Computational Poetry Workshop

I AM THAT I AM

Abstract

Creativity cannot exist in a vacuum; it develops through feedback, learning and social interaction with others. However, this perspective has been relatively under-investigated in computational creativity research, which typically examines systems that operate individually. We develop a set of requirements for creativity systems that can incorporate communication and give and receive feedback. FloWr is intended as a paradigm in which computational creativity software can be implemented and integrated. We ask if the FloWr framework can model social creativity, and if not, what changes may need to be made in order to accommodate the requirements of social creativity. As a thought experiment to test these ideas, we consider a case study of how feedback and dialogues can help develop the creativity of computational poetry writing, and how such a system could be implemented in FloWr. We also consider alternatives to FloWr for modelling social creativity.

Keywords: poetry, social creativity, flowcharts, distributed computing, population-based methods, agent-based models, duration, temporality, serendipity, design patterns, Writer's Workshops

'We *can* talk,' said the Tiger-lily: 'when there's anybody worth talking to.'

Through the Looking Glass, Lewis Carroll

Introduction

We should clarify at the outset that a central part of this paper is not new. We are writing in a large part to champion Alan Turing's proposal that intelligent machines should "be able to converse with each other to sharpen their wits" (Turing, 1951). What is new is the particular approach to computation that we advance in support of this proposal.

While we do not precisely suggest an alternative to the input/output/process model of computation (Marr, 1981), we do propose to extend it to build social effects. A lot hinges on the understanding of the term "social." The formalism that is proposed here builds on the notion of second order cybernetics that is encapsulated by these two propositions of Heinz von Foerster's:

> "Anything said is said *by* an observer."
> "Anything said is said *to* an observer."
>
> (Von Foerster, 2003 [1979])

These propositions suggest a connection between observers, language, and a relationship in which the language is used. We call the indicated relationship "social." While the typical genre of design, programming and *first order cybernetics* is concerned with an observer who specifies a system's purpose (and its inner workings), the aim in *second-order cybernetics* is for a system participant to specify its own purpose in a "social" manner, that is, in relationship to the rest of the system.

This is closely related to W. Brian Arthur's way of thinking about the science of complexity. He suggests that for sufficiently complex problems, there is no correct statement of the problem. "All you can say is that you have this situation and there are many ways to cognize it" (Arthur, Jaworski, Jusela, and Scharmer, 1999). The consequence is that:

> Complexity is looking at interacting elements and asking how they form patterns and how the patterns unfold. It's important to point out that the patterns may never be finished. They're open-ended. (Arthur et al., 1999)

The aim in this paper is to enhance the computer's response-ability, its ability to identify its own approach to a given situation, including its ability to identify and encode new patterns. We can potentially apply this sort thinking at each level of a program. In this way, the familiar model of input/output/process morphs to become something more like *context/response*. A response may be in the form of "output" or it may be in the form of "process" or it may be a mixture of these. In particular, a satisfactory response may be for the entity in question to change its own structure. Another part of the response might change the context. This could all be viewed in a formal way as "output" – new code may be written to disk and update the entity's definition of "self," for example – but this isn't quite the same as the standard linear model that deals with components that have been precisely defined in terms of its input and output. We still have components, but their behaviour can change over time.

An approach like this will be necessary for building autonomous and adaptive machines. Equally, this context-driven approach seems necessary for the development of a theory of *social cybernetics* as outlined by Von Foerster. In the literature setting, similar comments had been made over a decade earlier, by Mikhail Bakhtin, who wrote:

> The thinking human consciousness and the dialogic

> sphere in which this consciousness exists, in all its depth and specificity, cannot be reached through a monologic artistic approach.
>
> (Bakhtin, 1984 [1963], p. 271)

Predicated on the assumption that *computers are not human* (Colton, 2012, pp. 12, 18), computers *must* be social, if they are to deal with problems of any great complexity (Minsky, 1967, 1988).

This paper outlines an approach to social creativity, taking computer poetry as our working domain. It uses the Writer's Workshop model (Gabriel, 2002) as its primary thought-architecture. It will be of interest to others working in the field of computational creativity (hereafter, CC), who, we hope, will read it as an invitation to a dialogue.

Background

Social creativity in CC

Although we have adopted the term "social creativity" following (Saunders, 2012) and with the specific understanding developed above, we could also refer in a similar spirit to situated, interactive, communal, contextual, conversational, group, dialogical, discourse-based, community-based, interaction-based, or feedback-informed creativity.

The point is that creativity cannot exist in a vacuum. The very essence of creativity lives in its appreciation by the creative entity themselves and its audience. As we have remarked elsewhere, creativity is in the eye of the beholder. During the creative process, self-evaluation abilities are crucial (Poincaré, 1929; Csikszentmihalyi, 1988). Social creativity expands upon this paradigm by bringing co-creators into the process, and creating works that rely on dialogue, reflection, and multiple perspectives. The "results" may be steeped in process and will not always be based in consensus.

The Four Ps of creativity – the creative Person, Product, Process and Press (i.e. environment) (Rhodes, 1961; MacKinnon, 1970) – have been emphasised in general creativity research. *Pluralising* these terms would call attention to a social dimension of creativity, and leads to a more inclusive and encompassing approach to the study of creativity – one that accommodates multiple perspectives. The Pluralised Ps remind us that it is not sufficient to model a lone creator or to generate an attractive artefact. To model creativity more completely, we also need to consider the environment in which a creative person operates, and how the environment is used in the creative process.

Computational creativity research has achieved many successes in computational generation of creative products. The question of how these systems could adapt and learn from feedback to improve their creativity, however, remains underexplored in computational creativity despite evaluation being a pivotal contributory part of the creative process. Researchers have generally preferred to take on the task of generating artefacts that could be seen as creative, as a necessary prior to the task of incorporating self-evaluation within a creative system (Jordanous, 2011).

Some notable exceptions exist, highlighting the importance of the environment in which a creative system is situated (McGraw and Hofstadter, 1993; Sosa, Gero, and Jennings, 2009; Pérez y Pérez, Aguilar, and Negrete, 2010; Pease, Guhe, and Smaill, 2010; Saunders, 2012), with some of this work influenced by the DIFI (Domain-Individual-Field-Interaction) framework (Csikszentmihalyi, 1988). Generally, however, social interaction between creative agents and their audience is an area which has been neglected. Increased development of the interactivity of creative systems, especially where this affects the way these systems works, is pleasing to see and deserves further attention (Colton and Wiggins, 2012).

. . . and in computer poetry

In the domain of poetry-generation, there have already been several attempts to simulate social creativity by incorporating multi-agent systems.

In WASP (**gervas01**; **gervas10**) the social behavior is simulated by incorporating a *cooperative society of readers/critics/editors/writers* consisting of specialized families of experts that cooperate during the poetry-generation process.

The McGONAGALL system (**manurung12**) incorporates diverse modules as operators of evolutionary algorithms that produce poems fulfilling the constraints on *grammar, meaning and poeticity*. This approach allows pursuing several alternative solution paths in parallel, focusing on more promising results or coming back to former ideas. However this solution does not provide any communication between modules.

In MASTER system for computer-aided poetry generation (**kirke13**) a *society* of agents in various emotional states influences each other's moods with their pieces of poetry. The poetry-generation process is based on *social learning* as the agents interact by reciting their own pieces of poetry to each other. The poetical form of the outputs is created by repeated words and sounds but the poems are not meaningful in the usual sense.

(**misztal14**) presents a Blackboard approach to poetry-generation in which independent specialized modules cooperate by sharing a common workspace – the blackboard. This solution fulfills the assumptions of the Global Workspace Theory of mind (**baars97**; **baars03**). The experts exchange information with use of the global blackboard, however there is no direct communication among the modules and they do not receive any feedback about their artifacts.

Writer's Workshops

Quoting (Gabriel, 2002, pp. 2–3):

> The original idea behind the writers' workshop was to do a *close reading* of a work, to use the term F. R. Leavis coined for the practice of looking at the words on the page rather than the intentions of the author or the historical and aesthetic context of the work. Under this philosophy, the workshop doesn't care much what the author feels about what he or she wrote, only what's on the page. This corresponds to the philosophy of the New Critics, which held that the work was its

own "being," with its own internal consistency and coherence, which could be studied apart from the author. Moreover, this approach is nearly identical to that of the Russian formalists, who thought that the proper approach to literature was to study how literary texts actually worked, their structures and devices.

Framing and any other contextualisation of the work *as it is intended to be presented* is permitted, and receives critical attention.

In (Corneli, Pease, Colton, Jordanous, and Guckelsberger, 2014), we described a template for a pattern language for interactions in a computational poetry workshop, closely following Gabriel's outline of the relevant steps: `presentation`, `listening`, `feedback`, `questions`, and `reflections`.[1] We used this template to expand several of the patterns of serendipity described by (Van Andel, 1994), showing how they could be used to foster discovery and invention in a workshop environment.

Philosophy and methods

Why do we need a model that might enable us to observe the creative process in the artistic outcome or practice e.g poems? Or, how can we justify building such a model based on the outcomes of creative practice i.e poems?

1. Because the originary and therefore the unpredetermined nature of the creative process means that the post-fact outcome represents a more accurate and objective evidence of it than the poet's attempt to explain it as it happens. According to Kant, the creation of a work of art (e.g poetry) succeeds in exhibiting originality that is neither predictable before it occurs nor traceable to prior rules (Anderson and Hausman, 1992). So a creator discovers how and what he/she is expressing through the creative process only in the course of doing it. And we, as observers, are therefore only able to consider how a creator selected and rejected various possibilities during the creative process, by considering the creation after the fact and within the finished whole.

2. Making a model of the creative process incorporates Dewey's ideas that the content of the art form is not the same as the aesthetic emotion expressed in it (Dewey, 1958 [1934], p. 35). It is a reasonable extrapolation from this notion to the idea that the content of an art form represents and indicates an examination of how it was made.

If content does not represent conceit, metaphor or what might be termed raw ingredients or some emotional spark felt the artist, how can a new way of considering content result in a rigorous and analytical study of the creative process?

Examining the content of the poem is a way of examining what it tells us about the drivers propelling it through its own making and how it stands as observer of its own process. "The painter does not paint; he watches himself paint" (Collingwood, 1972 [1938], p. 7) "In a poem, objective material becomes the content and the matter of the emotion and not just its evocative occasion" (Dewey, 1958 [1934], p. 69).

What is the central plank to this way of linking the outcome (or creative practice) with the creative process?

The idea that creation involves an exploration and expression of an aesthetic emotion and that both these can be charted or mapped in the creative outcome (the poem).

What is being expressed?

The artist, in the course of creating, is involved in something Collingwood referred to as "the expression of aesthetic emotion" (Collingwood, 1972 [1938], p. 117). In Part I of his Principles of Art, Collingwood suggests that the creative process takes place in stages. These are not necessarily chronological but present as a manifestation during creation that is visible in its outcome.

What do we mean by the "expression of an aesthetic emotion"?

I refer you to Collingwood and also to Benedetto Croce here for a combined definition of how an aesthetic emotion is expressed - An aesthetic emotion is expressed via a total imaginative activity. This is taken from Collingwood's Principles (1938) and Croce's Aesthetic (1902). It is be relevant to the analysis of the poems that Croce's Aesthetic defined intuition as "the non-divisible expression of sympathy" (Kemp, 2003, pp. 171–193).

What are the steps, stages or aspects of the creative process? ["Aspect" is my preferred term as it removes us from chronology and the implication that all these must be present all the time. Think instead that they can be "evidenced"].

Collingwood describes the initial stages of expression as "oppression"; as something that happens to the artist during his/her exploration of the creative process and, unexpressed, this produces feelings that are oppressive and which Dewey described as "disturbance" and which Anderson and Hausman see as a "colouring".

What happens to this oppression or disturbance?

The artist becomes conscious of it and starts to explore his/her own expression of it. This takes place as an intuited feeling (as described by Croce). This gives rise to a new feeling of alleviation or easement. That reference to novelty is crucial. If something is new, it cannot be predetermined.

What do we mean by "aesthetic emotion"?

PG Whitehouse on Dewey's Art as Experience suggests that Dewey joins Collingwood in separating aesthetic emotion from any notion that inspiration can be considered as something like raw materials. This fits in with our view of content as representational (and certainly indicative) of the creative process of the poet. So an emotion is aesthetic when it "adheres to an object formed by an expressive act" (Whitehouse, 1978, pp. 149–156). Or better still, "the art object does not have emotion for its significant content. . . .Emotion is a conscious sign of a break, actual or impending. It belongs to the self that is concerned in the movement of events toward an issue that is desired or disliked" (Dewey, 1958 [1934], p. 14).

What do we mean by experience?

"An unanalysed whole in a situation, having a pervasive quality in which the self finds itself" (Zeltner, 1975, p. 3).

[1] To this should be added the potential for real-time `replies` by critics to `questions` asked by the presenting author, before subsequent "offline" `reflections`.

In what way (in what phases/stages/aspects) can we see the artist experiencing aesthetic emotion in the making of his/her art?

In a study of Collngwood's theory of the expression of aesthetic emotion, Doug Anderson and Carl Hausman refine ideas on how we might see this and specifically how this relates to our way of studying process through practice (Anderson and Hausman, 1992, pp. 299-305):

> Aesthetic emotion... response... artist's decision on components of expression... feeling of easement plus a simultaneous emerging of a unique imaginative expression... alleviation... consciousness... specific to converting psychical emotion... unique aesthetic experience

What is psychical emotion?

The agent (through expression) discovers him/herself to have been feeling independently of expressing it. [The emotion of consciousness is where an agent only feels at all in so far as he/she thus expresses it].

How is easement understood to be unique/originary?

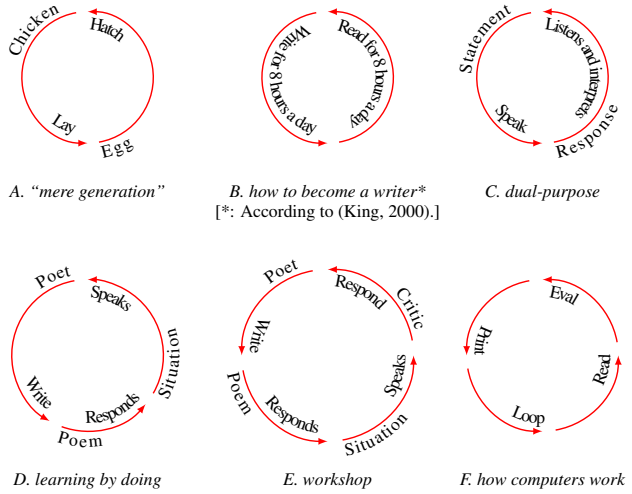
> Aesthetic emotion... attends to successful expression... contributes integrally to what is expressed in its specificity... functions as individualsed clue... at each crucial moment of a developing imaginative experience

Conclusion: The poem is a work of progress, rather than a work in progress.

Although it is beyond the scope of the current work to trace these connections, we will remark that this view is connected with the Bergson genre of philosophy, running to Mead who offers a generalised view of the social, to Bakhtin who develops the notion of dialogue in a broad metalinguistic frame, and to Deleuze who develops a processual ontology based on the idea of difference (Bergson, 1911 [1907]; Mead, 1932; Bakhtin, 1984 [1963]; Deleuze, 2004 [1968]). These perspectives are relevant to the interest we take here in emergence, polyvocality, and learning by specifying and engaging with problems.

Methods: "What are the proposed 'lab rats'?"

There are many possible places for a "dialogical" intervention within the writing process; see Figure 1. Figure 1(A) shows the standard chicken-and-egg problem, designed to provoke questions about *evolution*; 1(B) shows an analogous picture that gives a simple recipe for the growth and development of a writer; 1(C) is a formally similar diagram that squares up to the metalinguistic features of the situation, showing that a *response* (which may be verbal, visceral, physical or something else) always has dimensions that goes beyond the utterance that is overheard; 1(D) examines in further detail what happens when someone *writes* – namely, writing as a response to a situation that may allow the writer to make sense of this situation; 1(E) adds a *critic* who responds to the situation, particularly as it is expressed through and enhanced by the poem; 1(F) shows that this scenario is not as unfamiliar to computer programmers as it might otherwise sound – consider that the "Eval" phase



A. "mere generation" *B. how to become a writer** [*: According to (King, 2000).] *C. dual-purpose*

D. learning by doing *E. workshop* *F. how computers work*

Figure 1: Several illustrative cycles

in a Read-Eval-Print loop can be interrupted with a debugger to fine-tune program operation.

Our "lab rats" are, accordingly, not poems – which could, after all, be developed through "mere generation" – but are, rather, *instances of reading and responding to poetry*. This may take place within a formal "workshop" context or they may take place in smaller-scale experiments where a computer system reads and responds to other poets. Naturally, such responses can also be more or less "canned" (as with Michael Cook's humorously nonspecific AppreciationBot), so the question becomes what constitutes an authentic, interesting, or useful response, and how will these be developed? The idea of responses is also useful at the micro-level, as will be made clear in the following section. We focus here on the big picture of staging a encounter, supported by preliminary implementation work.

Design

Questions to ask when reading poems

Table 1 contains a list of questions that could be addressed, in a programmatic manner, to analyse an individual poem. These questions, coming from a computer poetry perspective, do not make the same assumptions about linguistic understanding or embodied experience that apply to human poets. It is worthwhile to compare this list with a list of questions that a reasonably sophisticated poetry reader might ask about poems (Table 2). The difference between these two frames of reference is most instructive.

In the approach to "sophisticated" reading considered here, we focus on the process-oriented question: "What does the poem tell us about how it was made?" This can be studied through the lens of the follow-up question "What are the aspects of the poem and how are they present to the reader?"

One of the striking things about Table 2 is that it does not easily divide itself into "levels" in the same way as the items in Table 1 do. For instance, even though lexical effects clearly have to do with an analysis taking place at the "word level" the task that a given selection of words performs is

Question	Agent concerned
Word level	
What does this word mean?	WordNet expert
Where does this word come from?	Provenance expert
Phrase level	
What is this line about?	Keywords expert
Line level	
What is the sentiment of this line?	Sentiment expert
Is this alliteration, rhyme, consonance, etc. important?	Style expert
Poem level	
How many rhymes are in the poem?	Rhymes expert
How well does the poem's metrical structure flow?	Rhythm expert
How repetitive is the poem?	Repetition expert

Table 1: Questions we could implement using various computational agents

typically global; that is, it is meaningful at the "poem level." The questions in Table 2 may themselves be divided into registers and positions. The process of reading a poem is also a process of *poiesis*. Each of the examples listed in the right-hand column of this table (and a plethora that are not listed) plays a role in the "society of mind" of a reader, analogous to the agents in Table 1.

Bridges between 'theory' and 'practice'

There are things we can actually point to in poems, and matching concepts in aesthetic philosophy. Furthermore, we can actually approach this scientifically. The computational approach to poetry is one way to build the practice/theory bridge. In particular, our *ansatz* is that the workshop could serve as a way to deepen an understanding of a poem's semantics!

There are certain prerequisites. In addition to the presentation of written work, an underlying situation is assumed, one that is shared (with respect to differing points of view) by the poet and the critic (see Figure 1). The poet and critic are assumed to have relatively stable, enduring but evolving, identities – so that it would be possible at a given juncture for either one to consider the question "Who am *I*?" and "Who are *you*?" (Bakhtin, 1984 [1963], p. 251).

To begin with, in response to a given computer-generated poem:

Oh dog the mysterious demon
Why do you feel startle of attention?
Oh demon the lonely encounter
ghostly elusive ruler
Oh encounter the horrible glimpse
helpless introspective consciousness

A human critic might offer the following feedback:

1. The use of the word *mysterious* in the first line has no resolution, real or attempted, or quest to find one.

Question	Examples
What is are the register(s) of the poem?	cliched, instructive, imperative
Who is addressed?	friend, rival, lover, confidante, pupil
What position(s) are present in the poem?	pleading, remonstrating, ephemeral
What becomes of the reader whilst reading the poem?	alienated, perplexed, amused
Who are the characters in the poem?	"the falconer", "you", narrator, "two men"
What is the role of image(s) in the poem?	"the sea", "a bicycle"; multiple meanings
What functions, mechanics, and paradigms are present for the reader to engage with?	communication, subverted cliche
What problems, discomforts, or diseasements are invoked in the poem?	horror, self-loathing, rejection, desire
How do these evolve?	E.g. an image may start to take over from a register
What *is* in the world of the poem as compared with what you only think is?	"Surely", "must"; sacred vs mundane; perspectival vs surreal
What are the overlaps, transitions, implicit dialogues?	"twinned" lines/ideas, juxtaposed parts of the poem
What role does the chronology of reading play, versus references to chronology and chronological positions within the poem?	flagged development, evolution, movement, stasis
How are lexical categories used?	flighty adverbs, solid nouns, tortuous adjectives
Are there discernible allusive effects?	illustrating the literary apprenticeship of the author (or reader)
How does Keats' idea of negative capability feature in the composition – "that is when man is capable of being in uncertainties"?	we must worry about overconfidence, overdetermined lines

Table 2: Questions that we actually ask when reading a poem

2. The use of the word *attention* is not being interrogated or acknowledged for its importance. Its qualifying word is *startle*, used here as an adjective; acknowledging the fact that the attention is noted but not yet part of the transformative of the poem.
3. This is repeated in the next references to the aesthetic experience as a *lonely encounter* and an *exclusive ruler*, which is then qualified as *a horrible glimpse*.
4. So reference to the contact made between the poem and its own event are made through the words *demon*, *encounter* and *consciousness* and all of these are qualified in negative terms.
5. This poem does not welcome the intimacy of bring-

ing anything to aesthetic consciousness so that it might be expressed. Why do I say that? Because the words are generalised and *horribly* imprecise.

6. The really interesting thing about it is its own apparent understanding that this is so. Look at the words *mysterious*, *feel lonely*, *elusive*, *horrible*, *glimpse*, *helpless*, *introspective*, *conscious*. They are unspecific – nothing has been explored as the poem moves toward a better understanding of these ideas. They describe but they do not illuminate by becoming anything else. They all associate exploration with fear and isolation and this is (paradoxically) quite an interesting acknowledgment of the poem's refusal to go anywhere i.e become a thing transformed by a creative process.

Each of these comments is *dual-voiced* in the sense that the critic is relaying the poet's speech with a new emphasis. Each such statement is one side of a micro-dialogue (Bakhtin, 1984 [1963], p. 73). The challenge is, of course, to bring the observations into the awareness of the computer poet, across the "digital/analogue divide."

From a programmer's standpoint, this involves massaging each of the observations into a language that the computer can understand – the most obvious candidate being the programming language the computer used to generate the poem. But care should be taken not to just blythely program the computer with more rules, but rather to give attention to the process of learning new rules contextually.

Rather more briefly, let us consider a reversal of roles, and put the computer in the position of critic, looking at a passage from an historical piece of poetry. We have selected one that might have – but in fact did not – serve as a model for the poem generated above.

I'm truly sorry man's dominion
Has broken Nature's social union,
An' justifies that ill opinion
Which makes thee startle
At me, thy poor, earth born companion
An' fellow mortal!

Naturally, the first problem is for the computer to *read* the poem. There are various possible approaches to this problem. One of the approaches that is most appealing from our point of view is the automatic generation of a semantic network from the input text (Harrington and Clark, 2007). This, again, could be enhanced by additional meanings that are not just factual, say, but aesthetic (drawing on the notions informing Table 2).

We do not propose that bridging in either direction is entirely easy, but both tasks are entirely feasible.

Prototyping a workshop in FloWr

Development plan (Christian):

- Define workshop, including product properties, e.g. variety, innovation, etc. Alternatively, refer to prior definition earlier in the paper and point out benefits again.

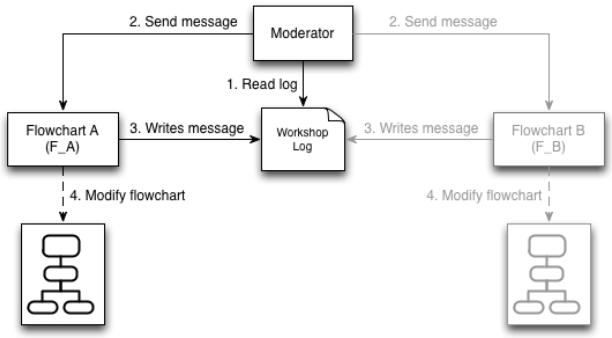


Figure 2: Schematic design for a workshop built in the FloWr system

- Introduce different roles in a workshop: master, working student, criticising student (anything else?). These roles can be combined into more complex ones.
- Introduce tasks they perform: introducing and demonstrating new tools, using tools to generate, analyse to improve creation, etc.
- Show the demon dog flowchart as part of the FloWr system, and highlight which roles the different parts represent, and which tasks are present.
  - A flowchart could be identified as a student that both creates and asseses (fitness functions) at the same time.
  - The script/moderator could be identified as the master who guides the student, tells it what to do in which way.
  - The set of all process nodes can be understood as a toolbox the master can access, to hand tools to the student.
- Show what's missing to fulfill the prior definition of a workshop
  - Multiple students that collaborate and help improving each other's creations.
  - Master as mediator between two students, asking one student what tools it uses, and telling the other to adapt them.
  - The moderator can introduce new tools to the workshop.
  - Students must be able to notice at one step of the creation process (e.g. while using one tool), that the usage of a prior tool could be improved. They could then either first finish or rewind.
  - Allow for more than one agent. Allow for more than one agent to work at a time.
- Show which features are required to realize that:
  - Understanding the workshop as a hierachical multi-agent system, where the master is at the top and the students are at the bottom of the hierarchy.
  - Simplification by separating flowcharts that create and assess from those which only assess.
  - Thus introducing external assesment.
  - Thus communication between flowcharts required.

- Enable an agent (more general, e.g. a student) to explain what tools it is using, in which order, and which parts of the output they affect.
- Allow other agents to improve their flowchart by means of this information, e.g. add a particular tool in a particular step.
- Enable master as mediator.
- Allow master to map observations of poems into new tools, that are made available to the workshop.
- Allow communication between process nodes, i.e. tools: E.g. assessment in rhyming node shows that too few words/sentences available for good results. Thus necessary to fetch more/different sentences in a prior step. Problem: agency when using the term "tool" - separates assessment by the agent from using the tool for creation.
- Introduce parallelisation, to allow multiple agents to work at the same time.

- Open questions:
  - Decision making: It's probably more important to answer how decisions are made to adapt another tool, etc., than stating where they're made. E.g. decision making by means of a fitness function of the current artefact, by means of curiosity, etc.
  - Add more implementation suggestions
  - Would it be better to focus on one new aspect of the workshop, and leave the others out? E.g. add master who can introduce new tools, or introduce multiple students that can communicate. One paper might be not enough to get from current FloWr to a full-fledged workshop.

What's the development plan look like? Should we show the flowchart for the "demon dog" poem as a very early prototype and concrete example to critique? We could illustrate – in principle – how it would be improved in a workshop.

We'll need to discuss the different levels of the design. E.g.

Moderator.

Flowchart A: "I do this" (service advertising what facilities it has available: if we can swap them in and out, we could do some kind of A/B test to check whether swapping in a different node actually improves the result according to some critic or other).

Flowchart B: "I would like to be able to do that too." Temporality. More feedback from critical agents. Learn and adapt the script.

Where is the decision made to modify (e.g. only by the Moderator, or at the level of individual flowcharts, or nodes, etc.?)

This is relevant to the issue of "parallel solutions". At the level of some downstream process: How do we decide which of the parallel solutions to pick and carry ahead to the next step? Do we give feedback to the previous step in the process?

If we are allowed to take multiple different paths, not just parallel copies of the same process, where is the decision made as to which path to take?

Central control Distributed control Autonomous Global wiring

Critic: "This 'Twitter' node is not good."

Follow the idea of the prepared mind, add any problem that is noticed to a list of "problems to solve." Again, the log of suggestions/outstanding problems could exist at different levels/timescales. (NB. And a similar approach can apply for "questions" as well as "problems." This "log" doesn't just have to be a list, it could also be a frame or flowchart etc.)

Protocol:

flowchart to flowchart?

Do we also need some modification for node-to-node communication? Alternatively, are we going to follow Christian's suggestion and merge flowcharts and nodes into one kind of entity?

Also, do we need an overall "protocol" for the Workshop demo application, different from the more general communication protocol that is used?

There will be three different type of messages: questions, answers and suggestions.

Questions can be about sources of information; e.g. files, online articles, input from another node, etc., about elements of poems; e.g. similes, rhymes, keywords, sentiment, etc.; about specific details; e.g. count, purpose, etc. Answers would be associated to previous questions, and suggestions are changes proposed by one system to the other.

Commentary is needed in order to enable the dialogue between flowcharts. Each node in FloWr has two main components, a set of input parameters and a set of output variables. Parameters can either be sources of information; e.g. the Guardian newspaper, or conditions; e.g. range of dates. Variables are outputs of different types. A commentary would be added to each of them in order to facilitate communication between flowcharts and nodes. This will enable the dialogue between the participants in the workshop; i.e. ask and answer questions, as well as it will allow to identify where to apply suggestions for new versions of a flowchart as suggested in a workshop session. The proposed commentary is presented in an Appendix.

Do we consider e.g. genetic algorithms present (i.e. generate) several options and allow the downstream nodes to comment on each one high level feedback (on the whole generated poem) and micro-feedback (at the level of individual nodes)

Atomic nodes vs composite nodes (flowcharts). Can we just forget about what level we are at? Node or flowchart – and use a recursive approach that can be applied to atomic or composite nodes? (Christian's diagram of the two different kinds of communication – between flowcharts or between nodes – reduce to one kind of communication if we take the recursion approach. Similarly, reification then becomes possible.

In itself this isn't a huge technical advance, but it might allow us to deal with examples of "morphogenesis", which is interesting. E.g. grow until I have 100 process nodes and then stop. That said, "reification" is a bit frowned upon – but provenance is always a good thing.)

Discussion

Potential applications

Eventually we would like to see the paradigm advanced here in effect across CC. This doesn't mean that we would remove the "generation" aspects of CC, but that we would pair them more closely with reflection. The workshop method of critique may shift to more closely model an *atelier* method of creation. The same skills that support learning in a writers workshop may support a form of dialogue with the work itself, leading to richer creative artefacts that show us more about the creative process.

The workshop brings a range of practical and philosophical challenges for CC, and the broader field of AI, related to asking and answering novel questions, the practicalities of learning over time, a sense of identity and personal style.

Focusing on these questions does not in any way suggest that we should devalue works from lone creatives, but it does suggest that we think about how we knit individuals together in the social fabric of the CC community. The current model at the International Conference for Computational Creativity (ICCC) is similar to many other academic conferences, even though our subject matter is really quite different. It's all well and good for us to travel and present *our* work to one another and build *our* sense of community in that way, but what about a track for computers to present their work?

As (Turing, 1951) foresaw, computers have gotten quite good at Chess and reasonably good at Go, using methods very similar to the workshop. Should we not follow their lead? Poetry seems a natural next step; prose literature may be approachable through similar methods. Indeed, why bother writing dialogue for a NaNoGenMo[2] novel, if you could simulate it?

Potential criticisms

One class of criticisms could relate to the appropriateness of dialogue per se: "Why not put everything into one flow chart? Or one node, for that matter?" In cases where dialogue is indeed seen to be necessary, a different sort of question arises, namely, how do we know if we're doing it well? E.g. how will we avoid the pitfalls of "design by committee"?

Regarding the first set of questions, following Bakhtin, programs that don't need to be explicitly social can continue as they are. The second set of questions will have to be worked out in practice, but we should keep in mind the potentially greater pitfalls of asocial design. Indeed, we wonder if apparent failures of social creativity are often due to a poor grasp of the social rather than an overly social approach.

[2]https://github.com/dariusk/NaNoGenMo

Another line of questioning that we may expect from some CC practitioners is as follows. Given the historical emphasis on *creating* new artefacts in CC, shifting the emphasis to the computational *appreciation* of already-created artefacts is somewhat strange. More pointedly, concerned members of the public may say: computers creating art is bad enough! Surely, you don't expect them to *study* too?

The actual problem is that appreciation of computationally created artefacts is *hard*. Consider the difference between creating a video game (for example) and playing a video game. In the first case, the designer has full control over the rule-set, game mechanics, interaction devices and so forth. In the second case, we're more or less in the world of general AI. It is of course less untoward for a computational video game designer to play its own games; this is state of the art.

While the sketch of a solution developed here is by no means complete even for poetry, we believe that extending capabilities from both sides is robust. However, as none of this has been tested in detailed experiment, a fair criticism is that we do not know, yet, either how much more work this approach will be, or how much better the results will be. We suspect it will be both harder, and worth it. In the following section we discuss the future outlook for the research approach.

Conclusions

We have made the case for dialogicity in CC and in CC research, building on a comparison of different ways to read poems, and considering the potential of an existing software system to support dialogue at various levels.

Our requirements for communication points to the need for program elements to be able to learn and adapt. Genetic programming (Koza, 1992) and related methods offer a certain precedent for this way of working.

The current paper has focused on more global concerns. The current FloWr "ecosystem" focuses on features like user interface ease for human programmers, plus reusability of modules. The next steps should involve an agent-based redesign. We pointed to a considerable amount of related work in an earlier section. Off-the-shelf open source software exists to support some relevant basic features.

However, the question of *context* has not been adequately addressed either in CC or in mainstream programming. While we do not agree with interpretations of artwork that macro-reductionistic in the sense that "the environment determines the artwork" nevertheless there are important contextual effects (Geertz, 1976), and artwork generally involves an engagement with context. Philosophically this situates the work in the realms of *pragmatics* (Korta and Perry, 2012) and *metalinguistics* (Gombert, 1994). Practically speaking, the questions relate to building sophistication in the specific "metalanguage" of programming.

The graphical programming environment that shipped with the 1984 robot simulation game ChipWits – not to be taken seriously as a competitor to FloWr – does nevertheless have some useful programming facilities, like the ability to loop and run different paths in the flowchart depending on

conditions, and the ability for one flowchart to reference another one, as with spreadsheets. However, it does not have the ability to self-program, which is the essence of the proposal for FloWr. The ability to generate-and-check (using a population-based mechanism) and more importantly, the ability to learn over time (as we explored from a formal perspective in (Colton, Pease, Corneli, Cook, and Llano, 2014)) are two other features that should come standard in future versions of FloWr. We want to be able to take account of the abundance of available information, to introduce "noise", and fully take account of the existing "framing" in relationship to the context/situation.

Although social creativity has been explored in CC, it tends to be an exception rather than the rule. In future work, we'd like to be able to say "We've done it!" although to develop a concrete proof of concept we will have to focus on a few simple metrics (like musicality).

There is also a "social engineering" component to this paper, hoping to motivate a new approach to research evaluation in CC. Between the kind of design research carried out in this paper and a large-scale double-blind study that would "prove" the superiority of a social approach is something more contextual, involving the actual practices and abilities of participants (Seikkula and Arnkil, 2006, pp. 167–185). We sketched an approach to the evaluation of poems, but similar thinking can help develop an evaluation of programs. The question of how much architecture should be shared in the CC community: do we need a shared "CCyc" platform, or should we "let a hundred flowers bloom"? One moderate approach would be to revive the *floral games* of the troubadours.

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