English Versification for the Billion: Translating the Early Latin Poetry Generator *Artificial Versifying* (1677)

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Abstract

Among the more remarkable antecedents to electronic literature is a little-known system for Latin poetry generation that was published in 1677 by its inventor John Peter, in a booklet titled *Artificial Versifying*. To generate a line of verse, the user produces a random number by which a sequence of words may be retrieved from tables containing scrambled letters. Improbably, Peter's strange invention was quite successful: the booklet appeared in three editions and the system was republished in various periodicals over the subsequent two centuries. In this paper, we present the first translation into English of this remarkable work. Critically, our translation is of the *system* as a whole, as opposed to individual outputs or isolated components. In discussing our translation experience, we connect to the emerging scholarship on *e-lit translation*, and echo earlier findings in that area. These resonances, we contend, demonstrate that the peculiar considerations inherent in the translation of electronic literature are already present in protocomputational works that are sufficiently *procedural*, such as John Peter's *Artificial Versifying*.

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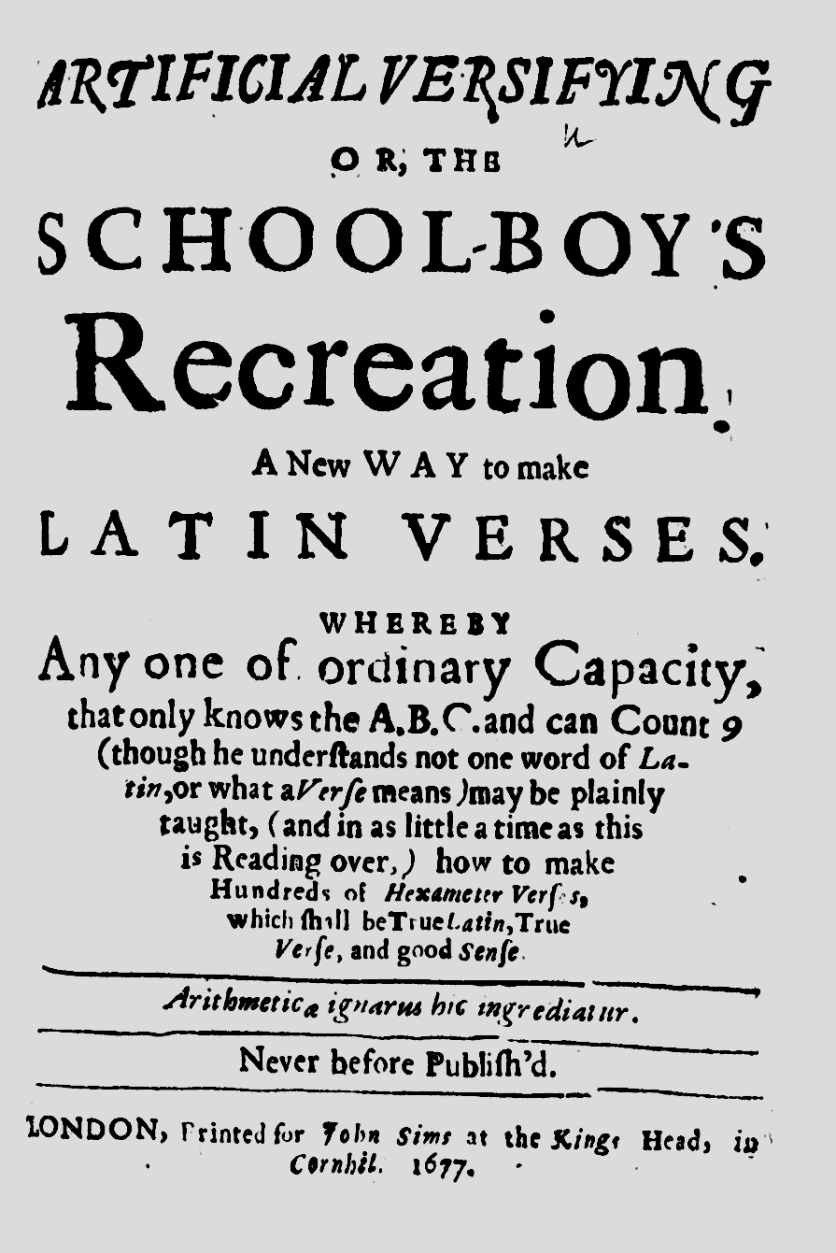
Introduction

In the middle 1660s, perhaps amid the Great Plague of London, a physician and polymath named John Peter developed a peculiar system allowing for the procedural generation of Latin poetry. A decade later, in 1677, Peter's system was published in a landmark booklet, titled *Artificial Versifying*, whose subtitle proclaimed that anyone "that only knows the A.B.C. and can count 9" could use its system to produce "true Latin, true verse, and good sense."[1] The system itself centers on a set of six "versifying tables" in which letters are distributed across grids of cells. To generate a line of poetry, the user first produces a string of six digits (e.g., *952129*). Next, each digit is used to retrieve a sequence of letters from the table corresponding to that digit's position in the string. The letters obtained in this way will form one of nine words contained in that table, and the concatenation of the six chosen words constitutes a line of Latin verse in dactylic hexameter. Given that each table contains nine words, Peter's system is capable of generating $9 * 9 * 9 * 9 * 9 * 9$—i.e., 9^6, or 531,441—lines of verse. Figure 2 includes the original tables, along with a more detailed description of the procedure.[2]

As a bizarre forerunner of electronic literature, *Artificial Versifying* was wildly successful: the booklet appeared in three or four editions, and its procedure was reprinted in books and periodicals for the next 200 years.[3] Sadly, Peter's innovative system has received scant treatment by scholars working today. Of particular note is Ruff (2001), who provides the most extensive treatment. Binder (2018) interprets *Artificial Versifying* in relation to a history of the algorithm as a cultural construct; he has also produced a remarkable computerization of the system (Binder 2019). Koch (1996) was likely the first to identify *Artificial Versifying* as a precursor to electronic literature. More recently, both Swidzinski (2015) and Rodgers (2017a, 2017b) have situated Peter's system against Swift's famous Engine from *Gulliver's Travels* and also the later *Eureka*, a physical machine constructed in the 1840s that generated Latin verse (see Blandford 1965, Hall 2007, Hall 2017).[4] Brief mentions also appear in Van Der Lee et al. (2019) and Henrickson (2021). This limited coverage of *Artificial Versifying* is incommensurate to its importance as



ARTIFICIAL VERSIFYING

OR, THE

SCHOOL-BOY'S

Recreation.

A New WAY to make

LATIN VERSES.

WHEREBY

Any one of ordinary Capacity,

that only knows the A.B.C. and can Count 9

(though he understands not one word of *Latin*, or what a *Verse* means) may be plainly

taught, (and in as little a time as this

is Reading over,) how to make

Hundreds of *Hexameter Verses*,

which shall be True *Latin*, True

Verse, and good *Sense*.

Arithmeticæ ignarus hic ingrediatur.

Never before Publish'd.

LONDON, Printed for *John Sims* at the *Kings* Head, in

Cornhil. 1677.

Figure 1. The title page of the first edition of *Artificial Versifying*, published by John Sims in London in 1677. Curiously, this edition does not identify the author, John Peter, to whose "same Hand" the second edition is attributed.

a groundbreaking work produced centuries ahead of its time—indeed, its specific combinatorial method prefigures much of the early computer poetry, such as Theo Lutz's "Stochastische Texte" (Lutz 1959, Bernhart 2020) and Allison Knowles and James Tenney's *A House of Dust* (Knowles et al. 1969, Buchloh 2012).

To better our own understanding, and to spur more critical engagement with Peter's work, we have carried out the first translation into English of the *Artificial Versifying* system.[6] While it is relatively trivial to translate any one of its 531,441 possible outputs, we sought instead to translate the *system* itself into English. Ultimately, this only entailed translating each of the 54 words in the six tables, but the process has nonetheless raised a number of interesting challenges. The major difficulty is in preserving both meaning and meter—Peter's system produces *hexameter* verse, specifically—though we identified additional dimensions of the original system that we sought to maintain in turn. In wrangling the interrelations between these features at the level of a combinatorial space, our design considerations were akin to those that structured Peter's invention. While a core aim of this process has been to make *Artificial Versifying* accessible to non-Latin speakers today, our translation has helped us to better appreciate the triumph of its design.

Broadly, we situate our project amid emerging scholarship on the challenges and opportunities of translating electronic literature. This subarea of *translation studies* (Bassnett 2013), called *e-lit translation*, is perhaps best characterized by the *Renderings* project carried out by Nick Montfort, Piotr Marecki, and other collaborators in the last decade (Montfort and Fedorova 2012, Małecka and Marecki 2014, Campana et al. 2014, Montfort 2016)—and interest in the area is growing (e.g., Regnauld and Abrioux 2015, Cayley 2015, Pisarski 2015, Pold et al. 2018, Montfort 2018, Raley and Mitchell 2019, Bouchardon and Meza 2020, Bouchardon 2020, Pisarski 2020). We briefly review this work in the next section.

In this paper, we present our English translation of the *Artificial Versifying* system, which may be used to procedurally generate English verse in the style of Peter's original Latin outputs. As we explain at length below, we have in fact produced a series of translation candidates—culminating in what we treat as our

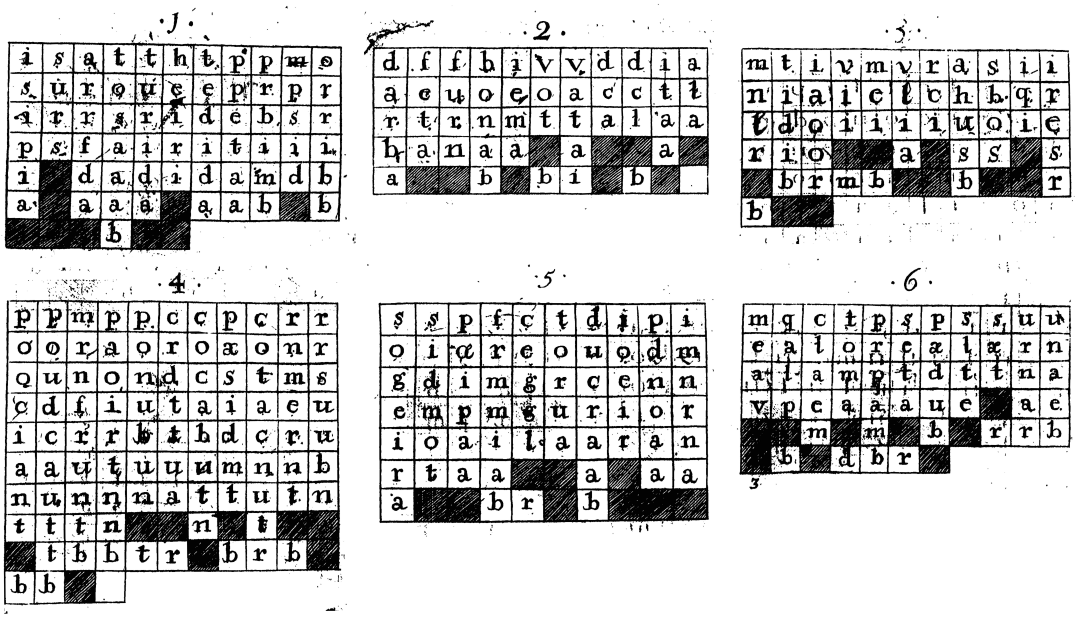


Figure 2. The "versifying tables" from the first edition of John Peter's *Artificial Versifying* (1677). To generate a line of verse from them, first produce a string of six digits, each between one and nine—e.g., *554165*. Next, take the first digit and the first table, and retrieve from that table the letter in the cell corresponding to the difference between nine and that digit. For instance, using a first digit of *3*, one would select the sixth letter in the first table, which is *h*. (If the digit is *9*, retrieve the ninth letter.) Now, repeatedly advance in the table by nine cells, retrieving the letters at those positions, until a black square is encountered. (The table proceeds left to right, top to bottom.) Concatenate the retrieved letters to form the first word in the verse. Now repeat this process for each digit–table pair, and combine the resulting six words to form a hexameter verse. As one example, using the input *554165*, one procedurally generates the verse *turbida ella malis producunt pignora tantum*, meaning 'for the evil, messy wars create only promises.' Note that the tables are simply word banks whose items are obfuscated by being interleaved such that the characters composing each word are spread nine cells apart from one another. Once a word is finished, the corresponding cell is filled in black to indicate that the word is finished; in the case of especially short words, additional unneeded cells (after a terminating black square) are filled with a random letter (likely to further obfuscate the generation method).[5] Given that each table contains nine words, Peter's system can produce $9 * 9 * 9 * 9 * 9 * 9$—i.e., 9^6, or 531,441—lines of verse.

final translation—each of which makes particular commitments to certain features of the original that are to be maintained. Generally, such commitments are incompatible with one another, which means there is no optimal policy. Of course, this is the essential problem of translation, but we will argue that such troubles are amplified in the case of translating a *system*, as opposed to a static text. In doing so, we echo earlier findings by Montfort and others, thereby demonstrating that the peculiar considerations inherent in the translation of electronic literature are already present in protocomputational works that are sufficiently procedural, such as *Artificial Versifying*. We hope that our work will stimulate interest in Peter's unheralded project, and also in (the translation of) other protocomputational works that have anticipated electronic literature in interesting ways.

Translating Electronic Literature

For space reasons, in this section we will only touch upon the growing area of *e-lit translation*—see Montfort (2018) for a nice overview—with a particular emphasis on the core notions that we echo below with regard to our translation of *Artificial Versifying*. While we have discovered a number of contemporaneous translations of early computer poetry, these are cases of translated *outputs*, not translated *systems*.[7] Early examples of the latter include the translations of Michael Joyce's *afternoon, a story* (Joyce 1987, Grigar 2020) into Italian (Vannini 1993) and German (Köhler and Krause 1998), though this hypertext work does not employ procedural generation. In 2005, Helen MacCormac translated Lutz (1959) into English, and thereby effectively translated his poetry generator in that she produced English versions of the word banks that drive the system. MacCormac did not computerize her translation, however, and she does not appear to have discussed her translation process.[8] One catalyst for scholarly interest in the translation of electronic literature was the *Translating E-Literature* conference held in Paris in 2012 (Regnauld and Abrioux 2015), and many contributions have appeared since (e.g., Cayley 2015, Pisarski 2015, Pold et al. 2018, Montfort 2018, Raley and Mitchell 2019, Bouchardon and Meza 2020, Bouchardon 2020, Pisarski 2020), with the aforemen-

tioned *Renderings* project providing a through line (Montfort and Fedorova 2012, Małecka and Marecki 2014, Campana et al. 2014, Montfort 2016).

A fundamental notion in this literature is that e-lit translation adds to the translator's burden the trouble of maintaining features of the source work at the level of a *possibility space* (see Karth 2019), rather than a static text. As Glazier (2015) puts it, the introduction of such procedurality has the effect of "adding lubricant" to the "already slippery slope of the location of meaning" (3). And there's more than just meaning to maintain. Montfort (2018) identifies among other dimensions the *metrical*, *material*, and *contextual*, all of which are present in conventional translation but exacerbated by what he calls the "computational aspect" (n.p.) that inheres in e-lit. In the case of a work like *Artificial Versifying*, a given verse is sampled from the possibility space—its 531,441 generable outputs—by carrying out the combinatorial procedure that recombines its 54 words. As translators, our task is to translate these 54 words so as to maintain the salient features of the original space of 531,441 verses. This pits us most painfully against what Cayley (2015) calls "local algorithmic dissonance": "The work may address (by way of its own algorithmic processes) and make (implicit) assumptions about the grammar of its particular original language [and] these may not 'work,' grammatically, in the host language" (n.p.). As we explain at length below, Peter's word banks are constructed in a way that relies on aspects of Latin that are not present in English—these function in the system as critical (though implicit) apparatus, but we had to reinvent English corollaries to make our translation work.

We contend that our project's indirect wrangling of system dynamics through the manipulation of system components is one expression of Montfort's 'computational aspect' of e-lit translation. Of course, *Artificial Versifying* is not computational—it predates even Babbage's Analytical Engine (Menabrea and Lovelace 1842) by a century and a half. In identifying the computational aspect, Montfort quotes Cayley (2018), who notes, "The making of certain linguistic artifacts"—the ones germane to e-lit translation—"cannot be achieved without digital media and digital affordances" (n.p.). We contend that it is not a digital materiality, or even a

computational mechanism, that underpins the 'computational' aspect that complicates e-lit translation—rather, these challenges are already present in any textual artifact that is sufficiently *procedural*.[9] Showing this, through our case study of translating *Artificial Versifying*, is this paper's contribution to e-lit translation.

Translating *Artificial Versifying*

In the course of our translation effort, we produced a succession of translation *candidates*, each of which resulted from a particular *policy* that aimed to preserve specific aspects, or *dimensions*, of the original. Broadly, we identified two primary dimensions, *meaning* and *meter*, and a handful of secondary dimensions, such as *grammaticality* (whether the translated outputs are grammatical in the host language), *interface* (whether the user experience is preserved), *system-internal features* (number of word banks, order of the word banks, number of items in each bank, item–bank associations, whether there are multiword items), *input–output relationship* (whether, e.g., *554165* in the translated system produces a translation of the output for *554165* in the original system), and *superficial features* (the degree to which our tables resemble the original tables). In our conception, primary dimensions are ones to which a translation policy can deeply commit, while secondary dimensions work to structure smaller decisions throughout the process. While it's possible to preserve both meaning and meter in certain individual outputs, doing so for the entire system—i.e., the space of 531,441 outputs—is not possible, as we explain below using specific examples. As such, the meaning and meter dimensions are inherently at odds in this translation problem, which allows for three fundamental policies in total: *aggressive meaning preservation*, *aggressive meter preservation*, and *meaning–meter compromise*.

In this section, we discuss our translation experience in terms of a progression through these policies (in order), and specifically three translation candidates that instantiated them. Our third and final candidate—which we identify as our translation of *Artificial Versifying*—strikes a compromise between meaning and meter preservation, with attention to a few secondary features. In tracing this

progression, we identify particular issues that emerged, along with our attempts to ameliorate them. Table 1 and Table 2 show our three translation candidates—i.e., translations of all 54 words—which respectively instantiate *aggressive meaning preservation*, *aggressive meter preservation*, and *meaning–meter compromise* translation policies. See Figure 3 for the actual presentation of our final translation in the form of English versifying tables. To be clear, our translation is specifically of the system presented in the first edition of *Artificial Versifying*, published in 1677. The second and third editions include revised hexameter tables as well as pentameter tables, and these remain to be translated.

Background: Meter in Artificial Versifying

As we have noted above, the *Artificial Versifying* system relies on six tables, each containing nine Latin words. By using a random number to select one item from each table, a line of verse is formed. A fundamental characteristic of the system is that the Latin verse that it generates is in *dactylic hexameter* (Cuddon 2012, 332), which is a famous metrical scheme that is associated with both Greek and Latin epic poetry, such as Homer's *Odyssey* and Virgil's *Aeneid*. In the scheme, each line of verse consists of six *feet*, each of which is either a *dactyl*, *spondee*, or *anceps*. A dactyl is a foot containing three syllables, the first being a long syllable and the second and third being short syllables. For example, the word *tristia* is a dactyl—we emphasize the syllable *trist*, but not *i* or *a*. Examples of English dactyls include *this is the* and *murmuring*. A spondee, then, is a foot with two syllables that are both emphasized. For example, in the Latin verb *portabunt*, the two syllables *a* and *bunt* form a spondee, because both are long. An *anceps* is the final foot in the line of hexameter and contains two syllables: the first is long, and the second can either be long or short. Finally, a metrical pattern instantiated in a particular verse is called its *scansion*.

Before moving on, we'll note a metrical quirk of Peter's original versifying tables. While all the words from a given table generally have the same scansion, this is not the case in Table 2. This table contains two words, *aliis* 'for others' and

inquam 'I say,' that do not conform to the scansion of the other seven words in the table. Unlike the other words, these two create an *elision* when combined with any word from the first table—this is when a word phonetically blends into the word preceding it—because both begin with a vowel, while all the words in Table 1 end with a vowel. As a result, the first syllable in each of these words is not pronounced, altering the rhythm of the dactylic hexameter from `<dactyl> <dactyl> <spondee> <spondee> <dactyl> <anceps>` to `<dactyl> <spondee> <spondee> <spondee> <dactyl> <anceps>`. As an illustration, here are two diagrams showing the distinction between the respective scansions of *pessima verba* ***vides*** *promittunt fœdera certa* 'I see horrible words that promise certain pacts' and *pessima verba* ***aliis*** *promittunt fœdera certa* 'for others, horrible words promise certain pacts':

— ⏑ ⏑ | — ⏑ ⏑|— — | – — | — ⏑ ⏑ | — ×
pessima verba vides promittunt fœdera certa

— ⏑ ⏑ | — — | — — | – — | — ⏑ ⏑ | — ×
pessima verba aliis promittunt fœdera certa

In this notation, — indicates a stressed syllable, ⏑ an unstressed syllable, × an anceps, and | the ending of a foot. As the diagrams show, the addition of *aliis* triggers an elision with the previous word, *verba*, which changes the second foot into a spondee, rather than a dactyl; this is marked by the curved line connecting *verba* and *aliis* in the bottom diagram. While we did not attempt to capture elision in our translation, it is an interesting characteristic of the system that we thought worth mentioning.

Policy 1: Aggressive Meaning Preservation

Our first translation candidate focused solely on preserving the literal meaning of the Latin, but without resorting to aggressive measures such as reordering the versifying tables; it is shown in Table 1 and Table 2. To produce this candidate, we started with the Latin word banks extracted from Peter's versifying tables by Ruff (2001, 248–250), and then used University of Chicago's Logeion resource

Original Latin		***Policy 1: Meaning***		***Policy 2: Meter***		***Policy 3: Compromise***	
T	**Word**	**T**	**Translation**	**T**	**Translation**	**T**	**Translation**
1	*pessima*	1	worst	1	pitiable	2	hideous
1	*turpia*	1	ugly	1	horrible	2	horrible
1	*horrida*	1	abrasive	1	boisterous	2	boisterous
1	*tristia*	1	sorrowful	1	sorrowful	2	sorrowful
1	*turbida*	1	confusing	1	desolate	2	difficult
1	*aspera*	1	bitter	1	rancorous	2	rancorous
1	*sordida*	1	filthy	1	splenetic	2	tarnished
1	*impia*	1	disloyal	1	traitorous	2	traitorous
1	*perfida*	1	dishonest	1	fraudulent	2	fraudulent
2	*dona*	2	gift	2	presents	3	gifts
2	*verba*	2	words	2	phrases	3	words
2	*vota*	2	vows	2	pledges	3	vows
2	*iura*	2	laws	2	orders	3	laws
2	*bella*	2	wars	2	battles	3	wars
2	*fata*	2	fates	2	chances	3	fates
2	*facta*	2	deeds	2	actions	3	deeds
2	*dicta*	2	remarks	2	mentions	3	talks
2	*damna*	2	damages	2	losses	3	costs
3	*aliīs*	3	other	3	to them	1	for them
3	*reor*	3	I think	3	I think	1	I think
3	*vides*	3	you see	3	you watch	1	you know
3	*mālīs*	3	to the evil	3	to sin	1	through spite
3	*viro*	3	for a man	3	to man	1	for man
3	*inquam*	3	i say	3	I say	1	I say
3	*tibi*	3	for you	3	to you	1	for you
3	*mihi*	3	for me	3	to me	1	for me
3	*scio*	3	I know	3	I know	1	I know

Table 1. Variant translations for the original Latin words in the first three versifying tables of *Artificial Versifying* (1677). The three translation candidates shown here each instantiate a particular transition policy: *aggressive meaning preservation*, *aggressive meter preservation*, or *meaning–meter compromise*. The latter policy represents our final translation of the system. Note that this policy necessitated changing the order of the tables, which is indicated by the columns labeled **T**. See Table 2 for a continuation of this table.

Original Latin		***Policy 1: Meaning***		***Policy 2: Meter***		***Policy 3: Compromise***	
T	**Word**	**T**	**Translation**	**T**	**Translation**	**T**	**Translation**
4	*producunt*	4	will produce	4	will create	4	will create
4	*concedunt*	4	will yield	4	will let go	4	will give up
4	*causabunt*	4	cause	4	do produce	4	do produce
4	*promittunt*	4	promise	4	do affirm	4	do maintain
4	*portabunt*	4	will bear	4	will endure	4	will endure
4	*monstrabunt*	4	will show	4	will display	4	will display
4	*procurant*	4	manage	4	do dictate	4	do dictate
4	*prædicunt*	4	declare	4	do declare	4	do proclaim
4	*confirmant*	4	encourage	4	do augment	4	do augment
5	*iurgia*	5	quarrels	5	annulments	6	battles
5	*dogmata*	5	decrees	5	principles	6	edicts
5	*tempora*	5	seasons	5	periods	6	seasons
5	*crimina*	5	verdicts	5	sentences	6	verdicts
5	*fœdera*	5	pacts	5	promises	6	pledges
5	*pignora*	5	wagers	5	covenents	6	wagers
5	*somnia*	5	dreams	5	fantasies	6	ideas
5	*sidera*	5	stars	5	galaxies	6	night stars
5	*pocula*	5	cups	5	chalices	6	goblets
6	*semper*	6	always	6	always	5	imminent
6	*prava*	6	wicked	6	wicked	5	villainous
6	*sola*	6	lone	6	lonely	5	desolate
6	*plane*	6	clearly	6	clearly	5	palpable
6	*tantum*	6	only	6	only	5	just those
6	*certa*	6	certain	6	destined	5	definite
6	*quædam*	6	specific	6	unique	5	different
6	*multa*	6	many	6	many	5	numerous
6	*sæpe*	6	often	6	often	5	regular

Table 2. Variant translations for the original Latin words in the latter three versifying tables of *Artificial Versifying* (1677). This is a continuation of Table 1.

Goldenberg and Shanahan (2011) to generate additional potential translations for each word. Upon comparing our generated list to Ruff's translation choices, we compiled a final list containing options that adequately captured meaning and also seemed amenable to combination with the other selected word translations.

Two words in particular were difficult to translate: *dicta* 'things having been said,' and *facta* 'things having been finished.' Both *facta* and *dicta* can function as *nominative/accusative* plural nouns, or *past perfect participles*; in Peter's original outputs, they serve variously as the subject, direct object, or past perfect participle of the sentence. For example, the sentence *turbida facta mihi promittunt tempora tantum* translates to 'disordered deeds for me promise times only' when we treat *facta* as the subject, but it could alternatively be translated to 'disordered times for me promise deeds only' by treating *facta* as a direct object or 'disordered things having been finished for me promise times only' by treating *facta* as a past perfect participle. Each of these translations are entirely plausible, which blows up the space of generable meanings when we consider all the contexts in which *facta* and *dicta* may appear. The English language doesn't have an elegant way of representing this flexibility. Ruff (2001), who was simply providing glosses for each word in the system, chose to present these as nouns: 'words' for *dicta*, and 'deeds' for *facta*. This translation loses some semantic nuance as 'words' doesn't fully convey the idea of past conversations; we instead translated it as 'remarks,' which we view as closer to the original meaning.

Generally, the flexible word order in Latin permits multiple valid translations for a given output. For example, the input *666666* gives us *aspera fata inquam monstrabunt pignora certa*. A direct transliteration might produce 'bitter fates I say will show wagers certain.' However, alternative translations include 'I say that certain fates will show bitter wagers,' 'I say that bitter wagers will show certain fates,' or even 'I say that certain bitter wagers will show fates.' Each noun can serve either as the subject or direct object of the line, and the adjectives can modify either noun. The word *certa* could also function as an adverb in this case, instead of an adjective. (It is more common for the first noun to be the subject in Latin

verse, so for our translations we pick the first word to be subject.)

Unfortunately, there is no way to preserve both this flexibility and *system-internal features* if we are to translate these tables into English. Other languages that have flexible word order, such as Polish or Portuguese, might allow for more faithful translations than English. In an experimental attempt to capture this flexibility, we prototyped a simple program that would carry out the *Artificial Versifying* procedure and then postprocess each generated line of English verse by randomizing the position of certain components, to capture the syntactic flexibility of the original. While this worked decently, the resulting procedure strayed too far from the original generation method, and it wasn't clear how we'd incorporate it into a non-computerized interface. Therefore, our subsequent translation policies were carried out with word order enforced solely through the ordering of the tables. If we wished to alter word order, we would have to re-arrange the tables, since preserving the original generation method is just as important to our project as translating the words themselves (this is the *interface* dimension).

This initial translation candidate did not produce hexameter verse—a fundamental goal of our project—and furthermore it failed to capture meaning adequately. As we'll discuss in the section below about our final translation policy, table-internal inconsistencies with regard to part of speech make even a loose transliteration futile. For instance, Table 6 includes both adjectives and adverbs, which in Latin can both serve as postmodifiers. In English, however, this leads to outputs such as 'the disloyal laws I think promise seasons lone.' One option is swapping Tables 5 and 6, but this would then produce outputs such as 'the dishonest gift you see encourage clearly verdicts.' Here, both the *meaning* and the *grammaticality* dimensions are not handled well. Translating any given output on its own is trivial, but in a combinatorial system like *Artificial Versifying*, each decision in a given translation affects thousands and thousands of other translations. While Latin's freer word order generally challenges translation into English, the issue is exacerbated here due to the combinatorics inherent in Peter's system—Montfort's 'computational aspect' rears its head.

Policy 2: Aggressive Meter Preservation

For our second translation candidate, we took on an alternative policy that aimed to aggressively preserve the poetic meter used by John Peter. First, we note that while Latin hexameter is often translated into English as iambic pentameter, this is not always the case (e.g., see Gray 2004), and we sought to preserve the specific hexameter scansion of the original. To do this, we tried to translate each of the Latin words into English such that the number of syllables matched. For example, we translated the Table 1 adjective *pessima* to 'pathetic.' Problems arose when translating verbs from Table 4. In the system's original outputs, each verb from the fourth table completes the third foot and then fully constitutes the fourth foot of the verse, all by using its three stressed syllables. But in English, there are few words that are naturally pronounced with three stressed syllables, let alone verbs.

While Latin uses vowel length to create poetic rhythm, English verse tends to use stressed and unstressed syllables to assign meter and rhythm. This is in part because the English language has an unreliable vowel-length system, where vowel length can change with the meaning of the word, and differences in regional dialects further complicate assigning accurate length. To derive more robust metrical interpretations for our word candidates, based on vowel stress, we consulted phoneticizations (in American English) in International Phonetic Alphabet (IPA) format (International Phonetic Association 1999). Here, our goal was to identify word candidates whose vowel stresses corresponded to the vowel lengths of the associated Latin words (long to stressed, short to unstressed). While this isn't an ideal conversion, vowel strength is more reliable than vowel length in English, and we found that this method generated in our translated verses a similar rhythm to the original Latin outputs.

Our main work in instantiating this policy involved poring over our the list of syllable-matched words to identify which words violated our strength-based meter. For each word needing replacement, we tested possible synonyms and analyzed their vowel-strength patterns. For most words, this was a quick process, but there were a few trouble spots. In Table 3, Peter uses the Latin words *reor* 'I think,'

inquam 'I say,' and *scio* 'I know' as *iambs* (`<stressed> <unstressed>`), to fill out the last unstressed syllable of the second dactyl. These three are verbs, which complicates the translation, because in Latin, the verb form is partially based on the subject, and therefore the subject is often redundant and excluded. To convert these into proper English, we have to reintroduce the subject—'I' in these cases, as the verbs are first-person singular. In English, 'I' is a stressed vowel. As such, introducing the subject 'I' means those three elements cannot be iambs, because any one-syllable verb following 'I' will always itself be stressed. Such intervention therefore breaks our meter. We struggled to find an elegant solution to this until our final translation, where we swapped Table 3 with another to both better match the Latin meter and improve along the *grammaticality* dimension. Similarly, the datives require a multi-word translation into English—to preserve the meaning, we needed to supply a preposition before the noun. For example, *viro* would be translated as 'for man.'

While our second translation candidate faithfully preserved meter, the outputs that it produces violate the *grammaticality* dimension to the point of severely disrupting meaning—for instance, 'pitiable presents to them will create periods destined.' Though we were reticent to do so, since it would violate the *system-internal features* and *input–output relationship* dimensions, we determined that it would be necessary to reorder our versifying tables.

Policy 3: Meaning–Meter Compromise

To adequately preserve both meaning and meter, we would have to make some drastic trade-offs. While our previous translation candidate was missing the mark, this was partially a fault of the original Latin verse. *Artificial Versifying*'s outputs aren't guaranteed to be proper sentences—rather, many of the outputs comprise two syntactically disjoint three-word sentences with an implied connection. For example, 'I know pitiable words will certainly display seasons' is a syntactically well-formed English sentence, but its Latin counterpart *pessima verba scio monstrabunt certa tempora* is grammatically incorrect. In classical Latin, the use of *reor*

'I think,' *inquam* 'I say,' or *scio* 'I know' in tandem with another verb in the sentence implies an indirect statement—as in 'I know [that] pitiable words will display certain seasons'—but that is not what Latin grammar dictates. In Latin, indirect statements require an infinitive verb and an accusative subject. Though the nouns chosen by Peters have a form that could be accusative, there are no infinitive verbs in the tables. Instead, we have two sentence fragments. To use an English example, the syntax of the previous example causes it to read something like 'I know pitiable words. Seasons certainly will display.' Though the Latin grammar results in two sentence fragments, Peter intends for such examples to read as single lines, via parataxis. To capture this in English, we treated these three verbs as introducing an indirect statement—e.g., "I know [that] pitiable words will display certain seasons"—even though this does not maintain the awkward fragmentation of the original Latin. Though this peculiar syntax sort of works in Latin, its preservation in English would have resulted in nonsense.

While relying on indirect statements maintained grammaticality of our outputs, further problems arose. As we noted above, English has a stricter word order than Latin, with adjectives generally directly preceding nouns and adverbs tending to appear adjacently to the verbs they modify. In *Artificial Versifying*, the sixth table exclusively contains adverbs and adjectives, and as a result each output ends with one of these parts of speech. If the order of the tables was to be preserved to maintain the *system-internal features* and *input–output relationship* dimensions, the resulting outputs would be ungrammatical—for example, 'boisterous phrases I think do affirm pledges lonely' and 'boisterous phrases I think do affirm pledges many.' In our final translation candidate, which instantiates a *meaning–meter compromise* policy, we swapped Table 5 with Table 6. While we hoped that repositioning the adverbs to immediately follow verbs would help, the translation candidate still produced bad outputs such as 'splenetic mentions I know do dictate totally edicts.' This demonstrated that it would be necessary not only to swap Table 5 and Table 6, but to dramatically alter the contents of (the original) Table 6 as well.

Toward this, we attempted to turn the adverbs into corresponding adjectives while maintaining some semblance of the original meanings. This was an incredibly difficult task, especially given the additional metrical constraints. We focused on the relationship between the verb from Table 4 and the noun from Table 5 to produce these pseudo-synonyms. As one example, we had to convert the adverb *sæpe* 'often/again' into an adjective, for which we produced 'regular,' to give the Table 4 nouns modified by the word a sense of being periodic or expected. This worked fairly well—e.g., 'for me boisterous phrases will produce regular battles.' Finally, the verbs and datives in Table 3 didn't fit into the meter properly, and to produce an indirect statement, they had to be at the front of the sentence. To fix both issues, we swapped Table 3 with Table 1, causing an output like 'traitorous words you know will create only the edicts' to become 'you know traitorous words will create only the edicts.' Doing so drastically improved the readability of the outputs, but it altered the scansion, as our translations of the items in the original Table 3 were now spondees, while Peter's items were dactyls. This necessitated that the words in Table 3 be translated so as to each comprise a single stressed syllable (to constitute the first syllable of the third foot). We also produced a few translated items that do not match the scansion of their counterparts in the same table, namely *tarnished* in Table 2, *just those* in Table 5, and *ideas* in Table 6. This does not deviate from dactylic hexamater, however, and we note that Peter's original outputs scanned in different ways, as we explained above.

Discussion

We made several concessions in our final translation candidate. To maintain the *interface* dimension, we gave up the flexibility of the ambiguous noun–adjective pairings, and decided that the first noun is always the subject. In support of *meaning* and *grammatically*, we rearranged the versifying tables to accommodate English's stricter word order. We also converted all the original adverbs into adjectives that only captured some of the semantic nuances of the former. As a balance between meaning and meter, we were a bit looser with scansion than Peter was

in his original tables. These changes produced outputs that maintain meaning to a fair degree, while still preserving the dactylic hexameter of the original Latin verses. Unfortunately, the shuffling of the tables totally violates the *input–output relationship* dimension. In our first two translation candidates, any input to the original *Artificial Versifying* would produce a corresponding English translation when submitted to our versifying tables. This relationship is unfortunately lost in our final translation, given our reordering of the tables. For instance, the output for input *123456* in Peter's original system now corresponds to the output for *312465* in our English translation of the system. Relatedly, the *system-internal features* dimension is harmed, because one such feature is the order of the versifying tables. We did, however, abstain from swapping words between tables, which was one option that we had considered. Critically, our final translation candidate does quite well in terms of *grammaticality*, which was not true of our initial candidates. We believe that this is worth the cost of these other two secondary dimensions. Additionally, none of our design choices compromised our ability to maintain Peter's peculiar *interface*. As we discuss next, the final presentation of our translation comes in the form of a new set of six versifying tables, which are compatible with Peter's original procedure for verse generation.

In the end, we are quite pleased with our English translation of *Artificial Versifying*. With our process having now concluded, we believe that we have produced a "least bad" translation, which is what we can reasonably pursue in the challenging space of e-lit translation.

Final Presentation

A faithful translation of the *Artificial Versifying* system should preserve its *interface* dimension, and toward this the final presentation of our English translation takes the form of a set of six versifying tables with which hexameter verse may be generated using the same procedure that Peter invented over four centuries ago. This presentation is given in Figure 3. One distinction in our tables is the inclusion of blank white squares to represent spaces within items retrieved from a table—this

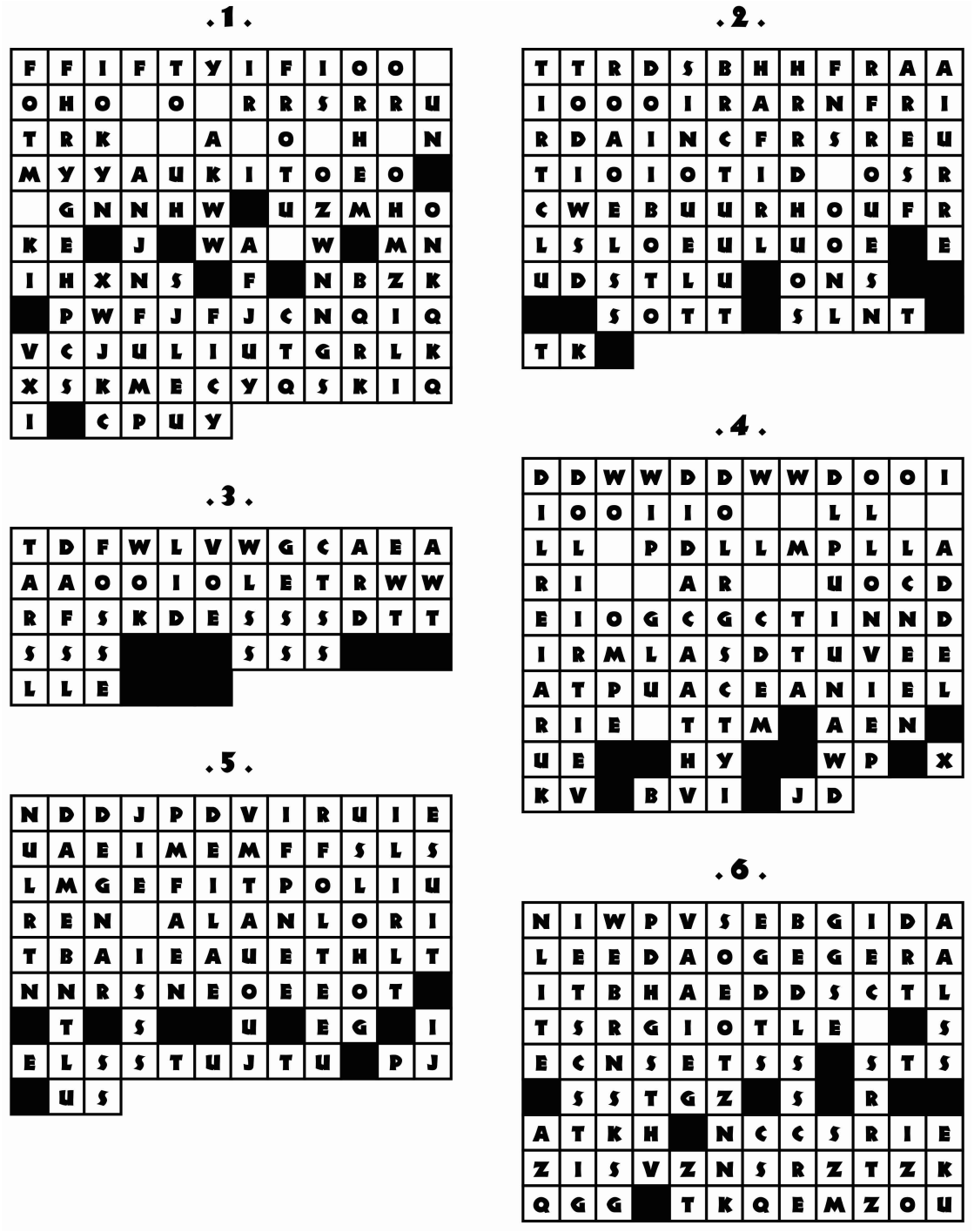


Figure 3. The final presentation of our English translation of John Peter's *Artificial Versifying* (1677), in the form of versifying tables from which English hexameter verse may be generated. To produce a line of English verse, carry out the procedure that is explained in Figure 2, with an additional instruction: if a white square is traversed, insert a space into the current item.

was necessary because some of our items span multiple words. As another visual difference, in our tables the black squares that terminate items tend to appear earlier in the table. This is due to our word banks being less uniform in terms of the lengths of their items. Until producing our tables, we hadn't considered that Peter may have been concerned in his translation with superficial aesthetics of the tables themselves, which may have led him to devise word banks containing items of roughly the same length. While we remain pleased with our final translation, the variability of item length within our tables works against the *superficial features* dimension, causing ours to diverge from Peter's in terms of appearance.

Conclusion

John Peter's *Artificial Versifying* was a wild success in part because of the inventor's cleverness in developing the system. By exploiting specific aspects of the Latin language, such as its relatively free word order and loose restrictions on modifiers, an elegant combinatorial procedure was enabled—one that was entirely feasible to invent, and to disseminate, in the material conditions of Peter's day. In translating the system to English, we experienced firsthand the pain of Cayley's (2015) "local algorithmic dissonance," discussed above. Peter deftly leverages the features of Latin that lubricate his combinatorial procedure, but these features are not present in English. Our first attempt at translation, essentially a meaning-oriented transliteration that maintained word order, produced wonky outputs such as 'the bitter gift I say will show quarrels many.' By adding metrical constraints to our design considerations, the process became even more difficult in our second phase of translation. Ultimately, we found that rearranging Peter's versifying tables would be necessary to produce grammatical outputs, but this too was complicated by Peter's mixing of adverbs and adjectives in Table 6. Ultimately, we not only swapped tables, but altered the part of speech of certain items to produce a "least bad" system translation that we are pleased to present in this article.

Again, we would like to emphasize that translating any isolated output from the original *Artificial Versifying* is a trivial problem relative to the one we undertook.

In our case, each decision about how to translate one of the system's 54 items affected tens of thousands of translations, those being all the 9^5 possible outputs including that item. The peculiar challenge of wrangling system dynamics by making decisions about individual components is what Montfort (2018) has referred to as the 'computational aspect' that complicates e-lit translation. In this article, we have shown that these difficulties are already present in protocomputational works that are sufficiently *procedural*, such as John Peter's *Artificial Versifying*. We hope that readers will enjoy using our English translation of the system, shown in Figure 3, and that our project will stimulate interest in the translation of other curious systems that intriguingly prefigured electronic literature.[10]

Acknowledgments

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Notes

[1] The full title of the booklet, published in London by John Sims, is *Artificial Versifying or, The School-boy's Recreation: A New Way to make Latin Verses. Whereby Any one of ordinary Capacity, that only knows the A.B.C. and can Count 9 (though he understands not one word of Latin, or what a Verse means) may be plainly taught, (and in as little a time as this is Reading over,) how to make Hundreds of Hexameter Verses, which shall be True Latin, True verse, and good Sense.* While Peter is not identified in the first edition, a second edition "By the same Hand of John Peter" includes an author's preface in which he notes, "It is twice five years and upwards, since the Model of this Fancie was first influenced into my Brain" (A2). Given that this preface is dated September 1677, we speculate a time frame for the system's invention roughly in the range of the London's last major outbreak of bubonic plague, which spanned 1655–1666 (see Moote and Moote 2004). Did a peculiar muse visit Peter in his quarantine boredom? The

date of this current publication may suggest a bias for our speculation. Details including Peter's occupation and other publications are given in Ruff (2001), which supplies the most extensive critical treatment of Peter's work to date.

[2] See Ruff (2001) for a deeper explanation of the system.

[3] Ruff (2001) implies that there were two distinct third editions (243), and Binder (2018) notes a fourth edition in 1679 (368), likely following Ruff. Binder discovered reproductions of Peter's tables in *The Curiosity: or, the Gentleman and Lady's Library* (1739) (193–201) and other eighteenth century texts. As for the latter, we have personally identified John Hill's popular *Arithmetick*, published in several editions that century (e.g., see 159–164 of the 1712 edition). The latest reprint of Peter's tables that we have encountered appeared in an 1875 issue of *The Huddersfield College Magazine* (vol. III, 223–226), under the heading "Latin Versification for the Million" (whence this article's title). Of particular note is an obscure 1860 booklet by "H. S. G." that reprints Peter's tables under the title *Carminarium Latinum; Whereby any one of ordinary capacity, though he understands not one word of Latin, may be taught immediately to make 590,490 hexameters and pentameters, true Latin, true verse, and good sense.* These two sources show that Peter's system was in use a full two centuries. Will any work of e-lit have such staying power?

[4] The procedure that drives John Clark's *Eureka* machine is believed to have been inspired by *Artificial Versifying*. Rodgers (2017a) has evocatively identified the latter as the "software" of the former (2).

[5]Curiously, however, Table 3 instead uses extra black squares in lieu of random letters, while Table 4 ends with an empty white square.

[6] Ruff (2001) includes English glosses for each of the 54 words in Peter's six tables. Binder's (2019) computerization of the procedure is an interactive visualization that affords an English mode, but this is a simple word-for-word translation that swaps the Latin words for Ruff's glosses, producing results like *sad vows for a man will cause quarrels evil*. To be clear, neither Ruff or Binder claim to have produced a bona fide translation.

[7] We will list here a few of the earliest instances of which we are currently aware. An English translation of Theo Lutz's "Und Kein Engel Ist Schön" (see Bernhart 2020) appeared in various newspapers in July 1963 (e.g., Palmer 1963), via the Associated Press wire service. Russian translations of Victor Yngve's computer-generated sentences (Yngve 1962) are included in Apresyan (1966). A remarkable article by Hans-Jørgen Nielsen (1967) includes his Danish translations of Lutz's computer poetry, Yngve's random sentences, and also Christopher Strachey's computer-generated love letters (Strachey 1954, Wardrip-Fruin 2011). Selections from *A House of Dust* (Knowles et al. 1969) were translated into Polish by Vilim Crlenjak for Putar (1968). English translations of Boris Katz's Russian computer poetry appeared in Zientara (1978). We have also

encountered a number of later examples.

[8] Montfort (2014) computerized MacCormac's translation for his *Memory Slam* suite of reimplementations of historical text generators.

[9] It is with some deliberation that we have selected the word 'procedural.' One might be inclined to associate 'interactive' or 'ergodic' works (Aarseth 1997) with Montfort's computational aspect, but this would be misguided, because it is not (just) interactivity that troubles translation. For instance, while *Artificial Versifying* is ergodic, John Clark's *Eureka* is not, but it is procedural enough to complicate translation. Likewise, cursory consideration of many non-ergodic text generators (e.g., Strachey 1954, Lutz 1959, Yngve 1962, Knowles et al. 1969) will reveal this notion.

[10] Pertinent Latin options here include the revised hexameter and new pentameter verse of the second edition of *Artificial Versifying*, as well as John Clark's aforementioned *Eureka* machine, which takes up a similar combinatorial procedure.

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