Husserl vs. Derrida? Intermittent Critical Finite Automation through Second Person Self-Differential Reference

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Abstract We present a single non-cellular finite automaton (FA) model exhibiting intermittency and criticality in a simple self-referential dynamics. Because of the correspondence of non-deterministic and deterministic FA to first and third person description, we can say that the model's dynamics is dialogue with oneself in second person. It gives rise to self-organizing behavior that is intermittent and critical. It is argued that the model is a scientific realization of deconstruction by Jacques Derrida.
Keywords : Second Person; Internal Measurement; Inner Speech; Intermittency; Criticality.

1 Introduction

Dubois has presented the general framework for implementing anticipation in dynamical systems [3]. Anticipation is the crossing of potential and actual, or formal and real, thus essentially self-referential, since it traverses logical types. However, for anticipatory systems in dynamical systems, as Dubois has shown, the difference does not need to be investigated as far as the phase space is well-defined.

Here we study anticipation in cognitive systems where logical type and self-referential aspects matter. An internal observer with cognitive capability can not look over the whole possibility and thereby an actual event is *singular*. On the other hand, anticipated potential events are *individual*; it means that its background domain to which the elements belong always accompany. The potential events are elements in a set, the domain. Thus a potential future event is substantially a set of events with an indication of the elemental event. Actual and possible necessarily have different status or logical type. Logical type signifies for cognition in general, because heterogeneous objects or signs coexist there [11]; they are sometimes treated as homogeneous, that is to be of the same logical type, whereas in the other cases they are distinguished as heterogeneous. It is crucial to discern the difference in logical type between potential and actual, and to simultaneously admit the dynamics of identification or confusion across the logical hierarchies. Anticipatory systems try to realize anticipated events by bridging a gap between actual and potential across

different logical types, object level and meta level. In this article, we focus on the form and dynamics of the bridging, studying a certain computational model. We realize an anticipatory dynamical model driven by bridging or confusing actual and potential. The time development gives intermittent critical results. This is the first time that a non-cellular single finite automaton exhibits such self-organizing behavior. We begin with the philosophical background.

2 Deconstructive Methodology

Jacques Derrida is known by practicing deconstruction. The first total practice has been given to Husserl's phenomenology in [2]. We summarize the procedure so as to make it possible to utilize the methodology in science.

1. Find metaphysical assumptions in an existing theory or model.
2. Prove the impossibility or contradiction in principle behind the assumptions.
3. Construct a new model with weakened assumptions, or stand the old theory on its head.

Deconstruction in this form is always valid and scientifically meaningful as far as the assumptions to criticize are actually too strongly metaphysical. Our model presented in this study is the simplest realization.

The model is the overall refinement of the second person model presented in CASYS'07 [10]. In the previous paper we argued that rule-following is anticipatory act in the foregoing sense, through Kripke's or Wittgenstein's paradox. Here some settings are inherited: there is one agent who has its own syntax; the grammar is represented by a finite automaton. It dialogues with itself, speaking to itself and hearing oneself speaking ("s'entendre parler"), like self-echoic. The agent outputs a sentence according to its own grammar and then it hears and tries to parse and understand the sentence. If the grammar has deterministic structure and behavior, the self-dialogue causes nothing; speaking (output) and hearing (input) are just symmetrical and the self-relationship is transparent and fictional; it cannot be essentially in second person (Husserl [6]). However, the determinacy is a metaphysical assumption that is rarely satisfied in the world. It is because of not only that there are many ways (hence forks) to do something, but also there must be some room represented as non-determinacy to represent and accommodate itself to open environment, or implicit context. However, the normal treatment of non-determinacy is metaphysical as well (Derrida)[1]. The behavior of non-deterministic systems assumes non-limited resources for parallel and/or backtracking. This assumption that makes non-determinacy equivalent to determinacy is the metaphysical one we deconstruct.

[1]It is important to make clear what Derrida implicitly placed on second person self-relation. However, it needs further investigation.

3 Modeling Dialogue

We formalize dialogue between agents. Agent has its own perspective represented by a formal grammar. It generates and utters a sentence according to the grammar, and then it analyzes and recognizes the sentence. As the model of the grammar, we employ finite automaton that is simplest and without loss of generality.

3.1 Finite Automaton

A graph consists of some nodes and edges between the nodes. In a directed graph, the edges are directed. It means that there are two edges between node A and B, from A to B and from B to A. A finite automaton (FA) is a particular directed graph, where nodes and edges are called states and state transitions. One state in FA is called an initial state and some states are called final states. Each edge in FA is labeled. The set of labels are called alphabet. Here we fix the alphabet to $\{0, 1\}$. The characters in alphabet is considered to be words, so a sentence is a sequence of characters in alphabet. Therefore, the sentences are bit strings.

An FA represents a grammar belonging to a class called regular grammar. A grammar gives a set of rules generating a sentence from words. The set of all sentences generated by a grammar is called language. The function of FA is to input and output a sentence. In input of a sentence w to an FA A, the first state of A is the initial state. Then, the i-th word w_i of the inputted sentence $w = w_1 w_2 ... w_n$ is translated to a state transition. A's state changes according to the translated transition. When the translation of the last word w_n is finished, if the state of A is one of the final states, A is said to accept the sentence w. If not, A rejects w. The output process on A in this study is defined by a randomly chosen sequence of state transition from the initial state to a final state. The output sentence is formed according to the state transitions executed. It is one acceptable to A itself. FA can be deterministic or non-deterministic. In a deterministic FA (DFA), the state to transit is uniquely determined on any state and any input. In a non-deterministic FA (NFA), the ambiguity or undefinedness of the state to transit is permitted.

3.2 First Person and Third Person

Matsuno [9] analyzes scientific description in terms of tense and person. One of the main contradistinction in his analysis is between first person and third person. Characterizing first person and third person descriptions with respect to the objects and the relations among objects in the descriptions, we show the correspondence between first and third person and non-determinacy and determinacy.

In first person description, the objects are concrete and they can be indexical. We can use demonstratives such and "this" and "that". A specific context is given in this kind of description. In communicating and understanding a first person description, the context must be shared. The relations in first person are ambiguous, since the

objects are not well-defined by the consistent pair of intension and extension. The relation between "this" and "that" can not be uniquely determined since they have no intensional definition.

On the other hand, in third person description, the objects are not concrete things but concepts. A concept is defined by a pair of its intension and extension. It is not a singular thing but a set of things. Because it is a set, indicating an object always accompanies ambiguity. Since the relations among objects in third person are ones among concepts, they can be uniquely determined according to the relation between the intensions or extensions such as inclusive relation between the extension sets. The contrast is summarized in Table 1.

Table 1: The duality about definiteness between first and third person descriptions, contrasted with NFA and DFA that are connected with $sc()$.

person	object	relationship
first person (object-level)	tangible	ambiguous
third person (meta-level)	concept or collection	unique

FA type	state	state transition
NFA	individual objects	ambiguous or undefined
DFA	set of individual objects	unique

The categories of NFA and DFA are connected by an operation "subset construction" ($sc()$). It constructs the equivalent DFA from an NFA. The basic idea of $sc()$ is to form a collective state consisting of the states reachable from a state for each input. At first the initial state is the only reachable state. So $sc()$ starts at the singleton of the initial state, which becomes the initial state of the new FA in construction. Then, the reachable states are made a collective state of the new FA. For each formed collective state, the collection is repeated. The procedure $sc()$ stops when the transitions from all the states of the new FA are defined and the number and kind of the transitions agree the number of alphabet. It means that the constructed FA is deterministic. Its final states are all the collective states that have one of the final states of the original NFA.

This operation $sc()$ is construction of objective (third person) description from subjective (first person) description. The objects in third person, that are sets of the ones in first person, are concepts. $sc()$ makes the relations between the objects unique by ascending logical type from object level to meta level. Compare the relationship between NFA and DFA constructed by $sc()$ from the NFA in Table 1.

3.3 Self Dialogue

We define self dialogue of agent. Dialogue between agents consists of transmission of sentences from an agent to the other. A turn in self-dialogue consists of the

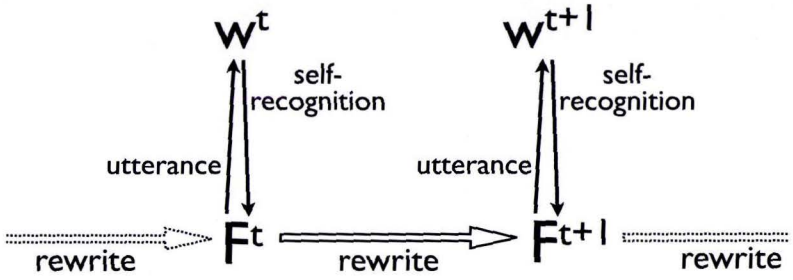

Fig. 1: The conceptual scheme of self dialogue.

conversion from a sequence of state transition to a sentence (output or utterance) and the conversion of the other way around (input or (self-)recognition). It is succession of an agent's utterance and self-recognition. The properties of self dialogue process differs according to the (non-)determinacy of FA as the agent's grammar. The scheme for self dialogue is in Fig. 1. t is the index for turn. F^t and w^t are respectively the FA and the uttered word at the t-th turn. It is first (third) person self dialogue if F is NFA (DFA).

Third person self dialogue on DFA progresses with no conflict. A sentence generated as a random sequence of state transitions is translated to the exactly same state transition sequence when inputted. There is one-to-one correspondence between the state transition sequences from the initial to a final state and the sentences that can be uttered and recognized. There is no chance of change in third person self dialogue.

First person self dialogue takes place on NFA. The indeterminacy, the ambiguity and undefinedness of state transition, causes some problems in self-recognition[2]. There are two possible failures. One is to get *stuck*, that self-recognition reaches to a dead end before getting at a final state. It is to go to a state that has no transition defined corresponding to the present word in the sentence to recognize. The other is to get *lost*, caused by ambiguity of state transition. It is that the lastly reached state at the end of self-recognition, when the last input word has been interpreted to a state transition, is not a final state. In this wise, first person self dialogue may fail in self-recognition.

Getting *stuck* and *lost* can be made dynamic if we define some structure modification, change of state transition network, to solve these problems. It has been realized in our previous study [10]. In this study, we define another solution that brings about much more significant results.

[2]Here we interpret and implement indeterminacy as uniformly probabilistic. Refer the following arguments for its meaning.

3.4 Second Person Self-Recognition

Here we introduce second person self dialogue. Second person is characterized by the fact that the two agents in dialogue must share some context, and that we can use indexical expressions because of the context sharing as in first person. However, the use of indexical expression or ostensive definition is incomplete. It involves ambiguity, indeterminacy or misunderstanding. We can also exploit concepts as in third person. The use of concepts is incomplete as well. Sharing of the concept definition is not always realized.

Second person self dialogue consists of utterance and recognition, in the same way as in first and third person. The utterance procedure is the same as first and third person one. The difference is in the recognition process.

Second person is originally only in the course of dialogue. The dialogue in second person has present progressive tense [9]. The progression necessarily accompanies not only ambiguity bringing about misunderstanding, but also indeterminacy that creates the scope for skepticism.

3.4.1 Kripke's Second Person Skeptic

This skepticism is that of Kripke ([7], [10]) which is universal in dialogue with others. In his original exposition, the elementary notion of 'plus' is put into the interrogative form 'quus', and a non-monologous question can exist only in second person.

The skepticism points to the confusion between individual and general, and the point is that the pointing at the confusion itself by the skeptic is also another confusion. Kripkean skeptic knows that my use of the infinity concept is not closed to me, the speaker. It also depends to him, the hearer. The fiction of privacy of the mental is to be revealed only in conversation in second person.

In second person, the general notions can be expressed only individually. The expression requires the confusion between individual and general. The expansion of the concepts is executed in conversation real-time. The confusion crossing the logical types always accompanies to language use and it poses a threat to the ground where the skeptics stands. Second person that has this progression as its essence is a dynamic process of mutual complementation between the incompleteness of first and third person.

3.4.2 The Definition

Each step in second person self-recognition (SPSR) is an incessant comings and goings between first and third person pictures. First a first person picture, an NFA is given. Then the third person picture, a DFA, is constructed by $sc()$. A sentence is outputted (uttered) from the NFA and it is recognized by the NFA itself. SPSR is defined as the process based on the first person picture. It always refers to the third person picture in the recognition process and it makes difference in the critical

situation of first person self-recognition (FPSR). The crisis in FPSR is stuck and lost, as noted above. The object of self-recognition is a sentence. The sentence is uttered from an FA that recognizes it. Hence there is a state transition sequence corresponding to the sentence. If the FA is non-deterministic, there can be more than one corresponding sequence. One of the sequences is necessarily the one used for the output of the sentence. Therefore, its recognition is always possible. However, the success of recognition is not necessary. Random solution for the critical situations is given in [10]. In SPSR here, stuck and lost are given other solutions. The solutions bring about the change in the NFA.

We denote the set of states in NFA $\mathcal{G}$ by Q, the initial state by $q_0 \in Q$, the set of final states by $F \subseteq Q$. The transitional structure is defined by a transition function $\delta : Q \times \Sigma \to \mathcal{P}(Q)$. $\mathcal{P}(X)$ is the power set, the set of all subsets, of X. Note that the empty set belongs to $\mathcal{P}(X)$. When $\mathcal{G}$ gets the input $s \in \Sigma$ at state $q \in Q$, the set of reachable states is given as $\delta(q, s) \in \mathcal{P}(Q)$. If $|\delta(q, s)| = 0$, i.e. $\delta(q, s) = \emptyset$, the transition target is undefined. If $|\delta(q, s)| > 1$, it is ambiguous.

Definition 3.1. *(Second Person Self-Recognition) We define second person self-recognition of* $w = w_0 w_1 ... w_{n-1} \in L(\mathcal{G})$ *on an NFA* $\mathcal{G} = (Q, \Sigma, \delta, q_0, F)$. *A sequence of state transitions* $P_0 = \{q_0\} \xrightarrow{w_0} P_1 \xrightarrow{w_1} \cdots \xrightarrow{w_{n-1}} P_n$ *for* w *on* $\mathcal{R} = sc(\mathcal{G})$, *determined by* $P_i := \bigcup_{p \in P_{i-1}} \delta(p, w_i)$, *is made use in the recognition process.* P_i *is the set of reachable states at each step* i.

1. *(Initial Setting)* ($i = 0$) *Make the present state* q_0 *and the present possible states* $P_0 := \{q_0\}$.

2. *(Step)* ($0 \leq i \leq n$)

   (a) *(Termination Check) If* $i = n$, *go to (5).*

   (b) *(Stuck Check) If* $\delta(q_i, w_i)$ *is empty, i.e. it is stuck, go to (3). If it is the second time to get stuck in this recognition process, go to (6).*

   (c) *(Transition) Otherwise go to (4) with a state* q *randomly determined from* $\delta(q_i, w_i)$.

3. *(Second Person Stuck Resolution) Randomly choose* p *from* $P_i \backslash \{q_i\}$ *satisfying* $|\delta(p, w_i)| \geq 1$ *and* q *from* $\delta(p, w_i) \subseteq P_i$. *Remove* $p \xrightarrow{w_i} q$ *from the transitional structure of* $\mathcal{G}$. *Simultaneously add* $q_i \xrightarrow{w_i} q$ *to it.*

4. *(Preparing for the Next Step) If* $i = n$, *go to (5). If not, make the present state* $q_i := q$ *and the present possible states* $P_{i+1} := \bigcup_{p \in P_i} \delta(p, w_i)$. *GO to the second step of second person self-recognition. It is to increment* i *and to go back to (2).*

5. *(Termination Processing: Lost Resolution) Terminate the recognition process. If* $q_n \notin F$, *add* q_n *to* F. *Randomly choose a state from* $F \backslash \{q_n\}$ *and remove it from* F. *If the inner dialogue continues, go to the next turn's utterance.*

6. *(Handling Second Stuck) When it gets stuck for the second time, Keeping the rewrite occurred for the resolution of the first stuck, quit the recognition process. Go to the next turn with the changed grammar.*

Second person self-recognition does not make any difference with first person self-recognition unless it gets stuck. Additionally, it is equivalent to third person self-recognition if it is executed on a DFA (given the DFA is converted to a congruent NFA). In second person it does a transition toward the next step (2) and resolves lost as in (5) in the same way as in first person. However, in each step the process in second person comes and goes between first and third person. Since third person is the meta level of first person, universalization going up a level and individualization going down are realized alternately. This succession of universalization and individualization resolves stuck in a natural way. (3), rewrite of the transitional structure for stuck resolution, is proper to second person. The rewrite conserves the number of transitions.

4 Simulation and Result

We simulated the second person self dialogue. Our model, second person inner dialogue process, has no parameter. Initially given first person perspective (NFA) is the only initial setting. In an actual simulation, we give a random seed but we do not call it a parameter. Nevertheless, the process frequently shows self-organization such as intermittency and criticality.

From the first person perspective (NFA) $\mathcal{G}^t$ of each turn t, the third person perspective (DFA) $\mathcal{R}^t = sc(\mathcal{G}^t)$ is constructed and exploited in the time developoment for the second person self-recognition. We can construct the unique reduced third person perspective (minimal recognizer, $\mathcal{MR}^t$) by the DFA minimization ([5]) that is a kind of Occam's razor. We denote the number of states of $\mathcal{MR}^t$ by $|\mathcal{MR}^t|$. It represents the complexity of the original $\mathcal{G}^t$.

For the time development shown here, we define the initial NFA $\mathcal{G}^0 := \mathcal{G}_3$ with some degree of size. In the temporal change in the NFA among some types, starting from $G^0 = \mathcal{G}_3$, we observe six types of $\mathcal{MR}$s constructed from the NFAs. The initial $G^0 = \mathcal{G}_3$ is the most complex and it becomes simplified through the transformations by the second-person stuck resolutions.

As a measure of the time development of our second-person inner dialogue process, we calculate $|MR^t|$ as the complexity for each G^t. The plot along the time axis shows the intermittent behavior in the Fig. 4. There are 175 invariant periods in the first $1,000$ turns. As in Fig. 3, the cumulative frequency roughly obeys the power law with the exponent -1. We can see the alternation of longer "laminar" periods with simpler FA structure and shorter "burst" periods with more complicated FA structure.

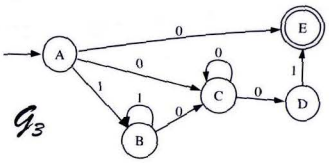

Fig. 2: The initial grammar NFA $G^0 = \mathcal{G}_3$, given in the example of the time development.

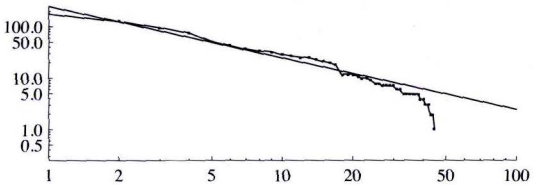

Fig. 3: The log-log plot of the cumulative frequency for the first 10,000 turns. The solid line is $f(x) = x^{-1}$.

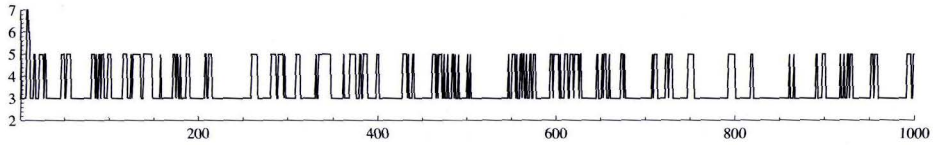

Fig. 4: The time development of $|MR^t|$, the complexity of MR^t, for the first 1,000 turns.

5 Discussion

In third person description, the observer=describer can behave as the transcendent. He can abstract himself from his surroundings, the concrete context. He gets thereby the capacity to construct even infinite sets. In contrast, in second person the observer is simultaneously an actor in the system that he is observing and describing. The concepts that he needs to use can not be got just by definition. They must be launched on the spot. The launch is essentially a bilateral work. Language use in general is not closed to the observer but open to the hearer, and both are actors in the system. It leaves room for skepticism.

Haruna and Gunji modeled second person with respect to the plurality of the context and the dynamical relationship between context and law[4]. What we achieved is the formalization of second person self-relationship. It is not static and consistent as in first and third person. It is mutual complement of incompleteness of first and third person. It is incessant traffic between first and third person.

Only in the self-relationship in first or third person, it is possible that a self is one-fold, tautologically identical. In second person, not only the relationship with the others but also the difference of dual subjects drives the change and development of the subject. Hence identity is not static but becoming. It is absolutely an endless process in which the surplus of identification results non-identity to be resolved and identified again.[13, 1, 8].

Self-referrential contradiction matters only when the subjects in first and third persons are substantively reserved and then the relationship between them is in-

quired. Such contradiction is a contradictory state problematic when the both subjects are placed in an external relationship. The relationship is external in the sense that the both does not get essentially affected by it.

In second person, first and third persons have an internal relationship [13]. It is that they change themselves by having the relationship. Rather, precisely speaking, it is not that first and third persons are existent before everything start to have a relationship at a moment. There is a gap between first and third persons or between active ad passive. The gap and the movement to infill the gap precipitate bipolar first and third persons. Second person is at the foundation, and it is not first or third person[3]. In this sense, our methodology to reconstruct second person from first and third persons is deconstructive and the theoretical sequence does not follow the developmental sequence.

Being in second person is the condition for all the internal observers. Internal observers make nothing of contradiction since, primarily, self-referrential contradiction is an abstraction. What drives the second person movement is discrepancy as dynamic contradictory processes. It is not contradiction as contradictory state.

5.1 "s'entendre parler" as Becoming

Our second person model can be considered as a realization of the argument by Derrida [2]. Derrida's criticism against Husserl has been focused on the fundamental assumption of phenomenology and western metaphysics. The metaphysics is a form of thought based on the unmediated transparent self relation. It is that in third person self dialogue, the grammar of the dialoguing agent is deterministic, hence the transformation between sentences and state transition sequences is one on one. The sentences mediating the self dialogue are transparent and so negligible.

Interpreting its unreality as the ordinary transcendent behavior of non-determinacy, we could make the criticism mathematically concrete. Even self dialogue, that is usually considered as pure self relation in "solitary mental life" (einsames Seelenleben), is contaminated by the mediation of signs. The contamination is exactly what brings about, not just formal identity nor random change but, critical and intermittent behavior. Thus we have formalized self dialogue as becoming. The transparency under which one hears oneself speaking (s'entendre parler), that is to hear oneself speak and immediately grasp the sense of one's own utterance, is atemporality in which no delay, discrepancy nor "differance" can exist. The atemporality corresponds to the standard interpretation of non-determinacy in mathematics, since in the interpretation it is possible to backtrack or to uncountable present time concurrently working can coexist. Our probabilistic modification of non-determinacy has been to resuscitate temporality.

[3]It is similar to that abduction is foundational an induction and deduction are derivatives.

6 Conclusion

In this study, we have shown the intermittent and critical dynamics of second person self-relationship. It is self dialogue or thinking process, dialoguing with oneself. True inner dialogue is such a temporal process, essentially in second person. It is the duality of the self that organizes thinking.

Acknowledgements

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