Theory of Fuzzy Time Computation (2)

$(\mathbf{TC} + \mathbf{CON}(\mathbf{TC}^*) \vdash \mathbf{P} \neq \mathbf{NP})$

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Abstract. This paper is continuation of [1]. In [1], we introduceTC^*(Theory of fuzzy time Computation)

. Here, we prove $(\mathrm{TC} + \mathrm{CON}(TC^*) \vdash \mathrm{P} \neq \mathrm{NP})$, as it was reported in [2], [3]. In [4], [5], [6] the author shows How fuzzy time is possible in the real Physical world.

Keywords. TC^*, scope^* , $\mathrm{P} \neq \mathrm{NP}$, $\mathrm{P}^* \neq \mathrm{NP}^*$, Fuzzy time

Introduction

Throughout this paper, we prove $\mathrm{TC} + \mathrm{CON}(TC^*) \vdash \mathrm{P} \neq \mathrm{NP}$. To do that, firstly we introduce the definition of scope^* . This definition is based on the practical situation of computation in the real world. In the real world and real computational activities, we face finite number of efficient computable functions which work in a limited time. Inspired by this fact and considering time as a fuzzy concept, we have the definition. By employing this definition, we reach to a world of computation, in which our time is non-classical and fuzzy, so we have random generations, but the set of all computations (our computational world) is the same as we have in classical time (TC). The result will be $\mathrm{P} \neq \mathrm{NP}$ and $\mathrm{P}^* \neq \mathrm{NP}^*$. Throughout this article, we discuss around the impact of TC^* on TC.

Section 1 $\mathbf{P}$ vs $\mathbf{NP}$, $\mathbf{P}^*$ vs $\mathbf{NP}^*$

As we say in above the central concept of the proof is scope^* which is inspired by the real computational activities in the real world.

Definition A $scope^*$ is a triple $(\{f_l\}_{l\in I}, \tau_i, [a_i, b_i])$ in which I is a finite set. $\{f_l\}_{l\in I}$ is a finite set of polynomial Computable Functions. τ_i is associated fuzzy function, $[a_i, b_i]$ is a closed interval in real line as the domain of τ_i.

Definition. Chain of scope^* s:

For two scope^* $\mathrm{S}_1, \mathrm{S}_2$ $\mathrm{S}_1 = \left(\{\mathrm{f}_\mathrm{l}\}_{\mathrm{l}\in\mathrm{I}}, \tau_{\mathrm{i},1}, [\mathrm{a}_{\mathrm{i},1}, \mathrm{b}_{\mathrm{i},1}]\right)$is a continuation of $\mathrm{S}_2 = \left(\{\mathrm{f}_\mathrm{l}\}_{\mathrm{l}\in\mathrm{J}}, \tau_{\mathrm{i},2}, [\mathrm{a}_{\mathrm{i},2}, \mathrm{b}_{\mathrm{i},2}]\right)$ if

1. $\{\mathrm{f}_\mathrm{l}\}_{\mathrm{l}\in\mathrm{I}} \subset \{\mathrm{f}_{\mathrm{l},2}\}_{\mathrm{l}\in\mathrm{J}}$

2. $\mathrm{b}_{\mathrm{i},1} = \mathrm{a}_{\mathrm{i},2}$.

For two scope^* s $\mathrm{S}_1, \mathrm{S}_2$ $\mathrm{S}_1 = \left(\{\mathrm{f}_\mathrm{l}\}_{\mathrm{l}\in\mathrm{I}}, \tau_{\mathrm{i},1}, [\mathrm{a}_{\mathrm{i},1}, \mathrm{b}_{\mathrm{i},1}]\right)$is a restrict continuation of $\mathrm{S}_2 = \left(\{\mathrm{f}_\mathrm{l}\}_{\mathrm{l}\in\mathrm{J}}, \tau_{\mathrm{i},2}, [\mathrm{a}_{\mathrm{i},2}, \mathrm{b}_{\mathrm{i},2}]\right)$ if

1. $\{f_l\}_{l\in I} \subsetneq \{f_l\}_{l\in J}$

2. $b_{i,1} = a_{i,2}$.

Definition. $S_1, S_2 \dots, S_i, \dots$ of *scope** s ($S_i = \left(\{f_l\}_{l\in I_{1,i}}, \tau_i, [a_i, b_i]\right)$is a chain iff for each i, S_{i+1} is continuation of S_i and $\bigcup_{i=1}^{\infty}[a_i, b_i] = R$.

$S_1, S_2 \dots, S_i, \dots$ of scope*s is a restrict chain iff for each i, S_{i+1} is restrict continuation of S_i, and $\bigcup_{i=1}^{\infty}[a_i, b_i] = R$.

A complete restrict chain, is a restrict chain which all polynomial computable functions contribute in it.

To each scope* S_i, we associate $W_{1,i}$, $W_{2,i}$,…, $W_{k,i}$,… as following:

In scope* S_i, we have interval of abstract time $[a_i, b_i]$ ($b_i = a_{i+1}$), and τ_i as fuzzy time function associated to S_i.

$f_{1,i}$, $f_{2,i}$,…, $f_{l_{S_i},i}$ is the list of l_{S_i} “Polynomial time Computable Functions” associated to S_i.

Definition. For any scope* S_i , in the abstract time interval $[a_i, b_i]$ ($b_i = a_{i+1}$), and τ_i as fuzzy time function associated to S_i. At the time b_i, we will have a set of configurations of associated Turing Machines of computing $f_{1,i}$, $f_{2,i}$,…, $f_{l_{S_i},i}$ in the interval $[\mathbf{a_i}, \mathbf{b_i}]$. Since time is considered fuzzy, this set varies by computation of the equivalent Turing machines with the same input.Conequenly, we have a set of possible sets of configurations instead of one set. Each of these sets could be considered as a set of possible worlds associated to S_i.By above, we define $\mathrm{Record}(S_i)$ as

$$\mathrm{Record}(S_i) = \left\{W_{1,i}, W_{2,i}, \dots, W_{k,i}, \dots\right\}$$

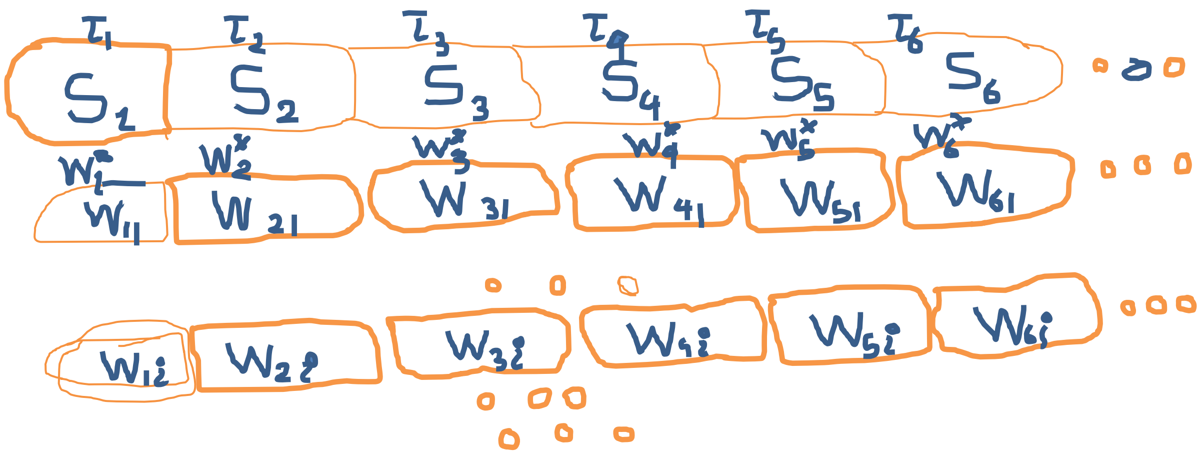
In above, $\mathrm{Record}(S_i)$ is the set of these possible worlds. If time is classical time, the cardinality of $\mathrm{Record}(S_i)$ is equal to one.

The point is, at least one of these worlds is the same as when time is classical time. We rename it as W_i^*.

(It is remarkable, for S_i, S_j, if $W_i^* = W_{p,i}$ and $W_j^* = W_{q,j}$, it is not essential that $p = q$).

More exactly, in any transition from a configuration C_1 to configuration C_2 by fuzzy time,

There is a positive probability the process of transition acts exactly like classical time case. So, in the finite set of transitions of computational activities in S_i, there is a positive probability the whole process of computation acts as it acts in the classical time case. This provides W_i^* as our desired element of $\mathrm{Record}(S_i)$, which acts similar to the classical time case.



Now consider $\bigcup_{i=1}^{\infty} W_i^* = W$. In this world W, the time is fuzzy by function τ_i, but the functions act as classical time.

In a specific example, of a complete restrict chain (*), let

1. $[a_i, b_i] = [i, i+1]$,
2. For the polynomial time computable functions $F = \{f_1, f_2, .., f_n, \dots\}$, let the computable functions in S_i be the set $F_i = \{f_1, f_2, .., f_i\}$.

In this example we define W_i^* as above again and consider $\bigcup_{i=1}^{\infty} W_i^* = W$. W is a world which the associated Polynomial Computable functions to it is set F, with non-classical Fuzzy time. The fuzziness of time, concludes the existence of random generator[1],[3]. Consequently, this world is equivalent to the classical time world with random generator. Therefore, we have $P \neq NP$ so we have $P^* \neq NP^*$[1].

The first point is: All of the above discussions are true for "restrict chains" and "chains" instead of Complete restrict chain.

The second point is about PH. Seemingly, independent of the oracle we use, the supposed random generator remains random generator. In this case, analogues to the above argument

repeat in all levels of hierarchy, Consequently, the hierarchy never collapse. $P \subsetneq NP \subsetneq PH$ and $P \subsetneq NP \subsetneq PSPACE$ $(P^* \subsetneq NP^* \subsetneq PH^*$ and $P^* \subsetneq NP^* \subsetneq PSPACE^*)$.

So, $PH \subsetneq PSPACE$ (probably a parallel proof shows, $PH^* \subsetneq PSPACE^*$, should be checked more carefully).

Remark. In the above conclusion, some are theorems in TC but we need CON(TC^*) and existence of a model for TC^*. It is noticeable that, our language is not first order. More exactly, we have

1. $TC + CON(TC^*) \vdash P \neq NP, P \subsetneq NP \subsetneq PH \subsetneq PSPACE$

The second type of conclusions, needs TC^* as premises too,

2. $\mathrm{TC} + \mathrm{CON}(\mathrm{TC}^*) + \mathrm{TC}^* \vdash \mathrm{P}^* \neq \mathrm{NP}^*, \mathrm{P}^* \subsetneq \mathrm{NP}^* \subsetneq \mathrm{PH}^* \subsetneq \mathrm{PSPACE}^*$

In above, by $\mathrm{CON}(\mathrm{T})$ we mean theory T is consistent and has a model.

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