycles, five 4-cycles, and two 5-cycles. These values appear in the second column of Table 1. Order matters in the walks, as a reader who reads cantos 1, 3, and 4, in that order will have a different experience than one who reads cantos 4, 1, and 3, in that order. So each k-cycle represents k different poems.

A cycle-terminating walk on Figure 1 may be a cycle itself, or it may have some number of vertices preceding the cycle in the walk. For example, the walk $5, j, 2, d, 4, h, 1, b, 3, e, 4$ terminates in a 3-cycle but has two vertices (5 and 2) appearing in the walk before the cycle. There are eight ways each 3-cycle can be included in a cycle-terminating walk: three options in the case the cycle-terminating walk *is* the 3-cycle (as there are three possible starting vertices), three options for one vertex preceding the 3-cycle in the walk (for example, $2, d, 4, h, 1, b, 3, e, 4$), and two options for two vertices preceding the 3-cycle (for example, $5, j, 2, d, 4, h, 1, b, 3, e, 4$). Similarly, there are six ways each 4-cycle can be included in a cycle-terminating walk, and five ways each 5-cycle can be included in a cycle-terminating walk. These values appear in the third column of Table 1. The fourth column is obtained by multiplying entries from the second and third
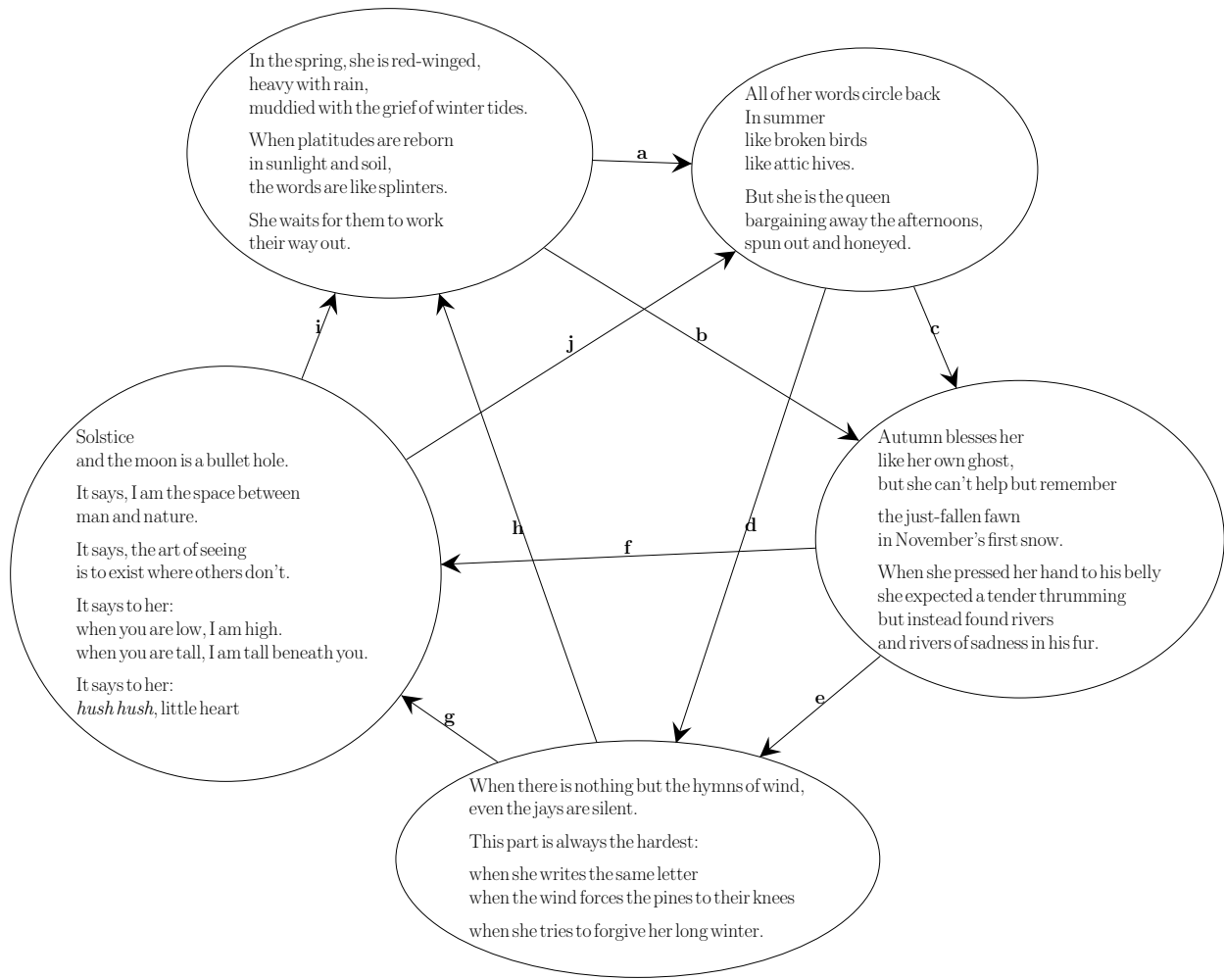
Figure 2: "This is Where You'll Find Her" by Courtney Huse Wika

columns; for example there are 40 walks that terminate in a 3-cycle. The sum of the fourth column is thus the total number of cycle-terminating walks in Figure 1, so there are 80 different poems contained in "This is Where You'll Find Her" which terminate upon the reader first encountering a repeated canto.

Table 2: Narrative Edge Choices for "This is Where You'll Find Her"

a. Spring breaks and she counts her trade-offs.　**b.** Hope wanes, and twilight contradicts the sun.
c. She falls and sunlight turns to stone.　**d.** Bartering leaves her with a frostbitten heart.
e. She enters her blue period, frozen to the bone.　**f.** She surrenders on the shortest day, an epitaph to sufferance.
g. She measures her days in resignation.　**h.** Winter breaks, and she is back to her beginning.
i. The sun rises, then sets; she denies both.　**j.** She needs more time; the solace of solstice is fleeting.

Analysis of the Poetry

Writing along the digraph construct naturally lends itself to lyric free-verse. While it would be difficult to craft a strictly descriptive poem because the poem's multiplicities would likely deny a coherent, concrete message, it still offers natural structures for the remaining two rhetorical modes in poetry: argument (where the speaker proffers a theory or stance and proves it with poetic evidence) and narrative (where the speaker crafts a story with all of the required narrative elements: exposition, rising action, crisis, falling action, and resolution). The latter is tricky, as each vertex of the graph must work in a multitude of ways to tell a coherent story. The separate vertices might also be conceptualized as cantos to move between motifs of rhetorical modes, to approach a theme from multiple perspectives, or to layer voices. Specifically, in "This Is Where You'll Find Her," they are used to indicate jumps in time and shifts in thought.

Perhaps the only restriction this graph applies in terms of imagery is that the writer must limit the field; in order for the various progressions to make sense, the imagery should remain in agreement either thematically or through a governing metaphor/analogy. (For example, in "This Is Where You'll Find Her," the extended metaphor of the ungovernable seasons is compared to the *ungovernableness* of grief and its respective stages.)

Many free-verse lyric poems employ circularity, ending where they begin, which provides a natural resolution to the poem. This particular graph necessitates circularity: no matter where the reader begins, they *can* be returned, as one option, to the original stanza to conclude the poem — or begin again. But it also *negates* circularity, as the reader can always choose to continue along the graph walk; unceasing and boundless, the poem resists a concrete resolution. In this way, the poem's stanzas are parataxic: no one stanza has more weight than any other.

Beyond these constraints, the writer is free to play with poetic elements and structural tools. Specifically, "This is Where You'll Find Her" relies on the structural tools of free verse such as symmetry, circularity, parallelism, extended metaphors, and parataxis. Free verse poetry relies not so much on formal rules (such as metre and rhyme) but on structural tools such as the repetition of imagery or an initial word or phrase (also known as anaphora), visual and grammatical parallelism or the echoing of syntax (chiasmus), inversion (where the normal order of words is inverted in a sentence), half-rhyme and occasional rhyme, line breaking methods like enjambment (when the sentence is completed in the next line) and caesura (pauses in lines, such as with a comma or period), and sound patterns (such as assonance, dissonance, consonance, and alliteration). Clearly, this graph does not limit the use of these elements to construct meaning.

The directed graph not only offers questions of how a poem means, but what a poetic construct is. Like the multiple choice aspects of its creation, reader participation is required to find its ending. In this paper we envision one poetic rotation ending once the reader reaches a repeat canto, but a reader might continue along the graph walk until all five cantos have been experienced, or experienced twice or three times, and so on. Ultimately, the possibilities are limitless as the reader — not the writer — dictates where the poem begins and where (or *if*) it ends.

References

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