Flight: A Scene of Escape

Topic: Agent Driven Narrative

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Abstract
This paper describes the attempt to construct the emergent narrative, *Flight,* which tells the story of a series of departures, movements, or escapes across an abstracted map or terrain. An evolving group of entities drifts across an arrangement of boundaries while competing for the reader's attention. Entities can render several categories of text to the screen, each of which are affected by elements and boundaries in the terrain. The internal design of entities allows them to evolve through collision with terrain elements as well as boundary events. Complex narrative conditions emerge as agents move toward their spatial goals.

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Narrative In 'Maps of a Future War: Flight'

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Abstract

This paper describes the attempt to construct the emergent narrative, Flight, which tells the story of a series of departures, movements, or escapes across an abstracted map or terrain. An evolving group of entities drifts across an arrangement of boundaries while competing for the reader's attention. Entities can render several categories of text to the screen, each of which are affected by elements and boundaries in the terrain. The internal design of entities allows them to evolve through collision with terrain elements as well as boundary events. Complex narrative conditions emerge as agents move toward their spatial goals.

Keywords

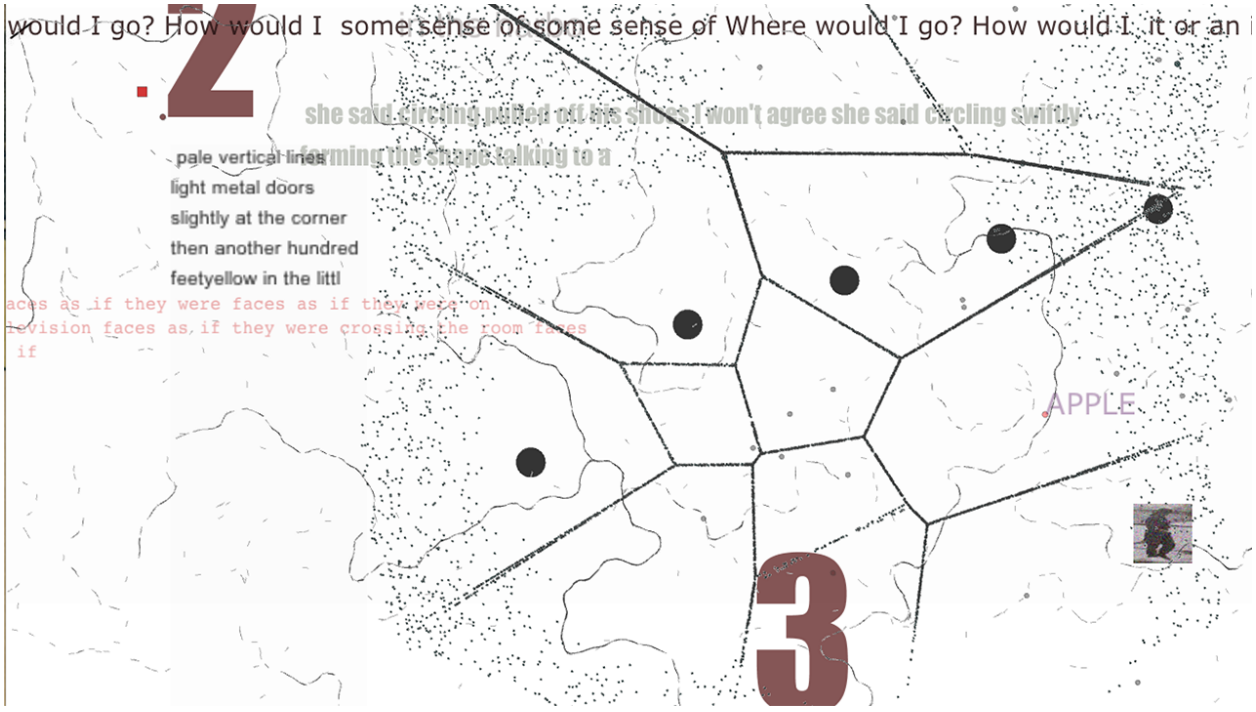
generative art, computational narrative, genetic algorithms, narrative,

Introduction

Recently I began work on a digital project comprised of a series of artist's maps meant to describe social, financial, and political precursors to military conflict. *Flight*' is a screen-based digital artwork, one of the generative art works in the speculative series '*Maps of a Future War*'. For this artist's map, a system of agents, signals, and boundaries interact in a digital environment to produce a fragmented story about migration, or accounts of flight from conflict, poverty, danger, injustice, or oppression. The story is advanced through the use of genetic computation on text blocks that are allowed to drift across regions, boundaries, graphic elements, and area textures. These narrative blocks, or text agents, can sense signals from other map elements, and pick up traces or evolve according to elements from their surrounding boundaries or their larger regional environments. Texts are computed and then tested for coherence to a group of predetermined or 'written' state rules which can be viewed as the system's narrative phases and which in turn affect certain types of organization in the world narrative. Each of the maps in the series is intended as a fragment of a larger, non-coherent narrative. In keeping with plasticity of the theme, and with skepticism as to the ability of a linear narrative to represent a story that consists imaginatively as a dynamic situation, the agent texts within each map were initially conceived as evolving assertions which would arise from movement across terrains and the shifts in system processes.

There are several motivations underlying a work of this type. The first is the creative aim of showing that satisfying and 'writerly' narratives can operate as dynamic systems, texts that are nonlinear and emergent as opposed to causal and progressive. The second, more technical idea, is that of continuing experiments [2] [3] [5] [7] in the application of genetic algorithms to narrative environments. The goal in writing each map's 'story' or 'account' was to build a generative process for the development of a story whose sum meaning might exhibit a kind of organization or pattern that would reach beyond the events described in any single thread of discourse within a fictional story world. Overall, the *Maps* project is a work of nine interrelated story worlds, each a visual art work consisting of text agents, a signal system, boundaries, regions, animations, and other graphic elements.

The whole work, and even the work involved in the creation of the single map *Flight*, is larger than the scope of this paper. The goal of this paper is to describe the construction of the generative system used to construct narrative, so what follows is not a comprehensive design document detailing all elements of *Flight* or of the series, *'Maps of a Future War'*, but an outline of the features of one part of this project's design for agent led narrative, identifying key structures of the agents themselves, the system's overall narrative states, and the resulting forms, behaviors, patterns, or actions of the story. This description starts by listing the overall narrative phases of this segment of the project and then goes on to describe the composition of the individual agents in *Flight*, their identify key features (forms) and behaviours (actions) and the way those forms and behaviors are encoded as data strings similar to genes. Using genetic algorithms, these narrative 'genes' are then evolved to other identities helping the story system as a whole cycle through a series of predetermined or written narrative states. The results are then demonstrated as a dynamic story as generated by the map *Flight*. Though genetically evolved, all subsequent instantiations and narrative states derive from the initial narrative archive.



Maps of a Future War: Map #3 Flight (2017)

1. Instantiation as Representation

In *Flight*, the idea of narrative state is used to model the central conflict of the story, while short texts, sentences, and fragments, which can be thought of as instantiations of those states, are the fictional representation of conflict on screen.

Narrative states in *Flight* were based on readings that described the erosion of political solutions to conflict [9]. Compared to the real world, the structure of *Flight* is very simple, limited to five contexts, fifteen states, and the resulting transitions, as shown in Figure 1. *Flight* uses these symbolic narrative states and text instantiations to tell stories of people in transit and to model situations that are dynamic and interrelated. In addition, instantiations are influenced by the specifics of their phase, location, and history as calculated by the digital environment.

Maps of a Future War: Map #3 Flight

Figure 1. Narrative Contexts, States, and Transitions

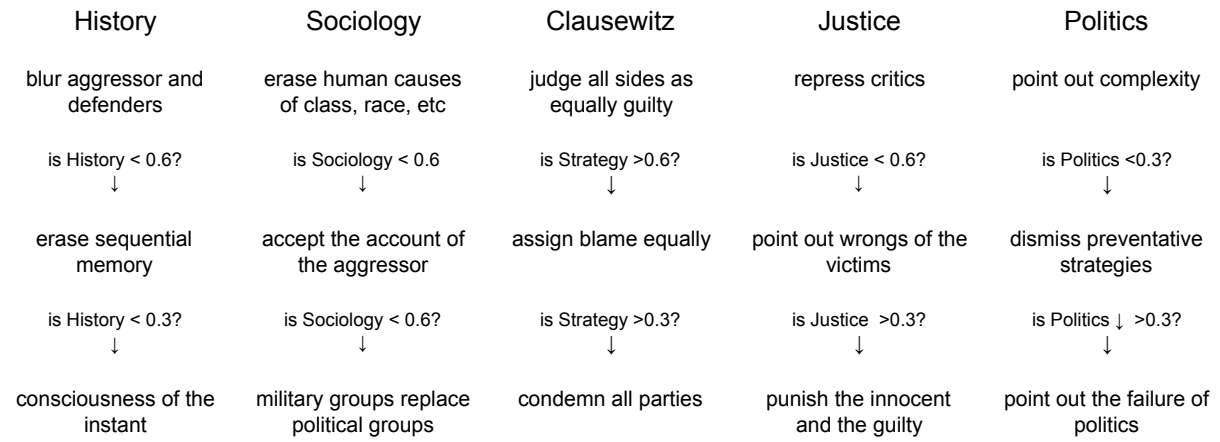


Figure 1. *Maps of a Future War: Map #3 : Flight* Narrative Contexts, States, and Transitions.

Starting from these states and transitions, text agents in *Flight* drift across regions, collide with boundaries, and update according to chance, proximity, and context. However, these instantiations are expected to change through genetic replication and mutation, thereby developing in unanticipated ways. The intent is to move the system forward towards an exploration of unanticipated states that are explicitly dependent on the historical evolution of the map's lifecycle and to give text agents the ability to create instantiations that represent emergent states, or narrative conditions that are not programmed or anticipated by the map's initial model.

2. Narrative Design of Agents

In *Flight*, text agents produce instantiations of the story, acting as the narrators of the world. Each agent has a set of internal states and behavioral rules, as well as a string or pattern of 'DNA' that describes their starting context and identity. As described in Figure 2., some aspects of an agent's state is fixed for the agent's lifetime while other aspects are expected to change through interaction with the environment, replication, or mutation. In the model below, the agent's context, font, and color are fixed for life while it's attributes for location, observation, belief, and action are expected to evolve with the narrative system. Movements, evolution, state changes, and the resulting shifts in instantiation depend on the state of the environment and genetic computation.

Maps of a Future War: Map #3 Flight
Figure 2.. Agent Design

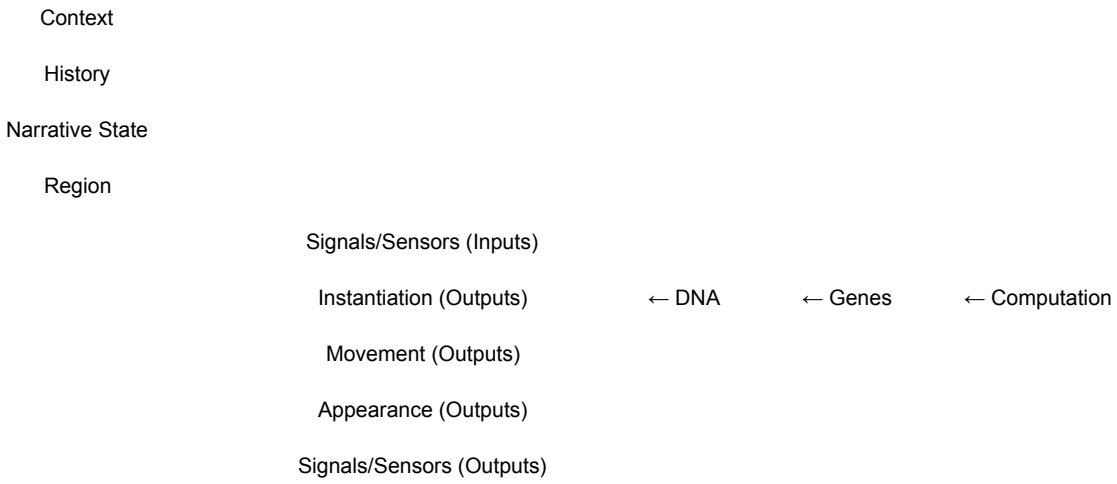


Figure 2. *Maps of a Future War: Map #3 : Flight* Agent Design

Text instantiations produced by agents are formed in three sections: observation, belief, and action, and are computed via a genetic algorithm from a population of solution fragments that depend on that agent's situation in the world, its narrative state in the map, and its genetic identity. For example, a text agent may sense change based on the reception of a signal from the environment. That agent will then generate a set of possible instantiation solutions and assemble a text based on that text's coherence with the current narrative state. Figure 3. shows an instantiation plan for text fragments.

Maps of a Future War: Map #3 Flight
Figure 3. Instantiation Plan

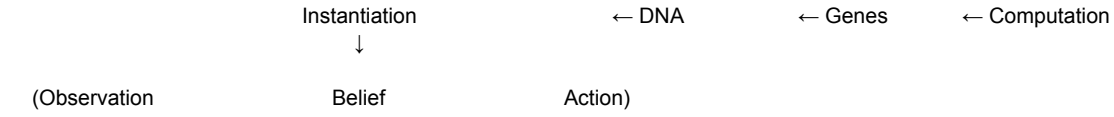


Figure 3. *Maps of a Future War: Map #3 : Flight* Instantiation Plan

The relationship of observation, belief and action in agent instantiations is the basis for the emergence of new narrative states. Each instantiation of observation and action has equal probability of presenting new instantiations, while changes in belief are slightly more difficult to achieve. Figure 4. shows a possible instantiation set for an agent over several iterations. In turn, the environment can receive signals from agents, and serve as a feedback medium responsive to agent evolution.

Maps of a Future War: Map #3 Flight
Figure 4. Instantiation Plan

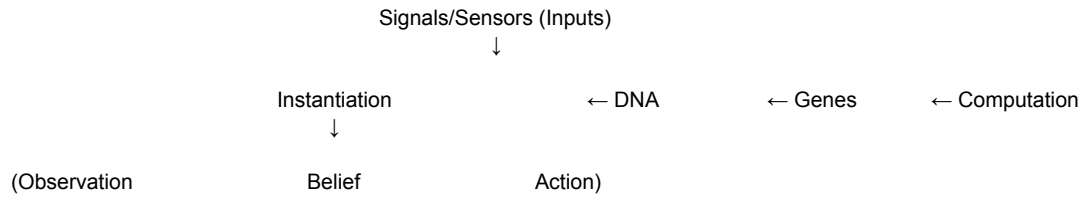


Figure 4. *Maps of a Future War: Map #3 : Flight* Instantiation Plan

3. Rules of the World

Finally, there are rules for agent behavior on the map. An example of a behavior rule for an agent might be: Find the region of least conflict and move in that direction. These rules are classified in three groups: agent to environment, agent to agent, and environment to environment, controlled by the map's event/signal system, and computed as state coherence during replication. They are meant to express the overall narrative state of the map, and to couple agents to the world at large. Examples of world rules for a single agent in a predefined narrative state are listed in Figure 5.

Maps of a Future War: Map #3 Flight
Figure 5. Sample World Rules

Narrative State	Region Rule	Boundary Rule	Agent to Agent Rule	Agent Rule
consciousness of the instant	increase observation	increase action	increase action	weaken belief
military groups replace political groups	increase action	increase observation	increase action	increase belief
punish the innocent and the guilty	decrease observation	increase belief	increase action	increase action

Figure 5. *Maps of a Future War: Map #3 : Flight* Sample World Rules

As described earlier, the construction of instantiations depends on the assembly of three component text fragments categorized as observations, beliefs, and actions and assigned to the current narrative state. That is, each narrative state has an archive of possible text solutions per component. A component's judged distance from the narrative state is termed the agent's coherence weight. Coherence value of each component is calculated during selection when a final instantiation is chosen and printed to the screen as story.

4. Using an Evolutionary Approach to Assemble Instantiations

4.1 Genetic codes

From this archive of text components, *Flight* determines an initial or parent population of agent instantiations which in turn define the map's opening narrative state. *Flight* then uses an evolutionary approach to create story [5]. Using a 'DNA' string which contains nine 'genes', three for each of the component text fragments (observation, belief, and action) and which is meant to index the characteristics of that agent's component text blocks, each agent assembles enough text components to achieve two possible parent instantiations. These parent texts then undergo two evolutionary routines (crossover, mutation), and are then assigned an instantiation weight based on their dominant component. Figure 6. illustrates an example gene and the calculation of its component index.

Maps of a Future War: Map #3 Flight
Figure 6. Example Component Assembly

DNA (random (0,1))	0.23	0.42	0.17	0.34	0.78	0.41	0.50	0.03	0.21
Environmental Signals (assigned)	0.45	0.33	0.67	0.21	0.33	0.42	0.54	0.10	0.72
Component Index (without mutation)	norm(0.23 + 0.42 + 0.17) + (0.45 + 0.33+ 0.67) *0.25) = 0.42			norm(0.34 + 0.78 + 0.41) + ((0.21 + 0.33 + 0.42)*0.25) = 0.47			norm (0.50 + 0.03 + 0.21) + ((0.54 + 0.10 + 0.72) * 0.25) = 0.28		

* norm() =(value - min) /(max - min)

Figure 6. *Maps of a Future War: Map #3 : Flight* Example Component Assembly

4.2 Genetic operators

Flight uses two genetic operators, mutation and crossover, to evolve instantiations:

Mutation

Mutation is an operation to change the i^{th} index in the in the chromosome code. For example, Figure 7. demonstrates a parent chromosome mutating one 'gene' in the fourth DNA index which would manifest as a component text mutation from Group 5 to Group 1.

Crossover

Crossover intermixes the existing DNA strings to population to create new indices. In this initial version of *Flight*, only single point crossover is used. A dividing point is selected from one of the three component block (observation, belief, action) and the transfer of data is applied. Figure 8. shows a crossover at the action component. The child instantiation inherits its action index from Parent B, while retaining its observation and belief indices from Parent A.

Maps of a Future War: Map #3 Flight
Figure 7. Mutation

DNA (random (0,1))	0.23	0.42	0.17	0.34	0.78	0.41	0.50	0.03	0.21
Mutation Index random(9) ex. random(9) = 4	0.45	0.33	0.67	0.21	~~0.33~~ **0.33 * 0.5 = 0.17**	0.42	0.54	0.10	0.72
Environmental Signals (assigned)	0.45	0.33	0.67	0.21	0.17	0.42	0.54	0.10	0.72
Component Index with Mutation	norm(0.23 + 0.42 + 0.17) + (0.45 + 0.33+ 0.67) *0.25) = 0.42			norm(0.34 + 0.78 + 0.41) + ((0.21 + 0.17 + 0.42)*0.25) = 0.13			norm (0.50 + 0.03 + 0.21) + ((0.54 + 0.10 + 0.72) * 0.25) = 0.28		

* norm() =(value - min) /(max - min)

Figure 7. *Maps of a Future War: Map #3 : Flight* Mutation

Maps of a Future War: Map #3 Flight
Figure 8. Example of Single Point Crossover

Parent A - Observation (weight 0.20)	Parent A - Belief (weight 0.44)	Parent A - Action (weight 0.36)
Parent B - Observation (weight 0.32)	Parent B - Belief (weight 0.82)	Parent B - Action (weight 0.44)
Child 1 - Observation (weight 0.51)	Child 1 - Belief (weight 0.62)	Child 1 - Action (weight 0.36)
Child 2 - Observation (weight 0.63)	Child 2 - Belief (weight 0.44)	Child 2 - Action (weight 0.43)

Figure 8. *Maps of a Future War: Map #3 : Flight* Example Component Assembly

After mutation and crossover have been performed, component instantiation weights are calculated and used as indices to determine text selection.

Maps of a Future War: Map #3 Flight
Figure 9. Instantiation Weights

DNA (random (0,1))	0.23	0.42	0.17	0.34	0.78	0.41	0.50	0.03	0.21
Mutation Index random(9) ex. random(9) = 4	0.45	0.33	0.67	0.21	~~0.33~~ **0.33 * 0.5 = 0.17**	0.42	0.54	0.10	0.72
Environmental Signals (assigned)	0.45	0.33	0.67	0.21	0.17	0.42	0.54	0.10	0.72
Component Index with Mutation	norm(0.23 + 0.42 + 0.17) + (0.45 + 0.33+ 0.67) *0.25) = 0.42			norm(0.34 + 0.78 + 0.41) + ((0.21 + 0.17 + 0.42)*0.25) = 0.13			norm (0.50 + 0.03 + 0.21) + ((0.54 + 0.10 + 0.72) * 0.25) = 0.28		
Instantiation Weight	0.42			0.13			0.28		
Mutated Component Text	round(0.42) → Group 4			round(0.13) → Group 1			round(0.28) → Group 3		

* norm() =(value - min) /(max - min)

Figure 9. *Maps of a Future War: Map #3 : Flight* Instantiation Weights

4.3 Selection and Coherence Weights

Now that each instantiation has been assembled and weighted, one child can be compared to another, to agent rules, world rules, and to the narrative state of the system. Selection is carried out in two steps. First, an instantiation rule coherence is determined. Rule coherence is a measure of how closely instantiation components follow agent rules as determined by the narrative state. Examples of the calculation of rule coherence are seen in Figure 10.

Maps of a Future War: Map #3 Flight
Figure 10. Rule Coherence

Narrative State: ‘Consciousness of the Instant’

Instantiation Weight	Observation 0.42	Belief 0.14	Action 0.28
Change from Prior Instantiation	+0.10	-0.32	-0.14
Region Rule (increase observation)	yes abs(0.10)		

Maps of a Future War: Map #3 Flight
Figure 10. Rule Coherence (Continued)

Narrative State: ‘Consciousness of the Instant’

Boundary Rule (increase action)		no
Agent to Agent Rule (increase action)		no
Agent Rule (weaken belief)	yes abs(0.32)	
Rule Coherence	norm(0.10 +0.32) = 0.14	

* norm() =(value - min) /(max - min)

Figure 8. *Maps of a Future War: Map #3 : Flight* Rule Coherence

In the second round of selection, the state coherence of text fragments is compared to the conflict levels of the narrative state as shown in Figure 11.

Maps of a Future War: Map #3 Flight
Figure 11. Use of Coherence Weights

Narrative State	State Coherence	Instantiation Component		
		Observation	Belief	Action
	0.6	seeing battalions in the street	a problem with governments distant faltering disappearing in silence without debate protests overnight without warning	
	0.3			regaining the will of the moment demanding it much as we should have insisted on all the rest
military groups replace political groups (conflict - high) (weight 0.9)	0.9		we don't need another failed negotiation we need progress some solution an army	

Figure 9. *Maps of a Future War: Map #3 : Flight* State Coherence

Initially, children of closest state coherence have a fifty fifty chance of being selected as a final instantiation, but as the narrative state tends toward conflict, the systems chance of choosing children of closer coherence increases. In this way, the map dynamically adjusts the need for narrative coherence to the amount of conflict in the system. Figure 12 describes the selection of a final child text.

Maps of a Future War: Map #3 Flight
Figure 12. State Coherence

Narrative State	Coherence Weight Child 1	Coherence Weight Child 2	Final Instantiation
consciousness of the instant (conflict - low)	0.24	0.65	Random Child 1 or Child 2
accept the account of the aggressor (conflict - moderate)	0.36	0.32	Random Child 1 or Child 2
military groups replace political groups (conflict - high)	0.46	0.32	Child 1

Figure 12. *Maps of a Future War: Map #3 : Flight* State Coherence

The process of selection gives us two measures, the child with the greatest rule coherence and the child with the closest state coherence. If conflict is low or moderate, the child with the greatest rule coherence is chosen. In states of high conflict, the child with the highest state coherence is chosen as in Figure 13.

Maps of a Future War: Map #3 Flight
Figure 13. Final Instantiation

Narrative State	Rule Coherence Child 1	Rule Coherence Child 2	State Coherence Child 1	State Coherence Child 2	Final Instantiation
consciousness of the instant (conflict - low)	0.24	0.65	0.70	0.21	Child 2
accept the account of the aggressor (conflict - moderate)	0.36	0.32	0.34	0.32	Random (Child 1 or Child 2)
military groups replace political groups (conflict - high)	0.46	0.32	0.34	0.44	Child 1
punish the innocent and the guilty (conflict - high)	0.32	0.32	0.62	0.13	Child 1

Figure 13. *Maps of a Future War: Map #3 : Flight* Final Instantiation

5. Implementation

This section describes the operations of one text agent at an initial narrative state in order to illustrate an evolutionary approach to text.

All agents texts are written as fragments and classified hierarchically first by state, then by group. An example of text classification is shown in Figure 14.

Maps of a Future War: Map #3 Flight

Figure 14. Text Group Assignments

Narrative State	Component	Instantiation Weight	Group ID	Text
		0.1	1	bald stooping escorted by two soldiers one wearing the insignia
		0.1	1	flags hanging on terraces
		0.2	2	apparently in pursuit of something staggering forward stammering what was it he looked
		0.2	2	the border still far ahead of us
		0.3	3	odd the hair red scarf around her throat not from this area
		0.3	3	we looked up a sky full of clouds a blue sky
military groups		0.4	4	we argue grieve offer prayers send condolences
replace		0.4	5	so far from the city
political groups	Observation	0.5	5	and the child running up and down the line up and down
(conflict - high)		0.6	6	he went on talking he seemed to be a thousand years old
		0.6	6	shaking his head holding his hands over his ears
		0.7	7	he had a medal hanging around his neck
		0.7	7	she came toward us beginning to reproach us for walking toward the road who was she to interfere we
		0.8	8	no he said waving us back toward the white markers no I’m telling you for the last time
		0.8	8	even in outskirts now streets full of soldiers

Maps of a Future War: Map #3 Flight

Figure 14. Text Group Assignments (Continued)

		0.9	9	without asking sitting in the empty chair next to me he began whispering
		0.9	9	he stared at
		0.1	1	too bored to go on
		0.1	1	the guilty ones taking advantage of the confusion slipping out the back

		0.2	2	like the middle of nowhere
		0.2	2	impressed with ideas innovation leaving the house at all hours to hear a speaker or attend
		0.3	3	like one of their forms a piece of paper
		0.3	3	dedicated to the virtues of maintaining his position
military groups		0.4	4	because people will believe anything especially if it's in their interest to believe it
replace		0.4	4	we could have continued we could have gone farther now it's more dangerous more expensive
political groups	Belief	0.5	5	time to acknowledge a long list of grievances offenses useless demands
(conflict - high)		0.5	5	that visa it will never come through
		0.6	6	a problem with governments distant faltering disappearing in silence without debate protests overnight without warning
		0.6	6	no one is resettled unless their identity background motives affiliations have been ascertained beyond doubt
		0.7	7	she's unlucky for me
		0.7	7	there was something else something dependant of his good health but he was sick he was sick
		0.8	8	but going to the police or the embassy what a waste
		0.8	8	I have things to sell things people want
		0.9	9	he'll make us pay
		0.9	9	do people believe those stories

Maps of a Future War: Map #3 Flight
Figure 14. Text Group Assignments (Continued)

		0.1	1	we decided to go east hoping to get on a plane that would take us further
		0.1	1	but I refuse to pay attention
		0.2	2	coming over to look at the sky
		0.2	2	discarding our letters photographs anything that would draw attention
		0.3	3	I was looking out for myself looking ahead I had a ticket a way to the airport then at the last moment I turned back

		0.3	3	let’s quit listening to these morbid stories
military groups		0.4	4	I thought I’m sitting here I’m still here while everything is moving around me
replace		0.4	4	though as I listened to her story I was annoyed by her plain accounting of the facts her matter of fact opinions her common sense
political groups	Action	0.5	5	I’ll go back to the first town I think they’ll take me back
(conflict - high)		0.5	5	we decided to back to Sweden we still knew some people there
		0.6	6	keep walking I told them until someone tells us otherwise
		0.6	6	he felt he was in danger I wanted to know why wasn’t everyone here in some kind of trouble
		0.7	7	I was startled but I recognized him I understood the expression on his face
		0.7	7	we won't report it we won’t say anything about any of this
		0.8	8	and if anyone tries coming near me
		0.8	8	I’m not going to sit here watching truckloads of refugees roll past keeping silent doing nothing
		0.9	9	let them try it they’ll see what they get
		0.9	9	I'll make myself invisible move past this I’ll move right between them

Figure 14. *Maps of a Future War: Map #3 : Flight* Text Group Assignment

Since what is of interest is the way evolutionary conventions might lead to emergent states, the start state of the system is somewhat arbitrary. The idea is to see if the map can produce emergent narratives, or emergent narrative states as text generations are computed. Therefore, the initial narrative state is chosen at random. This initial state governs world rules (as shown above in Figure 5) as well as initial signal states for boundaries, regions, and worldscape textures. Also assigned randomly, but operating within the parameters of their starting conditions, text agents are assigned a nine float ‘DNA’ code to determine the base segments their generation zero text outputs, and story is assembled from these base classifications: observation, belief, and action. Floats 0-2 define the agent’s ‘observation’ statements, floats 3-5 govern the agent’s ‘belief’ statements, and floats 6-8 decide the agent’s ‘action’ statements as shown in Figure 15.

Maps of a Future War: Map #3 Flight
Figure 15. Groups Assignments

Narrative State	Component	Rule (assigned)	DNA (random)	Instantiation Weight	Group Assignment	Text (randomly chosen

				Needed		from group population)
military groups	observation	increase observation	0.32	>0.3	Group 4	we argue grieve offer prayers send condolences
replace	belief	increase belief	0.45	>0.5	Group 6	a problem with governments distant faltering disappearing in silence without debate protests overnight without warning
political groups	action	increase action	0.29	>0.3	Group 4	turning to the window

Figure 15. *Maps of a Future War: Map #3 : Flight* Text Group Assignments

Figure 16 shows an example of a starting assembled text.

Maps of a Future War: Map #3 Flight

Figure 16. Assembled Text

Observation	→	we argue grieve offer prayers send condolences	→	we argue grieve offer prayers send condolences a problem with governments distant faltering disappearing in silence without debate protests overnight without warning turning to the window
Belief	→	a problem with governments distant faltering disappearing in silence without debate protests overnight without warning		
Action	→	turning to the window		

Figure 16. *Maps of a Future War: Map #3 : Flight* Example of Assembled Parent Text

This initial text is regarded as Parent Text A. When system signals reach a point of where text generation is called, the same routine is used to select new instantiation weights for Parent Text B. Weight values for both parent texts undergo mutation and crossover as described in

Section 4 (above). The parents then undergo crossover to produce two child texts whose coherence weights are calculated for the selection of a final Generation 1 child text. With final coherence weight of the child text calculated, the narrative state of the system is updated and signaled to the system agents controlling regions, boundaries, and landscape textures.

6. Conclusions

This paper describes the generative construction of text in the Maps of a Future War: Map #3 Flight and explained the methods used to attempt emergent narrative states in this story. Through a system of text agents, components, DNA strings, signal, boundaries, state, and coherence weights, the story in this digital map was constructed by using an evolutionary approach based on genetic algorithms. The use of evolutionary methods in the assembly of this story helped achieve the emergent characteristics of the text.

7. References

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