$P \neq NP$, By accepting to make a shift in the Theory (Time as a fuzzy concept)

The Structure of a Theory (TC*, Theory of Computation based on Fuzzy time)

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Abstract. In a series of articles we try to show the need of a novel Theory for Theory of Computation based on considering time as a Fuzzy concept. Time is a central concept In Physics. First we were forced to consider some changes and modifications in the Theories of Physics. In the second step and throughout this article we show the positive Impact of this modification on Theory of Computation and Complexity Theory to rebuild it in a more successful and fruitful approach. We call this novel Theory TC*.

Keywords. $\mathrm{P} \neq \mathrm{NP}$, P=BPP, Fuzzy Time, Probabilistic Time, TC*, Reducibility, Complexity Theory Problems

1. Introduction

Here, we try to build the structure of a Theory of computation based on considering time as a fuzzy concept. The necessity of such a theory is shown in [8], [6], [7]. Besides all, I find the work of Physicist Professor Christof Witterich from Heidelberg University which he used the term “probabilistic time” in his work [1]. That approves the approach too.

Seemingly, to consider time as an operator is an idea that has existed among Physicists for quite a long time, but simultaneously there is a large inertia to accept it. Psychologically, their thoughts and ideas are so involved in Classical time that they do not consider seriously any other approaches. Possibly, from the Physics point of view and Physicists, sufficient evidences to make this shift in the paradigm doesn’t exist (Here by applying the statement “making a shift in the paradigm”, we mean assuming the two following steps. First considering time as a fuzzy concept and in the second step introducing a new interpretation of Quantum mechanics [2], [4], [7], [9]). Nevertheless, we stress on the following point

”It is convenient to consider this shift in the paradigm when we consider the evidences from Theory of Algorithm and Complexity Theory besides the evidences in Physics”.

Throughout this article, we show the Theory of Computation with Fuzzy time is on the right track and have a better situation rather than Classical Theory of Computation, actually in ITS Complexity Theory part. The major reason is the numerous number of unsolved problems in Complexity Theory besides the contradiction in this theory as it is mentioned in [8]. In the new Theory the major obstacles and unsolved problems are solved [5].

Also in this article, we consider the classical definition of Turing Machine but we change and modify

the concept of Time to Fuzzy Time. We call this new Theory TC* [5] and this type of computation “Fuzzy time Computation”. Indeed, our motto is:

"We have sufficient evidences in Physics and Theory of Algorithm to accept time as a fuzzy concept".

2. Reducibility

Indeed, in "fuzzy time computation" when configurations transfer to each other it is possible that we have running back in time. More precisely, we should consider a probability distribution of coming back in different steps. By having this distribution function D, our purpose is to know the probability to reach the expected point (It is easy to see, the expected point of computation in TC* is the value which is computed in TC, when the probability of running back in time is sufficiently small). Actually, to make a progress in TC*, we define the reducibility in TC* as a starting point.

First we repeat the Classical definition of reducibility:

$Y >_m X$, if there is a polynomial time computable function f such that:

$$x \in X \leftrightarrow f(x) \in Y$$

Associated definition in TC*

For $\alpha > \frac{1}{2}$, $Y >_{\boldsymbol{m}}^{\boldsymbol{\alpha}} X$ if there is a polynomial time computable* function f such that:

1. $x \in X \,\&\, f(x) \downarrow in\ bounded\ time \leftrightarrow (f(x) \in Y)$

2. Pr $(f(x) \downarrow in\ bounded\ time) > \ \alpha$

Is this definition independent from the value of α? ($\alpha > \frac{1}{2}$))

We represent $Y >_{\boldsymbol{m}}^{\boldsymbol{\alpha}} X$ by a 5-tuple, (Y, X, f, S_f, α), $S_f(x)$ is the number of steps that f(x) is computed. It is a distribution. We define it as follows

$$Y >_{\boldsymbol{m}}^{\boldsymbol{\alpha}} X \leftrightarrow (Y, X, f, S_f, \alpha) \text{ is an acceptable 5-tuple}$$

For our purposes, we need the following simple lemma from probability. We get around more complex ones.

Lemma 1. Let $Y >_m X$ by function f (Classical reduction), there is $\beta > \frac{1}{2}$ and function g such that (Y, X, g, S_g, β) is an acceptable 5-tuple.

Proof. Consider g exactly f, each step computes s_g times. s_g is a constant associated to g.

Lemma 2. Let for $1 > \alpha > \frac{1}{2}$, (Y, X, f, S_f, α) is an acceptable 5-tuple then for any $1 > \beta > \frac{1}{2}$ there is computable function g in which (Y, X, g, S_g, β) is a 5-tuple.

Proof. Actually there is k, such that g= (k times repeating f till we reach a solution with probability β) . By applying lemma 1, there is such a k.

Remark 1. Lemma 2, shows for $1 > \alpha > \frac{1}{2}$, $Y >_{\boldsymbol{m}}^{\boldsymbol{\alpha}} X$ is independent from α. So, we write $Y >'_{\boldsymbol{m}} X$.

Remark 2. $Y >_m X$ implies $Y >'_{\boldsymbol{m}} X$.

We define NP*-Complete, NP*-hard, likewise.

Definition X is NP*-hard if for any $Y \in \mathrm{NP*}$, $X >'_{\boldsymbol{m}} Y$.

Definition X is NP*-Complete if X is NP*-hard and $X \in \mathrm{NP*}$.

Theorem 1 SAT is NP*-Complete.

Proof. SAT belongs to NP, hence $SAT \in \mathrm{NP*}$.

Analogous proof to the original proof shows this problem is NP*-Complete … .

3. The Major Problems of Complexity Theory

In appearance, by Theorem 1 and remark 2 some famous Problems in Algorithm and Complexity Theory like Sat, 3-CNF Sat, Clique Problem, vertex Cover, Hamiltonian Cycle, Traveling Sales man Problem, Subset sum Problem, Knapsack problem, bin packing problem are NP*-Complete problems.

Possibly, we need more abstract and logical Theorems like

*Conjecture: If we have a proof for NP-completeness of problem X without any mentioning

to Time runs Backward, we have a proof for NP*-Completeness of X.

Generalized Ladner* Theorem: For any problems Y, X, $X >'_{\boldsymbol{m}} Y$ and $X \not\equiv'_{\boldsymbol{m}} Y$, there is problem Z such that $X >'_{\boldsymbol{m}} Z >'_{\boldsymbol{m}} Y$.

Generalized *Conjecture: If we have a proof for Theorem P in TC without any mentioning to Time runs backward, we will have a proof for P* in TC*.

P* is a proposition by substituting time by fuzzy time in P.

By "Generalized *Conjecture" approximately every existed theorem P in TC, P* is true in TC*.

Discussions around "*Generalized *Conjecture*".

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Theorem Random Generator exists [3], [5].

Theorem P* ≠NP*, P*=BPP* [3], [5].

Corollary. PH* doesn't collapse.

Some Problems in New Theory:

1- Creativity and P vs NP

2-MA*=AM*

3-P*=NP* ∩ CO-NP*

4. A brief of what did happen

1. By employing a new version of Unexpected Hanging Paradox we show that we have a real contradiction around the concept of time. It shows our model of Computation leads us to a contradiction.
2. To resolve this contradiction we accept time as a Fuzzy concept. This modify our model of Computation. Time is a central concept of Physics. We should show that it is in consistency of whole body of existed Theories in Physics. By introducing a new interpretation of Physics "Fuzzy time-Particle interpretation" we try to do that. "Probabilistic Time" by Christof Witterich make us more hopeful.
3. Now, we have a new Theory of Computation (TC*).
4. We have parallel definitions and problems: P*, NP*, BPP*.
5. It is proven in TC*, P* ≠NP*, P*=BPP*. It is a valuable information for people in the scope of Algorithm.
   We have a new list of problems and a new story.
   Here again, we repeat our motto

"We have sufficient and overwhelming evidences in Physics and Theory of Algorithm to accept time as a fuzzy concept".

Conclusion TC* ("Fuzzy Time Computation") seems to be convenient Theories to replace TC. Lesser unsolved problems in this Theory besides evidences in Physics are sufficient to consider time as a

Fuzzy concept.

We provide a reason why answering to some questions like P vs NP are so hard. The reason is the Physical Model we employ, not the complexities in the subject of Algorithm and Computation and consequently not the sophisticated problems in Combinatorics and Theory of Probability. The central concept in the Physical Models we will be faced here is time. By changing and modification of our Classical understanding of time to a more convenient one (Fuzzy time) some of the most important problems in this area i.e P vs NP and P=BPP will be solved [3], [5]. Forthcoming, in the next step we face to a new group of unsolved problems and starting of a new story.

More exactly, in the case that we do not accept any changing in Modeling we should tolerate a contradiction in Theory of computation [8]. Most Mathematicians and scientists do not prefer this approach, but possibly a convenient approach for people and specialists in Non-Classical logic.

5. $\boldsymbol{P \neq NP}$

In our approach we change the classical time to fuzzy time and firstly we provide a reason for that.

Actually, we stress on this point and change.

Nevertheless, in this chapter we neglect this point! We try to provide an argument for $\boldsymbol{P \neq NP}$.

To prove $\mathrm{P} \neq \mathrm{NP}$, We apply Theorem 1 and Remark 2.

Suppose $\mathrm{P} = \mathrm{NP}$ and we remind that SAT is a NP-Complete problem. Hence, there is an algorithm A which solves SAT in Polynomial time.

By considering Fuzzy time, A solves SAT in polynomial time too and SAT belongs to P*. SAT is NP*-Complete, so P*=NP*. A contradiction.

Consequently, $\mathrm{P} \neq \mathrm{NP}$.

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